FASSAROE INERT WASTE RECOVERY FACILITY

Fassaroe, Bray, Co. Wicklow

Technical Amendment of Waste Licence to Remove Backfilled Lands from Licenced Area

Detailed Quantitative Risk Assessment

Prepared for: Roadstone Ltd.

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BASIS OF REPORT

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1.0 INTRODUCTION

SLR Consulting Ireland (SLR) has been commissioned by Roadstone Ltd to undertake a quantitative risk assessment in respect of its inert waste recovery facility at Fassaroe, immediately west of Bray Co. Wicklow.

The waste recovery facility is a former sand and gravel pit which is understood to have been worked until the mid-1990s. Thereafter sand continued to be imported to the facility from external sites for processing (washing) up to around 2008. Fines removed by the washing process were deposited on the floor of the former pit and permitted to drain to ground and dry out.

A planning application to provide for the backfilling and restoration of the former pit at Fassaroe using excess soil and stone imported from construction and development sites around the Greater Dublin Area was submitted to Wicklow County Council in July 2008. The development application was approved and the final grant of a 10 year planning permission was issued in March 2009 (Planning Ref. No. 08/1258). The life of the permission was extended by 5 years in early 2019 by way of a Section 42 application to provide additional time to complete restoration works and remove / surrender the restored lands from the licensed site area.

Backfilling of the former pit commenced some years later, following grant of a waste licence in respect of the activity, by the Environmental Protection Agency (EPA) in April 2011 (Licence Ref. W0269-01). Backfilling and restoration of the former pit to pre-development ground levels was recently completed in early summer 2020 and the site has been restored to grassland. The site layout in 2019, prior to final restoration works, is shown in an aerial photograph in Figure 1.

The lowest final floor level of the former pit is understood to have been around localised sumps in the pit floor, at approx. 68mOD. The EIA submitted in support of the waste licence application (in 2009) reported that the final floor level for the pit was 70mOD and that the final restored ground level would be just below 90mOD.

A cross-section through the backfilled pit is presented in the Conceptual Site Model in Figure 2. It shows that the surveyed (ie. recorded) pit floor level back in 2008, prior to commencement of soil backfilling activities was typically around 75mOD. It is inferred on this basis that following cessation of extraction activities, fines generated by on-site sand washing activities deposited across the former pit floor could be up to 5m deep.

This report presents an assessment of the long-term impact of the backfilled pit on local groundwater, surface water and human health receptors.

1.1 Objectives

The objective of this assessment is to demonstrate that the backfilling and restoration of the former pit at Fassaroe has met the requirements of the EC Groundwater Regulations, 2010 (as amended) and that it achieves the environmental objective outlined within the European Water Framework Directive (WFD) and European Groundwater Directive (GWD), namely:

- prevent (in the case of hazardous substances) and limit (in the case of non-hazardous substances) the input of pollutants into groundwater and prevent the deterioration of the status of all bodies of groundwater

An initial assessment of the potential long-term impact of the backfilled pit on human receptors has also been undertaken.

1.2 Legislative Background

The requirement to assess or monitor potential pollution impacts on groundwater is outlined within the Environmental Protection Agency (EPA) *Guidance on the Authorisation of Discharges to Groundwater (2011)*. This guidance aims to ensure that development sites meet the requirements of the European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010) (as amended, the 'Groundwater Regulations'), the Water Framework Directive (2000/60/EC) and the Groundwater Directive (2006/118/EC).

This report follows the structure outlined within the *EPA Template for Hydrogeological Reviews / Technical Assessment Reports* and has also had regard to the following technical guidance:

- Environmental Protection Agency (2011) *Guidance on the Authorisation of Discharges to Groundwater;* and
- Environmental Protection Agency (2013) *Guidance on the Management of Contaminated Land and Groundwater at EPA Licensed Sites*

1.3 Report Scope

This report outlines the current site setting, conceptual site model (CSM), and a quantitative risk assessment of the potential impact of the recently completed backfilling activities at the former pit at Fassaroe on identified groundwater and surface water receptors.

2.0 ENVIRONMENTAL SITE SETTING

A summary of the environmental site setting of the former pit at Fassaroe is outlined below and includes a review of geological and hydrogeological mapping published by the Geological Survey of Ireland (GSI).

2.1 Soils and Subsoils

Prior to development, much of the footprint of the former pit was underlain by shallow well drained mineral soils, which are classified as grey brown podzolics. These soils were derived from glaciofluvial subsoil parent material which underlies the site.

The subsoils (Quaternary drift deposits) occurring beneath the entire site at Fassaroe comprise glaciofluvial sand and gravels derived mainly from Carboniferous Limestones. From a review of published topographic and geological maps, it is expected that the sands and gravels are laterally extensive to the north and west and had an original thickness in excess of 30m thick. Due to the relatively steep topography it is also expected that this sand and gravel has a thick unsaturated zone.

2.2 Solid Geology

The superficial deposits under the licensed site and surrounding area are underlain by bedrock of the Maulin Formation and the Glencullen River Formation. The published geological map of the area shows that these formations are part of the Ribband Group and are of Lower Ordovician age. The Maulin Formation comprises of slates, phyllites and schists whilst the Glencullen River Formation comprises tuffs and greywacke.

2.2.1 Local Geology

Seven groundwater monitoring boreholes have been installed across the licensed site since 2008. These have been used to characterise the nature of the quaternary drift deposits beneath the site. None of the boreholes encountered the underlying bedrock.

Three wells (designated BH1, BH2 and BH3) were initially installed across the site in December 2008 to depths of 21m (BH1), 24m (BH2) and 30m (BH3). Of the three wells, BH1 and BH2 were downgradient of the then open pit while BH3 lay upgradient. In general, over the installation depths, the monitoring wells encountered sand and gravel overlying gravelly sand with localised clayey horizons.

BH1 was replaced by a deeper well (BH4) in November 2011. The drillers logs for this replacement well encountered notably more clayey horizons within the soil profile than had been recorded in the original three wells.

An additional four boreholes were installed in the Spring of 2017 following cessation of soil waste intake. Two of these wells, down gradient of the backfilled pit, designated BH6 and BH7, were installed to depths of 30m. Of the two installed up-gradient of the pit, one, designated BH5, was installed to 30m depth, while the other, designated BH8, was installed to 40m depth (note that BH8 was identified on drilling logs as BH3A at the time of its installation but was subsequently renamed). These wells generally encountered intermixed sandy gravel, gravelly sand and poorly sorted sand over their full depth.

As no groundwater samples were recovered in wells BH2 and BH7 in mid-2017, two deeper replacement wells, identified as BH2A and BH7A, were installed in September of that year to depths of 43m and 49m respectively. These wells generally encountered similar ground conditions to those in the wells they replaced.

Well installation details, based on drillers / site records are presented in Appendix 01, together with a plan showing the well location and construction (level) details.

2.3 Hydrogeology

2.3.1 Aquifer Characteristics and Properties

The published geological memoir for the region reports that sands and gravels cover a significant part of this region of Ireland and can be developed to provide reasonable water supplies. There are no groundwater well records identified by the GSI in the gravel aquifer downgradient of the licensed site, and all local residences are understood to be supplied by mains water.

The Quaternary strata play an important role in the groundwater flow regime of this region. The sands and gravels allow a high level of recharge, provide additional storage to the underlying bedrock aquifers and, where sufficiently thick, can be an aquifer in their own right. Well yields for the sand and gravel deposits are typically between 100m^3/d and 3000m^3/d.

The published geological memoir indicates that the bedrock hydrogeology in this region of Ireland is dominated by secondary fissure permeability. This is the case for both the Maulin Formation and Glencullen River Formation, which are considered to be aquitards. The bulk permeability of both bedrock formations is low, with groundwater storage and movement constrained to the upper weathered horizons of this unit and fractures / faults. Well yields in the bedrock are generally only sufficient for domestic or farm supplies and range from 20m^3/d to 50m^3/d, except along faults where they may be in excess of 200m^3/d.

The licensed site is located above a locally important sand and gravel aquifer, which is extensive to the north and west of the licensed site boundary. The published subsoil map shows the extent of the sand and gravel deposit locally. The site is located towards the south of the eastern spur of the Enniskerry GWB sand and gravel aquifer, which is described in more detail below. The Enniskerry GWB is underlain by the Wicklow GWB, which includes the poorly productive bedrock underlying the site.

Groundwater vulnerability maps indicate that the site is located within an area having High Groundwater Vulnerability status. The groundwater vulnerability reflects the high recharge infiltration into the sand and gravel deposits.

Groundwater in the sand and gravel aquifer was not intercepted or lowered by the former pit workings. Surface water ponding that previously occurred across the quarry floor was perched above the water table, over layers of silt and clay generated by sand and gravel processing (washing) activities at the site. It is estimated that the silt and clay ranges from 1m up to 5m in thickness.

Enniskerry GWB

The GSI has issued an initial characterisation for the Enniskerry GWB, which has an area of 11.17km^2 and is classified as Lg: Locally Important Gravel Aquifer. This aquifer is located in North Wicklow and centred around Enniskerry village. The GWB straddles several valleys and is surrounded by hills with elevations rising to over 300mOD, whereas within the groundwater body itself, the highest elevations are around 200mOD. The land generally slopes east (towards Enniskerry) with the lower elevations at 50mOD to 100mOD.

Though permeability testing data are limited, productivity, borehole logging and quarry data tend to indicate that coarse material predominates and that the permeability and storativity in the aquifer are high. LandSim default values suggest a typical hydraulic conductivity of between 9x10^{-7}m/s to 3x10^{-2}m/s for coarse sands and gravels. While no specific values are available for the Enniskerry GWB, assessments completed on the Pollardstown Fen sands and gravels, located approximately 45km west of the site, indicate typical permeabilities of between 22m/d and 33m/d (equivalent to between 2.55x10^{-4}m/s and 3.82x10^{-4} m/s)[1].

[1] Mistear, B.and Brown, L. Water Framework Directive : Recharge and Groundwater Vulnerability, Final Report, Report Ref. 2002-W-MS/16, Environmental Protection Agency, Wexford

By definition[2], the locally important aquifer at this location must be at least 10m thick. Drilling evidence during well installation suggests the thickness of this deposit varies and is in excess of 30m thick across the licensed site.

The GWB is recharged by rainwater percolating through the topsoil and unsaturated sand and gravel deposits. Surface runoff is probably less than 20% of effective rainfall. The presence of less permeable layers in the deposit, even if thin, may create perched water tables and prevent recharge of the true water table. There are no recorded large abstractions from the Enniskerry GWB.

Although the aquifer is permeable, groundwater velocity is slow, because storativity is high and water table elevations are generally subdued. This also means that discharge to rivers will not be flashy and will be sustained through drier periods of the year.

Wicklow GWB

The Wicklow GWB covers a large area within Co. Wicklow and a smaller area of Co. Dublin. The topography of the area is mountainous, comprising the Wicklow and Dublin Mountains. The GWB is composed primarily of low permeability rocks, although localised zones of enhanced permeability do occur.

Groundwater flow occurs mostly in a shallow upper weathered zone; deeper groundwater flow is possible along fractures, joints and major faults. Recharge occurs diffusely through the subsoils and via outcrops. There are large areas where the rock is close to surface, which would suggest high potential recharge values, but calculations must consider the effect of recharge diverted by lower permeability rocks. The aquifers within the GWB are generally unconfined but may become locally confined where the subsoil is thicker and/or of lower permeability.

Groundwater flow is considered to recharge and discharge on a local scale. Drainage density values suggest shorter flow paths in the granites than on the flatter Lower Paleozoics. Groundwater discharges to the numerous small streams crossing the aquifer, to springs and seeps and also directly to the Irish Sea.

2.3.2 Groundwater Levels and Flow

The published geological memoir for the region reports that the groundwater table and the superficial sand and gravel deposits can be relatively deep, with the deposit having a thick unsaturated zone.

As previously noted, groundwater monitoring boreholes have been installed around the perimeter of the former pit. Available well logs indicate that all are likely to be installed within the sands and gravels. The monitoring locations are shown in plan in Appendix 01, with the following locations currently monitored:

- Up-Gradient: BH03, BH05 and BH08
- Down-Gradient: BH02A, BH04, BH06 and BH07A

Backfilling the former pit with relatively low permeability inert soil material has the potential to create a low permeability zone which can alter the pattern of groundwater recharge through the unsaturated soils. The regional permeability of the unsaturated zone of the sand and gravel aquifer is high, which will maintain the regional groundwater flow direction, and runoff from the backfilled pit will most likely recharge to groundwater on the downstream side, thereby maintaining aquifer recharge.

Groundwater in the sand and gravel aquifer was not intercepted by the former pit workings. Ponding that was previously observed on the pit floor was perched above the water table on a deposit of silt and clay that developed from the settling out of fines generated by previous sand and gravel washing activities. The water table occurs at depths of 19m to 21m below the original ground surface level and the indicative groundwater flow direction is towards the east / southeast, following the local topographic gradient. The mapped boundary of the Enniskerry gravel aquifer is located approximately 300m downgradient of the backfilled pit.

[2] Groundwater Protection Schemes, (DELG/EPA/GSI, 1999)

Groundwater level monitoring results obtained between 2017 and 2020 are presented in Table 2-1 below.

Table 2-1
Groundwater Levels (2017 – 2020)

DATE	BH03 (UG)	BH08 (BH03A) (UG)	BH05 (UG)	BH06 (DG)	BH02A (GW2A) (DG)	BH04 (DG)	BH07A (GW07A) (DG)
Ground Level (mOD)	85.088	96.415	88.38	73.969	77.996	74.605	79.593
Approximate Basal Elevation (mOD)	45.0	Unknown	58.0	44.0	35.0	Unknown	31.5
01/06/2017	63.168	62.025	62.418	44.589		41.835	
06/07/2017	63.565	62.636	62.435	45.286		42.704	
17/08/2017	63.775	62.636	62.425			42.634	
26/09/2017	63.755	62.566	62.225		43.915	42.314	41.971
31/10/2017	63.775	62.316	62.195		43.555	42.264	41.651
29/11/2017	63.805	62.236	62.245		43.605	42.304	41.581
22/07/2019	63.845	62.876	62.615		43.705	42.334	42.011
17/10/2019	63.815	62.596	62.455		43.575	41.994	41.771
27/01/2020	63.988	62.715			43.496	42.905	42.153
19/05/2020	63.988	63.625			44.066	42.935	42.313
07/07/2020	63.938	63.555			44.086	42.705	42.143

Assuming that the base of the pit prior to backfilling was around 75mOD, the groundwater level data from the surrounding area suggests a minimum unsaturated zone beneath the floor level of 11.2m (BH3) and a maximum of 33m(BH7a).

A hydraulic gradient of 0.026 towards the southeast has been calculated for the groundwater within the sand and gravel deposits beneath the licensed site, with groundwater falling from elevations of 64mOD on the upgradient side to 42mOD on the downgradient side.

The monitoring data also indicates a saturated aquifer thickness typically between 5m and 15m within the boreholes. It is however noted that none of the boreholes have reached bedrock and therefore the saturated aquifer thickness is potentially greater than this.

2.3.3 Groundwater Recharge

Rainfall in North Wicklow is of the order of 700mm/yr to 1000mm/yr. Potential recharge to the aquifers ranges from 325mm/yr to 550 mm/yr, depending on the elevation and location. The bulk of this recharge occurs between late October and early March. Although the ground wets after rainfall, it drains rapidly. This, coupled with the lack of surface water features across the area, indicates that the sand and gravel aquifer has a high infiltration and that the unsaturated zone has a high permeability.

2.3.4 Groundwater Quality (Pre-Backfilling)

Baseline groundwater samples were obtained for hydrochemical analysis from monitoring wells BH2 (down-gradient of the quarry floor) and BH3 (up-gradient of the quarry floor) in January 2009, prior to commencement of backfilling activities at Fassaroe. As reported in the EIS submitted to the EPA in 2009 in support of the waste licence application, groundwater quality was generally good. With the exception of high levels of manganese in BH2, all analysed parameters were noted at that time to have concentrations below EU Drinking Water Standards. Water quality was also good for the ponded water on the pit floor.

List I analyses for Diesel and Petrol Range Organics, Mineral Oils, Benzene, Toluene, Ethylbenzene and Total Xylene, were undertaken on a sample obtained from the surface water pond on the quarry floor. None of these contaminants were detected in the test sample.

The hydrochemistry of the groundwater samples indicated hard calcium-type water with moderately low sodium and magnesium. This type of water is typical of groundwater from sand and gravel with limestone parent material. Potassium, chloride, ammoniacal nitrogen, nitrite and nitrate concentrations were all low. Samples also indicated minimal organic contamination. The nitrate level in BH3, although still low, was higher than BH2, most likely due to its closer proximity to agricultural land.

Recent groundwater quality test results are discussed in further detail within Section 3.

2.4 Hydrology

2.4.1 Regional Hydrology

The nearest watercourse to the site is the Cookstown River, which is identified as the Glencullen River upstream of Enniskerry (2km west of the licensed site).

The backfilled pit at Fassaroe lies within the catchment of the Cookstown River which flows 400m to the south. The restored ground surface at the pit is elevated approximately 60m above the river channel.

The Cookstown River is a tributary of the Dargle River. Its confluence with the Dargle lies approximately 400m to the south east of the Roadstone landholding, in the south-eastern corner of Fassaroe townland.

3.0 CONCEPTUAL SITE MODEL

Based on the above review of the environmental site setting at Fassaroe, a Conceptual Site Model (CSM) has been developed for the purposes of this hydrological risk assessment. The CSM is outlined in a Source-Pathway-Receptor (SPR) approach to aid understanding.

3.1 Source

For the purposes of this assessment, the potential source of contamination at the licensed site at Fassaroe is potentially contaminated water (identified hereinafter as "leachate") arising from the inert backfill material placed at the licensed facility.

The total estimated amount of soil and stone imported and used to backfill the former pit is approximately 750,000 tonnes. Ground levels surrounding the infill area are between 90mOD and 80mOD, and the former floor level (prior to backfilling) was approximately 75mOD. The thickness of backfilled soil is therefore estimated at between 5m and 15m.

3.1.1 Source Terms

Regular Waste Acceptance Criteria (WAC) testing was undertaken on the inert waste materials placed into the facility between 2012 and 2014. A total of 190 soil intake samples were tested and the results are tabulated and summarised in Table 3-1 below.

Table 3-1
WAC Testing of Existing Backfill Area

Determinand	Inert WAC Limit (mg/kg unless stated)	No. of Samples Tested	No. of Detects	Concentration (mg/kg)		
				Min	Mean	Max
Antimony	**0.06**	190	4	<0.001	0.018	0.001
Arsenic	**0.50**	190	8	<0.001	0.021	0.13
Barium	**20**	190	70	<0.01	0.051	0.9
Cadmium	**0.04**	190	16	<0.001	0.0081	0.18
Chromium	**0.50**	190	43	<0.01	0.033	0.41
Copper	**2.00**	190	65	<0.01	0.0537	0.38
Lead	**0.50**	190	14	<0.001	0.0195	0.18
Mercury	**0.01**	190	7	<0.0002	0.00306	0.008
Molybdenum	**0.50**	190	13	<0.001	0.0686	0.01
Nickel	**0.40**	190	31	<0.001	0.0128	0.40
Selenium	**0.10**	190	10	<0.001	0.018	0.002
Zinc	**4.00**	190	63	<0.08	0.0905	0.86
Chloride	**800**	190	185	<10	26.89	270.8
Fluoride	**10**	190	181	<0.2	1.91	12

Determinand	Inert WAC Limit (mg/kg unless stated)	No. of Samples Tested	No. of Detects	Concentration (mg/kg)		
				Min	Mean	Max
Sulphate	**1000**	190	189	<2.5	170.5	2,987
Phenols	**1.0**	178	53	<0.005	0.237	6.34
Carbon, Organic (diss.filt)	**500**	190	176	<1	59.98	402
TDS	**4000**	190	190	40	685.76	4024
Total Organic Carbon	**30,000**	182	182	11	8855.9	36,000
Sum of BTEX	**6.0**	190	28	<0.01	0.012	0.04
Sum of PCBs (ug/kg)	**1000 µg/kg**	165	0	<0.001	-	<21
Mineral Oil	**500**	190	79	<0.01	45.54	750
Sum of PAHs	**100**	178	29	<0.001	3.65	140

Note: Mean concentrations calculated assuming '<' values equivalent to half the value (i.e. <1 treated as 0.5)
Highlighted cells exceed IWAC

The available WAC test results indicate that the material accepted within the pit area typically recorded concentrations well below the Inert WAC limits (IWAC), with the average of most determinands greater than an order of magnitude lower than IWAC. A few isolated samples have been recorded marginally above IWAC limits, with cadmium, fluoride, sulphate, phenol, TDS and TOC having been recorded above their respective limits.

Most of the exceedances can be considered one-off readings, and not representative of the typical content of the backfilled / restoration material, for example:

- the maximum sulphate of 2,987mg/kg is significantly higher than all other results, with the next highest reading of 887mg/kg (below IWAC) and an average of just 170mg/kg; and
- the fluoride maximum of 12mg/kg, marginally above its IWAC is also the only result recorded above IWAC with the next highest of 9.30mg/kg and an average of just 1.91mg/kg

The above data were supplemented through post-closure testing of samples taken from trial pits excavated in the inert waste backfill by Roadstone on 17 February 2017 and subsequently by SLR Consulting Ireland on 20th and 21st July 2017.

A total of 6 trial pits were excavated in February 2017 from whence 21 samples were taken for WAC testing at 1m depth intervals between ground level and 4m depth. A total of 12 trial pits were excavated in July 2017, from whence 12 representative stockpile samples were taken by SLR staff for independent testing at an accredited testing laboratory.

The trial pits excavated in July 2017 were also inspected at that time by an Inspector from the Environmental Protection Agency. A record of trial pit excavations overseen and logged by SLR personnel are presented together with a plan showing trial pit locations in Appendix 02.

The monitoring results for the near surface soil samples are summarised in Table 3-2 below. Laboratory test reports presenting results of soil testing are presented in Appendix 03.

Table 3-2
Trial Pitting Sample WAC Test Results

Determinand	Inert WAC Limit (mg/kg unless stated)	No. of Samples Tested	Concentration (mg/kg)		
			Min	Mean	Max
Antimony	**0.06**	33	0.01	0.027	0.09
Arsenic	**0.50**	33	0.0148	0.036	0.12
Barium	**20**	33	0.0495	0.143	0.29
Cadmium	**0.04**	33	0.0008	0.0035	0.005
Chromium	**0.50**	33	0.01	0.013	0.015
Copper	**2.00**	33	0.0169	0.058	0.114
Lead	**0.50**	33	0.002	0.034	0.05
Mercury	**0.01**	33	<0.0001	0.00013	0.0003
Molybdenum	**0.50**	33	<0.04	0.131	0.24
Nickel	**0.40**	33	<0.0103	0.023	0.05
Selenium	**0.10**	33	<0.005	0.0225	0.03
Zinc	**4.00**	33	<0.01	0.0386	0.418
Chloride	**800**	33	3	16.15	38
Fluoride	**10**	33	3	3.89	7.7
Sulphate	**1000**	33	1.4	169.59	324
Phenols	**1.0**	33	<0.1	-	<0.1

The monitoring results indicate that the results of contaminant testing on near surface samples are typically comparable to the WAC testing data for the inert waste intake, with concentrations consistently recorded well below respective WAC limits, the only exception being a single exceedance of antimony.

3.1.2 Speciated Substances

Speciated results for BTEX, mineral oil and PAHs are available for the trial pit samples and are summarised in Table 3-3 below.

Table 3-3
Speciated Organics

Component	Speciated Substance	No. of Samples Tested	Concentration (mg/kg)			
			Min	Mean	Max	Average % Total*
BTEX	Total BTEX	12	<24	-	<24	N/A
	Benzene	12	<10	-	<10	
	mp-Xylene	12	<6.0		6.76	

Component	Speciated Substance	No. of Samples Tested	Concentration (mg/kg)			
			Min	Mean	Max	Average % Total*
	O-Xylene	12	<3.0	-	<3	
	Ethylbenzene	12	<3.0	5.95	14.6	
	Toluene	12	<2.0	5.27	16.7	
PAHs	Total PAH	21	0.64	1.324	6.57	100%
	Naphthalene	21	0.04	0.046	0.16	3.49%
	Acenaphthylene	21	0.03	0.033	0.1	2.52%
	Acenaphthene	21	0.05	0.051	0.08	3.88%
	Fluorene	21	0.04	0.042	0.06	3.20%
	Phenanthrene	21	0.03	0.121	0.8	9.17%
	Anthracene	21	0.04	0.056	0.16	4.21%
	Fluoranthene	21	0.03	0.189	1.15	14.24%
	Pyrene	21	0.03	0.168	0.93	12.69%
	Benzo(a)anthracene	21	0.06	0.135	0.59	10.21%
	Chrysene	21	0.02	0.109	0.59	8.23%
	Benzo(bk)fluoranthene	21	0.07	0.187	0.92	14.13%
	Benzo(a)pyrene	21	0.04	0.115	0.54	8.67%
	Indeno(123cd)pyrene	21	0.04	0.076	0.33	5.75%
	Dibenzo(ah)anthracene	21	0.04	0.043	0.09	3.27%
	Benzo(ghi)perylene	21	0.04	0.069	0.27	5.18%
Mineral Oil	C10 – C40	12	14.2	50.7	132	

*Determined as Average % of speciated PAH / Average of Total PAH

The monitoring data obtained and presented above indicate that BTEX and PAHs are recorded at very low levels, with total BTEX recorded at less than detection limit within all samples. PAHs have been detected but at very low concentrations, with a maximum Total PAH of 6.57mg/kg, well below the IWAC of 100mg/kg.

The PAH data indicates that the highest recorded PAHs are Fluoranthene (14.24% of total), benzo(bk)fluoranthene (14.13%), pyrene (12.69%) and benzo(a)anthracene (10.21%).

Given the lack of BTEX detected within the samples it appears that the risk from BTEX is very low, however it is noted that BTEX have been recorded in the WAC data of the waste intake.

3.1.3 Input Parameters for Modelling

To develop a suitable "leachate value" for leachate flow modelling purposes, the inorganics recorded in mg/kg at a 10:1 leaching ratio in the waste intake dataset are divided by 10 to provide a representative leachate value in mg/l. The UK Environment Agency spreadsheet *'Hydrogeological Risk Assessment for Land Contamination Remedial Targets Worksheet, Release 3.1'* (P20) has been used to convert the mg/kg concentration of organics into a representative leachate concentration in mg/l. The spreadsheet uses the following variables:

- Water Filled Porosity (fraction)
- Air Filled Porosity (fraction)
- Bulk Density (g/cm^3)
- Henry's Law Constant

All inorganics and a number of key PAHs, BTEX and mineral oil concentrations have been converted to a leachate concentration (expressed in mg/l) in Table 3-4 and Table 3-5 below for modelling purposes. The converted leachate concentration results are compared against several assessment criteria, in the following order (where available):

- SI No 366 of 2016 (Groundwater Regulations);
- SI No 122 of 2014 (Drinking Water Regulations) and
- EPA Interim Guideline Values (IGVs).

Table 3-4
Inorganics Converted to mg/l

Determinand	Recorded Maximum Waste Intake Value (mg/kg)	Converted Maximum Waste Intake Value (mg/l)	Assessment Criteria GW Regulations unless specified (mg/l)
Arsenic	0.13	0.013	0.0075
Barium	0.90	0.09	0.10**
Cadmium	0.18	0.018	0.005*
Chromium	0.41	0.041	0.0375
Copper	0.38	0.038	2.00
Mercury	0.008	0.0008	0.00075
Molybdenum	0.01	0.001	-
Nickel	0.40	0.04	0.02*
Lead	0.18	0.018	0.0075
Antimony	0.001	0.0001	0.005*
Selenium	0.002	0.0002	0.01*
Zinc	0.86	0.086	0.075
Chloride	270.8	27.08	187.5
Fluoride	12.0	1.20	0.8

Determinand	Recorded Maximum Waste Intake Value (mg/kg)	Converted Maximum Waste Intake Value (mg/l)	Assessment Criteria GW Regulations unless specified (mg/l)
Sulphate	2987	298.7	187.5
Total Dissolved Solids	4024	402.4	-
Phenol	6.34	0.634	0.0005**
Dissolved Organic Carbon (DOC)	36,000	3,600	-

* Drinking Water Standards

** EPA IGVs

In view of the low concentrations of BTEX in the trial pit test data relative to that recorded in the waste intake testing, results from speciated data at another licensed Roadstone facility (Huntstown Quarry, Waste Licence Ref. No. W0277-03) have been taken to be broadly representative of the potential split of speciated substances at this facility. The relative concentrations of BTEX substances were found to be relatively evenly distributed at Huntstown, with benzene recorded at the highest concentration (comprising an average of 33.75% of the total BTEX), followed by mp-Xylene (30.5%), O-xylene (20.5%) and Toluene (15.8%).

It is also noted that whilst limited data for total mineral oil is available, there is no speciated data available. In these circumstances therefore, speciated data from the Huntstown Quarry soil recovery facility has been used as a worst case approach.

Table 3-5
Organics Converted to mg/l

Component	Speciated Substance	Maximum Waste Intake Value (mg/kg) [1]	Typical Proportion of Component in Waste Intake (%)	Maximum Speciated Value (mg/kg)	Conversion to mg/l
BTEX	Benzene	0.04	33.75%	0.0135	0.00852
	mp-Xylene		30.5%	0.0122	0.00133
	O-Xylene		20.5%	0.0082	0.00089
	Toluene		15.8%	0.0063	0.00146
PAHs	Fluoranthene	140	14.24%	19.93	0.067
	benzo(bk)fluoranthene		14.13%	19.78	0.0069
	pyrene		12.69%	17.77	0.054
	benzo(a)anthracene		10.21%	14.29	0.0085
Mineral Oil	C10 – C12	750	20%	150	3.42

Note: The maximum intake concentration refers to the maximum total values recorded in all monitoring data. Note that for BTEX, analogue data from Huntstown soil recovery facility is used given low detection levels within soil intake to Fassaroe. For mineral oil, regard has also been had to speciated data from the Huntstown facility.

3.2 Pathways

Pathways are the means by which a receptor could be impacted by a source. The primary pathway is considered to be vertical migration of potential leachate from the backfilled soil material down to the underlying sand and gravel aquifer.

Previously, following screening and washing of sand and gravel on-site at Fassaroe, washed out fines (silt and clay sized particles) generated by processing activities were placed across the floor of the former pit and it is assumed will inhibit vertical migration of any potential leachate from the backfilled material.

For risk assessment purposes, it is assumed that a low permeability layer of 1m – 5m of silt and clay is present everywhere at the base of the imported backfill material.

Groundwater levels reported in the underlying sand and gravel aquifer show that there is a minimum unsaturated zone beneath the base of the backfilled material of 11.2m.

3.2.1 Groundwater

As detailed within Section 2 above, the former pit at Fassaroe is located within the locally important Enniskerry Groundwater Body (GWB) which comprises of superficial sands and gravels. Groundwater flow will primarily occur via interparticulate or matrix flow (ie. in the pore space between soil particles).

The available groundwater level monitoring data confirms that flow is in a predominantly south-easterly direction at a gradient of 0.026 with groundwater levels present at a depth of between 11m and 33m below ground level. Based on the groundwater level monitoring the following boreholes are considered to be up-gradient (background) and down-gradient of the backfilled site area:

- up-gradient (background): BH03, BH05, BH08
- down-gradient: BH02A, BH04, BH06, BH07A

Background Groundwater Quality

Background groundwater quality is represented by boreholes BH03, BH05 and BH08 with monitoring data collected between June 2017 and November 2017 and between July 2019 and July 2020. Monitoring data have been collected for a range of determinands, with key substances summarised in Table 3-6 and time-series graphs presented in Appendix 04.

A review of the results indicates :

- the groundwater is near neutral (or very slightly alkaline) with pH ranging between 7.46 and 7.91;
- conductivity levels are relatively low, ranging between c.449 and 805 µS/cm;
- concentrations of major ions including sulphate, chloride and fluoride are well below their respective water quality standards;
- metal concentrations are typically low with most substances typically more than an order of magnitude below respective water quality standards;
- orthophosphates and ammoniacal nitrogen have on occasion been recorded in the groundwater at concentrations above the assessment criteria.

Table 3-6
Background Groundwater Quality

Determinand	Assessment Criteria GW Regulations unless specified (mg/l)	BH03			BH05			BH08			Combined Background		
		Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Conductivity (mS/cm)	1.875	0.475	0.566	0.616	0.537	0.591	0.805	0.449	0.561	0.659	0.449	0.571	0.805
pH Value	6.5 - 9.5*	7.46	7.60	7.90	7.55	7.62	7.87	7.47	7.70	7.91	7.46	7.64	7.91
Fluoride (mg/l)	0.8	<0.05	0.230	<0.5	<0.05	0.222	<0.5	<0.05	0.230	<0.5	<0.05	0.228	<0.5
Chloride (mg/l)	187.5	13.8	15.6	18.8	13.4	14.2	15.4	18.0	22.4	28.0	13.4	17.7	28.0
Sulphate (mg/l)	187.5	32.3	48.5	70.5	17.1	42.5	170	23.7	53.4	85.7	17.1	48.7	170
Selenium (mg/l)	0.01*	0.000922	0.00134	0.00184	<0.001	0.000732	0.00155	<0.001	0.00145	0.00237	<0.001	0.001	0.00237
Mercury (mg/l)	0.00075	<0.00001	0.00001	<0.00001	<0.00001	0.000005	<0.00001	<0.00001	0.000005	<0.00001	<0.00001	0.00001	<0.00001
Zinc (mg/l)	0.075	0.00184	0.00477	0.0101	<0.001	0.00212	0.00532	<0.001	0.00333	0.00578	<0.001	0.004	0.0101
Nickel (mg/l)	0.02*	<0.00004	0.000275	0.00121	<0.0004	0.000867	0.00195	<0.0004	0.000891	0.00242	<0.00004	0.001	0.00242
Lead (mg/l)	0.0075	<0.00002	0.000158	0.000823	<0.00002	0.000103	0.000216	<0.00002	0.000104	0.000230	<0.00002	0.0001	0.000823
Copper (mg/l)	2.00	<0.00003	0.000241	0.00112	<0.00003	0.000306	0.00153	<0.00003	0.000214	0.000583	<0.00003	0.0002	0.00153
Antimony (mg/l)	0.005*	<0.0001	0.000214	<0.001	<0.0001	0.000106	<0.001	<0.0001	0.000231	<0.001	<0.0001	0.0002	<0.001
Barium (mg/l)	0.10**	0.0438	0.0500	0.0560	0.0442	0.0515	0.0581	0.0394	0.0550	0.0673	0.0394	0.052	0.0673
Cadmium (mg/l)	0.005*	<0.00008	0.00004	<0.00008	<0.00008	0.00004	<0.00008	<0.00008	0.00004	<0.00008	<0.00008	0.00004	<0.00008
Chromium (mg/l)	0.0375	<0.001	0.00200	0.00317	<0.001	0.0005	<0.001	<0.001	0.000972	0.00336	<0.001	0.001	0.00336
Arsenic (mg/l)	0.0075	<0.00005	0.000348	0.00122	<0.00005	0.000292	0.000540	<0.0005	0.000432	0.000964	<0.00005	0.0004	0.00122
Nitrate as NO_3 (mg/l)	37.5	8.61	11.0	22.4	3.33	6.21	8.31	1.75	7.58	28.8	1.75	8.48	28.8
Ammoniacal Nitrogen (mg/l)	0.15**	0.0116	0.0249	0.0512	0.0125	0.0500	0.106	<0.01	0.0340	0.0742	<0.01	0.0350	0.106
Orthophosphate (mg/l)	0.03**	<0.05	0.0250	<0.05	<0.05	0.0370	0.121	<0.05	0.0250	<0.05	<0.05	0.0282	0.121
Carbon Organic (Dissolved) (diss. filt) (mg/l)	-	<0.016	1.25	<3	<0.016	1.00	<3	<0.016	1.25	<3	<0.016	1.20	<3
Total Phenols (mg/l)	0.0005**	<0.002	0.00660	<0.016	<0.002	0.00625	<0.016	<0.002	0.00660	<0.016	<0.002	0.007	<0.016

* Drinking Water Standards
** EPA IGVs

3.3 Receptors

The following three receptors, designated as R1 to R3 and shown in Figures 1 and 2, have been identified as being potentially at risk from leachate emissions generated by the backfilled soils:

- Locally important sand and gravel aquifer underlying the former pit (R1);
- Poorly productive bedrock aquifer underlying the sand and gravel aquifer (R2); and
- Cookstown River (R3) 400m south of the former pit.

The primary receptor is considered to be the locally important gravel aquifer R1 underlying the site. Potential leachate from the backfilled soil materials could migrate vertically down to the underlying sand and gravel aquifer. It is noted that a low permeability layer of 1m - 5m of silt and clay occurring below the backfilled materials will impede the vertical migration of any potential leachate towards this aquifer.

The mapped boundary of the sand and gravel aquifer is 300m down-gradient of the backfilled area at Fassaroe. There are no groundwater well records identified by the GSI in the sand and gravel aquifer down-gradient of this area and all local residences are understood to be supplied by Irish Water from public watermains.

3.4 Source-Pathway-Receptor Linkages – Risk Screening

The conceptual hydrogeological site model is based on the source-pathway-receptor linkages outlined above, as summarised within Table 3-7 below. The CSM is presented in the cross-section in Figure 2.

Table 3-7
Summary of Conceptual Hydrogeological Model

Attribute	Details
Source	The void created by extraction of sands and gravels has been backfilled and restored using imported inert soil waste and some site-derived overburden / interburden materials; depth of backfilling extends to a maximum thickness of up to 15m. The source material was tested at the time of infilling. The testing confirms that the infill material primarily meets the Inert Waste Acceptance Criteria (IWAC).
Pathways	Migration of effective infiltration and groundwater through the inert waste soil backfill materials under unsaturated and saturated flow conditions. Migration through the 1m – 5m thick low permeability layer of silt and clay covering the floor of the former pit. Migration through the 11m – 33m unsaturated zone beneath the floor of the former pit. Lateral groundwater flow through the underlying locally important sand and gravel aquifer, and to a lesser extent, the poorly productive bedrock aquifer.
Receptors	Three receptors are identified: 1. Locally important sand and gravel aquifer (R1) 2. Poorly productive bedrock aquifer (R2) 3. Cookstown River (R3) In order to comply with the Environmental Protection Agency guidance, the following are considered the appropriate receptors: • Hazardous Substances: Groundwater within the locally important superficial gravel aquifer (R1) pathway immediately down-gradient of the inert soil waste, after immediate dilution by groundwater directly adjacent to the sides of the backfilled void, but prior to any attenuation within this aquifer.

Attribute	Details
	• Non-Hazardous Substances: Groundwater within the superficial gravel aquifer at the down-gradient boundary of the site, after dilution, dispersion and attenuation along this flow pathway. The underlying bedrock aquifer (R2) and Cookstown river (R3) to the south of the former pit are considered to be secondary receptors, given that they potentially receive groundwater baseflow from the sand and gravel aquifer.
Compliance Point	For the purposes of monitoring compliance, the compliance points for hazardous substances and non-hazardous substances are taken to be at the down-gradient property site boundary. Compliance with the regulations at the down-gradient site boundary will ensure that other receptors are protected.
Risk Screening	The backfilled pit is in continuity with the groundwater within the sand and gravel aquifer, which is in turn potentially in continuity with the surface waters. As the imported waste could have the potential for the release of both Hazardous Substances and non-hazardous substances, the potential risk posed by the backfilled materials is assessed as High.

3.5 Appropriate Tier of Assessment

As outlined within Section 4 of the EPA's publication *Guidance on the Authorisation of Discharges to Groundwater (2011),* a tiered approach is required for assessing the potential impact on groundwater and the level of assessment required is:

- Tier 1 Assessment : Low Risk Sites – Typically requires a characterisation exercise to demonstrate that risk to receptors is low, along with details of the site setting;
- Tier 2 Assessment : Moderate Risk Sites – must demonstrate sufficient infiltration and attenuation potential to mitigate any impact on quality: basic calculations required to assess the potential impact of discharge on receptors;
- Tier 3 Assessment : High Risk Sites – same objective and content as a Tier 2 assessment but with greater level of technical detail required to characterise the waste body and groundwater characterisation.

Given the high risk potentially posed to the sand and gravel aquifer and secondary receptors (watercourses and bedrock aquifer), it is considered that a Tier 3 assessment is required. As per *Guidance on the Management of Contaminated Land and Groundwater at EPA Licensed Sites (2013)*, this consists of a Detailed Quantitative Risk Assessment (DQRA).

4.0 DETAILED GROUNDWATER QUANTITATIVE RISK ASSESSMENT

4.1 Methodology

To undertake the risk assessment, quantitative models have been developed to assess the potential impact of leaching from the backfilled / restored site on the underlying sand and gravel aquifer.

Site specific data have been used as far as possible for developing the model, including site-specific WAC data. Where site specific data are not available, appropriate literature values or comparable reference datasets have been used.

4.1.1 Key Determinands

To determine which substances require risk assessment, the maximum recorded waste acceptance criteria (WAC) data, as outlined in Section 3.1.3 of the CSM, have been assessed against background groundwater quality and groundwater limits.

Any substances which have lower maximum recorded WAC than background groundwater quality have been excluded from any further assessment, as they do not pose a risk of adverse impact on water quality. The risk factors for inorganics are outlined in Table 4-1 below. Scatter graphs of the data (converted to mg/l) are presented in Appendix 05.

Table 4-1
Assessment of Risk Factors

Determinand	Recorded Maximum Waste Intake Value (mg/kg)	Converted Maximum Waste Intake Value (mg/l)	Average Background Groundwater Quality (mg/l)	Assessment Criteria GW Regulations unless specified (mg/l)	Risk Factor [a]
Arsenic	0.13	0.013	0.0004	0.0075	32.5
Barium	0.90	0.09	0.052	0.10**	1.73
Cadmium [b]	0.18	0.018	0.00004	0.005*	450
Chromium	0.41	0.041	0.001	0.0375	41.0
Copper	0.38	0.038	0.0002	2.00	190
Mercury [b]	0.008	0.0008	0.00001	0.00075	80.0
Nickel	0.40	0.04	0.001	0.02*	40.0
Lead	0.18	0.018	0.0001	0.0075	180
Antimony	0.001	0.0001	0.0002	0.005*	0.500
Selenium	0.002	0.0002	0.001	0.01*	0.200
Zinc	0.86	0.086	0.004	0.075	21.5
Chloride	270.8	27.08	17.7	187.5	1.53
Fluoride [b]	12.0	1.20	0.228	0.8	5.26

Determinand	Recorded Maximum Waste Intake Value (mg/kg)	Converted Maximum Waste Intake Value (mg/l)	Average Background Groundwater Quality (mg/l)	Assessment Criteria GW Regulations unless specified (mg/l)	Risk Factor [a]
Sulphate as SO_4	2987	298.7	48.7	187.5	6.13
Phenol	6.34	0.634	0.007	0.0005**	90.6
Dissolved Organic Carbon (DOC)[C]	36,000	3,600	1.20	-	3000

Note: * Drinking Water Standards
** EPA IGVs

[a] *Risk Factor calculated as Maximum Waste Intake Value (converted to mg/l) divided by Average Background Groundwater*

[b] *In absence of mean value, upper limit of detection is adopted as average value*

[C] *DOC has been assessed against TOC therefore the presented risk factor is considered worst case*

Molybdenum not assessed as no assessment criteria available

The above assessment indicates that most substances have a higher (converted) maximum value in the waste intake than the respective background groundwater quality value, although it is noted that most remain below their respective water quality standards. As a worst case scenario, the risk assessment has been undertaken against background groundwater quality to ensure there is no deterioration in groundwater quality.

It is proposed that all determinands with a risk factor greater than c.5 will be included in the assessment. Antimony and selenium have been excluded as the (converted) maximum value for these determinands in the waste intake is below the recorded background groundwater concentration. Barium and chloride have also been excluded as they have low risk factors of 1.73 and 1.53. Fluoride has also been excluded as sulphate, a similarly conservative substance has been assessed at a higher risk factor.

For BTEX, Mineral Oil and PAHs an appropriate speciated substance has been selected and included in the quantitative modelling / risk analyses. The proportion of individual selected PAHs, BTEX and Mineral Oils parameters within the determinand group (as determined in Table 3-5), has been applied to the maximum total concentration value of the determinand group within the WAC dataset and converted to mg/l equivalents using the approach outlined previously in Section 3.1.3.

Following analysis, the predicted concentrations for speciated substances have been assessed against their respective background groundwater quality, Limit of Quantification (LOQ) or Minimum Reporting Value (MRV), whichever is lowest, to determine risk factors and assess which substance has the highest risk factor for modelling purposes. Based on this assessment the respective determinands with the highest risk factors are Benzene, Fluoranthene and aromatic C10-C12 (Mineral Oils), these will be modelled as representative substances for BTEX, PAH and Mineral Oils respectively.

Appropriate source terms based on Inert WAC limits have been calculated using the remedial Targets Worksheet, V3.2. The values used within the calculations and appropriate leachate source terms are included in Table4-2 below. The calculations are included within Appendix 06.

Table 4-2
Organics Source Term for Input into LandSim Modelling

Component	Speciated Substance	Maximum Waste Intake Value (mg/kg)	Maximum Speciated Value (mg/kg)	Conversion to mg/l	MRV	Risk Factor
BTEX	Benzene	0.04	0.0135	0.00852	0.001	8.52
	mp-Xylene		0.0122	0.00133	0.003	0.44
	O-Xylene		0.0082	0.00089	0.003	0.30
	Toluene		0.0063	0.00146	0.004	0.365
PAHs	Fluoranthene	140	19.93	0.067	0.01	6.70
	benzo(bk)fluoranthene		19.78	0.0069	0.01	0.69
	pyrene		17.77	0.054	0.01	5.41
	benzo(a)anthracene		14.29	0.0085	0.01	0.85
Mineral Oil	C10 – C12	750	150	3.42	0.10	34.2

Based on the assessment above the quantitative modelling will be undertaken on the following determinands:

- Arsenic;
- Cadmium;
- Chromium;
- Copper;
- Mercury;
- Nickel;
- Lead;
- Zinc;
- Sulphate;
- Phenol;
- Benzene;
- Fluoranthene; and
- Aromatic C10 – C12 (Mineral Oil)

4.2 Modelling Methodology

4.2.1 Proposed Assessment Scenarios

Groundwater monitoring data indicate that groundwater levels are well below the base of the pit, therefore the main modelling scenario relates to the advective migration of potentially contaminated water (identified as “leachate”) across the low permeability silts and clays to the underlying sand and gravel aquifer.

4.2.2 Numerical Modelling : LandSim Modelling

The LandSim model manual was published jointly by consultants and the UK (England and Wales) Environment Agency (EA) as Research and Development Publication 120 (2001). The introduction states that the model was '*Developed for use by the EA to provide risk assessments of specific landfill site performance in relation to groundwater protection, LandSim … allows users to better assess the suitability of proposed schemes'.*

The ongoing usefulness of LandSim modelling for assessment of proposed landfills is confirmed in the current EA online guidance 'Groundwater Risk Assessment for your Environmental Permit' which states: '*For pollution sources e.g. landfill or other permanent deposits of waste on land … you can carry out probabilistic calculations using probabilistic tools developed by the EA e.g. LandSim*'.

LandSim modelling has been widely used by SLR Consulting internationally to assist national regulators in assessing the efficacy of various proposed landfills and waste lining systems.

The updated LandSim software (Version 2.5.17) has been used to provide an estimate of the potential risks associated with the backfilled site at Fassaroe. This software was used for the following reasons:

- it provides a consistent approach to the estimation of hydrogeological risks;
- it provides an audited and verified code that is widely accessible;
- it allows the estimation of the attenuation of potential pollutants through any lining system (as well as instances where no lining system exists);
- it allows the attenuation and dispersion of potential pollutants within unsaturated horizons;
- it uses Monte Carlo (stochastic) techniques and so allows a probabilistic appreciation of the site's performance, including reporting of the 95%ile worst case impact on groundwater as well as the 50%ile most likely impact; and
- it aids comprehensive reporting of input values, assumptions and results.

The LandSim model has been assessed in a stochastic fashion and throughout this assessment the acceptable probability of an undesirable outcome occurring has been set at the 95%ile confidence level. In addition, the 95%ile is commonly selected as a reasonable worst case, as the 95%ile effectively combines worst case values for key parameters. The 95%ile result can then be used to assist decision making, while taking into account assumptions and limitations of modelling.

4.3 Determination of Environmental Assessment Limits (EALs)

The setting of Environment Assessment Limits (EALs) is necessary in order to set the point at which an adverse impact is recorded at a down-gradient receptor. Discernible inputs (discharge) of Hazardous Substances to groundwater must be prevented. An input is considered to have been prevented if the substance concerned is not:

- discernible in the groundwater above natural background concentrations; or
- above a relevant minimum reporting value[3] (MRV) after immediate dilution as the discharge enters the groundwater.

As MRVs have not yet been published for some Hazardous Substances, the Limits of Quantification (LOQs) achieved by accredited laboratories for those substances have been adopted as EALs for assessment purposes.

For non-hazardous substances, the EALs have been set as one of the following:

- where background groundwater is above the assessment criteria, the limit has been set at background groundwater quality; or

[3] https://www.gov.uk/government/publications/values-for-groundwater-risk-assessments/hazardous-substances-to-groundwater-minimum-reporting-values

- where the background groundwater is close to the assessment criteria, then the assessment criteria has been used; or
- where the background quality is significantly lower than the assessment criteria a concentration mid-way between background and the assessment criteria has been used.

The selected EALs are included in Table 4-3 below.

Table 4-3
Environmental Assessment Limits

Determinand	Classification[a]	Assessment Criteria – GW Regs unless specified (mg/l)	MRV[b] or LOQ (mg/l)	Max Background Groundwater Quality Value[c] (mg/l)	Proposed EAL (mg/l)
Arsenic	Hazardous	0.0075	0.005 (LOQ)	0.00122	0.005
Cadmium	Hazardous	0.005*	0.0001 (MRV)	<0.00008	0.0001
Chromium	Non-Hazardous	0.0375	N/A	0.00336	0.00336
Copper	Non-Hazardous	2.00*	N/A	0.00153	1
Mercury	Hazardous	0.00075	0.00001 (MRV)	<0.00001	0.00001
Nickel	Non-Hazardous	0.02*	N/A	0.00242	0.01
Lead	Undetermined (Hazardous)	0.0075	0.0017 (LOQ)	0.00082	0.0017
Zinc	Non-Hazardous	0.075	N/A	0.0101	0.043
Sulphate	Undetermined (Non-Hazardous)	187.5	N/A	170	187.5
Phenol	Non-Hazardous	0.0005**	N/A	<0.016	0.0005
Fluoranthene	Hazardous	-	0.0001 (LOQ)	0.00647	0.0001
Benzene	Hazardous	0.00075	0.001 (MRV)	<0.0002	0.00075
Aromatic C10 – C12	Hazardous	-	0.005 (LOQ)	<0.1	0.005

Notes: * Drinking Water Standards
** EPA IGVs

[a] specified in Environmental Protection Agency (Dec 2010) *Classification of Hazardous and Non-Hazardous Substances in Groundwater*
[b] As specified in Environmental Protection Agency (Dec 2011) *Guidance on the Authorisation of Discharges to Groundwater*
[c] Based on combined background groundwater quality concentration recorded from boreholes BH03, BH05 and BH08 excluding outliers

4.4 Parameterisation

A parameterisation table has been developed for the backfilled pit at Fassaroe, based on the CSM developed for the site outlined in Section 3 and Figure 2. This table which identifies the input parameters to the LandSim model is presented in Appendix 07.

The parameterisation has used site specific data wherever possible, and suitable literature values where no site-specific data are available.

5.0 MODELLING RESULTS

The LandSim model has been run for a 20,000-year period to reflect the long-term post closure of the site at Fassaroe. Non-hazardous substances have been assessed at an a down-gradient compliance point, assumed for the purposes to be a theoretical future borehole 20m immediately down-gradient of the backfilled pit, within the sand and gravel aquifer. Hazardous substances have been assessed at the base of the unsaturated zone.

It is noted that typically hazardous substances would be assessed within the aquifer directly beneath the site (following dilution, but prior to attenuation or dispersion) however for the purposes of this assessment, the base of the unsaturated zone has been chosen to demonstrate the very low risk presented by the backfilled pit.

The model results are summarised in Table 5-1 below and presented in Appendix 08.

Table 5-1
LandSim Model Results

Determinand	Maximum Waste Intake Value (Converted to mg/l)	EAL (mg/l)	95th %ile Resultant Concentration (mg/l)
Non-Hazardous Substances[1]			
Chromium	0.041	0.00336	0.0023
Copper	0.038	1	0.000848
Nickel	0.04	0.01	0.00141
Zinc	0.086	0.043	0.00567
Sulphate (Undetermined)	298.7	187.5	70.6
Phenol	0.634	0.0005	3.91×10^{-7}
Hazardous Substances[2]			
Arsenic	0.013	0.005	0.00319
Cadmium	0.018	0.0001	8.95×10^{-5}
Mercury	0.0008	0.00001	5.52×10^{-6}
Lead (Undetermined)	0.018	0.0017	$<1 \times 10^{-10}$
Fluoranthene	0.067	0.0001	3.75×10^{-9}
Benzene	0.0085	0.00075	3.04×10^{-7}
Aromatic C10 – C12 (Mineral Oil)	3.42	0.005	0.0026

Notes:
[1] 95th percentile resultant concentrations for Non-Hazardous Substances assessed at the down-gradient compliance point (20m down-gradient of the landfill)
[2] 95th percentile resultant concentrations for Hazardous Substances assessed at base of the unsaturated zone

The LandSim modelling results indicates that the release of non-hazardous substances is limited such as to have no adverse impact on down-gradient groundwater quality, with the release of most substances limited to the extent that the concentrations at the base of the unsaturated zone are below background groundwater quality.

There is no release of hazardous substances predicted above their respective EALs at the base of the unsaturated zone. Notwithstanding this, it is also noted that the predicted concentrations of hazardous substances would be reduced further due to dilution in the underlying aquifer.

5.1 Sensitivity Analysis

Several key assumptions have been made in the development of the LandSim model. In general the worst case assumption has been made, i.e. by including the maximum recorded WAC data in the leachate source term, and assuming a relatively high rate of infiltration through the backfilled waste.

It is however recognised that there is some uncertainty as to the thickness of the silt horizon in the base of the former pit which acts as a defacto geological barrier. A range of between 1m and 5m has been assumed on the basis of the anecdotal and survey information available at the time that consent for backfilling was sought back in 2008 and 2009. In light of this, it was considered prudent to undertake some sensitivity analysis to reflect this uncertainty. As a result, the following sensitivity runs have been undertaken:

- Silt range of 0.01m – 1.0m to reflect potential gaps in the barrier or thinner than anticipated conditions; and
- Aquifer Thickness of 5m to reflect uncertainties as to elevation of base of aquifer, based on BH5 where the saturated zone is at least 4m thick, but the borehole is not deep enough to confirm the full depth.

5.1.1 Sensitivity Analysis 1 – Reduced Silt Barrier Thickness

The model results from the first sensitivity run are outlined in Table 5-2 below.

Table 5-2
Sensitivity 1 – Reduced Silt Barrier Thickness

Determinand	Maximum Waste Intake Value (Converted) mg/l	EAL (mg/l)	95th %ile Resultant Concentration (mg/l)	
			Unsaturated Zone	Aquifer
Non-Hazardous Substances[1]				
Chromium	0.041	0.00336	$4.75x10^{-5}$	0.0023
Copper	0.038	1	$2.31x10^{-8}$	0.00085
Nickel	0.04	0.01	0.0012	0.0014
Zinc	0.086	0.043	$4.81x10^{-6}$	0.0057
Sulphate (Undetermined)	298.7	187.5	162.33	71.86
Phenol	0.634	0.0005	0.0046	0.00015
Hazardous Substances[2]				
Arsenic	0.013	0.005	0.0035	0.00168
Cadmium	0.018	0.0025	0.00013	$4.21x10^{-6}$
Mercury	0.0008	0.00001	$5.39x10^{-5}$	$8.71x10^{-6}$
Lead (Undetermined)	0.018	0.005	$6.39x10^{-5}$	$1.57x10^{-4}$ [(a)]
Fluoranthene	0.067	0.0001	0.0038	$6.48x10^{-5}$
Benzene	0.0085	0.00075	0.0025	$7.93x10^{-5}$
Aromatic C10 – C12	3.42	0.005	0.046	0.004

Notes:

[1] 95th percentile resultant concentrations for Non-Hazardous Substances assessed at the down-gradient compliance point (20m down-gradient of the landfill)

[2] 95th percentile resultant concentrations for Hazardous Substances assessed at base of the unsaturated zone

[(a)] results in the aquifer pathway include background groundwater quality at higher concentration than predicted release from site

The following is noted from the results of the LandSim sensitivity analysis on reduced silt barrier thickness:

- There is a potential release of fluoranthene, benzene and aromatic C10-C12 above their respective EALs at the base of the unsaturated zone. However once dilution within the aquifer is taken into account (as provided for in published EPA guidance), the resultant concentrations drop below respective EALs;
- There is also the potential that sulphate and phenol concentrations at the base of the unsaturated zone would be slightly above the respective EALs. However once dilution, dispersion and attenuation in the aquifer are factored in, the predicted concentrations remain well below their EALs; and
- All other substances remain at very low risk and there is no predicted impact from the site.

5.1.2 Sensitivity Analysis 2 – Reduced Aquifer Thickness

The LandSim model has been re-run with a reduced aquifer thickness of 5m. The model results from this sensitivity analysis are presented in Table 5-3 below.

Table 5-3
Sensitivity 2 – Reduced Aquifer Thickness

Determinand	Maximum Waste Intake Value (Converted) mg/l	EAL (mg/l)	95th Percentile Resultant Concentration (mg/l)	
			Unsaturated Zone	Aquifer
Non-Hazardous Substances[1]				
Chromium	0.041	0.00336	$1.04x10^{-5}$	0.0025
Copper	0.038	1	$<1x10^{-10}$	0.00072
Nickel	0.04	0.01	0.00074	0.0014
Zinc	0.086	0.043	$<1x10^{-10}$	0.0058
Sulphate (Undetermined)	298.7	187.5	135.2	73.19
Phenol	0.636	0.0005	$2.28x10^{-5}$	$4.04x10^{-7}$
Hazardous Substances[2]				
Arsenic	0.013	0.005	0.0031	0.0019
Cadmium	0.018	0.0025	0.00011	$7.39x10^{-6}$
Mercury	0.0008	0.00001	$6.88x10^{-6}$	$6.53x10^{-7}$
Lead (Undetermined)	0.018	0.005	$<1x10^{-10}$	0.00015
Fluoranthene	0.067	0.0001	$1.05x10^{-8}$	$<1x10^{-10}$
Benzene	0.0085	0.00075	$9.37x10^{-7}$	$1.59x10^{-8}$
Aromatic C10 – C12	3.42	0.005	0.0041	$9.27x10^{-5}$

Notes:

[1] 95th percentile resultant concentrations for Non-Hazardous Substances assessed at the down-gradient compliance point (20m down-gradient of the landfill)

[2] 95th percentile resultant concentrations for Hazardous Substances assessed at base of the unsaturated zone

[(a)] results in the aquifer pathway include background groundwater quality at higher concentration than predicted release from site

The updated model results indicate that there is no release of non-hazardous or hazardous substances predicted above background levels were the aquifer thickness to be reduced.

5.2 Summary of Modelling Results

The modelling completed for the site has demonstrated that the materials deposited in the restoration of Fassaroe pit will pose no risk to long-term groundwater or surface water quality down-gradient of the site. Sensitivity analysis has also confirmed that even where there are uncertainties within the model parameters, there is still no adverse impact even when highly conservative assumptions are built into the model.

6.0 GROUNDWATER QUALITY REVIEW

A review of background and down-gradient groundwater quality available to date has been completed to assess the current compliance of the restored site. Down-gradient groundwater quality is assessed at boreholes BH02A, located to the east of the site and BH04, BH06 and BH07A to the south.

Monitoring data is summarised in Table 6-1 and Table 6-2, overleaf. A review of the monitoring data and graphs included in Appendix 09 indicates:

- Generally, most down-gradient boreholes are comparable to background up-gradient borehole water quality data;
- While chloride concentrations vary slightly, it is most likely associated with natural variation within sand and gravel deposits. All concentrations are below the assessment criteria of 187.5mg/l and within the expected range for clean groundwater in a coastal environment;
- Sulphate concentrations remain well below the assessment criteria of 187.5mg/l in all boreholes across the site, although concentrations in BH02A are slightly higher when compared with the background data;
- Arsenic concentrations are higher in BH04 compared with background data and is consistently recorded above its assessment criteria of 0.0075mg/l. Concentrations within the other three down-gradient boreholes are comparable to background groundwater and remain below assessment criteria;.
- Ammoniacal nitrogen as N and ammonia (NH_3) concentrations are both consistently recorded slightly above the assessment criteria and background groundwater in down-gradient borehole BH04. BH02 and BH07A have also recorded occasional marginal exceedances of either background groundwater or assessment criteria but overall concentrations in these boreholes are typically comparable to background groundwater.

It is noted that down-gradient borehole BH04 has recorded elevated concentrations of arsenic, ammoniacal nitrogen and ammonia. The other down-gradient boreholes demonstrate 1 or 2 monitoring rounds in 2017 where the assessment criteria of ammonia and ammoniacal nitrogen have been exceeded, but this has not happened since, indicating there is no significant deterioration of concern.

The arsenic maximum WAC levels appear to be equal to the average arsenic groundwater levels seen in BH04. However, the maximum groundwater concentration seen in BH04 for arsenic are higher than the maximum WAC, indicating the site is unlikely to be the source of the higher arsenic concentrations at BH04.

Further review has been conducted on the down-gradient boreholes to determine the source of the arsenic, ammonia and ammoniacal nitrogen recorded at BH04. Graphs of the monitoring data to support the below statements are included in Appendix 9:

- BH04 indicates different geology to the other down-gradient boreholes which might play a part in the different groundwater chemistry noted. The BH04 drilling / well installation record indicates approximately 42m of clay overlying the sands and gravels, whereas the other boreholes are predominantly installed through sand and gravel. The presence of the clay at this depth in BH04 is most likely to induce a lower redox environment which can cause an elevation in arsenic concentrations;
- Oxidation Reduction Potential (ORP) in BH04 generally demonstrates higher negative values than the other boreholes, supporting a low redox environment.
- There is a very clear trend of low nitrate concentrations in BH04, where ammonium concentrations are much higher, and this is not seen at other borehole / well locations. This analysis will also support a low redox environment. Ammonia is calculated based on pH and temperature using ammoniacal nitrogen so both ammonium and ammonia are expected to behave the same.
- It is not possible to do a direct comparison of ammonia / ammonium within the restored site against the groundwater quality as these have are not included within the WAC suite, however given the nature of the deposited materials and the generally low organic content within the deposits, it is considered

unlikely that the site would have high concentrations of ammoniacal nitrogen or ammonia. In addition, given that modelling results suggest that the release of non-hazardous substances from the soil waste body is such as to have no adverse impact on the down-gradient groundwater, it is unlikely that any ammoniacal nitrogen release is taking place from the backfilled site. The most likely source of the elevated ammoniacal nitrogen and ammonia is considered to be from agricultural run-off, it is also noted that higher orthophosphate concentrations were seen in BH04 compared with the other down-gradient boreholes which also suggests agricultural processes to be the most likely source.

The above assessment indicates that the elevated arsenic recorded within BH04 is likely to be naturally occurring and related to redox conditions associated with the overlying clay intercepted by this borehole, and absent from other boreholes including borehole BH06, located in very close proximity.

The source of the elevated ammonia and ammoniacal nitrogen is less clear, however the lack of evidence of any WAC substances being released from the backfilled site, along with the surrounding rural setting suggests that agricultural activity is the most likely source for the elevated concentrations recorded in BH04.

The above assessment confirms that the restored site is not impacting groundwater quality down-gradient of Fassaroe waste recovery facility.

Table 6-1

Down-Gradient Groundwater Quality (BH02A and BH04)

Determinand	Assessment Criteria GW Regulations unless specified (mg/l)	Combined Background (Up-gradient)			BH02A			BH04		
		Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Conductivity (mS/cm)	1.875	0.449	0.571	0.805	0.525	0.567	0.623	0.468	0.558	0.612
pH Value	6.5 - 9.5*	7.46	7.64	7.91	7.59	7.74	7.93	7.86	8.00	8.18
Fluoride (mg/l)	0.8	<0.05	0.228	<0.5	<0.05	0.218	<0.5	<0.05	0.230	<0.5
Chloride (mg/l)	187.5	13.4	17.7	28.0	23.3	25.2	27.9	19.9	21.1	21.9
Sulphate (mg/l)	187.5	17.1	48.7	170	53.8	60.6	68.6	18.9	20.1	21.9
Selenium (mg/l)	0.01*	<0.001	0.001	0.00237	<0.0005	0.00048	<0.001	<0.0005	0.00035	<0.001
Mercury (mg/l)	0.00075	<0.00001	0.00001	<0.00001	<0.00001	0.00001	<0.00001	<0.00001	0.00001	<0.00001
Zinc (mg/l)	0.075	<0.001	0.004	0.0101	<0.001	0.00458	0.0128	<0.001	0.00402	0.00876
Nickel (mg/l)	0.02*	<0.00004	0.001	0.00242	<0.0004	0.00063	0.00129	0.000481	0.00069	0.00119
Lead (mg/l)	0.0075	<0.00002	0.0001	0.000823	<0.0002	0.00015	0.000463	<0.00002	0.00009	<0.0002
Copper (mg/l)	2.00	<0.00003	0.0002	0.00153	<0.0003	0.00038	0.0015	<0.00003	0.00023	0.00108
Antimony (mg/l)	0.005*	<0.0001	0.0002	<0.001	<0.0001	0.00005	<0.0001	<0.0001	0.00011	0.000545
Barium (mg/l)	0.10**	0.0394	0.052	0.0673	0.0336	0.0404	0.0445	0.0623	0.0660	0.0693
Cadmium (mg/l)	0.005*	<0.00008	0.00004	<0.00008	<0.00008	0.00004	<0.00008	<0.00008	0.00004	<0.00008
Chromium (mg/l)	0.0375	<0.001	0.001	0.00336	<0.001	0.00203	0.00597	<0.001	0.0005	<0.001

Determinand	Assessment Criteria GW Regulations unless specified (mg/l)	Combined Background (Up-gradient)			BH02A			BH04		
		Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Arsenic (mg/l)	0.0075	<0.00005	0.0004	0.00122	<0.0005	0.00087	0.00118	0.00855	0.0129	0.0185
Nitrate as NO3 (mg/l)	37.5	1.75	8.48	28.8	5.05	8.19	11.3	<0.3	0.389	2.42
Ammoniacal Nitrogen as N (mg/l)	0.15**	<0.01	0.0350	0.106	0.0137	0.0632	0.166	0.0335	0.236	0.387
Total Ammonia as NH3 (mg/l)	0.212	<0.01	0.0394	0.128	0.0167	0.0537	0.176	0.305	0.415	0.47
Orthophosphate (mg/l)	0.03**	<0.05	0.0282	0.121	<0.05	0.0250	<0.05	<0.05	0.0746	0.215
Total Carbon Organic (diss. filt) (mg/l)	-	<0.016	1.20	<3	<3	1.50	<3	<0.016	1.25	<3
Total Phenols (mg/l)	0.0005**	<0.002	0.007	<0.016	<0.016	0.00800	<0.016	<0.002	0.00660	<0.016

* Drinking Water Standards

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Table 6-2

Down-Gradient Groundwater Quality (BH06 and BH07A)

Determinand	Assessment Criteria GW Regulations unless specified (mg/l)	Combined Background (Up-gradient)			BH06			BH07A		
		Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Conductivity (mS/cm)	1.875	0.449	0.571	0.805	0.413	0.419	0.424	0.458	0.504	0.536
pH Value	6.5 - 9.5*	7.46	7.64	7.91	7.9	7.97	8.04	7.62	7.76	8.02
Fluoride (mg/l)	0.8	<0.05	0.228	<0.5	<0.5	0.250	<0.5	<0.05	0.222	<0.5
Chloride (mg/l)	187.5	13.4	17.7	28.0	15	15.3	15.6	14.7	15.4	16
Sulphate (mg/l)	187.5	17.1	48.7	170	38.3	39.1	39.9	12.5	17.9	26.1
Selenium (mg/l)	0.01*	<0.001	0.001	0.00237	0.00173	0.00179	0.00184	<0.0005	0.00053	<0.001
Mercury (mg/l)	0.00075	<0.00001	0.00001	<0.00001	<0.00001	0.00001	<0.00001	<0.00001	0.00001	<0.00001
Zinc (mg/l)	0.075	<0.001	0.004	0.0101	<0.001	0.00102	0.00153	<0.001	0.00243	0.00445
Nickel (mg/l)	0.02*	<0.00004	0.001	0.00242	<0.0004	0.00033	0.000456	<0.0004	0.00078	0.00209
Lead (mg/l)	0.0075	<0.00002	0.0001	0.000823	<0.00002	0.00006	<0.0002	<0.0002	0.00015	0.000429
Copper (mg/l)	2.00	<0.00003	0.0002	0.00153	<0.0003	0.00024	0.00032	<0.0003	0.00034	0.00135
Antimony (mg/l)	0.005*	<0.0001	0.0002	<0.001	<0.0001	0.00008	0.000118	<0.0001	0.00008	0.000207
Barium (mg/l)	0.10**	0.0394	0.052	0.0673	0.0308	0.0319	0.0329	0.0505	0.0533	0.0568
Cadmium (mg/l)	0.005*	<0.00008	0.00004	<0.00008	<0.00008	0.00004	<0.00008	<0.00008	0.00004	<0.00008
Chromium (mg/l)	0.0375	<0.001	0.001	0.00336	<0.001	0.00077	0.00103	<0.001	0.00057	0.00107

Determinand	Assessment Criteria GW Regulations unless specified (mg/l)	Combined Background (Up-gradient)			BH06			BH07A		
		Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Arsenic (mg/l)	0.0075	<0.00005	0.0004	0.00122	<0.00005	0.00035	0.000675	<0.0005	0.00042	0.000908
Nitrate as NO3 (mg/l)	37.5	1.75	8.48	28.8	2.97	3.09	3.2	1.6	2.81	3.64
Ammoniacal Nitrogen as N (mg/l)	0.15**	<0.01	0.0350	0.106	0.0238	0.0490	0.0742	0.0264	0.0487	0.112
Total Ammonia as NH3 (mg/l)	0.212	<0.01	0.0394	0.128	0.053	0.0530	0.053	0.0321	0.0882	0.202
Orthophosphate (mg/l)	0.03**	<0.05	0.0282	0.121	<0.05	0.0250	<0.05	<0.05	0.0250	<0.05
Carbon Organic (diss.filt) (mg/l)	-	<0.016	1.20	<3	<0.016	0.00800	<0.016	<3	1.50	<3
Total Phenols (mg/l)	0.0005**	<0.002	0.007	<0.016	<0.002	0.00100	<0.002	<0.016	0.00800	<0.016

* Drinking Water Standards

** EPA IGVs

7.0 GENERIC QUANTITATIVE HUMAN HEALTH RISK ASSESSMENT

7.1 Introduction

In order to provide an initial indication of whether the backfilled soil and C&D materials within the former pit void could have the potential to pose a significant risk to human receptors, SLR subjected the relevant laboratory data to a Generic Quantitative Risk Assessment.

7.2 Sample Recovery and Laboratory Analysis

Although extensive laboratory analysis of the materials imported to the site for restoration purposes has been carried out since 2012, it should be noted that the significant majority of this data comprised Waste Acceptance Criteria (WAC) analysis. The available WAC data predominately reports the concentrations of leachable determinands, and as such this information is not directly comparable to available human health assessment criteria which consider the total concentrations of contaminants in soils. However, some of the WAC data, such as polyaromatic hydrocarbons (PAH), BTEX compounds and poly chlorinated biphenyls (PCB), are reported as total concentrations and where these are available they have been considered by this risk assessment.

Notwithstanding the above, SLR was supplied with chemical data relating to samples recovered during a trial pitting investigation undertaken in July 2017. This phase of investigation comprised the mechanical excavation of 12 trial pits, denoted as TP101 to TP112, to depths of up to 5.5m below backfilled ground level (bgl). Trial pit logs and a figure showing trial pit locations across the plan footprint of the backfilled pit are presented in Appendix 02.

As the exploratory hole logs show, Made Ground (backfill) was proven to the final depth of all 12 trial pits. The ground conditions predominantly comprised light brown, brown and sandy gravelly clay with inclusions of gravel, cobble and boulder sized concrete and brick. Occasional inclusions of other fill materials, such as metal, clay pipe, asphalt, plastic, wood, paving slabs and wire were also observed.

Upon completion of the 2017 investigation 12 soil samples were forwarded to an accredited analytical laboratory where they were tested for the following suite of determinands:

- A suite of metals including As, Cd CrIII, CrVI, Cu, Pb, Hg, Ni, Se and Zn;
- Speciated PAH;
- Petroleum hydrocarbons including BTEXs;
- Semi volatile organic compounds (SVOCs);
- Volatile organic compounds (VOCs);
- PCBs;
- Asbestos identification;
- Total Cyanide; and
- pH.

The results of the analysis considered by this assessment are included in full as Laboratory Reports Ref. 17/4299 and 418738 in Appendix 03 of this assessment.

7.3 GRA Assessment Methodology

With regard to the assessment of the results, it should be noted that the Generic Assessment Criteria (GAC) utilised by SLR are drawn from several sources of guidance. SLR uses a combination of assessment criteria that are currently available to assist in the screening of soil data prior to determining whether further action is required. The following assessment criteria have been used for the assessment of contaminants in soil:

- Soil Guideline Values (SGV) – since March 2002, the UK Department for Environment, Food and Rural Affairs (Defra) and the UK Environment Agency have worked on the publication a series of reports that provide a scientifically based framework for the assessment of risks to human health from land contamination;
- LQM / CIEH Generic Assessment Criteria (GAC) – Land Quality Management and the Chartered Institute of Environmental Health have published GACs derived following CLR technical guidance and using the Environment Agency's Contaminated Land Exposure Assessment (CLEA) UK model;
- LQM / CIEH Suitable for Use Levels (S4ULs) – in 2015 Land Quality Management and the Chartered Institute of Environmental Health published Suitable for Use Levels (S4Uls) derived following CLEA technical guidance and using the Environment Agency's CLEA UK model, with updated toxicological and exposure parameters and land-uses following the publication of the draft C4SLs;
- SLR's own in-house screening criteria derived following CLR technical guidance using the CLEA UK model;
- CLAIRE / AGS / EIC Generic Assessment Criteria (GAC) – these institutions have published publicly available GACs derived following CLR technical guidance and using the Environment Agency's CLEA UK model; and
- Category 4 Screening Levels (DEFRA).

The SGVs and GAC have been developed as a guide for regulators and developers; if the concentrations recorded on site are lower than the SGV / GAC it is generally accepted that the contaminants in question are present at acceptable concentrations which are not capable of putting human health at significant risk as long as people make normal use of the site. An exceedance of these values indicates to an assessor that soil contaminant concentrations would need to be considered further. SGV / GAC values combine both authoritative science and policy judgements.

In order to provide an initial indication of whether the tested samples of fill material could pose a risk to future site users, the available laboratory data has been compared to the following GAC that consider a range of potential land uses of varying sensitivity:

- Residential with homegrown produce (RwHP) – considers frequent and prolonged exposure to soils in a residential garden setting within which fruit and vegetables could be grown for consumption. The most sensitive receptor is judged to be a female child between the ages of 0 and 6;
- Public Open Space Park (POS2) – considers infrequent exposure to soils in a park scenario used for "family visits and picnics, a children's play area, sporting activities and dog walking"; and
- Commercial – considers sites predominantly covered by buildings and permanent hardstanding used for commercial/industrial purposes. The most sensitive receptor is judged to be a young female adult of employment age (i.e. 17 years old).

7.4 Results of Soil Assessment

As part of an initial screening exercise, the soil analytical results from the site were grouped together, and the maximum recorded concentration for each contaminant was used as the representative concentration (RC) for consideration in risk assessment. The use of maximum values as RCs is used as a rapid initial screen only; further assessment using 95th percentiles may be used, subject to a normality test of the sample dataset.

The recorded concentrations of PCBs, cyanides and volatile/semi volatile organic compounds (VOC/SVOC) were less than the respective laboratory limits of detection in all tested samples.

A summary of the metal concentrations recorded in the 12 tested soil samples is provided in Table 7-1:

Table 7-1
Comparison of Recorded Metal Concentrations with Selected GACs

Contaminant	No. Tested Samples	Max Conc. (mg/kg)	RwHP GAC (mg/kg)	POS2 GAC (mg/kg)	Commercial GAC (mg/kg)
Arsenic	12	**66.4**	**37**	170	640
Cadmium	12	1.8	11	532	190
Chromium	12	22.4	910	33 000	8600
Chromium CrVI	12	<0.6	6	220	33
Copper	12	76.6	2400	44000	68000
Lead	12	95	200	1300	2330
Mercury	12	0.87	40	240	1100
Nickel	12	39.9	180	3400	980
Selenium	12	<1	250	1800	12000
Zinc	12	115	3700	170 000	730 000

As the above table demonstrate, most of the metal concentrations recorded by the analysis were less than the GACs that considered the most sensitive residential with homegrown produce (RwHP) end use. The only exception was the arsenic concentration of 66.4mg/kg recorded in TP109 that exceeded the RwHP GAC of 37mg/kg.

Based upon this result the Made Ground soils present at the location of TP109 could have the potential to pose a risk to human health if exposed in a private garden area as part of any future residential development of the site. It should be noted however that this concentration was significantly less than the GAC that considered the less sensitive potential public park / open space (POS2) and commercial end uses.

A summary of the PAH concentrations recorded in the 33 tested soil samples is provided in Table 7-2 below.

Table 7-2
Comparison of Recorded PAH Concentrations with Selected GACs

Contaminant	No. tested samples	Max Conc. (mg/kg)	RwHP GAC (mg/kg)	POS2 GAC (mg/kg)	Commercial GAC (mg/kg)
Naphthalene	33	0.16	2.3	1200	190
Acenaphthylene	33	0.10	170	29 000	83 000
Acenaphthene	33	0.10	210	29 000	84 000
Fluorene	33	0.10	170	20 000	63 000
Phenanthrene	33	0.80	95	6200	22 000
Anthracene	33	0.22	2400	150 000	520 000
Fluoranthene	33	1.37	280	6300	23 000
Pyrene	33	1.27	620	15 000	54 000

Contaminant	No. tested samples	Max Conc. (mg/kg)	RwHP GAC (mg/kg)	POS2 GAC (mg/kg)	Commercial GAC (mg/kg)
Benzo(a)anthracene	33	0.66	7.2	49	170
Chrysene	33	0.64	15	93	350
Benzo(b)fluoranthene	33	0.66	2.6	13	44
Benzo(k)fluoranthene	33	0.55	77	370	1200
Benzo(a)pyrene	33	0.64	2.2	11	35
Indeno(123cd)pyrene	33	0.45	27	150	500
Dibenzo(ah)anthracene	33	0.10	0.24	1.1	3.5
Benzo(ghi)perylene	33	0.37	320	1400	3900

As the above tables shows, the concentrations of all tested samples were less than the sensitive residential with homegrown produce (RwHP) GAC criteria and as such the tested soils are not considered to have the potential to pose a significant risk to human health.

A summary of the petroleum hydrocarbon and BTEX concentrations recorded in the tested soil samples is provided in Table 7-3 below:

Table 7-3
Comparison of Recorded TPH and BTEX Concentrations with Selected GACs

Contaminant	No. tested samples	Max Conc. (mg/kg)	RwHP GAC (mg/kg)	POS2 GAC (mg/kg)	Commercial GAC (mg/kg)
GRO C6-C10*	12	**156**	**27**	7200	2000
TPH C10-C25*	12	**233**	**74**	7600	9700
TPH C25-C40*	12	479	1100	7800	28 000
Mineral Oil (C8-C40)*	21	<0.01	27	7200	2000
Benzene	33	0.010	0.38	90	27
Toluene	33	0.070	880	87000	56000
Ethylbenzene	33	0.015	83	17000	5700
m/p-Xylene	33	0.007	82	17000	6200
o-Xylene	33	0.005	88	17000	6600

*- the recorded TPH concentrations have been compared to the *most sensitive* aromatic/aliphatic hydrocarbon fraction

In all instances the recorded concentrations of BTEX compounds and petroleum hydrocarbons from the heavier C25 to C40 carbon range were all less than the corresponding RwHP GAC. However, lighter phase hydrocarbons, from the C6 to C10 gasoline range and from the TPH C10-C25 range, did exceed the RwHP GAC in several of the tested samples and this suggests that these soils could pose a risk to future site users in a residential setting.

When assessing the significance of the recorded petroleum hydrocarbon concentrations, it is important to consider the nature of the test data provided and assessed and that the recovered samples were tested (in the absence of any significant evidence of hydrocarbon contamination) for a banded TPH screen as opposed to fully speciated petroleum hydrocarbon analysis in accordance with the TPH CWG method

In the absence of speciated data, and to ensure a conservative approach to this initial risk assessment, it was therefore necessary to compare the recorded concentrations with the most sensitive GACs for individual aromatic and aliphatic hydrocarbon fractions.

When considering the data set as a whole, in conjunction with the nature of the backfilled soils examined and described in the trial pit logs, it is judged that there is likely to be negligible risk of the soil encountered during the 2017 trial pitting investigation being significantly impacted by hydrocarbons. This hypothesis is supported by the laboratory data provided in Report 418738 that specifically states that neither gasoline or diesel range organic compounds were encountered in any of the twelve tested samples.

7.5 Assessment of Asbestos Risk

Asbestos was not positively identified in any of the 12 samples of backfilled soil material recovered during the trial pitting investigation.

7.6 Risks to Construction Workers

Construction workers involved with any future development of the site are potentially at greater risk from contaminated soils as they are more likely to be subjected to the direct contact and ingestion exposure pathways. However, when considering the results of this initial assessment, it is considered likely that any such risks could be effectively controlled using appropriate personal protective equipment (PPE) and good health and hygiene practices.

Dust inhalation could represent a significant exposure pathway if the soils were to be significantly disturbed during periods of dry weather. However, in line with accepted good practice, appropriate dust suppression measures should be adopted during any such works, irrespective of the presence / absence of contamination.

7.7 Qualitative Ground Gas Risk Assessment

In order to provide an indication of whether the backfilled soil materials placed at the site at Fassaroe could have the potential to represent a significant source of ground gases such as methane and carbon dioxide, a review of the available total organic carbon (TOC) results was undertaken.

The results of the 12 samples recovered by the 2017 trial pitting investigation, as well as the routine WAC testing performed upon materials accepted at the site since 2012, recorded TOC concentrations ranging from between 0.001% and 3.6% with an average content of 0.91%. In only one instance did the recorded TOC concentration exceed the 3% Inert WAC threshold.

When considering that the material imported to the site was not found to contain significant quantities of organic matter, it is concluded that there is a relatively low likelihood that the imported soil waste will provide a source of ground gases with the potential to pose significant risk to human receptors.

7.8 Summary

To provide an initial indication of whether materials placed at the soil waste recovery facility at Fassaroe, Co. Wicklow could have the potential to pose a risk to human health, the results of chemical analysis obtained as part of a 2017 ground investigation were subjected to a generic human health risk assessment.

Recovered samples of the placed backfill material recovered from 12 trial pits were tested for a range of potential contaminants including metals, asbestos and petroleum hydrocarbons. These concentrations were compared to a series of Generic Assessment Criteria (GAC) that considered a range of potential end uses including residential properties with private gardens, an open public park and a commercial / industrial development.

In all instances the concentrations of the determinands tested were less than the corresponding GAC that considered the public park / open space (POS2) and commercial thresholds. With regards to the most sensitive thresholds that considered a residential end use and the consumption of homegrown produce (RwHP), a single arsenic concentration was found to exceed the respective GAC.

Elevated petroleum hydrocarbon concentrations from the lighter C6 to C25 carbon ranges were also recorded in excess of the RwHP GACs, however these exceedances are considered more likely to be as a result of the analytical method employed as opposed to the tested soils being subject to significant hydrocarbon contamination. As the supplied laboratory report stated that both petroleum and diesel range hydrocarbon compounds were not present in any of the tested soils, it is considered likely that it would be possible to definitively dismiss these risks if fully speciated petroleum hydrocarbon data for the materials was available.

In order to ascertain whether the placed fill materials could potentially represent a significant source of ground gases reference was made to the results of Total Organic Carbon (TOC) analysis performed upon 215 tested soil samples. The data identified that the tested materials generally had a relatively low organic matter content that averaged 0.91%. Furthermore, all but one of the tested samples recorded a TOC concentration in excess of the Inert WAC threshold of 3%.

8.0 SITE CLOSURE AND MONITORING

The above assessment confirms that the risk to the groundwater beneath the licensed waste recovery facility at Fassaroe, and therefore other hydraulically connected groundwater and surface water receptors, is very low and there is considered to be no long-term impact on groundwater quality. It is therefore considered that no additional measures are required in respect of the site closure and no long-term monitoring of either groundwater or surface water is considered to be necessary.

The generic quantitative human health risk assessment has indicated that from the available data, the risk to human health from a range of potential development land-uses including private gardens, open park or commercial / industrial development is low and no additional measure for closure or ongoing monitoring is proposed. However, it is noted that further assessment of in-situ soil quality should be undertaken dependent on nature of any future proposals providing for a change of existing land-use.

9.0 SUMMARY AND CONCLUSIONS

SLR Consulting Ltd has been retained by Roadstone to prepare a Risk Assessment in respect of the restored sand and gravel pit at Fassaroe, Co. Wicklow. The site geological / hydrogeological setting has been reviewed and a Conceptual Site Model (CSM) developed for the site.

Based on the CSM, a quantitative assessment was undertaken of the potential impact of the imported soil waste material used to backfill the former pit to original ground level. An assessment of the impact on groundwater, surface water and surface receptors has been undertaken. A generic quantitative human health risk assessment has also been undertaken to assess the potential risk to human health.

To assess the impact on groundwater and surface water receptors a quantitative assessment has been completed using the UK Environment Agency LandSim software. The software has been used to assess the impact of the infilling on down-gradient groundwater quality. The site has been assessed in accordance with the requirements of the Water Framework Directive (2000/60/EC), Groundwater Directive (2006/118/EC) and the European Environmental Objectives (Groundwater) Regulations, 2010.

The assessment indicates that given the nature of the waste input, the attenuation provided by the silty deposits present in the base of the site, the underlying unsaturated zone and the aquifer itself, the predicted impact from the site is considered to be negligible.

Sensitivity analysis indicates that even in the event that the key parameters are extreme worst case, no impact is predicted on down-gradient groundwater quality.

Given that there is no impact predicted in the sand and gravel aquifer (R1) beneath the site, it is also considered that there will be no subsequent impact on the underlying poorly productive aquifer (R2) or the Cookstown River (R3), both of which are considered to be in continuity with the aquifer.

Although the generic quantitative human health risk assessment has indicated a low risk to human health from the restored site, it has indicated that further assessment would be required dependent on the nature of any future development proposals which may provide for a change of existing land-use.

FIGURES

N

0.5km

NOTES

SOURCE: GEOLOGICAL SURVEY IRELAND SPATIAL RESOURCES

ORDNANCE SURVEY IRELAND LICENCE NO. **SU 0000720 (c)**
ORDNANCE SURVEY IRELAND AND GOVERNMENT OF IRELAND

LEGEND

- ROADSTONE LTD. LAND INTEREST (CA. 65.1 HA)
- ROADSTONE LIMITED LAND INTEREST **(c.66.2 HECTARES)**
- LANDS TO BE REMOVED FROM LICENSED SITE AREA **(c.11.7 HECTARES)**
- ENNISKERRY GRAVEL AQUIFER GWB (R1)
- WICKLOW POORLY PRODUCTIVE BEDROCK AQUIFER (R2)
- COOKSTOWN RIVER (R3)

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ROADSTONE LTD.

FASSAROE CONCEPTUAL SITE MODEL, FASSAROE, BRAY, CO. WICKLOW

WATER RECEPTORS

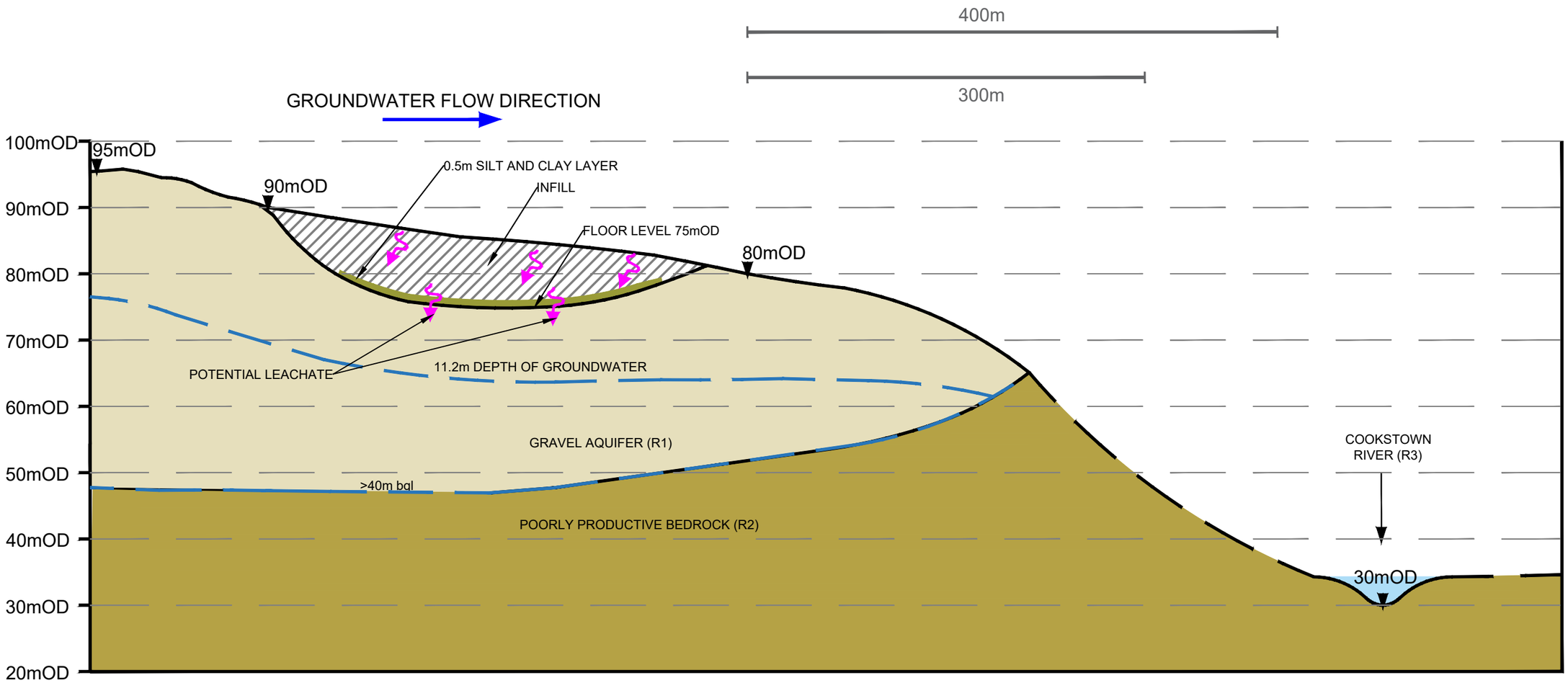
FIGURE 1

Scale 1:8,000 @ A3

Date NOVEMBER 2020

00180.00186.0.Fig 1.Water Receptors.dwg

FASSAROE CONCEPTUAL SITE MODEL



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FASSAROE CONCEPTUAL SITE MODEL, FASSAROE, BRAY, CO. WICKLOW

CONCEPTUAL SITE MODEL

FIGURE 2

Scale	Date
NTS @ A3	NOVEMBER 2020

00180.00186.0.Fig 2.Conceptual Site Model.dwg

APPENDICES

APPENDIX 01

Groundwater Well Installation Details

Glover Site Investigations Ltd

Site: Fassaroe Quarry, Bray, Co. Wicklow			Borehole Number: BH01
Boring Method: Symmetrix & Open Hole Drilling	Casing Diameter: 152mm cased to 21.00m	Ground Level (mOD):	Client: Roadstone Dublin Ltd
	Location:	Dates: 01/12/2008	Engineer: John Barnett & Associates/SLR Consulting Ireland
Job Number: 08-0821			Sheet: 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(21.00)	Brown sandy subangular to subrounded fine to coarse GRAVEL and fine SAND (Driller's description)		
				Water Strike(1) at 18.00m.					▽1
				01/12/2008:		21.00	Complete at 21.00m		

Remarks
Standpipe installed to 21.00m.

Scale (approx)	Logged By
1:200	PD/HH

Figure No.
08-0821.BH01

Glover Site Investigations Ltd

Site: Fassaroe Quarry, Bray. Co. Wicklow

Borehole Number: BH01

Installation Type: Standpipe

Dimensions: Internal Diameter of Tube [A] = 50 mm; Diameter of Filter Zone = 152 mm

Client: Roadstone Dublin Ltd

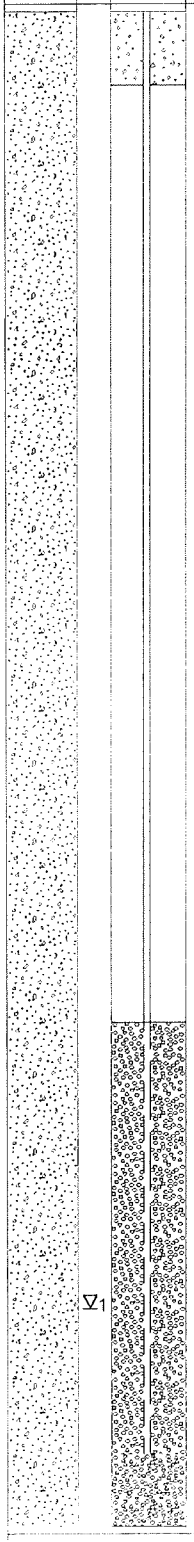
Job Number: 08-0821

Location

Ground Level (mOD)

Engineer: John Barnett & Associates/SLR Consulting Ireland

Sheet: 1/1



Level (mOD)	Depth (m)	Description
	1.00	Concrete
	14.00	Bentonite Seal
	20.00	Slotted Standpipe
	21.00	Gravel Filter

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	Readings 10 min	Readings 15 min	Readings 20 min	Depth Sealed (m)
		18.00		Water Strike					

Groundwater Observations During Drilling

Date	Start of Shift Time	Start of Shift Depth Hole (m)	Start of Shift Casing Depth (m)	Start of Shift Water Depth (m)	Start of Shift Water Level (mOD)	End of Shift Time	End of Shift Depth Hole (m)	End of Shift Casing Depth (m)	End of Shift Water Depth (m)	End of Shift Water Level (mOD)
01/12/08							21.00			

Instrument Groundwater Observations

Inst. [A] Type :

Date	Instrument [A] Time	Instrument [A] Depth (m)	Instrument [A] Level (mOD)	Remarks

Remarks
Upright cover fitted.

Glover Site Investigations Ltd

Site: Fassaroe Quarry, Bray, Co. Wicklow			Borehole Number: BH02
Boring Method: Symmetrix & Open Hole Drilling	Casing Diameter: 152mm cased to 24.00m	Ground Level (mOD):	Client: Roadstone Dublin Ltd
	Location:	Dates: 03/12/2008	Engineer: John Barnett & Associates/SLR Consulting Ireland
Job Number: 08-0821			Sheet: 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(20.00)	Brown sandy subangular to subrounded fine to coarse GRAVEL and very fine SAND (Driller's description)		
				Water Strike(1) at 20.00m.		20.00			▽1
						(4.00)	Brown sandy subangular to subrounded fine to coarse GRAVEL and very fine SAND (Driller's description)		
				03/12/2008:		24.00	Complete at 24.00m		

Remarks
Standpipe installed to 24.00m.

Scale (approx)	Logged By
1:200	PD/HH

Figure No.
08-0821.BH02

Glover Site Investigations Ltd

Site: Fassaroe Quarry, Bray, Co. Wicklow

Borehole Number: BH02

Installation Type: Standpipe

Dimensions: Internal Diameter of Tube [A] = 50 mm; Diameter of Filter Zone = 152 mm

Client: Roadstone Dublin Ltd

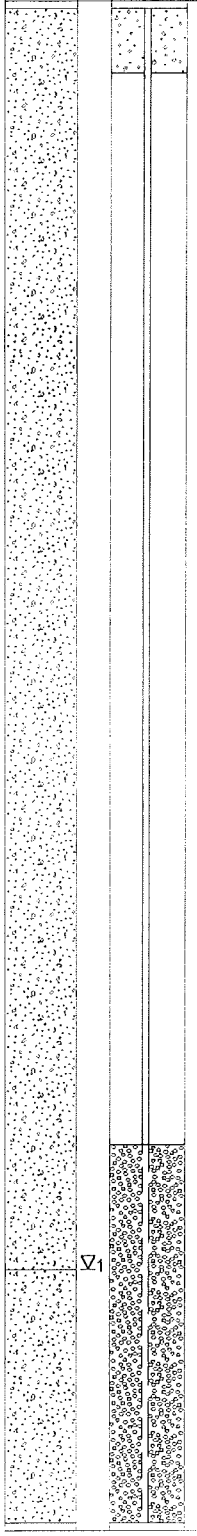
Job Number: 08-0821

Location:

Ground Level (mOD):

Engineer: John Barnett & Associates/SLR Consulting Ireland

Sheet: 1/1



Level (mOD)	Depth (m)	Description
	1.00	Concrete
	18.00	Bentonite Seal
	24.00	Slotted Standpipe

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	Readings 10 min	Readings 15 min	Readings 20 min	Depth Sealed (m)
		20.00		Water Strike					

Groundwater Observations During Drilling

Date	Start of Shift Time	Start of Shift Depth Hole (m)	Start of Shift Casing Depth (m)	Start of Shift Water Depth (m)	Start of Shift Water Level (mOD)	End of Shift Time	End of Shift Depth Hole (m)	End of Shift Casing Depth (m)	End of Shift Water Depth (m)	End of Shift Water Level (mOD)
03/12/08							24.00			

Instrument Groundwater Observations

Inst. [A] Type :

Date	Instrument [A] Time	Instrument [A] Depth (m)	Instrument [A] Level (mOD)	Remarks

Remarks
Upright cover fitted.

BOREHOLE LOG

BOREHOLE No **BH2A**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00270	01/09/2017		

Project: **Fassaroe**

Sheet 1 of 1

SAMPLES & TESTS				Water	STRATA				
Depth	Type No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
1–43				▼ 37.00 ▼ 40.00			(37.00) 37.00 (4.00) 41.00 (2.00) 43.00	SAND and GRAVEL mix. GRAVEL bed Grey SAND Borehole Complete at 43.00m	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling company: Tom Briody & Son. Drill rig: T4. Drilling method unknown. Exact date unknown. Well development tested at 39m at 100gph for 1.5 hours.

All dimensions in metres	Contractor:	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:291	Plant:	Hole Size:		John Fennell

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

Glover Site Investigations Ltd

Site	Borehole Number
Fassaroe Quarry. Bray. Co. Wicklow	BH03

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Symmetrix & Open Hole Drilling	152mm cased to 30.00m		Roadstone Dublin Ltd	08-0821
	Location	**Dates** 09/12/2008	**Engineer** John Barnett & Associates/SLR Consulting Ireland	**Sheet** 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(15.00)	Brown sandy SILT and fine SAND and GRAVEL (Driller's description)		
				Water Strike(1) at 15.00m.		15.00			▽1
						(3.00)	Stiff brown CLAY (Driller's description)		
						18.00			
						(12.00)	Brown gravelly CLAY (Driller's description)		
				09/12/2008:		30.00	Complete at 30.00m		

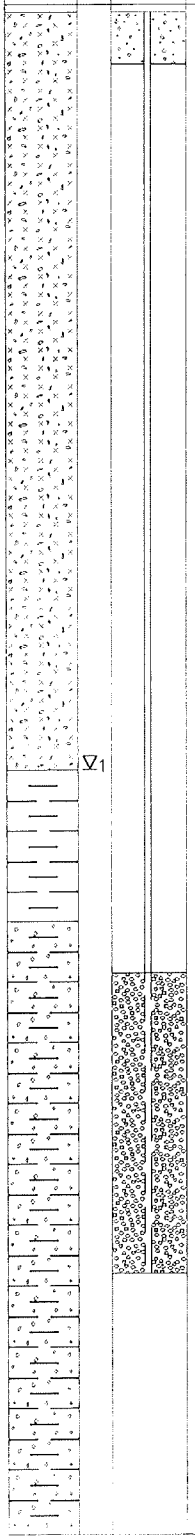
Remarks
Standpipe installed to 30.00m

Scale (approx)	Logged By
1:200	PD/HH

Figure No.
08-0821.BH03

Glover Site Investigations Ltd

Site: Fassaroe Quarry, Bray, Co. Wicklow		Borehole Number: BH03
Installation Type: Standpipe	Dimensions: Internal Diameter of Tube [A] = 50 mm; Diameter of Filter Zone = 152 mm	Client: Roadstone Dublin Ltd
		Job Number: 08-0821
Location	Ground Level (mOD)	Engineer: John Barnett & Associates/SLR Consulting Ireland
		Sheet: 1/1



Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	Readings 10 min	Readings 15 min	Readings 20 min	Depth Sealed (m)
		15.00		Water Strike					

Groundwater Observations During Drilling

Date	Start of Shift Time	Start of Shift Depth Hole (m)	Start of Shift Casing Depth (m)	Start of Shift Water Depth (m)	Start of Shift Water Level (mOD)	End of Shift Time	End of Shift Depth Hole (m)	End of Shift Casing Depth (m)	End of Shift Water Depth (m)	End of Shift Water Level (mOD)
09/12/08							30.00			

Instrument Groundwater Observations

Inst. [A] Type :

Date	Instrument [A] Time	Instrument [A] Depth (m)	Instrument [A] Level (mOD)	Remarks

Remarks
Upright cover fitted.

BOREHOLE LOG

BOREHOLE No **BH4**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00270	28/11/2011		

Project: **Fassaroe**

Sheet 1 of 1

SAMPLES & TESTS				Water	STRATA				
Depth	Type No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
1–54				▼ 42.00			(4.00) 4.00	Boulder CLAY	
							(4.00) 8.00	Stiff brown CLAY	
							(2.00) 10.00	Light brown CLAY and SAND	
							(5.00) 15.00	Stiff brown CLAY	
							(2.00) 17.00	Light brown CLAY and SAND	
							(3.00) 20.00	Darker coloured hard CLAY	
							(5.00) 25.00	Dark, solid MUDSTONE type ground	
							(2.00) 27.00	Light brown CLAY and SAND	
							(3.00) 30.00	Very broken with loss of air circulation	
							(9.00) 39.00	More competent CLAY	
							(3.00) 42.00	Broken with stones	
							(13.00) 55.00	Fine SAND with water and stones	
								Borehole Complete at 55.00m	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling company: Patrick Briody & Sons Ltd. Drill rig: Kmebel. Drilling method unknown. Backfill details: 0-37m is cement, 37-38m is sand & bentonite. Well developed for one hour. Installation (plain/slotted) not noted, assumed to be placed corresponding to gravel backfill.

All dimensions in metres	Contractor:	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:366	Plant:	Hole Size:		

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **BH5**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00270	01/04/2017		

Project: **Fassaroe**

Sheet 1 of 1

SAMPLES & TESTS				Water	STRATA				
Depth	Type No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
							(4.00) 4.00	Brown/ grey slightly gravelly, poorly sorted SAND. Gravels sub-angular and small to large pebble sized.	
							(5.50) 9.50	Brown/ grey slightly gravelly, poorly sorted SAND. Gravels sub-angular and small to large pebble sized. Gravel content increases with depth.	
							(2.00) 11.50	Brown/ beige, poorly to moderately sorted sandy GRAVEL.	
							(6.50) 18.00	Brown/ grey slightly gravelly SAND. Gravels are cobble sized and sub-angular.	
							(2.00) 20.00	Brown/ grey slightly gravelly SAND. Gravels are cobble sized and sub-angular. Gravel content and grain size (large cobbles) increases with depth.	
							(1.50) 21.50	Brown/ grey very gravelly SAND. Sand is fine to medium.	
							(8.50) 30.00	Poorly sorted, fine to medium sandy GRAVEL.	
								Borehole Complete at 30.00m	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Top of backfill is drill cuttings/ arisings.

All dimensions in metres	Contractor:	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:216	Plant:	Hole Size:		

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **BH6**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00270	01/04/2017		

Project: **Fassaroe**

Sheet 1 of 1

SAMPLES & TESTS				Water	STRATA				
Depth	Type No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
1–2							(2.00) 2.00	Brown/ grey slightly gravelly, poorly sorted SAND. Gravel sub-rounded to rounded. Occasionally some clay dispersed through the material.	
3–4							(2.50) 4.50	Brown/ grey gravelly, poorly sorted SAND. Gravel sub-rounded to rounded. Gravels getting larger. Occasionally some clay dispersed through the material.	
5–16							(12.50) 17.00	Brown/ grey very sandy GRAVEL. Gravels are cobble size and sub-angular.	
17–24							(7.00) 24.00	Beige fine to very fine, poorly sorted SAND.	
25							(2.00) 26.00	Poorly sorted, very sandy GRAVEL	
26–27				▼			(2.00) 28.00	Lense of brown, well sorted, rounded gravels.	
28–29							(2.00) 30.00	Poorly sorted, very sandy GRAVEL	
30–32								Borehole Complete at 30.00m	?

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Top of backfill is drill cuttings/ arisings.

All dimensions in metres	Contractor:	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:216	Plant:	Hole Size:		

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **BH7**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00270	01/04/2017	81.00m	E723823 N717460

Project: **Fassaroe**

Sheet 1 of 1

SAMPLES & TESTS				Water	STRATA				
Depth	Type No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
1–5					76.00		(5.00) 5.00	Brown/ grey slightly gravelly, poorly sorted coarse SAND. Gravels occasional and dispersed through the sand matrix, sub-angular to rounded. Some clay present.	
6–8					72.50		(3.50) 8.50	Brown/ grey slightly gravelly, very poorly sorted coarse SAND. Slightly more gravels and rounded cobbles. Finer gravel lense present. Some clay present.	
9–16					65.00		(7.50) 16.00	Beige fine to very fine SAND.	
17–20					60.50		(4.50) 20.50	Grey poorly sorted sandy GRAVEL. Gravels larger with increasing depth. Gravels rounded.	
21–30					51.00		(9.50) 30.00	Beige fine, well sorted SAND.	
31–32								Borehole Complete at 30.00m	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. No water strike. Top of backfill is drill cuttings/ arisings.

All dimensions in metres	Contractor:	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:216	Plant:	Hole Size:		

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **BH7A**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00270	01/09/2017		

Project: **Fassaroe**

Sheet 1 of 1

SAMPLES & TESTS				Water	STRATA				
Depth	Type No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
1–51							(39.60)	SAND and GRAVEL mix.	
							39.60		
							(9.40)	GRAVEL and stones	
							49.00		
								Borehole Complete at 49.00m	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling company: Tom Briody & Son. Drill rig: T4. Drilling method unknown. Exact date unknown. Top of backfill is drill cuttings/ arisings. Well development tested at 38m at 60gph for 0.5 hours, and at 46m at 120gph for 1 hour.

All dimensions in metres	Contractor:	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:341	Plant:	Hole Size:		John Fennell

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **BH8**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00270	01/04/2017		

Project: **Fassaroe**

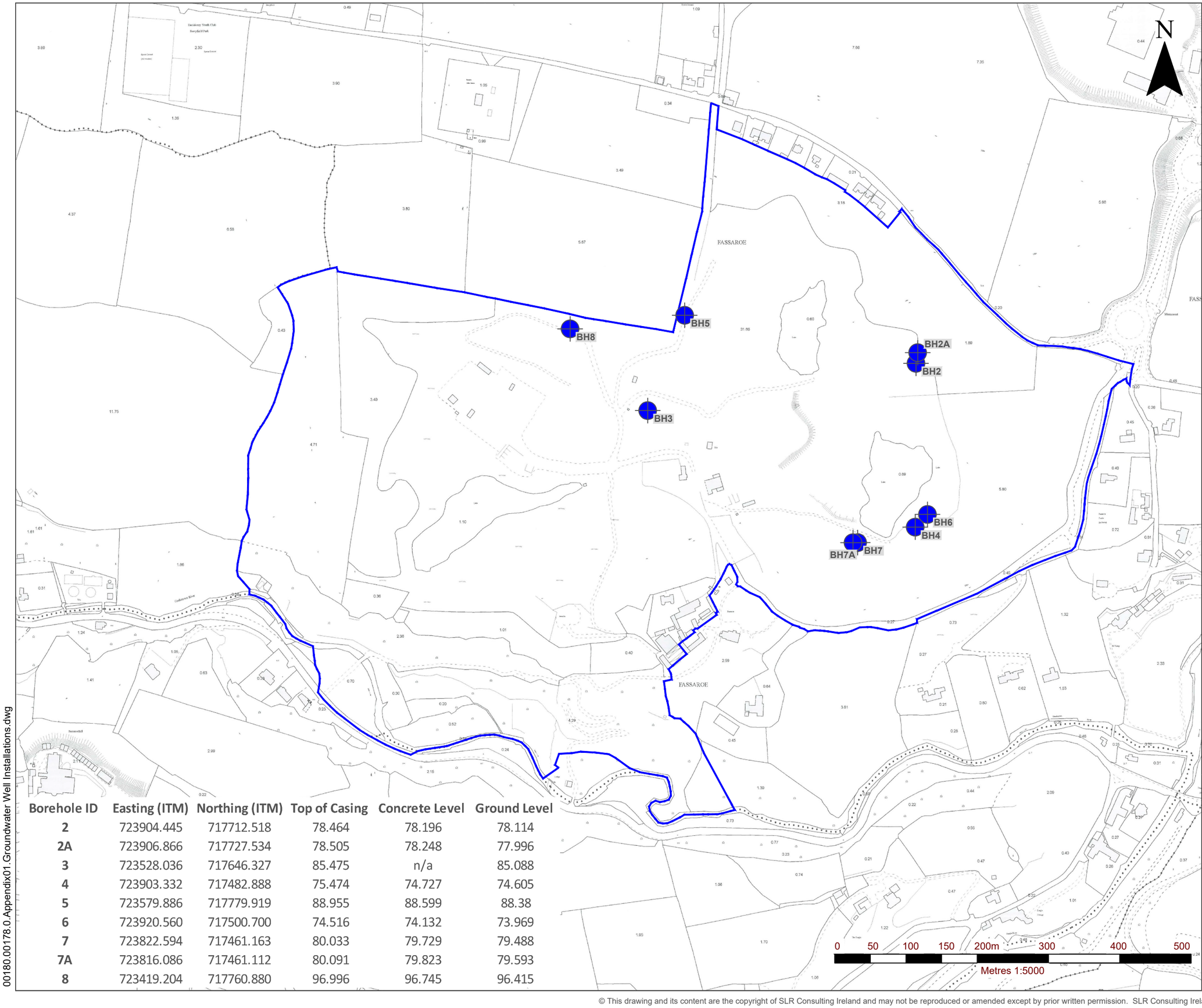
Sheet 1 of 1

SAMPLES & TESTS				Water	STRATA				
Depth	Type No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
1–9							(10.00)	Brown/ grey slightly gravelly, poorly sorted coarse SAND. Gravels are sub-angular to rounded comprising small to large pebbles.	
10							10.00		
10–15							(6.00)	Brown/ grey slightly gravelly, poorly sorted coarse SAND. Gravels are sub-angular to rounded comprising small to large pebbles. Gravel content increases with depth.	
16							16.00		
16–18							(3.00)	Sandy GRAVEL. Gravels comprising small and large cobbles. Sand conent comprising medium to coarse grains.	
19							19.00		
19–29							(21.00)	Poorly sorted gravelly SAND. Gravel content comprising small to large, sub-angular to rounded pebbles.	
30–39				▼			40.00		
								Borehole Complete at 40.00m	?

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Also labelled BH03A. Drilling method unknown. Top of backfill is drill cuttings/ arisings.

All dimensions in metres	Contractor:	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:266	Plant:	Hole Size:		

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015



Borehole ID	Easting (ITM)	Northing (ITM)	Top of Casing	Concrete Level	Ground Level
2	723904.445	717712.518	78.464	78.196	78.114
2A	723906.866	717727.534	78.505	78.248	77.996
3	723528.036	717646.327	85.475	n/a	85.088
4	723903.332	717482.888	75.474	74.727	74.605
5	723579.886	717779.919	88.955	88.599	88.38
6	723920.560	717500.700	74.516	74.132	73.969
7	723822.594	717461.163	80.033	79.729	79.488
7A	723816.086	717461.112	80.091	79.823	79.593
8	723419.204	717760.880	96.996	96.745	96.415

NOTES

1. EXTRACT FROM ORDNANCE SURVEY 6 INCH MAP NO'S. **WW003 & WW007**

2. ORDNANCE SURVEY IRELAND LICENCE NO. **SU 0000720 (C)** ORDNANCE SURVEY & GOVERNMENT OF IRELAND

LEGEND

ROADSTONE LIMITED LAND INTEREST (c.71.3 HECTARES)

BH6 BOREHOLE LOCATION

SLR CONSULTING IRELAND
7 DUNDRUM BUSINESS PARK
WINDY ARBOUR
DUBLIN 14
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www.slrconsulting.com

ROADSTONE LIMITED

FASSAROE WASTE RECOVERY FACILITY
FASSAROE, BRAY, CO. WICKLOW

GROUNDWATER WELL INSTALLATIONS

APPENDIX 01

Scale: 1:5,000 @ A3

Date: OCTOBER 2020

00180.00178.0.Appendix01.Groundwater Well Installations.dwg

APPENDIX 02

SLR Trial Pit Logs (July 2017)

Trial Pit Log

Trialpit No
Trial Pit 101
Sheet 1 of 1

Project Name: Fassaroe Waste Licence Review Application	Project No. 501.00180.00186	Co-ords: 723757.00 - 717840.00 Level:	Date 20/07/2017
Location: Fassaroe, Co. Wicklow		Dimensions (m): Depth 4.20	Scale 1:25
Client: Roadstone			Logged

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.10			Friable with rootlets
				0.50			Friable, medium grey brown, silty SOIL with frequent sub rounded cobbles
							Stiff, medium dark brown to black, sandy gravelly CLAY. Boulder Clay.
				4.20			End of pit at 4.20 m

1
2
3
4
5

Remarks: Inclusions: Concrete bricks, red brick, rootlets, rare plastic bags, 1 steel cable, wood.
Dry / No water
Stable

Stability:

Trial Pit Log

Trialpit No
Trial Pit 102
Sheet 1 of 1

Project Name: Fassaroe Waste Licence Review Application	Project No. 501.00180.00186	Co-ords: 723733.00 - 717795.00 Level:	Date 20/07/2017
Location: Fassaroe, Co. Wicklow		Dimensions (m): Depth 4.90	Scale 1:25
Client: Roadstone			Logged

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Generally soft, friable, medium grey brown, sandy gravelly CLAY with frequent cobbles and rare boulders.
				1.00			Generally firm, friable, medium dark brown and black, sandy CLAY with some to many cobbles and boulders. Boulder Clay.
				4.90			End of pit at 4.90 m

1 2 3 4 5

Remarks: Inclusions: Concrete bricks, 1 red brick, 1 piece of steel cable, 1 iron grill.
Dry / No water
Stable. Small volumes of material spalling down.

Stability:

Trial Pit Log

Trialpit No
Trial Pit 103
Sheet 1 of 1

Project Name:	Fassaroe Waste Licence Review Application	Project No. 501.00180.00186	Co-ords: 723773.00 - 717754.00 Level:
Location:	Fassaroe, Co. Wicklow	Dimensions (m): Depth 4.60	Date 20/07/2017 Scale 1:25
Client:	Roadstone		Logged

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Generally firm to stiff, medium brown, sandy CLAY with occasional cobbles.
				1.00			Generally firm to stiff, medium dark brown and black, sandy CLAY with frequent cobbles and rare boulders. (Boulders of black asphalt).
				3.50			Soft to firm, medium light brown, very sandy CLAY (quartz and mica grains). Granitic Sand.
				4.00			Generally firm to stiff, medium brown grey, sandy CLAY.
				4.60			End of pit at 4.60 m

1
2
3
4
5

Remarks: Inclusions: Small plastic pieces, red and yellow brick, wood, broken pavement/asphalt, concrete boulders (more than previous).
Partial tree obstruction
Dry / No water
Stable

Stability:

Trial Pit Log

Trialpit No
Trial Pit 104
Sheet 1 of 1

Project Name: Fassaroe Waste Licence Review Application	Project No. 501.00180.00186	Co-ords: 723735.00 - 717715.00 Level:	Date 20/07/2017
Location: Fassaroe, Co. Wicklow		Dimensions (m): Depth 4.30	Scale 1:25
Client: Roadstone			Logged

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
							Generally firm, medium light brown, sandy gravelly CLAY with frequent cobbles.
				0.50			Generally firm to stiff, medium dark brown to black (mottled), sandy CLAY with frequent cobbles and occasional granite boulders.
				4.30			End of pit at 4.30 m

Remarks: Inclusions: Plant/tree, red brick, concrete blocks, plywood, granite boulders, wood, 1 large concrete column, tubing, cable, plastic.
Dry / No water
Unstable. Significant over break on western face.

Stability:

Trial Pit Log

Trialpit No
Trial Pit 105
Sheet 1 of 1

Project Name: Fassaroe Waste Licence Review Application	Project No. 501.00180.00186	Co-ords: 723800.00 - 717673.00 Level:	Date 20/07/2017
Location: Fassaroe, Co. Wicklow		Dimensions (m): Depth 4.90	Scale 1:25
Client: Roadstone			Logged

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Generally firm to stiff, medium light brown grey, sandy CLAY with occasional cobbles and boulders.
				1.50			Generally firm to stiff, dark brown to black, sandy CLAY with occasional to frequent cobbles and boulders.
				4.90			End of pit at 4.90 m

1
2
3
4
5

Remarks: Inclusions: Red bricks, plastic, roots, 1 steel pipe (50cm long), asphalt, 1 paving slab, concrete bricks.
Dry / No water
Stable

Stability:

Trial Pit Log

Trialpit No
Trial Pit 106
Sheet 1 of 1

Project Name: Fassaroe Waste Licence Review Application	Project No. 501.00180.00186	Co-ords: 723754.00 - 717631.00 Level:	Date 20/07/2017
Location: Fassaroe, Co. Wicklow		Dimensions (m): Depth 5.00	Scale 1:25
Client: Roadstone			Logged

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Generally firm to stiff, medium light brown, sandy CLAY with occasional cobbles and rare boulders.
				1.50			Generally firm to stiff, dark brown and black, sandy CLAY with occasional to frequent cobbles and boulders.
				5.00			End of pit at 5.00 m

1
2
3
4
5

Remarks: Inclusions: Concrete boulders, 1 metal paint can, 1 porcelain frame, roots, red and yellow bricks, 1 orange plastic pipe.
Dry / No water
Stable

Stability:

Trial Pit Log

Trialpit No
Trial Pit 107
Sheet 1 of 1

Project Name: Fassaroe Waste Licence Review Application	Project No. 501.00180.00186	Co-ords: 723824.00 - 717616.00 Level:	Date 20/07/2017
Location: Fassaroe, Co. Wicklow		Dimensions (m): Depth 5.00	Scale 1:25
Client: Roadstone			Logged

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
							Generally firm to stiff, medium light brown, sandy CLAY with occasional to frequent cobbles. Rare boulders.
				1.50			Generally firm to stiff, dark brown and black, sandy CLAY with occasional cobbles and rare boulders. One 10cm wide lens of medium light grey, very sandy clay (weathered granite), @3m.
				5.00			End of pit at 5.00 m

1
2
3
4
5

Remarks: Inclusions: 1 plastic piping, steel wire, roots, bricks.
Dry / No water
Stable

Stability:

Trial Pit Log

Trialpit No
Trial Pit 108
Sheet 1 of 2

Project Name: Fassaroe Waste Licence Review Application	Project No. 501.00180.00186	Co-ords: 723772.00 - 717558.00 Level:	Date 21/07/2017
Location: Fassaroe, Co. Wicklow		Dimensions (m): Depth 5.50	Scale 1:25
Client: Roadstone			Logged

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				1.50			Stiff to firm, light to medium brown, sandy CLAY with frequent to numerous cobbles.
							Stiff to firm, dark brown (slight black mottling), sandy CLAY with frequent to occasional cobbles to boulders.
							Continued on next sheet

1
2
3
4
5

Remarks: Inclusions: Granite boulders, 2 pieces of red and yellow brick, wood, plastic bags, 2 concrete boulders.
Dry / No water
Stable, with 1 collapse on 1 side.

Stability:

AGS

Trial Pit Log

Trialpit No
Trial Pit 108
Sheet 2 of 2

Project Name: Fassaroe Waste Licence Review Application	Project No. 501.00180.00186	Co-ords: 723772.00 - 717558.00 Level:	Date 21/07/2017
Location: Fassaroe, Co. Wicklow		Dimensions (m): Depth 5.50	Scale 1:25
Client: Roadstone			Logged

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				5.50			End of pit at 5.50 m

6
7
8
9
10

Remarks: Inclusions: Granite boulders, 2 pieces of red and yellow brick, wood, plastic bags, 2 concrete boulders.
Dry / No water
Stable, with 1 collapse on 1 side.

Stability:

Trial Pit Log

Trialpit No
Trial Pit 109
Sheet 1 of 2

Project Name: Fassaroe Waste Licence Review Application	Project No. 501.00180.00186	Co-ords: 723839.00 - 717586.00 Level:	Date 21/07/2017
Location: Fassaroe, Co. Wicklow		Dimensions (m): Depth 5.50	Scale 1:25
Client: Roadstone			Logged

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Firm to stiff, light brown, sandy gravelly CLAY with numerous cobbles.
				0.50			Firm to stiff, medium brown (slight black mottling), sandy gravelly CLAY with frequent cobbles and occasional boulders. Minor pockets of highly weathered granite/ granitic sand.
				3.50			Firm to stiff, dark brown to black, sandy CLAY lens.
				3.70			Firm to stiff, medium dark brown, sandy CLAY with occasional cobbles.
							Continued on next sheet

1 2 3 4 5

Remarks:

Stability:

Trial Pit Log

Trialpit No
Trial Pit 109
Sheet 2 of 2

Project Name: Fassaroe Waste Licence Review Application	Project No. 501.00180.00186	Co-ords: 723839.00 - 717586.00 Level:	Date 21/07/2017
Location: Fassaroe, Co. Wicklow		Dimensions (m): Depth 5.50	Scale 1:25
Client: Roadstone			Logged

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				5.50			End of pit at 5.50 m

Remarks:

Stability:

Trial Pit Log

Trialpit No
Trial Pit 110
Sheet 1 of 1

Project Name:	Fassaroe Waste Licence Review Application	Project No. 501.00180.00186	Co-ords: 723881.00 - 717586.00 Level:	Date 21/07/2017
Location:	Fassaroe, Co. Wicklow		Dimensions (m): Depth 5.00	Scale 1:25 Logged
Client:	Roadstone			

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
							Firm to stiff, medium light brown, sandy CLAY with numerous cobbles.
				1.00			Firm to stiff, medium dark brown (mottled black), sandy CLAY with frequent cobbles and occasional to rare boulders. Common black and yellow mottled clay pockets throughout.
				5.00			End of pit at 5.00 m

1
2
3
4
5

Remarks:

Stability:

Trial Pit Log

Trialpit No
Trial Pit 111
Sheet 1 of 1

Project Name: Fassaroe Waste Licence Review Application	Project No. 501.00180.00186	Co-ords: 723896.00 - 717543.00 Level:	Date 21/07/2017
Location: Fassaroe, Co. Wicklow		Dimensions (m): Depth 4.50	Scale 1:25
Client: Roadstone			Logged

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Firm to stiff, medium light brown, sandy gravelly CLAY with occasional to frequent cobbles. Dry.
				2.00			Soft to firm, medium light grey brown, sandy CLAY layer.
				2.30			Soft to very soft, grey, sandy very gravelly CLAY. Wet to damp, very weak - collapsing.
				2.50			Soft, dark brown (mottled black), gravelly CLAY with occasional cobbles.
				4.50			End of pit at 4.50 m

Remarks: Inclusions: Small bits of wood, minor asphalt (less than previous), trace bits of plaster.
Wet from 2m.
Very unstable - continuously collapsing.

Stability:

Trial Pit Log

Trialpit No
Trial Pit 112
Sheet 1 of 1

Project Name: Fassaroe Waste Licence Review Application	Project No. 501.00180.00186	Co-ords: 723850.00 - 717522.00 Level:	Date 21/07/2017
Location: Fassaroe, Co. Wicklow		Dimensions (m): Depth 4.50	Scale 1:25
Client: Roadstone			Logged

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Soft to firm, medium brown (mottled black) sandy gravelly CLAY with frequent to occasional cobbles and occasional to rare boulders.
				3.50			Soft, medium light grey brown, clayey SAND. Fine sand. No visible cobbles/gravels.
				4.50			End of pit at 4.50 m

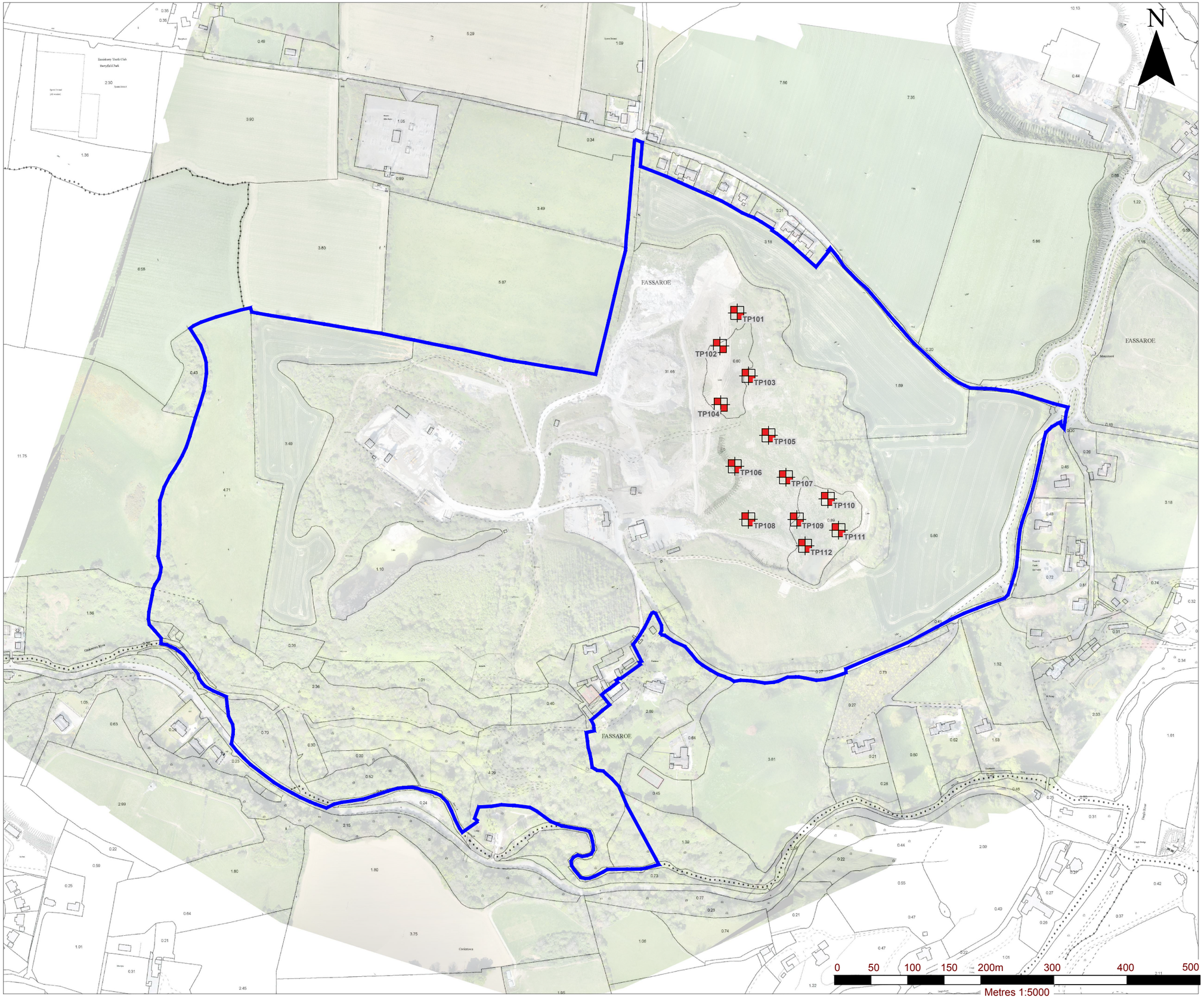
1
2
3
4
5

Remarks: Inclusions: Wood, rootlets, 1 piece of plastic piping, orange clay piping, 2 pieces white tile, asphalt, red brick.
Wet to damp throughout.
Very unstable - collapsing.

Stability:

AGS

DRAFT FOR REVIEW



NOTES

1. EXTRACT FROM ORDNANCE SURVEY 6 INCH MAP NO'S. **WW003 & WW007**

2. ORDNANCE SURVEY IRELAND LICENCE NO. **SU 0000717 (C)** ORDNANCE SURVEY & GOVERNMENT OF IRELAND

LEGEND

ROADSTONE LIMITED LAND INTEREST (c.71.3 HECTARES)

TP101 PROPOSED TRIAL PIT LOCATION

Trial Pit ID	Easting (ITM)	Northing (ITM)
TP101	723757	717840
TP102	723733	717795
TP103	723773	717754
TP104	723735	717715
TP105	723800	717673
TP106	723754	717631
TP107	723824	717616
TP108	723772	717558
TP109	723839	717558
TP110	723881	717586
TP111	723896	717543
TP112	723850	717522

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ROADSTONE LIMITED

FASSAROE BOREHOLE LOCATIONS
FASSAROE, BRAY, CO. WICKLOW

SITE LAYOUT MAP
TRIAL PIT LOCATIONS

FIGURE 1

Scale: 1:5,000 @ A3

Date: AUGUST 2017

00180.00186.0.Site Layout Plan - Trial Pit Locations.dwg

APPENDIX 03

Laboratory Analysis Reports (Soil Quality)

Exova Jones Environmental

Registered Address : Exova (UK) Ltd, Lochend Industrial Estate, Newbridge, Midlothian, EH28 8PL

Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

Tel: +44 (0) 1244 833780
Fax: +44 (0) 1244 833781

Roadstone Ltd
Roadstone Inert Waste Recovery Facility
Huntstown Quarry
North Road
Finglas
Dublin 11
DA11 A337

Attention :	Leonard Grogan
Date :	8th March, 2017
Your reference :	
Our reference :	Test Report 17/4299 Batch 1
Location :	Fassaroe
Date samples received :	21st February, 2017
Status :	Final report
Issue :	1

Twenty one samples were received for analysis on 21st February, 2017 of which twenty one were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Where Waste Acceptance Criteria Suite (EC Decision of 19 December 2002 (2003/33/EC)) has been requested, all analyses have been performed using the relevant EN methods where they exist.

Compiled By:

Phil Sommerton BSc
Project Manager

Client Name: Roadstone Ltd
Reference:
Location: Fassaroe
Contact: Leonard Grogan
JE Job No.: 17/4299

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	1	2	3	4	5	6	7	8	9	10	LOD/LOR	Units	Method No.
Sample ID	TP201	TP201	TP201	TP202	TP202	TP202	TP203	TP203	TP203	TP204			
Depth	0.00-1.00	1.00-2.00	2.00-3.00	0.00-1.00	1.00-2.00	2.00-3.00	0.00-1.00	1.00-2.00	2.00-3.00	0.00-1.00			
COC No / misc													
Containers	J	J	J	J	J	J	J	J	J	J			
Sample Date	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017			
PAH MS													
Naphthalene #	<0.04	<0.04	<0.04	<0.04	<0.04	0.16	0.05	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Acenaphthylene	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.10	<0.03	mg/kg	TM4/PM8
Acenaphthene #	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM4/PM8
Fluorene #	<0.04	<0.04	<0.04	<0.04	<0.04	0.06	0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Phenanthrene #	0.03	<0.03	0.04	0.05	<0.03	0.18	0.40	<0.03	0.05	0.11	<0.03	mg/kg	TM4/PM8
Anthracene #	<0.04	<0.04	<0.04	<0.04	<0.04	0.07	0.13	<0.04	<0.04	0.08	<0.04	mg/kg	TM4/PM8
Fluoranthene #	0.07	0.06	0.05	0.07	<0.03	0.24	0.61	<0.03	0.18	0.32	<0.03	mg/kg	TM4/PM8
Pyrene #	0.05	0.05	0.04	0.07	<0.03	0.20	0.50	<0.03	0.17	0.46	<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene #	<0.06	<0.06	<0.06	0.09	<0.06	0.15	0.33	<0.06	0.15	0.25	<0.06	mg/kg	TM4/PM8
Chrysene #	0.04	0.03	0.03	0.05	<0.02	0.12	0.30	<0.02	0.12	0.22	<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	0.08	<0.07	<0.07	0.09	<0.07	0.23	0.46	<0.07	0.22	0.30	<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	<0.04	<0.04	<0.04	0.06	<0.04	0.13	0.30	<0.04	0.14	0.19	<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene #	<0.04	<0.04	<0.04	<0.04	<0.04	0.09	0.18	<0.04	0.08	0.10	<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.05	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	<0.04	<0.04	<0.04	<0.04	<0.04	0.07	0.14	<0.04	0.06	0.10	<0.04	mg/kg	TM4/PM8
Coronene	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
PAH 6 Total #	<0.22	<0.22	<0.22	0.22	<0.22	0.76	1.69	<0.22	0.68	1.01	<0.22	mg/kg	TM4/PM8
PAH 17 Total	<0.64	<0.64	<0.64	<0.64	<0.64	1.70	3.49	<0.64	1.17	2.23	<0.64	mg/kg	TM4/PM8
Benzo(b)fluoranthene	0.06	<0.05	<0.05	0.06	<0.05	0.17	0.33	<0.05	0.16	0.22	<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	0.02	<0.02	<0.02	0.03	<0.02	0.06	0.13	<0.02	0.06	0.08	<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	103	97	101	100	100	101	101	100	101	100	<0	%	TM4/PM8
Mineral Oil >C8-C10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	mg/kg	TM5/PM16
Mineral Oil >C10-C12	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	mg/kg	TM5/PM16
Mineral Oil >C12-C16	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	mg/kg	TM5/PM16
Mineral Oil >C16-C21	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	mg/kg	TM5/PM16
Mineral Oil >C21-C40	<10	<10	28	<10	<10	<10	<10	<10	<10	<10	<10	mg/kg	TM5/PM16
Mineral Oil >C8-C40	<45	<45	<45	<45	<45	<45	<45	<45	<45	<45	<45	mg/kg	TM5/PM16
MTBE #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM31/PM12
Benzene #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM31/PM12
Toluene #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM31/PM12
Ethylbenzene #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM31/PM12
m/p-Xylene #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM31/PM12
o-Xylene #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM31/PM12
PCB 28 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 52 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 101 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 118 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 138 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 153 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 180 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8

Please see attached notes for all abbreviations and acronyms

Client Name: Roadstone Ltd
Reference:
Location: Fassaroe
Contact: Leonard Grogan
JE Job No.: 17/4299

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	1	2	3	4	5	6	7	8	9	10	LOD/LOR	Units	Method No.
Sample ID	TP201	TP201	TP201	TP202	TP202	TP202	TP203	TP203	TP203	TP204			
Depth	0.00-1.00	1.00-2.00	2.00-3.00	0.00-1.00	1.00-2.00	2.00-3.00	0.00-1.00	1.00-2.00	2.00-3.00	0.00-1.00			
COC No / misc													
Containers	J	J	J	J	J	J	J	J	J	J			
Sample Date	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017			
Total 7 PCBs #	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	ug/kg	TM17/PM8
Natural Moisture Content	8.5	13.9	9.3	13.1	11.8	3.1	5.6	11.1	7.6	8.0	<0.1	%	PM4/PM0
% Dry Matter 105°C	87.3	82.4	88.2	90.1	86.3	89.3	85.3	85.7	85.3	82.3	<0.1	%	NONE/PM4
Total Organic Carbon #	1.12	1.39	0.83	0.79	1.15	0.18	1.78	1.69	0.65	1.82	<0.02	%	TM21/PM24
Mass of raw test portion	0.1028	0.1095	0.1016	0.0999	0.1043	0.1009	0.1054	0.1047	0.1051	0.1089		kg	NONE/PM17
Mass of dried test portion	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09		kg	NONE/PM17

Please see attached notes for all abbreviations and acronyms

Client Name: Roadstone Ltd
Reference:
Location: Fassaroe
Contact: Leonard Grogan
JE Job No.: 17/4299

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	11	12	13	14	15	16	17	18	19	20	LOD/LOR	Units	Method No.
Sample ID	TP204	TP204	TP204	TP205	TP205	TP205	TP205	TP206	TP206	TP206			
Depth	1.00-2.00	2.00-3.00	3.00-4.00	0.00-1.00	1.00-2.00	2.00-3.00	3.00-4.00	0.00-1.00	1.00-2.00	2.00-3.00			
COC No / misc													
Containers	J	J	J	J	J	J	J	J	J	J			
Sample Date	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017			
PAH MS													
Naphthalene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Acenaphthylene	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM4/PM8
Acenaphthene #	<0.05	<0.05	0.08	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM4/PM8
Fluorene #	<0.04	<0.04	0.06	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Phenanthrene #	<0.03	0.08	0.80	0.07	0.08	<0.03	0.05	<0.03	0.12	0.04	<0.03	mg/kg	TM4/PM8
Anthracene #	<0.04	<0.04	0.16	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Fluoranthene #	<0.03	0.14	1.15	0.13	0.13	0.04	0.14	0.04	0.18	0.10	<0.03	mg/kg	TM4/PM8
Pyrene #	<0.03	0.12	0.93	0.10	0.11	0.04	0.16	0.04	0.15	0.10	<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene #	<0.06	0.13	0.59	0.10	0.11	<0.06	0.15	0.07	0.10	0.11	<0.06	mg/kg	TM4/PM8
Chrysene #	<0.02	0.08	0.59	0.07	0.07	0.03	0.18	0.04	0.10	0.10	<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	<0.07	0.15	0.92	0.13	0.09	<0.07	0.35	<0.07	0.14	0.19	<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	<0.04	0.09	0.54	0.09	0.07	<0.04	0.21	0.04	0.10	0.11	<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene #	<0.04	0.06	0.33	0.06	<0.04	<0.04	0.14	<0.04	0.05	0.07	<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	<0.04	<0.04	0.09	<0.04	<0.04	<0.04	0.05	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	<0.04	0.05	0.27	0.05	<0.04	<0.04	0.14	<0.04	0.05	0.07	<0.04	mg/kg	TM4/PM8
Coronene	<0.04	<0.04	0.06	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
PAH 6 Total #	<0.22	0.49	3.21	0.46	0.29	<0.22	0.98	<0.22	0.52	0.54	<0.22	mg/kg	TM4/PM8
PAH 17 Total	<0.64	0.90	6.57	0.80	0.66	<0.64	1.57	<0.64	0.99	0.89	<0.64	mg/kg	TM4/PM8
Benzo(b)fluoranthene	<0.05	0.11	0.66	0.09	0.06	<0.05	0.25	<0.05	0.10	0.14	<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	<0.02	0.04	0.26	0.04	0.03	<0.02	0.10	<0.02	0.04	0.05	<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	99	100	101	100	105	92	102	99	101	102	<0	%	TM4/PM8
Mineral Oil >C8-C10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	mg/kg	TM5/PM16
Mineral Oil >C10-C12	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	mg/kg	TM5/PM16
Mineral Oil >C12-C16	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	mg/kg	TM5/PM16
Mineral Oil >C16-C21	<10	<10	<10	<10	13	<10	<10	<10	<10	<10	<10	mg/kg	TM5/PM16
Mineral Oil >C21-C40	<10	<10	<10	<10	36	<10	15	<10	<10	<10	<10	mg/kg	TM5/PM16
Mineral Oil >C8-C40	<45	<45	<45	<45	49	<45	<45	<45	<45	<45	<45	mg/kg	TM5/PM16
MTBE #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM31/PM12
Benzene #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM31/PM12
Toluene #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM31/PM12
Ethylbenzene #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM31/PM12
m/p-Xylene #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM31/PM12
o-Xylene #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM31/PM12
PCB 28 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 52 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 101 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 118 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 138 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 153 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 180 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8

Please see attached notes for all abbreviations and acronyms

Client Name: Roadstone Ltd
Reference:
Location: Fassaroe
Contact: Leonard Grogan
JE Job No.: 17/4299

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	11	12	13	14	15	16	17	18	19	20	LOD/LOR	Units	Method No.
Sample ID	TP204	TP204	TP204	TP205	TP205	TP205	TP205	TP206	TP206	TP206			
Depth	1.00-2.00	2.00-3.00	3.00-4.00	0.00-1.00	1.00-2.00	2.00-3.00	3.00-4.00	0.00-1.00	1.00-2.00	2.00-3.00			
COC No / misc													
Containers	J	J	J	J	J	J	J	J	J	J			
Sample Date	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017			
Total 7 PCBs #	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	ug/kg	TM17/PM8
Natural Moisture Content	13.5	17.6	17.4	15.4	14.6	6.6	13.0	12.2	15.3	21.5	<0.1	%	PM4/PM0
% Dry Matter 105°C	84.7	82.3	91.6	85.3	85.2	77.6	85.6	86.1	83.5	83.0	<0.1	%	NONE/PM4
Total Organic Carbon #	1.02	1.26	1.50	1.20	0.93	0.51	0.57	0.76	1.16	1.44	<0.02	%	TM21/PM24
Mass of raw test portion	0.1067	0.1089	0.0987	0.1052	0.1059	0.1157	0.1049	0.1044	0.1074	0.1081		kg	NONE/PM17
Mass of dried test portion	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09		kg	NONE/PM17

Please see attached notes for all abbreviations and acronyms

Client Name: Roadstone Ltd
Reference:
Location: Fassaroe
Contact: Leonard Grogan
JE Job No.: 17/4299

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	21										Please see attached notes for all abbreviations and acronyms		
Sample ID	TP206												
Depth	3.00-4.00												
COC No / misc													
Containers	J												
Sample Date	17/02/2017												
Sample Type	Soil												
Batch Number	1										LOD/LOR	Units	Method No.
Date of Receipt	21/02/2017												
PAH MS													
Naphthalene #	<0.04										<0.04	mg/kg	TM4/PM8
Acenaphthylene	<0.03										<0.03	mg/kg	TM4/PM8
Acenaphthene #	<0.05										<0.05	mg/kg	TM4/PM8
Fluorene #	0.05										<0.04	mg/kg	TM4/PM8
Phenanthrene #	0.27										<0.03	mg/kg	TM4/PM8
Anthracene #	0.09										<0.04	mg/kg	TM4/PM8
Fluoranthene #	0.22										<0.03	mg/kg	TM4/PM8
Pyrene #	0.15										<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene #	0.09										<0.06	mg/kg	TM4/PM8
Chrysene #	0.06										<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	0.09										<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	0.06										<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene #	<0.04										<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	<0.04										<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	<0.04										<0.04	mg/kg	TM4/PM8
Coronene	<0.04										<0.04	mg/kg	TM4/PM8
PAH 6 Total #	0.37										<0.22	mg/kg	TM4/PM8
PAH 17 Total	1.08										<0.64	mg/kg	TM4/PM8
Benzo(b)fluoranthene	0.06										<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	0.03										<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	95										<0	%	TM4/PM8
Mineral Oil >C8-C10	<5										<5	mg/kg	TM5/PM16
Mineral Oil >C10-C12	<10										<10	mg/kg	TM5/PM16
Mineral Oil >C12-C16	<10										<10	mg/kg	TM5/PM16
Mineral Oil >C16-C21	<10										<10	mg/kg	TM5/PM16
Mineral Oil >C21-C40	<10										<10	mg/kg	TM5/PM16
Mineral Oil >C8-C40	<45										<45	mg/kg	TM5/PM16
MTBE #	<5										<5	ug/kg	TM31/PM12
Benzene #	<5										<5	ug/kg	TM31/PM12
Toluene #	<5										<5	ug/kg	TM31/PM12
Ethylbenzene #	<5										<5	ug/kg	TM31/PM12
m/p-Xylene #	<5										<5	ug/kg	TM31/PM12
o-Xylene #	<5										<5	ug/kg	TM31/PM12
PCB 28 #	<5										<5	ug/kg	TM17/PM8
PCB 52 #	<5										<5	ug/kg	TM17/PM8
PCB 101 #	<5										<5	ug/kg	TM17/PM8
PCB 118 #	<5										<5	ug/kg	TM17/PM8
PCB 138 #	<5										<5	ug/kg	TM17/PM8
PCB 153 #	<5										<5	ug/kg	TM17/PM8
PCB 180 #	<5										<5	ug/kg	TM17/PM8

Client Name: Roadstone Ltd
Reference:
Location: Fassaroe
Contact: Leonard Grogan
JE Job No.: 17/4299

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	21										Please see attached notes for all abbreviations and acronyms		
Sample ID	TP206												
Depth	3.00-4.00												
COC No / misc													
Containers	J												
Sample Date	17/02/2017												
Sample Type	Soil												
Batch Number	1										LOD/LOR	Units	Method No.
Date of Receipt	21/02/2017												
Total 7 PCBs #	<35										<35	ug/kg	TM17/PM8
Natural Moisture Content	17.9										<0.1	%	PM4/PM0
% Dry Matter 105°C	80.8										<0.1	%	NONE/PM4
Total Organic Carbon #	0.63										<0.02	%	TM21/PM24
Mass of raw test portion	0.1112											kg	NONE/PM17
Mass of dried test portion	0.09											kg	NONE/PM17

Client Name: Roadstone Ltd
Reference:
Location: Fassaroe
Contact: Leonard Grogan
JE Job No.: 17/4299

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	1	2	3	4	5	6	7	8	9	10	LOD/LOR	Units	Method No.
Sample ID	TP201	TP201	TP201	TP202	TP202	TP202	TP203	TP203	TP203	TP204			
Depth	0.00-1.00	1.00-2.00	2.00-3.00	0.00-1.00	1.00-2.00	2.00-3.00	0.00-1.00	1.00-2.00	2.00-3.00	0.00-1.00			
COC No / misc													
Containers	J	J	J	J	J	J	J	J	J	J			
Sample Date	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017			
Dissolved Antimony #	<0.002	<0.002	0.003	<0.002	0.002	0.003	<0.002	<0.002	0.002	<0.002	<0.002	mg/l	TM30/PM17
Dissolved Antimony (A10) #	<0.02	<0.02	0.03	<0.02	0.02	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Arsenic #	<0.0025	<0.0025	<0.0025	<0.0025	0.0026	0.0029	0.0031	<0.0025	0.0047	0.0033	<0.0025	mg/l	TM30/PM17
Dissolved Arsenic (A10) #	<0.025	<0.025	<0.025	<0.025	0.026	0.029	0.031	<0.025	0.047	0.033	<0.025	mg/kg	TM30/PM17
Dissolved Barium #	0.021	0.015	0.019	0.010	0.015	0.008	0.007	0.007	0.016	0.015	<0.003	mg/l	TM30/PM17
Dissolved Barium (A10) #	0.21	0.15	0.19	0.10	0.15	0.08	0.07	0.07	0.16	0.15	<0.03	mg/kg	TM30/PM17
Dissolved Cadmium #	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	mg/l	TM30/PM17
Dissolved Cadmium (A10) #	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM30/PM17
Dissolved Chromium #	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	mg/l	TM30/PM17
Dissolved Chromium (A10) #	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	mg/kg	TM30/PM17
Dissolved Copper #	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	mg/l	TM30/PM17
Dissolved Copper (A10) #	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	mg/kg	TM30/PM17
Dissolved Lead #	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/l	TM30/PM17
Dissolved Lead (A10) #	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM30/PM17
Dissolved Molybdenum #	0.010	0.015	0.012	0.009	0.015	0.013	0.012	0.014	0.013	0.013	<0.002	mg/l	TM30/PM17
Dissolved Molybdenum (A10) #	0.10	0.15	0.12	0.09	0.15	0.13	0.12	0.14	0.13	0.13	<0.02	mg/kg	TM30/PM17
Dissolved Nickel #	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.002	<0.002	mg/l	TM30/PM17
Dissolved Nickel (A10) #	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	mg/kg	TM30/PM17
Dissolved Selenium #	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	mg/l	TM30/PM17
Dissolved Selenium (A10) #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
Dissolved Zinc #	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	mg/l	TM30/PM17
Dissolved Zinc (A10) #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
Mercury Dissolved by CVAF #	<0.00001	<0.00001	<0.00001	0.00001	<0.00001	<0.00001	0.00003	<0.00001	0.00003	<0.00001	<0.00001	mg/l	TM61/PM38
Mercury Dissolved by CVAF #	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0003	<0.0001	0.0003	<0.0001	<0.0001	mg/kg	TM61/PM38
Phenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l	TM26/PM0
Phenol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM26/PM0
Fluoride	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	mg/l	TM173/PM0
Fluoride	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	mg/kg	TM173/PM0
Sulphate as SO4 #	0.14	23.97	15.81	22.99	15.17	24.78	19.70	21.19	9.93	23.31	<0.05	mg/l	TM38/PM0
Sulphate as SO4 #	1.4	239.7	158.1	229.9	151.7	247.7	196.9	211.9	99.3	233.2	<0.5	mg/kg	TM38/PM0
Chloride #	<0.3	0.9	1.5	1.2	1.3	1.1	1.2	1.5	1.3	0.8	<0.3	mg/l	TM38/PM0
Chloride #	<3	9	15	12	13	11	12	15	13	8	<3	mg/kg	TM38/PM0
Dissolved Organic Carbon	4	5	4	5	3	8	4	4	7	6	<2	mg/l	TM60/PM0
Dissolved Organic Carbon	40	50	40	50	30	80	40	40	70	60	<20	mg/kg	TM60/PM0
Total Dissolved Solids #	76	121	131	133	112	139	122	103	108	178	<35	mg/l	TM20/PM0
Total Dissolved Solids #	760	1210	1310	1330	1120	1390	1219	1030	1079	1781	<350	mg/kg	TM20/PM0

Please see attached notes for all abbreviations and acronyms

Client Name: Roadstone Ltd
Reference:
Location: Fassaroe
Contact: Leonard Grogan
JE Job No.: 17/4299

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	11	12	13	14	15	16	17	18	19	20	LOD/LOR	Units	Method No.
Sample ID	TP204	TP204	TP204	TP205	TP205	TP205	TP205	TP206	TP206	TP206			
Depth	1.00-2.00	2.00-3.00	3.00-4.00	0.00-1.00	1.00-2.00	2.00-3.00	3.00-4.00	0.00-1.00	1.00-2.00	2.00-3.00			
COC No / misc													
Containers	J	J	J	J	J	J	J	J	J	J			
Sample Date	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017	21/02/2017			
Dissolved Antimony #	0.009	<0.002	0.003	<0.002	<0.002	0.005	<0.002	<0.002	<0.002	<0.002	<0.002	mg/l	TM30/PM17
Dissolved Antimony (A10) #	0.09	<0.02	0.03	<0.02	<0.02	0.05	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Arsenic #	0.0108	0.0028	0.0026	<0.0025	<0.0025	0.0055	0.0029	<0.0025	<0.0025	<0.0025	<0.0025	mg/l	TM30/PM17
Dissolved Arsenic (A10) #	0.108	0.028	0.026	<0.025	<0.025	0.055	0.029	<0.025	<0.025	<0.025	<0.025	mg/kg	TM30/PM17
Dissolved Barium #	0.007	0.019	0.023	0.017	0.012	0.029	0.021	0.006	0.011	0.016	<0.003	mg/l	TM30/PM17
Dissolved Barium (A10) #	0.07	0.19	0.23	0.17	0.12	0.29	0.21	0.06	0.11	0.16	<0.03	mg/kg	TM30/PM17
Dissolved Cadmium #	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	mg/l	TM30/PM17
Dissolved Cadmium (A10) #	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM30/PM17
Dissolved Chromium #	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	mg/l	TM30/PM17
Dissolved Chromium (A10) #	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	mg/kg	TM30/PM17
Dissolved Copper #	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	mg/l	TM30/PM17
Dissolved Copper (A10) #	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	mg/kg	TM30/PM17
Dissolved Lead #	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/l	TM30/PM17
Dissolved Lead (A10) #	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM30/PM17
Dissolved Molybdenum #	0.016	0.016	0.005	0.012	0.006	0.024	0.013	0.004	0.016	0.015	<0.002	mg/l	TM30/PM17
Dissolved Molybdenum (A10) #	0.16	0.16	0.05	0.12	0.06	0.24	0.13	0.04	0.16	0.15	<0.02	mg/kg	TM30/PM17
Dissolved Nickel #	0.003	0.002	<0.002	0.002	<0.002	0.005	<0.002	<0.002	<0.002	<0.002	<0.002	mg/l	TM30/PM17
Dissolved Nickel (A10) #	0.03	0.02	<0.02	0.02	<0.02	0.05	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Selenium #	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	mg/l	TM30/PM17
Dissolved Selenium (A10) #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
Dissolved Zinc #	0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	mg/l	TM30/PM17
Dissolved Zinc (A10) #	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
Mercury Dissolved by CVAF #	0.00002	0.00002	0.00001	0.00001	0.00001	0.00003	<0.00001	<0.00001	0.00001	0.00001	<0.00001	mg/l	TM61/PM38
Mercury Dissolved by CVAF #	0.0002	0.0002	0.0001	0.0001	<0.0001	0.0003	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	mg/kg	TM61/PM38
Phenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l	TM26/PM0
Phenol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM26/PM0
Fluoride	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	mg/l	TM173/PM0
Fluoride	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	mg/kg	TM173/PM0
Sulphate as SO4 #	18.35	27.43	16.64	24.49	6.97	19.94	8.91	11.77	23.68	29.00	<0.05	mg/l	TM38/PM0
Sulphate as SO4 #	183.5	274.4	166.4	245.0	69.7	199.4	89.1	117.6	236.8	290.1	<0.5	mg/kg	TM38/PM0
Chloride #	1.0	1.9	3.4	1.6	1.2	1.3	1.6	0.5	0.7	0.8	<0.3	mg/l	TM38/PM0
Chloride #	10	19	34	16	12	13	16	5	7	8	<3	mg/kg	TM38/PM0
Dissolved Organic Carbon	8	7	7	9	5	8	5	5	5	5	<2	mg/l	TM60/PM0
Dissolved Organic Carbon	80	70	70	90	50	80	50	50	50	50	<20	mg/kg	TM60/PM0
Total Dissolved Solids #	157	120	120	137	107	140	83	124	83	135	<35	mg/l	TM20/PM0
Total Dissolved Solids #	1570	1200	1200	1371	1070	1400	830	1239	830	1351	<350	mg/kg	TM20/PM0

Please see attached notes for all abbreviations and acronyms

Client Name: Roadstone Ltd
Reference:
Location: Fassaroe
Contact: Leonard Grogan
JE Job No.: 17/4299

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	21										Please see attached notes for all abbreviations and acronyms		
Sample ID	TP206												
Depth	3.00-4.00												
COC No / misc													
Containers	J												
Sample Date	17/02/2017												
Sample Type	Soil												
Batch Number	1										LOD/LOR	Units	Method No.
Date of Receipt	21/02/2017												
Dissolved Antimony #	<0.002										<0.002	mg/l	TM30/PM17
Dissolved Antimony (A10) #	<0.02										<0.02	mg/kg	TM30/PM17
Dissolved Arsenic #	<0.0025										<0.0025	mg/l	TM30/PM17
Dissolved Arsenic (A10) #	<0.025										<0.025	mg/kg	TM30/PM17
Dissolved Barium #	0.011										<0.003	mg/l	TM30/PM17
Dissolved Barium (A10) #	0.11										<0.03	mg/kg	TM30/PM17
Dissolved Cadmium #	<0.0005										<0.0005	mg/l	TM30/PM17
Dissolved Cadmium (A10) #	<0.005										<0.005	mg/kg	TM30/PM17
Dissolved Chromium #	<0.0015										<0.0015	mg/l	TM30/PM17
Dissolved Chromium (A10) #	<0.015										<0.015	mg/kg	TM30/PM17
Dissolved Copper #	<0.007										<0.007	mg/l	TM30/PM17
Dissolved Copper (A10) #	<0.07										<0.07	mg/kg	TM30/PM17
Dissolved Lead #	<0.005										<0.005	mg/l	TM30/PM17
Dissolved Lead (A10) #	<0.05										<0.05	mg/kg	TM30/PM17
Dissolved Molybdenum #	0.016										<0.002	mg/l	TM30/PM17
Dissolved Molybdenum (A10) #	0.16										<0.02	mg/kg	TM30/PM17
Dissolved Nickel #	<0.002										<0.002	mg/l	TM30/PM17
Dissolved Nickel (A10) #	<0.02										<0.02	mg/kg	TM30/PM17
Dissolved Selenium #	<0.003										<0.003	mg/l	TM30/PM17
Dissolved Selenium (A10) #	<0.03										<0.03	mg/kg	TM30/PM17
Dissolved Zinc #	<0.003										<0.003	mg/l	TM30/PM17
Dissolved Zinc (A10) #	<0.03										<0.03	mg/kg	TM30/PM17
Mercury Dissolved by CVAF #	0.00003										<0.00001	mg/l	TM61/PM38
Mercury Dissolved by CVAF #	0.0003										<0.0001	mg/kg	TM61/PM38
Phenol	<0.01										<0.01	mg/l	TM26/PM0
Phenol	<0.1										<0.1	mg/kg	TM26/PM0
Fluoride	0.4										<0.3	mg/l	TM173/PM0
Fluoride	4										<3	mg/kg	TM173/PM0
Sulphate as SO4 #	12.59										<0.05	mg/l	TM38/PM0
Sulphate as SO4 #	125.9										<0.5	mg/kg	TM38/PM0
Chloride #	1.0										<0.3	mg/l	TM38/PM0
Chloride #	10										<3	mg/kg	TM38/PM0
Dissolved Organic Carbon	12										<2	mg/l	TM60/PM0
Dissolved Organic Carbon	120										<20	mg/kg	TM60/PM0
Total Dissolved Solids #	99										<35	mg/l	TM20/PM0
Total Dissolved Solids #	990										<350	mg/kg	TM20/PM0

Mass of sample taken (kg)	0.1028	Dry Matter Content Ratio (%) =	87.3
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.887
Particle Size <4mm =	>95%	Eluate Volume (l)	0.75

		Landfill Waste Acceptance Criteria Limits		
JEFL Job No	**17/4299**			
Sample No	**1**			
Client Sample No	**TP201**			
Depth/Other	**0.00-1.00**	**Inert**	**Stable Non-reactive**	**Hazardous**
Sample Date	**17/02/2017**			
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	1.12	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	<0.22	-	-	-
PAH Sum of 17 (mg/kg)	<0.64	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	<0.025	0.5	2	25
Barium	0.21	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	<0.0001	0.01	0.2	2
Molybdenum	0.10	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	<0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	<0.03	4	50	200
Chloride	<3	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	1.4	1000	20000	50000
Total Dissolved Solids	760	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	40	500	800	1000

Mass of sample taken (kg)	0.1095	Dry Matter Content Ratio (%) =	82.4
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.881
Particle Size <4mm =	>95%	Eluate Volume (l)	0.75

JEFL Job No	**17/4299**	**Landfill Waste Acceptance Criteria Limits**		
Sample No	**2**			
Client Sample No	**TP201**	**Inert**	**Stable Non-reactive**	**Hazardous**
Depth/Other	**1.00-2.00**			
Sample Date	**17/02/2017**			
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	1.39	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	<0.22	-	-	-
PAH Sum of 17 (mg/kg)	<0.64	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	<0.025	0.5	2	25
Barium	0.15	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	<0.0001	0.01	0.2	2
Molybdenum	0.15	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	<0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	<0.03	4	50	200
Chloride	9	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	239.7	1000	20000	50000
Total Dissolved Solids	1210	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	50	500	800	1000

Mass of sample taken (kg)	0.1016	Dry Matter Content Ratio (%) =	88.2
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.888
Particle Size <4mm =	>95%	Eluate Volume (l)	0.74

JEFL Job No	**17/4299**	**Landfill Waste Acceptance Criteria Limits**		
Sample No	**3**			
Client Sample No	**TP201**	**Inert**	**Stable Non-reactive**	**Hazardous**
Depth/Other	**2.00-3.00**			
Sample Date	**17/02/2017**			
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	0.83	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	<0.22	-	-	-
PAH Sum of 17 (mg/kg)	<0.64	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	<0.025	0.5	2	25
Barium	0.19	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	<0.0001	0.01	0.2	2
Molybdenum	0.12	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	0.03	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	<0.03	4	50	200
Chloride	15	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	158.1	1000	20000	50000
Total Dissolved Solids	1310	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	40	500	800	1000

Mass of sample taken (kg)	0.0999	Dry Matter Content Ratio (%) =	90.1
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.89
Particle Size <4mm =	>95%	Eluate Volume (l)	0.78

		Landfill Waste Acceptance Criteria Limits		
JEFL Job No	**17/4299**			
Sample No	**4**			
Client Sample No	**TP202**			
Depth/Other	**0.00-1.00**	**Inert**	**Stable Non-reactive**	**Hazardous**
Sample Date	**17/02/2017**			
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	0.79	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	0.22	-	-	-
PAH Sum of 17 (mg/kg)	<0.64	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	<0.025	0.5	2	25
Barium	0.10	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	<0.0001	0.01	0.2	2
Molybdenum	0.09	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	<0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	<0.03	4	50	200
Chloride	12	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	229.9	1000	20000	50000
Total Dissolved Solids	1330	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	50	500	800	1000

Mass of sample taken (kg)	0.1043	Dry Matter Content Ratio (%) =	86.3
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.886
Particle Size <4mm =	>95%	Eluate Volume (l)	0.75

JEFL Job No	**17/4299**	**Landfill Waste Acceptance Criteria Limits**		
Sample No	**5**			
Client Sample No	**TP202**	**Inert**	**Stable Non-reactive**	**Hazardous**
Depth/Other	**1.00-2.00**			
Sample Date	**17/02/2017**			
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	1.15	3	5	6
Sum of BTEX (mg/kg)	-	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	<0.22	-	-	-
PAH Sum of 17 (mg/kg)	<0.64	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	0.026	0.5	2	25
Barium	0.15	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	<0.0001	0.01	0.2	2
Molybdenum	0.15	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	<0.03	4	50	200
Chloride	13	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	151.7	1000	20000	50000
Total Dissolved Solids	1120	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	30	500	800	1000

Mass of sample taken (kg)	0.1009	Dry Matter Content Ratio (%) =	89.3
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.889
Particle Size <4mm =	>95%	Eluate Volume (l)	0.81

JEFL Job No	**17/4299**	**Landfill Waste Acceptance Criteria Limits**		
Sample No	**6**			
Client Sample No	**TP202**	**Inert**	**Stable Non-reactive**	**Hazardous**
Depth/Other	**2.00-3.00**			
Sample Date	**17/02/2017**			
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	0.18	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	0.76	-	-	-
PAH Sum of 17 (mg/kg)	1.70	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	0.029	0.5	2	25
Barium	0.08	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	<0.0001	0.01	0.2	2
Molybdenum	0.13	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	0.03	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	<0.03	4	50	200
Chloride	11	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	247.7	1000	20000	50000
Total Dissolved Solids	1390	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	80	500	800	1000

Mass of sample taken (kg)	0.1054	Dry Matter Content Ratio (%) =	85.3
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.884
Particle Size <4mm =	>95%	Eluate Volume (l)	0.8

JEFL Job No	**17/4299**	**Landfill Waste Acceptance Criteria Limits**		
Sample No	**7**			
Client Sample No	**TP203**	**Inert**	**Stable Non-reactive**	**Hazardous**
Depth/Other	**0.00-1.00**			
Sample Date	**17/02/2017**			
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	1.78	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	1.69	-	-	-
PAH Sum of 17 (mg/kg)	3.49	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	0.031	0.5	2	25
Barium	0.07	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	0.0003	0.01	0.2	2
Molybdenum	0.12	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	<0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	<0.03	4	50	200
Chloride	12	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	196.9	1000	20000	50000
Total Dissolved Solids	1219	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	40	500	800	1000

Mass of sample taken (kg)	0.1047	Dry Matter Content Ratio (%) =	85.7
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.885
Particle Size <4mm =	>95%	Eluate Volume (l)	0.75

JEFL Job No	**17/4299**	**Landfill Waste Acceptance Criteria Limits**		
Sample No	**8**			
Client Sample No	**TP203**	**Inert**	**Stable Non-reactive**	**Hazardous**
Depth/Other	**1.00-2.00**			
Sample Date	**17/02/2017**			
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	1.69	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	<0.22	-	-	-
PAH Sum of 17 (mg/kg)	<0.64	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	<0.025	0.5	2	25
Barium	0.07	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	<0.0001	0.01	0.2	2
Molybdenum	0.14	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	<0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	<0.03	4	50	200
Chloride	15	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	211.9	1000	20000	50000
Total Dissolved Solids	1030	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	40	500	800	1000

Mass of sample taken (kg)	0.1051	Dry Matter Content Ratio (%) =	85.3
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.884
Particle Size <4mm =	>95%	Eluate Volume (l)	0.8

JEFL Job No	**17/4299**	**Landfill Waste Acceptance Criteria Limits**		
Sample No	**9**			
Client Sample No	**TP203**	**Inert**	**Stable Non-reactive**	**Hazardous**
Depth/Other	**2.00-3.00**			
Sample Date	**17/02/2017**			
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	0.65	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	0.68	-	-	-
PAH Sum of 17 (mg/kg)	1.17	100	-	-
Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	0.047	0.5	2	25
Barium	0.16	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	0.0003	0.01	0.2	2
Molybdenum	0.13	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	<0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	<0.03	4	50	200
Chloride	13	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	99.3	1000	20000	50000
Total Dissolved Solids	1079	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	70	500	800	1000

Mass of sample taken (kg)	0.1089	Dry Matter Content Ratio (%) =	82.3
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.881
Particle Size <4mm =	>95%	Eluate Volume (l)	0.76

JEFL Job No	**17/4299**	**Landfill Waste Acceptance Criteria Limits**		
Sample No	**10**			
Client Sample No	**TP204**	**Inert**	**Stable Non-reactive**	**Hazardous**
Depth/Other	**0.00-1.00**			
Sample Date	**17/02/2017**			
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	1.82	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	1.01	-	-	-
PAH Sum of 17 (mg/kg)	2.23	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	0.033	0.5	2	25
Barium	0.15	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	<0.0001	0.01	0.2	2
Molybdenum	0.13	0.5	10	30
Nickel	0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	<0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	<0.03	4	50	200
Chloride	8	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	233.2	1000	20000	50000
Total Dissolved Solids	1781	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	60	500	800	1000

Mass of sample taken (kg)	0.1067	Dry Matter Content Ratio (%) =	84.7
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.884
Particle Size <4mm =	>95%	Eluate Volume (l)	0.82

JEFL Job No	**17/4299**	**Landfill Waste Acceptance Criteria Limits**		
Sample No	**11**			
Client Sample No	**TP204**	**Inert**	**Stable Non-reactive**	**Hazardous**
Depth/Other	**1.00-2.00**			
Sample Date	**17/02/2017**			
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	1.02	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	<0.22	-	-	-
PAH Sum of 17 (mg/kg)	<0.64	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	0.108	0.5	2	25
Barium	0.07	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	0.0002	0.01	0.2	2
Molybdenum	0.16	0.5	10	30
Nickel	0.03	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	0.09	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	0.03	4	50	200
Chloride	10	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	183.5	1000	20000	50000
Total Dissolved Solids	1570	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	80	500	800	1000

Mass of sample taken (kg)	0.1089	Dry Matter Content Ratio (%) =	82.3
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.881
Particle Size <4mm =	>95%	Eluate Volume (l)	0.75

JEFL Job No	**17/4299**	**Landfill Waste Acceptance Criteria Limits**		
Sample No	**12**			
Client Sample No	**TP204**	**Inert**	**Stable Non-reactive**	**Hazardous**
Depth/Other	**2.00-3.00**			
Sample Date	**17/02/2017**			
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	1.26	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	0.49	-	-	-
PAH Sum of 17 (mg/kg)	0.90	100	-	-
Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	0.028	0.5	2	25
Barium	0.19	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	0.0002	0.01	0.2	2
Molybdenum	0.16	0.5	10	30
Nickel	0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	<0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	<0.03	4	50	200
Chloride	19	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	274.4	1000	20000	50000
Total Dissolved Solids	1200	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	70	500	800	1000

Mass of sample taken (kg)	0.0987	Dry Matter Content Ratio (%) =	91.6
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.892
Particle Size <4mm =	>95%	Eluate Volume (l)	0.8

JEFL Job No	**17/4299**	**Landfill Waste Acceptance Criteria Limits**		
Sample No	**13**			
Client Sample No	**TP204**	**Inert**	**Stable Non-reactive**	**Hazardous**
Depth/Other	**3.00-4.00**			
Sample Date	**17/02/2017**			
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	1.50	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	3.21	-	-	-
PAH Sum of 17 (mg/kg)	6.57	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	0.026	0.5	2	25
Barium	0.23	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	0.0001	0.01	0.2	2
Molybdenum	0.05	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	0.03	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	<0.03	4	50	200
Chloride	34	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	166.4	1000	20000	50000
Total Dissolved Solids	1200	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	70	500	800	1000

Mass of sample taken (kg)	0.1052	Dry Matter Content Ratio (%) =	85.3
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.885
Particle Size <4mm =	>95%	Eluate Volume (l)	0.71

		Landfill Waste Acceptance Criteria Limits		
JEFL Job No	**17/4299**			
Sample No	**14**			
Client Sample No	**TP205**			
Depth/Other	**0.00-1.00**	**Inert**	**Stable Non-reactive**	**Hazardous**
Sample Date	**17/02/2017**			
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	1.20	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	0.46	-	-	-
PAH Sum of 17 (mg/kg)	0.80	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	<0.025	0.5	2	25
Barium	0.17	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	0.0001	0.01	0.2	2
Molybdenum	0.12	0.5	10	30
Nickel	0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	<0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	<0.03	4	50	200
Chloride	16	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	245.0	1000	20000	50000
Total Dissolved Solids	1371	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	90	500	800	1000

Mass of sample taken (kg)	0.1059	Dry Matter Content Ratio (%) =	85.2
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.884
Particle Size <4mm =	>95%	Eluate Volume (l)	0.75

		Landfill Waste Acceptance Criteria Limits		
JEFL Job No	**17/4299**			
Sample No	**15**			
Client Sample No	**TP205**			
Depth/Other	**1.00-2.00**	**Inert**	**Stable Non-reactive**	**Hazardous**
Sample Date	**17/02/2017**			
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	0.93	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	49	500	-	-
PAH Sum of 6 (mg/kg)	0.29	-	-	-
PAH Sum of 17 (mg/kg)	0.66	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	<0.025	0.5	2	25
Barium	0.12	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	<0.0001	0.01	0.2	2
Molybdenum	0.06	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	<0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	<0.03	4	50	200
Chloride	12	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	69.7	1000	20000	50000
Total Dissolved Solids	1070	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	50	500	800	1000

Mass of sample taken (kg)	0.1157	Dry Matter Content Ratio (%) =	77.6
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.874
Particle Size <4mm =	>95%	Eluate Volume (l)	0.7

		Landfill Waste Acceptance Criteria Limits		
JEFL Job No	**17/4299**			
Sample No	**16**			
Client Sample No	**TP205**			
Depth/Other	**2.00-3.00**	**Inert**	**Stable Non-reactive**	**Hazardous**
Sample Date	**17/02/2017**			
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	0.51	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	<0.22	-	-	-
PAH Sum of 17 (mg/kg)	<0.64	100	-	-
Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	0.055	0.5	2	25
Barium	0.29	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	0.0003	0.01	0.2	2
Molybdenum	0.24	0.5	10	30
Nickel	0.05	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	0.05	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	<0.03	4	50	200
Chloride	13	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	199.4	1000	20000	50000
Total Dissolved Solids	1400	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	80	500	800	1000

Mass of sample taken (kg)	0.1049	Dry Matter Content Ratio (%) =	85.6
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.885
Particle Size <4mm =	>95%	Eluate Volume (l)	0.66

JEFL Job No	**17/4299**	**Landfill Waste Acceptance Criteria Limits**		
Sample No	**17**			
Client Sample No	**TP205**	**Inert**	**Stable Non-reactive**	**Hazardous**
Depth/Other	**3.00-4.00**			
Sample Date	**17/02/2017**			
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	0.57	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	0.98	-	-	-
PAH Sum of 17 (mg/kg)	1.57	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	0.029	0.5	2	25
Barium	0.21	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	<0.0001	0.01	0.2	2
Molybdenum	0.13	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	<0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	<0.03	4	50	200
Chloride	16	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	89.1	1000	20000	50000
Total Dissolved Solids	830	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	50	500	800	1000

Mass of sample taken (kg)	0.1044	Dry Matter Content Ratio (%) =	86.1
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.885
Particle Size <4mm =	>95%	Eluate Volume (l)	0.07

		Landfill Waste Acceptance Criteria Limits		
JEFL Job No	**17/4299**			
Sample No	**18**			
Client Sample No	**TP206**			
Depth/Other	**0.00-1.00**	**Inert**	**Stable Non-reactive**	**Hazardous**
Sample Date	**17/02/2017**			
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	0.76	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	<0.22	-	-	-
PAH Sum of 17 (mg/kg)	<0.64	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	<0.025	0.5	2	25
Barium	0.06	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	<0.0001	0.01	0.2	2
Molybdenum	0.04	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	<0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	<0.03	4	50	200
Chloride	5	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	117.6	1000	20000	50000
Total Dissolved Solids	1239	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	50	500	800	1000

Mass of sample taken (kg)	0.1074	Dry Matter Content Ratio (%) =	83.5
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.882
Particle Size <4mm =	>95%	Eluate Volume (l)	0.71

JEFL Job No	**17/4299**	**Landfill Waste Acceptance Criteria Limits**		
Sample No	**19**			
Client Sample No	**TP206**	**Inert**	**Stable Non-reactive**	**Hazardous**
Depth/Other	**1.00-2.00**			
Sample Date	**17/02/2017**			
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	1.16	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	0.52	-	-	-
PAH Sum of 17 (mg/kg)	0.99	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	<0.025	0.5	2	25
Barium	0.11	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	<0.0001	0.01	0.2	2
Molybdenum	0.16	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	<0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	<0.03	4	50	200
Chloride	7	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	236.8	1000	20000	50000
Total Dissolved Solids	830	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	50	500	800	1000

Mass of sample taken (kg)	0.1081	Dry Matter Content Ratio (%) =	83.0
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.882
Particle Size <4mm =	>95%	Eluate Volume (l)	0.7

		Landfill Waste Acceptance Criteria Limits		
JEFL Job No	**17/4299**			
Sample No	**20**			
Client Sample No	**TP206**			
Depth/Other	**2.00-3.00**	**Inert**	**Stable Non-reactive**	**Hazardous**
Sample Date	**17/02/2017**			
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	1.44	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	0.54	-	-	-
PAH Sum of 17 (mg/kg)	0.89	100	-	-
Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	<0.025	0.5	2	25
Barium	0.16	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	0.0001	0.01	0.2	2
Molybdenum	0.15	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	<0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	<0.03	4	50	200
Chloride	8	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	290.1	1000	20000	50000
Total Dissolved Solids	1351	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	50	500	800	1000

Mass of sample taken (kg)	0.1112	Dry Matter Content Ratio (%) =	80.8
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.879
Particle Size <4mm =	>95%	Eluate Volume (l)	0.69

		Landfill Waste Acceptance Criteria Limits		
JEFL Job No	**17/4299**			
Sample No	**21**			
Client Sample No	**TP206**			
Depth/Other	**3.00-4.00**	**Inert**	**Stable Non-reactive**	**Hazardous**
Sample Date	**17/02/2017**			
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	0.63	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	0.37	-	-	-
PAH Sum of 17 (mg/kg)	1.08	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	<0.025	0.5	2	25
Barium	0.11	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	0.0003	0.01	0.2	2
Molybdenum	0.16	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	<0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	<0.03	4	50	200
Chloride	10	800	15000	25000
Fluoride	4	10	150	500
Sulphate as SO4	125.9	1000	20000	50000
Total Dissolved Solids	990	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	120	500	800	1000

Client Name: Roadstone Ltd

Matrix : Solid

Reference:

Location: Fassaroe

Contact: Leonard Grogan

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Analysis	Reason
17/4299	1	TP202	1.00-2.00	5	GRO	Sample holding time exceeded

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.

Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

JE Job No.: 17/4299

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS) accredited - UK.
SA	ISO17025 (SANAS) accredited - South Africa.
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

JE Job No: 17/4299

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.	PM0	No preparation is required.				
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.	PM0	No preparation is required.			AR	
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM16	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.			AR	Yes
TM17	Modified US EPA method 8270. Determination of specific Polychlorinated Biphenyl congeners by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM20	Modified BS 1377-3: 1990/USEPA 160.3 Gravimetric determination of Total Dissolved Solids/Total Solids	PM0	No preparation is required.	Yes		AR	Yes
TM21	Modified USEPA 415.1. Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection.	PM24	Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis.	Yes		AD	Yes
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM0	No preparation is required.			AR	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7 and 6010B	PM17	Modified method EN12457-2 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio.	Yes		AR	Yes

JE Job No: 17/4299

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM31	Modified USEPA 8015B. Determination of Methyltertbutylether, Benzene, Toluene, Ethylbenzene and Xylene by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM31	Modified USEPA 8015B. Determination of Methyltertbutylether, Benzene, Toluene, Ethylbenzene and Xylene by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM0	No preparation is required.	Yes		AR	Yes
TM60	Modified USEPA 9060. Determination of TOC by calculation from Total Carbon and Inorganic Carbon using a TOC analyser, the carbon in the sample is converted to CO2 and then passed through a non-dispersive infrared gas analyser (NDIR).	PM0	No preparation is required.			AR	Yes
TM61	Modified US EPA methods 245.7 and 200.7. Determination of Mercury by Cold Vapour Atomic Fluorescence.	PM38	Samples are brominated to reduce all mercury compounds to Mercury (II) which is analysed using method TM061.	Yes		AR	Yes
TM173	Analysis of fluoride by ISE (Ion Selective Electrode) using modified ISE method 340.2	PM0	No preparation is required.			AR	Yes
NONE	No Method Code	PM17	Modified method EN12457-2 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio.				
NONE	No Method Code	PM17	Modified method EN12457-2 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio.			AR	
NONE	No Method Code	PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.			AR	

Appendix - Methods used for WAC (2003/33/EC)

Leachate tests	
10l/kg; 4mm	I.S. EN 12457-2:2002 Specified particle size; water added to L/S ratio; capped; agitated for 24 ± 0.5 hours; eluate settled and filtered over 0.45 µm membrane filter.
Eluate analysis	
As	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Ba	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Cd	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Cr total	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Cu	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Hg	I.S. EN 13370 rec. EN 1483 (CVAAS)
Mo	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Ni	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Pb	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Sb	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Se	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Zn	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Chloride	I.S. EN 12506 rec. EN ISO 10304-part 1 (liquid chromatography of ions)
Fluoride	I.S. EN 12506 rec. EN ISO 10304-part 1 (liquid chromatography of ions)
Sulphate	I.S. EN 12506 rec. EN ISO 10304-part 1 (liquid chromatography of ions)
Phenol index	I.S. EN 13370 rec. ISO 6439 (4-Aminoantipyrine spectrometic methods after distillation)* (BY HPLC - Jones Env)
DOC	I.S. EN 1484
TDS	I.S. EN 15216
Compositional analysis	
TOC	I.S. EN 13137 Method B: carbonates removed with acid; TOC by combustion.
BTEX	GC-FID
PCB7**	I.S. EN 15308 analysis by GC-ECD.
Mineral oil	I.S. EN 14039 C10 to C40 analysis by GC-FID.
PAH17***	I.S. EN 15527 PAH17 analysis by GC-MS
Metals	I.S. EN 13657 - Aqua regia digestion: EN ISO 11885 (ICP-OES)
Other	
Dry matter	I.S. EN 14346 sample is dried to a constant mass in an oven at 105 ± 3 °C; Method B Water content by direct Karl-Fischer-titration and either volumetric or coulometric detection.
LOI	I.S. EN 15169 Difference in mass after heating in a furnace up to 550 ± 25 °C.
ANC	CEN/TS 15364 Determined by amouns of acid or base needed to cover the pH range

Notes:

*If not suitable due to LOD, precision, etc., any other suitable method can be used, e.g. AFS, ICP-MS

**PCB-28, PCB-52, PCB-101, PCB-118, PCB-138, PCB-153 and PCB-180

***Naphthalene, Acenaphthylene, Acenaphthene, Anthracene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(g,h,i)perylene, Benzo(a)pyrene, Chrysene, Coronene, Dibenzo(a,h)anthracene, Fluorene, Fluoranthene, Indeno(1,2,3-c,d)pyrene, Phenanthrene and Pyrene.

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Attention: Aldona Binchy

CERTIFICATE OF ANALYSIS

Date:	03 August 2017
Customer:	D_SLRCON_DUB
Sample Delivery Group (SDG):	170724-30
Your Reference:	501.00180.00186
Location:	Fassaroe
Report No:	418738

This report has been revised and directly supersedes 418386 in its entirety.

We received 13 samples on Saturday July 22, 2017 and 12 of these samples were scheduled for analysis which was completed on Thursday August 03, 2017. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Environmental Hawarden (Method codes TM) or ALS Environmental Aberdeen (Method codes S).

Approved By:

Sonia McWhan

Operations Manager

CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
15892040	NO ID			21/07/2017
15892026	TP101			20/07/2017
15892027	TP102			20/07/2017
15892028	TP103			20/07/2017
15892029	TP104			20/07/2017
15892030	TP105			20/07/2017
15892031	TP106			20/07/2017
15892032	TP107			20/07/2017
15892034	TP108			21/07/2017
15892035	TP109			21/07/2017
15892036	TP110			21/07/2017
15892037	TP111			21/07/2017
15892038	TP112			21/07/2017

Maximum Sample/Coolbox Temperature (°C) : **18**

ISO5667-3 Water quality - Sampling - Part3 -
During Transportation samples shall be stored in a cooling device capable of maintaining a temperature of (5±3)°C.

ALS have data which show that a cool box with 4 frozen icepacks is capable of maintaining pre-chilled samples at a temperature of (5±3)°C for a period of up to 24hrs.

Only received samples which have had analysis scheduled will be shown on the following pages.

Validated

CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

Results Legend

X Test

N No Determination Possible

Sample Types -
S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

Lab Sample No(s)			15892026			15892027			15892028			15892029			15892030			15892031			15892032
Customer Sample Reference			TP101			TP102			TP103			TP104			TP105			TP106			TP107
AGS Reference																					
Depth (m)																					
Container			1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB
Sample Type			S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
ANC at pH4 and ANC at pH 6	All	NDPs: 0 Tests: 12		X			X			X			X			X			X		
Anions by Kone (w)	All	NDPs: 0 Tests: 12	X			X			X			X			X			X			X
Asbestos ID in Solid Samples	All	NDPs: 0 Tests: 12	X			X			X			X			X			X			X
CEN Readings	All	NDPs: 0 Tests: 12	X			X			X			X			X			X			X
Chromium III	All	NDPs: 0 Tests: 12		X			X			X			X			X			X		
Cyanide Comp/Free/Total/Thiocyanate	All	NDPs: 0 Tests: 12		X			X			X			X			X			X		
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 12	X			X			X			X			X			X			X
Dissolved Organic/Inorganic Carbon	All	NDPs: 0 Tests: 12	X			X			X			X			X			X			X
Fluoride	All	NDPs: 0 Tests: 12	X			X			X			X			X			X			X
GRO by GC-FID (S)	All	NDPs: 0 Tests: 12			X			X			X			X			X			X	
Hexavalent Chromium (s)	All	NDPs: 0 Tests: 12		X			X			X			X			X			X		
Loss on Ignition in soils	All	NDPs: 0 Tests: 12		X			X			X			X			X			X		
Mercury Dissolved	All	NDPs: 0 Tests: 12	X			X			X			X			X			X			X
Metals in solid samples by OES	All	NDPs: 0 Tests: 12		X			X			X			X			X			X		
Mineral Oil	All	NDPs: 0 Tests: 12		X			X			X			X			X			X		

15892038	TP112			60g VOC (ALE215)	S											x						
				400g Tub (ALE214)	S		x		x		x				x		x		x					
				250g Amber Jar (ALE210)	S	x						x		x					x		x		x		x
15892037	TP111			60g VOC (ALE215)	S													x						
				250g Amber Jar (ALE210)	S	x						x		x					x		x		x		x
				1kg TUB	S		x		x		x				x		x		x					
15892036	TP110			60g VOC (ALE215)	S													x						
				250g Amber Jar (ALE210)	S	x						x		x					x		x		x		x
				1kg TUB	S		x		x		x				x		x		x					
15892035	TP109			60g VOC (ALE215)	S													x						
				250g Amber Jar (ALE210)	S	x						x		x					x		x		x		x
				1kg TUB	S		x		x		x				x		x		x					
15892034	TP108			60g VOC (ALE215)	S													x						
				250g Amber Jar (ALE210)	S	x						x		x					x		x		x		x
				1kg TUB	S		x		x		x				x		x		x					
15892032	TP107			60g VOC (ALE215)	S													x						
				250g Amber Jar (ALE210)	S	x						x		x					x		x		x		x

Validated

CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

Results Legend

X Test

N No Determination Possible

Sample Types -

S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
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UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

			Lab Sample No(s)																			
			15892026			15892027			15892028			15892029			15892030			15892031			15892032	
			Customer Sample Reference																			
			TP101			TP102			TP103			TP104			TP105			TP106			TP107	
			AGS Reference																			
			Depth (m)																			
			Container	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB
			Sample Type	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
PAH by GCMS	All	NDPs: 0 Tests: 12		X		X		X		X		X		X		X		X			
PCBs by GCMS	All	NDPs: 0 Tests: 12		X		X		X		X		X		X		X		X			
pH	All	NDPs: 0 Tests: 12		X		X		X		X		X		X		X		X			
Phenols by HPLC (W)	All	NDPs: 0 Tests: 12	X			X			X			X			X			X				X
Sample description	All	NDPs: 0 Tests: 12		X		X		X		X		X		X		X		X			
Semi Volatile Organic Compounds	All	NDPs: 0 Tests: 12		X		X		X		X		X		X		X		X			
Soil Density	All	NDPs: 0 Tests: 12		X		X		X		X		X		X		X		X			
Total Dissolved Solids	All	NDPs: 0 Tests: 12	X			X			X			X			X			X				X
Total Organic Carbon	All	NDPs: 0 Tests: 12		X		X		X		X		X		X		X		X			
TPH C6-C40 Value of soil	All	NDPs: 0 Tests: 12		X		X		X		X		X		X		X		X			
VOC MS (S)	All	NDPs: 0 Tests: 12			X			X			X			X			X				X	

15892038	TP112			60g VOC (ALE215)	S		
				400g Tub (ALE214)	S		
				250g Amber Jar (ALE210)	S	X	
15892037	TP111			60g VOC (ALE215)	S		X
				250g Amber Jar (ALE210)	S	X	
				1kg TUB	S		X
15892036	TP110			60g VOC (ALE215)	S		X
				250g Amber Jar (ALE210)	S	X	
				1kg TUB	S		X
15892035	TP109			60g VOC (ALE215)	S		X
				250g Amber Jar (ALE210)	S	X	
				1kg TUB	S		X
15892034	TP108			60g VOC (ALE215)	S		X
				250g Amber Jar (ALE210)	S	X	
				1kg TUB	S		X
15892032	TP107			60g VOC (ALE215)	S	X	
				250g Amber Jar (ALE210)	S	X	

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SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

Sample Descriptions

Grain Sizes

very fine	<0.063mm	fine	0.063mm - 0.1mm	medium	0.1mm - 2mm	coarse	2mm - 10mm	very coarse	>10mm

Lab Sample No(s)	Customer Sample Ref.	Depth (m)	Colour	Description	Inclusions	Inclusions 2
15892026	TP101		Dark Brown	Sandy Loam	Glass & Stones	Vegetation
15892027	TP102		Dark Brown	Loamy Sand	Glass & Stones	Vegetation
15892028	TP103		Dark Brown	Sandy Loam	Stones	Vegetation
15892029	TP104		Dark Brown	Sandy Loam	Vegetation	Stones
15892030	TP105		Dark Brown	Sandy Loam	Stones	Coal fragments
15892031	TP106		Dark Brown	Sandy Loam	Stones	Vegetation
15892032	TP107		Dark Brown	Sandy Silt Loam	Glass & Stones	Vegetation
15892034	TP108		Dark Brown	Sandy Clay Loam	Stones	None
15892035	TP109		Dark Brown	Sandy Loam	Stones	Glass
15892036	TP110		Dark Brown	Sandy Loam	Stones	Vegetation
15892037	TP111		Dark Brown	Sandy Clay Loam	Stones	None
15892038	TP112		Light Brown	Sandy Silt Loam	Stones	None

These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally ocurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	Depth (m)	Sample Type	Date Sampled	Sample Time	Date Received	SDG Ref	Lab Sample No.(s)	AGS Reference
			TP101	.	Soil/Solid (S)	20/07/2017	.	22/07/2017	170724-30	15892026	
			TP102	.	Soil/Solid (S)	20/07/2017	.	22/07/2017	170724-30	15892027	
			TP103	.	Soil/Solid (S)	20/07/2017	.	22/07/2017	170724-30	15892028	
			TP104	.	Soil/Solid (S)	20/07/2017	.	22/07/2017	170724-30	15892029	
			TP105	.	Soil/Solid (S)	20/07/2017	.	22/07/2017	170724-30	15892030	
			TP106	.	Soil/Solid (S)	20/07/2017	.	22/07/2017	170724-30	15892031	
Moisture Content Ratio (% of as received sample)	%	PM024	14	12	6.5	13	11	12			
Loss on ignition	<0.7 %	TM018	3.4 M	4.43 M	2.99 M	3.09 M	3.26 M	6.16 M			
Mineral oil >C10-C40	<1 mg/kg	TM061	41.1	53.2	58	21.6	63.2	132			
Mineral Oil Surrogate % recovery**	%	TM061	85.9	83.3	85.5	82.7	80.1	80.3			
Organic Carbon, Total	<0.2 %	TM132	0.881 M	2.01 M	1.42 M	0.488 M	1.25 M	1.34 M			
pH	1 pH Units	TM133	8.11 M	8.26 M	8.52 M	8.46 M	8.31 M	8.3 M			
Chromium, Hexavalent	<0.6 mg/kg	TM151	<0.6 #	<0.6 #	<0.6 #	<0.6 #	<0.6 #	<0.6 #			
Cyanide, Total	<1 mg/kg	TM153	<1 M	<1 M	<1 M	<1 M	<1 M	<1 M			
Cyanide, Free	<1 mg/kg	TM153	<1 M	<1 M	<1 M	<1 M	<1 M	<1 M			
Cyanide, Complex	<1 mg/kg	TM153	<1	<1	<1	<1	<1	<1			
PCB congener 28	<3 µg/kg	TM168	<3 M	<3 M	<3 M	<3 M	<3 M	<3 M			
PCB congener 52	<3 µg/kg	TM168	<3 M	<3 M	<3 M	<3 M	<3 M	<3 M			
PCB congener 101	<3 µg/kg	TM168	<3 M	<3 M	<3 M	<3 M	<3 M	<3 M			
PCB congener 118	<3 µg/kg	TM168	<3 M	<3 M	<3 M	<3 M	<3 M	<3 M			
PCB congener 138	<3 µg/kg	TM168	<3 M	<3 M	<3 M	<3 M	<3 M	<3 M			
PCB congener 153	<3 µg/kg	TM168	<3 M	<3 M	<3 M	<3 M	<3 M	<3 M			
PCB congener 180	<3 µg/kg	TM168	<3 M	<3 M	<3 M	<3 M	<3 M	<3 M			
Sum of detected PCB 7 Congeners	<21 µg/kg	TM168	<21	<21	<21	<21	<21	<21			
Chromium, Trivalent	<0.9 mg/kg	TM181	9.63	9.15	12.3	6.58	10.3	8.26			
Arsenic	<0.6 mg/kg	TM181	15.1 M	15.7 M	16.3 M	11.4 M	14.1 M	17.4 M			
Cadmium	<0.02 mg/kg	TM181	1.29 M	1.27 M	1 M	1.45 M	0.96 M	0.7 M			
Chromium	<0.9 mg/kg	TM181	9.63 M	9.15 M	12.3 M	6.58 M	10.3 M	8.26 M			
Copper	<1.4 mg/kg	TM181	22.5 M	26.2 M	25 M	19.4 M	31.3 M	27.6 M			
Lead	<0.7 mg/kg	TM181	34.6 M	65.3 M	40.6 M	28.1 M	47 M	95 M			
Mercury	<0.14 mg/kg	TM181	0.474 M	0.463 M	0.434 M	0.554 M	0.622 M	0.767 M			
Nickel	<0.2 mg/kg	TM181	32.8 M	32.4 M	31 M	31.7 M	30.5 M	21.9 M			
Selenium	<1 mg/kg	TM181	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #			
Zinc	<1.9 mg/kg	TM181	95 M	93 M	95.3 M	85.6 M	94.6 M	95.2 M			
ANC @ pH 4	<0.03 mol/kg	TM182	0.925	0.402	0.317	1.48	0.265	0.338			
ANC @ pH 6	<0.03 mol/kg	TM182	0.105	0.083	0.0685	0.179	0.0575	0.0526			
Soil Density	g/ml	TM339	1	1.01	1.09	1.04	1.11	1			

CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	TP107	TP108	TP109	TP110	TP111	TP112
			Depth (m)	.	.	.	.	.	.
			Sample Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
			Date Sampled	20/07/2017	21/07/2017	21/07/2017	21/07/2017	21/07/2017	21/07/2017
			Sample Time	.	.	.	.	.	.
			Date Received	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017
			SDG Ref	170724-30	170724-30	170724-30	170724-30	170724-30	170724-30
			Lab Sample No.(s)	15892032	15892034	15892035	15892036	15892037	15892038
			AGS Reference						
Moisture Content Ratio (% of as received sample)	%	PM024		9.7	14	12	14	15	17
Loss on ignition	<0.7 %	TM018		3.39 M	3.58 M	3.62 M	3.5 M	2.59 M	3.49 M
Mineral oil >C10-C40	<1 mg/kg	TM061		14.2	35.8	36	30.4	79.8	43.1
Mineral Oil Surrogate % recovery**	%	TM061		83.4	79.1	83.1	82.4	80.4	80.6
Organic Carbon, Total	<0.2 %	TM132		0.801 M	1 M	1.13 M	0.83 M	0.933 M	1.04 M
pH	1 pH Units	TM133		8.4 M	8.24 M	8.57 M	8.21 M	8.35 M	8.52 M
Chromium, Hexavalent	<0.6 mg/kg	TM151		<0.6 #	<0.6 #	<0.6 #	<0.6 #	<0.6 #	<0.6 #
Cyanide, Total	<1 mg/kg	TM153		<1 M	<1 M	<1 M	<1 M	<1 M	<1 M
Cyanide, Free	<1 mg/kg	TM153		<1 M	<1 M	<1 M	<1 M	<1 M	<1 M
Cyanide, Complex	<1 mg/kg	TM153		<1	<1	<1	<1	<1	<1
PCB congener 28	<3 µg/kg	TM168		<3 M	<3 M	<3 M	<3 M	<3 M	<3 M
PCB congener 52	<3 µg/kg	TM168		<3 M	<3 M	<3 M	<3 M	<3 M	<3 M
PCB congener 101	<3 µg/kg	TM168		<3 M	<3 M	<3 M	<3 M	<3 M	<3 M
PCB congener 118	<3 µg/kg	TM168		<3 M	<3 M	<3 M	<3 M	<3 M	<3 M
PCB congener 138	<3 µg/kg	TM168		<3 M	<3 M	<3 M	<3 M	<3 M	<3 M
PCB congener 153	<3 µg/kg	TM168		<3 M	<3 M	<3 M	<3 M	<3 M	<3 M
PCB congener 180	<3 µg/kg	TM168		<3 M	<3 M	<3 M	<3 M	<3 M	<3 M
Sum of detected PCB 7 Congeners	<21 µg/kg	TM168		<21	<21	<21	<21	<21	<21
Chromium, Trivalent	<0.9 mg/kg	TM181		16.1	11.2	<0.9	9	22.4	18.4
Arsenic	<0.6 mg/kg	TM181		12.5 M	14.3 M	66.4 M	14.2 M	19 M	13.7 M
Cadmium	<0.02 mg/kg	TM181		1.12 M	1.23 M	0.738 M	1.84 M	0.758 M	0.754 M
Chromium	<0.9 mg/kg	TM181		16.1 M	11.2 M	<0.9 M	9 M	22.4 M	18.4 M
Copper	<1.4 mg/kg	TM181		22.1 M	24.8 M	76.6 M	23.1 M	26.1 M	24.3 M
Lead	<0.7 mg/kg	TM181		44.8 M	43.2 M	61 M	30.4 M	40 M	29.5 M
Mercury	<0.14 mg/kg	TM181		0.7 M	0.503 M	0.866 M	0.47 M	0.508 M	0.517 M
Nickel	<0.2 mg/kg	TM181		38.4 M	36.4 M	39.9 M	36.4 M	32.8 M	34.6 M
Selenium	<1 mg/kg	TM181		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
Zinc	<1.9 mg/kg	TM181		99.2 M	113 M	102 M	115 M	92.2 M	73.7 M
ANC @ pH 4	<0.03 mol/kg	TM182		0.599	0.855	0.635	0.566	0.717	0.608
ANC @ pH 6	<0.03 mol/kg	TM182		0.109	0.115	0.107	0.0943	0.143	0.0756
Soil Density	g/ml	TM339		0.98	1.03	1.15	1.15	1.19	0.99

Validated

CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

Oily Waste

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
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1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	TP101	TP102	TP103	TP104	TP105	TP106
			Depth (m)	.	.	.	.	.	.
			Sample Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
			Date Sampled	20/07/2017	20/07/2017	20/07/2017	20/07/2017	20/07/2017	20/07/2017
			Sample Time	.	.	.	.	.	.
			Date Received	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017
			SDG Ref	170724-30	170724-30	170724-30	170724-30	170724-30	170724-30
			Lab Sample No.(s)	15892026	15892027	15892028	15892029	15892030	15892031
			AGS Reference						
Methyl tertiary butyl ether (MTBE)	<5 µg/kg	TM089		<5 #	<5 #	<5 #	<5 #	<5 #	<5 #
Benzene	<10 µg/kg	TM089		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
Toluene	<2 µg/kg	TM089		8.12 M	<2 M	2.14 M	2.3 M	<2 M	4.56 M
Ethylbenzene	<3 µg/kg	TM089		10.4 M	6.84 M	7.49 M	5.75 M	14.6 M	6.84 M
m,p-Xylene	<6 µg/kg	TM089		<6 M	<6 M	<6 M	<6 M	6.72 M	<6 M
o-Xylene	<3 µg/kg	TM089		<3 M	<3 M	<3 M	<3 M	<3 M	<3 M
sum of detected mpo xylene by GC	<9 µg/kg	TM089		<9	<9	<9	<9	<9	<9
sum of detected BTEX by GC	<24 µg/kg	TM089		<24	<24	<24	<24	<24	<24
GRO >C6-C10	<10 µg/kg	TM089		25.5	156	19.3	17.3	44.8	57
TPH >C10-25	<10 mg/kg	TM154		70.6	102	79.4	15.7	42.7	53.8
TPH >C25-40	<10 mg/kg	TM154		274	188	165	30.4	90.1	160
TPH C6-40	<10 mg/kg	TM154		344	291	244	46.2	133	214
Contains Petrol	-	TM154		No	No	No	No	No	No
Contains Diesel	-	TM154		No	No	No	No	No	No

Validated

CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

Oily Waste

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	TP107	TP108	TP109	TP110	TP111	TP112
			Depth (m)	.	.	.	.	.	.
			Sample Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
			Date Sampled	20/07/2017	21/07/2017	21/07/2017	21/07/2017	21/07/2017	21/07/2017
			Sample Time	.	.	.	.	.	.
			Date Received	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017
			SDG Ref	170724-30	170724-30	170724-30	170724-30	170724-30	170724-30
			Lab Sample No.(s)	15892032	15892034	15892035	15892036	15892037	15892038
			AGS Reference						
Methyl tertiary butyl ether (MTBE)	<5 µg/kg	TM089		<5 #	<5 #	<5 #	<5 #	<5 #	<5 #
Benzene	<10 µg/kg	TM089		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
Toluene	<2 µg/kg	TM089		16.7 M	9.28 M	4.56 M	4.68 M	<2 M	2.42 M
Ethylbenzene	<3 µg/kg	TM089		4.44 M	<3 M	<3 M	<3 M	<3 M	<3 M
m,p-Xylene	<6 µg/kg	TM089		<6 M	<6 M	<6 M	<6 M	<6 M	<6 M
o-Xylene	<3 µg/kg	TM089		<3 M	<3 M	<3 M	<3 M	<3 M	<3 M
sum of detected mpo xylene by GC	<9 µg/kg	TM089		<9	<9	<9	<9	<9	<9
sum of detected BTEX by GC	<24 µg/kg	TM089		<24	<24	<24	<24	<24	<24
GRO >C6-C10	<10 µg/kg	TM089		48.8	68.4	21.7	30.4	<10	<10
TPH >C10-25	<10 mg/kg	TM154		233	<10	<10	24.8	52	35.4
TPH >C25-40	<10 mg/kg	TM154		479	25.9	99.3	135	211	105
TPH C6-40	<10 mg/kg	TM154		712	35.2	110	160	263	140
Contains Petrol	-	TM154		No	No	No	No	No	No
Contains Diesel	-	TM154		No	No	No	No	No	No

Validated

CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

PAH by GCMS

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	TP101	TP102	TP103	TP104	TP105	TP106
			Depth (m)	.	.	.	.	.	.
			Sample Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
			Date Sampled	20/07/2017	20/07/2017	20/07/2017	20/07/2017	20/07/2017	20/07/2017
			Sample Time	.	.	.	.	.	.
			Date Received	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017
			SDG Ref	170724-30	170724-30	170724-30	170724-30	170724-30	170724-30
			Lab Sample No.(s)	15892026	15892027	15892028	15892029	15892030	15892031
			AGS Reference						
PAH total 17 (inclusive of Coronene)	<10 mg/kg	TM218		<10	<10	16.1	<10	<10	<10

Validated

CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

PAH by GCMS

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	TP107	TP108	TP109	TP110	TP111	TP112
			Depth (m)	.	.	.	.	.	.
			Sample Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
			Date Sampled	20/07/2017	21/07/2017	21/07/2017	21/07/2017	21/07/2017	21/07/2017
			Sample Time	.	.	.	.	.	.
			Date Received	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017
			SDG Ref	170724-30	170724-30	170724-30	170724-30	170724-30	170724-30
			Lab Sample No.(s)	15892032	15892034	15892035	15892036	15892037	15892038
			AGS Reference						
PAH total 17 (inclusive of Coronene)	<10 mg/kg	TM218		<10	<10	<10	<10	<10	13.7

CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

Semi Volatile Organic Compounds

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	TP101	TP102	TP103	TP104	TP105	TP106
			Depth (m)	.	.	.	.	.	.
			Sample Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
			Date Sampled	20/07/2017	20/07/2017	20/07/2017	20/07/2017	20/07/2017	20/07/2017
			Sample Time	.	.	.	.	.	.
			Date Received	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017
			SDG Ref	170724-30	170724-30	170724-30	170724-30	170724-30	170724-30
			Lab Sample No.(s)	15892026	15892027	15892028	15892029	15892030	15892031
			AGS Reference						
Phenol	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Pentachlorophenol	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
n-Nitroso-n-dipropylamine	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Nitrobenzene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Isophorone	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Hexachloroethane	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Hexachlorocyclopentadiene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Hexachlorobutadiene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Hexachlorobenzene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
n-Dioctyl phthalate	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Dimethyl phthalate	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Diethyl phthalate	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
n-Dibutyl phthalate	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Dibenzofuran	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Carbazole	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Butylbenzyl phthalate	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
bis(2-Ethylhexyl) phthalate	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
bis(2-Chloroethoxy)methane	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
bis(2-Chloroethyl)ether	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Azobenzene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
4-Nitrophenol	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
4-Nitroaniline	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
4-Methylphenol	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
4-Chlorophenylphenylether	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
4-Chloroaniline	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
4-Chloro-3-methylphenol	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
4-Bromophenylphenylether	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
3-Nitroaniline	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
2-Nitrophenol	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
2-Nitroaniline	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
2-Methylphenol	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
1,2,4-Trichlorobenzene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
2-Chlorophenol	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100

CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

Semi Volatile Organic Compounds

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	TP101	TP102	TP103	TP104	TP105	TP106
			Depth (m)	.	.	.	.	.	.
			Sample Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
			Date Sampled	20/07/2017	20/07/2017	20/07/2017	20/07/2017	20/07/2017	20/07/2017
			Sample Time	.	.	.	.	.	.
			Date Received	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017
			SDG Ref	170724-30	170724-30	170724-30	170724-30	170724-30	170724-30
			Lab Sample No.(s)	15892026	15892027	15892028	15892029	15892030	15892031
			AGS Reference						
2,6-Dinitrotoluene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
2,4-Dinitrotoluene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
2,4-Dimethylphenol	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
2,4-Dichlorophenol	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
2,4,6-Trichlorophenol	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
2,4,5-Trichlorophenol	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
1,4-Dichlorobenzene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
1,3-Dichlorobenzene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
1,2-Dichlorobenzene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
2-Chloronaphthalene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
2-Methylnaphthalene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Acenaphthylene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Acenaphthene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Anthracene	<100 µg/kg	TM157		<100	158	153	<100	<100	<100
Benzo(a)anthracene	<100 µg/kg	TM157		<100	647	657	<100	173	<100
Benzo(b)fluoranthene	<100 µg/kg	TM157		<100	501	469	<100	157	114
Benzo(k)fluoranthene	<100 µg/kg	TM157		<100	472	548	<100	150	<100
Benzo(a)pyrene	<100 µg/kg	TM157		<100	557	641	<100	194	146
Benzo(g,h,i)perylene	<100 µg/kg	TM157		<100	322	371	<100	136	<100
Chrysene	<100 µg/kg	TM157		<100	584	637	<100	185	126
Fluoranthene	<100 µg/kg	TM157		<100	1370	1080	<100	331	191
Fluorene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Indeno(1,2,3-cd)pyrene	<100 µg/kg	TM157		<100	395	453	<100	133	<100
Phenanthrene	<100 µg/kg	TM157		<100	188	247	<100	192	<100
Pyrene	<100 µg/kg	TM157		<100	1270	992	<100	334	205
Naphthalene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Dibenzo(a,h)anthracene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Bis(2-chloroisopropyl) ether	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100

CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

Semi Volatile Organic Compounds

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	TP107	TP108	TP109	TP110	TP111	TP112
			Depth (m)	.	.	.	.	.	.
			Sample Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
			Date Sampled	20/07/2017	21/07/2017	21/07/2017	21/07/2017	21/07/2017	21/07/2017
			Sample Time	.	.	.	.	.	.
			Date Received	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017
			SDG Ref	170724-30	170724-30	170724-30	170724-30	170724-30	170724-30
			Lab Sample No.(s)	15892032	15892034	15892035	15892036	15892037	15892038
			AGS Reference						
Phenol	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Pentachlorophenol	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
n-Nitroso-n-dipropylamine	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Nitrobenzene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Isophorone	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Hexachloroethane	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Hexachlorocyclopentadiene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Hexachlorobutadiene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Hexachlorobenzene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
n-Dioctyl phthalate	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Dimethyl phthalate	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Diethyl phthalate	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
n-Dibutyl phthalate	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Dibenzofuran	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Carbazole	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Butylbenzyl phthalate	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
bis(2-Ethylhexyl) phthalate	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
bis(2-Chloroethoxy)methane	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
bis(2-Chloroethyl)ether	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Azobenzene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
4-Nitrophenol	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
4-Nitroaniline	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
4-Methylphenol	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
4-Chlorophenylphenylether	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
4-Chloroaniline	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
4-Chloro-3-methylphenol	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
4-Bromophenylphenylether	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
3-Nitroaniline	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
2-Nitrophenol	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
2-Nitroaniline	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
2-Methylphenol	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
1,2,4-Trichlorobenzene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
2-Chlorophenol	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100

CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

Semi Volatile Organic Compounds

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	TP107	TP108	TP109	TP110	TP111	TP112
			Depth (m)	.	.	.	.	.	.
			Sample Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
			Date Sampled	20/07/2017	21/07/2017	21/07/2017	21/07/2017	21/07/2017	21/07/2017
			Sample Time	.	.	.	.	.	.
			Date Received	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017
			SDG Ref	170724-30	170724-30	170724-30	170724-30	170724-30	170724-30
			Lab Sample No.(s)	15892032	15892034	15892035	15892036	15892037	15892038
			AGS Reference						
2,6-Dinitrotoluene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
2,4-Dinitrotoluene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
2,4-Dimethylphenol	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
2,4-Dichlorophenol	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
2,4,6-Trichlorophenol	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
2,4,5-Trichlorophenol	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
1,4-Dichlorobenzene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
1,3-Dichlorobenzene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
1,2-Dichlorobenzene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
2-Chloronaphthalene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
2-Methylnaphthalene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Acenaphthylene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Acenaphthene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Anthracene	<100 µg/kg	TM157		208	<100	<100	<100	223	148
Benzo(a)anthracene	<100 µg/kg	TM157		622	<100	166	<100	403	222
Benzo(b)fluoranthene	<100 µg/kg	TM157		302	<100	115	<100	293	159
Benzo(k)fluoranthene	<100 µg/kg	TM157		349	<100	130	<100	269	144
Benzo(a)pyrene	<100 µg/kg	TM157		388	<100	175	<100	345	183
Benzo(g,h,i)perylene	<100 µg/kg	TM157		195	<100	<100	<100	203	<100
Chrysene	<100 µg/kg	TM157		545	<100	149	<100	313	197
Fluoranthene	<100 µg/kg	TM157		933	<100	298	<100	854	557
Fluorene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Indeno(1,2,3-cd)pyrene	<100 µg/kg	TM157		220	<100	116	<100	235	122
Phenanthrene	<100 µg/kg	TM157		336	<100	177	<100	472	618
Pyrene	<100 µg/kg	TM157		762	<100	316	<100	839	544
Naphthalene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	152
Dibenzo(a,h)anthracene	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100
Bis(2-chloroisopropyl) ether	<100 µg/kg	TM157		<100	<100	<100	<100	<100	<100

CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

VOC MS (S)

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	TP101	TP102	TP103	TP104	TP105	TP106
			Depth (m)	.	.	.	.	.	.
			Sample Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
			Date Sampled	20/07/2017	20/07/2017	20/07/2017	20/07/2017	20/07/2017	20/07/2017
			Sample Time	.	.	.	.	.	.
			Date Received	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017
			SDG Ref	170724-30	170724-30	170724-30	170724-30	170724-30	170724-30
			Lab Sample No.(s)	15892026	15892027	15892028	15892029	15892030	15892031
			AGS Reference						
Dibromofluoromethane**	%	TM116		119	117	128	124	115	123
Toluene-d8**	%	TM116		90.9	96.1	91.9	97	94.6	93.9
4-Bromofluorobenzene**	%	TM116		73.9	77.3	75.7	85.1	80.5	71.6
Dichlorodifluoromethane	<6 µg/kg	TM116		<6 M	<6 M	<6 M	<6 M	<6 M	<6 M
Chloromethane	<7 µg/kg	TM116		<7 #	<7 #	<7 #	<7 #	<7 #	<7 #
Vinyl Chloride	<6 µg/kg	TM116		<6 M	<6 M	<6 M	<6 M	<6 M	<6 M
Bromomethane	<10 µg/kg	TM116		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
Chloroethane	<10 µg/kg	TM116		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
Trichlorofluorormethane	<6 µg/kg	TM116		<6 M	<6 M	<6 M	<6 M	<6 M	<6 M
1,1-Dichloroethene	<10 µg/kg	TM116		<10 #	<10 #	<10 #	<10 #	<10 #	<10 #
Carbon Disulphide	<7 µg/kg	TM116		<7 M	<7 M	<7 M	<7 M	<7 M	<7 M
Dichloromethane	<10 µg/kg	TM116		<10 #	<10 #	<10 #	<10 #	<10 #	<10 #
Methyl Tertiary Butyl Ether	<10 µg/kg	TM116		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
trans-1,2-Dichloroethene	<10 µg/kg	TM116		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
1,1-Dichloroethane	<8 µg/kg	TM116		<8 M	<8 M	<8 M	<8 M	<8 M	<8 M
cis-1,2-Dichloroethene	<6 µg/kg	TM116		<6 M	<6 M	<6 M	<6 M	<6 M	<6 M
2,2-Dichloropropane	<10 µg/kg	TM116		<10	<10	<10	<10	<10	<10
Bromochloromethane	<10 µg/kg	TM116		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
Chloroform	<8 µg/kg	TM116		<8 M	<8 M	<8 M	<8 M	<8 M	<8 M
1,1,1-Trichloroethane	<7 µg/kg	TM116		<7 M	<7 M	<7 M	<7 M	<7 M	<7 M
1,1-Dichloropropene	<10 µg/kg	TM116		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
Carbontetrachloride	<10 µg/kg	TM116		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
1,2-Dichloroethane	<5 µg/kg	TM116		<5 M	<5 M	<5 M	<5 M	<5 M	<5 M
Benzene	<9 µg/kg	TM116		<9 M	<9 M	<9 M	<9 M	<9 M	<9 M
Trichloroethene	<9 µg/kg	TM116		<9 #	<9 #	<9 #	<9 #	<9 #	<9 #
1,2-Dichloropropane	<10 µg/kg	TM116		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
Dibromomethane	<9 µg/kg	TM116		<9 M	<9 M	<9 M	<9 M	<9 M	<9 M
Bromodichloromethane	<7 µg/kg	TM116		<7 M	<7 M	<7 M	<7 M	<7 M	<7 M
cis-1,3-Dichloropropene	<10 µg/kg	TM116		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
Toluene	<7 µg/kg	TM116		<7 M	<7 M	<7 M	<7 M	<7 M	<7 M
trans-1,3-Dichloropropene	<10 µg/kg	TM116		<10	<10	<10	<10	<10	<10
1,1,2-Trichloroethane	<10 µg/kg	TM116		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
1,3-Dichloropropane	<7 µg/kg	TM116		<7 M	<7 M	<7 M	<7 M	<7 M	<7 M

CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

VOC MS (S)

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	TP101	TP102	TP103	TP104	TP105	TP106
			Depth (m)	.	.	.	.	.	.
			Sample Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
			Date Sampled	20/07/2017	20/07/2017	20/07/2017	20/07/2017	20/07/2017	20/07/2017
			Sample Time	.	.	.	.	.	.
			Date Received	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017
			SDG Ref	170724-30	170724-30	170724-30	170724-30	170724-30	170724-30
			Lab Sample No.(s)	15892026	15892027	15892028	15892029	15892030	15892031
			AGS Reference						
Tetrachloroethene	<5 µg/kg	TM116		<5 M	<5 M	<5 M	<5 M	<5 M	<5 M
Dibromochloromethane	<10 µg/kg	TM116		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
1,2-Dibromoethane	<10 µg/kg	TM116		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
Chlorobenzene	<5 µg/kg	TM116		<5 M	<5 M	<5 M	<5 M	<5 M	<5 M
1,1,1,2-Tetrachloroethane	<10 µg/kg	TM116		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
Ethylbenzene	<4 µg/kg	TM116		<4 M	<4 M	<4 M	<4 M	7.15 M	<4 M
p/m-Xylene	<10 µg/kg	TM116		<10 #	<10 #	<10 #	<10 #	<10 #	<10 #
o-Xylene	<10 µg/kg	TM116		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
Styrene	<10 µg/kg	TM116		<10 #	<10 #	<10 #	<10 #	<10 #	<10 #
Bromoform	<10 µg/kg	TM116		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
Isopropylbenzene	<5 µg/kg	TM116		<5 #	<5 #	<5 #	<5 #	<5 #	<5 #
1,1,2,2-Tetrachloroethane	<10 µg/kg	TM116		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
1,2,3-Trichloropropane	<16 µg/kg	TM116		<16 M	<16 M	<16 M	<16 M	<16 M	<16 M
Bromobenzene	<10 µg/kg	TM116		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
Propylbenzene	<10 µg/kg	TM116		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
2-Chlorotoluene	<9 µg/kg	TM116		<9 M	<9 M	<9 M	<9 M	<9 M	<9 M
1,3,5-Trimethylbenzene	<8 µg/kg	TM116		<8 M	<8 M	<8 M	<8 M	<8 M	<8 M
4-Chlorotoluene	<10 µg/kg	TM116		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
tert-Butylbenzene	<14 µg/kg	TM116		<14 M	<14 M	<14 M	<14 M	<14 M	<14 M
1,2,4-Trimethylbenzene	<9 µg/kg	TM116		<9 #	<9 #	<9 #	<9 #	<9 #	<9 #
sec-Butylbenzene	<10 µg/kg	TM116		<10	<10	<10	<10	<10	<10
4-Isopropyltoluene	<10 µg/kg	TM116		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
1,3-Dichlorobenzene	<8 µg/kg	TM116		<8 M	<8 M	<8 M	<8 M	<8 M	<8 M
1,4-Dichlorobenzene	<5 µg/kg	TM116		<5 M	<5 M	<5 M	<5 M	<5 M	<5 M
n-Butylbenzene	<11 µg/kg	TM116		<11	<11	<11	<11	<11	<11
1,2-Dichlorobenzene	<10 µg/kg	TM116		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
1,2-Dibromo-3-chloropropane	<14 µg/kg	TM116		<14 M	<14 M	<14 M	<14 M	<14 M	<14 M
Tert-amyl methyl ether	<10 µg/kg	TM116		<10 #	<10 #	<10 #	<10 #	<10 #	<10 #
1,2,4-Trichlorobenzene	<20 µg/kg	TM116		<20	<20	<20	<20	<20	<20
Hexachlorobutadiene	<20 µg/kg	TM116		<20	<20	<20	<20	<20	<20
Naphthalene	<13 µg/kg	TM116		<13 M	<13 M	<13 M	<13 M	<13 M	<13 M
1,2,3-Trichlorobenzene	<20 µg/kg	TM116		<20 #	<20 #	<20 #	<20 #	<20 #	<20 #

CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

VOC MS (S)

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	TP107	TP108	TP109	TP110	TP111	TP112
			Depth (m)	.	.	.	.	.	.
			Sample Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
			Date Sampled	20/07/2017	21/07/2017	21/07/2017	21/07/2017	21/07/2017	21/07/2017
			Sample Time	.	.	.	.	.	.
			Date Received	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017
			SDG Ref	170724-30	170724-30	170724-30	170724-30	170724-30	170724-30
			Lab Sample No.(s)	15892032	15892034	15892035	15892036	15892037	15892038
			AGS Reference						
Dibromofluoromethane**	%	TM116		110	131	116	107	127	120
Toluene-d8**	%	TM116		98.4	100	98.7	96.1	95.3	103
4-Bromofluorobenzene**	%	TM116		93.4	82.4	94.7	84.9	82.4	88.4
Dichlorodifluoromethane	<6 µg/kg	TM116		<60 M	<6 M	<60 M	<6 M	<6 M	<6 M
Chloromethane	<7 µg/kg	TM116		<70 #	<7 #	<70 #	<7 #	<7 #	<7 #
Vinyl Chloride	<6 µg/kg	TM116		<60 M	<6 M	<60 M	<6 M	<6 M	<6 M
Bromomethane	<10 µg/kg	TM116		<100 M	<10 M	<100 M	<10 M	<10 M	<10 M
Chloroethane	<10 µg/kg	TM116		<100 M	<10 M	<100 M	<10 M	<10 M	<10 M
Trichlorofluoromethane	<6 µg/kg	TM116		<60 M	<6 M	<60 M	<6 M	<6 M	<6 M
1,1-Dichloroethene	<10 µg/kg	TM116		<100 #	<10 #	<100 #	<10 #	<10 #	<10 #
Carbon Disulphide	<7 µg/kg	TM116		<70 M	<7 M	<70 M	<7 M	<7 M	<7 M
Dichloromethane	<10 µg/kg	TM116		<100 #	<10 #	<100 #	<10 #	<10 #	<10 #
Methyl Tertiary Butyl Ether	<10 µg/kg	TM116		<100 M	<10 M	<100 M	<10 M	<10 M	<10 M
trans-1,2-Dichloroethene	<10 µg/kg	TM116		<100 M	<10 M	<100 M	<10 M	<10 M	<10 M
1,1-Dichloroethane	<8 µg/kg	TM116		<80 M	<8 M	<80 M	<8 M	<8 M	<8 M
cis-1,2-Dichloroethene	<6 µg/kg	TM116		<60 M	<6 M	<60 M	<6 M	<6 M	<6 M
2,2-Dichloropropane	<10 µg/kg	TM116		<100	<10	<100	<10	<10	<10
Bromochloromethane	<10 µg/kg	TM116		<100 M	<10 M	<100 M	<10 M	<10 M	<10 M
Chloroform	<8 µg/kg	TM116		<80 M	<8 M	<80 M	<8 M	<8 M	<8 M
1,1,1-Trichloroethane	<7 µg/kg	TM116		<70 M	<7 M	<70 M	<7 M	<7 M	<7 M
1,1-Dichloropropene	<10 µg/kg	TM116		<100 M	<10 M	<100 M	<10 M	<10 M	<10 M
Carbontetrachloride	<10 µg/kg	TM116		<100 M	<10 M	<100 M	<10 M	<10 M	<10 M
1,2-Dichloroethane	<5 µg/kg	TM116		<50 M	<5 M	<50 M	<5 M	<5 M	<5 M
Benzene	<9 µg/kg	TM116		<90 M	<9 M	<90 M	<9 M	<9 M	<9 M
Trichloroethene	<9 µg/kg	TM116		<90 #	<9 #	<90 #	<9 #	<9 #	<9 #
1,2-Dichloropropane	<10 µg/kg	TM116		<100 M	<10 M	<100 M	<10 M	<10 M	<10 M
Dibromomethane	<9 µg/kg	TM116		<90 M	<9 M	<90 M	<9 M	<9 M	<9 M
Bromodichloromethane	<7 µg/kg	TM116		<70 M	<7 M	<70 M	<7 M	<7 M	<7 M
cis-1,3-Dichloropropene	<10 µg/kg	TM116		<100 M	<10 M	<100 M	<10 M	<10 M	<10 M
Toluene	<7 µg/kg	TM116		<70 M	<7 M	<70 M	<7 M	<7 M	<7 M
trans-1,3-Dichloropropene	<10 µg/kg	TM116		<100	<10	<100	<10	<10	<10
1,1,2-Trichloroethane	<10 µg/kg	TM116		<100 M	<10 M	<100 M	<10 M	<10 M	<10 M
1,3-Dichloropropane	<7 µg/kg	TM116		<70 M	<7 M	<70 M	<7 M	<7 M	<7 M

CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

VOC MS (S)

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	TP107	TP108	TP109	TP110	TP111	TP112
			Depth (m)	.	.	.	.	.	.
			Sample Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
			Date Sampled	20/07/2017	21/07/2017	21/07/2017	21/07/2017	21/07/2017	21/07/2017
			Sample Time	.	.	.	.	.	.
			Date Received	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017	22/07/2017
			SDG Ref	170724-30	170724-30	170724-30	170724-30	170724-30	170724-30
			Lab Sample No.(s)	15892032	15892034	15892035	15892036	15892037	15892038
			AGS Reference						
Tetrachloroethene	<5 µg/kg	TM116		<50 M	<5 M	<50 M	<5 M	<5 M	<5 M
Dibromochloromethane	<10 µg/kg	TM116		<100 M	<10 M	<100 M	<10 M	<10 M	<10 M
1,2-Dibromoethane	<10 µg/kg	TM116		<100 M	<10 M	<100 M	<10 M	<10 M	<10 M
Chlorobenzene	<5 µg/kg	TM116		<50 M	<5 M	<50 M	<5 M	<5 M	<5 M
1,1,1,2-Tetrachloroethane	<10 µg/kg	TM116		<100 M	<10 M	<100 M	<10 M	<10 M	<10 M
Ethylbenzene	<4 µg/kg	TM116		<40 M	<4 M	<40 M	<4 M	<4 M	<4 M
p/m-Xylene	<10 µg/kg	TM116		<100 #	<10 #	<100 #	<10 #	<10 #	<10 #
o-Xylene	<10 µg/kg	TM116		<100 M	<10 M	<100 M	<10 M	<10 M	<10 M
Styrene	<10 µg/kg	TM116		<100 #	<10 #	<100 #	<10 #	<10 #	<10 #
Bromoform	<10 µg/kg	TM116		<100 M	<10 M	<100 M	<10 M	<10 M	<10 M
Isopropylbenzene	<5 µg/kg	TM116		<50 #	<5 #	<50 #	<5 #	<5 #	<5 #
1,1,2,2-Tetrachloroethane	<10 µg/kg	TM116		<100 M	<10 M	<100 M	<10 M	<10 M	<10 M
1,2,3-Trichloropropane	<16 µg/kg	TM116		<160 M	<16 M	<160 M	<16 M	<16 M	<16 M
Bromobenzene	<10 µg/kg	TM116		<100 M	<10 M	<100 M	<10 M	<10 M	<10 M
Propylbenzene	<10 µg/kg	TM116		<100 M	<10 M	<100 M	<10 M	<10 M	<10 M
2-Chlorotoluene	<9 µg/kg	TM116		<90 M	<9 M	<90 M	<9 M	<9 M	<9 M
1,3,5-Trimethylbenzene	<8 µg/kg	TM116		<80 M	<8 M	<80 M	<8 M	<8 M	<8 M
4-Chlorotoluene	<10 µg/kg	TM116		<100 M	<10 M	<100 M	<10 M	<10 M	<10 M
tert-Butylbenzene	<14 µg/kg	TM116		<140 M	<14 M	<140 M	<14 M	<14 M	<14 M
1,2,4-Trimethylbenzene	<9 µg/kg	TM116		<90 #	<9 #	<90 #	<9 #	<9 #	<9 #
sec-Butylbenzene	<10 µg/kg	TM116		<100	<10	<100	<10	<10	<10
4-Isopropyltoluene	<10 µg/kg	TM116		<100 M	<10 M	<100 M	<10 M	<10 M	<10 M
1,3-Dichlorobenzene	<8 µg/kg	TM116		<80 M	<8 M	<80 M	<8 M	<8 M	<8 M
1,4-Dichlorobenzene	<5 µg/kg	TM116		<50 M	<5 M	<50 M	<5 M	<5 M	<5 M
n-Butylbenzene	<11 µg/kg	TM116		<110	<11	<110	<11	<11	<11
1,2-Dichlorobenzene	<10 µg/kg	TM116		<100 M	<10 M	<100 M	<10 M	<10 M	<10 M
1,2-Dibromo-3-chloropropane	<14 µg/kg	TM116		<140 M	<14 M	<140 M	<14 M	<14 M	<14 M
Tert-amyl methyl ether	<10 µg/kg	TM116		<100 #	<10 #	<100 #	<10 #	<10 #	<10 #
1,2,4-Trichlorobenzene	<20 µg/kg	TM116		<200	<20	<200	<20	<20	<20
Hexachlorobutadiene	<20 µg/kg	TM116		<200	<20	<200	<20	<20	<20
Naphthalene	<13 µg/kg	TM116		<130 M	<13 M	<130 M	<13 M	<13 M	<13 M
1,2,3-Trichlorobenzene	<20 µg/kg	TM116		<200 #	<20 #	<200 #	<20 #	<20 #	<20 #

CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

Asbestos Identification - Solid Samples

		Date of Analysis	Analysed By	Comments	Amosite (Brown) Asbestos	Chrysotile (White) Asbestos	Crocidolite (Blue) Asbestos	Fibrous Actinolite	Fibrous Anthophyllite	Fibrous Tremolite	Non-Asbestos Fibre
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	TP101 SOLID 20/07/2017 00:00:00 26/07/2017 07:45:44 170724-30 15892026 TM048	28/07/17	Christian Hallam	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	TP102 SOLID 20/07/2017 00:00:00 26/07/2017 07:37:29 170724-30 15892027 TM048	28/07/17	Christian Hallam	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	TP103 SOLID 20/07/2017 00:00:00 26/07/2017 11:29:11 170724-30 15892028 TM048	28/07/17	Christian Hallam	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	TP104 SOLID 20/07/2017 00:00:00 26/07/2017 11:30:58 170724-30 15892029 TM048	28/07/17	Christian Hallam	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	TP105 SOLID 20/07/2017 00:00:00 26/07/2017 10:43:06 170724-30 15892030 TM048	28/07/17	Christian Hallam	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	TP106 SOLID 20/07/2017 00:00:00 26/07/2017 10:44:22 170724-30 15892031 TM048	28/07/17	Christian Hallam	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected

Validated

CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

		Date of Analysis	Analysed By	Comments	Amosite (Brown) Asbestos	Chrysotile (White) Asbestos	Crocidolite (Blue) Asbestos	Fibrous Actinolite	Fibrous Anthophyllite	Fibrous Tremolite	Non-Asbestos Fibre
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	TP107 SOLID 20/07/2017 00:00:00 27/07/2017 08:48:26 170724-30 15892032 TM048	28/07/17	Christian Hallam	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	TP108 SOLID 21/07/2017 00:00:00 27/07/2017 08:45:08 170724-30 15892034 TM048	31/07/17	Christian Hallam	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	TP109 SOLID 21/07/2017 00:00:00 26/07/2017 15:26:12 170724-30 15892035 TM048	28/07/17	Christian Hallam	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	TP110 SOLID 21/07/2017 00:00:00 26/07/2017 15:22:29 170724-30 15892036 TM048	28/07/17	Christian Hallam	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	TP111 SOLID 21/07/2017 00:00:00 27/07/2017 08:44:07 170724-30 15892037 TM048	28/07/17	Christian Hallam	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	TP112 SOLID 21/07/2017 00:00:00 27/07/2017 08:41:51 170724-30 15892038 TM048	28/07/17	Christian Hallam	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected

Validated

CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

CEN 10:1 SINGLE STAGE LEACHATE TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference		**Site Location**	Fassaroe
Mass Sample taken (kg)	0.105	**Natural Moisture Content (%)**	16.3
Mass of dry sample (kg)	0.090	**Dry Matter Content (%)**	86
Particle Size <4mm	>95%		

Case	
SDG	170724-30
Lab Sample Number(s)	15892026
Sampled Date	20-Jul-2017
Customer Sample Ref.	TP101
Depth (m)	

Solid Waste Analysis	**Result**	**Landfill Waste Acceptance Criteria Limits**		
		Inert Waste Landfill	**Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon (%)	0.881	3	5	6
Loss on Ignition (%)	3.4	-	-	10
Sum of BTEX (mg/kg)	<0.024	6	-	-
Sum of 7 PCBs (mg/kg)	<0.021	1	-	-
Mineral Oil (mg/kg)	41.1	500	-	-
PAH Sum of 17 (mg/kg)	<10	100	-	-
pH (pH Units)	8.11	-	>6	-
ANC to pH 6 (mol/kg)	0.105	-	-	-
ANC to pH 4 (mol/kg)	0.925	-	-	-

Eluate Analysis	**C_2 Concⁿ in 10:1 eluate (mg/l)**		**A_2 10:1 concⁿ leached (mg/kg)**		**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
	Result	**Limit of Detection**	**Result**	**Limit of Detection**			
Arsenic	0.00546	<0.0005	0.0546	<0.005	0.5	2	25
Barium	0.0214	<0.0002	0.214	<0.002	20	100	300
Cadmium	0.000111	<0.00008	0.00111	<0.0008	0.04	1	5
Chromium	<0.001	<0.001	<0.01	<0.01	0.5	10	70
Copper	0.00382	<0.0003	0.0382	<0.003	2	50	100
Mercury Dissolved (CVAF)	<0.00001	<0.00001	<0.0001	<0.0001	0.01	0.2	2
Molybdenum	0.0114	<0.0005	0.114	<0.005	0.5	10	30
Nickel	0.00371	<0.0004	0.0371	<0.004	0.4	10	40
Lead	0.00104	<0.0002	0.0104	<0.002	0.5	10	50
Antimony	0.00477	<0.0001	0.0477	<0.001	0.06	0.7	5
Selenium	0.0013	<0.0005	0.013	<0.005	0.1	0.5	7
Zinc	0.00258	<0.001	0.0258	<0.01	4	50	200
Chloride	<2	<2	<20	<20	800	15000	25000
Fluoride	<0.5	<0.5	<5	<5	10	150	500
Sulphate (soluble)	13.8	<2	138	<20	1000	20000	50000
Total Dissolved Solids	112	<5	1120	<50	4000	60000	100000
Total Monohydric Phenols (W)	<0.016	<0.016	<0.16	<0.16	1	-	-
Dissolved Organic Carbon	8.6	<3	86	<30	500	800	1000

Leach Test Information

Date Prepared	27-Jul-2017
pH (pH Units)	8.40
Conductivity (µS/cm)	144.00
Temperature (°C)	19.80
Volume Leachant (Litres)	0.885

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and ALS Environmental cannot be held responsible for any discrepancies with current legislation
Mcerts Certification does not apply to leachates
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CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

CEN 10:1 SINGLE STAGE LEACHATE TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference		**Site Location**	Fassaroe
Mass Sample taken (kg)	0.103	**Natural Moisture Content (%)**	13.6
Mass of dry sample (kg)	0.090	**Dry Matter Content (%)**	88
Particle Size <4mm	>95%		

Case	
SDG	170724-30
Lab Sample Number(s)	15892027
Sampled Date	20-Jul-2017
Customer Sample Ref.	TP102
Depth (m)	

Solid Waste Analysis	**Result**	**Landfill Waste Acceptance Criteria Limits**		
		Inert Waste Landfill	**Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon (%)	2.01	3	5	6
Loss on Ignition (%)	4.43	-	-	10
Sum of BTEX (mg/kg)	<0.024	6	-	-
Sum of 7 PCBs (mg/kg)	<0.021	1	-	-
Mineral Oil (mg/kg)	53.2	500	-	-
PAH Sum of 17 (mg/kg)	<10	100	-	-
pH (pH Units)	8.26	-	>6	-
ANC to pH 6 (mol/kg)	0.083	-	-	-
ANC to pH 4 (mol/kg)	0.402	-	-	-

Eluate Analysis	**C_2 Conc^n in 10:1 eluate (mg/l)**		**A_2 10:1 conc^n leached (mg/kg)**		**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
	Result	**Limit of Detection**	**Result**	**Limit of Detection**			
Arsenic	0.00506	<0.0005	0.0506	<0.005	0.5	2	25
Barium	0.0181	<0.0002	0.181	<0.002	20	100	300
Cadmium	<0.00008	<0.00008	<0.0008	<0.0008	0.04	1	5
Chromium	<0.001	<0.001	<0.01	<0.01	0.5	10	70
Copper	0.00384	<0.0003	0.0384	<0.003	2	50	100
Mercury Dissolved (CVAF)	<0.00001	<0.00001	<0.0001	<0.0001	0.01	0.2	2
Molybdenum	0.0184	<0.0005	0.184	<0.005	0.5	10	30
Nickel	0.00367	<0.0004	0.0367	<0.004	0.4	10	40
Lead	0.00166	<0.0002	0.0166	<0.002	0.5	10	50
Antimony	0.00545	<0.0001	0.0545	<0.001	0.06	0.7	5
Selenium	0.00125	<0.0005	0.0125	<0.005	0.1	0.5	7
Zinc	0.00272	<0.001	0.0272	<0.01	4	50	200
Chloride	3.8	<2	38	<20	800	15000	25000
Fluoride	<0.5	<0.5	<5	<5	10	150	500
Sulphate (soluble)	14.7	<2	147	<20	1000	20000	50000
Total Dissolved Solids	113	<5	1130	<50	4000	60000	100000
Total Monohydric Phenols (W)	<0.016	<0.016	<0.16	<0.16	1	-	-
Dissolved Organic Carbon	6.37	<3	63.7	<30	500	800	1000

Leach Test Information

Date Prepared	27-Jul-2017
pH (pH Units)	8.34
Conductivity (µS/cm)	142.00
Temperature (°C)	20.20
Volume Leachant (Litres)	0.888

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and ALS Environmental cannot be held responsible for any discrepancies with current legislation
Mcerts Certification does not apply to leachates
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CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

CEN 10:1 SINGLE STAGE LEACHATE TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference		**Site Location**	Fassaroe
Mass Sample taken (kg)	0.096	**Natural Moisture Content (%)**	6.95
Mass of dry sample (kg)	0.090	**Dry Matter Content (%)**	93.5
Particle Size <4mm	>95%		

Case	
SDG	170724-30
Lab Sample Number(s)	15892028
Sampled Date	20-Jul-2017
Customer Sample Ref.	TP103
Depth (m)	

Solid Waste Analysis	**Result**	**Landfill Waste Acceptance Criteria Limits**		
		Inert Waste Landfill	**Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon (%)	1.42	3	5	6
Loss on Ignition (%)	2.99	-	-	10
Sum of BTEX (mg/kg)	<0.024	6	-	-
Sum of 7 PCBs (mg/kg)	<0.021	1	-	-
Mineral Oil (mg/kg)	58	500	-	-
PAH Sum of 17 (mg/kg)	16.1	100	-	-
pH (pH Units)	8.52	-	>6	-
ANC to pH 6 (mol/kg)	0.0685	-	-	-
ANC to pH 4 (mol/kg)	0.317	-	-	-

Eluate Analysis	**C_2 Concⁿ in 10:1 eluate (mg/l)**		**A_2 10:1 concⁿ leached (mg/kg)**		**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
	Result	**Limit of Detection**	**Result**	**Limit of Detection**			
Arsenic	0.00191	<0.0005	0.0191	<0.005	0.5	2	25
Barium	0.00947	<0.0002	0.0947	<0.002	20	100	300
Cadmium	<0.00008	<0.00008	<0.0008	<0.0008	0.04	1	5
Chromium	<0.001	<0.001	<0.01	<0.01	0.5	10	70
Copper	0.0021	<0.0003	0.021	<0.003	2	50	100
Mercury Dissolved (CVAF)	<0.00001	<0.00001	<0.0001	<0.0001	0.01	0.2	2
Molybdenum	0.00996	<0.0005	0.0996	<0.005	0.5	10	30
Nickel	0.00159	<0.0004	0.0159	<0.004	0.4	10	40
Lead	<0.0002	<0.0002	<0.002	<0.002	0.5	10	50
Antimony	0.00128	<0.0001	0.0128	<0.001	0.06	0.7	5
Selenium	0.000969	<0.0005	0.00969	<0.005	0.1	0.5	7
Zinc	0.0011	<0.001	0.011	<0.01	4	50	200
Chloride	2.5	<2	25	<20	800	15000	25000
Fluoride	<0.5	<0.5	<5	<5	10	150	500
Sulphate (soluble)	11.2	<2	112	<20	1000	20000	50000
Total Dissolved Solids	102	<5	1020	<50	4000	60000	100000
Total Monohydric Phenols (W)	<0.016	<0.016	<0.16	<0.16	1	-	-
Dissolved Organic Carbon	<3	<3	<30	<30	500	800	1000

Leach Test Information

Date Prepared	27-Jul-2017
pH (pH Units)	7.93
Conductivity (µS/cm)	130.00
Temperature (°C)	19.10
Volume Leachant (Litres)	0.894

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and ALS Environmental cannot be held responsible for any discrepancies with current legislation
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CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

CEN 10:1 SINGLE STAGE LEACHATE TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference		**Site Location**	Fassaroe
Mass Sample taken (kg)	0.103	**Natural Moisture Content (%)**	14.9
Mass of dry sample (kg)	0.090	**Dry Matter Content (%)**	87
Particle Size <4mm	>95%		

Case	
SDG	170724-30
Lab Sample Number(s)	15892029
Sampled Date	20-Jul-2017
Customer Sample Ref.	TP104
Depth (m)	

Solid Waste Analysis	**Result**	**Landfill Waste Acceptance Criteria Limits**		
		Inert Waste Landfill	**Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon (%)	0.488	3	5	6
Loss on Ignition (%)	3.09	-	-	10
Sum of BTEX (mg/kg)	<0.024	6	-	-
Sum of 7 PCBs (mg/kg)	<0.021	1	-	-
Mineral Oil (mg/kg)	21.6	500	-	-
PAH Sum of 17 (mg/kg)	<10	100	-	-
pH (pH Units)	8.46	-	>6	-
ANC to pH 6 (mol/kg)	0.179	-	-	-
ANC to pH 4 (mol/kg)	1.48	-	-	-

Eluate Analysis	**C_2 Concⁿ in 10:1 eluate (mg/l)**		**A_2 10:1 concⁿ leached (mg/kg)**		**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
	Result	**Limit of Detection**	**Result**	**Limit of Detection**			
Arsenic	0.0055	<0.0005	0.055	<0.005	0.5	2	25
Barium	0.0163	<0.0002	0.163	<0.002	20	100	300
Cadmium	0.0000933	<0.00008	0.000933	<0.0008	0.04	1	5
Chromium	<0.001	<0.001	<0.01	<0.01	0.5	10	70
Copper	0.0114	<0.0003	0.114	<0.003	2	50	100
Mercury Dissolved (CVAF)	<0.00001	<0.00001	<0.0001	<0.0001	0.01	0.2	2
Molybdenum	0.0158	<0.0005	0.158	<0.005	0.5	10	30
Nickel	0.00414	<0.0004	0.0414	<0.004	0.4	10	40
Lead	0.00133	<0.0002	0.0133	<0.002	0.5	10	50
Antimony	0.00563	<0.0001	0.0563	<0.001	0.06	0.7	5
Selenium	0.00123	<0.0005	0.0123	<0.005	0.1	0.5	7
Zinc	0.0418	<0.001	0.418	<0.01	4	50	200
Chloride	<2	<2	<20	<20	800	15000	25000
Fluoride	<0.5	<0.5	<5	<5	10	150	500
Sulphate (soluble)	19.9	<2	199	<20	1000	20000	50000
Total Dissolved Solids	121	<5	1210	<50	4000	60000	100000
Total Monohydric Phenols (W)	<0.016	<0.016	<0.16	<0.16	1	-	-
Dissolved Organic Carbon	6.09	<3	60.9	<30	500	800	1000

Leach Test Information

Date Prepared	27-Jul-2017
pH (pH Units)	7.18
Conductivity (µS/cm)	153.00
Temperature (°C)	18.80
Volume Leachant (Litres)	0.887

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and ALS Environmental cannot be held responsible for any discrepancies with current legislation
Mcerts Certification does not apply to leachates
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CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

CEN 10:1 SINGLE STAGE LEACHATE TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference		**Site Location**	Fassaroe
Mass Sample taken (kg)	0.101	**Natural Moisture Content (%)**	12.4
Mass of dry sample (kg)	0.090	**Dry Matter Content (%)**	89
Particle Size <4mm	>95%		

Case	
SDG	170724-30
Lab Sample Number(s)	15892030
Sampled Date	20-Jul-2017
Customer Sample Ref.	TP105
Depth (m)	

Solid Waste Analysis	**Result**	**Landfill Waste Acceptance Criteria Limits**		
		Inert Waste Landfill	**Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon (%)	1.25	3	5	6
Loss on Ignition (%)	3.26	-	-	10
Sum of BTEX (mg/kg)	<0.024	6	-	-
Sum of 7 PCBs (mg/kg)	<0.021	1	-	-
Mineral Oil (mg/kg)	63.2	500	-	-
PAH Sum of 17 (mg/kg)	<10	100	-	-
pH (pH Units)	8.31	-	>6	-
ANC to pH 6 (mol/kg)	0.0575	-	-	-
ANC to pH 4 (mol/kg)	0.265	-	-	-

Eluate Analysis	**C_2** Concⁿ in 10:1 eluate (mg/l)		**A_2** 10:1 concⁿ leached (mg/kg)		**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
	Result	**Limit of Detection**	**Result**	**Limit of Detection**			
Arsenic	0.00199	<0.0005	0.0199	<0.005	0.5	2	25
Barium	0.00974	<0.0002	0.0974	<0.002	20	100	300
Cadmium	<0.00008	<0.00008	<0.0008	<0.0008	0.04	1	5
Chromium	<0.001	<0.001	<0.01	<0.01	0.5	10	70
Copper	0.00304	<0.0003	0.0304	<0.003	2	50	100
Mercury Dissolved (CVAF)	<0.00001	<0.00001	<0.0001	<0.0001	0.01	0.2	2
Molybdenum	0.0083	<0.0005	0.083	<0.005	0.5	10	30
Nickel	0.00187	<0.0004	0.0187	<0.004	0.4	10	40
Lead	0.000229	<0.0002	0.00229	<0.002	0.5	10	50
Antimony	0.00133	<0.0001	0.0133	<0.001	0.06	0.7	5
Selenium	0.000638	<0.0005	0.00638	<0.005	0.1	0.5	7
Zinc	<0.001	<0.001	<0.01	<0.01	4	50	200
Chloride	2.5	<2	25	<20	800	15000	25000
Fluoride	<0.5	<0.5	<5	<5	10	150	500
Sulphate (soluble)	13.2	<2	132	<20	1000	20000	50000
Total Dissolved Solids	101	<5	1010	<50	4000	60000	100000
Total Monohydric Phenols (W)	<0.016	<0.016	<0.16	<0.16	1	-	-
Dissolved Organic Carbon	3.16	<3	31.6	<30	500	800	1000

Leach Test Information

Date Prepared	27-Jul-2017
pH (pH Units)	8.30
Conductivity (µS/cm)	128.00
Temperature (°C)	18.90
Volume Leachant (Litres)	0.889

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and ALS Environmental cannot be held responsible for any discrepancies with current legislation
Mcerts Certification does not apply to leachates
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CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

CEN 10:1 SINGLE STAGE LEACHATE TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference		**Site Location**	Fassaroe
Mass Sample taken (kg)	0.102	**Natural Moisture Content (%)**	13.6
Mass of dry sample (kg)	0.090	**Dry Matter Content (%)**	88
Particle Size <4mm	>95%		

Case	
SDG	170724-30
Lab Sample Number(s)	15892031
Sampled Date	20-Jul-2017
Customer Sample Ref.	TP106
Depth (m)	

Solid Waste Analysis	**Result**	**Landfill Waste Acceptance Criteria Limits**		
		Inert Waste Landfill	**Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon (%)	1.34	3	5	6
Loss on Ignition (%)	6.16	-	-	10
Sum of BTEX (mg/kg)	<0.024	6	-	-
Sum of 7 PCBs (mg/kg)	<0.021	1	-	-
Mineral Oil (mg/kg)	132	500	-	-
PAH Sum of 17 (mg/kg)	<10	100	-	-
pH (pH Units)	8.3	-	>6	-
ANC to pH 6 (mol/kg)	0.0526	-	-	-
ANC to pH 4 (mol/kg)	0.338	-	-	-

Eluate Analysis	**C_2 Concⁿ in 10:1 eluate (mg/l)**		**A_2 10:1 concⁿ leached (mg/kg)**		**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
	Result	**Limit of Detection**	**Result**	**Limit of Detection**			
Arsenic	0.012	<0.0005	0.12	<0.005	0.5	2	25
Barium	0.0166	<0.0002	0.166	<0.002	20	100	300
Cadmium	<0.00008	<0.00008	<0.0008	<0.0008	0.04	1	5
Chromium	<0.001	<0.001	<0.01	<0.01	0.5	10	70
Copper	0.00634	<0.0003	0.0634	<0.003	2	50	100
Mercury Dissolved (CVAF)	<0.00001	<0.00001	<0.0001	<0.0001	0.01	0.2	2
Molybdenum	0.0142	<0.0005	0.142	<0.005	0.5	10	30
Nickel	0.00365	<0.0004	0.0365	<0.004	0.4	10	40
Lead	0.00125	<0.0002	0.0125	<0.002	0.5	10	50
Antimony	0.00441	<0.0001	0.0441	<0.001	0.06	0.7	5
Selenium	0.00119	<0.0005	0.0119	<0.005	0.1	0.5	7
Zinc	0.00182	<0.001	0.0182	<0.01	4	50	200
Chloride	<2	<2	<20	<20	800	15000	25000
Fluoride	<0.5	<0.5	<5	<5	10	150	500
Sulphate (soluble)	32.4	<2	324	<20	1000	20000	50000
Total Dissolved Solids	120	<5	1200	<50	4000	60000	100000
Total Monohydric Phenols (W)	<0.016	<0.016	<0.16	<0.16	1	-	-
Dissolved Organic Carbon	9.62	<3	96.2	<30	500	800	1000

Leach Test Information

Date Prepared	27-Jul-2017
pH (pH Units)	8.24
Conductivity (µS/cm)	153.00
Temperature (°C)	18.70
Volume Leachant (Litres)	0.888

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and ALS Environmental cannot be held responsible for any discrepancies with current legislation
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CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

CEN 10:1 SINGLE STAGE LEACHATE TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference		**Site Location**	Fassaroe
Mass Sample taken (kg)	0.100	**Natural Moisture Content (%)**	10.7
Mass of dry sample (kg)	0.090	**Dry Matter Content (%)**	90.3
Particle Size <4mm	>95%		

Case	
SDG	170724-30
Lab Sample Number(s)	15892032
Sampled Date	20-Jul-2017
Customer Sample Ref.	TP107
Depth (m)	

Solid Waste Analysis	**Result**	**Landfill Waste Acceptance Criteria Limits**		
		Inert Waste Landfill	**Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon (%)	0.801	3	5	6
Loss on Ignition (%)	3.39	-	-	10
Sum of BTEX (mg/kg)	<0.024	6	-	-
Sum of 7 PCBs (mg/kg)	<0.021	1	-	-
Mineral Oil (mg/kg)	14.2	500	-	-
PAH Sum of 17 (mg/kg)	<10	100	-	-
pH (pH Units)	8.4	-	>6	-
ANC to pH 6 (mol/kg)	0.109	-	-	-
ANC to pH 4 (mol/kg)	0.599	-	-	-

Eluate Analysis	**C_2 Concⁿ in 10:1 eluate (mg/l)**		**A_2 10:1 concⁿ leached (mg/kg)**		**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
	Result	**Limit of Detection**	**Result**	**Limit of Detection**			
Arsenic	0.00304	<0.0005	0.0304	<0.005	0.5	2	25
Barium	0.0167	<0.0002	0.167	<0.002	20	100	300
Cadmium	<0.00008	<0.00008	<0.0008	<0.0008	0.04	1	5
Chromium	<0.001	<0.001	<0.01	<0.01	0.5	10	70
Copper	0.00338	<0.0003	0.0338	<0.003	2	50	100
Mercury Dissolved (CVAF)	<0.00001	<0.00001	<0.0001	<0.0001	0.01	0.2	2
Molybdenum	0.0109	<0.0005	0.109	<0.005	0.5	10	30
Nickel	0.00207	<0.0004	0.0207	<0.004	0.4	10	40
Lead	0.000628	<0.0002	0.00628	<0.002	0.5	10	50
Antimony	0.00209	<0.0001	0.0209	<0.001	0.06	0.7	5
Selenium	0.0013	<0.0005	0.013	<0.005	0.1	0.5	7
Zinc	0.00292	<0.001	0.0292	<0.01	4	50	200
Chloride	<2	<2	<20	<20	800	15000	25000
Fluoride	<0.5	<0.5	<5	<5	10	150	500
Sulphate (soluble)	16.4	<2	164	<20	1000	20000	50000
Total Dissolved Solids	104	<5	1040	<50	4000	60000	100000
Total Monohydric Phenols (W)	<0.016	<0.016	<0.16	<0.16	1	-	-
Dissolved Organic Carbon	4.63	<3	46.3	<30	500	800	1000

Leach Test Information

Date Prepared	27-Jul-2017
pH (pH Units)	8.25
Conductivity (µS/cm)	131.00
Temperature (°C)	20.10
Volume Leachant (Litres)	0.890

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
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CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

CEN 10:1 SINGLE STAGE LEACHATE TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference		**Site Location**	Fassaroe
Mass Sample taken (kg)	0.105	**Natural Moisture Content (%)**	16.3
Mass of dry sample (kg)	0.090	**Dry Matter Content (%)**	86
Particle Size <4mm	>95%		

Case	
SDG	170724-30
Lab Sample Number(s)	15892034
Sampled Date	21-Jul-2017
Customer Sample Ref.	TP108
Depth (m)	

Solid Waste Analysis	**Result**	**Landfill Waste Acceptance Criteria Limits**		
		Inert Waste Landfill	**Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon (%)	1	3	5	6
Loss on Ignition (%)	3.58	-	-	10
Sum of BTEX (mg/kg)	<0.024	6	-	-
Sum of 7 PCBs (mg/kg)	<0.021	1	-	-
Mineral Oil (mg/kg)	35.8	500	-	-
PAH Sum of 17 (mg/kg)	<10	100	-	-
pH (pH Units)	8.24	-	>6	-
ANC to pH 6 (mol/kg)	0.115	-	-	-
ANC to pH 4 (mol/kg)	0.855	-	-	-

Eluate Analysis	**C_2 Concⁿ in 10:1 eluate (mg/l)**		**A_2 10:1 concⁿ leached (mg/kg)**		**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
	Result	**Limit of Detection**	**Result**	**Limit of Detection**			
Arsenic	0.00188	<0.0005	0.0188	<0.005	0.5	2	25
Barium	0.0184	<0.0002	0.184	<0.002	20	100	300
Cadmium	<0.00008	<0.00008	<0.0008	<0.0008	0.04	1	5
Chromium	<0.001	<0.001	<0.01	<0.01	0.5	10	70
Copper	0.00184	<0.0003	0.0184	<0.003	2	50	100
Mercury Dissolved (CVAF)	<0.00001	<0.00001	<0.0001	<0.0001	0.01	0.2	2
Molybdenum	0.0146	<0.0005	0.146	<0.005	0.5	10	30
Nickel	0.00232	<0.0004	0.0232	<0.004	0.4	10	40
Lead	0.000239	<0.0002	0.00239	<0.002	0.5	10	50
Antimony	0.00263	<0.0001	0.0263	<0.001	0.06	0.7	5
Selenium	<0.0005	<0.0005	<0.005	<0.005	0.1	0.5	7
Zinc	0.0014	<0.001	0.014	<0.01	4	50	200
Chloride	2.1	<2	21	<20	800	15000	25000
Fluoride	<0.5	<0.5	<5	<5	10	150	500
Sulphate (soluble)	<2	<2	<20	<20	1000	20000	50000
Total Dissolved Solids	100	<5	1000	<50	4000	60000	100000
Total Monohydric Phenols (W)	<0.016	<0.016	<0.16	<0.16	1	-	-
Dissolved Organic Carbon	6.32	<3	63.2	<30	500	800	1000

Leach Test Information

Date Prepared	27-Jul-2017
pH (pH Units)	8.17
Conductivity (µS/cm)	127.00
Temperature (°C)	20.10
Volume Leachant (Litres)	0.885

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and ALS Environmental cannot be held responsible for any discrepancies with current legislation
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CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

CEN 10:1 SINGLE STAGE LEACHATE TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference		**Site Location**	Fassaroe
Mass Sample taken (kg)	0.102	**Natural Moisture Content (%)**	13.6
Mass of dry sample (kg)	0.090	**Dry Matter Content (%)**	88
Particle Size <4mm	>95%		

Case	
SDG	170724-30
Lab Sample Number(s)	15892035
Sampled Date	21-Jul-2017
Customer Sample Ref.	TP109
Depth (m)	

Solid Waste Analysis	**Result**	**Landfill Waste Acceptance Criteria Limits**		
		Inert Waste Landfill	**Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon (%)	1.13	3	5	6
Loss on Ignition (%)	3.62	-	-	10
Sum of BTEX (mg/kg)	<0.024	6	-	-
Sum of 7 PCBs (mg/kg)	<0.021	1	-	-
Mineral Oil (mg/kg)	36	500	-	-
PAH Sum of 17 (mg/kg)	<10	100	-	-
pH (pH Units)	8.57	-	>6	-
ANC to pH 6 (mol/kg)	0.107	-	-	-
ANC to pH 4 (mol/kg)	0.635	-	-	-

Eluate Analysis	**C_2 Concⁿ in 10:1 eluate (mg/l)**		**A_2 10:1 concⁿ leached (mg/kg)**		**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
	Result	**Limit of Detection**	**Result**	**Limit of Detection**			
Arsenic	0.00563	<0.0005	0.0563	<0.005	0.5	2	25
Barium	0.00957	<0.0002	0.0957	<0.002	20	100	300
Cadmium	0.00009	<0.00008	0.0009	<0.0008	0.04	1	5
Chromium	<0.001	<0.001	<0.01	<0.01	0.5	10	70
Copper	0.00363	<0.0003	0.0363	<0.003	2	50	100
Mercury Dissolved (CVAF)	<0.00001	<0.00001	<0.0001	<0.0001	0.01	0.2	2
Molybdenum	0.0175	<0.0005	0.175	<0.005	0.5	10	30
Nickel	0.00217	<0.0004	0.0217	<0.004	0.4	10	40
Lead	0.000453	<0.0002	0.00453	<0.002	0.5	10	50
Antimony	0.00256	<0.0001	0.0256	<0.001	0.06	0.7	5
Selenium	0.00105	<0.0005	0.0105	<0.005	0.1	0.5	7
Zinc	0.00209	<0.001	0.0209	<0.01	4	50	200
Chloride	<2	<2	<20	<20	800	15000	25000
Fluoride	<0.5	<0.5	<5	<5	10	150	500
Sulphate (soluble)	17.8	<2	178	<20	1000	20000	50000
Total Dissolved Solids	94.1	<5	941	<50	4000	60000	100000
Total Monohydric Phenols (W)	<0.016	<0.016	<0.16	<0.16	1	-	-
Dissolved Organic Carbon	3.59	<3	35.9	<30	500	800	1000

Leach Test Information

Date Prepared	27-Jul-2017
pH (pH Units)	8.46
Conductivity (µS/cm)	119.00
Temperature (°C)	18.80
Volume Leachant (Litres)	0.888

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
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CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

CEN 10:1 SINGLE STAGE LEACHATE TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference		**Site Location**	Fassaroe
Mass Sample taken (kg)	0.105	**Natural Moisture Content (%)**	16.3
Mass of dry sample (kg)	0.090	**Dry Matter Content (%)**	86
Particle Size <4mm	>95%		

Case	
SDG	170724-30
Lab Sample Number(s)	15892036
Sampled Date	21-Jul-2017
Customer Sample Ref.	TP110
Depth (m)	

Solid Waste Analysis	**Result**	**Landfill Waste Acceptance Criteria Limits**		
		Inert Waste Landfill	**Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon (%)	0.83	3	5	6
Loss on Ignition (%)	3.5	-	-	10
Sum of BTEX (mg/kg)	<0.024	6	-	-
Sum of 7 PCBs (mg/kg)	<0.021	1	-	-
Mineral Oil (mg/kg)	30.4	500	-	-
PAH Sum of 17 (mg/kg)	<10	100	-	-
pH (pH Units)	8.21	-	>6	-
ANC to pH 6 (mol/kg)	0.0943	-	-	-
ANC to pH 4 (mol/kg)	0.566	-	-	-

Eluate Analysis	**C_2** Concⁿ in 10:1 eluate (mg/l)		**A_2** 10:1 concⁿ leached (mg/kg)		**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
	Result	**Limit of Detection**	**Result**	**Limit of Detection**			
Arsenic	0.00148	<0.0005	0.0148	<0.005	0.5	2	25
Barium	0.0156	<0.0002	0.156	<0.002	20	100	300
Cadmium	<0.00008	<0.00008	<0.0008	<0.0008	0.04	1	5
Chromium	<0.001	<0.001	<0.01	<0.01	0.5	10	70
Copper	0.00186	<0.0003	0.0186	<0.003	2	50	100
Mercury Dissolved (CVAF)	<0.00001	<0.00001	<0.0001	<0.0001	0.01	0.2	2
Molybdenum	0.0176	<0.0005	0.176	<0.005	0.5	10	30
Nickel	0.00239	<0.0004	0.0239	<0.004	0.4	10	40
Lead	0.00038	<0.0002	0.0038	<0.002	0.5	10	50
Antimony	0.00216	<0.0001	0.0216	<0.001	0.06	0.7	5
Selenium	0.000574	<0.0005	0.00574	<0.005	0.1	0.5	7
Zinc	0.00139	<0.001	0.0139	<0.01	4	50	200
Chloride	2.3	<2	23	<20	800	15000	25000
Fluoride	0.675	<0.5	6.75	<5	10	150	500
Sulphate (soluble)	10.1	<2	101	<20	1000	20000	50000
Total Dissolved Solids	137	<5	1370	<50	4000	60000	100000
Total Monohydric Phenols (W)	<0.016	<0.016	<0.16	<0.16	1	-	-
Dissolved Organic Carbon	4.25	<3	42.5	<30	500	800	1000

Leach Test Information

Date Prepared	27-Jul-2017
pH (pH Units)	8.17
Conductivity (µS/cm)	175.00
Temperature (°C)	19.00
Volume Leachant (Litres)	0.885

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and ALS Environmental cannot be held responsible for any discrepancies with current legislation
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CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

CEN 10:1 SINGLE STAGE LEACHATE TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference		**Site Location**	Fassaroe
Mass Sample taken (kg)	0.106	**Natural Moisture Content (%)**	17.6
Mass of dry sample (kg)	0.090	**Dry Matter Content (%)**	85
Particle Size <4mm	>95%		

Case	
SDG	170724-30
Lab Sample Number(s)	15892037
Sampled Date	21-Jul-2017
Customer Sample Ref.	TP111
Depth (m)	

Solid Waste Analysis	**Result**	**Landfill Waste Acceptance Criteria Limits**		
		Inert Waste Landfill	**Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon (%)	0.933	3	5	6
Loss on Ignition (%)	2.59	-	-	10
Sum of BTEX (mg/kg)	<0.024	6	-	-
Sum of 7 PCBs (mg/kg)	<0.021	1	-	-
Mineral Oil (mg/kg)	79.8	500	-	-
PAH Sum of 17 (mg/kg)	<10	100	-	-
pH (pH Units)	8.35	-	>6	-
ANC to pH 6 (mol/kg)	0.143	-	-	-
ANC to pH 4 (mol/kg)	0.717	-	-	-

Eluate Analysis	**C_2 Concⁿ in 10:1 eluate (mg/l)**		**A_2 10:1 concⁿ leached (mg/kg)**		**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
	Result	**Limit of Detection**	**Result**	**Limit of Detection**			
Arsenic	0.00194	<0.0005	0.0194	<0.005	0.5	2	25
Barium	0.0106	<0.0002	0.106	<0.002	20	100	300
Cadmium	<0.00008	<0.00008	<0.0008	<0.0008	0.04	1	5
Chromium	<0.001	<0.001	<0.01	<0.01	0.5	10	70
Copper	0.00201	<0.0003	0.0201	<0.003	2	50	100
Mercury Dissolved (CVAF)	<0.00001	<0.00001	<0.0001	<0.0001	0.01	0.2	2
Molybdenum	0.0167	<0.0005	0.167	<0.005	0.5	10	30
Nickel	0.0014	<0.0004	0.014	<0.004	0.4	10	40
Lead	<0.0002	<0.0002	<0.002	<0.002	0.5	10	50
Antimony	0.00103	<0.0001	0.0103	<0.001	0.06	0.7	5
Selenium	0.000631	<0.0005	0.00631	<0.005	0.1	0.5	7
Zinc	0.00429	<0.001	0.0429	<0.01	4	50	200
Chloride	<2	<2	<20	<20	800	15000	25000
Fluoride	0.77	<0.5	7.7	<5	10	150	500
Sulphate (soluble)	21.1	<2	211	<20	1000	20000	50000
Total Dissolved Solids	110	<5	1100	<50	4000	60000	100000
Total Monohydric Phenols (W)	<0.016	<0.016	<0.16	<0.16	1	-	-
Dissolved Organic Carbon	3.33	<3	33.3	<30	500	800	1000

Leach Test Information

Date Prepared	28-Jul-2017
pH (pH Units)	8.69
Conductivity (µS/cm)	146.00
Temperature (°C)	19.20
Volume Leachant (Litres)	0.884

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and ALS Environmental cannot be held responsible for any discrepancies with current legislation
Mcerts Certification does not apply to leachates
03/08/2017 15:54:02

15:53:50 03/08/2017

Validated

CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

CEN 10:1 SINGLE STAGE LEACHATE TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference		**Site Location**	Fassaroe
Mass Sample taken (kg)	0.108	**Natural Moisture Content (%)**	20.5
Mass of dry sample (kg)	0.090	**Dry Matter Content (%)**	83
Particle Size <4mm	>95%		

Case	
SDG	170724-30
Lab Sample Number(s)	15892038
Sampled Date	21-Jul-2017
Customer Sample Ref.	TP112
Depth (m)	

Solid Waste Analysis	**Result**	**Landfill Waste Acceptance Criteria Limits**		
		Inert Waste Landfill	**Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon (%)	1.04	3	5	6
Loss on Ignition (%)	3.49	-	-	10
Sum of BTEX (mg/kg)	<0.024	6	-	-
Sum of 7 PCBs (mg/kg)	<0.021	1	-	-
Mineral Oil (mg/kg)	43.1	500	-	-
PAH Sum of 17 (mg/kg)	13.7	100	-	-
pH (pH Units)	8.52	-	>6	-
ANC to pH 6 (mol/kg)	0.0756	-	-	-
ANC to pH 4 (mol/kg)	0.608	-	-	-

Eluate Analysis	**C_2** Concⁿ in 10:1 eluate (mg/l)		**A_2** 10:1 concⁿ leached (mg/kg)		**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
	Result	**Limit of Detection**	**Result**	**Limit of Detection**			
Arsenic	0.00287	<0.0005	0.0287	<0.005	0.5	2	25
Barium	0.00495	<0.0002	0.0495	<0.002	20	100	300
Cadmium	<0.00008	<0.00008	<0.0008	<0.0008	0.04	1	5
Chromium	<0.001	<0.001	<0.01	<0.01	0.5	10	70
Copper	0.00169	<0.0003	0.0169	<0.003	2	50	100
Mercury Dissolved (CVAF)	<0.00001	<0.00001	<0.0001	<0.0001	0.01	0.2	2
Molybdenum	0.00725	<0.0005	0.0725	<0.005	0.5	10	30
Nickel	0.00103	<0.0004	0.0103	<0.004	0.4	10	40
Lead	0.000225	<0.0002	0.00225	<0.002	0.5	10	50
Antimony	0.001	<0.0001	0.01	<0.001	0.06	0.7	5
Selenium	0.000678	<0.0005	0.00678	<0.005	0.1	0.5	7
Zinc	0.00142	<0.001	0.0142	<0.01	4	50	200
Chloride	<2	<2	<20	<20	800	15000	25000
Fluoride	<0.5	<0.5	<5	<5	10	150	500
Sulphate (soluble)	10.3	<2	103	<20	1000	20000	50000
Total Dissolved Solids	83.9	<5	839	<50	4000	60000	100000
Total Monohydric Phenols (W)	<0.016	<0.016	<0.16	<0.16	1	-	-
Dissolved Organic Carbon	7.43	<3	74.3	<30	500	800	1000

Leach Test Information

Date Prepared	28-Jul-2017
pH (pH Units)	8.32
Conductivity (µS/cm)	109.00
Temperature (°C)	19.20
Volume Leachant (Litres)	0.882

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and ALS Environmental cannot be held responsible for any discrepancies with current legislation
Mcerts Certification does not apply to leachates
03/08/2017 15:54:02

15:53:50 03/08/2017

Table of Results - Appendix

Method No	Reference	Description	Wet/Dry Sample [1]	Surrogate Corrected
PM001		Preparation of Samples for Metals Analysis		
PM024	Modified BS 1377	Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material		
PM115		Leaching Procedure for CEN One Stage Leach Test 2:1 & 10:1 1 Step		
TM018	BS 1377: Part 3 1990	Determination of Loss on Ignition		
TM048	HSG 248, Asbestos: The analysts' guide for sampling, analysis and clearance procedures	Identification of Asbestos in Bulk Material		
TM061	Method for the Determination of EPH,Massachusetts Dept.of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)		
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)		
TM090	Method 5310, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 415.1 & 9060	Determination of Total Organic Carbon/Total Inorganic Carbon in Water and Waste Water		
TM104	Method 4500F, AWWA/APHA, 20th Ed., 1999	Determination of Fluoride using the Kone Analyser		
TM116	Modified: US EPA Method 8260, 8120, 8020, 624, 610 & 602	Determination of Volatile Organic Compounds by Headspace / GC-MS		
TM123	BS 2690: Part 121:1981	The Determination of Total Dissolved Solids in Water		
TM132	In - house Method	ELTRA CS800 Operators Guide		
TM133	BS 1377: Part 3 1990;BS 6068-2.5	Determination of pH in Soil and Water using the GLpH pH Meter		
TM151	Method 3500D, AWWA/APHA, 20th Ed., 1999	Determination of Hexavalent Chromium using Kone analyser		
TM152	Method 3125B, AWWA/APHA, 20th Ed., 1999	Analysis of Aqueous Samples by ICP-MS		
TM153	Method 4500A,B,C, I, M AWWA/APHA, 20th Ed., 1999	Determination of Total Cyanide, Free (Easily Liberatable) Cyanide and Thiocyanate using the Skalar SANS+ System Segmented Flow Analyser		
TM154	In - house Method	Determination of Petroleum Hydrocarbons by EZ Flash GC-FID in the Carbon range C6- C40		
TM157	HP 6890 Gas Chromatograph (GC) system and HP 5973 Mass Selective Detector (MSD).	Determination of SVOC in Soils by GC-MS extracted by sonication in DCM/Acetone		
TM168	EPA Method 8082, Polychlorinated Biphenyls by Gas Chromatography	Determination of WHO12 and EC7 Polychlorinated Biphenyl Congeners by GC-MS in Soils		
TM181	US EPA Method 6010B	Determination of Routine Metals in Soil by iCap 6500 Duo ICP-OES		
TM182	CEN/TC 292 - WI 292046-chacterization of waste-leaching Behaviour Tests- Acid and Base Neutralization Capacity Test	Determination of Acid Neutralisation Capacity (ANC) Using Autotitration in Soils		
TM183	BS EN 23506:2002, (BS 6068-2.74:2002) ISBN 0 580 38924 3	Determination of Trace Level Mercury in Waters and Leachates by PSA Cold Vapour Atomic Fluorescence Spectrometry		
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers		
TM218	Determination of PAH by GCMS Microwave extraction	The determination of PAH in soil samples by microwave extraction and GC-MS		
TM259	by HPLC	Determination of Phenols in Waters and Leachates by HPLC		
TM339				

[1] Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Environmental Hawarden (Method codes TM) or ALS Environmental Aberdeen (Method codes S).

CERTIFICATE OF ANALYSIS

SDG:	170724-30	**Client Reference:**	501.00180.00186	**Report Number:**	418738
Location:	Fassaroe	**Order Number:**	3419	**Superseded Report:**	418386

Test Completion Dates

Lab Sample No(s)	15892026	15892027	15892028	15892029	15892030	15892031	15892032	15892034	15892035	15892036
Customer Sample Ref.	TP101	TP102	TP103	TP104	TP105	TP106	TP107	TP108	TP109	TP110
AGS Ref.										
Depth										
Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
ANC at pH4 and ANC at pH 6	28-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017	01-Aug-2017	01-Aug-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017
Anions by Kone (w)	29-Jul-2017	29-Jul-2017	29-Jul-2017	29-Jul-2017	29-Jul-2017	29-Jul-2017	29-Jul-2017	29-Jul-2017	29-Jul-2017	29-Jul-2017
Asbestos ID in Solid Samples	28-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017	31-Jul-2017	28-Jul-2017	28-Jul-2017
CEN 10:1 Leachate (1 Stage)	27-Jul-2017	27-Jul-2017	27-Jul-2017	27-Jul-2017	27-Jul-2017	27-Jul-2017	27-Jul-2017	27-Jul-2017	27-Jul-2017	27-Jul-2017
CEN Readings	29-Jul-2017	29-Jul-2017	30-Jul-2017	30-Jul-2017	30-Jul-2017	30-Jul-2017	28-Jul-2017	28-Jul-2017	30-Jul-2017	30-Jul-2017
Chromium III	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	01-Aug-2017	01-Aug-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017
Cyanide Comp/Free/Total/Thiocyanate	28-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017
Dissolved Metals by ICP-MS	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017
Dissolved Organic/Inorganic Carbon	01-Aug-2017	01-Aug-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	01-Aug-2017	01-Aug-2017	31-Jul-2017	01-Aug-2017
Fluoride	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017
GRO by GC-FID (S)	29-Jul-2017	29-Jul-2017	29-Jul-2017	29-Jul-2017	29-Jul-2017	29-Jul-2017	29-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017
Hexavalent Chromium (s)	28-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017
Loss on Ignition in soils	31-Jul-2017	01-Aug-2017	01-Aug-2017	01-Aug-2017	01-Aug-2017	01-Aug-2017	31-Jul-2017	01-Aug-2017	31-Jul-2017	31-Jul-2017
Mercury Dissolved	01-Aug-2017	01-Aug-2017	01-Aug-2017	01-Aug-2017	01-Aug-2017	01-Aug-2017	01-Aug-2017	01-Aug-2017	01-Aug-2017	01-Aug-2017
Metals in solid samples by OES	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	01-Aug-2017	01-Aug-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017
Mineral Oil	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	01-Aug-2017	31-Jul-2017	31-Jul-2017	01-Aug-2017	31-Jul-2017	01-Aug-2017
PAH by GCMS	27-Jul-2017	27-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017	30-Jul-2017	30-Jul-2017	31-Jul-2017	31-Jul-2017
PCBs by GCMS	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017
pH	28-Jul-2017	28-Jul-2017	31-Jul-2017	27-Jul-2017	31-Jul-2017	31-Jul-2017	01-Aug-2017	01-Aug-2017	31-Jul-2017	28-Jul-2017
Phenols by HPLC (W)	29-Jul-2017	29-Jul-2017	29-Jul-2017	29-Jul-2017	29-Jul-2017	29-Jul-2017	29-Jul-2017	29-Jul-2017	29-Jul-2017	29-Jul-2017
Sample description	26-Jul-2017	26-Jul-2017	26-Jul-2017	26-Jul-2017	26-Jul-2017	26-Jul-2017	26-Jul-2017	26-Jul-2017	26-Jul-2017	26-Jul-2017
Semi Volatile Organic Compounds	27-Jul-2017	27-Jul-2017	27-Jul-2017	28-Jul-2017	27-Jul-2017	27-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017
Soil Density	27-Jul-2017	27-Jul-2017	27-Jul-2017	27-Jul-2017	28-Jul-2017	28-Jul-2017	27-Jul-2017	27-Jul-2017	27-Jul-2017	27-Jul-2017
Total Dissolved Solids	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017
Total Organic Carbon	28-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017	31-Jul-2017	31-Jul-2017	28-Jul-2017	31-Jul-2017	28-Jul-2017	28-Jul-2017
TPH C6-C40 Value of soil	01-Aug-2017	01-Aug-2017	01-Aug-2017	01-Aug-2017	01-Aug-2017	01-Aug-2017	01-Aug-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017
VOC MS (S)	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	31-Jul-2017	03-Aug-2017	28-Jul-2017	01-Aug-2017	01-Aug-2017

Lab Sample No(s)	15892037	15892038
Customer Sample Ref.	TP111	TP112
AGS Ref.		
Depth		
Type	Soil/Solid (S)	Soil/Solid (S)
ANC at pH4 and ANC at pH 6	01-Aug-2017	01-Aug-2017
Anions by Kone (w)	01-Aug-2017	01-Aug-2017
Asbestos ID in Solid Samples	28-Jul-2017	28-Jul-2017
CEN 10:1 Leachate (1 Stage)	28-Jul-2017	28-Jul-2017
CEN Readings	30-Jul-2017	30-Jul-2017
Chromium III	01-Aug-2017	01-Aug-2017
Cyanide Comp/Free/Total/Thiocyanate	01-Aug-2017	01-Aug-2017
Dissolved Metals by ICP-MS	31-Jul-2017	31-Jul-2017
Dissolved Organic/Inorganic Carbon	01-Aug-2017	01-Aug-2017
Fluoride	31-Jul-2017	31-Jul-2017
GRO by GC-FID (S)	01-Aug-2017	01-Aug-2017
Hexavalent Chromium (s)	01-Aug-2017	31-Jul-2017
Loss on Ignition in soils	31-Jul-2017	31-Jul-2017
Mercury Dissolved	01-Aug-2017	01-Aug-2017
Metals in solid samples by OES	01-Aug-2017	01-Aug-2017
Mineral Oil	31-Jul-2017	01-Aug-2017
PAH by GCMS	31-Jul-2017	31-Jul-2017
PCBs by GCMS	01-Aug-2017	01-Aug-2017
pH	28-Jul-2017	28-Jul-2017
Phenols by HPLC (W)	01-Aug-2017	01-Aug-2017
Sample description	27-Jul-2017	27-Jul-2017
Semi Volatile Organic Compounds	28-Jul-2017	28-Jul-2017
Soil Density	28-Jul-2017	28-Jul-2017
Total Dissolved Solids	31-Jul-2017	31-Jul-2017
Total Organic Carbon	01-Aug-2017	01-Aug-2017
TPH C6-C40 Value of soil	01-Aug-2017	01-Aug-2017
VOC MS (S)	01-Aug-2017	28-Jul-2017

Appendix General

1. Results are expressed on a dry weight basis (dried at 35ºC) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as “Not detected”. If no asbestos fibre types are found all will be reported as “Not detected” and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

7. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.

9. NDP - No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals - total metals must be requested separately.

11. Results relate only to the items tested.

12. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%, they are generally wider for volatiles analysis, 50-150%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

14. **Product analyses** - Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethyphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

20. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

21. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

24. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as “mixed hydrocarbons”. Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

Sample Deviations

If a sample is classed as deviated then the associated results may be compromised.

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
4	**Holding time exceeded before sample received**
5	**Samples exceeded holding time before presevation was performed**
§	**Sampled on date not provided**
♦	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to sampled on date**
&	**Sample Holding Time exceeded - Late arrival of instructions.**

Asbestos

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

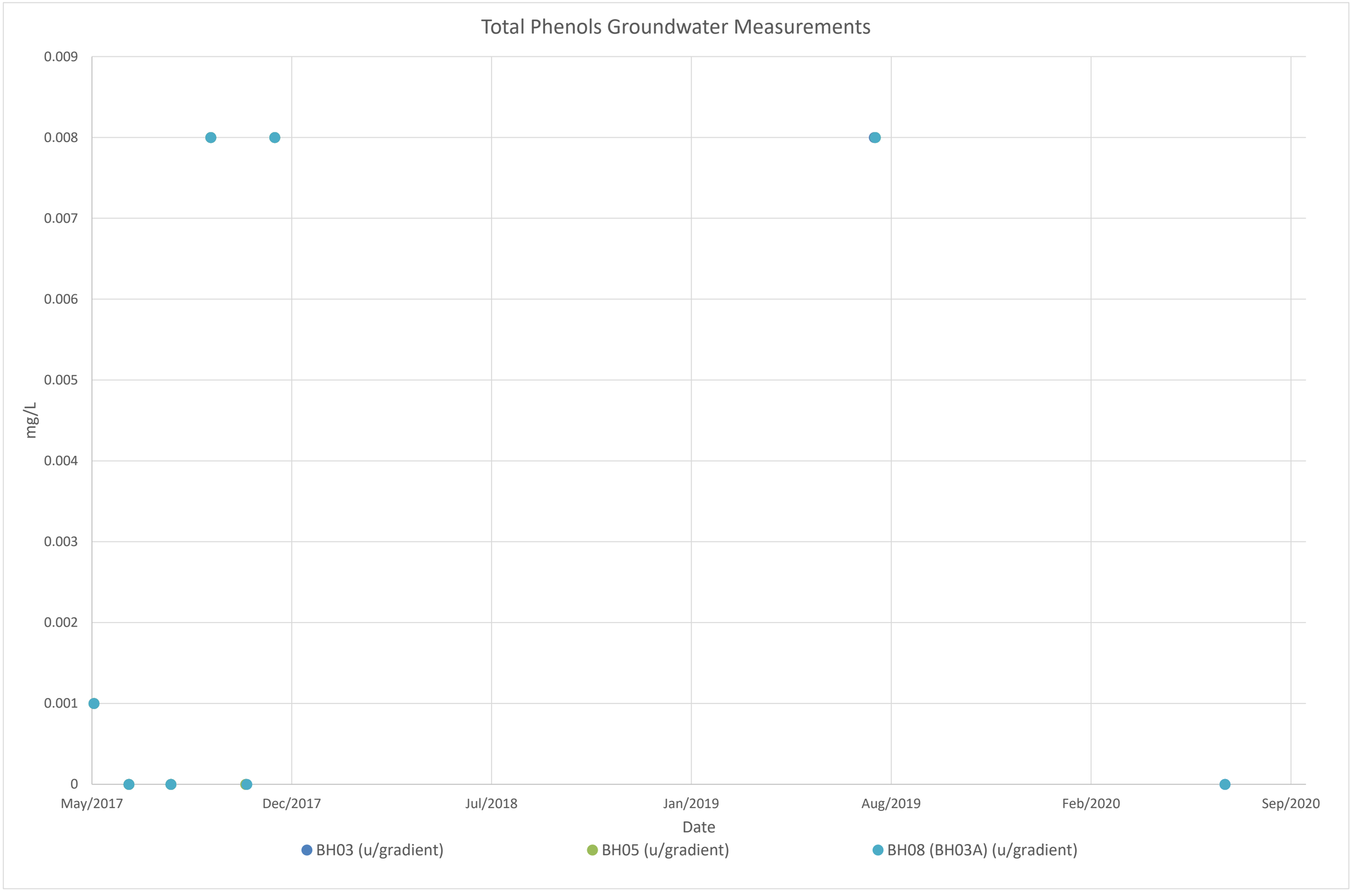
Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

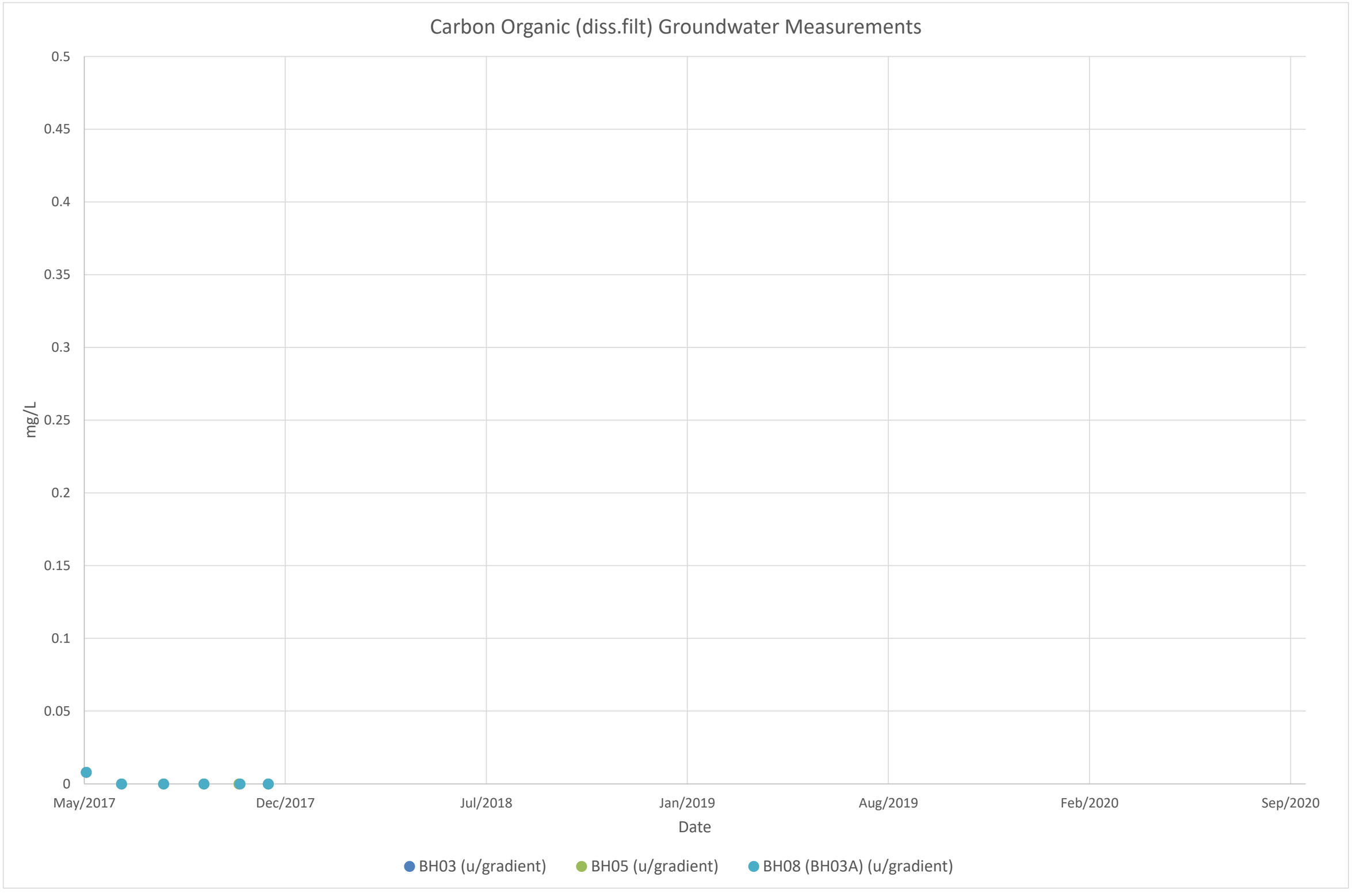
Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

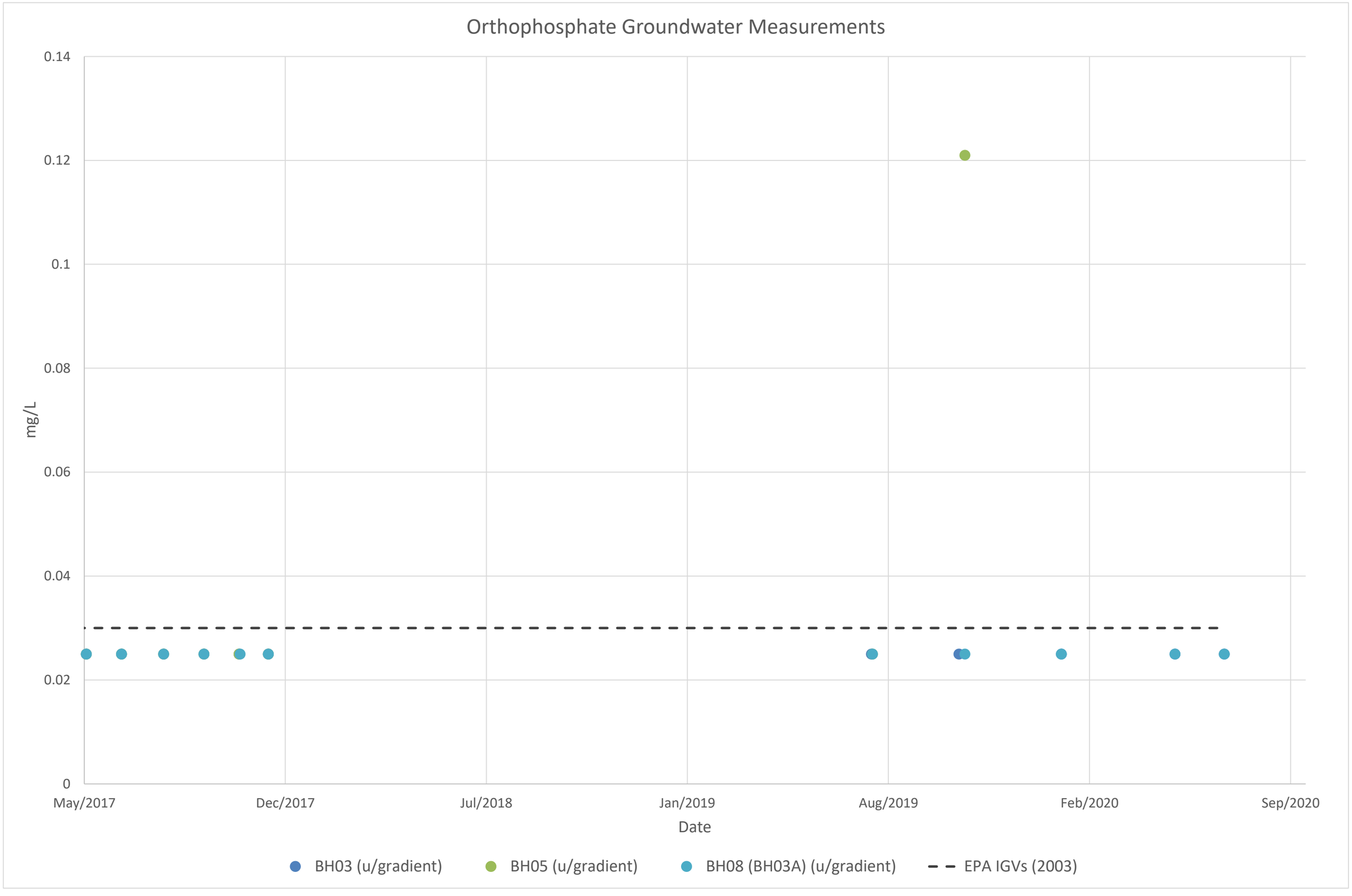
The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

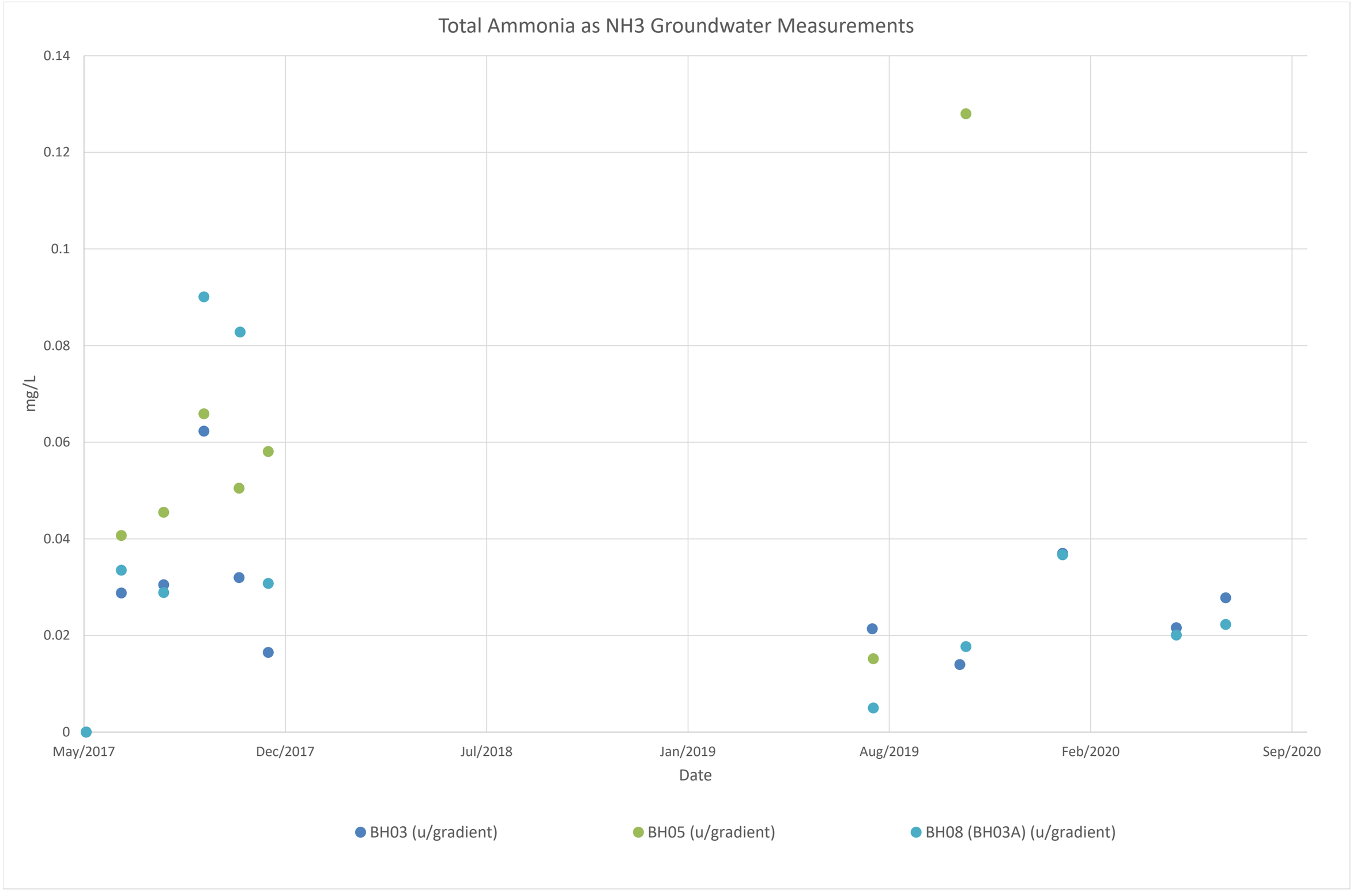
APPENDIX 04

Background Groundwater Quality Data

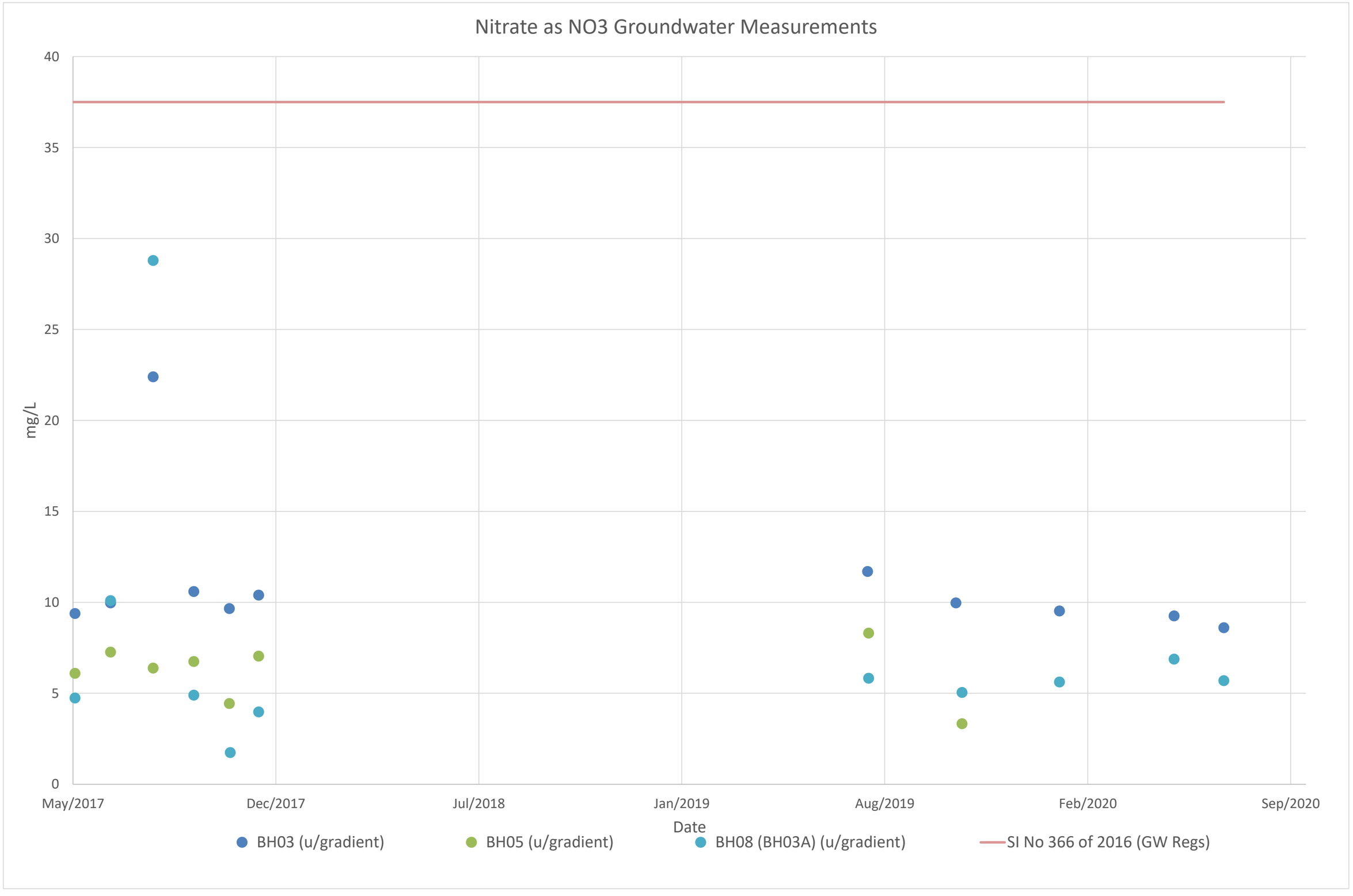

Total Phenols Groundwater Measurements
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH03 (u/gradient)
BH05 (u/gradient)
BH08 (BH03A) (u/gradient)

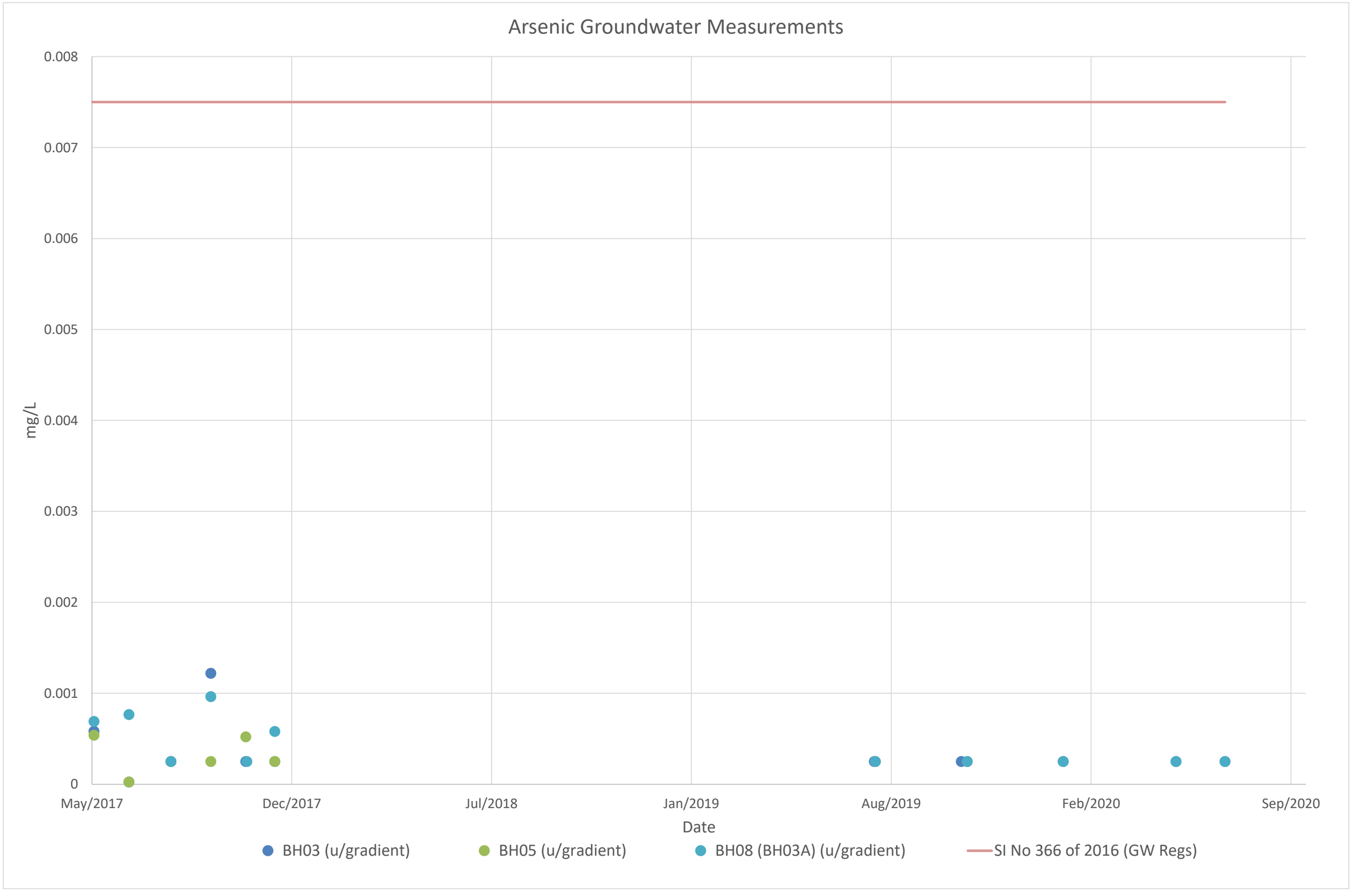

Carbon Organic (diss.filt) Groundwater Measurements
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH03 (u/gradient)
BH05 (u/gradient)
BH08 (BH03A) (u/gradient)

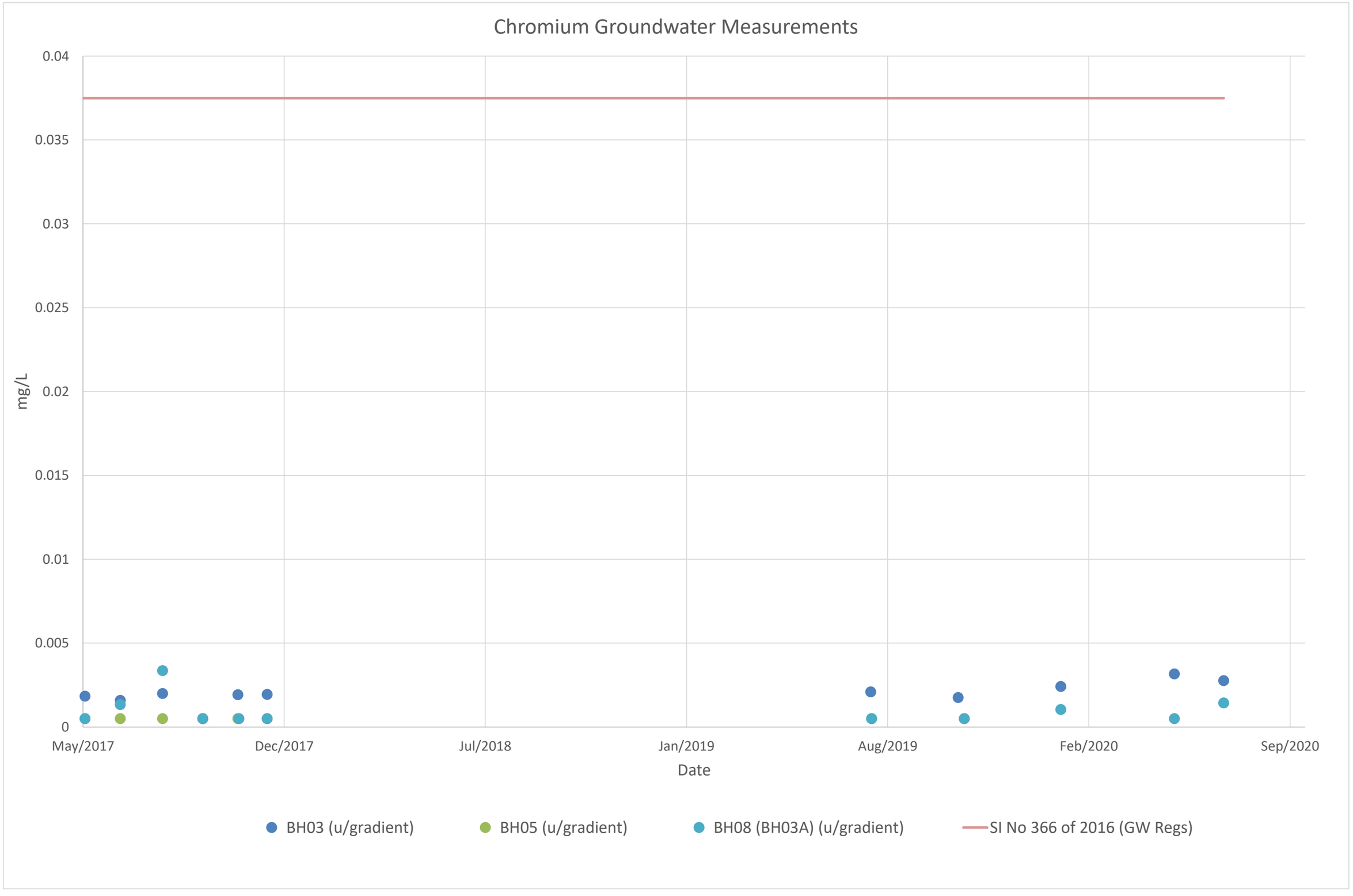

Orthophosphate Groundwater Measurements
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
mg/l
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH03 (u/gradient)
BH05 (u/gradient)
BH08 (BH03A) (u/gradient)
EPA IGVs (2003)

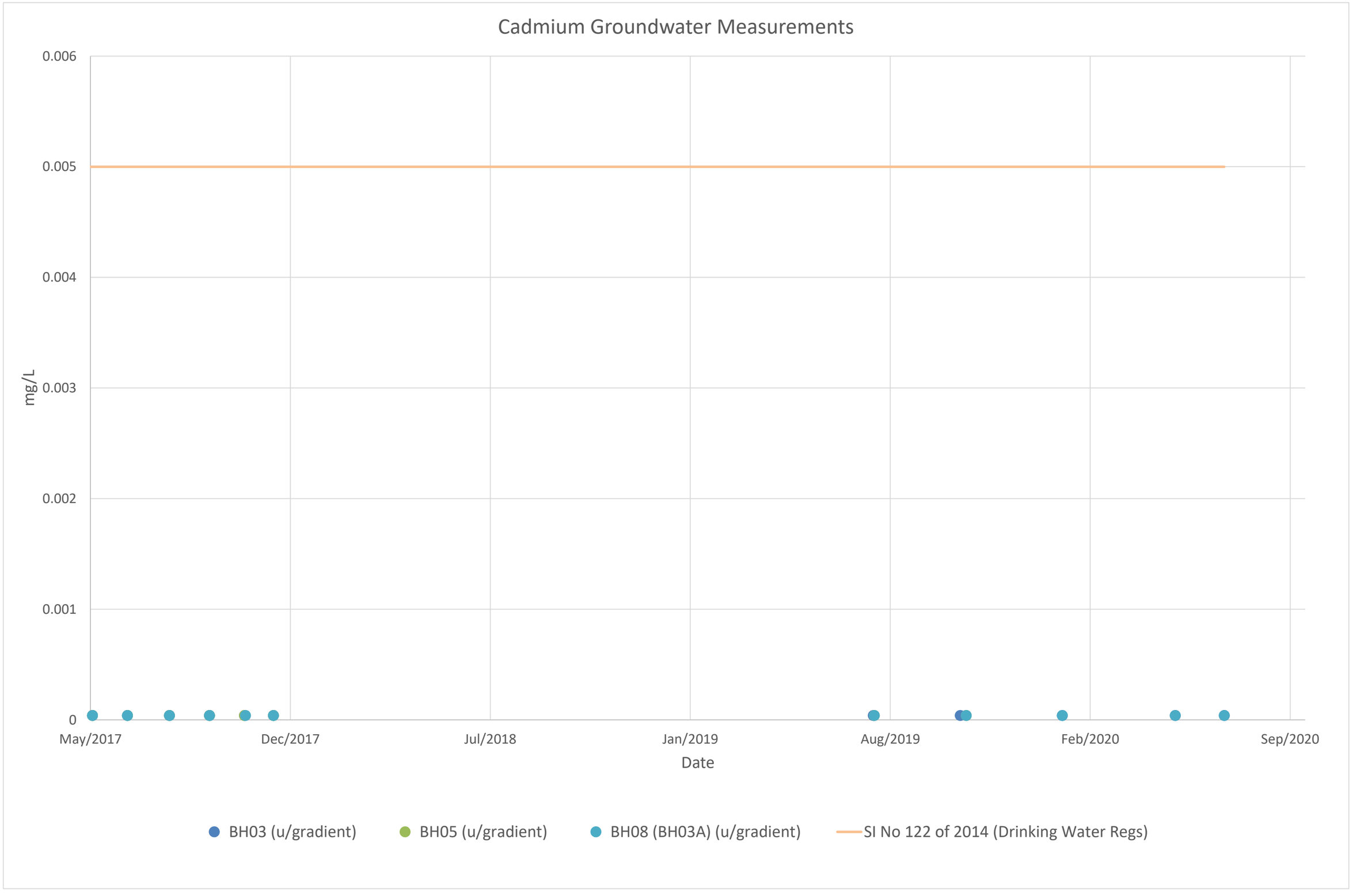

Total Ammonia as NH3 Groundwater Measurements
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH03 (u/gradient)
BH05 (u/gradient)
BH08 (BH03A) (u/gradient)

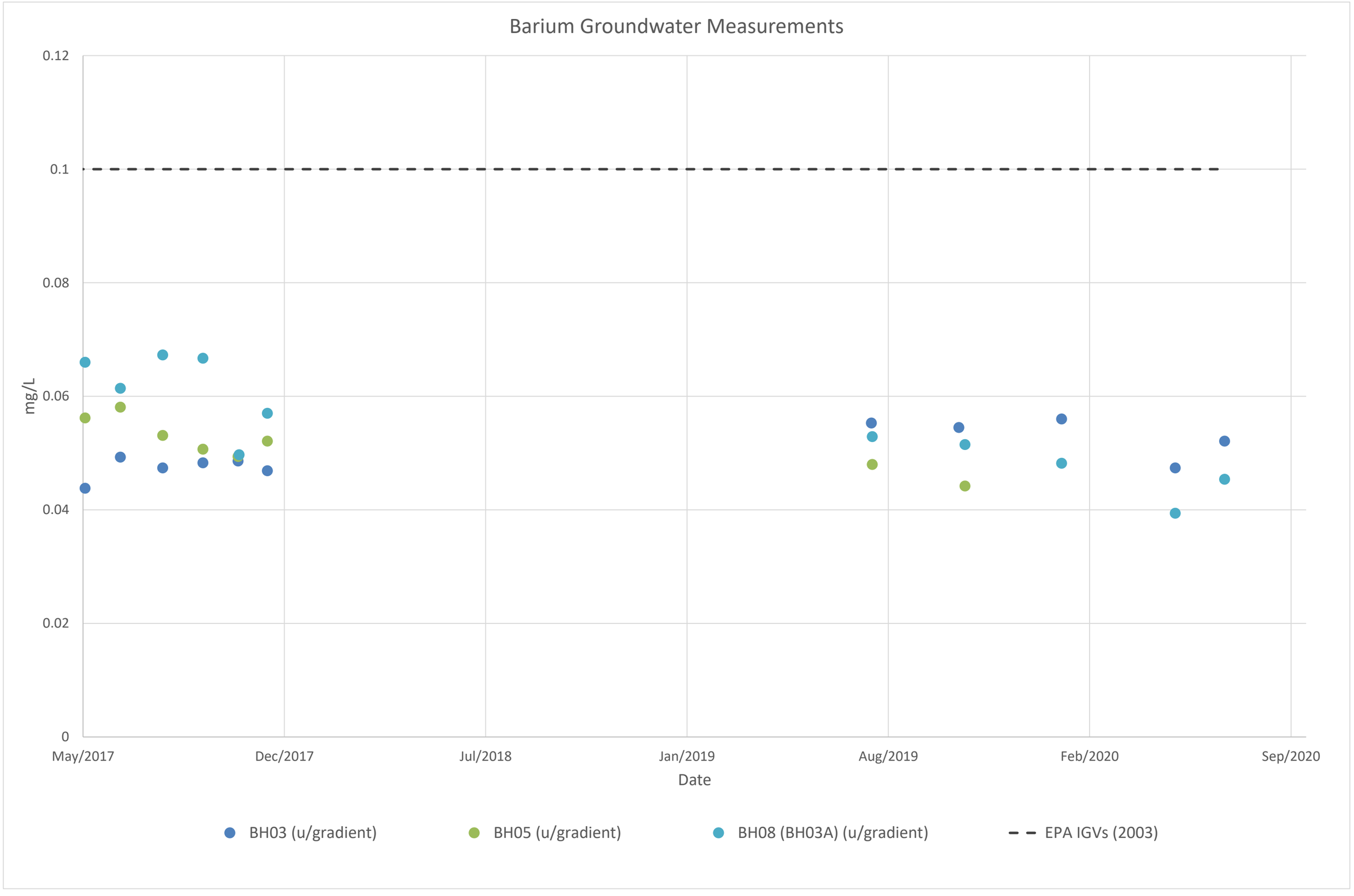

Ammoniacal Nitrogen as N Groundwater Measurements
0.12
0.1
0.08
0.06
0.04
0.02
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH03 (u/gradient)
BH05 (u/gradient)
BH08 (BH03A) (u/gradient)

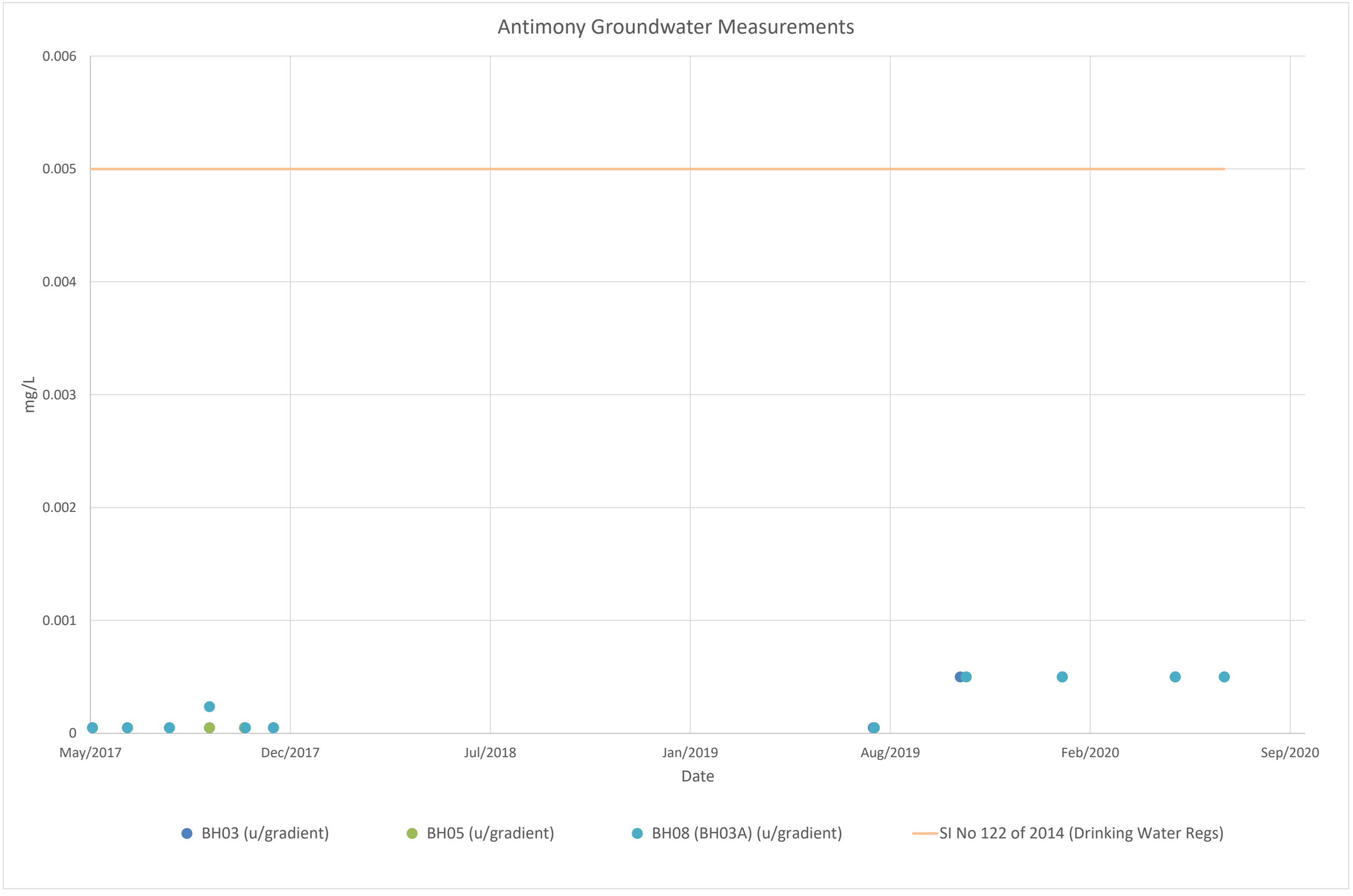

Nitrate as NO3 Groundwater Measurements
40
35
30
25
20
15
10
5
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH03 (u/gradient)
BH05 (u/gradient)
BH08 (BH03A) (u/gradient)
SI No 366 of 2016 (GW Regs)

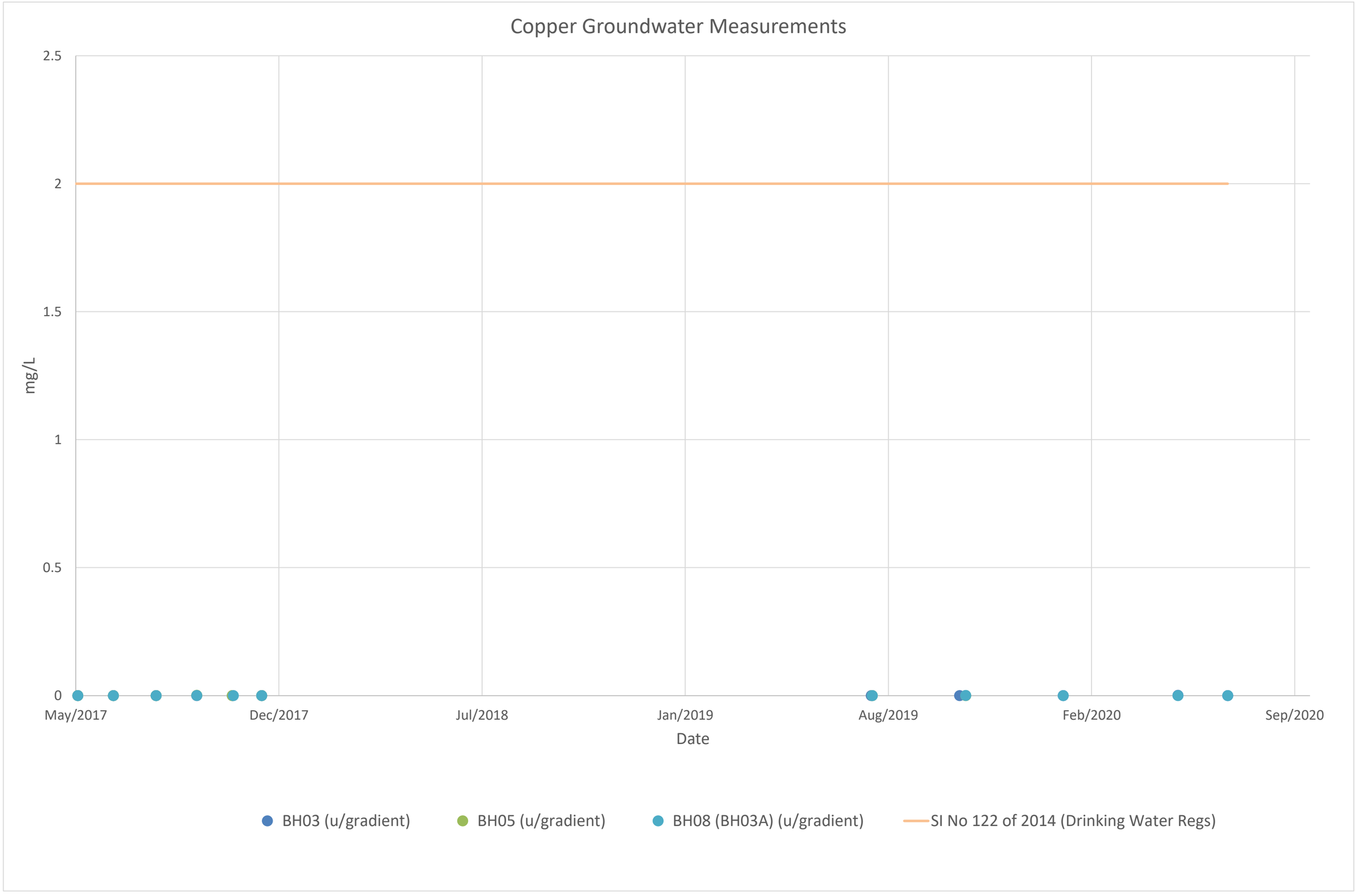

Arsenic Groundwater Measurements
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH03 (u/gradient)
BH05 (u/gradient)
BH08 (BH03A) (u/gradient)
SI No 366 of 2016 (GW Regs)

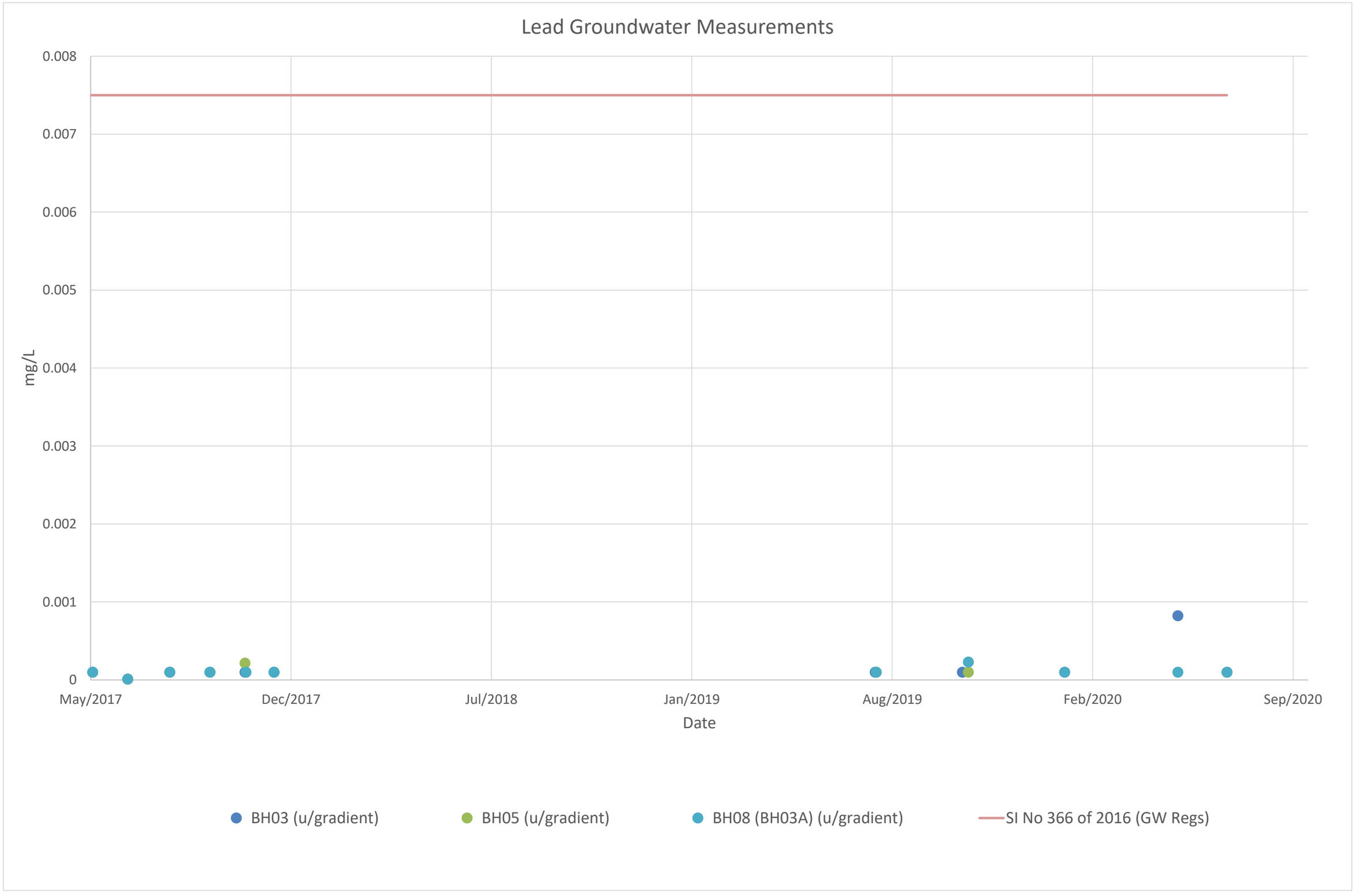

Chromium Groundwater Measurements
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH03 (u/gradient)
BH05 (u/gradient)
BH08 (BH03A) (u/gradient)
SI No 366 of 2016 (GW Regs)

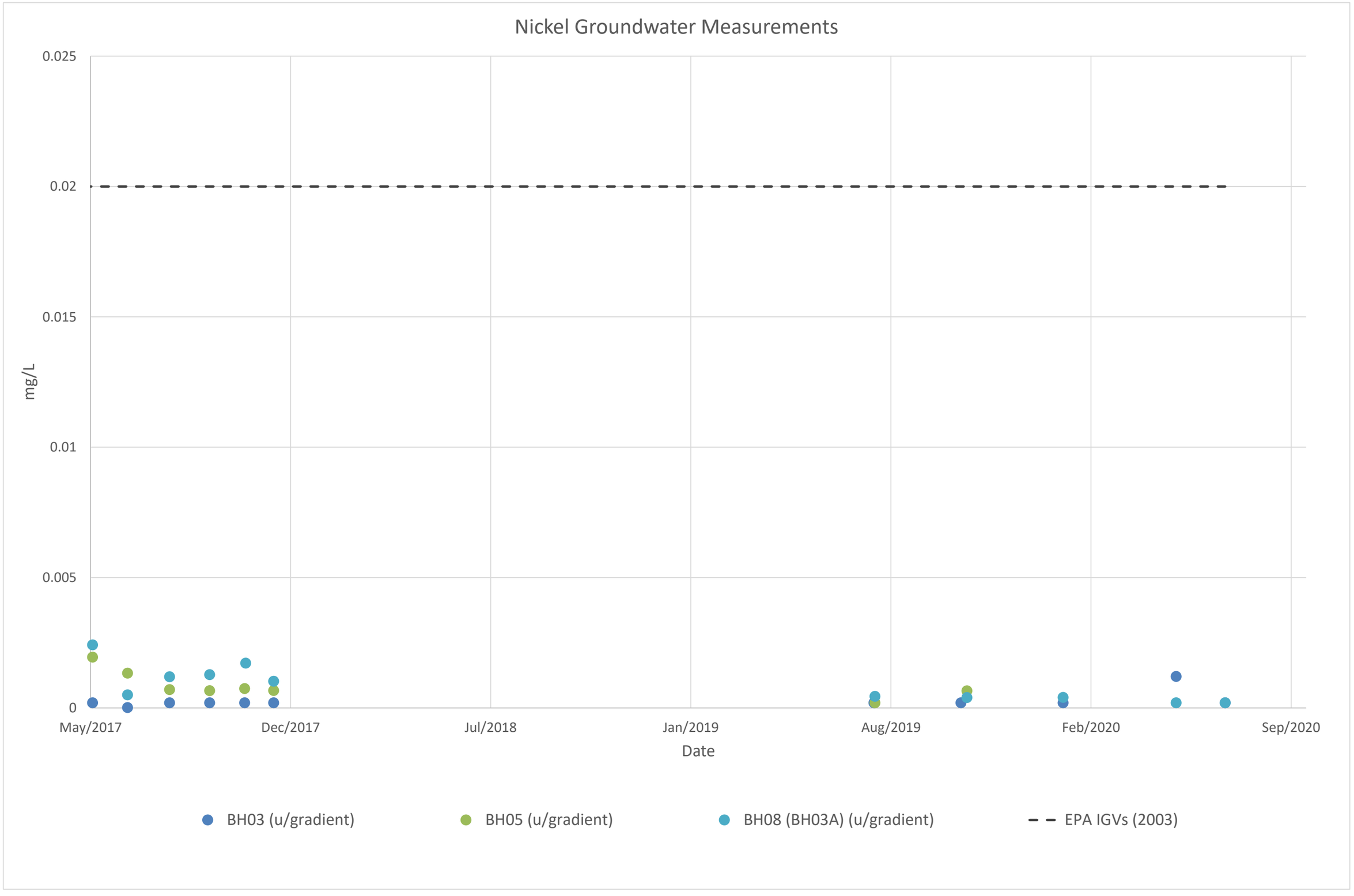

Cadmium Groundwater Measurements
0.006
0.005
0.004
0.003
0.002
0.001
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH03 (u/gradient)
BH05 (u/gradient)
BH08 (BH03A) (u/gradient)
SI No 122 of 2014 (Drinking Water Regs)

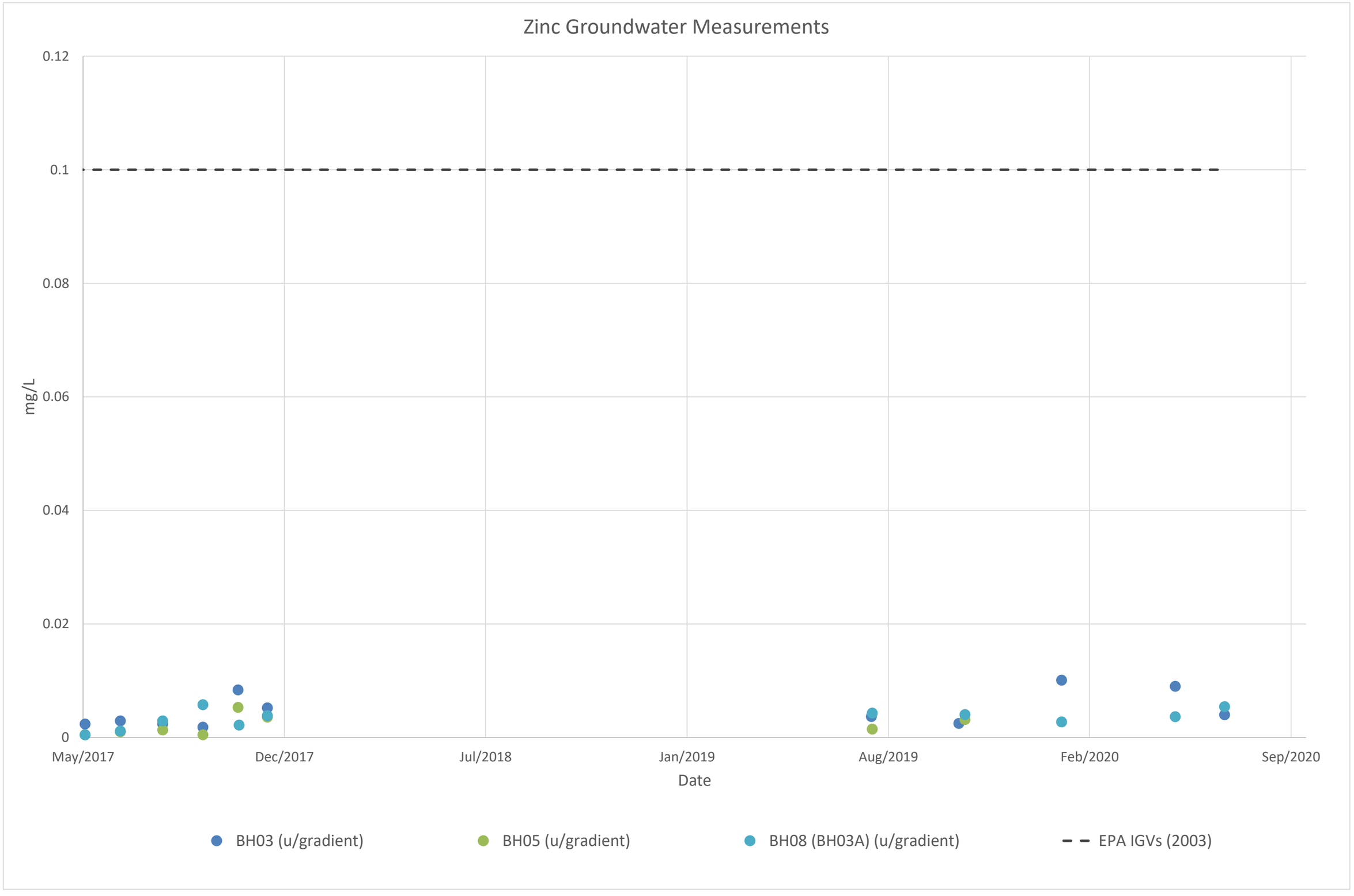

Barium Groundwater Measurements
0.12
0.1
0.08
0.06
0.04
0.02
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH03 (u/gradient)
BH05 (u/gradient)
BH08 (BH03A) (u/gradient)
EPA IGVs (2003)

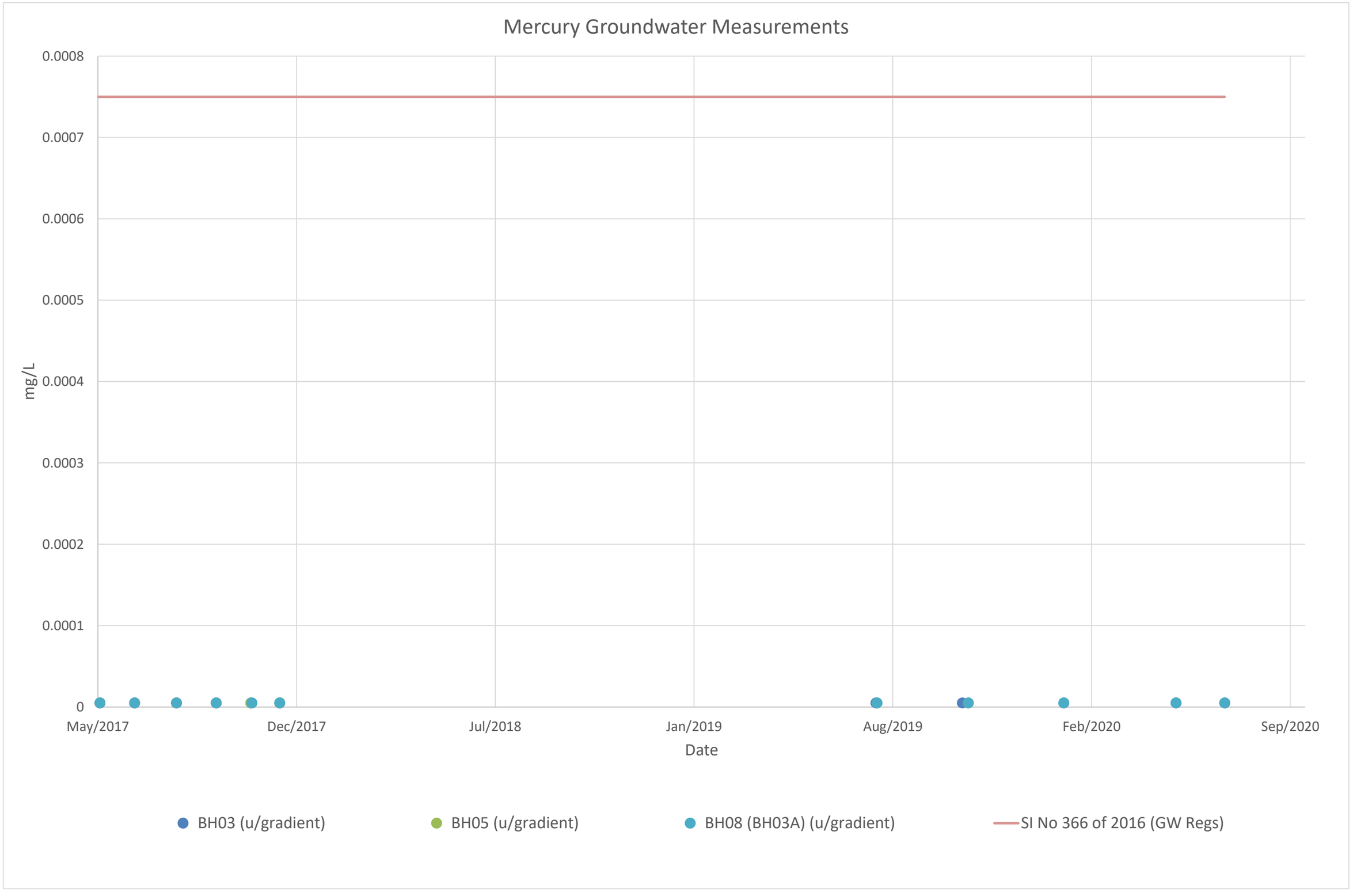

Antimony Groundwater Measurements
0.006
0.005
0.004
0.003
0.002
0.001
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH03 (u/gradient)
BH05 (u/gradient)
BH08 (BH03A) (u/gradient)
SI No 122 of 2014 (Drinking Water Regs)

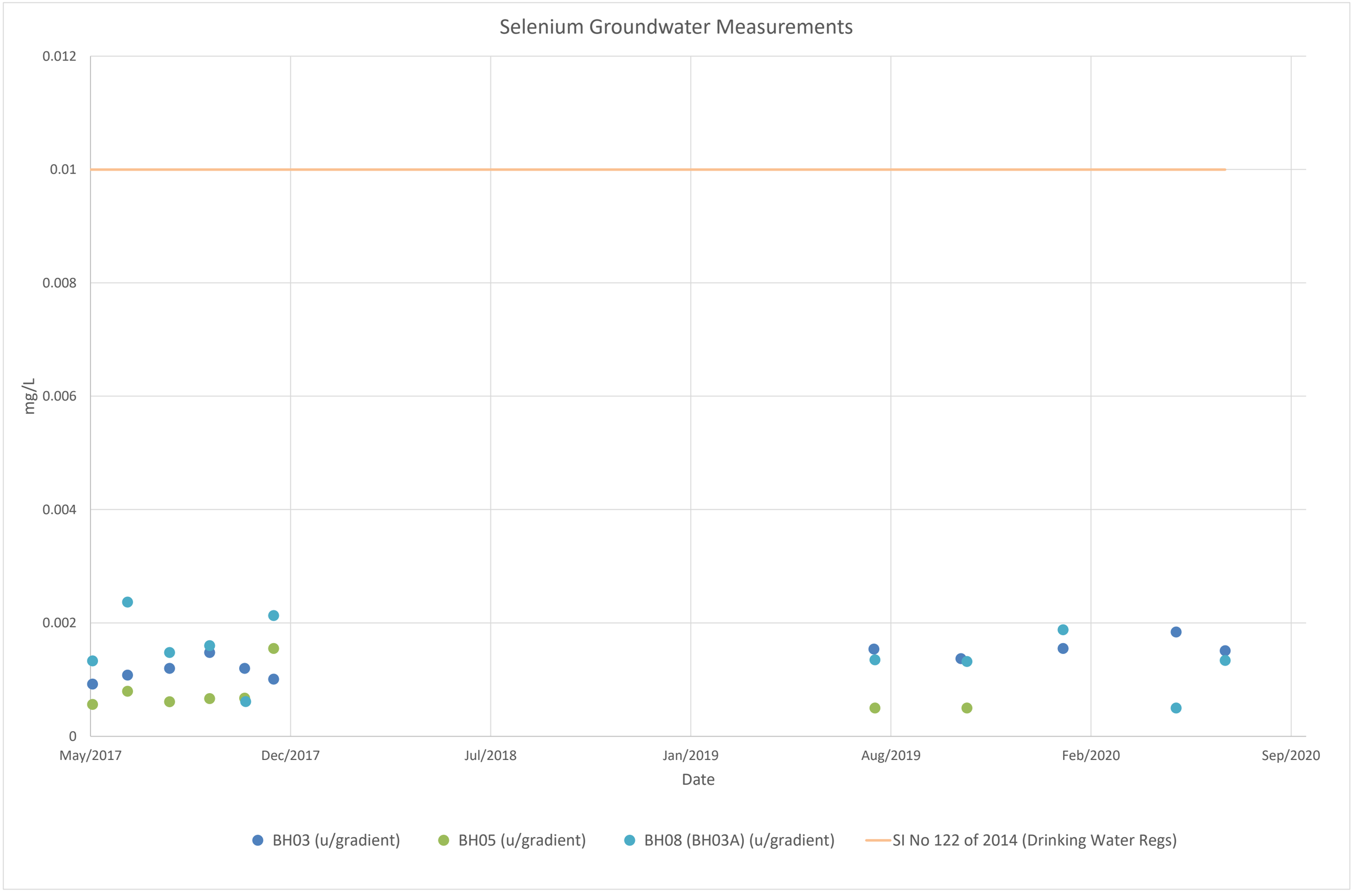

Copper Groundwater Measurements
2.5
2
1.5
1
0.5
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH03 (u/gradient)
BH05 (u/gradient)
BH08 (BH03A) (u/gradient)
SI No 122 of 2014 (Drinking Water Regs)

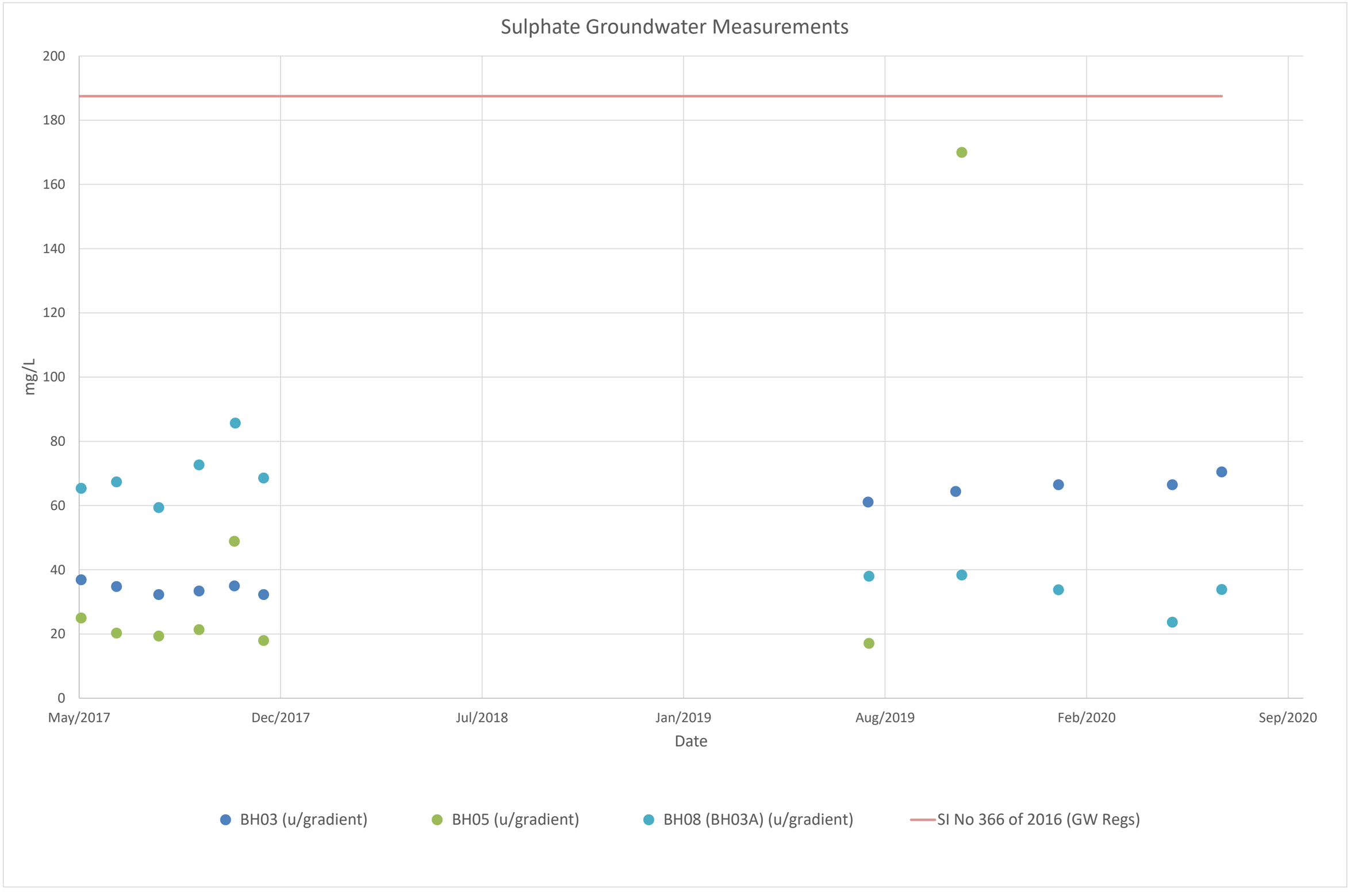

Lead Groundwater Measurements
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH03 (u/gradient)
BH05 (u/gradient)
BH08 (BH03A) (u/gradient)
SI No 366 of 2016 (GW Regs)

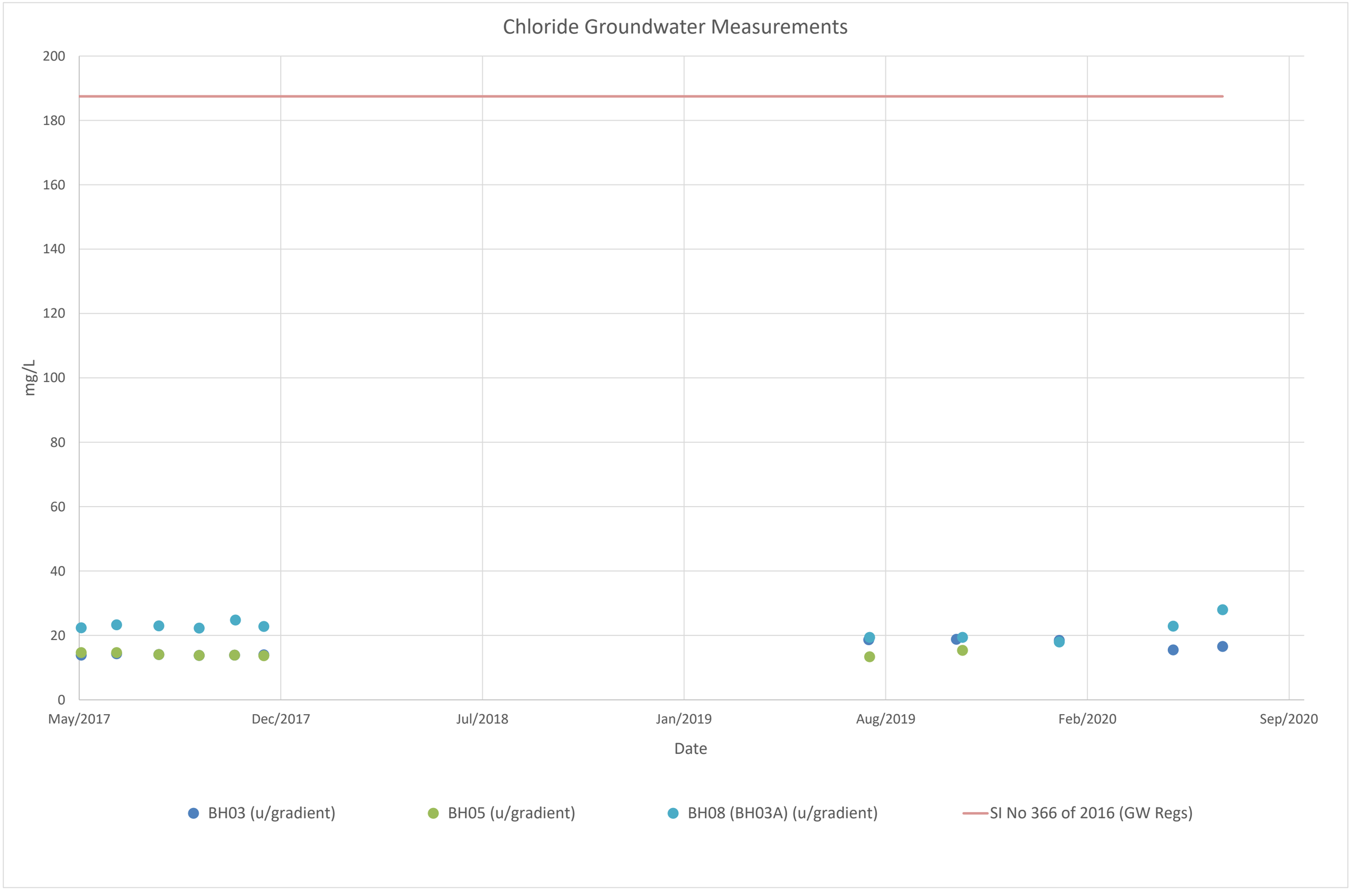

Nickel Groundwater Measurements
0.025
0.02
0.015
0.01
0.005
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH03 (u/gradient)
BH05 (u/gradient)
BH08 (BH03A) (u/gradient)
EPA IGVs (2003)

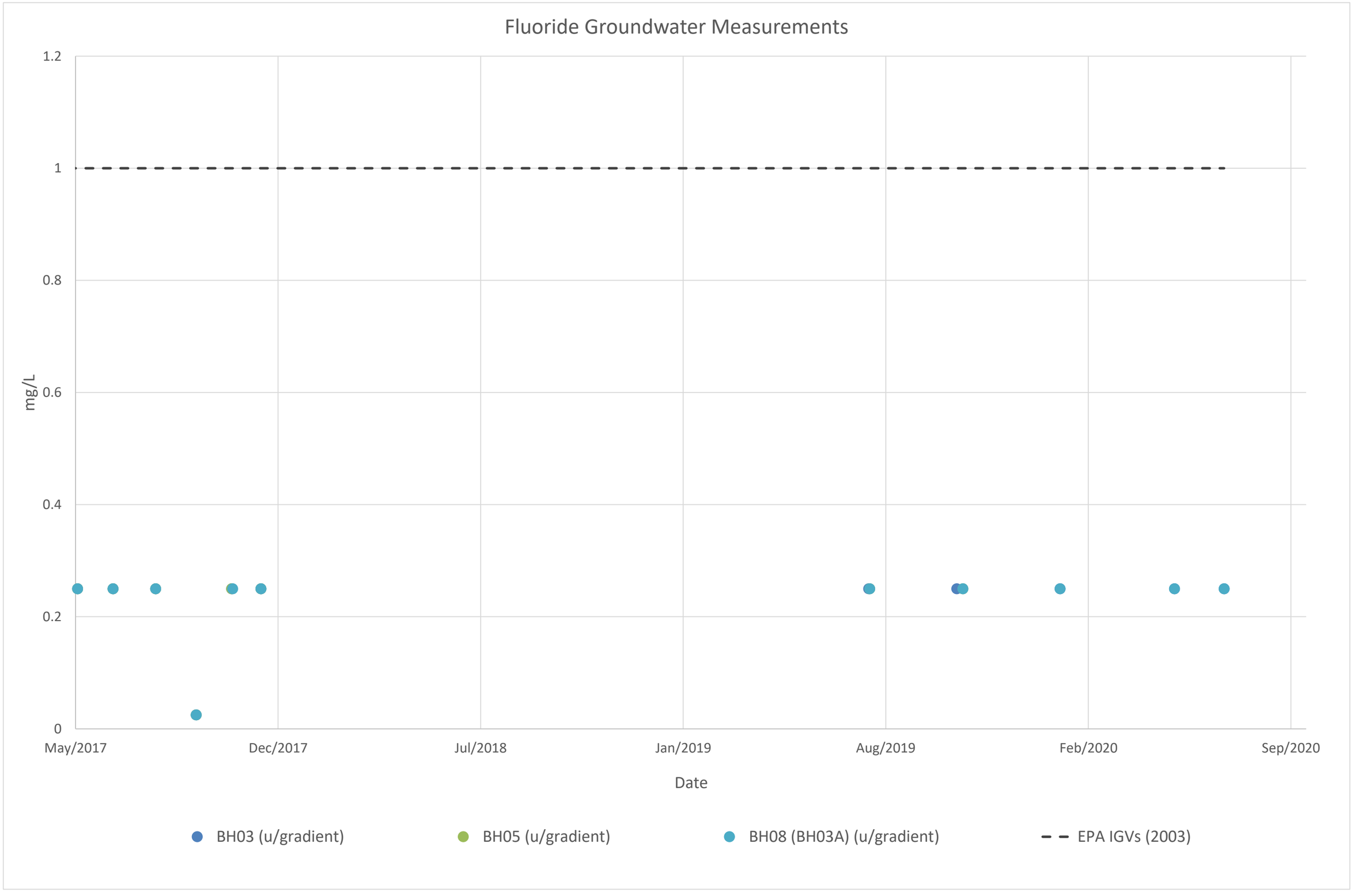

Zinc Groundwater Measurements
0.12
0.1
0.08
0.06
0.04
0.02
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH03 (u/gradient)
BH05 (u/gradient)
BH08 (BH03A) (u/gradient)
EPA IGVs (2003)

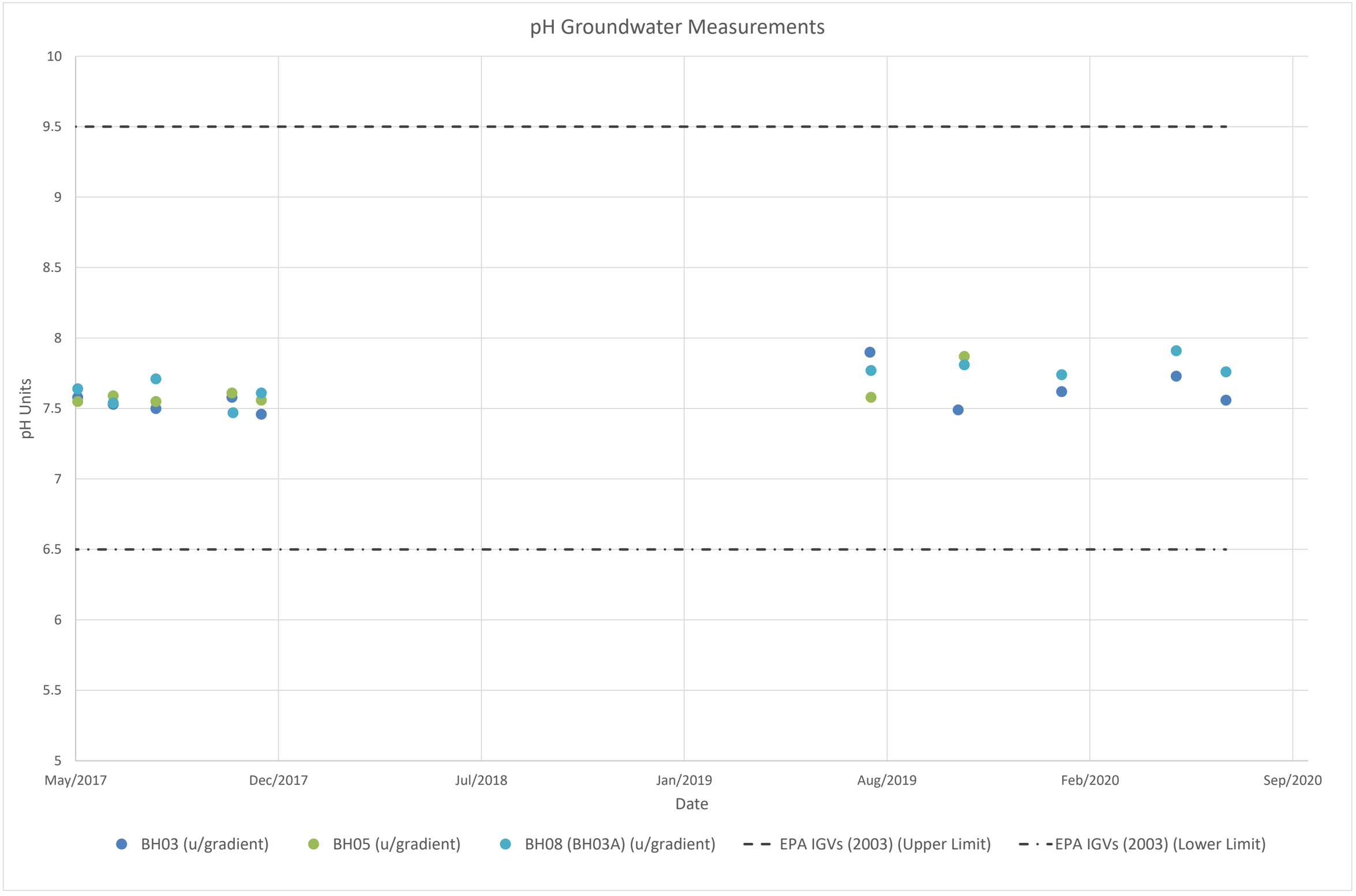

Mercury Groundwater Measurements
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH03 (u/gradient)
BH05 (u/gradient)
BH08 (BH03A) (u/gradient)
SI No 366 of 2016 (GW Regs)

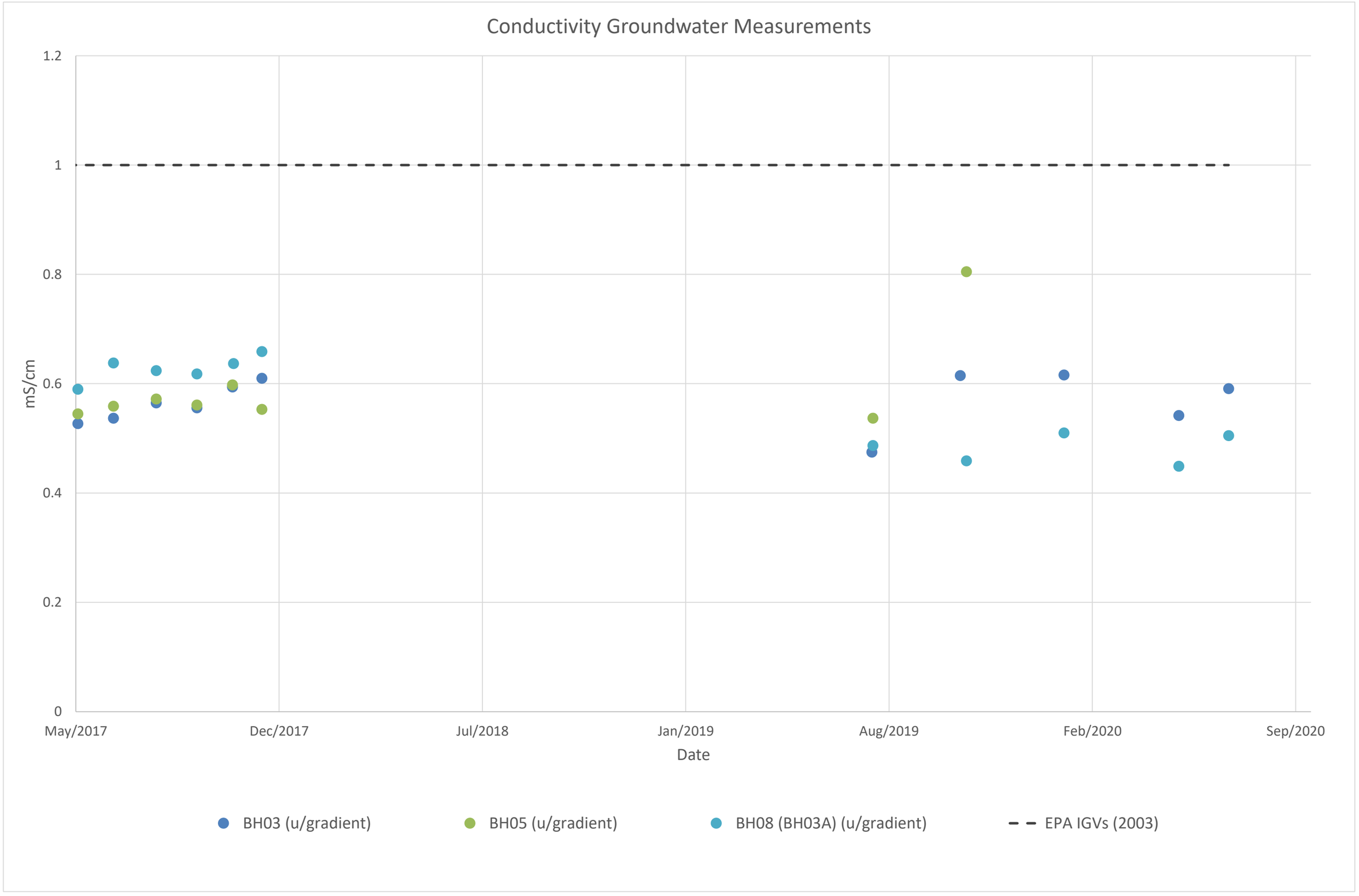

Selenium Groundwater Measurements
0.012
0.01
0.008
0.006
0.004
0.002
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH03 (u/gradient)
BH05 (u/gradient)
BH08 (BH03A) (u/gradient)
SI No 122 of 2014 (Drinking Water Regs)


Sulphate Groundwater Measurements
200
180
160
140
120
100
80
60
40
20
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH03 (u/gradient)
BH05 (u/gradient)
BH08 (BH03A) (u/gradient)
SI No 366 of 2016 (GW Regs)


Chloride Groundwater Measurements
200
180
160
140
120
100
80
60
40
20
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH03 (u/gradient)
BH05 (u/gradient)
BH08 (BH03A) (u/gradient)
SI No 366 of 2016 (GW Regs)

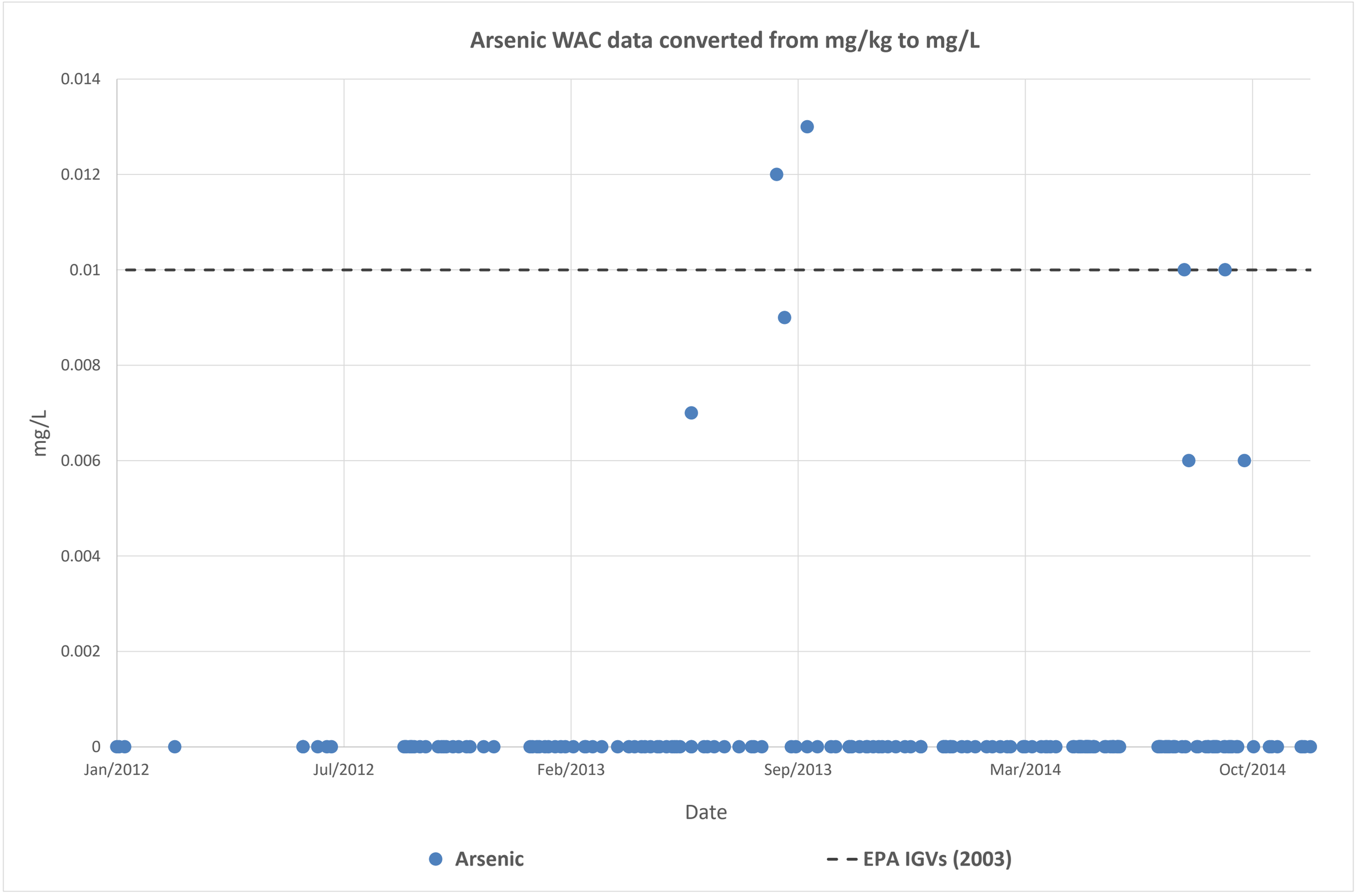

Fluoride Groundwater Measurements
1.2
1
0.8
0.6
0.4
0.2
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH03 (u/gradient)
BH05 (u/gradient)
BH08 (BH03A) (u/gradient)
EPA IGVs (2003)

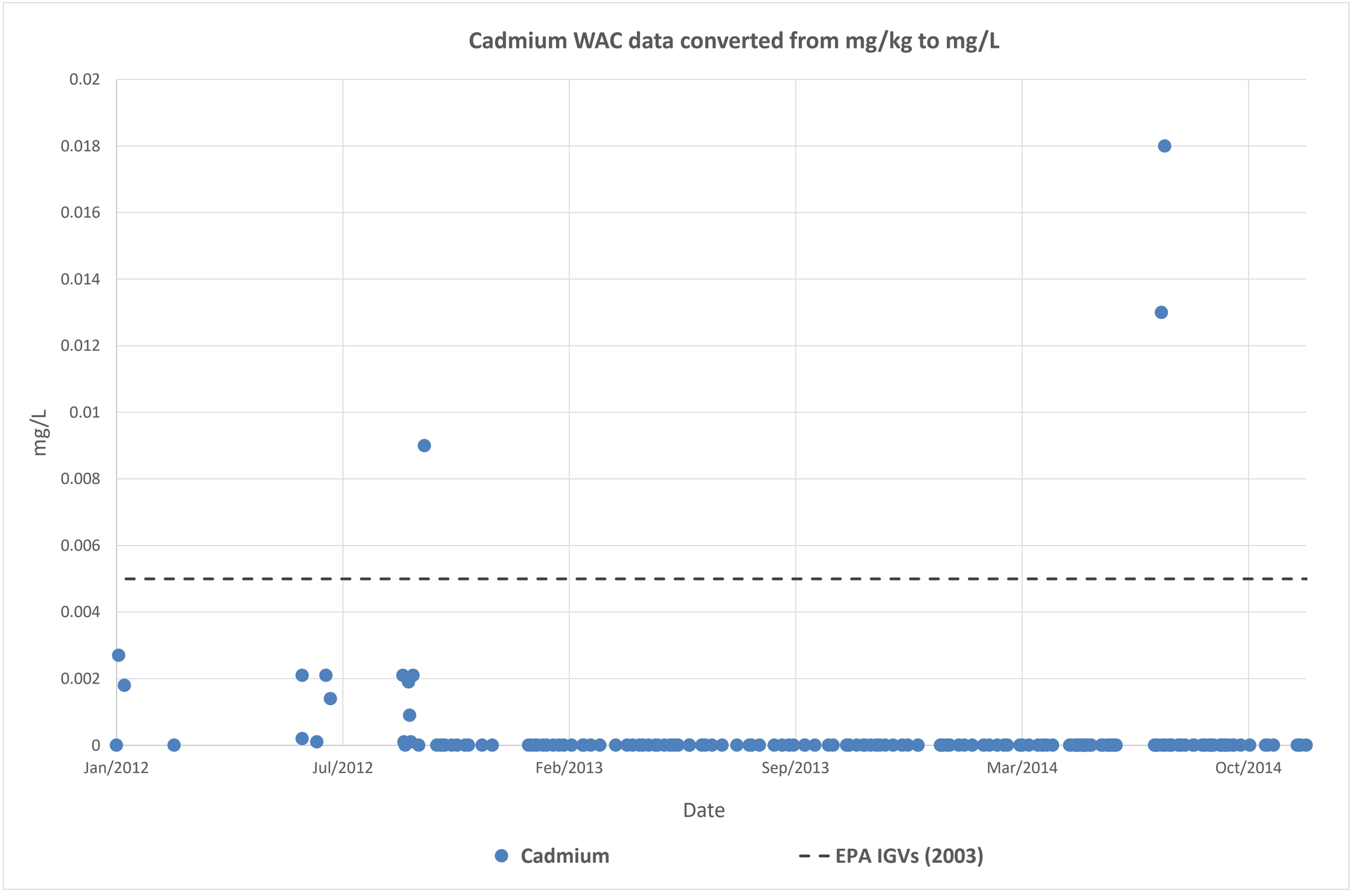

pH Groundwater Measurements
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
pH Units
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH03 (u/gradient)
BH05 (u/gradient)
BH08 (BH03A) (u/gradient)
EPA IGVs (2003) (Upper Limit)
EPA IGVs (2003) (Lower Limit)

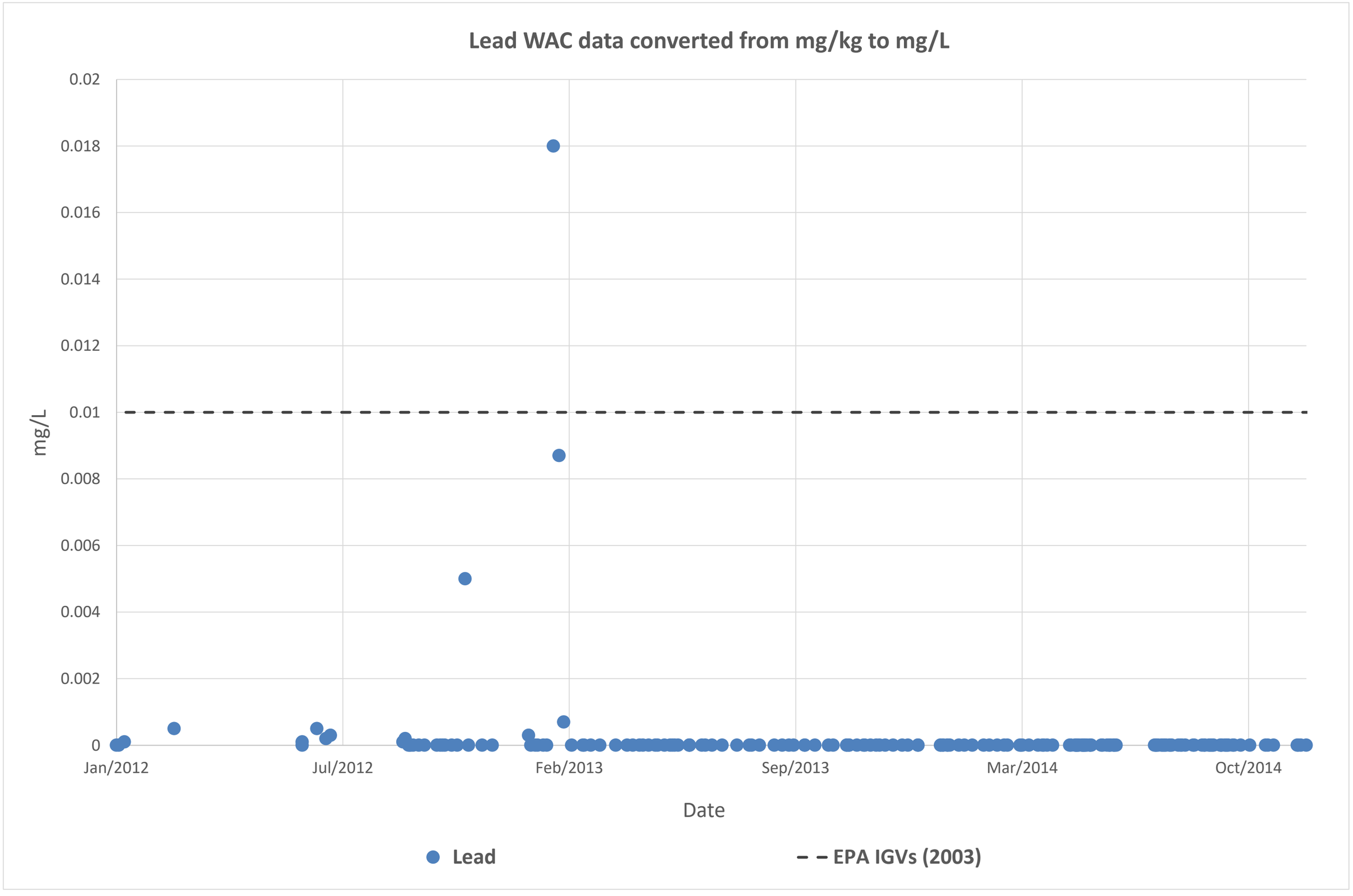

Conductivity Groundwater Measurements
1.2
1
0.8
0.6
0.4
0.2
0
mS/cm
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH03 (u/gradient)
BH05 (u/gradient)
BH08 (BH03A) (u/gradient)
EPA IGVs (2003)

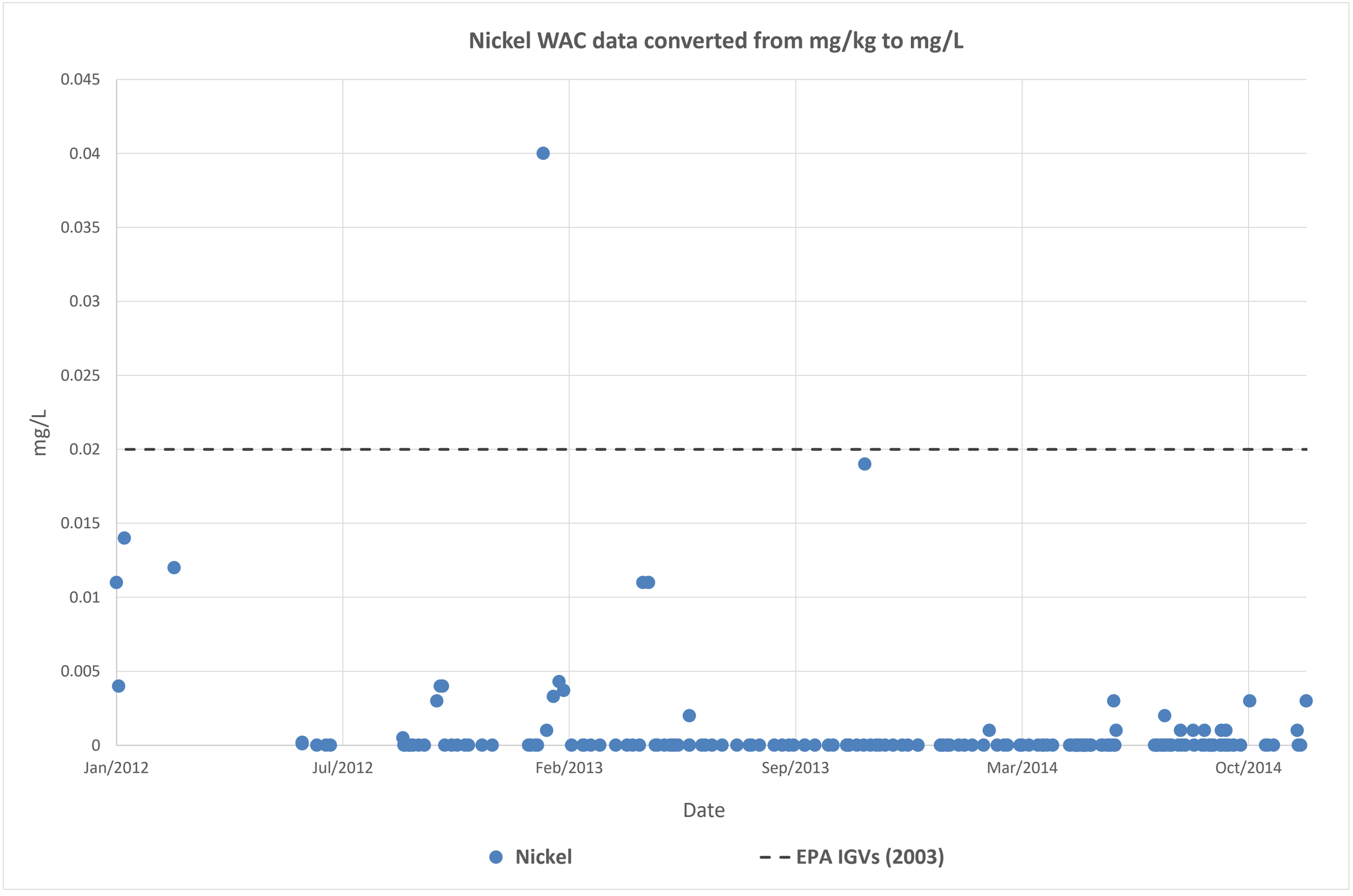
APPENDIX 05

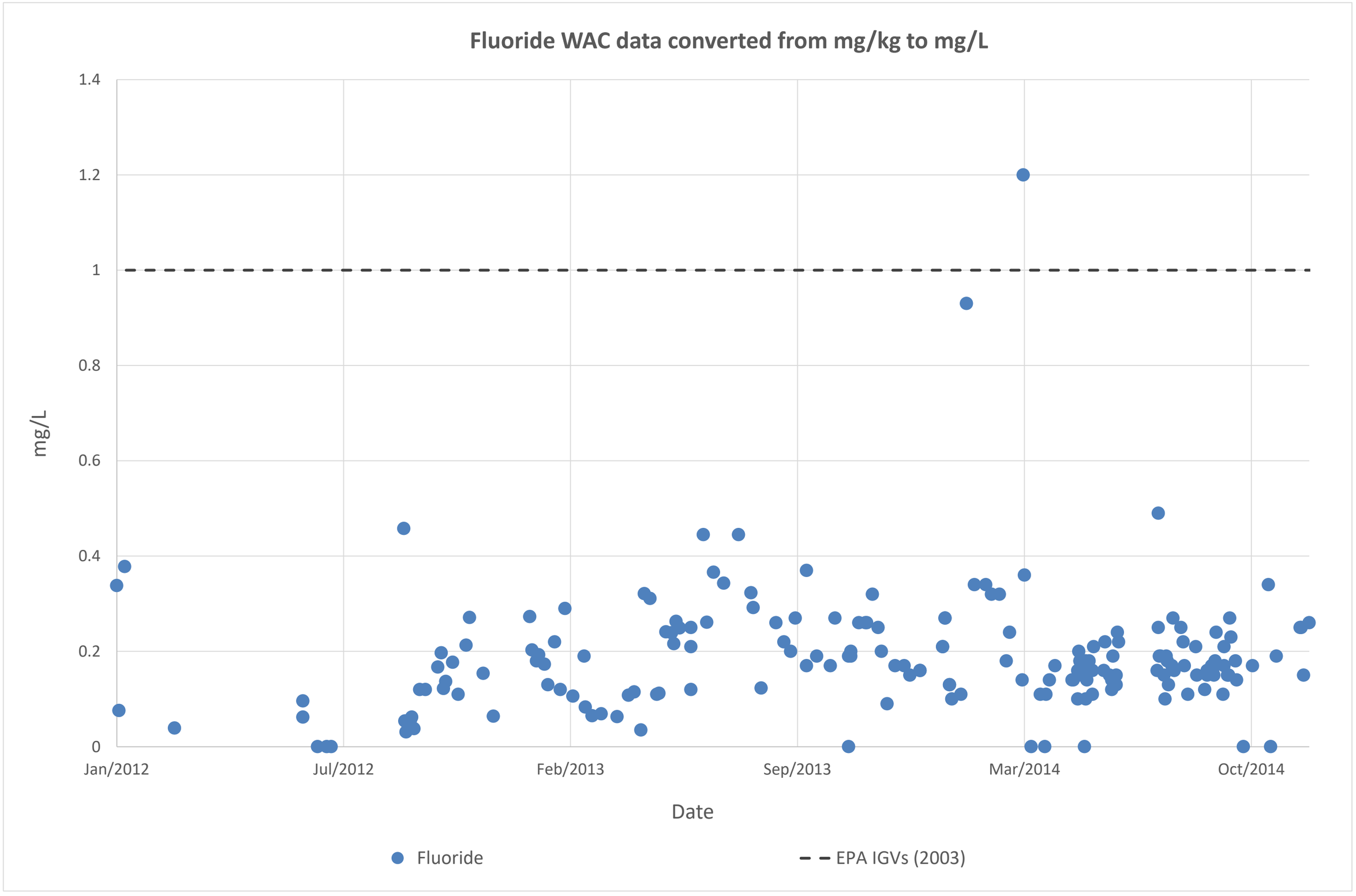
WAC Data Scatter Graphs

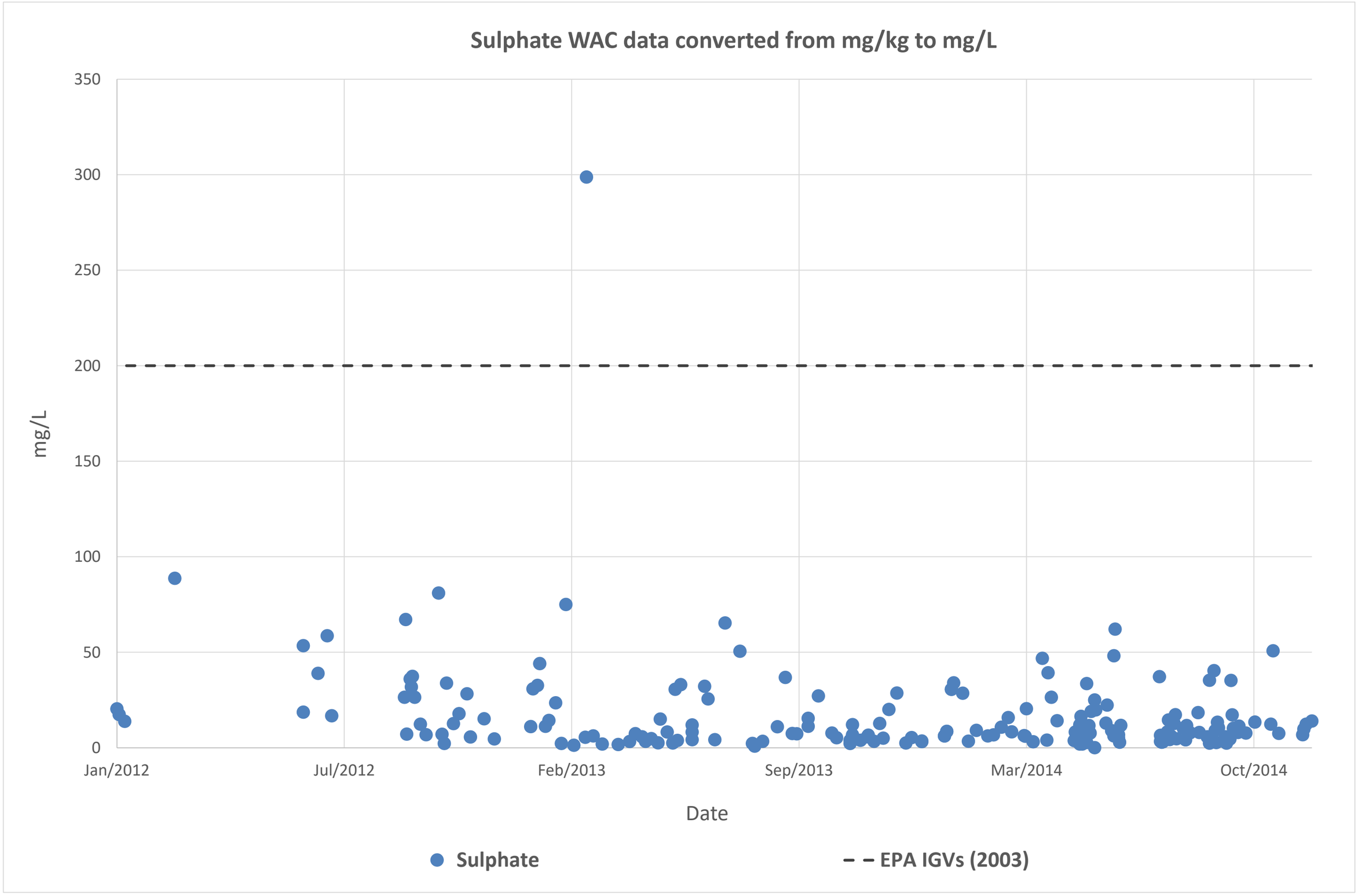

Arsenic WAC data converted from mg/kg to mg/L
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
mg/L
Jan/2012
Jul/2012
Feb/2013
Sep/2013
Mar/2014
Oct/2014
Date
Arsenic
EPA IGVs (2003)

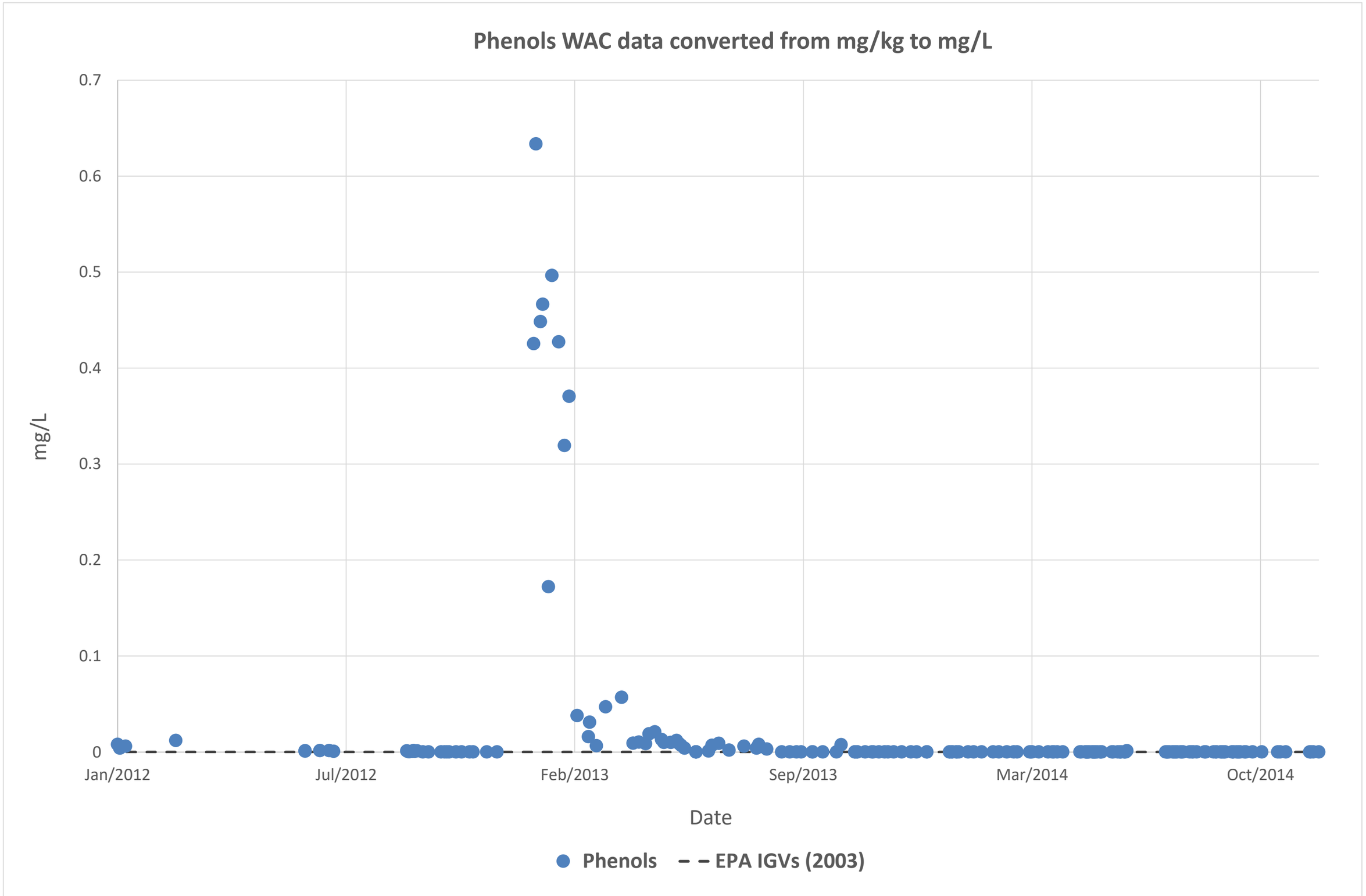

Cadmium WAC data converted from mg/kg to mg/L
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
mg/L
Jan/2012
Jul/2012
Feb/2013
Sep/2013
Mar/2014
Oct/2014
Date
Cadmium
EPA IGVs (2003)


Lead WAC data converted from mg/kg to mg/L
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
mg/L
Jan/2012
Jul/2012
Feb/2013
Sep/2013
Mar/2014
Oct/2014
Date
Lead
EPA IGVs (2003)


Nickel WAC data converted from mg/kg to mg/L
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
mg/L
Jan/2012
Jul/2012
Feb/2013
Sep/2013
Mar/2014
Oct/2014
Date
Nickel
EPA IGVs (2003)


Fluoride WAC data converted from mg/kg to mg/L
1.4
1.2
1
0.8
0.6
0.4
0.2
0
mg/L
Jan/2012
Jul/2012
Feb/2013
Sep/2013
Mar/2014
Oct/2014
Date
Fluoride
EPA IGVs (2003)


Sulphate WAC data converted from mg/kg to mg/L
350
300
250
200
150
100
50
0
mg/L
Jan/2012
Jul/2012
Feb/2013
Sep/2013
Mar/2014
Oct/2014
Date
Sulphate
EPA IGVs (2003)


Phenols WAC data converted from mg/kg to mg/L
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
mg/L
Jan/2012
Jul/2012
Feb/2013
Sep/2013
Mar/2014
Oct/2014
Date
Phenols
EPA IGVs (2003)

APPENDIX 06

P20 Remedial Targets Worksheet

Remedial Targets Worksheet , Release 3.2

Calculation of contaminant concentration in groundwater from a soil source

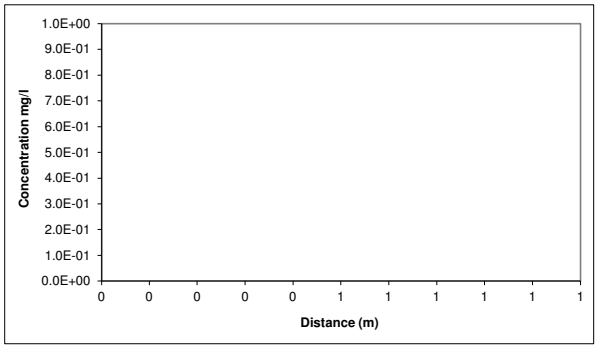
Only input required is Soil Contaminant Concentration

	Input Parameters			
	Soil contaminant concentration	C_0	1.35E-02	mg/kg
Level 1 Parameters				
	Water filled soil porosity	θ_W	3.00E-01	fraction
	Air filled soil porosity	θa	2.00E-01	fraction
	Bulk density	ρ	1.50E+00	g/cm^3
	Henry's Law constant	H	1.82E-01	dimensionless
	Soil water partition coefficient used in Level Assessment	Kd	1.36E+00	l/kg
	Factor (partitioning between soil and water)		1.58E+00	dimensionless
Level 2 Parameters	**Dilution Factor**	DF	#DIV/0!	
Level 3 Parameters	**Attenuation factor (C_O/C_{ED})**	AF	#DIV/0!	

Predicted concentrations at compliance point

Level 1	C	#DIV/0!	mg/l	No dilution or attenuation
Level 2	C	#DIV/0!	mg/l	Dilution taken into account
Level 3	C	#DIV/0!	mg/l	Dilution and attenuation taken into account

Predicted concentrations between source and compliance point - Level 3



Distance m	Concentration mg/l
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!

Remedial Targets Worksheet , Release 3.2

Calculation of contaminant concentration in groundwater from a soil source

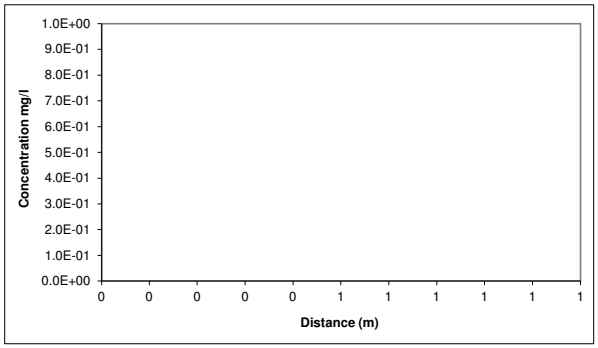
Only input required is Soil Contaminant Concentration

	Input Parameters			
	Soil contaminant concentration	C_0	1.99E+01	mg/kg
Level 1 Parameters				
	Water filled soil porosity	θ_W	3.00E-01	fraction
	Air filled soil porosity	θa	2.00E-01	fraction
	Bulk density	ρ	1.50E+00	g/cm^3
	Henry's Law constant	H	4.20E-04	dimensionless
	Soil water partition coefficient used in Level Assessment	Kd	3.64E+02	l/kg
	Factor (partitioning between soil and water)		3.64E+02	dimensionless
Level 2 Parameters	**Dilution Factor**	DF	#DIV/0!	
Level 3 Parameters	**Attenuation factor (C_O/C_{ED})**	AF	#DIV/0!	

Predicted concentrations at compliance point

Level 1	C	5.47E-02	mg/l	No dilution or attenuation
Level 2	C	#DIV/0!	mg/l	Dilution taken into account
Level 3	C	#DIV/0!	mg/l	Dilution and attenuation taken into account

Predicted concentrations between source and compliance point - Level 3



Distance m	Concentration mg/l
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!

Remedial Targets Worksheet , Release 3.2

Calculation of contaminant concentration in groundwater from a soil source

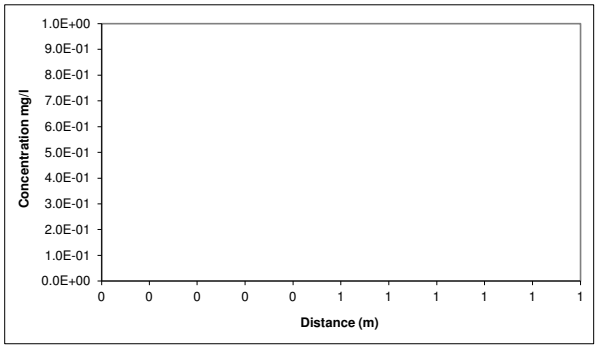
Only input required is Soil Contaminant Concentration

	Input Parameters			
	Soil contaminant concentration	C_0	1.50E+02	mg/kg
Level 1 Parameters				
	Water filled soil porosity	θ_W	1.80E-01	fraction
	Air filled soil porosity	θa	2.00E-02	fraction
	Bulk density	ρ	1.50E+00	g/cm^3
	Henry's Law constant	H	1.40E-01	dimensionless
	Soil water partition coefficient used in Level Assessment	Kd	4.37E+01	l/kg
	Factor (partitioning between soil and water)		4.38E+01	dimensionless
Level 2 Parameters	**Dilution Factor**	DF	#DIV/0!	
Level 3 Parameters	**Attenuation factor (C_O/C_{ED})**	AF	#DIV/0!	

Predicted concentrations at compliance point

Level 1	C	3.42E+00	mg/l	No dilution or attenuation
Level 2	C	#DIV/0!	mg/l	Dilution taken into account
Level 3	C	#DIV/0!	mg/l	Dilution and attenuation taken into account

Predicted concentrations between source and compliance point - Level 3



Distance m	Concentration mg/l
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!

APPENDIX 07

Parameterisation Table

Appendix 07: LandSim Parameterisation Table

Table 1
Leachate Source

Item	Value/Description	Source of Data
Infiltration to Open Waste (mm/year)	668± 66.8 Normal	Based on geological survey of Ireland effective rainfall
Infiltration to Capped Areas (mm/year)	100± 10 Normal	Based on geological survey of Ireland groundwater recharge to low permeability subsoils (as representative of backfilled material)
Time Offset (years)	0	Modelled as single cell
End of Filling (years from start of waste disposal)	5	Based on development timeframe
Duration of Management Control (years from start of waste disposal)	0 Single value	No leachate management
Base Area (ha)	4.85 Single Value	Equal to quarry area (assuming leachate leakage through base of site)
Top Area (ha)	4.85 Single Value	Equal to quarry area
Final Waste Thickness (m)	Min: 5 Max: 15 Uniform	typical thickness of quarry
Waste Porosity (fraction)	Min: 0.35 Max: 0.45 Uniform	Typical range for clay as representative of main waste stream
Waste Density (kg/l)	Min: 1.80 Max: 2.20 Uniform	Typical range for clays (main waste stream)
Waste Field Capacity (fraction)	Min: 0.45 Max: 0.55 Uniform	Typical range for clays used as worst case

Item	Value/Description	Source of Data
Head of Leachate when Surface Water Breakout Occurs (m)	Min: 5 Max: 15 Uniform	Equal to thickness of landfill
Specified Leachate Head (m)	N/A	Calculated by Model

Table 2
Leachate Quality

Item	Value/Description	Source of Data
Arsenic (mg/l)	Min: 0.00005 ML: 0.0021 Max: 0.013 Log Triangular	As per Inert WAC data – converted to mg/l. Minimum set at half detection limit as worst case Not appropriate to model TOC, TDS or DOC (as composite parameters) or PCBs (as highly insoluble)
Cadmium (mg/l)	Min: 0.00005 ML: 0.000814 Max: 0.018 Log Triangular	
Chromium (mg/l)	Min: 0.0005 ML: 0.00326 Max: 0.041 Log Triangular	
Copper (mg/l)	Min: 0.0005 ML: 0.0054 Max: 0.038 Log Triangular	
Mercury (mg/l)	Min: 0.00001 ML: 0.00031 Max: 0.0008 Log Triangular	
Lead (mg/l)	Min: 0.00005 ML: 0.00194 Max: 0.018 Log Triangular	
Nickel (mg/l)	Min: 0.00005 ML: 0.00128	

Item	Value/Description	Source of Data
	Max: 0.04 Log Triangular	
Zinc (mg/l)	Min: 0.004 ML: 0.0091 Max: 0.086 Log Triangular	
Sulphate (mg/l)	Min: 0.125 ML: 17.05 Max: 298.7 Log Triangular	
Phenol (mg/l)	Min: 0.00025 ML: 0.024 Max: 0.636 Log Triangular	
Fluoranthene (mg/l)	Min: 2.40E-6 ML: 1.75E-3 Max: 0.067 Log Triangular	Fluoranthene – most common PAH, assumed to be 17.5 % of Total PAH, leachate concentration derived from WAC value using P20
Benzene (mg/l)	Min: 0.0001 ML: 0.0026 Max: 0.0085 Log Triangular	Benzene – most common BTEX assumed to be 33.75 % of Total BTEX, leachate concentration derived from WAC value using P20
Mineral Oil (Aromatic C10 – C12) (mg/l)	Min: 2.25E-5 ML: 0.208 Max: 3.42 Log Triangular	Aromatic C10-C12 – most mobile Mineral Oil, assumed to be 20% of Total Mineral Oils, leachate concentration derived from WAC value using P20

Table 3
Leachate Source Term Kappa Values and Half Lives

Item	Value/Description	Source of Data
Values of m and c used to calculate the kappa value		
Arsenic	m = 0.0415 c = -0.0862	LandSim V2.5 default
Cadmium	m = 0.0823 c = 0.1589	LandSim V2.5 default

Item	Value/Description	Source of Data
Chromium	m = 0.0514 c = 0.045	LandSim V2.5 default
Copper	m = 0.0664 c = -0.0488	LandSim V2.5 default
Mercury	m = 0.0767 c = 0.1643	LandSim V2.5 default
Nickel	m = 0.0987 c = 0.1479	LandSim V2.5 default
Lead	m = 0.0443 c = 0.0171	LandSim V2.5 default
Zinc	m = 0.0403 c = 0.0561	LandSim V2.5 default
Sulphate	m = 0.0166 c = 0.1209	LandSim V2.5 default
Phenols	m = 0.0298 c = 0.2919	Chloride values used as representative worst case
Fluoranthene	m = 0.0298 c = 0.2919	
Benzene	m = 0.0298 c = 0.2919	
Mineral Oil C10 – C12	m = 0.0298 c = 0.2919	

Table 4
Geological Barrier (silty clay)

Item	Value/Description	Source of Data
Thickness (m)	Min: 1.0 Max: 5.0 Uniform	Estimated thickness of silt based on CSM
Moisture Content (%)	Min: 0.34 Max: 0.61 Uniform	LandSim default range for silts
Hydraulic Conductivity (m/sec)	Min: 1.0E-9 Max: 2.0E-5 Log Uniform	LandSim default range for silts
Longitudinal Dispersivity	Min: 0.10 Max: 0.50 Uniform	10% of pathway length

Table 5
Retardation Values - Made Ground (Geological Barrier)

Item	Value/Description	Source of Data
Pathway Density (kg/l) – Silt Clay Made Ground	Min: 1.82 Max: 2.15 Uniform	Typical range for silts and clays from ConSim helpfile
Retardation Coefficient (Kd) – Arsenic	Min: 25 Max: 250 Uniform	LandSim Default
Retardation Coefficient (Kd) – Cadmium	Min: 1.60 ML: 40 Max: 990 Triangular	Typical range for Loam soils from ConSim helpfiles
Retardation Coefficient (Kd) – Chromium	Min: 0.091 ML: 30 Max: 999 Triangular	Typical range for Loam soils from ConSim helpfiles
Retardation Coefficient (Kd) – Copper	Min: 40 Max: 295 Uniform	Typical range (unspecified conditions) from ConSim helpfiles
Retardation Coefficient (Kd) – Lead	Min: 990 ML: 16,000 Max: 275,000 Triangular	Typical range for Loam soils from ConSim helpfiles
Retardation Coefficient (Kd) – Mercury	Min: 1500 Max: 3535.4 Uniform	Typical range for Loam soils / glacial till from ConSim helpfiles
Retardation Coefficient (Kd) – Nickel	Min: 85.7 Max: 300 Uniform	Typical range for Loam soils / glacial till from ConSim helpfiles
Retardation Coefficient (Kd) – Zinc	Min: 11 ML: 1,300 Max: 165,000 Triangular	Typical range for Loam soils from ConSim helpfiles
Retardation Coefficient (Kd) – Sulphate	0 Single	No retardation assumed as worst case
Fraction of Organic Carbon (FoC) (%) – Geological Barrier	Min: 0.0002 Max: 0.0025 Uniform	Typical range for silts from ConSim helpfile

Item	Value/Description	Source of Data
Partition to organic Carbon (KoC) - Phenol	83.18 Single	Compilation of Data for Priority Organic pollutants for Derivation of Soil Guideline Values Science report SC050021/SR7
Partition to organic Carbon (KoC) - Benzene	67.61 Single	
Partition to organic Carbon (KoC) - Fluoranthene	18,197 Single	
Partition to organic Carnon (KoC) – Aromatic C10 – C12	2510 Single	EA R&D Report P2-228

Table 6
Half Lives (Made Ground only)

Item	Value/Description	Source of Data
Half Life (Years) - Phenol	Min: 0.005 Max: 0.068 Uniform	Howard et al (1991) *Handbook of Environmental Degradation Rates*
Half Life (Years) - Benzene	Min: 0.014 Max: 0.044 Uniform	
Half Life (Years) - Fluoranthene	Min: 0.38 Max: 1.21 Uniform	
Half Life (Years) - Aromatic C10 – C12	Min: 0.30 Max: 0.90 Uniform	
All other substances	1E+009	No Half-life assumed

Table 7
Unsaturated Pathway – Unsaturated Gravels

Item	Value/Description	Source of Data
Pathway Length (m)	Min: 11.2 Max: 33.0 Uniform	Based on groundwater levels beneath base of site
Moisture Content (%)	Min: 0.24 Max: 0.38 Uniform	LandSim default range for gravels
Hydraulic Conductivity (m/sec)	Min: 1.0E-5 Max: 3.0E-2 Log Uniform	Potential range based on LandSim defaults for gravle and range for Pollardstown Fen gravels (22 – 33m/d)
Longitudinal Dispersivity	Min: 1.12 Max: 3.30 Uniform	10% of pathway length
Attenuation Parameters	See Table 8	

Table 8
Aquifer Flow – Mixing with groundwater Ingress

Item	Value/Description	Source of Data
Pathway Length (m)	Min: 20 Max: 370 Uniform	Min assumes down-gradient boreholes are compliance point Max equal to maximum pathway length beneath base of quarry
Pathway Width (m)	140 Single Value	Estimated width of quarry perpendicular to groundwater flow
Mixing Zone Thickness (m)	10 Single Value	Assumed minimum thickness of gravel aquifer beneath the site
Hydraulic Conductivity (m/sec)	Min: 1.0E-5 Max: 3.0E-2 Log Uniform	Based on nearby Pollardstown Fen sands and gravels (22 – 33m/d) but range extended with reference to LandSim defaults for sands and gravels
Regional Gradient	0.026 Single	Based on groundwater monitoring data
Porosity (fraction)	Min: 0.24 Max: 0.38 Uniform	LandSim default range for gravels

Item	Value/Description	Source of Data
Density (kg/l)	Min: 1.6 Max: 1.8 Uniform	Typical range for sand and gravels
Fraction of organic Carbon (fraction)	Min: 0.0001 Max: 0.001 Uniform	Typical range for sands from ConSim helpfiles
Longitudinal Dispersivity (m)	Min: 2 Max: 37 Uniform	10% of pathway length
Transverse Dispersivity (m)	Min: 0.6 Max: 11.1 Uniform	3% of pathway length
Retardation Coefficient (Unsaturated Pathway only)		
Retardation Coefficient (Kd) – Arsenic	Min: 25 Max: 250 Uniform	LandSim Default
Retardation Coefficient (Kd) – Cadmium	Min: 3.7 ML: 74 Max: 1500 Triangular	Typical range for sands from ConSim helpfiles
Retardation Coefficient (Kd) – Mercury	450 ± 45 Normal	Typical range for sands from ConSim helpfiles
Retardation Coefficient (Kd) – Lead	Min: 27 ML: 270 Max: 2,700 Log Triangular	Typical range for sands from ConSim helpfiles
Retardation Coefficient (Unsaturated Pathway & Aquifer Pathway)		
Retardation Coefficient (Kd) – Chromium	Min: 1.0 ML: 67 Max: 4400 Triangular	Typical range for sands from ConSim helpfiles
Retardation Coefficient (Kd) – Copper	Min: 40 Max: 30,000 Uniform	LandSim default

Item	Value/Description	Source of Data
Retardation Coefficient (Kd) – Nickel	Min: 20 ML: 400 Max: 8100 Triangular	Typical range for sands from ConSim helpfiles
Retardation Coefficient (Kd) – Zinc	Min: 1.10 ML: 200 Max: 3600 Triangular	Typical range for sands from ConSim helpfiles
Retardation Coefficient (Kd) – Sulphate	0 Single	No retardation assumed
Organic Substances	0 Single	No retardation assumed as worst case

Table 9
Background Groundwater Quality (mg/l)

Item	Value/Description	Source of Data
Arsenic (mg/l)	Min: 0.000025 ML: 0.00041 Max: 0.00122 Log Triangular	Based on combined background groundwater quality (BH03, BH05A and BH08)
Chromium (mg/l)	Min: 0.0005 ML: 0.00108 Max: 0.00336 Log Triangular	
Copper (mg/l)	Min: 0.000015 ML: 0.00022 Max: 0.00153 Log Triangular	
Lead (mg/l)	Min: 0.00001 ML: 0.00009 Max: 0.000216* Log Triangular	
Nickel (mg/l)	Min: 0.00002 ML: 0.00077 Max: 0.00242 Log Triangular	

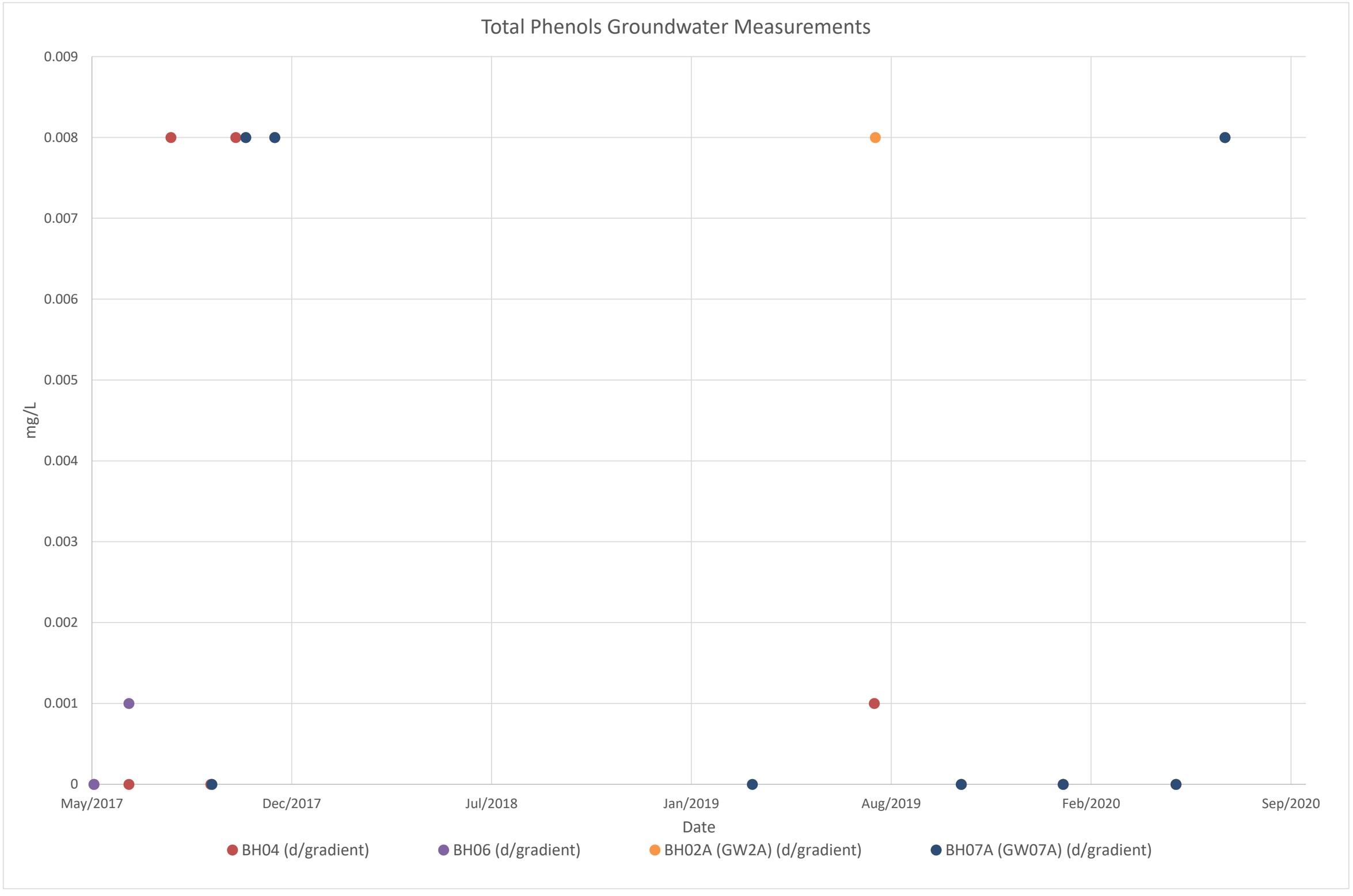
Item	Value/Description	Source of Data
Zinc (mg/l)	Min: 0.0005 ML: 0.00292 Max: 0.00839* Log Triangular	
Sulphate (mg/l)	Min: 17.1 ML: 42.53 Max: 85.7* Log Triangular	
Cadmium, mercury, phenol, fluoranthene, benzene and mineral Oil C10-C12	Not detected in background groundwater	
* Excluding one off outliers		

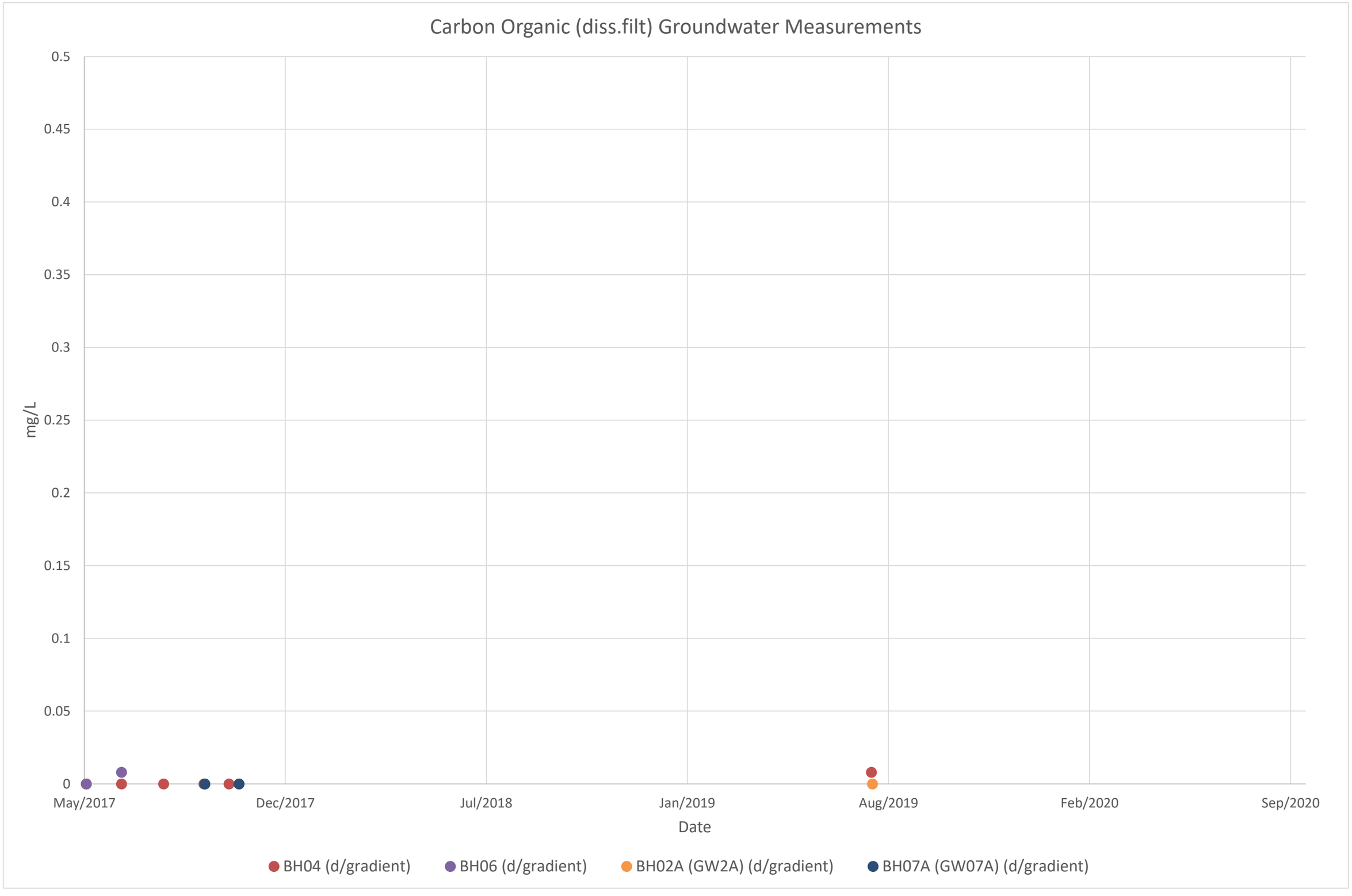
APPENDIX 08

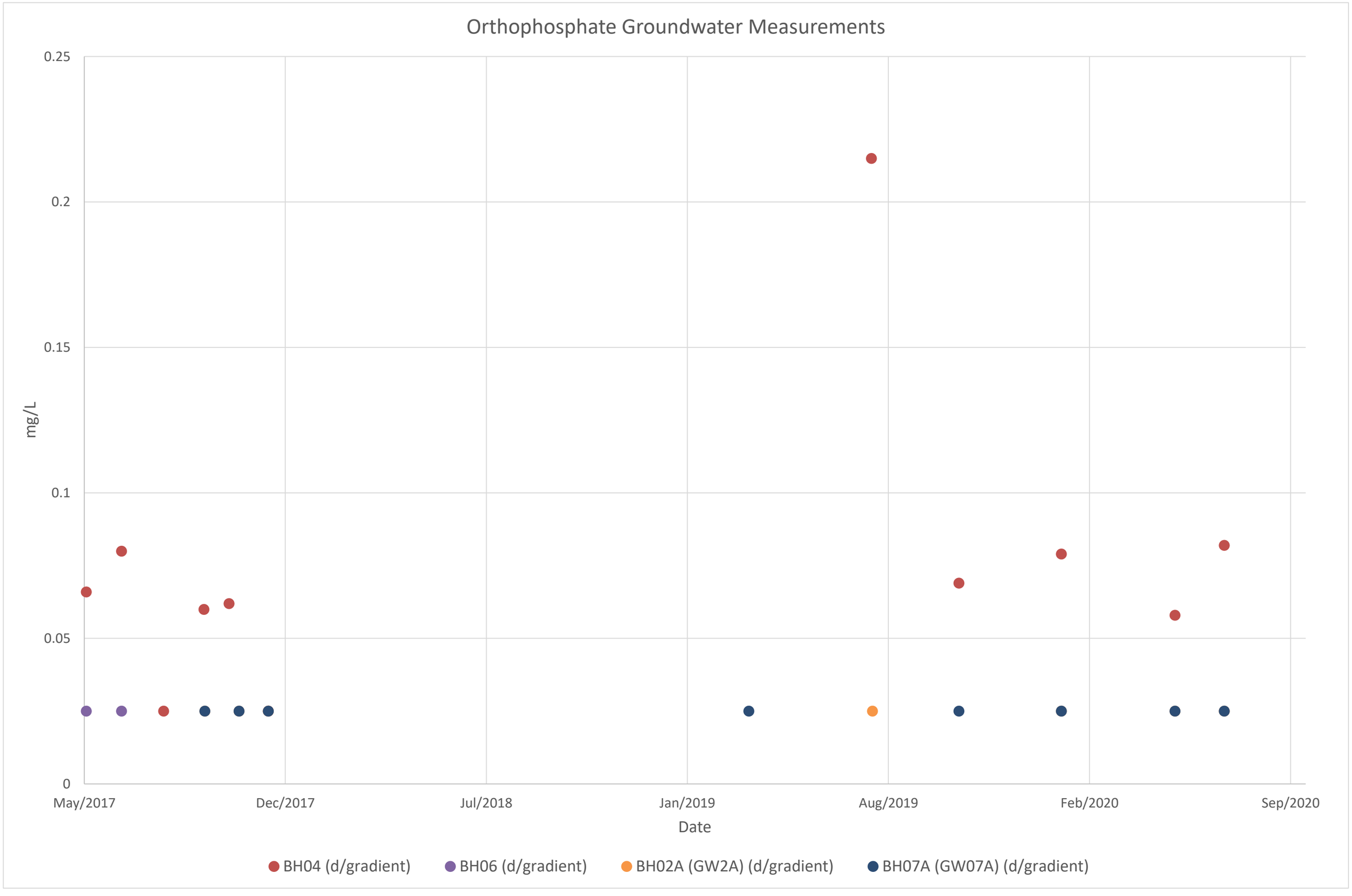
Electronic Copy of LandSim Modelling Files

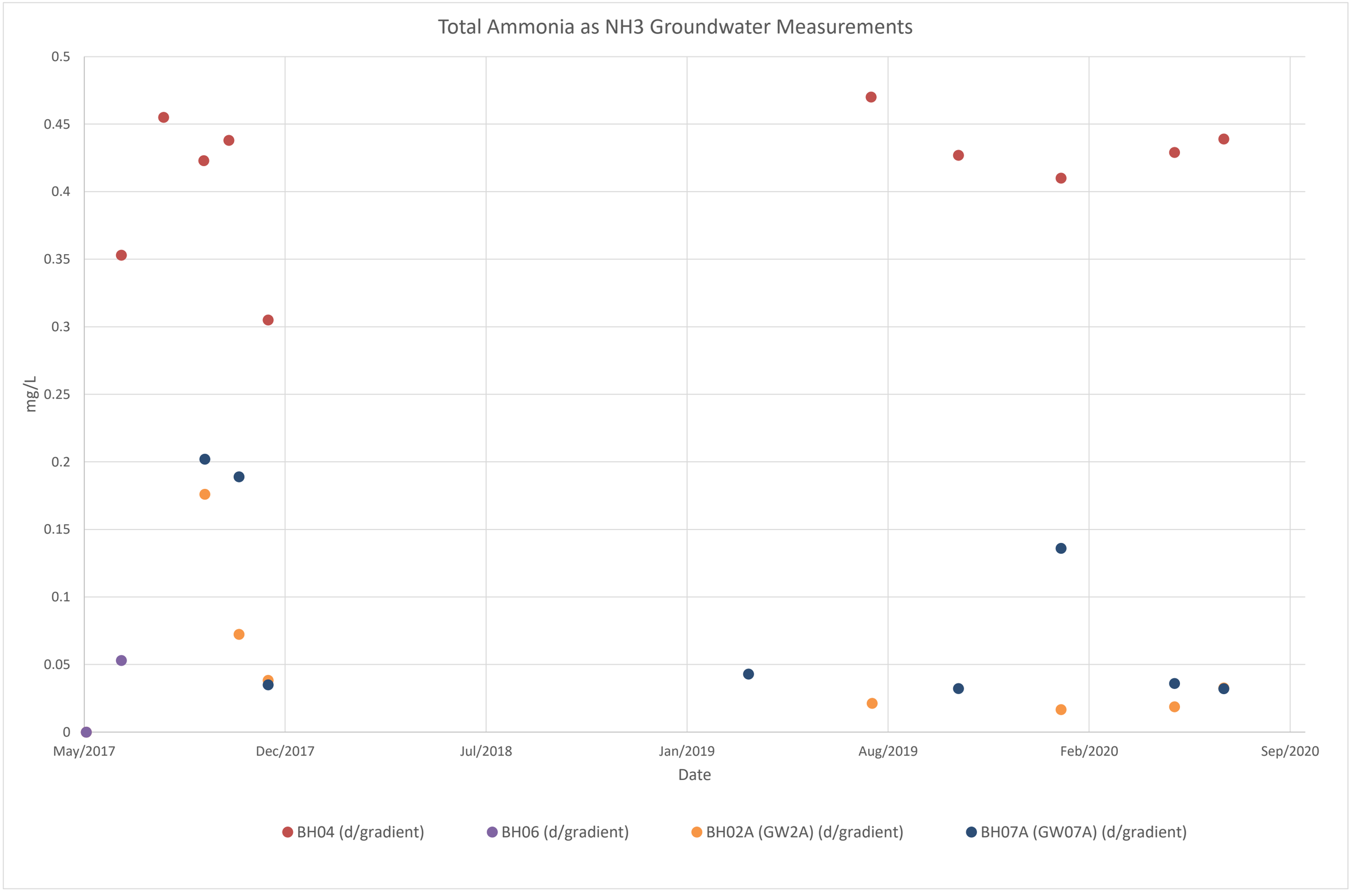
APPENDIX 09

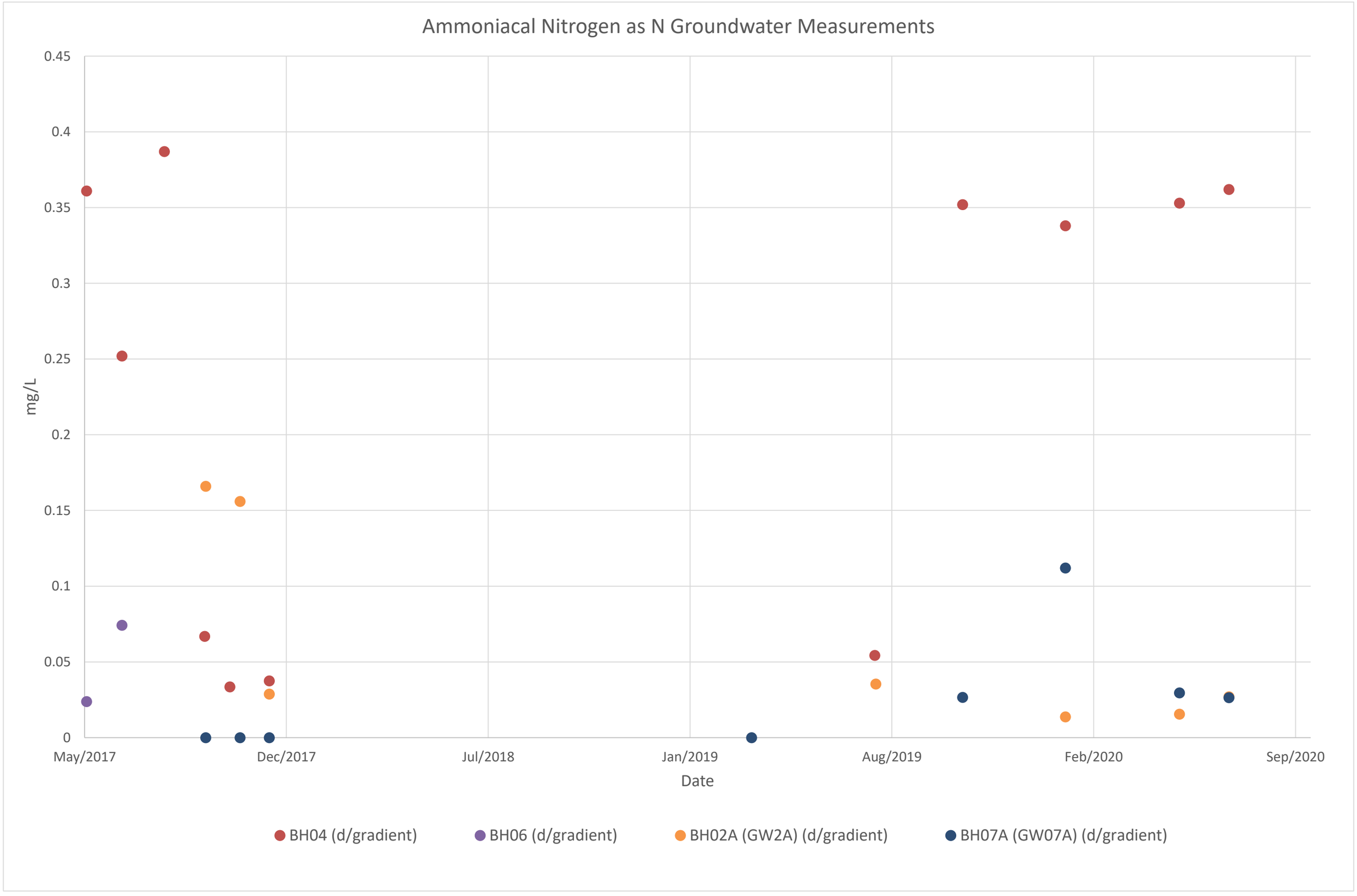
Down-Gradient Groundwater Quality

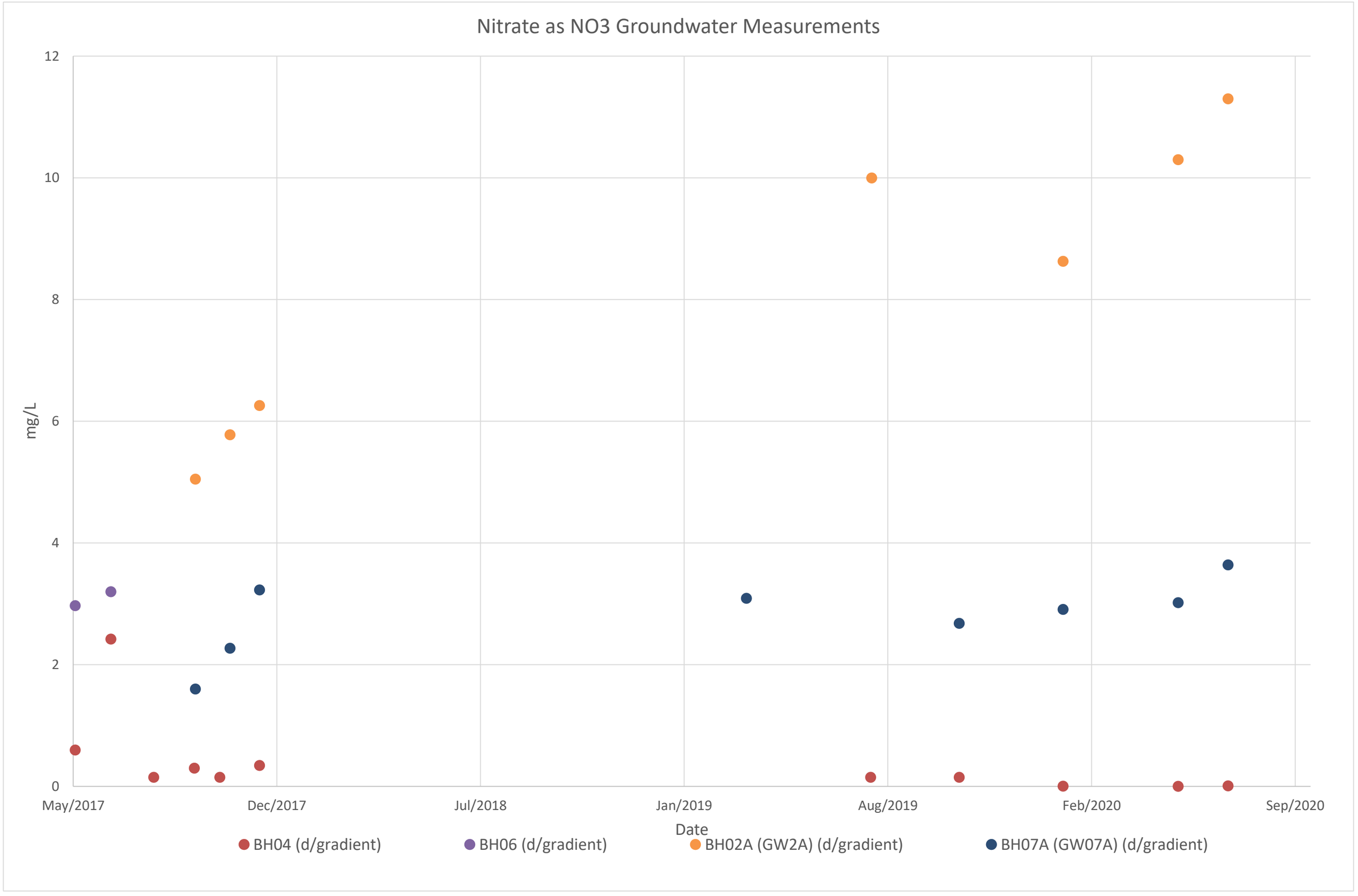

Total Phenols Groundwater Measurements
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH04 (d/gradient)
BH06 (d/gradient)
BH02A (GW2A) (d/gradient)
BH07A (GW07A) (d/gradient)

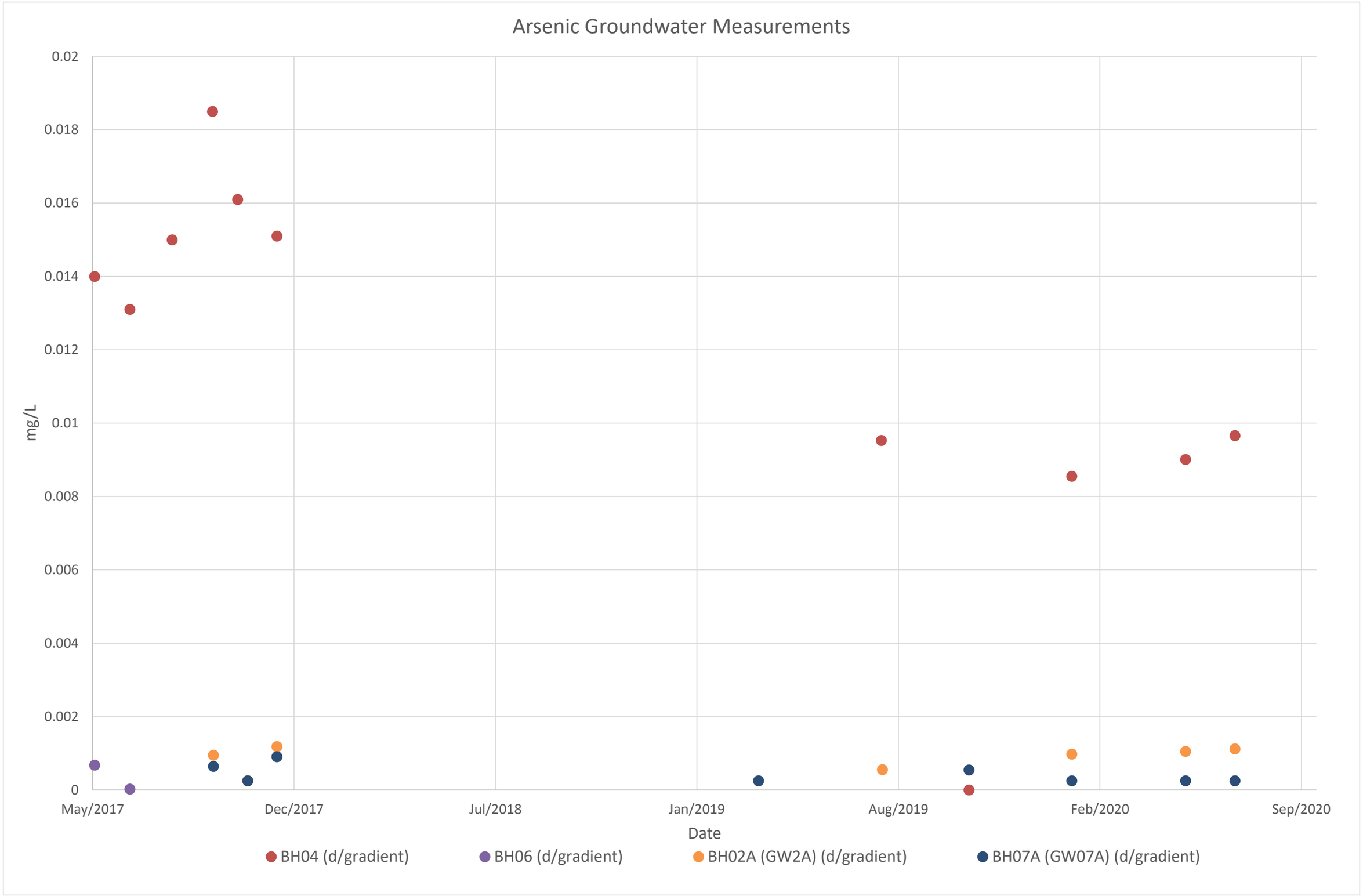

Carbon Organic (diss.filt) Groundwater Measurements
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH04 (d/gradient)
BH06 (d/gradient)
BH02A (GW2A) (d/gradient)
BH07A (GW07A) (d/gradient)

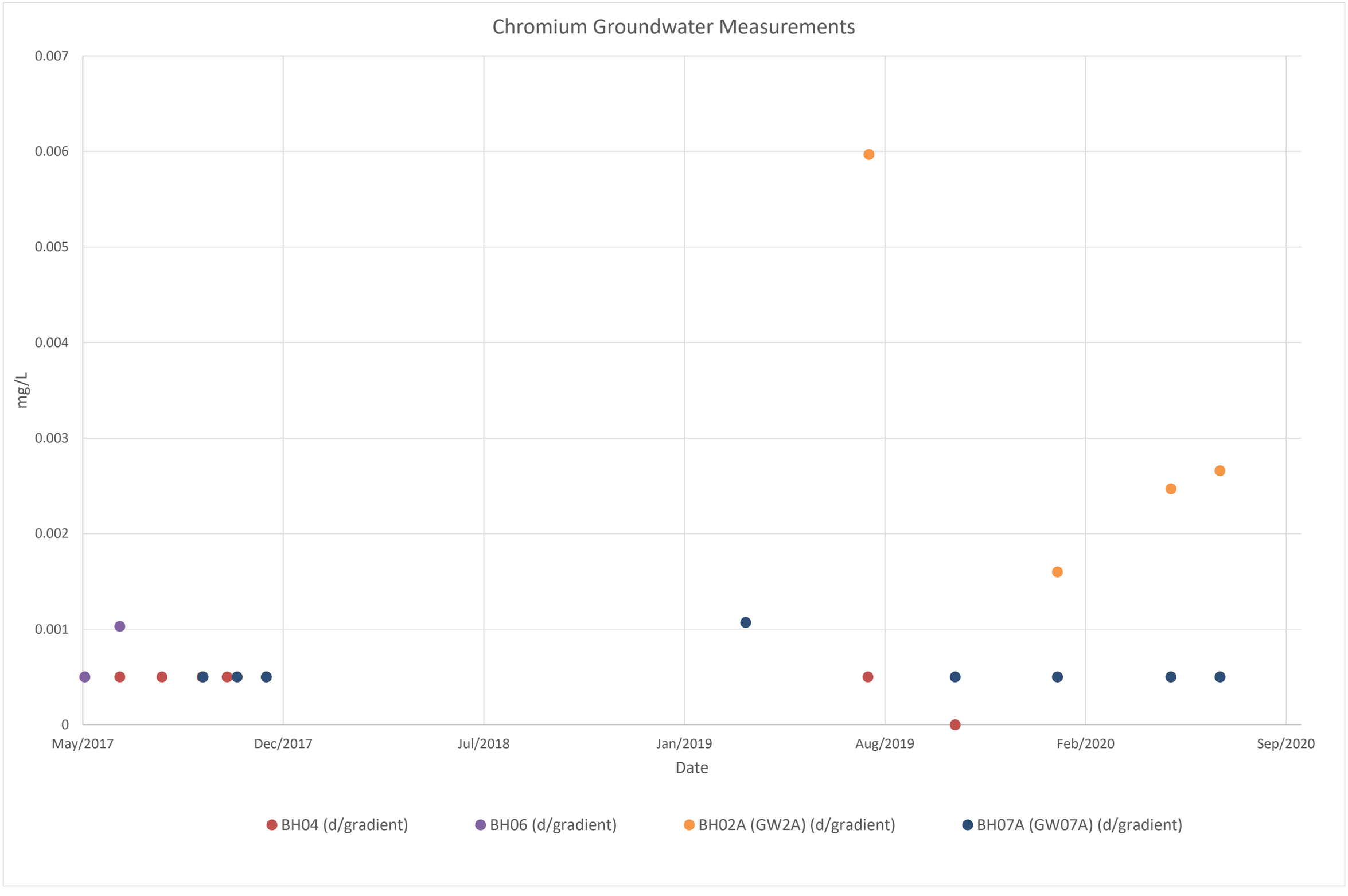

Orthophosphate Groundwater Measurements
0.25
0.2
0.15
0.1
0.05
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH04 (d/gradient)
BH06 (d/gradient)
BH02A (GW2A) (d/gradient)
BH07A (GW07A) (d/gradient)

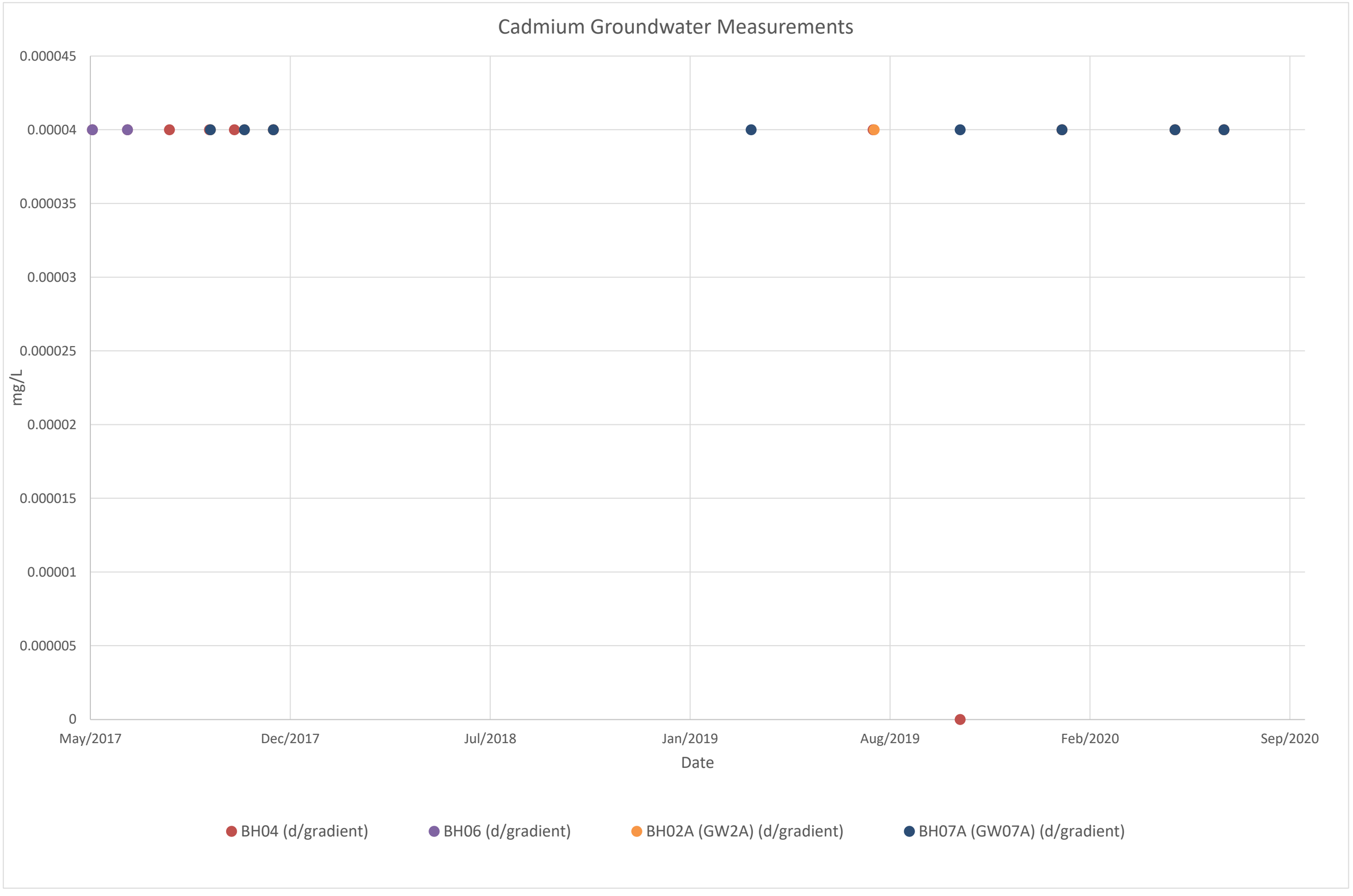

Total Ammonia as NH3 Groundwater Measurements
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH04 (d/gradient)
BH06 (d/gradient)
BH02A (GW2A) (d/gradient)
BH07A (GW07A) (d/gradient)

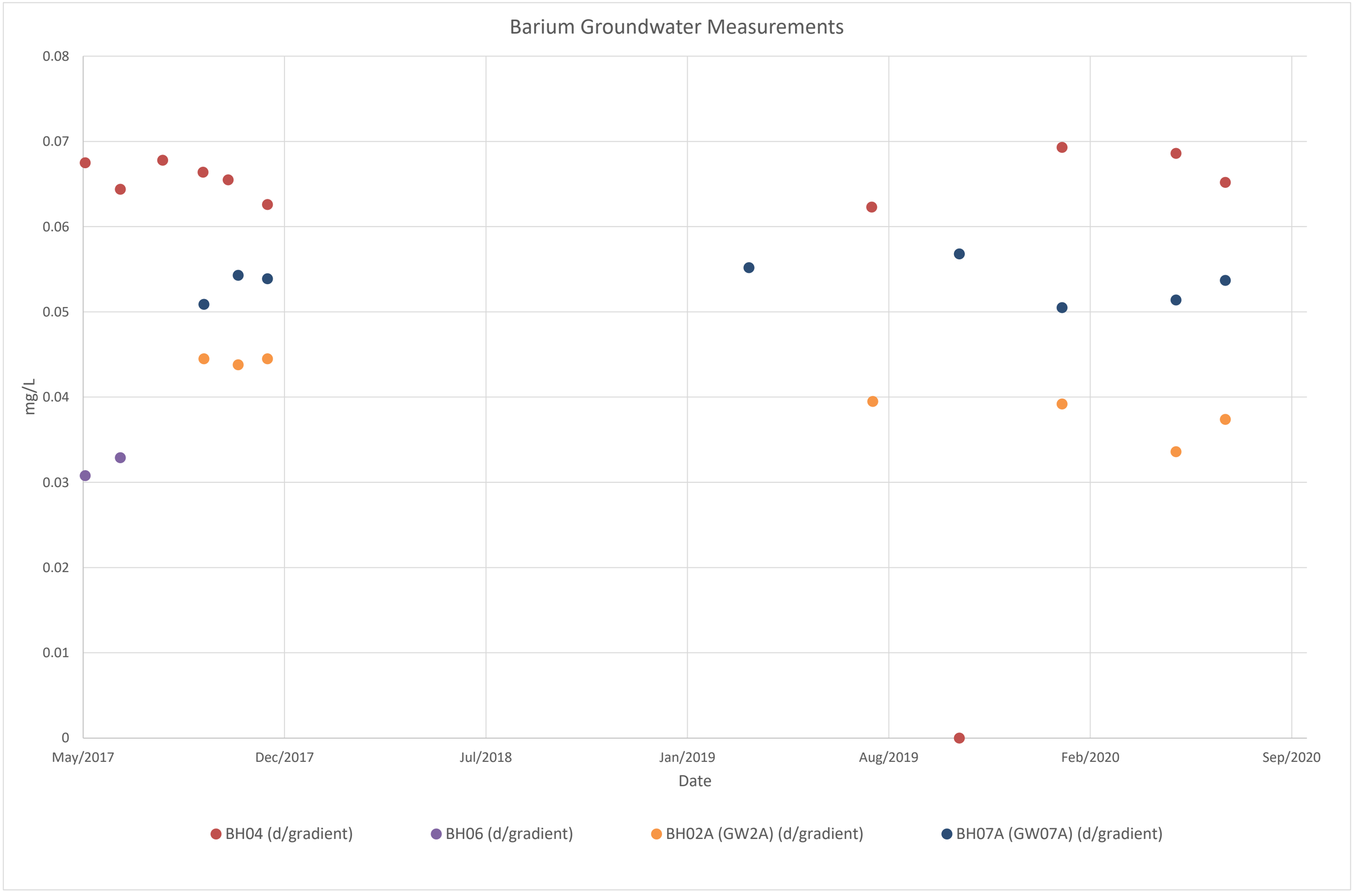

Ammoniacal Nitrogen as N Groundwater Measurements
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH04 (d/gradient)
BH06 (d/gradient)
BH02A (GW2A) (d/gradient)
BH07A (GW07A) (d/gradient)

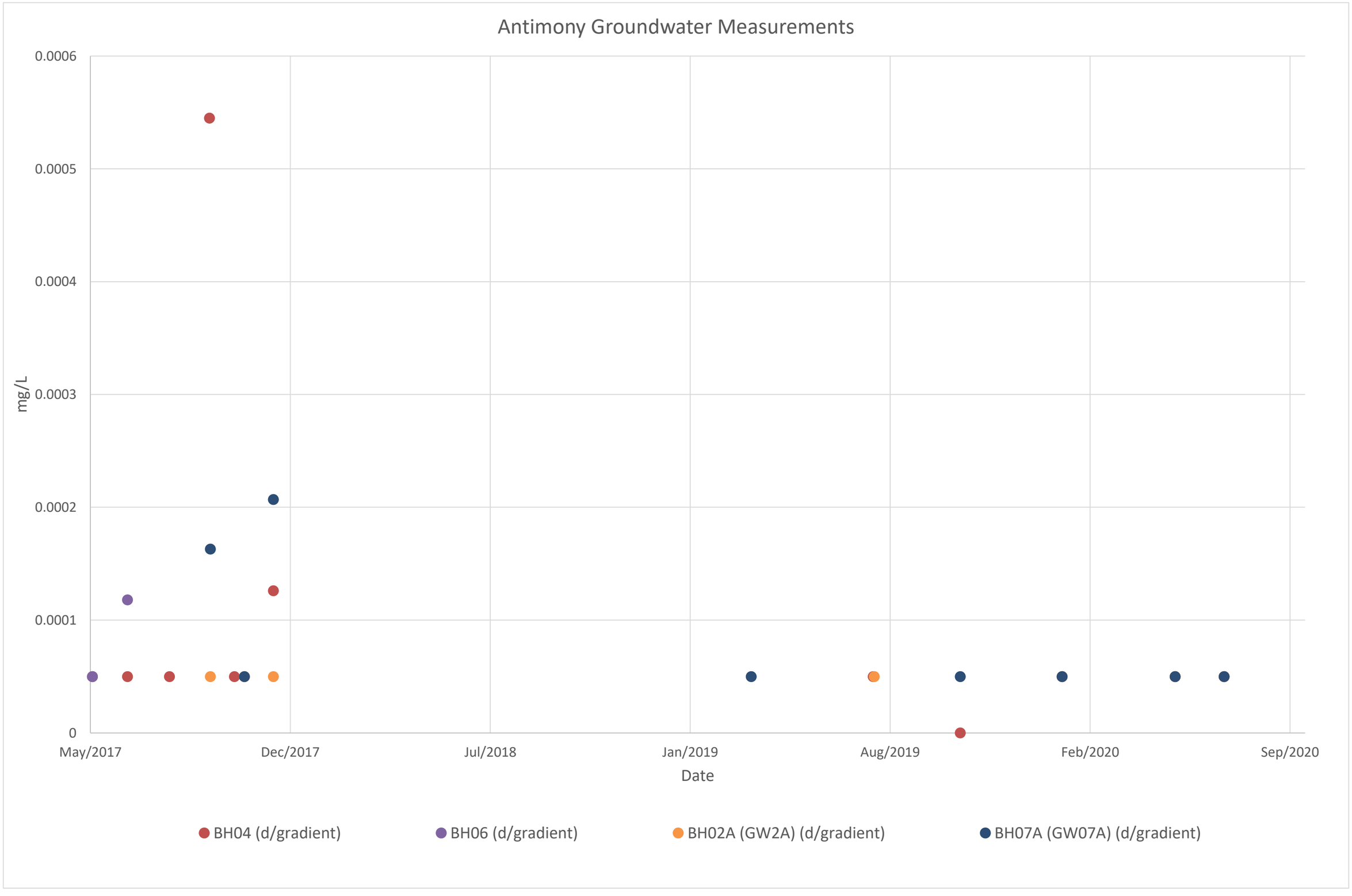

Nitrate as NO3 Groundwater Measurements
12
10
8
6
4
2
0
mg/l
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH04 (d/gradient)
BH06 (d/gradient)
BH02A (GW2A) (d/gradient)
BH07A (GW07A) (d/gradient)

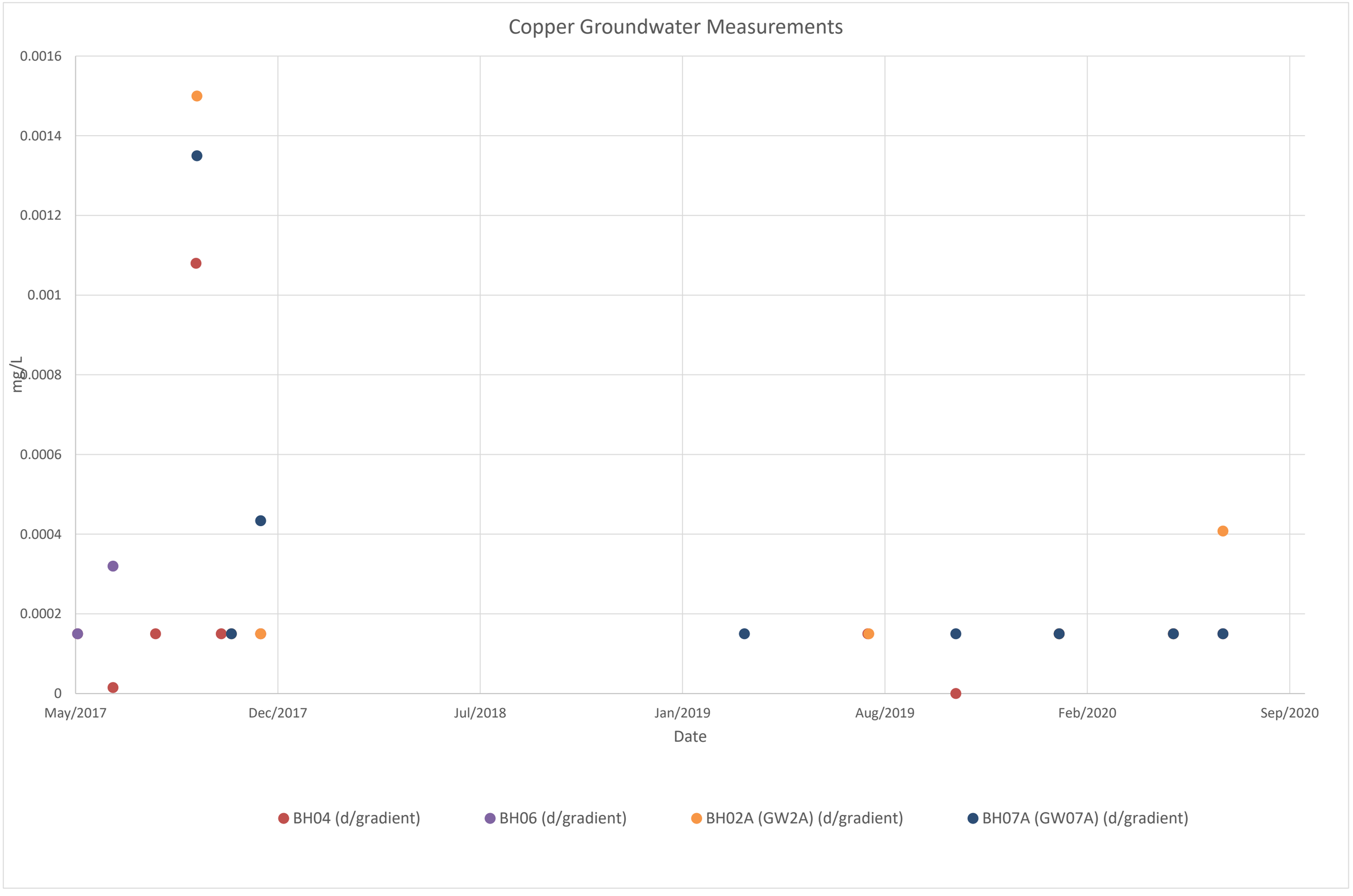

Arsenic Groundwater Measurements
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH04 (d/gradient)
BH06 (d/gradient)
BH02A (GW2A) (d/gradient)
BH07A (GW07A) (d/gradient)


Chromium Groundwater Measurements
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH04 (d/gradient)
BH06 (d/gradient)
BH02A (GW2A) (d/gradient)
BH07A (GW07A) (d/gradient)

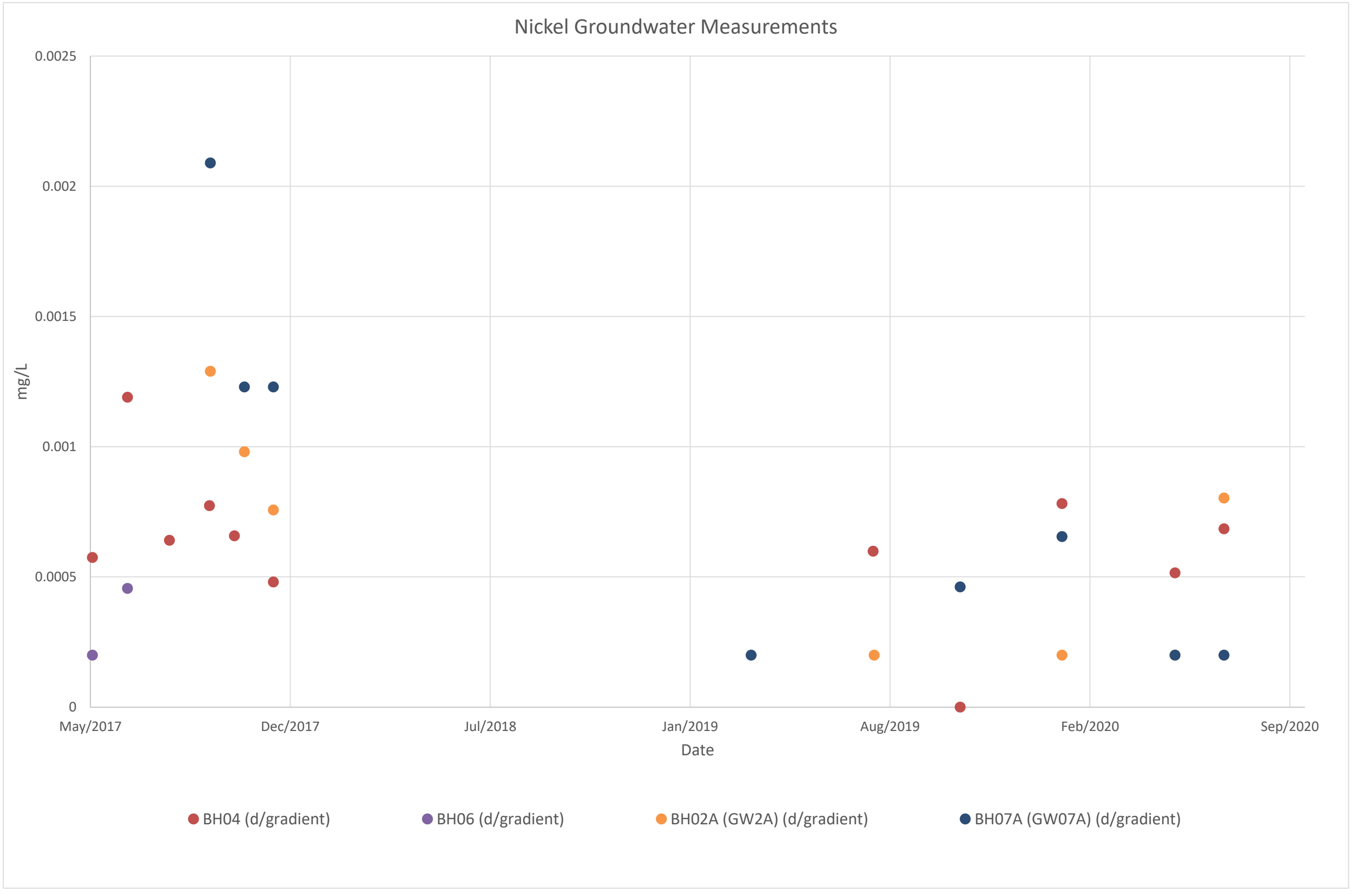

Cadmium Groundwater Measurements
0.000045
0.00004
0.000035
0.00003
0.000025
0.00002
0.000015
0.00001
0.000005
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH04 (d/gradient)
BH06 (d/gradient)
BH02A (GW2A) (d/gradient)
BH07A (GW07A) (d/gradient)

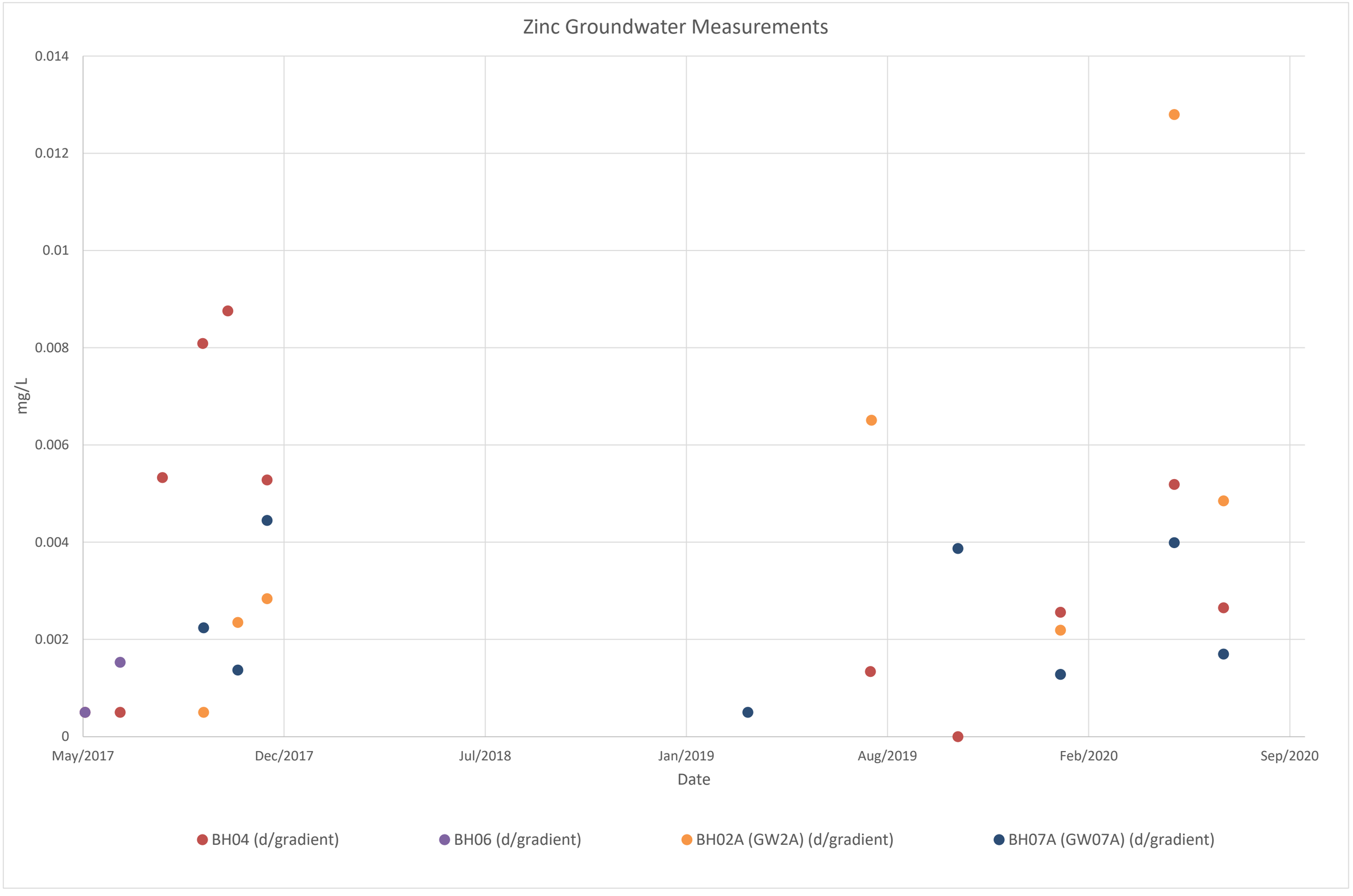

Barium Groundwater Measurements
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH04 (d/gradient)
BH06 (d/gradient)
BH02A (GW2A) (d/gradient)
BH07A (GW07A) (d/gradient)

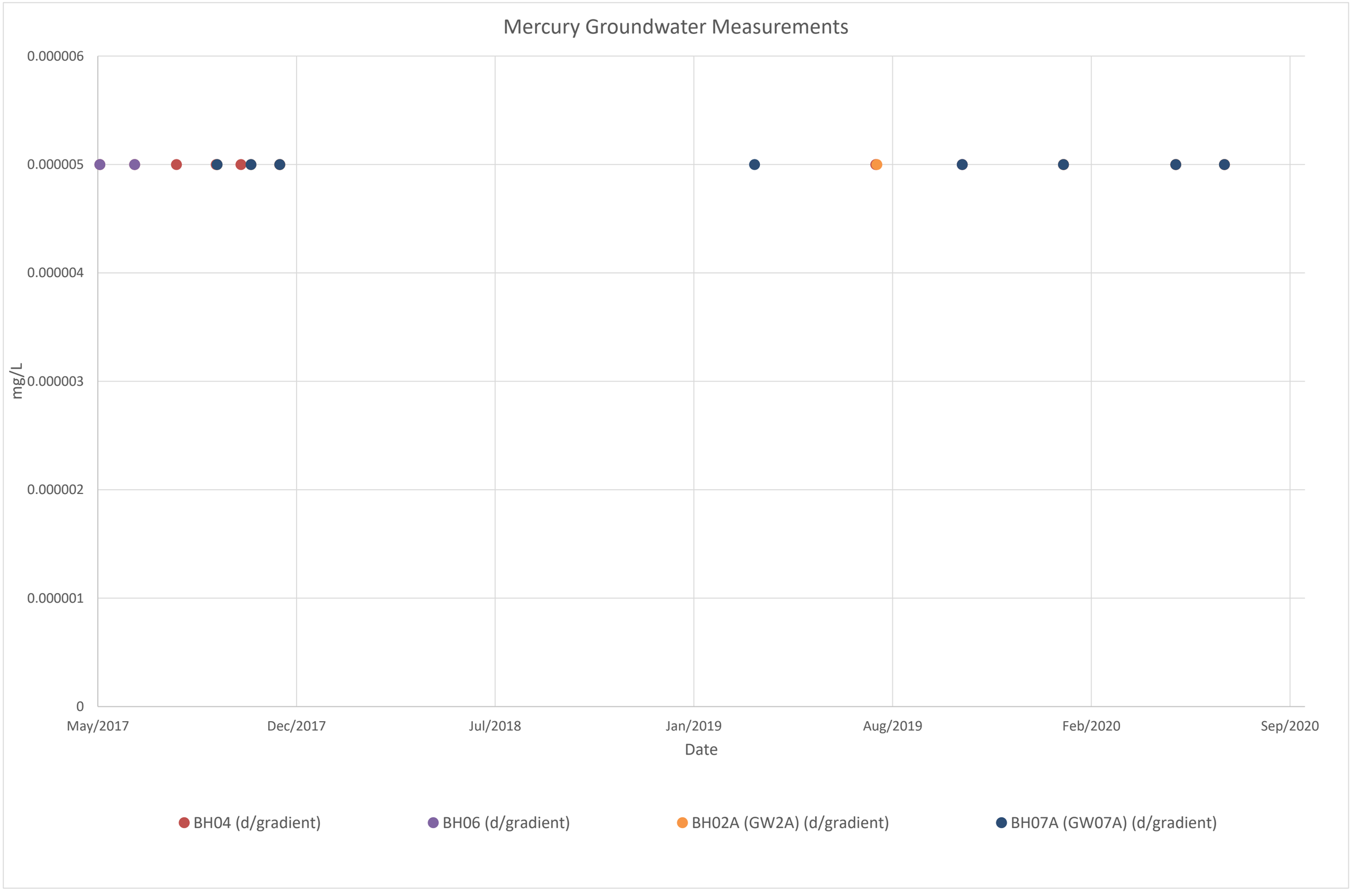

Antimony Groundwater Measurements
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH04 (d/gradient)
BH06 (d/gradient)
BH02A (GW2A) (d/gradient)
BH07A (GW07A) (d/gradient)

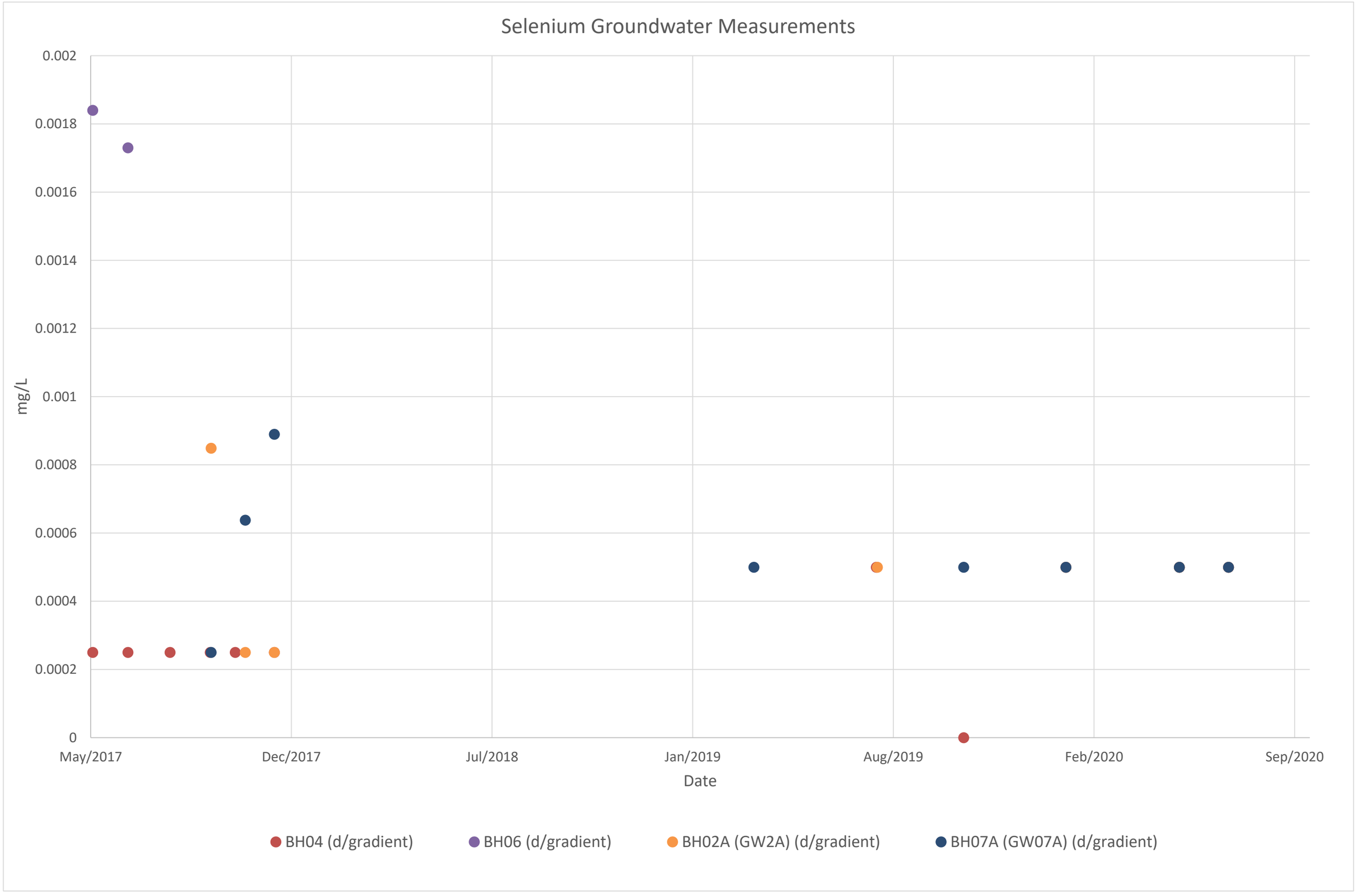

Copper Groundwater Measurements
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH04 (d/gradient)
BH06 (d/gradient)
BH02A (GW2A) (d/gradient)
BH07A (GW07A) (d/gradient)

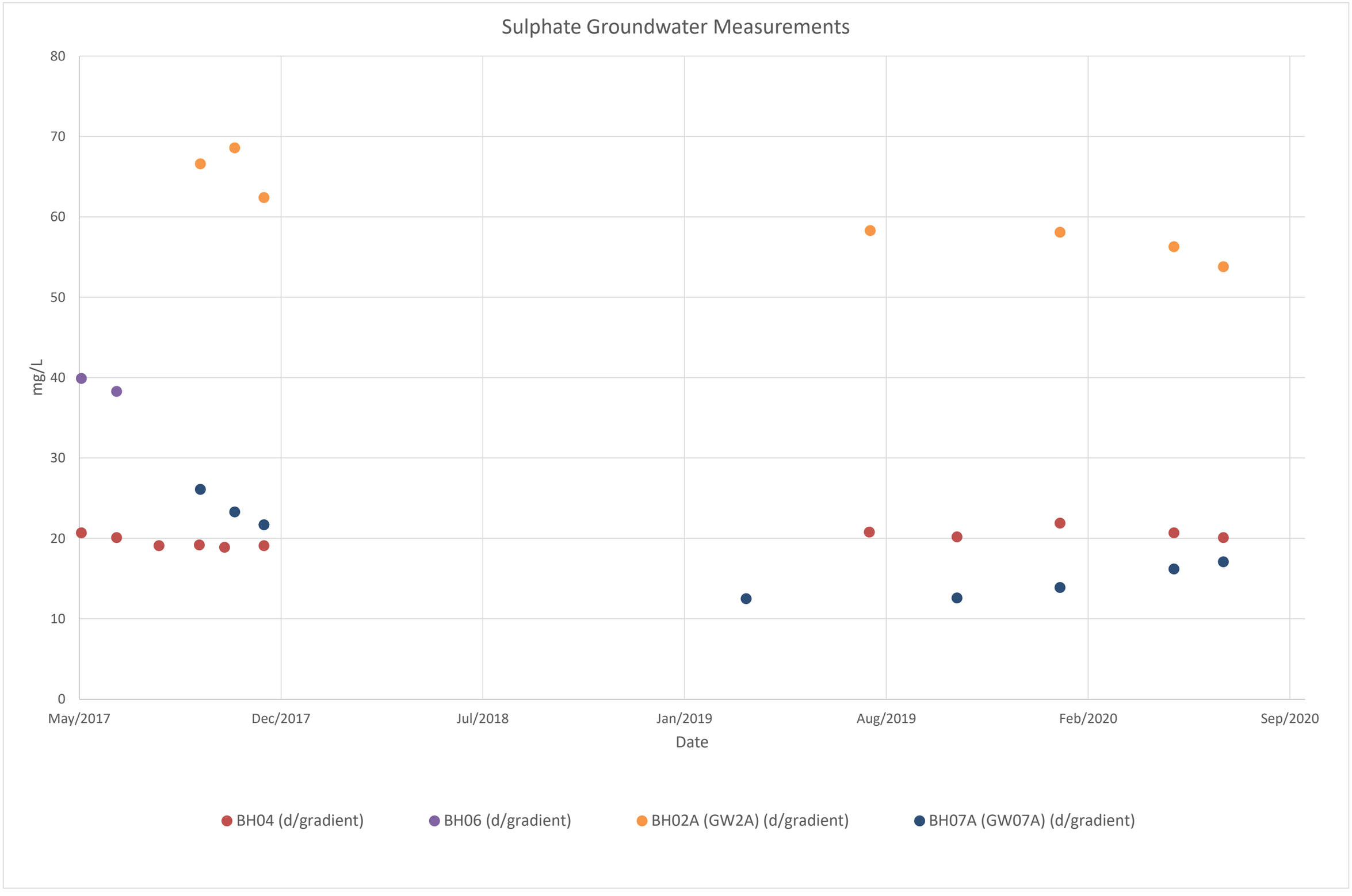

Lead Groundwater Measurements
0.0005
0.00045
0.0004
0.00035
0.0003
0.00025
0.0002
0.00015
0.0001
0.00005
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH04 (d/gradient)
BH06 (d/gradient)
BH02A (GW2A) (d/gradient)
BH07A (GW07A) (d/gradient)

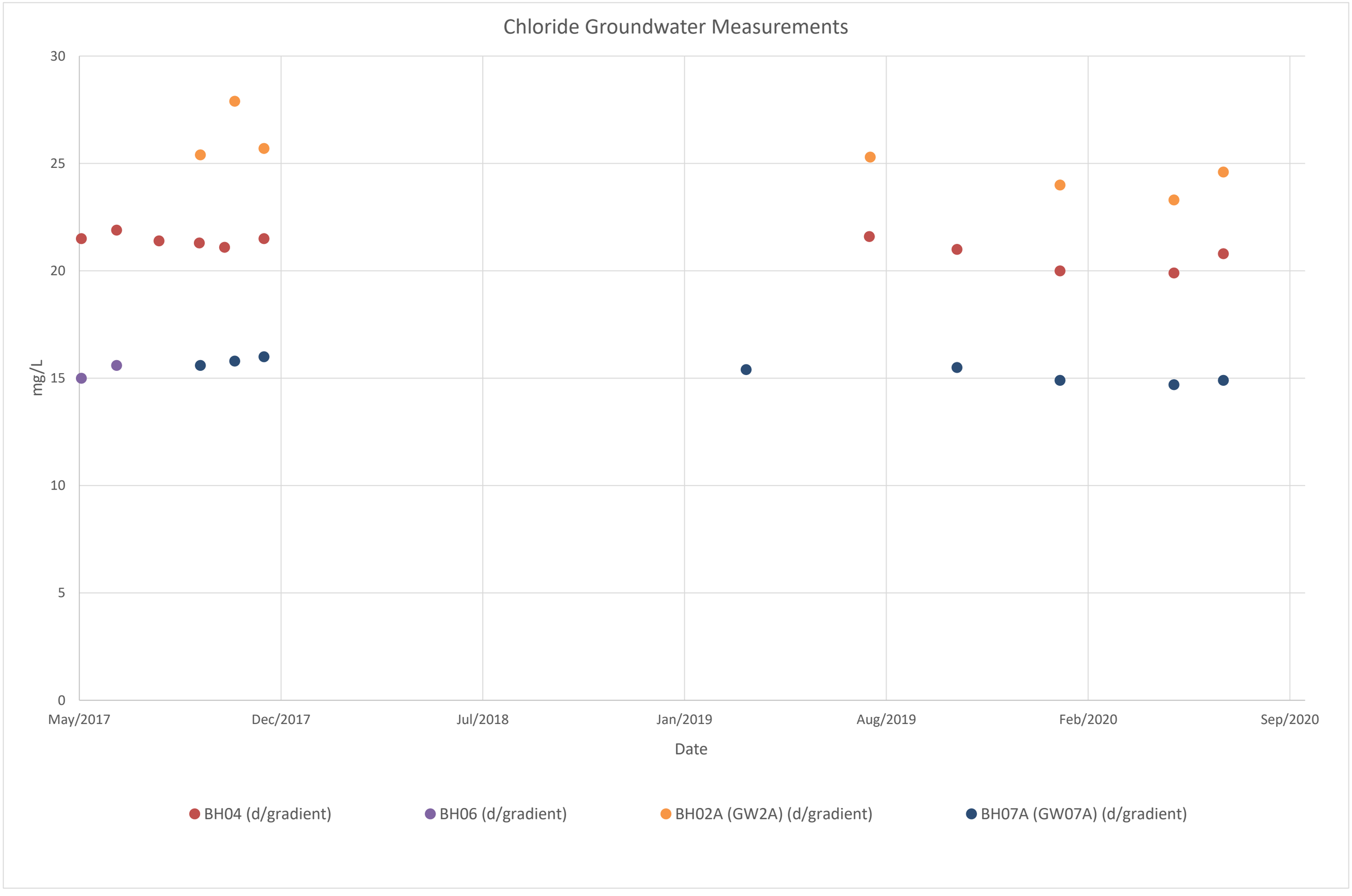

Nickel Groundwater Measurements
0.0025
0.002
0.0015
0.001
0.0005
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH04 (d/gradient)
BH06 (d/gradient)
BH02A (GW2A) (d/gradient)
BH07A (GW07A) (d/gradient)

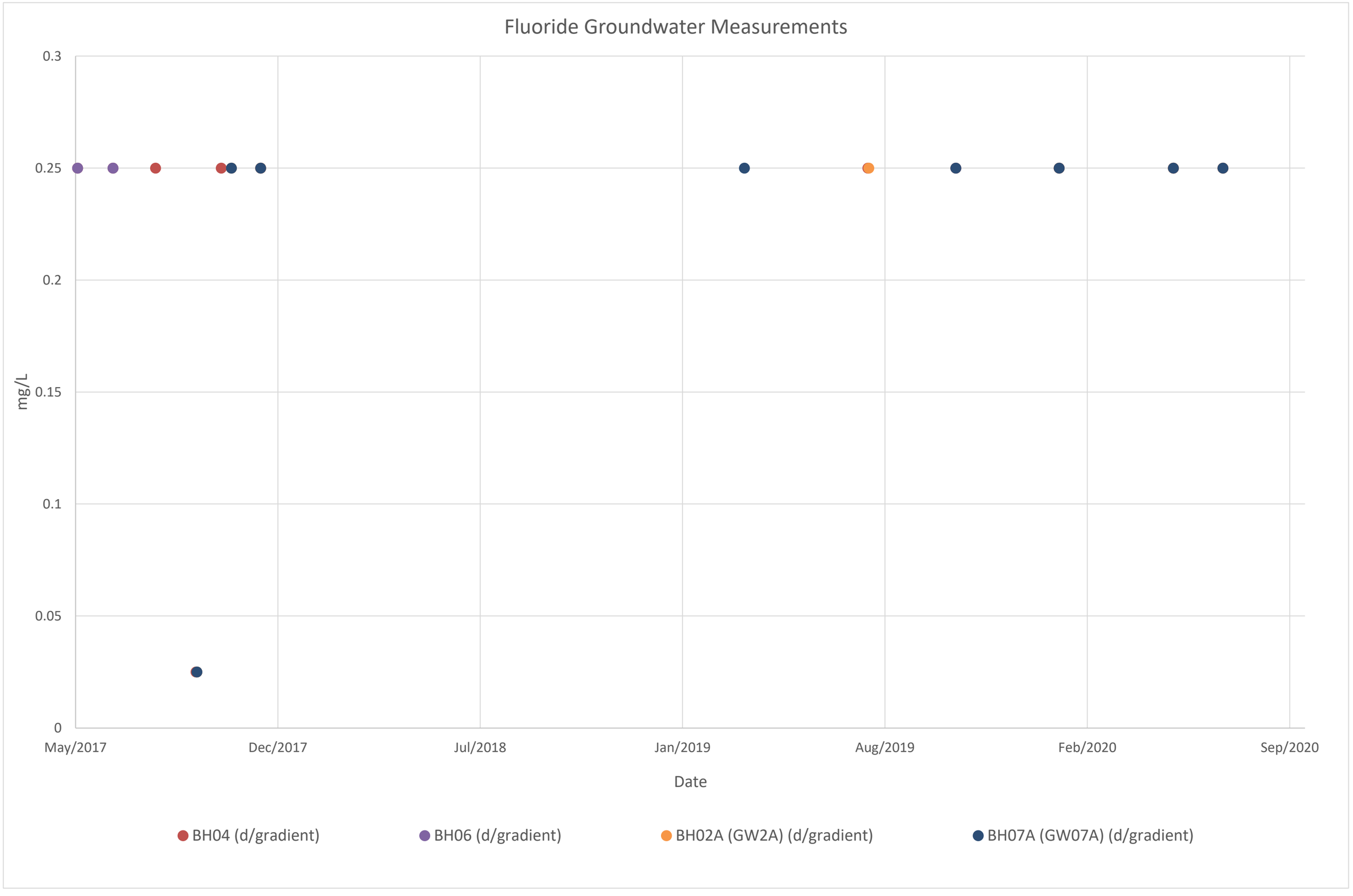

Zinc Groundwater Measurements
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH04 (d/gradient)
BH06 (d/gradient)
BH02A (GW2A) (d/gradient)
BH07A (GW07A) (d/gradient)

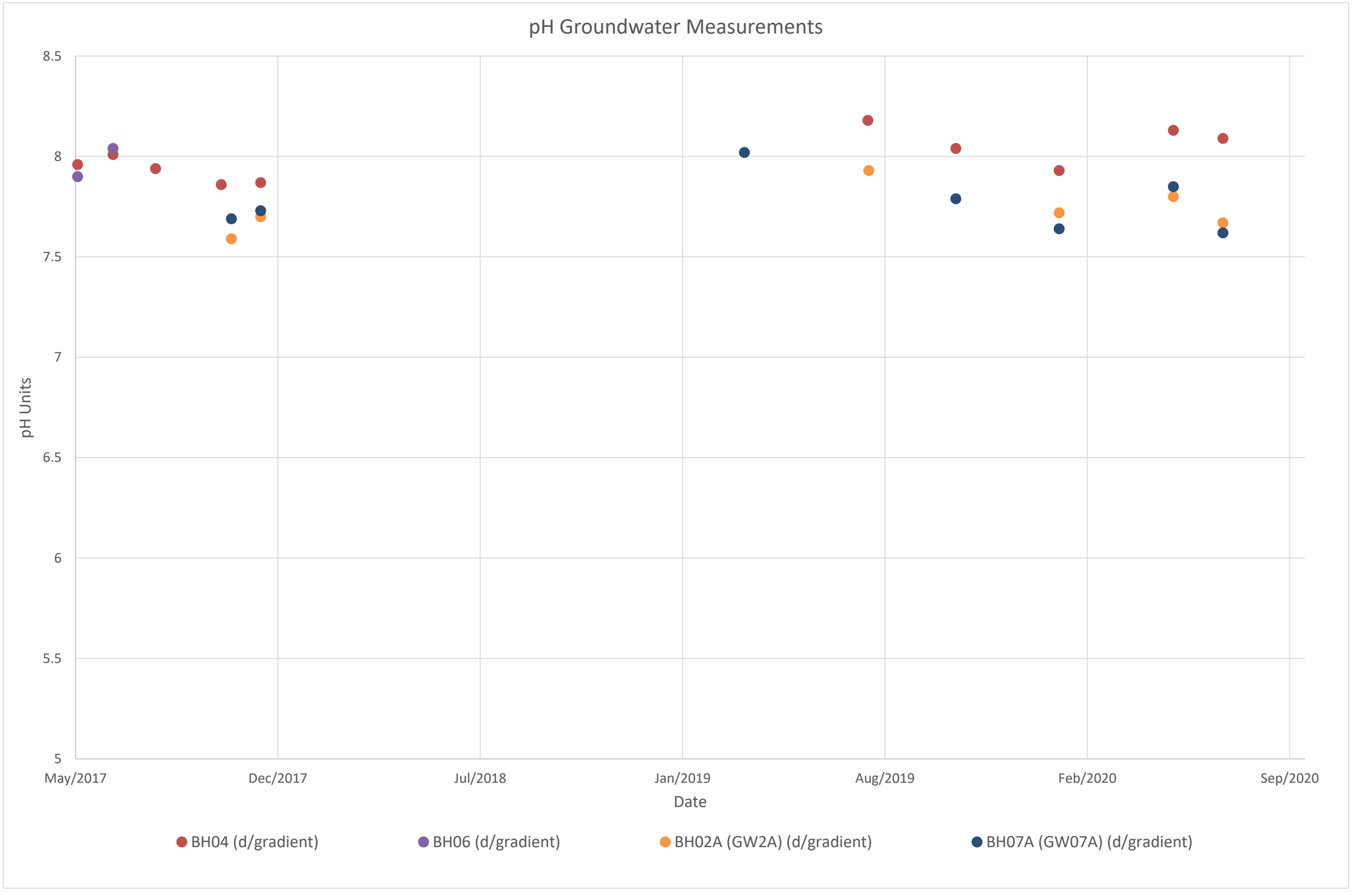

Mercury Groundwater Measurements
0.000006
0.000005
0.000004
0.000003
0.000002
0.000001
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH04 (d/gradient)
BH06 (d/gradient)
BH02A (GW2A) (d/gradient)
BH07A (GW07A) (d/gradient)

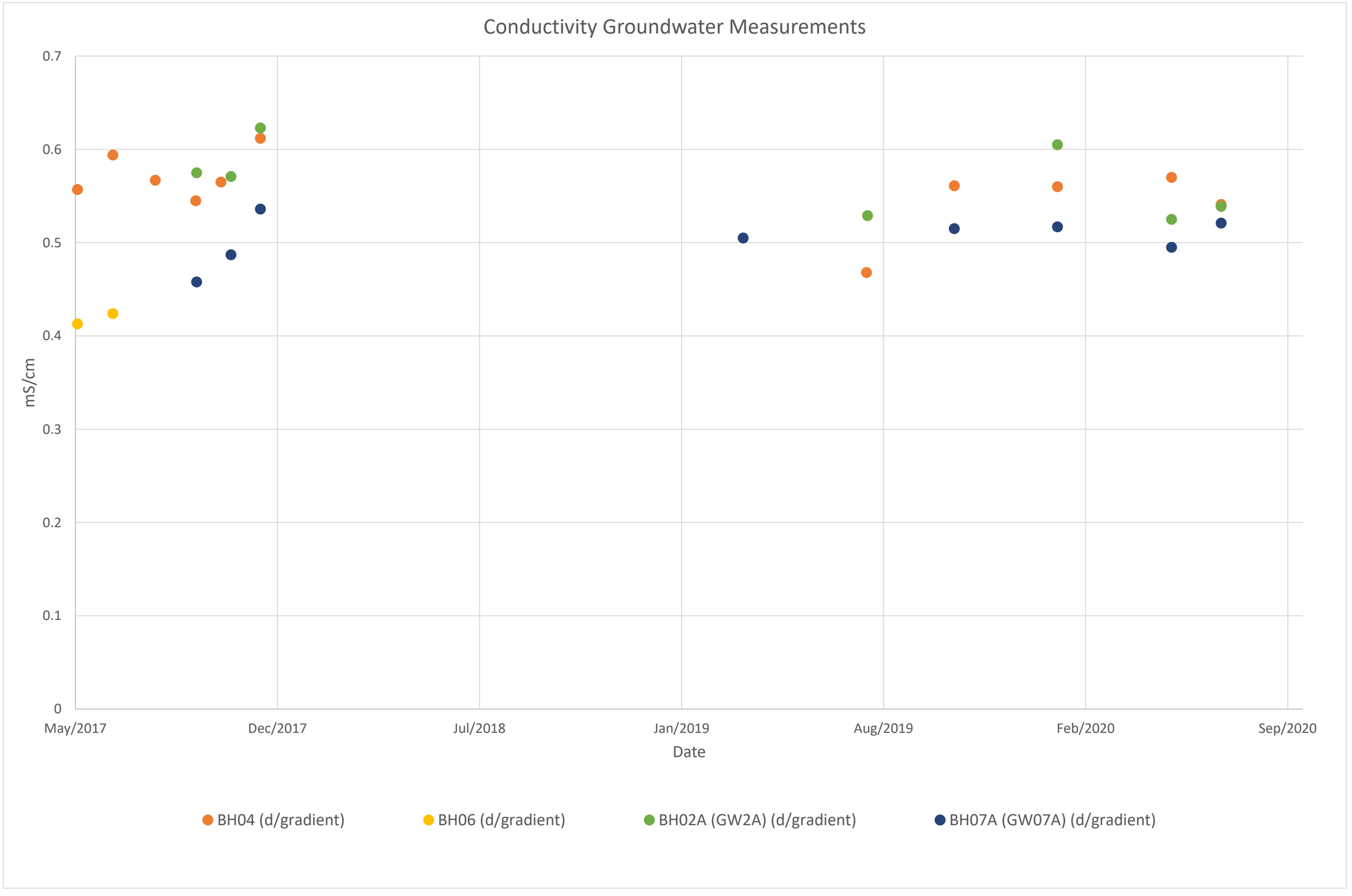

Selenium Groundwater Measurements
0.002
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH04 (d/gradient)
BH06 (d/gradient)
BH02A (GW2A) (d/gradient)
BH07A (GW07A) (d/gradient)

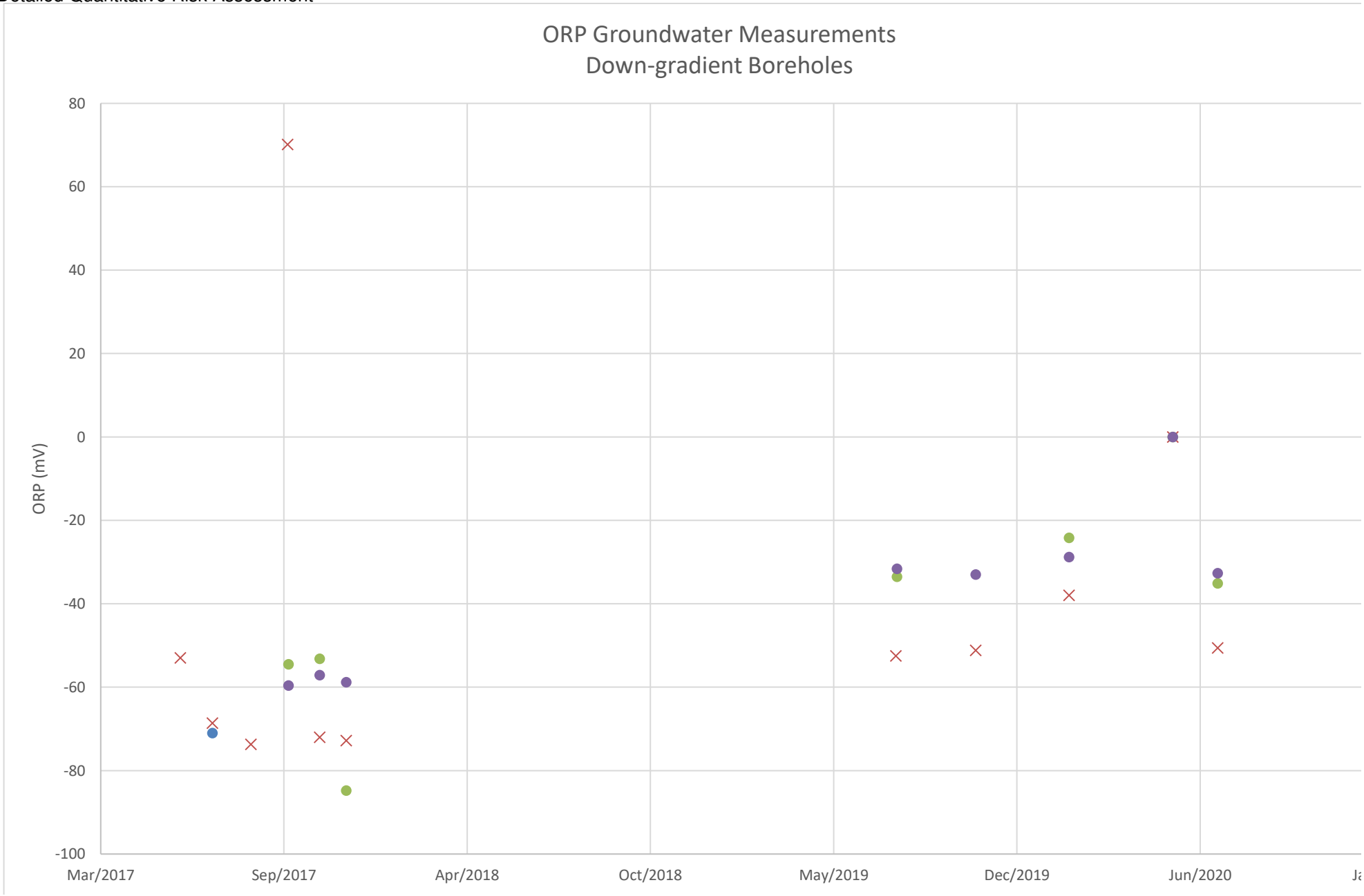

Sulphate Groundwater Measurements
80
70
60
50
40
30
20
10
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH04 (d/gradient)
BH06 (d/gradient)
BH02A (GW2A) (d/gradient)
BH07A (GW07A) (d/gradient)

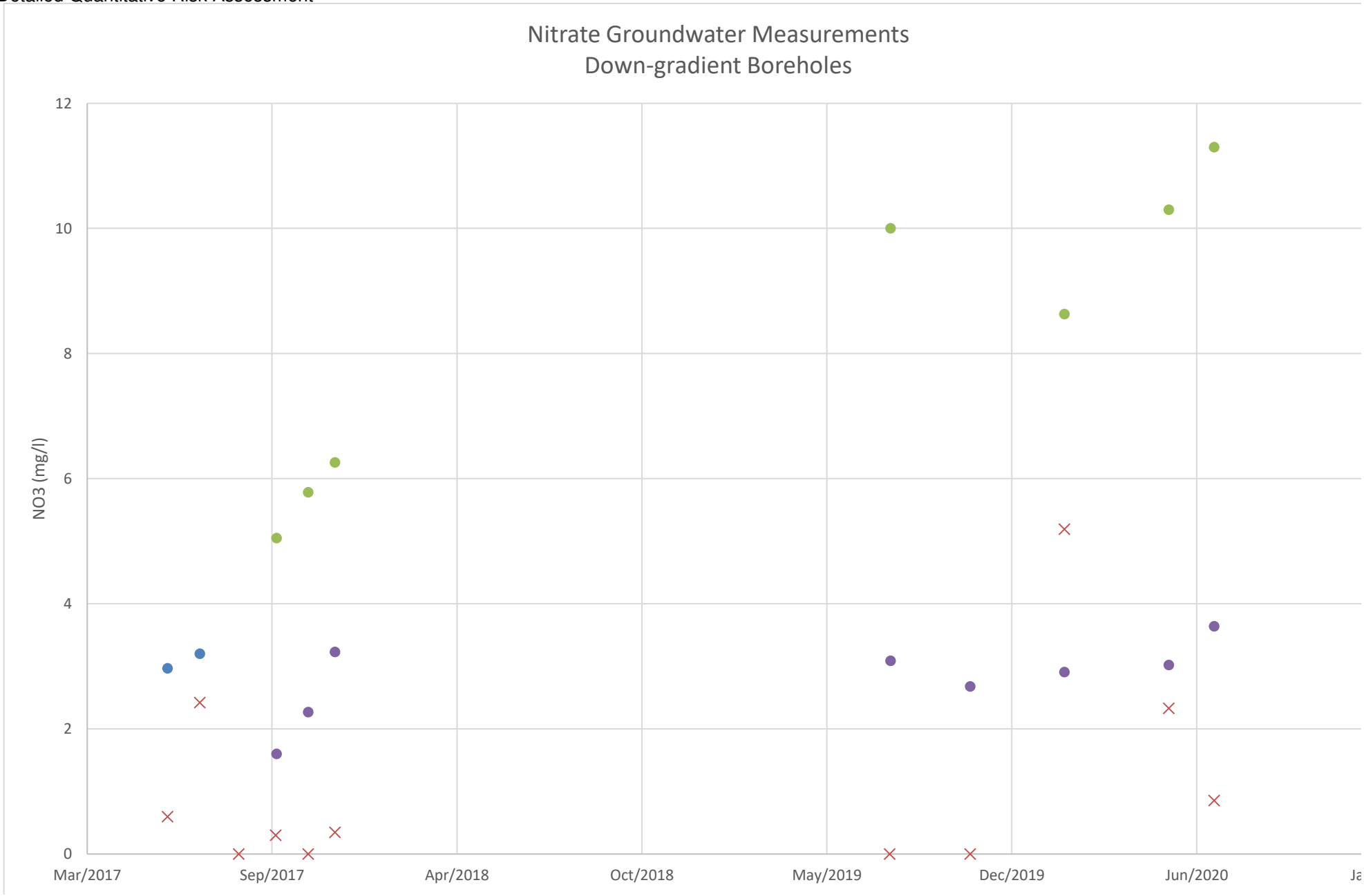

Chloride Groundwater Measurements
30
25
20
15
10
5
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH04 (d/gradient)
BH06 (d/gradient)
BH02A (GW2A) (d/gradient)
BH07A (GW07A) (d/gradient)

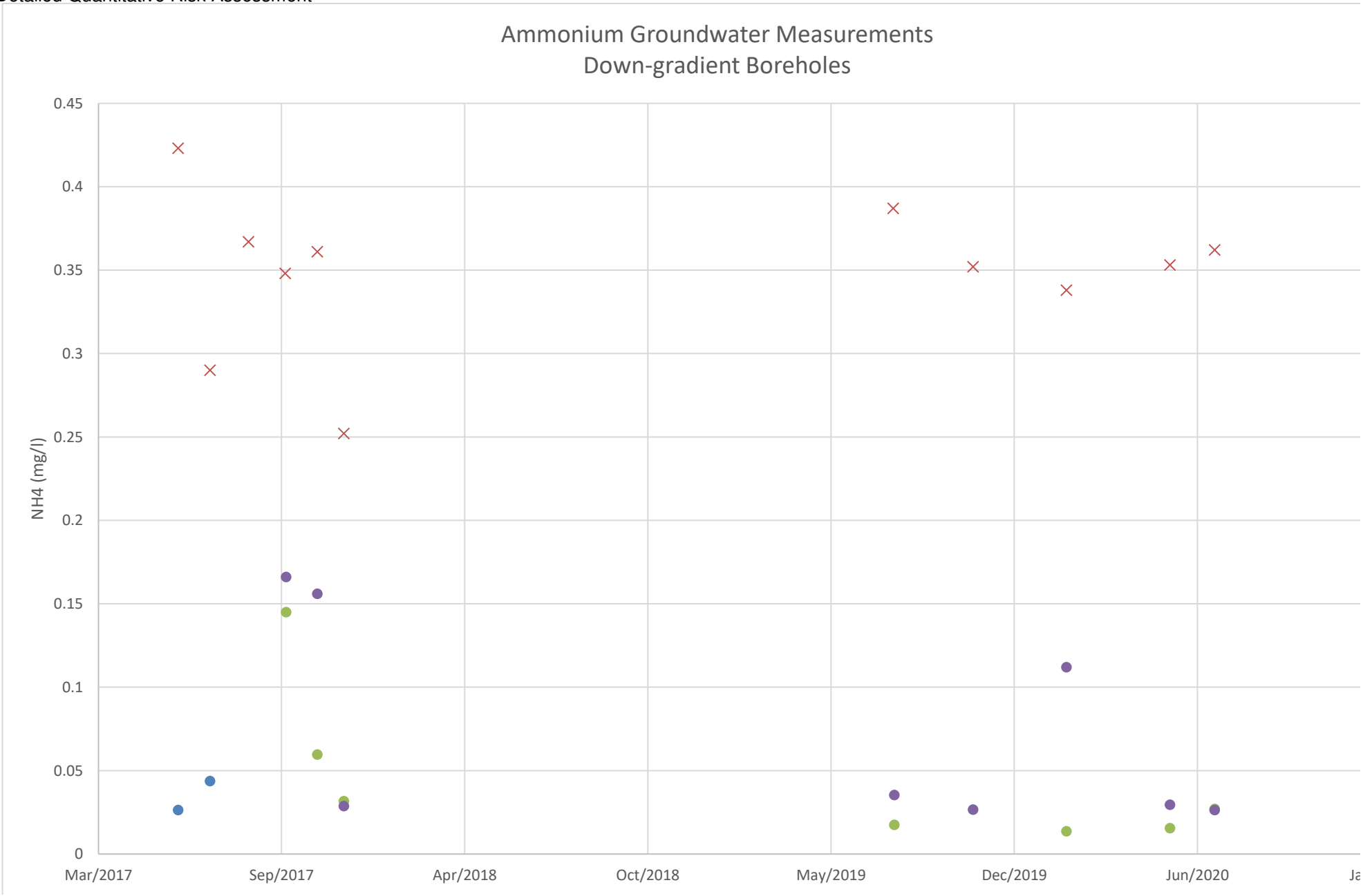

Fluoride Groundwater Measurements
0.3
0.25
0.2
0.15
0.1
0.05
0
mg/L
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH04 (d/gradient)
BH06 (d/gradient)
BH02A (GW2A) (d/gradient)
BH07A (GW07A) (d/gradient)

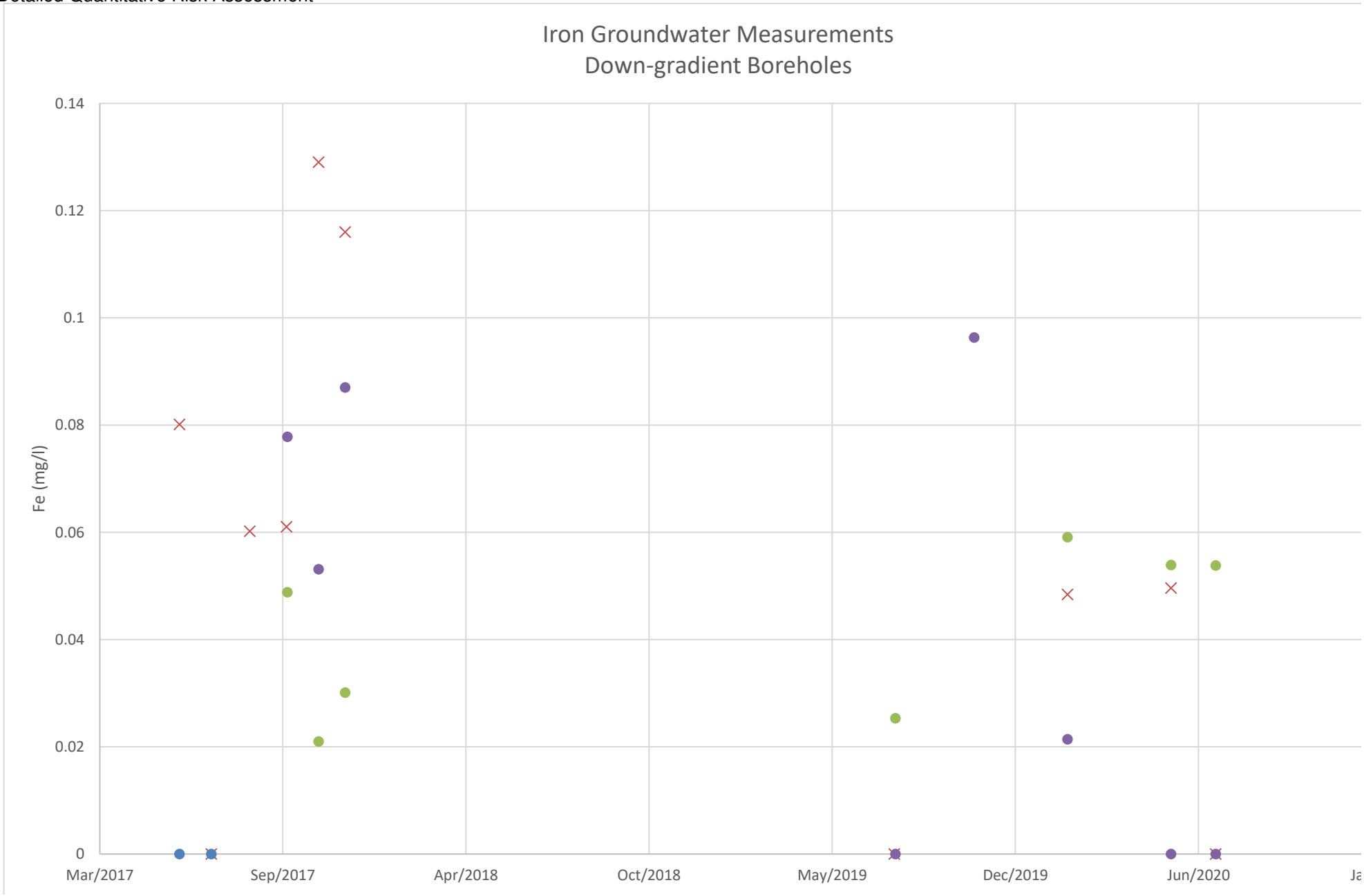

pH Groundwater Measurements
8.5
8
7.5
7
6.5
6
5.5
5
pH Units
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH04 (d/gradient)
BH06 (d/gradient)
BH02A (GW2A) (d/gradient)
BH07A (GW07A) (d/gradient)

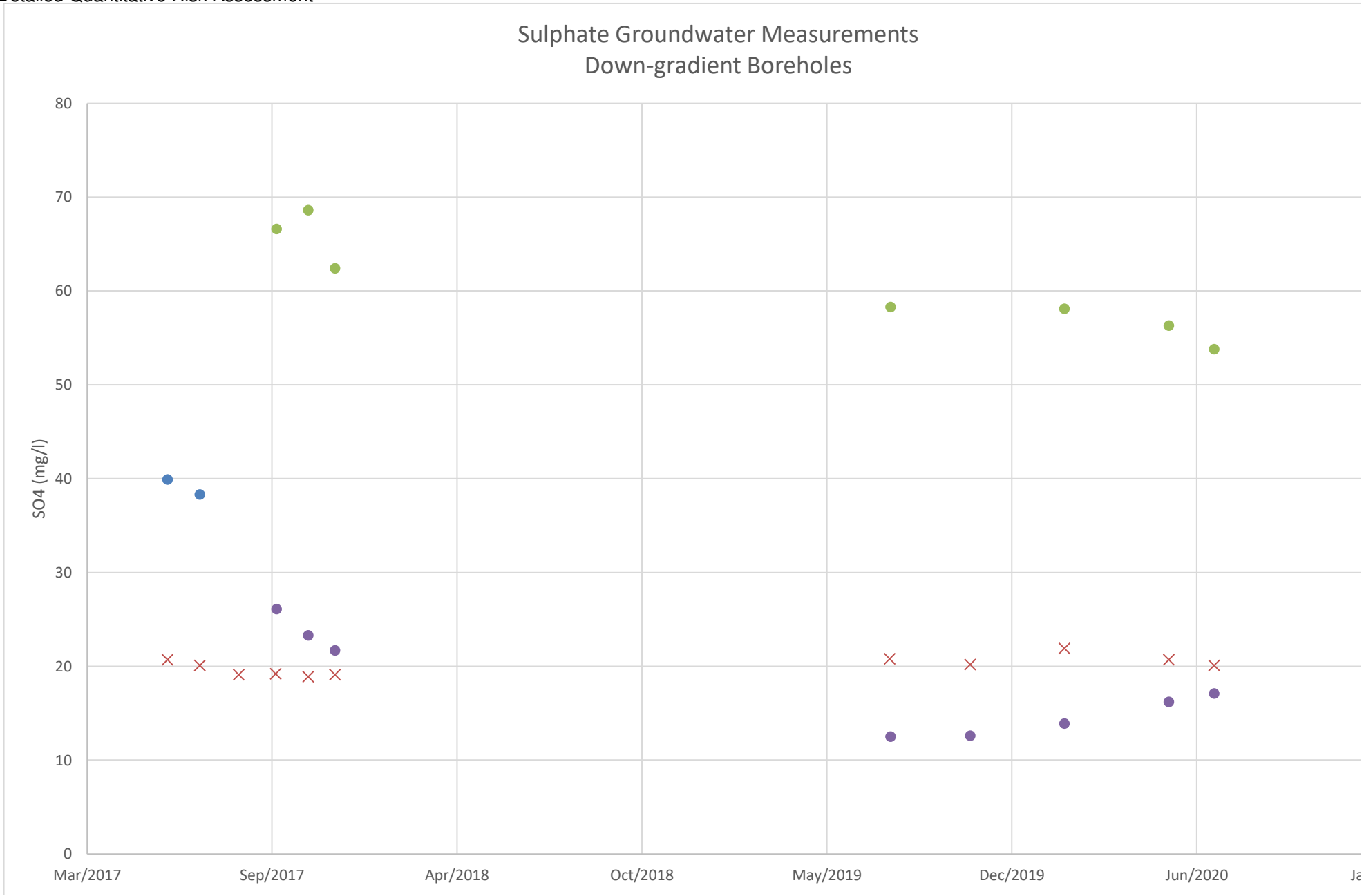

Conductivity Groundwater Measurements
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
mS/cm
May/2017
Dec/2017
Jul/2018
Jan/2019
Aug/2019
Feb/2020
Sep/2020
Date
BH04 (d/gradient)
BH06 (d/gradient)
BH02A (GW2A) (d/gradient)
BH07A (GW07A) (d/gradient)

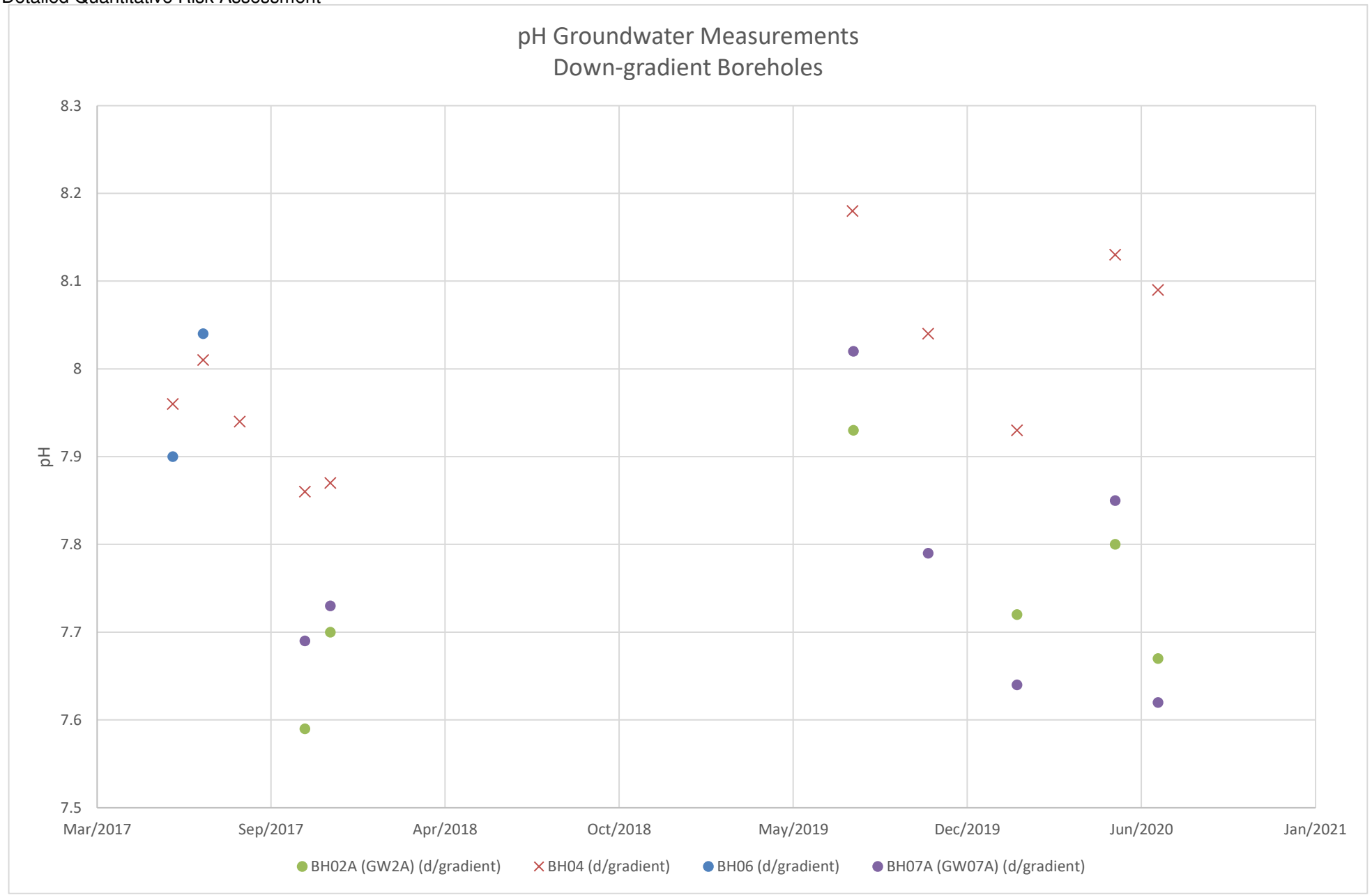

ORP Groundwater Measurements
Down-gradient Boreholes
ORP (mV)
80
60
40
20
0
-20
-40
-60
-80
-100
Mar/2017
Sep/2017
Apr/2018
Oct/2018
May/2019
Dec/2019
Jun/2020


Nitrate Groundwater Measurements
Down-gradient Boreholes
NO3 (mg/l)
12
10
8
6
4
2
0
Mar/2017
Sep/2017
Apr/2018
Oct/2018
May/2019
Dec/2019
Jun/2020


Ammonium Groundwater Measurements
Down-gradient Boreholes
NH4 (mg/l)
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Mar/2017
Sep/2017
Apr/2018
Oct/2018
May/2019
Dec/2019
Jun/2020


Iron Groundwater Measurements
Down-gradient Boreholes
Fe (mg/l)
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Mar/2017
Sep/2017
Apr/2018
Oct/2018
May/2019
Dec/2019
Jun/2020


Sulphate Groundwater Measurements
Down-gradient Boreholes
SO4 (mg/l)
80
70
60
50
40
30
20
10
0
Mar/2017
Sep/2017
Apr/2018
Oct/2018
May/2019
Dec/2019
Jun/2020


pH Groundwater Measurements
Down-gradient Boreholes
pH
8.3
8.2
8.1
8
7.9
7.8
7.7
7.6
7.5
Mar/2017
Sep/2017
Apr/2018
Oct/2018
May/2019
Dec/2019
Jun/2020
Jan/2021
BH02A (GW2A) (d/gradient)
BH04 (d/gradient)
BH06 (d/gradient)
BH07A (GW07A) (d/gradient)

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