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LEVIN LANDFILL JULY 2019 QUARTERLY GROUNDWATER, SURFACE WATER AND LEACHATE MONITORING REPORT

PREPARED FOR HOROWHENUA DISTRICT COUNCIL

September 2019

Stantec

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Executive Summary

Horowhenua District Council (HDC) is required to carry out quarterly compliance monitoring for the Levin Landfill as part of Resource Consents DP6009, DP6010, DP6011 and DP102259. This report summarises the findings for the July 2019 quarterly monitoring event, including monitoring results for:

- Background (natural) groundwater condition;
- The landfill leachate pond and effluent;
- Groundwater bores within the new landfill and irrigation area;
- Shallow aquifers, down-gradient of the old landfill;
- Deep aquifer, and
- Hokio Stream.

We have reviewed the results of this monitoring on behalf of HDC.

Monitoring for other aspects of the landfill operation, such as landfill gas, air quality/odour, stormwater and soil, are reported separately as per resource consent requirements.

Samples were collected from 23 groundwater bores, the landfill leachate effluent and seven surface water sites during July 2019 from around the Levin Landfill, and were analysed for parameters as set out in Discharge Permit 6010.

These samples were collected progressively over a three-week period, which does introduce some uncertainty to the interpretation of results. It is recommended that sampling be completed within not more than a one-week period from the collection of the first sample, and that HDC take steps to improve monitoring practices for future events.

The resource consents for the landfill (namely discharge permit 6010) contain compliance limits for the quality of groundwater and surface water, which are based upon the Drinking Water Standards for New Zealand – Maximum Acceptable Values (DWSNZ MAVs) and ANZECC 2000 Livestock Drinking Water (ANZECC LDW) trigger values respectively. The July 2019 results have been assessed against these limits, where they are applicable.

Non-compliant results were recorded at six monitoring locations as follows:

- Exceedance of DWSNZ for iron (at bore G1D) and manganese (at bore C2DD) in the deep gravel aquifer
- Exceedance of ANZECC LDW for faecal coliforms (100 CFU/100mL limit) at bore C2, with a faecal coliform count of 3900 CFU/100mL.
- The ANZECC LDW trigger value for faecal coliforms was also exceeded at all three monitoring locations within Hokio Stream (HS1, HS2, and HS3). The results indicated that upstream activities are likely to be contributing bacterial contamination to Hokio Stream.

The July 2019 results were also considered within the context of background water quality, both within the groundwater aquifers (shallow and deep bores) and the surface water receiving environment. For example, low pH at background bore G1S, and elevated chloride and iron concentrations in the same bore indicated that groundwater could be impacted by up-gradient activities unrelated to the landfill operations.

Results from a sample of effluent taken from the leachate pond were within the range of data obtained from previous monitoring events and are generally well below that recorded at typical Class 1 landfills in New Zealand.

Horowhenua District Council

Levin Landfill July 2019 Quarterly Groundwater, Surface Water and Leachate Monitoring Report

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1. Introduction

Horowhenua District Council (HDC) commissioned Stantec New Zealand to carry out environmental reporting for the discharge consent monitoring undertaken at the Levin Landfill site. Monitoring is undertaken every three months at 27 locations, as required by the resource consent conditions (namely for discharge permit 6010). There are 23 boreholes penetrating the sand and gravel aquifers; three surface water sampling locations within Hokio Stream and a leachate sampling point as shown in the Site Plan in Appendix A. In addition, HDC has agreed to undertake voluntary surface water monitoring at four locations along the Tatana Property drain.

The Levin Landfill site is comprised of two landfills; one old, closed and unlined landfill and the new, lined and active landfill. The new landfill footprint is being developed in stages. The most recent stage is Stage 3C which was developed in 2017, though landfill operations are now occurring over the top of Stages 1A, 2 and 3C.

The Levin Landfill site is located above two identified aquifers, a shallow sand aquifer and a deeper gravel aquifer. The shallow aquifer is unconfined, has a low to moderate permeability, and flows in a northerly direction. The deeper gravel aquifer is a confined to semi-confined aquifer. Horizons Regional Council hydrology staff advised that '*the general confined groundwater flow direction is towards the west*'. Groundwater quality in the area is highly variable because of interaction with peat deposits that are prevalent in the area, localised effects such as from grazing activities, droppings from scavenging birds and from nitrogen-fixing plants such as gorse.

Since July 2010 groundwater has been tested for dissolved metals and nutrients rather than total concentrations. For simplicity, results from monitoring prior to July 2010 (which were tested for total metal and nutrient concentrations) have not been compared to the results from July 2010 onwards.

This report presents the results from the July 2019 quarterly monitoring round which have been compared with the Drinking Water Standards for New Zealand 2008 (DWSNZ), and the Australian and New Zealand Environment and Conservation Council (ANZECC) 2000 Livestock Drinking Water Trigger Values (ANZECC LWD) as per Discharge Consent 6010.

It is noted that a resource consent review process initiated in 2015 for this site has not yet been finalised. To date the process has resulted in revised resource consent conditions being agreed. At the time of preparing this Quarterly Report the revised resource consent conditions had not been approved by the Environment Court and so compliance has been assessed against existing consent conditions.

2. Groundwater and Surface Water Monitoring

2.1 Sample Analysis

Samples were collected by Downer (a contractor to HDC) between 11 and 31 July 2019. Collected samples were couriered overnight and analysed by Eurofins ELS Ltd in Lower Hutt, Wellington, the following day. We note that the monitoring period (over 20 days to collect all the July 2019 samples) potentially jeopardises the value of the exercise and brings uncertainty to any interpretation of results. For example, if downstream samples are not collected from Hokio Stream on the same day (within less than 8 hours) of the upstream samples, then any inference of downstream trends in water quality cannot be made with confidence.

The sampling programme for 2017-2020 is summarised in the schedule in Appendix B. From July 2019, faecal coliform counts analysis will be included within the indicator and comprehensive analytical suites, as agreed by HDC with the Horizons Regional Council (HRC). This means that faecal coliform counts will be assessed more frequently throughout each year, compared to past monitoring.

Groundwater samples taken from the boreholes; surface water samples from Hokio Stream, and samples of landfill leachate effluent were analysed for the indicator suite of parameters which are outlined in Table 2-1. Surface water samples collected from the Tatana Property drain were analysed based on a specific parameter list agreed to by Horizons Regional Council as detailed in Section 2.7.

Table 2-1: Indicator Parameters

Type	Parameters
Characteristics	pH Electrical Conductivity (EC)
Oxygen demand	Chemical Oxygen Demand (COD)
Nutrients*	Nitrate nitrogen (NO_3-N), Ammoniacal-nitrogen (NH_4-N)
Metals*	Aluminium, Iron**,Lead, Manganese, Nickel
Other elements	Boron, Chloride, Sodium**
Biological+	Faecal coliforms

Note: *Analyses performed for nutrients and metals are for dissolved rather than total concentrations.
**Selected bores as per stormwater consent 102559
+Faecal coliforms added from July 2019 onwards (see Appendix B)

2.1.1 Note regarding interpretation of non-detected results

For those chemical constituents which were found to be below laboratory detection limits during the reporting period, the results have been analysed at 50% of the laboratory limit, and a median calculated on this basis. This is standard practice when dealing with chemical concentrations in water. However, the same rule cannot be applied for faecal coliforms in the context of the Levin Landfill.

The laboratory detection limit for faecal coliforms is 4 CFU/100mL. As the resource consent requires that groundwater results for faecal coliforms be compared against the NZDWS (for compliance), which is NIL (I.e. 0 CFU/100mL), we have chosen to indicate where faecal coliforms were not detected, rather than calculating a median as we would for chemical constituents (described above). This method has been applied in all instances where faecal coliforms are assessed for compliance with the NZDWS.

2.2 Background Groundwater Quality

Water quality from the natural **background water up-gradient from the landfill site is not subject to any consent conditions**. However, for comparison purposes, both the ANZECC LDW trigger values and the DWSNZ guidelines were used to benchmark the quality of water up-gradient from the landfill site.

Groundwater samples were collected from two background bores situated hydraulically up-gradient from both the new and old landfills to the southeast of the site (bores G1S and G1D, Site Plan, Appendix A). These two bores were constructed in late 2009 to sample background water quality from the two main hydrogeological units. The first sampling round from these two bores was completed in July 2010.

The results are presented in Table 2-2. Bore F3 is also included in the background table as it is near the southern boundary of the landfill site (and further west) and is unlikely to be impacted by landfill activities. A full laboratory report containing analytical results is presented in Appendix C.

Table 2-2: Background Monitoring Results for July 2019

Determinant	Units	DWSNZ MAV	ANZECC STOCK	G1S	G1D	F3
Water level	mBGL	-	-	14.32	14.65	5.45
pH	-	7 to 8.5*	6 to 9	**6.3**	7.0	7.0
Conductivity	mS/m	-	-	126	28.6	20.6
COD	mg/L	-	-	58	63	56
Faecal coliforms	CFU/100ml	NIL	100	ND	ND	ND
Chloride	mg/L	250*	-	**330**	31.5	20.6
Nitrate-N	mg/L	11.3	90.3	0.25	*0.005*	1.52
Ammoniacal-N	mg/L	1.17	-	0.06	0.09	*0.005*
Sodium	mg/L	200*	-	151	19.0	22.0

Determinant	Units	DWSNZ MAV	ANZECC STOCK	G1S	G1D	F3
Aluminium	mg/L	0.1*	5	0.013	*0.001*	*0.001*
Boron	mg/L	1.4	5	*0.015*	0.05	*0.015*
Iron	mg/L	0.2*	-	**8.29**	**1.49**	*0.005*
Lead	mg/L	0.01	0.1	*0.00025*	*0.00025*	*0.00025*
Manganese	mg/L	0.4	-	0.180	0.0650	*0.00025*
Nickel	mg/L	0.08	1	0.0007	*0.00025*	*0.00025*

Note: *denotes guideline values for aesthetic determinants (G.V.). **Bold** – denotes an exceedance of the relevant DWSNZ guidelines. Underlined – denotes an exceedance of the ANZECC LDW Trigger Values. All `<' values have been reported as half the detection limit for statistical purposes and are expressed in italics. "ND" indicates where faecal coliforms were not detected.

The result in Table 2-2 indicate that all background bores (G1S, G1D and F3) are within the ANZECC guidelines.

There were some exceedances of the DWSNZ limits during the July 2019 monitoring round:

- pH in bore G1S was below the DWSNZ GV
- Chloride concentration in bore G1S was above the DWSNZ GV
- Iron concentration in bores G1S and G1D were above the DWSNZ GV.

2.3 Groundwater Quality Hydraulically Down-Gradient of the New Landfill

Monitoring is carried out within the two main hydrogeological units for bores hydraulically up-gradient of the old landfill and hydraulically down-gradient of the new landfill.

2.3.1 Shallow Aquifer

Bores D1, D2, D3(r), D4, D5, D6 and E1S (Refer to Site Plan, Appendix A) are located hydraulically up-gradient of the old landfill, but down-gradient of the new landfill. This means they are uninfluenced by potential leaching from the old landfill and can act as a warning system for any leaching from the new landfill. Borehole D4 is likely to show any leaching from the new landfill. Borehole D5 is located at the south western corner of the site and is expected to provide an indication of shallow background groundwater quality because it is unlikely to be influenced by either landfill. It is unlikely that leachate from the new landfill will significantly affect groundwater quality due to a leachate collection system which is in place in the new landfill, but these bores would give early warning of potential problems.

The results from the July 2019 monitoring round for these bores are presented in Table 2-3 along with the shallow background bore results (G1S). The results have been compared with the ANZECC LDW trigger values as per the consent conditions. The full laboratory report is included in Appendix C.

There were no exceedances of the ANZECC LDW trigger values during the July 2019 monitoring round and so the **results comply with the resource consent conditions**.

Table 2-3: D-Series and E1S Monitoring Bores for July 2019

Determinant	Units	ANZECC STOCK	D1	D2	D3(r)	D4	D5	D6	E1S	G1S
Water level	mBGL	-	16.32	21.6	4.56	8.41	9.77	16.38	11.25	14.32
pH	-	6 to 9	6.7	6.4	6.8	6.9	7.0	6.8	6.9	6.3
Conductivity	mS/m	-	51.9	37.6	23.0	29.4	28.7	41.9	26.7	126
COD	mg/L	-	*7.5*	32	*7.5*	*7.5*	*22.0*	*7.5*	*7.5*	58
Faecal coliforms	CFU/100ml	100	4	20	ND	ND	4	ND	ND	ND
Chloride	mg/L	-	36.9	42.1	21.6	45.3	29.3	27.7	30.7	330
Nitrate-N	mg/L	90.3	13.0	*0.005*	0.17	*0.005*	1.45	17.7	*0.005*	0.25
Ammoniacal-N	mg/L	-	*0.005*	0.48	0.12	0.22	*0.005*	*0.005*	0.18	0.06
Sodium	mg/L	-	23.5	20.4	21.3	32.2	36.8	24.8	22.9	151
Aluminium	mg/L	5	0.006	*0.001*	0.003	*0.001*	*0.001*	0.016	0.002	0.013
Boron	mg/L	5	*0.015*	0.03	0.03	0.04	*0.015*	0.03	0.04	*0.015*
Iron	mg/L	-	4.66	0.02	2.20	1.91	*0.005*	14.2	0.02	8.29
Lead	mg/L	0.1	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*
Manganese	mg/L	-	0.218	0.0153	0.160	0.181	0.0035	0.372	0.0353	0.180
Nickel	mg/L	1	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	0.0007

Note: **Bold** – denotes an exceedance of the ANZECC LDW trigger values. All `<' values have been reported as half the detection limit for statistical purposes and are expressed in italics. "ND" indicates where faecal coliforms were not detected.

2.3.2 Deep Gravel Aquifer

Bores E1D, C2DD, E2D and G1D all penetrate the deeper gravel aquifer. Deep groundwater flow is assumed to be towards the northwest. Boreholes E2D and C2DD are located to the north-northwest of both the landfills and are therefore considered to be hydraulically down gradient of both landfills. Borehole E1D is located to the southwest of the old landfill and it is therefore considered that this bore would be unlikely to be affected by either landfill. Borehole G1D is located hydraulically up-gradient from both landfills and is assumed to represent background water quality (refer to Site Plan, Appendix A).

Results for the July 2019 compliance monitoring round are presented in Table 2-4. The results have been compared with the DWSNZ as per the discharge consent 6010. The full laboratory report is included in Appendix C.

Table 2-4: Monitoring Bores within the Deep Aquifer for July 2019

Determinant	Units	DWSNZ MAV	E1D	C2DD	E2D	G1D
Water level	mBGL	-	11.33	2.26	5.66	14.65
pH	-	7 to 8.5*	7.5	7.4	7.6	7.0
Conductivity	mS/m	-	45.2	52.3	34.8	28.6
COD	mg/L	-	45	*7.5*	*7.5*	63
Faecal coliforms	CFU/100ml	NIL	ND	ND	ND	ND
Chloride	mg/L	250*	39.4	38.2	48.2	31.5
Nitrate-N	mg/L	11.3	*0.005*	*0.005*	*0.005*	*0.005*
Ammonia-N	mg/L	1.17	0.21	0.33	0.30	0.09
Sodium	mg/L	200*	43.9	26.5	27.2	19.0
Aluminium	mg/L	0.1*	*0.001*	0.006	*0.001*	*0.001*
Boron	mg/L	1.4	0.04	0.05	*0.015*	0.05
Iron	mg/L	0.2*	0.05	0.01	0.05	**1.49**
Lead	mg/L	0.01	*0.00025*	*0.00025*	*0.00025*	*0.00025*
Manganese	mg/L	0.4	0.235	**0.488**	0.219	0.0650
Nickel	mg/L	0.08	*0.00025*	*0.00025*	*0.00025*	*0.00025*

Note: * denotes guideline values for aesthetic determinants (G.V.). **Bold** – denotes an exceedance of the relevant DWSNZ (2008) standard. All `<' values have been reported as half the detection limit for statistical purposes and are expressed in italics. n/r – not required to be tested during this monitoring period. "ND" indicates where faecal coliforms were not detected.

There were **two exceedances of the resource consent conditions** in samples from the deep gravel aquifer during the July 2019 sampling round:

- Manganese concentration in bore C2DD exceeded the DWSNZ MAV.
- Iron concentration in bore G1D exceeded the DWSNZ MAV.

2.4 Impact of Old Landfill on Groundwater Quality

Water sampling is carried out to characterise the groundwater quality in a series of shallow bores situated hydraulically down-gradient from the old unlined landfill. The series B boreholes are located within 50m of the old landfill in a line along its northern edge. The series C boreholes are located further down the hydraulic gradient from the old landfill towards Hokio Beach Road to detect whether leachate is moving off site. Borehole E2S is located northwest of the old landfill to detect any leachate moving directly towards the nearest house down-stream of the site. Bore G2S was installed in late 2009 and is located to the north of the landfill site, hydraulically down-gradient of the old landfill by Hokio Road and the entrance road to the landfill (See Site Plan, Appendix A).

The results from the July 2019 consent monitoring round for these bores are presented in Table 2-5 and have been compared with the ANZECC Livestock Drinking Water Trigger Values as per the discharge consent 6010. The full laboratory report is included in Appendix C.

There was **one exceedance of the resource consent conditions** in samples from the shallow bores during the July 2019 sampling round:

- Faecal coliform levels in bore C2 exceeded the ANZECC LDW trigger value.

Table 2-5: Results from Shallow Boreholes Down-Gradient from the Old Landfill for July 2019

Determinant	Units	ANZECC STOCK	E2S	B1	B2	B3	C1	C2	C2DS	G2S
Water level	mBGL	-	4.75	1.01	1.44	0.21	0.20	0.36	2.51	2.18
pH	-	6 to 9	7.4	7.0	6.7	7.1	6.6	7.1	6.7	6.6
Conductivity	mS/m	-	44.2	119	135	294	145	242	178	186
COD	mg/L	-	*7.5*	58	50	221	70	141	100	90
Faecal coliforms	CFU/100ml	100	ND	ND	48	ND	ND	**3900**	ND	ND
Chloride	mg/L	-	41.4	118	87.2	179	283	170	133	327
Nitrate-N	mg/L	90.3	*0.005*	9.46	30.4	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*
Ammoniacal-N	mg/L	-	0.25	7.79	21.4	170	0.76	124	1.45	0.01
Sodium	mg/L	-	44.5	111	85.0	157	137	183	132	224
Aluminium	mg/L	5	*0.001*	0.007	0.017	0.003	0.010	0.018	*0.001*	*0.001*
Boron	mg/L	5	0.05	0.64	0.92	1.40	0.69	1.81	1.01	0.98
Iron	mg/L	-	0.05	0.02	0.04	0.34	3.49	2.48	9.45	0.44
Lead	mg/L	0.1	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*
Manganese	mg/L	-	0.404	6.23	2.27	3.83	0.419	0.0524	2.80	0.163
Nickel	mg/L	1	*0.00025*	0.0013	0.0010	0.0101	0.0007	0.0049	0.0023	0.0042

Note: **Bold** – denotes an exceedance of the ANZECC Livestock Drinking Water Trigger Values. All `<' values have been reported as half the detection limit for statistical purposes and are expressed in italics. n/r – not required to be tested during this monitoring period. "ND" indicates where faecal coliforms were not detected.

2.5 Groundwater Quality Down-Gradient of the Irrigation Area

The F-series boreholes intersect the shallow aquifer down-gradient of the area used to irrigate leachate from 2004 to October 2008. All leachate is now pumped to the Levin Wastewater Treatment Plant. The F1 borehole is located within the area where leachate from the new landfill was irrigated. F2 and F3 boreholes are located in an area that was set aside for leachate irrigation but never used as such. It is expected that bores F2 and F3 would therefore be representative of background groundwater quality. The shallow groundwater at the irrigation area has been compared to that from the background bore (G1S).

The results from the F series boreholes are presented in Table 2-6 and have been compared with the ANZECC Livestock Drinking Water Trigger Values as per the discharge consent 6010. The full laboratory report is included in Appendix C.

Table 2-6: Results from the Irrigation Area for July 2019

Determinant	Units	ANZECC STOCK	F1	F2	F3	G1S
Water level	mBGL	-	7.89	2.87	5.45	14.32
pH	-	6 to 9	7.9	7.3	7.0	6.3
Conductivity	mS/m	-	46.8	22.9	20.6	126
COD	mg/L	-	30	51	56	58
Faecal coliforms	CFU/100ml	100	ND	ND	ND	ND
Chloride	mg/L	-	49.6	22.8	20.6	330
Nitrate-N	mg/L	90.3	1.54	0.74	1.52	0.25
Ammoniacal-N	mg/L	-	*0.005*	*0.005*	*0.005*	0.06
Sodium	mg/L	-	30.7	23.8	22.0	151
Aluminium	mg/L	5	0.003	0.002	*0.001*	0.013
Boron	mg/L	5	*0.015*	0.04	*0.015*	*0.015*
Iron	mg/L	-	*0.005*	*0.005*	*0.005*	8.29
Lead	mg/L	0.1	*0.00025*	*0.00025*	*0.00025*	*0.00025*
Manganese	mg/L	-	0.0133	0.0010	*0.00025*	0.180
Nickel	mg/L	1	0.0014	*0.00025*	*0.00025*	0.0007

Note: **Bold** – denotes an exceedance of the ANZECC LDW trigger values. All `<' values have been reported as half the detection limit for statistical purposes and are expressed in italics. n/r – not required to be tested during this monitoring period. "ND" indicates where faecal coliforms were not detected.

There were no exceedances of the ANZECC LDW trigger values during the July 2019 monitoring round and so the **results comply with the resource consent conditions**.

2.6 Leachate Effluent Results

Leachate effluent from the landfill is **not subject to any water quality consent conditions**. However, for comparison purposes, typical leachate characteristics for landfills published by the Waste Management Institute New Zealand (*Technical Guidelines for Disposal to Land*, August 2018, WasteMINZ) have been compared against the leachate quality (Table 2-7). The full laboratory report is included in Appendix C. Table 2-7 shows that characteristics of leachate effluent samples collected in July 2019 were well within the typical ranges to be expected for this type of landfill.

Table 2-7: Results from Leachate Effluent for July 2019

Determinant	Units	Typical Leachate Characteristics* (range)	Leachate Effluent
pH	-	5.9 - 8.5	7.7
Conductivity	mS/m	308 – 27,900	1,350
COD	mg/L	84 – 5,090	3,690
Faecal coliforms	CFU/100ml	-	2,000
Chloride	mg/L	45 – 2,584	1,010
Nitrate-N	mg/L	-	0.60
Ammoniacal-N	mg/L	3.4 – 1,440	1,100
Sodium	mg/L	50 – 4,000**	932
Aluminium	mg/L	-	0.186
Boron	mg/L	0.54 – 20.1	7.05
Iron	mg/L	1.6 – 220	4.70
Lead	mg/L	0.001 - 0.42	0.0023
Manganese	mg/L	0.3 - 45***	1.22
Nickel	mg/L	0.02 – 2.05**	0.123

Note:
* for Class 1-type landfills, Table 5-5, p82, Technical Guidelines for Disposal to Land, WasteMINZ August 2018 (same as Table 4.2 of the CAE Landfill Guidelines 2000, but corrections made to Table 5-5 in line with Table 4.2).
**Data taken from Table 5-4, p81 of the same guideline, for parameters for which no differences between phases could be observed
***Data taken from Table 5-4, p81 of the same guideline, for parameters during the methanogenic phase.

The July 2019 monitoring round results for the leachate effluent were with the typical leachate composition range for Class 1 landfills published in the WasteMINZ 2018 Technical Guidelines for Disposal to Land.

2.7 Tatana Property Drain

A drain is located on the Tatana property (see Site Plan in Appendix A). Four sampling points were selected to represent the top of the drain (SW1), middle of the drain (SW2 and SW3) and lower drain (SW4). Results from the July 2019 sampling round are presented in Table 2-8 and have been compared with the ANZECC LDW trigger values because the water is most reflective of shallow groundwater. **Results from the Tatana Property drain sampling points are presently not subject to any consenting conditions.**

Table 2-8: Tatana's Drain Results for July 2019

Determinant	Units	ANZECC STOCK	SW1	SW2	SW3	SW4
pH		6 to 9	7.7	7.4	7.2	7.3
Faecal coliforms	CFU/100 ml	100	100	54	**380**	44
Total Suspended Solids	mg/L	-	88	14	19	*3*
Conductivity	mS/m	-	222	120	52.4	58.1
COD	mg/L	-	153	96	109	64
Total Kjeldahl Nitrogen	mg/L	-	77.6	24.0	6.0	5.8
BOD5-Total	mg/L	-	264	6	*3*	*3*
Chloride	mg/L	-	227	126	69.2	65.7
Nitrite-N	mg/L	-	0.03	0.09	0.03	0.04
Nitrate-N	mg/L	90.3	0.12	2.77	0.19	0.18
Ammoniacal-N	mg/L	-	77.4	22.0	3.6	4.7
Total-N	mg/L	-	81.2	27.3	6.70	6.58

Determinant	Units	ANZECC STOCK	SW1	SW2	SW3	SW4
Iron	mg/L	-	1.65	0.66	1.49	0.90
Manganese	mg/L	-	0.965	0.522	0.117	0.107

Note: **Bold** – denotes an exceedance of the ANZECC LDW trigger values. All `<' values have been reported as half the detection limit for statistical purposes and are expressed in italics.

Faecal coliform counts at SW3 **exceeded the ANZECC LDW trigger value** in July 2019.

2.8 Hokio Stream

Surface water grab samples are obtained from Hokio Stream at sites HS1, HS2 and HS3 (refer to Appendix A) to investigate whether groundwater containing leachate is having an adverse environmental effect on the stream. Site HS1 is situated up-stream of the old landfill, HS2 is situated alongside the old landfill and up-stream of the Tatana Property Drain discharge, and HS3 is located approximately 50m down-stream of the landfill site property boundary and the Tatana Property Drain discharge. Samples from Hokio Stream are analysed for indicator parameters every six months (as shown in Appendix B).

Results from the July 2019 sampling round are presented in Table 2-9 and have been compared with the ANZECC LDW trigger values as required by Discharge Permit 6010.

Table 2-9: Hokio Stream Results for July 2019

Determinant	Units	ANZECC STOCK	HS1	HS2	HS3
pH		6 to 9	7.9	7.7	7.7
Conductivity	mS/m	-	22.6	22.8	23.1
COD	mg/L	-	27	31	31
Faecal coliforms	CFU/100ml	100	**210**	**160**	**190**
Chloride	mg/L	-	22.1	22.3	22.4
Nitrate-N	mg/L	90.3	1.95	2.02	2.09
Ammoniacal-N	mg/L	-	*0.005*	0.02	*0.005*
Sodium	mg/L	-	14.8	15.0	15.6
Aluminium	mg/L	5	0.013	0.013	0.014
Boron	mg/L	5	0.05	0.05	0.05
Iron	mg/L	-	0.07	0.07	0.09
Lead	mg/L	0.1	*0.00025*	*0.00025*	*0.00025*
Manganese	mg/L	-	0.0182	0.0199	0.0239
Nickel	mg/L	1	*0.00025*	*0.00025*	0.0005

Note: **Bold** – denotes an exceedance of the ANZECC LDW trigger values. All `<' values have been reported as half the detection limit for statistical purposes and are expressed in italics.

There were **three exceedances of the resource consent conditions** in samples from the Hokio Stream during the July 2019 sampling round:

- Faecal coliform counts in samples from HS1, HS2 and HS3 exceeded the ANZECC LDW trigger values.

3. Discussion

3.1 Sampling Quality Control and Assurance

It was noted that samples were collected progressively over a 3-week period between 11 July and 31 July 2019. Whilst it is reasonable to understand that the landfill site is a large area and sample collection may require multiple trips to complete, a sampling interval that is too long may prevent realistic comparison between samples. The same was noted in the April 2019 report. It is recommended that sampling be completed within not more than a one-week period from the collection of the first sample.

3.2 Background Groundwater Quality

Water quality from the natural background water up-gradient from the landfill site is not subjected to any consenting conditions.

Results since 2010 from the background bores indicate that low pH values are representative of background water quality in the shallow sand aquifer (G1S). The deeper gravel aquifer (G1D) has pH levels that are slightly higher but occasionally dip below the DWSNZ lower guideline of 7.

Chloride concentrations have also fluctuated considerably at the G1S bore and are occasionally above the DWSNZ GV. During the July 2019 sampling round, chloride concentration at G1S was 330 mg/L, higher than the DWSNZ GV of 250 mg/L but within the historical result range recorded at this bore.

Iron concentrations have fluctuated considerably at both the G1S and G1D bores since monitoring began and is occasionally above the DWSNZ GV. During the July 2019 sampling round, iron concentrations at G1S and G1D were 8.29mg/L and 1.49mg/L respectively, higher than the DWSNZ GV of 0.2mg/L but within the historical result ranges recorded at these bores. Elevated iron concentrations in groundwater is likely to be related to hydrogeological conditions found at the site and is common in groundwater in this area.

The monitoring results suggests that the background groundwater is being impacted by local ground conditions and/or activities up-gradient of the landfill.

3.3 Shallow Aquifer Groundwater Quality

3.3.1 Hydraulically Up-gradient from the Old landfill

Sampling results from the July 2019 monitoring round show that water quality from the shallow monitoring bores hydraulically up-gradient from the old landfill complies with the discharge consent conditions

In general, historical trends of leachate indicators chloride, boron and ammoniacal nitrogen in the D-series and E1S bores are comparable to the concentrations in the background bore G1S, with the exception of nitrate nitrogen. Nitrate nitrogen is consistently elevated in bores D1 and D6 when compared to background (G1S) as shown in Figure 3-1 though there appears to be a slightly decreasing trend in recent sampling rounds. These bores are both located down gradient of the new landfill, with bore D1 located hydraulically up-gradient of the leachate effluent pond and bore D6 located down gradient of the leachate pond. Other leachate indicators such as boron, chloride and ammoniacal nitrogen are all consistent with background concentrations and historical record, however conductivity results are also elevated within these bores.

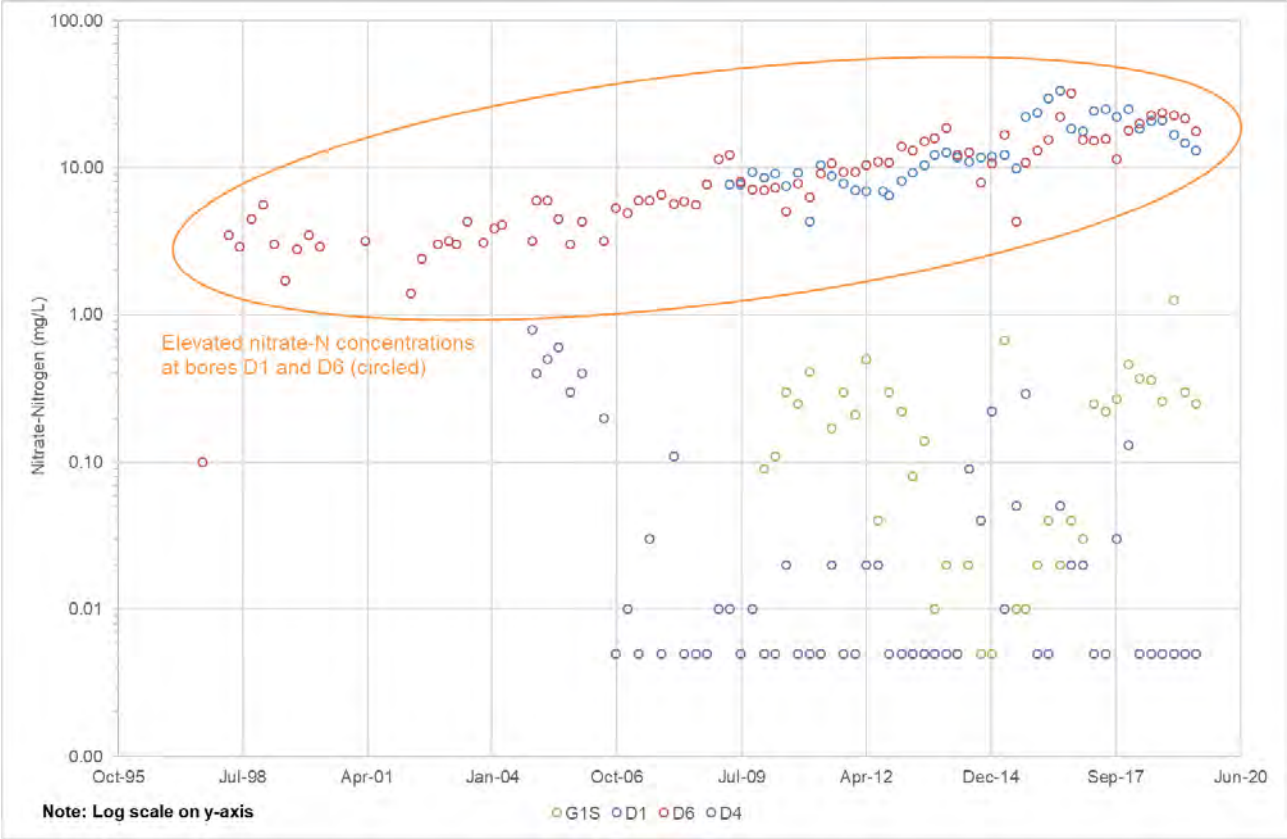


Figure 3-1: Nitrate Nitrogen Concentration in the D-Series Bores

In previous quarterly reports, it was recommended that further investigations be carried out to identify the possible cause (or causes) of the elevated levels of nitrate nitrogen and conductivity in bores D1 and D6.

Such investigations should include regular monitoring of groundwater levels to be undertaken in all the bores monitored for the 2019-2020 monitoring period so that groundwater flow and the depth of the unsaturated zone can be assessed. This will enable more conclusions to be drawn as to the source of the elevated nitrate nitrogen and conductivity values.

3.3.2 Irrigation area

Sampling results from all shallow bores located hydraulically down-gradient of the irrigation area[1] (F series bores) is consistent with historical results and complies with the discharge consent conditions.

Historical trends of leachate indicators chloride, boron and ammoniacal nitrogen in the F-series bores are generally stable and did not show any indication of an increasing trend.

3.3.3 Hydraulically Down-gradient from the Old landfill

During the July 2019 sampling round, there was one exceedance of the resource consent conditions in samples from the shallow bores where faecal coliform counts in bore C2 (3900 CFU/100mL) exceeded the ANZECC LDW trigger values. The previous sampling result (April 2019) also recorded an elevated faecal coliform concentration (1070 CFU/100ml). This is inconsistent with historical record, as faecal coliform counts at C2 have consistently complied with consenting conditions since1996. The groundwater level at C2 is very close to the surface and is near the Tatana Drain. However, the monitoring point SW1 at Tatana Drain, located nearest to C2, had a lower faecal coliform count (100 CFU/100ml), indicating that the surface water from Tatana Drain is not affecting the results in C2. Localised sources such as animal

[1] Irrigation of leachate within this area ceased in October 2008.

excrement may have affected the faecal coliform counts at C2. Further review of the results during the next monitoring round is recommended.

During the April 2019 monitoring, the boron concentration at C2 recorded the highest concentration since monitoring began. The July 2019 results in C2 indicate boron concentrations are returning to historical levels.

Bores C1 and G2S are located down gradient of the old landfill to the east. These bores have consistently recorded low concentrations of ammoniacal nitrogen, with G2S often recording concentrations below detection limit. These bores are likely to be located beyond the eastern edge of the leachate plume.

Bores B1, B2, B3 and C2 all appear to be located and screened within the leachate plume and have significantly elevated concentrations of ammoniacal nitrogen. All four bores are plotted in Figure 3-2 below, along with the background bore, G1S. It is noted that the concentration of ammoniacal nitrogen in bore C2 has been elevated since 2009. It is possible that the leachate plume has shifted resulting in the different spatial pattern from five years ago. The regular monitoring of the groundwater levels in the bores over the 2019-2020 monitoring period will allow further conclusions to be drawn in the next annual report.

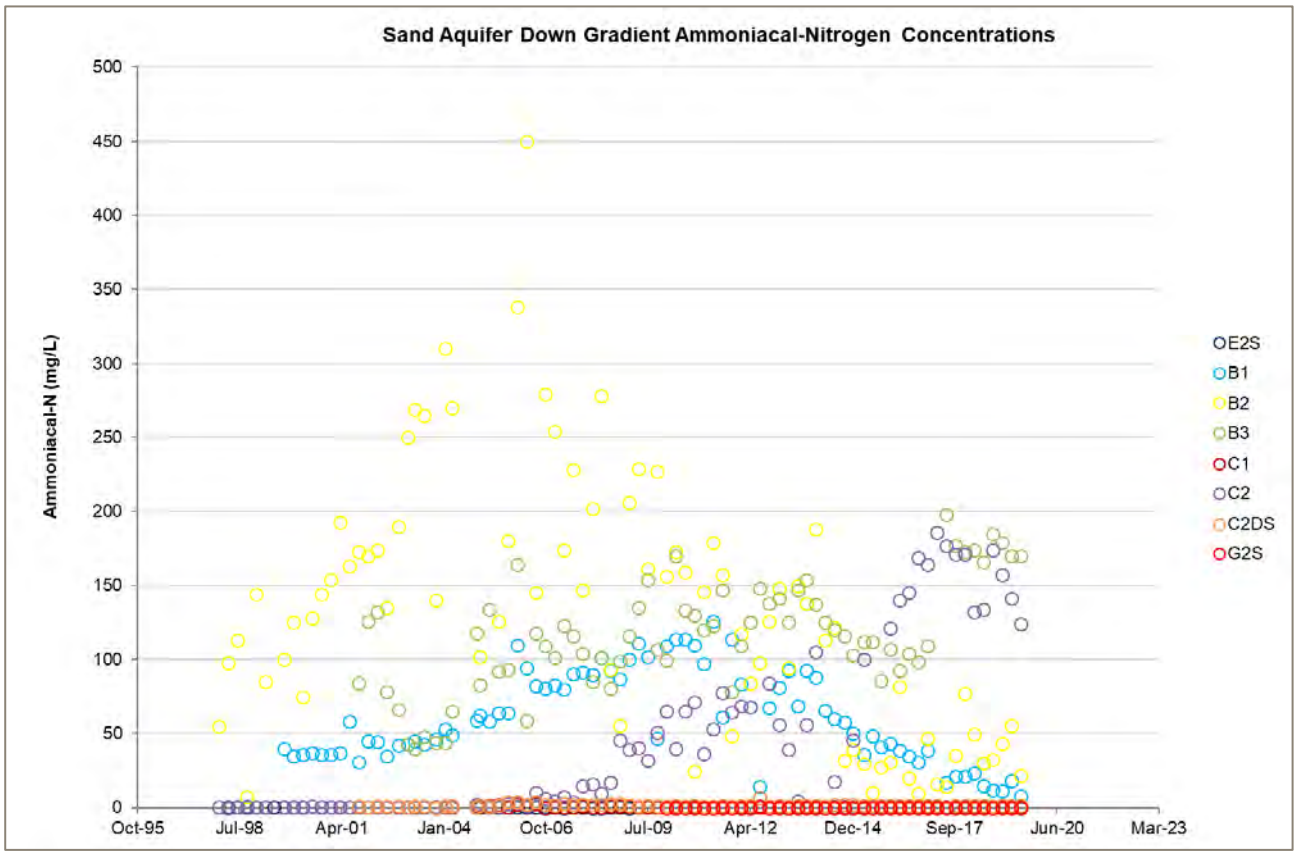


Figure 3-2: Shallow Bores Screened in the Leachate Plume

Other key leachate indicators, boron, conductivity and chloride are also all elevated within the bores that are located and screened in the leachate plume as would be expected.

The leachate plume appears to have a confined radius northward and is not extending to the north-west and the north-east. The leachate plume width was estimated to be 300-500m in 2014.

3.4 Deep Aquifer Groundwater Quality

Concentrations of manganese and iron exceeded the respective DWSNZ MAVs at C2DD (manganese) and G1D (iron), within the deep gravel aquifer, in July 2019. However, it is noted that the manganese concentration at C2DD (0.488mg/L) was consistent with historical results and representative of background

groundwater quality in the area. The concentration of iron in July 2019 is elevated above historic results for bore G1D (which have typically been below 1 mg/L until 2019).

3.5 Leachate Effluent

Monitoring results from the leachate effluent samples are not required to meet either the ANZECC or DWSNZ standards. Results from the July 2019 monitoring round were all within the typical leachate composition range for Class 1 landfills published in the WasteMINZ 2018 Technical Guidelines for Disposal to Land.

3.6 Tatana Property Drain

Monitoring results from the Tatana's Property drain samples are not required to meet either the ANZECC LDW trigger values or DWSNZ MAVs.

As requested by HDC, analysis for faecal coliforms was added to the Comprehensive and Indicator Parameter Lists from this (July 2019) monitoring period onwards. During the July 2019 sampling period faecal coliform counts at SW3 within the Tatana Property drain exceeded the ANZECC LDW trigger values. Faecal coliform counts at locations in the upper section of the drain (SW1 and SW2) and lower drain (SW4) were lower than those observed at SW3, suggesting that localised activities may have contributed to the elevated faecal coliform counts in the drain at SW3.

3.7 Hokio Stream

The consented limit for faecal coliforms in Hokio Stream (the ANZECC LDW trigger value) **was exceeded** at all three sampling locations (HS1, HS2 and HS3) during the July 2019 sampling event.

The highest faecal coliform counts within Hokio Stream in July 2019 were detected at HS1, upstream of the landfill (210 CFU/100mL), while the lowest counts were recorded at HS2, alongside the old landfill and upstream of the Tatana Property drain (160 CFU/100mL). The furthest downstream location (HS3) was recorded as having faecal coliform count of 190 CFU/100mL.

These results indicate that upstream activities are likely to be contributing bacterial contamination to Hokio Stream.

Current observations indicate that leachate from the landfill is not having a significant adverse environmental effect on Hokio Stream.

3.8 Consent Compliance

Discharge permit 6010 states that quarterly and annual monitoring results should comply with the ANZECC LDW trigger values in the shallow groundwater aquifer (sand aquifer) and surface water bodies. Samples from the deep groundwater (gravel aquifer) should comply with DWSNZ. Should any parameters be more than these guidelines, the permit holder shall report to the Regional Council as soon as practicable on the significance of the results and, where the change can be attributed to landfill leachate, consult with the Regional Council to determine if further investigation or remedial measures are required.

Shallow sand aquifer

There was **one exceedance** of the resource consent conditions during the July 2019 sampling round:

- Faecal coliform levels in bore C2 exceeded the ANZECC LDW trigger value.

Deeper gravel aquifer

There were **two exceedances** of the resource consent conditions in samples from the deep gravel aquifer during the July 2019 sampling round:

- Iron concentration in bore G1D exceeded the DWSNZ MAV.
- Manganese concentration in bore C2DD exceeded the DWSNZ MAV.

Hokio stream

There were **three exceedances** of the resource consent conditions during the July 2019 sampling round monitoring the Hokio Stream:

- Faecal coliform levels in HS1, HS2 and HS3 exceeded the ANZECC LDW trigger value.

At this time these exceedances cannot be clearly attributed to landfill leachate discharges. However, the potential influence of landfill leachate on groundwater and surface water quality will be further explored in the annual report.

4. Conclusions

Current monitoring results suggests that the background groundwater is being impacted by local ground conditions, the old unlined landfill and/or activities up-gradient of the landfill.

During the July 2019 monitoring period there were six exceedances of the resource consent conditions.

The concentration of iron in July 2019 is elevated above historic results for bore G1D (which have typically been below 1 mg/L until 2019).

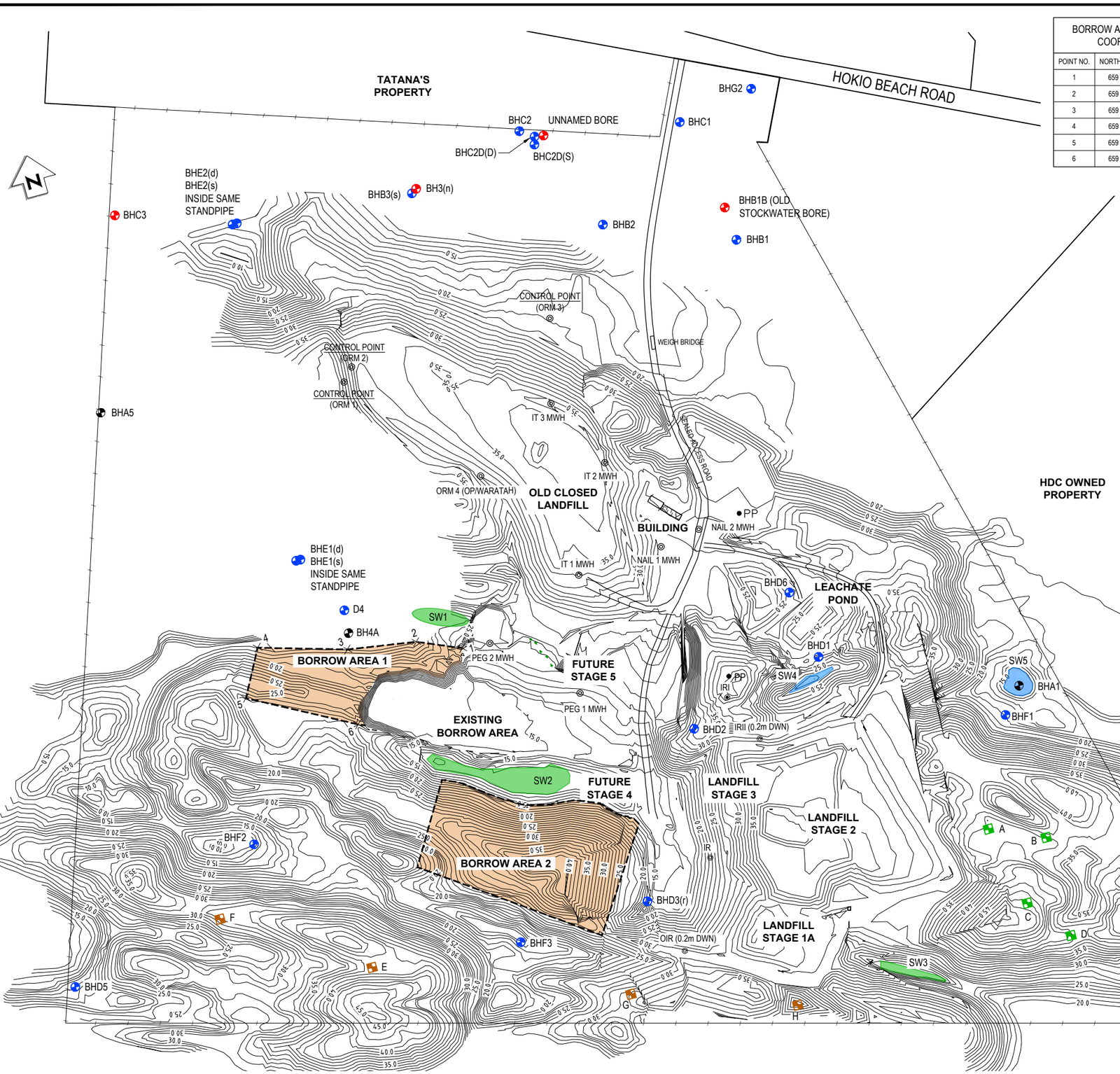
The deep-water bore C2DD located immediately down-gradient hydraulically of the old unlined landfill showed a manganese concentration marginally above the DWSNZ MAV. The concentration of manganese at this bore is consistent with historical results and is representative of ground water quality in the area.

There were three exceedances from surface monitoring at the Hokio Stream; faecal coliform upstream of the old landfill (HS1), mid-stream (HS2) and downstream (HS3) of the old landfill were all above the ANZECC LDW trigger values. Exceedances in faecal coliform may be related to activities upstream of the landfill.

Faecal coliform levels in bore C2 (3,900 CFU/100ml) exceeded the ANZECC LDW trigger values. As noted above, with the exception of the April 2019 monitoring round, faecal coliform counts at C2 have consistently complied with consenting conditions since 1996. The groundwater depth at C2 is very close to the surface and it is possible that surface water may have been affected by localised activities. It is recommended faecal coliform counts at this bore be revisited during the October 2019 sampling round.

Appendices

Appendix A Site Plans



BORROW AREA 1 SET-OUT COORDINATES

POINT NO.	NORTHINGS mN	EASTINGS mE
1	659 230.38	276 453.28
2	659 247.32	276 413.49
3	659 257.33	276 349.62
4	659 280.93	276 269.42
5	659 238.49	276 246.50
6	659 187.34	276 341.04

BORE LOCATIONS AND DETAILS

BORE HOLE NO	NORTHING mN	EASTING mE	R.L. (m)	DEPTH OF WELL (m)	PIEZOMETER DIAMETER (mm)	FUNCTION
A1	659 060.15	276 944.89	12.95			SHALLOW AQUIFER
A2 (DESTROYED)						SHALLOW AQUIFER
A3 (DESTROYED)						SHALLOW AQUIFER
A4	659 271.67	276 354.72	10.10			SHALLOW AQUIFER
A5	659 530.47	276 185.91	9.62			SHALLOW AQUIFER
B1	659 561.81	276 797.35	9.04	4.3	40	SHALLOW AQUIFER
B1B (STOCK BORE)	659 530.08	276 799.91	9.28	10		
B2	659 576.32	276 683.50	9.42	3.5	50	SHALLOW AQUIFER
B3(s)	659 651.19	276 519.52	7.76	2.83	50	SHALLOW AQUIFER
B3(n)	659 654.26	276 524.38	7.49	2.33	32	DEEP AQUIFER
C1	659 649.64	276 777.83	7.47	3.60	50	SHALLOW AQUIFER
C2	659 680.80	276 631.22	7.50	2.81	32	SHALLOW AQUIFER
C2D(s)	659 671.19	276 641.63	10.13	12.88	32	SHALLOW AQUIFER
C2D(d)	659 671.19	276 641.63	10.11	18.85	32	DEEP AQUIFER
C3	659 704.29	276.246.89	7.22	2.8	32	SHALLOW AQUIFER
D1	659 134.97	276 771.65	27.46	23.69	50	EARLY DETECTION
D2	659 101.02	276 642.06	32.12	29.46	50	EARLY DETECTION
D3-DESTROYED						
D4	659 293.20	276 356.60	20.50	17.0		SHALLOW AQUIFER
D5	659 020.80	276 022.40	17.8	18		SHALLOW AQUIFER BACKGROUND
D6	659 200.31	276 761.08	26.41	16.07	50	EARLY DETECTION
E1(d)	659 349.54	276 329.48	20.91	37.80	32	SHALLOW AQUIFER
E1(s)	659 349.54	276 329.48	20.91	20.05	32	DEEP AQUIFER
E2(s)	659 667.30	276 354.69	13.15	15.24	32	SHALLOW AQUIFER
E2(d)	659 667.30	276 354.69	13.15	28.66	32	DEEP AQUIFER
F1	659 037.10	276 925.50	18.90	15.0	50	SHALLOW AQUIFER LEACHATE IRRIGATION
F2	659 105.00	276 218.00	13.50	10.2	50	SHALLOW AQUIFER LEACHATE IRRIGATION
F3	658 951.7	276 434.0	16.70	10.5	50	SHALLOW AQUIFER LEACHATE IRRIGATION
G1(s) [4]	658 786	277 046	24	15	50	SHALLOW AQUIFER BACKGROUND
G1(d) [4]	658 786	277 046	24	31.5	50	DEEP AQUIFER BACKGROUND
G2 [4]	659 673	276 835	8	4	50	SHALLOW AQUIFER
D3(r) REINSTATED [4]	658 953	276 552	18	10	50	EARLY DETECTION
COORDINATES ARE IN TERMS OF NEW ZEALAND GEODETIC DATUM 1949: WANGANUI CIRCUIT						

COORDINATES OF SURVEY CONTROL MARKS

PT	NORTHING mN	EASTING mE	RL
ORM 1	659 498.38	276 412.21	38.94
ORM 2	659 510.09	276 422.72	34.98
ORM 3	659 505.14	276 612.86	21.10
ORM 4(OP/W)	659 380.16	276 511.94	30.92
MWH NAIL 1	659 272.67	276 656.87	27.61
MWH NAIL 2	659 278.98	276 695.22	28.40
MWH IT 1	659 267.33	276 576.02	30.03
MWH IT 2	659 361.94	276 627.00	33.70
MWH IT 3	659 428.24	276 593.00	32.74
MWH PEG 1	659 160.94	276 548.30	32.99
MWH PEG 2	659 227.86	276 479.35	30.49
IRII	659 075.85	276 698.70	30.04
OIR	658 903.62	276 579.37	30.35
IRI	659 121.09	276 679.47	40.00
IR	276 625.10	658 981.29	21.30
COORDINATES ARE IN TERMS OF NEW ZEALAND GEODETIC DATUM 1949: WANGANUI CIRCUIT			

SOIL MONITORING LOCATIONS	CO-ORDINATES		LEVEL (m)
	NORTHING mN	EASTING mE	
PEG A	658 938.80	276 882.30	39.2
PEG B	658 917.00	276 932.10	39.5
PEG C	658 862.70	276 899.00	46.1
PEG D	658 822.90	276 930.40	40.4
PEG E	658 965.50	276 294.00	36.6
PEG F	659 046.20	276 169.10	32.9
PEG G	658 878.00	276 520.20	32.6
PEG H	658 827.40	276 667.60	23.5

NOTES:

1. LEVELS ARE TOP OF STANDPIPE. WHERE THERE IS NO STANDPIPE, LEVELS ARE TOP OF PVC PIPE.
2. BHA2, BHA3 AND BHD3 HAVE BEEN LOST DUE TO SITE WORKS.
3. "A" SERIES BORE HOLES ARE AUGER HOLES ONLY AND MAY NOT BE ABLE TO BE LOCATED.
4. BORES INSTALLED IN AUG 2009. DETAILS ARE APPROXIMATE.
5. CONTOUR INTERVALS: 5m MAJOR, 1m MINOR

LEGEND

- MONITOR BORES CURRENTLY SAMPLED (FROM JAN 2010)
- BORES NOT SAMPLED
- SHALLOW HANDAUGER STANDPIPES NOT ABLE TO BE LOCATED
- SOIL SAMPLING LOCATION PEG - MONITORED
- SOIL SAMPLING LOCATION PEG - NOT MONITORED
- EXISTING STORMWATER SOAKAGE AREA
- PROPOSED STORMWATER SOAKAGE AREA
- PROPOSED BORROW AREAS

NOT FOR CONSTRUCTION

DO NOT SCALE - IF IN DOUBT, ASK

ORIGINAL SIZE A1

26/08/2019 9:35 a.m.

REV	REVISIONS	DRN	CHK	APP	DATE
A	FOR INFORMATION	BCJ	PSL	PSL	26.08.19

SURVEYED	MWH	
DESIGNED	N/A	-
DRAWN	Brent James	08.2019
CAD REVIEW	Brent James	26.08.19
APPROVED	Phil Landmark	26.08.19
PROF REGISTRATION:		

Stantec

Client:

HOROWHENUA DISTRICT COUNCIL
LEVIN LANDFILL

MONITORING BORES, SOIL SAMPLING LOCATIONS & BORROW AREAS
SITE PLAN, LOCATION AND DETAILS

Status Stamp: **FOR INFORMATION ONLY**
Date Stamp: **26.08.19**
Scales: 1:2000 (A1) 1:4000 (A3)
Drawing No.: 310101088-19-001-G001
Rev.: A

pw:\\asiavpwint05.mwhglobal.com:AP_PROJECTS\Documents\New Zealand Clients\Horowhenua District Council\60500724 - Levin Landfill Volumes\2019\General\310101088-19-001-G001

Hokio Stream ("HS") and Tatana's Property Drain ("SW") Monitoring Locations

Appendix B Sampling Schedule

LEVIN LANDFILL - SUMMARY OF SURFACE AND GROUNDWATER MONITORING REQUIREMENTS (July 2019 - April 2022).

(The testing regime is based on Consent Conditions following the completion of the 2015 Resource Consent Review process).

Reports Due		Sampling Month	Table A (Condition 3, DP 6010)					Table B (Condition 3, DP 6010)																			Table C (Condition 3, DP 6010)						
			Deep Aquifer Bores					Shallow Aquifer Bores																			Irrigation Bores				Hokio Stream[4]				Tatana Drain	Leachate Pond[5]	
Annual	Quarterly		C2dd	E1d	E2d	G1d	Xd1[1]	C1	C2	C2ds	D4	B1	B2	B3s	E1s	E2s	D1[2]	D2[2]	D3r[2]	D6[2]	G1s	G2s	Xs1[1]	Xs2[1]	D5[3]	F1[3]	F2[3]	F3[3]	HS1	HS1A	HS2	HS3	TD1		
Sep-19	**Aug-19**	**Jul-19**	I	I + SW	I	I	C + A	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	C + A	C + A	I	I	I	I + SW	Monthly Comprehensive for 2 Years	Monthly Comprehensive for 2 Years	Monthly Comprehensive for 2 Years	Monthly Comprehensive for 2 Years	I	Monthly Comprehensive for 2	
	Nov-19	**Oct-19**	I	I + SW	I	I	C + A	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	C + A	C + A	I	I	I	I + SW					C		A
	Feb-20	**Jan-20**	I	I + SW	I	I	C + A	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	C + A	C + A	I	I	I	I + SW					I		
	May-20	**Apr-20**	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A					C		A
Sep-20	**Aug-20**	**Jul-20**	I	I + SW	I	I	I	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	C + A	C + A	I	I	I	I + SW					I		
	Nov-20	**Oct-20**	I	I + SW	I	I	I	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	C + A	C + A	I	I	I	I + SW					C		A
	Feb-21	**Jan-21**	I	I + SW	I	I	I	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	C + A	C + A	I	I	I	I + SW					I		
	May-21	**Apr-21**	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A					C		A
Sep-21	**Aug-21**	**Jul-21**	I	I + SW	I	I	I	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	I	I	I	I	I	I + SW	Discontinue after 2 years	I	I	I	I	I	
	Nov-21	**Oct-21**	I	I + SW	I	I	I	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	I	I	I	I	I	I + SW		C	C	C	C	C	
	Feb-22	**Jan-22**	I	I + SW	I	I	I	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	I	I	I	I	I	I + SW		I	I	I	I	I	
	May-22	**Apr-22**	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A		C	C	C	C	C + A	

Measure groundwater level and sample all bores for CH_4, CO_2 and O_2 each time that groundwater is sampled (Condition 4a of DP 6011)

Notes:

(1) Bores to be developed by Consent Holder
(2) See table below
(3) If irrigation re-commences then the annual sampling is to change from comprehensive + 3 times indicator to bi-annual comprehensive + indicator (Clause D of Condition 3, DP 6010) .
(4) See table below
(5) See table below
C Comprehensive list (see below)
I Indicator list (see below)
A Annual Pesticide and SVOC analysis
SW Add sodium and iron analysis (for stormwater consent 102559)

A reduction in sampling frequency at any **groundwater monitoring point** is conditional on (Clauses A - D of Condition 3, DP 6010):

A. Completion of the initial monitoring program;
B. Good consistency of groundwater sample analysis results, or a clearly identified reason for inconsistent results that excludes the contaminant source being landfill operations, stored waste or leachate;
C. No decline in groundwater quality as determined from indicator parameter trends over a period of four consecutive sampling rounds;
D. If a well being monitored on a conditional frequency becomes non-compliant with condition C, the monitoring frequency for that well should return to the base case intensive monitoring until conditions B and C are again being fulfilled.

(2) If site management planning indicates any **early detection monitoring well** is likely to become buried or otherwise destroyed within the following year as a result of normal operations (Clauses E - H, Condition 3, DP 6010):

E. This must be communicated to the regional council;
F. A replacement well is to be constructed in a position agreed upon with Horizons Regional Council
G. The replacement well should be installed in a position suitable to act as a early detection well and be classed as an early detection well;
H. The replacement well should be constructed as a nested well (or two separate wells) with screens positioned in both shallow and deep aquifers.

(4) A reduction in sampling frequency at the **Hokio Stream monitoring locations (HS1A, HS2 and HS3)** is conditional on (Clauses I - L, Condition 3 of DP 6010):

I. No signficant increases in the concentrations between monitoring sites HS1A and HS3, for parameters exceeding the trigger values contained in Table C1 at Site HS3.
J. A statistical analysis approach is to be used to determine if there is a significant increase in contaminant levels between HS1A and HS3.
K. Following the 24 month monitoring period, there shall be no significant increases in concentrations between monitoring sites HS1A and HS3.
L. If the Hokio Stream monitoring locations are being sampled on a conditional frequency and do not meet condition K, the monitoring frequency for all three monitoring locations (HS1A, HS2 and HS3) shall return to the base case intensive monitoring until conditions J and K are again being fulfilled.

(5) A reduction in sampling frequency at the **leachate pond outlet** is conditional on (Clauses M - P, Condition 3, DP 6010):

M. Completion of the initial 2 year monitoring program;
N. Good consistency of water sample analysis results, or a clearly identified reason for inconsistent results;
O. No decline in water quality over a period of four consecutive sampling rounds;
P. If the leachate pond outlet is being sampled on a conditional frequency and becomes non-compliant with condition O, the monitoring frequency should return to the base case intensive monitoring until conditions N and O are again being fulfilled.

COMPREHENSIVE PARAMETER LIST (Table E of Condition 3, DP 6010)

Characterising parameters	pH
	electrical conductivity (EC)
	alkalinity
	total hardness
	suspended solids
Oxygen demand	COD and $scBOD_5$
Nutrients*	NO3-N, NH4-N, DRP and SO_4
Metals*	Al, As, Cd, Cr, Cu, Fe, Mg, Mn, Ni, Pb, Zn and Hg
Other elements	B, Ca, Cl, K and Na
Organics	Total organic carbon, total phenols, volatile acids
Biological	E. coli

* Analyses performed for nutrients and metals are for dissolved rather than total concentrations

INDICATOR PARAMETER LIST (Table F, Condition 3, DP 6010)

Characterising parameters	pH
	electrical conductivity (EC)
Oxygen demand	COD and $scBOD_5$
Nutrients*	NO3-N and NH4-N
Metals*	AL, Mn, Ni, Pb and Hg
Other elements	B and Cl
Biological+	E. coli

* Analyses performed for nutrients and metals are for dissolved rather than total concentrations

+ E. coli added from April 2019 sampling onwards

Appendix C Analytical Results

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Eurofins ELS Limited

Analytical Report

Downer EDI Levin - Landfill
P O Box 642
LEVIN 5540
Attention: Bruce Marshall

Report Number: 19/22163
Issue: 1
12 August 2019

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-01	Levin Landfill quarterly SW5		25/07/2019 00:00	25/07/2019 14:46	0

Notes: 126900-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.3		Gordon McArthur KTP
0002	Suspended Solids - Total	26	g/m³	Marylou Cabral KTP
0055	Conductivity at 25°C	58.7	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	83	g/m³	Gordon McArthur KTP
0083	Total Kjeldahl Nitrogen	6.2	g/m³	Marylou Cabral KTP
0085	BOD5 - Total	< 6	g/m³	Marylou Cabral KTP
0602	Chloride	65.8	g/m³	Shanel Kumar KTP
0603	Nitrite - Nitrogen	0.05	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	0.20	g/m³	Shanel Kumar KTP
0719	Ammonia Nitrogen	4.9	g/m³	Divina Lagazon KTP
2127	Total Nitrogen	6.68	g/m³	Divina Lagazon KTP
6717	Iron - Dissolved	1.04	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.119	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	28	cfu/100ml	Maria Norris KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-02	Levin Landfill quarterly SW4		25/07/2019 00:00	25/07/2019 14:46	0

Notes: 126899-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.3		Marylou Cabral KTP
0002	Suspended Solids - Total	< 6	g/m³	Marylou Cabral KTP
0055	Conductivity at 25°C	58.1	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	64	g/m³	Gordon McArthur KTP
0083	Total Kjeldahl Nitrogen	5.8	g/m³	Marylou Cabral KTP
0085	BOD5 - Total	< 6	g/m³	Marylou Cabral KTP
0602	Chloride	65.7	g/m³	Shanel Kumar KTP
0603	Nitrite - Nitrogen	0.04	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	0.18	g/m³	Shanel Kumar KTP
0719	Ammonia Nitrogen	4.7	g/m³	Divina Lagazon KTP
2127	Total Nitrogen	6.58	g/m³	Divina Lagazon KTP
6717	Iron - Dissolved	0.90	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.107	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	44	cfu/100ml	Maria Norris KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-03	Levin Landfill quarterly SW3		25/07/2019 00:00	25/07/2019 14:46	0

Notes: 126898-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.2		Marylou Cabral KTP
0002	Suspended Solids - Total	19	g/m³	Marylou Cabral KTP
0055	Conductivity at 25°C	52.4	mS/m	Marylou Cabral KTP
0081	Chemical Oxygen Demand	109	g/m³	Gordon McArthur KTP
0083	Total Kjeldahl Nitrogen	6.0	g/m³	Marylou Cabral KTP
0085	BOD5 - Total	< 6	g/m³	Marylou Cabral KTP
0602	Chloride	69.2	g/m³	Shanel Kumar KTP
0603	Nitrite - Nitrogen	0.03	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	0.19	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-03	Levin Landfill quarterly SW3		25/07/2019 00:00	25/07/2019 14:46	0

Notes: 126898-0 Levin Landfill

	Test	Result	Units	Signatory
0719	Ammonia Nitrogen	3.6	g/m³	Divina Lagazon KTP
2127	Total Nitrogen	6.70	g/m³	Divina Lagazon KTP
6717	Iron - Dissolved	1.49	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.117	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	380	cfu/100ml	Maria Norris KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-04	Levin Landfill quarterly SW2		25/07/2019 00:00	25/07/2019 14:46	0

Notes: 126897-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.4		Marylou Cabral KTP
0002	Suspended Solids - Total	14	g/m³	Marylou Cabral KTP
0055	Conductivity at 25°C	120	mS/m	Marylou Cabral KTP
0081	Chemical Oxygen Demand	96	g/m³	Gordon McArthur KTP
0083	Total Kjeldahl Nitrogen	24.0	g/m³	Marylou Cabral KTP
0085	BOD5 - Total	6	g/m³	Marylou Cabral KTP
0602	Chloride	126	g/m³	Shanel Kumar KTP
0603	Nitrite - Nitrogen	0.09	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	2.77	g/m³	Shanel Kumar KTP
0719	Ammonia Nitrogen	22.0	g/m³	Divina Lagazon KTP
2127	Total Nitrogen	27.3	g/m³	Divina Lagazon KTP
6717	Iron - Dissolved	0.66	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.522	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	54	cfu/100ml	Maria Norris KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-05	Levin Landfill quarterly SW1		25/07/2019 00:00	25/07/2019 14:46	0

Notes: 126896-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.7		Marylou Cabral KTP
0002	Suspended Solids - Total	88	g/m³	Marylou Cabral KTP
0055	Conductivity at 25°C	222	mS/m	Marylou Cabral KTP
0081	Chemical Oxygen Demand	153	g/m³	Gordon McArthur KTP
0083	Total Kjeldahl Nitrogen	77.6	g/m³	Marylou Cabral KTP
0085	BOD5 - Total	264	g/m³	Gordon McArthur KTP
0602	Chloride	227	g/m³	Shanel Kumar KTP
0603	Nitrite - Nitrogen	0.03	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	0.12	g/m³	Shanel Kumar KTP
0719	Ammonia Nitrogen	77.4	g/m³	Divina Lagazon KTP
2127	Total Nitrogen	81.2	g/m³	Divina Lagazon KTP
6717	Iron - Dissolved	1.65	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.965	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	100	cfu/100ml	Maria Norris KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-06	Levin HS2		31/07/2019 00:00	31/07/2019 16:04	0

Notes: 126886-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.7		Gordon McArthur KTP
0055	Conductivity at 25°C	22.8	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	31	g/m³	Gordon McArthur KTP
0602	Chloride	22.3	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	2.02	g/m³	Amit Kumar KTP
0760	Ammonia Nitrogen	0.02	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.013	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-06	Levin HS2		31/07/2019 00:00	31/07/2019 16:04	0

Notes: 126886-0 Levin Landfill

	Test	Result	Units	Signatory
6707	Boron - Dissolved	0.05	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	0.07	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.0199	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	15.0	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	160	cfu/100ml	Juana Tamayo KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-07	Levin HS3		31/07/2019 00:00	31/07/2019 16:04	0

Notes: 126885-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.7		Gordon McArthur KTP
0055	Conductivity at 25°C	23.1	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	31	g/m³	Gordon McArthur KTP
0602	Chloride	22.4	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	2.09	g/m³	Amit Kumar KTP
0760	Ammonia Nitrogen	< 0.01	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.014	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	0.05	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	0.09	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.0239	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	15.6	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	190	cfu/100ml	Juana Tamayo KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-08	Levin HS1		31/07/2019 00:00	31/07/2019 16:04	0

Notes: 126884-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.9		Gordon McArthur KTP
0055	Conductivity at 25°C	22.6	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	27	g/m³	Gordon McArthur KTP
0602	Chloride	22.1	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	1.95	g/m³	Amit Kumar KTP
0760	Ammonia Nitrogen	< 0.01	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.013	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	0.05	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	0.07	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.0182	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	14.8	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	210	cfu/100ml	Juana Tamayo KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-09	Levin G2s		11/07/2019 00:00	11/07/2019 14:44	0

Notes: 126883-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.6		Gordon McArthur KTP
0055	Conductivity at 25°C	186	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	90	g/m³	Gordon McArthur KTP
0602	Chloride	327	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	< 0.10	g/m³	Amit Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-09	Levin G2s		11/07/2019 00:00	11/07/2019 14:44	0

Notes: 126883-0 Levin Landfill

	Test	Result	Units	Signatory
0760	Ammonia Nitrogen	0.01	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	< 0.002	g/m³	Sharon van Soest KTP
6707	Boron - Dissolved	0.98	g/m³	Sharon van Soest KTP
6717	Iron - Dissolved	0.44	g/m³	Sharon van Soest KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Sharon van Soest KTP
6721	Manganese - Dissolved	0.163	g/m³	Sharon van Soest KTP
6724	Nickel - Dissolved	0.0042	g/m³	Sharon van Soest KTP
6731	Sodium - Dissolved	224	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	< 4	cfu/100ml	Maria Norris KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-10	Levin G1D		11/07/2019 00:00	11/07/2019 14:44	0

Notes: 126882-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.0		Gordon McArthur KTP
0055	Conductivity at 25°C	28.6	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	63	g/m³	Gordon McArthur KTP
0602	Chloride	31.5	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	< 0.01	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	0.09	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	< 0.002	g/m³	Sharon van Soest KTP
6707	Boron - Dissolved	0.05	g/m³	Sharon van Soest KTP
6717	Iron - Dissolved	1.49	g/m³	Sharon van Soest KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Sharon van Soest KTP
6721	Manganese - Dissolved	0.0650	g/m³	Sharon van Soest KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Sharon van Soest KTP
6731	Sodium - Dissolved	19.0	g/m³	Sharon van Soest KTP
M0102	Faecal Coliforms	< 4	cfu/100ml	Maria Norris KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-11	Levin G1S		11/07/2019 00:00	11/07/2019 14:44	0

Notes: 126881-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.3		Gordon McArthur KTP
0055	Conductivity at 25°C	126	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	58	g/m³	Gordon McArthur KTP
0602	Chloride	330	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	0.25	g/m³	Amit Kumar KTP
0760	Ammonia Nitrogen	0.06	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.013	g/m³	Sharon van Soest KTP
6707	Boron - Dissolved	< 0.03	g/m³	Sharon van Soest KTP
6717	Iron - Dissolved	8.29	g/m³	Sharon van Soest KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Sharon van Soest KTP
6721	Manganese - Dissolved	0.180	g/m³	Sharon van Soest KTP
6724	Nickel - Dissolved	0.0007	g/m³	Sharon van Soest KTP
6731	Sodium - Dissolved	151	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	< 4	cfu/100ml	Maria Norris KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-12	Levin F3		22/07/2019 00:00	23/07/2019 09:31	0

Notes: 126880-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.0		Jennifer Mont KTP
0055	Conductivity at 25°C	20.6	mS/m	Jennifer Mont KTP
0081	Chemical Oxygen Demand	56	g/m³	Gordon McArthur KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-12	Levin F3		22/07/2019 00:00	23/07/2019 09:31	0

Notes: 126880-0 Levin Landfill

	Test	Result	Units	Signatory
0602	Chloride	20.6	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	1.52	g/m³	Amit Kumar KTP
0760	Ammonia Nitrogen	< 0.01	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	< 0.002	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	< 0.03	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	< 0.01	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Sharon van Soest KTP
6721	Manganese - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	22.0	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	< 4	cfu/100ml	Juana Tamayo KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-13	Levin F2		22/07/2019 00:00	22/07/2019 14:27	0

Notes: 126879-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.3		Jennifer Mont KTP
0055	Conductivity at 25°C	22.9	mS/m	Jennifer Mont KTP
0081	Chemical Oxygen Demand	51	g/m³	Gordon McArthur KTP
0602	Chloride	22.8	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	0.74	g/m³	Amit Kumar KTP
0760	Ammonia Nitrogen	< 0.01	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.002	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	0.04	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	< 0.01	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.0010	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	23.8	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	< 4	cfu/100ml	Yuemei Yu KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-14	Levin F1		22/07/2019 00:00	22/07/2019 14:27	0

Notes: 126878-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.9		Jennifer Mont KTP
0055	Conductivity at 25°C	46.8	mS/m	Jennifer Mont KTP
0081	Chemical Oxygen Demand	30	g/m³	Gordon McArthur KTP
0602	Chloride	49.6	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	1.54	g/m³	Amit Kumar KTP
0760	Ammonia Nitrogen	< 0.01	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.003	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	< 0.03	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	< 0.01	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.0133	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	0.0014	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	30.7	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	< 4	cfu/100ml	Yuemei Yu KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-15	Levin E2s		24/07/2019 00:00	24/07/2019 14:35	0

Notes: 126877-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.4		Gordon McArthur KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-15	Levin E2s		24/07/2019 00:00	24/07/2019 14:35	0

Notes: 126877-0 Levin Landfill

	Test	Result	Units	Signatory
0055	Conductivity at 25°C	44.2	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	< 15	g/m³	Gordon McArthur KTP
0602	Chloride	41.4	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	< 0.01	g/m³	Amit Kumar KTP
0760	Ammonia Nitrogen	0.25	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	< 0.002	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	0.05	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	0.05	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.404	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	44.5	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	< 4	cfu/100ml	Yuemei Yu KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-16	Levin E2d		22/07/2019 00:00	23/07/2019 09:31	0

Notes: 126876-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.6		Jennifer Mont KTP
0055	Conductivity at 25°C	34.8	mS/m	Jennifer Mont KTP
0081	Chemical Oxygen Demand	< 15	g/m³	Gordon McArthur KTP
0602	Chloride	48.2	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	< 0.01	g/m³	Amit Kumar KTP
0760	Ammonia Nitrogen	0.30	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	< 0.002	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	< 0.03	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	0.05	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Sharon van Soest KTP
6721	Manganese - Dissolved	0.219	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	27.2	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	< 4	cfu/100ml	Juana Tamayo KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-17	Levin E1s		23/07/2019 00:00	24/07/2019 09:43	0

Notes: 126875-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.9		Gordon McArthur KTP
0055	Conductivity at 25°C	26.7	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	< 15	g/m³	Gordon McArthur KTP
0602	Chloride	30.7	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	< 0.01	g/m³	Amit Kumar KTP
0760	Ammonia Nitrogen	0.18	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.002	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	0.04	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	0.02	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.0353	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	22.9	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	< 4	cfu/100ml	Juana Tamayo KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-18	Levin E1d		22/07/2019 00:00	23/07/2019 09:31	0

Notes: 126874-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.5		Jennifer Mont KTP
0055	Conductivity at 25°C	45.2	mS/m	Jennifer Mont KTP
0081	Chemical Oxygen Demand	45	g/m³	Gordon McArthur KTP
0602	Chloride	39.4	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	< 0.01	g/m³	Amit Kumar KTP
0760	Ammonia Nitrogen	0.21	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	< 0.002	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	0.04	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	0.05	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Sharon van Soest KTP
6721	Manganese - Dissolved	0.235	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	43.9	g/m³	Sharon van Soest KTP
M0102	Faecal Coliforms	< 4	cfu/100ml	Juana Tamayo KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-19	Levin D6		23/07/2019 00:00	24/07/2019 09:43	0

Notes: 126873-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.8		Gordon McArthur KTP
0055	Conductivity at 25°C	41.9	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	< 15	g/m³	Gordon McArthur KTP
0602	Chloride	27.7	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	17.7	g/m³	Amit Kumar KTP
0760	Ammonia Nitrogen	< 0.01	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.016	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	0.03	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	14.2	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.372	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	24.8	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	< 4	cfu/100ml	Juana Tamayo KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-20	Levin D5		22/07/2019 00:00	23/07/2019 09:31	0

Notes: 126872-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.0		Jennifer Mont KTP
0055	Conductivity at 25°C	28.7	mS/m	Jennifer Mont KTP
0081	Chemical Oxygen Demand	22	g/m³	Gordon McArthur KTP
0602	Chloride	29.3	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	1.45	g/m³	Amit Kumar KTP
0760	Ammonia Nitrogen	< 0.01	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	< 0.002	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	< 0.03	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	< 0.01	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Sharon van Soest KTP
6721	Manganese - Dissolved	0.0035	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	36.8	g/m³	Sharon van Soest KTP
M0102	Faecal Coliforms	4	cfu/100ml	Juana Tamayo KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-21	Levin D4		23/07/2019 00:00	24/07/2019 09:43	0

Notes: 126871-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.9		Gordon McArthur KTP
0055	Conductivity at 25°C	29.4	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	< 15	g/m³	Gordon McArthur KTP
0602	Chloride	45.3	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	< 0.01	g/m³	Amit Kumar KTP
0760	Ammonia Nitrogen	0.22	g/m³	Divina Lagazon KTP
1819	Iron - Dissolved	1.88	g/m³	Richard Zhao KTP
1834	Sodium - Dissolved	32.2	g/m³	Richard Zhao KTP
6701	Aluminium - Dissolved	< 0.002	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	0.04	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	1.91	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.181	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	29.5	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	< 4	cfu/100ml	Juana Tamayo KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-22	Levin D3r		23/07/2019 00:00	23/07/2019 14:33	0

Notes: 126870-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.8		Gordon McArthur KTP
0055	Conductivity at 25°C	23.0	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	< 15	g/m³	Gordon McArthur KTP
0602	Chloride	21.6	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	0.17	g/m³	Amit Kumar KTP
0760	Ammonia Nitrogen	0.12	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.003	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	0.03	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	2.20	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.160	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	21.3	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	< 4	cfu/100ml	Yuemei Yu KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-23	Levin D2		23/07/2019 00:00	24/07/2019 09:43	0

Notes: 126869-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.4		Gordon McArthur KTP
0055	Conductivity at 25°C	37.6	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	32	g/m³	Gordon McArthur KTP
0602	Chloride	42.1	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	< 0.01	g/m³	Amit Kumar KTP
0760	Ammonia Nitrogen	0.48	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	< 0.002	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	0.03	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	0.02	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.0153	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	20.4	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	20	cfu/100ml	Juana Tamayo KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-24	Levin D1		23/07/2019 00:00	24/07/2019 09:43	0

Notes: 126868-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.7		Gordon McArthur KTP
0055	Conductivity at 25°C	51.9	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	< 15	g/m³	Gordon McArthur KTP
0602	Chloride	36.9	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	13.0	g/m³	Amit Kumar KTP
0760	Ammonia Nitrogen	< 0.01	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.006	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	< 0.03	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	4.66	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.218	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	23.5	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	4	cfu/100ml	Juana Tamayo KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-25	Levin C2ds		24/07/2019 00:00	25/07/2019 08:18	0

Notes: 126867-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.7		Jennifer Mont KTP
0055	Conductivity at 25°C	178	mS/m	Jennifer Mont KTP
0081	Chemical Oxygen Demand	100	g/m³	Gordon McArthur KTP
0602	Chloride	133	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	< 0.10	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	1.45	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	< 0.002	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	1.01	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	9.45	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	2.80	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	0.0023	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	132	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	< 4	cfu/100ml	Maria Norris KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-26	Levin C2dd		23/07/2019 00:00	23/07/2019 14:33	0

Notes: 126866-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.4		Gordon McArthur KTP
0055	Conductivity at 25°C	52.3	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	< 15	g/m³	Gordon McArthur KTP
0602	Chloride	38.2	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	< 0.01	g/m³	Amit Kumar KTP
0760	Ammonia Nitrogen	0.33	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.006	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	0.05	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	0.01	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.488	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	26.5	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	< 4	cfu/100ml	Yuemei Yu KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-27	Levin C2		24/07/2019 00:00	25/07/2019 08:18	0

Notes: 126865-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.1		Jennifer Mont KTP
0055	Conductivity at 25°C	242	mS/m	Jennifer Mont KTP
0081	Chemical Oxygen Demand	141	g/m³	Gordon McArthur KTP
0602	Chloride	170	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	< 0.10	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	124	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.018	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	1.81	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	2.48	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.0524	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	0.0049	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	183	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	3,900	cfu/100ml	Maria Norris KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-28	Levin C1		24/07/2019 00:00	25/07/2019 08:18	0

Notes: 126864-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.6		Jennifer Mont KTP
0055	Conductivity at 25°C	145	mS/m	Jennifer Mont KTP
0081	Chemical Oxygen Demand	70	g/m³	Gordon McArthur KTP
0602	Chloride	283	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	< 0.10	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	0.76	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.010	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	0.69	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	3.49	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.419	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	0.0007	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	137	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	< 4	cfu/100ml	Maria Norris KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-29	Levin B3s		24/07/2019 00:00	24/07/2019 14:35	0

Notes: 126863-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.1		Gordon McArthur KTP
0055	Conductivity at 25°C	294	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	221	g/m³	Gordon McArthur KTP
0602	Chloride	179	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	< 0.10	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	170	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.003	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	1.40	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	0.34	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	3.83	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	0.0101	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	157	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	< 4	cfu/100ml	Yuemei Yu KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-30	Levin B2		24/07/2019 00:00	24/07/2019 14:35	0

Notes: 126862-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.7		Gordon McArthur KTP
0055	Conductivity at 25°C	135	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	50	g/m³	Gordon McArthur KTP
0602	Chloride	87.2	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	30.4	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	21.4	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.017	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	0.92	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	0.04	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	2.27	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	0.0010	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	85.0	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	48	cfu/100ml	Yuemei Yu KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-31	Levin Leachate Pond		11/07/2019 00:00	11/07/2019 14:44	0

Notes: 126861-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.7		Gordon McArthur KTP
0055	Conductivity at 25°C	1,350	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	3,690	g/m³	Gordon McArthur KTP
0602	Chloride	1,010	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	0.60	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	1,100	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.186	g/m³	Sharon van Soest KTP
6707	Boron - Dissolved	7.05	g/m³	Sharon van Soest KTP
6717	Iron - Dissolved	4.70	g/m³	Sharon van Soest KTP
6718	Lead - Dissolved	0.0023	g/m³	Sharon van Soest KTP
6721	Manganese - Dissolved	1.22	g/m³	Sharon van Soest KTP
6724	Nickel - Dissolved	0.123	g/m³	Sharon van Soest KTP
6731	Sodium - Dissolved	932	g/m³	Sharon van Soest KTP
M0102	Faecal Coliforms	2,000	cfu/100ml	Maria Norris KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/22163-32	Levin B1		24/07/2019 00:00	25/07/2019 08:18	0

Notes: 126860-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.0		Jennifer Mont KTP
0055	Conductivity at 25°C	119	mS/m	Jennifer Mont KTP
0081	Chemical Oxygen Demand	58	g/m³	Gordon McArthur KTP
0602	Chloride	118	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	9.46	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	7.79	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.007	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	0.64	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	0.02	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	6.23	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	0.0013	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	111	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	< 4	cfu/100ml	Maria Norris KTP

Comments:

Sampled by customer using ELS approved containers.

All samples analysed as we receive them. Delivery was within the correct time and temperature conditions.

Test Methodology:

Test	Methodology	Detection Limit
pH	Dedicated pH meter following APHA Online Edition Method 4500 H.	0.1
Suspended Solids - Total	APHA Online Edition Method 2540 D	3 g/m³
Conductivity at 25°C	APHA Online Edition Method 2510 B.	0.1 mS/m
Chemical Oxygen Demand	APHA Online Edition Method 5220 D.	15 g/m³
Total Kjeldahl Nitrogen	APHA Online Edition 4500-N(org) B	0.8 g/m³
BOD5 - Total	APHA Online Edition Method 5210 B.	1 g/m³
Chloride	Ion Chromatography following APHA 4110B.	0.02 g/m³
Nitrite - Nitrogen	Ion Chromatography following APHA 4110B.	0.01 g/m³
Nitrate - Nitrogen	Ion Chromatography following APHA 4110B.	0.01 g/m³
Ammonia Nitrogen	Discrete Analyser. In House method based on ISBN 0117516139.	0.01 g/m³
Ammonia Nitrogen	Flow Injection Autoanalyser following APHA Online Edition Method 4500 NH3-H.	0.01 g/m³
Iron - Dissolved	ICP-OES following APHA Online Edition Method 3120 B (modified).	0.005 g/m³
Sodium - Dissolved	ICP-OES following APHA Online Edition Method 3120 B (modified).	0.02 g/m³
Total Nitrogen	Flow Injection Autoanalyser following APHA Online Edition Method 4500-NO3 I. Persulphate digestion follows APHA Online Edition 4500-N C.	0.05 g/m³
Aluminium - Dissolved	ICP-MS following APHA Online Edition method 3125 (modified).	0.002 g/m³
Boron - Dissolved	ICP-MS following APHA Online Edition method 3125 (modified).	0.03 g/m³
Iron - Dissolved	ICP-MS following APHA Online Edition method 3125 (modified).	0.01 g/m³
Lead - Dissolved	ICP-MS following APHA Online Edition method 3125 (modified).	0.0005 g/m³
Manganese - Dissolved	ICP-MS following APHA Online Edition method 3125 (modified).	0.0005 g/m³
Nickel - Dissolved	ICP-MS following APHA Online Edition method 3125 (modified).	0.0005 g/m³
Sodium - Dissolved	ICP-MS following APHA Online Edition method 3125 (modified)	0.01 g/m³
Faecal Coliforms	APHA 9222D:Online Edition	1 cfu/100ml

Unless otherwise stated, all tests are performed in Wellington.

"<" means that no analyte was found in the sample at the level of detection shown. Detection limits are based on a clean matrix and may vary according to individual sample.

g/m3 is the equivalent to mg/L and ppm.

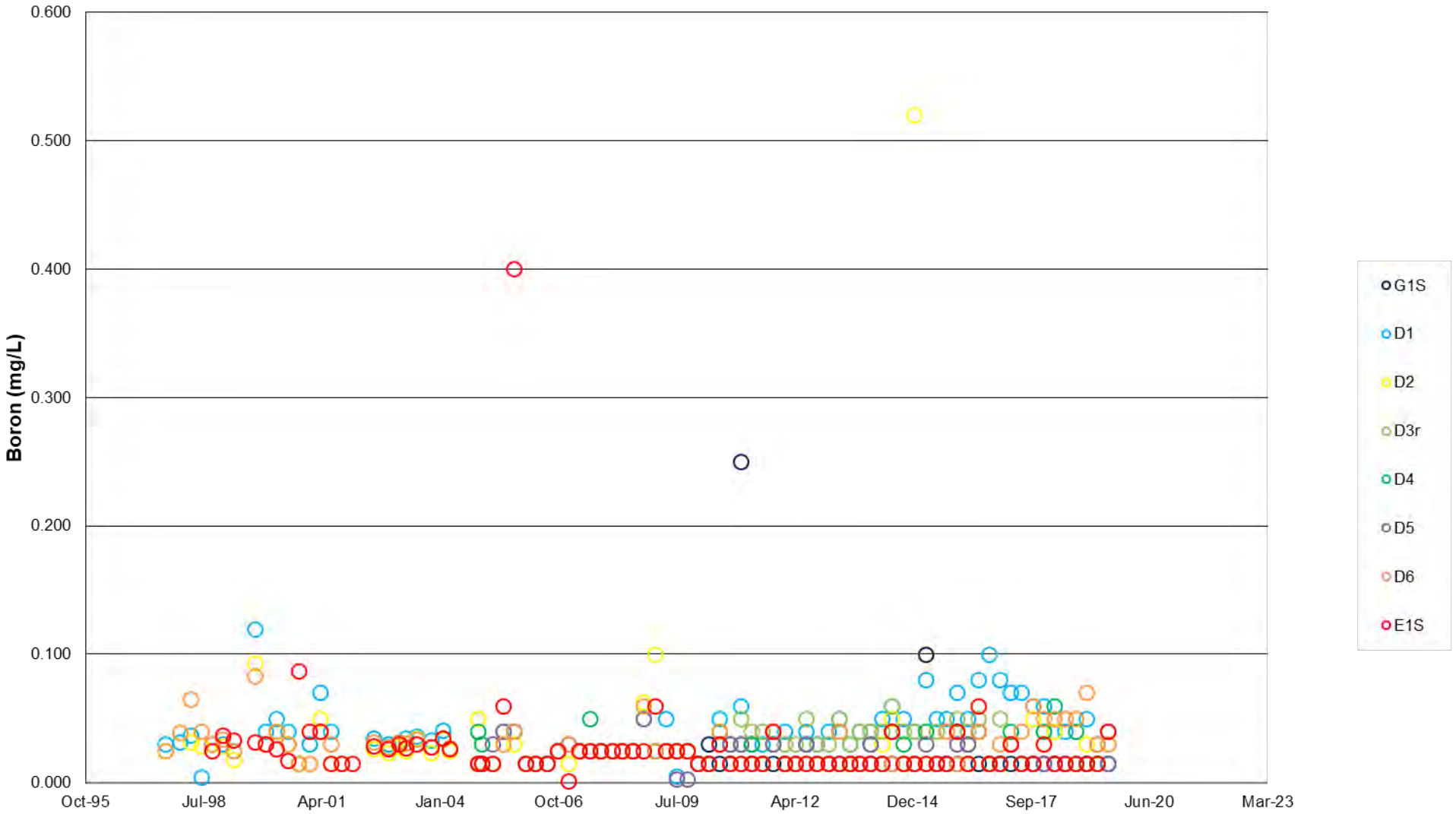
Samples will be retained for a period of time, in suitable conditions appropriate to the analyses requested.

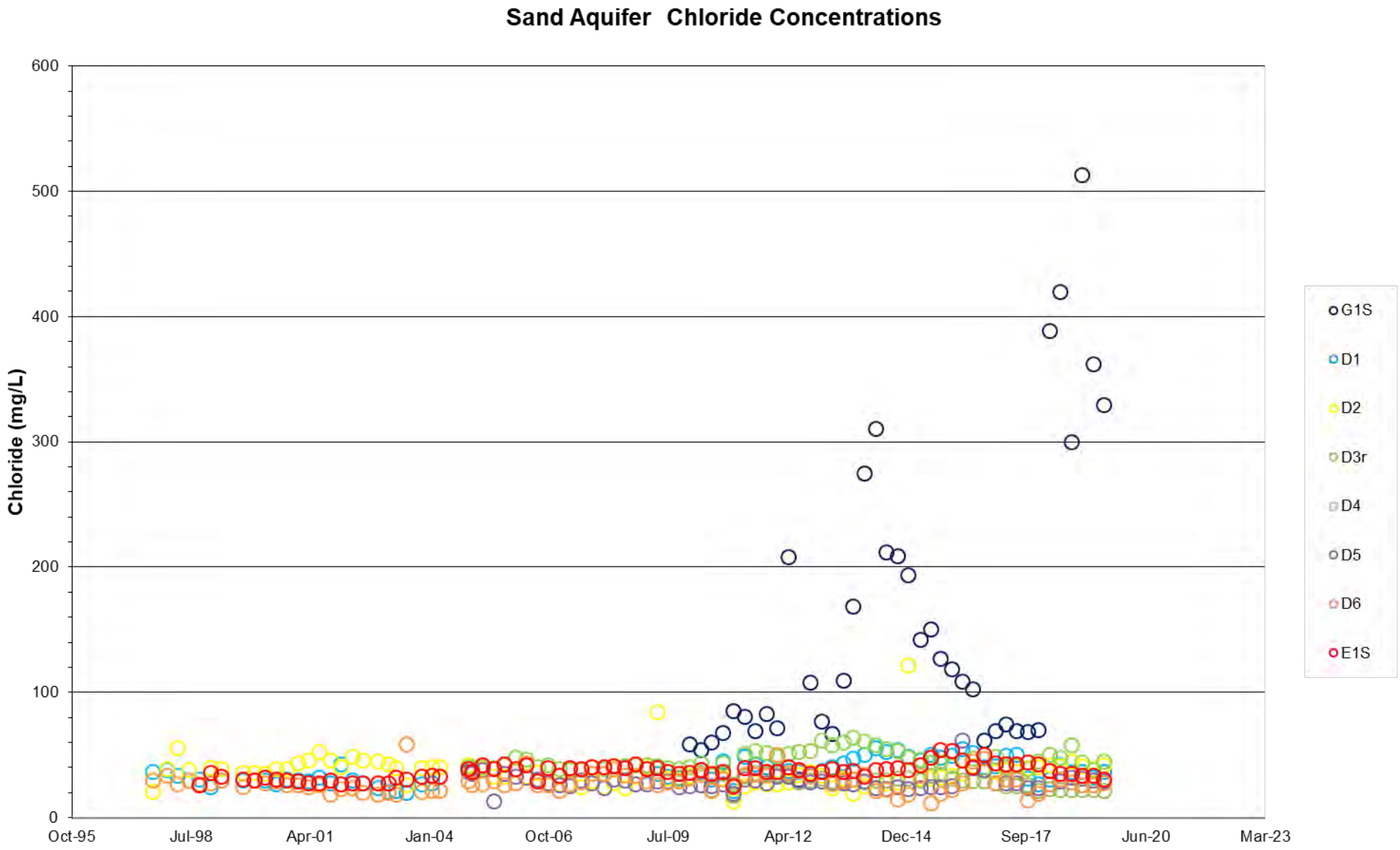
Report Released By

Rob Deacon

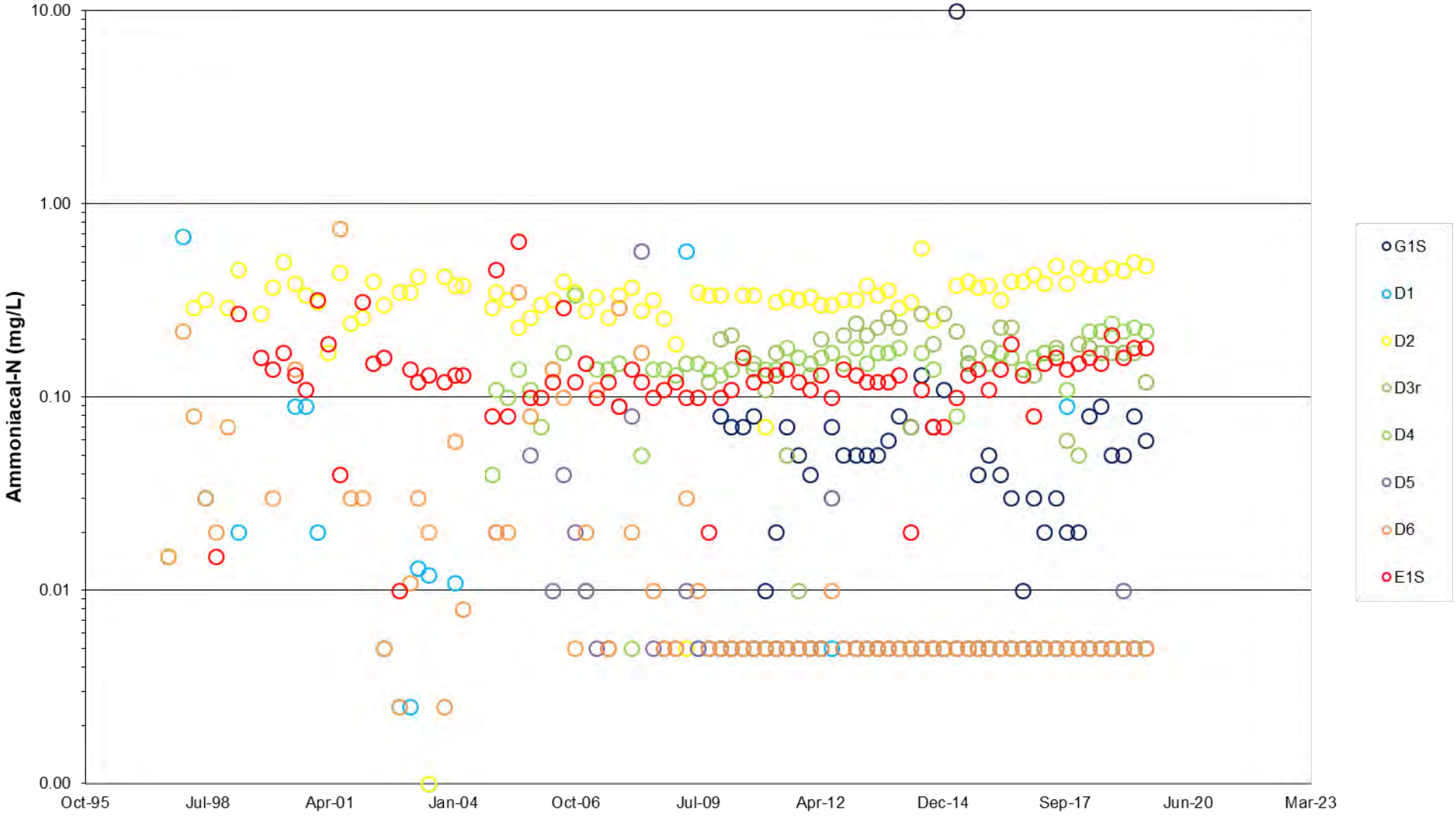
This laboratory is accredited by International Accreditation New Zealand and its reports are recognised in all countries affiliated to the International Laboratory Accreditation Co-operation Mutual Recognition Arrangement (ILAC-MRA). The tests reported have been performed in accordance with our terms of accreditation, with the exception of tests marked "not IANZ", which are outside the scope of this laboratory's accreditation.

Appendix D Historical Result Graphs

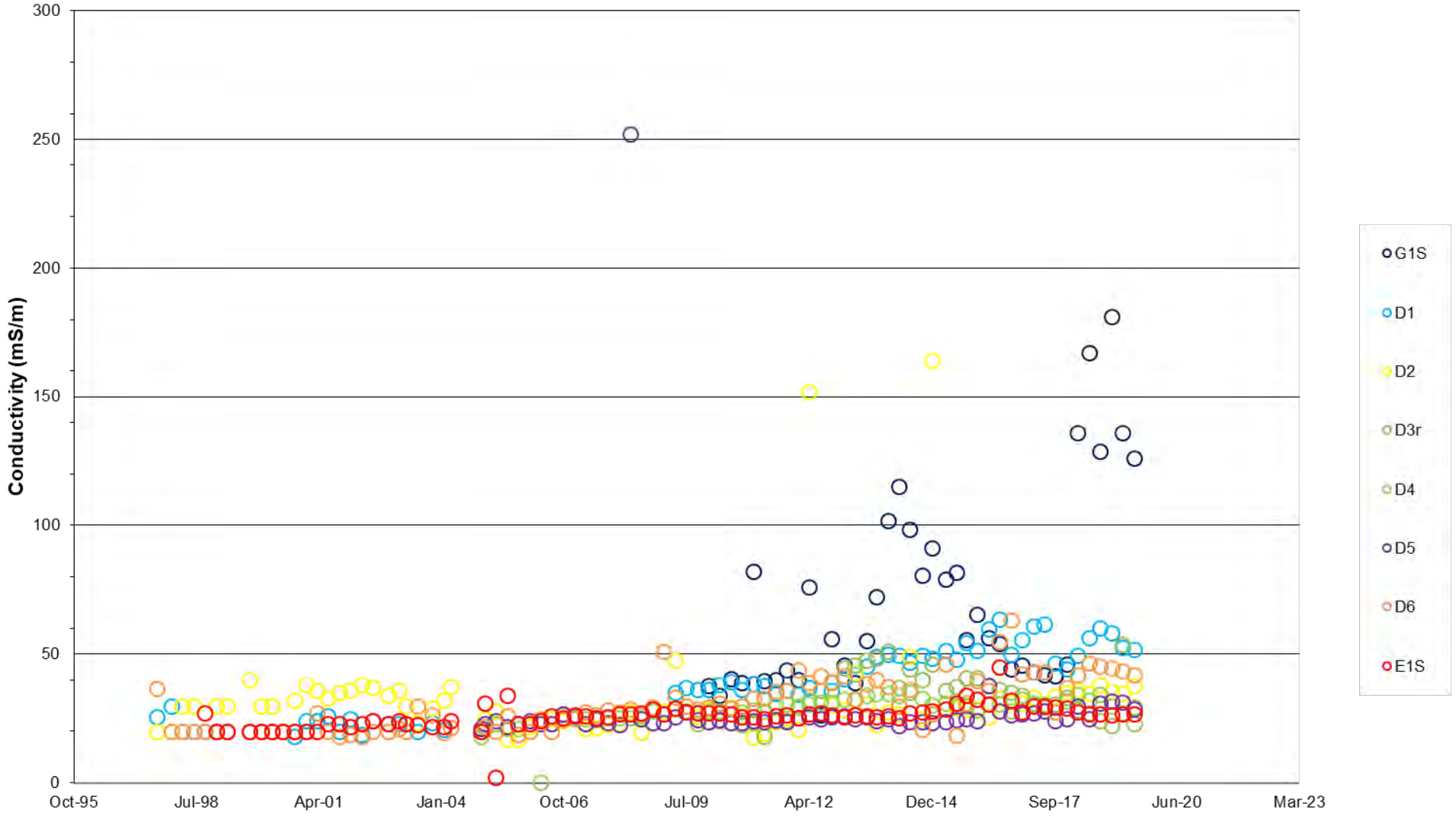

Sand Aquifer Boron Concentrations
Boron (mg/L)
0.600
0.500
0.400
0.300
0.200
0.100
0.000
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
Mar-23
G1S
D1
D2
D3r
D4
D5
D6
E1S

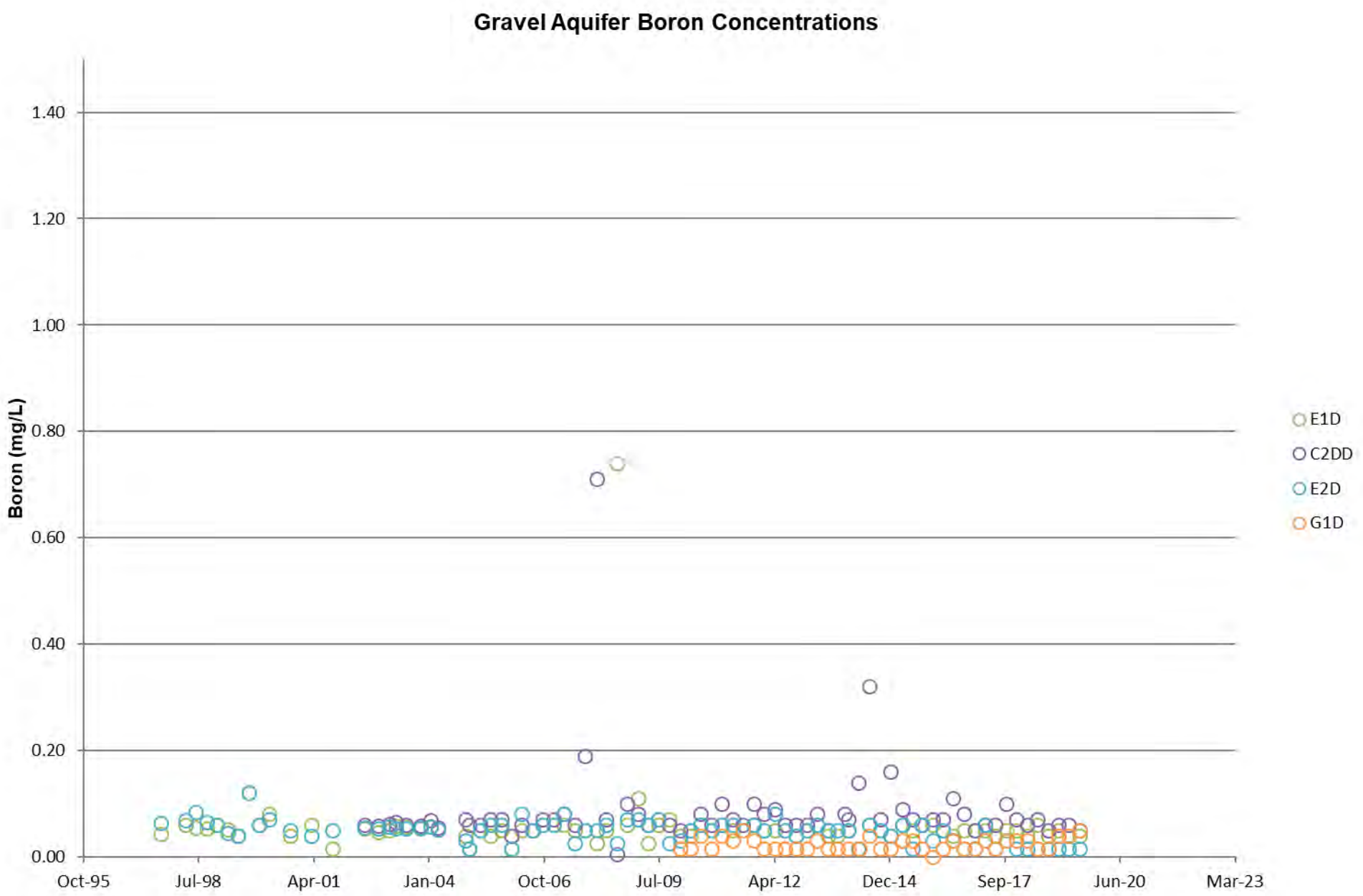

Sand Aquifer Chloride Concentrations
Chloride (mg/L)
600
500
400
300
200
100
0
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
Mar-23
G1S
D1
D2
D3r
D4
D5
D6
E1S

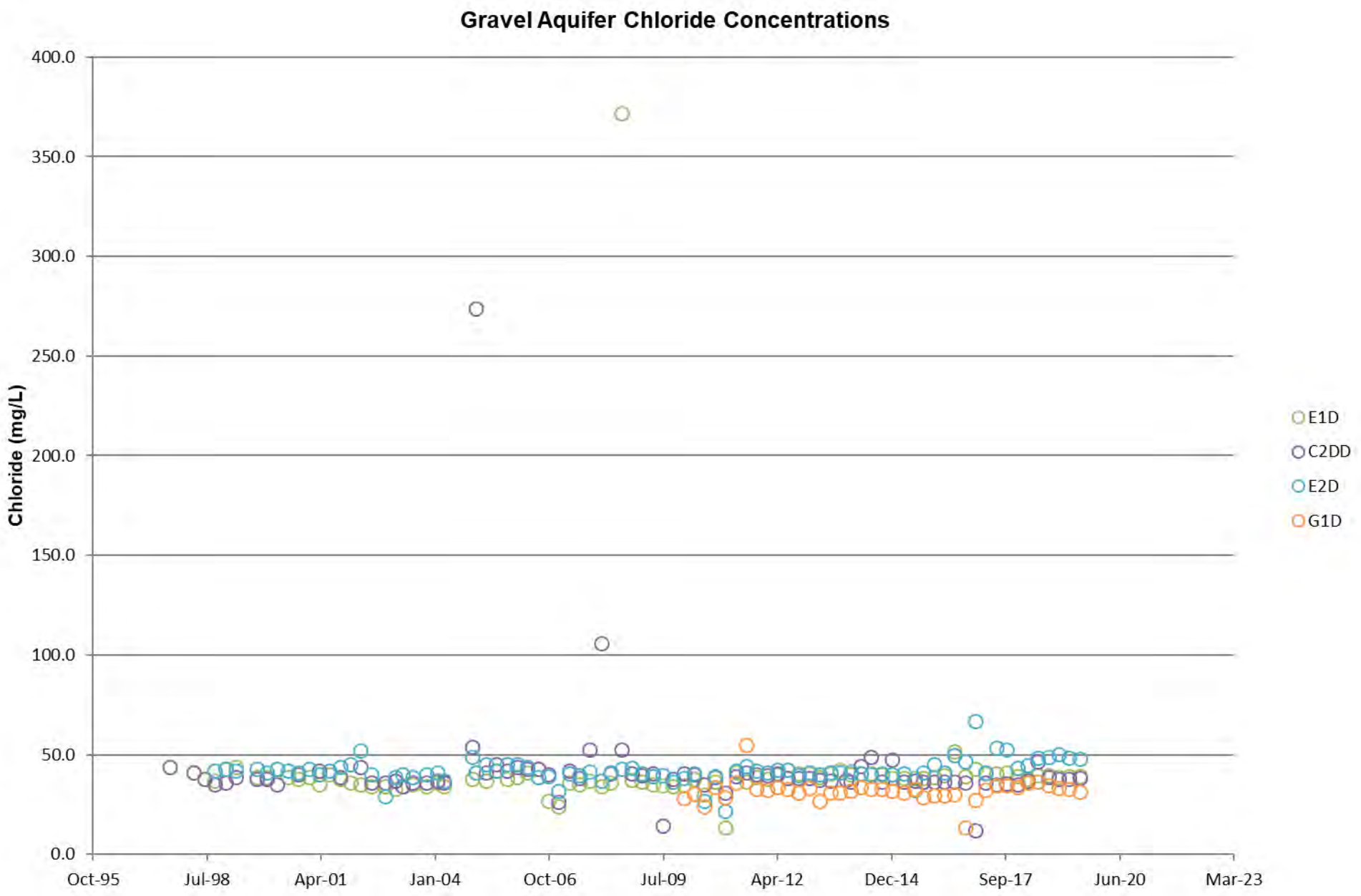
Sand Aquifer Ammoniacal-Nitrogen Concentrations

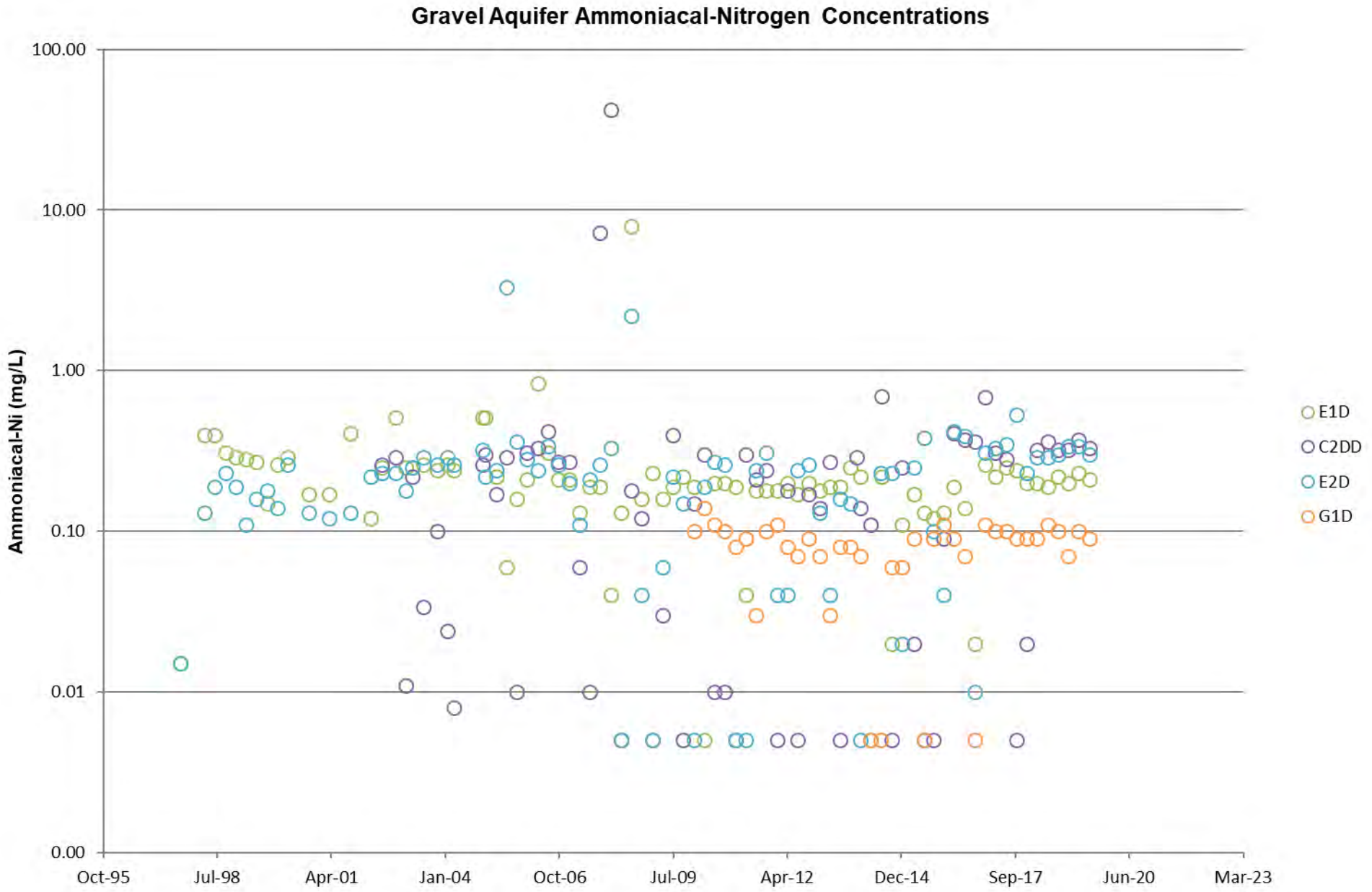


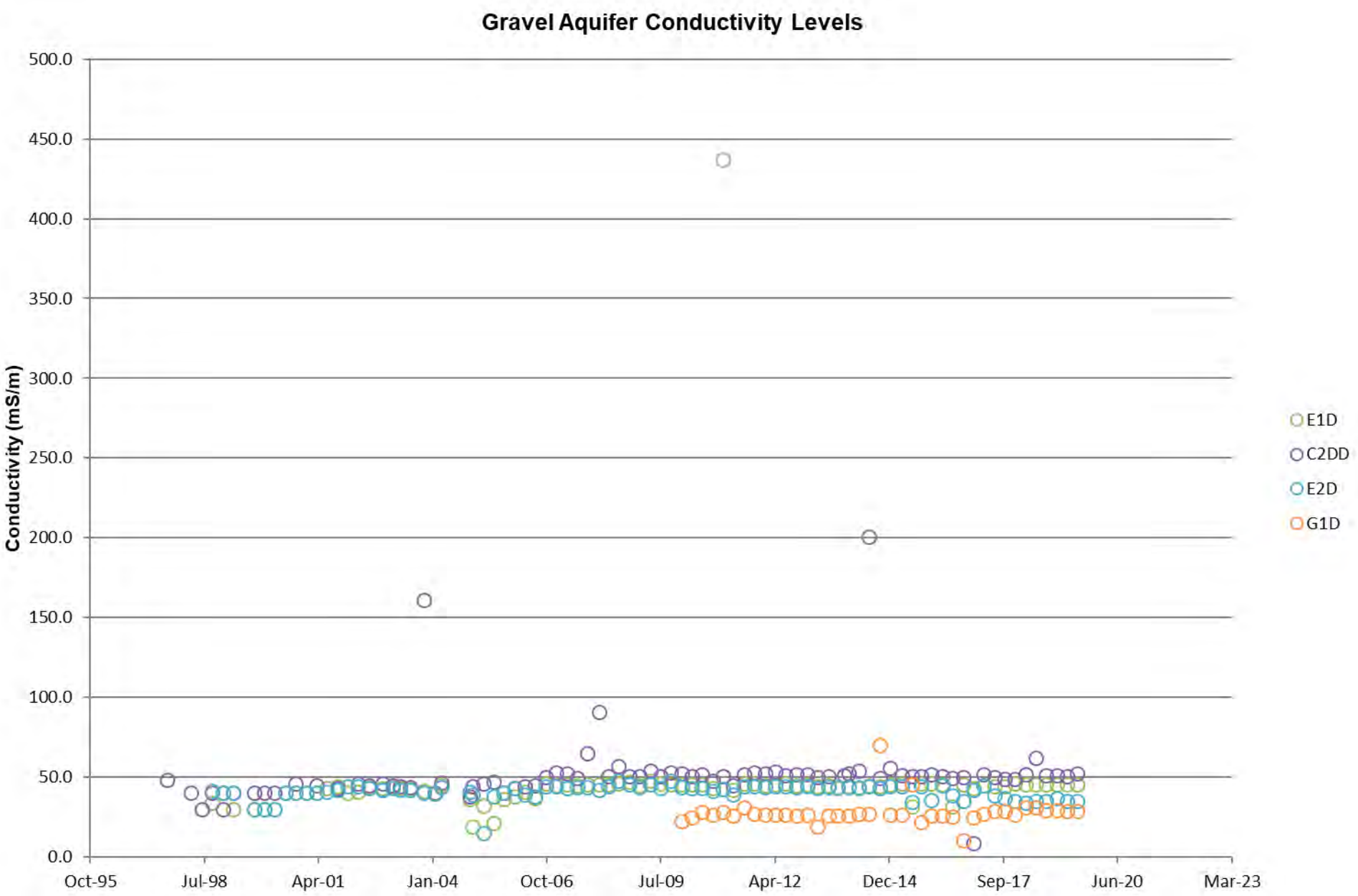
Sand Aquifer Conductivity Levels

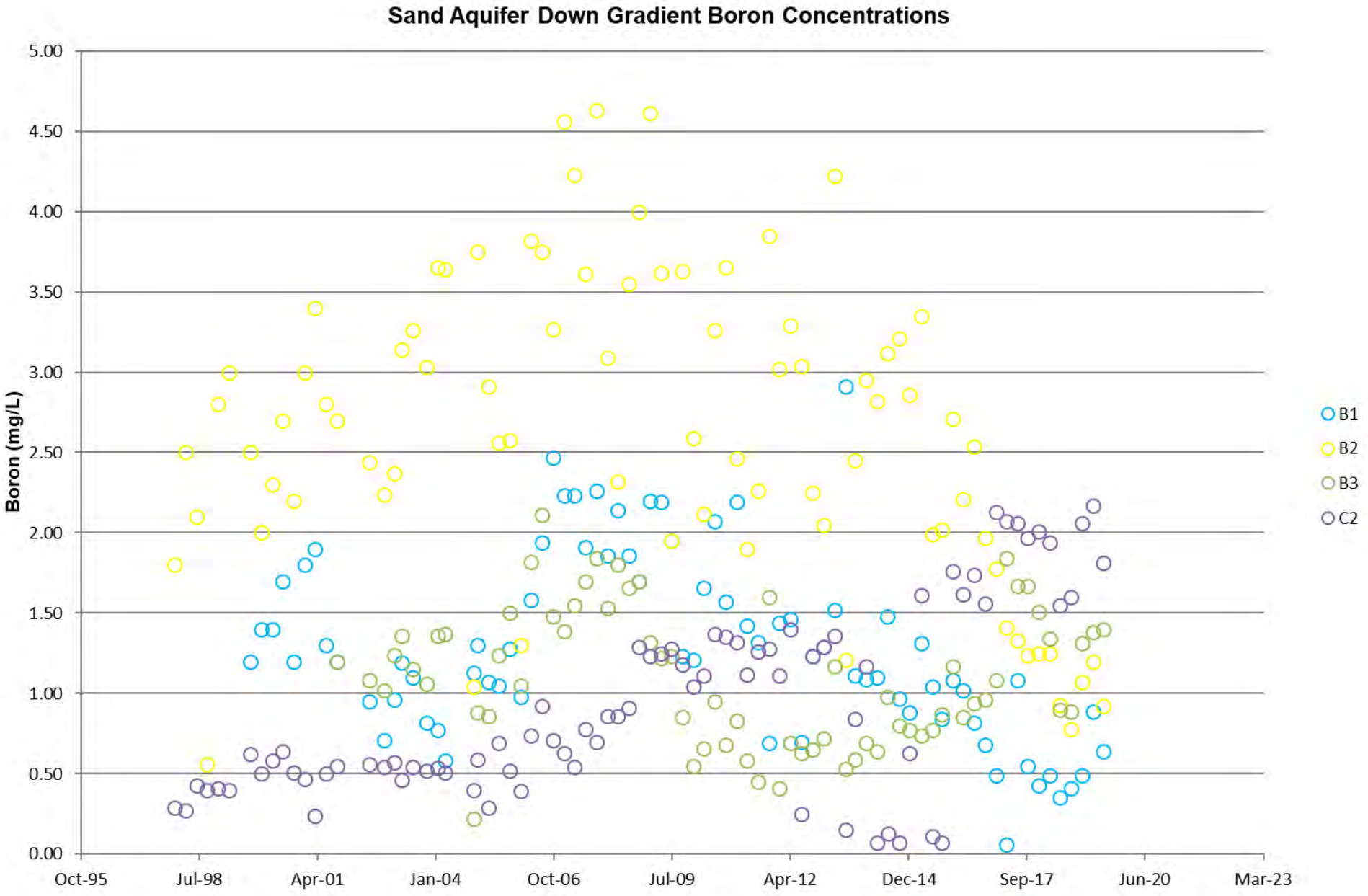


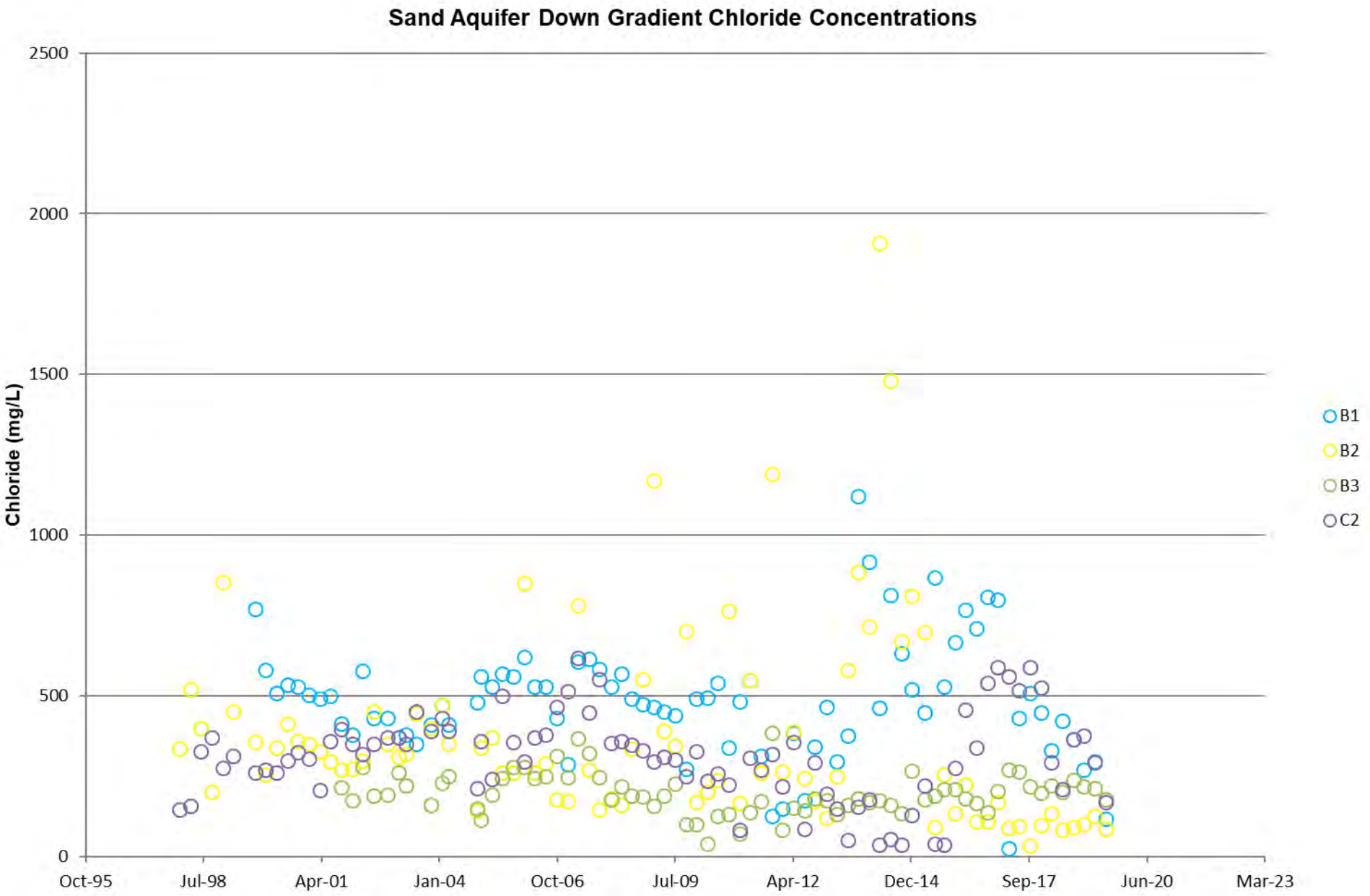

Gravel Aquifer Boron Concentrations
Boron (mg/L)
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
Mar-23
E1D
C2DD
E2D
G1D

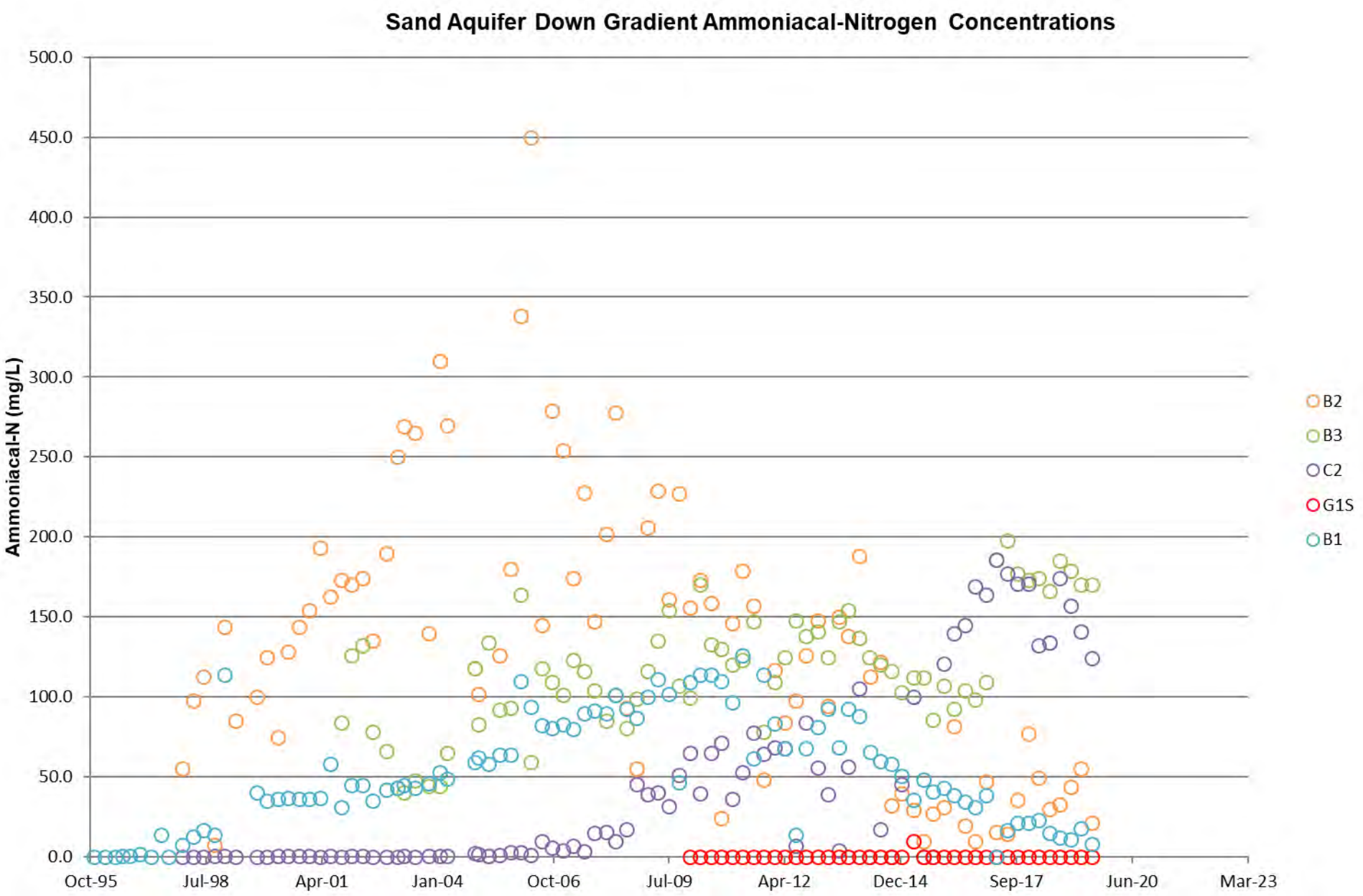

Gravel Aquifer Chloride Concentrations
Chloride (mg/L)
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
Mar-23
E1D
C2DD
E2D
G1D

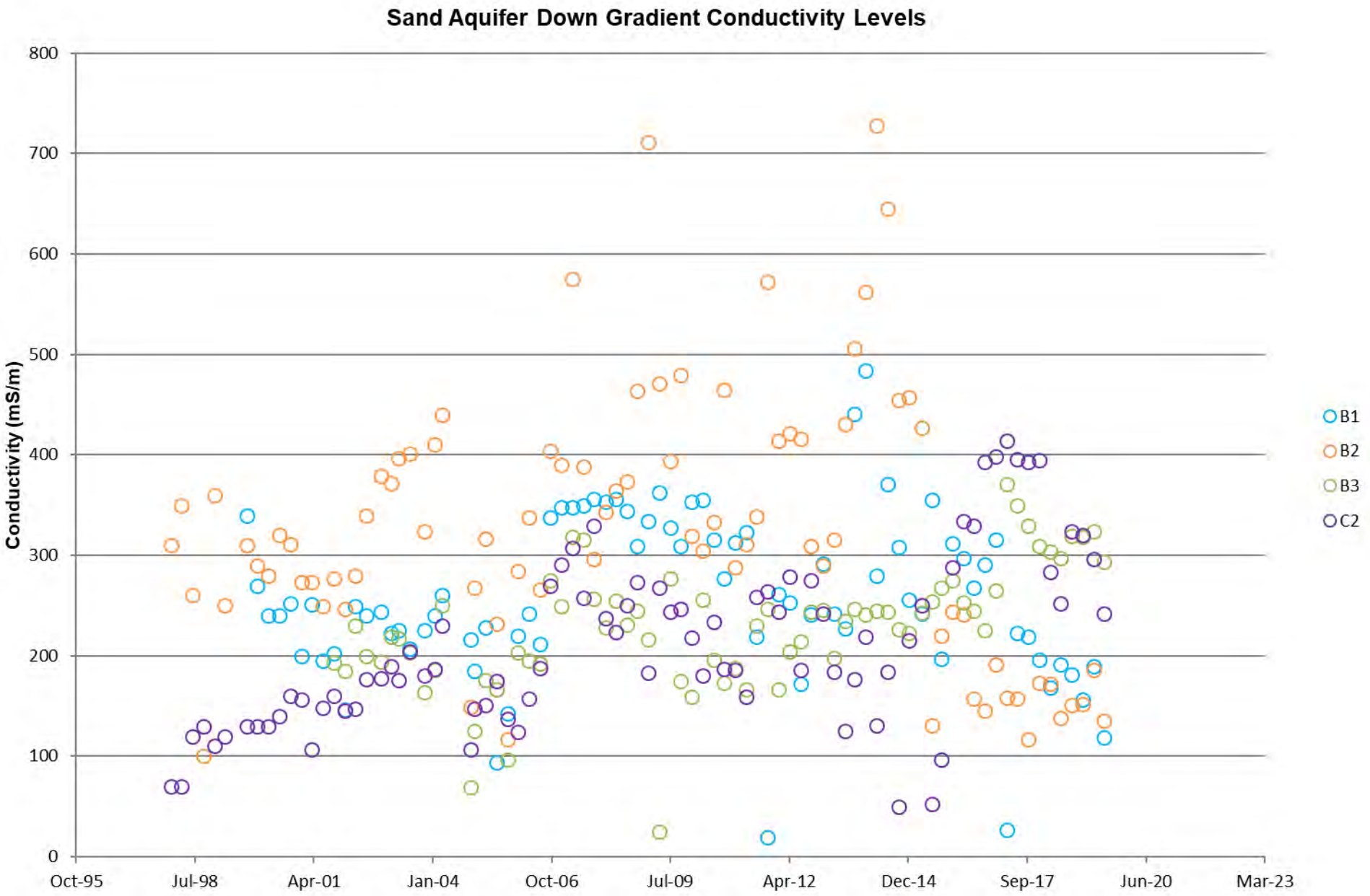

Gravel Aquifer Ammoniacal-Nitrogen Concentrations
Ammoniacal-Ni (mg/L)
100.00
10.00
1.00
0.10
0.01
0.00
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
Mar-23
E1D
C2DD
E2D
G1D

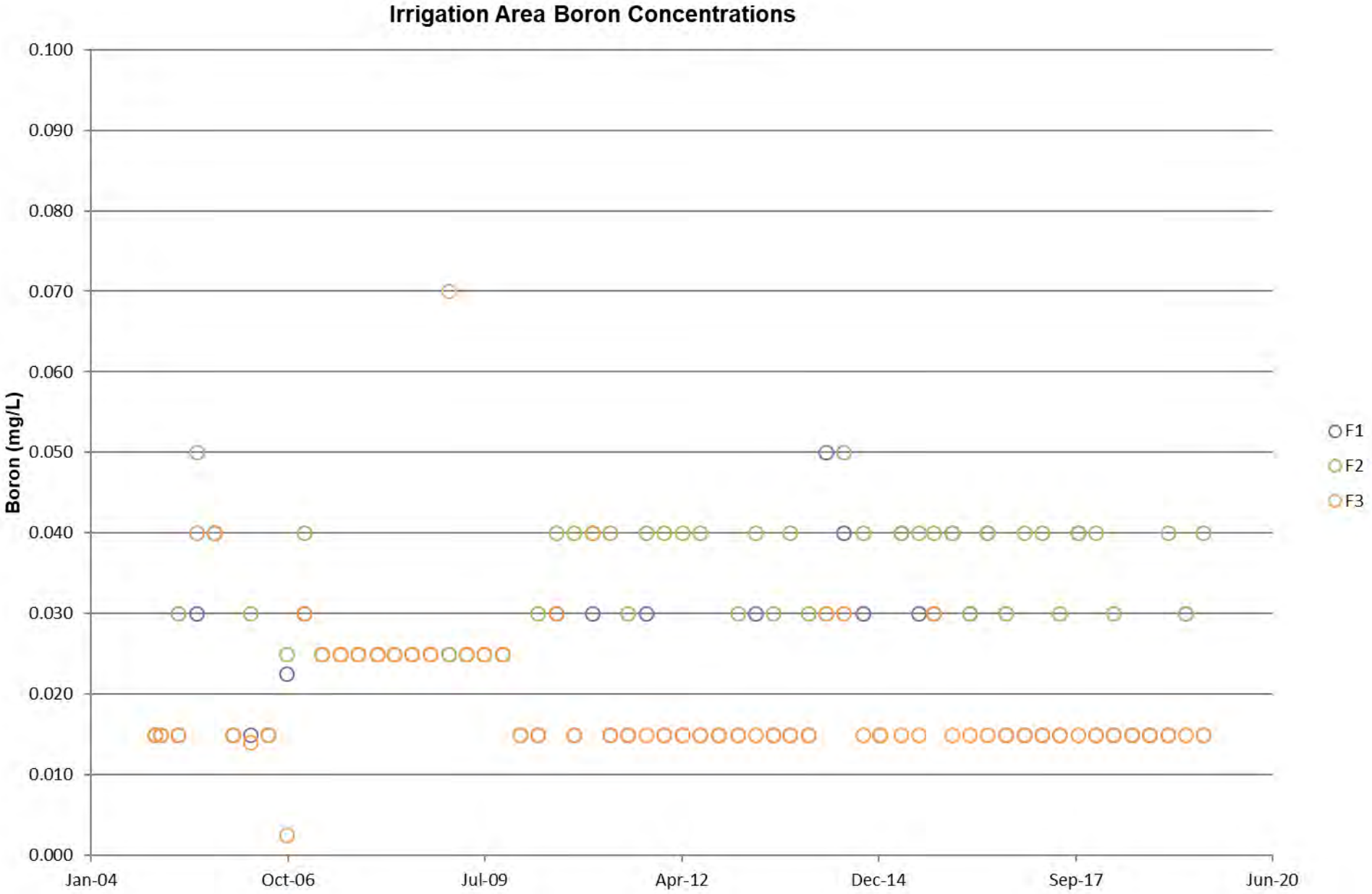

Gravel Aquifer Conductivity Levels
Conductivity (mS/m)
500.0
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
Mar-23
E1D
C2DD
E2D
G1D

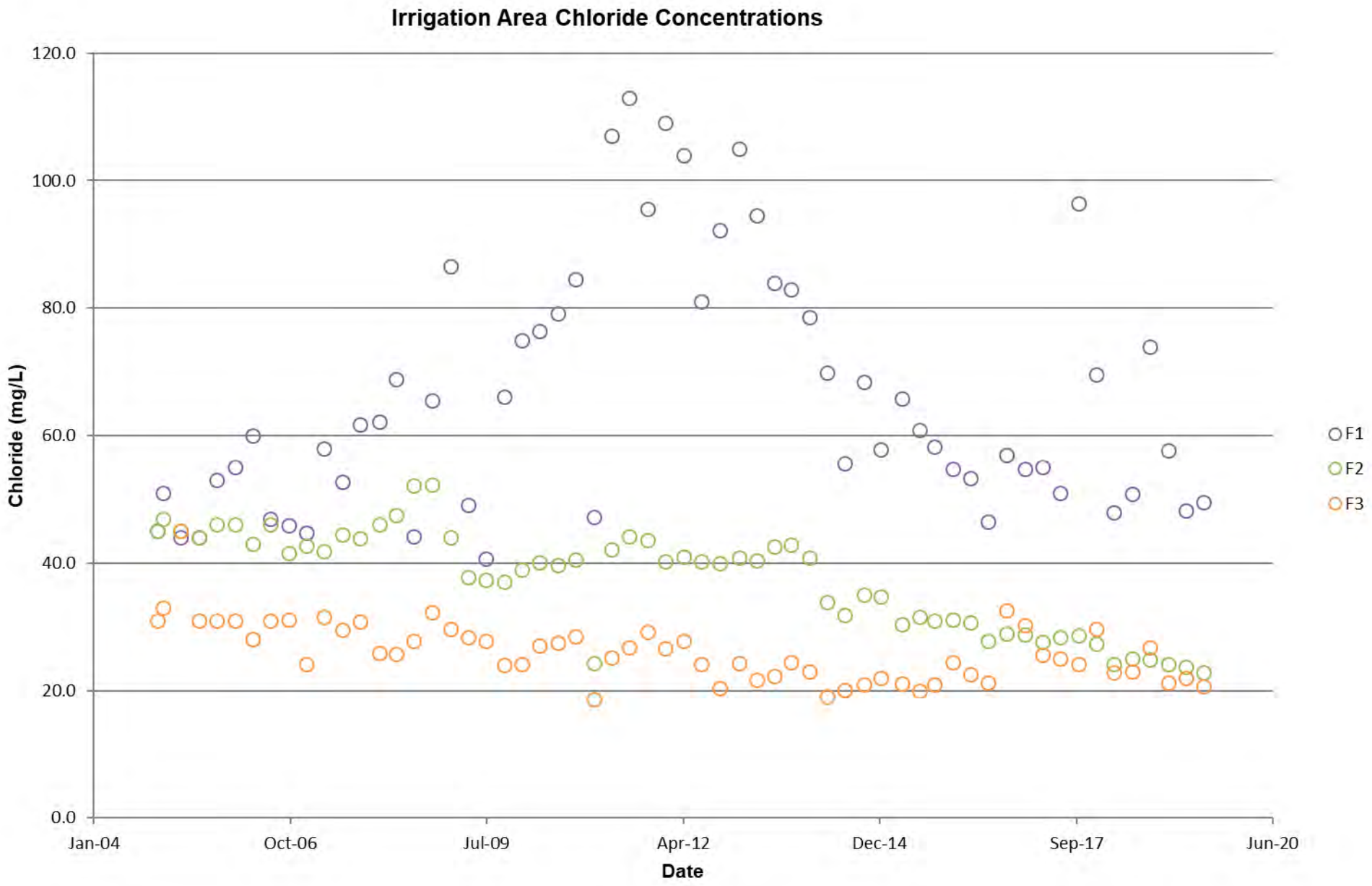

Sand Aquifer Down Gradient Boron Concentrations
Boron (mg/L)
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
Mar-23
B1
B2
B3
C2

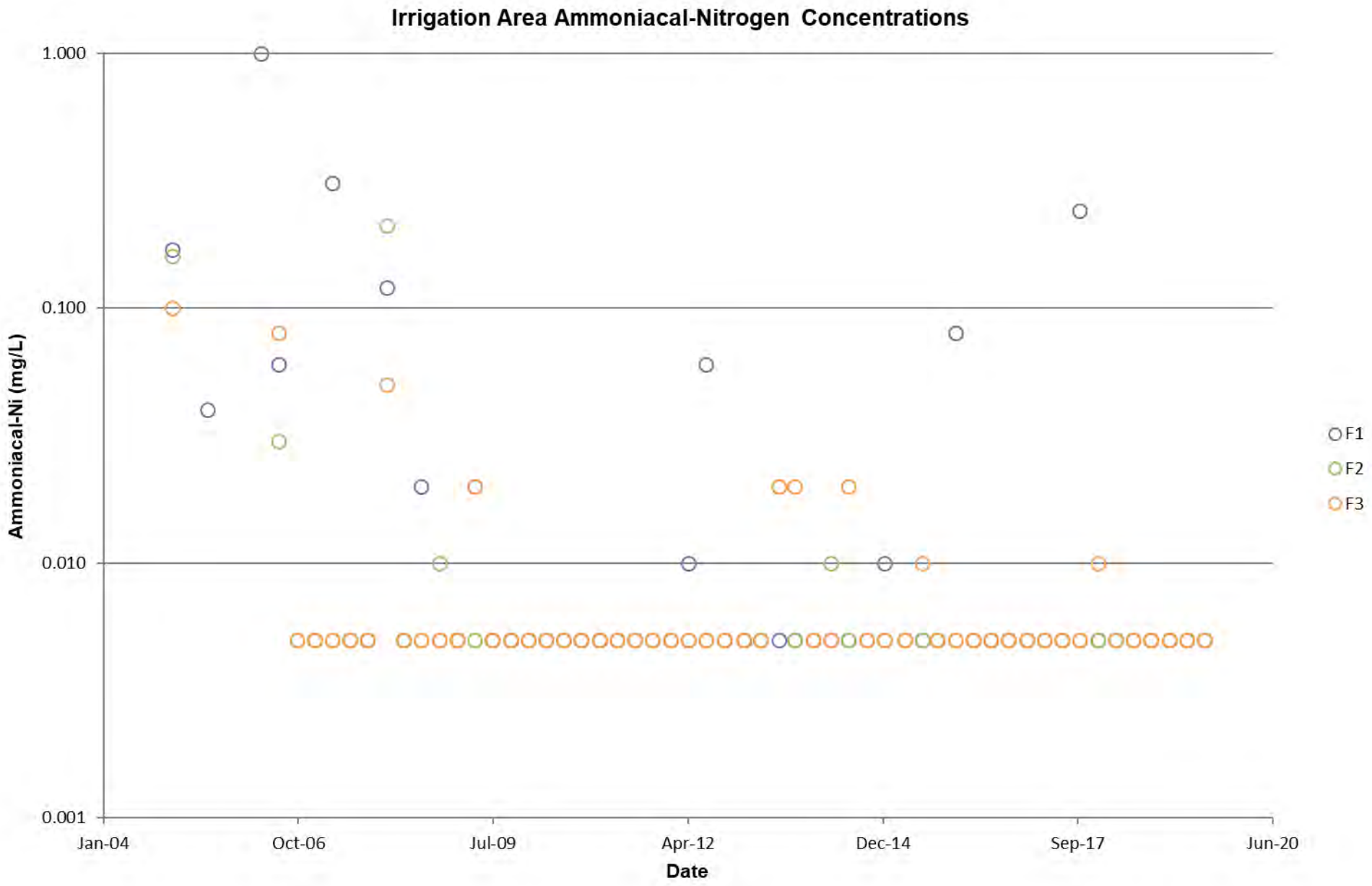

Sand Aquifer Down Gradient Chloride Concentrations
Chloride (mg/L)
2500
2000
1500
1000
500
0
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
Mar-23
B1
B2
B3
C2

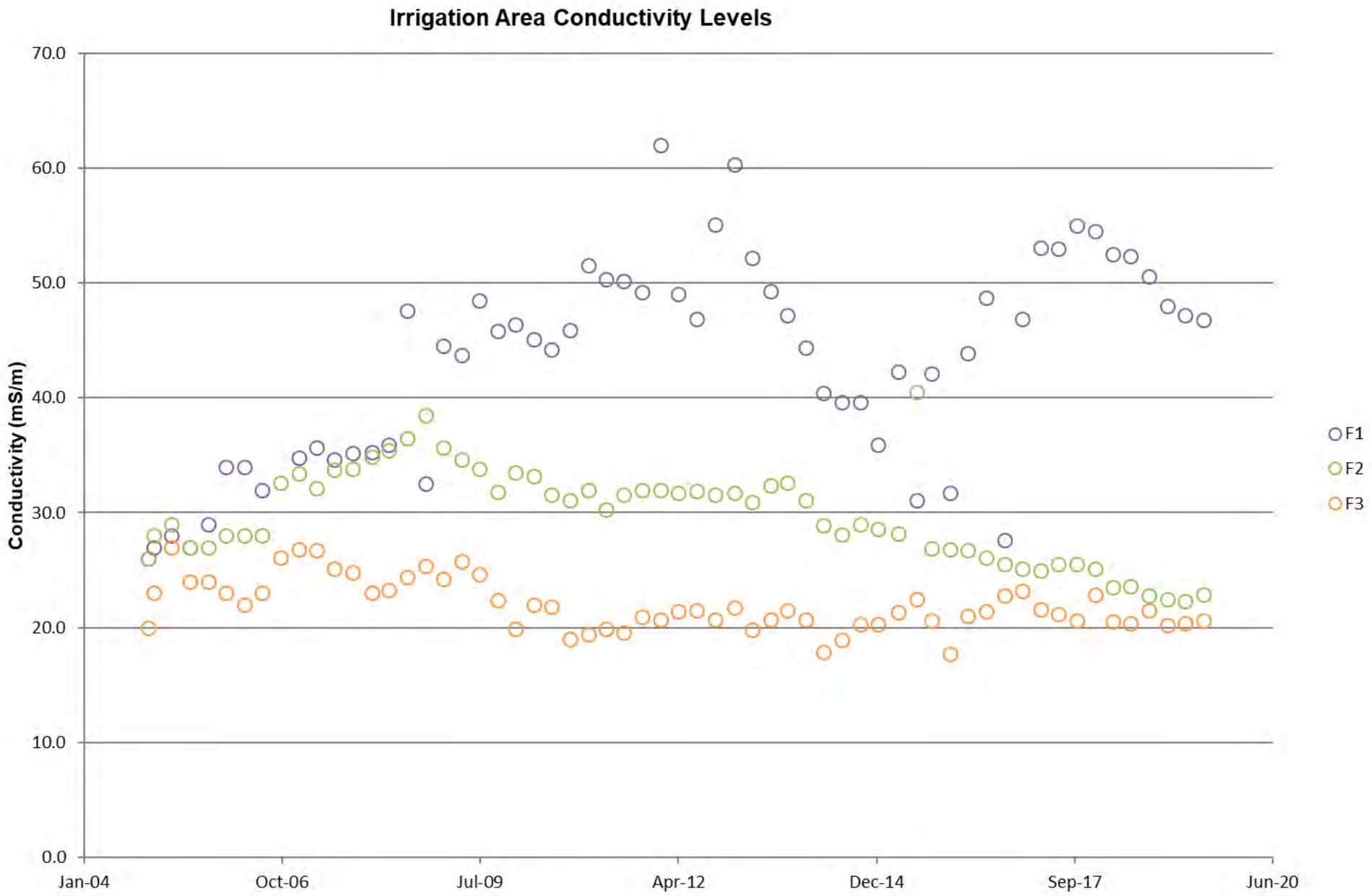

Sand Aquifer Down Gradient Ammoniacal-Nitrogen Concentrations
Ammoniacal-N (mg/L)
500.0
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
Mar-23
B2
B3
C2
G1S
B1

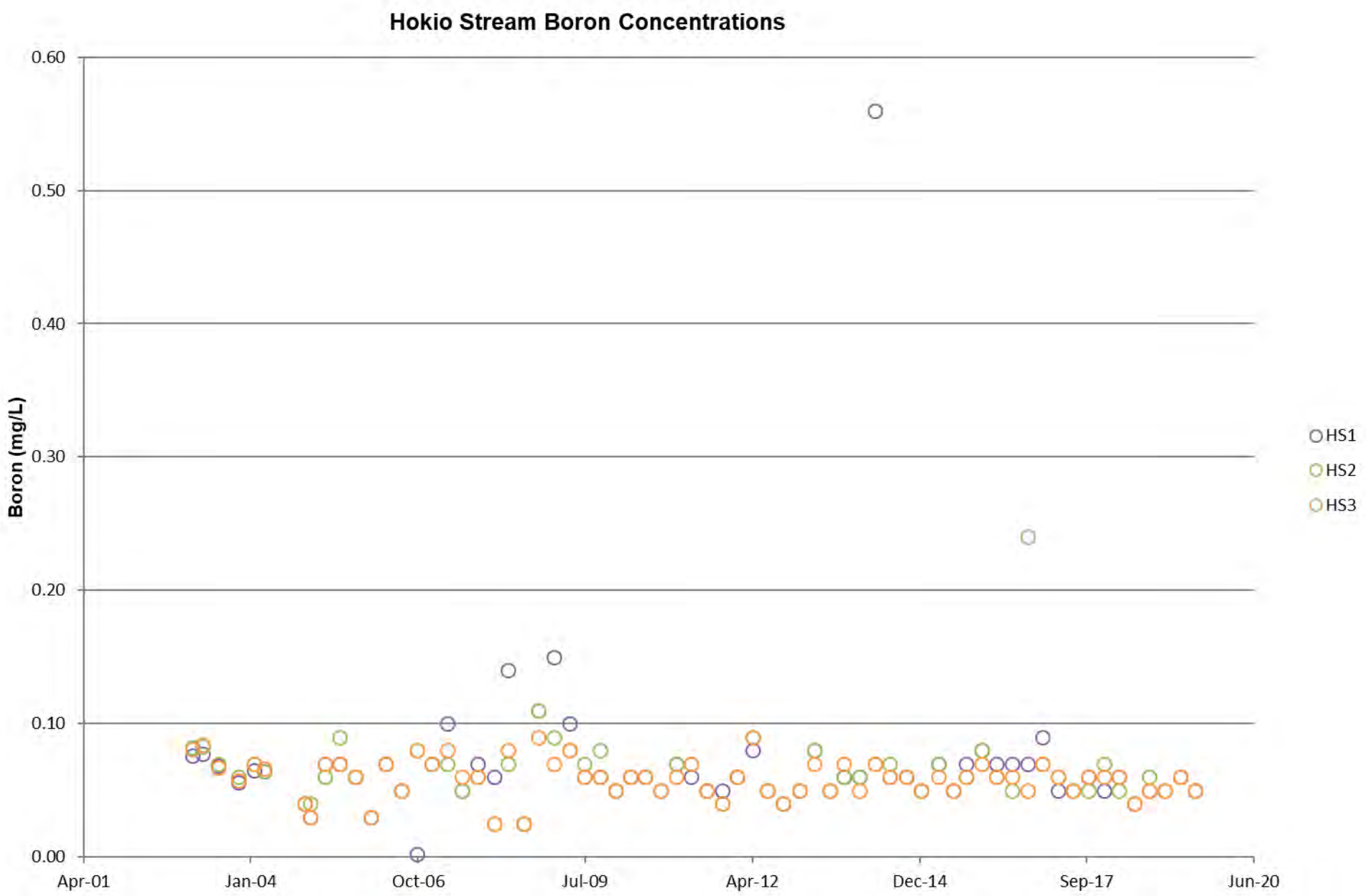

Sand Aquifer Down Gradient Conductivity Levels
Conductivity (mS/m)
800
700
600
500
400
300
200
100
0
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
Mar-23
B1
B2
B3
C2

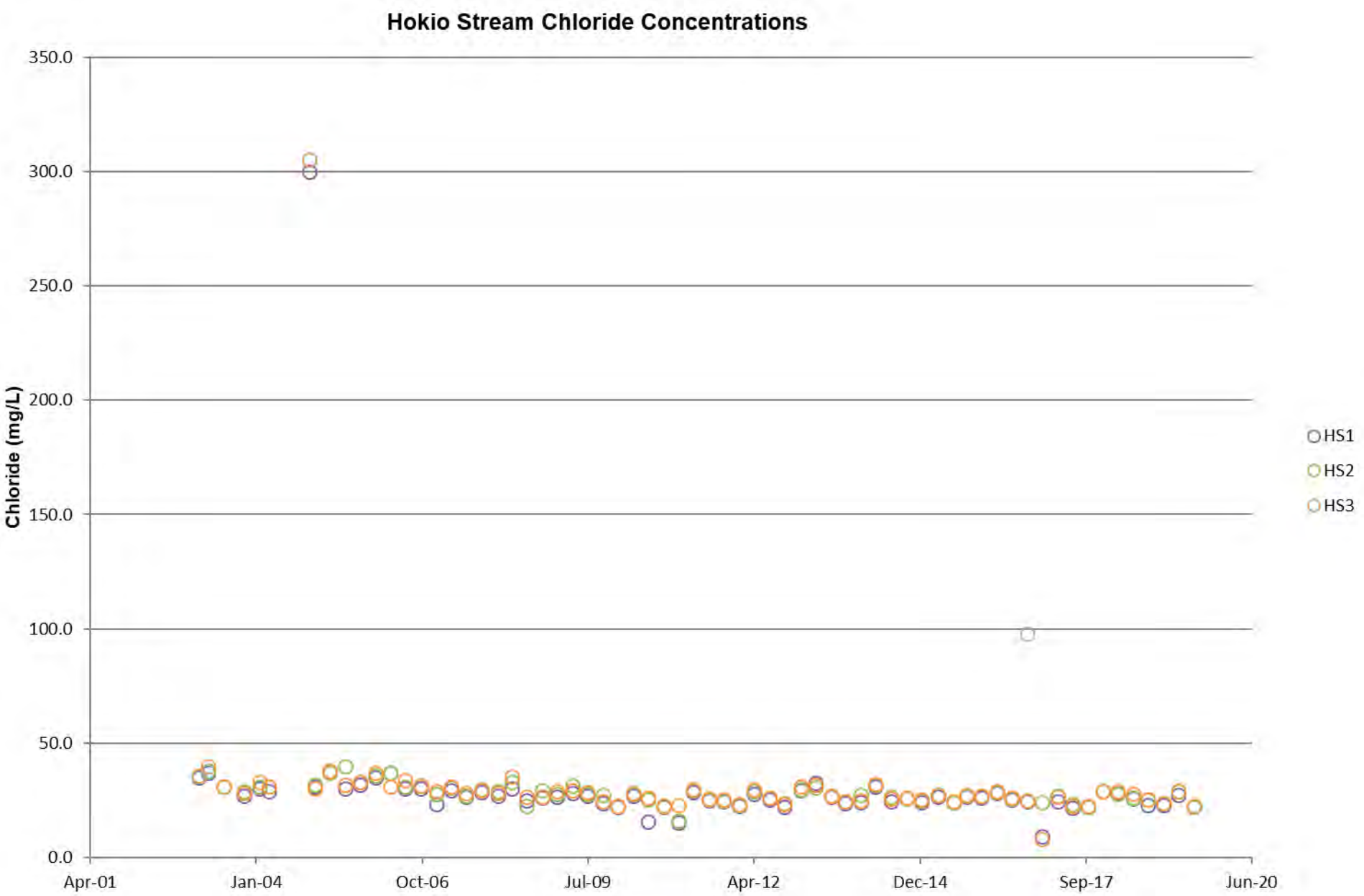

Irrigation Area Boron Concentrations
Boron (mg/L)
0.100
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
F1
F2
F3

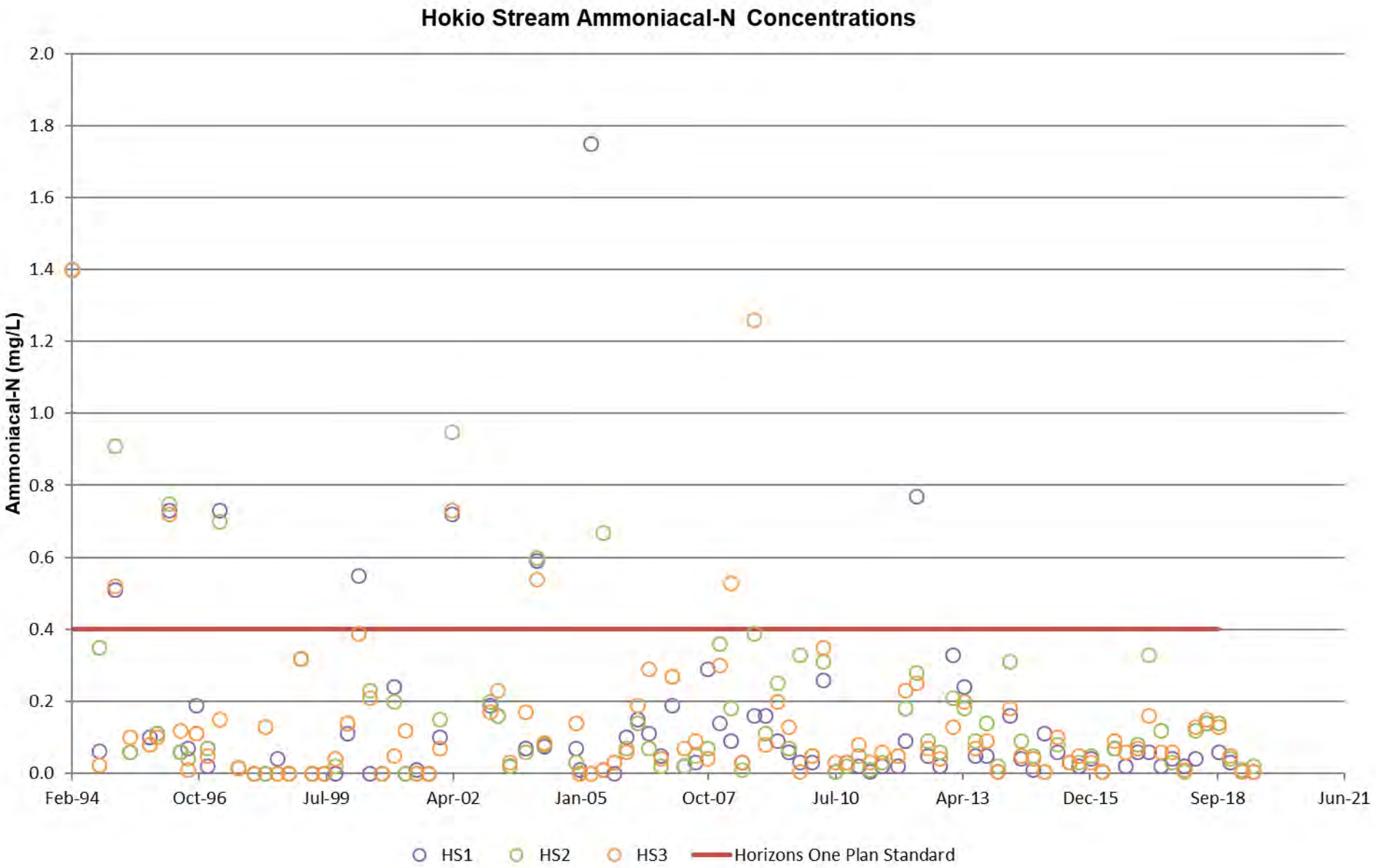

Irrigation Area Chloride Concentrations
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Chloride (mg/L)
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
Date
F1
F2
F3

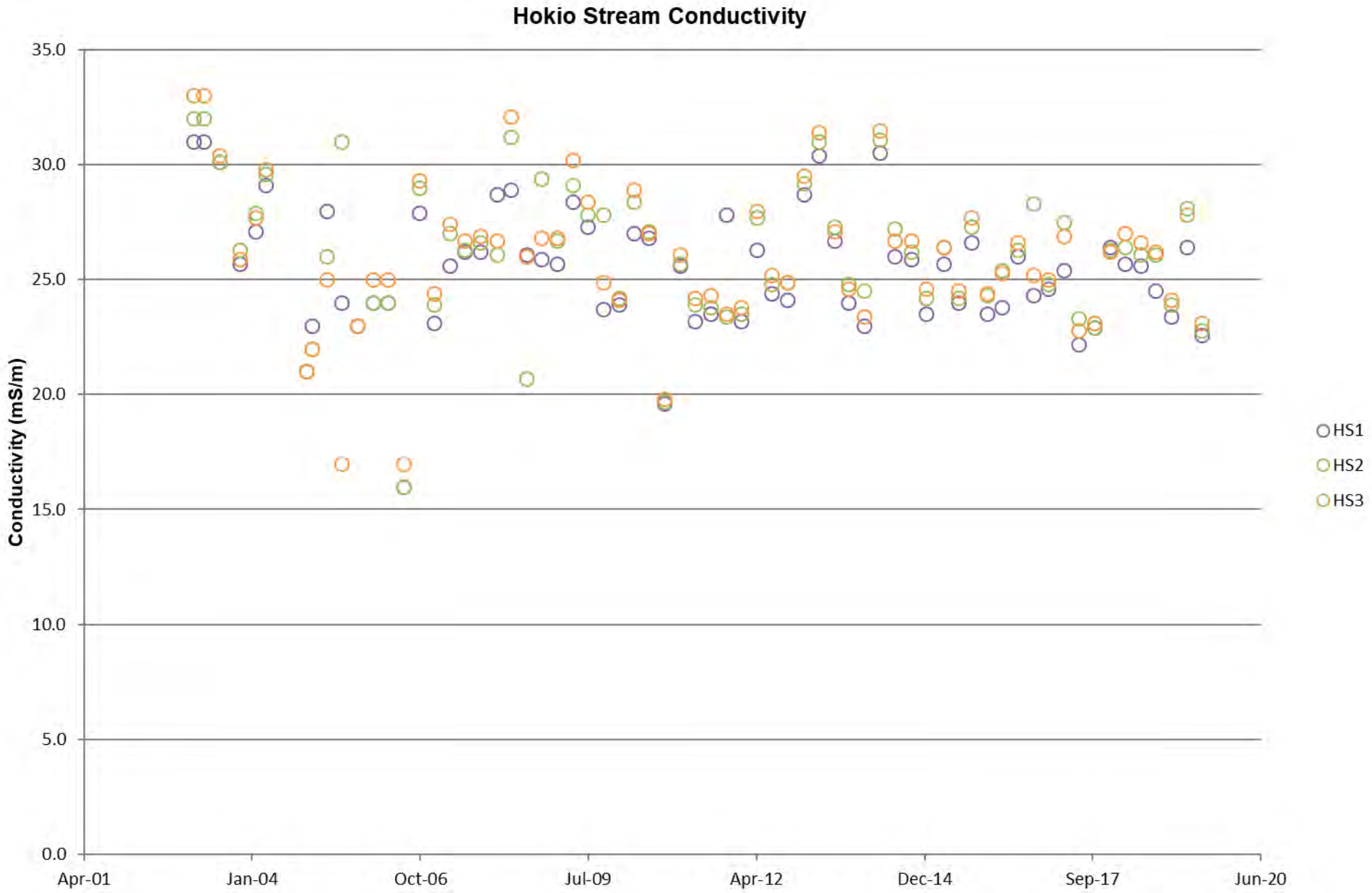

Irrigation Area Ammoniacal-Nitrogen Concentrations
1.000
0.100
0.010
0.001
Ammoniacal-Ni (mg/L)
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
Date
F1
F2
F3


Irrigation Area Conductivity Levels
Conductivity (mS/m)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
F1
F2
F3


Hokio Stream Boron Concentrations
Boron (mg/L)
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
HS1
HS2
HS3


Hokio Stream Chloride Concentrations
Chloride (mg/L)
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
HS1
HS2
HS3


Hokio Stream Ammoniacal-N Concentrations
Ammoniacal-N (mg/L)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Feb-94
Oct-96
Jul-99
Apr-02
Jan-05
Oct-07
Jul-10
Apr-13
Dec-15
Sep-18
Jun-21
HS1
HS2
HS3
Horizons One Plan Standard


Hokio Stream Conductivity
Conductivity (mS/m)
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
HS1
HS2
HS3

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