**BEFORE ENVIRONMENT SOUTHLAND**

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| **IN THE MATTER** | of the Resource Management Act 1991 |
| **AND** | |
| **IN THE MATTER** | of Mataura Processing Plant resource consent applications |

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**STATEMENT OF EVIDENCE OF RICHARD MONTGOMERIE ON BEHALF OF ALLIANCE GROUP LIMITED**

**Dated 16 November 2020**

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**Counsel:**
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**QUALIFICATIONS AND EXPERIENCE**

1 My full name is Richard Neilsen Montgomerie.

2 I am a freshwater scientist and a director of Freshwater Solutions Limited, a specialist freshwater environmental consultancy. I have held senior roles at Kingett Mitchell Ltd, the Water Research Centre (UK) and Golder Associates. I have worked as a freshwater scientist and environmental consultant throughout New Zealand and in Europe since 1998. I specialise in monitoring and assessing the ecological effects associated with a wide range of activities including land development, discharges to water, land use change, water takes, damming and diverting water.

3 I hold the qualification of Master of Science in Freshwater Ecology from Otago University.

4 I have been involved in monitoring the effects of Alliance's treated wastewater discharge to the Mataura River since 1998 including preparing the assessment of water quality and ecological effects for of the previous application in 2003. I have been involved in work associated with the assessment of the current and possible future treated wastewater discharge and water abstraction effects on the Mataura River since 2018 including the following:

(a) Environmental data review and monitoring plan preparation.

(b) Water quality, periphyton, benthic invertebrate and fish surveys in 2017 – 2018.

(c) Assessment of the water quality and ecology of the receiving environment.

(d) Assessment of the water quality and ecological effects within the Mataura River and Toetoes Estuary.

5 I have visited the Alliance Mataura processing plant and undertaken monitoring or other water quality and ecology related assessments on numerous occasions since 1998.

6 In preparing this evidence I have reviewed:

(a) The reports and statements of evidence of other experts giving evidence relevant to my area of expertise, including:

(i) Mr Azam Khan.

(ii) Dr Mark James.

(iii) Dr Chris Dada.

(b) Submissions.

(c) The Section 42A Officers' Report and the supporting technical reports and statements of evidence.

7 I have read and agree to comply with the Code of Conduct for Expert Witnesses (Environment Court Practice Note 2014). This evidence is within my area of expertise except where I state that I am relying on facts or information provided by another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

## SCOPE OF EVIDENCE

8 My evidence is divided into two parts and addresses the following matters:

(a) A description of the existing aquatic receiving environment including hydrology, water quality and ecology of the Mataura River and Toetoes Estuary; and

(b) A review of the relevant treated wastewater, receiving water quality and ecology data collected under the existing treated wastewater discharge and water take consents.

## EXECUTIVE SUMMARY

9 The Mataura River drains a 5,400 $km^2$ catchment from headwaters south and east of Lake Wakatipu to the south coast at Toetoes Estuary. The majority of the Mataura River catchment has been developed for agriculture which is particularly intensive in the middle and lower reaches.

10 The water quality at Gore, since 2000, is characterised by low nitrate and ammoniacal nitrogen concentrations and low to moderate phosphorus concentrations. River water temperature and DO concentrations are suitable for protecting river ecosystem health. Clarity is variable and *E. coli* counts make the reach of the Mataura River at Gore unsuitable for swimming. The median Macroinvertebrate Community Index (MCI) score

at the Gore site was 94 (range 91–100) and exceeded the ES lowland hard bottom site guideline (>80) and NPS-FM bottom line (>90).

11 A total of 12 fish species are listed on the NZFFD database from the Mataura catchment above the Mataura Falls, including the native shortfin and longfin eel, common and upland bully, galaxias southern, alpine galaxias, gollum galaxias, giant kokopu and lamprey. Introduced species include brown trout and perch with one record of rainbow trout.

12 The Alliance plant lies downstream of the Mataura Falls, which are a significant barrier to fish passage for all but the most adept climbers. All other fish species recorded above the Mataura Falls are non-migratory or landlocked populations. A Mātaitai reserve was established in 2006, extending approximately 3 km upstream and 5 km downstream of the Plant, for the purpose of recognising and providing for customary management practices and food gathering. The Mataura River has nationally outstanding fisheries and angling amenity as outlined in the Water Conservation (Mataura River) Order 1997.

13 Downstream of the Alliance plant, water quality at Mataura Bridge and Mataura Island sites met the NPS-FM (2020) numeric attribute state A for nitrate-nitrogen, attribute state A and B for ammoniacal nitrogen at the Mataura Island and Mataura Bridge sites respectively and was generally within the top end of attribute state C for DRP. Water temperature and DO concentrations at Mataura Bridge and Mataura Island sites are suitable for protecting river ecosystem health. Clarity is variable and *E. coli* counts are often elevated, particularly at the Mataura Bridge site.

14 Compared with the Gore Site, water quality at the Mataura Bridge Site degrades slightly with respect to ammoniacal nitrogen and DRP concentrations, and *E.coli* counts, although the only difference in the categorisation is for ammoniacal nitrogen, which changes from attribute state A to the top of attribute state B. At the Mataura Island Bridge Site water quality categorisations are the same as the Gore Site.

15 The lower Mataura River is characterised by moderate benthic invertebrate community health and occasional exceedance of periphyton chlorophyll-*a* guidelines.

16 A total of 15 species are listed in the NZFFD downstream of Mataura Township including 13 native species (longfin and shortfin eels, torrentfish, lamprey, gollum galaxias, galaxias southern, redfin bully,

common bully, upland bully, common smelt, kōaro, giant kōkopu and īnanga) and the introduced brown trout and perch.

17 Toetoes Estuary is a 'tidal lagoon' estuary that discharges to Toetoes Beach at the mouth of the Mataura River and Titiroa Stream. The estuary forms part of the Awarua Plains Wetland Complex and supports a wide range of habitats including extensive mudflats and saltmarsh areas and very small patches of seagrass and has high native fish and avifauna values.

18 Summertime DO survey results in the vicinity of the plant between 2012 and 2017 were comparable across all years with DO concentrations well above the consent limit of 5 g/m³ during all surveys except 2012. Continuous DO results since 2013 indicate the downstream attribute state is B or greater.

19 There was no change in either the 7-day mean minimum DO attribute state or the 1-day minimum DO attribute between upstream and downstream (Chalmers Rd) sites during the January 2018.

20 During the February–March 2019 DO survey, following a very long accrual period with extensive algae growths and elevated river water temperatures, there was little deterioration in the 7-day mean minimum DO status of the Mataura River at Chalmers Rd.

21 The maximum river temperature recorded upstream (in the Hydro race) and downstream (at the bridge) has exceeded the thermal tolerance for sensitive benthic invertebrates such as *Deleatidium* (< 23 °C) on one occasion in January 2018 and at other times has been close to exceeding the thermal tolerance of *Deleatidium* sp.

22 BOD concentrations were similar and <2 g/m³ at the hydro race and bridge sites between December 2017 and March 2019 and well below the guideline of <5 g/m³ for avoiding sewage fungus growths. Regular visual observations during summer low flow conditions between the discharge point and Mataura Bridge by Alliance staff between 2012 and 2018 have not recorded conspicuous sewage fungus.

23 Mean monthly DIN concentrations at all sites (upstream and downstream) exceeded the MfE periphyton guideline for protecting benthic biodiversity across all accrual periods. The median DRP concentration at the

upstream and downstream sites was within the NPS-FM (2020) attribute state B and Attribute State C respectively.

24 The Summer 2018 survey results indicate that foams and scums form below the falls and upstream of the Plant discharge. This conclusion is consistent with my 2003 assessment of foams and scums made for the previous assessment of effects.

25 With the exception of Site U1 and U2 in April 2013 periphyton cover has been below the MfE periphyton cover guidelines at all sites during all surveys between January 2012 and March 2019. Following long accrual periods periphyton chlorophyll-*a* levels can become elevated in response to a range of factors including nutrient enrichment upstream and downstream of the discharge.

26 MCI scores hover close to the SWLP guideline and NPS-FM bottom line of 90 above and below the discharge and reflect the cumulative effect that catchment inputs and in particular nutrients from diffuse sources have on periphyton and benthic invertebrate community health. QMCI scores have been variable among years and reflect accrual period length and differences in the relative abundance of the mayfly *Deleatidium*.

27 The Fish IBI score, for the combined fish assemblage across the Summer 2019 fish monitoring sites was 42 placing the sites in the 'good' category.

28 The Mataura River supports a world-renowned brown trout fishery and the river downstream of the Plant is heavily fished by resident and overseas anglers. The presence of large numbers of brown trout and seasonal migration of brown trout and salmon indicate that the water quality in this section of the river is suitable for supporting water quality sensitive salmonids.

29 The section of river between the Plant's intake and hydro race outlet is a shallow bedrock dominated, 270 m length of river. At low flow most of the flow is in a channel that is located near the centre of the river. At higher flows the entire bedrock channel is covered with swiftly flowing water.

30 Bedrock is poor habitat for most benthic invertebrates and fish as it lacks interstitial spaces for refuge from flood and predators and the diversity of habitats required to support productive and diverse biological communities.

31 There were no issues or areas of contention raised by submitters or in the Section 42A report relating to the scope of my evidence.

## ASSESSMENT OF RECEIVING ENVIRONMENT

### MATAURA RIVER UPSTREAM OF THE PLANT

32 The Mataura River catchment is the largest river catchment in the Southland Region and faces pressures from land use and industrial and domestic water takes and discharges.

33 The Mataura River catchment is subject to a Water Conservation Order (WCO), primarily to protect the nationally significant brown trout fishery. The WCO lists as protected waters the Mataura River from its source to the sea.

34 The Mataura River catchment can be divided into three climate zones: coastal areas south of the Hokonui Hills, the Waimea Plains extending between Gore and Lumsden and the upper Mataura (Hughes et al 2011). According to Hughes et al (2011) the Mataura River hydrology can be divided into the steep alpine headwaters extending from the upper catchment to Garston, the middle reaches between Garston (approximately 300 m above sea level) and Gore (approximately 50 m above sea level) and the lowland section between Gore and the Toetoes Estuary.

35 The Mataura River drains a 5,400 $km^2$ catchment from headwaters south and east of Lake Wakatipu to the south coast at Toetoes Estuary. The majority of the Mataura River catchment has been developed for agriculture which is particularly intensive in the middle and lower reaches.

36 Between 1940 to 1980 there was widespread willow clearing, channel straightening and artificial drainage installed throughout the catchment (Wilson, 2008) which significantly altered the catchment hydrology in many areas.

37 The key Environment Southland (ES) water quality and ecological monitoring sites and the ES Tuturau hydrology site on the Mataura River are shown in **Attachment 1** of my evidence. **Attachment 2** of my evidence shows the location of the Plant along with Alliance's water quality and biological monitoring sites.

38 ES has monitored water quality at Gore since 2000. The site is classified by ES as a 'lowland hard bed' waterway and is considered representative of the 'Mataura 3' Surface Water Zone. The Gore Site is approximately 14 km upstream of the discharge point.

39 In general terms the ES water quality results show that the Mataura River at Gore is characterised by low nitrate (annual median range: 0.78–0.94 g/m$^3$) and ammoniacal nitrogen (annual median < 0.01 g/m$^3$) concentrations and low to moderate phosphorus concentrations. River water temperatures and DO concentrations are suitable for protecting river ecosystem health. Clarity is variable and *E. coli* counts make the reach of the Mataura River at Gore unsuitable for swimming.

40 ES has monitored benthic invertebrates at the Gore site since 2000 and periphyton since 2014. The median Macroinvertebrate Community Index (MCI) score, a measure of organic enrichment and benthic invertebrate community health in stony bed rivers, at the Gore site was 94 (range 91–100) and exceeded the ES lowland hard bottom site guideline (>80) on all sampling occasions.

41 The chlorophyll-a level, a measure of nutrient conditions, at the Gore site did not exceed the MfE guideline for aesthetic/recreation or trout habitat & angling (<120 mg/m$^2$) or the NPS-FM (2020) bottom line (200 mg/m$^2$) on any sampling occasion (median 3.0 range 0–11.5 mg/m$^2$). Chlorophyll-a concentrations are not recorded monthly and thus cannot yet really be compared with NPS periphyton attribute states as 3 years of monthly data is required.

42 ES monitors fish in two tributaries upstream of Gore (Waikawa River at Biggar Road and Meadow Burn at Round Hill Road) as part of its State of the Environment monitoring programme. The Integrated Biological Index (IBI) score, which is a measure of the overall health of the fish community, was 'good' at both sites during the most recent surveys (Waikawa River, IBI 40 in 2009/10 and Meadow Burn, IBI 36 in 2008/09).

43 A total of 12 fish species are listed on the NZFFD database from the Mataura catchment above the Falls, including the native shortfin and longfin eel, common and upland bully, galaxias southern, alpine galaxias, gollum galaxias, giant kokopu and lamprey. Introduced species include brown trout and perch with one record of rainbow trout.

44 The Alliance plant lies downstream of the Mataura Falls, which were blasted by dynamite in the 1800's to harness water for industry. The Mataura Falls today are much smaller than their natural form but still remain a barrier to fish passage for all but the most adept climbers such as tuna (eels), kanakana (lamprey) and certain galaxiids. All other species recorded above the Mataura Falls are non-migratory or landlocked populations.

45 The riparian margins and gravel beaches provide important habitat for black fronted terns which have a 'nationally endangered' threat classification (Robertson et al. 2016). The Mataura River has been identified as a popular recreational site in Southland ranked 4th out of 25 locations (including coastal, lake and river locations) in a 2015 survey (Ward 2015).

46 The Mataura River was particularly noted for the gathering of kanakana and tuna, with annual fishing expeditions in season to favoured nohoanga (campsites) along the river.

47 A Mātaitai reserve was established in 2006, extending approximately 3 km upstream and 5 km downstream of the Plant, for the purpose of recognising and providing for customary management practices and food gathering. The Mataura River has nationally outstanding fisheries and angling amenity as outlined in the Water Conservation (Mataura River) Order 1997.

48 National angling survey results recorded 19,100 ± 3,000 angler days were spent fishing the lower Mataura River (below Gore) in the 2014/15 season with the Mataura River recording the greatest number of angler-days in the Southland Region (36% of regional total) followed by the Waiau (35%), Oreti (15% and the Aparima (8%) (NIWA 2016). The Southland Fish and Game Council information on angler access points indicates that there are five angler access points in the mid Mataura between Gore and the Plant.

49 Bacterial conditions classify the Gore site as 'unsuitable for swimming most of the time' (LAWA 2018).

## MATAURA RIVER DOWNSTREAM OF THE PLANT

50 Major tributaries in the lower catchment between Mataura and Toetoes Estuary include the Mimihau Stream and Mokoreta River. The lower river

is the most heavily modified section with water quality influenced by the cumulative effects of land use and diffuse and point source discharges.

51 River flow rate and variability exerts an important influence on periphyton, benthic invertebrates, in-stream habitat and water quality. The Mataura River flow is continuously monitored by ES at Tuturau, approximately 6 km downstream of the Plant. The minimum flow, median flow, and 7 day Mean Annual Low Flow (MALF) and annual number of FRE3 events (3x annual median flow) for Tuturau flow data between 1982 and 2018 was 10.1 $m^3/s$, 56.8 $m^3/s$, 19.0 $m^3/s$ and 21 respectively.

52 In general terms the ES water quality results show that the Mataura River at Mataura Bridge and Mataura Island sites met the NPS-FM (2020) numeric attribute state A for nitrate-nitrogen (annual median ≤ 1.0 $g/m^3$) for all years of sampling, attribute site A and B for ammoniacal nitrogen at the Mataura Island and Mataura Bridge sites respectively and were generally within the top end of attribute state C for DRP. Water temperature and DO concentrations at both ES water quality sites in the lower Mataura River are suitable for protecting river ecosystem health. Clarity is variable and *E. coli* counts are often elevated, particularly at the Mataura Bridge site.

53 Compared with the Gore Site, water quality at the Mataura Bridge Site degrades slightly with respect to ammoniacal nitrogen and DRP concentrations, and *E.coli* counts, although the only difference in the categorisation is for ammoniacal nitrogen, which changes from Attribute State A to the top of Band B. At the Mataura Island Bridge Site water quality categorisations are the same as the Gore Site.

54 The ES ecology monitoring results show that the lower Mataura River is characterised by moderate benthic invertebrate community health and occasional exceedance of periphyton chlorophyll-*a* guidelines.

55 The only ES SoE fish monitoring site in the lower Mataura River catchment is on the Oteramika Stream at Seaward Downs and was ranked lowest out of the 14 ES SoE fish monitoring sites between 2007 - 2010.

56 A total of 15 species are listed in the NZFFD downstream of Mataura Township including 13 native species (longfin and shortfin eels, torrentfish, lamprey, gollum galaxias, galaxias southern, redfin bully,

common bully, upland bully, common smelt, kōaro, giant kōkopu and īnanga) and the introduced brown trout and perch.

57 Whitebaiting and trout fishing are significant recreational activities in the lower reaches of the Mataura River. The Southland Fish and Game Council information on angler access points indicates that there are 25 angler accesses in the lower Mataura River.

## TOETOES ESTUARY

58 Toetoes Estuary is a 'tidal lagoon' estuary that discharges to Toetoes Beach at the mouth of the Mataura River and Titiroa Stream. It drains a large and primarily high productivity agricultural catchment and has a large freshwater influence because the estuary is small in relation to the freshwater input.

59 The estuary supports a wide range of habitats including extensive mudflats and saltmarsh areas and very small patches of seagrass. The estuary has lost large areas of saltmarsh and virtually all the surrounding wetland has been lost through drainage and land use intensification.

60 The estuary forms part of the Awarua Plains Wetland Complex. This complex is known for its high ecological values including mudflats, sandflats, saltmarsh, extensive peatlands, ponds, cushion bog, shrublands, tussocklands, rushlands, podocarp forest, intact vegetation sequences, and invertebrate, bird, fish, and threatened species habitat (Wildland Consultants 2011).

61 Fine scale monitoring of the Toetoes Estuary in 2008/09 concluded that water quality is moderately degraded with reduced clarity, elevated faecal coliforms and elevated nutrients, particularly in high river flows (Robertson and Stevens 2009).

62 Physical and chemical sediment sampling during 2008/09 show they were in good condition with well oxygenated sediment, low total organic carbon (≤0.5%), low nitrogenous and phosphorus nutrients, and heavy metal contaminants well below the ANZECC ISQG-Low threshold11.

63 Stevens and Robertson (2012 and 2017) reported that the extensive subtidal algae growth present in the estuary is driven by the very high nutrient loads entering the estuary. Stevens and Robertson reported that

the estimated N load based on NIWA's CLUES model with 2002 land cover is 2,450 tonnes N year, and therefore based on current land use is likely to be >4,000 tonnes N year.

64 Because Toetoes Estuary is relatively small in comparison to the very large freshwater inflow (mean river flow is 76 $m^3/s$), most of the N inflow is rapidly flushed out to sea. However, the high N inputs support excessive growths of nuisance macroalgae in areas exposed to elevated nutrient concentrations and low salinity conditions.

65 Dense seagrass cover (> 50%) was very scarce (0.3ha, < 1%) and a 40% loss in dense seagrass was recorded since 2013. Macroalgal smothering appears to be the probable cause of this loss (Stevens and Robertson 2017). Seagrass is vulnerable to fine sediments in the water column and sediment quality, rapid sediment deposition, excessive macroalgal growth, high nutrient concentrations, and reclamation. Decreases in seagrass extent is likely to indicate an increase in these types of pressures.

66 The Toetoes Estuary provides good habitat for fish (including breeding areas for whitebait and flatfish), birdlife and tidal flat organisms. Stevens (2018) reported that the estuary is rated as of outstanding importance in the "Wetlands of National Importance to Fisheries Database".

67 The waters, mudflats and marginal vegetation of Southland's large tidal estuaries and coastal lagoons including Toetoes Estuary make up the most important bird habitat in Southland.

68 The benthic invertebrate community has moderate diversity and is comprised primarily of small surface and subsurface deposit-feeders tolerant of low to moderate mud content, shallow Redox Potential Discontinuity, strong salinity fluctuations during floods, and moderate organic enrichment. The benthic invertebrate community rating indicates a slightly polluted or 'good' condition (Robertson and Stevens 2009).

69 Human use of the estuary is moderate and it is mainly used for walking, shellfish collection, bird study, scenic, fishing, duck shooting, white baiting, and bathing (Robertson and Stevens 2008).

## DISCHARGE VOLUME AND QUALITY

70 Extensive work was undertaken in the mid-2000s to separate high phosphorus wastewater streams within the Plant and apply targeted dissolved reactive phosphorus treatment to those streams resulting a significant reduction in phosphorus concentration in the discharge and phosphorus loads to the river.

71 The sheep and lamb processing operation at the Plant closed on 26 September 2012 with that operation shifting to Alliance's large plant at Lorneville, near Invercargill. Removal of sheep and lamb processing resulted in a significant reduction in water use and contaminant loads in the treated wastewater including reducing low molecular weight BOD, (which can cause sewage fungus), sulphide and remaining issues with targeted dissolved reactive phosphorus treatment.

72 Calf processing ceased in November 2013 and rendering ceased in January 2014 leading to further improvements in wastewater quality.

73 This section of my evidence presents the discharge volume and water quality data for the period between October 2012 and 12 March 2019.

### Discharge Volume

74 The processing season typically starts in October and ends in September with a short 'off season' between late September and mid-late October.

75 Alliance's current discharge permit requires that the discharge not exceed 14,400 $m^3$/day. The maximum daily discharge volume has been well below that with a peak of 7,602 $m^3$/day in the 2013/14 season.

76 The median discharge for the period between October 2012 and March 2019 was 3,305 $m^3$/day. On no occasion was the consent limit for discharge volume exceeded. The lowest completed seasonal daily median was in 2015/16 (2,994 $m^3$/day) and the highest was in 2017/18 (4,418 $m^3$/day).

77 The median discharge volumes remained steady at around 3,000 $m^3$/day between the 2012/13 and 2016/17 seasons and increased to 4,418 $m^3$/day (approximately 47% increase) in the 2017/18 season.

78 The median daily discharge volume in the 2018-2019 was 5,014 $m^3$/day well above the median daily discharge volume in the 2012/13 – 2016/17 seasons, but still well within the authorised discharge volume.

79 Increased water use in the 2018 – 2019 season was the result of a combination of factors including increased cleaning and hygiene requirements for processing *Micoplasma bovis* affected stock, increased cattle numbers and weights and changed product requirements. These factors combined to increase the total volume of treated wastewater discharged to the river in the 2018 – 2019 season compared to the 2012 – 2017 period.

**Discharge Quality**

80 Between 2012 and March 2019 the treated wastewater discharge had a median pH of 7.2 – 8.8, conductivity of 94 – 140 µS/cm and median TSS of 57 – 76 g/$m^3$. Median sulphide has ranged between < 0.4 – 0.57 g/$m^3$ with no consent exceedances.

81 Median BOD has ranged between 150 – 220 g/$m^3$ with 9 exceedances of the 300 g/$m^3$ consent limit since 2012. Median low molecular weight BOD has ranged between 60 – 92 g/$m^3$ since 2012.

82 Median ammoniacal-nitrogen has ranged between 13 – 21 g/$m^3$ and was compliant with the upper consent limit of 50 g/$m^3$ 100% of the time with the ‘consistently maintain’ consent limit of 30 g/$m^3$ exceeded on one occasion.

83 Median TP ranged between 2.3 and 4.1 g/$m^3$ with an increasing trend evident between 2012 and 2018. TP was also elevated in the first half of the 2018 – 2019 season. Median DRP ranged from 0.18 to 0.23 g/$m^3$ and was also elevated in the first half of the 2018 – 2019 season.

84 The microbiological characteristics and microbial treatment performance of the meat works plant discharge was assessed by Streamlined Environmental Ltd and is addressed in Dr Dada’s evidence.

85 Discharge loads of key parameters (TSS, BOD, TKN and TP) were calculated on a daily basis. On days when discharge occurred the average daily discharge loads between October 2012 and March 2019

were: TSS = 236 kg/d; BOD = 641 kg/d; TKN = 137 kg/d; and, TP = 11.7 kg/d. Apart from BOD and DRP, there is no limit on nutrient discharge loads. The 3,500 kg/day limit on the discharge load of BOD and 14.4 kg/day limit on the discharge load of DRP achieved 100% compliance over the monitoring period.

86 TSS loads ranged from 62–91 t/yr, BOD 158-241 t/yr, TKN 33-52 t/yr and TP 2.4-4.4 t/yr. Results show a 47% increase in TSS load, 48% increase in BOD load, 33% increase in TKN load and 22% increase in TP load in the 2017/18 season compared to the 2016/17 season.

## RIVER WATER QUALITY AND CHARACTERISTICS

### *Dissolved Oxygen*

### January 2018 Longitudinal Survey

87 Dissolved oxygen concentration and percent saturation in the Mataura River early morning longitudinal survey ranged between 8.2 g/m³ and 86% at Chalmers Road, 13 km downstream of the discharge, and 9.5 g/m³ and 98% 315 m downstream of the treated wastewater discharge. Dissolved oxygen remained near the lower end of the survey range at Sites 10, 11, 12 and 13 (8.2–8.3 g/m³; 87–88%) (**Attachment 3** of my evidence).

### 2012 – 2017 Data Sonde Surveys

88 Summertime continuous DO surveys have been undertaken at the Chalmers Road site in 2012, 2013, 2014, 2016 and 2017. DO survey results were comparable across all years with DO concentrations well above the consent limit of 5 g/m³ during all surveys except 2012. Continuous DO results since 2013 indicate the downstream attribute state is B or greater.

### Summer 2018 Data Sonde Results

89 Data sondes were installed in the Mataura River 1.2 km upstream from the discharge and at Chalmers Road 13 km downstream from the discharge in Summer 2018 and Summer 2019.

90 Dissolved oxygen concentrations upstream ranged between 6.8–10.7 g/m³ (mean 8.8 g/m³; 7-day mean minimum 7.6 g/m³; 1-day minimum 6.8 g/m³) and saturation ranged from 77.2–125% (mean = 100%) with depressed DO saturation (<80%) recorded on 24 January in the early morning. DO concentration at Chalmers Road ranged between 5.9–10.6 g/m³ (mean 8.2 g/m³; 7-day mean minimum 7.1 g/m³; 1-day minimum 5.9 g/m³) and fell below 80% DO saturation on several days (range 67.1–127%; mean 93.8%) within the monitoring period.

91 The NPS-FM (2020) provides guidance on how to interpret continuous DO data versus the various attribute states as follows, "the DO attribute states are defined in the NPS-FM by two expressions of DO minima; the lowest 7-day mean of daily minima (the '7-day mean minimum') and the lowest daily minimum (the '1-day minimum')". Hence, the two-classification DO attribute states are B (7-day mean minimum: ≥7.0 and <8.0 g/m³) and B (1-day mean minimum: ≥5.0 and <7.5 g/m³) upstream and downstream.

92 Although there was a noticeable reduction in DO concentrations downstream during the January 2018 survey, there was no change in either the 7-day mean minimum attribute state or the 1-day minimum attribute state between upstream and downstream sites. The NPS-FM narrative states that both sites could be expected to experience 'occasional minor stress on sensitive organisms caused by short periods (a few hours each day) of lower dissolved oxygen' and potential for 'reduced abundance of sensitive fish and macroinvertebrate species'. The potential effects of the DO concentrations on the ecological health of the river are set out in the evidence of Dr Mark James.

**Summer 2019 Data Sonde Results**

93 Dissolved oxygen concentrations upstream ranged between 8.1–11.8 g/m³ (mean 10.0 g/m³; 7-day mean minimum 8.7 g/m³; 1-day minimum 8.1 g/m³) and did not fall below 80% DO saturation on any occasion (range 86.5–122%; mean 100%).

94 Dissolved oxygen concentrations downstream ranged between 6.8–11.6 g/m³ (mean 9.2 g/m³; 7-day mean minimum 8.0 g/m³; 1-day minimum 6.8 g/m³). Downstream DO saturation ranged from 72.9–119% (mean = 93.4%) with a spell of depressed DO saturation (<80%) recorded on 7 March and 13 March in the early morning.

95 The NPS classifications of DO attribute states (7-day minimum and 1-day minimum, respectively) were A (≥8.0 $g/^3$) and A (≥7.5 $g/m^3$) upstream and B (≥7.0 and <8.0 $g/m^3$) and B (≥5.0 and <7.5 $g/m^3$) downstream. Hence, during the February–March 2019 survey, following a very long accrual period with extensive algae growths and elevated river water temperatures, there was little deterioration in the 7-day mean minimum DO status of the Mataura River downstream of the discharge.

**Hydro race and Bridge Sites**

96 DO concentrations monitored weekly between January 2018 and March 2019 remained above the Operative Regional Water Plan and Proposed Regional Water and Land Plan (Decisions Version) standard (>5 $g/m^3$) on all sampling occasions (median 10.5 $g/m^3$, range 8.3–12.5 $g/m^3$ and median 10.9 $g/m^3$, range 8.0–12.8 $g/m^3$, respectively).

97 The NPS-FM (2020) numeric attribute state A for DO is > 8.0 $g/m^3$ (7-day mean, Summer Period: 1 November – 30 April) and > 7.5 $g/m^3$ (1-day minimum, Summer Period: 1 November – 30 April) and was also met at upstream and downstream sites.

***Temperature***

98 River water temperature ranged between 2.3–23.2°C (median 11.2°C) upstream (Hydro race) and 2.3–23.2°C (median 11.2°C) downstream (Bridge). The SWLP (2018) upper temperature guideline for lowland streams that receive discharges (< 23°C) was exceeded once in January 2018 (23.2°C); on that occasion the upstream temperature was also 23.2°C.

99 The maximum river temperature recorded upstream (in the Hydro race) and downstream (at the bridge) has exceeded the thermal tolerance for sensitive benthic invertebrates such as *Deleatidium* (< 23 °C) on one occasion in January 2018 and at other times has been close to exceeding the thermal tolerance.

### *Total Suspended Solids*

100 TSS concentrations exhibited a similar pattern at the hydro race and bridge sites. In my opinion the slight difference in median TSS concentrations upstream (5 $g/m^3$) compared with downstream (6 $g/m^3$) is attributed to the slightly higher downstream concentrations on the occasions when river TSS was high at both sites, rather than any consistent increase downstream.

### *Nutrients*

**January 2018 and 2019 Longitudinal Survey Results**

101 A longitudinal survey of nutrients in the Mataura River was undertaken on 12 January 2018 and 23 January 2019. Tributaries were also sampled during the 12 January 2018 survey.

102 At sites immediately upstream and immediately downstream of the discharge there was little evidence of changes in water quality due to the discharge other than an approximately 0.2 $g/m^3$ increase in TN (attributable to TKN) at Site 4 and Site PDP3 (**Attachment 4** of my evidence).

103 Total nitrogen concentrations returned to close to upstream concentrations at Sites 5 and Site 6. This suggests that TN concentrations in the Plant discharge will only potentially affect the river for approximately 2.5 km downstream of the discharge. Below that point concentrations trend upward and then downwards; such variability is expected given there are other opportunities for nitrogen input downstream of the discharge (e.g., tributaries, sediment release) as well as consumptive processes occurring in the river. TN concentrations exceeded the ANZECC (2000) 'stressors' trigger for lowland rivers (0.614 $g/m^3$) at all sites (upstream and downstream of the discharge) indicating the potential for stimulating algal growths.

104 BOD concentrations were < 2 g $O2/m^3$ and TP concentrations showed little variability over the reach surveyed. DRP showed an increase at Site 8 and decreased further downstream.

**Hydro race and Bridge Sites**

***BOD***

105 BOD concentrations were similar and <2 g/m³ at the hydro race and bridge sites between December 2017 and March 2019 and well below the guideline of <5 g/m³ for avoiding sewage fungus growths.

106 Regular visual observations during summer low flow conditions between the discharge point and Mataura Bridge by Alliance staff between 2012 and 2018 have not recorded conspicuous sewage fungus. What appeared to be a very small amount of sewage fungus was recorded at Site D1 in March 2019 with the aid of an underwater viewer by Alliance staff.

***Nitrate+Nitrite Nitrogen***

107 The discharge contains low concentrations of nitrate-nitrogen and this is consistent with the observation that there is little difference in nitrate-nitrogen concentrations upstream and downstream of the discharge. At both sites annual median nitrate-nitrogen concentrations met the NPS-FM (2020) numeric attribute state A for toxicity (≤1.0 g/m³) for all years of sampling. It is noted nitrate nitrogen concentrations at both sites exceeded the ANZECC (2000) 'physical and chemical stressor' trigger value, which relates to nuisance plant growths, for lowland rivers (0.444 g/m³). The potential effects of this are described in the evidence of Dr James.

***Ammoniacal-nitrogen***

108 The median discharge concentrations of ammoniacal-nitrogen for the monitoring period was 15 g/m³ (5%-ile-95%-ile: 5.9–29 g/m³), therefore there is potential for a measurable increase in ammoniacal-nitrogen to be found downstream of the discharge.

109 The attribute state A for ammoniacal nitrogen for toxicity (≤ 0.03 g/m³) was always met at the upstream site (annual medians 0.02–0.03 g/m³). Ammoniacal nitrogen concentrations were consistently slightly higher downstream and just fall into NPS attribute state B for toxicity (>0.03 and ≤0.24 g/m³) on all occasions (annual medians 0.05-0.06 g/m³).

110 Median ammoniacal nitrogen concentrations exceeded ANZECC (2000) 'physical and chemical stressor' trigger values, which relate general water quality and an increased risk of nuisance plant growths, for lowland rivers (<0.021 g/m$^3$) at both sites. The potential and actual effects associated with ammoniacal nitrogen are set out in the evidence of Dr James.

***Total nitrogen***

111 TN median concentrations between December 2017 to March 2019 were slightly higher downstream 1.2 g/m$^3$ (range 0.62–3.5 g/m$^3$) compared to upstream 1.1 g/m$^3$ (range 0.56–3.4 g/m$^3$).

***Dissolved inorganic nitrogen***

112 DIN results for Sites U1, U2, D1 and D2 between July 2018 and February 2019 were very similar between sites. Mean monthly DIN concentrations at all sites exceeded the MfE periphyton guideline for protecting benthic biodiversity across all accrual periods.

113 Algal growth in rivers is strongly influenced by a range of chemical (e.g. nutrient concentrations), biological (e.g. grazing pressure from macroinvertebrates) and physical factors (e.g. frequency of flow disturbance events). The DIN concentration upstream and downstream of the Plant far exceeded the recommended DIN guideline for preventing excessive periphyton growths across the range of accrual periods over the 8 months of sampling between July 2018 and February 2019.

***Total phosphorus***

114 Annual median total phosphorus concentrations at both the Hydro-race and Bridge sites did not exceed the ANZECC (2000) guideline of <0.33 g/m$^3$.

***Dissolved reactive phosphorus***

115 The median DRP concentration at the upstream Hydro-race site (median = 0.009 g/m$^3$) was within the NPS-FM (2020) attribute state B (>0.006 and

≤0.010) and the median DRP concentration at the downstream Bridge site (0.013 g/m³) was within the attribute state C (>0.010 and ≤0.018).

116 The median 0.04 $g/m^3$ increase in DRP concentrations at the Bridge site is not consistent with the low concentrations of DRP in the discharge (median = 0.20 $g/m^3$), which would typically report as a downstream increase of DRP of approximately 0.0002 $g/m^3$. Hence, it is likely the increase in DRP at the Bridge site is due to release of phosphorus from sediment, suspended and/or on the river bed or is sourced from the tributary that enters the Mataura River just upstream of the treated wastewater discharge.

117 Median DRP concentrations at Sites U1, U2, D1 and D2 between July 2018 and February 2019 were within the NPS-FM (2020) attribute state B noting that the medians were based on eight rounds of monthly monitoring and thus cannot yet really be compared with NPS-FM DRP attribute states that require 5 years of monthly data.

**Nutrient Loads to Toetoes Estuary**

118 Stevens (2018) reports NIWA's CLUES model outputs from October 2018, which estimates a catchment load of 3,110 tonnes N per Year - significantly lower than a previous estimate of >4,000 tonnes N per year. The estimated catchment load of phosphorus is 345 tonnes per year.

119 Based on data from the five seasons from 2012/13 to 2017/18, the Plant discharge loads of TN (estimated from TKN) have ranged from 33-52 tonnes N per year. Hence the TN discharge contribution to the Toetoes Estuary load is 1.1-1.7% (based on 3,110 tonnes). Likewise, the seasonal TP loads have ranged from 2.4–4.4 tonnes P per year and, therefore, the estimated TP discharge contribution to the Toetoes Estuary load is 0.7–1.3%.

120 There is limited TN and TP data for the Mataura River, however based on data collected weekly from 1 January 2018 to 31 December 2018 the annual river load estimates of TN are 4,400 tonnes at both the upstream and downstream site. It is evident the vast majority of TN to Toetoes Estuary is derived from inputs upstream of the Plant's discharge.

121 Likewise, the annual river load estimates of TP at the upstream and downstream sites are 360 tonnes and 390 tonnes, respectively. This

compares reasonably well with the CLUES estimate of 345 tonnes from the Toetoes Estuary and infers the vast bulk of the TP load entering Toetoes Estuary is from the Mataura River upstream of the Plant.

122 BOD seasonal discharge loads ranged from 158–241 tonnes per year (as O2). BOD loads are estimated as <510 tonnes per year and <470 tonnes per year, respectively for upstream and downstream sites. This difference is most likely due to BOD consumption occurring between the upstream and downstream site. The actual and potential effects of the BOD load from the Plant on the river are set out in the evidence of Dr James.

***Colour***

123 Hue and brightness are the main attributes used to describe water colour (MfE 1994). Alliance conducted a series of Munsell colour measurements at the Hydro-race and Bridge Site between 13 December 2017 and 27 March 2018. The water colour at both sites was predominantly pale greenish yellow and only differed marginally between upstream and downstream sites on two occasions. The actual and potential effects of this minor colour change is set out in the evidence of Dr James.

***Clarity***

124 Water clarity can affect aesthetic values and aquatic biological communities (MFE 1994). The Mataura River upstream and downstream of the discharge meets the black disc visual sighting distance of >1.6 m for waterways that are managed for contact recreation (MFE 1994).

125 The current consent does not set clarity limit of change between upstream and downstream and instead the 20% guideline appears to have been selected from the MFE guidelines (MFE 1994), which states that ‘for class A waters (where visual clarity is an important characteristic of the water body): the visual clarity should not be changed by more than 20%’.

126 MFE (1994) states that ‘for other waters: the visual clarity should not be changed by more than 33–50% depending on the site conditions’. The RMA Section 107 also states that a discharge permit should not be granted if there is ‘any conspicuous change in the colour or visual clarity’.

127 River water clarity has been monitored at Sites U1, U2, D1 and D2 during biological surveys since 2012. The clarity has been lower at the downstream sites compared to upstream on most sampling occasions with the difference in the mean upstream and the mean of the mean downstream clarity ranging from -20% to +1%. There are various factors that may influence water clarity between the upstream and downstream sites, including the Mataura Falls, a tributary and stormwater discharges. All black disc readings have been above the MfE guideline of >1.6 m for swimming at all sites on all sampling occasions.

128 Median TSS and turbidity results from the upstream and downstream monitoring sites are similar with just a slight increase in both at the downstream sites. It is possible that the decline in clarity observed at Sites D1 and D2 is the combined effect of the energy from the Mataura Falls resuspending fine material and the discharge. The actual and potential effects associated with clarity changes is set out in the evidence of Dr James.

***Foams and scums***

129 Conspicuous foams and scums can reduce the aesthetic values and human enjoyment of waterways (MFE 1994). The RMA Section 107 requires that a discharge cannot be permitted, if after reasonable mixing, there is ‘production of any conspicuous oil, or grease films, scums or foams of floatable or suspended materials’.

130 Alliance maintained a register of any foam or scum observed during the 2017/18 processing season. Foam was observed on 14 occasions with the foam originating below the falls upstream of the Alliance discharge on all occasions with the exception of 2 February 2018 and 28 March 2018. The foam observed on 2 February 2018 was recorded when the discharge was closed. The survey results indicate that foams and scums form below the falls and upstream of the Plant discharge.

131 This conclusion is consistent with my 2003 assessment of foams and scums made for the previous assessment of effects. The actual and potential effects associated with foams and scums is set out in the evidence of Dr James.

## MATAURA RIVER ECOLOGY

### Habitat

132 The Plant is located on the Mataura Falls. The Mataura Falls is a dominant feature of the river and along with the weir is likely to influence habitat upstream and downstream by acting as a hydraulic and sediment transport control. These influences have the potential to alter habitat characteristics and this is evident between the Mataura Falls and Mataura Bridge where the river bed is bedrock dominated with very little gravel or cobble substrate that is such a dominant feature throughout the river. The influence of the Mataura Falls is also evident at Site D1 where the river bed is dominated by bedrock and large boulders.

133 Habitat at the long-term ecological monitoring sites (Sites U1, U2, D1 and D2) is characterised by a coarse boulder-cobble-gravel dominated riverbed, variable flow velocities, poor channel shading due to wide channel widths and dominated by run habitat with shallow fast flowing riffle and deep pools being less common. Sites U1 and D1 are most similar and have shallower water depths and a higher proportion of loosely compacted gravel. Sites U2 and D2 are most similar and have a higher proportion of boulders, more stable and compacted substrate and deeper riffle habitat. Habitat conditions have remained similar at monitoring sites between 2012 and 2019.

### Periphyton community

134 Periphyton forms the base of the food chain and is a primary source of food for aquatic invertebrates, which become food for fish. The amount of periphyton in a river is determined by interactions between flow regime, nutrients, light, temperature, streambed substrate and invertebrate grazing. Excessive periphyton in rivers can cause detrimental impacts on instream values (e.g., ecological, recreation, aesthetics and ecosystem health).

#### *Periphyton cover*

135 The SWLP (2018) defines thresholds for stream periphyton cover (as a percentage of the stream bed) to support instream values affected by

periphyton in the Southland Region. The Mataura River, in the area of the discharge, is classed as a 'lowland hard bed' river and has the following guideline:

*For the period 1 November through to 30 April, filamentous algae of greater than 2 cm long shall not cover more than 30% of the visible stream bed. Growths of diatoms and cyanobacteria >0.3 cm thick shall not cover more than 60% of the visible stream bed.*

136 Periphyton cover has been assessed at upstream (U1 and U2) and downstream (D1 and D2) sites using the MfE Rapid Assessment Method 2 (RAM2) outlined in Biggs and Kilroy (2002) since January 2012. With the exception of Site U1 and U2 in April 2013, periphyton cover has been below the MfE guideline of < 60% cover of thick algal mats (>3 mm thick) at all sites during all surveys between January 2012 and March 2019.

***Periphyton biomass***

137 The Mataura River in the SWLP (2018) is classed as a Mataura 3 waterbody. There are no periphyton guidelines for the Mataura 3 water body class so the following 'lowland hard bed' river guidelines have been used:

- Biomass shall not exceed 35 g/m$^2$ for either filamentous algae or diatoms and cyanobacteria.
- Chlorophyll-*a* shall not exceed 120 mg/m$^2$ for filamentous algae and 200 mg/m$^2$ for diatoms and cyanobacteria.

138 There are four attribute states (A to D) defined in the national objectives framework (NOF) in the NPS-FM. Chlorophyll-*a* is the periphyton attribute unit and targets ecosystem health as the value for protection.

***Chlorophyll-a upstream and downstream of the Plant discharge***

139 Chlorophyll-*a* concentrations measured at Sites U1, U2, D1 and D2 between January 2012 and March 2019 show that following long accrual periods chlorophyll-*a* levels can become elevated in response to a range of factors including nutrient enrichment upstream and downstream of the discharge.

140 Chlorophyll-*a* concentrations have been the highest at Site D1 compared to the other sites on 1 out of the 10 surveys (January 2012) when levels at both Site D1 and D2 exceeded the NPSFM (2020) national bottom line of > 200 mg/m$^2$ and when sheep and lamb processing was still occurring.

141 Chlorophyll-*a* concentrations have been the highest at Site D2 compared to the other sites on 4 out of the 10 surveys (February 2016, January 2017, February 2019 and March 2019) when levels were within attribute state A in January 2016, attribute state B in January 2017 and February 2019 and exceeded the national bottom line limit of > 200 mg/m$^2$ in March 2019.

142 Chlorophyll-*a* concentrations have been the highest at either of the upstream sites compared to the other sites on 4 out of the 10 surveys (March 2013, March 2014, January 2018 and January 2019) when levels were within attribute state A, attribute state B or attribute state C (**Attachment 5** of my evidence).

143 Chlorophyll-*a* concentrations increased sharply at all sites between the February 2019 and March 2019 surveys reflecting the significant effect that accrual period length has on chlorophyll-*a* levels generally. Between the February 2019 and March 2019 surveys the chlorophyll-*a* levels at Site D1 went from attribute state A to the upper end of attribute state C, Site D2 went from the middle of attribute state B to attribute state D (exceeding the national bottom line), Site U1 went from the lower end of attribute state B to the upper end of attribute state B and Site U2 went from attribute state A to the upper end of attribute state C.

***Ash free dry weight upstream and downstream of the Plant discharge***

144 Ash Free Dry Weight (AFDW) of periphyton recorded at Sites U1, U2, D1 and D2 between January 2012 and March 2019 have been below the guideline of 35 g/m$^2$ in the SWLP (2018) with the exception of Sites U1 and D2 in April 2013 (**Attachment 5** of my evidence).

145 AFDW has been variable between sites over this period with no consistent upstream-downstream trend. Highest AFDW has been recorded at upstream Sites U1 or U2 on 6 occasions (March 2013, April 2013, January 2015, February 2016, January 2018 and January 2019) and at downstream Sites D1 or D2 on 6 occasions (January 2012, March 2014, January 2017, December 2017, February 2019 and March 2019).

**Benthic invertebrate community**

146 Benthic invertebrates have been monitored at least annually since the early 1990s. The existing benthic invertebrate data set therefore provides a sound basis on which to assess the potential effects of the current discharges and take. Benthic invertebrates are an important component of the ecosystem e.g. through grazing pressure controlling algal growths and as a food source for native fish and trout (**Attachment 6** of my evidence).

***Total taxa number***

147 Taxa number has been variable across sites and between surveys over the 2012–2019 period (range: 8–22 taxa). Taxa number has typically been lowest at the upstream Site U2 (range: 9–15 taxa) and increases downstream of the discharge at Site D1 (range: 12–22 taxa) and Site D2 (range: 11–18 taxa).

***EPT taxa number***

148 EPT taxa number recorded at sites across surveys between January 2012 and February 2019 has ranged between 4–8 taxa. EPT taxa number increases downstream of the discharge between Sites U2 and D1. EPT taxa number recorded at Sites U1, D1 and D2 are generally within a similar range. EPT taxa followed the same statistical pattern as taxa number with downstream sampling locations having statistically higher EPT taxa number than upstream locations ($p<0.05$).

***Percent EPT***

149 Percent EPT (a measure of the water and habitat sensitive taxa) has been variable between January 2012 and March 2019 with a general increase at sites between April 2013 and December 2017. There was a decrease in percent EPT at sites with the exception of Site U2 between December 2017 and February 2019 and especially at Site D1.

150 Percent EPT decreased sharply at Site U1, U2 and D2 and increased slightly at Site D1 between the February 2019 and March 2019 indicating a general deterioration in water quality upstream and downstream of the discharge occurred between the February and March 2019 surveys.

151 This effect is consistent with the long accrual period in mid to late summer creating stressful conditions (e.g. elevated temperature, thick algae mats) in the river upstream and downstream of the discharge at the time of the February 2019 and in particular March 2019 surveys. A similarly long mid to late summer accrual period prior to the April 2013 survey (81 days) also saw low %EPT at all sites with the lowest %EPT recorded at Sites U1, U2 and D1.

152 Percent EPT has been lowest at Site D1 compared to the other 3 monitoring sites on 6 out of the last 10 surveys between January 2012 and March 2019. Percent EPT has never been the highest at Site D1 compared to the other 3 sites over the 10 surveys.

153 Percent EPT has never been the lowest at Site D2 compared to the other 3 monitoring sites over the 10 surveys. Percent EPT has been highest at Site D2 compared to the other 3 monitoring sites on 6 out of the 10 surveys between January 2012 and March 2019.

154 Percent EPT at downstream sites and in particular at Site D1 was lower compered to upstream sites in February and March 2019 and reflected the decrease in *Deleatidium* abundance at these sites at the time of these surveys.

155 In my opinion it is likely that the combination of stressful instream conditions (elevated temperature and extensive late successional stage algae growths) throughout the river at the time of the February 2019 and March 2019 surveys resulted in the decrease in %EPT but may not have been as pronounced in February across the survey sites except Site D1.

***Deleatidium* abundance**

156 *Deleatidium* is a water and habitat sensitive mayfly that is a very important component of the benthic invertebrate community in the Mataura River. *Deleatidium* abundance was significantly lower at downstream sites ($p<0.05$). Prior to the February 2019 survey there had been a general increasing *Deleatidium* abundance trend at Site D1 since April 2013.

157 In February 2019 *Deleatidium* abundance at Sites D1 and D2 was approximately 1/3 of the *Deleatidium* abundance at Sites U1 and U2. The last time such a significant decrease in *Deleatidium* abundance was recorded at downstream sites was in January 2012 prior to the transferring of sheep and lamb processing to Lorneville.

158 The decline in *Deleatidium* abundance at downstream sites in February 2019 is not explained by periphyton cover and biomass data which was similar among sites upstream and downstream of the discharge and below levels known to reduce the abundance of sensitive taxa at the time of the survey.

159 *Deleatidium* is sensitive to elevated Amm-N concentrations. The Amm-N concentrations at the time of the February and March 2019 surveys were typical and do not explain the unexpected decline in *Deleatidium* at the time of the February 2019 survey.

160 *Deleatidium* abundance decreased at all sites between the February 2019 and March 2019 surveys mirroring the %EPT decline. The decline in *Deleatidium* abundance between the February 2019 and March 2019 surveys was particularly sharp at the upstream sites indicating that the upstream river water quality and/or periphyton community characteristics had deteriorated significantly between the surveys.

161 The sharp decline in *Deleatidium* abundance at upstream sites in March 2019 is most likely to be related to the very long mid to late summer accrual period creating stressful conditions (elevated river temperatures and extensive growths of late successional stage periphyton growths) that were not suited to supporting an abundant *Deleatidium* population at the time of the March 2019 survey.

***MCI scores***

162 MCI scores have been similar upstream and downstream of the Plant over the period between January 2012 and March 2019 and remained within the ‘fair’ stream health range for all sites.

163 The SWLP (2018) does not define macroinvertebrate guidelines for Mataura 3 water bodies so the guideline for macroinvertebrates in ‘lowland hard bed’ rivers of a MCI score >90 has been used. MCI scores have been above the SWLP (2018) lowland hard bed guideline at Site D1

on all sampling occasions except in the 3 most recent surveys in December 2017, February 2019 and March 2019. The only survey when MCI scores were below 90 at all sites (Sites U1, U2, D1 and D2) was December 2017. In February 2019 Site D1 was the only site below 90 while in March 2019 all sites except D2 were below 90.

164 MCI scores for Site D2 and the upstream Site U1 and Site U2 have been below 90 on 4, 3 and 6 occasions respectively.

165 Overall the MCI results among the 10 surveys indicate that the MCI scores hover close to the SWLP guideline of 90 above and below the discharge and reflect the cumulative effect that catchment inputs and in particular nutrients from diffuse sources have on periphyton and benthic invertebrate community health.

***QMCI scores***

166 QMCI scores, like MCI scores reflect the cumulative effect that catchment inputs and in particular nutrients from diffuse sources have on periphyton and benthic invertebrate community health. QMCI scores have been variable among years and reflect accrual period length and is largely as a result of differences in the relative abundance of the mayfly *Deleatidium*.

167 Since April 2013 QMCI scores have been highest at the Site U2. QMCI scores at Sites U1, D1 and D2 were generally within a similar range between March 2013 and January 2017. QMCI scores were lower at downstream sites compared to upstream sites in January 2012, December 2017, February 2019 and March 2019.

168 The greatest decrease in QMCI scores between upstream and downstream sites was recorded in February 2019 when Site U1 and U2 were in the ‘good’ QMCI score range and Site D1 and D2 were in the ‘poor’ QMCI score range.

169 The QMCI scores at Sites U1 and U2 decreased by approximately 2 and 1.5 points respectively between the February 2019 and March 2019 surveys. This result mirrors the decreases in %EPT and *Deleatidium* abundance reflecting the close linkage between these 3 indices and the effect of the high periphyton chlorophyll-*a* levels in the river at the time of the survey.

170 The only other survey when QMCI scores were ‘poor’ among all sites was April 2013 after an extended period of low flow in late summer and early autumn. A key difference between the April 2013 survey and the March 2019 survey is that in the April 2013 survey the QMCI scores at Sites D1 and D2 were higher compared to Sites U1 and U2 while the reverse occurred in the March 2019 survey. The low QMCI scores at all sites in April 2013 appear to be linked to the high periphyton biomass (AFDW) at the time of the survey.

**Fish Community**

***New Zealand Freshwater Fish Database Records***

171 The New Zealand Freshwater Fish Database records show that the lower Mataura River supports moderate to high native fish diversity including eight species with an ‘At Risk-Declining’ conservation status (Goodman et al. 2014); longfin eels, torrentfish, lamprey, gollum galaxias, galaxias southern, īnanga, giant kōkopu and koaro.

172 The Mataura River is an important eel fishery with the main stem Mataura River fished several times each year and major tributaries such as the Mimihau Stream and the Mokoreta fished once a year (Graynoth *et al* 2008).

173 The Mataura River provides good eel habitat. Large longfin eels prefer deep, slow flowing water with good cover in the form of heavy weed growth, overhung banks or deep turbid water (Graynoth and Niven 2004) in the upper reaches while shortfin eels tend to take up residence in the lower reaches. Juvenile longfin and shortfin eels migrate up the lower Mataura River in summer while adults migrate downstream in summer and autumn.

174 The lower Mataura River is a popular and at times productive whitebait fishery. As with other whitebait runs around the country by far the most abundant species is īnanga. Inanga is a diadromous species that spawn in the tidal zone near estuaries in autumn. Hicks et al (2013) identified key īnanga spawning areas in the marine and freshwater interface in the lower Mataura River. Juvenile inanga are likely to migrate up the lower Mataura River between August and November, with peak migrations occurring a few days after floods in early spring. Larval īnanga are

expected to be washed downstream of the inanga spawning areas between March and August.

175 Juvenile smelt migrate up the lower Mataura River at the tail end of the whitebait run. Smelt are likely to spend up to a year in the Mataura River before spawning on sand banks and sand bars in the lower river. Juvenile smelt are also likely to be an important seasonal food source for large eels and adult trout in the lower Mataura River.

176 Kanakana begin life in freshwater where juveniles live in burrows in muddy/sandy backwaters and along river margins and filter feed on microorganisms (McDowall 1990). After approximately 4–5 years, adult kanakana begin to migrate to sea in late winter early spring. Kanakana adults come back into freshwater to spawn and support a valued traditional fishery. Kanakana have historically been collected at the bottom of the Mataura Falls.

177 Juvenile common bully typically migrate from estuaries into freshwater to spawn in summer and the larvae are then washed out to sea in spring (McDowall 1990). However, some populations, such as those found above the Mataura Falls, become landlocked and complete their life cycle without the sea phase. Common bully can be an important food source for large eels and adult.

178 Unlike other bully species, the young of the upland bully do not go to sea but live and grow in freshwater near where they hatch. The larvae are carried downstream some distance soon after hatching and the yearlings migrate back upstream to occupy adult habitat (McDowall 1990). Upland bully is likely to be a food source for large eels and adult trout. fish living in or migrating through the mixing zone.

***Summer 2019 fish survey results***

179 The February 2019 electric fishing survey results indicate the fish community in run habitat is dominated by a small number of common species – longfin and shortfin eel elvers and upland bully. A single juvenile kanakana was recorded at Site U1. Elvers were more abundant at downstream sites compared to upstream sites and could be the result of differences in habitat suitability or simply the timing of the upstream migration by a particular group of new recruits into the river. The highest

total density of run dwelling fish was recorded at Site D1 (0.36 fish/$m^2$) followed by Site U2 (0.25 fish/$m^2$).

180 The February 2019 results indicate the fish community in riffle habitat is dominated by elvers with upland bully and unidentified galaxiids recorded in low numbers. The highest total density of riffle dwelling fish was recorded at Site D1 (0.38 fish/$m^2$) followed by Site U1 (0.23 fish/$m^2$).

181 The Fish IBI score, using the Southland Fish IBI calculator for the combined fish assemblage across the Summer 2019 fish monitoring sites and including brown trout which are abundant upstream and downstream of the discharge and shortfin eel which were not recorded in the survey was 42 placing the sites in the 'good' IBI category and in attribute state A of the NPS-FM.

182 The reach between the Mataura Falls and Mataura Bridge supports a healthy longfin eel population including several very large fish (+5 kg). Based on an external visual assessment all of the fish captured using nets and by electric fishing appeared to be in a healthy condition. The actual and potential effects on native fish populations and health are set out in the evidence of Dr James.

***Trout fishery***

183 The Mataura River supports a world-renowned brown trout fishery and the river downstream of the Plant is heavily fished by resident and overseas anglers. There is a large resident population of brown trout and late summer and early autumn run of sea run brown trout and salmon are seen and caught between the Mataura Falls and the Mataura Bridge. The presence of such large numbers of brown trout and seasonal migration of brown trout and salmon indicate that the water quality in this section of the river is suitable for supporting water quality sensitive salmonids.

## WATER ABSTRACTION

184 Alliance's existing consent authorises the taking of up to 35,600 $m^3$/day of water from the hydro-race for processing purposes and cooling water. Water is diverted by the weir into the hydro-race under another consent

that was granted by ES in 2019. This diversion has been in place for many decades.

185 The Mataura River Conservation Order 1997 protects the river from adverse effects associated with abstraction. However, Clause 6 (3) specifically allows for the weir if the water permits are granted or renewed subject to similar terms and conditions to which the former permits were subject.

186 Because the weir water level and its associated river flow has been set through another resource consent process, the effects of the established water level and river flow have been assessed as part of that process.

187 The Mataura River between the weir and Plant treated wastewater discharge point is dominated by a short length of deep, swiftly flow water, the Mataura Falls and a 270 m shallow bedrock section. Between the Plant treated wastewater discharge point and the Mataura Falls there is a 155 m length of river characterised by deep moderately swift bedrock habitat.

188 The effects of Alliance's water take from the Mataura River were assessed using a combination of desktop and field survey results. Water quality, periphyton and benthic invertebrates were surveyed. Sites with very similar habitat (substrate size distribution, depth and velocity) were selected to minimise the effect of habitat differences on biological sampling results.

189 Between the Mataura Falls and the weir there is a shallow bedrock dominated, 270 m length of river. At low flow most of the flow is in a channel that is located near the centre of the river. At higher flows the entire bedrock channel is covered with swiftly flowing water.

190 Bedrock is poor habitat for most benthic invertebrates and fish as it lacks interstitial spaces for refuge from flood and predators and the diversity of habitats required to support productive and diverse biological communities. As a consequence, bedrock sections of rainfed rivers tend to be characterised by low diversity biological communities.

191 Water is taken from the hydro-race via 18 pumps. Pumps 1–11 are fitted with 5 – 6 mm mesh screens and Pumps 12–18 are behind a 1.5 mm bar screens to prevent debris and fish from being drawn into the takes (Doyle Richardson pers. comm.).

192 Up to 14,400 $m^3$/day of the 35,600 $m^3$/day take is returned to the river via the treated wastewater outlet, while the remaining 21,200 $m^3$/day of cooling water is returned to the hydro-electric scheme discharge.

## SECTION 42A REPORT AND RELATED EVIDENCE

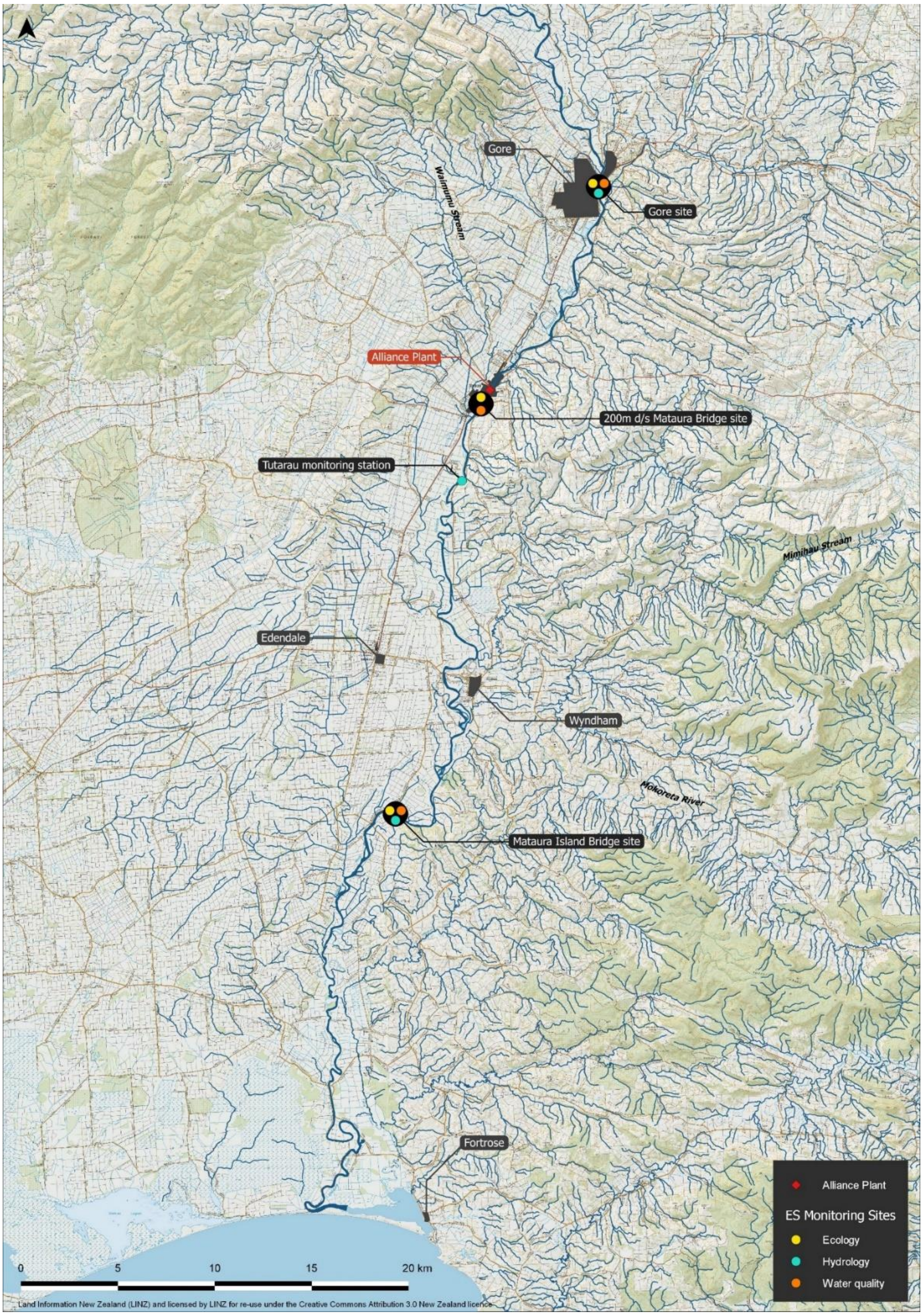
193 Water quality and ecology technical reviews by Dr Peter Wilson and Ms Keren Bennett form part of the background information covered in the 42A report. I have reviewed this material and note that within the scope of my evidence the report, accompanying technical reviews, and evidence of Dr Wilson and Ms Bennett do not raise any concerns or areas of disagreement.

## MATTERS RAISED BY SUBMITTERS

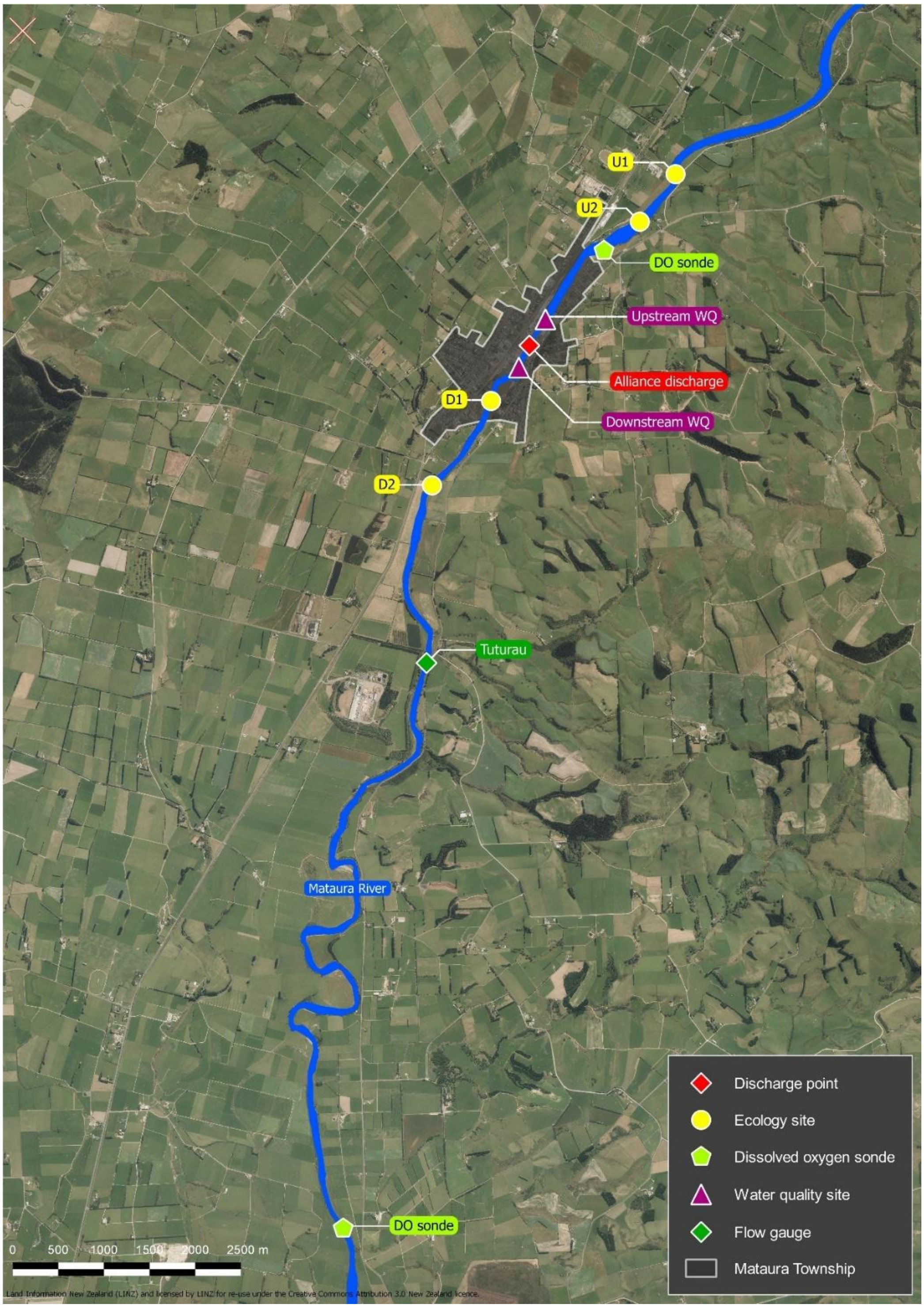
194 I note that Dr Mark James addresses matters raised by submitters relating to water quality and ecology in his evidence.

Richard Montgomerie
16 November 2020

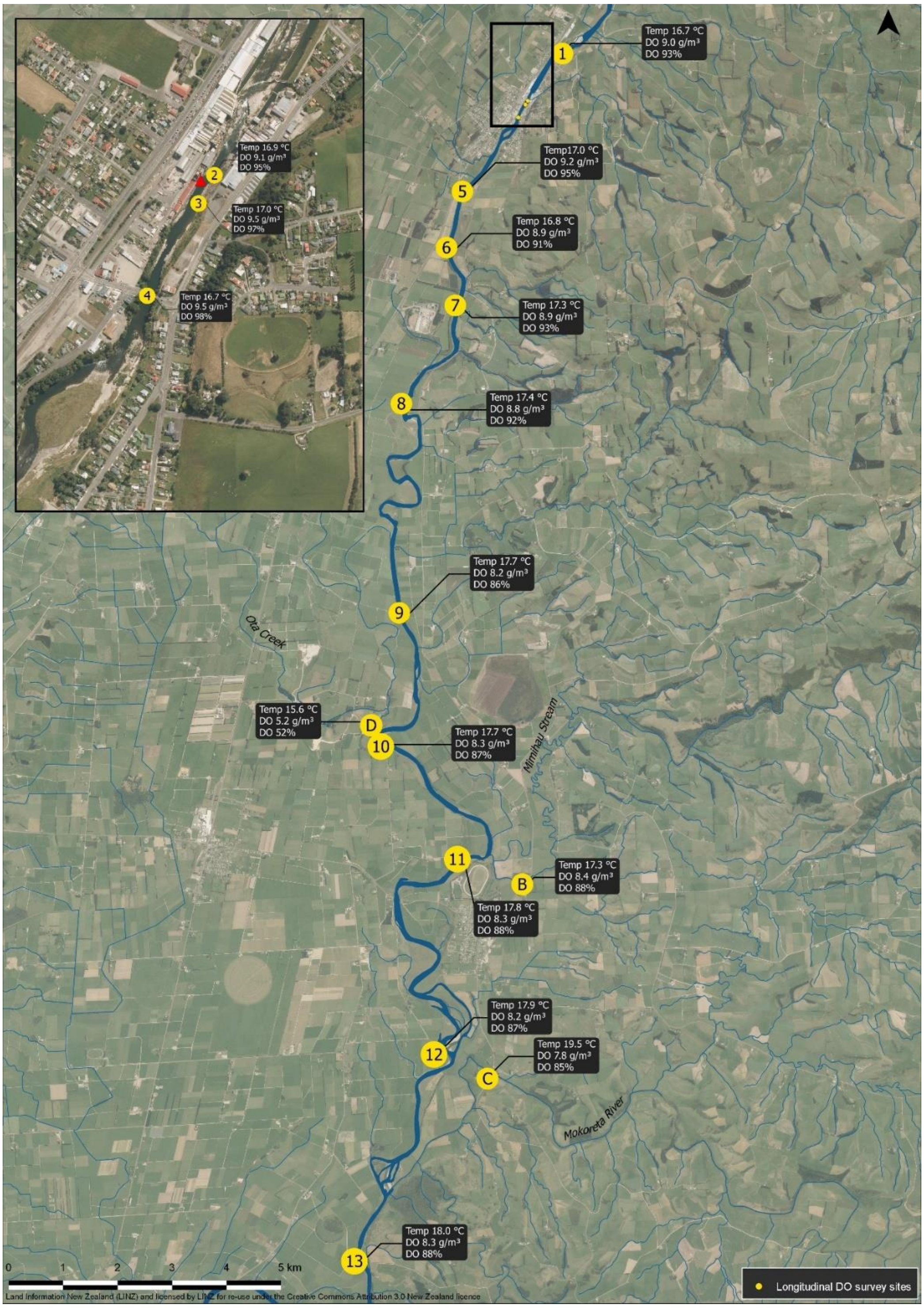
**Attachment 1 – Location of Environment Southland Monitoring Sites**



**Attachment 2 – Location of Alliance Monitoring Sites**

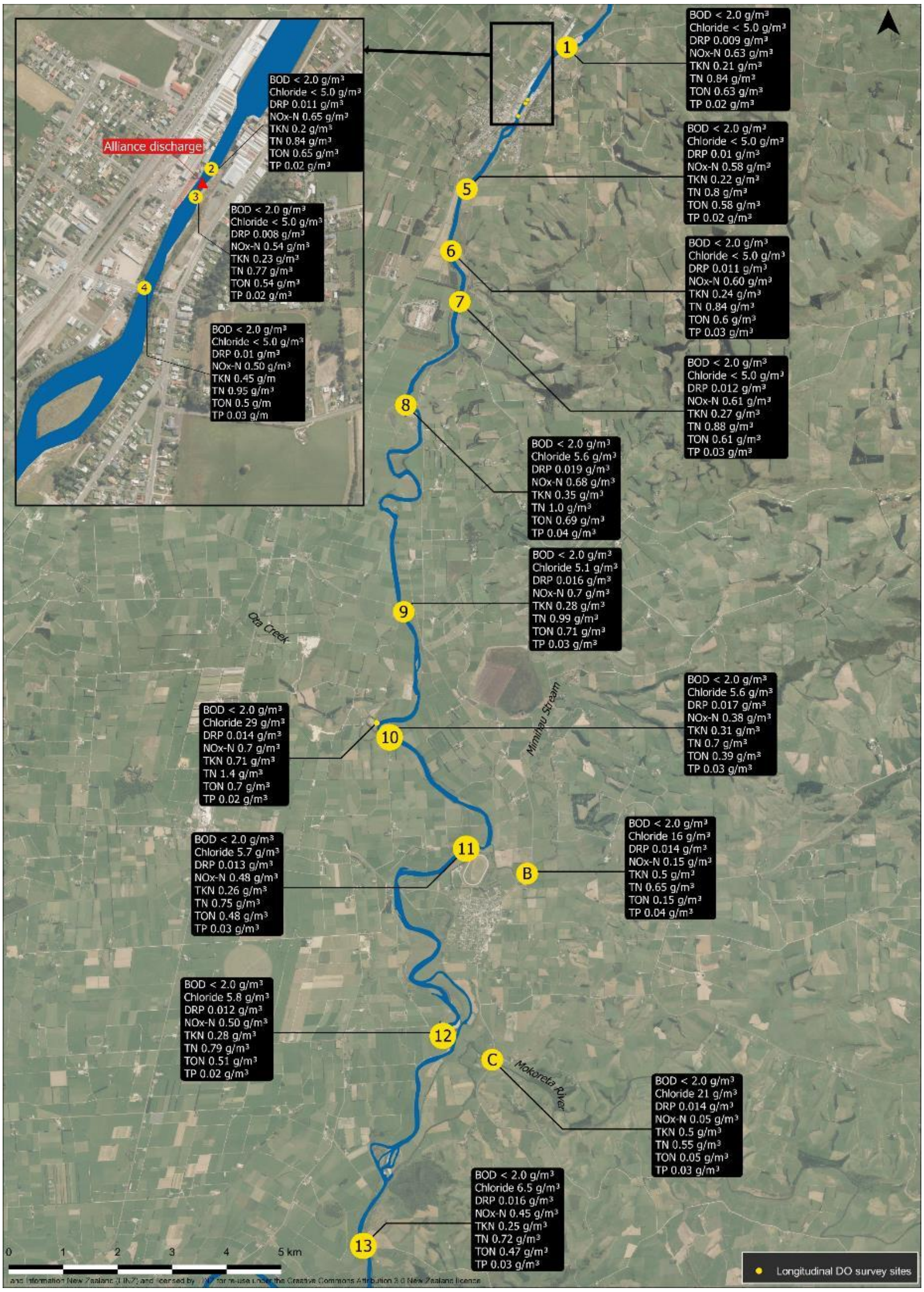


## Attachment 3 – January 2018 Longitudinal DO Survey

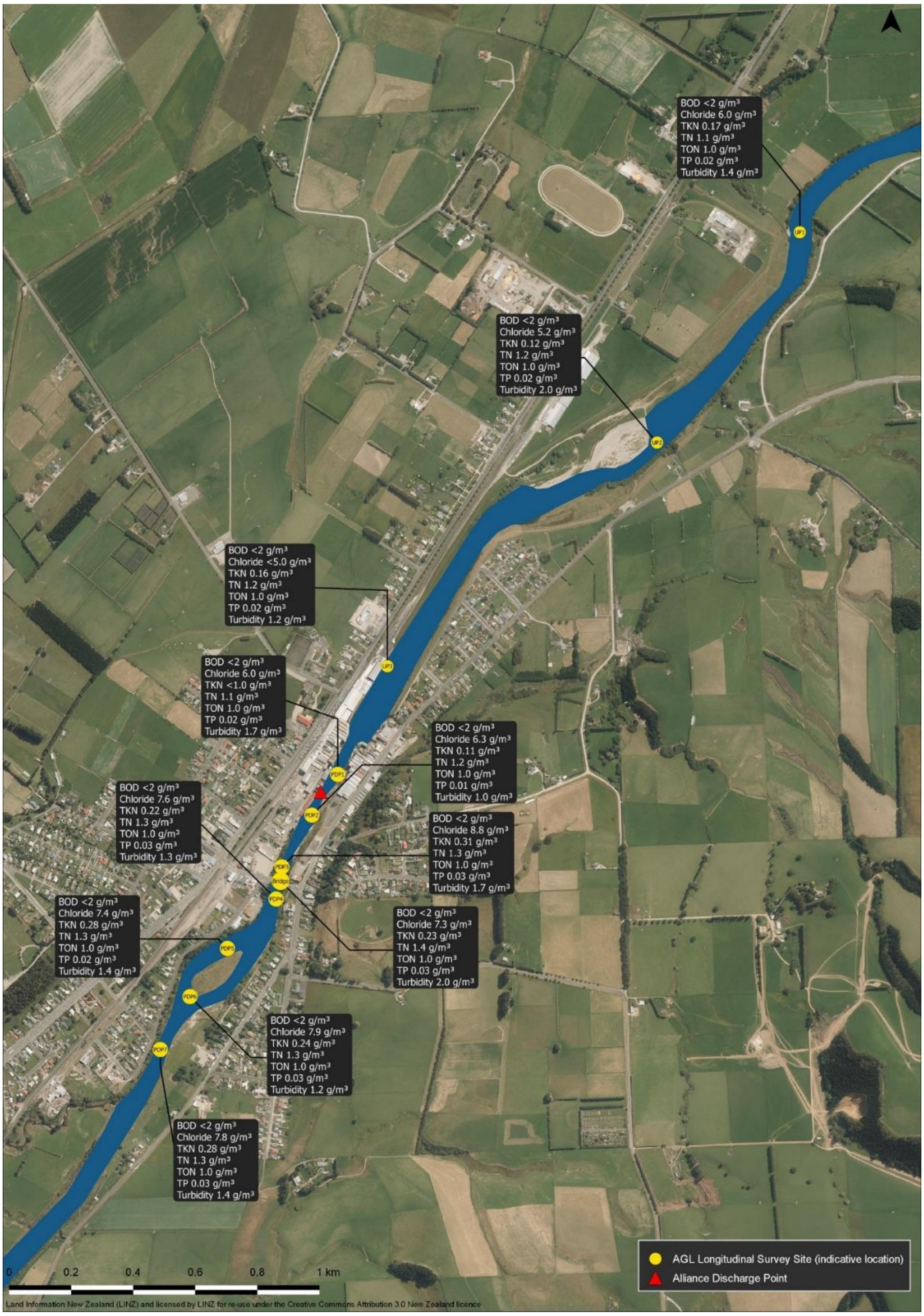


## Attachment 4 - January 2018 and 2019 Longitudinal Nutrient Surveys

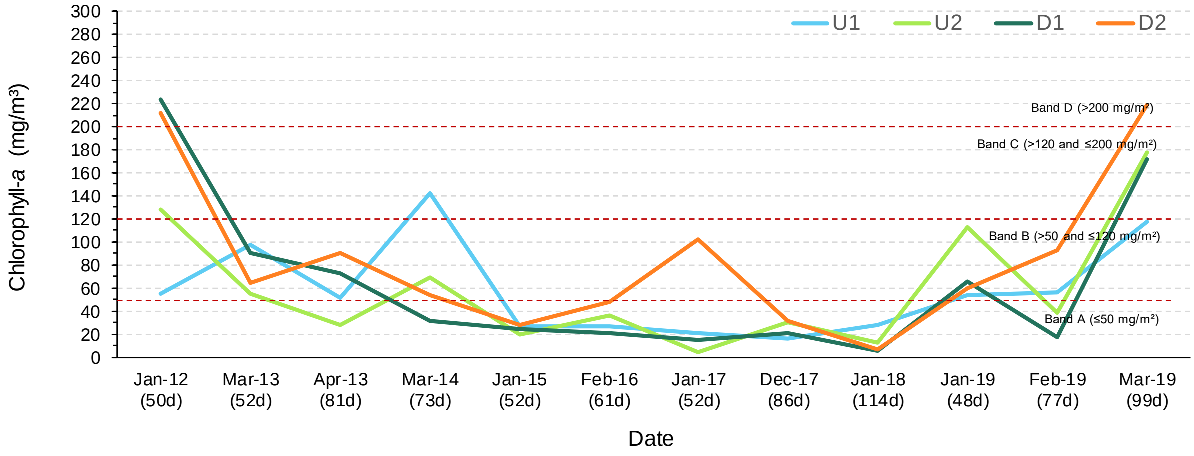
### *12 January 2018 longitudinal survey sampling locations and results*

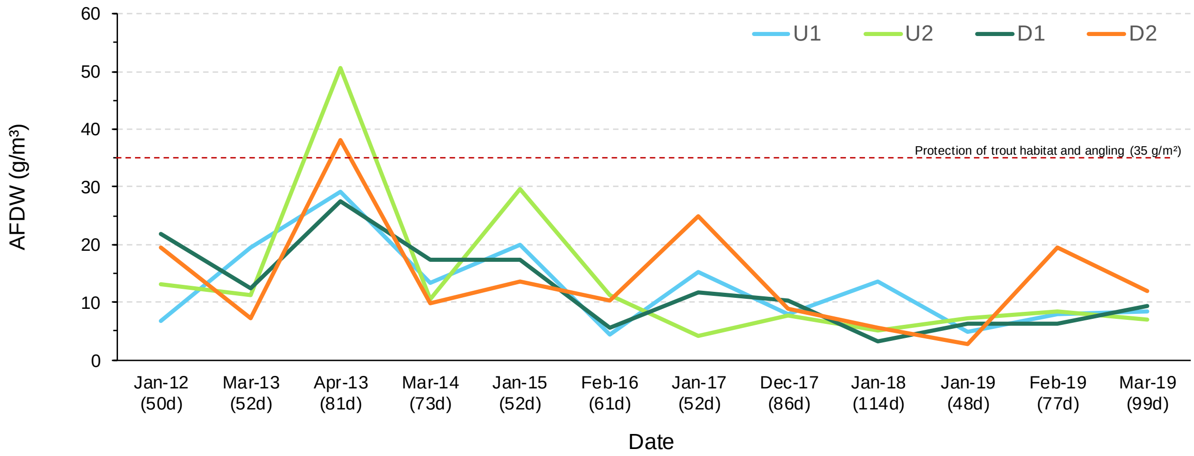


***23 January 2019 longitudinal survey sampling locations and results***

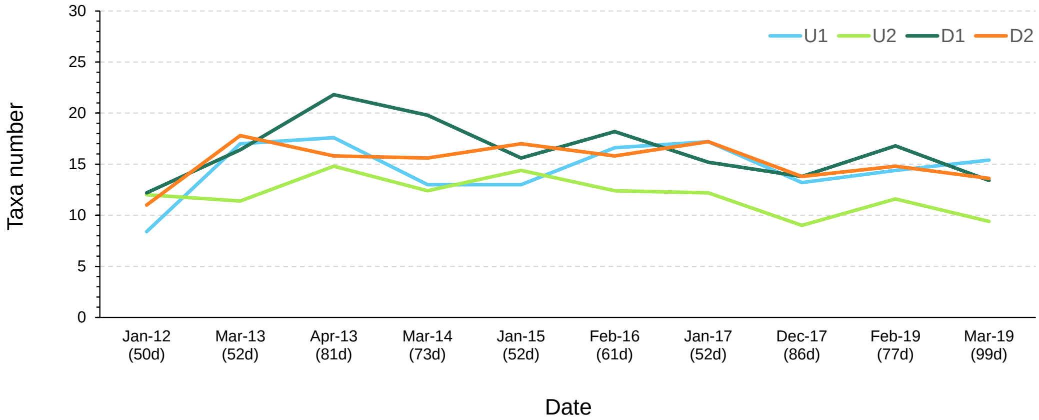


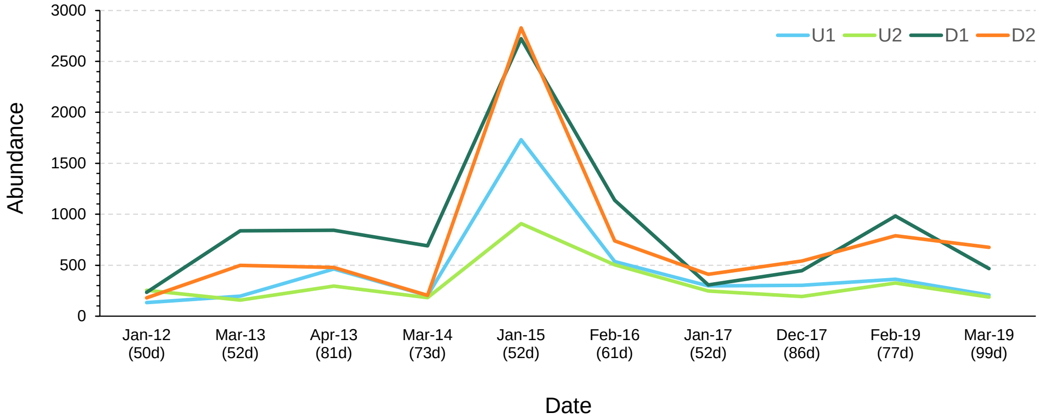
**Attachment 5 – Mean chlorophyll-*a* and AFDW concentrations between 2012 and 2019.**

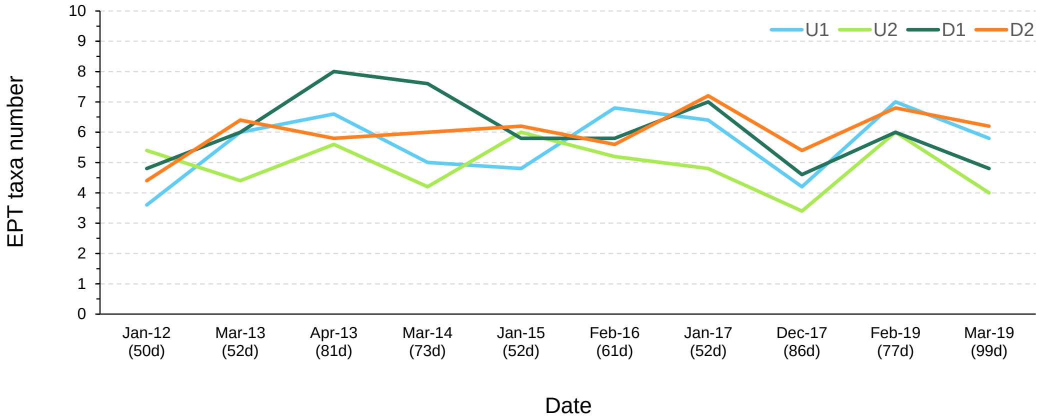


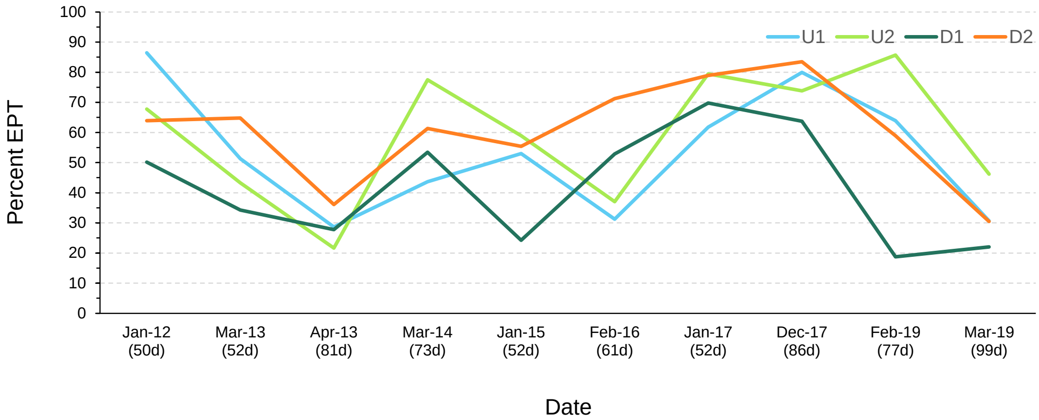



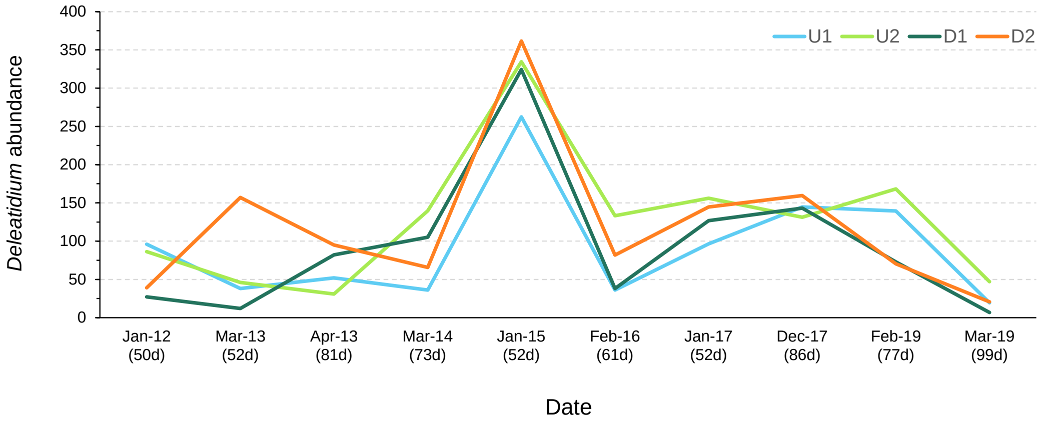
## Attachment 6 - Benthic invertebrate indices

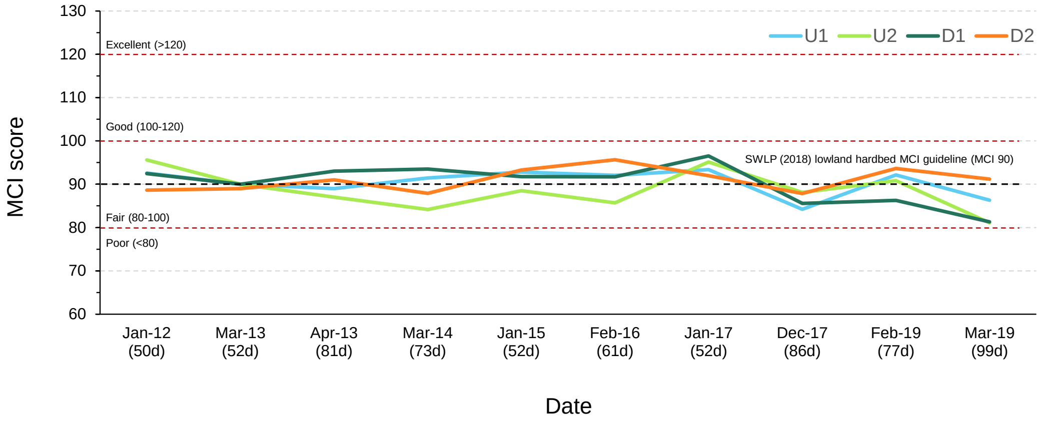


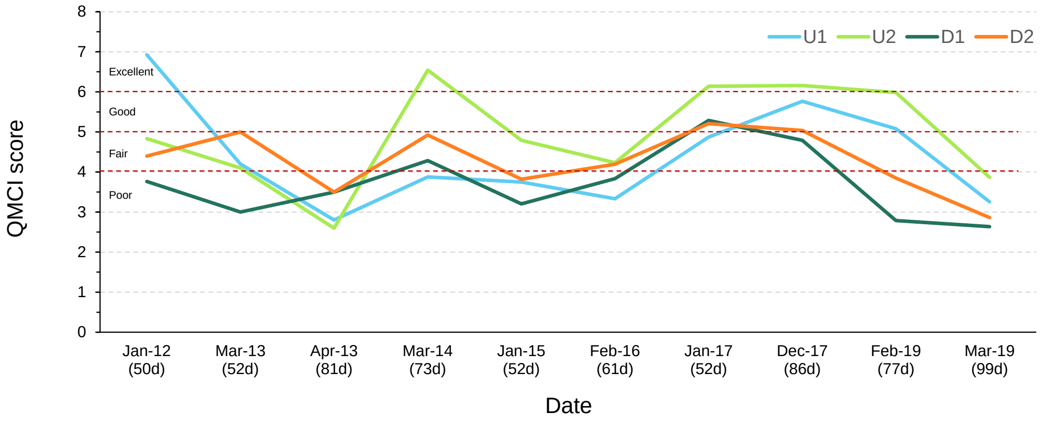




Deleatidium abundance
400
350
300
250
200
150
100
50
0
U1 U2 D1 D2
Jan-12 (50d)
Mar-13 (52d)
Apr-13 (81d)
Mar-14 (73d)
Jan-15 (52d)
Feb-16 (61d)
Jan-17 (52d)
Dec-17 (86d)
Feb-19 (77d)
Mar-19 (99d)
Date


MCI score
130
120
110
100
90
80
70
60
Excellent (>120)
Good (100-120)
SWLP (2018) lowland hardbed MCI guideline (MCI 90)
Fair (80-100)
Poor (<80)
U1 U2 D1 D2
Jan-12 (50d)
Mar-13 (52d)
Apr-13 (81d)
Mar-14 (73d)
Jan-15 (52d)
Feb-16 (61d)
Jan-17 (52d)
Dec-17 (86d)
Feb-19 (77d)
Mar-19 (99d)
Date


QMCI score
8
7
6
5
4
3
2
1
0
Excellent
Good
Fair
Poor
U1 U2 D1 D2
Jan-12 (50d)
Mar-13 (52d)
Apr-13 (81d)
Mar-14 (73d)
Jan-15 (52d)
Feb-16 (61d)
Jan-17 (52d)
Dec-17 (86d)
Feb-19 (77d)
Mar-19 (99d)
Date