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WAIHI GOLD MINE

Annual Compliance Monitoring Report 2016/17

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REPORT

Golder Associates

Executive Summary

OGNZL holds a permit to discharge treated mine water to the Ohinemuri River from its WTP at Waihi. This discharge permit, among others, requires OGNZL to monitor water, sediment and ecological quality, as well as to meet conditions designed to protect the downstream receiving environment. The data presented in this report were measured between 1 May 2016 and 31 May 2017 and are summarised below. In general, the data indicate that any impact as a result of the OGNZL's mining operations has not been detectable above background variation in many of the environmental parameters measured.

Treated water discharge

Discharge volumes complied with the relevant conditions of the discharge permit throughout the monitoring period. OGNZL was fully compliant with Condition 14 of the discharge permit, with concentrations complying with the limits specified in Tables 1 to 3 of the discharge permit.

Receiving water

The river flow and quality data measured between 1 May 2016 and 31 May 2017 indicated that OGNZL achieved a high level of compliance with the conditions of the discharge permit over this period. Although there were six technical non-compliances (one pH, one dissolved lead and four total suspended solids), there was no evidence to indicate these non-compliances were related to OGNZL's mining activities. The overflow from a number of silt and collection ponds during two high rainfall events in September 2016 and March 2017 did not result in any non-compliances in receiving water. An exceedance of suspended solids was reported for a carpark discharge to a tributary of the Ohinemuri River but monitoring in the Ohinemuri found no increase in concentration compared to upstream.

Sediment

Sediment sampled from the Ohinemuri River and the Ruahorehore Stream in 2016/2017 was predominantly sandy (as seen in prior years). Some shifts in textural classes occurred between surveys with small increases in the mud % from November 2016 to May 2017. Some shifts in gravel and sand proportions were evident between the surveys at sites OH1 and RU1.

As in prior surveys the sediments from the Ruahorehore Stream displayed some differences (e.g., lower mercury, copper, iron and nickel and higher cadmium) compared to sediments in the Ohinemuri River. These differences were similar to those reported in previous years

Overall, the pattern of concentrations measured in the <2 mm and <63 µm sediment fractions that exceeded sediment quality was similar to that reported for the 2015/2016 period. In the <2 mm fraction this included exceedance of the mercury and iron guidance values (the OME and NOAA guidelines). The exceedance has been discussed in previous annual reports as arising due to natural variation in the amount of iron and the widespread distribution of mercury in the Ohinemuri River system. The exceedance of iron and mercury also occurred in the <63 µm fraction. Exceedances were also identified in the <63 µm fraction (not the <2 mm) for arsenic at the upstream site OC2 (not related to mining operations), copper at sites OH5 and OH6 (similar to site exceedances in 2015/2016) and silver (in this case the ANZECC SQGV) at Site OH5. The copper and silver elevations in the fine sediment fraction have been consistently reported in previous annual compliance reports.

Habitat characteristics

Consistent with previous years, during both surveys most stream sites were dominated by run and riffle habitat and had little to no stream shading. The largest habitat change between the November 2016 and May 2017 surveys is the proportion of riffle and run habitats at most sites. There were notable changes in the substrate composition at all monitoring sites on the Ohinemuri River. For sites OH3 and OH6, there was an increase in the proportions of gravel and silt relative to other substrates, while for sites OH5 and OH1 there was a decrease in silt and gravel proportions. These changes reflect streambed disturbances most likely a result of flood flows and are not related to mining activities.

Periphyton

All sites were below the New Zealand periphyton guideline values for both filamentous algae (≥30 %), and mats (≥60 %), for the protection of aesthetics and recreation and trout habitat and angling.

A total of 52 algae and cyanobacteria species were recorded across all sites in November and a total of 46 species were recorded across all sites in May. Diatoms were the most frequently occurring taxa with 38 species recorded in November and 35 species recorded in May. Green algae (including filamentous and unicellular) were the second most frequently occurring taxa with 12 and 7 species recorded across all sites in November and May, respectively.

During both the spring and autumn surveys, chl-*a* concentrations were higher at the most upstream site, OC2, than all other sites. During the May 2017 survey, chl-*a* concentrations at sites OC2 and OH6 exceeded guidelines for the protection of benthic biodiversity (50 mg/m^2). Mean AFDW biomass measured in the Ohinemuri River and Ruahorehore Stream sites were below the New Zealand periphyton guideline of 35 g/m^2 for the protection of aesthetics/recreation and trout habitat and angling.

Periphyton selenium concentrations collected from sites OC2 and OH6 were similar to each other during the autumn survey. At Site OC2, the May 2017 selenium concentration was within the top 90th percentile of the historic range (for that site), while for Site OH6, the May 2017 selenium concentration was within the upper 75th percentile of the historic range.

Macrophytes

Submerged macrophyte cover was low at all sites (except OH6) during the spring and autumn surveys. Percentage cover of macrophytes at Site OH6 was ~ 50% during the autumn survey, comprised mainly of a native charophyte (40%), as well as oxygen weed (10%).

At Site OH6, the selenium concentration in the oxygen weed stems was 1.85 mg/kg dry weight. Placed in context of the long term macrophyte selenium concentrations, the 2017 result was in the lower 25th percentile of Site OH6 data range, although higher than the long term data range for Site OC2.

Benthic macroinvertebrates

Taxa group dominance varied between sites and between sampling occasions. Diptera larvae were often the most dominant or co-dominant taxa during the November 2016 survey. During the May 2017 survey, the relative abundance of Oligochaeta increased at the expense of Diptera at sites OC2, OH5 and OH1.

Differences in community composition between sites in spring was mainly driven by significant differences in the midges and caddisflies and stony cased caddis. During autumn, between sites differences in community composition was driven by significantly higher oligochaetes population at the most upstream control site (OC2) and lower overall abundance of most taxa at RU1.

Changes in taxa richness were unrelated to site position with respect to discharge locations during the spring 2016 survey. However, during the autumn 2017 survey, taxa richness was higher at the most upstream control site (OC2) relative to all sites downstream of discharges and the Ruahorehore Stream site.

The percentage change in taxa richness between sites upstream and downstream of each discharge was within allowable limits during both the spring 2016 and autumn 2017 surveys. The percentage change in macroinvertebrate abundance between sites upstream and downstream of the upper discharge was within consented limits on both monitoring occasions. However, for the lower discharge, the percentage change in abundance exceeded consented limits during the spring 2016 survey but was within limits during the autumn 2017 survey. Consent conditions for macroinvertebrate taxa richness and abundance were met during the 2016-2017 monitoring period and no additional monitoring is required.

Fish

Consistent with previous years, shortfin eels and common bullies were the most widespread and common species recorded at Ohinemuri River sites. Shortfin eels were most abundant downstream of the upper discharge, with a large proportion of the shortfin eels recorded at this site falling into the elver category. These results indicate good recruitment to these populations.

Bully selenium concentrations measured at both the upstream and downstream sites in February and May 2017 were below trigger limits and within the historical range for each site. Eel, selenium concentrations at Site OH6 exceeded the threshold limits in February. This was the first eel trigger exceedance since 2006. As a result of this exceedance, and as required by the Conditions of consent, the selenium concentrations of the discharge were reviewed. Discharge selenium concentrations were below the lowest discharge requirements of the resource consent to reduce selenium concentrations. As such, no discharge concentration management was required.

Repeat sampling in May resulted in only a single eel being caught at Site OH6. This eel was larger, and therefore older, than those typically collected. This eel contained a lower selenium concentration than the February 2017 concentration data. The lower concentration may be a result of changes in diet and eating patterns, or movement of this individual eel within the Ohinemuri River and its tributaries. Changes in the sampling conditions during the autumn survey relative to the summer survey may explain why few eels were caught in autumn.

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Abbreviation List

AFDW	Ash free dry weight
ANZECC	Australian and New Zealand Environment and Conservation Council
CAR	Corrective action request
$CaCO_3$	Calcium carbonate
Chl-*a*	Chlorophyll-*a*
CN_{WAD}	Weak acid dissociable cyanide
Cr (VI)	Chromium (VI)
dw	Dry weight
E1	Upper discharge
E2	Lower discharge
EPT	Taxa in Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) groups
Fe	Iron
g/m^2	Grams per square metre
g/m^3	Grams per cubic metre
IANZ	International Accreditation NZ
ICP-MS	Inductively coupled plasma mass spectrometry
ISO	International Standards Organisation
ISQG-Low	Low interim sediment quality guidelines
ISQG-High	High interim sediment quality guidelines
KH_2PO_4	Monopotassium phosphate
L	Litres
LEL	Lowest effect level - Lowest concentration at which toxic effects have been observed
m^2	Square metres
MCI	Macroinvertebrate community index
mg/kg	Milligram per kilogram
mm	Millimetres
NA	Not applicable
NCP	Northern collection pond
NH_3	Ammonia
NIWA	National Institute of Water & Atmospheric Research
nm	Nanometre
NO_2-N	Nitrite nitrogen
NO_3-N	Nitrate nitrogen
NL	No limit
NOAA	National Oceanic and Atmospheric Administration
NSPSP	North stockpile silt pond
OGNZL	Oceana Gold (New Zealand) Limited
OME	Ontario Ministry of the Environment
PEL	Probable effects level - Concentration above which adverse effects are frequently expected
pH	Unit less measurement of acidity
PP2	Polishing Pond 2
QMCI	Quantitative macroinvertebrate community index

QOWQ	Quality of work query
SEL	Severe effect level - Concentration above which most benthic organisms cannot tolerate
SQGV	Sediment quality guideline values
SQG-High	Sediment quality guideline - High value
TB1	TB1 tributary
TEL	Threshold effects level – below which adverse effects are expected to occur only rarely
TMAH	tetramethylammonium hydroxide
TLB	True left bank
TRB	True right bank
TSF2	Tailings storage facility 2
TSS	Total suspended solids
µm	Micrometre
USEPA	United States Environmental Protection Agency
WGC	Waihi Gold Company
WRC	Waikato Regional Council
wt%	Dry weight
WTP	Water treatment plant

1.0 INTRODUCTION

1.1 Background

OceanaGold (New Zealand) Limited (OGNZL) owns and operates an open pit (the Martha mine) and underground mines (Correnso and Slevin Underground Project Area (SUPA) mines) in Waihi. As part of operations, OGNZL holds a discharge permit (Discharge Permit 971318) to discharge treated mine water to the Ohinemuri River.

Mine water is treated in a water treatment plant (WTP) before being discharged to the river through either (or both, as circumstances dictate) the upper or lower discharge. The upper and lower discharges, referred to as E1 and E2, respectively, are shown in Figure 1. Discharge Permit 971318 (“the discharge permit”) provides for the WTP to operate under four separate regimes (Regimes A, B, C and D), each with criteria relating to discharge volumes and quality.

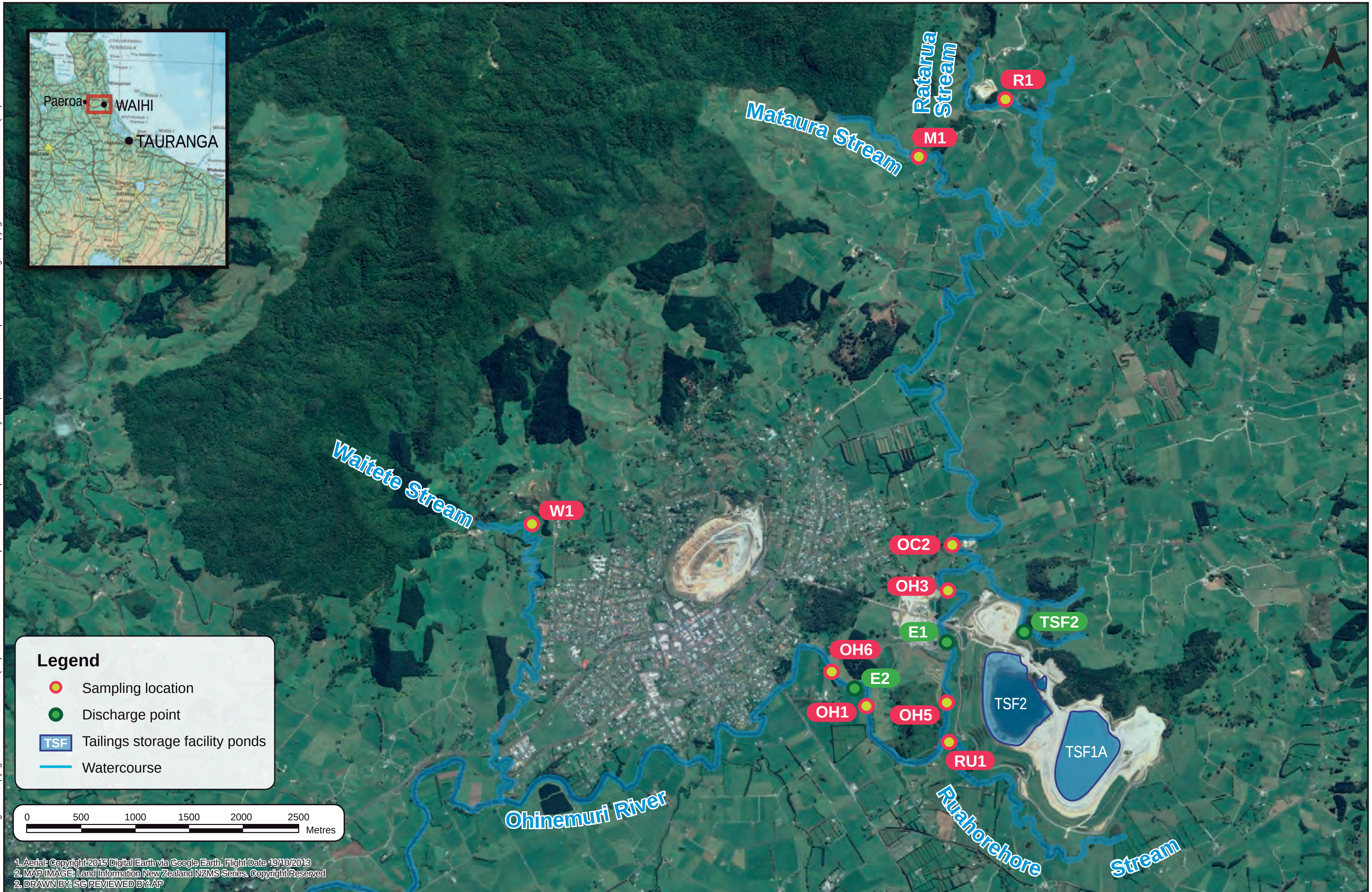
The conditions of the discharge permit, which are summarised in Appendix A, require OGNZL to undertake a range of biological, sediment and water quality monitoring. The monitoring results are to be reported annually to Waikato Regional Council (WRC).

This report presents the results of monitoring undertaken between 1 May 2016 and 31 May 2017. It builds on information provided in an interim report (Golder 2016) that was prepared by Golder Associates (NZ) Limited (Golder) in December 2016 through the addition of data obtained since 1 November 2016.

1.2 Operational Considerations

Key operational considerations between 1 May 2016 and 31 May 2017 relevant to this report include:

- The monitoring period covered in this report was extended to 13 months to include treated water and receiving water data collected at the time the autumn survey was undertaken, which had been delayed to May 2017 as a result of a series of elevated river flow events in March and April 2017.
- As permitted by Discharge Permit 971323, intermittent discharges from the decommissioned tailings storage facility 2 (TSF2) tailings pond into an unnamed tributary (referred to as TB1) that joins the Ohinemuri River upstream of the upper discharge.
- As permitted by Discharge Permit 971311, direct discharge from the silt ponds to the Ohinemuri River and Ruahorehore Stream.
- As permitted by Discharge Permit 971312, direct discharge from the collection ponds to the Ohinemuri River and Ruahorehore Stream.
- Overflows from five ponds occurred during two high rainfall events in September 2016 and March 2017. These ponds are the North Collection Pond (NCP), the West Silt Pond (WSP), the North Stockpile Silt Pond (NSPSP), the South 3 Collection Pond (S3) and the Conveyor Silt Pond 2 South (CSP2S). Water quality sampling during these events at the river sampling sites showed no non compliances in the receiving waters due to these events. Sampling in the ponds showed one high level of TSS in both the NSP and CSP2S during the March 2017 event. However, the overflow of these two ponds to the Ohinemuri River and a tributary of Ruahorehore Stream is not considered to have had adverse effects on downstream receiving waters due to the high naturally occurring TSS as a result of heavy rainfall occurring at that time.



Golder Associates

TITLE DISCHARGE POINTS AND SAMPLING LOCATIONS

JULY 2017

PROJECT 1413045

FIGURE 1

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2.0 METHODS

2.1 Introduction

OGNZL monitors the water quality of the WTP discharge and receiving waters, and continuously measures Ohinemuri River and Ruahorehore Stream flows. The Ruahorehore Stream is a tributary of the Ohinemuri River that joins the river between the two treated water discharge points. The sites used in the programme are listed in Section 2.2 with the monitoring activities undertaken at each site identified in Section 2.3. The methods employed for monitoring are described in Sections 2.4 to 2.11. The results of the laboratory audits of Hill Laboratories and SGS Waihi, which undertake analyses for OGNZL, are provided in Section 2.12.

2.2 Monitoring Sites

The locations of each site employed in the receiving water quality and biological monitoring programme are provided in Table 1 and shown in Figure 1.

Table 1: Location and NZTM 2000 Map Series grid references for each monitoring site.

Site	Stream/River	Location description	NZTM 2000	
			Northing	Easting
OC2	Ohinemuri	Upstream of all mine related discharges	5858577	1854003
OH3	Ohinemuri	600 m upstream of E1 but downstream of an unnamed tributary of the Ohinemuri River into which TSF2 discharges	5858176	1853904
OH5	Ohinemuri	500 m downstream from E1	5857176	1853806
OH1	Ohinemuri	Approximately 150 m upstream of E2	5857174	1853106
OH6	Ohinemuri	200 m along walking track and 500 m downstream of E2	5857174	1852805
RU1	Ruahorehore	Immediately upstream of confluence with Ohinemuri River	5856776	1853907
M1	Mataura	Through farm at end of Willows Road	5862178	1853697
R1	Ratarua	Downstream of stream confluence with side tributary	5862480	1854897
W1	Waitete	Vicinity of Waihi Motor camp (Waitete Road)	5858269	1850002

2.3 Monitoring Activities

The activities undertaken at each site are summarised in Table 2. The conditions of the discharge permit, which are summarised in Appendix A, provide direction in relation to the timing of the monitoring activities. Periphyton, macrophytes, macroinvertebrate and sediment surveys are undertaken in spring (October through December[1]) and autumn (March through May) each year, while fish populations are assessed in summer (January through March[1]) each year.

Following changes to its resource consents in September 2015, OGNZL is no longer required to assess selenium concentrations in biota on a biannual basis. Selenium concentrations in fish are now only measured during the summer survey, while selenium concentrations in periphyton and macrophytes are now assessed during the autumn survey. However, during the 2017 summer survey, eel selenium concentrations exceeded trigger limits, necessitating a second sampling, which was undertaken during the autumn survey.

[1] As defined in Table 5 of Discharge Permit 97318 (refer to Appendix A).

Table 2: Monitoring activities undertaken at each site.

Type	Activity	Site								
		OC2	OH3	OH5	OH1	OH6	RU1	M1	R1	W1
River water quality	Sampling	✓	✓	✓	✓	✓	✓			
Habitat	Visual	✓	✓	✓	✓	✓	✓			
Sediments	Metal/metalloid concentrations	✓	✓	✓	✓	✓	✓			
Periphyton	Coverage and biomass*	✓	✓	✓	✓	✓	✓			
	Selenium concentrations	✓				✓				
Macrophytes	Coverage	✓	✓	✓	✓	✓	✓			
	Selenium concentrations	✓				✓				
Macroinvertebrates	Biological indices	✓	✓	✓	✓	✓	✓			
Fish	Population counts	✓		✓	✓	✓	✓	✓	✓	✓
	Selenium concentrations	✓				✓				

Notes: * Periphyton community composition is also assessed at each identified monitoring site.

The spring survey was undertaken on 9-10 November 2016, and the autumn survey was undertaken on 23-24 May 2017. Fish populations were assessed at Sites OC2, OH1, OH6, M1, R1 and W1 during the summer survey on 9-10 February 2017.

2.4 Water

Treated water discharged to the Ohinemuri River was monitored by OGNZL in general accordance with Condition 15 of the discharge permit. The receiving water was monitored in accordance with Conditions 15 and 16 of the permit.

The pH, temperature and conductivity of the treated water and river water at each site were measured by OGNZL in situ. Samples collected from these sites at the same time as the biological monitoring were forwarded to Hill Laboratories for analysis. Continuous river flow, pH, Electrical conductivity and temperature data were measured by OGNZL at the Frendrups site. All parameters (refer Appendix A) were also measured in the river during biological sampling.

2.5 Sediment

2.5.1 Sample collection

Sediments were collected within the survey reach at each of Sites OC2, OH3, OH5, OH1, OH6 and RU1 in the autumn survey. The method employed was adapted from USEPA (1998). Each reach extended approximately five channel widths upstream and the same distance downstream.

A plastic snap lid container with 20 mm sides was used to collect surficial sediment, which was transferred to a pre-labelled snap-lock plastic bag. Any visible organisms and larger stones were removed before the bag was placed inside a second bag with a waterproof paper label. The sample was kept cool until analysis. The sample containers were cleaned and rinsed at each site following sampling. The equipment was also rinsed thoroughly at the next site prior to sampling to prevent any potential cross-contamination.

2.5.2 Sample analysis

Sediment samples were analysed at Hill Laboratories. Samples were wet-sieved to separate the <63 µm and <2 mm fractions. Sediment fractions were then air dried at 35 °C prior to digestion with nitric acid and hydrochloric acid. Following digestion, each fraction was analysed for the elements listed in Table 6 of the discharge permit (reproduced in Appendix A) using inductively coupled plasma mass spectrometry (ICP-MS); chromium (VI) concentrations were also measured in both fractions. As specified in Condition 17 of the discharge permit, data were compared to NOAA (1999) and OME (1993) sediment quality guidelines.

2.6 In-stream and Riparian Habitat

In-stream and riparian habitat characteristics were assessed at each of Sites OC2, OH3, OH5, OH1, OH6 and RU1 to assist with interpreting biological community data. Habitat characteristics assessed included estimates of channel width, depth, substrate composition, proportion of each habitat type (e.g., run, riffle, pool and cascades), streambank erosion and riparian shading. The methods used were the same as used during previous annual monitoring (e.g., Golder 2016) and allow for comparisons over time to be made.

2.7 Periphyton

2.7.1 Visual percentage cover

The visual percentage cover of periphyton across the streambed was assessed at all sites and compared with the New Zealand Periphyton Guidelines (MfE 2000). These guidelines specify maximum percentage cover of visible stream bed for recreational and aesthetic values as ≥30 % for filamentous algae and ≥60 % for diatoms and cyanobacteria for the protection of aesthetics and recreation and trout habitat and angling (Biggs 2000).

2.7.2 Biomass

2.7.2.1 Sample collection

Five replicate periphyton samples were collected from each site using the methods described in Biggs & Kilroy (2000). Briefly, each replicate was collected by scrubbing the periphyton off the rock using a nylon brush. The three main axes of each rock were measured and used to estimate the rock surface area. Rock surface area, S, was calculated using the formula presented in Biggs & Kilroy (2000) as follows:

$S = \pi / 3 (lw + lh + wh)$ where: l = length, w = width and h = height

2.7.2.2 Ash free dry weight analysis

Ash free dry weight (AFDW) analysis was undertaken by NIWA (Christchurch) followed standard protocols outlined in Biggs & Kilroy (2000). Each replicate sample was homogenised using a hand-held blender then a 10 mL subsample was filtered onto a pre-rinsed, pre-combusted and pre-weighed GF/C filter. Filters were oven dried (60 ^{o}C for 48 hours) and then weighted, once cooled, to determine total solids. Filters were then combusted at 400 °C for four hours, cooled in a desiccator, and re-weighed to determine ash weight. AFDW was estimated as the difference between total solids and ash weight. AFDW weights were then converted to g/m^2 of streambed area. AFDW results were compared to recommended New Zealand periphyton guideline values (Biggs 2000).

2.7.2.3 Chlorophyll-a analysis

Chlorophyll-a analysis was undertaken by NIWA (Christchurch). A 10 mL subsample of the homogenised replicate was filtered on to a GF/C filter and the filters boiled in 90 % ethanol at 78 °C for 10 minutes then extracted at 4 °C, in the dark, for 24 hours. Samples were then centrifuged at 3,000 rpm for 10 minutes and the absorbance of the supernatant read at 665 nm and 750 nm, before and after acidification, on a Shimadzu UV-2550 spectrophotometer. Chlorophyll-*a* concentrations were estimated according to Biggs & Kilroy

(2000). Chlorophyll-*a* concentrations were then converted to mg/m^2 of streambed area. Chlorophyll-*a* concentrations were compared with recommended New Zealand periphyton guideline values (Biggs 2000).

2.7.3 Algal and cyanobacterial community composition

Following AFDW and chlorophyll-*a* determination, remaining replicate samples were pooled and a subsample taken for algal community composition (by NIWA Christchurch). Each subsample was settled in a chamber and viewed on a Leica inverted microscope. Random fields of view were selected to identify dominant algal species present using the keys of Entwisle et al. (1988), Biggs & Kilroy (2000), Moore (2000) and unpublished keys (NIWA). At least 200 cells were counted in each subsample. Counts were then converted to number of algae per sample.

2.7.4 Selenium analysis

A single composite sample comprising between 150 g and 200 g of filamentous green algae (periphyton) was collected from a range of large gravel and cobble sized substrates at each of Sites OC2 and OH6. Samples were chilled and returned to the laboratory for the removal of any benthic macroinvertebrates, organic material and sediment, and rinsed four times in deionised water before being dispatched to Hill Laboratories for analysis. Selenium was analysed by Hill Laboratories in duplicate in each of the periphyton samples using ICP-MS following aqueous tetramethylammonium hydroxide (TMAH) digestion at 90 ˚C for one hour.

2.8 Macrophytes

2.8.1 Coverage

Macrophyte percentage coverage was estimated at each of Sites OC2, OH3, OH5, OH1, OH6 and RU1. The species present and type of macrophytes present (i.e., submerged or emergent) was recorded.

2.8.2 Selenium analysis

Since changes to the resource consent in 2015, macrophyte samples are no longer separated into root and stem sub-samples, and only the stems are analysed for selenium concentration. At Site OH6, approximately 500 g (wet weight) of *Elodea canadensis* (oxygen weed) stems were collected from two separate macrophyte beds and combined to form a single sample. The plant material was rinsed in river water, placed in a plastic bag and stored on ice until returned to the laboratory. All non-target species were then removed from the plant material, which was then rinsed in de-ionised water before sending to Hills Laboratory for analysis. Like periphyton, selenium was analysed in duplicate in each sample using ICP-MS following aqueous TMAH digestion at 90 ˚C for one hour.

2.9 Benthic Macroinvertebrates

2.9.1 Sample collection and processing

Benthic macroinvertebrate samples were collected using the same methods as employed in previous years. At each of Sites OC2, OH3, OH5, OH1, OH6 and RU1, six individual replicates were collected from riffle habitats using a Surber sampler (0.1 m^2; 300 µm mesh) following Protocol C3 for quantitative sampling in stony streams (Stark et al. 2001). Samples were preserved in 95 % ethanol in the field.

Benthic macroinvertebrates were processed by an independent taxonomist using a modified version of Protocol P3 (full count with sub-sampling option). The sub-sampling option used was developed by the taxonomist and involved picking out abundant taxa from 12.5 % or 25 % of the total sample and multiplying the count by eight or four, respectively. Individuals with which the taxonomist was uncertain were sent to a second independent taxonomist for identification. Benthic macroinvertebrates were identified to the minimum level in Stark (1998) using keys in Winterbourn et al. (2006) and Chapman et al. (2011).

2.9.2 Biological indices

The following biological indices were calculated from macroinvertebrate community data to assess river health:

- Taxa richness
- Abundance
- EPT taxa richness and %EPT
- Macroinvertebrate community index (MCI) and the quantitative MCI (QMCI)

Taxa richness is a measure of the number of macroinvertebrate taxa in a sample. In general, streams that support a high number of macroinvertebrate taxa are more likely to be of a higher environmental quality than streams with few taxa present. However, interpretation of taxa richness data as an environmental indicator is dependent on the pollution sensitivity or tolerance of taxa present.

Abundance is a measure of the total number of macroinvertebrates in a sample. Macroinvertebrate abundance can increase in the presence of mild organic or nutrient enrichment, but decreases in the presence of gross enrichment. Abundance is a useful measure for comparison between sites, but can be highly variable.

EPT refers to the number of taxa that belong to the Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) groups. EPT taxa are generally ‘sensitive’ to changes in water/habitat quality. Percentage EPT (%EPT) is a measure of the abundance of EPT taxa making up the community (Lenat 1988). The caddisflies *Oxyethira* and *Paroxyethira* are not sensitive to nutrient enrichment and are excluded from EPT and %EPT calculations (Collier 2005). EPT and %EPT values can provide a good indication of environmental quality, with high values indicating good water/habitat quality and low values poor water/habitat quality.

The MCI (Stark 1985) and QMCI (Stark 1998) are biological indices based on the organic enrichment tolerance values assigned to individual taxa. These indices have been adapted as general indicators of stream health. MCI scores are based on presence/absence data while the QMCI includes an abundance component. Higher MCI and QMCI scores generally indicate better water and habitat quality with scores interpreted following the thresholds and classes provided in Table 3 (Stark & Maxted 2007).

An assessment of the change in taxa number and abundance between sites upstream and downstream from each discharge is undertaken as part of Condition 18 of the discharge permit (refer Section 9.4). MCI, QMCI and %EPT indices are not defined in the discharge permit, and are only provided as an additional means of assessing stream health.

Table 3: Estimates of stream health using MCI and QMCI indices.

Quality class	MCI	QMCI
Excellent	>119	>5.99
Good	100-119	5.00-5.99
Fair	80-99	4.00-4.99
Poor	<80	<4.00

2.10 Fish

2.10.1 Fish population sampling

As specified in Condition 16 of the discharge permit, fish populations were surveyed within a reach at each of Sites OC2, OH5, OH1, OH6, RU1, M1, R1 and W1 using a backpack electric fishing machine. The fish

survey was undertaken following sampling protocols described in Joy et al. (2013). Each reach consisted of riffle, run and pool habitat. The area of each reach was estimated in order to allow the calculation of fish densities (fish/m^2). Each survey reach was electric fished three times (i.e., three passes). Fish captured during each pass were kept in separate buckets filled with river water. All fish collected were identified, counted and their lengths measured. Fish species caught were identified in the field using taxonomic keys provided in McDowall (1990, 2000). A note was made of any skin lesions or deformities before returning the fish to the river.

The estimated (maximum likelihood) fish populations at each site were determined using MicroFish 3.0 (van Deventer & Platts 1989). Fish abundance data for each of the three passes was entered into the MicroFish 3.0 model, which estimates the fish population using the Burnham maximum likelihood population formula. The result is expressed as fish density (fish/m^2) for each species.

2.10.2 Whole body selenium analysis

Sample collection

Sampling was conducted in accordance with the methods provided in USEPA (1998). Two species of fish were targeted at Sites OC2 and OH6. The primary target species was the common bully (*Gobiomorphus cotidianus*) and the secondary target species was the shortfin eel (*Anguilla australis*). The common bully was chosen as the primary target species due to its diet and because bullies may be consumed by eels.

A composite sample comprising five eels was collected from each site, together with composite samples of between 10 and 15 bullies. Bully samples were washed four times in river water and four times in deionised water. Once washed, the sample was placed into a labelled plastic bag. Each eel collected was, similarly, washed four times in river water and four times in deionised water, before being wrapped in tin foil and placed in a plastic bag. The five individually bagged eels comprising each sample were placed into a single labelled plastic bag and labelled accordingly. All samples were kept frozen prior to sending to the laboratory.

Sample analysis

The length and weight of each eel was measured in the laboratory, as was the weight of each bully sample. The five eels comprising the sample from each site were composited prior to homogenisation to produce a composite homogenised eel sample. The bully sample was also homogenised. Selenium was determined in each of the homogenised samples following aqueous TMAH digestion at 90 ˚C for one hour.

2.11 Statistical Analysis

For both the periphyton biomass and macroinvertebrate biological indices, significant differences between sites were determined using ANOVA, followed by post-hoc Tukey-Kramer HSD, using the statistical software package STATISTICA (v13).

To investigate relationships between environmental variables and the periphyton and macroinvertebrate communities, first Bray-Curtis similarity index and nonmetric multidimensional scaling (NMDS) were used to construct a map of similarity between samples. This method systematically groups and ranks replicates based on similarities between the communities at each site. Relationships between communities and environmental variables were then explored using LINKTREE analysis, which identified statistically significantly differences in taxa between communities and between environmental variables at these sites. Bray-Curtis, NMDS and LINKTREE were performed using PRIMER (v6).

2.12 Audit of Analytical Procedures

2.12.1 Introduction

A laboratory audit of OGNZL and SGS Waihi was undertaken on 14 July 2017 by Paul Kennedy. This was followed by a laboratory audit of Hill Laboratories in Hamilton on 24 July 2017. Samples collected by OGNZL in accordance with the conditions of the discharge permit are forwarded to Hill Laboratories or SGS Waihi for analysis. The results of these audits are summarised below.

2.12.2 Audit of OGNZL

OGNZL staff undertake field sampling and measurement of a limited number of parameters in the field. These are temperature, pH and electrical conductivity. Chain of custody (COC) sheets were inspected for samples (1771059-67, collected on 11/07/2017) recently sent to Hill Labs. pH calibration buffers held on site were within expiry dates. During discussion with Anne Mazzetti, it was noted that time of sampling is not registered with field measurements. Due to the diurnal changes in parameters such as pH in some bodies of water it was recommended that time of day be recorded on field sheets.

2.12.3 Audit of SGS Waihi

SGS Waihi is an ISO and IANZ accredited testing laboratory. The SGS staff member interviewed was Mr Andre Liedke. SGS receive a limited number of water samples from OGNZL during the year. There were no queries raised by OGNZL in relation to any results received by OGNZL during the 2016-2017 data period. Three sets of lab process sheets were examined. All COCs and lab process sheets appeared in order, pH calibration was present on all sheets where pH was measured and pH calibration buffers were inspected within expiry dates.

2.12.4 Audit of Hill Laboratories

Hill Laboratories is an ISO and IANZ accredited analytical testing laboratory. The audit of Hill Laboratories involved a discussion with Graham Corban, a Client Services Manager in the Environmental Division at Hill Laboratories, and inspection of laboratory records for OGNZL water samples that included COC and laboratory process sheets.

Two sets of lab process sheets were examined for two sets of samples. 1766855 to 59 sampled on 20/04/2017 and received on 21/04/2017. These were seepage samples and were collected in the correct containers and were field filtered for nitrate-nitrogen. 1770071 to 73 sampled on 15/06/2017 and processed on 19/06/2017 and tested for OGNZL Code 64 plus fluoride. Process sheets contained all pH calibration data for the day of measurement, pH standards were inspected and were within expiry dates. TSS balance weighing calibration records were not held in the on-line laboratory system. The balance calibration records were held in a log book in the balance room. This confirmed calibration using standard weights on the days in question.

OGNZL had raised three analysis reporting queries during the 2016-2017 period. These along with a query raised by Golder were discussed.

- On 20 March 2017, OGNZL raised a query for a sample (220572) which was reported to have a pH of 9.1. A retesting of the sample produced a pH of 7.8 and this was communicated to the client. Examination of the laboratory process sheets showed that the pH of 9.1 was obtained independently using two different instruments (one measuring pH and a second measuring alkalinity). As such, based on the calibration and the two methods there was no immediate reason to suspect that the reported pH was incorrect. A check of the repeat measurement returning 7.8 showed that it was made nine days after the sample was collected. We would note that this time period is well outside of laboratory recommended holding times (of immediate testing for pH) and as such there was no immediate information that would lead to the 9.1 pH measurement being rejected. Follow up of field measurement data showed that OGNZL had a field pH measurement for the sample in question of 7.8. We have no explanation for the laboratory readings of 9.1.

- On August 16 2016, OGNZL requested a repeat analysis of copper in sample 889789. The results for acid-soluble copper were confirmed. The results for dissolved copper were not. The laboratory undertook two sets of analysis. The first was a repeat of the field filtered sample, which returned a result of 0.0044 compared to 0.0043 g/m^3. The second was the analysis of a filtered sample taken from the 1 L unfiltered field sample which returned results of 0.000055 and 0.00053 g/m^3.

- OGNZL also requested a re-test of a dissolved copper result for sample 220519 (3 October 2016). The re-analysis of the sample retuned a result of 0.0068 compared to the original result of 0.0131 g/m^3. Analysis of the 1 L unpreserved sample produced a result of <0.0005 g/m^3. Examination of the set of samples (220514 to 24) identified that all were <0.0005 g/m^3.

The two re-tests involving dissolved copper are similar to a previous query raised in the 2015-2016 period (refer Golder 2016). The copper analysis queries in 2016, raise the possibility of random copper contamination in the field filtered samples. Using the unpreserved 1 L water sample for check analysis is not ideal as if there was low concentrations of copper in the sample, it may not have been in the dissolved phase by the time the re-testing was carried out (i.e., it may had been adsorbed to the container etc.). Although all other samples in the batch analysed contained no measurable copper lends weight to there being no copper in the sample but it does not categorically indicate there was no copper. Based on the occurrence of the anomalous copper results we would recommend that a review of the potential for copper contamination during field sampling or handling be carried out. This should include potential sources of contamination associated that the sampler may come in contact with, how the containers are stored, how samples are collected (are gloves used etc.) and are field blanks tested.

- The final query related to the provision of selenium results in <63 µm fraction of sediments collected in May 2017 during the autumn field survey. All samples were reported as containing <5 mg/kg selenium. Following a query, the results were updated and 'as expected" results were provided. This was discussed with Mr Corban as being a "loss of process" issue. The job sheet and laboratory report identified that selenium analysis in sediment had a default detection limit of 0.5 mg/kg. No note was provided on the laboratory report indicating that there was a deviation from the requested analysis. It was agreed that this should have been identified and assessed at the time in the laboratory.

2.12.5 Conclusions

The audit identified that COC and analytical requests are undertaken systematically. Sample management and data management appeared appropriate. Examination of the laboratory queries during 2016-2017 identified concerns in relation to dissolved copper analysis which appears to affect a small number of samples in any given year. It is recommended that OGNZL review dissolved metal sampling and handling in relation to possible copper contamination.

3.0 TREATED WATER DISCHARGE

3.1 Introduction

Treated water produced by the mine is discharged from the upper (E1) and lower (E2) discharges to the Ohinemuri River after passing through two polishing ponds. As described in Section 1.1, there are four operating regimes (Regimes A, B, C and D), each with criteria relating to discharge volumes and quality. These criteria are reproduced in Appendix A. The discharge concentration limits for each operating regime ensure the resultant in-river concentrations meet relevant water quality criteria.

3.2 Discharge Volumes

3.2.1 Water treatment plant

Between 1 May 2016 and 31 May 2017, OGNZL operated the WTP under Regime B for 267 days and Regime D for 129 days. Regimes A and C were not employed over this period. Treated water was discharged to the Ohinemuri River largely through the upper discharge, with the lower discharge used less frequently (on 253 days throughout the period as opposed to 396 days for the upper discharge). The average daily volume of treated water discharged via the upper discharge (E1) was 11,140 m^3/day. When the lower discharge (E2) was used, the average daily discharge volume was 2,100 m^3/day (average over the days for which water was discharged), with a combined daily discharge average of 12,600 m^3/day.

The combined volume of treated water discharged to the Ohinemuri River each day through both discharge points is shown as a percentage of the applicable limit on Figure 2. Daily volumes discharged through the upper discharge, which are also subject to a compliance limit, are also shown on Figure 2. Discharge

volume limit criteria, which are river flow dependent, are outlined in Table A of the discharge permit, and are reproduced in Appendix A. Raw data and discharge regime information are provided in Appendix B.

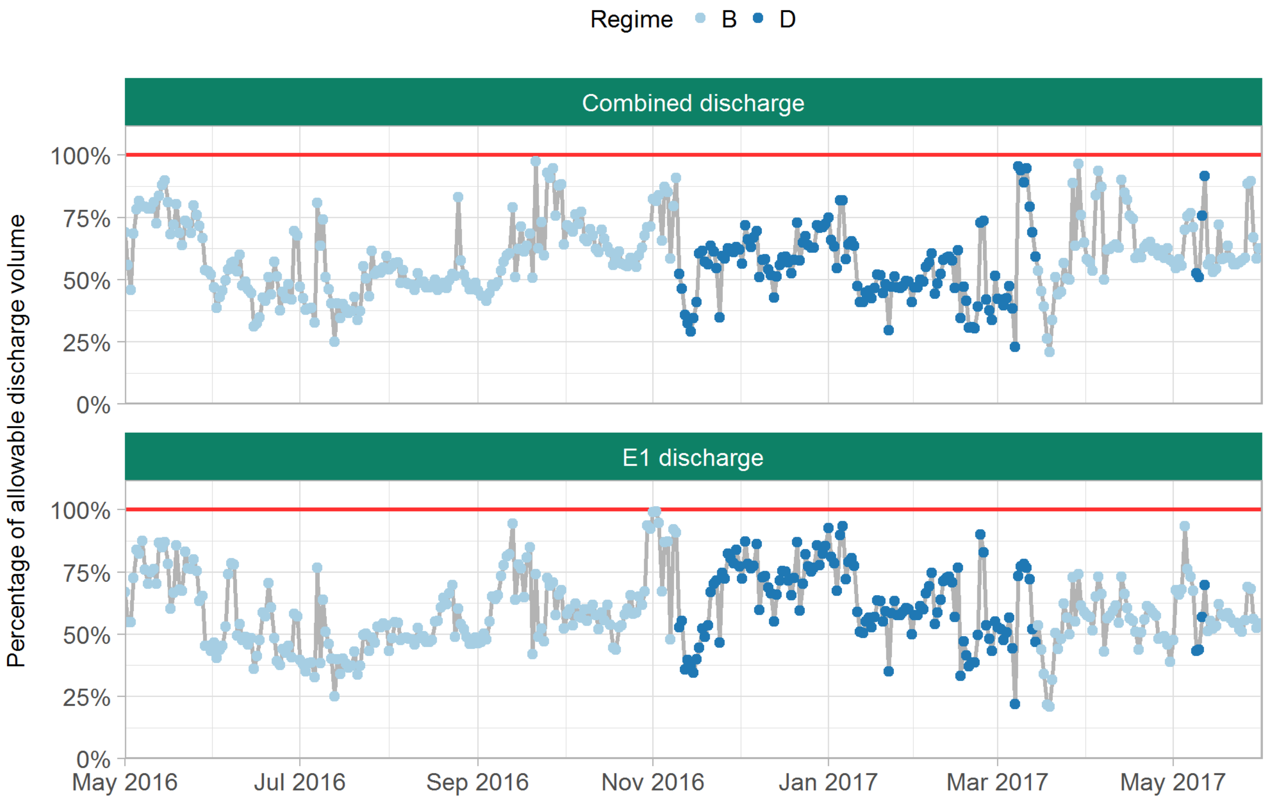

Figure 2: Daily volumes of treated water discharged from the WTP between 1 May 2016 and 31 May 2017 as a percentage of the applicable compliance limit (represented by a red line).

The combined volume of treated water discharged did not exceed the applicable limit between 1 May 2016 and 31 May 2017. The daily volume of treated water discharged through the upper discharge was, similarly, below the limit applicable to this location.

3.2.2 Tailings storage facility 2

As part of mining operations, OGNZL holds resource consent (Discharge Permit 971323) to discharge water from TSF2 into an unnamed tributary (TB1) of the Ohinemuri River. The conditions of Discharge Permit 971323 prohibit the discharge of water from TSF2 if the resultant receiving water quality will not meet criteria described in Table 1 of Discharge Permit 971318 after reasonable mixing (Table 1 is reproduced in Appendix A). To ensure this condition is met, water is discharged from TSF2 only when TSF2 water quality meets these criteria. A summary of TSF2 discharges between 1 May 2016 and 31 May 2017 is provided in Table 4. Raw data are provided in Appendix B.

3.2.3 Direct discharges

OGNZL holds resource consent (Discharge Permit 971312) to discharge water from collection ponds to the Ohinemuri River and Ruahorehore Stream if the resultant receiving water quality meets relevant criteria (refer Table 1 in Appendix A). Condition 13 of Discharge 971312 permits the direct discharge from these ponds provided the consent holder can demonstrate to the WRC *“the quality of the water entering the ponds is of a sustainable quality such that on a continuous basis the effects of the discharge from these ponds after mixing meets or is better than the receiving water criteria.”*

In July 2014 OGNZL was granted approval to commence direct discharge of the water from the S3, S4 and S5 collection ponds to the Ruahorehore Stream. Table 5 provides a summary of direct discharges between 1 May 2016 and 31 May 2017. Raw data are provided in Appendix B.

Table 4: Summary of discharges from TSF2 from 1 May 2016 to 31 May 2017.

Start date	Finish date	Duration (days)	Discharge volume (2)	
			Mean (m^3/day) (1)	Total (m^3)
10/06/2016	15/06/2016	6	5,300	32,000
23/06/2016	5/07/2016	13	5,300	69,000
8/07/2016	21/07/2016	14	5,300	74,600
26/07/2016	29/07/2016	4	5,300	21,300
25/08/2016	2/09/2016	9	5,300	48,000
21/09/2016	28/10/2016	38	5,300	202,500
9/03/2017	5/05/2017	58	5,300	307,800
29/05/2017	31/05/2017	3	3,600	10,900

Notes: (1) Represents the mean discharged volume for the days where TSF2 was discharging. (2) Numbers rounded to the nearest hundred.

Table 5: Summary of collection pond direct discharges from 1 May 2016 to 31 May 2017.

Collection pond	Total days discharging	Discharge volumes (2)	
		Mean (m^3/day) (1)	Total (m^3)
S3	179	2,600	472,400
S4	138	2,900	301,600
S5	175	2,400	369,600

Notes: (1) Represents the mean discharged volume for the days where the pond was discharging. (2) Numbers rounded to the nearest hundred.

3.2.4 Collection and silt pond discharges

On 7-8 March 2017 a rain event greater than a 1-in-10 year return period event occurred generating 131 mm of rain over a six hour period. The rainfall resulted in pond overflows. OGL undertook sampling, as required, to assess compliance with water quality conditions. The letter provided to WRC dated 27 March 2017, presenting the results of the sampling is provided in full in Appendix K. Overall, it was concluded that the site discharges in combination complied with the consent conditions.

3.3 Discharge Quality

3.3.1 Introduction

The treated water quality data in this report relates to samples collected from polishing pond 2 (PP2), as the water in PP2 represents the treated water discharged to the Ohinemuri River. Samples are collected from PP2 twice daily and analysed for pH, TSS, total ammonia, CN_{WAD}, copper, iron, manganese and silver. The daily results of each parameter are entered in OGNZL's environmental database and used in this report. Samples are collected on a weekly basis for the additional analysis of dissolved and acid soluble antimony and selenium, and on a monthly basis for the additional analysis of acid soluble arsenic, cadmium, chromium, cobalt, lead, mercury, nickel and zinc plus, calcium, magnesium, Cr^{+6}, sulfate, and EC.

The consent provides discharge concentration limits for each operating regime that ensure the resultant in-river concentrations are lower than relevant criteria. A maximum concentration limit is specified for each parameter that must be met at all times. A normal concentration limit (or trigger limit in the case of antimony and selenium) is also specified for TSS, ammonia, CN_{WAD}, antimony, copper, iron, manganese, selenium and silver. The normal concentration limit (or trigger limit) provides for the discharge concentration to exceed that limit on no more than 3 % of the days during which the WTP is discharging in any three-month period.

3.3.2 Daily measured parameters

Data relating to parameters measured on a daily basis between 1 May 2016 and 31 May 2017 are presented on Figure 3 and summarised in Table 6. Normal concentration limits are identified by an orange line, while a red line identifies maximum concentration limits. Raw data are provided in Appendix C, together with plots showing the long term dataset (from May 2005) for each parameter. For the purposes of calculating means, and graphically representing the data, values below their respective detection limits have been assigned the value of half the detection limit, as is accepted practice.

Table 6: Summary of daily data measured in the treated water between 1 May 2016 and 31 May 2017.

Statistic	pH	TSS	Ammonia	CN_{WAD}	Copper	Iron	Manganese	Silver
Mean*	8.8	<3.0	3.5	0.009	0.0031	0.026	0.007	<0.0004
Minimum	7.6	<3.0	0.3	<0.007	<0.0001	<0.008	0.001	<0.0004
Maximum	9.4	8.0	11.0	0.110	0.1020	0.140	0.038	0.0017
Count	396	396	396	396	396	396	396	396
Hist. range	6.6-11	<2-48	0.1-15	<0.007-0.35	<0.00098-0.41	<0.008-0.85	0.001-0.75	<0.0004-0.047

Notes: All units g/m^3 unless stated; Hist. (historical) range derived from data measured between May 2005 and May 2016, inclusive; TSS = total suspended solids; CN_{WAD} = weak acid dissociable cyanide; and * with the exception of pH which is the median.

Treated water concentrations of the parameters pH, total suspended solids (TSS), ammonia, CN_{WAD}, copper, iron, manganese and silver were below the normal and maximum concentration limits over the period 1 May 2016 to 31 May 2017. TSS were equal to the normal limit on two occasions (5 May 2016 and 21 January 2017), while ammonia concentrations (1.1 g/m^3) was just below the normal limit (average 1.6 g/m^3) on 5-6 March 2017. Ammonia concentrations started the annual period at high concentrations (about 10 g/m^3) following an increase from mid-2015 but remained within compliance limits. By the end of 2016 concentrations remained below 5 g/m^3.

Overall, ammonia concentrations were higher in winter and lower during the late summer period, while pH values peaked during spring and autumn (Figure 3). The reason for this may be related to variations in ore quality (which will effect variations in mine water quality), or any changes to mine water treatment process, including plant maintenance and / or upgrade.

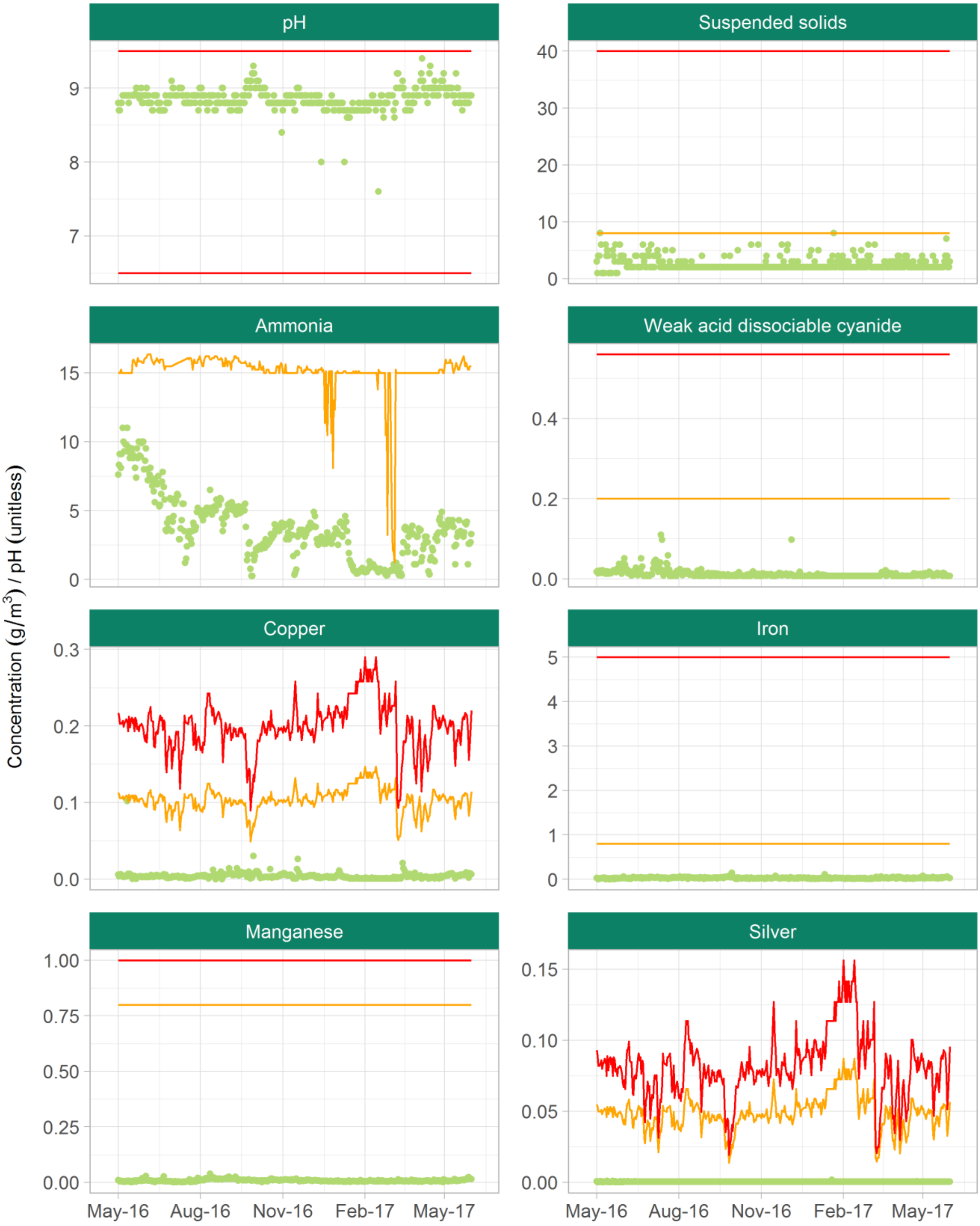

Figure 3: Daily pH, total suspended solids, ammonia, weak acid dissociable cyanide, copper, iron, manganese and silver concentrations in treated water between 1 May 2016 and 31 May 2017, with maximum compliance limits represented by a red line and normal compliance limits represented by an orange line.

3.3.3 Less frequently monitored parameters

Data relating to parameters measured between 1 May 2016 and 31 May 2017 on a weekly, monthly or intermittent basis are shown in Figure 4. The maximum concentration limits are shown in red and, where applicable, trigger limits shown in orange. Data are summarised in Table 7, and tabulated in full in Appendix C together with plots showing the long term dataset (from May 2005) for each parameter.

Table 7: Summary of data measured in the treated water between 1 May 2016 and 31 May 2017.

Statistic	Antimony	Arsenic	Cadmium	Chromium (VI)	Cobalt
Mean	0.0090	<0.002	<0.0001	<0.01	0.019
Minimum	0.0007	<0.002	<0.0001	<0.01	0.007
Maximum	0.0180	<0.002	<0.0001	<0.01	0.031
Count	55	13	13	15	14
Historical range	<0.0002-0.19	<0.001-0.005	<0.00005-0.0003	<0.01-0.012	<0.0002-0.17

Statistic	Lead	Mercury	Nickel	Selenium	Zinc
Mean	<0.0002	<0.00008	0.0006	0.0095	0.0017
Minimum	<0.0002	<0.00008	<0.005	<0.0004	<0.001
Maximum	<0.0002	<0.00008	0.0012	0.0220	0.0052
Count	13	15	13	55	13
Historical range	<0.0001-0.0013	<0.00008	<0.0005-0.036	<0.0004-0.058	<0.001-0.023

Notes: All units g/m^3; and historical range derived from data measured between May 2005 and May 2016, inclusive.

All elements analysed were below their respective maximum concentration limits and, where applicable, below their trigger limits (Figure 4). Concentrations of the elements arsenic, cadmium, chromium (as hexavalent chromium), lead and mercury were consistently below the laboratory detection limits throughout the year (Table 7). There were no observable trends in concentrations for any element throughout the year.

3.4 Summary

Discharge volumes complied with the relevant conditions of the discharge permit throughout the monitoring period. OGNZL was fully compliant with Condition 14 of the discharge permit, with concentrations complying with the limits specified in Tables 1 to 3 of the discharge permit.

Overflows from five ponds occurred during two high rainfall events in September 2016 and March 2017. These overflows are authorised by Consents 971211, 971312 and W1743. Water quality sampling during these events recorded no non-compliances for the September 2016 event and one high level of TSS in both the NSP and CSP2S for the March 2017 event. However, the overflow of these two ponds is not considered to have had adverse effects on downstream receiving waters due to the high naturally occurring TSS at the time as a result of the heavy rainfall.

Figure 4: Acid soluble metal and metalloid concentrations in the treated water between 1 May 2016 and 31 May 2017, with applicable trigger limits in orange line and maximum compliance limits in red (there is no limit for cobalt).

4.0 RECEIVING WATER

4.1 River Flows

The flows in the Ohinemuri River and the Ruahorehore Stream are monitored continuously by OGNZL to satisfy the requirements of Condition 6 of the discharge permit. This condition specifies that the consent holder establish and maintain river gauging facilities to determine the river flow at the points of discharge.

The river flow at the upper discharge (E1) is measured at the Frendrups site, approximately 5 m upstream of the upper discharge. The river flow at the lower discharge (E2), which is downstream of the confluence with the Ruahorehore Stream, is calculated by adding Ohinemuri River flow (as measured at Frendrups) to Ruahorehore Stream flow (as measured at the Ruddock (Torrens) site).

Daily river flows at E1 and E2 from 1 May 2016 to 31 May 2017 are shown on Figure 5 with the timing of the surveys denoted with a blue triangle. Raw data are provided in Appendix B. Mean flow at Frendrups over this period was 208 x 10^3 m^3/day, higher than the long term mean flow at this site (145 x 10^3 m^3/day) (Golder 2012). The highest flow in the 2016/17 monitoring period was 3,182 x 10^3 m^3/day. This flow was recorded on 25 September 2016 following a rain event on 25 September 2016 in which 167 mm of rain fell over a 24 hour period.

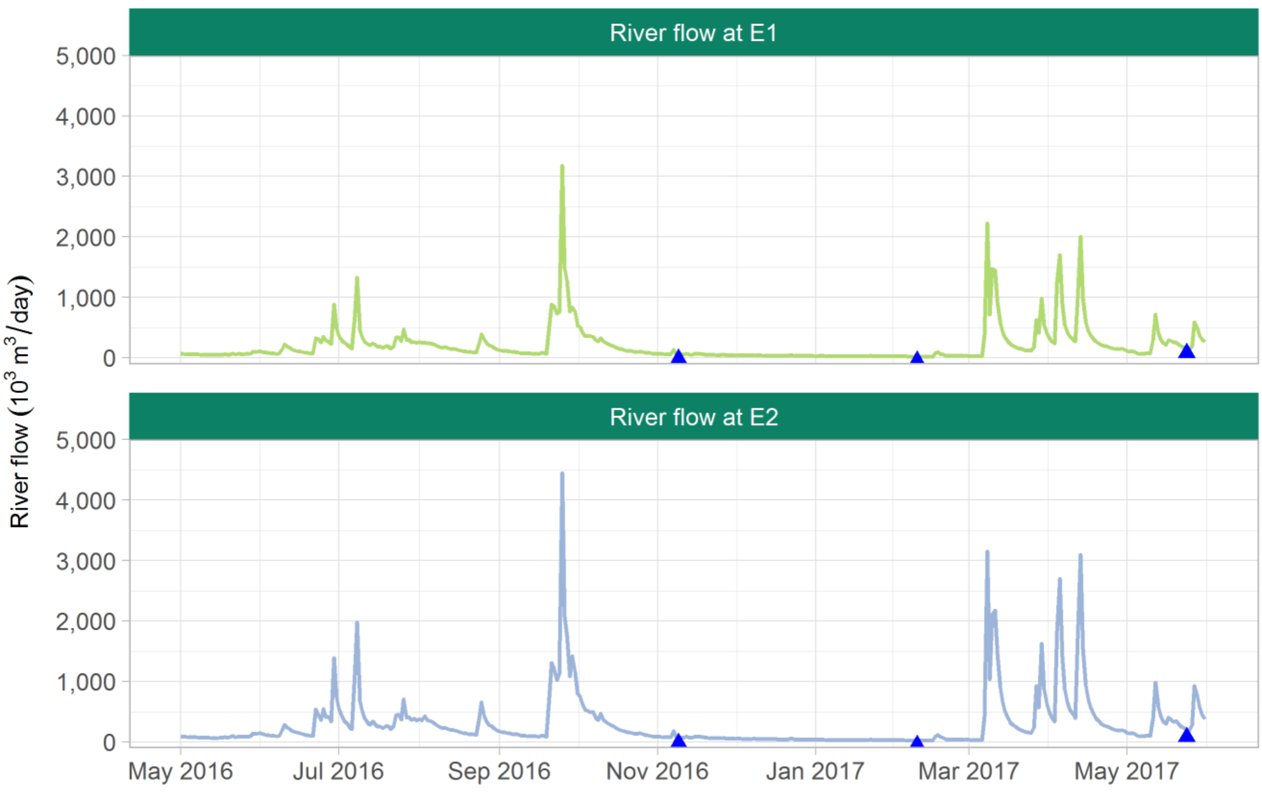

Figure 5: Ohinemuri River flow (10^3 m^3/day) at the upper (E1) and lower (E2) discharge from 1 May 2016 to 31 May 2017. Blue triangles denote the timing of the ecological surveys.

4.2 River Water Quality

4.2.1 Introduction

Condition 16 of Discharge Permit 971318 specifies the collection of river water samples from Sites OH3, OH5, OH1, OH6 and RU1 in spring and autumn each year. These samples are to be analysed for the parameters

listed in Table 1 of the discharge permit, and for nitrate-nitrogen (NO_3-N). In addition, several consents (refer to Appendix A) provide receiving water limits that apply to these sites.

OGNZL monitors water quality at the sites listed above on a more frequent basis than required, with many parameters measured weekly. Water quality is also measured on a voluntary basis at Site OC2, upstream of all mine related inputs, to allow comparison with sites downstream. The receiving water quality data measured between 1 May 2016 and 31 May 2017 are presented in Sections 4.2.2 to 4.2.4. Raw data are provided in Appendix D with a series of plots showing the long term dataset for each parameter. The figures in Appendix D show compliance limits in red and guidelines (which apply to Site OC2) in orange.

4.2.2 General water quality characteristics

The general water quality characteristics of the Ohinemuri River and Ruahorehore Stream monitoring sites from 1 May 2016 to 31 May 2017 are summarised by site in Table 8 with relevant compliance limits and the historical range for each parameter. Compliance limits apply only to Sites OH3, OH5, OH1, OH6 and RU1.

Table 8: Receiving water physico-chemistry between 1 May 2016 and 31 May 2017.

Parameter	Statistic	OC2	OH3	OH5	OH1	OH6	RU1
pH (unitless)	Mean	7.3	7.1	7.1	7.1	7.0	7.1
	Minimum	6.4	6.8	6.4	6.8	6.5	6.5
	Maximum	8.2	7.8	7.9	7.5	7.6	7.6
	Count	58	14	58	3	54	28
	Limit	NL	6.5-9.0				
	Exceedances	NA	0	1	0	0	0
	Historical range	6.2-8.4	6.1-8.2	6.1-8.5	6.2-7.8	6.2-8.4	6.0-8.1
Temperature (˚C)	Mean	16.7	16.9	16.6	15.5	16.8	16.1
	Minimum	11.2	11.6	11.3	12.7	11.5	11.3
	Maximum	24.2	24.8	23.2	17.8	24.1	19.8
	Count	49	14	49	3	46	13
	Limit	NL	NL	<3˚C change	NL	<3˚C change	NL
	Exceedances	NA	NA	0	NA	0	NA
	Historical range	8.0-24.5	8.4-24.8	8.2-25	9.1-26	8.5-25.8	9.5-23.4
TSS (g/m^3)	Mean	13.8	16.9	10.0	<3.0	9.8	7.2
	Minimum	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	Maximum	310	171	250	<3.0	200	66
	Count	58	14	58	3	54	28
	Limit	NL	NL	<10 g/m^{3} #	NL	<10 g/m^{3} #	NL
	Exceedances	NA	NA	1	NA	3	NA
	Historical range	<3.0-650	<3.0-1,200	<3.0-590	<3.0-290	<3.0-350	<3.0-385

Notes: NL = no limit; NA = not applicable; historical range derived from data measured May 2005 to April 2016 inclusive; and # if upstream concentration >100 g/m^3, downstream concentration must be <10 % greater than the upstream concentration.

pH

During the period 1 May 2016 to 31 May 2017, the pH of the receiving waters ranged from 6.4 to 7.9, and the pH at Site OC2 ranged from 6.4 to 8.2, with the mean pH for all sites at or slightly above neutral (Table 8). pH did not exceed the upper compliance limit of pH 9.0 on any monitoring occasion but was below the lower

limit of 6.5 on one occasion at Site OH5 (pH = 6.4 on 8 March 2017). This non-compliance is unlikely to be related to mining activity as the pH recorded at Site OC2 (the most upstream site) on 8 March 2017 was also 6.4 (Appendix D).

Temperature

Temperature compliance limits are applicable to Site OH5, downstream from the upper discharge, and Site OH6, downstream from the lower discharge. The surface water temperature at Site OH5 must be no more than 3 °C higher than that measured upstream of the upper discharge at Site OH3 (or Site OC2). Similar conditions apply to Site OH6, where the surface water temperature must be no more than 3 °C higher than that upstream of the lower discharge but downstream of the upper discharge (i.e., Site OH5 or OH1). The differences in water temperature at both sites for which compliance limits apply were less than 3 °C on all occasions for which there were paired data.

Total suspended solids

TSS compliance limits are applicable to Sites OH2, OH5, and OH6 plus RU1. With the exception of the conveyor silt ponds CSP1 and CSP2, all of the silt ponds are authorised by RC 971311. Condition 7 requires that *"For rainfall events less than or equal to the 2-year return period, the silt pond discharges shall have a suspended solids concentration of no greater than 100 g/m³"*. Table 1 of RC 971311 requires "*No greater than a 10% increase compared with upstream concentrations for rainfall events greater than the design storm"*.

The collection ponds are authorised by RC971312. Condition 5 requires that for rainfall events with a return period less than or equal to ten years, all storm water reporting to the collection ponds shall be pumped to the Water Treatment Plant for treatment. Table 2 of RC971312 requires *"For upstream concentrations of less than or equal to 100g/m³ the increase shall be no greater than 10g/m³. For upstream concentrations of greater than 100 g/m³ the increase shall be no greater than 10%"*. It should be noted that WSP, S3, S4 and S5 can switch between being silt ponds and collection ponds depending on the water quality.

Discharges from the decommissioned TSF2 tailings pond are authorised by RC971323. Table 1 of RC971323 requires that "For upstream concentrations of less than or equal to 100g/m³ the increase shall be no greater than 10g/m³. For upstream concentrations of greater than 100 g/m³ the increase shall be no greater than 10%."

During the two periods of discharge from the silt ponds (26 September 2017 and 7-8 March 2017) TSS concentrations in the discharge and river where within the consent limits. For all other discharge occasions, the upstream site OC2, TSS was at or below detection limit (<3 g/m³) only on 36 % of sampling occasions. TSS was above 100 g/m³ on one sampling occasion of 58 occasions.

At sites OH5 and OH6 TSS concentrations were generally low, typically at or below laboratory detection limit (3 g/m³) for the majority of sampling occasions (79 % of occasions for OH5 and 81 % for OH6). At Site OH5, TSS exceeded the consent limits on one sampling occasions, while at Site OH6 TSS exceeded the consent limits on three sampling occasions. These exceedance events occurred on:

- 30 June 2016

  The TSS concentration downstream of the lower discharge at Site OH6 was 37 g/m³, compared to only 23 g/m³ upstream at Site OH5. Since TSS concentrations at the most upstream site (OC2) were the same as OH6, this is unlikely to be a true exceedance (and suggests that the TSS concentration measured in the sample collected from OH5 could be artificially low) and not related to mine activities.

- 11 August 2016

  The TSS concentration downstream of the upper discharge at Site OH5 was 28 g/m³, compared to only 10 g/m³ upstream at Site OC2 and 8 g/m³ downstream of the lower discharge (Site OH6). While wastewater was being released via the upper discharge during this time, the measured TSS concentration in this discharge was <3 g/m³, suggesting that this exceedance may not be related to mine activities.

- 28 September 2016

  TSS concentration at Site OH6 was 56 g/m³, compared to 12 g/m³ at Site OH5. At the time of this exceedance, the wastewater was being released via the lower discharge although the TSS

concentrations in the discharge were <3 g/m^3, suggesting that this exceedance may not be related to mine activities.

- 30 March 2017

  TSS concentration at Site OH6 was 22 g/m^3 compared to 10 g/m^3 at Site OH5. At the time of this exceedance, the wastewater discharge was <3 g/m^3, suggesting that this exceedance may not be related to mine activities.

On 7-8 March 2017, TSS concentrations at sites OH5 and OH6 were 250 and 200 g/m^3, respectively. However, neither were regarded to be in breach of the consent limits as the TSS concentrations at both sites were below their respective upstream sites TSS concentrations. The high TSS concentrations were a result of the high rain event that occurred on 7-8 March 2017, prior to sampling. Information associated with this rainfall event is provided in Appendix K.

An elevated discharge TSS concentration (160 g/m^3) was also reported for 23 June 2016 for the discharge from the underground carpark to a tributary of the Ohinemuri River (TB3). This was reported to WRC in the June 2016 receiving water quality compliance correspondence (dated 19 July 2016). Sampling of the Ohinemuri River at OH5 and upstream OC2 both recorded concentrations of 29 g/m^3. The discharge occurred during a period of intense rainfall over two days in Waihi. There was no indication the discharge had any effect on TSS concentrations in the Ohinemuri River.

4.2.3 Nitrogen compounds

Concentrations of ammonia, NO_3-N and CN_{WAD} between 1 May 2016 and 31 May 2017 are summarised by site in Table 9 together with relevant limits and the historical range for each parameter. As in previous years, ammonia concentrations were consistently below the temperature and pH dependent limits (Figure 6). Nitrate concentrations measured at all sites were within the historical range at each monitoring site, as were CN_{WAD} concentrations. In-river concentrations of CN_{WAD} were consistently less than the compliance limit of 0.093 g/m^3. There is no compliance limit for nitrate.

Table 9: Receiving water concentrations of ammonia, NO_3-N and CN_{WAD} from May 2016 to May 2017.

Parameter	Statistic	OC2	OH3	OH5	OH1	OH6	RU1
Ammonia	Mean	0.020	0.016	0.497	0.546	0.373	0.046
	Minimum	<0.012	<0.012	0.044	0.267	<0.012	<0.012
	Maximum	0.108	0.051	1.457	0.910	1.166	0.401
	Count	16	14	15	3	16	28
	Limit	NL	Temperature and pH dependent (e.g., 2.6 g/m^3 when T=15 ˚C and pH=7.0)				
	Exceedances	NA	0	0	0	0	0
	Hist. range	<0.012-0.155	<0.012-1.70	<0.012-1.50	<0.012-1.07	<0.012-1.82	<0.012-0.60
NO_3-N (gN/m^3)	Mean	0.63	0.62	0.91	1.08	1.03	0.82
	Minimum	0.05	0.05	0.54	0.97	0.51	0.05
	Maximum	1.32	1.30	1.29	1.23	1.41	1.72
	Count	14	14	14	3	14	13
	Limit	NL					
	Exceedances	NA					
	Hist. range	0.024-1.32	<0.020-1.41	0.044-1.50	0.025-1.42	0.022-1.51	<0.002-2.70
CN_{WAD}	Mean	<0.0010	<0.0010	0.0014	0.0020	0.0014	<0.0010
	Minimum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Maximum	<0.0010	<0.0010	0.0035	0.0034	0.0081	<0.0010

Parameter	Statistic	OC2	OH3	OH5	OH1	OH6	RU1
	Count	16	14	15	3	16	28
	Limit	NL	0.093				
	Exceedances	NA	0	0	0	0	0
	Hist. range	<0.001-0.002	<0.001-0.021	<0.001-0.073	<0.001-0.024	<0.001-0.022	<0.001-0.013

Notes: All units g/m^{3}unless otherwise stated; NL = no limit; NA = not applicable; CN_{WAD} is weak acid dissociable cyanide; NO_3-N is nitrate nitrogen; and hist. (historical) range derived from data measured between May 2005 and May 2017, inclusive.

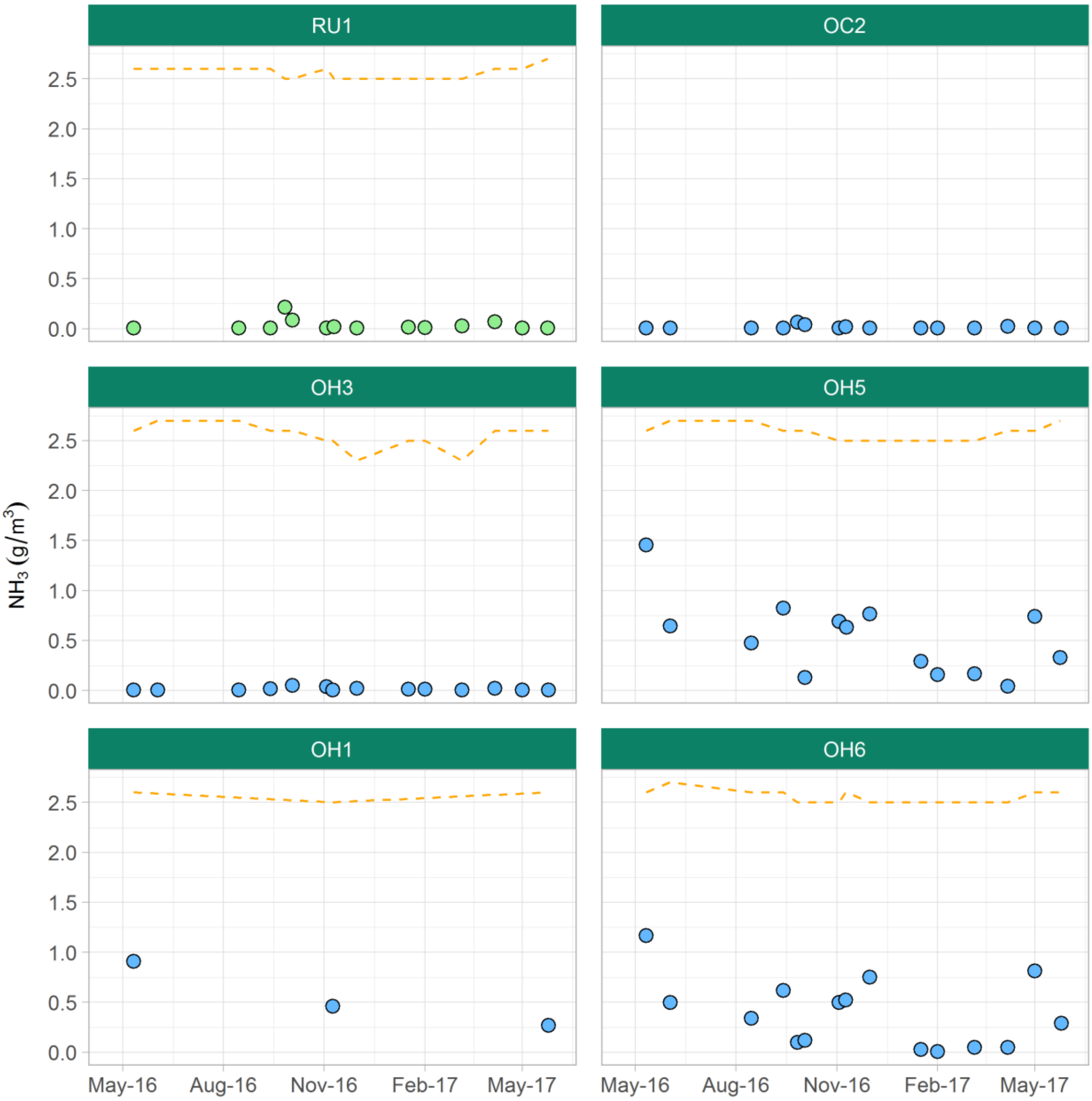

Figure 6: Ammonia concentrations at Sites RU1, OC2, OH3, OH5, OH1 and OH6 between 1 May 2016 and 31 May 2017. Dashed line indicates the temperature and pH dependent compliance limit.

4.2.4 Metals and metalloids

Dissolved[2] metal and metalloid concentrations in the receiving waters between 1 May 2016 and 31 May 2017 are summarised by site in Table 10 with compliance limits and the historical range for each element. Generally, in-river concentrations of metals and metalloids were below compliance limits, and often below detection limit. There was one exceedance of the compliance limits for lead at Site OH5 on 8 March 2017. However, as the lead concentrations at the most upstream site, OC2, was also elevated on 8 March, there is no evidence to suggest that the exceedance at OH5 was related to mining activities. Given natural concentrations of lead in freshwater are very low, it is considered that the measurable concentration at both sites is potentially an occasion specific sample contamination issue. The assessment of water quality against the mercury compliance limit is not possible because the laboratory detection limit (0.00008 g/m^3) is greater than the consented compliance limit (0.000012 g/m^3). Mercury concentrations were below detection limits on all sampling occasions during the 2016-2017 period.

Table 10: Receiving water metal/metalloid concentrations between 1 May 2016 and 31 May 2017.

Parameter	Statistic	OC2	OH3	OH5	OH1	OH6	RU1
Antimony	Mean	<0.0002	<0.0002	0.0010	0.0011	0.0009	<0.0002
	Minimum	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
	Maximum	<0.0002	0.0004	0.0034	0.0016	0.0034	<0.0002
	Count	58	14	58	3	58	15
	Limit	NL	0.03				
	Exceedances	NA	0	0	0	0	0
	Hist. range	<0.0002-0.0008	<0.0002-0.0091	<0.0002-0.011	<0.0002-0.01	<0.0002-0.026	<0.0002
Arsenic	Mean	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Minimum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Maximum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Count	16	14	15	3	16	15
	Limit	NL	0.19				
	Exceedances	NA	0	0	0	0	0
	Hist. range	<0.001	<0.001	<0.001-0.0013	<0.001	<0.001-0.0046	<0.001
Cadmium	Mean	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
	Minimum	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
	Maximum	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
	Count	16	14	15	3	16	15
	Limit	NL	Hardness dependent (e.g., 0.001 g/m^3 at a hardness of 100 g/m^3 as $CaCO_3$)				
	Exceedances	NA	0	0	0	0	0
	Hist. range	<0.00005	<0.00005	<0.00005	≤0.00005	<0.00005	<.00005-0.00007
Chromium (VI)	Mean	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Minimum	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Maximum	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010

[2] Dissolved metals and metalloids with the exception of mercury, which is measured in the acid soluble fraction.

Parameter	Statistic	OC2	OH3	OH5	OH1	OH6	RU1
	Count	16	14	15	3	16	15
	Limit	NL	0.01				
	Exceedances	NA	0	0	0	0	0
	Hist. range	<0.010-0.015	<0.010-0.017	<0.010	<0.010	<0.010	<0.010
Copper	Mean	<0.0005	<0.0005	0.0006	<0.0005	<0.0005	<0.0005
	Minimum	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Maximum	0.0009	<0.0005	0.0011	0.0007	0.0012	0.0010
	Count	31	14	30	3	31	28
	Limit	NL	Hardness dependent (e.g., 0.011 g/m^3 at a hardness of 100 g/m^3 as $CaCO_3$)				
	Exceedances	NA	0	0	0	0	0
	Hist. range	<0.0005-0.004	<0.0005-0.0080	<0.0005-0.0092	<0.0005-0.0037	<0.0005-0.0040	<0.0005-0.0031
Iron	Mean	0.10	0.11	0.09	0.08	0.09	0.16
	Minimum	0.05	0.05	0.04	0.06	0.05	0.04
	Maximum	0.18	0.19	0.23	0.09	0.24	0.25
	Count	16	14	15	3	16	28
	Limit	NL	1				
	Exceedances	NA	0	0	0	0	0
	Hist. range	0.01-0.25	0.04-0.45	0.03-0.38	0.01-0.26	0.01-0.27	0.04-0.64
Lead	Mean	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Minimum	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Maximum	0.00022	<0.0001	0.00023	0.0003	0.0006	<0.0001
	Count	16	14	15	3	16	15
	Limit	NL	Hardness dependent (e.g., 0.0025 g/m^3 at a hardness of 100 g/m^3 as $CaCO_3$)				
	Exceedances	NA	0	1	0	0	0
	Hist. range	<0.0001-0.0006	<0.0001-0.0013	<0.0001-0.00025	<0.0001-0.0013	<0.0001-0.00084	<0.0001-0.00030
Manganese	Mean	0.014	0.011	0.017	0.015	0.026	0.042
	Minimum	0.004	0.004	0.005	0.011	0.007	0.013
	Maximum	0.077	0.021	0.074	0.018	0.113	0.106
	Count	31	14	30	3	31	28
	Limit	NL	2				
	Exceedances	NA	0	0	0	0	0
	Hist. range	0.0011-0.077	0.0049-0.49	0.0052-0.32	0.0012-0.27	0.0016-0.26	0.014-0.88
Mercury	Mean	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008
	Minimum	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008
	Maximum	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008
	Count	16	14	15	3	16	15

Parameter	Statistic	OC2	OH3	OH5	OH1	OH6	RU1
	Limit	NL	0.000012				
	Exceedances	NA	Compliance limit currently < detection limit.				
	Hist. range	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008-0.0001	<0.00008
Nickel	Mean	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Minimum	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Maximum	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0010
	Count	16	14	15	3	16	15
	Limit	NL	Hardness dependent (e.g., 0.16 g/m³ at a hardness of 100 g/m³ as $CaCO_3$)				
	Exceedances	NA	0	0	0	0	0
	Hist. range	<0.0005	<0.0005-0.001	<0.0005-0.0036	<0.0005-0.0023^	<0.0005-0.0025	<0.0005-0.0058
Selenium#	Mean	0.0006	<0.0002	0.0013	0.0012	0.0012	0.0003
	Minimum	<0.0002	<0.0002	<0.0002	0.0006	0.0001	<0.0002
	Maximum	0.0010	0.0005	0.0034	0.0019	0.0034	0.0010
	Count	58	14	58	3	58	15
	Limit	NL	0.020*				
	Exceedances	NA	0	0	0	0	0
	Hist. range	<0.001-0.0010	<0.0002-0.0029	<0.0002-0.0045	<0.0002-0.004	<0.0002-0.0095	<0.0002 – 0.0005
Silver	Mean	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Minimum	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Maximum	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Count	16	14	15	3	16	15
	Limit	NL	Hardness dependent (e.g., 0.0028 g/m³ at a hardness of 100 g/m³ as $CaCO_3$)				
	Exceedances	NA	0	0	0	0	0
	Hist. range	<0.0001	<0.0001-0.00040	<0.0001-0.0015	<0.0001-0.00091	<0.0001-0.0014	<0.0001
Zinc	Mean	0.003	0.003	0.003	0.002	0.010	0.005
	Minimum	0.001	<0.001	<0.001	0.001	0.001	<0.001
	Maximum	0.009	0.006	0.007	0.002	0.055	0.014
	Count	16	14	15	3	16	15
	Limit	NL	Hardness dependent (e.g., 0.10 g/m³ at a hardness of 100 g/m³ as $CaCO_3$)				
	Exceedances	NA	0	0	0	0	0
	Hist. range	<0.001-0.016	<0.001-0.055	<0.001-0.011	<0.001-0.082	<0.001-0.013	<0.001-0.014

Notes: All units g/m³; NL = no limit; NA = not applicable; with the exception of mercury, concentrations determined on dissolved fraction; mercury concentrations determined on acid soluble fraction; hist. (historical) range derived from data measured May 2005 to April 2016; * selenium trigger limit requires that concentrations remain below 0.02 g/m³ 97 % of time, and must not exceed 0.035 g/m³ in any one analysis; #selenium summary statistics derived after excluding higher detection limit (0.001 g/m³) data; and ^excluding elevated arsenic (0.0013 g/m³), cadmium (0.00051 g/m³), copper (0.099 g/m³), iron (1.35 g/m³), lead (0.0045 g/m³), nickel (0.022 g/m³) and zinc (0.26 g/m³) measured on 23 February 2012 not considered to be related to mining activities (refer Golder 2013 for further information).

Generally, in-river concentrations of metals and metalloids were below compliance limits, and often below detection limit. There was one exceedance of the compliance limits for lead at Site OH5 on 8 March 2017. However, as the lead concentrations at the most upstream site, OC2, was also elevated there is no evidence to suggest that the exceedance at OH5 was related to mining activities. The assessment of water quality against the mercury compliance limit is not possible because the laboratory detection limit (0.00008 g/m^3) is greater than the consented compliance limit (0.000012 g/m^3). Mercury concentrations in the Ohinemuri River were below detection limits on all sampling occasions during the 2016-2017 period. However, it should be noted that with minimal dilution, the concentration that is below the detection limit would be expected to be below the mercury compliance limit.

4.3 Summary

Overall, OGNZL has achieved a high level of compliance with the receiving water consent conditions between 1 May 2016 and 31 May 2017. There were several technical non-compliances in two of the physico-chemical parameters. There was no evidence to suggest that these non-compliances were related to mining activities. Specifically:

- pH was below the lower consent limit of 6.5 downstream of the upper discharge on one occasion.
- The compliance limit for TSS was exceeded on one occasion downstream of the upper discharge and on three occasions downstream of the lower discharge. Although the cause of the individual increases measured in TSS concentration has not been identified, the small exceedances are not considered to be the result of mining activity.
- An exceedance of TSS concentration in the discharge from the underground carpark to TB3 was identified on 26 June 2016. Sampling in the Ohinemuri River did not show any increase in TSS compared to upstream concentration.

5.0 SEDIMENT

5.1 Introduction

Condition 16 of the discharge permit requires OGNZL to assess the total recoverable metal and metalloid concentrations (as listed in Table 1 of the discharge permit) in sediments collected from Sites OH3, OH5, OH1, OH6 and RU1, on two occasions each year. Sediment was also collected on a voluntary basis from the upstream control site (Site OC2). The sampling sites are the same as those employed for water quality monitoring, and are shown on Figure 1. The discharge permit specifies that sampling should be undertaken in spring (October to December) and autumn (March to May).

Results relating to the samples collected during the spring (November 2016) and autumn (May 2017) surveys are presented in the following sections. Sample textures (broad grain size distributions) are described in Section 5.2. Section 5.3 presents information on the concentrations of metals and metalloids in the two sediment fractions (<2 mm and <63 µm), the sediment quality criteria that the concentrations are compared to (as defined by the resource consent) and sets out any exceedances of the criteria.

5.2 Textures

Sediment textures at each site broadly reflect the hydrodynamic environment within the tributaries and Ohinemuri River (how much sediment enters the river and its characteristics plus the flow velocities within the waterways). Of the sediments present in the river bed, it is the fine sediment (generally less than 63 µm (0.063 mm) in size) that has the capacity to attract (adsorb) contaminants that may enter the river via the discharges. The sediment grain size characteristics are an important aspect of trace element concentration variability.

As concentrations of metals and metalloids are typically higher in finer grained sediments, which have relatively larger surface area to volume ratios, it is important to consider sediment textural data to ensure that any apparent variability in elemental concentrations is not related to the spatial variability in the amount of finer grained sediments. This effect of texture is reduced by examining concentrations in the <63 µm fraction in addition to the <2 mm fraction as set out in the following section.

As shown in Table 11, sediments in the Ohinemuri River and Ruahorehore Stream were dominated by sand. Sediment textures were comparable between seasons at Sites OC2, OH3 and OH5. The other two sites on the Ohinemuri River (OH1 and OH6) and Site RU1, exhibited greater variability between the two monitoring rounds. The key observations in relation to sediment grain size characteristics were:

- Fine sediment (silt and clay = particles <63 µm) comprised 10 % or less in both seasons at all sites.
- The proportion of sand at Site RU1 was higher in spring compared to autumn whereas it was higher in autumn compared to spring at sites OH1 and OH6.
- The gravel proportion was correspondingly higher in autumn at RU1 and higher in spring at OH1 and OH6.

It should be noted that the sediment textures represent the characteristics of the sediment collected for the purpose of analysis rather than the physical nature of the bed of the river. The scale of subsamples collected from the river and stream beds excludes large sized bed materials.

The gravel proportion in the samples varied with RU1 higher in May 2017. The material larger than sand (2 mm) comprises gravels (2-64 mm) (with coarse and very coarse gravel in the range 16 to 64 mm), cobbles (64 to 256 mm) and boulders larger than 256 mm. The sampling method avoids the materials larger than coarse gravel and with possible exclusion of some coarse gravel during the sampling, the method provides a general indication of the nature of the finer bed materials. At the Ohinemuri sites OH1 and OH6 gravel proportions were lower in autumn compared to spring and sands were correspondingly lower in autumn. Overall, there is not enough information on the hydrodynamics of the river to determine why the OH6 site in particular had less sand in spring 2016 compared to the other sites.

Table 11: Textures of sediments collected from the Ohinemuri River and Ruahorehore Stream.

Fraction*	Survey	OC2	OH3	OH5	OH1	OH6	RU1
Mud	November 2016	5.7	0.5	2.3	2.8	2.0	2.4
	May 2017	10.4	4.6	4.7	3.5	4.5	2.7
	Historical range	1.2-48.9	0.6-19.1	0.7-23.3	0.05-31.5	1.4-40	0.4-10.4
Sand	November 2016	90.3	98.9	95.4	72.6	44.2	93.9
	May 2017	81.7	95.4	93.2	93.9	85.2	74.6
	Historical range	40.1-96.9	73.8-94.2	54.8-99.1	58.4-99.1	56.6-97.8	84.1-98.6
Gravel	November 2016	4.0	0.6	2.3	24.6	53.8	3.7
	May 2017	7.9	<0.1	2.0	2.6	10.3	22.7
	Historical range	0.2-19.2	0.6-19.1	<0.1-31.1	0.2-26.9	0.2-21.1	0.5-10.7

Notes: All units % = g/100 g dry weight; * gravel is sediment ≥2 mm diameter, sand is sediments <2 mm and ≥63 µm diameter, mud is sediment <63 µm diameter; and historical range derived from data measured between December 2005 and May 2016.

Overall, sediment sampled from the Ohinemuri River and the Ruahorehore Stream in 2016/2017 was predominantly sandy (as in prior years). Some shifts in textural classes occurred at sites between surveys with small increases in the mud % from the November 2016 to May 2017. Some shifts in gravel and sand proportions were evident between the surveys at sites OH1 and RU1. These shifts are not likely to influence the sediment chemistry assessment as that analysis is carried out on particles sizes classes less than 2 mm in size.

5.3 Sediment Quality

5.3.1 Introduction

Total recoverable metal and metalloid dry weight concentrations in the <2.0 mm fraction of sediments collected in the 2016/17 period are provided in Table 12 and the corresponding concentrations in the <63 µm fraction are provided in Table 13. For each monitoring site and element, the historical data (December 2005 to May 2016) are also provided. Laboratory analysis reports are presented in Appendix E with a time series plot for each element measured in both sediment fractions, at each site. Section 5.3.2 describes the 2016/2017 element concentrations highlighting changes compared to the historical data. Section 5.3.3 compares the sediment element concentrations with sediment quality guidelines. In Table 12 and Table 13 element abundances outside of the historical range are presented in bold and concentrations above either of the two sediment quality guidelines are shown in blue.

5.3.2 2016-2017 concentration data

Based on the summarised concentration data presented in Table 12 and Table 13, the following observations were made:

- Overall, elemental abundances measured in the <2 mm fraction of sediment collected in November 2016 and May 2017 were generally consistent with earlier surveys (December 2005 to May 2016) with the following exceptions:
  - Where sediment concentrations differed to the historical range, the concentrations were lower than the historical range.
  - A lower concentration of arsenic was measured at Site OH3 in May 2017 (Table 12) and a lower concentrations of nickel were measured at OH3 in May 2017 and OH6 in November 2016.
  - Lower concentrations of silver were measured at OH5 in the November 2016 survey, OH1 and OH6 in the May 2017.
  - Sediment samples collected from Site RU1 contained lower concentrations of copper, iron, mercury, nickel and higher concentrations of cadmium compared to other sites on the Ohinemuri River.
- Elemental abundances measured in the <0.63 µm fraction of sediment collected in November 2016 and May 2017 were also generally consistent with the historic range, with the following exceptions and comments:
  - Where the <0.63 µm sediment fraction concentrations differed compared to the historical range, the concentrations were, in all cases, lower than the historical range.
  - Arsenic concentration at OH6 in May 2017 was lower than the historical range (Table 13).
  - Cadmium, copper and lead concentrations at RU1 in May 2017 were lower than the historical range (Table 13).
  - Mercury concentrations in the <0.063 mm fraction at sites OH3 and OH6 were below the historical minima in November 2016 and lower than the historical minima at site RU1 in both surveys.
  - Nickel concentrations were lower than the historical minima at sites OH3 (May 2017), OH6 (November 2016, May 2017) and RU1 (May 2017).
  - Silver concentrations were lower than the historical minima at OH1 (May 2017) and OH6 (November 2016, May 2017) and highest in both surveys at OH5 (consistent with the 2015/2016 survey). Further comment on the silver concentration is provided in section 5.5.3.
  - Selenium concentrations were lowest at sites OC2 and OH3 and elevated by comparison at sites OH5, OH1 and OH6 (the difference is typically less than a factor of two). This pattern is similar to that seen in the 2015/2016 survey.
  - Zinc concentrations at Site RU1 were lower than the previous minima in both the November 2016 and May 2017 surveys.
  - Fraction samples collected from site RU1 sediment contained lower concentrations of copper and mercury and higher concentrations of arsenic, cadmium, lead and zinc compared to other sites on the Ohinemuri River.

Table 12: Total recoverable metal and metalloid concentrations in <2.0 mm sediment fraction.

Site	Survey	OC2	OH3	OH5	OH1	OH6	RU1
Antimony	November 2016	<0.040	<0.040	<0.040	0.04	0.09	<0.040
	May 2017	0.050	<0.040	0.05	0.05	0.06	<0.040
	Historical range	<0.040-0.097	<0.040-0.079	<0.040-0.47	<0.040-0.67	<0.040-2.7	<0.40-0.048
Arsenic	November 2016	3.0	2.4	2.3	2.7	2.9	2.0
	May 2017	3.5	**1.8**	2.7	2.4	2.5	1.8
	Historical range	1.9-4.6	2.0-5.4	2.1-6.3	1.5-6.8	1.8-7.1	0.90-6.0
Cadmium	November 2016	0.093	0.059	0.047	0.047	0.079	0.136
	May 2017	0.129	0.063	0.069	0.056	0.079	0.116
	Historical range	0.050-0.31	0.040-0.20	0.043-0.22	0.040-0.33	0.039-0.49	0.05-0.60
Chromium (VI) *	November 2016	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
	May 2017	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
	Historical range	<0.40-<2.0	<0.40-<2.0	<0.40-<2.0	<0.40-<2.0	<0.40-<2.0	<0.40-<2.0
Copper	November 2016	5.8	5.1	4.6	4.0	5.0	1.9
	May 2017	8.8	4.8	6.9	5.0	5.8	2.0
	Historical range	4.8-11	4.2-10	3.7-13	3.7-14	4.5-24	1.0-13
Iron (% dry wt.)	November 2016	1.83	1.59	1.43	1.38	1.47	0.84
	May 2017	2.30	1.52	1.78	1.54	1.69	0.94
	Historical range	1.60-2.70	1.40-2.60	1.25-2.70	0.93-3.40	1.26-2.80	0.44-2.20
Lead	November 2016	7.8	6.2	9.0	5.4	6.5	6.4
	May 2017	11.0	7.8	7.2	5.7	7.3	6.0
	Historical range	5.7-12.0	4.5-14.0	4.4-13	3.7-15	5.0-14	3.1-14
Manganese	November 2016	410	370	250	240	220	420
	May 2017	410	280	320	210	300	340
	Historical range	230-580	210-680	168-680	150-1,100	126-590	185-1,200
Mercury	November 2016	0.34	0.34	0.22	0.21	0.27	0.094
	May 2017	0.42	0.28	0.34	0.27	0.36	0.071
	Historical range	0.21-0.63	0.18-9.80	0.18-3.1	0.14-0.75	0.20-0.65	0.045-0.20
Nickel	November 2016	5.8	6.0	5.3	3.9	**4.7**	1.8
	May 2017	7.4	**4.0**	6.2	6.1	6.5	2.2
	Historical range	5.1-9.4	4.2-8.2	3.5-10.2	3.7-9.9	4.8-11.3	1.3-6.0
Selenium	November 2016	<0.50	<0.50	<0.50	0.6	0.8	0.7
	May 2017	0.70	<0.50	<0.50	<0.50	0.5	<0.50
	Historical range	<0.50-2.0	<0.50-1.25	<0.50-1.7	<0.50-2.5	<0.50-6.1	<0.50-2.6
Silver	November 2016	0.07	0.05	**0.08**	0.09	0.42	0.05
	May 2017	0.15	0.08	0.15	**0.07**	**0.10**	0.10
	Historical range	0.037-0.49	<0.04-0.35	0.091-1.3	0.09-1.5	0.18-4.8	0.03-1.4
Zinc	November 2016	41	37	31	27	31	32
	May 2017	57	32	40	38	41	33
	Historical range	31-72	27-57	24-67	19-80	28-89	21-120

Notes: All units, with the exception of Fe, mg/kg dry weight; units for Fe are wt % (dry weight); historical range from December 2005 through May 2016, inclusive; results in blue indicate concentrations elevated above OME (1993) LEL or NOAA (1999) TEL guidelines; results bolded indicate concentration outside historical range; * - 0.01 M KH_2PO_4 extraction used to determine Cr(VI) concentration.

Table 13: Total recoverable metal and metalloid concentrations in <63 µm sediment fraction.

Site	Survey	OC2	OH3	OH5	OH1	OH6	RU1
Antimony	November 2016	0.10	0.12	0.22	0.30	0.25	0.16
	May 2017	0.16	0.14	0.18	0.15	0.24	0.17
	Historical range	0.06-2.0	0.08-0.23	0.13-0.94	0.13-0.9	0.20-1.7	0.12-0.33
Arsenic	November 2016	5.9	6.2	7.5	7.4	7.7	9.0
	May 2017	6.0	6.0	7.0	7.5	**6.0**	8.0
	Historical range	4.7-11	4.8-8.0	6.0-9.8	5.6-10	6.2-9.0	7.6-11
Cadmium	November 2016	0.36	0.27	0.28	0.38	0.40	0.68
	May 2017	0.38	0.24	0.42	0.28	0.34	**0.57**
	Historical range	0.29-0.70	0.21-0.82	0.21-1.36	0.24-0.76	0.28-0.54	0.64-1.4
Chromium (VI) *	November 2016	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
	May 2017	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
	Historical range	<0.40-<2.0	<0.40-<2.0	<0.40-<2.0	<0.40-<2.0	<0.40-<2.0	<0.40-<2.0
Copper	November 2016	14.0	14.4	20.0	17.8	17.8	12.4
	May 2017	12.9	13.2	17.4	15.1	14.7	**10.2**
	Historical range	12-18	12-19	15.5-27	14.5-34	17-27	12-17
Iron	November 2016	2.9	3.2	3.3	3.2	3.2	3.5
	May 2017	3.3	3.2	3.1	3.4	3.1	3.3
	Historical range	2.8-5.0	2.7-3.9	2.8-4.2	2.7-3.9	2.5-4.0	3.0-4.7
Lead	November 2016	15.1	15.4	17.1	16.9	16.6	20
	May 2017	17.8	17.6	17.7	17.7	17.7	**19.5**
	Historical range	16-19	15-19	16-18	16-19	16-22	20-26
Manganese	November 2016	1140	970	910	1340	780	2100
	May 2017	690	960	740	1070	830	1730
	Historical range	600-1,940	730-1,330	500-1,170	590-1,330	360-1,860	1,420-3,200
Mercury	November 2016	0.44	**0.38**	0.49	0.40	**0.39**	**0.156**
	May 2017	0.54	0.56	0.67	0.54	0.52	**0.168**
	Historical range	0.40-0.69	0.43-1.8	0.43-1.2	0.40-0.78	0.44-1.1	0.18-0.30
Nickel	November 2016	9.3	8.9	10.3	9.0	**8.6**	7.0
	May 2017	7.0	**7.7**	8.4	8.6	**7.8**	**5.8**
	Historical range	6.5-12.2	7.9-14	7.8-14	8.3-13	9.0-14	6.9-11.4
Selenium	November 2016	1.8	1.6	2.7	2.8	3.0	2.7
	May 2017	1.7	1.9	2.4	2.2	2.3	2.6
	Historical range	<2.0-2.9	<2.0-3.0	<2.0-4.3	<2.0-5.3	<2.0-7.2	<2.0-4.7
Silver	November 2016	0.30	0.27	1.52	0.80	**0.99**	0.31
	May 2017	0.49	0.76	1.11	**0.54**	**0.61**	0.38
	Historical range	0.20-0.92	0.24-0.94	1.0-4.9	0.71-5.4	1.02-7.5	0.31-0.64
Zinc	November 2016	77	68	78	77	77	**103**
	May 2017	84	66	91	71	74	**94**
	Historical range	65-140	62-122	66-99	70-124	72-108	121-189

Notes: All units, with the exception of Fe, are mg/kg dry weight; units for Fe are wt% (dry weight); historical range derived from data measured between December 2005 and Ma6 2016, inclusive; results in blue indicate concentrations elevated above OME (1993) LEL or NOAA (1999) TEL guidelines; results bolded indicate concentration outside historical range; * - 0.01M KH_2PO_4 extraction used to determine Cr (VI) concentration.

In summary, measured concentrations of metals and metalloids at Site OC2 were within the historical range for both sediment fractions. At all other sites, the differences in concentrations compared to the historical range, in both fractions, where they occurred were lower. Lower concentrations in the <2 mm fraction occurred mainly for nickel and silver. Lower concentrations in the <63 µm fraction occurred mainly for nickel, silver and mercury with the majority of other lower element concentration differences occurred at site RU1 (refer Table 13). The general between site trends in the concentrations of the elements silver and mercury seen in the 2016/2017 sediments are similar to those seen in previous annual surveys.

5.3.3 Comparison with sediment quality guidelines

Condition 17 of the discharge permit requires the comparison of sediment quality data to guidelines derived by Ontario Ministry of the Environment (OME 1993) and National Oceanic and Atmospheric Administration (NOAA 1999). Since neither set of guidelines specify which fraction should be assessed, a conservative approach has been adopted and guidelines applied to both fractions. EC (2007) notes that "*quality criteria developed using data for sediments with a highly variable particle grain-size distribution can be applied to all types of sediments, except sediment with grains larger than 2 mm*". Sediment data were also compared to the revised ANZECC (2000) sediment quality guideline values (SQGV) in Simpson et al. (2013). Sediment quality guidelines are summarised in Table 14.

Table 14: Sediment quality guidelines.

Element	OME (1993)		NOAA (1999)		Revised ANZECC (2000)*	
	LEL[A]	SEL[B]	TEL[C]	PEL[D]	SQGV[E]	SQG-High[F]
Antimony	-	-	-	-	2.0	25
Arsenic	6.0	33	5.9	17	20	70
Cadmium	0.60	10	0.60	3.5	1.5	10
Chromium	26	110	37	90	80	370
Copper	16	110	36	197	65	270
Iron	2.0	4.0	-	-	-	-
Lead	31	250	35	91	50	220
Mercury	0.20	2.0	0.17	0.49	0.15	1.0
Nickel	16	75	18	36	21	52
Silver	-	-	-	-	1.0	4.0
Zinc	120	820	123	315	200	410

Notes: All units mg/kg dry weight (dw) except Fe, which is wt % (dw); *Simpson et al. (2013); [A] Lowest effect level; [B] Severe effect level; [C] Threshold effects level; [D] Probable effects level; [E] Sediment quality guideline values; and [F] Sediment quality guidelines – High value.

OME (1993) provides a lowest effect level (LEL) and a severe effect level (SEL). The LEL is the lowest concentration at which toxic effects have been observed, while the SEL represents a concentration above which most benthic organisms cannot tolerate. NOAA (1999) guidelines for freshwater sediments use a threshold effects level (TEL) and a probable effects level (PEL). The TEL is the geometric mean of the 15th percentile of the toxic effects data set and median of the no-effects data set. The TEL is the concentration below which adverse effects are expected to occur only rarely. The PEL is the geometric mean of the 50th percentile of impacted samples and the 85th percentile of non-impacted samples, and is the concentration above which adverse effects are frequently expected (Buchman 1999).

The interim sediment quality guidelines (ISQG) in ANZECC (2000), which are based on data used in the NOAA (1999) guidelines, have been revised in Simpson et al. (2013). The revised ANZECC (2000) SQG values (SQGV) and upper guidelines (SQG-High values) for each element identified in Table 14 are, with the exception of silver, unchanged from the ISQG-Low and ISQG-High identified in ANZECC (2000). The SQG-High value for silver has increased from 3.7 mg/kg to 4.0 mg/kg.

The concentration summaries in Table 12 and Table 13 show that there are fewer exceedances of the sediment quality in the <2 mm fraction compared to the <63 µm fraction. This is typically what would be expected as the concentrations of most elements will tend to be higher in the finer grain sizes especially where the concentration increases are associated with adsorption processes.

The pattern of concentrations measured in the <2 mm fraction that exceeded the NOAA (1999) and OME (1993) sediment quality guidelines was very similar to that reported for the 2015/2016 period. This included:

- Exceedance of the mercury guidelines at all sites except RU1 in both surveys. In both 2016/2017 surveys the highest concentrations were measured at the upstream site OC2. Concentrations of mercury in the <2 mm sediment fraction are strongly related to the sediment iron concentration reflecting the role of oxide coatings in mercury distribution in sediments.
- Exceedance of the iron guideline in the <2 mm fraction of sediment at site OC2 in the May 2017 survey. A single exceedance was identified in the November 2015 survey at site OH3. Iron concentrations exceed the consent sediment quality guidance values naturally. The sediment iron concentrations measured are considered to reflect natural variation in Ohinemuri River bed sediment chemistry. No iron floc was identified at the sites during sampling.

The pattern of concentrations measured in the <63 µm fraction that exceeded the guidelines was also very similar to that reported for the 2015/2016 period. This included:

- Arsenic concentrations were measured at concentrations above the guidelines at all sites and surveys with the exception of the November 2016 sample from site OC2 which sat at the NOAA (1999) TEL of 5.9 mg/kg. As with the previous year the highest concentrations were recorded in samples from site RU1. The elevation at the upstream OC2 site is not due to any activity associated with the mine operation.
- Copper concentrations were measured at concentrations over the guidelines at sites OH5 (November 2016 and May 2017 surveys), OH1 (November 2016) and OH6 (November 2016). In the previous 2014/2015 and 2015/2016 annual reports, copper concentrations in about half of the <63 µm fraction samples collected from the Ohinemuri River exceeded the guidelines (sites OH1, OH5 and OH6). Although an exceedance of the ANZECC guidance was identified based on the <63 µm fraction, no whole sediment (<2 mm fraction) exceedances of the ANZECC guidance were identified. Concentrations of copper at site OH3 above the E1 discharge concentrations were below the guideline.
- The iron concentration guidelines were exceeded at all sites in both surveys. The higher concentration measured in the <63 µm fraction compared to the <2 mm fraction is common to many sediments. Typically the concentration of iron increases as the proportion of finer grain sizes (silts and clays) increases. Coarse fractions can have high concentrations where coarse sand particles are sedimentary in origin. Overall, the pattern in concentrations is similar to that seen in previous surveys and is considered natural and the exceedance of the guidelines is not considered to have adverse environmental implications.
- Mercury concentrations exceeded the guidelines at all sites including RU1 (refer comments for <2 mm fraction above). This concentration pattern is similar to that reported for the 2015/2016 survey and is considered to reflect the significance of mercury in the mineralisation of the Waihi area.
- The concentration of silver in the <63 µm sediment fraction at site OH5 in both surveys exceeded the ANZECC (2000) SQGV guideline (1.0 mg/kg). Concentrations at all other sites were lower. The pattern in silver concentration was very similar to that reported for the 2015/2016 surveys. In that survey Site OH5 was the only site to report silver concentrations above the guidelines. The survey concentration data indicates that there is some influence of the upper and lower discharges of sediment concentrations in the river. Although an exceedance of the ANZECC guidance was identified based on the <63 um fraction, no whole sediment (<2 mm fraction) exceedances of the ANZECC guidance were identified.

- Although concentrations of cadmium, lead and zinc in <63 µm fraction sediment at site RU1 were higher than measured at other sites, only cadmium was above the guidance in the November 2016 survey. As described in the 2015/2016 annual report (Golder 2016), the results seen at RU1 are consistent with previous surveys and are considered to reflect catchment geochemistry.

6.0 HABITAT CHARACTERISTICS

6.1 Aquatic and Riparian Habitat

Aquatic and riparian habitat characteristics at Ohinemuri River and Ruahorehore Stream monitoring sites during the spring and autumn surveys are summarised in Table 15. Photos of each site taken during the spring 2016 and summer 2017 surveys are shown in Appendix F.

Table 15: Habitat characteristics at Ohinemuri River and Ruahorehore Stream monitoring sites.

Parameter	OC2		OH3		OH5		OH1		OH6		RU1	
	Nov 16	May 17	Nov 16	May 17	Nov 16	May 17	Nov 16	May 17	Nov 16	May 17	Nov 16	May 17
Water depth (m)	0.10-0.24	0.15-0.25	0.25-0.80	0.30-0.40	0.15-0.80	0.40-0.45	0.30-0.70	0.20-0.60	0.1-0.8	1.0-1.1	0.15-0.30	0.3-0.42
Water width (m)	15-21	15-20	6-8	6-7	7-10	9-10	6-12	6-8	6-10	10-15	4-5	5-7
Run (%)	60	0	45	80	35	60	92	50	85	40	80	50
Riffle (%)	40	70	50	20	50	40	5	30	15	10	20	50
Pool (%)	0	30	5	0	15	0	2	20	0	50	0	0
Chute (%)	0	0	0	0	0	0	1	0	0	0	0	0
Shading	Open	Open	Open	Open	Open	Open	Open	Partial	Open	Open	Partial	Partial
TLB stability	Stable	Stable*	Highly unstable	Mostly stable	Mostly stable	Mostly stable	Mostly stable	Mostly stable	Mostly stable	Highly unstable	Stable	Stable
TRB stability	Mostly stable	Stable*	Undercut	Highly unstable	Highly unstable	Highly unstable	Mostly stable	Mostly stable	Highly unstable	Undercut	Mostly stable	Mostly stable

Notes: TLB = true left bank; TRB = true right bank. * Site OC2 moved ~20m upstream due to the original site being highly unstable.

Consistent with previous years, during the spring and autumn surveys most stream sites in the Ohinemuri River were dominated by run and/or riffle habitat and had little to no shading. There was partial shading of the stream channel at RU1. The largest habitat change between the November 2016 and May 2017 surveys is the proportion of riffle and run habitats at most sites. This was most likely associated with changes in the streambed substrate composition (see Section 6.2 below). For sites OH3, OH5 and OH1, there was a decrease in the maximum water depth recorded in May relative to November (Table 15).

While best endeavors were carried out to ensure the exact same location at each site was surveyed in autumn and spring, higher river flows on the day (e.g., OH1 flow was 2.42 m^3/s on the survey day in May compared to 0.79 m^3/s on the survey day in November) coupled with bankside instability at some sites, may have resulted in subtle shifts in the location where water depth and channel width were measured and may account for some of the between survey differences.

6.2 Streambed Substrate Characteristics

Bed substrate composition at the Ohinemuri River and Ruahorehore Stream sites during the November 2016 and May 2017 surveys is presented in Figure 7. With the exception of Site RU1, there were notable changes in the substrate composition at all monitoring sites between the surveys (Figure 7). For sites OH3, OH1 and OH6, there was an increase in the proportions of silt and sand relative to other substrates (i.e., a decrease in gravel), while for sites OC2 and OH5 there was a decrease in gravel and increase in cobble proportions. High river flows between the November 2016 and May 2017 surveys (Figure 5) may have been a contributing factor to streambed substrate modifications. Due to bank collapse and channel scouring, Site OC2 was relocated approximately 20 m upstream in the May 2017 survey. This is likely to account for the increase in the proportion of boulder substrate during the May 2017 survey relative to the November 2016 survey (Figure 7). These changes reflect streambed disturbances most likely a result of recent flood flows prior to the surveys and are not related to mining activities.

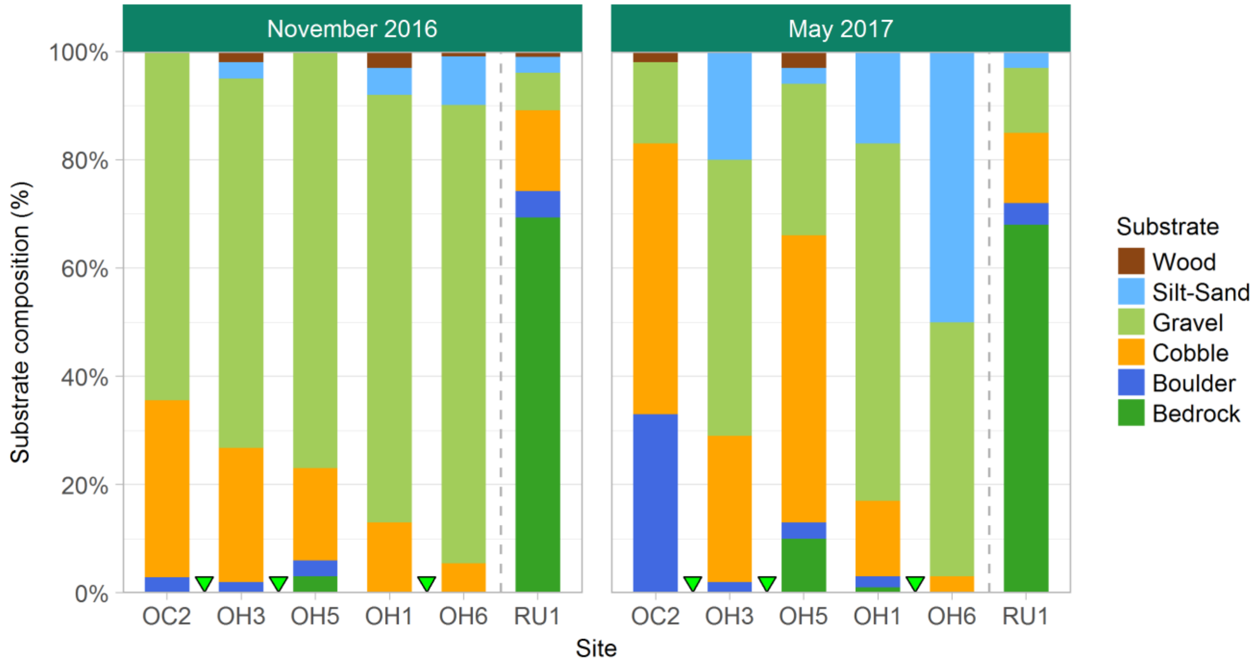

Figure 7: Ohinemuri River and Ruahorehore Stream streambed substrate composition during the 2016-2017 surveys. Green triangles indicate relative location of discharges.

7.0 PERIPHYTON

7.1 Introduction

The algal and cyanobacterial components of the periphyton community (cover, community composition and biomass) recorded at the Ohinemuri River and Ruahorehore Stream sites during the spring (November 2016) and autumn (May 2017) surveys are reported in Sections 7.2 to 7.4. Raw data are tabulated in Appendix G. As part of the condition 16 of the discharge permit (Discharge Permit 971318), OGNZL is required to assess selenium concentrations in the filamentous algae tissue at these sites during the autumn survey. The selenium results for samples collected at Sites OC2 and OH6 in the survey are presented in Section 7.5 and the laboratory report in Appendix G.

7.2 Periphyton Visual Cover

The visual percentage cover of the different morphological groups of algae and cyanobacteria recorded across the streambed at each monitoring site is presented in Figure 8. The key findings from the periphyton visual cover data are:

- During the November 2016 survey, film, mat and filamentous periphyton were recorded at sites OC2, OH3 and RU1, while only film and filamentous periphyton were recorded at sites OH5, OH1 and OH6 (Figure 8). During the May 2017 survey mat periphyton was less prevalent, being recorded at Site OC2 only, while film and filamentous periphyton were recorded at all sites (Figure 8). The may reflect differences in re-colonisation time between mats and films, following recent flood flows.
- For each site, on both monitoring occasions, the estimated percentage cover of long filamentous algae (i.e., >20 mm long) was ≤10 %, while the estimated percentage cover of periphyton mats ranged from 5 % to 65 %. High filament percentage cover at Site OC2 was related to the presence of short filaments (<10 mm long). All sites were below the New Zealand periphyton guideline values for both long filamentous algae (≥30 %), and mats (≥60 %), for the protection of aesthetics and recreation and trout habitat and angling (Biggs 2000).

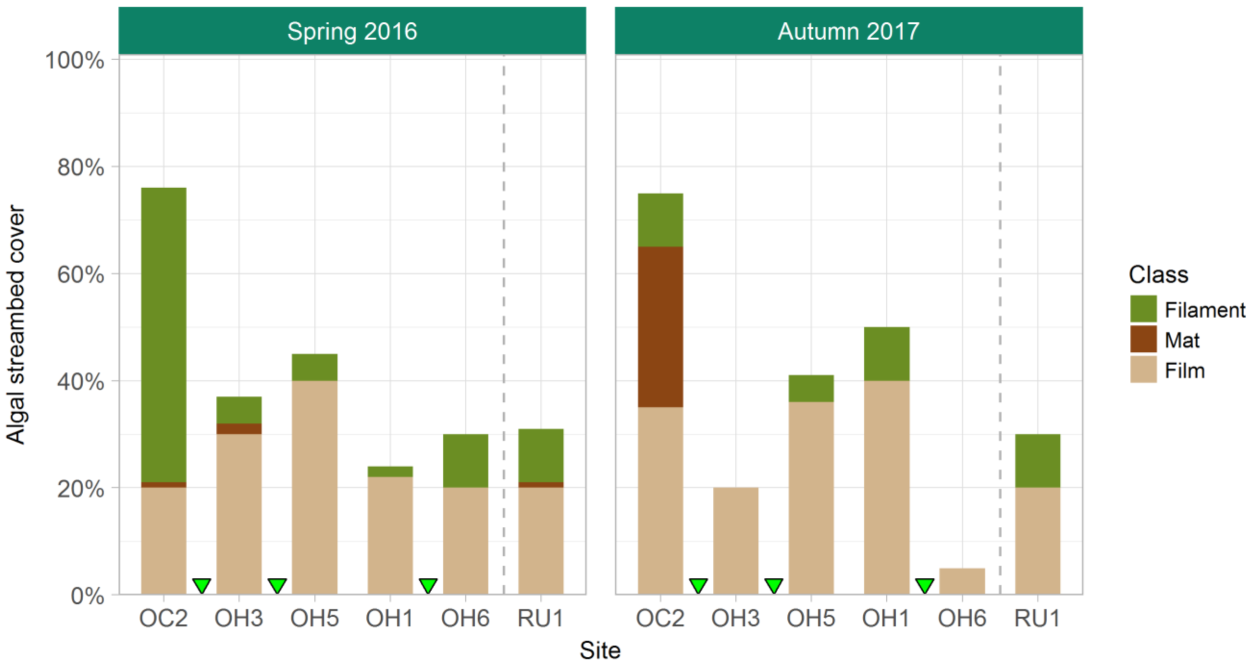

Figure 8: Visual percentage cover estimate of the three main periphyton classes at sites OC2, OH3, OH5, OH1 and OH6 on the Ohinemuri River and RU1 on the Ruahorehore Stream during the November 2016 and May 2017 surveys. Green triangles indicate discharge locations.

7.3 Periphyton Community Composition

The periphyton species list for both the November 2016 and May 2017 surveys is provided in Appendix G. The key findings from the periphyton composition data are:

- A total of 52 algae and cyanobacteria species were recorded across all sites in November, while a total of 46 species were recorded across all sites in May. In November, Site OC2 recorded the highest number of taxa (34) while sites OH1, OH6 and RU1 all recorded the lowest number of taxa (23). In

May, Site RU1 recorded the highest number of taxa (33), while Site OH6 recorded the lowest number of taxa (21).

- Diatoms were the most frequently occurring taxa with 38 species recorded across all sites in November and 35 species recorded across all sites in May. Green algae (including filamentous and unicellular) were the second most frequently occurring taxa with 12 and 7 species recorded across all sites in November and May, respectively.
- Diatoms were the most abundant taxa, comprising of at least 58 % (range 58 – 97 %) of the total abundance across all sites during both sampling occasions (Figure 9). For all sites, the three most dominant species are considered to be common and widespread throughout New Zealand, particularly in moderately enriched streams (Biggs & Kilroy 2000).
- For Site OH3, the abundance of the cyanobacterium *Phormidium* sp., increased from 0.2 % in November to 34 % in May (Figure 9). While increased *Phormidium* sp., are often associated with increased dissolved inorganic nitrogen, dissolved reactive phosphorus, water temperature and conductivity (Wood et al. 2016), the increased abundance at Site OH3 was not explained by any water quality variable measured within the month prior to the survey. Smaller increases in cyanobacteria abundance between the November and May surveys were recorded at sites OC2 (6 %), OH5 (3 %), OH6 (6 %) and RU1 (0.5 %). Cyanobacteria was not recorded at Site OH1 during either survey (Figure 9).

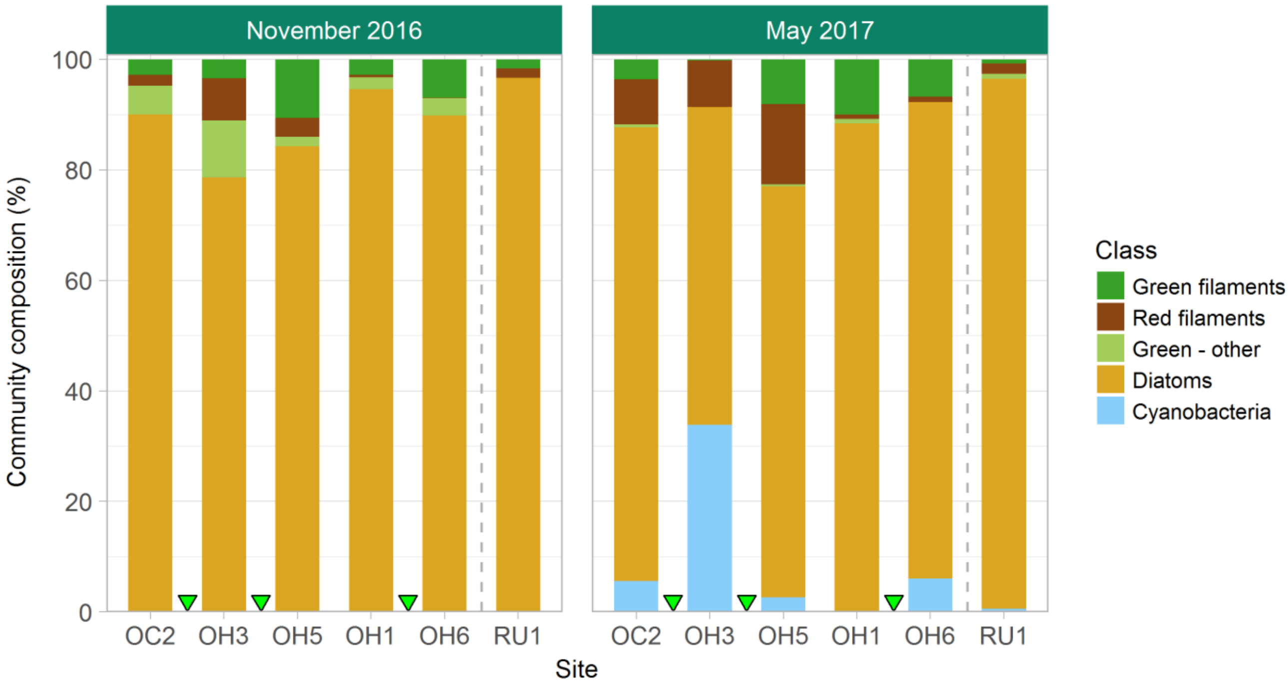

Figure 9: Percentage composition of the five main algae and cyanobacteria groups that comprised the periphyton community at Sites OC2, OH3, OH5, OH1 and OH6 on the Ohinemuri River and Site RU1 on the Ruahorehore Stream. Green triangles indicate the relative location of the discharges.

- During the November 2016 survey, Bray-Curtis and NMDS analyses showed that the periphyton communities at sites OH3 and OH5 were at least 50% dissimilar to all other sites (Figure 10a). The measured environmental variables (see Section 4), singularly or in combination, could not significantly explain the differences in periphyton communities at sites OH3 and OH5 compared to all other sites. This suggests that factors other than mine discharge determine community composition at sites OH3 and OH5.
- During the May 2017 survey, Bray-Curtis and NMDS analyses showed that the periphyton community at Site OC2 was at least 70 % dissimilar to all other sites, while Site OH3 was at least 50 % dissimilar to the sites downstream of that site (Figure 10b). The environmental variables bicarbonate, alkalinity,

manganese, magnesium and conductivity were considered as possible explanatory factors for differences between the periphyton community structure at Site OC2 and all other sites ($p < 0.01$). For Site OH3, the environmental variables pH, manganese, magnesium, conductivity, selenium, zinc, hardness and calcium were considered as possible explanatory factors for difference in the periphyton community structure compared to downstream sites ($p < 0.001$). It should be noted that environmental variables considered as possible explanatory factors were below consent limits and indicate the natural variability in the periphyton communities between sites.

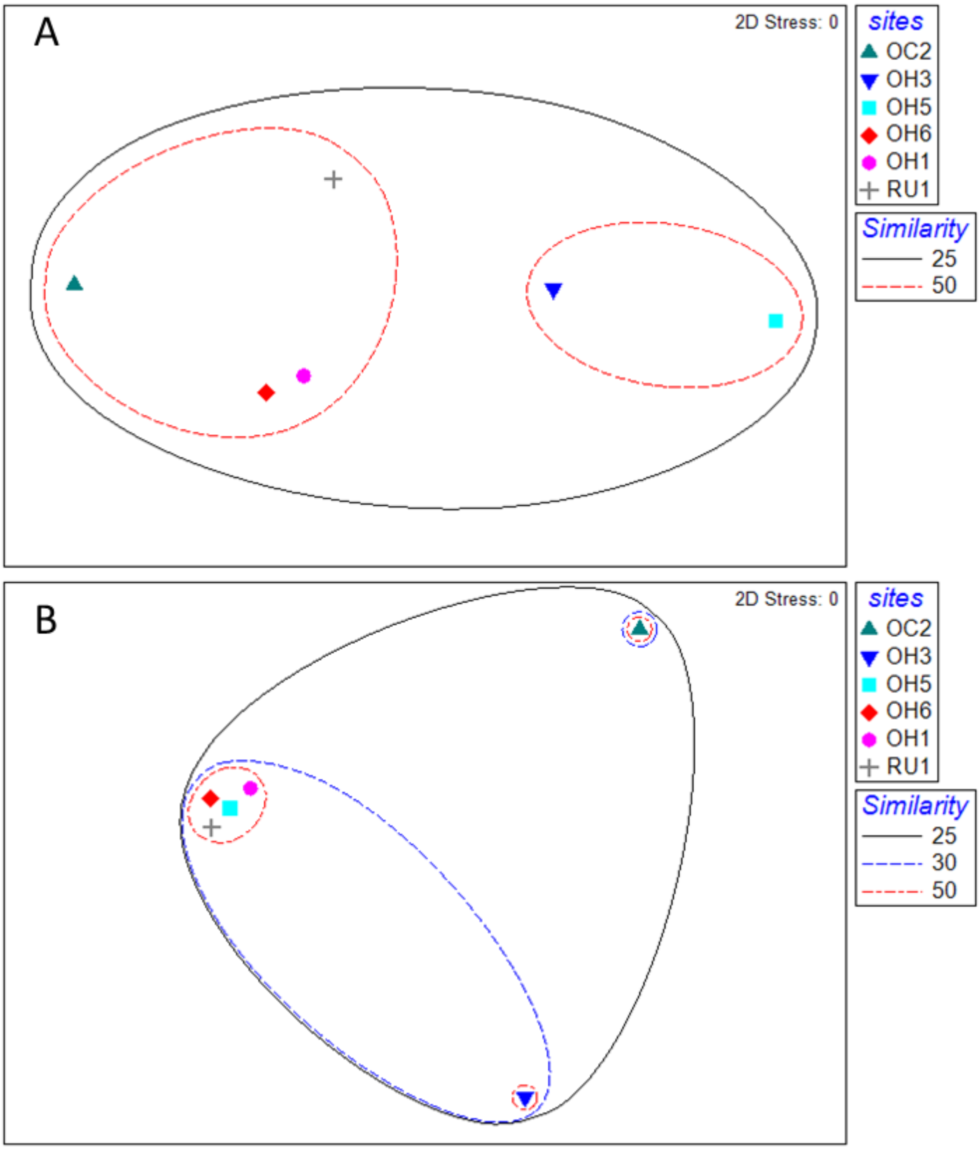

Figure 10: NMDS plot showing percentage similarity of the periphyton community at each sampling site in a) November 2016 and b) May 2017.

7.4 Periphyton Biomass

7.4.1 Chlorophyll-*a*

Chlorophyll-*a* (chl-*a*) concentrations of samples collected from all sites during the two surveys are presented in Figure 11. The mean at each monitoring site is identified by a square.

The key findings from the chl-*a* data collected in November 2016 and May 2017 are:

- During the November 2016 survey, chl-*a* concentrations were significantly higher at OC2 (above all discharges) than all other sites ($p < 0.01$ for sites OH3, OH5 and RU1; $p < 0.05$ for sites OH1 and OH6). Chl-*a* was significantly higher at sites OH1 and OH6 ($p < 0.05$) compared to OH3, but did not differ significantly to each other or to Site RU1 (Figure 13).
- During the May 2017 survey, chl-*a* concentrations were significantly higher at site OC2 ($p < 0.01$) and OH6 ($p < 0.05$) compared to all other sites, but did not differ significantly to each other. Chl-*a* concentrations at sites OH3, OH5, OH1 and RU1 did not differ significantly from each other.
- On both monitoring occasions, Site OH3 had the lowest chl-*a* concentrations, with a mean chl-*a* of 5.42 mg/m^2 in November and 2.98 mg/m^2 in May. This contrasts with previous years where Site RU1 consistently had the lowest chl-*a* concentrations (Golder 2015, Golder 2016).

During the May 2017 survey, chl-*a* concentrations at sites OC2 (mean 105 mg/m^2) and OH6 (mean 66 mg/m^2) exceeded guidelines for the protection of benthic biodiversity (50 mg/m^2). However, the high chl-*a* at Site OH6 may potentially be a result of sample contamination during scrubbing. The periphyton at this site was closely associated with moss and bryophytes that were also growing attached to the cobbles, which appear to have gotten into the rock scrub sample despite best endeavours. Following a request to the laboratory, a recent microscopic check of the rock scrub sample confirmed the presence of cells of higher plants (the bryophytes) present in the sample. High flows in the vast majority of the river channel on the day of sampling also limited the substrate for sampling to the side margins of the river, while the visual assessment was integrated across the full width of the river. The chl-*a* concentrations at Site OH6 should be viewed with caution and the reader is directed to the visual percentage cover across the entire transect. High chl-*a* at Site OC2 probably reflects the change in survey location and associated substrate differences. The higher proportion of boulder and cobbles at the new OC2 site provides a more stable substrate compared to gravel at the old OC2 site.

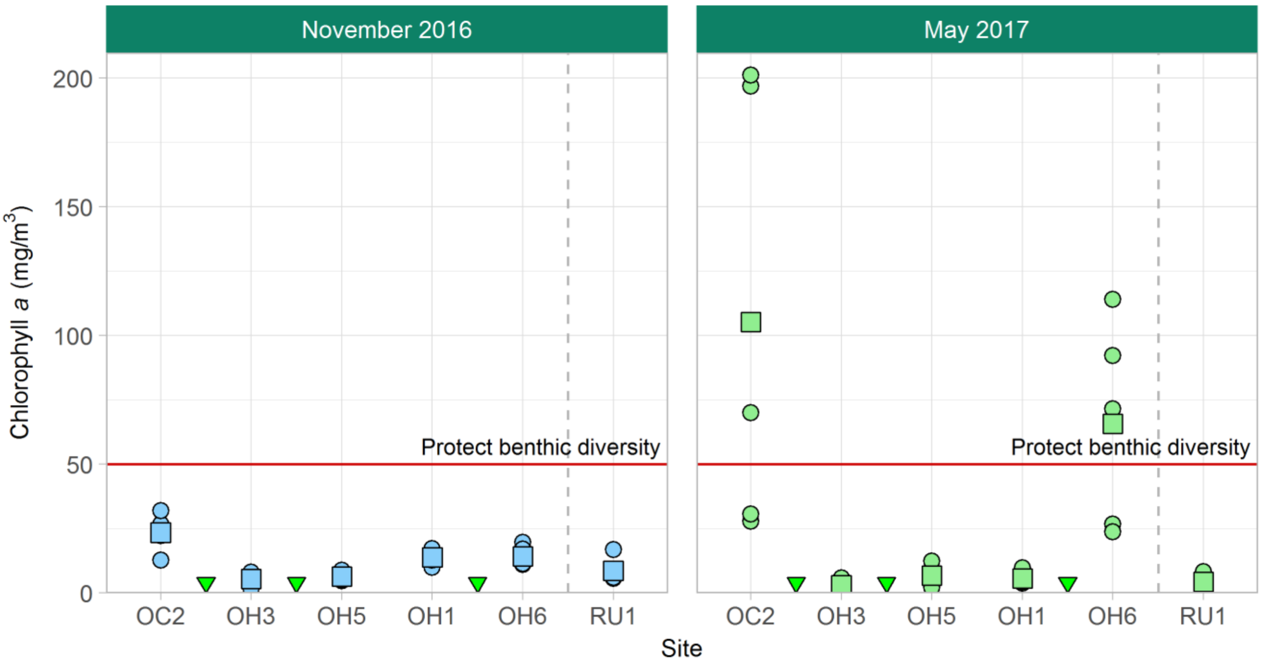

Figure 11: Measured chlorophyll-a concentrations from Sites OC2, OH3, OH5, OH1 and OH6 on the Ohinemuri River and Site RU1 on the Ruahorehore Stream. Squares represent means, green triangles indicate relative location of discharges and the red line represents the guideline for the protection of benthic biodiversity (50 mg/m^2).

7.4.2 Ash free dry weight

The AFDW of the samples collected from all sites during the November 2016 and May 2017 are presented in Figure 12. The mean AFDW at each monitoring site is identified by a square.

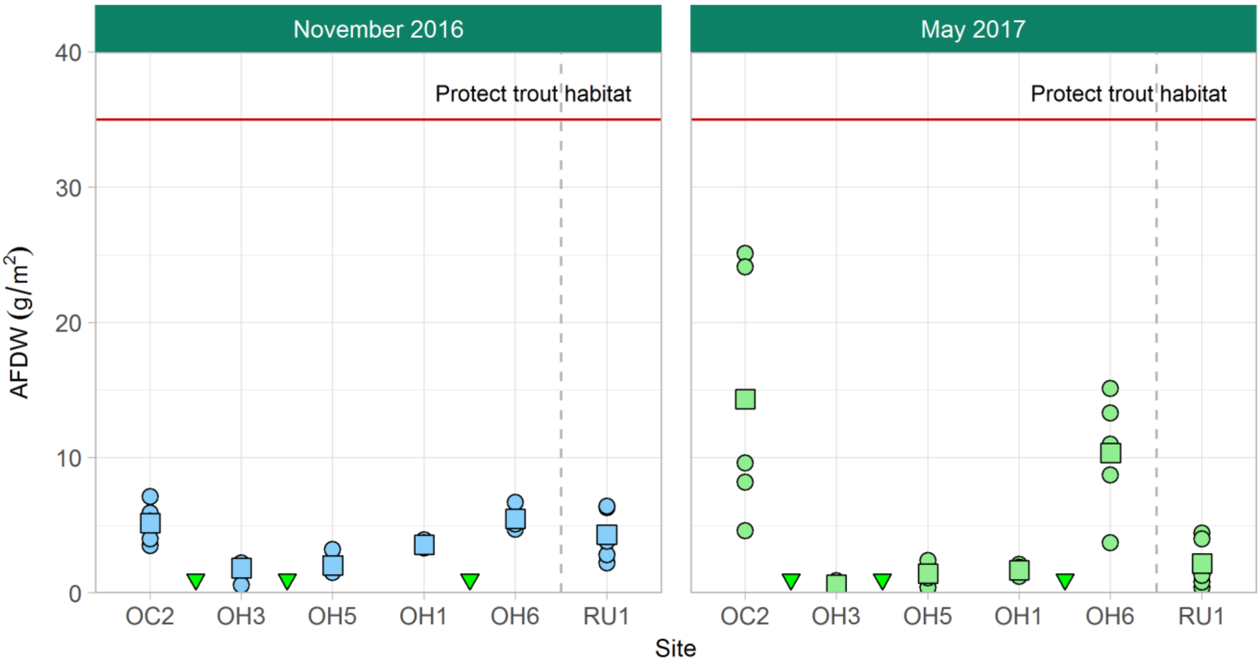

Figure 12: AFDW biomass from Sites OC2, OH3, OH5, OH1 and OH6 on the Ohinemuri River and Site RU1 on Ruahorehore Stream in November 2016 and May 2017. Squares represent means, green triangles indicate relative location of discharges and the red line represents the guideline for the protection of trout habitat.

The key findings from the AFDW data are:

- The AFDW biomass followed the same pattern as chl-*a* biomass at all sites, with significantly higher AFDW at Site OC2 than all other sites in November ($p < 0.01$ for sites OH3, OH5 and RU1; $p < 0.05$ for sites OH1 and OH6) and in May ($p < 0.01$ for all sites).
- AFDW was significantly higher at sites OH1 and OH6 relative to OH5 ($p < 0.05$) during the November 2016 survey. AFDW was significantly higher at Site OH6 compared to OH3, OH5 and OH1 ($p < 0.05$) during the May 2017 survey.
- The autotrophic index (AI), defined as the ratio of total amount of organic matter (AFDW) to chl-*a* biomass, is indicative of the proportions of the periphyton community that is comprised of heterotrophic (fungi, bacteria and microinvertebrates) and autotrophic (algae and cyanobacteria) organisms (Biggs & Kilroy 2000). AI values of 50 – 100 are characteristic of unpolluted conditions, while values >400 are taken to indicate communities affected by organic pollution (Biggs & Kilroy 2000). On both monitoring occasions, Site RU1 had the highest AI value of all the sites and exceeded 400 on both occasions (560 in November 2016 and 634 in May 2017). Site OC2 had the lowest AI of all the sites on both monitoring occasions (237 in November 2016 and 163 in May 2017).
- Mean AFDW biomass measured in the Ohinemuri River and Ruahorehore Stream sites were below the New Zealand periphyton guideline of 35 g/m^2 for the protection of aesthetics/recreation and trout habitat and angling (Biggs 2000).

7.5 Selenium Concentrations

As noted in Section 1.2, following changes to its consents in September 2015, OGNZL is no longer required to assess selenium concentrations in periphyton on a biannual basis and are now carried out in autumn only.

Both the current and historic periphyton selenium concentrations measured at Sites OC2 and OH6 are shown in Figure 13. The analysis report for the 2016/17 period is provided in Appendix G.

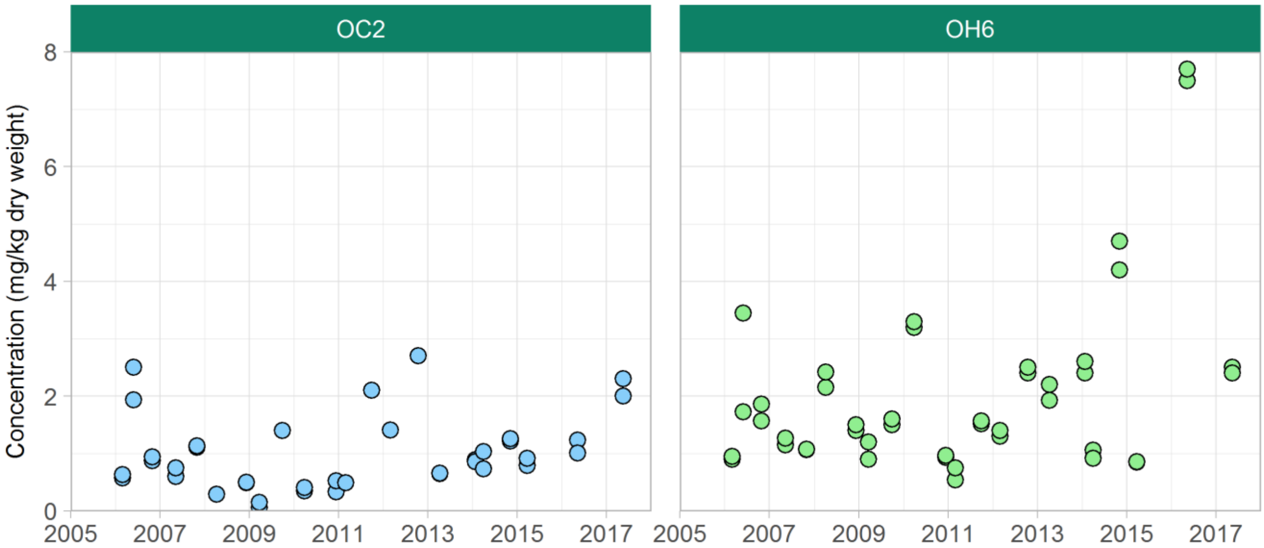

Figure 13: Selenium concentrations in periphyton collected from Sites OC2 and OH6 between 2006 and 2017.

The key points arising from the data measured are:

- At sites OC2 and OH6, mean periphyton selenium concentrations were similar to each other (2.15 mg/kg dry weight for Site OC2 and 2.45 mg/kg dry weight for Site OH6). Differences in selenium concentrations between the two sites have been inconsistent over time, with concentrations at Site OH6 exceeding OC2 by ≥0.5 mg/kg dry weight on 41 % of occasions, while on 23 % of occasions selenium concentrations have been ≤ to those measured at OC2.
- At Site OC2, the May 2017 selenium concentration was within the top 90th percentile of the historic range, while for Site OH6, the May 2017 selenium concentration was within the upper 75th percentile of the historic range.

8.0 MACROPHYTES

8.1 Introduction

Macrophyte cover recorded at all sites during the November 2016 and May 2017 surveys is summarised in Section 8.2. As part of the conditions of the discharge permit (Discharge Permit 971318), OGNZL is required to assess selenium macrophyte concentrations at Sites OC2 and OH6 during the autumn survey. Selenium concentrations in macrophyte samples collected from these two sites are discussed in Section 8.3

8.2 Macrophyte Cover

During the November 2016 survey, percentage macrophyte cover was low at all sites. The highest percentage cover recorded was at Site OH6, with an overall cover score of 14 %. This comprised the introduced oxygen weed (*Elodea canadensis* 8 %), the introduced curly pondweed (*Potamogen crispus* 4 %) and a native charophyte (*Nitella masonae* 2 %). At Site OC2, 1 % cover of oxygen weed was recorded and at Site OH1, 2 % cover of bryophytes. No macrophytes were recorded at sites OH3, OH5 and RU1.

During the May 2017 survey, percentage cover of macrophytes had increased at all sites compared to the previous survey. The highest percentage cover was recorded at Site OH6 at 50 % (40 % *N. masonae* and 10 % oxygen weed), followed by Site RU1 with 25% cover (20 % bryophytes and 5 % native creeping herb, *Glossostigma diandrum*). At Site OC2, bryophytes were recorded at 2 % cover across the site, at Site OH3 *G. diandrum* and oxygen weed were both recorded at 1 % cover, while at sites OH5 and OH1 bryophytes were recorded at 2 % and 1 %, respectively.

8.3 Selenium Concentrations

During the May 2017 survey, macrophytes for selenium concentration analysis were only collected from Site OH6. This was due to the lack of macrophytes within a 1 km stretch of the stream at Site OC2. While there was a 2 % cover of bryophytes at Site OC2, these were considered unsuitable for analysis due to their different habitat (growing in association with periphyton mats attached to boulders) compared to true rooted macrophytes (soft fine sediments).

At Site OH6, the selenium concentration in the oxygen weed stems was 1.85 mg/kg (dry weight). Placed in context of the long term macrophyte selenium concentrations, the 2017 result was in the lower 25th percentile of Site OH6 data range, although higher than the long term data range for Site OC2 (Figure 14).

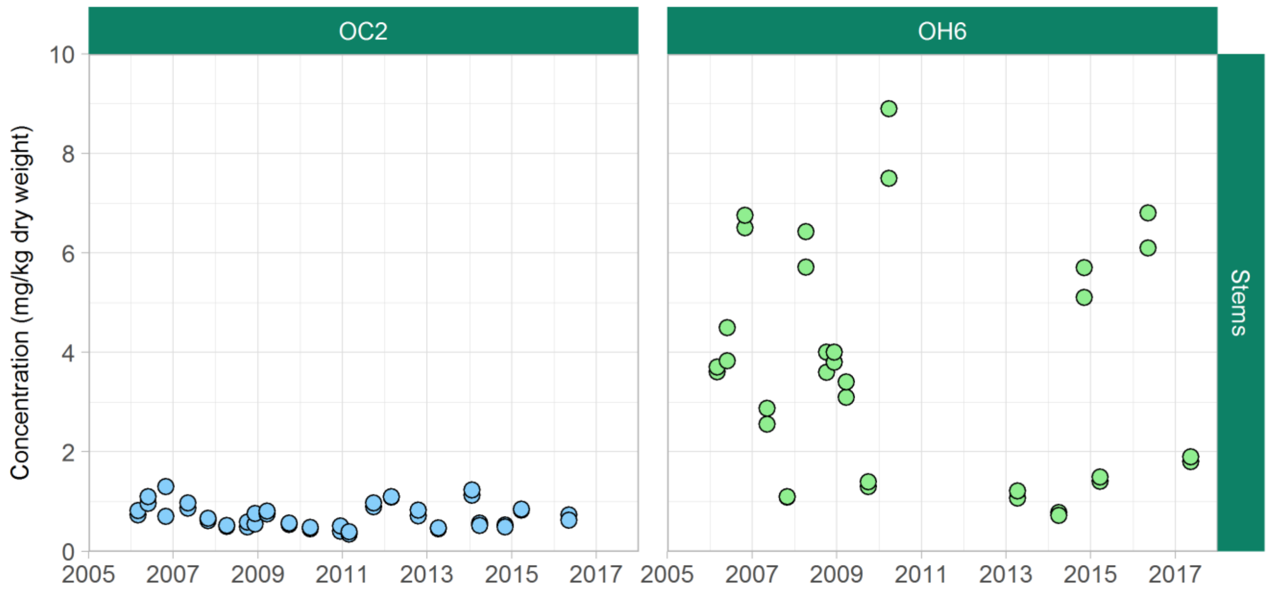

Figure 14: Selenium concentrations in submerged macrophyte stems collected from Sites OC2 and OH6 from 2006 to 2017.

9.0 BENTHIC MACROINVERTEBRATES

9.1 Introduction

Condition 16 of the discharge permit requires OGNZL to monitor benthic macroinvertebrate populations at Sites OH3, OH5, OH1, OH6 and RU1 on two occasions each year, once in spring (October through December) and once in autumn (March through May). Benthic macroinvertebrates are also measured by OGNZL on a voluntary basis at Site OC2, upstream of the upper discharge, to allow comparison with sites downstream.

Monitoring includes an assessment of community composition, key taxa, biological indices (i.e., abundance, taxa richness, MCI, QMCI, EPT and %EPT) and consideration of whether the change in macroinvertebrate taxa number and abundance between upstream and downstream sites complies with Condition 18 of the discharge permit.

The results of the spring and autumn benthic macroinvertebrate monitoring are reported in Sections 9.2 to 9.4. Raw benthic macroinvertebrate data are presented in Appendix I.

9.2 Community Composition

The percentage community composition of the main groups of macroinvertebrates recorded at Ohinemuri River and Ruahorehore Stream sites in November 2016 and May 2017 are presented in Figure 15 and NMDS plots showing community similarity between sites are shown in Figure 16.

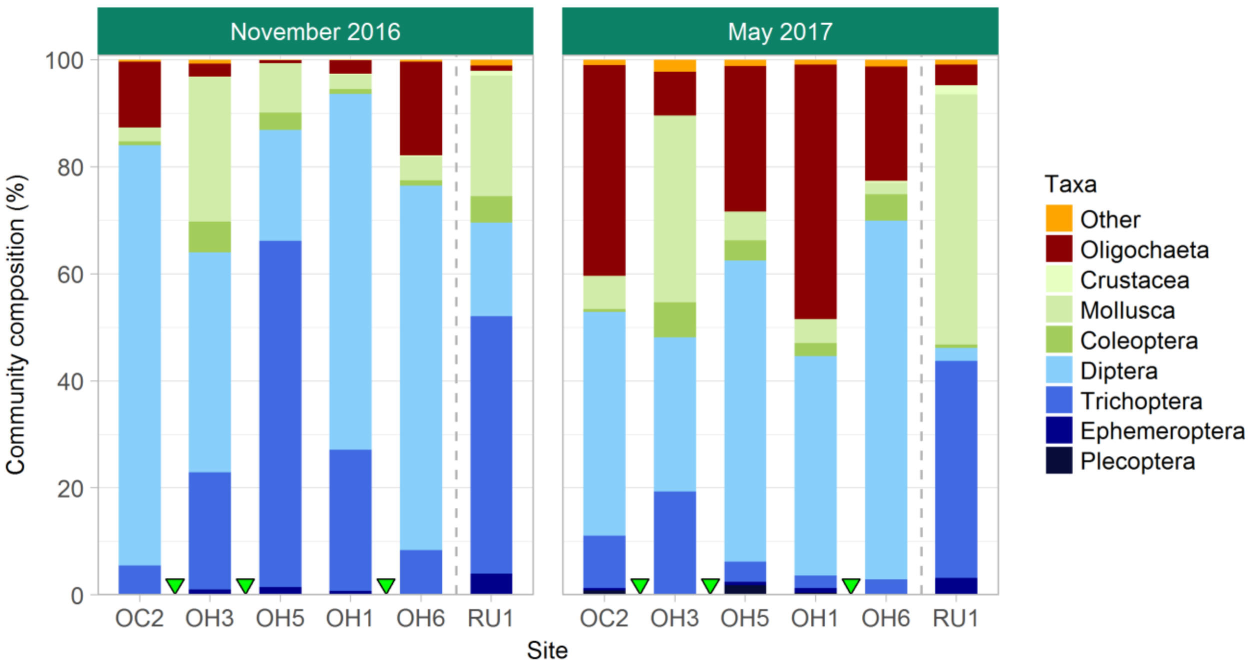

Figure 15: Macroinvertebrate community composition (%) at OC2, OH3, OH5, OH1 and OH6 on Ohinemuri River and RU1 on Ruahorehore Stream during the November 2016 and May 2017 surveys. Green triangles indicate relative location of discharges.

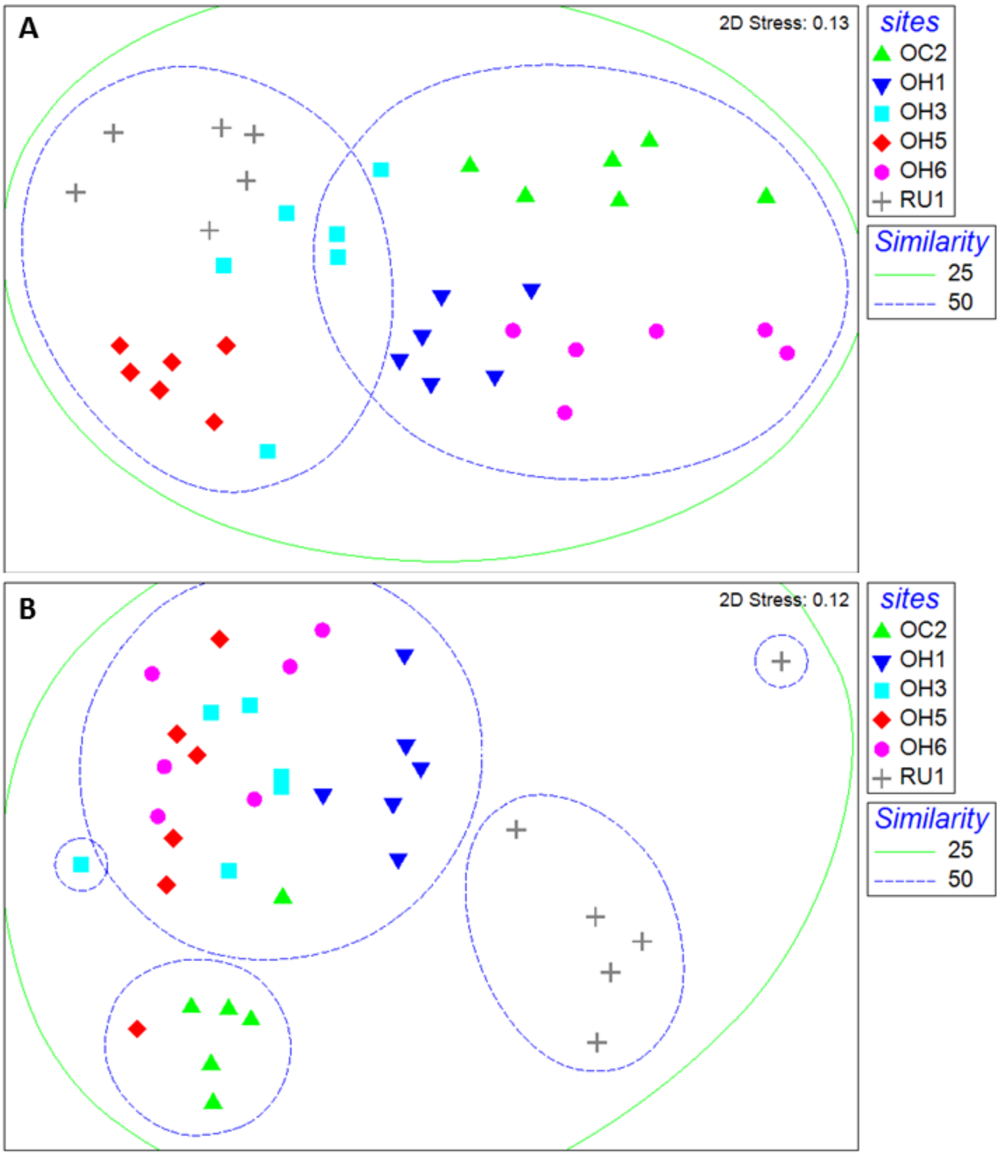

Figure 16: NMDS plots based on Bray-Curtis similarity of the macroinvertebrate communities at all monitoring sites in A) November 2016 and B) May 2017.

The key points arising from the community composition collected in November 2016 and May 2017 are:

- During the November 2016 survey, Diptera larva was the most dominant taxa at sites OC2, OH3, OH1 and OH6 while Trichoptera was the most dominant taxa at sites OH5 and RU1 (Figure 15). During the May 2017 survey, Diptera was the most dominant taxa at sites OH5 and OH6, Diptera and Oligochaeta were co-dominant at sites OC2 and OH1, Diptera and Mollusca were co-dominant at site OH3, while Trichoptera and Mollusca were co-dominant at site RU1 (Figure 15).
- Sites OC2, OH5 and OH1 followed a similar pattern of increasing relative abundance of Oligochaeta at the expense of Diptera during the May survey compared to the November survey (Figure 15).

- Bray-Curtis and NMDS analyses showed that during the November survey, macroinvertebrate communities at sites OC2, OH1 and OH6 were at least 50 % similar to each other, while site OH5 and RU1 were at least 50 % similar to each other. Site OH3 was at least 50 % similar to all sites (Figure 16). LINKTREE analysis revealed that these inter-site community differences were mainly driven by significantly higher ($p < 0.01$, $R = 0.71$, B% = 90.2) Orthocladiinae (non-biting midges) and Oxyethira (caddis) at sites OC2 and OH6 and significantly higher ($p < 0.01$, $R = 0.53$, B% = 63.5) Oxyethira at Site OH1 compared to sites OH3, OH5 and RU1, while Pycnocentrodes (stony cased caddis) were significantly higher ($p < 0.01$, $R = 0.63$, B% = 50.3) at sites OH3, OH5 and RU1 compared to OC2, OH1 and OH6.
- During the May survey, sites RU1 and OC2 were at least 50 % dissimilar to all other sites (with the exception of one replicate of OC2), while all sites downstream of the discharges were at least 50 % similar to each other (Figure 16). LINKTREE analysis revealed that these inter-site differences were mainly driven by the considerable lower abundance of most taxa (with the exception of Pycnocentrodes and Potamopyrgus (mud snail) at Site RU1 relative to all other sites and the significantly higher ($p < 0.01$, $R = 0.7$, B% 68.2) Oligochaeta abundance at Site OC2 compared to all other sites.

9.3 Biological Indices

9.3.1 Abundance

Macroinvertebrate abundance measured at all sites during the spring and autumn surveys is presented in Figure 17. The key points arising from the macroinvertebrate abundances are:

- During the spring survey, mean macroinvertebrate abundance in the Ohinemuri River ranged from 312 to 1600 across all sites. Abundance at the most downstream site, OH6 was significantly higher ($p < 0.01$) than all other sites except OC2, which did not differ significantly to any site (Figure 17). With the exception of Site OH6, the macroinvertebrate abundance was significantly lower ($p < 0.01$) at all sites during the November 2016 survey compared to the November 2015 survey (see Golder 2016 for data).
- During the autumn survey, the mean abundance of macroinvertebrates in the Ohinemuri River ranged from 78 to 605 across all sites. At the most upstream site, OC2, the abundance was significantly higher ($p < 0.05$) than all other sites except OH1, which did not differ significantly to any site (Figure 17). With the exception of Site OH1, macroinvertebrate abundance was significantly lower ($p < 0.01$) at all sites during the May 2017 survey compared to the May 2016 survey (see Golder 2016 for data).
- Mean macroinvertebrate abundances recorded at Site RU1 on Ruahorehore Stream was 382 during the spring survey and 63 during the autumn survey (Figure 17).

9.3.2 Taxa richness

Taxa richness recorded during the spring 2016 and autumn 2017 surveys is provided in Figure 18. The key points arising from the taxa richness are:

- During the November 2016 survey, the mean taxa richness in the Ohinemuri River ranged from 16 to 20 (Figure 18). Taxa richness was unrelated to site position in relation to discharge, with richness being significantly lower ($p < 0.05$) at sites OH5 and OH1 compared to sites OC2, OH3 and OH6.
- During the May 2017 survey, the mean taxa richness in the Ohinemuri River ranged from 10 to 22 (Figure 18). Taxa richness at the most upstream site, OC2, was significantly higher ($p < 0.01$) than all sites downstream of the discharges, which did not differ significantly from each other.
- Mean taxa richness recorded at Site RU1 on the Ruahorehore Stream was 21 during the November 2016 survey and 9 during the May 2017 survey.

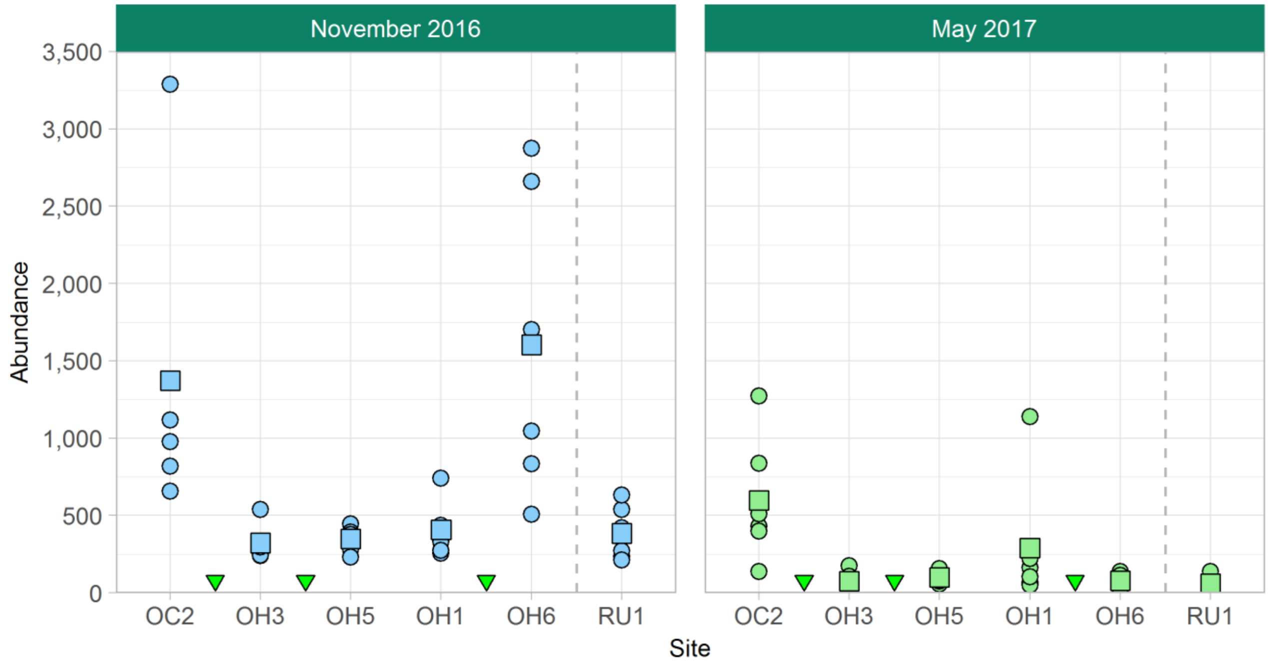

Figure 17: Macroinvertebrate abundance in samples from Sites OC2, OH3, OH5, OH1 and OH6 on the Ohinemuri River and Site RU1 on the Ruahorehore Stream collected during the November 2016 and May 2017 surveys. Individual replicates are represented by circles and the mean is represented by squares. Discharge locations indicated by green triangles.

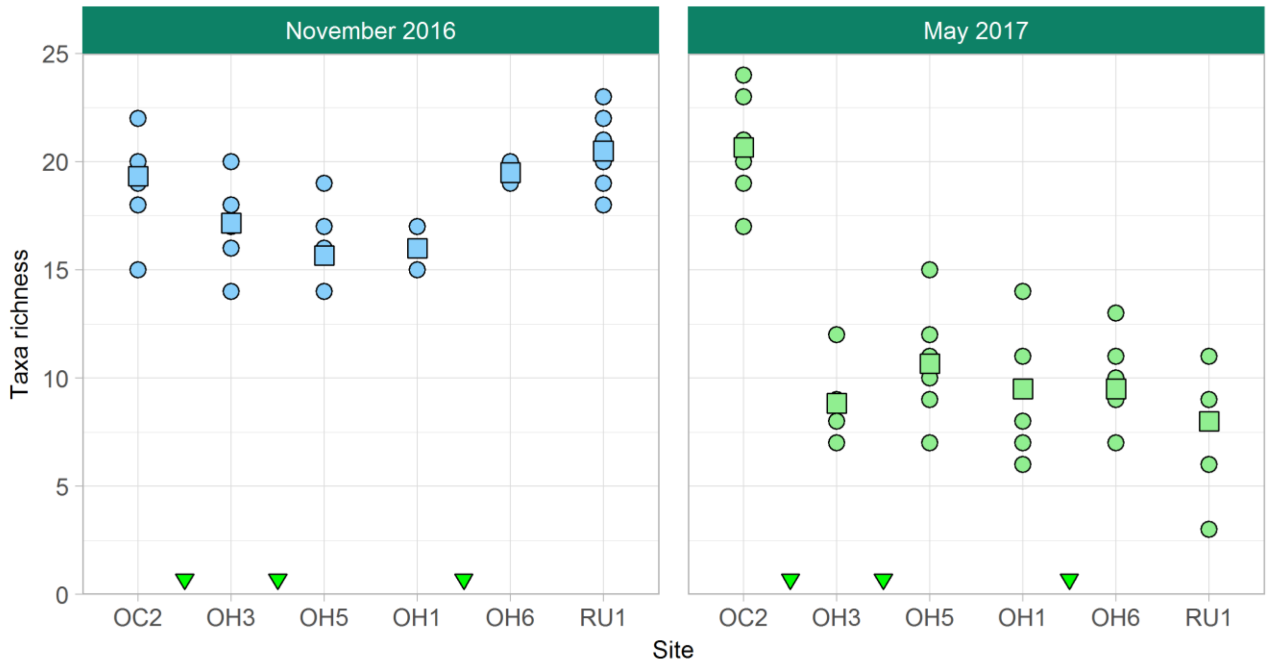

Figure 18: Taxa richness in samples collected from OC2, OH3, OH5, OH1 and OH6 on the Ohinemuri River and Site RU1 on the Ruahorehore Stream during the November 2016 and May 2017 surveys. Individual replicates are represented by circles and the mean is represented by squares. Discharge locations indicated by green triangles.

9.3.3 EPT taxa richness and Percentage EPT

EPT taxa richness recorded in the Ohinemuri River and in the Ruahorehore Stream during the spring and autumn surveys is provided in Figure 19.

The key points arising are:

- Ohinemuri River mean EPT taxa richness ranged from five to eight during the November 2016 survey and from two to seven during the May 2017 survey (Figure 19).
- EPT taxa richness did not differ significantly between sites during the November 2016 survey. During the May 2017 survey, EPT taxa richness was significantly higher (p <0.01) at the site upstream of all discharges, Site OC2, than all other sites, which did not differ significantly to each other.
- The proportion of the macroinvertebrate community comprising of sensitive EPT taxa (%EPT) at the Ohinemuri River sites ranged from <1 % to 66 % and from <1 % to 15 % during the November 2016 and May 2017 surveys, respectively (Figure 20).
- During the November 2016 survey, %EPT was significantly higher (p <0.01) at Site OH5 compared to all other Ohinemuri River sites, which did not differ significantly from each other. During the May 2017 survey, %EPT did not differ significantly between Ohinemuri River sites.
- Site RU1 on the Ruahorehore Stream had the second highest %EPT taxa in November 2016 (57 %) and the highest %EPT taxa in May 2017 (38 %).

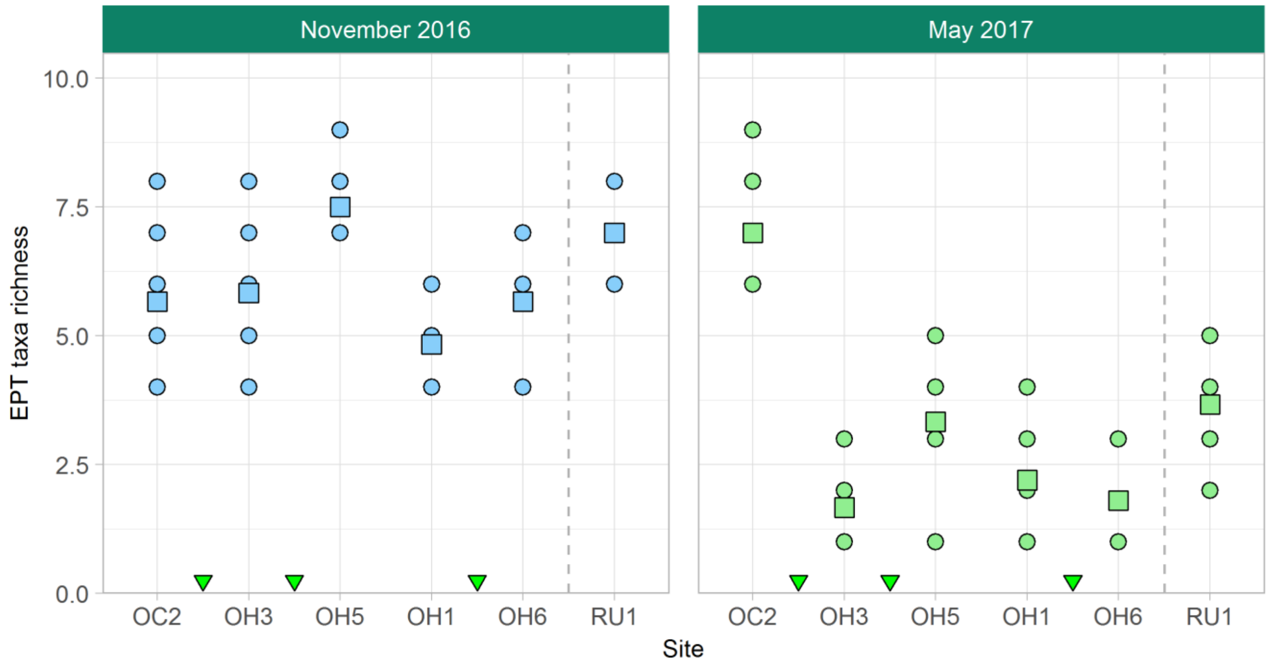

Figure 19: EPT taxa richness recorded in samples from Sites OC2, OH3, OH5, OH1 and OH6 on the Ohinemuri River and Site RU1 on the Ruahorehore Stream during the November 2016 and May 2017 surveys. Individual replicates are represented by circles and the mean is represented by squares. Discharge locations indicated by green triangles.

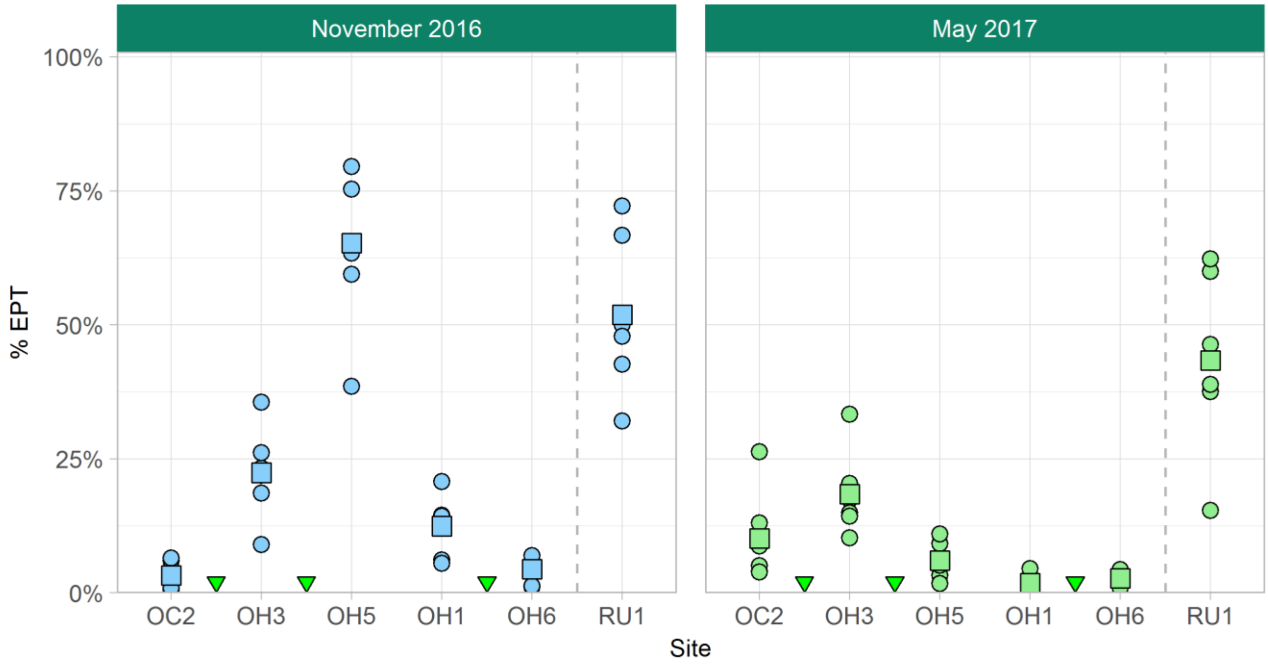

Figure 20: Percentage EPT abundances recorded in samples collected from Sites OC2, OH3, OH5, OH1 and OH6 on the Ohinemuri River and Site RU1 on the Ruahorehore Stream during the November 2016 and May 2017 surveys. Individual replicates are represented by circles and the mean is represented by squares. Discharge locations indicated by green triangles.

9.3.4 Macroinvertebrate community index

Mean MCI scores of samples collected from the Ohinemuri River and the Ruahorehore Stream during the spring and autumn surveys are provided in Figure 21.

The key points from assessing the MCI scores are:

- During the November 2016 survey, MCI scores did not differ significantly between sites (Figure 21). The mean MCI score of the upstream control site (OC2) was indicative of 'poor' habitat conditions, while all other Ohinemuri River sites were indicative of 'fair' conditions (Figure 21).
- During the May 2017 survey, MCI scores did not differ significantly between any of the Ohinemuri River sites. The mean MCI scores of sites OC2 and OH3 were on the border between 'poor' and 'fair' while the mean MCI scores for sites OH5, OH1 and OH6 were indicative of 'fair' habitat conditions (Figure 21).
- Site RU1 on Ruahorehore Stream had mean MCI scores that were indicative of 'fair' habitat conditions during both surveys. MCI scores at Site RU1 were significantly higher ($p < 0.01$) than the upstream control site OC2 during both surveys but did not differ significantly to all other Ohinemuri River sites.
- Mean MCI scores within the poor or fair categories indicate the sites are dominated primarily by taxa considered to be more tolerant to pollution or degradation in habitat and water quality in general.

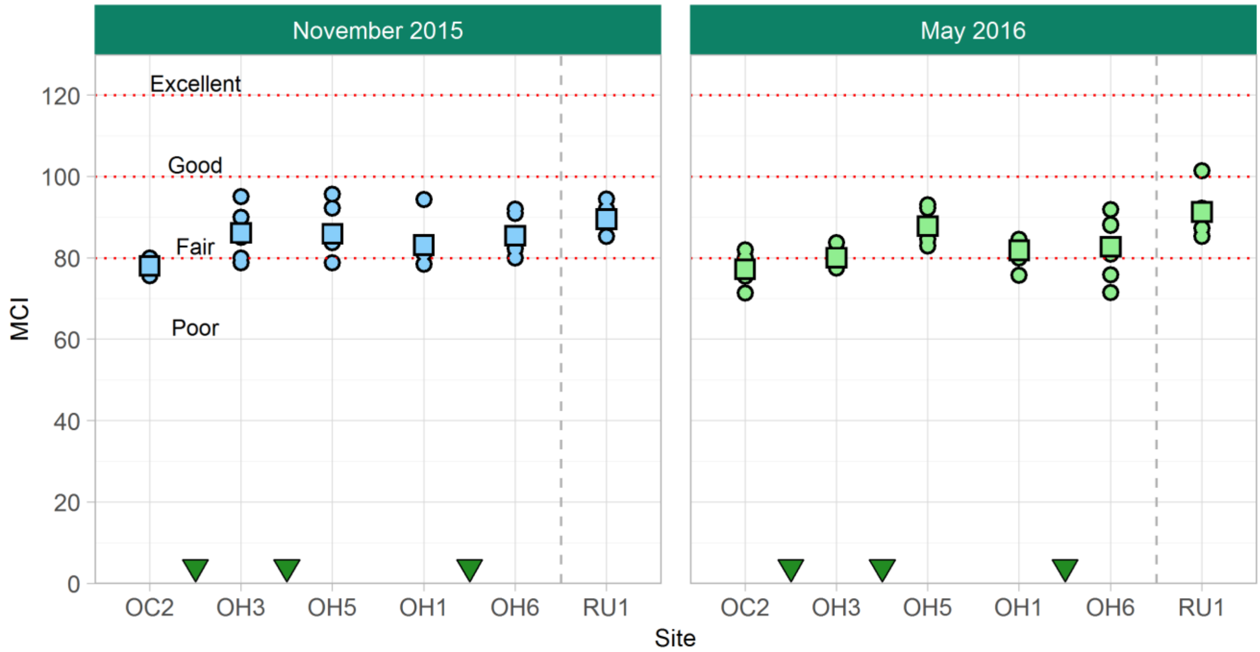

Figure 21: MCI scores for samples from sites on the Ohinemuri River and on the Ruahorehore Stream during the spring and autumn surveys. Squares represent mean values, green triangles indicate relative location of discharges and the dashed red lines represent 'stream health' thresholds (refer Table 4).

9.3.5 Quantitative macroinvertebrate community index

The quantitative macroinvertebrate community index (QMCI) scores derived from samples collected during the spring and autumn surveys are provided in Figure 22.

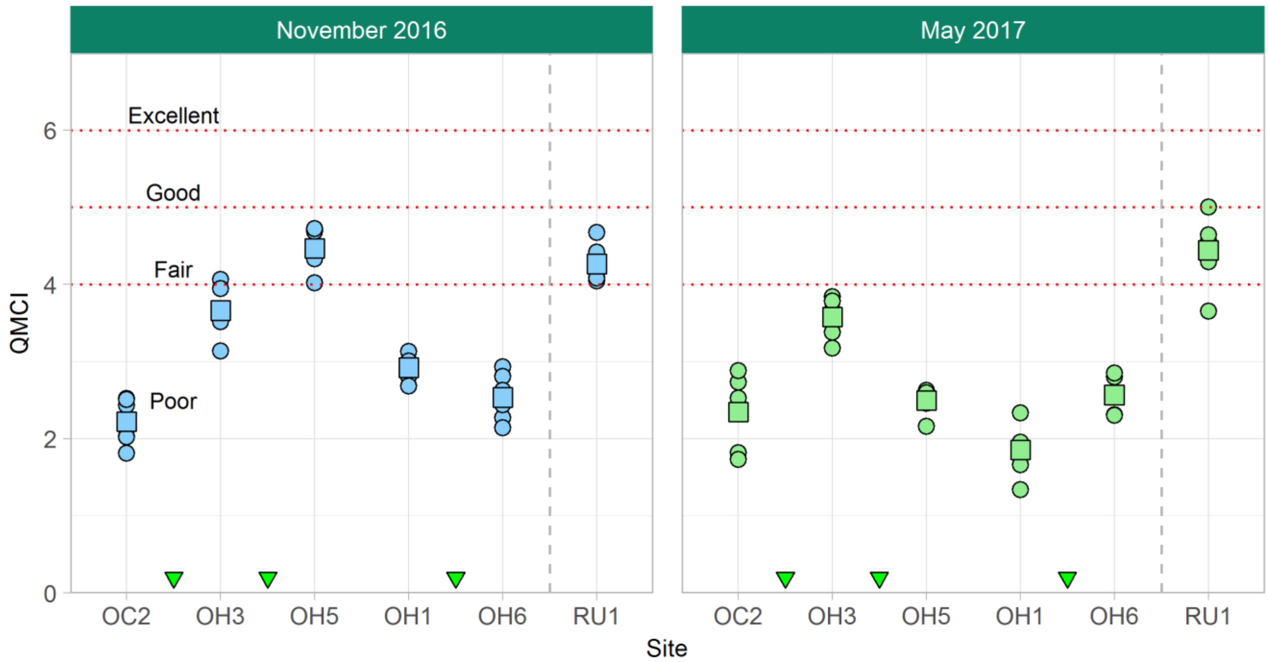

Figure 22: QMCI scores for samples collected from the Ohinemuri River and Ruahorehore Stream during the November 2016 and May 2017 surveys. Squares represent mean values, green triangles indicate relative location of discharges and the dashed red lines represent 'stream health' thresholds.

The key points from the QMCI data are:

- During the November 2016 survey, the mean QMCI scores for all Ohinemuri River sites ranged from 2.2 to 4.5 and were indicative of ‘fair’ to ‘poor’ habitat conditions (Figure 22). For Site OH5, the QMCI score was significantly higher ($p < 0.01$) than all other sites in the Ohinemuri River, while the upstream control site OC2 was significantly lower than all sites except OH6 (Figure 22).
- During the May 2017 survey, the mean QMCI scores for all Ohinemuri River sites ranged from 1.6 to 3.6 and were indicative of ‘poor’ habitat conditions (Figure 22). The MCI score at Site OH3 was significantly higher ($p < 0.01$) than all other Ohinemuri River sites, which did not differ significantly from each other.
- The low QMCI scores recorded at all sites, including those upstream of mining activities, reflect the dominance of organic pollution tolerant taxa and suggests that QMCI is a poor measure of mining impact in the Ohinemuri River.
- The QMCI scores at Site RU1 in the Ruahorehore Stream were significantly higher ($p < 0.01$) than all Ohinemuri River sites on both monitoring occasions (Figure 22).

9.4 Compliance

9.4.1 Introduction

Condition 18 of the discharge permit states that if at any time following the completion of two consecutive seasonal monitoring events (e.g., spring to spring), a significant difference in taxa number and abundance is deemed to have occurred between the paired sites upstream and downstream of each discharge on both occasions then the consent holder shall undertake immediate further monitoring.

A significant difference is deemed to have occurred if:

- There is a greater than 30 % change in taxa number (referred to in this report as taxa richness) over and above the natural variation between the paired sites upstream and downstream of each discharge.
- There is a greater than 50 % change in abundance over and above the natural variation between the paired upstream and downstream sites.

As agreed by WRC, natural variation in taxa richness and abundance was determined by calculating the coefficient of variation for each season using data collected from Site OH3 between 2002 and 2007. During this period, Site OH3 served as an upstream control site but in 2007permitted TSF2 discharge to a tributary upstream of Site OH3 commenced, meaning that this site could no longer be used as a control site.

9.4.2 Taxa richness change

Percentage change in taxa richness between sites upstream and downstream of each discharge from spring 2015 to spring 2016 and from autumn 2016 to autumn 2017 are shown on Figure 23 and tabulated in Table 16. The allowable percentage change in taxa richness includes the natural variation component of ±29 % in spring and ±24 % in autumn.

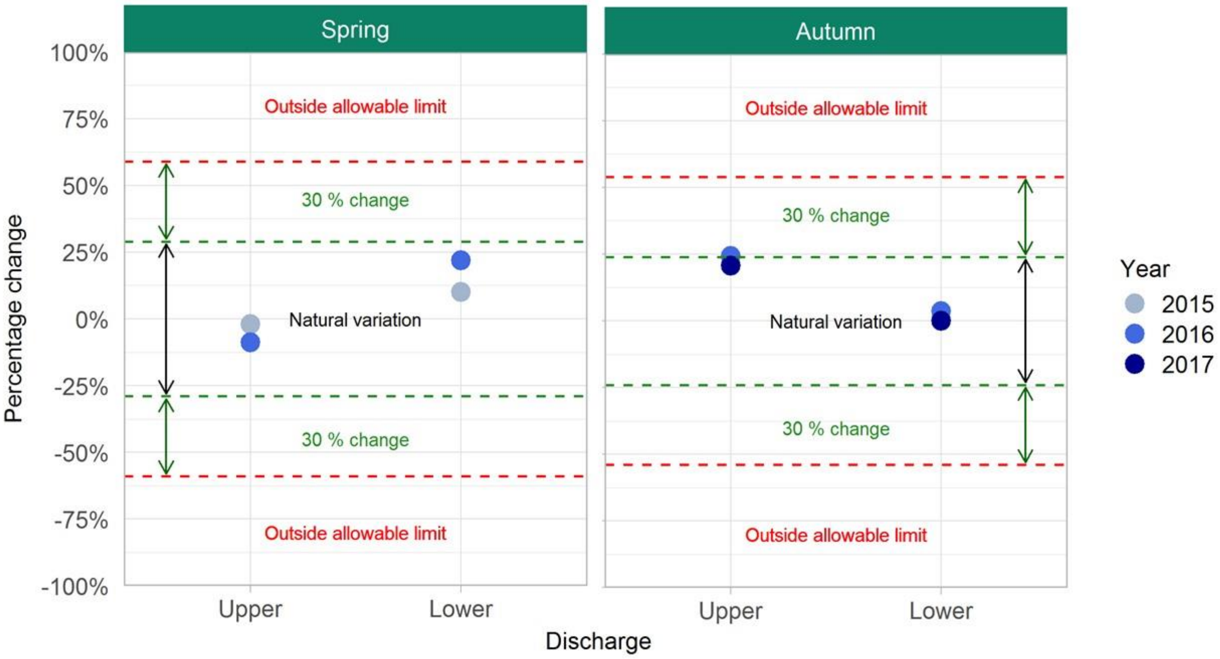

Figure 23: Percentage change in taxa richness between sites upstream and downstream of the upper and lower discharges *from spring 2015 to spring 2016 and from autumn 2016 to autumn 2017.*

Table 16: Percentage change in taxa richness between sites upstream and downstream of each discharge.

Date	Allowable limit A	Upper discharge (OH3 and OH5)		Lower discharge (OH1 and OH6)	
Spring 2016	± 59	-8	Within limit	22	Within limit
Spring 2015	± 59	-2	Within limit	10	Within limit
Autumn 2017	± 54	23	Within limit	0	Within limit
Autumn 2016	± 54	24	Within limit	4	Within limit

Note: A allowable limit in taxa number includes both the natural variation component (±29 % in spring and ±24 % in autumn) and the consented threshold of 30 %.

The percentage change in taxa richness between sites upstream and downstream of each discharge was within the allowable limits during both surveys. As such, no follow up monitoring is required with respect to taxa richness (refer Condition 18).

9.4.3 Abundance

Percentage change in macroinvertebrate abundance between sites upstream and downstream of each discharge from spring 2015 to spring 2016 and from autumn 2016 to autumn 2017 are shown in Figure 24 and tabulated in Table 17. The allowable percentage change in abundance shown includes a natural variation component (±59 % in spring and ±53 % in autumn).

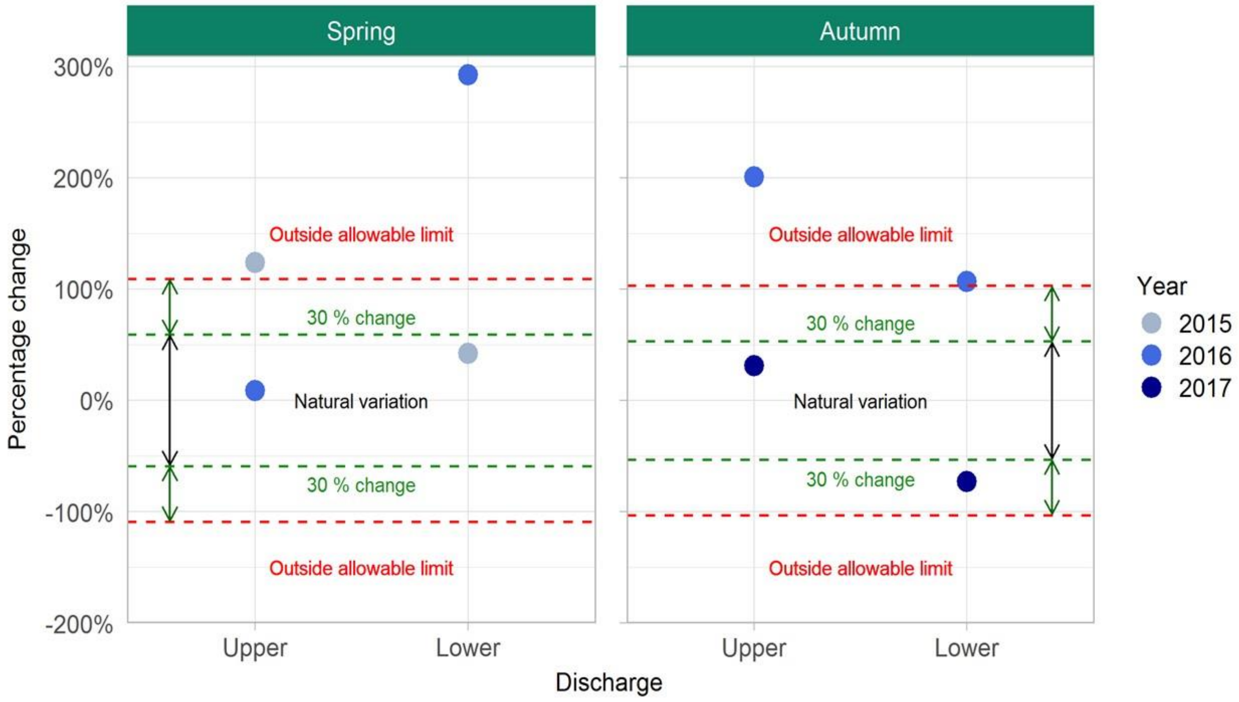

Figure 24: Percentage change in macroinvertebrate abundance between sites upstream and downstream of the upper and lower discharges from spring 2015 to spring 2016 and from autumn 2016 to autumn 2017.

Table 17: Percentage change in abundance between sites upstream and downstream of each discharge.

Date	Allowable limit [A]	Upper discharge (OH3 and OH5)		Lower discharge (OH1 and OH6)	
Spring 2016	±109	8	Within limit	**292**	Outside limit
Spring 2015	±109	**124**	Outside limit	42	Within limit
Autumn 2017	±103	32	Within limit	73	Within limit
Autumn 2016	±103	**201**	Outside limit	**107**	Outside limit

Notes: [A] allowable limit in abundance includes both the natural variation component (±59 % in spring and ±53 % in autumn) and the consented threshold of 50 % threshold.

The percentage change in macroinvertebrate abundance between sites upstream and downstream of the upper discharge (OH3 and OH5, respectively) was within the consented limit during the spring 2016 (8 %) and autumn 2017 surveys (32 %). This contrasts with the 2015-2016 monitoring periods when both the spring and autumn surveys were outside of the consented limits (Table 17). For the lower discharge, the percentage change in macroinvertebrate abundance between the upper and lower sites was outside of the consented limit during the spring 2016 survey (292 %) but within the consented limit during the autumn 2017 survey (73 %). During the 2015-2016 survey, the spring survey was within the consented limits but the autumn survey exceeded limits (Table 17).

Condition 18 states that further monitoring is undertaken only in the event allowable limits are exceeded in two consecutive seasonal monitoring events. No additional monitoring is required for any site following the 2016-2017 monitoring period.

9.5 Summary

Taxa group dominance varied between sites and between sampling occasions. Diptera larvae were often the most dominant or co-dominant taxa during the November 2016 survey. During the May 2017 survey, the relative abundance of Oligochaeta increased at the expense of Diptera at sites OC2, OH5 and OH1.

Differences in community composition between sites in spring was mainly driven by significant differences in the midges and caddisflies and stony cased caddis. During autumn, between sites differences in community composition was driven by significantly higher oligochaetes population at the most upstream control site (OC2) and lower overall abundance of most taxa at RU1.

Changes in taxa richness were unrelated to site position with respect to discharge locations during the spring 2016 survey. However, during the autumn 2017 survey, taxa richness was higher at the most upstream control site (OC2) relative to all sites downstream of discharges and the Ruahorehore Stream site.

EPT taxa richness did not differ significantly between sites during the spring survey but was significantly higher at the most upstream site compared to all sites downstream of discharges during the autumn survey. %EPT was significantly higher at the site (OH5) downstream of the upper discharge compared to all other Ohinemuri River sites during the spring 2016 survey. During the autumn 2017 survey there was no significant difference in %EPT between sites on the Ohinemuri River.

Both the MCI and QMCI scores during the spring and autumn surveys indicate that the aquatic habitat of both the Ohinemuri River and Ruahorehore Stream were between ‘fair’ and ‘poor’. All sites, both upstream and downstream of discharges, were dominated primarily by taxa considered to be more tolerant to organic pollution or habitat degradation.

The percentage change in taxa richness between sites upstream and downstream of each discharge was within allowable limits during both the spring 2016 and autumn 2017 surveys. The percentage change in macroinvertebrate abundance between sites upstream and downstream of the upper discharge was within consented limits on both monitoring occasions. However, for the lower discharge, the percentage change in abundance exceeded consented limits during the spring 2016 survey but was within limits during the autumn 2017 survey.

Consent conditions for macroinvertebrate taxa richness and abundance were met during the 2016-2017 monitoring period and no additional monitoring is required.

10.0 FISH

10.1 Introduction

Condition 16 of the discharge permit requires OGNZL to survey on one occasion each year (late summer) the fish populations at:

- Sites OC2, OH5, OH1 and OH6 on the Ohinemuri River.
- Sites RU1, M1, W1 and R1 on tributaries of the Ohinemuri River.

The survey includes an assessment of community composition, fish densities and size distribution. The results relating to the 2017 survey, which was undertaken on 9th and 10th of February 2017, are summarised in Sections 10.2 to 10.4. As part of the conditions of the discharge permit, OGNZL is required to assess selenium concentrations in fish tissue collected from Sites OC2 and OH6 during the summer survey. These results are presented in Section 10.5.

10.2 Community Composition

Fish communities recorded from the Ohinemuri River monitoring sites in 2017 comprised a total of five species; one introduced species, rainbow trout (*Oncorhynchus mykiss*), and four native species, shortfin eel (*Anquilla australis*), longfin eel (*A. dieffenbachii*), common bully (*Gobiomorphus cotidianus*) and Cran's bully (*G. basalis*). All species have been recorded in previous surveys. The most widespread species were shortfin eel and common bully, which were recorded at all Ohinemuri River and tributary sites.

The native Cran's bully and the introduced rainbow trout were observed at one of the Ohinemuri Sites (Site OC2) and at two tributary sites (Sites R1 and W1). The longfin eel was observed at one Ohinemuri Site (OC2) and one tributary site (M1). Banded kokopu (*Galaxias fasciatus*) had been recorded during the 2015 and the 2014 surveys, but were not observed during either the 2016 or 2017 surveys.

10.3 Fish Densities

The estimated (maximum likelihood) fish populations determined by MicroFish 3.0 for the Ohinemuri River and tributary monitoring sites February 2017 are shown with the results from the previous three surveys undertaken in 2014, 2015 and 2016 in Figure 25. Raw abundance data are provided in Appendix J. The key points arising from the fish densities recorded in February 2017 are:

- Estimated fish densities recorded at the Ohinemuri River sites ranged from 0.31 fish/m^2 at Site OH1 to 1.18 fish/m^2 at Site OH5. Total estimated fish densities increased slightly at Sites OH5 and OH6 from 2016 to 2017 (Site OH5 1.07 fish/m^2 to 1.08 fish/m^2; Site OH6 0.29 fish/m^2 to 0.33 fish/m^2), and decreased at Sites OH1 and OC2 from 2016 to 2017 (Site OH1: 0.46 fish/m^2 to 0.31 fish/m^2; Site OC2: 1.26 fish/m^2 to 0.81 fish/m^2).

- The most abundant fish species recorded in the Ohinemuri River sites was the common bully, with estimated densities that ranged from 0.18 common bullies/m^2 at Site OH1 to 1.08 common bullies/m^2 at Site OH5. The average estimated densities of common bullies across all Ohinemuri River sites in 2017 (0.53 common bullies/m^2) was consistent with estimated densities in 2016 and 2015 (0.45 common bullies/m^2 and 0.62 common bullies/m^2 respectively), but higher than those in 2014 (0.20 common bullies/m^2). Cran's bullies were uncommon at Ohinemuri Sites in 2017 (<0.01 Cran's bullies/m^2), however estimated densities of this species have been low in all previous surveys (0.01 Cran's bullies/m^2 in 2016, 0 Cran's bullies/m^2 in 2015, and 0.03 Cran's bullies/m^2 in 2014).

- Shortfin eels were the second most abundant fish species present in the Ohinemuri River sites, with an average estimated densities of 0.11 eels/ m^2 in these sites in 2017. Shortfin eel abundance was similar across the four Ohinemuri Sites, with estimated densities ranging from 0.1 eels/ m^2 in Site OH5 to 1.4 eels/m^2 in Site OH1. Few longfin eels were observed in the Ohinemuri River sites during the 2017 survey, and densities were consistent with previous years.

- Overall, fish densities recorded across the tributary sites in 2017 was consistent with previous years, with common bullies being the most abundant species. Estimated common bully density was higher in 2017 than that recorded in 2016 and 2015 at Site W1 (0.49 common bullies/m^2 in 2017; 0.3 common bullies/m^2 in both 2016 and 2015), but lower at Site R1 (0.84 common bullies/m^2 in 2017; 1.27 common bullies/m^2 in 2016; 1.61 common bullies/m^2 in 2015). The density of Cran's bully at all tributary sites in 2017 was low, with an average estimated density of 0.02 Cran's bullies/m^2 across the sites.

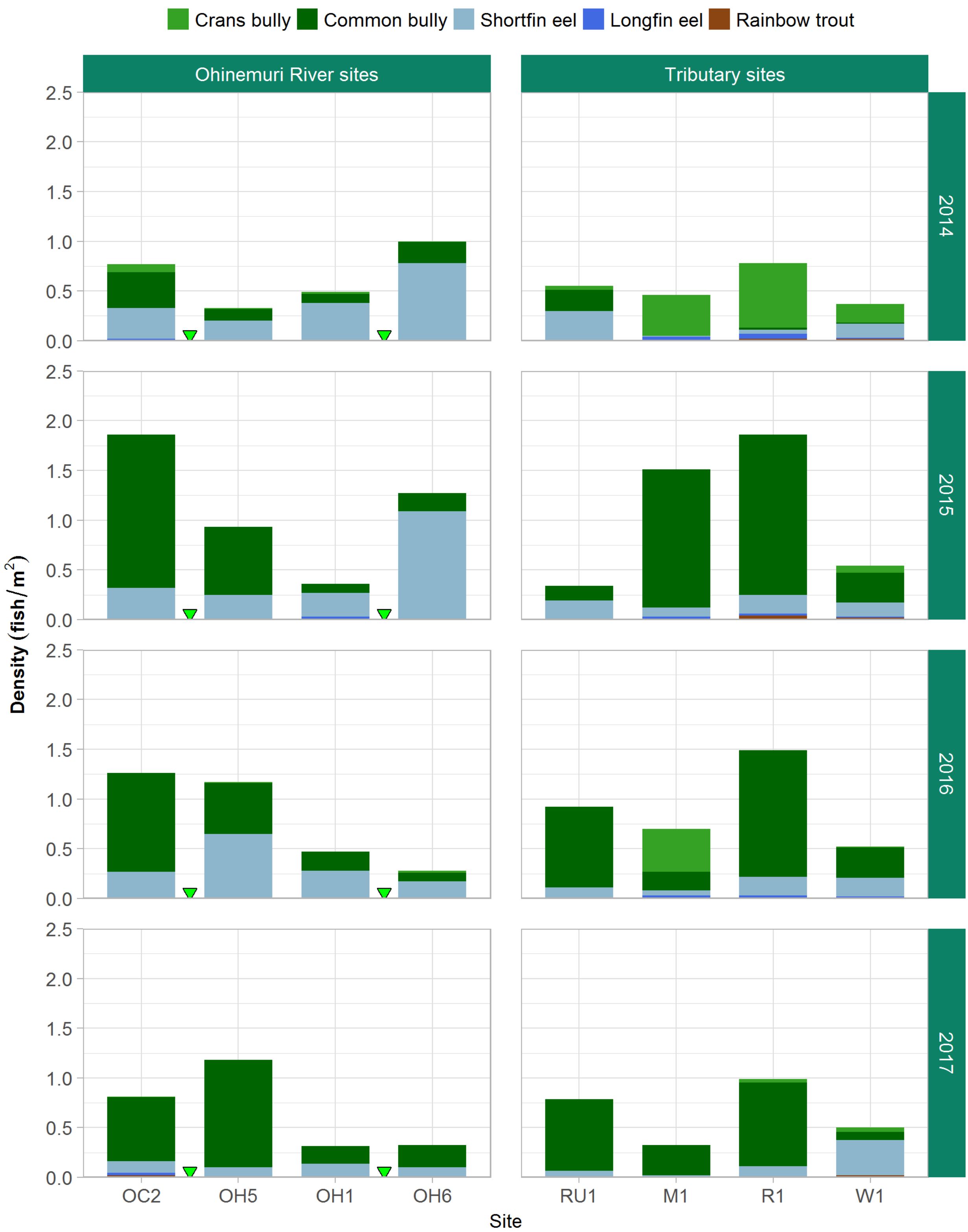

Figure 25: Fish density estimates (maximum likelihood) at Sites OC2, OH5, OH1 and OH6 on the Ohinemuri River and Sites RU1, M1, R1 and W1 on tributaries of the Ohinemuri River during summer surveys from 2014 -2017.

10.4 Size Distribution

10.4.1 Shortfin eels

The size frequency distribution of shortfin eels at Ohinemuri River and tributary sites during the summer survey in February 2017 is shown in Figure 26. The key points are:

- Shortfin eel populations at all Ohinemuri River sites were dominated by elvers (i.e., eels up to 200 mm in length), which indicates reasonable recruitment to the population. Larger eels (301 mm to 500 mm) were recorded in low densities in all four Ohinemuri River sites, however no eels greater than 500 mm in length were recorded in the 2017 survey.
- Tributary sites in 2017 supported lower densities of shortfin eels in comparison to the Ohinemuri River sites. The eels recorded in tributary sites were of similar sizes to those recorded in the Ohinemuri River sites; i.e., predominately small (elvers) with no eels greater than 500 mm in length.

10.4.2 Common bully

The size frequency distribution of common bully at Ohinemuri River and tributary sites during the 2017 summer survey is shown in Figure 27. The size frequency distribution of bullies recorded in Ohinemuri River and tributary sites during February 2017 was consistent across all sites; populations were dominated by small to medium sized fish (21 mm to 50 mm in length) with some larger fish present. This indicates a stable population with reasonable annual recruitment.

10.4.3 Other species

As described in Section 10.2, in addition to shortfin eels and common bullies, fish communities recorded during the summer 2017 survey included longfin eel, Cran's bully, and rainbow trout. The size distribution of these species is described below:

- Four longfin eels (up to 530 mm long) were recorded at Ohinemuri River site OC2 and one longfin eel (950 mm long) at tributary Site M1.
- One Cran's bully was recorded at Ohinemuri River site OC1, three at tributary Site R1, and four at tributary Site W1. These were all medium to large sized fish (41 mm to 80 mm in length).
- Three rainbow trout were recorded at Ohinemuri River site OC2 (3), one at tributary Site R1, and four at tributary Site W1. These were all juvenile fish <150 mm in length.

10.5 Selenium Concentrations

The whole body selenium concentrations of the bullies and eel replicates, collected February and May, are shown in Table 18 and Figure 28. The red line denotes the trigger limit of 8.1 mg/kg (dry wt) identified in Condition 14a of the discharge permit and the orange line is equivalent to 80 % of the trigger limit (i.e., 6.48 mg/kg dry wt). The analysis reports are provided in Appendix J.

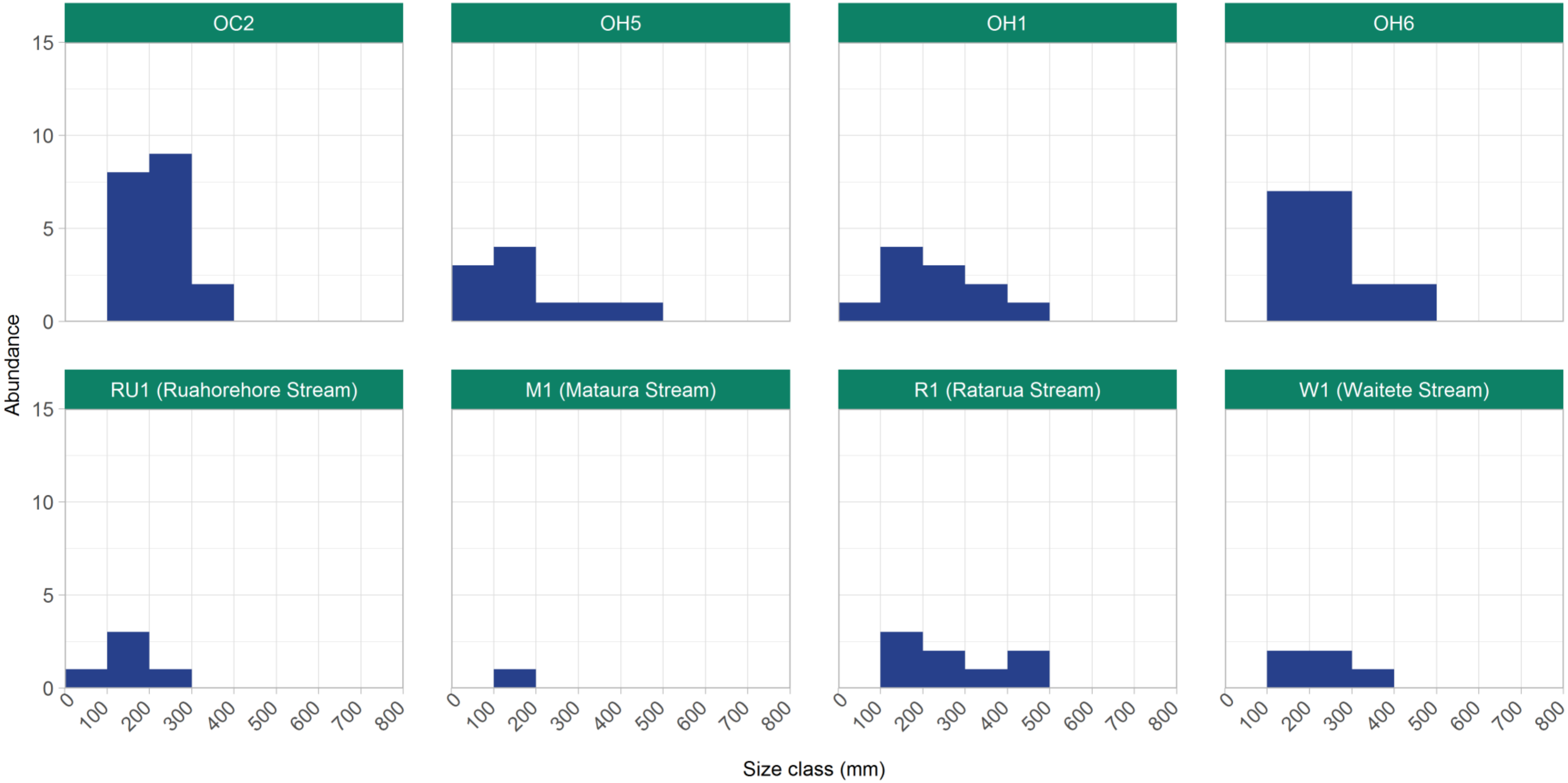

Figure 26: Size frequency data for shortfin eel in the Ohinemuri River (Sites OC2, OH5, OH1 and OH6) and tributaries (Sites RU1, W1, R1 and M1) during the summer 2017 survey.

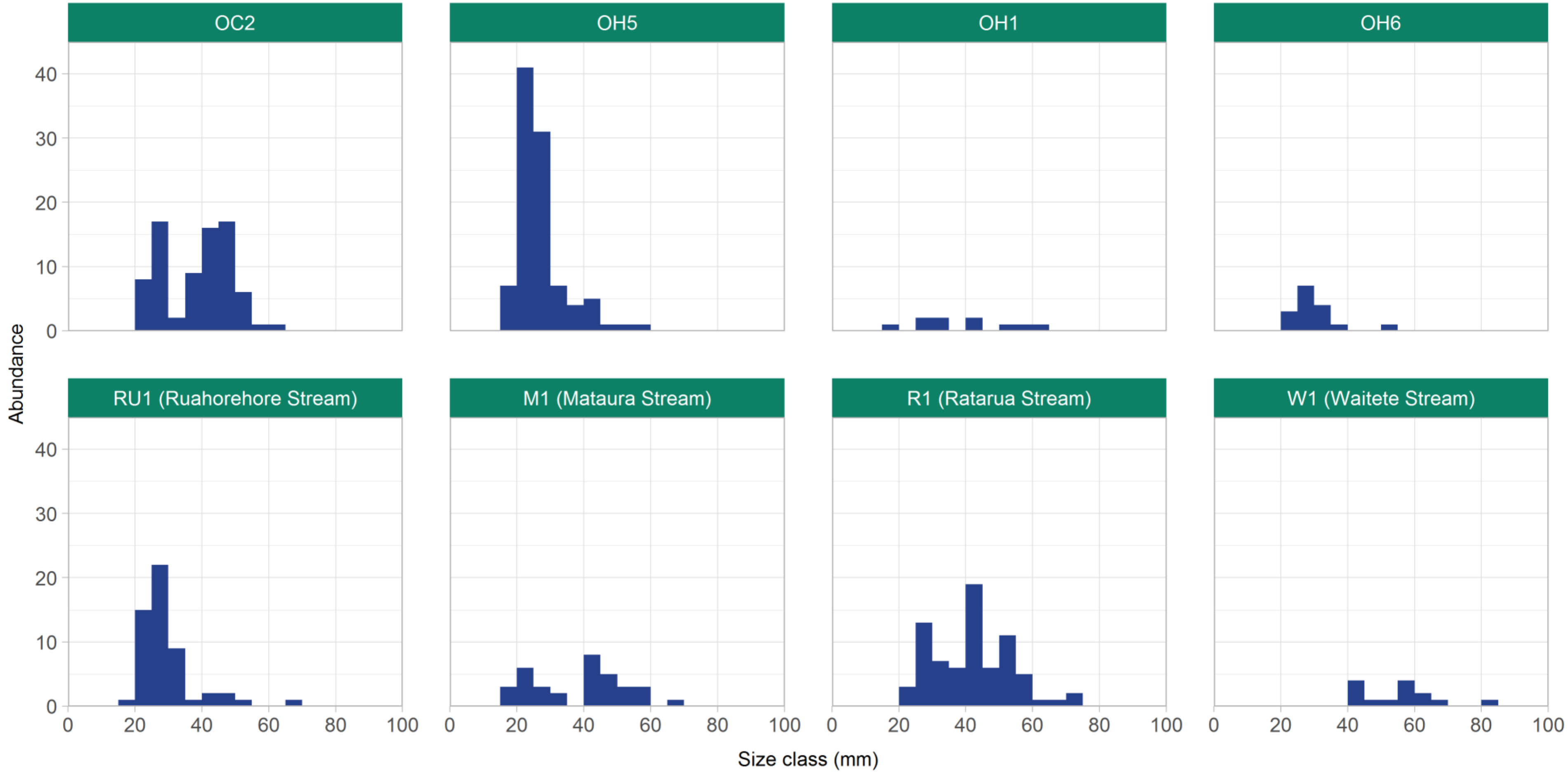

Figure 27: Size frequency data for all bullies in the Ohinemuri River (Sites OC2, OH5, OH1 and OH6) and tributaries (Sites RU1, W1 and R1) during the summer 2017 survey.

Table 18: Whole body selenium concentrations (dry weight) of fish caught at Sites OC2 and OH6 in February and May 2017.

Fish	Composite	OC2	OH6
Bully	Concentration (February)	2.9	NA
	Concentration (May)	3.6	7.8
	Historical range*	1.8-4.4	4.0-8.5
Eel	Concentration (February)	3.4	**9.1**
	Concentration (May)	3.1	4.0 (single eel)
	Historical range*	1.6-3.5	4.3-7.7

Notes: All units mg/kg dry weight; NA – sample not available and *historical range from July 2005 through to February 2016 inclusive.

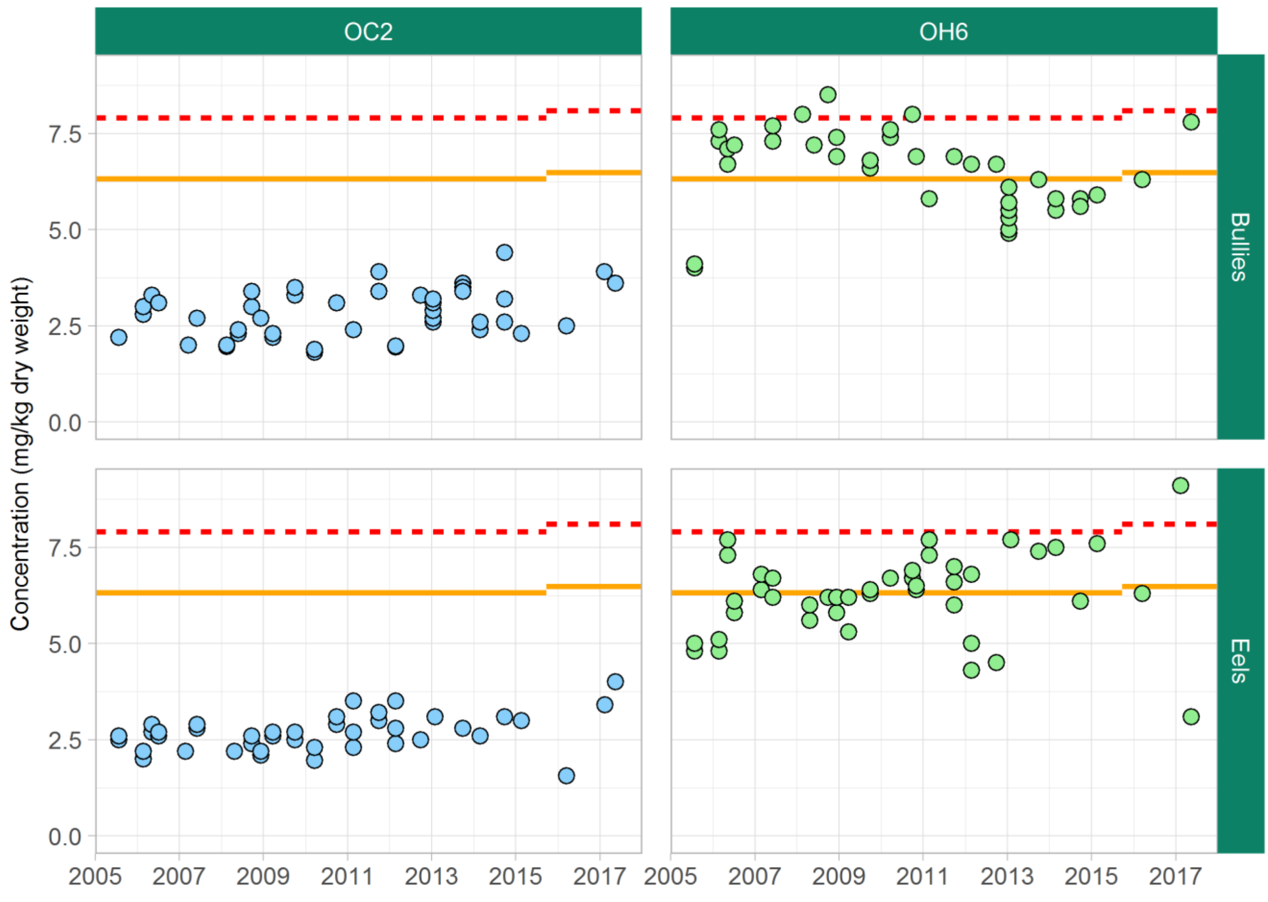

Figure 28: Selenium concentrations in the bully and eel replicates from Sites OC2 and OH6. The red line denotes the trigger limit and the orange line is equivalent to 80 % of trigger limit. Dashed line is the smoothed conditional mean.

The key points arising from the data measured over the monitoring period are:

- The selenium concentration in **eels** collected from site OH6 during the February 2017 survey was higher than the historical range for this site and exceeded the trigger limit of 8.1 mg/kg of dry weight. This is the first occasion over the 10 years of monitoring that an eel sample has recorded an exceedance of the trigger limit, although bullies have exceeded trigger limits on several occasions. The tissue samples were not able to be re-tested to confirm the result obtained. The selenium concentration in eels collected from site OC2 was at the upper end of the historical range but below the trigger limit. As a result of the trigger value exceedance for OH6 eel tissue, a second selenium in bully/eel tissue survey was undertaken.
- The selenium concentration in the May eel OC2 sample was similar to the February concentration (Table 18). Selenium concentration in the May eel from OH6 was lower than the February sample (Table 18). However, these results should be viewed with caution as only one eel was caught in May and it was considerably longer than the February composite eels, indicating an older fish. The diet of eels change with size (Jellyman 1987) and difference in selenium concentrations may reflect changes in diet or other factors (e.g., movement of the individual eel). Changes in the sampling conditions during the autumn survey relative to the summer survey may explain why few eels were caught in autumn.
- Selenium concentrations in the **bully** samples collected from site OC2 in February and May were both within the historical (long-term) range.
- No bully were collected from site OH6 in February 2017. Selenium concentrations in the May bully sample were in the upper part of the historical range but just below trigger levels (Table 18 and Figure 28).
- The resource consent requires that if the selenium concentration trigger limit, identified in Condition 14a of the consent[3], is exceeded then a response is required in relation to managing selenium in the discharge. This is discussed further below.

Compliance exceedance discharge concentrations

Condition 14a of the resource consent requires that compliance with the selenium in tissue condition is assessed and if the concentration exceeds the trigger value then "the consent holder is required to reduce the selenium concentration in the discharge to 0.04 g/m^3 for regime A, 0.03 g/m^3 for Regime B, 0.05 g.m^3 for Regime C and 0.02 g/m^3 for Regime D unless otherwise agreed with Waikato Regional Council in writing".

Table 19 summarises monitoring data for the treated water discharge from the beginning of 2017. Selenium concentrations in the treated water discharge have been below the lowest required regime concentration (Regime D) of 0.02 g/m^3 (should a trigger limit exceedance have occurred; Table 19). Concentrations were similar to this range during 2016. The highest concentration (of dissolved selenium) was measured in May 2016 at 0.022 g/m^3. During that period, based on the strictest river flow limits (Regime D), the normal compliance limit is 0.07 g/m^3 and maximum limit 0.12 g/m^3.

In summary, the selenium concentrations in the treated water discharge since February 2017 have been consistently below the selenium response limit changes (Regime D) required under the resource consent.

Additional actions

As a result of the exceedance of the tissue trigger value in the OH6 eel sample in February 2017, an additional survey of both eel and bully tissue selenium concentrations was recommended. This was undertaken in May 2017. No further actions were identified in relation to the discharge as the concentration of selenium in the discharge in early 2017 was lower than the lowest consent levels (Regime D).

[3] Until a change was made to the discharge permit in September 2015, the whole body selenium trigger limit was 7.91 mg/kg dw and the 80 % trigger limit was 6.33 mg/kg dw.

Table 19: Summary of weekly selenium concentration in the treated water discharge up to end of March 2017.

Date	Acid soluble selenium	Dissolved selenium
5/01/2017	0.0126	0.0131
11/01/2017	0.0148	0.0131
17/01/2017	0.0045	
25/01/2017	0.0029	0.0027
1/02/2017	0.0026	
6/02/2017	0.0029	0.0026
15/02/2017	0.0024	0.0022
22/02/2017	0.0023	0.0024
2/03/2017	0.0019	0.0021
7/03/2017	0.0027	
15/03/2017	0.0066	0.0068
23/03/2017	0.0094	0.0087
30/03/2017	0.003	0.003

Note: All units g/m^3.

10.6 Summary

Consistent with previous years, shortfin eels and common bullies were the most widespread and common species recorded at Ohinemuri River sites. Shortfin eels were most abundant downstream of the upper discharge, with a large proportion of the shortfin eels recorded at this site falling into the elver category. These results indicate good recruitment to these populations. In three of the four tributary sites (RU1, M1, R1), fish communities were dominated by common bullies with some shortfin eels, whereas site W1 was dominated by shortfin eels with some common bullies. Cran's bullies were rare across both the Ohinemuri River and tributary sites. Longfin eels and rainbow trout continue to be uncommon in Ohinemuri River and

Bully selenium concentrations measured at both the upstream and downstream sites in February and May 2017 were below trigger limits and within the historical range for each site. Eel, selenium concentrations at site OH6 exceeded the threshold limits in the February composite sample. This was the first eel trigger exceedance since 2006. As a result of this exceedance, and as required by the Conditions of consent, the selenium concentrations of the discharge were reviewed. Discharge selenium concentrations were below the lowest discharge requirements of the resource consent to reduce selenium concentrations. As such, no discharge concentration management was required.

Repeat sampling in May resulted in only a single eel being caught at site OH6. This eel was larger, and therefore older, than those typically collected. This eel contained a lower selenium concentration than the February 2017 concentration data. The lower concentration may be a result of changes in diet and eating patterns, or movement of this individual eel within the Ohinemuri River and its tributaries.

11.0 SUMMARY

OGNZL holds a permit to discharge treated mine water to the Ohinemuri River from its WTP at Waihi. This discharge permit, among others, requires OGNZL to monitor water, sediment and ecological quality, as well as to meet conditions designed to protect the downstream receiving environment. The data presented in this report were measured between 1 May 2016 and 31 May 2017 and are summarised below. In general, the data indicate that any potential impact of OGNZL's mining operations was not measurable above natural background levels for most of the environmental parameters measured.

Treated water discharge

Discharge volumes complied with the relevant conditions of the discharge permit throughout the monitoring period. OGNZL was fully compliant with Condition 14 of the discharge permit, with concentrations complying with the limits specified in Tables 1 to 3 of the discharge permit.

Five pond overflows occurred during two high rainfall events in September 2016 and March 2017. These overflows are authorised by Consents 971211, 971312 and W1743. Water quality sampling during these events recorded no non compliances for the September 2016 event and one high level of TSS at the NSP and CSP2S for the March 2017 event.

Receiving water

The river flow and quality data measured between 1 May 2016 and 31 May 2017 indicated that OGNZL achieved a high level of compliance with the conditions of the discharge permit over this period. Although there were five technical non-compliances, there was no evidence to indicate these non-compliances were related to OGNZL's mining activities.

The overflow of five ponds during two high rainfall events in September 2016 and March 2017 did not result in any non-compliances in receiving water.

Sediment

Sediment sampled from the Ohinemuri River and the Ruahorehore Stream in 2016/2017 was predominantly sandy (as seen in prior years). Some shifts in textural classes occurred between surveys with small increases in the mud % from the November 2016 to May 2017. Some shifts in gravel and sand proportions were evident between the surveys at sites OH1 and RU1. These shifts are not likely to influence the sediment chemistry assessment as that analysis is carried out on particles sizes classes less than 2 mm in size.

Sediment quality was assessed on <2 mm and <63 µm fractions of sediments. The concentrations of all elements measured in the 2016/2017 surveys were generally similar to those measured in previous surveys. There were few notable differences in the <2 mm sediment fraction. Some differences were identified compared to historical data and all were the result of lower measured concentrations compared to the historical range. As in previous surveys, the sediments from the Ruahorehore Stream displayed some differences (e.g., lower mercury, copper, iron and nickel and higher cadmium) compared to sediments in the Ohinemuri River. In the <63 µm fraction, a number of elements across several sites on the Ohinemuri River and at RU1 were measured at concentrations lower than historical minima.

Overall, the pattern of concentrations measured in the <2 mm and <63 µm sediment fractions that exceeded sediment quality was similar to that reported for the 2015/2016 period. In the <2 mm fraction this included exceedance of the mercury and iron guidance values (the OME and NOAA guidelines). The exceedance has been discussed in previous annual reports as arising due to natural variation in the amount of iron and the widespread distribution of mercury in the Ohinemuri River system. The exceedance of iron and mercury also occurred in the <63 µm fraction. Exceedances were also identified for arsenic at the upstream site OC2, copper at sites OH5 and OH6 (similar to site exceedances in 2015/2016) and silver (in this case the ANZECC SQGV) at Site OH5.

Habitat characteristics

Consistent with previous years, during both surveys most stream sites were dominated by run and riffle habitat and had little to no stream shading. The largest habitat change between the November 2016 and May 2017 surveys is the proportion of riffle and run habitats at most sites. There was notable changes in the substrate composition at all monitoring sites on the Ohinemuri River. For sites OH3 and OH6, there was an increase in the proportions of gravel and silt relative to other substrates, while for sites OH5 and OH1 there was a decrease in silt and gravel proportions.

Periphyton

During the November 2016 survey, film, mat and filamentous periphyton were recorded at sites OC2, OH3 and RU1, while only film and filamentous periphyton were recorded at sites OH5, OH1 and OH6. During the May 2017 survey mat type periphyton was less prevalent, being recorded at Site OC2 only, while film and filamentous periphyton were recorded at all sites. All sites were below the New Zealand periphyton guideline values for both filamentous algae (≥30 %), and mats (≥60 %), for the protection of aesthetics and recreation and trout habitat and angling.

A total of 52 algae and cyanobacteria species were recorded across all sites in November and a total of 46 species were recorded across all sites in May. Diatoms were the most frequently occurring taxa with 38 species recorded in November and 35 species recorded in May. Green algae (including filamentous and unicellular) were the second most frequently occurring taxa with 12 and 7 species recorded across all sites in November and May, respectively.

Bray-Curtis and NMDS analyses showed that the periphyton communities at sites OH3 and OH5 were at least 50% dissimilar to all other sites during November. These differences could not be explained by any measured environmental variable. During the May 2017 survey, the periphyton community at Site OC2 was at least 70 % dissimilar to all other sites, while Site OH3 was at least 50 % dissimilar to downstream sites. The environmental variables bicarbonate, alkalinity, manganese, magnesium and conductivity were considered as possible explanatory factors for differences measured at Site OC2, while pH, manganese, magnesium, conductivity, selenium, zinc, hardness and calcium were considered as possible explanatory factors for Site OH3.

During both the spring and autumn surveys, chl-*a* concentrations were higher at the most upstream site, OC2, than all other sites. During the May 2017 survey, chl-*a* concentrations at sites OC2 and OH6 exceeded guidelines for the protection of benthic biodiversity (50 mg/m^2). Mean AFDW biomass measured in the Ohinemuri River and Ruahorehore Stream sites were below the New Zealand periphyton guideline of 35 g/m^2 for the protection of aesthetics/recreation and trout habitat and angling.

Periphyton selenium concentrations collected from sites OC2 and OH6 were similar to each other during the autumn survey. At Site OC2, the May 2017 selenium concentration was within the top 90th percentile of the historic range, while for Site OH6, the May 2017 selenium concentration was within the upper 75th percentile of the historic range.

Macrophytes

With the exception of Site OH6, submerged macrophyte cover was low at all sites during the spring and autumn surveys. During the autumn survey, the percentage cover of macrophytes at Site OH6 was ~ 50%, comprised mainly of a native charophyte, as well as oxygen weed.

At Site OH6, the selenium concentration in the oxygen weed stems was 1.85 mg/kg dry weight. Placed in context of the long term macrophyte selenium concentrations, the 2017 result was in the lower 25th percentile of Site OH6 data range, although higher than the long term data range for Site OC2.

Benthic macroinvertebrates

Taxa group dominance varied between sites and between sampling occasions. Diptera larvae were often the most dominant or co-dominant taxa during the November 2016 survey. During the May 2017 survey, the relative abundance of Oligochaeta increased at the expense of Diptera at sites OC2, OH5 and OH1.

Differences in community composition between sites in spring was mainly driven by significant differences in the midges and caddisflies and stony cased caddis. During autumn, between sites differences in community composition was driven by significantly higher oligochaetes population at the most upstream control site (OC2) and lower overall abundance of most taxa at RU1.

Changes in taxa richness were unrelated to site position with respect to discharge locations during the spring 2016 survey. However, during the autumn 2017 survey, taxa richness was higher at the most upstream control site (OC2) relative to all sites downstream of discharges and the Ruahorehore Stream site.

EPT taxa richness did not differ significantly between sites during the spring survey but was significantly higher at the most upstream site compared to all sites downstream of discharges during the autumn survey. %EPT was significantly higher at the site (OH5) downstream of the upper discharge compared to all other Ohinemuri River sites during the spring 2016 survey. During the autumn 2017 survey there was no significant difference in %EPT between sites on the Ohinemuri River.

The percentage change in taxa richness between sites upstream and downstream of each discharge was within allowable limits during both the spring 2016 and autumn 2017 surveys. The percentage change in macroinvertebrate abundance between sites upstream and downstream of the upper discharge was within consented limits on both monitoring occasions. However, for the lower discharge, the percentage change in abundance exceeded consented limits during the spring 2016 survey but was within limits during the autumn 2017 survey.

Mean MCI scores within the poor or fair categories indicate the sites are dominated primarily by taxa considered to be more tolerant to pollution or degradation in habitat and water quality in general. The low QMCI scores recorded at all sites, including those upstream of mining activities, reflect the dominance of organic pollution tolerant taxa and suggests that QMCI is a poor measure of mining impact in the Ohinemuri River.

Consent conditions for macroinvertebrate taxa richness and abundance were met during the 2016-2017 monitoring period and no additional monitoring is required.

Fish

Consistent with previous years, shortfin eels and common bullies were the most widespread and common species recorded at Ohinemuri River sites. Shortfin eels were most abundant downstream of the upper discharge, with a large proportion of the shortfin eels recorded at this site falling into the elver category. These results indicate good recruitment to these populations. In three of the four tributary sites (RU1, M1, R1), fish communities were dominated by common bullies with some shortfin eels, whereas site W1 was dominated by shortfin eels with some common bullies. Cran's bullies were rare across both the Ohinemuri River and tributary sites. Longfin eels and rainbow trout continue to be uncommon in Ohinemuri River and

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Repeat sampling in May resulted in only a single eel being caught at site OH6. This eel was larger, and therefore older, than those typically collected. This eel contained a lower selenium concentration than the February 2017 concentration data. The lower concentration may be a result of changes in diet and eating patterns, or movement of this individual eel within the Ohinemuri River and its tributaries.

12.0 LIMITATIONS

Your attention is drawn to the document, “Report Limitations”, as attached in Appendix L. The statements presented in that document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise the risks to which this report relates which are associated with this project. The document is not intended to exclude or otherwise limit the obligations necessarily imposed by law on Golder, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing

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APPENDIX A

Resource Consent Conditions

1.0 TREATED WATER DISCHARGE

Discharge Permit 971318 authorises the Waihi Gold Company (WGC) to discharge treated water from the WTP to the Ohinemuri River via two discharge points, E1 (upper discharge) and E2 (lower discharge). The relevant conditions of the discharge permit are listed below:

2. *The maximum combined daily discharge from both discharge points shall be no greater than that shown in Table A.*

3. *The maximum combined rate of discharge from both discharge points shall be no greater than that shown in Table A.*

4. *The rate of discharge at point E1 shall not exceed the percentage of the instantaneous river flow above point E1 as shown in Table A.*

5. *For the combined discharge from points E1 and E2, the rate of discharge shall not exceed the percentage of the instantaneous river flow at discharge point E2, minus the discharge volume from point E1, (i.e. $E1+E2 \le (Q-E1)\times F$) as shown in Table A, where:*

   E1 = rate of discharge at point E1; E2 = rate of discharge at point E2; Q= river flow at E2.

   Table A: Discharge criteria for operating regimes.

Criteria	Operating regime			
	A	B	C	D
Daily discharge (m^3/day)	20,000	26,000	5,200	26,000
Discharge rate (L/s)	235	301	60	301
Percentage of river flow (F) (%)	15	20	10	40

14. *The treated water discharge shall at all times comply with the following limits specified in Tables 1, 2 and 3 of the consent* (Tables 1 to 3 of the consent are reproduced in Tables 1 to 3 of this document).

14a. *The consent holder shall manage the selenium concentration in the discharge to ensure that the whole body selenium concentration in fish does not exceed the trigger limits of 8.1 mg/kg dry weight as a result of the discharge. Compliance with this condition shall be assessed by the monitoring regime described in condition 16, Table 5.*

   In the event sample analysis indicates fish flesh values exceed 80 % of the trigger limit of 8.1 mg/kg, the consent holder shall advise Waikato Regional Council within 48 hours of receipt of the results.

   In the event of an exceedance of the fish flesh trigger limit, the consent holder shall reduce selenium concentrations in the discharge to 0.04 g/m³ for Regime A, 0.03 g/m³ for Regime B, 0.05 g/m³ for Regime C and 0.02 g/m³ for Regime D unless otherwise agreed with Waikato Regional Council in writing.

15. *Unless otherwise agreed in writing by Waikato Regional Council, the consent holder shall undertake the following programme of water monitoring (Table 4).* (Table 4 of the consent is reproduced in Table 4 of this document).

16. *Unless otherwise agreed with Waikato Regional Council the consent holder shall undertake the following monitoring throughout the period of wastewater discharge to the Ohinemuri River (Table 5 and Figure 1).* (Table 5 of the consent is reproduced in Table 5 of this document).

Table 1: Water treatment plant discharge compliance limits.

Parameter	Operating regime A		Operating regime B		Operating regime C		Operating regime D	
	Normal (1)	Maximum (1)	Normal (1)	Maximum (1)	Normal (1)	Maximum (1)	Normal (1)	Maximum (1)
pH range (unitless)	6.5-9.5		6.5-9.5		6.5-9.5		6.5-9.5	
Total suspended solids	10	50	8	40	5	10	8	40
Temperature (°C)	<3 °C rise	<3 °C rise	<3 °C rise	<3 °C rise	<3 °C rise	<3 °C rise	<3 °C rise	<3 °C rise
Ammonia	Refer Table 3		Refer Table 3		Refer Table 3		Refer Table 3	
Cyanide (CN_{WAD})	0.25	0.71	0.20	0.56	0.36	1.02	0.11	0.32
Antimony	-	0.23	0.1 (5)	0.18	0.07 (5)	0.33	0.06 (5)	0.1
Arsenic	-	1.45	-	1.14	-	0.02	-	0.66
Cadmium	-	0.008 (2)	-	0.007 (3)	-	0.004 (4)	-	0.004 (4a)
Chromium (VI)	-	0.08	-	0.06	-	0.05 (6)	-	0.04
Copper	0.07 (2)	0.13 (2)	0.055 (3)	0.10 (3)	0.031 (4)	0.054 (4)	0.033 (4a)	0.06 (4a)
Iron	1.0	6.7	0.8	5.0	0.1	0.3	0.5	3.1
Lead	-	0.02 (2)	-	0.018 (3)	-	0.006 (4)	-	0.011 (4a)
Manganese	1.0	1.3	0.8	1.0	0.1	0.4	0.5	0.6
Mercury	-	0.0005 (6)	-	0.0005 (6)	-	0.0005 (6)	-	0.0005 (6)
Nickel	-	1.2 (2)	-	0.94 (3)	-	0.64 (4)	-	0.55 (4a)
Selenium	0.15	0.27	0.12 (5)	0.2 (5)	0.22 (5)	0.38 (5)	0.07 (5)	0.12 (5)
Silver	0.02 (2)	0.03 (2)	0.017 (3)	0.024 (3)	0.005 (4)	0.005 (4)	0.01 (4a)	0.014 (4a)
Zinc	-	0.8 (2)	-	0.61 (3)	-	0.38 (4)	-	-
Hardness assumption	670		530		200 (4)		315	

Notes: All units g/m^3 unless stated; and refer to Table 1 Notes below.

Table 1 Notes

(1) *Normal compliance values to be met 97% of time based on all analyses taken during a quarterly period when the WTP is discharging. Maximum values are not to be exceeded in any analysis.*

(2) *Operating Regime A - For hardness related metals, the compliance values in Table 1 assume hardness in the WTP discharge of 670 g/m^3 as $CaCO_3$ prior to dilution in the Ohinemuri River. This equates to an in-river hardness of about 100 g/m^3 as $CaCO_3$ following mixing. Refer Table 2 for compliance levels at differing hardness concentrations*

(3) *Operating Regime B - For hardness related metals, the compliance values in Table 1 assume hardness in the RO only discharge of zero and 530 g/m^3 as $CaCO_3$ prior to dilution in the Ohinemuri River. This equates to an in-river hardness of about 100 g/m^3 as $CaCO_3$ following mixing. Refer Table 2 for compliance levels at differing hardness concentrations.*

(4) *Operating Regime C - Prior to discharge of Reverse Osmosis (RO) plant permeate, hardness must be added to achieve a minimum hardness of 200 g/m^3 as $CaCO_3$ to ensure in-river compliance for hardness related metals. Refer to Table 2 for compliance levels at differing hardness concentrations.*

(4a) *Operating Regime D – For hardness related metals, the compliance values in Table 1 assume a hardness in the WTP discharge of 315g/m^3 as $CaCO^3$ prior to dilution in the Ohinemuri River This equates to an in-river hardness of about 100 g/m$_3$ as $CaCO^3$ following mixing. Refer to Table 2 for compliance levels at differing hardness concentrations.*

(5) *Values are trigger limits, not compliance limits. In the event that the trigger limits are exceeded, the consent holder shall inform the Waikato Regional Council as soon as practicable and prepare a report, to the satisfaction of the council, to demonstrate that continued discharges at concentrations exceeding the trigger limits will have no more than minor effects on the Ohinemuri River. This report shall be provided to the council within two months of the consent holder becoming aware of the trigger exceedance.*

(6) *Current analytical procedures for mercury have a practical quantification limit (PQL) of 0.0005 g/m^3, and for chromium (VI) have a PQL of 0.05 g/m^3. The reporting limit for mercury and chromium concentrations shall be reviewed annually by the consent holder and shall be adjusted in line with improvements in analytical technology.*

(7) *Discharge limits for metals are for 'acid-soluble' concentration, determined on unfiltered samples.*

The maximum allowable concentration (g/m^3) for hardness related criteria = ((1 + Z) x Y) - X) / Z

where: $Y = (\exp(m(\ln H) + b) \times C \times 10^{-3}$

$H = (Z \times \text{WTP discharge hardness}) + 14) / (1 + Z)$

Z = 0.15 (Operating regime A); 0.2 (Operating regime B); 0.1 (Operating regime C); 0.4 (Operating regime D)

using the following constants:

Table 2: Calculation of compliance levels for hardness related criteria.

Parameter	Normal compliance		Maximum (1)		X (2)	C
	M	b	m	b		
Copper	0.8545 (3)	-1.465 (3)	0.9422	-1.464	0.001	0.85 (4) or 1.0
Nickel	N/A	N/A	0.846	1.1645	0.0006	1.0
Zinc	N/A	N/A	0.8473	0.7614	0.0047	1.0
Silver	1.51(5)	-9.72 (5)	1.72	-6.52	0.00005	45.2 (6) or 1.0
Cadmium	N/A	N/A	0.7852	-3.49	0.0001	1.0
Lead	N/A	N/A	1.273	-4.705	0.0002	1.0

Notes: (1) From USEPA acute criteria (copper and silver) or chronic criteria (nickel, zinc, cadmium and lead) for aquatic biota. (2) Mean receiving water quality as measured at Site OH3. (3) From USEPA chronic criteria for aquatic biota. (4) Constant to convert calculation for copper = 0.85 (compliance value) or = 1.0 (maximum value). (5) From site specific criteria, calculated using USEPA (1985) methodology. (6) Constant to convert calculation for silver = 10^3/22.1 (compliance value) or 1 = 1.0 (maximum value).

Table 3: Compliance criteria for total ammonia.

	Normal compliance (g/m³ as ammonia)							Maximum (g/m³ as ammonia)						
Temp (ºC)	**0**	**6**	**10**	**15**	**20**	**25**	**30**	**0**	**6**	**10**	**15**	**20**	**25**	**30**
pH	**Regime A**													
6.50	23.00	21.46	20.70	19.17	19.17	19.17	18.40	268.31	252.98	237.65	229.98	222.31	222.31	222.31
6.75	23.00	21.46	20.70	19.93	19.17	19.17	19.17	245.31	229.98	214.65	206.98	206.98	199.32	199.32
7.00	23.00	21.46	20.70	19.93	19.17	19.17	19.17	214.65	199.32	191.65	183.98	176.32	176.32	176.32
7.25	23.00	21.46	20.70	19.93	19.17	19.17	19.17	133.39	168.65	153.32	151.02	147.19	145.65	145.65
7.50	23.00	21.46	20.70	19.93	19.17	19.17	19.17	133.39	124.96	118.82	114.22	111.92	111.16	111.16
7.75	21.46	19.93	19.17	18.40	17.63	17.63	18.40	93.53	87.39	83.56	80.49	78.96	78.19	78.96
8.00	13.95	13.03	12.42	12.04	12.65	11.88	12.19	61.33	57.50	54.43	52.90	52.13	52.13	53.66
8.25	7.90	7.44	7.13	6.90	6.90	6.98	7.21	34.50	32.20	31.43	30.66	29.90	30.66	31.43
8.50	4.45	4.22	4.06	4.06	4.06	4.22	4.45	19.93	18.40	17.63	17.63	17.63	18.40	19.93
8.75	2.61	2.45	2.38	2.38	2.45	2.68	2.91	11.27	10.73	10.50	10.58	10.89	11.65	12.65
9.00	1.49	1.45	1.45	1.49	1.61	1.76	2.07	6.59	6.36	6.36	6.59	6.98	7.74	8.89
pH	**Regime B**													
6.50	18.00	16.79	16.20	15.00	15.00	15.00	14.40	209.98	197.98	185.99	179.98	173.98	173.98	173.98
6.75	18.00	16.79	16.20	15.60	15.00	15.00	15.00	191.98	179.98	167.99	161.98	161.98	155.99	155.99
7.00	18.00	16.79	16.20	15.60	15.00	15.00	15.00	167.99	155.99	149.99	143.98	137.99	137.99	137.99
7.25	18.00	16.79	16.20	15.60	15.00	15.00	15.00	104.39	131.99	119.99	118.19	115.19	113.99	113.99
7.50	18.00	16.79	16.20	15.60	15.00	15.00	15.00	104.39	97.79	92.99	89.39	87.59	86.99	86.99
7.75	16.79	15.60	15.00	14.40	13.80	13.80	14.40	73.20	68.39	65.39	62.99	61.79	61.19	61.79
8.00	10.92	10.20	9.72	9.42	9.90	9.30	9.54	48.00	45.00	42.60	41.40	40.80	40.80	41.99
8.25	6.18	5.82	5.58	5.40	5.40	5.46	5.64	27.00	25.20	24.60	23.99	23.40	23.99	24.60
8.50	3.48	3.30	3.18	3.18	3.18	3.30	3.48	15.60	14.40	13.80	13.80	13.80	14.40	15.60
8.75	2.04	1.92	1.86	1.86	1.92	2.10	2.28	8.82	8.40	8.22	8.28	8.52	9.12	9.90
9.00	1.17	1.13	1.13	1.17	1.26	1.38	1.62	5.16	4.98	4.98	5.16	5.46	6.06	6.96

	Normal compliance (g/m^3 as total ammonia)							Maximum, (g/m^3 as total ammonia)						
Temp (°C)	**0**	**6**	**10**	**15**	**20**	**25**	**30**	**0**	**6**	**10**	**15**	**20**	**25**	**30**
pH	**Regime C**													
6.50	33.00	30.79	29.70	27.50	27.50	27.50	26.40	384.97	362.97	340.98	329.97	318.97	318.97	318.97
6.75	33.00	30.79	29.70	28.60	27.50	27.50	27.50	351.97	329.97	307.98	296.97	296.97	285.98	285.98
7.00	33.00	30.79	29.70	28.60	27.50	27.50	27.50	307.98	285.98	274.98	263.97	252.98	252.98	252.98
7.25	33.00	30.79	29.70	28.60	27.50	27.50	27.50	191.39	241.98	219.98	216.68	211.19	208.98	208.98
7.50	33.00	30.79	29.70	28.60	27.50	27.50	27.50	191.39	179.29	170.48	163.88	160.58	159.49	159.49
7.75	30.79	28.60	27.50	26.40	25.30	25.30	26.40	134.20	125.39	119.89	115.49	113.29	112.19	113.29
8.00	20.02	18.70	17.82	17.27	18.15	17.05	17.49	88.00	82.50	78.10	75.90	74.80	74.80	76.99
8.25	11.33	10.67	10.23	9.90	9.90	10.01	10.34	49.50	46.20	45.10	43.99	42.90	43.99	45.10
8.50	6.38	6.05	5.83	5.83	5.83	6.05	6.38	28.60	26.40	25.30	25.30	25.30	26.40	28.60
8.75	3.74	3.52	3.41	3.41	3.52	3.85	4.18	16.17	15.40	15.07	15.18	15.62	16.72	18.15
9.00	2.14	2.08	2.08	2.14	2.31	2.53	2.97	9.46	9.13	9.13	9.46	10.01	11.11	12.76
pH	**Regime D**													
6.50	10.50	9.80	9.45	8.75	8.75	8.75	8.40	122.49	115.49	108.49	104.99	101.49	101.49	101.49
6.75	10.50	9.80	9.45	9.10	8.75	8.75	8.75	111.99	104.99	97.99	94.49	94.49	90.99	90.99
7.00	10.50	9.80	9.45	9.10	8.75	8.75	8.75	97.99	90.99	87.49	83.99	80.49	80.49	80.49
7.25	10.50	9.80	9.45	9.10	8.75	8.75	8.75	60.90	76.99	69.99	68.94	67.20	66.49	66.49
7.50	10.50	9.80	9.45	9.10	8.75	8.75	8.75	60.90	57.05	54.24	52.14	51.09	50.75	50.75
7.75	9.80	9.10	8.75	8.40	8.05	8.05	8.40	42.70	39.90	38.15	36.75	36.05	35.70	36.05
8.00	6.37	5.95	5.67	5.50	5.78	5.42	5.57	28.00	26.25	24.85	24.15	23.80	23.80	24.50
8.25	3.61	3.40	3.26	3.15	3.15	3.19	3.29	15.75	14.70	14.35	14.00	13.65	14.00	14.35
8.50	2.03	1.93	1.85	1.85	1.85	1.93	2.03	9.10	8.40	8.05	8.05	8.05	8.40	9.10
8.75	1.19	1.12	1.09	1.09	1.12	1.22	1.33	5.15	4.90	4.79	4.83	4.97	5.32	5.78
9.00	0.68	0.66	0.66	0.68	0.74	0.80	0.95	3.01	2.90	2.90	3.01	3.19	3.53	4.06

Table 4: Water treatment plant discharge monitoring.

Frequency	Site	Parameters
Continuously	WTP Discharge	Flow (E1, E2), turbidity, conductivity, pH and temperature
	Frendrups (Ohinemuri River)	Flow, temperature
	Torrens (Ruddock - Ruahorehore Stream)	
Daily	WTP Discharge	CN_{WAD}, suspended solids, ammonia, Cu, Fe, Mn, Ag
Weekly	WTP Discharge	Selenium and antimony (1)
	Ohinemuri River (Sites OH5, OH6)	
Monthly	WTP Discharge	Parameters listed in Condition 14 (Table 1)
Annual	WTP Discharge	Cobalt

Notes: The WTP discharge monitoring programme for metals are for 'acid-soluble' concentrates determined on unfiltered samples. Monitoring of selenium and antimony in the Ohinemuri River shall be based on the soluble test method, defined as the concentration of dissolved metal measured in that fraction which passes through a 0.45 µm filter. E1 is the upper treated water discharge. E2 is the lower treated water discharge. (1) Antimony added 28 June 2007.

17. *Unless otherwise agreed by Waikato Regional Council in writing, the results of the interim monitoring shall be reported to Council within two months of spring sampling. A full report detailing the results of all monitoring specified in Condition 16 shall be submitted to Waikato Regional Council by 30 July each year following the autumn sampling. This report shall include a comparison of the sediment data with the National Oceanic and Atmospheric Administration (NOAA) and Ontario Ministry of Environment (OME) sediment quality guidelines.*

    Should a more appropriate set of standards or guidelines be developed, then those could be substituted as the comparison guidelines by mutual agreement between Waikato Regional Council and the consent holder.

18. *At any time following the completion of two seasonal monitoring events (e.g., spring to spring), if a significant difference is deemed to have occurred between sites on both occasions then the consent holder shall undertake immediate further monitoring. Should a significant difference be recorded during this contingency monitoring the consent holder shall inform Council and shall determine any mitigation measures that need to be implemented to ensure that significant effects are remedied or mitigated. 'Significant' is defined as follows:*

    - *A significant difference in macroinvertebrate biota will be deemed to have occurred following a statistically significant change at test Sites OH5 and OH6 of 30% above the natural variation recorded at the control Sites OH3 and OH1;*
    - *A significant difference in total macro-invertebrate abundance will be deemed to have occurred following a statistically significant change at test Sites OH5 and OH6 of 50% above the natural variation recorded at the control Sites OH3 and OH1.*

22. *All biological monitoring sampling and analysis shall have regard to:*

    i. consistent quantitative estimates of the aquatic biota

    ii. consistent laboratory and sorting/counting protocols

    iii. consistent taxonomic resolution of aquatic biota

    and shall be undertaken to the satisfaction of the Council.

23. *All water quality and sediment sampling and analysis shall be undertaken using Standard Methods for the Examination of Water and Wastewater (19th Edition 1995, or updates), APHA, AWWA, and WEF, unless otherwise agreed in writing by Waikato Regional Council. All other measuring, testing, recording and analytical methods as may be required from time to time pursuant to the requirements of this consent shall be to the satisfaction of Council.*

Table 5: Biological, sediment and river water quality monitoring.

Aquatic biota	Frequency	Sites	Methods	Parameters
Fish	Late summer (Feb-Mar)	OC2, OH5, RU1, OH1, OH6, a site on Mataura (M1), Ratarua (R1), and Waitete (W1) Streams	Electric fishing	Species numbers Species abundance Fish lengths
Macroinvertebrates	Spring (Oct-Dec) Autumn (Mar-May)	OH3, OH5, RU1, OH1, OH6	Surber sampling	Taxa richness Total abundance Key taxa abundance
Periphyton	Spring (Oct-Dec) Autumn (Mar-May)	OH3, OH5, RU1, OH1, OH6	Rock scrape sampling	Chlorophyll-*a* AFDW Taxa richness
Water Quality	Spring (Oct-Dec) Autumn (Mar-May)	OH3, OH5, RU1, OH1, OH6	Spot sampling	All parameters listed in Condition 14 (Table 1) and nitrate
Sediment	Spring (Oct-Dec) Autumn (Mar-May)	OH3, OH5, RU1, OH1, OH6	Sediment coring	Metals listed in Condition 14 (Table 1)
Fish (eels and bullies)	Summer (Jan-Mar)	OC2, OH6	Analysed in accordance with appropriate USEPA procedures as agreed with WRC.	Composite whole body selenium concentration (dry weight)
Periphyton and macrophyte	Autumn (Mar-May)	OC2, OH6	Analysed in accordance with appropriate USEPA procedures as agreed with WRC.	Total selenium (both wet weight and dry weight)

2.0 RECEIVING WATER

Condition 6 of Discharge Permit 97318 requires WGC to establish and maintain river gauging facilities, for the purpose of determining the river flow at the points of discharge, while Condition 16 of this consent specifies the collection of water samples from sites within the Ohinemuri River and Ruahorehore Stream in spring and autumn each year. These samples are to be analysed for nitrate and for the parameters listed in Table 1. In addition, WGC is required to monitor the temperature of the Ohinemuri River (Frendrups) and Ruahorehore Stream (Torrens) continuously, while selenium and antimony concentrations are to be assessed at Sites OH5 and OH6 on a weekly basis.

The results of all analyses are to be reported to the Waikato Regional Council as specified in Condition 17 of this consent. Discharge Permits 971303, 971304, 971305, 971306, 971311, 971312, 971315 and 971323 provide receiving water quality standards; these criteria are summarised in Table 6.

Table 6: Receiving water quality standards.

Parameter	Receiving water concentration (1)	
	Hardness (20 g/m^3 $CaCO_3$)	Hardness (100 g/m^3 $CaCO_3$)
pH (unitless)	6.5-9.0	
Suspended solids	Refer Table 6 Notes below - Note (2)	
Temperature (˚C)	Refer Table 6 Notes below - Note (3)	
Total ammonia	Refer Table 7	
Cyanide (CN_{WAD})(4)	0.093	
Antimony	0.030	
Arsenic	0.190	
Cadmium	0.0003	0.001
Chromium (VI)	0.010	
Copper	0.003	0.011
Iron	1.0	
Lead	0.0004	0.0025
Manganese	2.0	
Mercury (5)	0.000012	
Nickel	0.040	0.160
Selenium	Refer Table 6 Notes below - Note (6)	
Silver (4)	0.00025	0.0028
Zinc	0.027	0.100

Notes: All units g/m^3 unless stated. Refer to Table 6 Notes below.

Table 6 Notes

(1) Monitoring of metals/metalloids shall be based on the soluble test method, defined as the concentration of dissolved metals/metalloids measured in that fraction which passes through a 0.45 µm filter except for mercury (Hg), which shall be based on acid soluble concentrations determined on unfiltered samples.

(2) *In the event of silt pond discharges authorised by RC 971311, either separately or in combination with other discharges: TSS shall increase by no more than 10 % compared with upstream concentrations for rainfall events greater than the design storm. In the event of collection pond discharges authorised by RC 971312, and tailings pond discharges authorised by RC 971323: for upstream concentrations of less than or equal to 100 g/m^3 the increase in TSS downstream shall be no greater than 10 g/m^3. For upstream concentrations of greater than 100 g/m^3 the increase shall be no greater than 10%.*

(3) *The temperature increase resulting from the tailings pond discharges authorised by RC 971323, in combination with all other discharges authorised for this site, shall be less than 3 ˚C.*

(4) *Site specific derived criteria using USEPA (1985) methodology.*

(5) *Current analytical procedures for mercury have a practical quantification limit (PQL) of 0.0005 ppm. This PQL is acceptable for the purposes of reporting mercury concentrations. The reporting 'limit' for mercury concentrations shall be reviewed annually by the consent holder and shall be adjusted in line with improvements in analytical technology.*

(6) *The selenium concentration in the receiving water shall remain below the trigger limits of 0.02 g/m^3 97 % of the time on an annual basis, and 0.035 g/m^3 in any single analysis, based on monitoring undertaken pursuant to Condition 16 of consent 971318. In the event that these limits are exceeded, the consent holder shall inform the Waikato Regional Council as soon as practicable and prepare a report, to the satisfaction of the Council, to demonstrate that continued discharges at concentrations exceeding the trigger limits will have no more than minor effects on the Ohinemuri River. This report shall be provided to the Council within two months of the consent holder becoming aware of the trigger exceedance.*

Table 7: Total ammonia criteria for receiving waters.

	Chronic criterion (g/m^3 as ammonia)						
Temperature (ºC)	0	5	10	15	20	25	30
pH (unitless)							
6.50	3.0	2.8	2.7	2.5	2.5	2.5	2.4
6.75	3.0	2.8	2.7	2.6	2.5	2.5	2.5
7.00	3.0	2.8	2.7	2.6	2.5	2.5	2.5
7.25	3.0	2.8	2.7	2.6	2.5	2.5	2.5
7.50	3.0	2.8	2.7	2.6	2.5	2.5	2.5
7.75	2.8	2.6	2.5	2.4	2.3	2.3	2.4
8.00	1.82	1.70	1.62	1.57	1.55	1.55	1.59
8.25	1.03	0.97	0.93	0.90	0.90	0.91	0.94
8.50	0.58	0.55	0.53	0.53	0.53	0.55	0.58
8.75	0.34	0.32	0.31	0.31	0.32	0.35	0.38
9.00	0.195	0.189	0.189	0.195	0.210	0.230	0.270

Note: To convert these values to g/m^3 as nitrogen, multiply by 0.822.

3.0 SUMMARY

A summary of the compliance limits for each of the parameters in the resource consents is presented in Table 8, together with an approach to their assessment.

Table 8: Summary of assessed parameters, compliance limits and assessment approach.

Component	Parameter assessed	Required [A]	Compliance limit provided	Approach to assessment
Treated water	Parameters listed in Table 1	Yes	Refer to Table 1	Assessed against compliance limits
River water	Parameters listed in Table 6	Yes	Refer to Table 6	Comparison between upstream and downstream Assessed against compliance limits
Sediment	Metals/metalloids listed in Table 6	Yes	Refer to Table 13 in the main body of the report	Comparison between upstream and downstream Assessed against compliance limits (NOAA 1999; OME 1993)
Periphyton	Chlorophyll-*a* AFDW Taxa richness	Yes	N/A	Comparison between upstream and downstream Chlorophyll-*a* <50 mg/m^2 for the protection of biodiversity values (Biggs 2000) AFDW <35 g/m^2 for the protection of trout habitat
Macroinvertebrates	Taxa richness Total abundance Key taxa abundance Community composition Biological Indices (MCI, QMCI, EPT, %EPT)	Yes No	No significant change in number of taxa (>30% change above natural variation) or abundance (>50% change above natural variation) recorded between upstream and downstream sites following the completion of two seasonal monitoring events (e.g., spring to spring)	Comparison between upstream and downstream Community composition and biological indices assessed against nationally recognised guidelines outlined in Stark (1985, 1993, 1998) & Lenat (1988)
Fish	Species numbers Species abundance Fish lengths	Yes	N/A	Comparison between upstream and downstream Assessed against published data
Periphyton Macrophyte Macroinvertebrates [B]	Total selenium concentration (wet and dry wt)	Yes	N/A	Comparison between upstream and downstream Assessed against published data (USEPA 2004)
Fish (eel and bully)	Composite whole body selenium concentration (dry weight)	Yes	Composited whole body selenium concentration less than 7.91 mg/kg. In the event fish flesh values exceed 80% of 7.91 mg/kg, must advise WRC	Comparison between upstream and downstream Assessed against compliance limits (USEPA 2004)

Notes: N/A = not applicable; [A] required by consent; and [B] unable to be sampled due to lack of appropriate test species.

4.0 REFERENCES

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APPENDIX B

Treated Water Volume and River Flow Data

Table 1: Discharge volumes and river flows between 1 May 2016 and 31 May 2017.

Date	Water treatment plant			TSF2 (m^3/day)	Ohinemuri River flows (m3/day)		Collection pond discharges (m^3/day)		
	Regime	E1 (m^3/day)	E2 (m^3/day)		Frendrups	Ruddocks	S3	S4	S5
1/05/2016	B	8,714	3,600	0	65,008	24,234	0	0	0
2/05/2016	B	6,828	2,734	0	62,401	23,145	0	0	0
3/05/2016	B	6,488	992	0	59,289	22,172	0	0	0
4/05/2016	B	8,430	2,442	0	58,023	21,447	0	0	0
5/05/2016	B	9,474	2,624	0	56,436	20,807	0	0	0
6/05/2016	B	8,980	3,188	0	54,464	20,096	0	0	0
7/05/2016	B	9,338	2,256	0	53,411	19,408	0	0	0
8/05/2016	B	7,838	3,348	0	51,659	18,903	0	0	0
9/05/2016	B	7,078	3,748	0	50,418	18,478	0	0	0
10/05/2016	B	7,468	3,236	0	49,908	18,219	0	0	0
11/05/2016	B	7,646	3,502	0	50,115	18,731	0	0	0
12/05/2016	B	7,250	3,018	0	51,502	19,274	0	0	0
13/05/2016	B	8,072	2,690	0	46,540	17,885	0	0	0
14/05/2016	B	7,618	3,314	0	44,857	17,300	0	0	0
15/05/2016	B	7,640	3,346	0	43,969	17,214	0	0	0
16/05/2016	B	8,008	3,242	0	51,153	18,340	0	0	0
17/05/2016	B	5,954	3,408	0	49,423	19,262	0	0	0
18/05/2016	B	8,076	3,952	0	60,576	22,914	0	0	0
19/05/2016	B	8,468	2,548	0	49,459	19,068	0	0	0
20/05/2016	B	7,814	3,360	0	57,502	23,741	0	0	613
21/05/2016	B	9,854	3,152	0	73,030	28,836	0	0	0
22/05/2016	B	9,036	2,294	0	54,430	22,459	0	0	0
23/05/2016	B	9,274	3,028	0	60,604	24,036	0	0	0
24/05/2016	B	9,174	2,386	0	60,238	23,817	0	0	0
25/05/2016	B	9,220	3,814	0	57,544	24,241	0	0	0
26/05/2016	B	9,422	3,626	0	62,424	23,525	0	0	0
27/05/2016	B	7,786	4,232	0	61,472	22,587	0	0	0
28/05/2016	B	9,320	4,036	0	71,365	28,848	0	0	0
29/05/2016	B	9,208	4,768	0	101,681	36,613	0	0	0
30/05/2016	B	8,920	4,960	0	98,480	34,056	0	0	0
31/05/2016	B	8,782	4,756	0	101,466	38,126	0	0	0
1/06/2016	B	9,370	2,828	0	100,759	38,977	4,144	106	0
2/06/2016	B	7,304	2,292	0	90,407	33,773	626	0	3,253
3/06/2016	B	7,368	2,604	0	84,112	31,859	0	1,578	82
4/06/2016	B	7,124	2,724	0	78,779	29,542	743	0	0
5/06/2016	B	7,844	2,270	0	74,054	27,658	0	0	0

Date	Water treatment plant			TSF2 (m^3/day)	Ohinemuri River flows (m3/day)		Collection pond discharges (m^3/day)		
	Regime	E1 (m^3/day)	E2 (m^3/day)		Frendrups	Ruddocks	S3	S4	S5
6/06/2016	B	10,586	0	0	71,480	26,452	0	0	0
7/06/2016	B	10,458	0	0	66,712	25,632	0	0	0
8/06/2016	B	11,100	22	0	71,173	26,225	612	0	259
9/06/2016	B	12,874	972	0	143,407	50,415	1,615	0	161
10/06/2016	B	14,086	1,508	5,328	222,938	56,786	4,860	0	4,843
11/06/2016	B	12,396	0	5,328	186,587	49,989	4,717	0	4,856
12/06/2016	B	12,748	30	5,328	166,001	48,614	1,304	640	4,112
13/06/2016	B	11,946	22	5,328	133,046	46,290	0	4,743	0
14/06/2016	B	11,586	0	5,328	119,617	41,175	1,607	130	0
15/06/2016	B	8,100	0	5,328	112,224	40,238	0	0	1,332
16/06/2016	B	8,408	0	0	101,886	37,242	404	0	0
17/06/2016	B	8,904	0	0	93,685	34,666	0	0	0
18/06/2016	B	10,264	0	0	87,624	32,470	0	0	0
19/06/2016	B	9,136	0	0	79,841	30,478	0	0	0
20/06/2016	B	10,492	0	0	74,371	28,411	0	0	0
21/06/2016	B	9,032	0	0	74,433	28,100	1	0	0
22/06/2016	B	12,552	2,312	0	324,926	212,548	1,147	3	1,755
23/06/2016	B	10,180	3,150	5,328	311,511	137,927	3,896	3,414	4,762
24/06/2016	B	9,792	0	5,328	253,804	109,824	4,507	1,912	2,792
25/06/2016	B	11,464	280	5,328	350,913	194,188	4,754	4,880	1,890
26/06/2016	B	11,024	0	5,328	286,403	125,183	3,586	1,809	1,664
27/06/2016	B	11,800	688	5,328	271,389	135,519	3,721	1,205	1,607
28/06/2016	B	10,570	362	5,328	233,977	106,866	1,354	669	1,378
29/06/2016	B	15,128	2,920	5,328	884,370	503,238	2,471	96	3,363
30/06/2016	B	14,834	2,768	5,328	496,266	252,159	4,819	1,608	4,860
1/07/2016	B	10,280	1,938	5,328	369,255	185,606	4,860	5,735	1,649
2/07/2016	B	9,836	1,220	5,328	297,963	135,875	4,088	2,510	300
3/07/2016	B	9,094	770	5,328	251,245	103,372	0	0	0
4/07/2016	B	9,950	0	5,328	218,720	85,328	0	0	207
5/07/2016	B	10,028	0	5,328	181,219	70,708	571	0	0
6/07/2016	B	8,484	0	0	153,993	61,152	0	0	0
7/07/2016	B	19,920	1,104	0	669,359	434,840	346	310	432
8/07/2016	B	9,958	6,552	5,328	1,328,340	644,883	2,273	0	4,472
9/07/2016	B	16,586	2,656	5,328	454,219	216,914	4,777	3,495	4,775
10/07/2016	B	13,224	0	5,328	336,258	161,648	4,857	4,928	4,860
11/07/2016	B	11,962	0	5,328	266,085	123,094	4,860	6,113	993
12/07/2016	B	10,474	10	5,328	226,614	93,413	4,748	471	137

Date	Water treatment plant			TSF2 (m^3/day)	Ohinemuri River flows (m3/day)		Collection pond discharges (m^3/day)		
	Regime	E1 (m^3/day)	E2 (m^3/day)		Frendrups	Ruddocks	S3	S4	S5
13/07/2016	B	6,476	0	5,328	207,371	77,682	1,105	0	0
14/07/2016	B	10,368	134	5,328	240,717	96,634	3,936	1,594	2,845
15/07/2016	B	8,840	116	5,328	216,340	77,547	1,998	329	942
16/07/2016	B	10,432	0	5,328	186,520	67,127	993	715	1,372
17/07/2016	B	9,878	0	5,328	184,954	64,247	680	0	40
18/07/2016	B	9,490	0	5,328	169,454	59,024	896	474	1,265
19/07/2016	B	9,724	0	5,328	190,175	69,413	539	114	264
20/07/2016	B	11,182	0	5,328	188,445	67,670	2,598	1,145	1,894
21/07/2016	B	8,762	0	5,328	154,066	56,205	141	0	0
22/07/2016	B	9,728	0	0	190,130	67,955	480	332	266
23/07/2016	B	12,932	1,488	0	334,734	110,763	4,838	2,410	4,699
24/07/2016	B	13,028	102	0	333,056	116,528	4,282	1,901	3,531
25/07/2016	B	11,216	0	0	277,120	93,856	1,333	146	947
26/07/2016	B	12,620	3,356	5,328	468,703	232,582	2,364	2,835	2,773
27/07/2016	B	12,120	1,466	5,328	295,242	109,189	4,040	895	1,290
28/07/2016	B	13,780	136	5,328	301,250	112,698	1,538	552	1,060
29/07/2016	B	13,712	0	5,328	257,682	102,683	1,457	431	1,831
30/07/2016	B	14,112	136	0	266,049	123,039	550	778	801
31/07/2016	B	13,904	1,560	0	248,658	108,551	2,765	1,623	2,652
1/08/2016	B	11,264	2,760	0	259,429	116,249	572	154	848
2/08/2016	B	12,588	1,800	0	244,858	113,541	2,882	1,508	1,855
3/08/2016	B	14,244	492	0	253,415	169,781	647	351	530
4/08/2016	B	14,156	656	0	240,662	122,905	4,015	1,926	2,801
5/08/2016	B	12,356	324	0	240,181	104,503	793	490	616
6/08/2016	B	12,568	1,436	0	233,347	97,665	1,092	0	1,260
7/08/2016	B	12,640	0	0	212,904	83,263	578	505	472
8/08/2016	B	12,528	0	0	194,597	73,826	314	272	398
9/08/2016	B	12,416	0	0	178,673	65,875	123	0	150
10/08/2016	B	11,896	0	0	166,694	60,247	193	0	53
11/08/2016	B	13,672	0	0	178,924	59,568	866	179	549
12/08/2016	B	12,616	0	0	156,570	56,441	540	287	829
13/08/2016	B	12,796	0	0	153,342	52,320	603	0	423
14/08/2016	B	12,176	0	0	144,517	47,713	13	62	0
15/08/2016	B	12,152	0	0	139,769	45,125	293	0	281
16/08/2016	B	12,388	0	0	129,831	41,757	0	0	0
17/08/2016	B	12,980	0	0	117,715	39,691	0	0	0
18/08/2016	B	11,924	0	0	107,741	36,903	0	0	0

Date	Water treatment plant			TSF2 (m³/day)	Ohinemuri River flows (m3/day)		Collection pond discharges (m³/day)		
	Regime	E1 (m³/day)	E2 (m³/day)		Frendrups	Ruddocks	S3	S4	S5
19/08/2016	B	12,428	0	0	102,379	34,877	0	0	0
20/08/2016	B	12,620	0	0	97,788	33,128	0	0	144
21/08/2016	B	11,760	0	0	94,639	31,622	0	0	0
22/08/2016	B	12,100	0	0	91,201	30,739	0	0	0
23/08/2016	B	12,084	0	0	86,594	29,274	0	0	0
24/08/2016	B	12,728	658	0	236,550	138,676	303	325	747
25/08/2016	B	15,684	5,954	5,328	389,954	266,326	4,274	2,687	4,840
26/08/2016	B	14,068	914	5,328	301,933	118,414	4,860	3,499	4,860
27/08/2016	B	13,496	0	5,328	237,658	95,077	4,860	2,328	4,373
28/08/2016	B	12,736	0	5,328	204,142	74,076	1,946	0	1,054
29/08/2016	B	11,972	0	5,328	193,959	68,439	292	0	286
30/08/2016	B	11,948	0	5,328	159,839	59,012	0	0	0
31/08/2016	B	12,680	0	5,328	137,901	52,135	0	0	0
1/09/2016	B	11,848	0	5,328	128,018	47,117	0	0	0
2/09/2016	B	11,296	0	5,328	120,415	44,666	210	198	206
3/09/2016	B	11,268	0	0	111,999	40,399	0	284	0
4/09/2016	B	10,772	0	0	112,287	39,182	0	0	0
5/09/2016	B	11,576	0	0	104,896	36,680	0	0	0
6/09/2016	B	12,020	0	0	92,204	33,478	0	0	0
7/09/2016	B	11,912	0	0	92,799	32,840	0	0	0
8/09/2016	B	11,844	270	0	90,129	33,853	776	539	639
9/09/2016	B	11,924	0	0	81,229	30,113	268	0	338
10/09/2016	B	11,692	0	0	75,120	27,390	0	0	0
11/09/2016	B	11,648	0	0	71,644	26,041	0	0	0
12/09/2016	B	11,404	0	0	69,561	24,766	0	0	0
13/09/2016	B	12,792	1,644	0	67,765	23,706	0	0	0
14/09/2016	B	8,488	616	0	66,474	22,979	0	0	0
15/09/2016	B	10,556	798	0	67,575	23,425	0	0	0
16/09/2016	B	9,860	2,506	0	64,503	22,202	0	0	0
17/09/2016	B	10,364	2,380	0	79,954	24,223	460	0	470
18/09/2016	B	12,752	346	0	78,861	24,030	836	0	96
19/09/2016	B	11,336	742	0	66,771	21,308	0	0	599
20/09/2016	B	10,908	2,280	0	524,170	209,654	653	10	772
21/09/2016	B	19,252	6,096	5,328	884,501	422,948	2,889	82	4,722
22/09/2016	B	12,696	3,596	5,328	849,787	366,649	4,797	3,280	4,860
23/09/2016	B	13,576	5,416	5,328	732,358	288,571	4,860	7,029	4,838
24/09/2016	B	12,216	3,294	5,328	752,072	373,664	4,860	7,020	4,860

Date	Water treatment plant			TSF2 (m³/day)	Ohinemuri River flows (m3/day)		Collection pond discharges (m³/day)		
	Regime	E1 (m³/day)	E2 (m³/day)		Frendrups	Ruddocks	S3	S4	S5
25/09/2016	B	18,844	5,298	5,328	3,182,069	1,264,774	4,577	2,679	4,657
26/09/2016	B	18,096	5,540	5,328	1,489,116	578,515	4,859	3,741	4,860
27/09/2016	B	18,388	6,238	5,328	1,265,326	486,225	4,795	7,289	4,860
28/09/2016	B	15,008	4,670	5,328	760,349	324,441	4,860	7,087	4,860
29/09/2016	B	17,104	5,700	5,328	834,702	584,803	4,559	7,020	4,860
30/09/2016	B	17,616	5,356	5,328	760,225	377,774	4,859	7,018	4,859
1/10/2016	B	13,584	3,044	5,328	532,595	267,844	4,750	6,758	4,637
2/10/2016	B	15,124	3,560	5,328	505,330	245,670	4,859	3,469	4,788
3/10/2016	B	15,576	2,896	5,328	407,264	202,365	4,860	1,393	2,516
4/10/2016	B	13,944	4,038	5,328	361,296	165,377	4,860	799	531
5/10/2016	B	16,164	3,670	5,328	357,458	152,569	4,860	1,064	1,550
6/10/2016	B	14,852	3,968	5,328	353,620	139,760	4,860	392	992
7/10/2016	B	14,752	5,288	5,328	351,520	149,326	4,860	1,640	2,771
8/10/2016	B	15,560	1,732	5,328	297,316	102,987	2,307	0	241
9/10/2016	B	14,392	2,576	5,328	270,227	92,802	0	0	300
10/10/2016	B	15,628	2,660	5,328	323,931	144,586	979	829	597
11/10/2016	B	16,056	1,530	5,328	266,562	99,563	2,729	1,752	2,551
12/10/2016	B	15,000	1,180	5,328	247,464	84,557	566	277	262
13/10/2016	B	13,514	2,316	5,328	219,388	76,441	0	0	17
14/10/2016	B	15,238	2,956	5,328	205,350	72,383	125	73	90
15/10/2016	B	14,432	2,834	5,328	191,313	68,325	783	211	199
16/10/2016	B	16,084	304	5,328	166,423	58,973	0	319	141
17/10/2016	B	14,020	1,826	5,328	149,278	53,242	0	0	0
18/10/2016	B	11,600	2,938	5,328	139,254	49,081	0	0	898
19/10/2016	B	11,380	3,832	5,328	130,604	46,269	0	0	0
20/10/2016	B	12,964	2,976	5,328	122,767	43,458	291	0	0
21/10/2016	B	12,216	2,442	5,328	113,922	39,946	0	0	0
22/10/2016	B	12,452	2,072	5,328	107,392	37,396	0	0	0
23/10/2016	B	11,872	2,528	5,328	98,486	34,363	0	0	0
24/10/2016	B	12,960	2,298	5,328	98,602	34,291	0	0	0
25/10/2016	B	12,452	2,432	5,328	107,239	37,053	136	0	102
26/10/2016	B	11,556	2,760	5,328	98,325	31,758	444	0	594
27/10/2016	B	11,780	2,516	5,328	90,576	28,899	0	0	0
28/10/2016	B	10,132	3,586	5,328	82,158	27,219	0	0	0
29/10/2016	B	10,268	3,428	0	76,407	24,883	0	385	1,122
30/10/2016	B	13,120	134	0	69,964	23,400	0	0	0
31/10/2016	B	12,256	328	0	66,311	21,943	0	0	0

Date	Water treatment plant			TSF2 (m^3/day)	Ohinemuri River flows (m3/day)		Collection pond discharges (m^3/day)		
	Regime	E1 (m^3/day)	E2 (m^3/day)		Frendrups	Ruddocks	S3	S4	S5
1/11/2016	B	12,816	1,288	0	64,615	21,008	0	0	0
2/11/2016	B	12,424	1,096	0	62,614	20,156	0	0	0
3/11/2016	B	11,564	1,790	0	61,070	18,526	0	0	0
4/11/2016	B	8,000	2,134	0	59,526	17,819	0	213	0
5/11/2016	B	10,036	3,048	0	57,630	17,323	0	0	0
6/11/2016	B	9,912	2,622	0	56,871	16,685	0	0	0
7/11/2016	B	12,472	2,726	0	131,226	50,872	2,435	414	1,530
8/11/2016	B	11,344	1,604	0	61,491	19,876	0	653	2,060
9/11/2016	B	9,940	3,052	0	54,780	16,722	0	0	2,654
10/11/2016	D	11,080	2,488	0	52,507	15,411	0	0	7
11/11/2016	D	11,892	172	0	53,648	15,253	0	0	0
12/11/2016	D	9,312	0	0	70,282	18,561	0	60	755
13/11/2016	D	8,452	0	0	53,231	15,131	519	111	7
14/11/2016	D	7,532	0	0	50,347	14,552	0	0	5
15/11/2016	D	8,976	0	0	65,919	18,710	45	0	579
16/11/2016	D	10,064	580	0	63,238	18,756	1,686	0	3,152
17/11/2016	D	11,568	4,164	0	75,423	20,008	1,404	0	1,016
18/11/2016	D	12,312	3,656	0	59,008	17,309	0	561	720
19/11/2016	D	11,024	3,852	0	56,469	16,733	0	0	0
20/11/2016	D	10,884	3,714	0	50,903	16,042	0	0	0
21/11/2016	D	12,408	3,306	0	46,415	15,328	0	0	0
22/11/2016	D	12,604	2,168	0	44,871	15,514	0	0	0
23/11/2016	D	12,704	342	0	44,333	15,330	0	0	0
24/11/2016	D	8,040	0	0	43,218	14,725	553	0	0
25/11/2016	D	15,308	124	0	51,276	17,023	0	0	822
26/11/2016	D	13,636	1,050	0	47,094	15,761	0	0	721
27/11/2016	D	14,400	112	0	43,761	14,156	0	0	0
28/11/2016	D	13,140	102	0	40,790	13,177	0	0	0
29/11/2016	D	12,436	310	0	39,595	12,610	0	0	0
30/11/2016	D	13,028	0	0	38,832	12,807	0	0	0
1/12/2016	D	12,452	612	0	40,376	12,213	0	0	0
2/12/2016	D	12,744	1,182	0	44,117	17,714	492	0	0
3/12/2016	D	13,652	662	0	39,166	10,705	4,524	30	0
4/12/2016	D	11,724	634	0	37,499	9,154	0	286	0
5/12/2016	D	11,048	314	0	36,183	8,808	0	0	0
6/12/2016	D	11,212	836	0	36,164	8,936	0	0	0
7/12/2016	D	12,460	120	0	36,145	9,065	0	0	7

Date	Water treatment plant			TSF2 (m^3/day)	Ohinemuri River flows (m3/day)		Collection pond discharges (m^3/day)		
	Regime	E1 (m^3/day)	E2 (m^3/day)		Frendrups	Ruddocks	S3	S4	S5
8/12/2016	D	11,640	496	0	48,696	10,761	0	0	8
9/12/2016	D	11,192	0	0	38,449	9,810	0	0	4
10/12/2016	D	11,200	0	0	38,237	10,004	0	0	0
11/12/2016	D	10,032	0	0	36,535	9,923	0	0	0
12/12/2016	D	9,280	0	0	34,931	9,845	0	0	0
13/12/2016	D	7,272	0	0	33,078	9,454	0	0	6
14/12/2016	D	8,820	0	0	33,439	9,631	0	0	0
15/12/2016	D	9,620	0	0	33,658	9,316	0	0	2
16/12/2016	D	9,676	0	0	32,129	9,002	0	0	0
17/12/2016	D	9,692	0	0	32,239	8,617	0	0	0
18/12/2016	D	9,184	0	0	32,034	8,268	0	0	3
19/12/2016	D	8,352	0	0	31,829	7,919	0	0	0
20/12/2016	D	8,560	0	0	29,518	7,393	0	0	0
21/12/2016	D	10,400	330	0	29,931	6,866	0	0	0
22/12/2016	D	11,204	1,666	0	47,145	8,721	0	0	15
23/12/2016	D	11,560	1,368	0	41,192	8,587	0	0	7
24/12/2016	D	10,468	0	0	31,853	6,890	0	0	0
25/12/2016	D	9,304	40	0	30,100	6,521	0	0	0
26/12/2016	D	9,040	144	0	30,075	6,522	0	0	0
27/12/2016	D	8,968	0	0	29,231	6,508	0	0	0
28/12/2016	D	10,068	208	0	29,355	6,398	0	0	0
29/12/2016	D	9,284	1,012	0	29,863	6,462	0	0	0
30/12/2016	D	9,556	568	0	29,002	6,587	0	0	0
31/12/2016	D	9,676	414	0	28,343	6,580	0	0	0
1/01/2017	D	9,888	90	0	26,694	6,591	0	0	0
2/01/2017	D	9,684	12	0	29,903	6,850	0	0	0
3/01/2017	D	10,036	0	0	31,985	7,663	2,921	0	1
4/01/2017	D	8,136	0	0	30,184	7,073	4,860	0	0
5/01/2017	D	9,280	1,176	0	25,849	6,046	525	0	0
6/01/2017	D	9,692	768	0	25,964	6,005	0	0	0
7/01/2017	D	7,492	0	0	25,992	6,150	0	0	0
8/01/2017	D	7,880	0	0	24,953	5,847	0	0	0
9/01/2017	D	7,936	0	0	24,603	5,715	0	0	0
10/01/2017	D	8,104	0	0	26,117	5,691	0	0	0
11/01/2017	D	5,660	0	0	24,028	5,872	0	0	0
12/01/2017	D	4,844	0	0	23,712	5,823	0	0	0
13/01/2017	D	4,920	0	0	24,339	5,798	0	0	0

Date	Water treatment plant			TSF2 (m^3/day)	Ohinemuri River flows (m3/day)		Collection pond discharges (m^3/day)		
	Regime	E1 (m^3/day)	E2 (m^3/day)		Frendrups	Ruddocks	S3	S4	S5
14/01/2017	D	5,280	0	0	23,978	5,487	0	0	0
15/01/2017	D	5,244	0	0	23,172	5,547	0	0	0
16/01/2017	D	4,824	10	0	22,808	5,579	0	0	0
17/01/2017	D	5,144	0	0	22,583	4,950	0	0	0
18/01/2017	D	5,748	0	0	22,599	4,982	0	0	0
19/01/2017	D	5,920	0	0	23,343	5,236	0	0	0
20/01/2017	D	4,968	0	0	22,595	5,269	0	0	0
21/01/2017	D	5,400	12	0	22,768	5,319	0	0	0
22/01/2017	D	5,076	0	0	36,364	6,661	0	0	0
23/01/2017	D	5,676	0	0	24,236	5,846	0	0	0
24/01/2017	D	5,924	0	0	23,405	5,509	0	0	0
25/01/2017	D	5,532	0	0	23,944	5,616	0	0	0
26/01/2017	D	5,408	0	0	23,423	5,541	0	0	0
27/01/2017	D	5,232	0	0	22,229	5,321	0	0	0
28/01/2017	D	5,172	0	0	21,384	4,786	0	0	0
29/01/2017	D	5,152	0	0	21,512	4,672	0	0	0
30/01/2017	D	4,228	0	0	21,132	4,751	0	0	0
31/01/2017	D	4,928	0	0	21,391	4,952	0	0	0
1/02/2017	D	4,896	0	0	21,241	4,819	0	0	0
2/02/2017	D	5,152	0	0	21,012	4,720	0	0	0
3/02/2017	D	5,120	0	0	21,329	4,734	0	0	0
4/02/2017	D	5,844	0	0	22,002	4,541	0	0	0
5/02/2017	D	5,556	0	0	20,052	4,373	0	0	0
6/02/2017	D	5,672	0	0	19,008	4,407	0	0	0
7/02/2017	D	4,160	0	0	19,221	4,300	0	0	0
8/02/2017	D	5,400	0	0	23,027	4,886	0	0	0
9/02/2017	D	6,040	0	0	23,658	5,219	0	0	0
10/02/2017	D	5,704	0	0	19,982	4,660	0	0	0
11/02/2017	D	5,524	0	0	19,059	4,478	0	0	0
12/02/2017	D	5,576	0	0	19,043	4,530	0	0	0
13/02/2017	D	5,620	0	0	19,821	4,529	0	0	0
14/02/2017	D	4,788	0	0	21,084	4,636	0	0	0
15/02/2017	D	5,988	0	0	19,533	4,693	0	0	0
16/02/2017	D	8,616	340	0	79,074	15,078	1,807	0	0
17/02/2017	D	12,236	0	0	93,037	21,757	705	1,369	337
18/02/2017	D	10,792	0	0	65,987	14,766	0	1,352	0
19/02/2017	D	7,956	0	0	53,673	12,371	3,127	359	5

Date	Water treatment plant			TSF2 (m^3/day)	Ohinemuri River flows (m3/day)		Collection pond discharges (m^3/day)		
	Regime	E1 (m^3/day)	E2 (m^3/day)		Frendrups	Ruddocks	S3	S4	S5
20/02/2017	D	5,404	0	0	35,096	8,791	1,132	0	3,149
21/02/2017	D	4,632	0	0	29,990	7,997	0	0	4,654
22/02/2017	D	5,928	0	0	29,792	7,992	0	0	3,004
23/02/2017	D	10,660	298	0	29,590	7,992	0	0	0
24/02/2017	D	9,748	1,242	0	29,388	7,992	0	0	0
25/02/2017	D	6,244	0	0	29,187	7,992	0	0	0
26/02/2017	D	5,572	0	0	28,987	7,992	0	0	0
27/02/2017	D	4,976	0	0	28,787	7,992	0	0	0
28/02/2017	D	8,488	1,206	0	38,549	8,637	0	256	0
1/03/2017	D	5,552	0	0	26,289	6,675	0	0	0
2/03/2017	D	5,212	0	0	25,012	5,975	0	0	0
3/03/2017	D	4,864	0	0	25,474	5,282	0	0	0
4/03/2017	D	5,056	0	0	24,879	4,810	0	0	0
5/03/2017	D	5,400	0	0	23,889	4,580	0	0	0
6/03/2017	D	5,256	0	0	29,683	4,471	0	0	0
7/03/2017	D	5,676	268	0	370,929	44,390	405	0	0
8/03/2017	D	19,068	5,756	0	2,222,769	927,912	2,869	0	3,875
9/03/2017	D	20,064	4,330	5,328	715,500	320,454	4,776	0	4,860
10/03/2017	D	20,332	2,838	5,328	1,471,106	632,104	4,804	463	4,859
11/03/2017	D	19,936	4,692	5,328	1,443,583	734,361	4,821	5,887	4,860
12/03/2017	D	18,732	1,896	5,328	917,583	531,653	4,859	7,290	4,860
13/03/2017	D	13,536	4,376	5,328	581,632	325,110	4,860	7,290	4,860
14/03/2017	D	12,160	3,218	5,328	419,193	229,650	4,860	7,288	4,859
15/03/2017	B	13,920	0	5,328	331,450	169,263	4,860	6,668	4,860
16/03/2017	B	11,396	408	5,328	269,369	127,710	4,860	4,148	4,860
17/03/2017	B	8,852	1,298	5,328	229,889	96,043	3,644	703	4,860
18/03/2017	B	5,596	1,260	5,328	201,289	81,334	4,860	2,001	4,464
19/03/2017	B	5,420	0	5,328	178,114	69,962	4,858	3,099	0
20/03/2017	B	8,228	568	5,328	161,418	61,104	4,619	3,218	0
21/03/2017	B	13,116	166	5,328	147,049	49,716	0	2,714	0
22/03/2017	B	11,456	0	5,328	133,099	43,800	0	0	0
23/03/2017	B	11,728	0	5,328	122,077	40,494	0	0	0
24/03/2017	B	14,696	0	5,328	117,981	36,405	0	0	0
25/03/2017	B	13,144	0	5,328	115,841	35,216	0	0	0
26/03/2017	B	12,972	10	5,328	177,906	54,370	304	150	0
27/03/2017	B	18,952	4,112	5,328	629,606	296,815	4,193	1,891	3,598
28/03/2017	B	14,332	2,186	5,328	411,027	159,008	4,860	4,077	4,859

Date	Water treatment plant			TSF2 (m^3/day)	Ohinemuri River flows (m3/day)		Collection pond discharges (m^3/day)		
	Regime	E1 (m^3/day)	E2 (m^3/day)		Frendrups	Ruddocks	S3	S4	S5
29/03/2017	B	19,304	5,778	5,328	975,811	652,740	4,850	251	4,465
30/03/2017	B	15,980	3,732	5,328	551,626	327,307	4,860	6,850	4,860
31/03/2017	B	15,308	1,584	5,328	403,291	220,686	4,717	6,511	2,028
1/04/2017	B	15,024	96	5,328	329,079	166,755	4,816	11	0
2/04/2017	B	14,800	0	5,328	273,999	125,451	2,457	0	358
3/04/2017	B	13,408	492	5,328	237,542	99,213	0	0	0
4/04/2017	B	16,928	4,860	5,328	1,257,047	576,662	3,200	3,028	2,952
5/04/2017	B	18,992	5,382	5,328	1,704,568	993,577	4,741	1,916	4,816
6/04/2017	B	17,208	5,494	5,328	900,930	506,839	4,904	7,082	4,903
7/04/2017	B	11,152	1,800	5,328	551,509	317,160	3,977	5,718	3,978
8/04/2017	B	14,684	1,448	5,328	414,796	228,103	4,691	2,678	4,850
9/04/2017	B	14,920	1,248	5,328	348,288	178,068	4,860	117	135
10/04/2017	B	15,436	1,052	5,328	307,239	160,652	4,052	538	752
11/04/2017	B	16,016	648	5,328	268,497	127,170	1,132	274	750
12/04/2017	B	14,216	2,108	5,328	979,268	727,872	2,776	692	2,512
13/04/2017	B	19,020	4,364	5,328	1,998,776	1,096,315	4,817	1,361	4,820
14/04/2017	B	17,224	4,824	5,328	978,319	548,624	4,860	7,096	4,859
15/04/2017	B	15,708	5,652	5,328	586,554	348,003	4,860	7,020	4,860
16/04/2017	B	14,680	4,968	5,328	443,950	259,622	4,860	7,020	4,860
17/04/2017	B	14,392	4,930	5,328	372,618	199,144	4,859	1,974	2,310
18/04/2017	B	13,280	1,966	5,328	312,156	153,783	2,809	0	53
19/04/2017	B	11,380	4,320	5,328	270,832	126,918	3,104	0	0
20/04/2017	B	13,176	2,158	5,328	239,917	103,700	240	0	0
21/04/2017	B	14,516	1,886	5,880	214,029	87,694	111	0	356
22/04/2017	B	15,904	832	5,880	196,968	77,526	340	0	0
23/04/2017	B	15,672	1,264	5,880	190,150	70,913	0	0	0
24/04/2017	B	15,236	754	5,880	178,087	64,807	266	255	0
25/04/2017	B	14,932	1,346	5,880	162,733	58,340	0	0	0
26/04/2017	B	12,512	3,004	5,880	151,610	53,596	0	0	0
27/04/2017	B	12,656	3,410	5,880	144,981	49,652	0	0	0
28/04/2017	B	12,768	2,514	5,880	141,064	46,365	0	0	0
29/04/2017	B	11,908	4,328	5,880	147,991	45,568	109	0	0
30/04/2017	B	10,136	4,896	5,880	131,769	44,313	553	0	0
1/05/2017	B	10,548	4,216	4,708	110,857	39,538	119	0	0
2/05/2017	B	13,500	690	4,708	99,631	36,605	0	0	0
3/05/2017	B	14,328	770	3,638	108,853	35,611	0	0	0
4/05/2017	B	13,192	1,254	4,708	97,181	34,680	0	0	0

Date	Water treatment plant			TSF2 (m^3/day)	Ohinemuri River flows (m3/day)		Collection pond discharges (m^3/day)		
	Regime	E1 (m^3/day)	E2 (m^3/day)		Frendrups	Ruddocks	S3	S4	S5
5/05/2017	B	13,516	1,120	2,134	72,428	31,934	0	0	0
6/05/2017	B	9,184	4,538	0	60,324	30,588	0	0	0
7/05/2017	B	8,844	4,944	0	60,539	29,243	175	0	0
8/05/2017	B	9,200	4,572	0	68,160	28,792	0	0	0
9/05/2017	D	11,212	2,462	0	71,457	27,350	0	0	0
10/05/2017	D	11,404	1,858	0	75,124	27,595	0	0	0
11/05/2017	D	14,804	4,856	0	303,131	88,571	3,205	0	1,329
12/05/2017	D	18,152	5,656	0	712,718	267,520	4,823	4,528	4,859
13/05/2017	B	13,324	1,292	0	415,004	170,804	4,616	6,648	4,860
14/05/2017	B	14,356	748	0	304,392	119,264	4,860	2,400	2,031
15/05/2017	B	13,556	248	0	243,816	94,529	3,848	0	0
16/05/2017	B	13,884	224	0	218,342	78,491	3,082	0	0
17/05/2017	B	16,128	2,636	0	294,669	107,181	1,926	1,504	2,276
18/05/2017	B	15,044	60	0	275,628	90,404	3,199	865	2,851
19/05/2017	B	14,840	384	0	254,622	77,746	405	571	379
20/05/2017	B	15,192	1,334	0	256,107	88,047	2,148	61	1,371
21/05/2017	B	14,652	608	0	215,993	72,083	0	1,006	0
22/05/2017	B	14,184	424	0	188,753	65,893	0	0	0
23/05/2017	B	14,156	426	0	167,732	62,359	662	0	0
24/05/2017	B	13,528	1,274	0	150,849	58,441	0	341	0
25/05/2017	B	13,240	1,778	0	138,075	53,406	0	0	0
26/05/2017	B	14,484	764	0	187,356	84,450	371	0	276
27/05/2017	B	17,912	5,084	0	585,866	344,085	3,335	63	3,739
28/05/2017	B	17,728	5,564	0	489,537	275,467	4,682	4,651	4,838
29/05/2017	B	14,604	2,762	1,760	368,141	201,446	4,860	6,052	1,785
30/05/2017	B	13,684	1,494	4,796	305,539	144,458	1,602	79	0
31/05/2017	B	14,112	2,158	4,360	259,980	115,999	329	0	276

Note: TSF2 = Tailings Storage Facility 2; E1 = upper water treatment plant (WTP) discharge; and E2 = lower WTP discharge.

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APPENDIX C

Treated Water Quality Data

Table 1: Treated water discharge quality (daily data) between 1 May 2016 and 31 May 2017.

Date	pH	TSS	Ammonia	CN_{WAD}	Hardness	Copper	Iron	Manganese	Silver
01/05/2016	8.8	3	7.6	0.017	1,240	0.0057	0.022	0.010	0.0008
02/05/2016	8.7	<2	8.3	0.019	1,210	0.0036	0.028	0.009	<0.0004
03/05/2016	8.7	4	9.1	0.014	1,150	0.0038	<0.008	0.005	<0.0004
04/05/2016	8.8	4	8.1	0.016	1,150	0.0059	0.013	0.004	<0.0004
05/05/2016	8.8	8	9.1	0.020	1,160	0.0047	0.020	0.006	0.0007
06/05/2016	8.9	6	11.0	0.017	1,180	0.0046	0.014	0.003	0.0007
07/05/2016	8.9	<2	10.0	0.015	1,130	0.0025	0.022	0.004	<0.0004
08/05/2016	8.9	<2	9.3	0.021	1,160	0.0032	0.022	0.003	<0.0004
09/05/2016	8.9	<2	9.8	0.017	1,170	0.0039	0.030	0.004	0.0006
10/05/2016	8.9	<2	9.8	0.016	1,190	0.0034	0.025	0.004	<0.0004
11/05/2016	8.9	6	11.0	0.013	1,180	0.1020	<0.008	0.006	0.0006
12/05/2016	8.9	4	9.3	0.017	1,090	0.0065	0.026	0.005	0.0007
13/05/2016	8.8	5	9.6	0.018	1,210	0.0048	0.020	0.006	0.0011
14/05/2016	8.9	4	8.8	0.013	1,120	0.0065	0.021	0.006	<0.0004
15/05/2016	8.9	<2	9.1	0.017	1,180	0.0038	<0.008	0.001	<0.0004
16/05/2016	8.9	<2	9.5	0.014	1,200	0.0020	0.017	0.003	<0.0004
17/05/2016	8.9	<2	9.1	0.014	1,160	<0.0010	<0.008	0.001	<0.0004
18/05/2016	8.9	<2	8.8	0.017	1,190	0.0027	0.019	0.006	<0.0004
19/05/2016	8.9	5	8.9	0.019	1,090	0.0043	0.019	0.004	0.0009
20/05/2016	8.9	4	8.1	0.021	1,200	0.0032	0.025	0.008	0.0008
21/05/2016	9.0	3	7.4	0.018	1,180	<0.0010	<0.008	0.003	<0.0004
22/05/2016	9.0	6	9.5	0.022	1,110	0.0027	0.025	0.006	0.0007
23/05/2016	8.9	<2	8.8	0.016	1,130	0.0029	0.028	0.008	<0.0004
24/05/2016	8.9	<2	10.0	0.025	1,090	0.0033	0.015	0.008	<0.0004
25/05/2016	8.9	3	9.0	0.027	1,140	0.0033	0.026	0.008	<0.0004
26/05/2016	8.9	3	8.9	0.037	1,140	0.0037	0.020	0.008	<0.0004
27/05/2016	9.0	6	9.9	0.032	1,150	0.0028	0.020	0.006	<0.0004
28/05/2016	8.8	4	10.0	0.022	1,140	0.0031	0.022	0.019	0.0007
29/05/2016	8.8	3	10.0	0.013	1,100	0.0025	0.026	0.011	<0.0004
30/05/2016	8.9	4	8.0	0.024	1,050	0.0032	0.029	0.009	<0.0004
31/05/2016	8.9	4	8.6	0.041	1,010	0.0029	0.063	0.011	<0.0004
01/06/2016	8.9	3	9.5	0.051	1060	0.0027	0.022	0.028	0.0007
02/06/2016	9.0	3	8.0	0.035	1000	0.0036	0.023	0.009	<0.0004
03/06/2016	8.8	3	7.2	0.024	1170	0.0029	0.022	0.009	<0.0004
04/06/2016	8.9	<3	7.2	0.024	1240	0.0029	0.019	0.008	<0.0004
05/06/2016	8.8	<3	7.6	0.014	1250	0.0028	0.018	0.008	0.0007
06/06/2016	8.8	3	8.1	0.019	1290	0.0036	0.027	0.007	<0.0004
07/06/2016	8.8	3	7.2	0.018	1180	0.0050	0.028	0.008	0.0005
08/06/2016	8.7	<3	6.8	0.012	1170	0.0032	0.012	0.005	<0.0004
09/06/2016	8.7	<3	7.3	0.008	1170	0.0031	0.026	0.007	<0.0004
10/06/2016	8.9	<3	6.4	0.017	970	0.0027	0.034	0.006	<0.0004
11/06/2016	8.9	<3	5.6	0.014	960	0.0042	0.051	0.001	0.0005
12/06/2016	8.9	<3	7.1	0.011	1080	0.0049	0.035	0.005	<0.0004
13/06/2016	8.9	4	6.9	0.015	1090	0.0054	0.036	0.006	0.0007
14/06/2016	8.8	4	6.9	0.028	1070	0.0036	0.024	0.006	<0.0004
15/06/2016	8.8	4	7.5	0.020	1120	0.0041	0.036	0.007	0.0005
16/06/2016	8.7	<3	5.3	0.009	1190	0.0031	0.031	0.007	<0.0004
17/06/2016	8.8	<3	5.4	0.011	1220	0.0042	0.031	0.008	0.0004
18/06/2016	8.7	<3	6.2	0.012	1180	0.0036	0.029	0.007	<0.0004
19/06/2016	8.7	<3	7.1	0.019	1200	0.0037	0.031	0.006	0.0005
20/06/2016	8.7	<3	7.8	0.051	1100	0.0043	0.040	0.006	<0.0004
21/06/2016	8.7	4	6.7	0.030	1180	0.0060	0.014	0.026	0.0005
22/06/2016	8.7	6	5.8	0.009	1160	0.0031	0.031	0.004	0.0006
23/06/2016	8.9	3	3.6	<0.007	830	0.0056	0.034	0.005	<0.0004
24/06/2016	8.8	4	3.5	<0.007	760	0.0017	0.027	0.005	<0.0004
25/06/2016	8.8	<3	4.1	0.009	920	0.0024	0.028	0.005	<0.0004
26/06/2016	8.8	<3	3.7	0.010	950	0.0013	0.035	0.005	<0.0004
27/06/2016	8.8	4	4.4	<0.007	1050	0.0017	0.032	0.005	<0.0004
28/06/2016	8.9	5	5.9	<0.007	990	0.0015	0.029	0.005	<0.0004

Golder Associates

Date	pH	TSS	Ammonia	CN_{WAD}	Hardness	Copper	Iron	Manganese	Silver
29/06/2016	8.9	4	5.8	<0.007	1020	0.0015	0.026	0.005	<0.0004
30/06/2016	9.1	<3	3.5	0.010	790	0.0028	0.047	0.005	<0.0004
01/07/2016	9.0	6	4.2	0.010	900	0.0037	0.051	0.002	<0.0004
02/07/2016	9.0	<3	4.6	0.011	960	0.0030	0.044	0.002	<0.0004
03/07/2016	8.9	<3	5.5	0.025	940	0.0025	0.039	0.001	<0.0004
04/07/2016	8.9	4	5.9	0.039	1050	0.0031	0.032	0.004	<0.0004
05/07/2016	8.9	<3	5.7	0.044	1090	0.0037	0.032	0.001	<0.0004
06/07/2016	8.9	4	6.2	0.047	1070	0.0035	0.032	0.001	<0.0004
07/07/2016	8.9	4	6.1	0.037	1090	0.0041	0.037	0.004	<0.0004
08/07/2016	9.0	5	2.9	0.024	820	0.0015	0.050	0.003	<0.0004
09/07/2016	9.0	4	2.9	0.017	630	0.0027	0.043	0.003	<0.0004
10/07/2016	9.0	3	3.7	0.029	790	0.0022	0.037	0.001	<0.0004
11/07/2016	9.0	<3	4.3	0.041	930	0.0022	0.016	0.001	<0.0004
12/07/2016	8.9	<3	5.5	0.110	910	0.0031	0.032	0.002	<0.0004
13/07/2016	8.9	<3	5.5	0.098	1030	0.0035	0.025	0.003	<0.0004
14/07/2016	8.8	3	3.5	0.021	1220	0.0026	0.036	0.002	<0.0004
15/07/2016	8.8	<3	1.2	0.008	1170	<0.0010	0.028	0.003	<0.0004
16/07/2016	8.9	<3	1.5	0.013	1160	0.0010	0.029	0.003	<0.0004
17/07/2016	8.8	5	2.4	0.021	1160	0.0022	0.037	0.004	<0.0004
18/07/2016	8.9	<3	3.1	0.039	1150	0.0017	0.027	0.004	<0.0004
19/07/2016	8.8	<3	3.3	0.036	1200	0.0015	0.024	0.005	<0.0004
20/07/2016	8.8	<3	3.5	0.058	1200	0.0010	<0.008	0.013	<0.0004
21/07/2016	8.8	<3	2.9	0.023	1210	0.0015	0.029	0.002	<0.0004
22/07/2016	8.8	3	2.6	<0.007	1220	0.0015	0.022	0.003	<0.0004
23/07/2016	8.9	<3	3.5	<0.007	1120	0.0018	0.023	0.004	<0.0004
24/07/2016	8.9	<3	4.1	<0.007	980	0.0021	0.026	0.003	<0.0004
25/07/2016	8.9	5	3.9	<0.007	990	0.0028	0.041	0.008	<0.0004
26/07/2016	8.8	<3	3.6	0.013	1150	0.0029	0.038	0.008	<0.0004
27/07/2016	8.9	<3	3.8	0.009	940	0.0030	0.041	0.003	<0.0004
28/07/2016	8.9	<3	4.9	0.014	1010	0.0040	0.035	0.010	<0.0004
29/07/2016	8.9	<3	5.2	<0.007	1030	0.0039	0.044	0.020	<0.0004
30/07/2016	8.7	<3	5.1	0.019	1050	0.0041	0.036	0.019	<0.0004
31/07/2016	9.0	3	5.0	0.014	990	0.0037	0.038	0.008	<0.0004
01/08/2016	8.8	<3	5.0	0.016	940	0.0040	0.043	0.014	<0.0004
02/08/2016	9.0	<3	4.6	0.024	960	0.0046	0.058	0.014	<0.0004
03/08/2016	8.9	<3	4.8	0.015	920	0.0046	0.034	0.011	<0.0004
04/08/2016	8.9	3	4.3	0.012	1000	0.0038	0.036	0.010	<0.0004
05/08/2016	8.9	<3	5.0	0.009	980	0.0031	0.027	0.009	<0.0004
06/08/2016	8.9	<3	5.0	0.014	1070	0.0050	0.039	0.013	<0.0004
07/08/2016	8.8	3	4.7	0.012	1270	0.0034	0.048	0.019	<0.0004
08/08/2016	8.8	3	5.2	0.019	1300	0.0031	0.053	0.018	<0.0004
09/08/2016	8.7	<3	5.2	0.013	1400	0.0036	0.053	0.015	<0.0004
10/08/2016	8.8	<3	4.9	0.016	1400	<0.0010	0.030	0.015	<0.0004
11/08/2016	8.9	<3	4.9	0.019	1400	0.0027	<0.008	0.018	<0.0004
12/08/2016	8.8	<3	6.5	0.016	1300	0.0034	0.048	0.038	<0.0004
13/08/2016	8.9	<3	5.2	0.010	1300	0.0030	0.044	0.018	<0.0004
14/08/2016	8.9	<3	4.7	0.012	1220	0.0037	0.041	0.016	<0.0004
15/08/2016	8.9	3	5.1	0.012	1280	0.0120	0.030	0.020	<0.0004
16/08/2016	8.9	<3	5.2	0.011	1230	0.0052	0.030	0.021	<0.0004
17/08/2016	8.7	<3	5.3	0.012	1150	0.0051	0.033	0.019	<0.0004
18/08/2016	8.7	<3	5.0	<0.007	1180	<0.0010	0.025	0.014	<0.0004
19/08/2016	8.8	<3	5.8	<0.007	1210	0.0058	0.023	0.016	<0.0004
20/08/2016	8.8	<3	5.4	0.012	1230	0.0048	0.031	0.016	<0.0004
21/08/2016	8.9	<3	5.5	0.014	1250	0.0056	0.023	0.014	<0.0004
22/08/2016	8.8	<3	5.4	0.020	1240	0.0059	0.025	0.015	<0.0004
23/08/2016	8.8	<3	5.9	0.011	1190	0.0048	0.031	0.016	<0.0004
24/08/2016	8.8	<3	5.8	<0.007	1190	0.0094	0.017	0.015	<0.0004
25/08/2016	9.0	<3	4.4	<0.007	1040	<0.0010	0.042	0.014	<0.0004
26/08/2016	9.0	<3	3.5	0.024	840	0.0024	0.031	0.015	<0.0004
27/08/2016	8.9	4	4.0	0.008	980	0.0040	0.035	0.015	<0.0004

Date	pH	TSS	Ammonia	CN_{WAD}	Hardness	Copper	Iron	Manganese	Silver
28/08/2016	8.8	<3	4.5	0.008	1090	0.0051	0.029	0.016	<0.0004
29/08/2016	8.8	<3	4.8	<0.007	1160	0.0059	<0.008	0.018	<0.0004
30/08/2016	8.8	<3	4.6	0.010	1100	0.0060	0.044	0.017	<0.0004
31/08/2016	8.8	<3	5.0	0.011	1070	0.0059	0.024	0.017	<0.0004
01/09/2016	8.8	<3	5.4	0.013	1100	0.0066	0.022	0.024	<0.0004
02/09/2016	8.8	<3	5.5	0.009	1120	0.0140	0.024	0.025	<0.0004
03/09/2016	8.7	<3	5.3	0.015	1150	0.0072	0.033	0.015	<0.0004
04/09/2016	8.7	<3	5.1	0.012	1020	0.0074	0.023	0.017	<0.0004
05/09/2016	8.7	<3	5.6	<0.007	1070	0.0074	0.029	0.019	<0.0004
06/09/2016	8.8	<3	5.3	<0.007	1040	0.0053	0.023	0.016	<0.0004
07/09/2016	8.8	<3	5.0	0.014	1120	0.0056	0.028	0.017	<0.0004
08/09/2016	8.9	<3	5.3	0.010	1090	0.0052	0.022	0.016	<0.0004
09/09/2016	8.8	<3	5.2	0.013	1110	0.0055	0.033	0.025	<0.0004
10/09/2016	8.9	<3	4.7	0.014	1050	0.0067	0.030	0.016	<0.0004
11/09/2016	8.7	<3	4.8	<0.007	1060	0.0140	0.030	0.015	<0.0004
12/09/2016	8.7	<3	5.1	0.011	1050	0.0055	0.035	0.009	<0.0004
13/09/2016	8.8	<3	5.3	0.013	1110	0.0046	0.021	0.013	<0.0004
14/09/2016	8.7	<3	4.8	0.012	1120	0.0054	0.032	0.012	<0.0004
15/09/2016	8.8	<3	4.9	0.012	1080	0.0057	0.032	0.011	<0.0004
16/09/2016	8.8	<3	4.9	<0.007	1120	0.0090	0.033	0.012	<0.0004
17/09/2016	8.9	<3	5.1	0.010	1080	0.0065	0.033	0.010	<0.0004
18/09/2016	8.9	<3	5.3	0.008	1060	0.0069	0.043	0.010	<0.0004
19/09/2016	8.8	<3	5.0	0.011	1030	0.0081	0.034	0.011	<0.0004
20/09/2016	8.9	<3	5.5	0.011	1070	0.0077	0.027	0.010	<0.0004
21/09/2016	9.0	4	3.8	0.010	890	0.0077	0.047	0.010	0.0004
22/09/2016	9.1	<3	1.4	<0.007	680	0.0025	0.050	0.009	<0.0004
23/09/2016	9.1	<3	1.8	<0.007	740	0.0052	0.048	0.011	<0.0004
24/09/2016	8.9	<3	2.6	0.008	790	0.0097	0.057	0.013	0.0005
25/09/2016	9.1	<3	2.7	0.011	770	0.0086	0.053	0.012	0.0004
26/09/2016	9.0	<3	0.8	<0.007	460	<0.0010	0.068	0.010	<0.0004
27/09/2016	9.1	4	0.3	0.008	580	0.0014	0.065	0.009	<0.0004
28/09/2016	9.2	<3	0.3	<0.007	610	0.0026	0.043	0.009	<0.0004
29/09/2016	9.3	<3	1.8	0.008	740	0.0300	0.140	0.009	<0.0004
30/09/2016	9.2	<3	1.4	0.008	690	0.0067	0.057	0.010	<0.0004
01/10/2016	9.0	<3	1.7	0.009	780	0.0070	0.042	0.010	<0.0004
02/10/2016	9.0	<3	2.2	<0.007	830	0.0100	0.028	0.008	<0.0004
03/10/2016	9.1	<3	2.1	<0.007	940	0.0083	0.033	0.007	<0.0004
04/10/2016	9.1	<3	2.3	0.011	1020	0.0099	<0.008	0.008	<0.0004
05/10/2016	9.1	<3	2.2	<0.007	1010	0.0082	0.032	0.007	<0.0004
06/10/2016	9.0	5	2.4	0.008	1010	0.0043	0.010	0.007	<0.0004
07/10/2016	9.0	<3	2.3	0.016	1070	0.0011	0.032	0.007	<0.0004
08/10/2016	8.9	<3	2.2	0.008	1060	0.0028	0.027	0.008	<0.0004
09/10/2016	8.9	<3	2.4	0.011	1120	0.0029	0.025	0.002	<0.0004
10/10/2016	9.0	<3	2.6	0.009	1170	0.0023	0.015	0.007	<0.0004
11/10/2016	9.0	<3	2.4	0.008	1140	0.0023	0.018	0.008	<0.0004
12/10/2016	9.0	<3	2.3	<0.007	1080	0.0026	0.022	0.007	<0.0004
13/10/2016	8.9	<3	2.9	<0.007	1110	0.0029	0.023	0.008	0.0005
14/10/2016	8.9	<3	2.7	<0.007	1060	0.0027	0.029	0.007	<0.0004
15/10/2016	8.9	<3	2.5	<0.007	1120	0.0027	0.019	0.005	<0.0004
16/10/2016	8.8	<3	2.8	0.010	1170	0.0024	0.030	0.010	<0.0004
17/10/2016	8.8	<3	2.7	0.008	1170	0.0025	0.020	0.011	<0.0004
18/10/2016	8.8	<3	2.8	0.011	1100	0.0130	0.023	0.012	0.0005
19/10/2016	8.8	<3	3.3	<0.007	1260	0.0029	0.009	0.017	<0.0004
20/10/2016	8.8	<3	3.0	<0.007	1130	0.0019	0.016	0.016	<0.0004
21/10/2016	8.8	6	3.1	0.010	1140	0.0035	0.037	0.010	<0.0004
22/10/2016	8.9	<3	3.2	0.016	1120	0.0032	0.028	0.011	<0.0004
23/10/2016	8.7	<3	4.0	0.018	1110	0.0027	0.017	0.011	<0.0004
24/10/2016	8.8	<3	3.6	0.010	1030	0.0030	0.021	0.011	<0.0004
25/10/2016	8.8	<3	3.9	0.009	1060	0.0030	0.021	0.012	<0.0004
26/10/2016	8.8	<3	3.7	0.010	1050	0.0026	0.016	0.012	<0.0004

Date	pH	TSS	Ammonia	CN_{WAD}	Hardness	Copper	Iron	Manganese	Silver
27/10/2016	8.8	<3	3.8	<0.007	1120	0.0034	0.017	0.010	<0.0004
28/10/2016	8.8	<3	3.5	0.012	1100	0.0047	0.028	0.008	<0.0004
29/10/2016	8.8	6	3.8	0.008	1100	0.0056	0.025	0.009	<0.0004
30/10/2016	8.8	<3	4.0	0.012	1120	0.0051	0.015	0.011	<0.0004
31/10/2016	8.4	<3	4.1	<0.007	1110	0.0050	0.025	0.010	<0.0004
01/11/2016	8.7	<3	4.0	<0.007	1080	0.0072	0.028	0.010	<0.0004
02/11/2016	8.8	<3	3.8	<0.007	1130	0.0068	0.024	0.011	<0.0004
03/11/2016	8.8	<3	4.0	0.014	1110	0.0074	0.025	0.012	<0.0004
04/11/2016	8.8	<3	4.0	0.013	1090	0.0058	0.016	0.014	<0.0004
05/11/2016	8.9	<3	2.9	0.011	1110	0.0050	<0.008	0.014	<0.0004
06/11/2016	8.8	3	3.1	0.009	1130	0.0047	0.023	0.012	<0.0004
07/11/2016	8.9	4	3.4	0.008	1180	0.0051	0.021	0.011	<0.0004
08/11/2016	8.9	<3	2.9	0.011	1090	0.0048	0.037	0.011	<0.0004
09/11/2016	8.8	<3	4.2	0.010	1020	0.0052	0.023	0.010	<0.0004
10/11/2016	8.9	<3	3.8	0.011	1080	0.0058	0.029	0.010	<0.0004
11/11/2016	8.9	<3	4.1	0.011	1080	0.0045	0.027	0.013	<0.0004
12/11/2016	8.8	<3	3.2	0.012	1160	0.0036	0.025	0.010	<0.0004
13/11/2016	8.8	<3	1.7	<0.007	1230	<0.0010	0.021	0.009	<0.0004
14/11/2016	8.7	<3	0.3	<0.007	1400	<0.0010	0.022	0.013	<0.0004
15/11/2016	8.7	<3	0.5	<0.007	1500	<0.0010	0.034	0.013	<0.0004
16/11/2016	8.9	<3	0.7	<0.007	1300	<0.0010	0.033	0.017	<0.0004
17/11/2016	9.0	<3	1.9	<0.007	1250	0.0130	0.073	0.014	<0.0004
18/11/2016	9.0	<3	3.1	0.010	1090	0.0260	0.046	0.009	<0.0004
19/11/2016	9.0	<3	3.3	0.010	1130	0.0087	0.036	0.006	<0.0004
20/11/2016	8.9	<3	3.6	0.009	1130	0.0057	0.022	0.005	<0.0004
21/11/2016	8.9	<3	3.4	0.015	1090	0.0035	0.024	0.007	<0.0004
22/11/2016	8.9	4	3.3	0.010	1020	0.0032	0.017	0.010	<0.0004
23/11/2016	8.9	<3	3.6	0.014	1070	0.0033	0.021	0.008	<0.0004
24/11/2016	8.8	6	2.4	0.009	1170	0.0020	0.025	0.006	<0.0004
25/11/2016	8.8	<3	2.5	0.009	1160	0.0030	0.034	0.008	<0.0004
26/11/2016	8.9	3	3.1	0.010	1150	0.0032	0.027	0.008	<0.0004
27/11/2016	8.9	<3	3.3	0.010	1220	0.0027	0.024	0.007	<0.0004
28/11/2016	8.9	<3	3.6	0.012	1150	0.0028	0.023	0.012	<0.0004
29/11/2016	8.8	<3	3.6	0.013	1100	0.0040	0.030	0.009	<0.0004
30/11/2016	8.8	5	3.8	0.01	1090	0.0038	0.025	0.012	<0.0004
01/12/2016	8.8	6	3.7	0.008	1100	0.0044	0.028	0.009	<0.0004
02/12/2016	8.8	2	4.1	0.011	1060	0.0053	<0.008	0.009	<0.0004
03/12/2016	8.9	<3	3.9	0.009	1060	0.0047	0.037	0.008	<0.0004
04/12/2016	8.8	<3	3.8	0.012	1110	0.0041	0.041	0.006	<0.0004
05/12/2016	8.8	3	3.9	0.098	1050	0.0047	0.030	0.007	<0.0004
06/12/2016	8.8	<3	4.9	0.010	1000	0.0051	0.026	0.008	<0.0004
07/12/2016	8.9	<3	4.6	<0.007	1060	0.0044	0.025	0.009	<0.0004
08/12/2016	8.9	3	3.8	<0.007	1100	0.0024	0.020	0.009	<0.0004
09/12/2016	8.8	<3	2.9	<0.007	1210	0.0018	0.021	0.008	0.0005
10/12/2016	8.9	<3	2.6	<0.007	1400	0.0017	0.024	0.008	<0.0004
11/12/2016	8.8	<3	2.5	<0.007	1240	0.0035	0.019	0.009	<0.0004
12/12/2016	8.9	3	2.7	0.010	1210	0.0018	0.031	0.008	<0.0004
13/12/2016	8.8	2	3.0	0.010	1250	0.0013	0.019	0.006	<0.0004
14/12/2016	8.0	<3	3.1	0.017	1210	0.0017	0.031	0.005	<0.0004
15/12/2016	8.8	<3	2.8	<0.007	1100	0.0018	0.022	0.007	<0.0004
16/12/2016	8.8	<3	2.9	<0.007	1170	0.0024	0.030	0.007	<0.0004
17/12/2016	8.7	<3	2.6	<0.007	1180	0.0023	0.029	0.006	<0.0004
18/12/2016	8.7	<3	2.6	<0.007	1190	0.0027	0.026	0.007	<0.0004
19/12/2016	8.7	<3	2.6	<0.007	1200	0.0029	0.036	0.007	<0.0004
20/12/2016	8.7	<3	3.0	<0.007	1200	0.0028	0.031	0.006	<0.0004
21/12/2016	8.7	<3	3.4	<0.007	1200	0.0036	0.029	0.007	<0.0004
22/12/2016	8.8	<3	3.0	<0.007	1300	0.0021	0.021	0.005	<0.0004
23/12/2016	8.8	<3	3.0	<0.007	1230	0.0017	0.020	0.005	<0.0004
24/12/2016	8.8	<3	2.9	<0.007	1240	0.0025	0.032	0.006	<0.0004
25/12/2016	8.8	4	2.8	0.010	1200	0.0030	0.020	0.006	<0.0004

Date	pH	TSS	Ammonia	CN_{WAD}	Hardness	Copper	Iron	Manganese	Silver
26/12/2016	8.9	<3	2.6	<0.007	1170	0.0019	<0.008	0.005	<0.0004
27/12/2016	8.8	5	3.0	<0.007	1090	0.0019	<0.008	0.005	<0.0004
28/12/2016	8.7	<3	3.2	<0.007	1250	0.0021	0.016	0.005	<0.0004
29/12/2016	8.7	<3	3.3	<0.007	1200	0.0017	0.025	0.006	<0.0004
30/12/2016	8.8	<3	3.7	<0.007	1290	0.0036	0.012	0.006	<0.0004
31/12/2016	8.8	3	3.6	<0.007	1300	0.0042	0.017	0.006	<0.0004
01/01/2017	8.8	<3	3.5	0.009	1290	0.0055	<0.008	0.006	<0.0004
02/01/2017	8.8	<3	2.5	<0.007	1240	0.0054	0.014	0.007	<0.0004
03/01/2017	8.7	<3	3.3	0.013	1240	0.0110	0.015	0.005	<0.0004
04/01/2017	8.7	5	4.1	<0.007	1200	0.0082	0.013	0.004	<0.0004
05/01/2017	8.8	<3	4.2	0.008	1210	0.0051	0.019	0.005	<0.0004
06/01/2017	8.8	<3	3.2	<0.007	1250	0.0031	0.017	0.005	<0.0004
07/01/2017	8.8	<3	3.1	0.009	1120	0.0042	0.023	0.005	<0.0004
08/01/2017	8.7	<3	3.8	0.010	1200	0.0023	0.028	0.004	<0.0004
09/01/2017	8.0	<3	4.1	0.010	1290	0.0028	0.019	0.005	<0.0004
10/01/2017	8.7	<3	4.6	<0.007	1280	0.0026	0.022	0.003	<0.0004
11/01/2017	8.7	<3	4.2	<0.007	1190	0.0018	0.110	0.003	<0.0004
12/01/2017	8.6	<3	3.5	0.009	1230	0.0025	0.014	0.004	<0.0004
13/01/2017	8.7	<3	2.7	<0.007	1400	0.0016	0.015	0.005	<0.0004
14/01/2017	8.6	<3	1.9	<0.007	1400	0.0011	0.016	0.008	<0.0004
15/01/2017	8.6	<3	1.4	<0.007	1400	<0.0010	0.031	0.004	<0.0004
16/01/2017	8.7	<3	1.2	<0.007	1400	<0.0010	0.020	0.004	<0.0004
17/01/2017	8.7	3	1.0	<0.007	1400	0.0013	0.030	0.005	<0.0004
18/01/2017	8.8	3	1.0	<0.007	1400	<0.0010	0.009	0.005	<0.0004
19/01/2017	8.7	<3	0.7	<0.007	1400	<0.0010	0.021	0.007	0.0017
20/01/2017	8.7	4	0.6	<0.007	1400	<0.0010	0.019	0.006	<0.0004
21/01/2017	8.7	8	0.6	<0.007	1400	<0.0010	0.029	0.005	<0.0004
22/01/2017	8.7	<3	0.6	<0.007	1500	0.0012	0.023	0.004	<0.0004
23/01/2017	8.7	<3	0.4	<0.007	1400	0.0021	0.036	0.006	<0.0004
24/01/2017	8.7	<3	0.4	<0.007	1500	<0.0010	0.025	0.003	<0.0004
25/01/2017	8.8	3	0.5	<0.007	1500	0.0012	0.023	0.004	<0.0004
26/01/2017	8.8	4	0.6	<0.007	1500	<0.0010	0.026	0.006	<0.0004
27/01/2017	8.7	3	0.6	<0.007	1600	<0.0010	0.024	0.010	<0.0004
28/01/2017	8.7	2	0.7	<0.007	1500	<0.0010	0.025	0.005	<0.0004
29/01/2017	8.7	3	0.8	<0.007	1500	<0.0010	0.024	0.006	<0.0004
30/01/2017	8.7	<3	0.8	<0.007	1500	<0.0010	0.025	0.005	<0.0004
31/01/2017	8.8	4	0.6	<0.007	1600	<0.0010	0.022	0.004	<0.0004
01/02/2017	8.7	<3	0.6	<0.007	1700	<0.0010	0.019	0.005	<0.0004
02/02/2017	8.8	<3	0.5	<0.007	1600	0.0017	0.019	0.005	<0.0004
03/02/2017	8.8	3	0.6	<0.007	1500	<0.0010	<0.008	0.004	<0.0004
04/02/2017	8.7	<3	0.7	<0.007	1600	<0.0010	0.015	0.005	<0.0004
05/02/2017	8.7	<3	0.8	<0.007	1500	<0.0010	0.027	0.007	<0.0004
06/02/2017	8.8	3	1.3	<0.007	1600	<0.0010	0.021	0.008	<0.0004
07/02/2017	8.8	3	1.0	<0.007	1600	<0.0010	0.021	0.009	<0.0004
08/02/2017	8.8	<3	0.9	<0.007	1500	<0.0010	0.023	0.009	<0.0004
09/02/2017	8.9	<3	1.1	<0.007	1500	0.0015	0.016	0.006	<0.0004
10/02/2017	8.9	<3	1.1	<0.007	1600	<0.0010	0.019	0.006	<0.0004
11/02/2017	8.8	<3	0.9	<0.007	1600	<0.0010	0.013	0.007	<0.0004
12/02/2017	8.8	5	0.9	<0.007	1600	<0.0010	0.016	0.005	<0.0004
13/02/2017	8.7	<3	0.8	<0.007	1700	0.0013	0.019	0.005	<0.0004
14/02/2017	8.8	4	0.8	<0.007	1600	<0.0010	0.011	0.006	<0.0004
15/02/2017	8.8	<3	0.6	<0.007	1500	<0.0010	0.015	0.004	<0.0004
16/02/2017	7.6	<3	0.5	<0.007	1500	<0.0010	0.015	0.010	<0.0004
17/02/2017	8.8	<3	0.7	<0.007	1300	<0.0010	0.022	0.005	<0.0004
18/02/2017	8.8	3	0.8	<0.007	1070	<0.0010	0.018	0.005	<0.0004
19/02/2017	8.9	<3	0.7	<0.007	1160	<0.0010	0.021	0.005	<0.0004
20/02/2017	8.9	<3	0.7	<0.007	1300	<0.0010	0.025	0.009	<0.0004
21/02/2017	8.7	5	0.6	<0.007	1250	<0.0010	0.020	0.007	<0.0004
22/02/2017	8.6	3	0.6	<0.007	1290	<0.0010	0.019	0.005	<0.0004
23/02/2017	8.8	<3	0.7	<0.007	1400	<0.0010	0.019	0.005	<0.0004

Date	pH	TSS	Ammonia	CN_{WAD}	Hardness	Copper	Iron	Manganese	Silver
24/02/2017	8.8	3	0.4	<0.007	1220	<0.0010	0.023	0.004	<0.0004
25/02/2017	8.8	<3	0.3	<0.007	1130	0.0011	0.029	0.004	<0.0004
26/02/2017	8.8	<3	0.3	<0.007	1200	<0.0010	0.013	0.003	<0.0004
27/02/2017	8.9	<3	0.5	<0.007	1290	<0.0010	<0.008	0.005	<0.0004
28/02/2017	8.9	4	0.6	<0.007	1400	<0.0010	<0.008	0.005	<0.0004
01/03/2017	8.9	6	0.6	<0.007	1250	<0.0010	<0.008	0.005	<0.0004
02/03/2017	8.9	3	0.7	<0.007	1260	<0.0010	0.011	0.008	<0.0004
03/03/2017	8.9	4	0.7	<0.007	1300	<0.0010	0.009	0.007	<0.0004
04/03/2017	8.9	<3	0.6	<0.007	1300	<0.0010	0.023	0.007	<0.0004
05/03/2017	8.7	<3	1.1	<0.007	1300	0.0027	<0.008	0.006	<0.0004
06/03/2017	8.6	<3	1.1	<0.007	1300	<0.0010	0.017	0.005	<0.0004
07/03/2017	8.8	<3	0.8	<0.007	1500	<0.0010	0.018	0.005	<0.0004
08/03/2017	9.0	6	1.2	<0.007	1040	<0.0010	0.032	0.007	<0.0004
09/03/2017	9.2	<3	0.5	<0.007	550	0.0020	0.041	0.006	<0.0004
10/03/2017	9.2	<3	0.6	<0.007	480	<0.0010	0.052	0.013	<0.0004
11/03/2017	9.0	<3	0.3	<0.007	540	0.0019	0.019	0.007	<0.0004
12/03/2017	9.0	<3	0.9	<0.007	540	0.0013	0.026	0.006	<0.0004
13/03/2017	9.0	<3	0.5	<0.007	660	<0.0010	0.027	0.007	<0.0004
14/03/2017	9.0	<3	0.3	<0.007	790	0.0025	0.019	0.008	<0.0004
15/03/2017	9.1	<3	1.9	0.010	870	0.0210	0.057	0.006	<0.0004
16/03/2017	9.0	<3	2.7	0.016	1010	0.0140	0.040	0.005	0.0004
17/03/2017	8.9	<3	3.7	0.012	1010	0.0110	0.034	0.006	<0.0004
18/03/2017	8.7	<3	3.8	0.017	1000	0.0046	0.029	0.005	0.0004
19/03/2017	8.7	3	3.6	0.015	1040	0.0042	0.024	0.009	<0.0004
20/03/2017	8.7	3	2.4	0.021	1220	0.0028	0.023	0.006	<0.0004
21/03/2017	8.8	<3	2.0	<0.007	1200	0.0028	0.041	0.004	<0.0004
22/03/2017	8.9	<3	3.1	0.010	1180	0.0035	0.034	0.005	<0.0004
23/03/2017	8.7	<3	3.4	0.012	1070	0.0068	0.018	0.005	<0.0004
24/03/2017	8.7	<3	3.7	0.015	1090	0.0033	0.022	0.007	<0.0004
25/03/2017	8.8	3	3.4	0.012	1210	0.0041	0.023	0.011	<0.0004
26/03/2017	8.8	<3	3.9	0.014	1180	0.0047	0.025	0.008	<0.0004
27/03/2017	8.9	<3	3.3	0.014	980	0.0039	0.039	0.004	<0.0004
28/03/2017	8.8	3	1.1	<0.007	790	0.0011	0.035	0.008	<0.0004
29/03/2017	9.0	3	1.9	<0.007	810	0.0082	0.054	0.004	<0.0004
30/03/2017	9.0	<3	1.1	<0.007	670	0.0024	0.041	0.008	<0.0004
31/03/2017	8.9	<3	3.1	0.011	840	0.0028	0.023	0.004	<0.0004
01/04/2017	8.9	3	3.1	0.014	960	0.0032	0.016	0.006	<0.0004
02/04/2017	8.9	<3	3.7	<0.007	1040	0.0034	0.021	0.004	<0.0004
03/04/2017	8.9	4	3.5	<0.007	1180	0.0028	0.053	0.006	<0.0004
04/04/2017	9.1	4	3.6	<0.007	900	0.0045	0.045	0.006	<0.0004
05/04/2017	9.2	<3	1.3	<0.007	610	<0.0010	0.051	0.005	<0.0004
06/04/2017	9.4	3	1.6	<0.007	740	<0.0010	0.030	0.003	<0.0004
07/04/2017	9.1	<3	2.2	<0.007	820	0.0018	0.027	0.006	<0.0004
08/04/2017	9.0	<3	2.5	0.008	1000	0.0023	0.031	0.006	<0.0004
09/04/2017	8.9	3	3.1	<0.007	1060	0.0026	0.019	0.007	<0.0004
10/04/2017	8.9	<3	2.8	<0.007	950	0.0032	0.022	0.007	<0.0004
11/04/2017	8.9	4	3.1	<0.007	900	0.0030	0.026	0.009	<0.0004
12/04/2017	8.8	3	2.7	<0.007	770	0.0025	0.012	0.007	<0.0004
13/04/2017	9.0	4	0.6	<0.007	840	<0.0010	0.037	0.008	<0.0004
14/04/2017	9.2	3	0.4	<0.007	860	<0.0010	0.036	0.005	<0.0004
15/04/2017	9.3	<3	1.4	<0.007	1020	0.0011	0.022	0.006	<0.0004
16/04/2017	9.0	<3	1.6	<0.007	1040	0.0021	0.017	0.004	<0.0004
17/04/2017	9.0	<3	2.3	<0.007	1140	0.0022	0.025	0.005	<0.0004
18/04/2017	8.9	<3	2.1	<0.007	1300	0.0023	0.021	0.005	<0.0004
19/04/2017	9.0	<3	1.4	<0.007	1300	0.0013	0.023	0.011	<0.0004
20/04/2017	9.1	3	1.3	<0.007	1270	<0.0010	<0.008	0.006	<0.0004
21/04/2017	9.0	<3	3.0	0.014	1210	0.0032	0.032	0.008	<0.0004
22/04/2017	8.9	<3	3.2	0.008	1180	0.0033	0.016	0.005	<0.0004
23/04/2017	8.9	<3	2.8	0.010	1180	0.0027	0.023	0.007	<0.0004
24/04/2017	8.9	<3	3.4	0.012	1110	0.0027	0.025	0.007	0.0007

Date	pH	TSS	Ammonia	CN_{WAD}	Hardness	Copper	Iron	Manganese	Silver
25/04/2017	9.0	<3	4.3	0.009	1200	<0.0010	0.024	0.008	<0.0004
26/04/2017	9.0	<3	4.5	0.011	1120	0.0021	0.025	0.005	<0.0004
27/04/2017	9.1	<3	4.0	0.012	1150	0.0042	0.035	0.006	<0.0004
28/04/2017	9.1	3	4.9	0.012	1180	0.0019	0.023	0.008	<0.0004
29/04/2017	9.1	<3	4.0	<0.007	1220	0.0035	0.027	0.001	<0.0004
30/04/2017	9.2	4	3.5	0.012	1180	0.0034	0.030	0.013	<0.0004
01/05/2017	9.0	3	3.3	0.012	1190	0.0040	0.078	0.009	<0.0004
02/05/2017	9.0	<3	3.7	<0.007	1130	0.0040	0.024	0.007	<0.0004
03/05/2017	8.9	3	3.8	0.014	1120	0.0048	0.019	0.008	<0.0004
04/05/2017	8.9	3	3.8	0.012	1070	0.0055	0.033	0.007	<0.0004
05/05/2017	9.0	<3	4.3	0.014	1120	0.0046	0.027	0.006	<0.0004
06/05/2017	9.0	<3	4.1	0.010	1140	0.0067	0.038	0.006	<0.0004
07/05/2017	9.0	<3	4.3	0.013	1180	0.0066	0.038	0.006	<0.0004
08/05/2017	9.0	<3	4.0	0.017	1130	0.0068	0.028	0.006	<0.0004
09/05/2017	9.0	<3	4.1	0.015	1170	0.0078	0.026	0.006	<0.0004
10/05/2017	8.9	<3	4.3	0.014	1170	0.0064	0.036	0.008	<0.0004
11/05/2017	8.9	<3	3.8	0.010	1140	0.0058	0.029	0.009	<0.0004
12/05/2017	8.9	4	2.4	<0.007	880	0.0032	0.055	0.015	<0.0004
13/05/2017	8.8	<3	1.1	<0.007	810	<0.0010	0.031	0.013	<0.0004
14/05/2017	9.2	<3	2.5	0.010	1020	0.0032	0.028	0.007	<0.0004
15/05/2017	9.0	3	3.1	0.009	1010	0.0036	0.026	0.008	<0.0004
16/05/2017	9.0	<3	3.4	0.013	1100	0.0047	0.031	0.007	<0.0004
17/05/2017	8.8	<3	4.3	0.015	1100	0.0037	0.024	0.008	<0.0004
18/05/2017	8.9	<3	3.4	0.009	1030	0.0036	0.014	0.009	<0.0004
19/05/2017	8.8	<3	3.5	0.012	980	0.0055	0.034	0.010	<0.0004
20/05/2017	8.8	<3	3.4	0.011	1120	0.0058	0.030	0.010	<0.0004
21/05/2017	8.7	<3	3.2	0.013	1190	0.0057	0.022	0.011	<0.0004
22/05/2017	8.9	<3	3.1	0.012	1210	0.0055	0.040	0.012	<0.0004
23/05/2017	8.9	<3	3.4	<0.007	1190	0.0051	0.028	0.009	<0.0004
24/05/2017	8.8	<3	4.1	0.015	1240	0.0069	0.034	0.011	<0.0004
25/05/2017	8.9	3	4.0	0.013	1230	0.0084	0.044	0.015	<0.0004
26/05/2017	8.8	4	4.2	0.011	1220	0.0074	0.044	0.014	<0.0004
27/05/2017	8.8	7	1.1	<0.007	1080	0.0065	0.050	0.021	<0.0004
28/05/2017	8.8	4	2.6	<0.007	860	0.0019	0.059	0.024	<0.0004
29/05/2017	8.9	<3	2.6	<0.007	960	0.0077	0.042	0.016	<0.0004
30/05/2017	8.9	<3	2.7	<0.007	1130	0.0073	0.031	0.017	<0.0004
31/05/2017	8.9	3	3.3	<0.007	1260	0.0060	0.023	0.015	<0.0004

Notes: All units except pH in g/m^3; pH is unitless; TSS = total suspended solids; CN_{WAD} = weak acid dissociable cyanide; metal data are acid soluble.

Table 2: Treated water discharge quality (non-daily data) between 1 May 2016 and 31 May 2017.

Date	Antimony	Arsenic	Cadmium	Cr (VI)	Cobalt	Lead	Mercury	Nickel	Selenium	Zinc
03/05/2016				<0.01			<0.00008			
04/05/2016	0.016				0.0300				0.0162	
11/05/2016	0.017				0.0300				0.0175	
25/05/2016	0.018				0.0300				0.0179	
02/06/2016	0.014			<0.01			<0.00008			
08/06/2016	0.015				0.0250				0.0195	
15/06/2016	0.008				0.0250				0.0220	
23/06/2016	0.007	<0.002	<0.0001	<0.01		<0.0002	<0.00008	0.0005	0.0104	0.0005
30/06/2016	0.012				0.0110				0.0080	
06/07/2016	0.007	<0.002	<0.0001	<0.01		<0.0002	<0.00008	0.0005	0.0163	0.0005
14/07/2016	0.007				0.0091				0.0085	
21/07/2016	0.012				0.0069				0.0070	
28/07/2016	0.011				0.0162				0.0133	
05/08/2016	0.011				0.0165				0.0099	
08/08/2016	0.011				0.0138				0.0114	
11/08/2016	0.008	<0.002	<0.0001	<0.01		<0.0002	<0.00008	0.0005	0.0138	0.0040
25/08/2016	0.011				0.0132				0.0114	
01/09/2016	0.012				0.0185				0.0158	
05/09/2016	0.012				0.0182				0.0159	
06/09/2016	0.003	<0.002	<0.0001	<0.01		<0.0002	<0.00008	0.0005	0.0144	0.0040
22/09/2016	0.001								0.0035	
28/09/2016	0.007								0.0010	
03/10/2016	0.008	<0.002	<0.0001	<0.01		<0.0002	<0.00008	0.0005	0.0072	0.0042
13/10/2016	0.008								0.0090	
21/10/2016	0.009								0.0079	
26/10/2016	0.013								0.0100	
03/11/2016	0.011	<0.002	<0.0001	<0.01		<0.0002	<0.00008	0.0005	0.0111	0.0005
09/11/2016	0.008	<0.002	<0.0001	<0.01		<0.0002	<0.00008	0.0005	0.0115	0.0005
17/11/2016	0.013								0.0050	
21/11/2016	0.017								0.0140	
01/12/2016	0.018	<0.002	<0.0001	<0.01		<0.0002	<0.00008	0.0005	0.0138	0.0005
05/12/2016	0.011								0.0170	
15/12/2016	0.012								0.0120	
20/12/2016	0.012								0.0100	
26/12/2016	0.013								0.0100	
05/01/2017	0.015								0.0140	
11/01/2017	0.005								0.0120	
17/01/2017	0.003	<0.002	<0.0001	<0.01		<0.0002	<0.00008	0.0005	0.0017	0.0005
25/01/2017	0.003								0.0010	
01/02/2017	0.003	<0.002	<0.0001	<0.01		<0.0002	<0.00008	0.0005	0.0006	0.0005
06/02/2017	0.002								0.0010	
15/02/2017	0.002								0.0010	
22/02/2017	0.002								0.0010	
02/03/2017	0.003								0.0020	
07/03/2017	0.007	<0.002	<0.0001	<0.01		<0.0002	<0.00008	0.0005	0.0002	0.0005
15/03/2017	0.009								0.0083	
23/03/2017	0.003								0.0100	
30/03/2017	0.003								0.0033	
06/04/2017	0.007	0.001	<0.0001	<0.01		<0.0002	<0.00008	0.0005	0.0009	0.0052
11/04/2017	0.006								0.0081	
21/04/2017	0.008								0.0050	
27/04/2017	0.009								0.0091	
04/05/2017	0.010								0.0100	
10/05/2017	0.009	<0.002	<0.0001	<0.01		<0.0002	<0.00008	0.0012	0.0108	0.0005
16/05/2017	0.008								0.0110	
24/05/2017	0.008								0.0110	
31/05/2017	0.014								0.0100	

Notes: All units g/m^3; Cr (VI) = chromium (VI); and metal/metalloid data are for acid soluble concentrations.

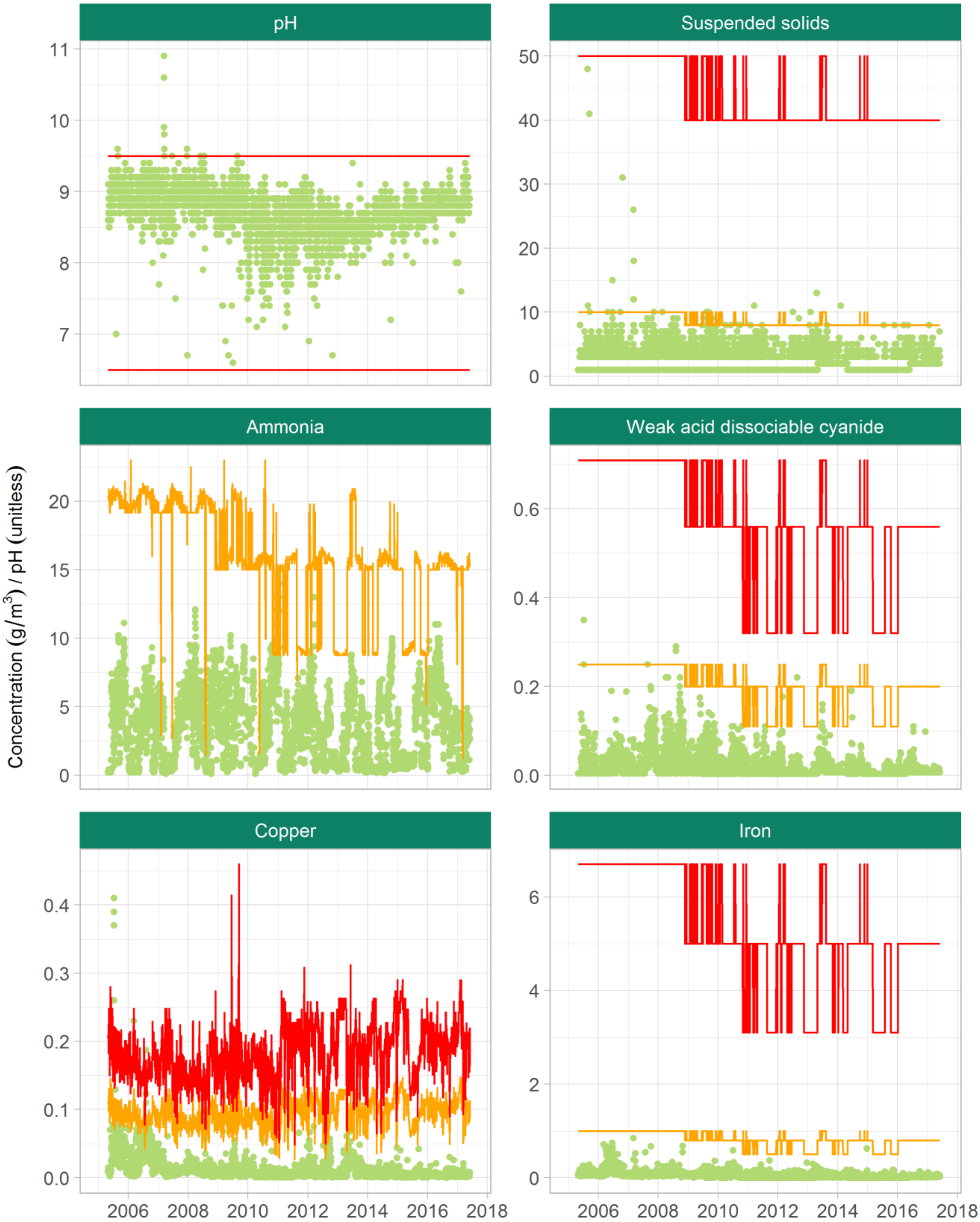

Figure 1:Daily pH, suspended solids, ammonia, weak acid dissociable cyanide, copper and iron concentrations in the treated water between 1 May 2005 and 31 May 2017 as measured in PP2 with maximum (red) and normal (orange) compliance limits.

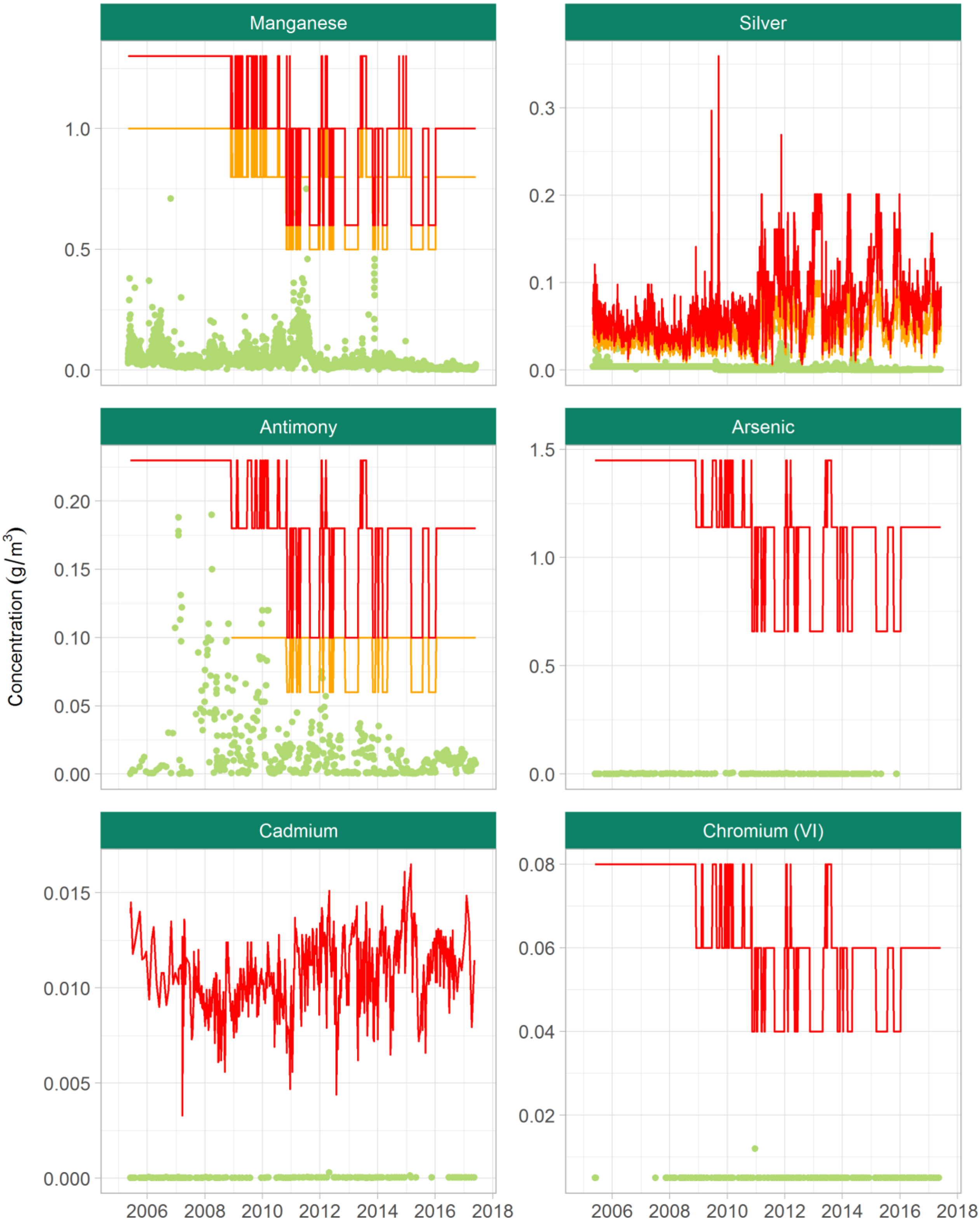

Figure 2:Acid soluble concentrations of manganese, silver, antimony, arsenic, cadmium and chromium (VI) in the treated water between 1 May 2005 and 31 May 2017 as measured in PP2 with maximum (red) and normal (orange) compliance limits. Normal compliance limit for antimony is a trigger value.

Figure 3:Acid soluble concentrations of cobalt, lead, mercury, nickel, selenium and zinc in the treated water between 1 May 2005 and 31 May 2017 as measured in PP2 with maximum (red) and normal (orange) compliance limits. The normal compliance limit for selenium is a trigger value.

APPENDIX D

Receiving Water Quality Data

Table 1: Receiving water physico-chemistry between 1 May 2016 and 31 May 2017.

Site	Date	pH [A]	Temp [B]	TSS	NH_4-N	NO_3-N	CN_{WAD}
OC2	04-May-16	7.2		<3			
OC2	11-May-16	7.6	15.3	5	<0.01	0.58	<0.001
OC2	19-May-16	6.8	13.1	15			
OC2	25-May-16	7.4	13.4	<3			
OC2	02-Jun-16	7.4	11.6	4	< 0.01	0.71	<0.001
OC2	08-Jun-16	7.0	13.5	<3			
OC2	15-Jun-16	7.0		<3			
OC2	23-Jun-16	6.6	15.2	29			
OC2	30-Jun-16	7.4	13.7	37			
OC2	14-Jul-16	7.1	13.2	20			
OC2	21-Jul-16	6.9		9			
OC2	27-Jul-16	6.9	14.0	11			
OC2	05-Aug-16	7.6	14.3	5			
OC2	11-Aug-16	7.7	11.9	10			
OC2	15-Aug-16	6.8	11.6	<3	< 0.01	0.9	<0.001
OC2	25-Aug-16	7.4	12.4	19			
OC2	01-Sep-16	7.5		<3			
OC2	08-Sep-16	6.9	11.2	<3			
OC2	13-Sep-16	7.1	14.8	4	< 0.01	0.68	<0.001
OC2	22-Sep-16	7.4	12.8	59			
OC2	26-Sep-16	6.6	14.7	34	0.053		<0.001
OC2	28-Sep-16	7.5	14.6	10			
OC2	03-Oct-16	7.5	14.8	5	0.032	1.19	<0.001
OC2	13-Oct-16	7.3	16.2	18			
OC2	21-Oct-16	7.6	18.0	4			
OC2	26-Oct-16	6.9	18.0	36			
OC2	03-Nov-16	7.8	18.3	25	< 0.01	0.57	<0.001
OC2	09-Nov-16	7.6	19.8	<3	0.016	0.67	<0.001
OC2	17-Nov-16	7.1	15.6	4			
OC2	21-Nov-16	7.7	19.1	<3			
OC2	01-Dec-16	7.6	21.9	6	< 0.01	0.34	<0.001
OC2	06-Dec-16	7.7	22.5	<3			
OC2	15-Dec-16	7.4	19.5	<3			
OC2	20-Dec-16	7.7	20.3	13			
OC2	29-Dec-16	7.7		<3			
OC2	05-Jan-17	7.5		<3			
OC2	11-Jan-17	7.4		<3			
OC2	17-Jan-17	7.2	22.4	4	< 0.01	0.05	<0.001
OC2	24-Jan-17	7.4	19.8	8			
OC2	01-Feb-17	7.0	23.5	4	< 0.01	0.05	<0.001
OC2	09-Feb-17	7.1	22.6	4			
OC2	15-Feb-17	7.5	24.2	<3			
OC2	22-Feb-17	7.2	22.3	6			
OC2	02-Mar-17	7.9	23.4	<3			
OC2	07-Mar-17	8.2	20.0	<3	< 0.01	0.05	<0.001
OC2	08-Mar-17	6.4		310	0.089		<0.001
OC2	15-Mar-17	7.1	17.8	3			
OC2	23-Mar-17	6.5	20.4	<3			
OC2	30-Mar-17	7.2	18.0	9			
OC2	06-Apr-17	6.9	17.6	19	0.02	1.32	<0.001
OC2	11-Apr-17	7.2		<3			
OC2	21-Apr-17	7.4	15.7	<3			
OC2	27-Apr-17	7.4	15.4	4			
OC2	01-May-17	7.4	15.0	4	< 0.01	0.65	<0.001
OC2	04-May-17	7.8	14.6	6			

OC2	16-May-17	7.5	13.5	<3			
OC2	25-May-17	7.1	11.9	<3	< 0.01	1.07	<0.001
OC2	31-May-17	6.9	15.0	<3			
OH3	07-Mar-16	7.1	18.2	<3	<0.010	0.65	<0.001
OH3	04-Apr-16	7.3	16.6	5	<0.010	0.8	<0.001
OH3	11-May-16	7.3	14.9	4	<0.010	0.58	<0.001
OH3	02-Jun-16	7.4	11.6	<3	<0.010	0.69	<0.001
OH3	15-Aug-16	6.8	11.6	<3	<0.010	0.89	<0.001
OH3	13-Sep-16	7.0	13.9	<3	0.014	0.66	<0.001
OH3	03-Oct-16	7.4	14.5	7	0.042	1.18	<0.001
OH3	03-Nov-16	7.4	18.4	17	0.031	0.63	<0.001
OH3	09-Nov-16	6.8	20.9	<3	<0.010	0.66	<0.001
OH3	01-Dec-16	7.7	21.9	<3	0.017	0.28	<0.001
OH3	17-Jan-17	6.9	18.7	<3	0.010	0.05	<0.001
OH3	01-Feb-17	6.9	24.8	171	0.012	0.05	<0.001
OH3	07-Mar-17	7.8	20.2	5	<0.010	0.05	<0.001
OH3	06-Apr-17	6.9	17.2	21	0.019	1.30	<0.001
OH3	01-May-17	6.9	15.1	<3	<0.010	0.65	<0.001
OH3	25-May-17	6.9	13.2	<3	<0.010	1.00	<0.001
OH5	04-May-16	6.9		<3			
OH5	11-May-16	7.5	15.4	<3	1.200	0.99	0.0025
OH5	19-May-16	7.5	13.4	6			
OH5	25-May-16	7.3	13.9	<3			
OH5	02-Jun-16	7.1	11.4	<3	0.530	0.89	0.0016
OH5	08-Jun-16	7.1	13.4	<3			
OH5	15-Jun-16	6.9		<3			
OH5	23-Jun-16	6.7	15.5	29			
OH5	30-Jun-16	7.1	13.8	23			
OH5	14-Jul-16	6.8	13.8	22			
OH5	21-Jul-16	6.8		<3			
OH5	27-Jul-16	7.1	14.0	5			
OH5	05-Aug-16	7.2	13.9	<3			
OH5	11-Aug-16	7.3	11.7	28			
OH5	15-Aug-16	6.9	12.4	<3	0.390	1.04	0.0016
OH5	25-Aug-16	7.0	12.2	21			
OH5	01-Sep-16	6.8		<3			
OH5	08-Sep-16	6.8	11.7	<3			
OH5	13-Sep-16	7.2	13.3	<3	0.680	0.90	0.0035
OH5	22-Sep-16	7.1	13.2	20			
OH5	28-Sep-16	7.5	14.2	12			
OH5	03-Oct-16	7.1	14.9	8	0.105	1.22	0.0010
OH5	13-Oct-16	7.1	15.6	<3			
OH5	21-Oct-16	7.3	18.1	<3			
OH5	26-Oct-16	7.4	17.5	<3			
OH5	03-Nov-16	7.5	18.6	<3	0.570	0.82	0.0016
OH5	09-Nov-16	7.6	19.7	<3			
OH5	10-Nov-16	7.5	18.6	<3	0.520	0.90	0.0016
OH5	17-Nov-16	6.5	15.8	<3			
OH5	21-Nov-16	7.2	19.5	<3			
OH5	01-Dec-16	7.2	21.4	<3	0.630	0.69	0.0021
OH5	06-Dec-16	7.9	23.2	<3			
OH5	15-Dec-16	7.5	19.5	<3			
OH5	20-Dec-16	7.3	20.0	<3			
OH5	29-Dec-16	7.5		<3			
OH5	05-Jan-17	7.2		<3			
OH5	11-Jan-17	7.2		<3			
OH5	17-Jan-17	6.9	19.6	<3	0.240	0.73	0.0005
OH5	24-Jan-17	6.9	20.5	3			

OH5	01-Feb-17	6.9	22.5	7	0.130	0.63	0.0005
OH5	09-Feb-17	7.0	22.0	6			
OH5	15-Feb-17	7.2	21.8	6			
OH5	22-Feb-17	7.5	22.7	4			
OH5	02-Mar-17	7.2	21.7	5			
OH5	07-Mar-17	7.2	20.5	32	0.139	0.54	0.0005
OH5	08-Mar-17	6.4		250	0.086		0.0005
OH5	15-Mar-17	6.8	18.1	3			
OH5	23-Mar-17	6.7	19.4	<3			
OH5	30-Mar-17	6.9	17.4	10			
OH5	06-Apr-17	6.8	17.0	23	0.036	1.29	0.0005
OH5	11-Apr-17	7.0		<3			
OH5	21-Apr-17	7.0	15.3	<3			
OH5	27-Apr-17	7.1	15.2	<3			
OH5	01-May-17	7.2	14.9	<3	0.610	0.96	0.0022
OH5	04-May-17	7.4	14.5	<3			
OH5	16-May-17	6.7	13.7	<3			
OH5	24-May-17	6.8	11.3	<3	0.270	1.08	0.0005
OH5	31-May-17	6.8	14.9	<3			
OH1	11-May-16	6.8	16.0	<3	0.750	1.05	0.0022
OH1	09-Nov-16	7.5	20.8	<3	0.461	0.97	0.0034
OH1	25-May-17	6.9	15.7	<3	0.267	1.23	<0.0010
OH6	04-May-16	7.3		<3			
OH6	11-May-16	7.3	16.6	<3	0.960	1.19	0.0028
OH6	19-May-16	7.4	13.6	12			
OH6	25-May-16	7.1	13.7	<3			
OH6	02-Jun-16	7.0	11.6	<3	0.410	1.05	<0.001
OH6	08-Jun-16	7.0	13.5	<3			
OH6	15-Jun-16	6.8		<3			
OH6	23-Jun-16	7.4	15.5	28			
OH6	30-Jun-16	7.0	14.1	37			
OH6	14-Jul-16	6.8	13.4	12			
OH6	21-Jul-16	6.7		<3			
OH6	27-Jul-16	6.9	14.0	5			
OH6	05-Aug-16	7.1	13.7	<3			
OH6	11-Aug-16	7.2	11.7	8			
OH6	15-Aug-16	7.5	12.8	<3	0.280	1.12	<0.001
OH6	25-Aug-16	7.0	12.1	29			
OH6	01-Sep-16	7.4		<3			
OH6	08-Sep-16	6.9	11.5	<3			
OH6	13-Sep-16	7.5	14.1	<3	0.510	1.02	0.0018
OH6	22-Sep-16	7.0	13.2	23			
OH6	26-Sep-16	6.5	14.2	56	0.081		<0.001
OH6	28-Sep-16	7.3	14.4	12			
OH6	03-Oct-16	6.5	14.6	10	0.098	1.35	<0.001
OH6	13-Oct-16	7.1	15.5	<3			
OH6	21-Oct-16	7.6	17.8	<3			
OH6	26-Oct-16	7.5	17.8	<3			
OH6	03-Nov-16	7.4	18.3	<3	0.410	0.94	0.0012
OH6	09-Nov-16	7.1	17.2	<3	0.430	1.07	0.0081
OH6	17-Nov-16	7.2	15.7	<3			
OH6	21-Nov-16	7.1	19.1	<3			
OH6	01-Dec-16	6.8	22.0	<3	0.620	1.16	0.0018
OH6	06-Dec-16	6.8	23.5	<3			
OH6	15-Dec-16	6.8	19.4	<3			
OH6	20-Dec-16	7.6	20.1	<3			
OH6	29-Dec-16	7.3		<3			
OH6	05-Jan-17	7.1		<3			

OH6	11-Jan-17	7.1		<3			
OH6	17-Jan-17	6.8	22.4	<3	0.022	0.58	<0.001
OH6	24-Jan-17	6.8	20.7	<3			
OH6	01-Feb-17	7.1	23.3	<3	0.005	0.51	<0.001
OH6	09-Feb-17	7.2	22.2	14			
OH6	15-Feb-17	7.3	24.1	<3			
OH6	22-Feb-17	7.3	23.3	<3			
OH6	02-Mar-17	7.2	21.3	<3			
OH6	07-Mar-17	7.5	20.4	<3	0.039	0.60	<0.001
OH6	08-Mar-17	6.5		200	0.096		<0.001
OH6	15-Mar-17	6.8	17.4	5			
OH6	23-Mar-17	6.5	19.8	5			
OH6	30-Mar-17	6.9	17.8	12			
OH6	06-Apr-17	6.6	17.4	22	0.041	1.41	<0.001
OH6	11-Apr-17	6.8		<3			
OH6	21-Apr-17	7.0	15.1	<3			
OH6	27-Apr-17	7.0	15.3	<3			
OH6	01-May-17	7.2	15.2	12	0.670	1.14	0.0016
OH6	04-May-17	7.3	14.6	<3			
OH6	16-May-17	6.7	13.8	<3			
OH6	25-May-17	7.0	13.4	4	0.240	1.22	<0.001
OH6	31-May-17	6.7	14.8	<3		1.05	
RU1	11-May-16	7.3	15.6	<3	<0.010	0.73	<0.001
RU1	22-May-16	7.4		<3	0.012		<0.001
RU1	24-May-16	7.5		<3	0.040		<0.001
RU1	25-May-16	7.4		<3	<0.010		<0.001
RU1	29-May-16	7.5		6	<0.010		<0.001
RU1	30-May-16	7.3		<3	<0.010		<0.001
RU1	01-Jun-16	7.5		6	0.030	0.75	<0.001
RU1	02-Jun-16	6.7		<3	<0.010		<0.001
RU1	03-Jun-16	7.0		<3	<0.010		0.002
RU1	08-Jun-16	7.6		<3	<0.010		<0.001
RU1	10-Jun-16	7.5		<3	0.200		<0.001
RU1	13-Jun-16	6.6		<3	<0.010		0.010
RU1	14-Jun-16	7.0		<3	<0.010		<0.001
RU1	15-Jun-16	6.9		<3	<0.010		<0.001
RU1	23-Jun-16	7.3		66	0.330		<0.001
RU1	15-Aug-16	7.3	14.5	27	<0.010	1.37	<0.001
RU1	13-Sep-16	7.5	13.6	<3	<0.010	0.98	<0.001
RU1	26-Sep-16	6.6	14.2	20	0.175		<0.001
RU1	03-Oct-16	6.6	14.7	5	0.072	1.72	<0.001
RU1	03-Nov-16	7.0	16.0	<3	<0.010	0.85	<0.001
RU1	10-Nov-16	7.5	17.5	<3	0.014	0.82	<0.001
RU1	01-Dec-16	6.7	17.9	<3	<0.010	0.21	<0.001
RU1	09-Jan-17	7.0		<3	<0.010		<0.001
RU1	17-Jan-17	7.0	18.6	<3	0.013	0.05	<0.001
RU1	01-Feb-17	6.8	19.8	30	0.010	0.05	<0.001
RU1	07-Mar-17	7.4	18.4	4	0.024	0.11	<0.001
RU1	06-Apr-17	6.7	17.4	9	0.056	1.69	<0.001
RU1	01-May-17	7.2	15.6	<3	<0.010	0.86	<0.001
RU1	24-May-17	6.5	11.3	<3	<0.010	1.23	<0.001

Notes: All units g/m^3 except ^{A} pH (unitless) and ^{B} temperature (˚C).

Table 2: In-river metal/metalloid concentrations between 1 May 2016 and 31 May 2017.

Site	Date	Antimony	Arsenic	Cadmium	Cr (VI)	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Zinc	Hardness
OC2	04-May-16	<0.0002				<0.0005			0.0087			<0.0002			16
OC2	11-May-16	<0.0002	<0.001		<0.01	0.0008	0.12	<0.0001	0.0060	<0.00008	<0.0005	<0.0002	<0.0001	0.0092	16
OC2	19-May-16	<0.0002				<0.0005			0.0075			<0.0002			17
OC2	25-May-16	<0.0002		<0.00005		0.0009			0.009			<0.0002			16
OC2	02-Jun-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.11	<0.0001	0.0114	<0.00008	<0.0005	<0.0002	<0.0001	0.0070	15
OC2	08-Jun-16	<0.0002				<0.0005			0.0083			<0.0002			16
OC2	15-Jun-16	<0.0002				<0.0005			0.0103			<0.0002			15
OC2	23-Jun-16	<0.0002				0.0009			0.0200			<0.0002			14
OC2	30-Jun-16	<0.0002				<0.0005			0.0360			<0.0002			12
OC2	14-Jul-16	<0.0002				<0.0005			0.0162			<0.0002			15
OC2	21-Jul-16	<0.0002				<0.0005			0.0122			<0.0002			15
OC2	27-Jul-16	<0.0002				<0.0005			0.0141			<0.0002			13
OC2	05-Aug-16	<0.0002				0.0006			0.0111			<0.0002			13
OC2	11-Aug-16	<0.0002				<0.0005			0.0128			<0.0002			15
OC2	15-Aug-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.06	<0.0001	0.0099	<0.00008	<0.0005	<0.0002	<0.0001	0.0030	14
OC2	25-Aug-16	<0.0002				0.0009			0.0147			<0.0002			11
OC2	01-Sep-16	<0.0002				<0.0005			0.0093			<0.0002			14
OC2	08-Sep-16	<0.0002				0.0006			0.0090			<0.0002			15
OC2	13-Sep-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.06	<0.0001	0.0073	<0.00008	<0.0005	<0.0002	<0.0001	0.0017	15
OC2	22-Sep-16	<0.0002										0.001			
OC2	26-Sep-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.05	<0.0001	0.0260	<0.00008	<0.0005	0.001	<0.0001	0.0028	12
OC2	28-Sep-16	<0.0002										0.001			
OC2	03-Oct-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.06	<0.0001	0.0178	<0.00008	<0.0005	<0.0002	<0.0001	0.0036	14
OC2	13-Oct-16	<0.0002										0.001			
OC2	21-Oct-16	<0.0002										0.001			
OC2	26-Oct-16	<0.0002										0.001			
OC2	03-Nov-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.09	<0.0001	0.0071	<0.00008	<0.0005	<0.0002	<0.0001	0.0048	14
OC2	09-Nov-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.10	<0.0001	0.0100	<0.00008	<0.0005	<0.0002	<0.0001	0.0012	14
OC2	17-Nov-16	<0.0002										0.001			
OC2	21-Nov-16	<0.0002										0.001			
OC2	01-Dec-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.15	<0.0001	0.0070	<0.00008	<0.0005	<0.0002	<0.0001	0.0047	15
OC2	06-Dec-16	<0.0002										0.001			
OC2	15-Dec-16	<0.0002										0.001			

Site	Date	Antimony	Arsenic	Cadmium	Cr (VI)	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Zinc	Hardness
OC2	20-Dec-16	<0.0002										0.001			
OC2	29-Dec-16	<0.0002										0.001			
OC2	05-Jan-17	<0.0002										0.001			
OC2	11-Jan-17	<0.0002										0.001			
OC2	17-Jan-17	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.17	<0.0001	0.0085	<0.00008	<0.0005	<0.0002	<0.0001	0.0038	16
OC2	24-Jan-17	<0.0002										0.001			
OC2	01-Feb-17	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.17	<0.0001	0.0095	<0.00008	<0.0005	<0.0002	<0.0001	0.0012	16
OC2	09-Feb-17	<0.0002										0.001			
OC2	15-Feb-17	<0.0002										0.001			
OC2	22-Feb-17	<0.0002										0.001			
OC2	02-Mar-17	<0.0002										0.001			
OC2	07-Mar-17	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.16	<0.0001	0.0040	<0.00008	<0.0005	<0.0002	<0.0001	0.0010	16
OC2	08-Mar-17	<0.0002	<0.001	<0.00005	<0.01	0.0006	0.18	0.00022	0.0770	<0.00008	<0.0005	0.001	<0.0001	0.0029	8
OC2	15-Mar-17	<0.0002										0.001			
OC2	23-Mar-17	<0.0002										0.001			
OC2	30-Mar-17	<0.0002										0.001			
OC2	06-Apr-17	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.05	<0.0001	0.0175	<0.00008	<0.0005	<0.0002	<0.0001	0.0049	14
OC2	11-Apr-17	<0.0002										0.001			
OC2	21-Apr-17	<0.0002										0.001			
OC2	27-Apr-17	<0.0002										0.001			
OC2	01-May-17	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.06	<0.0001	0.0078	<0.00008	<0.0005	<0.0002	<0.0001	0.0024	14
OC2	04-May-17	<0.0002										0.001			
OC2	16-May-17	<0.0002										0.001			
OC2	25-May-17	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.06	<0.0001	0.0117	<0.00008	<0.0005	<0.0002	<0.0001	0.0017	14
OC2	31-May-17	<0.0002										0.001			
OH3	11-May-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.13	<0.0001	0.0073	<0.00008	<0.0005	<0.0002	<0.0001	0.0022	15.9
OH3	02-Jun-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.11	<0.0001	0.0120	<0.00008	<0.0005	<0.0002	<0.0001	0.0051	16
OH3	15-Aug-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.06	<0.0001	0.0106	<0.00008	<0.0005	<0.0002	<0.0001	0.0023	14
OH3	13-Sep-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.06	<0.0001	0.0069	<0.00008	<0.0005	<0.0002	<0.0001	0.0014	14
OH3	03-Oct-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.07	<0.0001	0.0210	<0.00008	<0.0005	<0.0002	<0.0001	0.0033	17
OH3	03-Nov-16	0.0004	<0.001	<0.00005	<0.01	<0.0005	0.09	<0.0001	0.0082	<0.00008	<0.0005	0.0005	<0.0001	0.0022	55
OH3	09-Nov-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.11	<0.0001	0.0090	<0.00008	<0.0005	<0.0002	<0.0001	0.0011	15
OH3	01-Dec-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.15	<0.0001	0.0043	<0.00008	<0.0005	<0.0002	<0.0001	0.0026	15
OH3	17-Jan-17	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.19	<0.0001	0.0191	<0.00008	<0.0005	<0.0002	<0.0001	0.0014	18
OH3	01-Feb-17	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.19	<0.0001	0.0105	<0.00008	<0.0005	<0.0002	<0.0001	0.0058	16

Site	Date	Antimony	Arsenic	Cadmium	Cr (VI)	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Zinc	Hardness
OH3	07-Mar-17	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.17	<0.0001	0.0058	<0.00008	<0.0005	<0.0002	<0.0001	0.0005	16
OH3	06-Apr-17	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.05	<0.0001	0.0198	<0.00008	<0.0005	<0.0002	<0.0001	0.0055	15
OH3	01-May-17	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.07	<0.0001	0.0083	<0.00008	<0.0005	<0.0002	<0.0001	0.0017	14
OH3	25-May-17	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.06	<0.0001	0.0114	<0.00008	<0.0005	<0.0002	<0.0001	0.0013	14
OH5	04-May-16	0.0018				<0.0005			0.0061			0.0018			149
OH5	11-May-16	0.0023	<0.001	<0.00005	<0.01	<0.0005	0.08	<0.0001	0.0045	<0.00008	<0.0005	0.0028	<0.0001	<0.001	191
OH5	19-May-16	0.0022				<0.0005			0.0061			0.0024			180
OH5	25-May-16	0.0023				0.0007			0.0092			0.0029			173
OH5	02-Jun-16	0.0012	<0.001	<0.00005	<0.01	0.0007	0.10	<0.0001	0.0128	<0.00008	<0.0005	0.0019	<0.0001	0.0067	98
OH5	08-Jun-16	0.0016				0.0006			0.0103			0.0025			172
OH5	15-Jun-16	0.0011				<0.0005			0.0123			0.0018			104
OH5	23-Jun-16	<0.0002				0.0008			0.0240			0.0003			29
OH5	30-Jun-16	<0.0002				<0.0005			0.0410			0.0003			33
OH5	14-Jul-16	0.0003				0.0009			0.0230			0.0004			57
OH5	21-Jul-16	0.0005				0.0007			0.0149			0.0004			72
OH5	27-Jul-16	0.0003				<0.0005			0.0193			0.0006			49
OH5	05-Aug-16	0.0004				0.001			0.0200			0.0006			52
OH5	11-Aug-16	0.0006				<0.0005			0.0189			0.0006			93
OH5	15-Aug-16	0.0008	<0.001	<0.00005	<0.01	<0.0005	0.05	<0.0001	0.0103	<0.00008	<0.0005	0.0012	<0.0001	0.0019	121
OH5	25-Aug-16	0.0006				0.0011			0.0220			0.0006			72
OH5	01-Sep-16	0.0009				<0.0005			0.0108			0.0014			104
OH5	08-Sep-16	0.0011				0.0006			0.0101			0.0013			121
OH5	13-Sep-16	0.0016	<0.001	<0.00005	<0.01	0.0009	0.04	<0.0001	0.0071	<0.00008	<0.0005	0.0019	<0.0001	0.0014	168
OH5	22-Sep-16	<0.0002										0.0010			
OH5	28-Sep-16	<0.0002										0.0010			
OH5	03-Oct-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.06	<0.0001	0.0200	<0.00008	<0.0005	0.0003	<0.0001	0.0039	42
OH5	13-Oct-16	0.0004										0.0010			
OH5	21-Oct-16	0.0007										0.0010			
OH5	26-Oct-16	0.0007										0.0010			
OH5	03-Nov-16	0.002	<0.001	<0.00005	<0.01	0.0007	0.06	<0.0001	0.0086	<0.00008	<0.0005	0.0020	<0.0001	0.0024	200
OH5	09-Nov-16	0.0015										0.0016			
OH5	10-Nov-16	0.0018	<0.001	<0.00005	<0.01	0.001	0.08	<0.0001	0.0108	<0.00008	<0.0005	0.0018	<0.0001	<0.0010	180
OH5	17-Nov-16	0.0008										0.0010			
OH5	21-Nov-16	0.0021										0.0022			
OH5	01-Dec-16	0.0022	<0.001	<0.00005	<0.01	0.0009	0.11	<0.0001	0.0066	<0.00008	<0.0005	0.0024	<0.0001	0.0040	178

Site	Date	Antimony	Arsenic	Cadmium	Cr (VI)	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Zinc	Hardness
OH5	06-Dec-16	0.0034										0.0034			
OH5	15-Dec-16	0.0024										0.0027			
OH5	20-Dec-16	0.0024										0.0025			
OH5	29-Dec-16	0.0032										0.0024			
OH5	05-Jan-17	0.0034										0.0029			
OH5	11-Jan-17	0.0025										0.0025			
OH5	17-Jan-17	0.001	<0.001	<0.00005	<0.01	<0.0005	0.12	<0.0001	0.0161	<0.00008	<0.0005	0.0005	<0.0001	0.0013	320
OH5	24-Jan-17	0.0006										0.0010			
OH5	01-Feb-17	0.0006	<0.001	<0.00005	<0.01	<0.0005	0.12	<0.0001	0.0300	<0.00008	<0.0005	0.0002	<0.0001	0.0017	410
OH5	09-Feb-17	0.0005										0.0010			
OH5	15-Feb-17	0.0005										0.0010			
OH5	22-Feb-17	0.0004										0.0010			
OH5	02-Mar-17	0.0003										0.0010			
OH5	07-Mar-17	0.0005	<0.001	<0.00005	<0.01	<0.0005	0.12	<0.0001	0.0156	<0.00008	<0.0005	0.0001	<0.0001	0.0023	280
OH5	08-Mar-17	0.0001	<0.001	<0.00005	<0.01	0.0008	0.23	0.0002	0.0740	<0.00008	<0.0005	0.0010	<0.0001	0.0027	10
OH5	15-Mar-17	0.0002										0.0010			
OH5	23-Mar-17	0.0004										0.0010			
OH5	30-Mar-17	0.0001										0.0010			
OH5	06-Apr-17	0.0001	<0.001	<0.00005	<0.01	<0.0005	0.05	<0.0001	0.0200	<0.00008	<0.0005	0.0001	<0.0001	0.0032	23
OH5	11-Apr-17	0.0002										0.0010			
OH5	21-Apr-17	0.0004										0.0010			
OH5	27-Apr-17	0.001										0.0011			
OH5	01-May-17	0.0014	<0.001	<0.00005	<0.01	0.0006	0.05	<0.0001	0.0109	<0.00008	<0.0005	0.0013	<0.0001	0.0029	161
OH5	04-May-17	0.0009										0.0011			
OH5	16-May-17	0.0005										0.0010			
OH5	24-May-17	0.0006	<0.001	<0.00005	<0.01	<0.0005	0.05	<0.0001	0.0133	<0.00008	<0.0005	0.0007	<0.0001	0.0024	98
OH5	31-May-17	0.0006										0.0010			
OH1	11-May-16	0.0016	<0.001	<0.00005	<0.01	<0.0005	0.08	<0.0001	0.0106	<0.00008	<0.0005	0.0019	<0.0001	0.0011	129
OH1	09-Nov-16	0.0013	<0.001	<0.00005	<0.01	0.0007	0.09	<0.0001	0.0172	<0.00008	<0.0005	0.0013	<0.0001	0.0017	152
OH1	25-May-17	0.0005	<0.001	<0.00005	<0.01	<0.0005	0.06	0.00028	0.0176	<0.00008	<0.0005	0.0006	<0.0001	0.0020	77
OH6	04-May-16	0.0016				<0.0005			0.0152			0.0016			129
OH6	11-May-16	0.0021	<0.001	<0.00005	<0.01	0.0009	0.09	<0.0001	0.0141	<0.00008	<0.0005	0.0023	<0.0001	0.0049	165
OH6	19-May-16	0.0015				0.0007			0.0068			0.0018			124
OH6	25-May-16	0.0024				0.0009			0.0260			0.0028			200
OH6	02-Jun-16	0.0011	<0.001	<0.00005	<0.01	<0.0005	0.11	<0.0001	0.0176	<0.00008	<0.0005	0.0015	<0.0001	0.0054	90

Site	Date	Antimony	Arsenic	Cadmium	Cr (VI)	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Zinc	Hardness
OH6	08-Jun-16	0.0013				<0.0005			0.0162			0.0019			135
OH6	15-Jun-16	0.0009				<0.0005			0.018			0.0015			84
OH6	23-Jun-16	<0.0002				0.0009			0.036			0.0003			41
OH6	30-Jun-16	<0.0002				<0.0005			0.056			0.0003			36
OH6	14-Jul-16	<0.0002				<0.0005			0.041			0.0003			52
OH6	21-Jul-16	0.0003				<0.0005			0.02			0.0004			60
OH6	27-Jul-16	<0.0002				<0.0005			0.024			0.0003			31
OH6	05-Aug-16	0.0004				0.0009			0.0193			0.0006			50
OH6	11-Aug-16	0.0006				<0.0005			0.0187			0.0007			82
OH6	15-Aug-16	0.0007	<0.001	<0.00005	<0.01	0.0006	0.07	<0.0001	0.0172	<0.00008	<0.0005	0.0009	<0.0001	0.0133	94
OH6	25-Aug-16	0.0005				0.0012			0.036			0.0006			72
OH6	01-Sep-16	0.0006				<0.0005			0.0149			0.0008			77
OH6	08-Sep-16	0.0009				0.0009			0.0156			0.0010			97
OH6	13-Sep-16	0.0012	<0.001	<0.00005	<0.01	0.0008	0.05	<0.0001	0.0147	<0.00008	<0.0005	0.0014	<0.0001	0.0033	132
OH6	22-Sep-16	<0.0002										0.0010			
OH6	26-Sep-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.07	<0.0001	0.038	<0.00008	<0.0005	0.0010	<0.0001	0.0039	18
OH6	28-Sep-16	<0.0002										0.0010			
OH6	03-Oct-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.07	0.00062	0.03	<0.00008	<0.0005	0.0005	<0.0001	0.0049	43
OH6	13-Oct-16	0.0003										0.0010			
OH6	21-Oct-16	0.0007										0.0010			
OH6	26-Oct-16	0.0008										0.0010			
OH6	03-Nov-16	0.0017	<0.001	<0.00005	<0.01	0.0007	0.07	<0.0001	0.013	<0.00008	<0.0005	0.0017	<0.0001	0.0013	180
OH6	09-Nov-16	0.0015	<0.001	<0.00005	<0.01	0.0007	0.09	<0.0001	0.0185	<0.00008	<0.0005	0.0015	<0.0001	0.0015	180
OH6	17-Nov-16	0.0009										0.0010			
OH6	21-Nov-16	0.0027										0.0027			
OH6	01-Dec-16	0.0030	<0.001	<0.00005	<0.01	0.001	0.1	<0.0001	0.0186	<0.00008	<0.0005	0.0031	<0.0001	0.0089	250
OH6	06-Dec-16	0.0034										0.0034			
OH6	15-Dec-16	0.0020										0.0023			
OH6	20-Dec-16	0.0019										0.0022			
OH6	29-Dec-16	0.0030										0.0020			
OH6	05-Jan-17	0.0022										0.0020			
OH6	11-Jan-17	0.0029										0.0028			
OH6	17-Jan-17	0.0007	<0.001	<0.00005	<0.01	0.0006	0.1	<0.0001	0.0196	<0.00008	<0.0005	0.0006	<0.0001	0.0550	230
OH6	24-Jan-17	0.0005										0.0010			
OH6	01-Feb-17	0.0005	<0.001	<0.00005	<0.01	<0.0005	0.11	<0.0001	0.045	<0.00008	<0.0005	0.0004	<0.0001	0.0114	300

Site	Date	Antimony	Arsenic	Cadmium	Cr (VI)	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Zinc	Hardness
OH6	09-Feb-17	0.0006										0.0010			
OH6	15-Feb-17	0.0004										0.0010			
OH6	22-Feb-17	0.0003										0.0010			
OH6	02-Mar-17	0.0002										0.0010			
OH6	07-Mar-17	0.0004	<0.001	<0.00005	<0.01	<0.0005	0.1	<0.0001	0.0182	<0.00008	<0.0005	0.0001	<0.0001	0.0017	250
OH6	08-Mar-17	<0.0002	<0.001	<0.00005	<0.01	0.0006	0.24	0.00019	0.113	<0.00008	<0.0005	0.0010	<0.0001	0.0025	14
OH6	15-Mar-17	<0.0002										0.0010			
OH6	23-Mar-17	0.0006										0.0011			
OH6	30-Mar-17	<0.0002										0.0010			
OH6	06-Apr-17	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.05	<0.0001	0.025	<0.00008	<0.0005	0.0002	<0.0001	0.0176	26
OH6	11-Apr-17	0.0003										0.0010			
OH6	21-Apr-17	0.0003										0.0010			
OH6	27-Apr-17	0.0006										0.0010			
OH6	01-May-17	0.0016	<0.001	<0.00005	<0.01	0.0008	0.06	<0.0001	0.0146	<0.00008	<0.0005	0.0017	<0.0001	0.0110	189
OH6	04-May-17	0.0006										0.0010			
OH6	16-May-17	0.0003										0.0010			
OH6	25-May-17	0.0005	<0.001	<0.00005	<0.01	<0.0005	0.06	<0.0001	0.0164	<0.00008	<0.0005	0.0006	<0.0001	0.0019	81
OH6	31-May-17	0.0002										0.0010			
RU1	11-May-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.15	<0.0001	0.024	<0.00008	<0.0005	0.0002	<0.0001	0.0021	19
RU1	22-May-16					<0.0005	0.19		0.026						32
RU1	24-May-16					<0.0005	0.15		0.077						97
RU1	25-May-16					<0.0005	0.19		0.028						23
RU1	29-May-16					<0.0005	0.25		0.029						27
RU1	30-May-16					<0.0005	0.19		0.032						54
RU1	01-Jun-16	<0.0002	<0.001	<0.00005	<0.01	0.0008	0.19	<0.0001	0.106	<0.00008	0.0010	0.0002	<0.0001	0.0083	70
RU1	02-Jun-16					<0.0005	0.18		0.024						23
RU1	03-Jun-16					<0.0005	0.04		0.088						102
RU1	08-Jun-16					<0.0005	0.12		0.064						53
RU1	10-Jun-16					0.0008	0.2		0.073						71
RU1	13-Jun-16					<0.0005	0.14		0.034						49
RU1	14-Jun-16					<0.0005	0.15		0.076						64
RU1	15-Jun-16					<0.0005	0.13		0.025						21
RU1	23-Jun-16					0.0010	0.1		0.089						87
RU1	15-Aug-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.12	<0.0001	0.035	<0.00008	<0.0005	0.0003	<0.0001	0.0108	21
RU1	13-Sep-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.12	<0.0001	0.022	<0.00008	<0.0005	0.0003	<0.0001	0.0024	19

Site	Date	Antimony	Arsenic	Cadmium	Cr (VI)	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Zinc	Hardness
RU1	26-Sep-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.09	<0.0001	0.046	<0.00008	<0.0005	0.0010	<0.0001	0.0060	21
RU1	03-Oct-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.1	<0.0001	0.049	<0.00008	<0.0005	0.0003	<0.0001	0.0051	32
RU1	03-Nov-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.19	<0.0001	0.020	<0.00008	<0.0005	<0.0002	<0.0001	0.0064	19
RU1	10-Nov-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.21	<0.0001	0.022	<0.00008	<0.0005	<0.0002	<0.0001	0.0018	20
RU1	01-Dec-16	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.18	<0.0001	0.021	<0.00008	<0.0005	0.0003	<0.0001	0.0022	20
RU1	09-Jan-17	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.24	<0.0001	0.029	<0.00008	<0.0005	0.0005	<0.0001	0.0005	22
RU1	17-Jan-17	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.24	<0.0001	0.029	<0.00008	<0.0005	0.0003	<0.0001	0.0020	22
RU1	01-Feb-17	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.22	<0.0001	0.028	<0.00008	<0.0005	0.0004	<0.0001	0.0017	23
RU1	07-Mar-17	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.18	<0.0001	0.032	<0.00008	<0.0005	0.0003	<0.0001	0.0019	23
RU1	06-Apr-17	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.07	<0.0001	0.032	<0.00008	<0.0005	0.0003	<0.0001	0.0064	27
RU1	01-May-17	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.14	<0.0001	0.013	<0.00008	<0.0005	0.0003	<0.0001	0.0141	18
RU1	24-May-17	<0.0002	<0.001	<0.00005	<0.01	<0.0005	0.12	<0.0001	0.030	<0.00008	<0.0005	0.0003	<0.0001	0.0041	19

Notes: All units g/m^3; and concentrations are determined on soluble fraction, except mercury which is determined on acid soluble fraction.

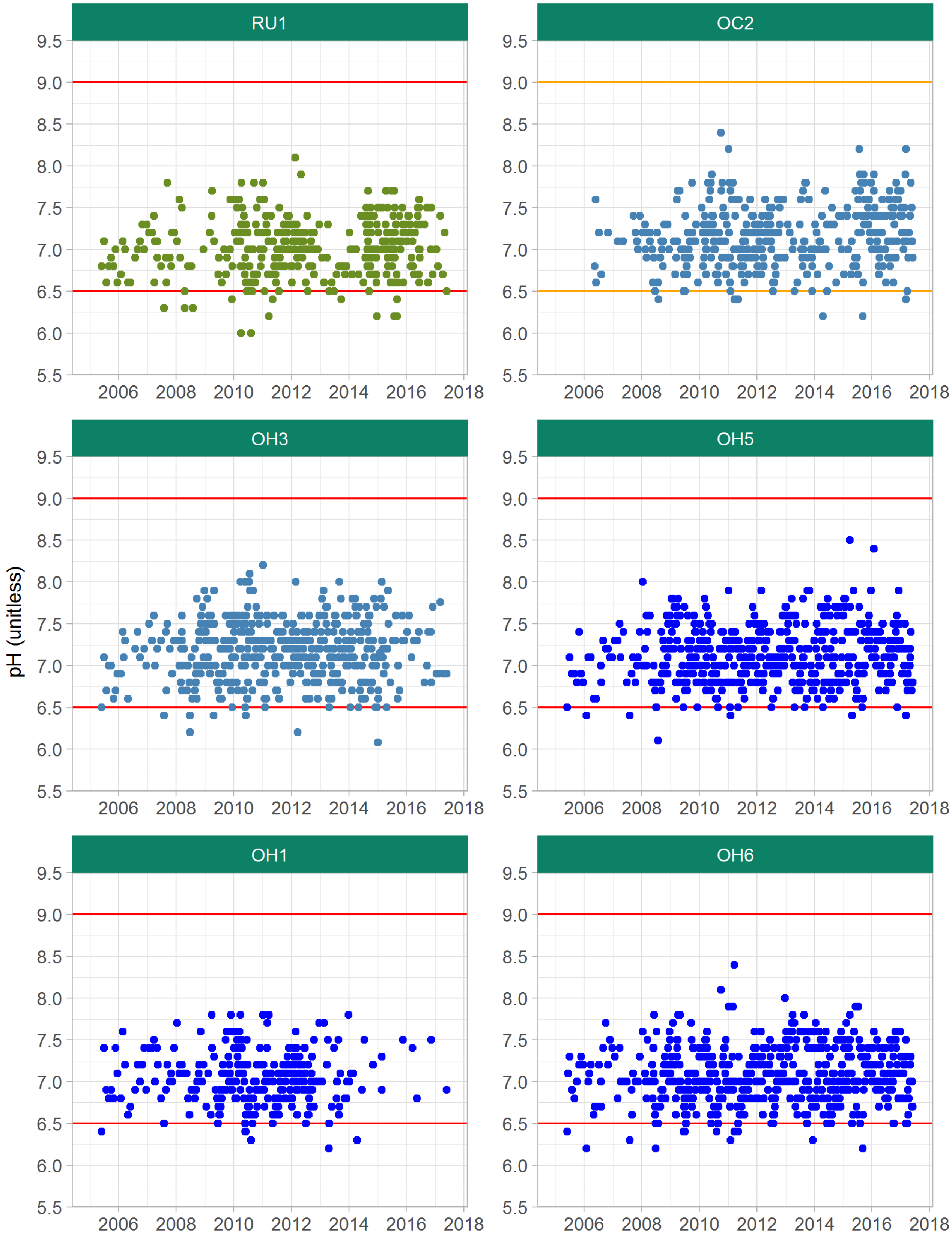

Figure 1: pH of the receiving waters at Sites RU1, OC2, OH3, OH5, OH1 and OH6.

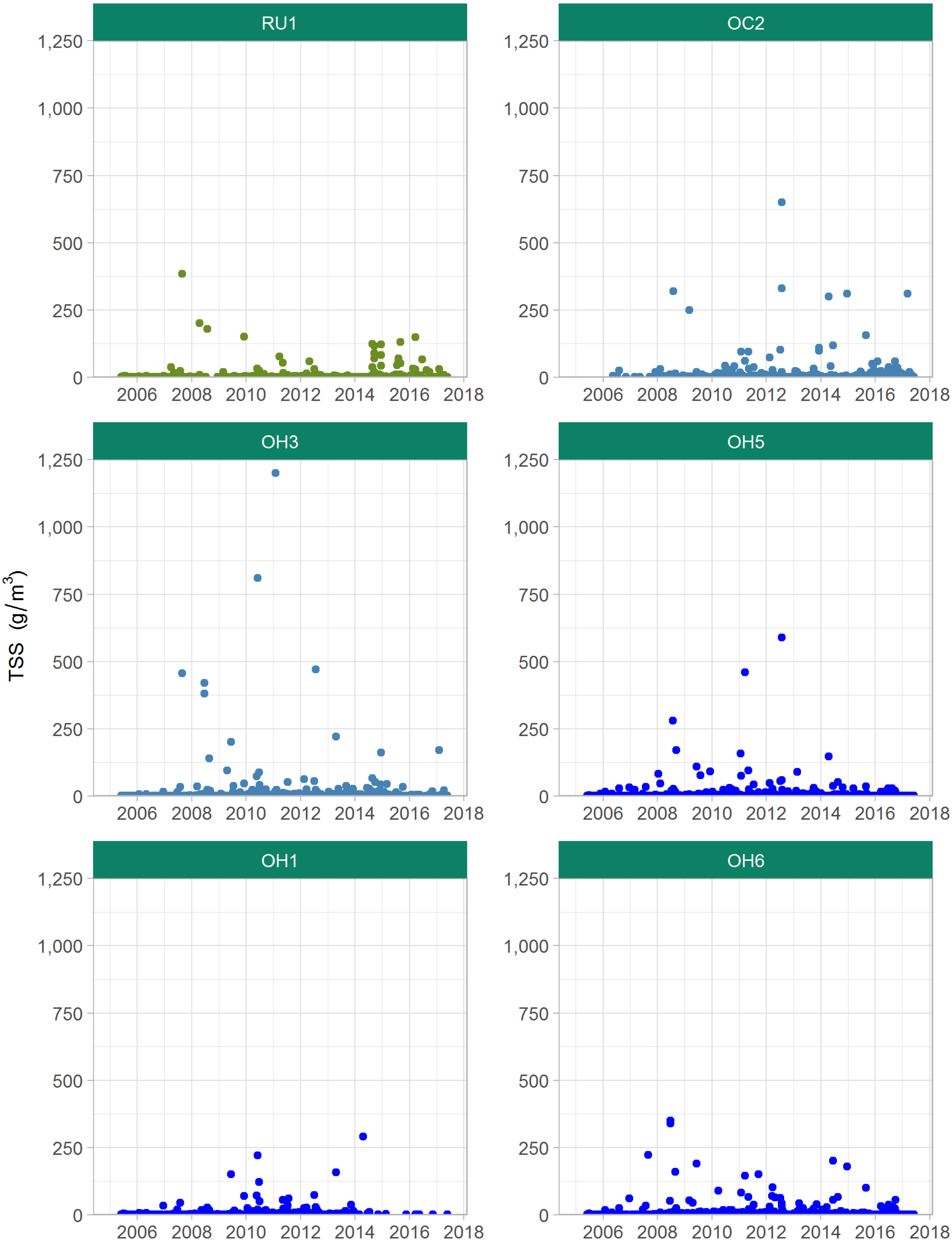

Figure 2: Total suspended solids concentrations in the receiving waters at Sites RU1, OC2, OH3, OH5, OH1 and OH6.

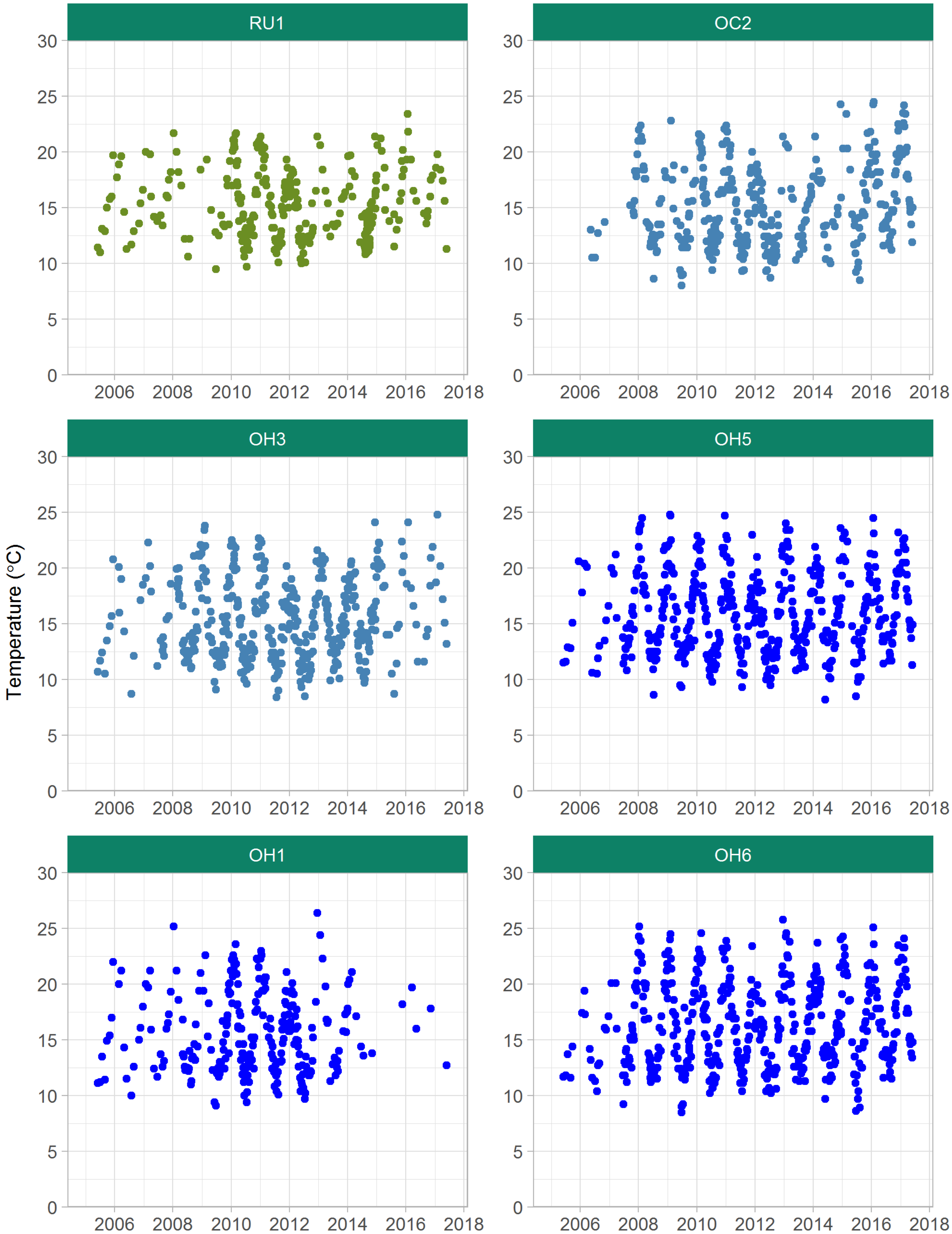

Figure 3: Temperature of the receiving waters at Sites RU1, OC2, OH3, OH5, OH1 and OH6.

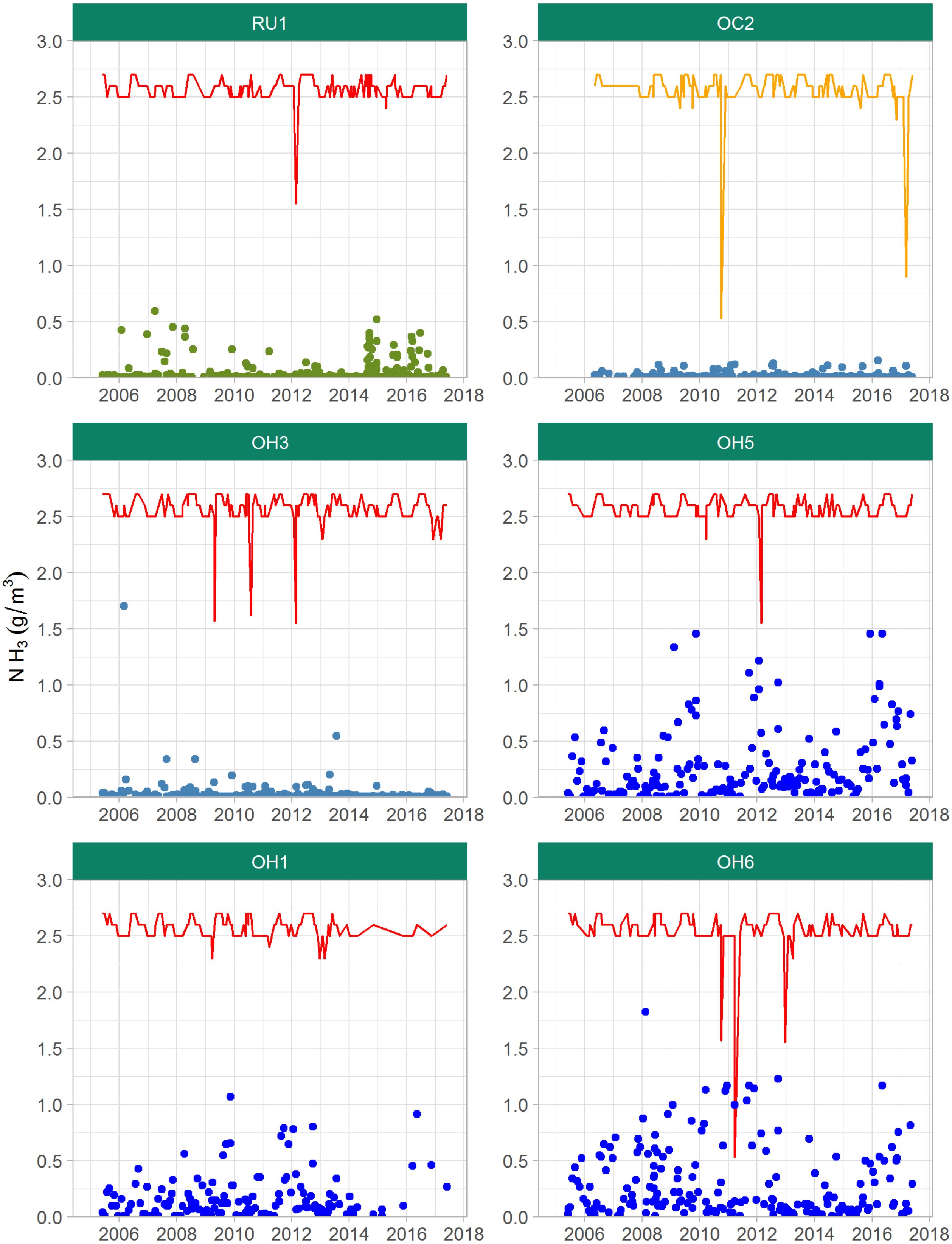

Figure 4: Total ammonia concentrations in the receiving waters at Sites RU1, OC2, OH3, OH5, OH1 and OH6.

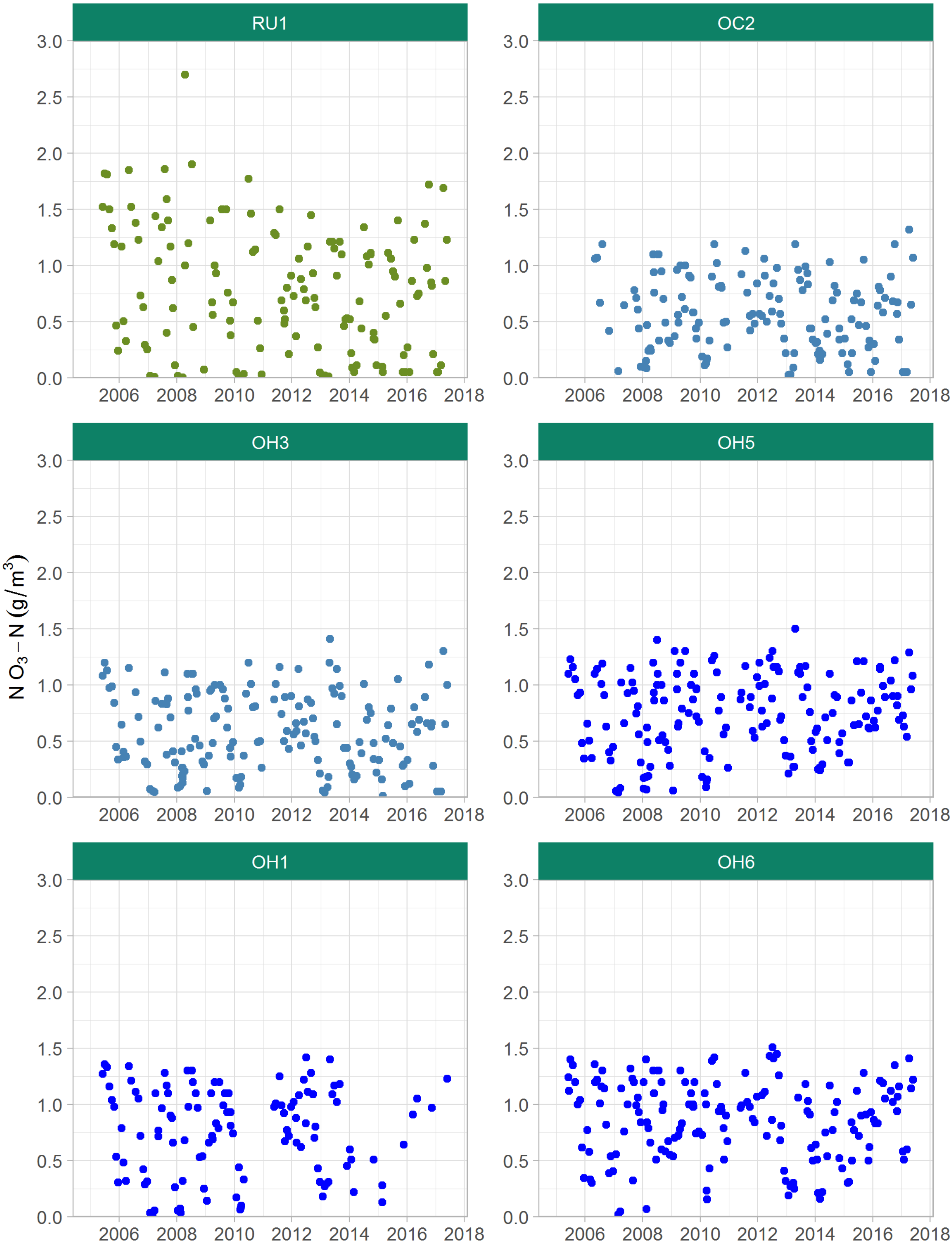

Figure 5: Nitrate nitrogen (NO_3-N) concentrations in the receiving waters at Sites RU1, OC2, OH3, OH5, OH1 and OH6.

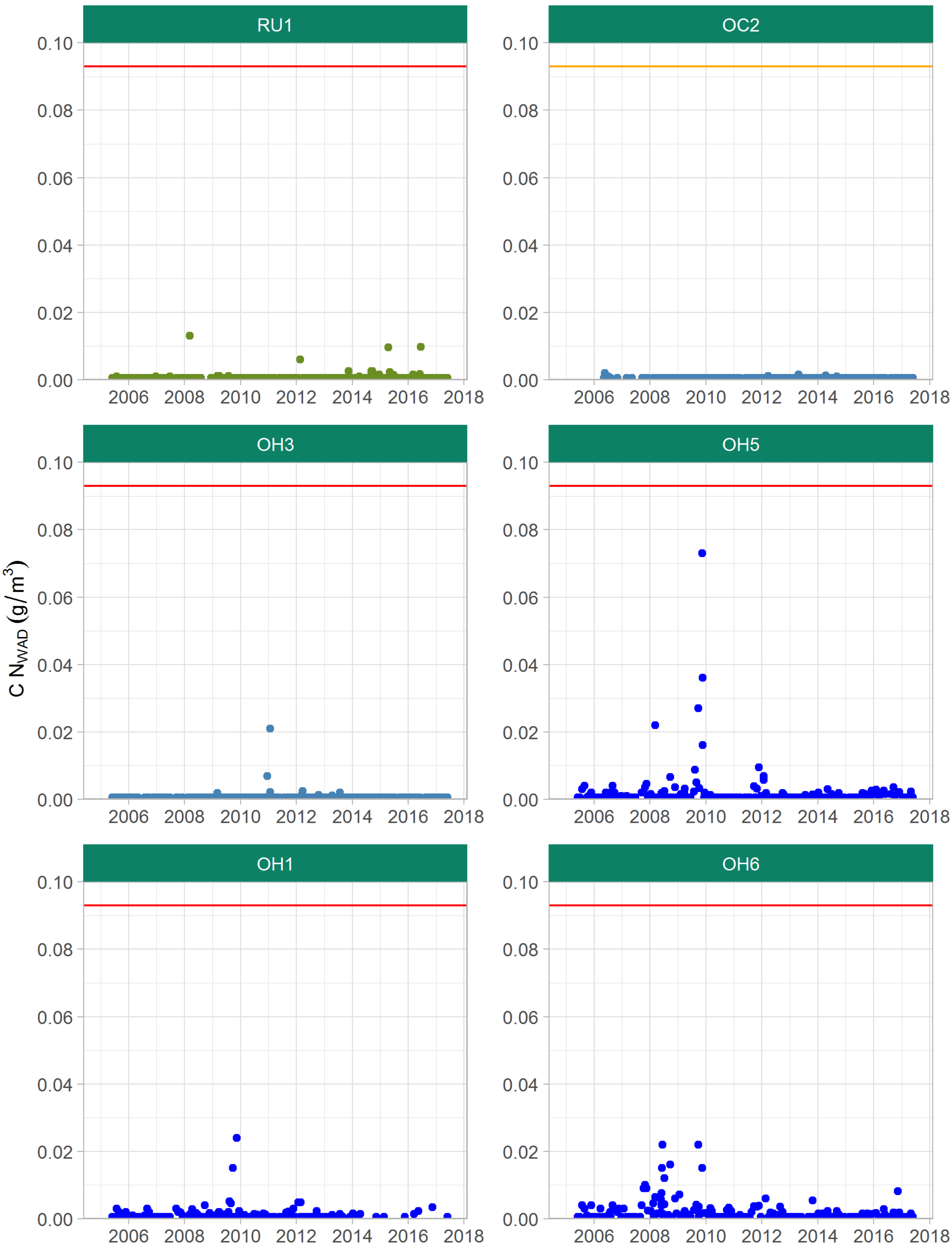

Figure 6: CN_{WAD} concentrations in the receiving waters at Sites RU1, OC2, OH3, OH5, OH1 and OH6.

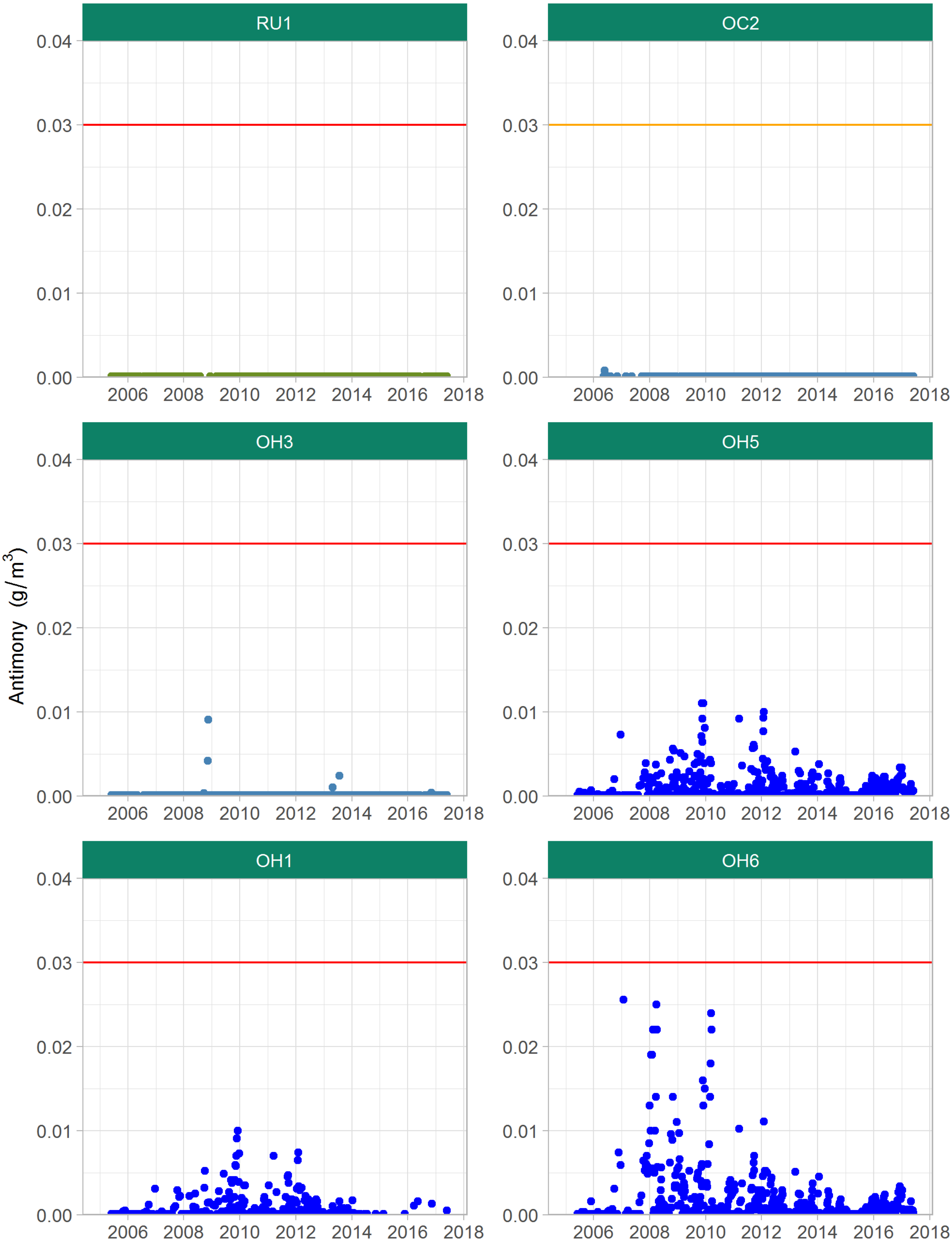

Figure 7: Dissolved antimony concentrations in the receiving waters at Sites RU1, OC2, OH3, OH5, OH1 and OH6.

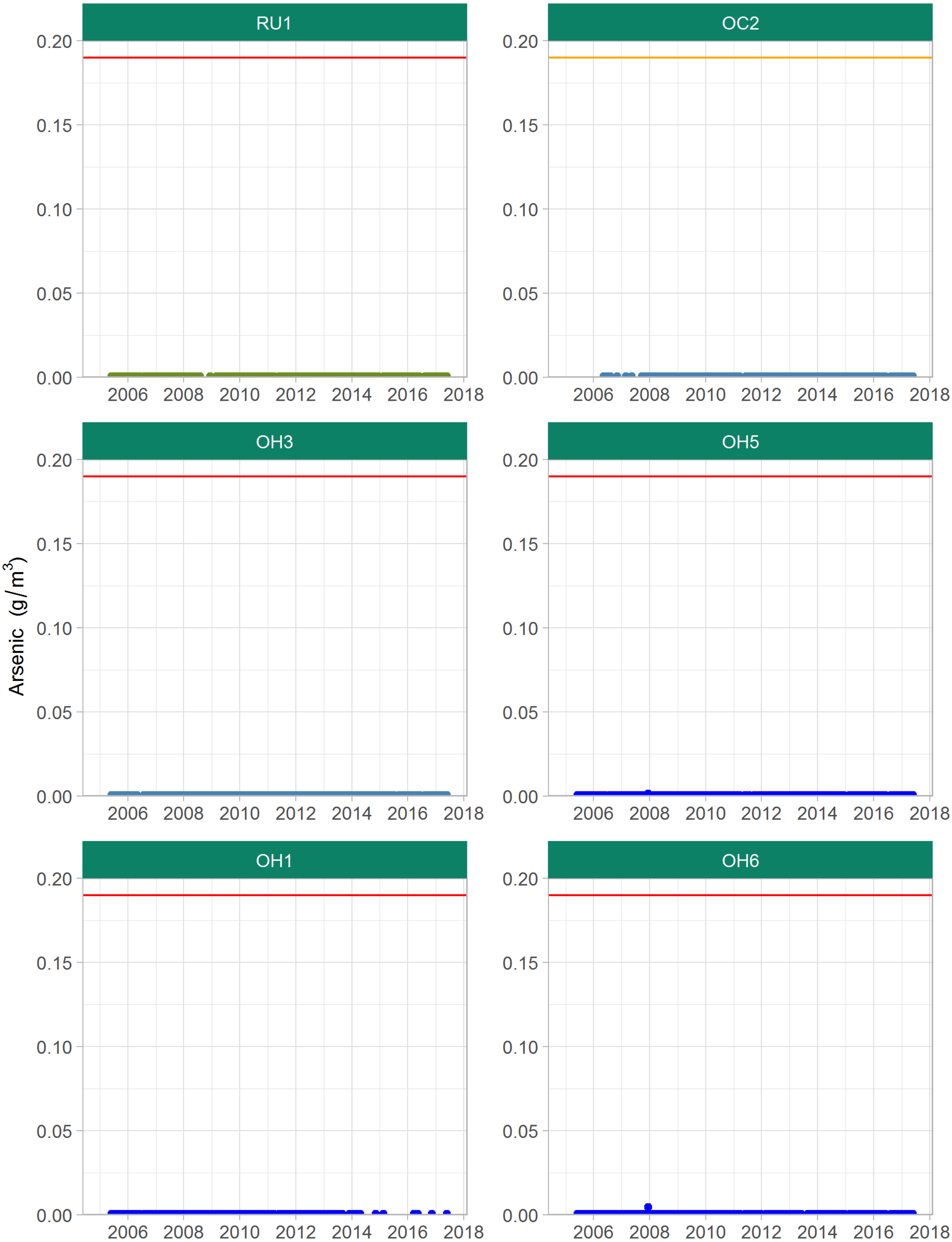

Figure 8: Dissolved arsenic concentrations in the receiving waters at Sites RU1, OC2, OH3, OH5, OH1 and OH6.

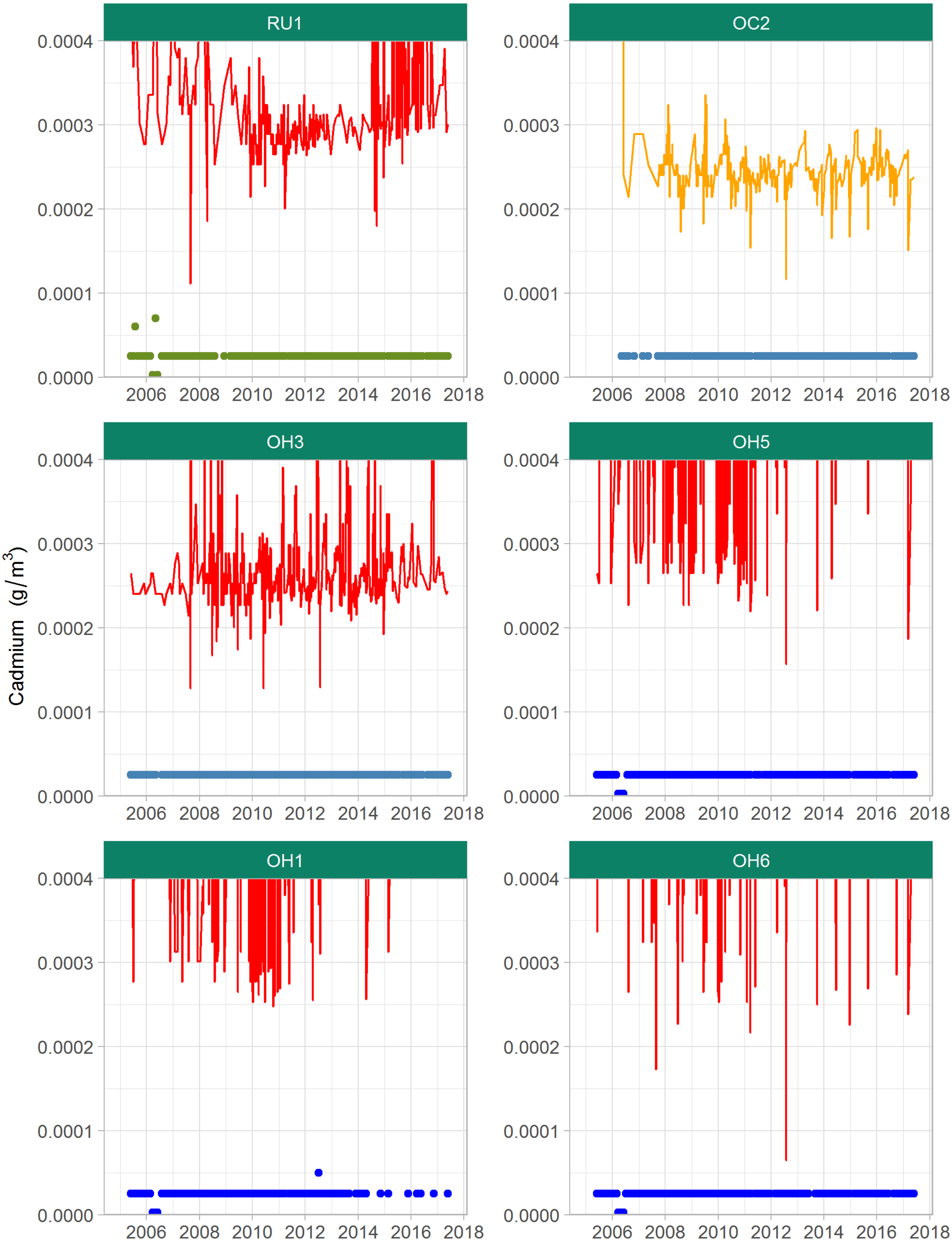

Figure 9: Dissolved cadmium concentrations in the receiving waters at Sites RU1, OC2, OH3, OH5, OH1 and OH6.

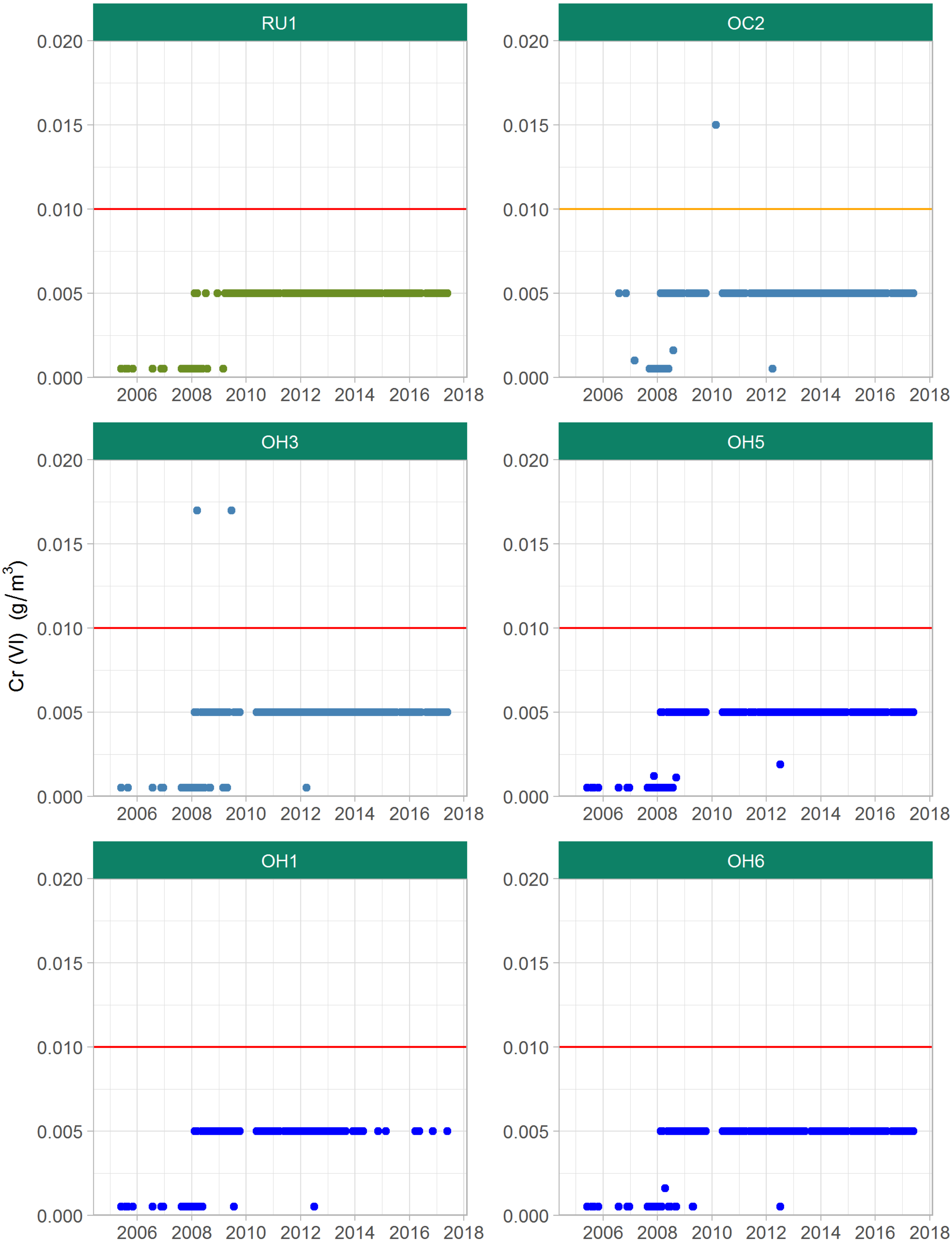

Figure 10: Chromium (VI) concentrations in the receiving waters at Sites RU1, OC2, OH3, OH5, OH1 and OH6.

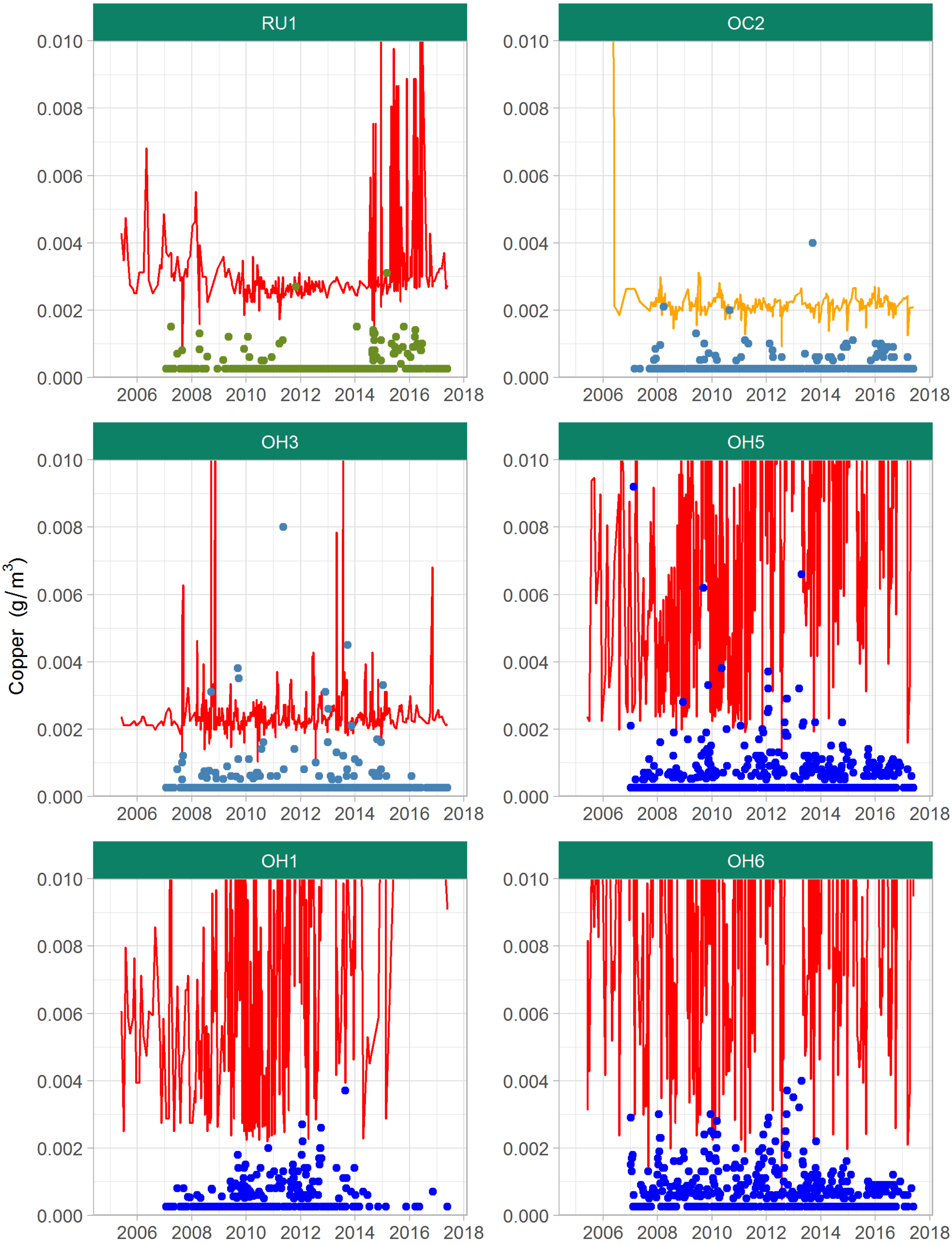

Figure 11: Dissolved copper concentrations in the receiving waters at Sites RU1, OC2, OH3, OH5, OH1 and OH6.

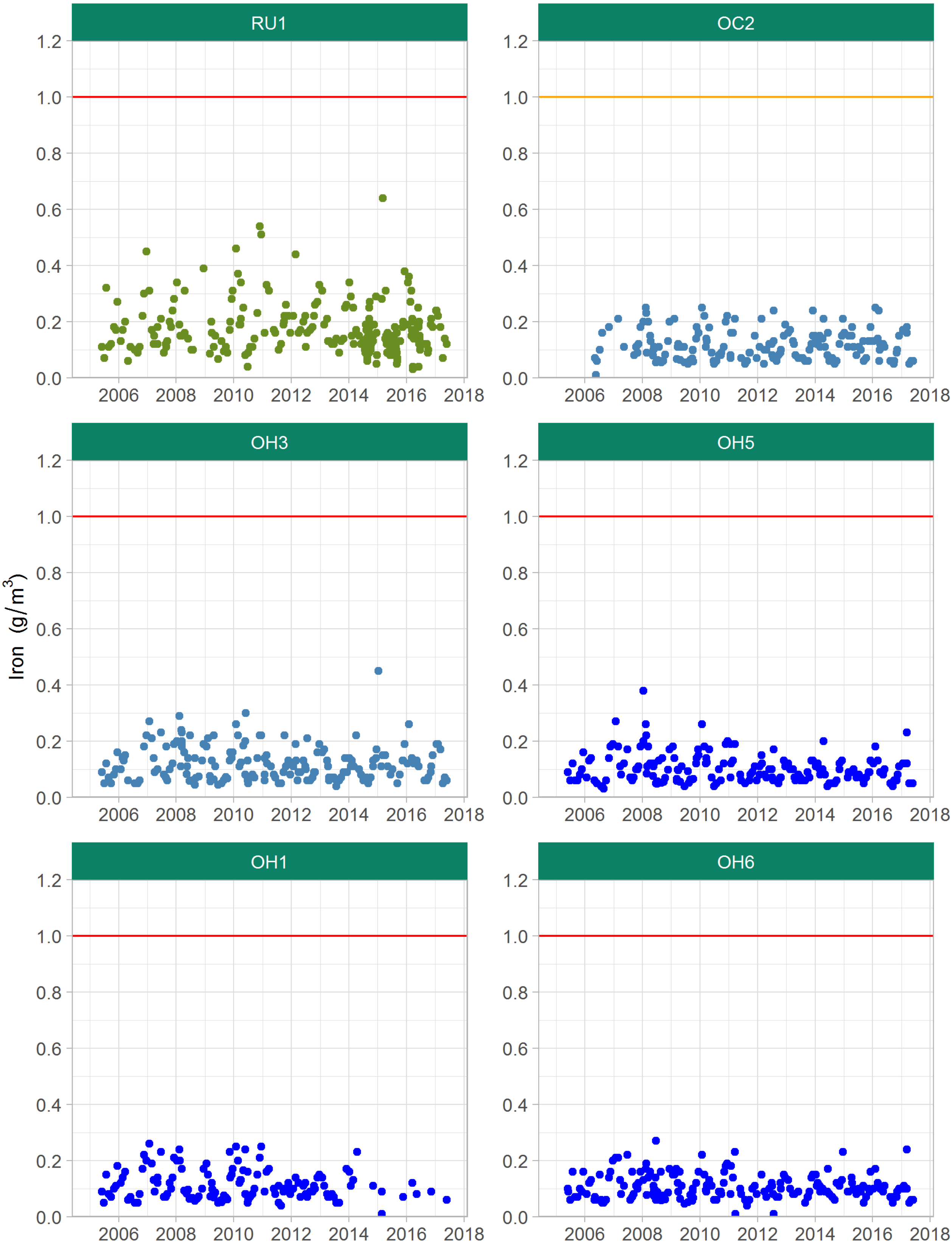

Figure 12: Dissolved iron concentrations in the receiving waters at Sites RU1, OC2, OH3, OH5, OH1 and OH6.

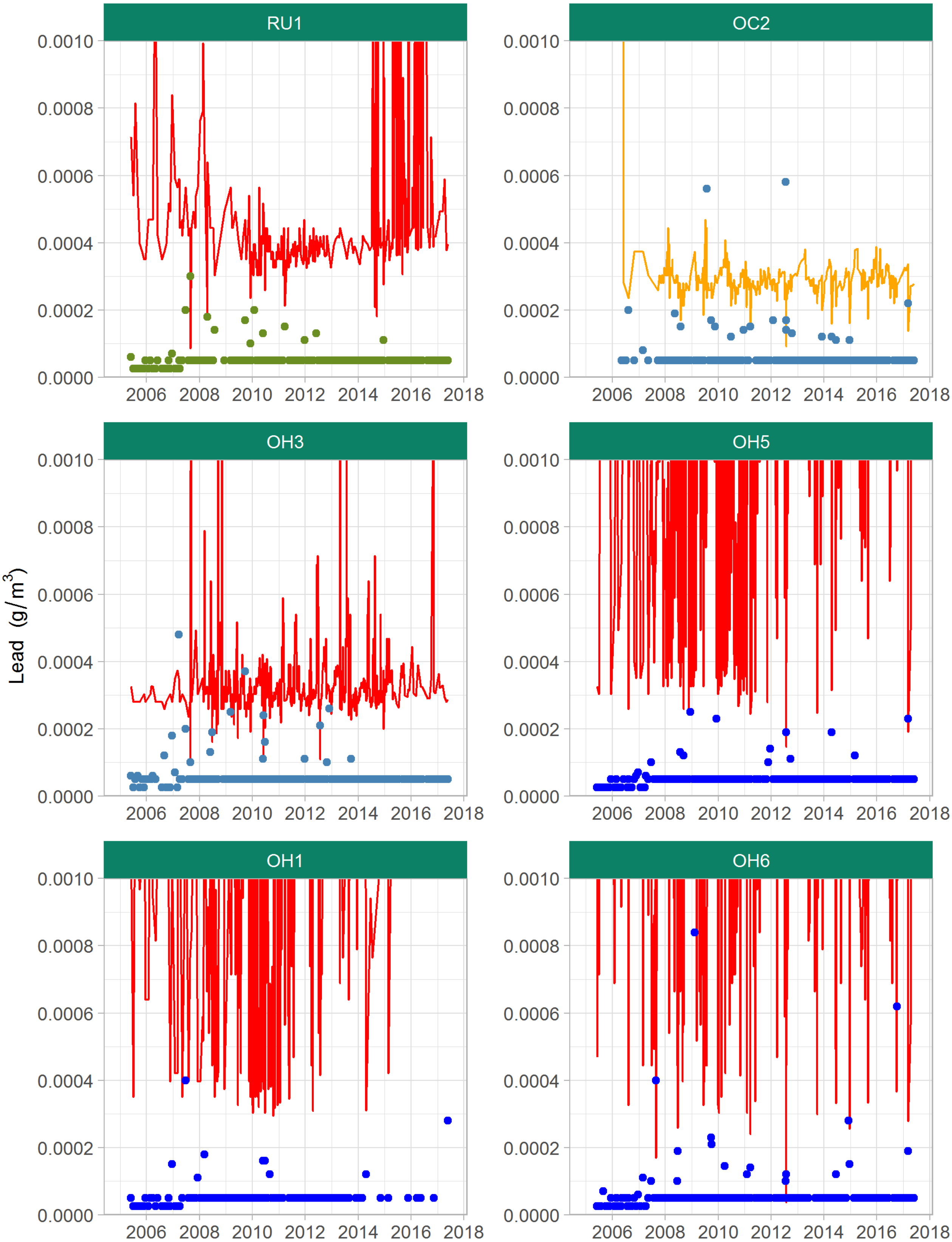

Figure 13: Dissolved lead concentrations in the receiving waters at Sites RU1, OC2, OH3, OH5, OH1 and OH6.

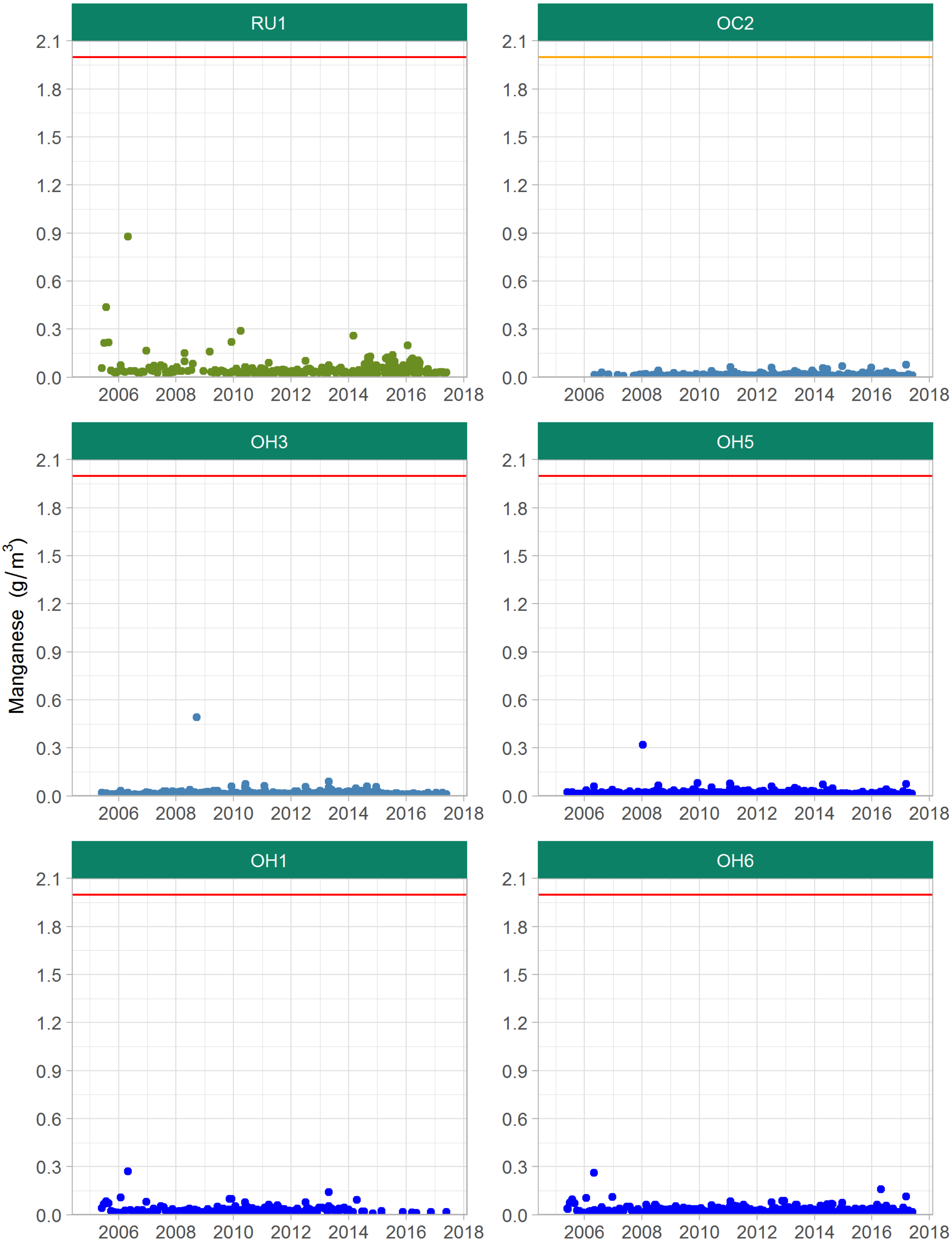

Figure 14: Dissolved manganese concentrations in the receiving waters at Sites RU1, OC2, OH3, OH5, OH1 and OH6.

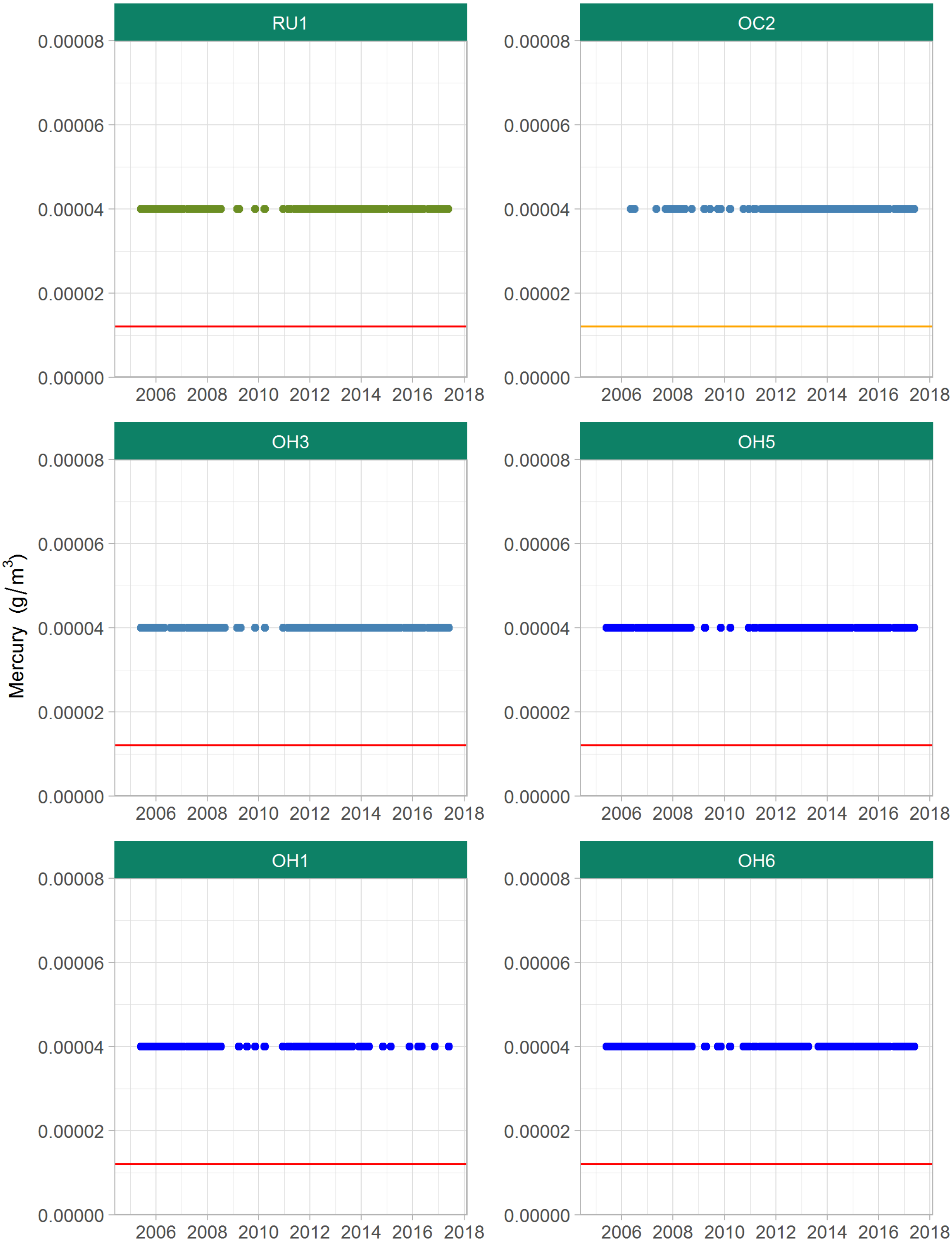

Figure 15: Acid soluble mercury concentrations in the receiving waters at Sites RU1, OC2, OH3, OH5, OH1 and OH6.

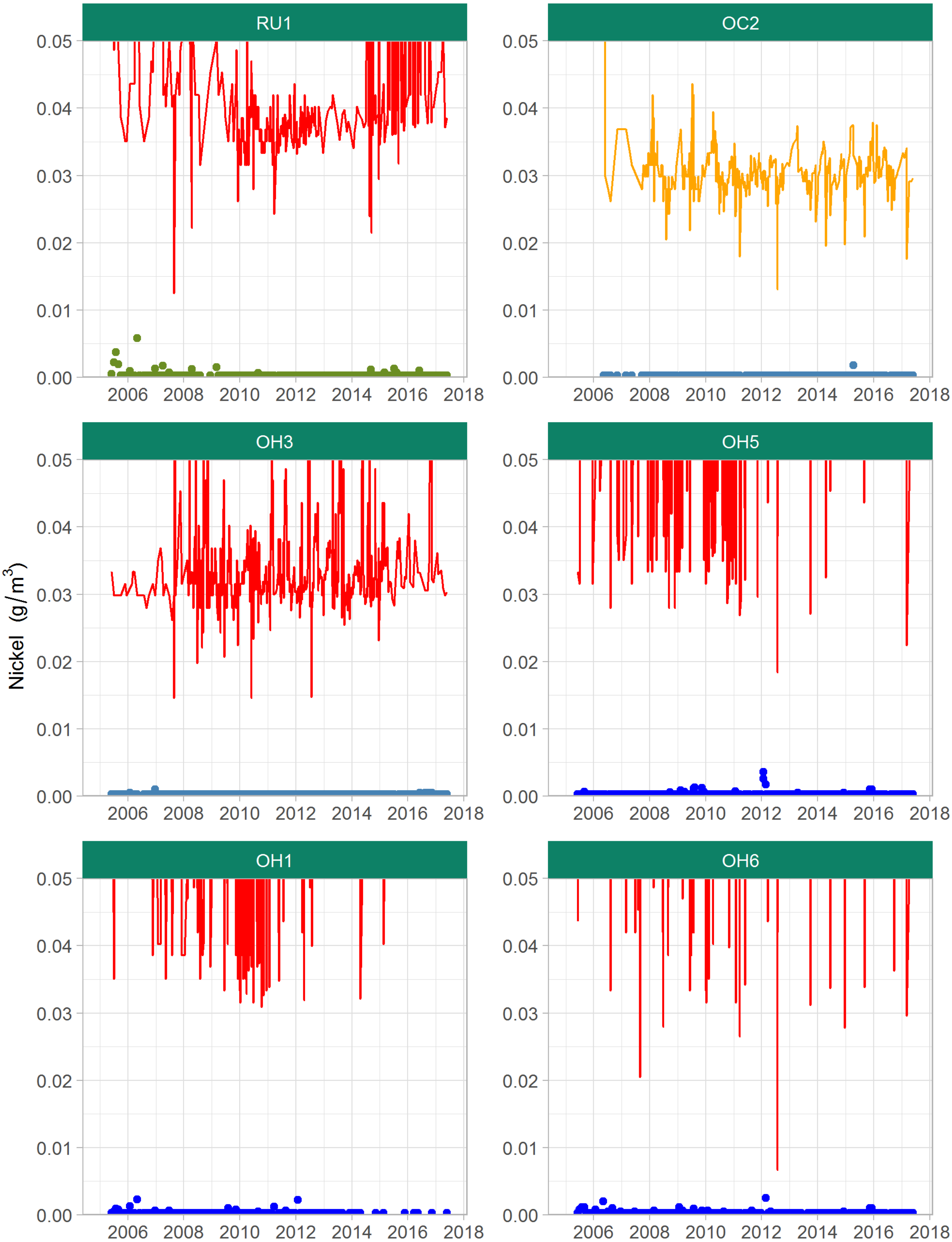

Figure 16: Dissolved nickel concentrations in the receiving waters at Sites RU1, OC2, OH3, OH5, OH1 and OH6.

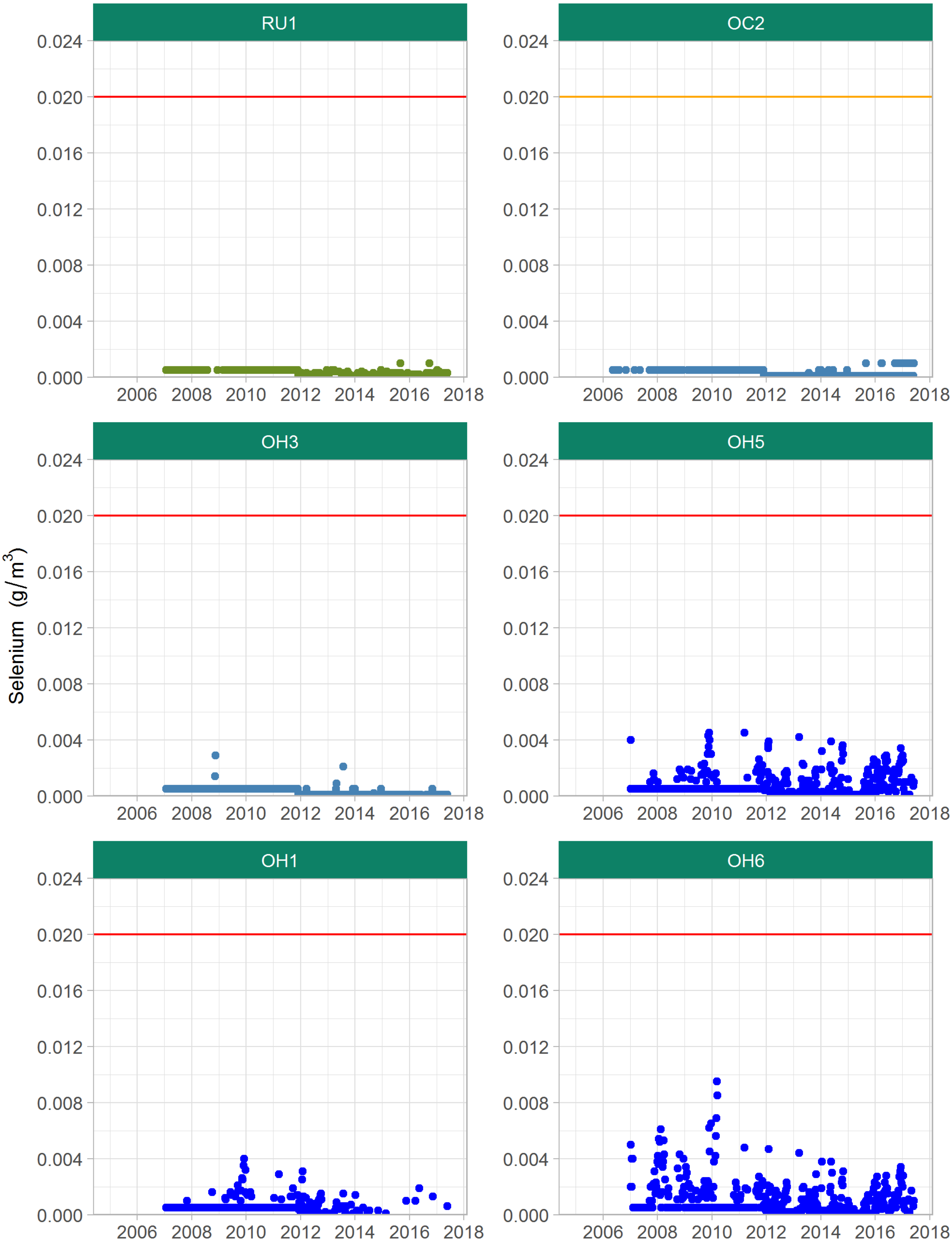

Figure 17: Dissolved selenium concentrations in the receiving waters at Sites RU1, OC2, OH3, OH5, OH1 and OH6.

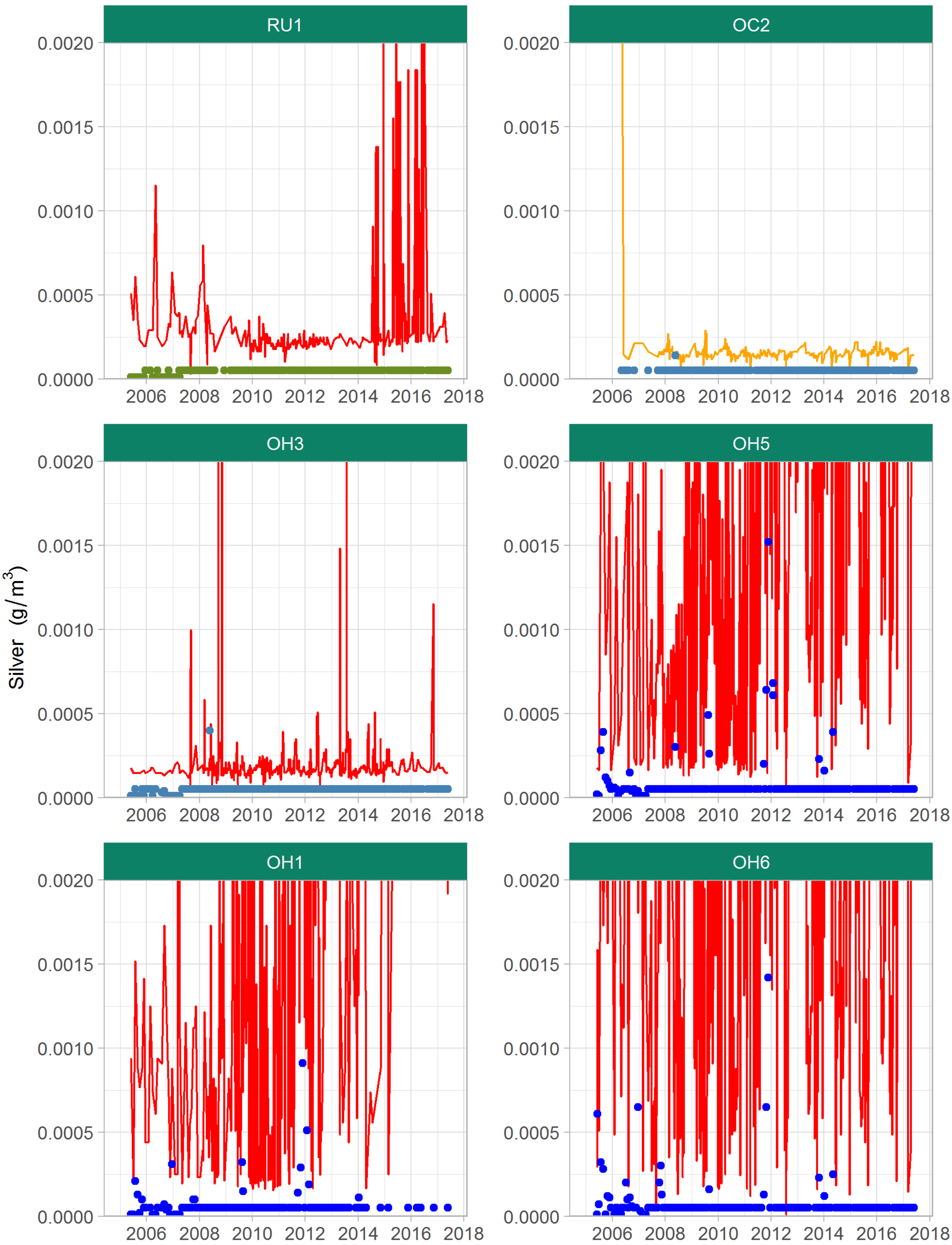

Figure 18: Dissolved silver concentrations in the receiving waters at Sites RU1, OC2, OH3, OH5, OH1 and OH6.

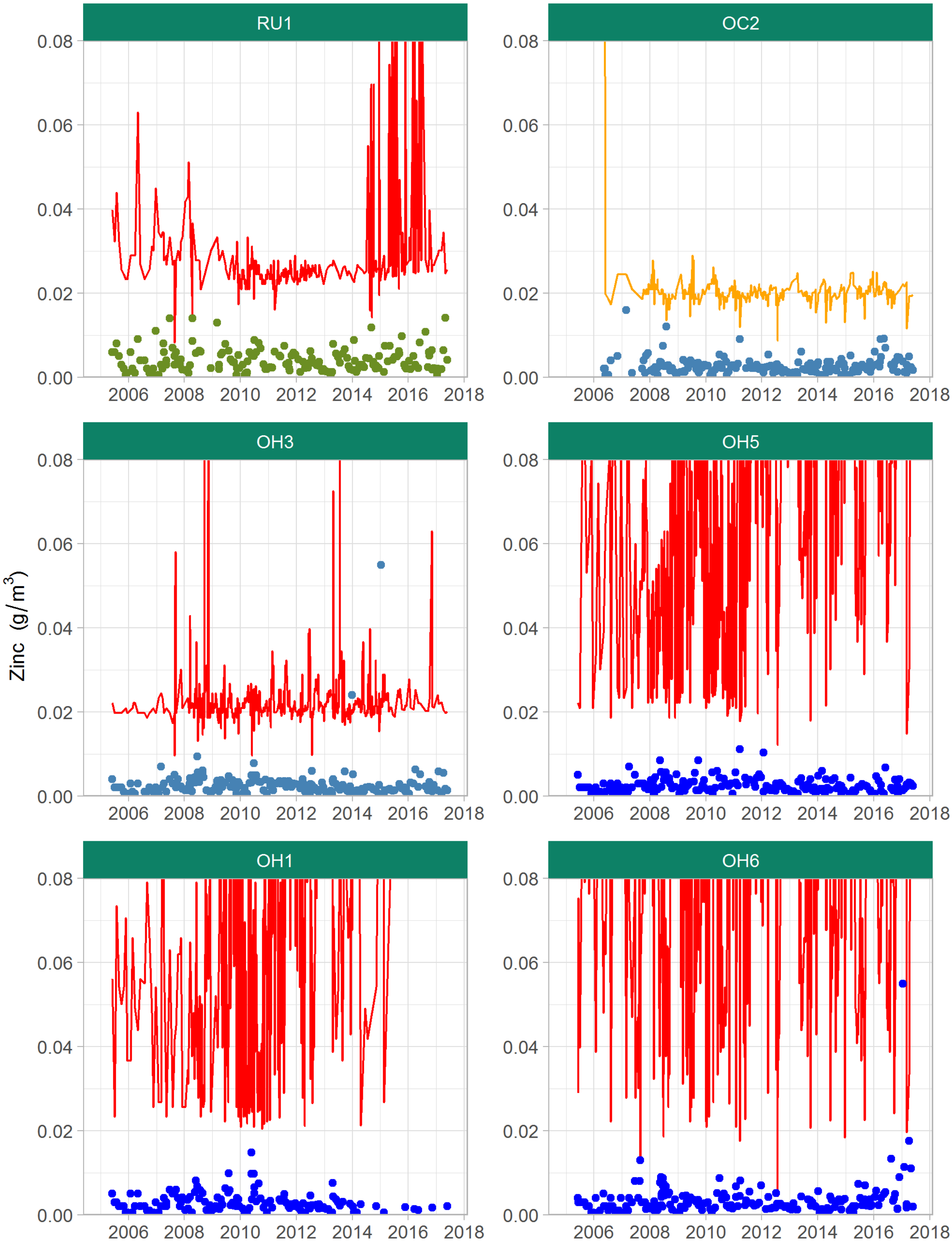

Figure 19: Dissolved zinc concentrations in the receiving waters at Sites RU1, OC2, OH3, OH5, OH1 and OH6.

APPENDIX E

Sediment Quality Data

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Hill Laboratories
BETTER TESTING **BETTER RESULTS**

ANALYSIS REPORT

Client:	Golder Associates (NZ) Limited	**Lab No:**	1679343 SPv1
Contact:	Dr Grant Allen	**Date Received:**	12-Nov-2016
	C/- Golder Associates (NZ) Limited	**Date Reported:**	29-Nov-2016
	PO Box 33849	**Quote No:**	34403
	Takapuna	**Order No:**	1413045
	Auckland 0740	**Client Reference:**	Sediments
		Submitted By:	Dr Grant Allen

Sample Type: Sediment

Sample Name:		OH6 09-Nov-2016 10:00 am	OH1 09-Nov-2016 11:30 am	OC2 09-Nov-2016 2:30 pm	OH3 09-Nov-2016 4:30 pm	OH5 10-Nov-2016 9:30 am
Lab Number:		1679343.1	1679343.2	1679343.3	1679343.4	1679343.5
Individual Tests						
Dry Matter	g/100g as rcvd	73	67	63	65	67
Total Recoverable Antimony	mg/kg dry wt	0.09	0.04	< 0.04	< 0.04	< 0.04
Chromium (hexavalent)*	mg/kg dry wt	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total Recoverable Iron	mg/kg dry wt	14,700	13,800	18,300	15,900	14,300
Total Recoverable Manganese	mg/kg dry wt	220	240	410	370	250
Total Recoverable Selenium	mg/kg dry wt	0.8	0.6	< 0.5	< 0.5	< 0.5
Total Recoverable Silver	mg/kg dry wt	0.42	0.09	0.07	0.05	0.08
Heavy metals, trace As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	2.9	2.7	3.0	2.4	2.3
Total Recoverable Cadmium	mg/kg dry wt	0.079	0.047	0.093	0.059	0.047
Total Recoverable Chromium	mg/kg dry wt	15.6	12.7	17.6	17.7	15.3
Total Recoverable Copper	mg/kg dry wt	5.0	4.0	5.8	5.1	4.6
Total Recoverable Lead	mg/kg dry wt	6.5	5.4	7.8	6.2	9.0
Total Recoverable Mercury	mg/kg dry wt	0.27	0.21	0.34	0.34	0.22
Total Recoverable Nickel	mg/kg dry wt	4.7	3.9	5.8	6.0	5.3
Total Recoverable Zinc	mg/kg dry wt	31	27	41	37	31
Texture Marine (2 mm, 63 µm fractions)						
Dry Matter	g/100g as rcvd	77	69	65	66	72
Fraction >/= 2 mm*	g/100g dry wt	53.8	24.6	4.0	0.6	2.3
Fraction < 2 mm, >/= 63 µm*	g/100g dry wt	44.2	72.6	90.3	98.9	95.4
Fraction < 63 µm*	g/100g dry wt	2.0	2.8	5.7	0.5	2.3

Sample Name:		RU1 10-Nov-2016 11:30 am	OH6 [63um Sieve Fraction]	OH1 [63um Sieve Fraction]	OC2 [63um Sieve Fraction]	OH3 [63um Sieve Fraction]
Lab Number:		1679343.6	1679343.7	1679343.8	1679343.9	1679343.10
Individual Tests						
Dry Matter	g/100g as rcvd	65	-	-	-	-
Total Recoverable Antimony	mg/kg dry wt	< 0.04	0.25	0.3	0.10	0.12
Chromium (hexavalent)*	mg/kg dry wt	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total Recoverable Iron	mg/kg dry wt	8,400	32,000	32,000	29,000	32,000
Total Recoverable Manganese	mg/kg dry wt	420	780	1,340	1,140	970
Total Recoverable Selenium	mg/kg dry wt	0.7	3.0	2.8	1.8	1.6
Total Recoverable Silver	mg/kg dry wt	0.05	0.99	0.80	0.30	0.27
Heavy metals, trace As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	2.0	7.7	7.4	5.9	6.2
Total Recoverable Cadmium	mg/kg dry wt	0.136	0.40	0.38	0.36	0.27
Total Recoverable Chromium	mg/kg dry wt	4.0	21	22	23	24
Total Recoverable Copper	mg/kg dry wt	1.9	17.8	17.8	14.0	14.4

Sample Type: Sediment

Sample Name:	RU1 10-Nov-2016 11:30 am	OH6 [63um Sieve Fraction]	OH1 [63um Sieve Fraction]	OC2 [63um Sieve Fraction]	OH3 [63um Sieve Fraction]
Lab Number:	1679343.6	1679343.7	1679343.8	1679343.9	1679343.10
Heavy metals, trace As,Cd,Cr,Cu,Ni,Pb,Zn,Hg					
Total Recoverable Lead mg/kg dry wt	6.4	16.6	16.9	15.1	15.4
Total Recoverable Mercury mg/kg dry wt	0.094	0.39	0.40	0.44	0.38
Total Recoverable Nickel mg/kg dry wt	1.8	8.6	9.0	9.3	8.9
Total Recoverable Zinc mg/kg dry wt	32	77	77	77	68
Texture Marine (2 mm, 63 µm fractions)					
Dry Matter g/100g as rcvd	66	-	-	-	-
Fraction >/= 2 mm* g/100g dry wt	3.7	-	-	-	-
Fraction < 2 mm, >/= 63 µm* g/100g dry wt	93.9	-	-	-	-
Fraction < 63 µm* g/100g dry wt	2.4	-	-	-	-

Sample Name:	OH5 [63um Sieve Fraction]	RU1 [63um Sieve Fraction]			
Lab Number:	1679343.11	1679343.12			
Individual Tests					
Total Recoverable Antimony mg/kg dry wt	0.22	0.16	-	-	-
Chromium (hexavalent)* mg/kg dry wt	< 0.4	< 0.4	-	-	-
Total Recoverable Iron mg/kg dry wt	33,000	35,000	-	-	-
Total Recoverable Manganese mg/kg dry wt	910	2,100	-	-	-
Total Recoverable Selenium mg/kg dry wt	2.7	2.7	-	-	-
Total Recoverable Silver mg/kg dry wt	1.52	0.31	-	-	-
Heavy metals, trace As,Cd,Cr,Cu,Ni,Pb,Zn,Hg					
Total Recoverable Arsenic mg/kg dry wt	7.5	9.0	-	-	-
Total Recoverable Cadmium mg/kg dry wt	0.28	0.68	-	-	-
Total Recoverable Chromium mg/kg dry wt	26	10.5	-	-	-
Total Recoverable Copper mg/kg dry wt	20	12.4	-	-	-
Total Recoverable Lead mg/kg dry wt	17.1	20	-	-	-
Total Recoverable Mercury mg/kg dry wt	0.49	0.156	-	-	-
Total Recoverable Nickel mg/kg dry wt	10.3	7.0	-	-	-
Total Recoverable Zinc mg/kg dry wt	78	103	-	-	-

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Sediment

Test	Method Description	Default Detection Limit	Sample No
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1-6
Heavy metals, trace As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, trace level.	0.010 - 0.4 mg/kg dry wt	1-12
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. US EPA 3550. (Free water removed before analysis).	0.10 g/100g as rcvd	1-6
Dry Matter	Drying for 16 hours at 103°C, gravimetry (Free water removed before analysis).	0.10 g/100g as rcvd	1-6
Extraction of Hexavalent Chromium in Environmental Solids*	0.01M KH_2PO_4 Extraction.	-	1-12
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1-12
Texture Marine (2 mm, 63 µm fractions) *		-	1-6
Fraction < 2 mm, >/= 63 µm*	Wet sieving, 2.00 mm and 63 µm sieves, gravimetry (calculation by difference).	0.1 g/100g dry wt	1-6
Sieving through 63 um sieve, no gravimetric result*	<63µm Wet Sieved with no gravimetric determination.	-	1-6
Fraction < 63 µm*	Wet sieving, 63 µm sieve, gravimetry (calculation by difference).	0.1 g/100g dry wt	1-6
Total Recoverable Antimony	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, trace level. US EPA 200.2.	0.04 mg/kg dry wt	1-12

Sample Type: Sediment			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Hexavalent Chromium in Dried and Sieved Environmental Solids*	Phosphate buffer extraction, colorimetry.	0.4 mg/kg dry wt	7-12
Hexavalent Chromium in Environmental Solids*	Phosphate buffer extraction, colorimetry.	0.4 mg/kg dry wt	1-6
Total Recoverable Iron	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	1-12
Total Recoverable Manganese	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	1.0 mg/kg dry wt	1-12
Total Recoverable Selenium Ultratrace	Dried sample, < 2mm fraction. Nitric / hydrochloric acid digestion, ICP-MS, trace level. US EPA 200.2.	0.5 mg/kg dry wt	1-12
Total Recoverable Silver	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, trace level. US EPA 200.2.	0.02 mg/kg dry wt	1-12

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

This report must not be reproduced, except in full, without the written consent of the signatory.

Ara Heron BSc (Tech)
Client Services Manager - Environmental

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TRIED, TESTED AND TRUSTED

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ANALYSIS REPORT

Client:	Golder Associates (NZ) Limited	**Lab No:**	1783646 SPv2
Contact:	Mr P Kennedy	**Date Received:**	30-May-2017
	C/- Golder Associates (NZ) Limited	**Date Reported:**	21-Jul-2017 **(Amended)**
	PO Box 33849	**Quote No:**	
	Takapuna	**Order No:**	
	Auckland 0740	**Client Reference:**	1413045/1630
		Submitted By:	Mr P Kennedy

Sample Type: Sediment

Sample Name:		OC2 24-May-2017	OH3 24-May-2017	OH5 23-May-2017	OH6 24-May-2017	OH1 24-May-2017
Lab Number:		1783646.1	1783646.2	1783646.3	1783646.4	1783646.5
Individual Tests						
Total Recoverable Antimony	mg/kg dry wt	0.05	< 0.04	0.05	0.06	0.05
Chromium (hexavalent)*	mg/kg dry wt	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total Recoverable Iron	mg/kg dry wt	23,000	15,200	17,800	16,900	15,400
Total Recoverable Manganese	mg/kg dry wt	410	280	320	300	210
Total Recoverable Selenium	mg/kg dry wt	0.7	< 0.5	< 0.5	0.5	< 0.5
Total Recoverable Silver	mg/kg dry wt	0.15	0.08	0.15	0.10	0.07
Heavy metals, trace As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	3.5	1.8	2.7	2.5	2.4
Total Recoverable Cadmium	mg/kg dry wt	0.129	0.063	0.069	0.079	0.056
Total Recoverable Chromium	mg/kg dry wt	24	16.5	18.0	18.0	16.8
Total Recoverable Copper	mg/kg dry wt	8.8	4.8	6.9	5.8	5.0
Total Recoverable Lead	mg/kg dry wt	11.0	7.8	7.2	7.3	5.7
Total Recoverable Mercury	mg/kg dry wt	0.42	0.28	0.34	0.36	0.27
Total Recoverable Nickel	mg/kg dry wt	7.4	4.0	6.2	6.5	6.1
Total Recoverable Zinc	mg/kg dry wt	57	32	40	41	38
Texture Marine (2 mm, 63 µm fractions)						
Dry Matter	g/100g as rcvd	59	66	69	70	68
Fraction >/= 2 mm*	g/100g dry wt	7.9	< 0.1	2.0	10.3	2.6
Fraction < 2 mm, >/= 63 µm*	g/100g dry wt	81.7	95.4	93.2	85.2	93.9
Fraction < 63 µm*	g/100g dry wt	10.4	4.6	4.7	4.5	3.5

Sample Name:		RU1 23-May-2017	OC2 [63um Sieve Fraction]	OH3 [63um Sieve Fraction]	OH5 [63um Sieve Fraction]	OH6 [63um Sieve Fraction]
Lab Number:		1783646.6	1783646.7	1783646.8	1783646.9	1783646.10
Individual Tests						
Total Recoverable Antimony	mg/kg dry wt	< 0.04	0.16	0.14	0.18	0.24
Chromium (hexavalent)*	mg/kg dry wt	< 0.4	< 0.4 #1	< 0.4 #1	< 0.4 #1	< 0.4 #1
Total Recoverable Iron	mg/kg dry wt	9,400	33,000	32,000	31,000	31,000
Total Recoverable Manganese	mg/kg dry wt	340	690	960	740	830
Total Recoverable Selenium	mg/kg dry wt	< 0.5	1.7	1.9	2.4	2.3
Total Recoverable Silver	mg/kg dry wt	0.10	0.49	0.76	1.11	0.61
Heavy metals, trace As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	1.8	6	6	7	6
Total Recoverable Cadmium	mg/kg dry wt	0.116	0.38	0.24	0.42	0.34
Total Recoverable Chromium	mg/kg dry wt	4.5	23	26	25	25
Total Recoverable Copper	mg/kg dry wt	2.0	12.9	13.2	17.4	14.7
Total Recoverable Lead	mg/kg dry wt	6.0	17.8	17.6	17.7	17.7
Total Recoverable Mercury	mg/kg dry wt	0.071	0.54	0.56	0.67	0.52

Sample Type: Sediment						
Sample Name:		RU1 23-May-2017	OC2 [63um Sieve Fraction]	OH3 [63um Sieve Fraction]	OH5 [63um Sieve Fraction]	OH6 [63um Sieve Fraction]
Lab Number:		1783646.6	1783646.7	1783646.8	1783646.9	1783646.10
Heavy metals, trace As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Nickel	mg/kg dry wt	2.2	7.0	7.7	8.4	7.8
Total Recoverable Zinc	mg/kg dry wt	33	84	66	91	74
Texture Marine (2 mm, 63 µm fractions)						
Dry Matter	g/100g as rcvd	70	-	-	-	-
Fraction >/= 2 mm*	g/100g dry wt	22.7	-	-	-	-
Fraction < 2 mm, >/= 63 µm*	g/100g dry wt	74.6	-	-	-	-
Fraction < 63 µm*	g/100g dry wt	2.7	-	-	-	-

Sample Name:		OH1 [63um Sieve Fraction]	RU1 [63um Sieve Fraction]			
Lab Number:		1783646.11	1783646.12			
Individual Tests						
Total Recoverable Antimony	mg/kg dry wt	0.15	0.17	-	-	-
Chromium (hexavalent)*	mg/kg dry wt	< 0.4 #1	< 0.4 #1	-	-	-
Total Recoverable Iron	mg/kg dry wt	34,000	33,000	-	-	-
Total Recoverable Manganese	mg/kg dry wt	1,070	1,730	-	-	-
Total Recoverable Selenium	mg/kg dry wt	2.2	2.6	-	-	-
Total Recoverable Silver	mg/kg dry wt	0.54	0.38	-	-	-
Heavy metals, trace As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	7.5	8	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	0.28	0.57	-	-	-
Total Recoverable Chromium	mg/kg dry wt	26	11.5	-	-	-
Total Recoverable Copper	mg/kg dry wt	15.1	10.2	-	-	-
Total Recoverable Lead	mg/kg dry wt	17.7	19.5	-	-	-
Total Recoverable Mercury	mg/kg dry wt	0.54	0.168	-	-	-
Total Recoverable Nickel	mg/kg dry wt	8.6	5.8	-	-	-
Total Recoverable Zinc	mg/kg dry wt	71	94	-	-	-

Analyst's Comments

#1 It should be noted that hexavalent chromium has been determined on the dried and 63um-sieved sample fraction at the request of the client. However hexavalent chromium is usually analysed on the as received soil because levels decrease during the drying process. Please interpret these results with caution as they may be underestimated.

Amended Report: This report replaces an earlier report issued on 20 Jun 2017 at 1:00 pm
Reason for amendment: The results for ultra-trace selenium on the sub-63um fraction samples have been reported to a lower detection limit following a query by the client.

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Sediment

Test	Method Description	Default Detection Limit	Sample No
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1-6
Heavy metals, trace As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, trace level.	0.010 - 0.4 mg/kg dry wt	1-12
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed). US EPA 3550.	0.10 g/100g as rcvd	1-6
Dry Matter	Drying for 16 hours at 103°C, gravimetry (Free water removed before analysis).	0.10 g/100g as rcvd	1-6
Extraction of Hexavalent Chromium in Environmental Solids*	0.01M KH_2PO_4 Extraction.	-	1-12
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1-12
Texture Marine (2 mm, 63 µm fractions) *		-	1-6
Fraction < 2 mm, >/= 63 µm*	Wet sieving, 2.00 mm and 63 µm sieves, gravimetry (calculation by difference).	0.1 g/100g dry wt	1-6

Sample Type: Sediment			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Sieving through 63 um sieve, no gravimetric result*	<63µm Wet Sieved with no gravimetric determination.	-	1-6
Fraction < 63 µm*	Wet sieving, 63 µm sieve, gravimetry (calculation by difference).	0.1 g/100g dry wt	1-6
Total Recoverable Antimony	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, trace level. US EPA 200.2.	0.04 mg/kg dry wt	1-12
Hexavalent Chromium in Dried and Sieved Environmental Solids*	Phosphate buffer extraction, colorimetry.	0.4 mg/kg dry wt	7-12
Hexavalent Chromium in Environmental Solids*	Phosphate buffer extraction, colorimetry.	0.4 mg/kg dry wt	1-6
Total Recoverable Iron	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	1-12
Total Recoverable Manganese	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	1.0 mg/kg dry wt	1-12
Total Recoverable Selenium Ultratrace	Dried sample, < 2mm fraction. Nitric / hydrochloric acid digestion, ICP-MS, trace level. US EPA 200.2.	0.5 mg/kg dry wt	1-12
Total Recoverable Silver	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, trace level. US EPA 200.2.	0.02 mg/kg dry wt	1-12

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental

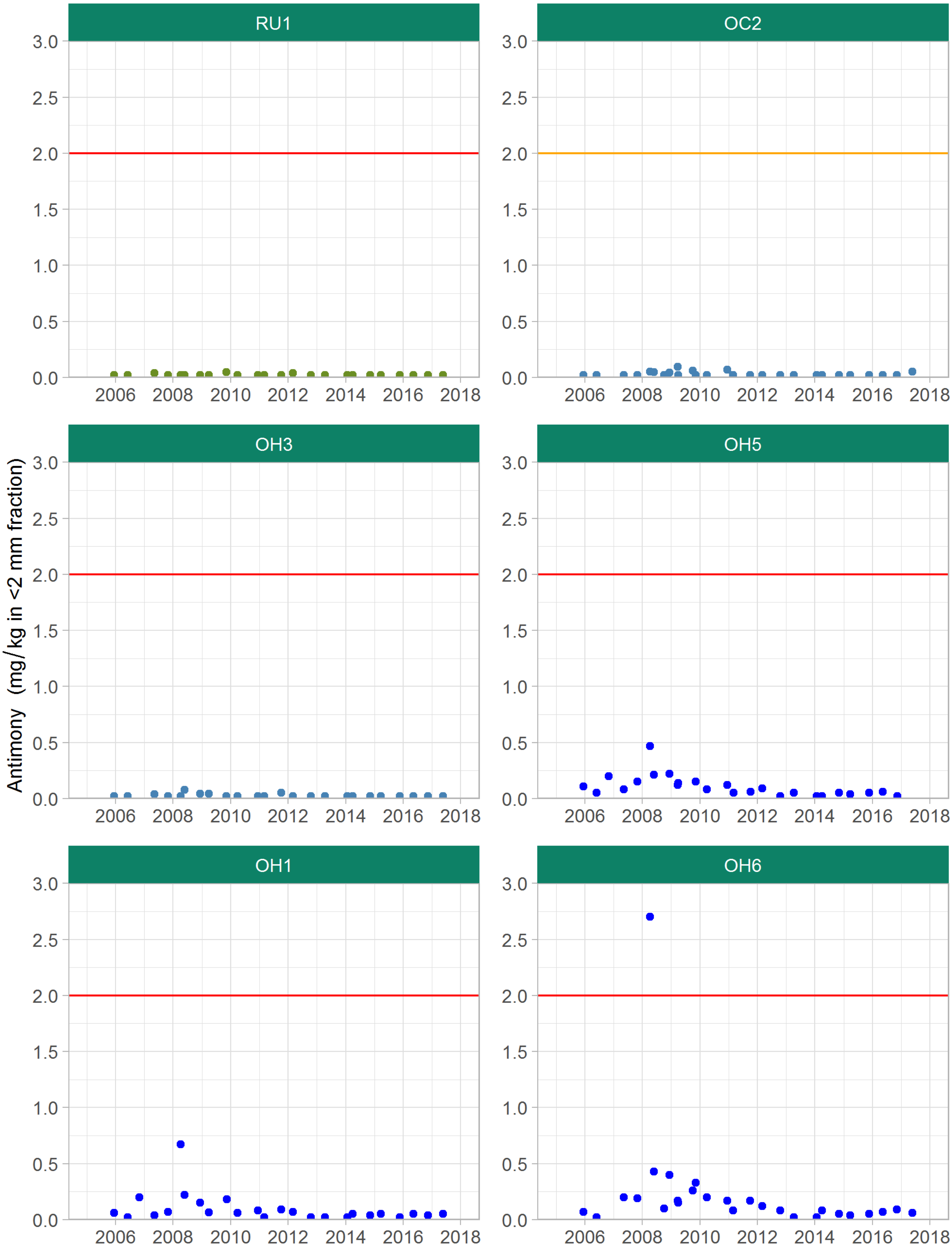

Figure 1: Antimony concentrations in the <2 mm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

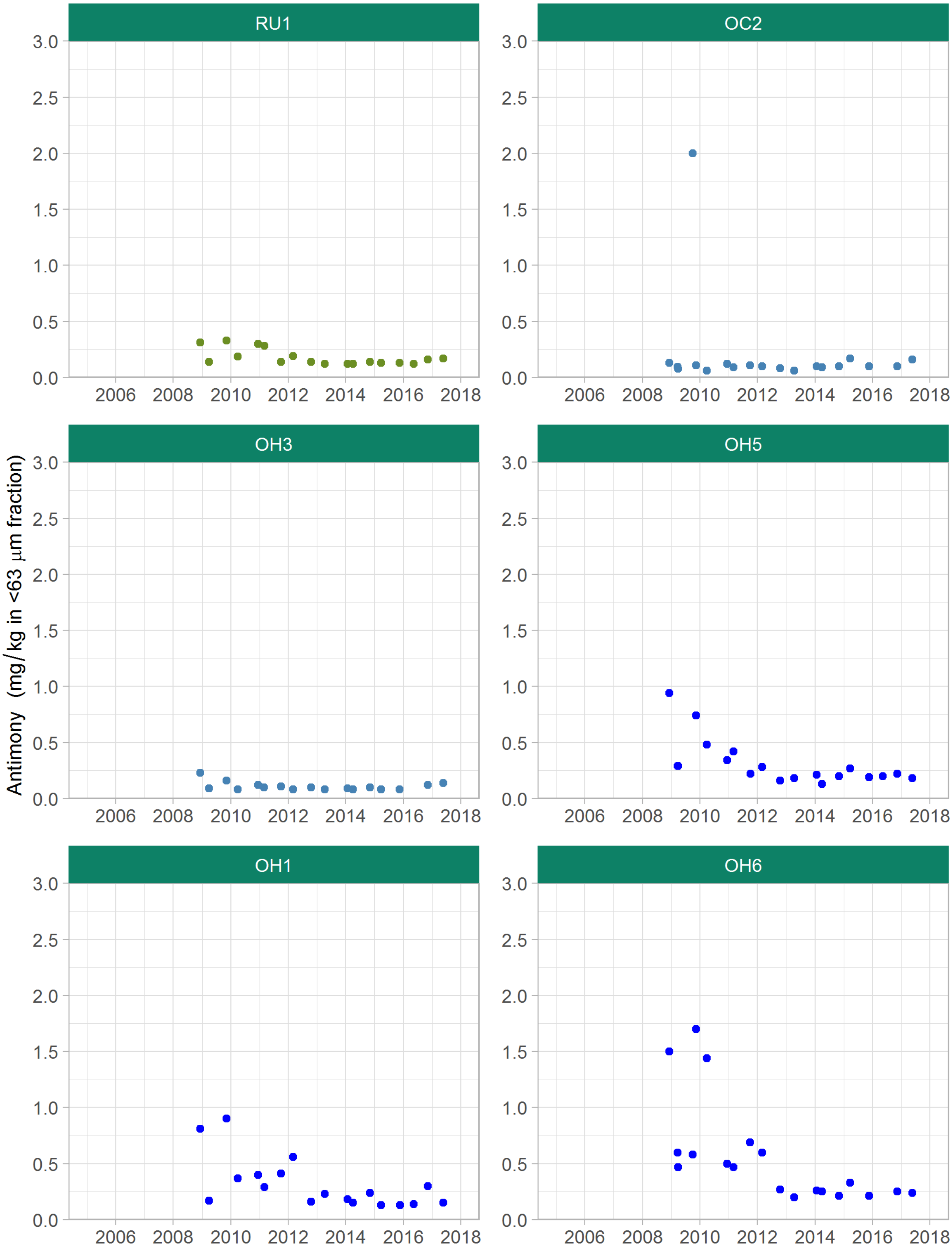

Figure 2: Antimony concentrations in the <63 µm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

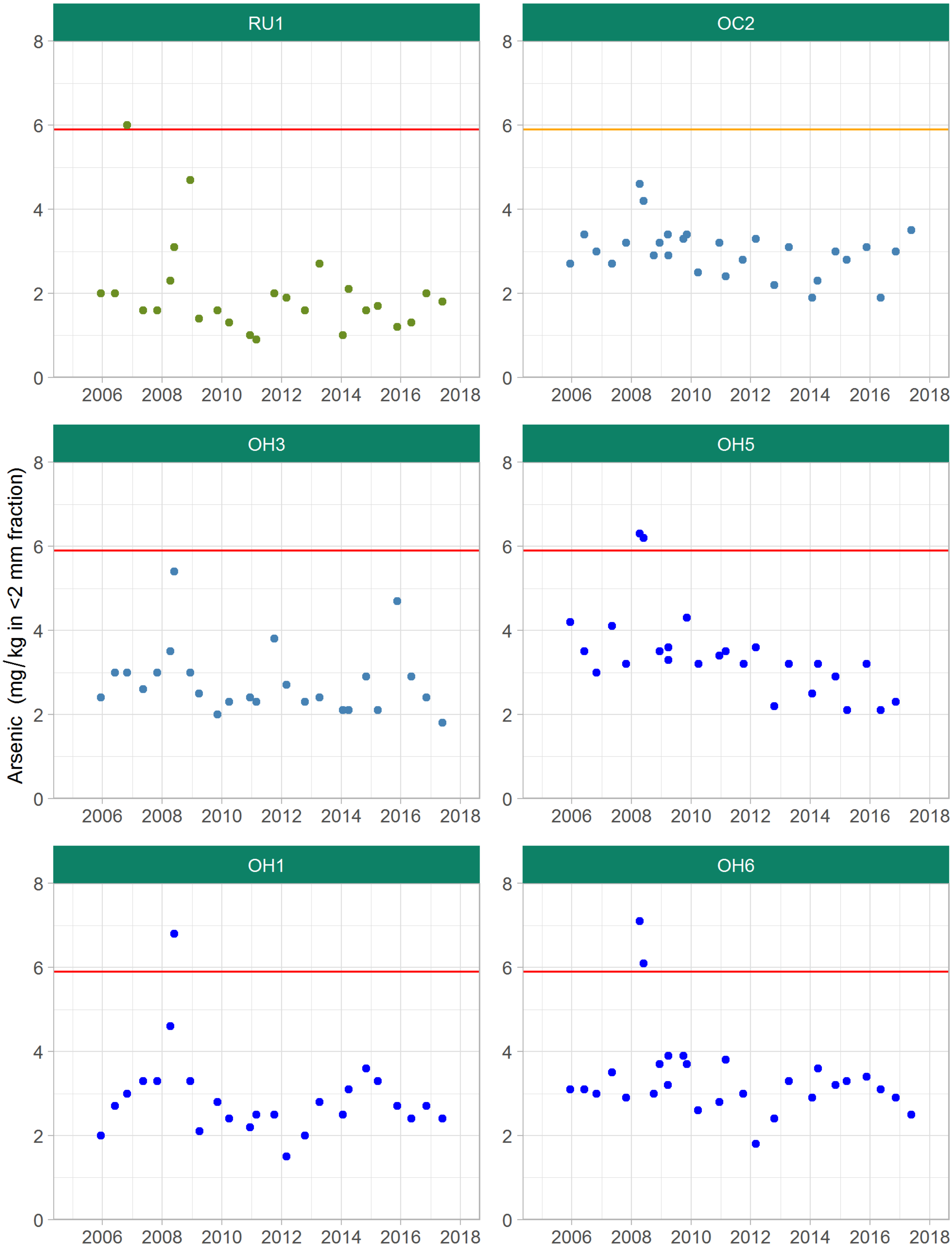

Figure 3: Arsenic concentrations in the <2 mm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

Figure 4: Arsenic concentrations in the <63 µm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

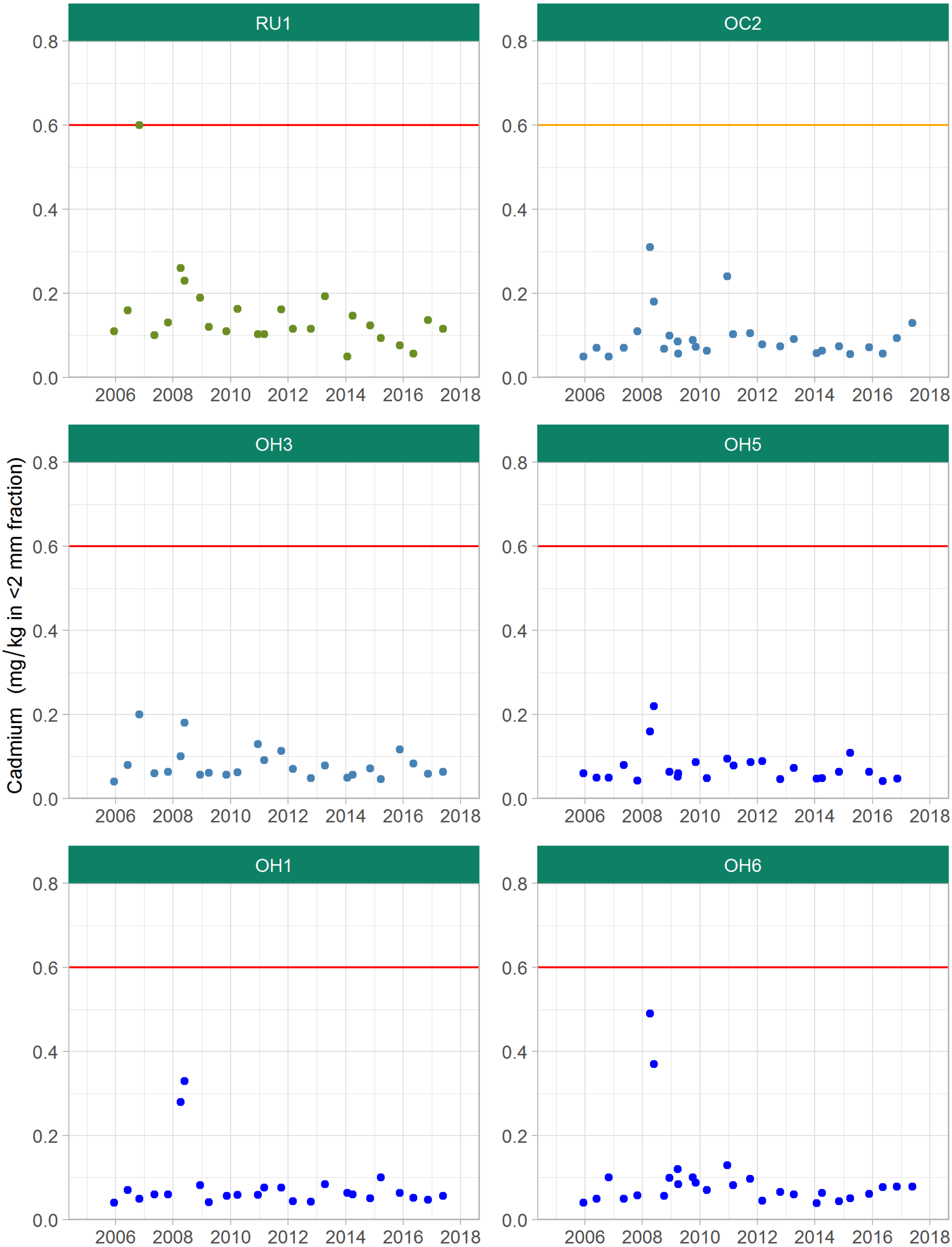

Figure 5: Cadmium concentrations in the <2 mm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

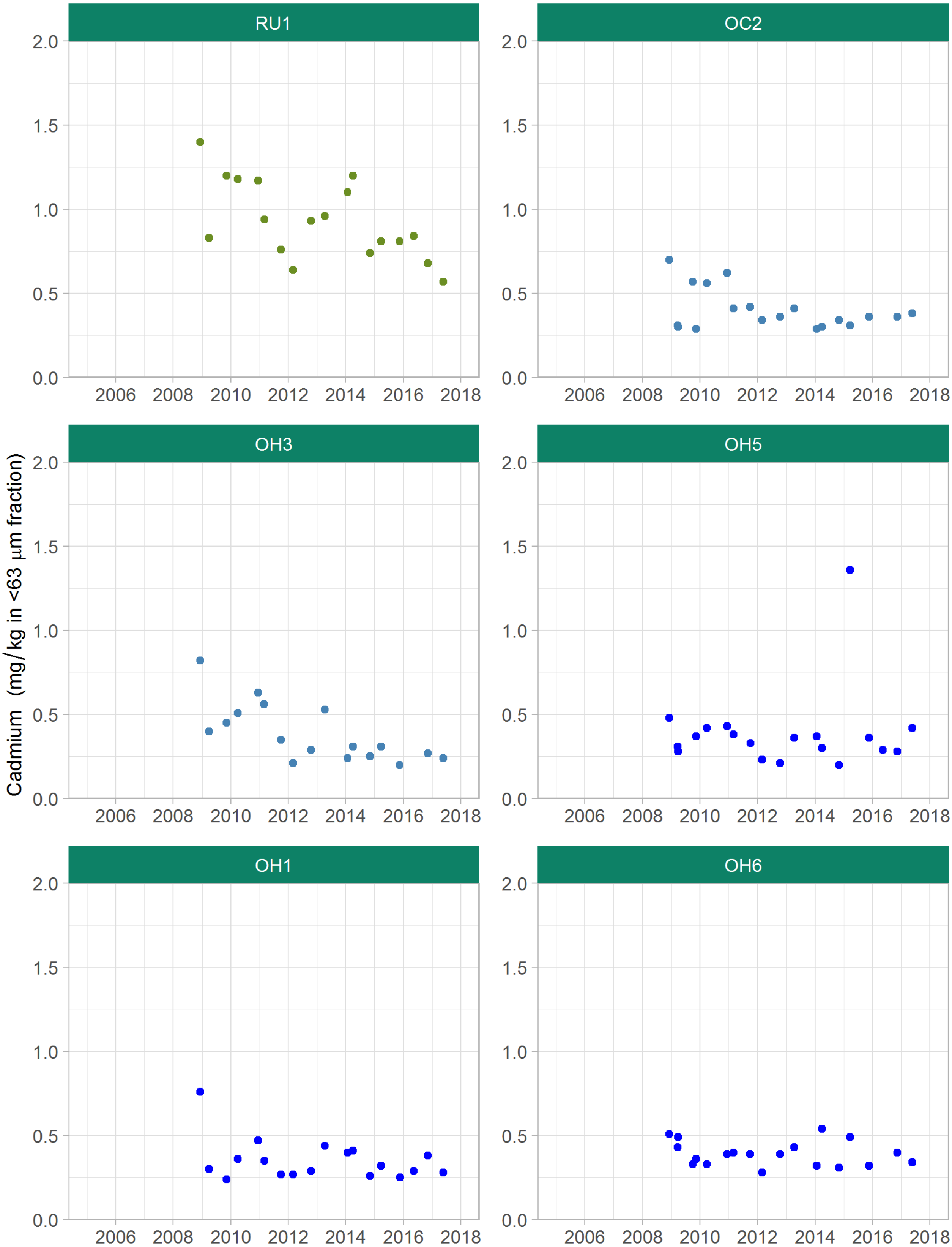

Figure 6: Cadmium concentrations in the <63 µm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

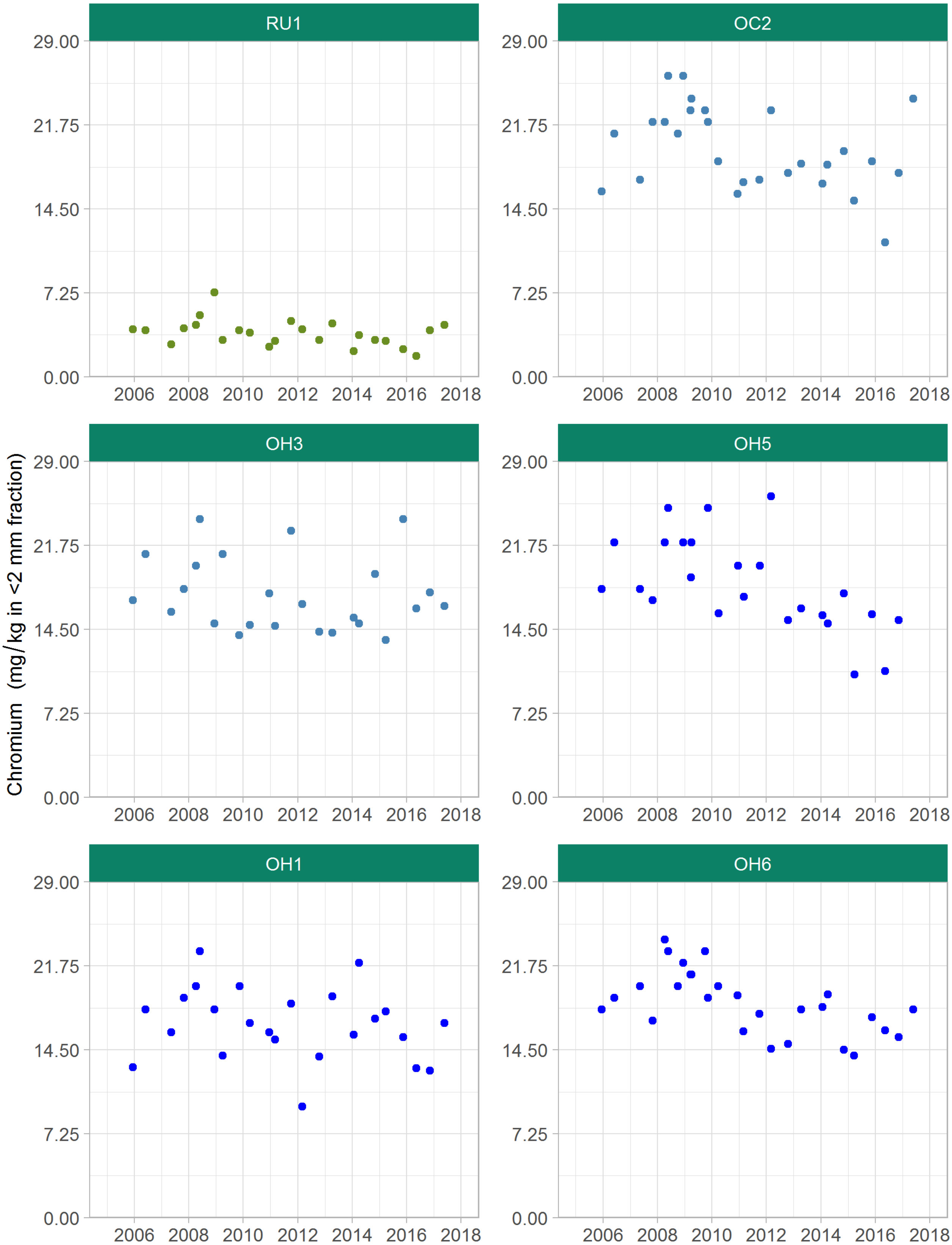

Figure 7: Chromium concentrations in the <2 mm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

Figure 8: Chromium concentrations in the <63 µm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

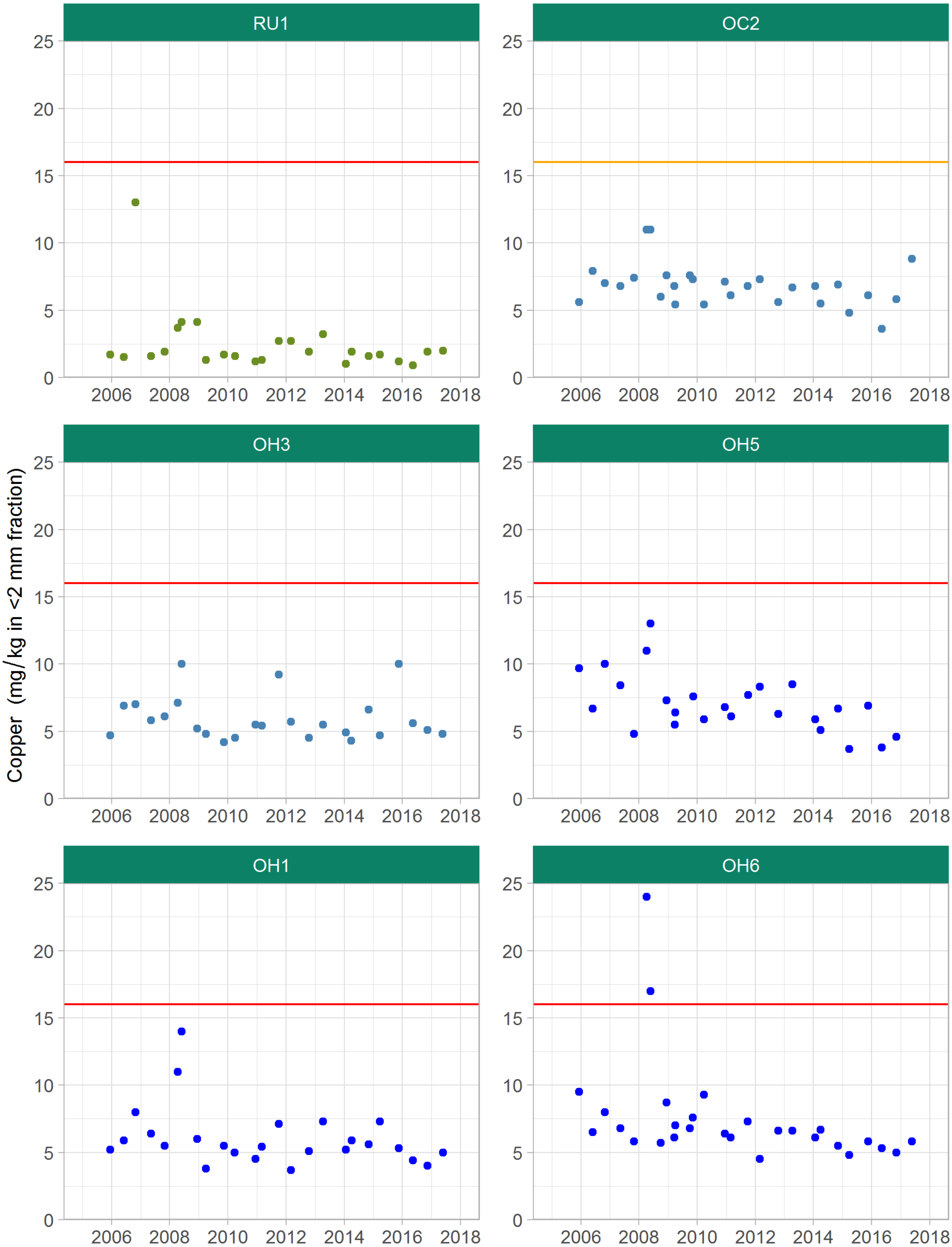

Figure 9: Copper concentrations in the <2 mm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

Figure 10: Copper concentrations in the <63 µm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

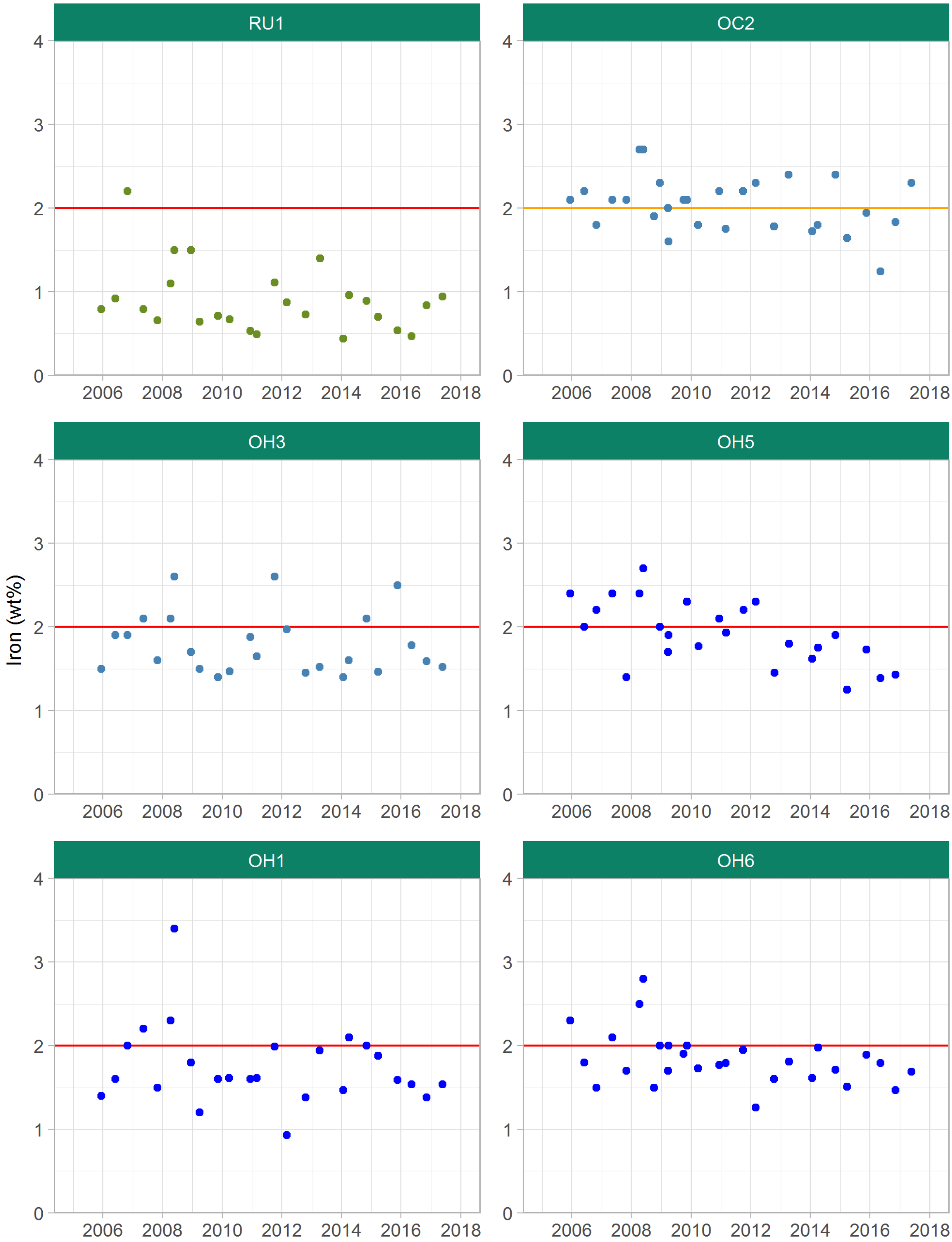

Figure 11: Iron concentrations in the <2 mm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

Figure 12: Iron concentrations in the <63 µm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

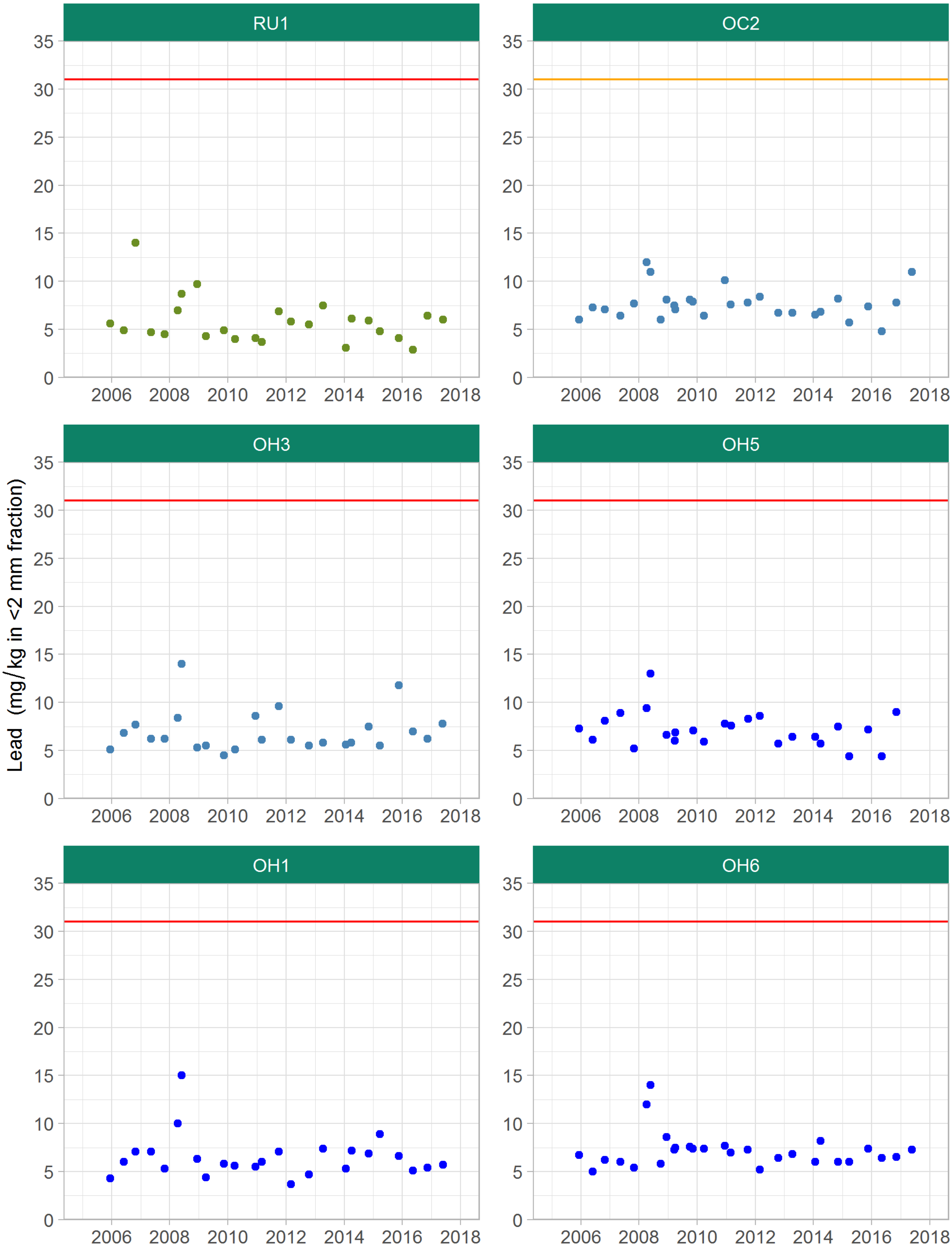

Figure 13: Lead concentrations in the <2 mm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

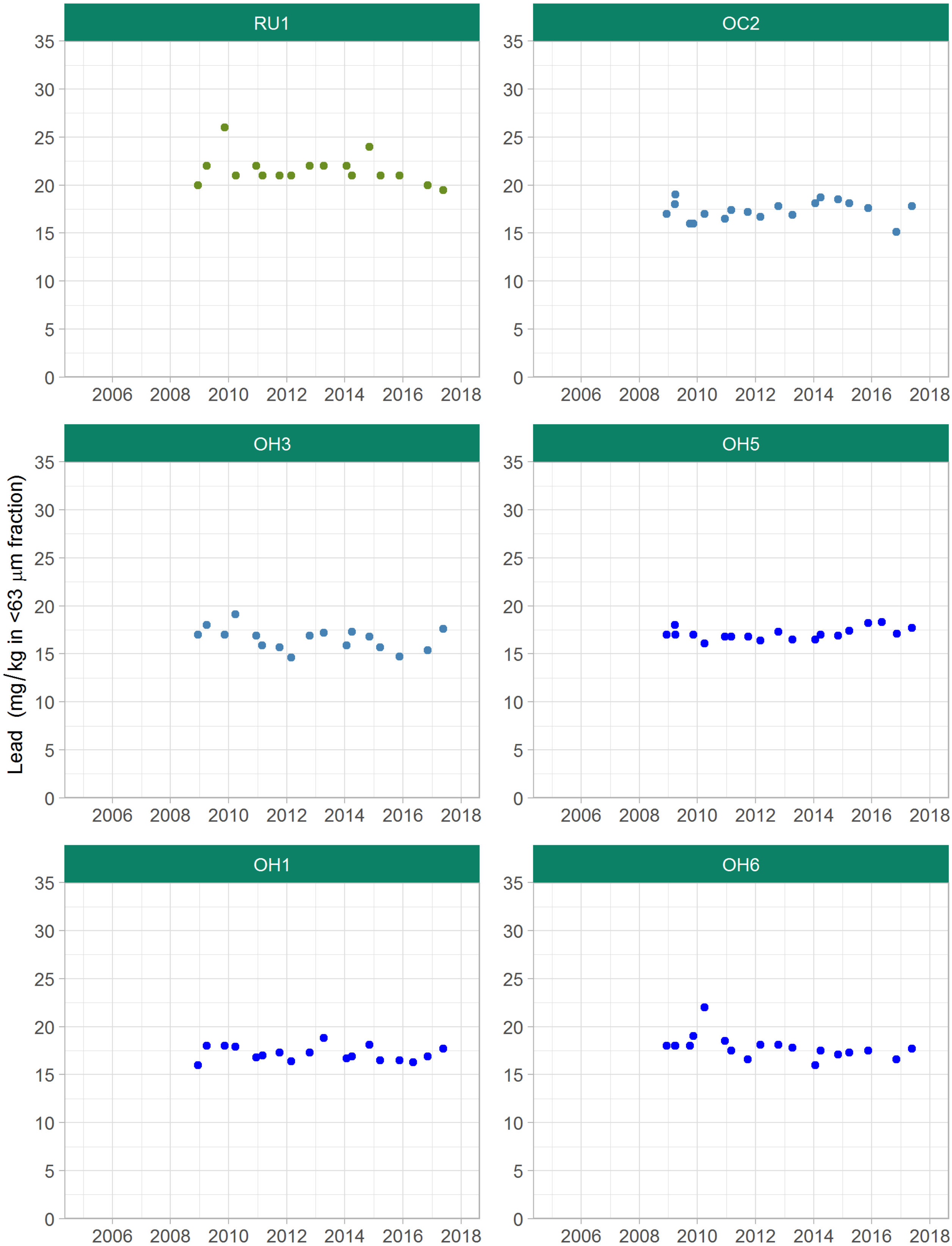

Figure 14: Lead concentrations in the <63 µm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

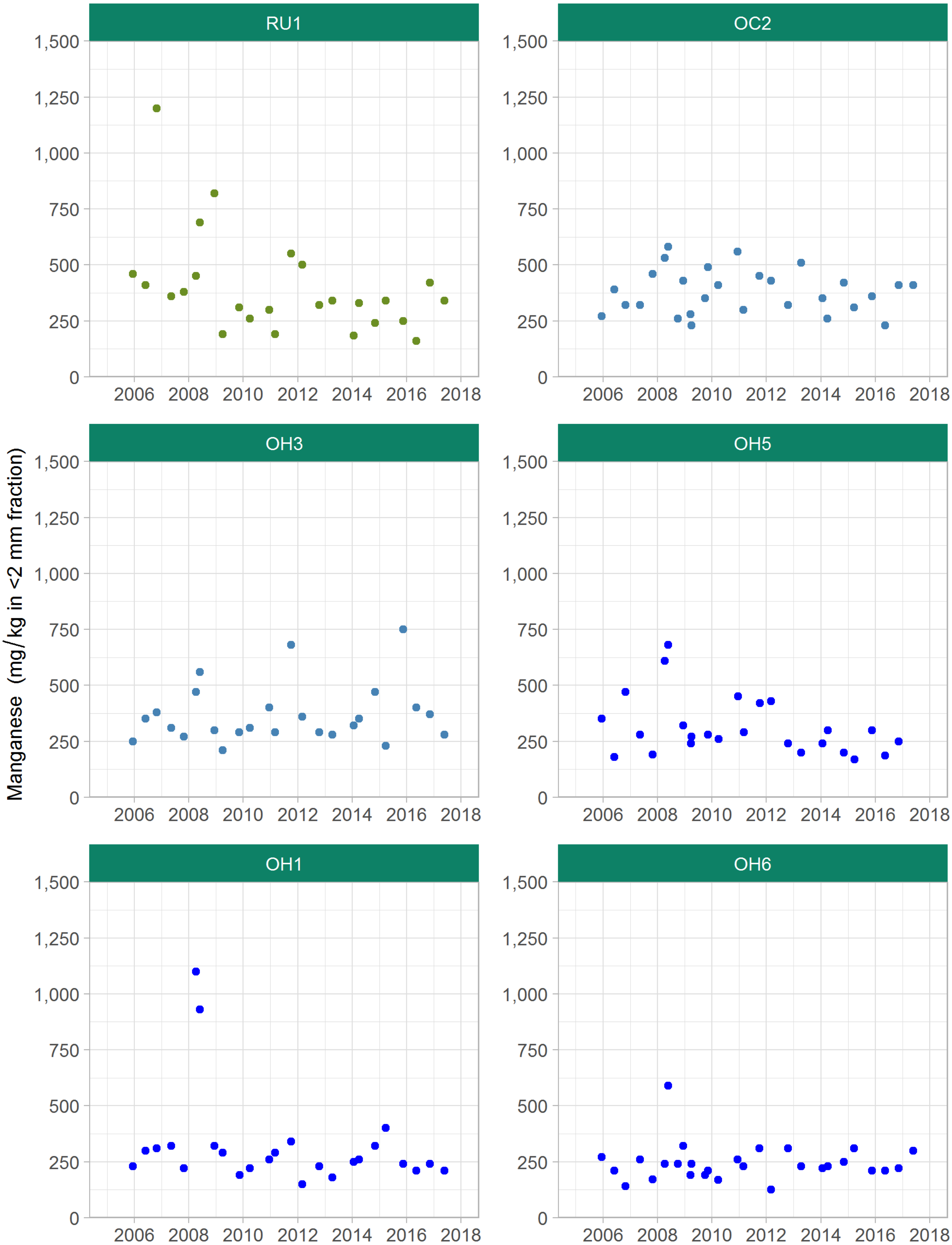

Figure 15: Manganese concentrations in the <2 mm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

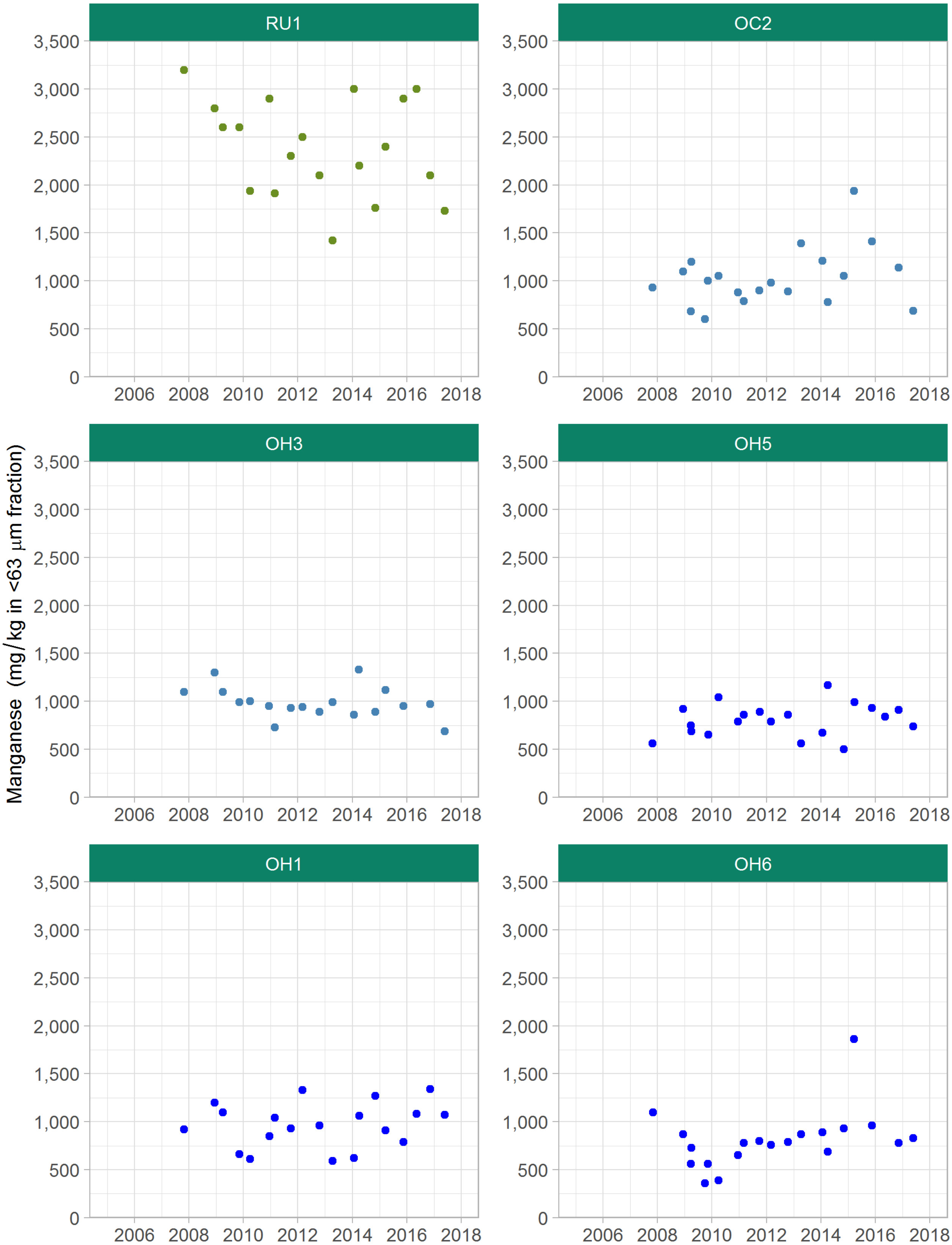

Figure 16: Manganese concentrations in the <63 µm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

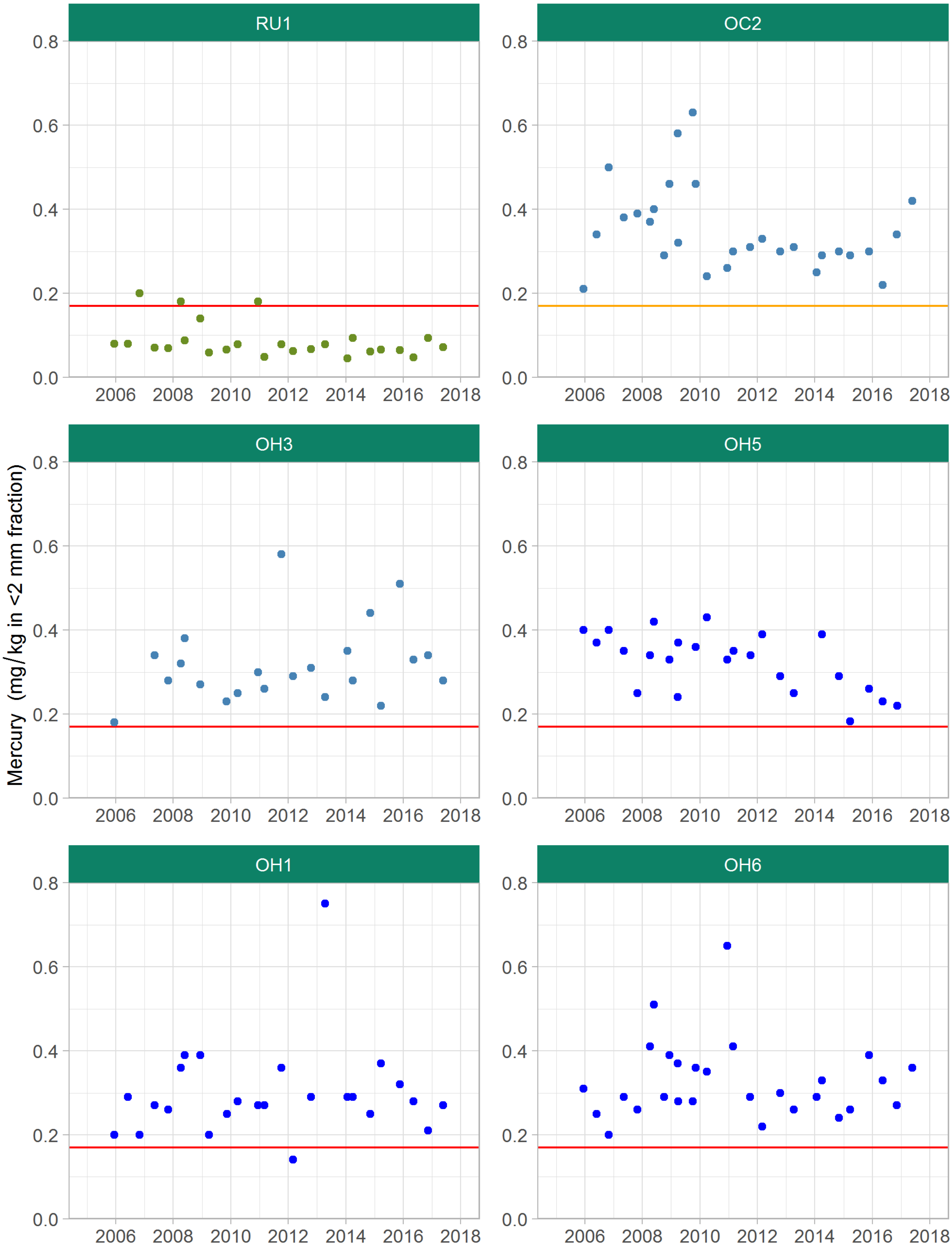

Figure 17: Mercury concentrations in the <2 mm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6 (note the mercury concentrations in sediments collected from Site OH3 on 1 June 2006 (3.3 mg/kg), 31 October 2006 (9.8 mg/kg) and 30 March 2009 (4.0 mg/kg) are off scale.

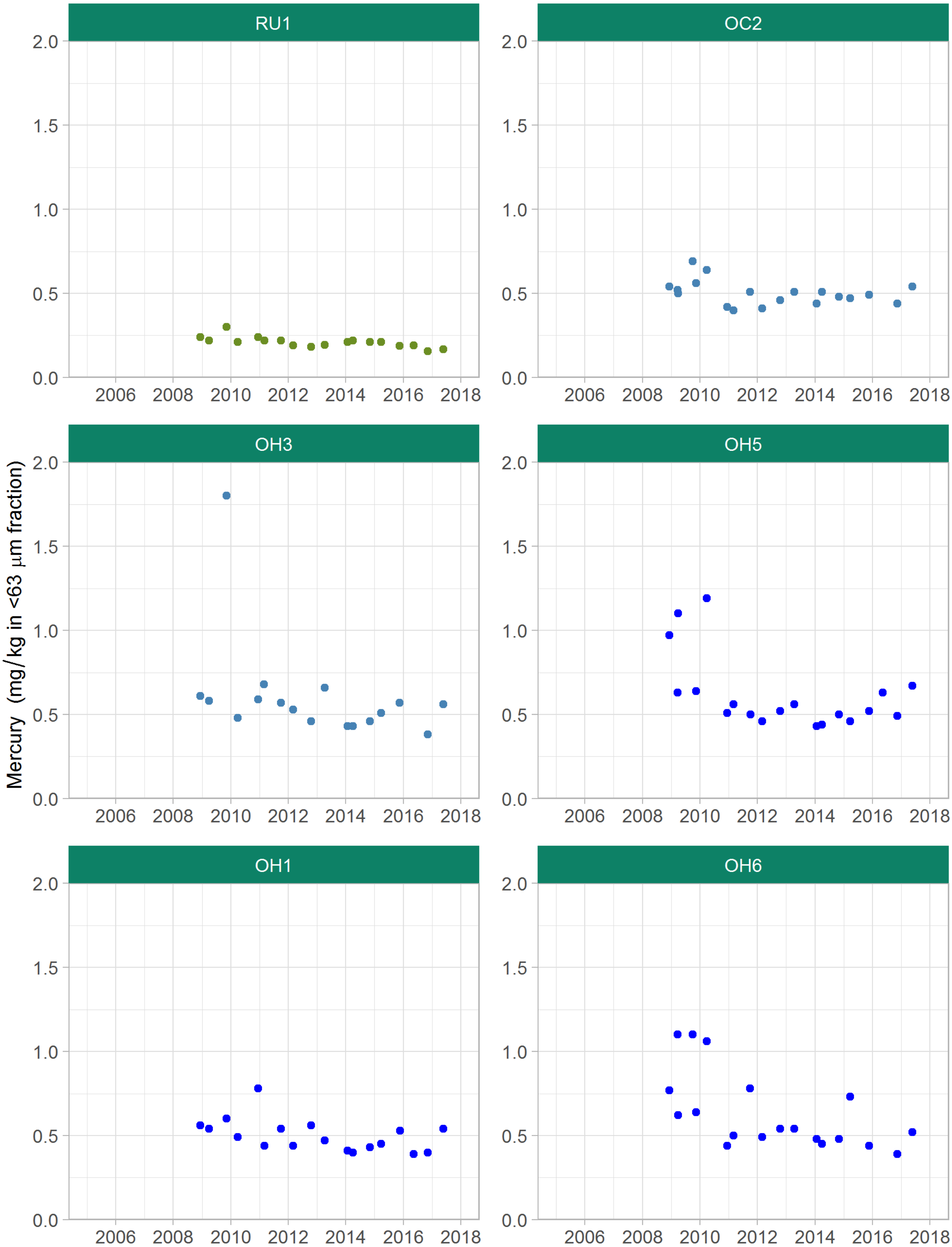

Figure 18: Mercury concentrations in the <63 µm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

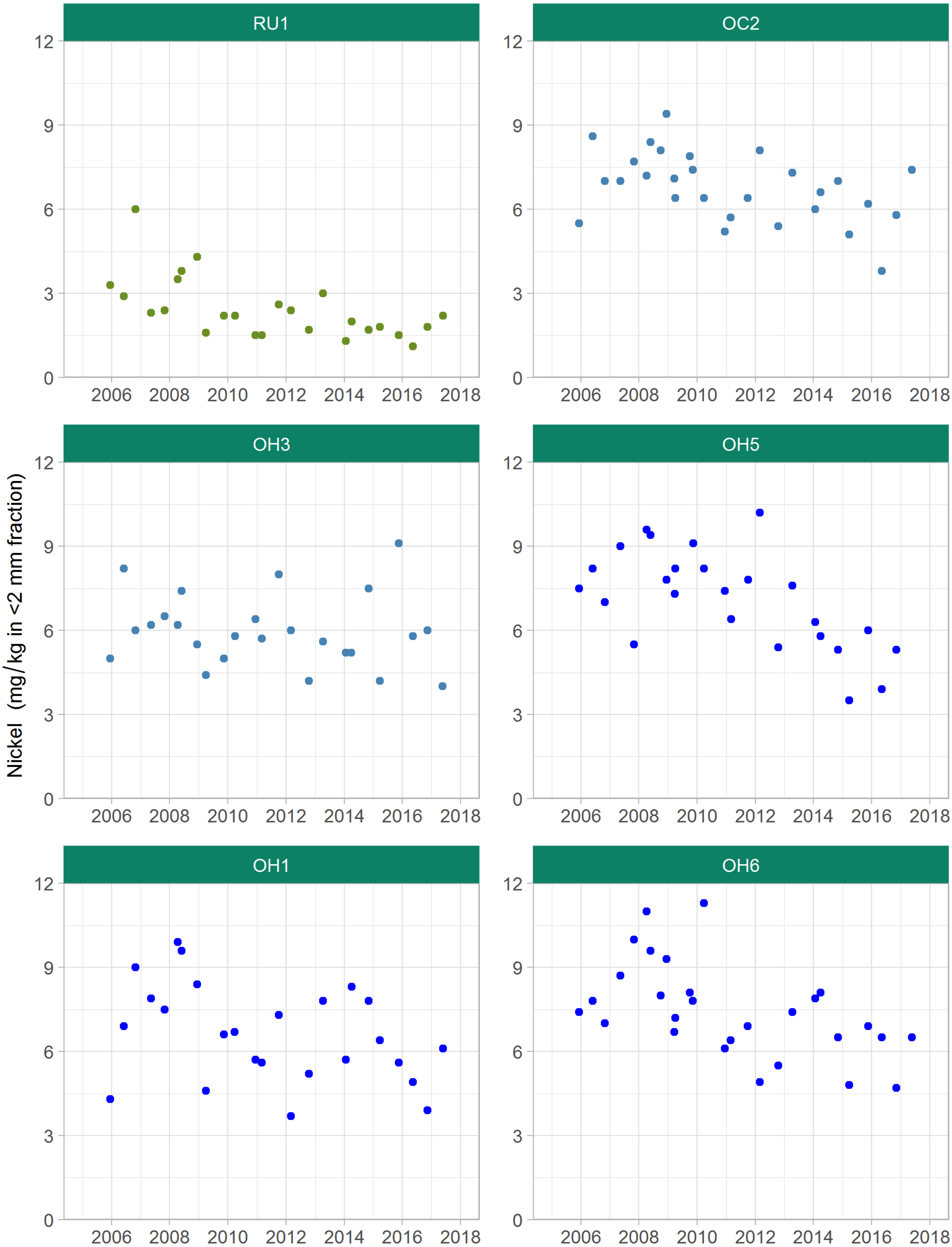

Figure 19: Nickel concentrations in the <2 mm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

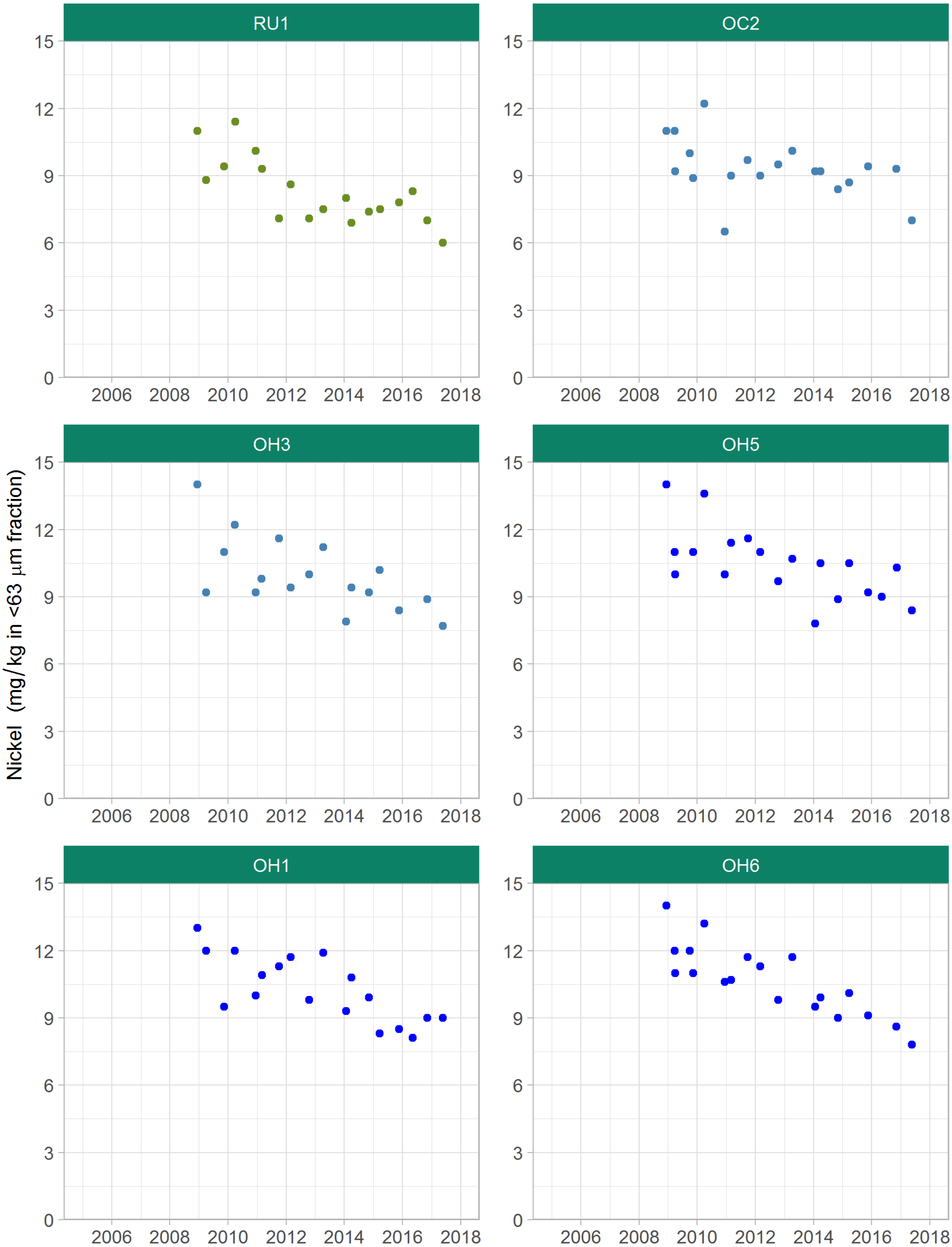

Figure 20: Nickel concentrations in the <63 µm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

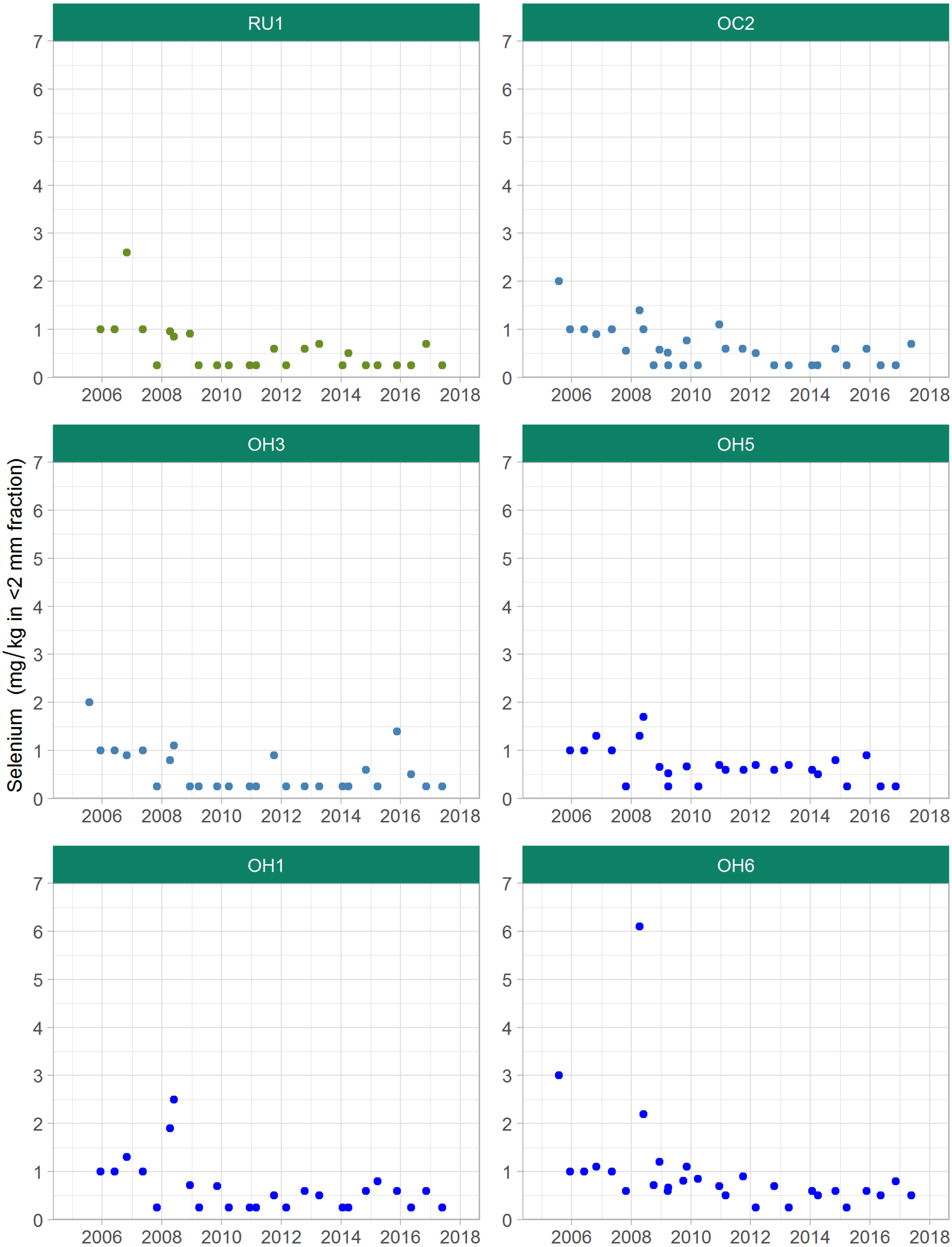

Figure 21: Selenium concentrations in the <2 mm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

Figure 22: Selenium concentrations in the <63 µm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

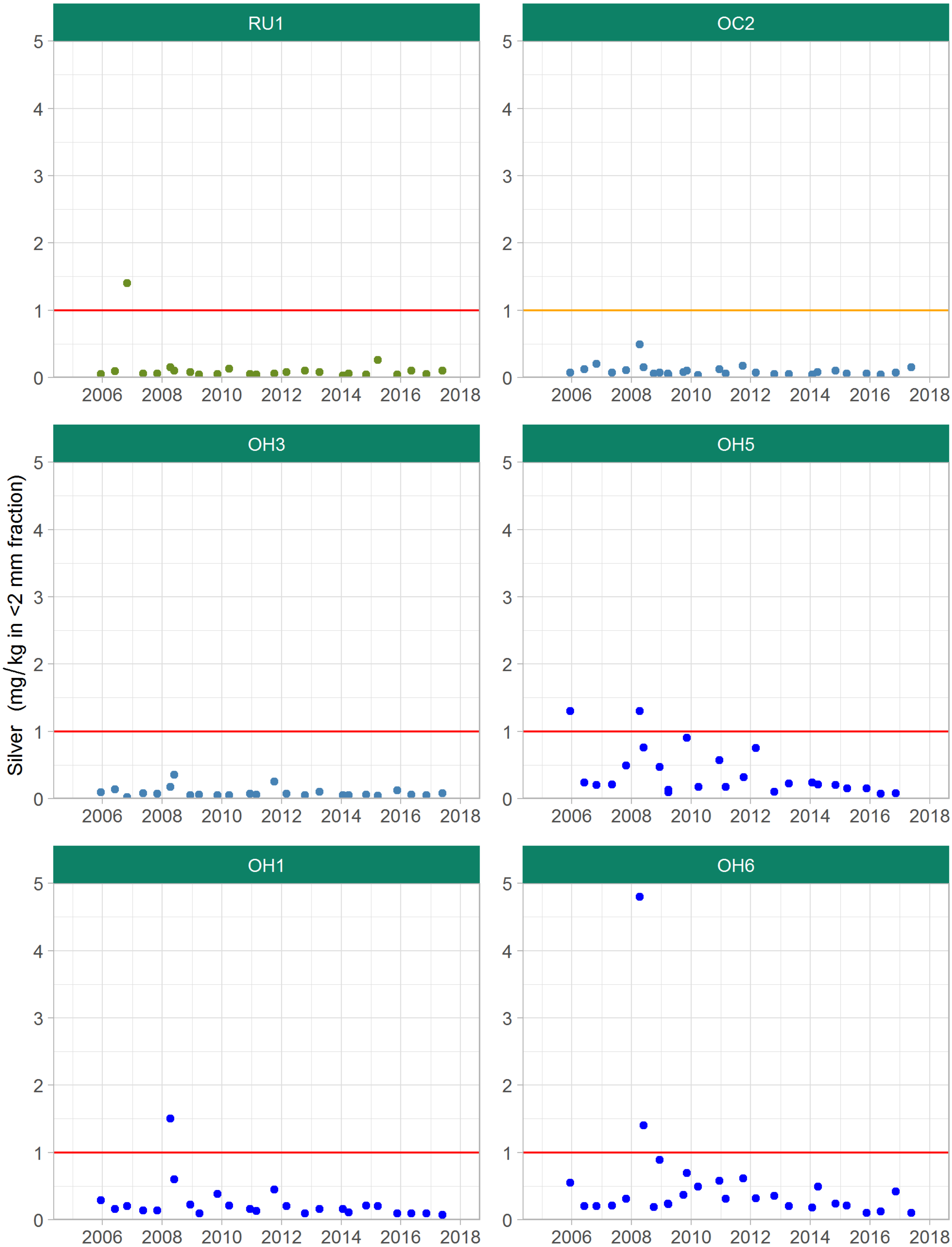

Figure 23: Silver concentrations in the <2 mm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

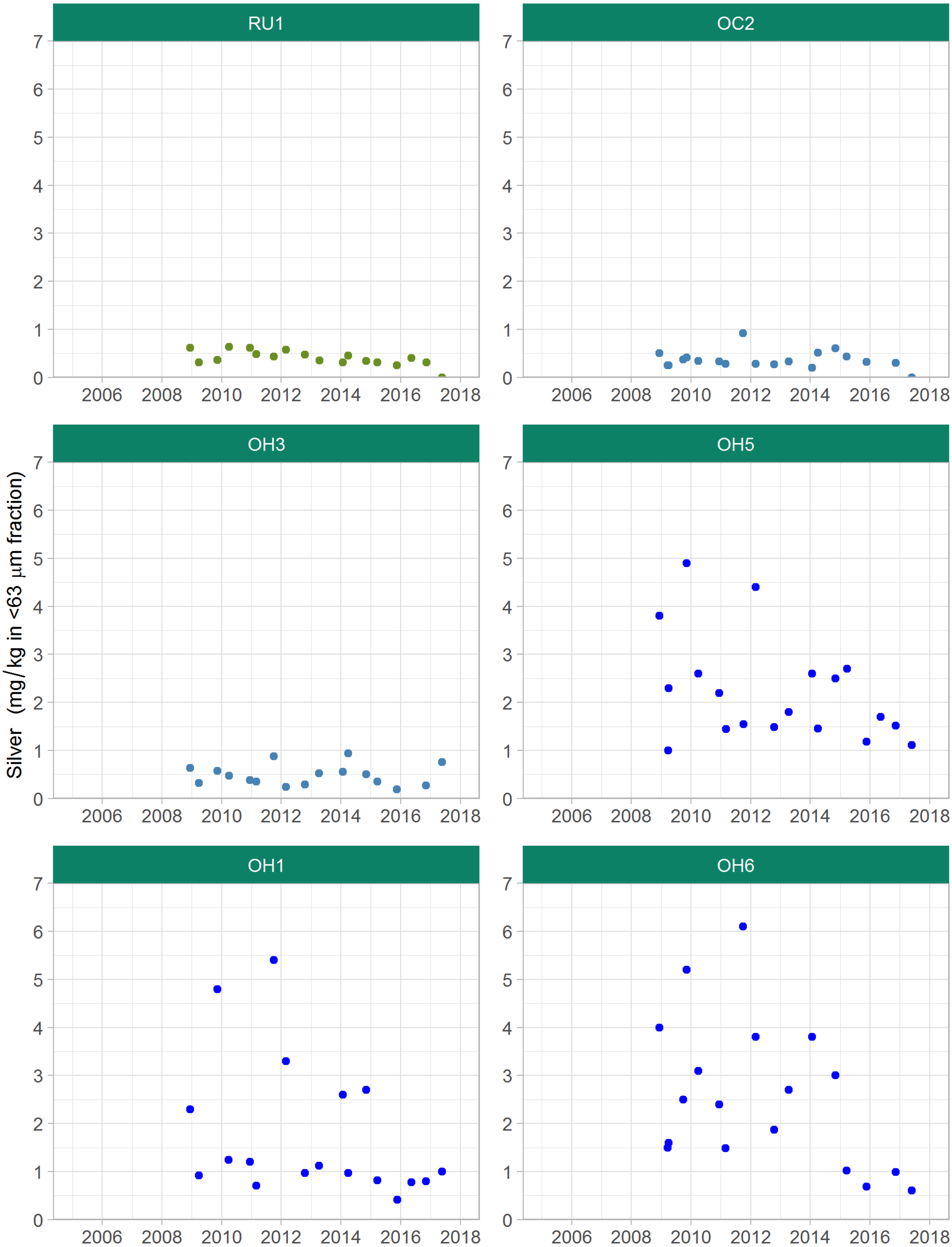

Figure 24: Silver concentrations in the <63 µm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

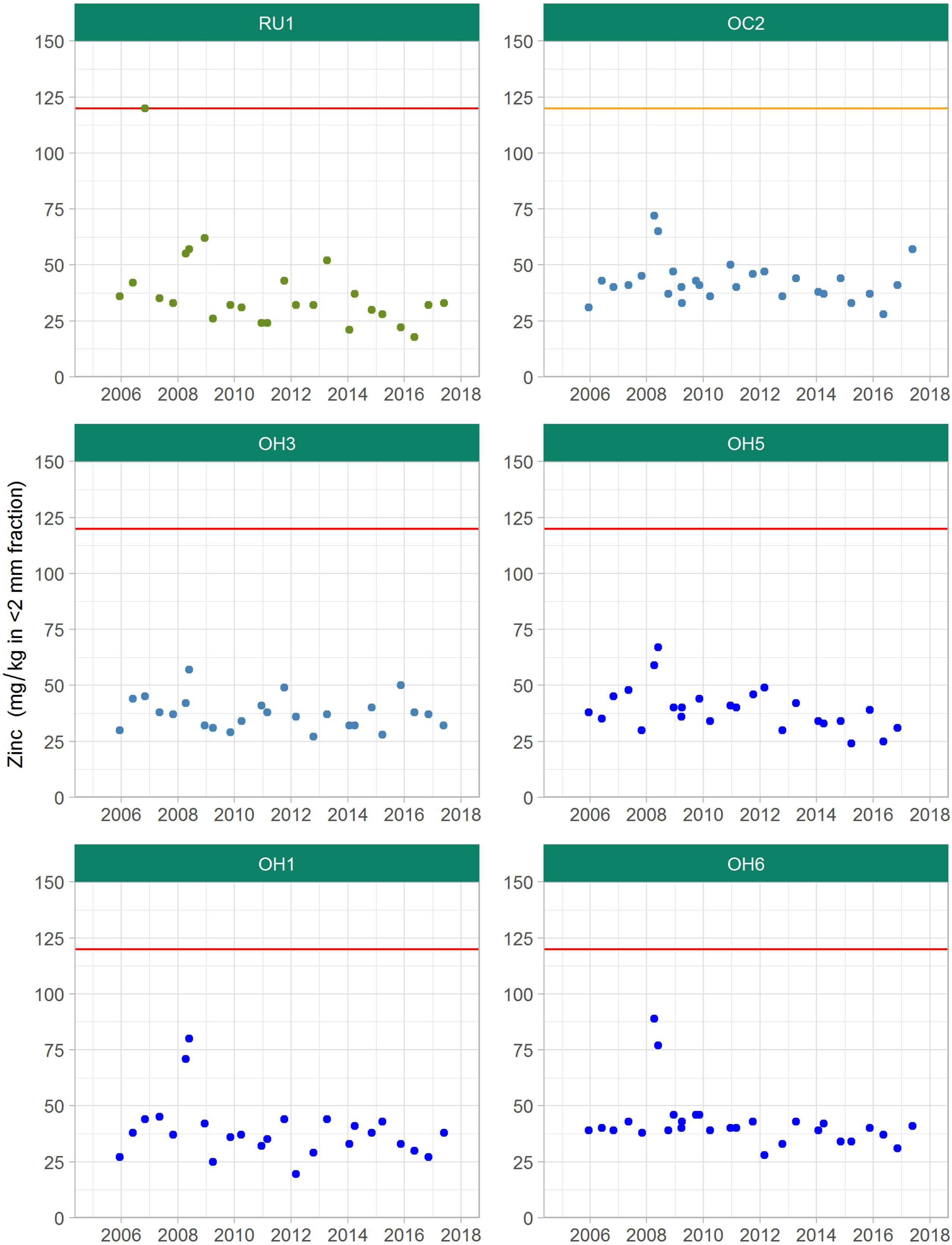

Figure 25: Zinc concentrations in the <2 mm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

Figure 26: Zinc concentrations in the <63 µm sediment fraction from Sites RU1, OC2, OH3, OH5, OH1 and OH6.

APPENDIX F

Site Photographs

Figure F1: Habitat conditions at Site OC2.

Figure F2: Habitat conditions at Site OH3.

Figure F3: Bank slumping at Site OH3 during the May 2017 survey.

Figure F4: Habitat conditions at Site OH5.

Figure F5: Habitat conditions at Site OH1.

Figure F6: Habitat conditions at Site OH6.

Figure F7: Habitat conditions at Site RU1.

APPENDIX G

Periphyton Data

Table 1: Estimated streambed algae coverage (%) during the spring survey in November 2016.

Class	Periphyton	OC2	OH3	OH5	OH1	OH6	RU1
Film	Thin mat/film (green)				2		
	Thin mat/film (light brown)	20	30	40	20	20	20
	Thin mat/film (dark brown)						
Mat	Medium mat (green)						
	Medium mat (light brown)						
	Medium mat (dark brown)						
	Thick mat (green)						
	Thick mat (light brown)						
	Thick mat (dark brown)	1	2				1
Filament	Short filaments (green)	50	5		1	10	5
	Short filaments (brown)						
	Long filaments (green)	5		5	1		5
	Long filaments (brown)						

Table 2: Estimated streambed algae coverage (%) during the autumn survey in May 2017.

Class	Periphyton	OC2	OH3	OH5	OH1	OH6	RU1
Film	Thin mat/film (green)	10	20	20			
	Thin mat/film (light brown)			15	40	5	20
	Thin mat/film (dark brown)	25		1			
Mat	Medium mat (green)						
	Medium mat (light brown)	15					
	Medium mat (dark brown)	10					
	Thick mat (green)						
	Thick mat (light brown)						
	Thick mat (dark brown)	5					
Filament	Short filaments (green)						
	Short filaments (brown)						
	Long filaments (green)	10		5	10		10
	Long filaments (brown)						

Table 3: Periphyton community composition during the spring survey in November 2016.

Taxa	OC2	OH3	OH5	OH1	OH6	RU1
Green filaments						
Cladophora spp.	5375	0	1889	0	0	0
Microspora spp.	0	0	106250	1127000	2818125	85833
Oedogonium spp.	1376000	336000	156400	424667	153640	84117
Spirogyra spp.	0	10000	0	0	0	0
Stigeoclonium spp.	1720000	0	0	0	0	0
Tribonema spp.	0	0	0	0	0	226600
Ulothrix spp.	317614	0	0	0	0	0
Red filaments						
Audouinella & Batrachospermum spp.	2436667	758333	85000	274400	50100	403417
Green – unicellular and colonial						
Ankistrodesmus spp.	4650880	1035125	21086	722705	1317073	0
Closterium spp.	0	0	0	240902	0	0
Cosmarium spp.	872040	0	0	0	0	0
Staurastrum spp.	0	0	10543	0	0	0
Scenedesmus spp.	872040	0	10543	240902	0	0
Diatoms						
Achnanthes exigua	290680	0	0	0	0	0
Achnanthes oblongella	0	36969	63259	2168116	1505227	1010729
Achnanthidium minutissimum	2616120	0	31629	481804	188153	0
Brachysira spp.	0	36969	10543	0	188153	0
Cocconeis placentula	1453400	443625	189776	1204509	1693380	1123032
Cyclotella spp.	0	0	0	722705	0	0
Cymbella aspera	290680	73938	0	0	0	112303
Cymbella cf. *naviculiformis*	0	36969	0	0	0	0
Cymbella tumida	6976320	1959344	221406	1686313	564460	561516
Encyonema minutum	14824680	443625	263578	16863127	13735193	5615161
Eunotia spp.	581360	0	0	0	0	112303
Fragilaria capucina	8139040	147875	84345	1445411	1881533	673819
Fragilaria vaucheriae	0	0	0	0	0	224606
Frustulia spp.	0	73938	0	0	0	224606
Frustulia vulgaris	2034760	0	31629	722705	188153	0
Gomphonema parvulum	6976320	591500	622044	5540742	4139373	3818310
Gomphonema cf. *minutum*	1453400	406656	42172	0	188153	2695277
Gomphonema cf. *clavatum*	290680	36969	0	0	0	0
Gyrosigma cf. *spencerii*	0	36969	0	0	0	0
Melosira varians	23254400	2366000	263578	2890822	5832753	1123032
Navicula cf. *capitatoradiata*	581360	36969	0	722705	376307	0
Navicula cf. *margalithi*	0	36969	10543	0	564460	112303
Navicula cryptocephala	1453400	73938	0	0	0	0

Navicula lanceolata	581360	73938	21086	0	0	112303
Navicula rhynchocephala	290680	110906	31629	722705	0	0
Navicula spp.	1453400	36969	31629	240902	188153	449213
Nitzschia cf. *intermedia*	581360	0	0	0	0	0
Nitzschia cf. *inconspicua*	290680	0	0	0	0	0
Nitzschia cf. *linearis*	0	0	10543	0	0	0
Nitzschia sp.	1162720	36969	21086	963607	1128920	336910
Pinnularia cf. *subcapitata*	1744080	0	42172	722705	188153	449213
Planothidium lanceolatum	872040	73938	21086	1686313	564460	449213
Rossithidium linearis	30521400	517563	52716	14695011	4891987	3930613
Surirella angusta	290680	0	0	0	0	0
Synedra acus	0	36969	42172	0	564460	0
Synedra ulna var. *contracta*	1744080	36969	0	0	0	0
Synedra ulna	0	73938	0	0	0	0
Tabellaria flocculosa	0	36969	0	0	0	0
Cyanobacteria						
Phormidium spp.	0	17500	0	0	0	0

Table 4: Periphyton community composition during the autumn survey in May 2017.

Taxa	OC2	OH3	OH5	OH1	OH6	RU1
Green filaments						
Cladophora spp.	19000	0	0	0	0	0
Microspora spp.	158333	0	0	0	0	0
Oedogonium spp.	3202857	2262	273857	311857	595500	21429
Spirogyra spp.	0	0	7714	0	0	0
Red filaments						
Audouinella & Batrachospermum spp.	7663333	137222	506250	0	87500	32500
Compsopogon spp.	0	0	0	25900	2100	24000
Green – unicellular and colonial						
Ankistrodesmus sp.	256880	0	0	13164	0	14383
Cosmarium sp.	256880	0	12854	0	0	0
Scenedesmus sp.	0	0	0	13164	0	14383
Diatoms						
Achnanthes exigua	0	0	0	0	0	14383
Achnanthes oblongella	0	4628	51414	105314	212940	143830
Achnanthidium minutissimum	2311920	0	12854	0	0	0
Cocconeis placentula	256880	9257	38561	13164	0	43149
Cymbella aspera	0	0	0	13164	0	14383
Cymbella cf. *naviculiformis*	0	0	12854	13164	0	0
Cymbella kappii	513760	27771	12854	0	70980	14383
Cymbella tumida	3596320	9257	77121	250120	35490	14383
Encyonema minutum	1027520	32399	115682	65821	35490	14383
Eunotia cf. *polydentula*	513760	0	0	0	0	0
Eunotia sp.	1798160	0	25707	65821	0	302043
Fragilaria capucina	3853200	9257	38561	52657	70980	129447
Fragilaria vaucheriae	2568800	0	115682	13164	425880	14383
Frustulia crassinervia	0	0	0	0	0	14383
Frustulia vulgaris	513760	0	25707	13164	35490	28766
Gomphoneis minuta var. cassieae	0	9257	0	0	0	0
Gomphonema parvulum	4366960	46285	719797	592389	2235870	632851
Gomphonema cf. *minutum*	0	671128	141389	39493	283920	776681
Gomphonema cf. *clavatum*	256880	32399	64268	52657	212940	100681
Gomphonema sp.	256880	0	0	0	0	0
Hantzschia virgata	0	0	0	13164	0	0
Melosira varians	30311840	27771	604115	1224272	2555280	71915
Navicula cf. capitatoradiata	256880	4628	12854	13164	0	14383
Navicula cf. *margalithi*	2055040	4628	12854	13164	35490	86298
Navicula cryptocephala	4623840	4628	25707	39493	70980	43149
Navicula lanceolata	256880	0	12854	0	0	0
Navicula radiosa	0	0	0	13164	0	0

Taxa	OC2	OH3	OH5	OH1	OH6	RU1
Nitzschia sigmoidea	0	0	0	0	0	14383
Nitzschia sp.	2311920	4628	64268	26328	177450	71915
Pinnularia cf. *subcapitata*	513760	9257	154242	52657	106470	143830
Planothidium lanceolatum	256880	9257	25707	39493	425880	43149
Rossithidium linearis	14642160	13885	205656	52657	674310	86298
Synedra ulna var. *biceps*	0	0	12854	0	0	14383
Synedra ulna var. *contracta*	256880	4628	12854	0	0	57532
Tabellaria flocculosa	0	0	0	0	0	14383
Cyanobacteria						
Lyngbya sp.	1710000	0	0	0	0	0
Phormidium sp	3528571	550774	90161	0	540000	16071

Table 5: Periphyton AFDW and chlorophyll-*a* biomass during the spring survey in November 2016.

Site	Replicate	AFDW (mg/sample)	Chlorophyll- *a* (mg/sample)	AFDW (g/m^2)	Chlorophyll-*a* (mg/m^2)	Autotrophic index
OC2	A	466.7	2.1	5.9	26.8	220
OC2	B	630.0	2.8	7.1	32.0	222
OC2	C	159.0	1.0	3.5	22.2	158
OC2	D	438.0	1.0	5.3	12.8	414
OC2	E	378.7	2.2	4.0	23.5	170
OH3	A	173.3	0.5	2.2	6.5	338
OH3	B	98.0	0.3	0.57	1.5	380
OH3	C	128.3	0.4	2.0	5.6	357
OH3	D	247.3	0.9	2.2	8.0	275
OH3	E	208.0	0.5	2.2	5.5	400
OH5	A	154.0	0.3	3.2	6.4	500
OH5	B	112.0	0.4	1.8	6.9	261
OH5	C	110.0	0.3	1.8	4.7	383
OH5	D	102.7	0.6	1.5	8.8	170
OH5	E	119.0	0.3	1.9	5.1	373
OH1	A	306.7	0.8	3.9	9.9	394
OH1	B	369.9	1.7	3.4	15.4	221
OH1	C	184.6	0.9	3.5	17.3	202
OH1	D	288.0	1.1	3.7	13.8	268
OH1	E	272.0	1.0	3.3	12.7	260
OH6	A	455.0	1.1	4.7	11.1	423
OH6	B	399.0	1.2	6.7	19.6	342
OH6	C	213.5	0.7	5.5	17.0	324
OH6	D	252.0	0.6	5.4	12.1	446
OH6	E	338.3	0.8	5.1	11.5	443
RU1	A	155.0	0.1	6.3	5.9	1068
RU1	B	85.3	0.2	2.2	5.7	386
RU1	C	253.3	0.8	2.8	8.5	329
RU1	D	200.7	0.3	3.8	6.0	633
RU1	E	193.7	0.5	6.4	16.8	381

Table 6: Periphyton AFDW and chlorophyll-*a* biomass during the autumn survey in May 2017.

Site	Replicate	AFDW (mg/sample)	Chlorophyll- *a* (mg/sample)	AFDW (g/m^2)	Chlorophyll-*a* (mg/m^2)	Autotrophic index
OC2	A	560.0	4.39	25.1	196.9	127
OC2	B	154.7	0.95	4.6	27.9	165
OC2	C	216.0	1.80	24.1	201.2	120
OC2	D	258.7	0.96	8.2	30.6	268
OC2	E	206.0	1.50	9.6	70.1	137
OH3	A	6.7	0.02	0.5	1.3	385
OH3	B	5.3	0.02	0.4	1.8	222
OH3	C	5.8	0.05	0.7	5.8	121
OH3	D	6.7	0.02	0.9	3.2	281
OH3	E	4.7	0.03	0.5	2.8	179
OH5	A	34.0	0.07	1.5	3.2	469
OH5	B	14.2	0.07	0.4	2.1	190
OH5	C	85.3	0.43	1.8	9.4	191
OH5	D	51.3	0.27	2.4	12.3	195
OH5	E	32.7	0.21	1.1	7.0	157
OH1	A	13.0	0.05	1.4	5.5	255
OH1	B	21.0	0.10	2.1	9.7	216
OH1	C	23.3	0.06	1.9	4.5	422
OH1	D	18.7	0.04	1.8	3.8	474
OH1	E	16.0	0.06	1.2	4.4	273
OH6	A	9.3	0.07	3.7	26.7	139
OH6	B	29.3	0.18	15.1	92.2	164
OH6	C	27.0	0.06	11.0	23.8	462
OH6	D	24.2	0.21	13.3	114.0	117
OH6	E	28.0	0.23	8.7	71.6	122
RU1	A	60.0	0.09	4.4	6.4	688
RU1	B	4.7	0.03	0.4	2.2	182
RU1	C	25.0	0.05	4.0	8.2	488
RU1	D	9.3	0.05	0.8	4.3	186
RU1	E	39.0	0.03	1.3	0.8	1625

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ANALYSIS REPORT

Client:	Golder Associates (NZ) Limited	**Lab No:**	1783644 SPv1
Contact:	Mr P Kennedy	**Date Received:**	30-May-2017
	C/- Golder Associates (NZ) Limited	**Date Reported:**	09-Jun-2017
	PO Box 33849	**Quote No:**	34427
	Takapuna	**Order No:**	1413045
	Auckland 0740	**Client Reference:**	1413045/1603
		Submitted By:	Mr P Kennedy

Sample Type: Plant Material

	Sample Name:	OC2 23-May-2017	OH6 24-May-2017	OC2 [Duplicate]	OH6 [Duplicate]	
	Lab Number:	1783644.1	1783644.2	1783644.3	1783644.4	
Dry Matter	g/100g as rcvd	13.0	4.1	11.7	4.6	-
Selenium	mg/kg as rcvd	0.26	0.100	0.26	0.11	-
Selenium	mg/kg dry wt	2.0	2.5	2.3	2.4	-

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Plant Material

Test	**Method Description**	**Default Detection Limit**	**Sample No**
Homogenise	Mincing, chopping, or blending of sample to form homogenous sample fraction. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton.	-	1-4
Dry Matter	Drying for 16 hours at 103°C, gravimetry. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton. AOAC 945.15, 19th Edition.	0.10 g/100g as rcvd	1-4
TMAH Digestion	Tetramethylammonium hydroxide micro digestion, filtration. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton. P.A.Fecher, I.Goldman and A.Nagengast. Journal of Analytical Atomic Spectrometry, 1998, **13**, 977-982.	-	1-4
Selenium	TMAH digestion on as received basis, ICP-MS, correction for dry matter.	0.004 mg/kg dry wt	1-4

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

Mark Bryant, NZCS (Chemistry)
Senior Technologist - Food & Bioanalytical

APPENDIX H

Macrophyte Data

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ANALYSIS REPORT

Client:	Golder Associates (NZ) Limited	**Lab No:**	1783645	SPv1
Contact:	Mr P Kennedy	**Date Received:**	30-May-2017	
	C/- Golder Associates (NZ) Limited	**Date Reported:**	07-Jun-2017	
	PO Box 33849	**Quote No:**	34422	
	Takapuna	**Order No:**	1413045	
	Auckland 0740	**Client Reference:**	14/3045/1603	
		Submitted By:	Mr P Kennedy	

Sample Type: Plant Material

	Sample Name:	OH6 24-May-2017	OH6 [Duplicate]			
	Lab Number:	1783645.1	1783645.2			
Dry Matter	g/100g as rcvd	7.2	7.6	-	-	-
Selenium	mg/kg as rcvd	0.13	0.145	-	-	-
Selenium	mg/kg dry wt	1.8	1.9	-	-	-

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Plant Material

Test	Method Description	Default Detection Limit	Sample No
Homogenise	Mincing, chopping, or blending of sample to form homogenous sample fraction. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton.	-	1-2
Dry Matter	Drying for 16 hours at 103°C, gravimetry. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton. AOAC 945.15, 19th Edition.	0.10 g/100g as rcvd	1-2
TMAH Digestion	Tetramethylammonium hydroxide micro digestion, filtration. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton. P.A.Fecher, I.Goldman and A.Nagengast. Journal of Analytical Atomic Spectrometry, 1998, **13**, 977-982.	-	1-2
Selenium	TMAH digestion on as received basis, ICP-MS, correction for dry matter.	0.004 mg/kg dry wt	1-2

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

Malar Sritharan BSc
Laboratory Technician - Food and Bioanalytical

APPENDIX I

Benthic Macroinvertebrate Data

Table 1: Benthic invertebrate data for Ohinemuri River and Ruahorehore Stream sites in November 2016.

Taxa	MCI	OC2						OH3						OH5						OH1						OH6						RU1					
		A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
Ephemeroptera																																					
Acanthophlebia	**7**								1																												
Ameletopsis	**10**																																				
Arachnocolus	**8**																																				
Atalophlebiodes	**9**																																				
Austroclima	**9**		1		1		1				5		4	2	2	1	2	1	1	4	2	1	1				2	2	4			11	7	4	7	16	14
Austronella	**7**																																				
Coloburiscus	**9**															1																1					
Deleatidium	**8**												1	2	1		1	1						1					1								
Ichthybotus	**8**																																				
Isothraulus	**8**																																				
Mauiulus	**5**																																				
Neozephlebia	**7**																																				
Nesameletus	**9**									1																											
Oniscigaster	**10**																																				
Rallidens	**9**																																				
Siphlaenigma	**9**																																				
Tepakia	**8**																																				
Zephlebia	**7**							1			1	1	1	4	5	1		2	1	2		2	2						1	1		2	4	2	8	9	4
Plecoptera																																					
Acroperla	**5**																																				
Austroperla	**9**																																				
Cristaperla	**8**																																				
Halticoperla	**8**																																				
Megaleptoperla	**9**																																				
Nesoperla	**5**																																				
Spaniocerca	**8**																																				
Spaniocercoides	**8**																																				
Stenoperla	**10**																																				

Taxa	MCI	OC2						OH3						OH5						OH1						OH6						RU1					
		A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
Taraperla	5																																				
Zealandobius	5																																				
Zealandoperla	10	1		2	1	2	1	1					1						2											1							
Notonemouridae	8						1																														
Trichoptera																																					
Alloecentrella	9																																				
Aoteapsyche	4	5	7	5	14	26	23	4	8	14	29	10	19	24	19	20	17	19	17	7	24	11	7	23	27	10	3	11	7	38	96	69	23	43	176	320	100
Beraeoptera	8																																				
Confluens	5																																				
Conuxia	8																																				
Costachorema	7		1		2	3	2	1		1	3	3	2			1												1				3		3	1	6	4
Edpercivalia	9																																				
Ecnomidae	8																																1				
Helicopsyche	10																																				
Hudsonema	6															1	1									1	4	2	1	1				1			
Hydrobiosella	9																																				
Hydrobiosis	5	3	6	2	15	15	9	7	8	3	11	7	6	10	12	15	16	21	21	3	4	1	6	2	4	8	11	4	13	4	5	5	5	8	19	16	14
Hydrochorema	9																																				
Kokiria	9																																				
Neurochorema	6				1		1								2	2	1	1						1	1									1	1		
Oecetis	6																																				
Oeconesidae	9																																				
Olinga	9																																				
Orthopsyche	9																																				
Oxyethira	2	112	16	6	10	15	48	1	1	2	5			8	2	1	1	3	1	41	96	64	62	26	68	208	41	15	48	22	80			1	2		1
Paraoxyethira	2															1																					
Philorheithrus	8																																				
Plectrocnemia	8																																				
Polyplectropus	8																																				
Psilochorema	8													1					2			1															

Taxa	MCI	OC2						OH3						OH5						OH1						OH6						RU1					
		A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
Pycnocentrella	**9**																																				
Pycnocentria	**7**					1					1						1										1			1		1			1		
Pycnocentrodes	**5**	3	6	4	2	5	2	71	100	8	22	23	42	120	128	102	256	224	252	21	14	7	26	27	28	10	29	7	9	12	14	24	47	27	176	52	44
Rakiura	**10**																																				
Tiphobiosis	**6**																																				
Triplectides	**5**																														1						
Triplectidina	**5**																																				
Zelolessica	**10**																																				
Megaloptera																																					
Archichauliodes	**7**				1	2				3	2	1	1									1	1		1		2	2	1	1	1	2	4		3	1	4
Odonata																																					
Aeshna	**5**																																				
Antipodochlora	**6**																																				
Austrolestes	**6**																																				
Hemicordulia	**5**																																				
Procordulia	**6**																																				
Uropetala	**5**																																				
Xanthocnemis	**5**																																				
Hemiptera																																					
Anisops	**5**																																				
Diaprepocoris	**5**																																				
Microvelia	**5**																																				
Saldidae	**5**																																				
Sigara	**5**																																				
Coleoptera																																					
Antiporus	**5**																																				
Berosus	**5**																				1			1		4	3	5	3		1						
Dytiscidae	**5**																																				
Elmidae	**6**	8	3	4	9	14	3	6	35	16	14	24	17	8	11	1	11	25	14	2	5	7	2	1	4	1	3	16	5	2	6	5	56	9	8	8	1
Homeodytes	**5**																																				

Taxa	MCI	OC2						OH3						OH5						OH1						OH6						RU1					
		A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
Hydraenidae	**8**																																				
Hydrophilidae	**5**																																				
Liodessus	**5**																																				
Ptilodactylidae	**8**																																				
Rhantus	**5**																																				
Scirtidae	**8**																																				
Staphylinidae	**5**																																				
Neuroptera																																					
Kempynus	**5**																																				
Diptera																																					
Austrosimulium	**3**	10	2	2	11	6	14	4	2	1	7	3	6	2						15	9	7	19	15	4	48		2		4	4		1	4	1	1	1
Aphrophila	**5**	10	3	16	13	14	9	9	5	6	11	6	11	6		3	5	5	2	1	5	1	3	2	14	1	6		4		5	6	9	14	8	25	26
Blephariceridae	**7**																																				
Calopsecta	**4**																																				
Ceratopogonidae	**3**																																				
Chironomidae	**2**																																				
Chironomus	**1**															1													1								1
Corynoneura	**2**																																				
Cryptochironomus	**3**																																				
Culex	**3**																																				
Culicidae	**3**																																				
Dolichopodidae	**3**																																				
Empididae	**3**	1							2							1										2	4	1	2	3	2						
Ephydridae	**4**		1							1																											
Eriopterini	**9**																																				
Harrisius	**6**																																				
Hexatomini	**5**																																				
Limonia	**6**																																				
Lobodiamesa	**5**																																				
Maoridiamesa	**3**	2	3	3	2	5	3					1	1							1				1									1	1		3	1

Taxa	MCI	OC2						OH3						OH5						OH1						OH6						RU1					
		A	**B**	**C**	**D**	**E**	**F**	**A**	**B**	**C**	**D**	**E**	**F**	**A**	**B**	**C**	**D**	**E**	**F**	**A**	**B**	**C**	**D**	**E**	**F**	**A**	**B**	**C**	**D**	**E**	**F**	**A**	**B**	**C**	**D**	**E**	**F**
Mischoderus	**4**																					1															
Molophilus	**5**																					1															
Muscidae	**3**	1	1		2																					1	3		2		1						1
Nannochorista	**7**																																				
Neocurupira	**7**																																				
Neoscatella	**7**																																				
Nothodixa	**5**																																				
Orthocladiinae	**2**	1712	688	992	304	576	464	32	88	80	40	26	56	3	2	9	6	5	8	56	128	144	37	32	40	720	176	160	928	96	336	20	1	5	4	56	29
Parochlus	**8**																																				
Paradixa	**4**																																				
Paralimnophila	**6**																																				
Paucispinigera	**6**																																				
Pelecorhynchidae	**9**																																				
Peritheates	**7**																																				
Podonominae	**8**																																				
Polypedilum	**3**						1																1												3		1
Psychodidae	**1**																																1				
Sciomyzidae	**3**																																				
Stratiomyidae	**5**																																				
Syrphidae	**1**																																				
Tabanidae	**3**																																				
Tanypodinae	**5**																									1											
Tanytarsini	**3**	176	64	80	112	64	256	13	7	112	65	40	66	60	176	40	32	39	22	84	352	144	127	120	172	992	720	176	1008	320	816	34	8	20	6	52	35
Tanytarsus	**3**																																				
Thaumaleidae	**9**																																				
Tipulidae	**5**																																				
Zelandotipula	**6**																																				
Lepidoptera																																					
Hygraula	**4**																																				
Collembola	**6**									1																1						2					

Taxa	MCI	OC2						OH3						OH5						OH1						OH6						RU1					
		A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
Acarina	**5**										1	1			1											4	1			1	4	1			1	1	
Crustacea																																					
Amphipoda	**5**		1																	1			1			4	1	3	1	3	4	1	7	3	1		5
Copepoda	**5**																																				
Cladocera	**5**																																				
Isopoda	**5**							1																													
Ostracoda	**3**																																				
Paranephrops	**5**																																				
Paratya	**5**																																				
Tanaidacea	**4**																																				
Mollusca																																					
Ferrissia	**3**	3	1	7	5	2	3				1	1		2					1	6	9		1	1	4		3			1		2	6	1	2	2	5
Gyraulus	**3**																																				
Hyridella	**3**																																				
Latia	**3**	3	5	2	6	7	1	7	6	38	54	61	5						1		1											13	30	19	48	32	52
Lymnaea	**3**																																				
Melanopsis	**3**																																				
Physa	**3**																																				
Physastra	**5**																																				
Potamopyrgus	**4**	80	4	17	9	44	6	69	264	6	21	19	19	22	80	25	39	4	25	1	5	14	7	7	7	64	17	46	17	64	80	21	57	31	61	23	76
Sphaeriidae	**3**																								1												
Oligochaeta	**1**	1056	144	192	80	1	7	1	7	3	17	7	11	1	1	1		6	3	8	4	7	11	6	18	576	10	48	816	256	240	8	3	1		3	1
Hirudinea	**3**																															1					1
Platyhelminthes	**3**	2	2		3		4			1	2																			1	2				1		
Nematoda	**3**				2									1														1									
Nematomorpha	**3**																																				
Nemertea	**3**	1					2																					1									
Coelenterata																																					
Hydra	**3**																																				

Table 2: Benthic invertebrate data for Ohinemuri River and Ruahorehore Stream sites in May 2017.

Taxa	MCI	OC2						OH3						OH5						OH1						OH6						RU1					
		A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
Ephemeroptera																																					
Acanthophlebia	**7**																																				
Ameletopsis	**10**																																				
Arachnocolus	**8**																																				
Atalophlebiodes	**9**																																				
Austroclima	**9**	3		1	1	1												1				1															
Austronella	**7**																																				
Coloburiscus	**9**																1			1																	
Deleatidium	**8**																																				
Ichthybotus	**8**																																				
Isothraulus	**8**																																				
Mauiulus	**5**																																				
Neozephlebia	**7**																																				
Nesameletus	**9**																																				
Oniscigaster	**10**																																				
Rallidens	**9**																																				
Siphlaenigma	**9**																																				
Tepakia	**8**																																				
Zephlebia	**7**		2		2		1												1	1			1				1						8	2			5
Plecoptera																																					
Acroperla	**5**	3		3	3	5	3			1					1		2	1	2	1				2													
Austroperla	**9**																																				
Cristaperla	**8**																																				
Halticoperla	**8**																																				
Megaleptoperla	**9**																																				
Nesoperla	**5**																																				
Spaniocerca	**8**																																				
Spaniocercoides	**8**																																				
Stenoperla	**10**																																				

Taxa	MCI	OC2						OH3						OH5						OH1						OH6						RU1					
		A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
Taraperla	5																																				
Zealandobius	5	1	1		1									1																							
Zealandoperla	10			1											1			2																			
Notonemouridae	8																																				
Trichoptera																																					
Alloecentrella	9																																				
Aoteapsyche	4	4	1	1	4	7	4	2						2	3	1	1		3			1					1		2		1	4	2	1		2	5
Beraeoptera	8																																				
Confluens	5																																				
Conuxia	8																																				
Costachorema	7																																				
Edpercivalia	9																																				
Ecnomidae	8																																				
Helicopsyche	10																																				
Hudsonema	6	1		1							1																		1			1	3				
Hydrobiosella	9																																				
Hydrobiosis	5		1	1		1	1			1							1										1										
Hydrochorema	9																																				
Kokiria	9																																				
Neurochorema	6			3	1																																
Oecetis	6																																				
Oeconesidae	9																																				
Olinga	9																																				
Orthopsyche	9																																				
Oxyethira	2	1	6	4	5	4	3		1	1		1							1	4	2	10	1	1	2	1			1		1						1
Paraoxyethira	2																																				
Philorheithrus	8																																				
Plectrocnemia	8																																				
Polyplectropus	8																																				
Psilochorema	8													1																							

Taxa	MCI	OC2						OH3						OH5						OH1						OH6						RU1					
		A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
Pycnocentrella	9																																				
Pycnocentria	7	2	1	2	4	4	1															1										2	3	1	1	3	1
Pycnocentrodes	5	3	128	22	26	31	8	16	12	10	9	16	3	5			2		3			1		1	1			1	1	1		11	38	4	2	20	22
Rakiura	10																																				
Tiphobiosis	6																																				
Triplectides	5																																				
Triplectidina	5																																				
Zelolessica	10																																				
Megaloptera																																					
Archichauliodes	7	1				1														1				1		1	1						1				
Odonata																																					
Aeshna	5																																				
Antipodochlora	6																																				
Austrolestes	6																																				
Hemicordulia	5																																				
Procordulia	6																																				
Uropetala	5																																				
Xanthocnemis	5																																				
Hemiptera																																					
Anisops	5																																				
Diaprepocoris	5																																				
Microvelia	5																																				
Saldidae	5																																				
Sigara	5																																				
Coleoptera																																					
Antiporus	5																																				
Berosus	5																						1														
Dytiscidae	5																																				
Elmidae	6	4	3	2	2	2	1	9	3	4	2	7	2	3		1	2	8	5		10	17	1	10		2	5	4	5	1	4			2			
Homeodytes	5																																				

Taxa	MCI	OC2						OH3						OH5						OH1						OH6						RU1					
		A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
Hydraenidae	**8**																																				
Hydrophilidae	**5**																																				
Liodessus	**5**																																				
Ptilodactylidae	**8**																																				
Rhantus	**5**																																				
Scirtidae	**8**																																				
Staphylinidae	**5**																																				
Neuroptera																																					
Kempynus	**5**																																				
Diptera																																					
Austrosimulium	**3**	5	2	12	8	11	3	1	1	3	3	2	1	2	4	2	1	1		8	7	41	4	11	6	1	5	3	7	1	2	3	2	5		3	14
Aphrophila	**5**	2	2	1	4	2	5								1					1				1								1					
Blephariceridae	**7**																																				
Calopsecta	**4**																																				
Ceratopogonidae	**3**																																				
Chironomidae	**2**																																				
Chironomus	**1**															1		2	5							2	1	1		1	2						
Corynoneura	**2**													3							1		1														
Cryptochironomus	**3**																																				
Culex	**3**																																				
Culicidae	**3**																																				
Dolichopodidae	**3**																																				
Empididae	**3**	1		2		2								1										1													
Ephydridae	**4**																																				
Eriopterini	**9**																																				
Harrisius	**6**																																				
Hexatomini	**5**																																				
Limonia	**6**																																				
Lobodiamesa	**5**																																				
Maoridiamesa	**3**	1																																			

Taxa	MCI	OC2						OH3						OH5						OH1						OH6						RU1					
		A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
Mischoderus	4																																				
Molophilus	5																																				
Muscidae	3	4	1	1	9	1	2							1																							
Nannochorista	7																																				
Neocurupira	7																																				
Neoscatella	7																																				
Nothodixa	5																																				
Orthocladiinae	2	92	40	124	144	128	19	15	6	19	10	12	5	29	67	15	19	13	14	23	52	112	25	92	48	11	21	11	17	4	21	3		2			
Parochlus	8																																				
Paradixa	4																																				
Paralimnophila	6																																				
Paucispinigera	6																																				
Pelecorhynchidae	9																																				
Peritheates	7																																				
Podonominae	8																																				
Polypedilum	3		1				1							1												1					1			1			
Psychodidae	1																																				
Sciomyzidae	3																																				
Stratiomyidae	5																																				
Syrphidae	1																																				
Tabanidae	3																																				
Tanypodinae	5																																				
Tanytarsini	3	108	120	76	132	224	51	10	2	12	7	8	3	57	76	17	12	16	18	8	3	48		13	3	27	51	17	61	7	62		1				
Tanytarsus	3																																				
Thaumaleidae	9																																				
Tipulidae	5																																				
Zelandotipula	6																																				
Lepidoptera																																					
Hygraula	4																																				
Collembola	6												1																								

Taxa	MCI	OC2						OH3						OH5						OH1						OH6						RU1					
		A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
Acarina	**5**	1		5		2																		1												1	
Crustacea																																					
Amphipoda	**5**																					1									1	1	1	4			
Copepoda	**5**																																				
Cladocera	**5**																																				
Isopoda	**5**																																				
Ostracoda	**3**																												1								
Paranephrops	**5**																																				
Paratya	**5**																																				
Tanaidacea	**4**																																				
Mollusca																																					
Ferrissia	**3**	3	1	6	2	10	2							1																							1
Gyraulus	**3**																																				
Hyridella	**3**																																				
Latia	**3**	3		3	2	1	1	1	1	1	1	1								1													1	4			
Lymnaea	**3**																																				
Melanopsis	**3**																																				
Physa	**3**																																				
Physastra	**5**																																				
Potamopyrgus	**4**	45	5	34	11	22	9	113	6	10	17	56	4	6	1	3	7	4	6	5	9	18	3	4	3		2	1	4	1	1	24	80	21	2	27	17
Sphaeriidae	**3**																																				
Oligochaeta	**1**	144	192	100	480	816	26	6	4	7	2	6	3	39	3	19	26	31	23	20	82	928	18	94	47	9	50	5	12	8	19			10		1	1
Hirudinea	**3**																							1													
Platyhelminthes	**3**	1	2	4	1	5		3	1	1				1	1		3		1		3			1		1	1		1			1	1				
Nematoda	**3**		2	1	2	3									1												1										
Nematomorpha	**3**																																				
Nemertea	**3**	1		2						2																	1										
Coelenterata																																					
Hydra	**3**																																				

APPENDIX J

Fish Data

Table 1: Fish lengths (mm) at Site OC2 during the summer 2017 fish population survey.

Pass 1 catch																						
Shortfin eel	227	340	250	166	230	243	255	245	315	115	125	120	110	220	205	195	195					
Longfin eel	460	530	475	30																		
Common bully	48	62	45	54	47	46	48	40	38	55	46	40	49									
Unidentified bully	25	22	27	24	27	28	30	43	45	29	28	24	47	45	53	45	25	44	46	45	40	35
Koura	24	21																				
Rainbow trout	142																					
Pass 2 catch																						
Shortfin eel	121																					
Common bully	50	45	52	53	49	54	41	37	45	48	48	42	40	38								
Crans bully	56																					
Unidentified bully	45	27	24	26	27	25	30	32	28	27	30	28										
Koura	19	17																				
Pass 3 catch																						
Shortfin eel	250																					
Common bully	44	40	48	40	45	24	28	47	46	45	27	50	49	41	26							
Koura	22																					
Rainbow trout	85																					

Note: Area fished = 160 m^2.

Table 2: Fish lengths (mm) at Site OH5 during the summer 2017 fish population survey.

Pass 1 catch																						
Shortfin eel	480	370	260	185	165	104	100															
Common bully	35	43	43	45	42	40																
Unidentified bully	30	28	26	32	25	27	32	33	22	22	25	25	37	27	26	20	22	24	26	36	25	21
Unidentified bully	29	26	26	27	25	24	29	27	25	26	20	24	25	32	27	24	24	21	30	29	33	25
Unidentified bully	20	19	30																			
Pass 2 catch																						
Shortfin eel	95	120	100																			
Common bully	56	22	41	50	52	35																
Unidentified bully	26	25	29	26	24	36	25	22	25	24	27	30	20	22	24	27	23	22	22	24	27	22
Unidentified bully	24	22	23	26	29	19	26	20	23													
Pass 3 catch																						
Unidentified bully	25	28	25	27	24	27	25	25														

Note: Area fished = 100 m^2.

Table 3: Fish lengths (mm) at Site OH1 during the summer 2017 fish population survey.

Pass 1 catch																						
Shortfin eel	450	140	135	400	200	210																
Common bully	43	51	42	60																		
Unidentified bully	30	32																				
Pass 2 catch																						
Shortfin eel	84	305	300																			
Unidentified bully	27	20																				
Pass 3 catch																						
Shortfin eel	260	115																				
Common bully	62																					
Unidentified bully	31																					

Note: Area fished = 80 m^2.

Table 4: Fish lengths (mm) at Site OH6 during the summer 2017 fish population survey.

Pass 1 catch																						
Shortfin eel	250	260	280	110	215	227	212	171														
Unidentified bully	26	31	30	30	27																	
Pass 2 catch																						
Shortfin eel	480	135	140	120	215	185	105															
Common bully	55																					
Unidentified bully	23	25	31	34	27																	
Pass 3 catch																						
Shortfin eel	420	400	330																			
Common bully																						
Unidentified bully	36	35	25	30	30																	

Note: Area fished = 205 m^2.

Table 5: Fish lengths (mm) at Site RU1 during the summer 2017 fish population survey.

Pass 1 catch																						
Shortfin eel	165	155	200																			
Common bully	66	55																				
Unidentified bully	44	33	29	26	25	30	29	25	26	33	25	29	29	32	21	26	28	25	28	25	30	24
Unidentified bully	44	33	29	26	25	50	32	29	32	49	44	28	30	25	35	31	30	30	21	30		
Koura	30																					
Pass 2 catch																						
Shortfin eel	82																					
Unidentified bully	24	21	26	36	24	24	29	29	24	16												
Pass 3 catch																						
Shortfin eel	120																					
Common bully																						
Unidentified bully	32	30	31	30																		

Note: Area fished = 75 m^2.

Table 6: Fish lengths (mm) at Site M1 during the summer 2017 fish population survey.

Pass 1 catch																						
Longfin eel	950																					
Common bully	70	52	56	41	56	50	41	25	41	51	46	45										
Unidentified bully	42	35	24	49	18	21	31	20	24	24	26	27	23									
Koura	15	18	20	18	17	23	12	15	18													
Pass 2 catch																						
Shortfin eel	170																					
Common bully	44	52	46	44	43	48	57															
Unidentified bully	26	17																				
Koura	18	14	18	14																		
Pass 3 catch																						
Koura	14	16																				
Common bully																						
Unidentified bully																						

Note: **Area fished = 110 m^2.**

Table 7: Fish lengths (mm) at Site R1 during the summer 2017 fish population survey.

Pass 1 catch																						
Shortfin eel	420	360	290	110																		
Common bully	44	45	45	59	45	42	45	52	53	43	42	59	55	42	45	59	45	43	59	51	52	42
Common bully	43	45	51	55	44	55	47	45	43	47	52											
Crans bully	74																					
Unidentified bully	35	26	26	25	38	39	32	30	35	30	22	22	27	32	29	26						
Koura	19	19	16	16																		
Pass 2 catch																						
Shortfin eel	150	250																				
Common bully	51	40	47																			
Crans bully	65																					
Unidentified bully	29	30	27	40	32	27																
Rainbow trout	99																					
Pass 3 catch																						
Shortfin eel	420	140																				
Common bully	48	40	66	52	60	48	50	38	32	41	31											
Crans bully	73																					
Unidentified bully	27	30																				
Koura	18	15	5																			

Note: Area fished = 90 m^2.

Table 8: Fish lengths (mm) at Site W1 during the summer 2017 fish population survey.

Pass 1 catch																						
Shortfin eel	245	330																				
Common bully	48	60	68	45	64	45																
Crans bully	60	57	65	60																		
Koura	16																					
Rainbow trout	136																					
Pass 2 catch																						
Common bully	82	54	45																			
Koura	13	14	14																			
Rainbow trout	126																					
Pass 3 catch																						
Shortfin eel	280	165	195																			
Common bully	44																					
Koura	15	15	12	16	8	6	7															

Note: Area fished = 90 m^2.

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Hill Laboratories TRIED, TESTED AND TRUSTED

ANALYSIS REPORT

Client:	Golder Associates (NZ) Limited	**Lab No:**	1722790 SPv1
Contact:	Mr P Kennedy	**Date Received:**	14-Feb-2017
	C/- Golder Associates (NZ) Limited	**Date Reported:**	23-Feb-2017
	PO Box 33849	**Quote No:**	38618
	Takapuna	**Order No:**	1413045
	Auckland 0740	**Client Reference:**	Eel and Bully Samples
		Submitted By:	Mr P Kennedy

Sample Type: Fish

Sample Name:		OC2 Eel 1 09-Feb-2017	OC2 Eel 2 09-Feb-2017	OC2 Eel 3 09-Feb-2017	OC2 Eel 4 09-Feb-2017	OC2 Eel 5 09-Feb-2017
Lab Number:		1722790.1	1722790.2	1722790.3	1722790.4	1722790.5
Length*	cm	18.5	18.5	20.0	21.0	19.0
Weight*	g	10.000	10.000	15.000	15.000	10.000

Sample Name:		OC2 Bully 09-Feb-2017	OH6 Eel 1 09-Feb-2017	OH6 Eel 2 09-Feb-2017	OH6 Eel 3 09-Feb-2017	OH6 Eel 4 09-Feb-2017
Lab Number:		1722790.6	1722790.7	1722790.8	1722790.9	1722790.10
Length*	cm	-	21.0	20.0	20.4	17.5
Weight*	g	25.00	15.000	10.000	10.000	10.000
Dry Matter*	g/100g as rcvd	22	-	-	-	-
Selenium	mg/kg as rcvd	0.64	-	-	-	-

Sample Name:		OH6 Eel 5 09-Feb-2017	Composite of OC2 Eel 1 , OC2 Eel 2, OC2 Eel 3, OC2 Eel 4 & OC2 Eel 5	Composite of OH6 Eel 1, OH6 Eel 2, OH6 Eel 3, OH6 Eel 4 & OH6 Eel 5		
Lab Number:		1722790.11	1722790.12	1722790.13		
Length*	cm	16.0	-	-	-	-
Weight*	g	5.000	58.46	53.99	-	-
Dry Matter*	g/100g as rcvd	-	23	23	-	-
Selenium	mg/kg as rcvd	-	0.79	2.1	-	-

Analyst's Comments

It should be noted that the eel composite samples were created by homogenisation of each whole eel, and the homogenates mixed to form the composite.

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Fish

Test	Method Description	Default Detection Limit	Sample No
Homogenise*	Mincing, chopping, or blending of sample to form homogenous sample fraction. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton.	-	6, 12-13
Length*	Measurement using tape measure, ruler, or callipers. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton.	0.1 cm	1-5, 7-11
Weight*	Measurement on analytical balance. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton.	0.0001 g	1-13

Sample Type: Fish			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Dry Matter*	Drying for minimum of 24 hours at 65°C, gravimetry. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton. Fact Sheet No 2.3.2-14, A Compendium of Chemical, Physical and Biological Methods for Assessing and Monitoring the Remediation of Contaminated Sediment Sites, 2003.	0.10 g/100g as rcvd	6, 12-13
TMAH Digestion*	Tetramethylammonium hydroxide micro digestion, filtration. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton. P.A.Fecher, I.Goldman and A.Nagengast. Journal of Analytical Atomic Spectrometry, 1998, **13**, 977-982.	-	6, 12-13
Composite Environmental Solid Samples*	Individual sample fractions mixed together to form a composite fraction.	-	1-5, 7-11
Selenium	TMAH digestion, ICP-MS.	0.004 mg/kg as rcvd	6, 12-13

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

Malar Sritharan BSc
Laboratory Technician - Food and Bioanalytical

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ANALYSIS REPORT

SPv1

Client:	Golder Associates (NZ) Limited	**Lab No:**	1783643
Contact:	Mr P Kennedy	**Date Received:**	30-May-2017
	C/- Golder Associates (NZ) Limited	**Date Reported:**	12-Jun-2017
	PO Box 33849	**Quote No:**	38618
	Takapuna	**Order No:**	1413045
	Auckland 0740	**Client Reference:**	Eel and Bully Samples
		Submitted By:	Mr P Kennedy

Sample Type: Fish

Sample Name:		OH6 Eel (single) 24-May-2017	OC2 Eel 1 24-May-2017	OC2 Eel 2 24-May-2017	OC2 Eel 3 24-May-2017	OC2 Eel 4 24-May-2017
Lab Number:		1783643.1	1783643.2	1783643.3	1783643.4	1783643.5
Length	cm	42.0	21.0	17.5	15.0	22.5
Weight	g	209.8	13.890	7.281	4.733	18.867
Dry Matter	g/100g as rcvd	20	-	-	-	-
Selenium	mg/kg as rcvd	0.81	-	-	-	-
Selenium	mg/kg dry wt	4.0	-	-	-	-

Sample Name:		OC2 Eel 5 24-May-2017	Composite of OC2 Eel 1, OC2 Eel 2, OC2 Eel 3, OC2 Eel 4 & OC2 Eel 5 24-May-2017	OH6 Bullies 24-May-2017	OC2 Bullies 24-May-2017	
Lab Number:		1783643.6	1783643.7	1783643.8	1783643.9	
Length	cm	16.5	-	-	-	-
Weight	g	6.444	-	7.133	4.450	-
Dry Matter	g/100g as rcvd	-	24	23	22	-
Selenium	mg/kg as rcvd	-	0.75	1.83	0.79	-
Selenium	mg/kg dry wt	-	3.1	7.8	3.6	-

Analyst's Comments

It should be noted that the eel composite samples were created by homogenisation of each whole eel, and the homogenates mixed to form the composite.
Please note that there were 7 Bullies in sample 8 and 10 Bullies in sample 9.

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Fish

Test	Method Description	Default Detection Limit	Sample No
Homogenise	Mincing, chopping, or blending of sample to form homogenous sample fraction. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton.	-	1, 7-9
Length	Measurement using tape measure, ruler, or callipers. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton.	0.1 cm	1-6
Weight	Measurement on analytical balance. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton.	0.0001 g	1-6, 8-9
Dry Matter	Drying for minimum of 24 hours at 65°C, gravimetry. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton. Fact Sheet No 2.3.2-14, A Compendium of Chemical, Physical and Biological Methods for Assessing and Monitoring the Remediation of Contaminated Sediment Sites, 2003.	0.10 g/100g as rcvd	1, 7-9

Sample Type: Fish			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
TMAH Digestion	Tetramethylammonium hydroxide micro digestion, filtration. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton. P.A.Fecher, I.Goldman and A.Nagengast. Journal of Analytical Atomic Spectrometry, 1998, **13**, 977-982.	-	1, 7-9
Composite Environmental Solid Samples	Individual sample fractions mixed together to form a composite fraction.	-	2-6
Selenium	TMAH digestion on as received basis, ICP-MS, correction for dry matter.	0.004 mg/kg dry wt	1, 7-9

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

Malar Sritharan BSc
Laboratory Technician - Food and Bioanalytical

APPENDIX K

Letter to WRC

27 March 2017

The General Manager
Waikato Regional Council
Private Bag 3038
Waikato Mail Centre
HAMILTON 3240

Attention: Ms Sheryl Roa

Dear Sheryl,

RE: Notification of Pond Overflows to the Receiving Water

Waihi experienced a rainfall event greater than the ten year return period on the 7th and 8th March 2017 (see Figure 1). During that time 131mm of rainfall was received within a 6 hour period.

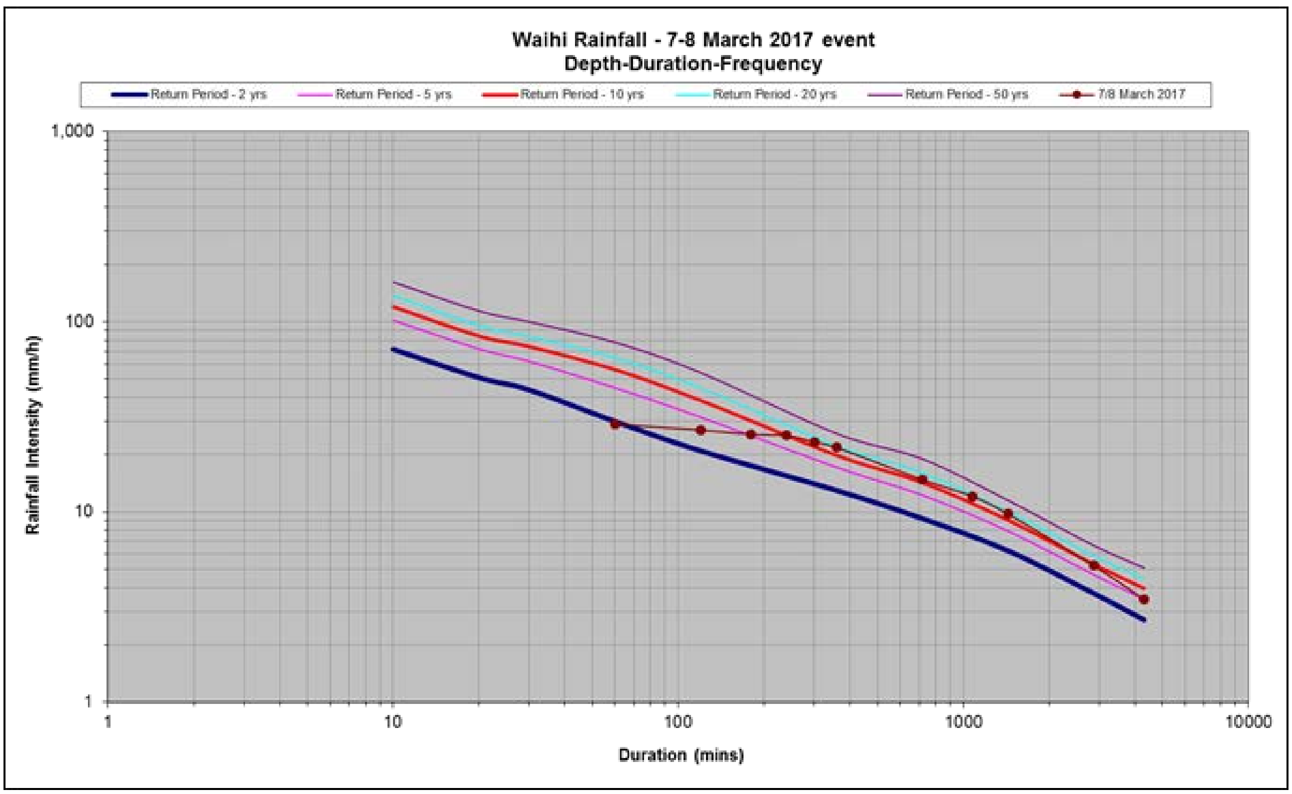

Figure 1 – Depth-Duration-Frequency Curves for 7-8 March 2017

As expected, a number of ponds overflowed during that time. The pond overflows together with the receiving water that they discharged into were sampled to assess compliance with the conditions of consent, as described below.

1. Conveyor Silt Pond CSP2[1]

Discharges from CSP2 are authorised by W1743. Consents W1742 and W1743 do not currently contain the table of receiving water standards that is included within the silt ponds consent 973111 that was granted for the Martha Mine Extended Project. They do however contain condition 4 (described further below) that sets limits on the total suspended solids (TSS) concentration in the pond discharge for storm events with a return period in excess of 2 years.

As you know, OGNZL recently applied for a replacement consent for W1742 and W1743 and in the application it was proposed that the conditions be aligned with those of the silt pond consent 971311. If the consent is granted as requested then the receiving water standards within 971311 will apply for discharges from conveyor silt ponds CSP1 and CSP2, and the existing condition 4 of W1743 will no longer apply. In the interim, we have assessed the CSP2 discharge against condition 4 of W1743, and the receiving water against the receiving water standards of consent 971311 in the table below. By doing so, we have assessed the results against the consent conditions as they stand at present, as well as those that will apply if the new consent is granted with the conditions applied for.

CSP2 discharges to a minor tributary known as TB5. TB5a is the upstream monitoring site and TB5 is the monitoring site downstream of the CSP2 discharge point.

1.1 Total Suspended Solids

Condition 4 of W1743 states:

"… For storms with a return period in excess of 2 years the suspended sediment concentration in the discharge shall be no greater than that of the receiving waters."

Condition 8 of consent 971311 states:

"The discharges authorised by this consent, in combination with all other discharges authorised for this site, shall not cause a significant adverse environmental effect on the receiving groundwater and surface water, or on users of these resources, or, in the case of surface water, aquatic biota. To that end, the silt pond discharges, either separately or in combination with those other discharges, shall not cause the receiving water standards in Table 1 to be breached."

Table 1 requires:

"No greater than a 10% increase compared with upstream concentrations for rainfall events greater than the design storm."

[1] Also known as CSP2S

On 8 March 2017 the total suspended solids in the pond discharge was 410 g/m^3. It is noted however that beyond the sampling point, the pond discharge travels overland through a grass swale before discharging to the tributary. For that reason:

- the water quality can be affected by the land use within the grass swale, downstream of the pond discharge and,
- it can be difficult to obtain a sample that is representative of what is flowing into the tributary as opposed to what is discharging from the pond.

TB5 was not sampled during the overflow event. The pond more than likely complied, however demonstrating compliance with the conditions of consent 971311 can be difficult due to the absence of an appropriate upstream site. Our view is that for this pond, a TSS condition requiring no greater than a 10% increase compared with upstream concentrations for rainfall events greater than the design storm is likely to present practical difficulties, and warrants a different approach prior to the grant of a replacement consent for W1742 and W1743.

1.2 pH and Metals

CSP2 was sampled on 8 March 2017 and the pH was 6.9. As stated, sampling at TB5a and TB5 was not undertaken, however the pond pH complied with the receiving water pH and all of the metals criteria included within consent 971311.

2. Collection/Silt Ponds at the Waste Disposal Area

During this event the following ponds at the Waste Disposal Area overflowed into the receiving water:

- North Stockpile Silt Pond
- West Silt Pond and
- S3.

As you are aware, when the water quality within S3, S4 and S5 is acceptable for direct discharge, the ponds operate under the conditions of the silt pond consent 971311. When the water is not acceptable for direct discharge the ponds operate under the conditions of collection pond consent 971312, and for all rainfall events with a return period less than or equal to ten years all stormwater reporting to the collection ponds is required to be pumped to the Water Treatment Plant for treatment. Just prior to the rainfall event on 7th March the water within S3 was acceptable for direct discharge and that being the case S3, the North Stockpile Silt Pond and West Silt Pond, were all operating in accordance with the silt pond consent 971311.

2.1 pH and Lead

Condition 7 of consent 971311 requires that for rainfall events less than or equal to the 2-year return period, the silt pond discharges shall have a pH within the range of 6.0 – 9.0 pH units. For discharges in rainfall events greater than or equal to the 2-year return period, the pH in the receiving water shall be 6.5 to 9.0.

The results are shown in the table below.

Date	Site	Criteria	In pond[2]	RWQC	Result
8/3/17	North Stockpile Silt Pond	pH	6.0-9.0		7.5
8/3/17	TB1b (U/S site)	pH		6.5-9.0	6.8
8/3/17	TB1a (D/S site)	pH			6.8
8/3/17	West silt pond	pH	6.0-9.0		7.1
8/3/17	OC2 (U/S site)	pH			6.4
8/3/17	OH5 (D/S site)	pH		6.5-9.0	6.4
8/3/17	S3	pH	6.0-9.0		7.3
8/3/17	RU10 (U/S site)	pH			6.3
8/3/17	RU1b (D/S site)	pH		6.5-9.0	6.4
8/3/17	OC2	Pb (g/m3)		0.000137	0.00022
8/3/17	OH5	Pb (g/m3)		0.000191	0.00023

The NSPSP discharge had a pH of 7.5. The pH within Tributary TB1 both upstream and downstream of the discharge complied with the receiving water criteria. For this reason the NSPSP discharge was compliant with the consent conditions for pH.

For NSPSP, WSP and S3, the pH in the pond discharges complied with the in receiving water criteria within the ponds themselves. The low pH results recorded at OC2, OH5, RU10 and RU1b are typical of previous results and are unrelated to the mine discharges.

It is unknown why lead was elevated at OC2 and OH5, however OC2 is upstream of operations and the high level is therefore not mine related. All of the other metals complied with the receiving water standards.

1.2 Total Suspended Solids

Condition 8 of consent 971311 states:

"The discharges authorised by this consent, in combination with all other discharges authorised for this site, shall not cause a significant adverse environmental effect on the receiving groundwater and surface water, or on users of these resources, or, in the case of surface water, aquatic biota. To that end, the silt pond discharges, either separately or in combination with those other discharges, shall not cause the receiving water standards in Table 1 to be breached."

Table 1 requires:

"No greater than a 10% increase compared with upstream concentrations for rainfall events greater than the design storm."

The available monitoring results for 8 March 2017 are summarised below. The monitoring locations are shown in Figure 2.

[2] While consent 971311 allows the pond discharges to have a pH range of 6.0-9.0 pH units for rainfall events less than or equal to the 2-year return period, in practice the continuous monitors within S3, S4 and S5 trigger at pH6.5 to ensure that the receiving water criteria pH cannot be exceeded as a result of the pond direct discharges.

Date	Site	Criteria	In pond[3]	RWQC	Result
8/3/17	OC2 (U/S site)	TSS (g/m^3)			310
8/3/17	North Stockpile Silt Pond	TSS (g/m^3)	100 g/m^3		61
8/3/17	TB1b (U/S site)	TSS (g/m^3)			64
8/3/17	TB1a (D/S site)	TSS (g/m^3)		Pond discharges to result in no greater than a 10% increase compared with upstream concentrations for rainfall events greater than the design storm	53
8/3/17	West silt pond	TSS (g/m^3)	100 g/m^3		42
8/3/17	OH5 (D/S site)	TSS (g/m^3)		Pond discharges to result in no greater than a 10% increase compared with upstream concentrations for rainfall events greater than the design storm	250
8/3/17	S3	TSS (g/m^3)	100 g/m^3		86
8/3/17	RU10 (U/S site)	TSS (g/m^3)			47
8/3/17	RU1b (D/S site)	TSS (g/m^3)			109
7/3/17	RU1 (D/S site)	TSS (g/m^3)		Pond discharges to result in no greater than a 10% increase compared with upstream concentrations for rainfall events greater than the design storm	4
8/3/17	OH6 (D/S site)	TSS (g/m^3)		Pond discharges to result in no greater than a 10% increase compared with upstream concentrations for rainfall events greater than the design storm	200

An assessment of the discharges in combination can be made by comparing OC2 data (310 g/m^3) with OH6 data (200 g/m^3). The total suspended solids concentration at the downstream site was significantly less

[3] While consent 971311 allows the pond discharges to have a TSS of no greater than 100 g/m^3 for rainfall events less than or equal to the 2-year return period, in practice the continuous monitors within S3, S4 and S5 trigger at 100 NTU.

than the upstream site, indicating that the discharges in combination complied with the conditions of consent.

An assessment of the separate silt pond discharges relies upon the results of upstream and downstream sites being sampled at the same time as each pond discharge. It has been agreed previously with WRC that for discharges from S3, S4 and S5, the downstream monitoring site for assessing the increase in suspended solids for all of the ponds combined is RU1 and the upstream monitoring site is RU10.

The TSS for NSPSP was 61 g/m^3 compared to 64 g/m^3 at the upstream site TB1b and 53 g/m^3 at the downstream site TB1a. The pond discharge therefore complied with the conditions of consent for TSS.

The TSS for the West Silt pond and the downstream sampling point OH5 were well below the level recorded at OC2 and demonstrates that the TSS discharged from West Silt Pond complied with the consent conditions. However we note that OH3 would be a more relevant upstream monitoring site for WSP than OC2, due to the inflow of TB1.

The TSS data for S3 and the Ruahorehore Stream highlights a sampling issue. While it appears that the S3 discharge may have elevated the TSS in the Ruahorehore Stream by greater than 10% (RU10 = 47 g/m3 and RU1b = 109 g/m^3), RU1b is not the correct site to assess compliance because it would be within the mixing zone for S3. In any event, the TSS concentration within S3 was less than that at RU1B, so the S3 discharge could not have been the only contributor to the reading at this site. RU1 is the correct downstream site but this was sampled the previous day.

In summary, our view is that all of the separate mine discharges probably complied with the consent conditions however we have identified a sampling issue that when addressed will allow a more definitive assessment of the compliance of separate discharges to be made. The site discharges in combination complied with the consent conditions.

Yours sincerely
OCEANA GOLD (NEW ZEALAND) LTD

Kerry Watson
HSEC Manager

Figure 2 – Monitoring Locations

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APPENDIX L

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APPENDIX L
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