Lower Thames Crossing Tunnels & Approaches

Tilbury Landfill Hydrogeological Risk Assessment 2026

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Lower Thames Crossing

Tilbury Landfill Hydrogeological Risk Assessment 2026

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1 Introduction

1.1 Summary of the scheme

1.1.1 The A122 Lower Thames Crossing ('LTC' and the scheme) is a new road that will connect the A2 and M2 in Kent to the A13 in Thurrock and Junction 29 of the M25 in the London Borough of Havering (Figure 1-1).

1.1.2 It will be approximately 23 kilometres long, with approximately 4.2 kilometres of new tunnel under the Thames. The tunnel portals will be located to the east of the village of Chalk on the southern side of the Thames, and to the west of East Tilbury on the northern side.

1.1.3 The project has been divided into three zones; Roads North, Tunnel and Approaches and Kent Roads.

Figure 1-1 Tunnels and Approaches package

1.2 Scope and objectives

1.2.1 National Highways is seeking approval for a new Environmental Permit to continue landfilling and Pulverised Fuel Ash (PFA) recovery at the former Tilbury Ash Disposal Site (formerly Environmental Permit EPR/GP3733DZ). National Highways wishes to create the required development levels for the LTC using waste derived from the adjacent Goshems Farm Deposit for Recovery (DfR) site (formerly Environmental Permit EPR/WP3094EP).

1.2.2 The site was formerly permitted to operate as a non-hazardous landfill under the conditions of an Environmental Permit, with the most recent variation (EPR/GP3733DZ/V007) issued on 09 December 2025.

1.2.3 This document provides an updated Hydrogeological Risk Assessment (HRA) for the new permit, reflecting the intention to continue the waste deposit and recovery activities authorised under the former permit.

1.2.4 This report is the HRA to support the Tilbury Landfill permit application by National Highways. It provides a review of the HRA submitted previously in support of Tilbury Ash Disposal Site Environmental Permit EPR/GP3733DZ. This report assesses the applicability of the previous HRAs to the proposed new landfill operation and identifies any new or different requirements in order to prevent risks to the water environment.

1.3 Supporting documents

1.3.1 This report should be read in conjunction with the following documents which have been submitted as part of the permit application:

- Environmental Permit Application Form parts A, B2, B4, F1;
- Environmental Setting and Installation Design Report (HE540039-BMJ-EAC-TA_SNZ_ZZ-RP-GS-000005)[1];
- Management Systems and Procedures (HE540039-BMJ-EAC-TA_SNZ_ZZ-RP-GS-000013)[2];
- Dust and Emissions Management Plan (HE540039-BMJ-EAC-TA_SNZ_ZZ-RP-GS-000008) (DEMP)[3];
- Closure and Aftercare Management Plan (HE540039-BMJ-EAC-TA_SNZ_ZZ-RP-GS-000007)[4];
- Site Operating and Waste Acceptance Procedures (HE540039-BMJ-EAC-TA_SNZ_ZZ-RP-GS-000015)[5];
- Stability Risk Assessment (HE540039-BMJ-EAC-TA_SNZ_ZZ-RP-GS-000010)[6], and
- Environmental Risk Assessment (HE540039-BMJ-EAC-TA_SNZ_ZZ-RP-GS-000006)[7].

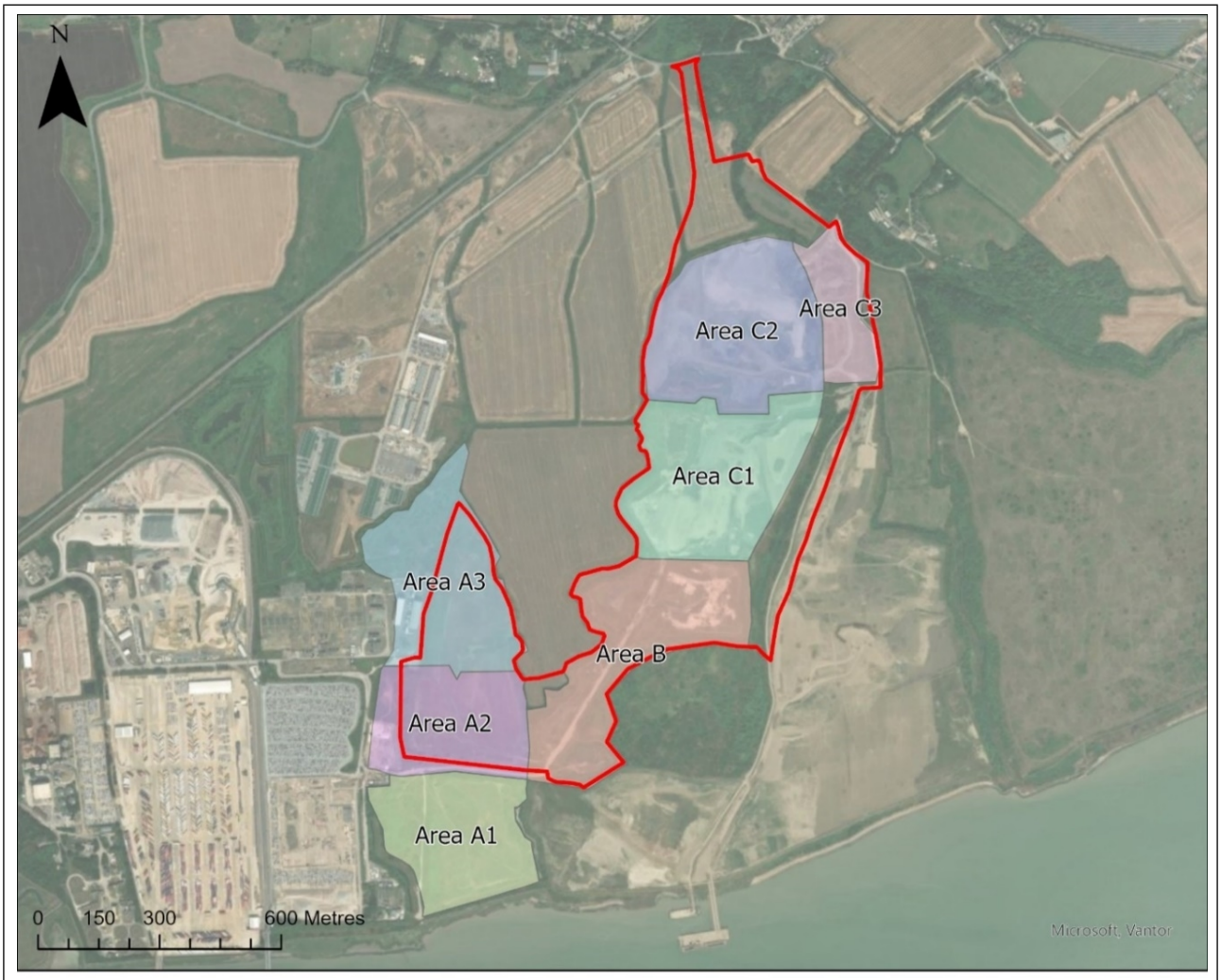
1.3.2 In addition to the documents required by the Environmental Permit, the work will be carried out in accordance with an Environmental Management Plan (EMP2)[8] and associated control documents.

2 Site details

2.1 Site location

2.1.1 Tilbury Ash Disposal Site is a non-hazardous landfill east of Tilbury, Essex, centred on national grid reference TQ671763. The 80ha site was spilt into seven areas A1 to A3, B1 and C1 to C3 as shown on Figure 2-1.

Figure 2-1 Former Tilbury Ash Disposal Site permit boundary and proposed new Tilbury Landfill permit boundary



The red line represents the proposed new permit boundary. The seven coloured areas represent the former Tilbury Ash Disposal Site permit boundary.

2.1.2 This new permit application covers some of the area included in the previous permit boundary but also includes additional areas to the north and east which form part of the LTC project. The previous environmental permit boundary (the site) and the proposed boundary for the new permit are shown on Figure 2-1.

2.1.3 The site is bounded by agricultural land to the north and west, with Port of Tilbury land also bounding the site to the west. The land to the east comprises a mix of agricultural land and Goshems Farm Deposit for Recovery site. The land

to the south comprises Goshems Farm Deposit for Recovery site and a wildlife area created from former landfill.

2.1.4 The main access to the site for commercial vehicles is from the former Tilbury Power Station area to the west. A second access point is in the north of the site via Station Road, but this access is for use only by staff vehicles.

2.2 Background

2.2.1 An Environmental Permit was originally issued in April 2007 (permit EPR/GP3739BQ) as Tilbury Ash Disposal Site to accept pulverised fuel ash (PFA) from Tilbury B Power Station until its closure in 2013. Prior to this the site was covered by four Waste Management Licences as discussed in Section 2.3.

2.2.2 The permit was transferred to Ingrebourne Valley Limited (IVL) in May 2017 (EPR/GP3733DZ/T001), with a variation granted in October 2017 to facilitate the restoration of site using imported inert wastes to a maximum elevation of nine metres above ordnance datum (mOD). The site formerly operated under permit variation EPR/GP3733DZ/V007[12].

2.3 Permitting history

2.3.1 The disposal of PFA to Tilbury Ash Disposal Site commenced shortly after the construction of the power station in 1968 and continued until its closure in 2013. The site was historically covered by four separate Waste Management Licences (WML), as follows:

- License EA/WML/71185 for Area A3 (Jan 1978);
- License EA/WML/71186 for Area C2 (Nov 1991);
- License 193/91 for Areas A1, A2 and C1 (June 2001); and;
- License 38/78 for Area B (June 2001)

2.3.2 Subsequent permitting history has been summarised in Table 2-1.

Table 2-1 Summary of Tilbury Ash Disposal Site permit history

Permit Number	Date	Description
RWE Npower plc		
GP3739BQ/A001	05/04/2007	Application determined for non-hazardous landfill accepting solely Pulverised Fuel Ash (PFA) produced by Tilbury B Power Station.
XP3236UR/V002	01/06/2009	Variation to GP3739BQ (PPC permit) for the extension of the landfill site to include an extension in Area C3.
GP3739BQ/V003	30/03/2010	Variation to increase final restoration levels from 6m AOD to 9m AOD and increase material accepted to allow an extra 1 million tonnes of PFA.
RWE Generation UK Plc		
GP3739BQ/V004	02/12/2014	Holder varied from RWE Npower plc to RWE Generation UK Plc.

Permit Number	Date	Description
Ingrebourne Valley Limited		
GP3733DZ/T001	19/05/2017	Transfer of the environmental permit from RWE Generation UK Plc to Ingrebourne Valley Limited. Permit reissued as EPR/GP3733DZ.
GP3733DZ/V002	13/10/2017	Expanded authorised waste types from PFA to include inert waste and updated the permit to modern conditions. Incorporated revised risk assessments and management plans.
GP3733DZ/V003	18/04/2019	Increased maximum annual throughput to 1,500,000 tonnes per annum, amended groundwater compliance limits, approved the restoration plan, and additional waste codes related to Thames Tideway Tunnelling project additives.
GP3733DZ/V004	27/01/2020	Updated the permit to modern conditions and revised waste acceptance criteria and associated procedures.
GP3733DZ/V005	13/08/2020	Added a new waste code 17 05 04, associated with exceedances identified during verification testing of Thames Tideway Tunnelling project waste stream, and updated waste acceptance procedures; included information on engineering and capping materials.
GP3733DZ/V006	09/08/2021	Added additional waste codes, 19 12 12 and 19 02 03 - treated chalk waste arising and introduced amendments to the site's improvement programme.
GP3733DZ/V007	09/12/2025	Update to the Monitoring Management Plan with the removal of groundwater compliance limits for BHC5D and BHC3D, with both reclassified to control levels, removed in-waste gas compliance limits.

2.4 Previous hydrogeological risk assessments

2.4.1 The original RWE Npower plc permit (GP3739BQ/A001) application in 2004 was submitted with an HRA produced by RWE Npower. Upon transfer to IVL, an HRA review was completed by SLR Consulting in 2017 to support the associated permit variation. Both reports are provided as Appendix B and Appendix D respectively.

2.4.2 In 2019 the permit was varied (GP3733DZ/V003) to accept inert material with soil conditioning agents and grease from Thames Tideway Tunnel. A copy of the risk assessment is provided as Appendix E.

2.4.3 A summary of the conclusions from the reports is provided below.

2004 original hydrogeological risk assessment

2.4.4 The 2004 HRA concluded the placement and long-term storage of PFA presented a low risk to groundwater and the wider environment. The assessment was underpinned by site investigation, batch leach trials, groundwater monitoring, a conceptual hydrogeological model, and a conservative quantitative risk assessment.

2.4.5 The assessment demonstrated that the PFA source was expected to produce limited or no leachate, and the underlying Alluvium forms a substantial and effective natural barrier to vertical contaminant migration into the underlying aquifers.

2017 review of hydrogeological risk assessment

2.4.6 The 2017 HRA review was undertaken as part of the permit variation applied for by IVL. The report included an assessment of the conceptual model and review of the monitoring results based on the site condition at the time of writing and the proposed permit variation activity i.e. import of an inert waste stream.

2.4.7 The 2017 review concluded the proposed source material (existing PFA and proposed inert waste stream) would pose a low risk to groundwater and surface water, and the thick, low-permeability Alluvium beneath the site continues to act as an effective natural geological barrier, preventing downward contaminant migration.

2019 soil conditioning agent and grease spoil deposition risk assessment

2.4.8 In 2019, Atkins completed an assessment to evaluate the risk to controlled waters from soil conditioning agents or greases associated with Tunnel Boring Machine (TBM) spoil from Thames Tideway Tunnel being placed in the Tilbury Ash Disposal Site. The assessment concluded the placement of Tideway spoil at Tilbury Ash Disposal Site was considered to pose a low to negligible risk to identified controlled waters receptors.

3 Current conceptual site model

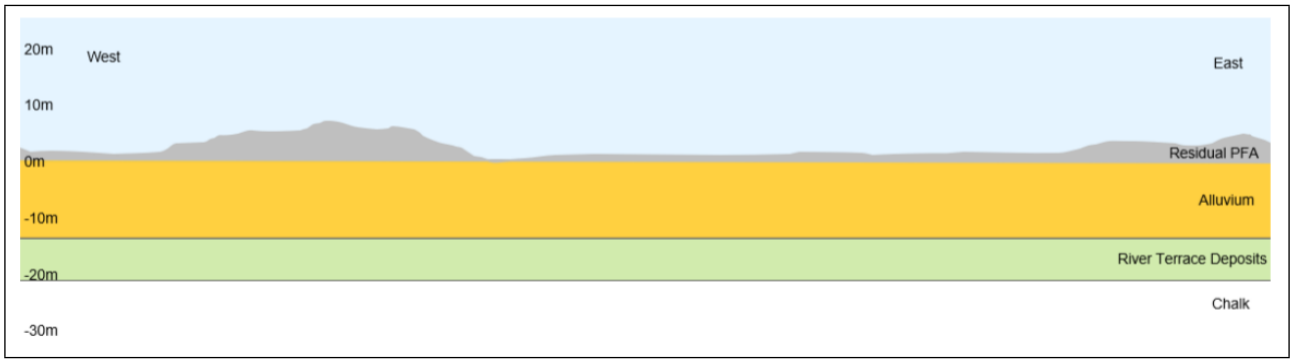
3.1 Source

3.1.1 Three main areas have been considered in relation to the landfill source; site design and construction, leachate management and leachate quality. These elements are considered further below.

Site design and construction

3.1.2 The Tilbury Ash Disposal Site was developed as a land raise. PFA was placed directly on top of the natural Alluvium up to 20 feet in height (to approximately 6.1m AOD). An illustrative cross section through the existing landfill is provided in Figure 3-1.

Figure 3-1 Illustrative cross section through Tilbury Ash Disposal Site (August 2025)



3.1.3 The total quantities of PFA disposed when the site was operated by RWE Npower are not available, however, the quantities produced and disposed of between 1998 and 2003 are provided in Table 3-1. This table gives an indication of the potential quantities of material placed. As detailed in the 2017 HRA, the conditioned PFA was laid in lifts of approximately 3m and initially compacted using tipping and levelling machines, with final compaction using a 10-tonne vibrating roller.

Table 3-1 Quantities of PFA produced and disposed by Tilbury B Power Station between 1998 and 2003

Year	Quantities PFA produced (tonnes)	Quantities PFA disposed at Tilbury Ash Disposal Site (tonnes)
1998	146,000	90,000
1999	151,000	102,000
2000	101,000	42,000
2001	203,000	139,000
2002	259,000	147,000
2003	238,000	102,000

3.1.4 Under IVL control, the permit was varied to reclaim the PFA and restore the site to 9m AOD with inert waste, to then be returned to grassland for agricultural use. Annual inputs of inert waste and derived volumes for 2019 to 2024 are presented in Table 3-2.

Table 3-2 Summary of waste accepted by IVL between 2019 and 2024

Year	Waste received (tonnes)	Derived waste volume (m^3)	Reclamation and treatment volume (tonnes)
2019	1,278,589	732,632	191,081
2020	610,091	348,623	154,995
2021	43,004	24,574	138,920
2022	209,673	593,728	200,097
2023	162,712	81,356	114,596
2024	9,278	4,639	62,690

3.1.5 PFA recovery is currently on going within Areas B, C1 and C2. Areas A1 (outside Tilbury Landfill boundary), A2 and A3 have been completed to their permitted restoration profiles. PFA was removed from Area A2 and A3 prior to infilling with inert waste.

3.1.6 The new permit would allow for continuation of the previous activity including, excavating, sorting, storing and reclaiming the residual PFA and importing and placing inert waste. The site will be restored to the levels required to create new construction platforms for LTC, which range from 3 to 7mOD (103 to 107m above project datum [APD]).

3.1.7 The site does not have an engineered barrier, instead relies on the underlying low permeability Alluvium. This is discussed further in Section 3.2.

Leachate management

3.1.8 No active leachate management is currently undertaken at the site. Previous assessments of both the PFA and the inert waste streams as discussed in Section 2.4 indicate that these materials are of low permeability and are not expected to generate significant quantities of leachate.

3.1.9 The proposed new landfilling activity aligns with activities under the previous permit. The movement and placement of inert waste undertaken as part of the LTC project is not considered to materially change the likelihood of leachate generation at the site. On this basis, the provision of leachate management systems is not considered necessary.

Leachate quality

3.1.10 There are three existing waste streams associated with Tilbury Ash Disposal Site.

i. Historically deposited PFA, which is being actively excavated and removed from site and was assessed in detail in the 2004 HRA. PFA is no longer being placed at the site.

ii. Inert waste from construction projects including the Thames Tideway Tunnel and Northern Line Extension Projects, which was assessed in detail in the 2017 HRA.

iii. TBM spoil from the Thames Tideway Tunnel. This inert material comprising London Clay, Lambeth Group, Thanet Sand Formation and Chalk includes soil conditioning agents and greases as a minor component of the waste. This was assessed in the 2019 Atkins Soil conditioning agent and grease – spoil deposition risk assessment.

3.1.11 The PFA source has significantly declined since IVL took over the permit in 2017, and only residual PFA remains in Area B, Area C1 and Area C2. The PFA from Area A2 and Area A3 has been removed and replaced with inert waste including spoil from Thames Tideway Tunnel.

3.1.12 The new permit will facilitate the following activities:

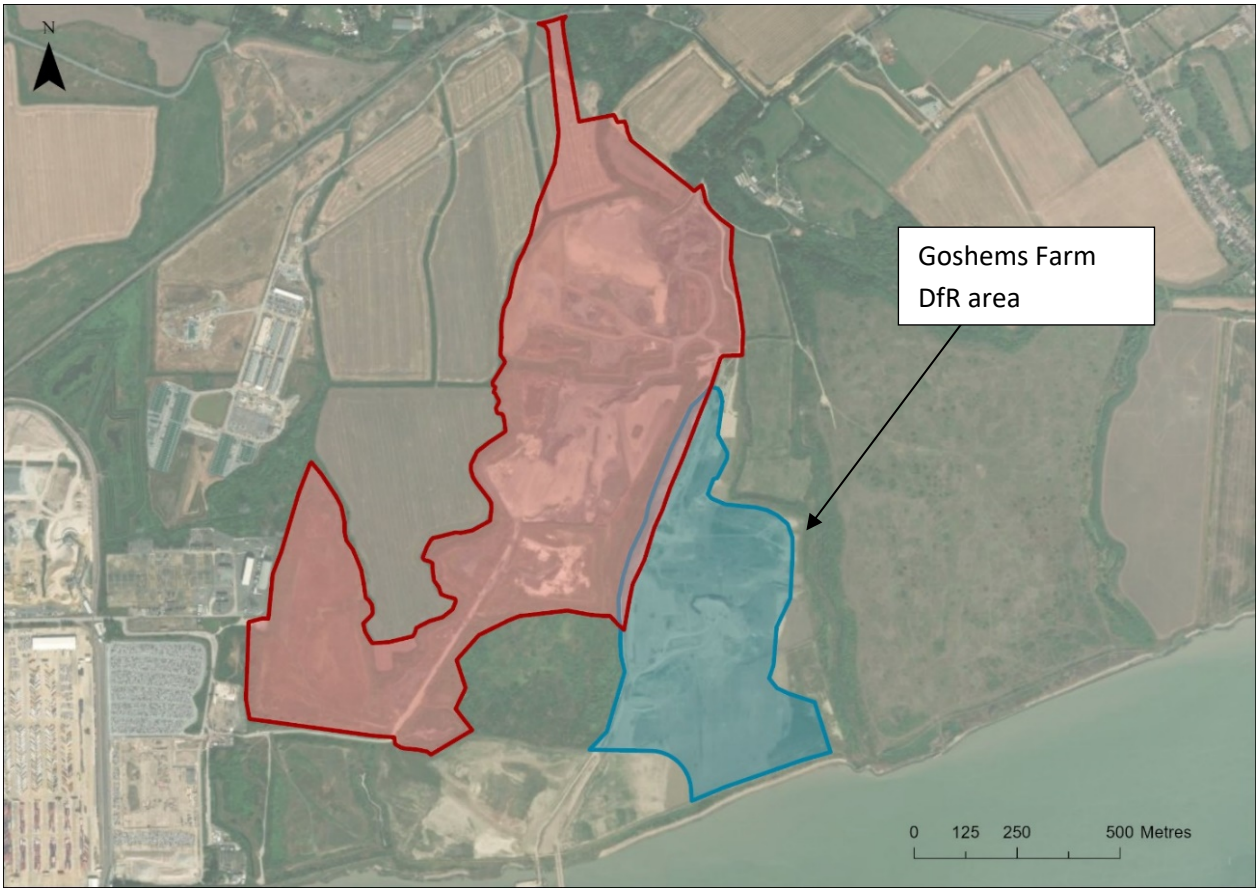
i. The recovery of suitable residual PFA from Areas B, C1 and C2 for stockpiling within the permit boundary. This PFA is required for use later in LTC for Open Mosaic Habitat creation.

ii. Reprofiling of waste already deposited within Tilbury Ash Disposal Site, to create a level working surface.

iii. The deposition of inert waste from the former DfR permit area in Goshems Farm shown on Figure 3-2 into Tilbury Landfill. The material placed in Goshems Farm under the DfR permit is inert waste from London and the Southeast and does not differ from the material assessed under the 2017 HRA. This material is the focus of this assessment.

3.1.13 There will be no new waste codes added to the new permit. The landfill will not be accepting waste from sites outside the LTC Order Limits. Thames Tideway Tunnel is now complete, and no additional material associated with this waste code will be placed in Tilbury Landfill.

Figure 3-2 Goshems Farm former DfR permit boundary area within DCO Order Limits



The red polygon represents the propsed new permit boundary. The blue polygon represents Goshems Farm DfR area, where waste will be imported from.

3.1.14 The available data for each of the waste streams is summarised in Table 3-3.

Table 3-3 Summary of waste streams and available data

Waste stream	Available data	Ref in Table 3-4
PFA	RWE Npower leaching (eluate) testing between 1994 and 2010. No data is available for 2010 to 2013 (up to initial closure); however, only limited filling occurred during this interval, and the existing dataset is considered representative of the PFA.	A and B
General inert material imported between 2017 to 2026 under IVL.	During IVL's operation of the site, incoming wastes were verified as inert and therefore not subject to routine leachability testing. Limited ground investigation completed by LTC in Area A2 includes testing from three borehole locations.	C
TBM tunnel spoil from the Thames Tideway Tunnel	Anecdotal evidence suggests this material was placed within Area A2 and Area A3, however, this has not been confirmed by IVL and verification testing has not been made available. Limited ground investigation completed by LTC in Area A2 includes testing from three borehole locations.	C

Waste stream	Available data	Ref in Table 3-4
Goshems Farm DfR material	Ground investigation data from LTC obtained between 2019 to 2025 available.	D

3.1.15 The available eluate data from the PFA and general inert material in the Tilbury Ash Disposal site and the Goshems Farm DfR material is presented in Table 3-4. This risk assessment is intended to build on the assessments submitted for the previous Environmental Permit, which considered the wastes already deposited within Tilbury Ash Disposal Site. As this proposal is to deposit inert waste from a new source (Goshems Farm DfR), the review has focussed on confirming whether there are any significant differences between the new waste and the material already deposited, and therefore whether any further assessment is required.

3.1.16 Drinking water standards (DWS) and saline environmental quality standards (SEQS) have been provided in the table below. DWS has been used as a conservative initial assessment to help benchmark the results.

3.1.17 As demonstrated in Table 3-4 the average concentrations in the Goshems DfR are all below the pollution thresholds calculated in the Tilbury Ash Disposal Site 2004 HRA.

3.1.18 In addition, the leachable concentration of determinants in the DfR are less than or comparable to the average leachable concentrations in the PFA or Tilbury Ash Disposal Site inert waste.

3.1.19 Hexavalent chromium was not tested for in the original assessment, but concentrations of total chromium in the DfR material do not exceed those in the PFA.

3.1.20 The new source of material from Goshems Farm DfR is therefore unlikely to introduce any new or different contaminants, or concentrations of contaminants, compared to the waste already deposited within Tilbury Ash Disposal Site, and is therefore acceptable for disposal at the site under the current permit. Further assessment is provided in Section 3.

Table 3-4 Comparison of the 2004 PFA eluate results against 2019 to 2025 LTC ground investigation sample results

Determinand	DWS (mg/l)	SEQS (mg/l)	Pollution threshold from 2004 HRA (mg/l)	1996 to 2010 PFA eluate results (mg/l) (17 samples) (A)			2019 to 2025 ground investigation soil sample leachability results (mg/l)								
							Tilbury Ash Disposal Site - PFA (10 samples) (B)			Tilbury Ash Disposal Site - Inert material (15 samples) (C)			Goshems Farm – DfR (297 samples) (D)		
				Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max
Groundwater Directive 2006/118/EC - Hazardous substances															
Arsenic	0.01	0.025	1.1	<0.002	0.027	0.08	0.002	0.015	0.028	<0.0005	0.0047	0.018	<0.0005	0.0096	0.83
Chromium - hexavalent	-	0.0006	-				<0.05	-[3]	<0.05	<0.003	0.012[6]	<0.05	<0.003	0.0042	0.22
Lead	0.01	0.0013	-	<0.001	0.025	0.030	<0.0002	0.00080	0.0030	<0.0002	0.0011	0.006	<0.0002	0.0010[6]	<0.1
Mercury	0.001	0.00005	-	<0.00004	0.0051	<0.1	<0.00001	-[3]	<0.0001	<0.00001	0.000029[6]	<0.0001	<0.00001	0.000035[6]	<0.003
Groundwater Directive 2006/118/EC – Non-hazardous substances															
Aluminium	0.2	0.015	21.1	0.17	7.58	18.0	-	-	-	-	-	-	-	-	-
Ammoniacal nitrogen (as N)	0.39	0.021	2.2	0.40	2.01	5.74	<0.02	-[3]	<0.02	<0.02	0.84	6	<0.01	1.76	29[5]
Antimony	0.005	-	-	<0.001	0.030	0.28	0.002	0.0066	0.018	<0.001	0.0031	0.019	<0.001	0.0085	0.56
Barium	0.7[2]	-	-	0.07	1.30	10.90	0.026	0.056	0.089	0.02	0.047	0.067	0.01	0.3	1.45
Boron	1	7	105	1.08	5.43	11.2	2.1	4.4	7.8	0.08	0.93	5.65	<0.01	0.33	10.80
Cadmium	0.005	0.0002	-	<0.0004	-	<0.1	<0.00008	-[3]	<0.001	<0.00002	0.00011[6]	<0.001	<0.00001	0.000071[6]	<0.002
Calcium	-	-	-	128.5	519.7	2840	22	75	139	10	66.99	232	8	258	833
Chloride	250	-	-	<0.01	6.16	28.0	<1	38	139	2	81	609	<1	45	857
Chromium	0.05	-	1.6	<0.1	0.30	1.58	<0.001	0.0036	0.0074	<0.001	0.0063	0.032	<0.001	0.0058	0.59
Chromium - trivalent	0.05	-	-	-	-	-	-	-	-	<0.003	0.0047	0.015	<0.003	0.0040	0.58
Cobalt	-	0.003	-	<0.001	0.011	0.02	-	-	-	0.00053	0.0011	0.002	0.0005	0.0032	0.26
Copper	2	0.00367 (where DOC <1mg/l)	-	<0.001	0.155	2.35	0.00033	0.0016	0.0071	0.00092	0.012	0.13	0.000564	0.042	9
Cyanide	0.05	0.001	-	-	-	-	<0.005	-[3]	<0.005	<0.005	0.018	0.03	<0.005	0.015	0.91
Fluoride	1.5	5	-	<0.5	7.94	104	<0.1	0.43	0.71	<0.1	0.79	2.0	0.1	0.53	2
Iron	0.2	1	-	<0.001	0.024	0.029	-	-	-	-	-	-	-	-	-
Magnesium	50	-	-	<0.05	0.576	4.00	1	15.25	30	1	10.06	23	0.036	37.4	266
Manganese	0.05	-	-	<0.01	0.011	0.03	-	-	-	-	-	-	-	-	-
Molybdenum	0.071[2]	-	7.4	<0.05	0.857	4.15	0.019	0.089	0.19	0.001	0.04	0.40	0.001	0.061	4.73
Nickel	0.02	0.0086	2.1	<0.001	0.017	0.02	<0.0004	0.0014	0.0067	<0.0004	0.0029	0.01	<0.001	0.010	0.81
Nitrite	0.5	-	-	<0.04	0.2	<0.5	-	-	-	-	-	-	-	-	-
Nitrate	50	-	-	<0.1	1.09	2.70	-	-	-	-	-	-	-	-	-
Phenols	0.0005	0.0077	-	<0.00075	-	<0.10	<0.01	-[3]	<0.016	<0.001	0.012[6]	<0.05	<0.0005	0.011	0.47[4]

Determinand	DWS (mg/l)	SEQS (mg/l)	Pollution threshold from 2004 HRA (mg/l)	1996 to 2010 PFA eluate results (mg/l) (17 samples) (A)			2019 to 2025 ground investigation soil sample leachability results (mg/l)								
							Tilbury Ash Disposal Site - PFA (10 samples) (B)			Tilbury Ash Disposal Site - Inert material (15 samples) (C)			Goshems Farm – DfR (297 samples) (D)		
				Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max
Phosphorus	2.2	-	-	<0.01	0.129	0.80	-	-	-	-	-	-	-	-	-
Potassium	12	-	-	0.59	16.21	69.9	-	-	-	-	-	-	-	-	-
Selenium	0.01	-	1.1	<0.005	0.063	0.18	0.001	0.010	0.022	<0.001	0.0045	0.023	<0.001	0.022	1.70
Silicon	-	-	-	0.14	1.09	2.38	-	-	-	-	-	-	-	-	-
Sodium	200	-	-	0.28	41.58	195	5	32	106	1	90	468	2	83	766
Sulphate [1]	250	-	26,316	182	1006	4920	82	350	763	<3	112	531	34	767	3250
Tin	-	-	-	<0.005	0.033	0.06	-	-	-	-	-	-	-	-	-
Titanium	-	-	-	<0.05	0.036	0.02	-	-	-	-	-	-	-	-	-
Vanadium	-	-	10.5	<0.01	0.281	1.07	0.011	0.024	0.033	<0.001	0.012	0.044	<0.001	0.066	8.98
Zinc	5	0.0068 (bioavailable)	-	<0.005	0.017	0.02751	<0.001	0.0036	0.0091	<0.001	0.0083	0.04	<0.001	0.010	0.36
Sulphide	-	-	-	<0.02	-	<0.05	-	-	-	-	-	-	-	-	-
Conductivity (uS/cm)	2500	-	-	0.621	516.3	3790	267	782	1,420	0.31	753	2,680	205	1,506	5,740
pH (pH Units)	-	-	-	7.87	10.59	12.1	7.48	8.97	10.8	7.2	8.61	11.4	6.95	8.33	12.3

Notes:

A, B, C, D refers to dataset reference as described in Table 3-3.

Professional judgement has been used when calculating mean concentrations where some results are below LOD. Typically, concentrations below LOD have been set to a finite value for the purposes of calculating a mean, either at the LOD or half the LOD dependent on how the LOD compared to other results.

1 Reported as Sulphate as SO4

2 WHO guideline value, reported in Guidelines for Drinking-water Quality 4th edition, incorporating the 1st addendum

3 No results above the method detection limit.

4 Two outliers removed from the dataset of 288.

5 Three outliers removed from the dataset of 290.

6 Maximum concentration is <LOD, however, measured results are available to calculate an average concentration.

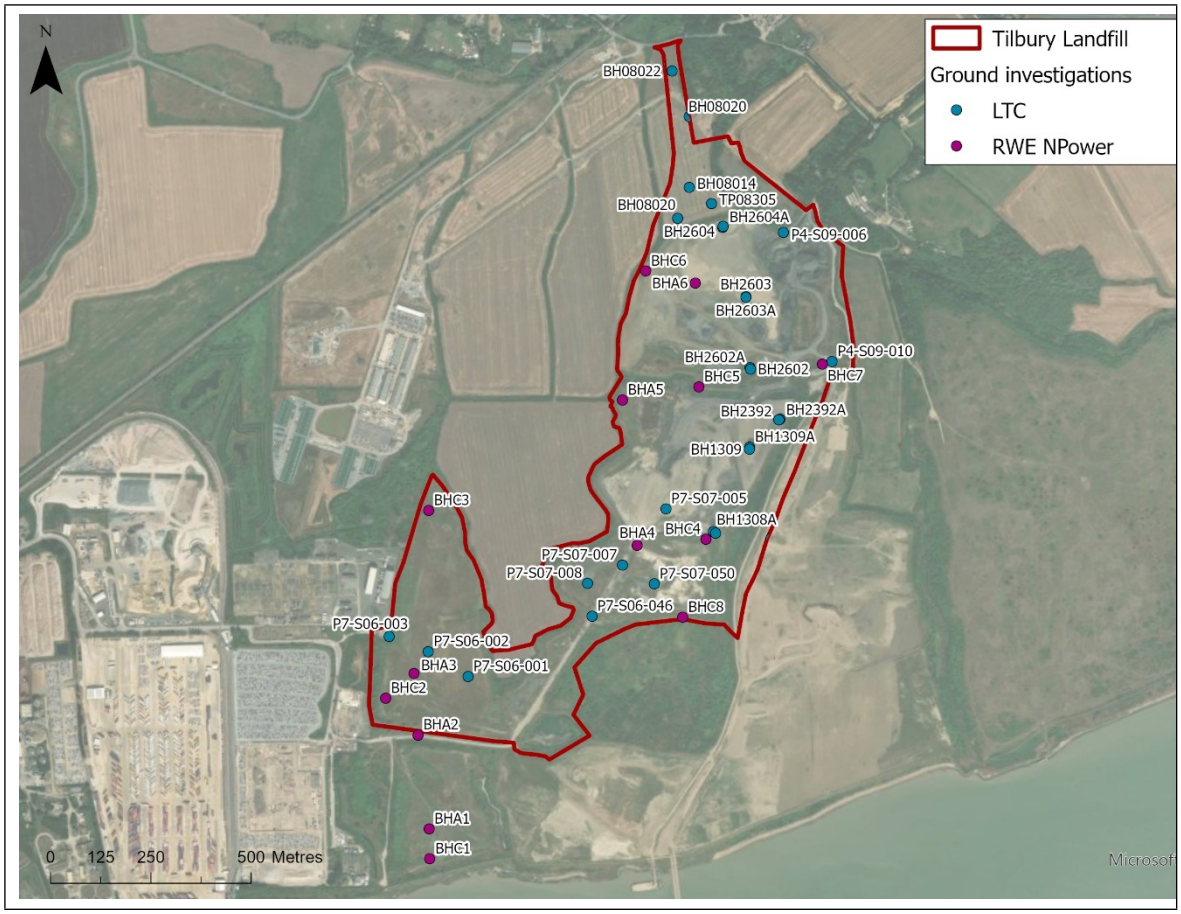
3.2 Pathways

Geology

3.2.1 The landfill material (geologically classified as Made Ground) at the former Tilbury Ash Disposal Site overlies superficial deposits comprising Alluvium and River Terrace Deposits (RTD), and Chalk bedrock.

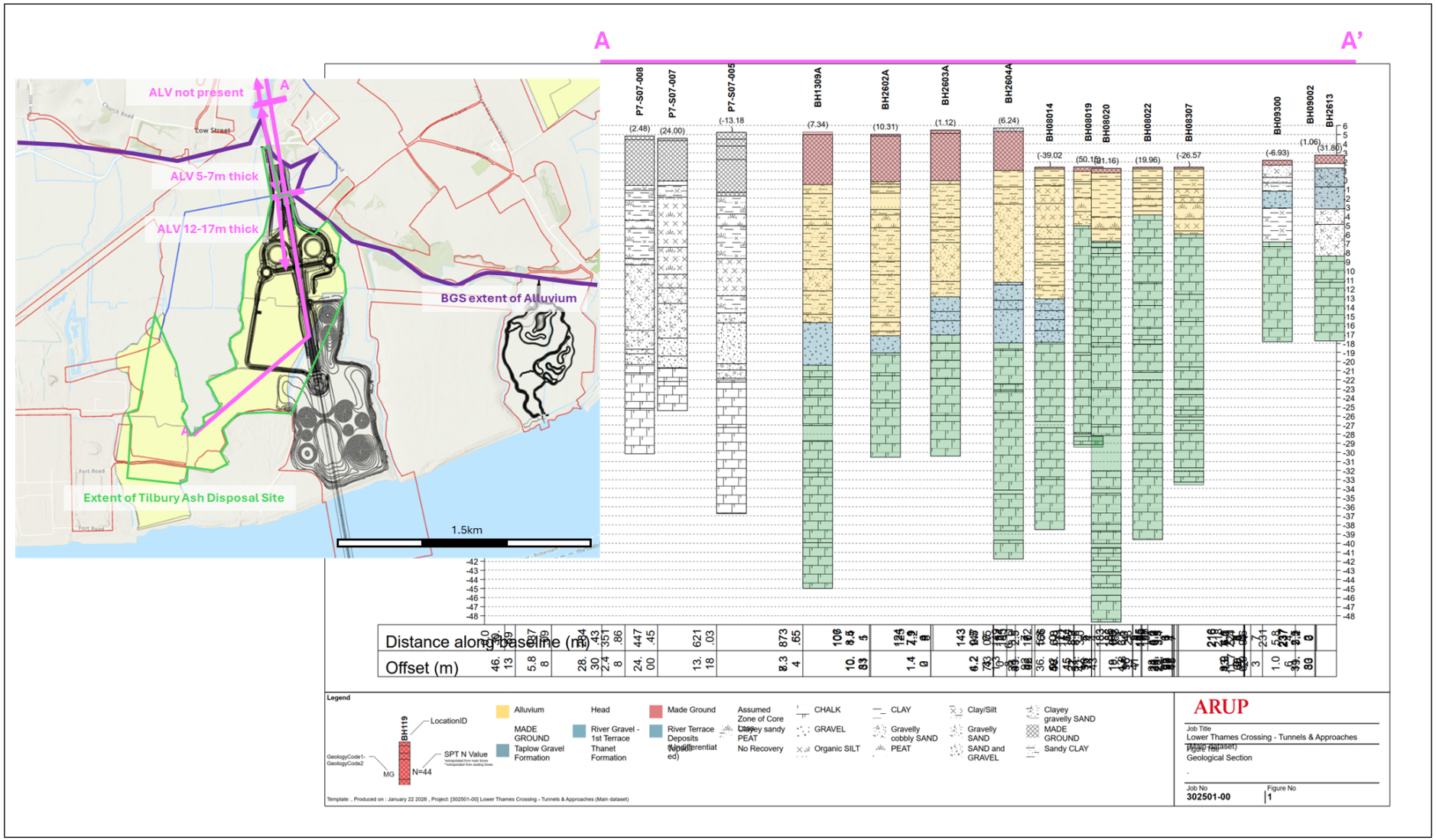
3.2.2 Ground investigation associated with LTC has been undertaken within the proposed Tilbury Landfill between 2018 and 2025, and investigation by RWE Npower was undertaken in 2006. The investigation locations are shown on Figure 3-3.

Figure 3-3 Exploratory hole locations



3.2.3 The Alluvium comprises very soft to soft clayey silt and silty clay, with peat layers locally up to 2m thick. Alluvium thickness decreases northwards away from the River Thames. LTC ground investigations indicate that the Alluvium is approximately 12m to 17m thick beneath the south and centre of Tilbury Landfill, with reduction in thickness to 5m to 7m in the north. The Alluvium thins out completely approximately 500 m north (Figure 3-4) of the proposed permit boundary. The change in Alluvium thickness observed across the site is likely related to historic valley terraces produced by the River Thames.

Figure 3-4 LTC ground investigation borehole log cross section with mapped Alluvium thicknesses



3.2.4 The RTD below the Alluvium are typically granular, comprising very loose to dense, brown to grey, multicoloured, slightly sandy and slightly silty, angular to well-rounded fine- to coarse-grained flint gravel with low cobble content. Thicknesses range between approximately 1.5 m and 7.5 m.

3.2.5 The Chalk below the RTD is generally described as very weak to weak, medium- to high-density white chalk. The upper 2 to 5 m consists of clast-supported chalk gravel, underlain by a 2 to 14 m interval of fractured Chalk associated with the Seaford Chalk Formation. Fracturing decreases within the underlying Lewes Nodular Chalk Formation.

Hydrogeological setting

3.2.6 Table 3-5 summarises the Environment Agency aquifer classification and hydrogeological characteristics of each stratigraphic unit.

Table 3-5 Hydrogeological unit summary

Geological unit	Measured thickness (m)	Aquifer type	Environment Agency aquifer designation [1]	Groundwater flow type
Landfill (Made Ground)	0 (north) to 10.3	Perched	Unclassified	Intergranular flow
Alluvium	5 to 7 (north) 12 to 17 (rest of area)	Aquitard	Secondary B	Intergranular flow
RTD	1.5 to 7.5	Aquifer	Secondary A	Intergranular flow
Seaford Chalk Formation	Not proven	Aquifer	Principal	Structureless - Intergranular flow Structured – Fracture flow
Lewes Nodular Chalk Formation	Not proven	Aquifer	Principal	Fracture flow

Notes

[1] Environment Agency Aquifer Classification definitions are:

Principal Aquifers - layers of rock or drift deposits that have high intergranular and / or fractured permeability that usually provide a high level of water storage. They may support water supply and / or river base flow on a strategic scale.

Secondary A aquifers - permeable layers capable of supporting water supplies at a local rather than strategic scale and being in cases an important component of base flow to rivers.

Secondary B aquifers - lower permeability layers that may store and yield limited amounts of groundwater in fractures and fissures, thin permeable horizons and weathered zones.

Landfill (Made Ground)

3.2.7 Groundwater movement within the landfill (Made Ground) is expected to be limited as the waste is largely cohesive.

3.2.8 Where isolated granular lenses are present, flow will be constrained by the surrounding low-permeability clay. The presence of cohesive strata may also induce perched or partially confined conditions within localised granular zones.

Although no site-specific permeability testing is available for the landfill, the material descriptions and previous assessments[9], suggest an hydraulic conductivity in the order of $1x10^{-7}$ to $1x10^{-8}$m/s.

3.2.9 PFA produced at Tilbury Power Station is composed mainly of silt-sized spherical glassy particles (typically 0.02 mm diameter), generally well compacted and undergo cementation through pozzolanic reactions, leading to a low permeability in the order of 10^{-7} to 10^{-8} m/s.

3.2.10 The inert waste materials deposited within Tilbury Ash Disposal Site comprise mostly clays and silts, which are of low permeability. Although no site-specific permeability testing is available for the landfill, the material descriptions and previous assessments[9], suggest a hydraulic conductivity in the order of $1x10^{-7}$ to $1x10^{-8}$m/s. The presence of cohesive strata may induce perched or partially confined conditions within any localised granular zones.

3.2.11 The inert wastes placed under the previous permit were not well compacted, as the proposed final use of the land was not sensitive to settlement. Any new or existing reworked inert waste placed within the landfill under this permit will be placed in a controlled manner and compacted to achieve the required engineering specification for LTC. Therefore, the hydraulic conductivity of the waste is predicted to be lower than previously assessed.

Alluvium

3.2.12 The Alluvium predominantly consists of cohesive silts and clays with interbedded peat horizons. Groundwater is present within the intergranular pore space, but flow within this unit is expected to be limited due to its low hydraulic conductivity. The cohesive nature of the Alluvium restricts hydraulic connectivity between the landfill and the underlying RTD and Chalk.

3.2.13 The bulk hydraulic conductivity of the Alluvium is expected to be very low, consistent with its cohesive nature. Six in situ variable-head hydraulic conductivity tests were undertaken within the Alluvium as part of the LTC ground investigation. Interpreted hydraulic conductivity values ranged from $4x10^{-8}$ to $1x10^{-6}$ m/s.

3.2.14 The variable-head test results represent horizontal hydraulic conductivity, which is expected to exceed vertical conductivity due to the sedimentary fabric and stratification of the Alluvium. Oedometer test interpretations indicate vertical hydraulic conductivity values of 5×10^{-11} to 5×10^{-9} m/s, approximately 20 times lower than the horizontal values.

3.2.15 Based on the overall dataset and material characteristics, a more representative range for hydraulic conductivity is considered to be between 1×10^{-9} and 1×10^{-7} m/s.

RTD

3.2.16 The RTD are characterised by intergranular groundwater flow. Nine in situ variable-head hydraulic conductivity tests provide the following interpreted range:

- minimum of 3.5 $x10^{-6}$ m/s;
- average of 5.0 $x10^{-5}$ m/s; and

- maximum of 5.2 x10^{-4} m/s.

3.2.17 These deposits predominantly comprise sandy, silty fine- to coarse-grained gravel, with localised clayey gravelly sand horizons. Hydraulic conductivity is expected to vary accordingly, typically ranging from 1 × 10^{-5} m/s to 1 × 10^{-3} m/s in sandy gravel units, reducing to around 1 × 10^{-6} m/s in finer-grained zones.

Chalk

3.2.18 The structureless chalk will be characterised by intergranular flow, whereas the groundwater flow in the underlying structured chalk is through secondary porosity features (i.e. fissures and joints) rather than through the primary chalk pore matrix, which tends to have a very low hydraulic conductivity.

3.2.19 Two pumping tests were undertaken in the Chalk during the LTC ground investigation. Interpreted aquifer properties are summarised in Table 3-6.

Table 3-6 Chalk pumping test results

Test	Aquifer transmissivity [1], m^2/d (average)	Uniform horizontal hydraulic conductivity [2], upper 50m Chalk, m/s (average)
PW07006A	593 to 1,440 (1,050) [3]	1.4 x10^{-4} to 3.3 x10^{-4} (2.4 x10^{-4})
PW06001A	1,200 [4]	2.8 x10^{-4}

Notes

[1] Derived transmissivity (hydraulic conductivity multiplied by aquifer thickness) based on analysis assuming aquifer thickness from top of Chalk to base of screened section of each pumping well

[2] Derived hydraulic conductivity assuming flow occurs within the upper 50m of the top of the Chalk

[3] Based on averages of different analysis methods from select drawdown analyses

[4] Assessment only using Theim steady state distance drawdown analysis

3.2.20 Hydraulic conductivity within the Chalk decreases with depth. While aquifer tests provide estimates of transmissivity, they do not resolve the vertical distribution. Geophysical log interpretation indicates hydraulic conductivity values of approximately 10^{-3} m/s in the shallowest fractured Chalk, reducing to around 10^{-5} m/s with depth. Although data from deeper horizons is limited, conductivity is expected to continue to decline as the frequency of open fractures decreases.

3.2.21 Faults have not been mapped by the British Geological Survey in Tilbury Landfill. Two “major fissures” were encountered during the construction of the Tilbury – Gravesend Cable Tunnel. Faults may act as both zones of higher hydraulic conductivity producing preferential groundwater flow paths for groundwater flow and as zones of lower hydraulic conductivity acting as barriers to groundwater flow.

Groundwater levels

3.2.22 The IVL groundwater level monitoring dataset associated with Tilbury Ash Disposal permit comprises 1,110 records from eight dual installation boreholes. All boreholes were installed in both the Alluvium and Chalk aquifers.

3.2.23 Manual groundwater levels were recorded as depths (m bgl) and converted to elevations (m AOD) using an established site datum level. Monitoring was undertaken quarterly, with most dips occurring in February (Q1), May (Q2), August (Q3) and November (Q4). A total of 69 records were blank within the monitoring spreadsheet.

3.2.24 Groundwater level data has been summarised in Figure 3-5 and Figure 3-6.

Figure 3-5 Hydrographs of groundwater levels in the Alluvium installations

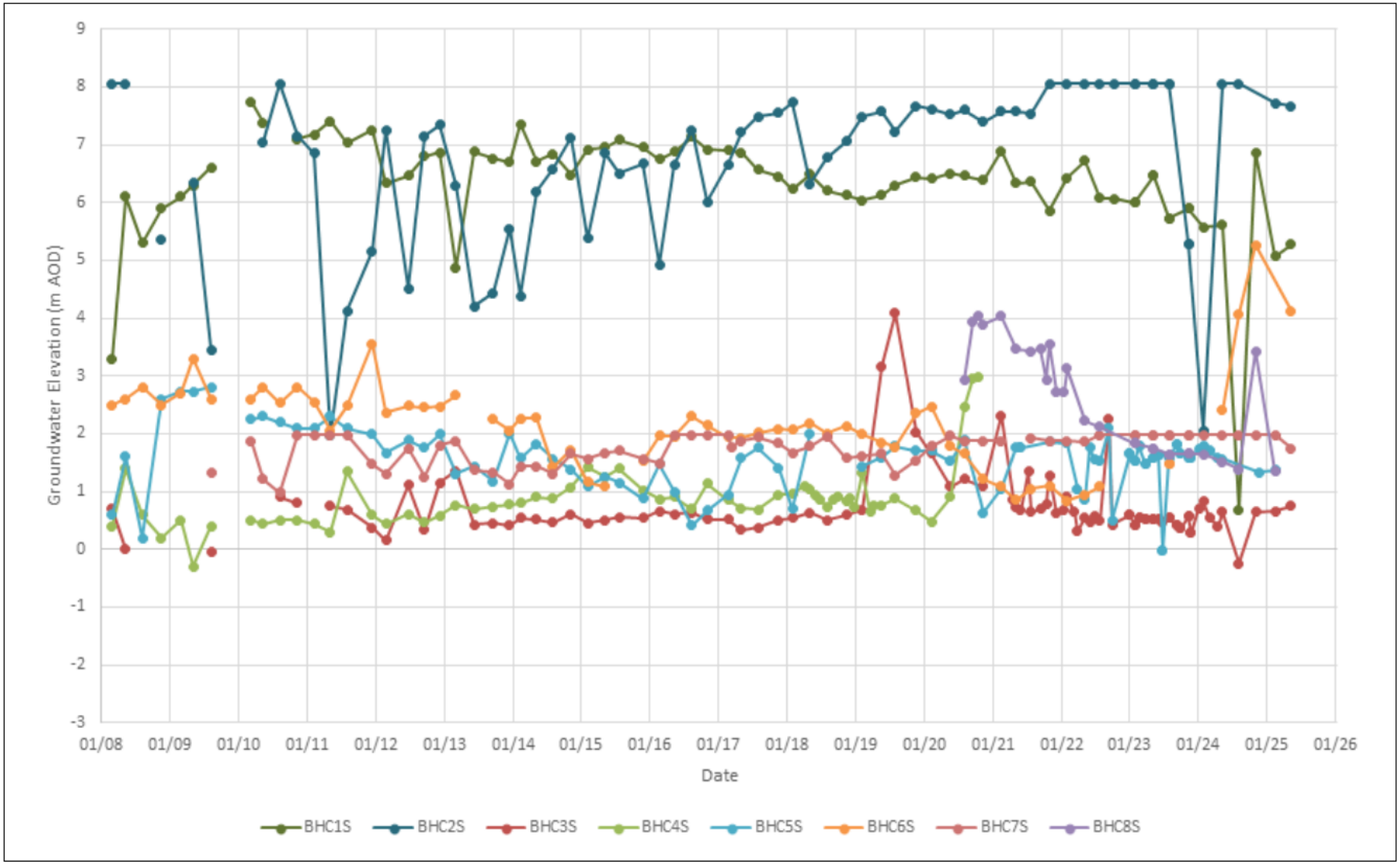


Figure 3-6 Hydrographs of groundwater levels in the Chalk installations

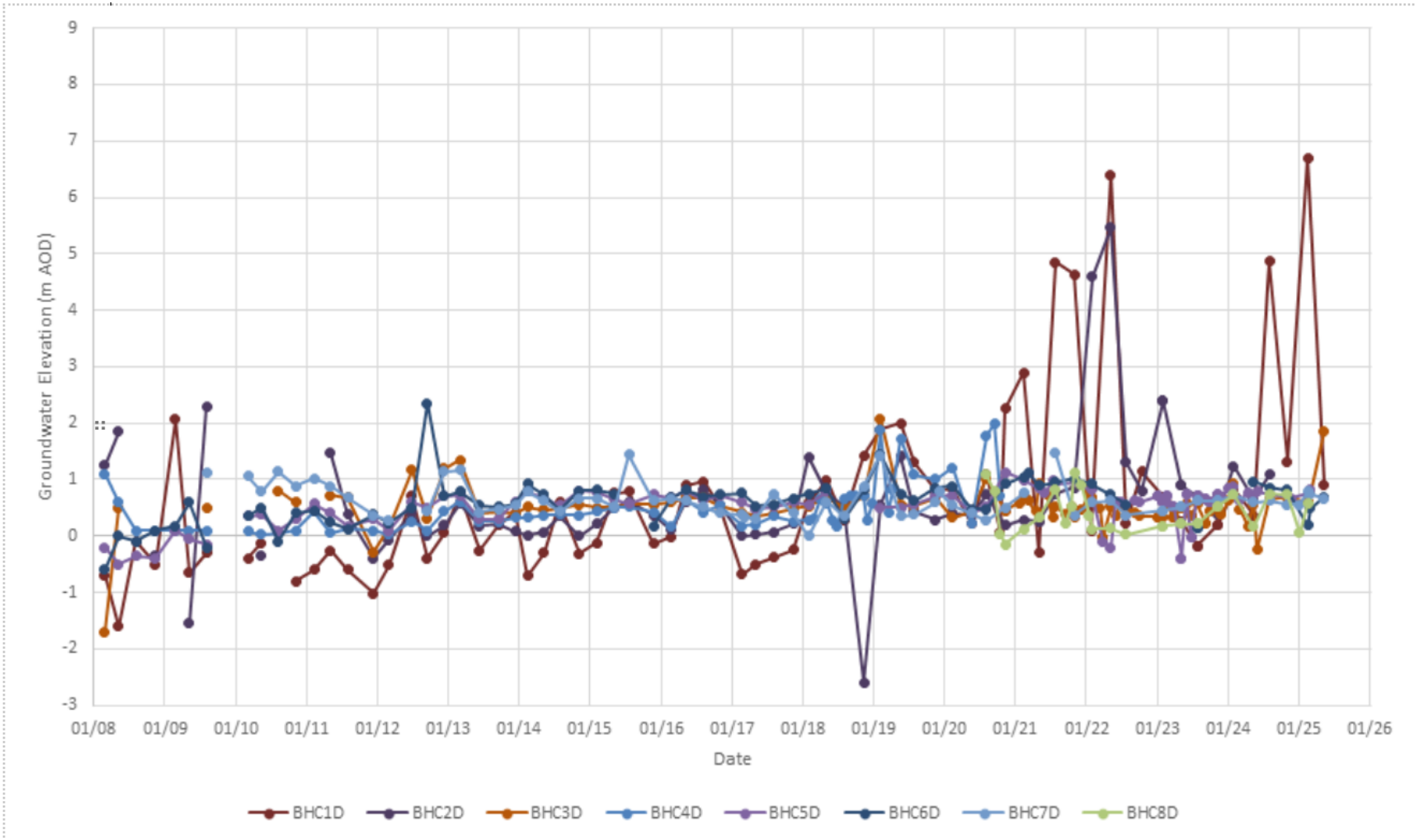


Table 3-7 Summary of groundwater level monitoring data

Borehole ID	Strata	Count	Groundwater Level (mAOD)			Comment
			Min	Average	Max	
BHC1S	Alluvium	72	0.69	6.33	7.74	Q1 2013 and Q3 2024 groundwater level erroneously low (0.60mAOD and 4.88mAOD). No commentary was provided in annual report, it has been assumed to be a reading error.
BHC2S	Alluvium	69	1.98	6.74	8.05	New borehole installed in May 2011, previous data assumed to be erroneous.
BHC3S	Alluvium	97	-0.24	0.71	4.08	Q2 and Q3 2019 records erroneously high, comment of level possibly being affected by slurry near borehole.
BHC4S	Alluvium	61	-0.30	0.87	2.98	Sudden rise in groundwater level in Q3 2020, expected to be associated by damage. Monitoring location replaced by BHC8S.
BHC5S	Alluvium	93	-0.01	1.56	2.80	-
BHC6S	Alluvium	62	0.84	2.16	5.26	Note in Q2 2016 that new borehole drilled. No significant change in levels.
BHC7S	Alluvium	66	0.98	1.75	1.98	Q4 2024 reading 1.7m higher than previously recorded. No comment seen in record, therefore unsure for high level.
BHC8S	Alluvium	28	1.34	2.56	4.05	Data starts in Q3 2020 as replacement for BHC4S.
BHC1D	Chalk	74	-1.60	0.65	6.70	Rise in base of standpipe from 31m bgl to 12m bgl in Q2 2018. Subsequent readings becoming highly variable and considered erroneous. This location is outside of the permit boundary and will

Borehole ID	Strata	Count	Groundwater Level (mAOD)			Comment
			Min	Average	Max	
						be decommissioned in line with the Environment Agency guidance 1.
BHC2D	Chalk	64	-2.60	0.64	5.47	Noted as blocked in Q3 2010 and replaced by new borehole in Q2 2011. Q4 2018 reading 2m lower than previously recorded, no comment provided. Rise in base of standpipe from 30m bgl to 11m bgl in Q2 2020. Subsequent readings becoming highly variable and considered erroneous. Q4 2022 it was noted that BHC2S may be overflow into BHC2D.[2]
BHC3D	Chalk	101	-1.70	0.52	2.08	Noted as being buried in 2008/09.
BHC4D	Chalk	62	0.02	0.49	2.00	Last recording Q4 2020, replaced by BHC8D
BHC5D	Chalk	98	-0.50	0.52	1.12	-
BHC6D	Chalk	68	-0.60	0.59	2.35	Note in Q2 2016 that new borehole drilled. No significant change in levels.
BHC7D	Chalk	68	0.00	0.64	1.46	Q1 2017 comment stating "Outer casing overflowing and bubbling", level maybe affected by high level in BHC7S.
BHC8D	Chalk	29	-0.15	0.40	1.12	Data starts in Q3 2020 as replacement for BHC4D.

[1] Environment Agency Guidance on the design and installation of groundwater quality monitoring points Science Report SC020093 https://assets.publishing.service.gov.uk/media/5a7ce4a1e5274a2c9a484c2e/scho0106bkct-e-e.pdf
[2] Based on a review of the data this borehole has been damaged and is no longer reliable. This location will be replaced within a suitable location as discussed in Section 5.2.

3.2.25 Groundwater levels within the Alluvium range from approximately 0m AOD to 8 m AOD across the site. In the northern and western areas (corresponding to Areas A3, B, C1, C2 and C3 in Figure 2-1), average groundwater elevations typically lie between 0.7 m and 2.6 m AOD. In contrast, the southern areas (A1 (outside Tilbury Landfill) and A2 in Figure 2-1) show higher average levels at 6.3m AOD to 6.7 m AOD. This spatial variation suggests the presence of multiple groundwater levels as locally disconnected water-bearing zones within the Alluvium. This may be attributed to placement of material in A1 and A2, resulting in high porewater pressures in the Alluvium under the waste.

3.2.26 Groundwater levels within the Chalk range from approximately –3 m AOD to 7m AOD. High-frequency LTC monitoring data indicates a clear tidal influence in both the RTD and Chalk, driven by fluctuations in the River Thames. Due to this influence, recorded groundwater levels exceeding 4 m AOD (higher than River Thames) are considered anomalous and have been treated as erroneous. Adjusting for these anomalies, the representative range for Chalk groundwater levels is 3.9m AOD to 1.3m AOD. Average groundwater levels show minimal spatial variation, indicating a flat or subdued hydraulic gradient.

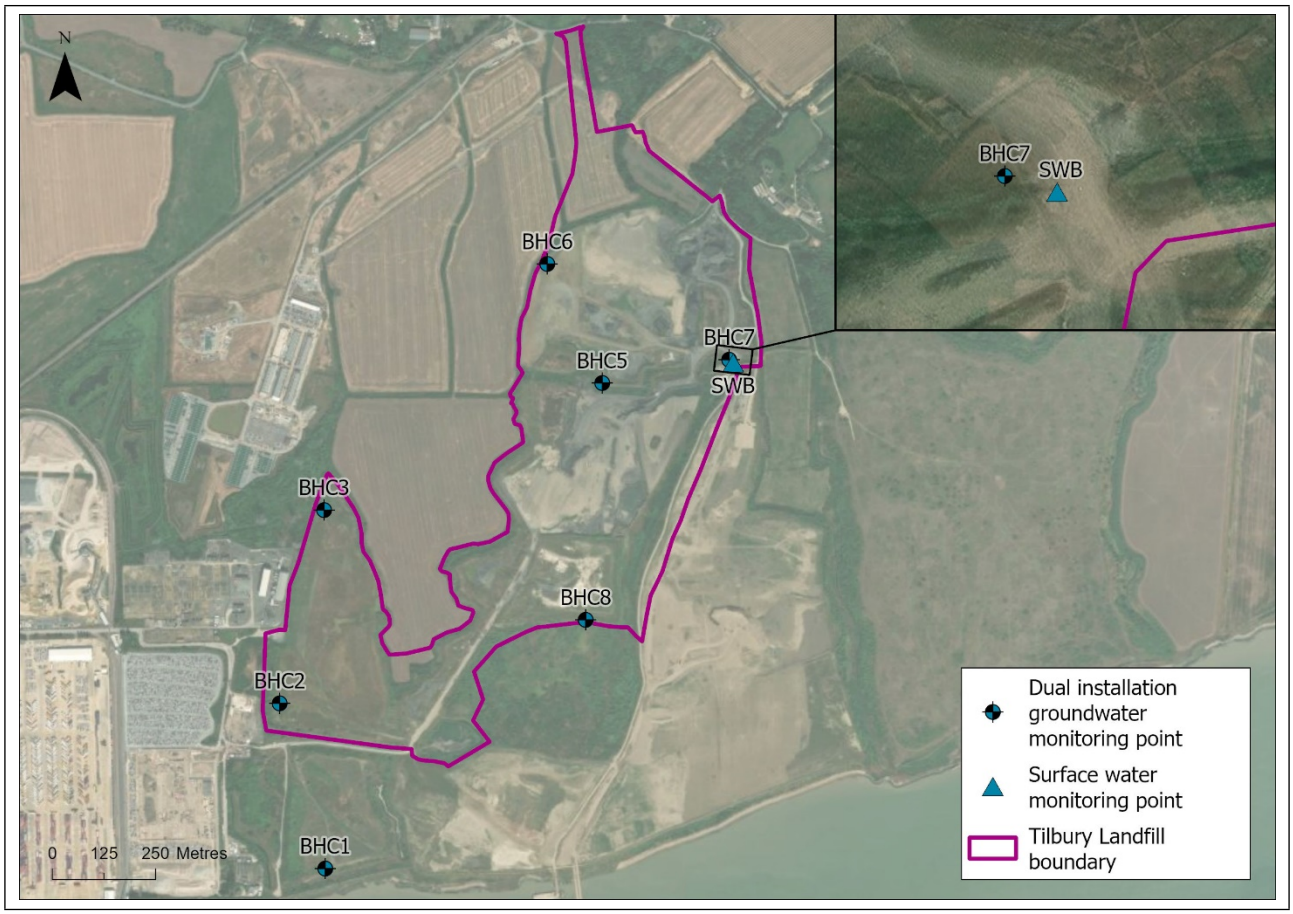
3.2.27 Environment Agency monitoring data from Brooke Farm (north of the site) records groundwater levels of 9m AOD to 10 m AOD, supporting a regional hydraulic gradient directed southwards towards the River Thames.

3.2.28 Tilbury Ash Disposal Site groundwater level monitoring is consistent with the wider observations as part of LTC ground investigation.

Groundwater quality

3.2.29 Groundwater quality in both the Alluvium and Chalk was monitored quarterly under the previous permit, with dual-installation standpipes shown in Figure 3-7. Monitoring data spans a 17-year period (2008 to 2025). Continuous datasets are available for seven boreholes, however, BHC4 exhibited deterioration in 2020 and was subsequently replaced with BHC8.

Figure 3-7 Tilbury Ash Disposal Site groundwater and surface water monitoring



Alluvium groundwater quality

3.2.30 A summary of the available groundwater quality data is provided in Table 3-8. As part of an initial review of the data, the results have been compared against DWS which is conservative. The average concentration is highlighted blue where above the DWS. The results are discussed further below.

3.2.31 Graphical presentation of key parameters is included in Appendix A.

Table 3-8 Summary of groundwater quality in the Alluvium

Determinand	DWS (mg/l)	Count	Groundwater concentration (mg/l)		
			Min	Average	Max (location ID)
pH units	-	507	6.5	7.2	12 (BHC8S)
Conductivity uS/cm @ 25C	2500 (uS/cm)	514	970	21000	42000 (BHC1S)
Total Alkalinity as CaCO3	-	424	155	2300	25000 (BHC1S)
Chloride	250	431	511	7500	17000 (BHC1S)
Fluoride	1.5	377	0.099	0.47	<5
Bromide	-	377	<0.05	54	1000 (BHC5S)
Total Sulphur as SO4	250	523	<2	190	3200 (BHC4S)

Determinand	DWS (mg/l)	Count	Groundwater concentration (mg/l)		
			Min	Average	Max (location ID)
Calcium	250	431	<1	360	1200 (BHC4S)
Magnesium	50	433	<1	550	1200 (BHC1S)
Barium	1	370	<0.0002	0.18	2 (BHC8S)
Sodium	200	433	<1	3800	13000 (BHC1S)
Potassium	12	433	<1	160	550 (BHC4S)
Nickel	0.02	508	<0.0003	0.0064	0.12 (BHC1S)
Chromium	0.05	508	<0.0002	0.0091	0.066 (BHC7S)
Cadmium	0.005	389	<0.00001	0.00019	0.0039 (BHC4S)
Copper	2	377	<0.0003	0.004	0.23 (BHC1S)
Lead	0.01	377	<0.0001	0.0014	0.066 (BHC1S)
Zinc	5	377	<0.001	0.013	0.76 (BHC1S)
Manganese	0.05	377	<0.00076	1.4	22 (BHC4S)
Iron	0.2	431	<0.01	5.3	49 (BHC1S)
Aluminium	0.2	508	0.001	0.05	2.5 (BHC7S)
Arsenic	0.01	509	0.0003	0.012	0.1 (BHC4S)
Boron	1	473	<0.005	2.9	55 (BHC4S)
Mercury	0.001	508	<0.00001	0.0001	0.0031 (BHC1S)
Selenium	0.01	508	<0.0005	0.011	0.21 (BHC1S)
Vanadium	-	508	0.0002	0.0058	0.064 (BHC3S)
Molybdenum	0.071	518	0.00009	0.46	23 (BHC4S)
Cobalt	-	377	<0.00015	0.0029	0.039 (BHC3S)
Tin	-	376	<0.0002	0.0018	<0.03
Thallium	-	357	<0.001	<0.002	<0.02
Antimony	0.005	508	<0.0001	0.0013	<0.01
Ammoniacal Nitrogen as N	0.39	412	4.24	52	140 (BHC5S)
Nitrate	50	419	<0.01	0.22	3.3 (BHC1S)
Chromium VI	0.05	410	0.00028	0.022	0.36 (BHC1S)
Total Oxidised Nitrogen	-	424	0.02	0.24	3.8 (BHC1S)
Phosphate	2.2	377	<0.01	1.3	15 (BHC3S)
Total Organic Carbon	-	423	1.9	35	150 (BHC6S)
Silicon	-	342	<0.1	21	280 (BHC7S)
Beryllium	-	342	<0.0001	0.0072	0.08 (BHC2S)

Notes:
1 No DWS are available for Molybdenum, values from WHO guidance used.

3.2.32 It has been noted in previous assessments that BHC1S, BHC2S and BHC6S are likely to be monitoring both the Alluvium and PFA waste.

3.2.33 A review of the data indicates that the Alluvium groundwater exhibits impact from saline intrusion, with average concentrations of sodium (3,800mg/l), chloride (7,500mg/l) and high concentrations of magnesium (550mg/l), calcium (360mg/l), potassium (160mg/l) and bromide (54mg/l). These levels have generally been consistent across the period of monitoring, highlighting the persistent nature of the saline intrusion.

3.2.34 Previously BHC4S has been highlighted as having higher concentrations of sulphate, aluminium, boron and molybdenum compared to other monitoring locations. As part of the 2020 annual review, it was determined that BH4Cs condition had deteriorated, potentially creating a pathway from the PFA to the Chalk aquifer. BH4C was subsequently decommissioned and replaced by BH8C. Subsequent monitoring of BH8Cs has demonstrated concentrations that align with other monitoring locations.

3.2.35 Hazardous metals arsenic, lead and mercury have previously been detected above the method detection limit. Concentrations of mercury and lead above the DWS have been recorded in BHC1s as detailed below.

- One sample with a concentration of mercury at 0.003mg/l in May 2016 above the DWS of 0.001mg/l. The preceding and following rounds were below the method detection limit.
- Three samples with concentrations of lead above the DWS of 0.01mg/l between July 2015 and May 2016. The results ranged between 0.029mg/l to 0.066mg/l. After May 2016 the results fell to below the method detection limit and remained consistently below detection up to 2025.

3.2.36 These elevated concentrations appear to be isolated events with no underlying trend.

3.2.37 Borehole average concentrations of arsenic range between 0.0067mg/l and 0.021 mg/l, with graphs (included as Appendix A) showing a general trend of reducing concentrations below the DWS of 0.01mg/l (except for slight increase in concentrations in the winter of 2024/25). Concentrations of leachable arsenic from the waste sources including the PFA are low as shown in Table 3-2, and the source of the recent increase in arsenic is unlikely to be attributable to the waste.

3.2.38 Non-hazardous metals including manganese, iron, boron and selenium have been recorded at most Alluvium boreholes above their respective DWS. The graphs showing the determinands which are included as Appendix A indicates that there is significant variation in concentrations of these determinands but typically no observable trend. It is therefore difficult to attribute the results to landfilling activities. It is noted that:

- the concentrations of manganese and iron in groundwater across the site are significantly higher than those in the PFA and therefore are unlikely to derive from landfilling activity – organic clay typically contains elevated concentrations of these metals.

- iron levels significantly reduced in 2020, remaining below 5mg/l, when previously spikes of 20mg/l to 30 mg/l were commonly observed.
- elevated boron concentrations could derive from saline intrusion

3.2.39 Ammoniacal nitrogen has been recorded in all Alluvium boreholes at concentrations between 7mg/l to 139mg/l, above the concentrations in the PFA leachability results (0.4mg/l to 5.74mg/l) and the DWS of 0.39mg/l. These results are considered to be reflective of non-landfill sources. Ammoniacal nitrogen is typically a ubiquitous contaminant from agricultural processes or could be as a result of natural processes in the alluvial clays and marshes.

3.2.40 Typically, maximum observed concentrations are from BH1CS. The land surrounding BH1CS has not been disturbed since the PFA was placed (over 15 years) and the results are often higher than the PFA leachability results (Table 3-2) therefore the results are likely a reflection of its location adjacent to the River Thames, highlighting the impact of the saline intrusion on groundwater quality in the Alluvium.

3.2.41 Overall, the natural water quality in the Alluvium is impacted by saline intrusion. Several determinands are found to be elevated in the groundwater and could be attributed to leaching from the PFA, including aluminium, boron, selenium, molybdenum and sulphate. However, it should be noted that the presence of these determinands within the Alluvium is not an indication of a failure of the geological barrier, as the Alluvium is over 10m thick. The results reflect the attenuation of these determinands as they migrate through the geological barrier.

Chalk groundwater quality

3.2.42 Groundwater quality data from the Chalk is summarised in Table 3-9 and graphical plots of key parameters are included in Appendix A.2.

3.2.43 As part of an initial review of the data, the results have been compared against DWS to benchmark the results. The average concentration is highlighted blue where above the DWS. The results are discussed further below.

3.2.44 The permit-specific compliance limits are discussed and provided in Section 5.

Table 3-9 Summary of groundwater quality in the Chalk

Determinand	DWS (mg/l)	Count	Groundwater concentration (mg/l)		
			Min	Average	Max (location ID)
pH units	-	510	6.6	7.3	13 (BHC8D)
Conductivity uS/cm @ 25C	2500 (uS/cm)	511	970	8800	41000 (BHC1D)
Total Alkalinity as CaCO3	-	429	91	980	15000 (BHC7D)
Chloride	250	431	239	2700	11000 (BHC1D)
Fluoride	1.5	380	0.16	0.45	7.3 (BHC6D)
Bromide	-	380	0.8	22	530 (BHC1D)
Total Sulphur as SO4	250	529	<2	140	1800 (BHC4D)

Determinand	DWS (mg/l)	Count	Groundwater concentration (mg/l)		
			Min	Average	Max (location ID)
Calcium a	250	429	<1	230	1200 (BHC8D)
Magnesium	50	431	0.111	210	960 (BHC1D)
Barium	1	366	<0.01	0.17	9.5 (BHC8D)
Sodium	200	431	<1	1500	6700 (BHC2D)
Potassium	12	431	<1	67	250 (BHC4D)
Nickel	0.02	504	<0.0004	0.0052	0.17 (BHC8D)
Chromium	0.05	502	<0.001	0.0045	0.03 (BHC3D)
Cadmium	0.005	385	<0.00002	0.00012	0.0012 (BHC2D)
Copper	2	373	<0.0003	0.0019	0.07 (BHC2D)
Lead	0.01	373	<0.0001	0.00093	<0.01[b]
Zinc	5	373	<0.001	0.011	0.77 (BHC7D)
Manganese	0.05	373	<0.003	1	19 (BHC5D)
Iron	0.2	429	<0.01	2	22 (BHC6D)
Aluminium	0.2	504	0.001	0.017	1.2 (BHC4D)
Arsenic	0.01	507	<0.00015	0.0041	0.036 (BHC2D)
Boron	1	465	0.0167	1.2	23 (BHC5D)
Mercury	0.001	502	<0.00001	0.000081	<0.001[b]
Selenium	0.01	502	<0.0005	0.0057	0.067 (BHC6D)
Vanadium	-	502	<0.0002	0.0023	0.019 (BHC8D)
Molybdenum[a]	0.071	521	<0.001	0.036	2.8 (BHC4D)
Cobalt	-	373	<0.00015	0.0021	0.026 (BHC5D)
Tin	-	372	<0.001	0.0013	0.014 (BHC1D)
Thallium	-	353	<0.001	0.0017	<0.02
Antimony	0.005	502	<0.0001	0.0011	<0.01
Ammoniacal Nitrogen as N	0.39	417	0.9	16	84 (BHC1D)
Nitrate	50	422	<0.01	0.24	7.2 (BHC1D)
Chromium VI	0.05	413	0.00024	0.018	0.15 (BHC7D)
Total Oxidised Nitrogen	-	429	0.02	0.26	7.2 (BHC1D)
Phosphate	2.2	380	<0.01	0.6	29 (BHC7D)
Total Organic Carbon	-	429	1.3	10	63 (BHC2D)
Silicon	-	338	0.184	9.5	26 (BHC7D)
Beryllium	-	338	<0.0001	0.007	<0.01

Notes:
A No DWS are available for Molybdenum, values from WHO guidance used.

Determinand	DWS (mg/l)	Count	Groundwater concentration (mg/l)		
			Min	Average	Max (location ID)
B Maximum concentration is <LOD, however, measured results are available to calculate an average concentration.					

3.2.45 The Chalk exhibits a chemistry that is saline in nature, similar to the Alluvium chemical signature demonstrated by average concentrations of sodium (1,500mg/l), chloride (2,700mg/l), magnesium (210mg/l), calcium (230mg/l), potassium (67mg/l), and bromide (22mg/l). These concentrations have generally been consistent across the monitoring period, highlighting the persistent nature of the saline intrusion.

3.2.46 Key determinands that could be considered as potentially sourced from the PFA include aluminium, selenium, molybdenum and sulphate.

- Aluminum concentrations have typically been below DWS of 0.1mg/l, however, isolated spikes of 0.16mg/l in BHC5D in March 2012 and 0.28mg/l in BHC2D in May 2017. These are considered outliers and are not indicative of a trend of reducing aquifer quality.
- Selenium concentrations have been elevated across the site. Before 2018 concentrations of selenium were above the DWS of 0.01mg/l at all locations. Since 2018 BHC1D, BHC2D, BH7CD and BHC8D have generally shown concentrations below the DWS (only a few isolated spikes). BH3CD, BHC5D and BHC6D have repeatedly exceeded DWS, however, there is no notable trend in the data.
- Concentrations of molybdenum and sulphate were typically below the DWS of 0.005mg/l and 250 mg/l respectively prior to 2019, with only a few isolated spikes. Elevated concentrations of molybdenum and sulphate have been recorded since 2019 in BHC3D and BHC5D. However, there is no evidence of wider aquifer deterioration, as down-gradient locations (BH1CD and BH2CD) do not show corresponding increases. These concentrations may be a result of damage to the monitoring standpipes as the results are consistent with the short-term spikes previously observed at BHC4D prior to its replacement by BHC8D.

3.2.47 Hazardous metals arsenic, lead and mercury have been detected above the method detection limit in the Chalk aquifer however, detections of mercury and lead were consistently below the DWS.

3.2.48 At each borehole, average arsenic concentrations range from 0.003mg/l to 0.006mg/l, which is below the DWS of 0.01mg/l. Graphs showing the arsenic concentrations included in Appendix A generally indicate declining arsenic levels, although there were abnormal increases during the winter of 2024/25 which mirrors the fluctuations in the Alluvium. The maximum concentration of 0.036mg/l is the same order of magnitude as the DWS and was recorded in BHC2D in 2008. More recent elevated concentrations of arsenic were recorded in BHC6D. The samples were recorded in November 2024 and March 2025 (0.023mg/l and 0.029mg/l respectively) and were both lower on retests (0.017mg/l in November and 0.00015mg/l in March).

3.2.49 Ammoniacal nitrogen concentrations ranged between 0.9mg/l and 84mg/l above the DWS of 0.39mg/l. Average concentrations at each installation ranged between 9mg/l and 54.4mg/l. These concentrations are significantly higher than the leachability test results from the PFA (0.4mg/l to 5.74mg/l) and are considered to be reflective of non-landfill sources.

3.2.50 Elevated concentrations of molybdenum and sulphate have been recorded in recent years in BHC3 and BHC5. However, there is no evidence of wider aquifer deterioration, as down-gradient locations (BH1C and BH2C) do not show corresponding increases. These concentrations may be a result of damage to the monitoring standpipes as the results are consistent with the short-term spikes previously observed at BHC4 prior to its replacement by BHC8.

Hydrology

3.2.51 Tilbury Main River runs through the northern portion of the permit boundary from west to east. At this point, the river is close to its source and is often dry in the summer months. Due to earthworks activities around the river, at some points the river has become blocked with sediment, resulting in sections of standing water.

3.2.52 As a result, there is currently little to no flow within Tilbury Main through the site. As part of LTC, the river will be culverted at two points and sediment will be removed. However, it is not anticipated this will result in a significant flow increase through the river.

3.2.53 At the southeastern corner of Area C2 of Tilbury Ash Disposal permit boundary, Tilbury Main River is joined by another drainage ditch and flows south, draining into the River Thames 1km downstream via Bowater sluice.

Surface water quality

3.2.54 Surface water quality is monitored on a quarterly basis from a single monitoring point (SWB) as shown Figure 3-7. Based on recent site visits it is understood that the surface water monitoring point is located on a part of the river which has been blocked and therefore the sampling is of standing water.

3.2.55 Due to the nature of the ditches around the landfill site, monitoring of upstream water quality has not been undertaken due to these areas typically being dry and inaccessible.

3.2.56 Surface water quality monitoring data from 2008 to 2005 is summarised in Table 3-10. As part of an initial review of the data, the results have been compared against SEQS to benchmark the results. The average concentration is highlighted blue where above the SEQS. The results are discussed further below.

Table 3-10 Surface water quality monitoring data

Determinand	SEQS	Count	Min (mg/l)	Average (mg/l)	Max (mg/l)	No. > SEQS
pH	-	66	7.4	7.9	8.5	
Conductivity uS/cm	-	66	1200	6300	18800	

Determinand	SEQS	Count	Min (mg/l)	Average (mg/l)	Max (mg/l)	No. > SEQS
Aluminium	0.015	66	<0.007	0.23	1.64	43
Arsenic	0.025	66	<0.001	0.0062	0.049	1
Boron	7	66	0.00482	7.7	26	37
Cadmium	0.0002	65	0.00003	0.00063	<0.0015	3
Calcium	-	66	110	330	912	
Chromium	0.0047	66	0.0002	0.0064	0.023	25
Magnesium	-	66	22	200	370	
Nickel	0.0086	66	<0.0007	0.011	0.047	37
Potassium	-	66	<0.18	140	291	
Molybdenum	-	49	0.000142	0.27	1.24	
Sulphate	-	62	209	1100	2660	
Antimony	-	48	<0.0003	0.0023	0.011	
Barium	-	47	0.000102	0.059	0.234	
Copper	0.00376	49	<0.0005	0.008	0.0222	21
Fluoride	5	48	0.02	0.58	1.29	0
Lead	0.0013	62	0.0004	0.006	0.0382	25
Mercury	-	49	<0.000002	0.000033	<0.0001	
Phosphate	-	49	<0.03	0.64	5.49	
Sulphide	-	49	<0.01	0.063	1.02	
Zinc	0.0079	62	0.0015	0.019	0.125	36
Sodium	-	60	<0.5	1000	2770	
Chloride	-	66	121	1600	4670	

3.2.57 Time-series analysis of concentrations at SWB (see graphs in Appendix B), indicates mixed behaviour across determinands. The patterns are consistent with the estuarine setting and local hydrography. For example, major cations dilute and vary seasonally, whereas certain metals and boron can concentrate under low-flow conditions and episodic inputs, particularly in Q2 and Q3.

3.2.58 Although the results are consistently elevated above the SEQS for some determinands including aluminium, boron, chromium and nickel, the results have been consistent since 2009, and the surface water quality has not shown evidence of deterioration during the monitoring period.

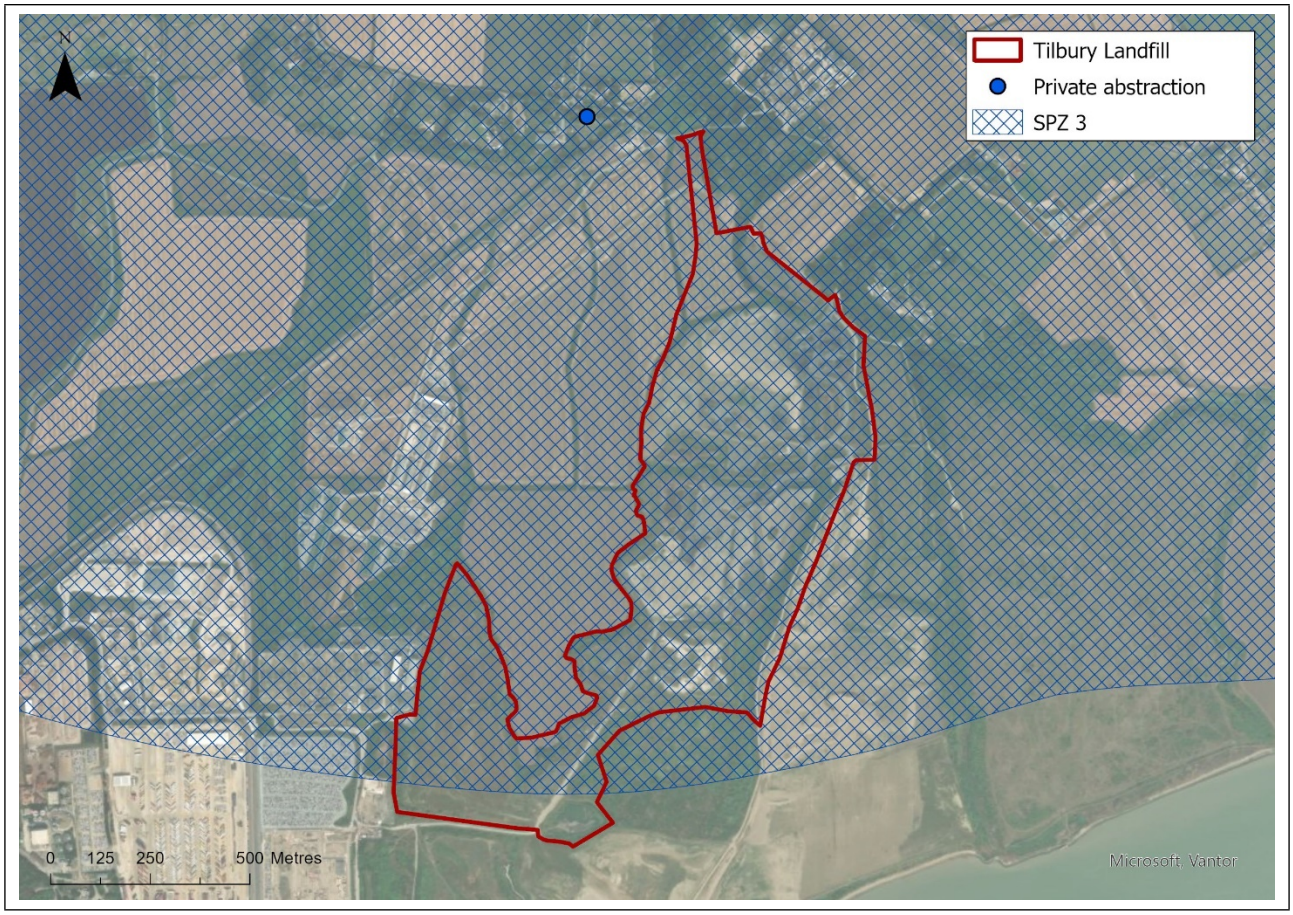
3.3 Receptors

3.3.1 The receptors identified at the site include the Chalk aquifer underlying the site and the adjacent surface watercourses, including the River Thames estuary.

3.3.2 Most of the permit boundary is located within a Source Protection Zone 3 (SPZ 3) as shown on Figure 3-8. The SPZ is within the Chalk bedrock aquifer associated with an abstraction located approximately 2.5km to the north at Linford. This abstraction is not currently used, however, will be brought back into use to supply water for the LTC Tunnel Boring Machine (TBM).

3.3.3 There is an active private groundwater abstraction registered to C H Cole & Sons (8/37/56/*G/0006) located 600m north of the site as shown on Figure 3-8. This is part of a combined licence of 1300 m^3/day associated with fluvial sands and gravels for spray irrigation.

Figure 3-8 Source protection zone and licensed abstraction



3.3.4 A summary of public licensed groundwater abstractions within a 5km radius of the site is presented in Table 3-11.

Table 3-11 Summary of licenced groundwater abstractions

Environmental permit licence	Eastings	Northings	Distance (km)[1]	Use	Max yearly abstraction m^3/a (abstracted strata)
8/37/56/*G/0006	566798	177598	1.4	General Farming & Domestic	18,200 (Fluvial sands and gravels)
8/37/56/*G/0073	567200	177802	1.4	General Use Relating to Secondary Category (Medium Loss)	1,100,000 (Chalk)
8/37/56/*G/0026	568800	177798	1.4	Mineral Washing	1,909 [2] (Fluvial sands and gravels)
8/37/56/*G/0062	568280	180300	2.0	Industrial, Commercial and Public Services, Extractive, Dust Suppression	6,000 (Gravel pit)
8/37/56/*G/0044	567168	179280	3.8	Linford public water supply	3,728,000 (Chalk)
AN/037/0056/012	565985	180732	4.5	Irrigation of the golf course	Unknown

[1] From northern edge of Tilbury Landfill permit boundary
[2] groundwater feature survey quoted “1909??”, therefore expecting value not to be correct

4 Hydrogeological risk assessment

4.1.1 The previous risk assessments prepared for Tilbury Ash Disposal Site concluded that the existing deposits of PFA and inert waste would not cause an unacceptable risk to controlled waters.

4.1.2 Leachability testing results from the DfR material indicates that the concentrations of determinands are similar or lower than the leachability than the wastes already deposited. No new or different contaminants have been identified in the Goshems Farm DfR material.

4.1.3 Quantities of leachate are expected to be very low, based on the cohesive nature of the DfR material from Goshems Farm and the proposals to compact the materials.

4.1.4 The conceptual model for the new landfill is the same as that previously assessed for Tilbury Ash Disposal Site. Although the boundary of the new permit extends further north than the previous permit boundary, the Chalk aquifer is still protected by between 5m to 17m of cohesive Alluvium which acts as an aquitard. The previous risk assessments for the Tilbury Ash Disposal Site concluded that there was minimal risk to the Chalk aquifer. The Chalk aquifer is impacted by saline intrusion and is not a drinking water source.

4.2 Potential discharge of hazardous substances

4.2.1 Due to the nature of the DfR material (predominantly clays) the material is unlikely to produce leachate as discussed in Section 3.1. Considering the ground conditions, environmental setting, characteristics of the waste and leachability testing results the assessment is therefore sufficiently conservative and indicates placing the DfR material at the site is unlikely to result in discharge of hazardous substances to groundwater.

4.3 Potential discharge of non-hazardous substances

4.3.1 The leachate results from the DfR for the remaining contaminants have been considered further in Table 4-1.

Table 4-1 Leachability testing results above DWS and background groundwater concentrations

Priority contaminant	DWS (mg/l)	Average groundwater concentration (mg/l)		Average DfR leachability testing results (mg/l)	With dilution factor applied (mg/l)
		Landfill monitoring			
		Alluvium	Chalk		
Antimony	0.005	0.0013	0.0011	0.0085	2.55E-11
Selenium	0.01	0.011	0.0057	0.022	6.6E-11
Phenols	0.0005	-	-	0.011	3.3E-11

4.3.2 The RWE Npower 2004 HRA calculated a dilution factor which was applied to the results. This dilution factor of 3 x 10^{-9} has been applied to the results for the determinands in Table 4-1, demonstrating that the resultant concentrations would be significantly lower than the conservative DWS and therefore the proposed source material would pose a negligible risk to the Chalk aquifer.

4.3.3 The proposed groundwater monitoring scope discussed in Section 5.2 takes into account the findings of this assessment.

4.4 Potential discharge of substances to surface water

4.4.1 As discussed in Section 3.2, Tilbury Main River is dry through large periods of the year, and is currently blocked, creating sections of standing water. The river is joined by a ditch on the corner of the new permit boundary in the east and drains into the River Thames located 1km down gradient via Bowaters sluice.

4.4.2 Due to the lack of water and poor connectivity within Tilbury Main River in the site boundary, it is considered that the following assessment is very conservative and assumes the river will potentially have a flow and connectivity to the River Thames in the future.

4.4.3 The assessment considers the leachability results from the DfR material against SEQS. The determinands have been spilt into three groups:

- Determinands where leachability test results from the DfR material are below the conservative SEQS. These results are not considered further in this assessment.
- Determinands where leachability test results from the DfR material are above the SEQS, but below average background surface water concentrations recorded during the IVL monitoring. Due to the potential for the river to be opened up in the future, these results are considered further below.
- Determinands where the leachability test results from the DfR material are above the SEQS and above the average surface water concentrations. These are considered further below.

Table 4-2 Leachability testing results above SEQS and background surface water concentrations

Determinand	SEQS (mg/l)	Average surface water concentration (mg/l)	Average LTC DfR leachability testing results (mg/l)
Chromium VI	0.0006	Total chromium results - 0.0064	0.0042
Ammoniacal Nitrogen as N	0.021	Not included in test suite.	1.7
Cobalt	0.003	Not included in test suite.	0.0032
Copper	0.00367 (where DOC <1mg/l)	0.008	0.042

Determinand	SEQS (mg/l)	Average surface water concentration (mg/l)	Average LTC DfR leachability testing results (mg/l)
Cyanide	0.001	Not included in test suite.	0.015
Nickel	0.0086	0.011	0.01
Phenols	0.0077	Not included in test suite.	0.011
Zinc	0.0068 (bioavailable)	0.019	0.01

4.4.4 The results from eight determinands were recorded above the SEQS. Concentrations of nickel, zinc and hexavalent chromium in the DfR material leachability testing were recorded below the average surface water concentrations at the site. Although these were recorded below the current average concentrations, as a conservative measure, all three of these determinands will be monitored as part of the annual monitoring suite discussed further in Section 5.3. Hexavalent chromium is not commonly detected in surface water as it requires reducing conditions and has not previously been monitored in surface water, therefore total chromium is proposed to be used as an indicator in surface water monitoring.

4.4.5 Concentrations of copper, cyanide and phenols from leachability testing have been recorded above the SEQS and above the average surface water concentrations or there is no available surface water test data to compare the results to. These determinands are therefore taken forward as part of the annual monitoring suite outlined in Section 5.3.

4.4.6 Concentrations of ammoniacal nitrogen have not previously been included in the surface water monitoring suite, however, groundwater monitoring has shown ammoniacal nitrogen is present across the site in the groundwater at elevated concentrations and based on the activities surrounding the site including agricultural land and historical landfills, it is anticipated that concentrations of ammoniacal nitrogen in surface water will also be elevated in this area. It is therefore not considered appropriate to monitor the surface water features for ammoniacal nitrogen.

4.4.7 Similarly, cobalt has not been tested for in the surface water features. The average concentrations in the DfR material leachability testing which is an aggressive test method, are 0.0002mg/l above the SEQS which is a marginal exceedance. Cobalt has therefore not been taken forward as part of the annual monitoring suite.

4.4.8 As outlined in Section 3.1, based on properties of the inert clayey DfR material and the proposed compaction of the material when placed, it is very unlikely that leachate will be generated by the proposed waste source.

4.4.9 Although Tilbury Main River has been observed to have little to no flow during most of the year, the proposed LTC scheme intends to remove any blockages therefore improving the flow into the River Thames. It is therefore considered appropriate to continue monitoring at SWB, during the landfilling activities quarterly. This is discussed further in Section 5.3.

5 Requisite surveillance

5.1 Leachate monitoring

5.1.1 The PFA and inert waste already deposited in Tilbury Ash Disposal Site is not considered to have the potential to generate leachate in any significant quantities and therefore leachate levels and quality are not monitored. The proposed site activities for Tilbury Landfill align with the previous activity, therefore the leachate generating potential remains low. Monitoring of leachate levels and quality is not proposed as part of the proposed works.

5.2 Groundwater monitoring

5.2.1 The proposed groundwater monitoring schedule has been defined in Table 5-1, with locations shown in Figure 5-1.

5.2.2 Groundwater levels and quality are currently monitored quarterly via seven dual-standpipe installations, with one standpipe screened in the Alluvium and the other in the Chalk at each location. As the proposed new permit maintains the same operational activities and sources as the previous permit, the current monitoring arrangements are considered appropriate. However, due to the change in permit boundary proposed under this new permit, some of the monitoring wells will change, as follows:

- Area A1 relating to the former Tilbury Ash Disposal Site permit boundary is to be permanently surrendered, therefore monitoring in BHC1S and BHC1D will not be continued under the new permit;
- BHC2D (Response zone from -17.0 to -20.0mOD) is suspected to be blocked and will be replaced by a well with a response zone covering the same area of chalk, to provide continued groundwater monitoring;
- BHC4D has already been decommissioned and replaced with BHC8D under the previous permit;
- BHC9D is a new monitoring location in the north of the permit boundary, to monitor the extended area of landfilling. Existing monitoring well BH08022 will be used to allow monitoring of the Chalk for this extended area.

5.2.3 The Alluvium forms an aquitard and functions as the site's geological barrier. Monitoring within this unit provides a direct indication of any potential leachate migration from the overlying PFA or inert waste. Groundwater quality results confirm that Alluvium chemistry is primarily controlled by the natural clay mineralogy and influence of saline intrusion. Accordingly, monitoring within the Alluvium focuses on key determinands that act as indicators of potential leakage from the PFA, existing inert waste and proposed waste from Goshems Farm DfR.

5.2.4 As the Chalk aquifer represents the principal receptor, quarterly monitoring is currently undertaken for key determinands, with a full suite of hazardous and non-hazardous substances monitored annually. Given that site operations are not proposed to change, this monitoring regime continues to provide an appropriate and proportionate level of risk based environmental monitoring.

Table 5-1 Proposed groundwater monitoring schedule

Location	Frequency	Measurement and analytical suite
Alluvium BHC2S, BHC3S, BHC5S, BHC6S, BHC7S, BHC8S	Quarterly	Water level (mAOD), aluminium, antimony, arsenic, boron, chromium, molybdenum, mercury, nickel, selenium, sulphate, vanadium
Chalk BHC2D, BHC3D, BHC5D, BHC6D, BHC7D, BHC8D, BHC9D (BH08022)	Quarterly	Water level (mAOD), aluminium, antimony, arsenic, boron, chromium, molybdenum, mercury, nickel, selenium, sulphate, vanadium
	Annual	pH, electrical conductivity, total alkalinity, chloride, fluoride, bromide, calcium, magnesium, barium, sodium, potassium, cadmium, copper, lead, zinc, manganese, iron, cobalt, tin, thallium, antimony, ammoniacal nitrogen, TON, TOC, phosphate and phenol Base of monitoring point (mAOD)

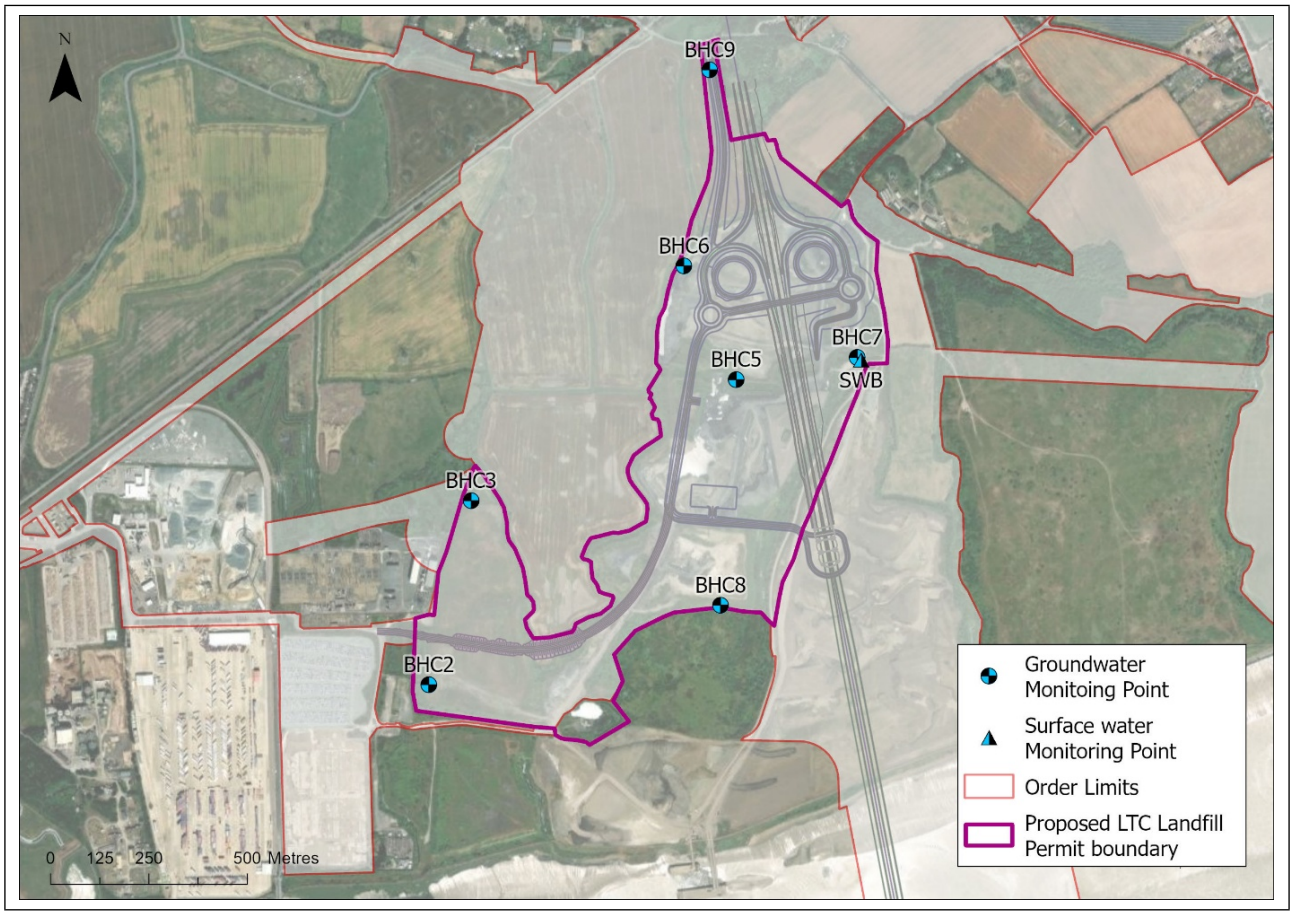
Compliance limits

5.2.5 Suitable control levels have been derived in line with previous HRAs (and given that site activities will remain unchanged under the new permit) and Permit Variation (EPR/GP3733DZ/V007 - 2025). The compliance limits for the existing permit have been adopted for this application as it has been demonstrated in Section 3 that the chemistry of the Goshems Farm DfR materials to be placed in the Tilbury Landfill is similar or less than the wastes currently disposed of in the Tilbury Ash Disposal Site.

5.2.6 Compliance limits have been set only for the Chalk aquifer, which constitutes the primary receptor. It is not considered appropriate to establish compliance limits for the Alluvium, as it functions as the geological barrier rather than a receptor. Monitoring shall continue to aid characterisation of the system. For the new monitoring location BHC9D, DWS have been applied as compliance limits.

5.2.7 The monitoring locations are set out in Figure 5-1.

Figure 5-1 Groundwater and surface water requisite surveillance monitoring locations.



5.2.8 The proposed control levels and compliance limits for each Chalk monitoring location are presented in Table 5-2. These values have been set to identify any potential deterioration relative to the current baseline, acknowledging that true background groundwater quality cannot be established due to historic site operations.

5.2.9 The limits have been derived as follows:

- Control levels – mean concentration plus two times standard deviations.
- Compliance limits – set at the relevant DWS (or WHO guidelines where DWS are not available). Where the previous compliance limits detailed in permit variation EPR/GP3733DZ/V007 are higher than the DWS, these have been taken forward as the proposed compliance limits.

5.2.10 In line with the Permit Variation EPR/GP3733DZ/V007, no compliance limits are proposed for the following installations:

- BHC3D: no compliance limits were set under the previous permit (V007) for this monitoring well.
- BHC5D: no compliance limits were set under the previous permit for this monitoring well.

Table 5-2 Proposed compliance limits

Borehole	Determinand	DWS (mg/l)	Mean concentration in Chalk (mg/l)	Proposed control level (mg/l)	Proposed compliance limit (mg/l)
BHC2D	Aluminium	0.2	0.018	0.088	0.2
	Nickel	0.02	0.0038	0.011	0.02
	Molybdenum [b]	0.07	0.0042	0.022	0.07
	Selenium	0.01	0.0056	0.023	0.02[a]
	Sulphate	250	8.9	50	250
	Arsenic	0.01	0.0041	0.016	0.026[a]
	Chromium	0.05	0.0044	0.016	0.05
BHC3D	Aluminium	0.2	0.013	0.050	No compliance limits proposed [c]
	Nickel	0.02	0.004	0.013	
	Molybdenum [b]	0.07	0.042	0.236	
	Selenium	0.01	0.0048	0.017	
	Sulphate	250	69	301	
	Arsenic	0.01	0.0033	0.011	
	Chromium	0.05	0.0029	0.012	
BHC5D	Aluminium	0.2	0.012	0.049	No compliance limits proposed [c]
	Nickel	0.02	0.0035	0.016	
	Molybdenum [b]	0.07	0.047	0.226	
	Selenium	0.01	0.0065	0.023	
	Sulphate	250	340	1177	
	Arsenic	0.01	0.003	0.011	
	Chromium	0.05	0.0038	0.015	
BHC6D	Aluminium	0.2	0.014	0.044	0.2
	Nickel	0.02	0.0028	0.010	0.02
	Molybdenum [b]	0.07	0.0063	0.052	0.07
	Selenium	0.01	0.0048	0.022	0.016[a]
	Sulphate	250	29	100	250
	Arsenic	0.01	0.0041	0.016	0.013 [a]
	Chromium	0.05	0.005	0.018	0.05
BHC7D	Aluminium	0.2	0.016	0.053	0.2
	Nickel	0.02	0.0066	0.026	0.02
	Molybdenum [b]	0.07	0.0033	0.012	0.07
	Selenium	0.01	0.0055	0.017	0.021 [a]
	Sulphate	250	110	312	250

Borehole	Determinand	DWS (mg/l)	Mean concentration in Chalk (mg/l)	Proposed control level (mg/l)	Proposed compliance limit (mg/l)
	Arsenic	0.01	0.0045	0.014	0.017 [a]
	Chromium	0.05	0.0051	0.017	0.05
BHC8D	Aluminium	0.2	0.014	0.052	0.2
	Nickel	0.02	0.017	0.087	0.02
	Molybdenum [b]	0.07	0.028	0.130	0.07
	Selenium	0.01	0.0028	0.006	0.01
	Sulphate	250	23	70	250
	Arsenic	0.01	0.0028	0.011	0.01
	Chromium	0.05	0.00092	0.003	0.05
BHC9D [ef] (BH08022)	Aluminium	0.2	Note d		0.2
	Nickel	0.02	0.021	0.021	0.02
	Molybdenum [b]	0.07	Note d		0.07
	Selenium	0.01	0.0036	0.0036	0.01
	Sulphate	250	134	134	250
	Arsenic	0.01	0.0079	0.0079	0.01
	Chromium	0.05	0.003	0.003	0.05

Notes:

a) Compliance limit as set in Tilbury Ash Disposal permit variation EPR/GP3733DZ/V007.

b) No DWS has been defined for Molybdenum, therefore WHO guidelines have been applied.

c) As noted in the permit variation BHC5D and BHC3D[12].

d) No historic sampling available to determine a mean concentration. No control level defined.

e) Single sampling result available taken as part of LTC ground investigation in 15/07/2020

f) BHC9d is a new monitoring location to cover extend permit area to the north, therefore compliance limits not reported in the 2025 permit variation[12].

5.3 Surface water monitoring

5.3.1 Surface water monitoring is restricted to a single downstream location, as potential upstream points are either inaccessible or dry for most of the year. In line with the previous permit, it is proposed that quarterly monitoring is undertaken only for key determinands to provide contextual information that supports the groundwater monitoring programme; no compliance limits are applied to surface water.

5.3.2 It should be noted that a new surface water discharge permit is being applied for by BMJV, which is also likely to include requirements for surface water monitoring.

5.3.3 The monitoring schedule from the previous permit is considered appropriate and is therefore retained, with the addition of contaminants identified from the risk assessment (chromium, copper, cyanide, nickel, phenols and zinc).

5.3.4 A summary of the monitoring schedule is provided in Table 5-3 and location of the sampling point in Figure 5-1.

Table 5-3 Proposed surface water monitoring schedule

Location	Frequency	Measurement and analytical suite
SWB	Quarterly	pH, Electrical Conductivity, Aluminium, Arsenic, Boron, Cadmium, Chromium, Copper, Chloride, Fluoride, Calcium, Magnesium, Nickel, Sodium, Sulphate, Potassium, Cadmium, Lead, Zinc, Phenols, Cyanide

6 Compliance with Environmental Permitting Regulations 2016

6.1.1 This section demonstrates how this HRA complies with the relevant parts of the Environmental Permitting Regulations 2016.

6.2 Schedule 9

6.2.1 In accordance with Schedule 9 of the Environmental Permitting (England and Wales) Regulations 2016, the proposed activities fall within the definition of waste operations associated with a landfill installation. Although the detailed LTC construction programme is still being finalised, the waste management activities under the new permit are expected to remain consistent with those authorised under the previous IVL permit. These activities include:

- Disposal of inert waste in line with permitted waste types;
- Recovery of PFA for stockpiling on site and later use as part of ecological mitigation.

6.2.2 Although the permit boundary is to change under the new permit, the overall area of the permit is not significantly different from that in the previous permit. The previous permit area was 80ha. The new permit area is approximately 76ha.

6.2.3 These activities remain within the scope of Schedule 9 and do not constitute a change in the nature or scale of the permitted waste operation.

6.2.4 To meet the requirements of Schedule 9 regarding record-keeping and management of waste operations, the operator (BMJV) will maintain detailed records of all waste movements to and from the site. The nature of the records to be kept is detailed in the Site Operation and Waste Acceptance Procedures document which is submitted with this permit application.

6.2.5 These measures ensure continued compliance with Schedule 9 and maintain consistency with the requirements of the previous permit.

6.3 Schedule 10

6.3.1 Schedule 10 of the Environmental Permitting (England and Wales) Regulations 2016 sets out the requirements for landfill installations, including:

- Geological/hydrogeological characteristics
- Protection measures
- Leachate & gas control systems
- Stability assessments
- Monitoring plans

6.3.2 The proposed permit application will operate fully within the scope of Schedule 10. As activities will remain consistent with those previously

authorised, the site continues to satisfy the regulatory expectations for landfill operations.

6.3.3 The HRA determined that the remaining and proposed new waste is of low permeability and low leachability, resulting in a very low potential for leachate generation. Accordingly, leachate management systems are not required under Schedule 10.

6.3.4 The conceptual model demonstrates that the underlying geological barrier, comprising very low-permeability Alluvium, provides effective attenuation and restricts vertical migration to the Chalk aquifer. Although the Chalk is designated as a Principal Aquifer, groundwater beneath the site is demonstrably influenced by saline intrusion and is not used for potable supply. The nearest licensed public water supply abstraction located 3.8 km away at Linford. This site is hydraulically upgradient of the landfill.

6.3.5 Residual risks will continue to be managed through the established environmental surveillance and monitoring programme described in Section 5.

6.3.6 BMJV will assume operational responsibility for the site for the purposes of constructing the A122 Lower Thames Crossing. Although detailed design works are ongoing, Schedule 10 requirements for assessing and maintaining landfill stability will be met through adherence to the Stability Risk Assessment prepared to accompany this permit application[6] and stringent temporary works assessments and slope-stability analyses, ensuring ongoing structural integrity during construction activities.

6.3.7 Upon completion of LTC-related works, the site will be progressed towards closure in accordance with Schedule 10 requirements and the Environment Agency's guidance on landfill cessation.

6.4 Schedule 21

6.4.1 Schedule 21 of the Environmental Permitting (England and Wales) Regulations 2016 governs all water discharge activities, including discharges to inland waters, coastal waters, and the marine environment. The operations at Tilbury Landfill will continue to fall within this regulatory framework.

6.4.2 The only current water management infrastructure on site relates to surface water drainage. This shall be replaced by a temporary works site drainage, for which BMJV is in the process of submitting an application for a discharge permit.

6.5 Schedule 22

6.5.1 Schedule 22 of the Environmental Permitting (England and Wales) Regulations 2016 sets out the regulatory requirements for activities that may result in direct or indirect inputs of pollutants into groundwater. The assessment undertaken for Tilbury Landfill has been completed in accordance with these requirements.

6.5.2 This HRA confirms the conclusions of the previous 2004 HRA, that the low-permeability Alluvium beneath the landfill provides an effective geological barrier, substantially limiting the potential for direct contaminant entry into the Chalk aquifer. While a residual potential exists for contaminants to percolate

through the Alluvium, the barrier significantly reduces the likelihood and magnitude of any indirect input to groundwater.

6.5.3 Assessment of the source term demonstrates that hazardous substances within the leachate are present at concentrations low enough that they do not pose a risk to groundwater. This satisfies the Schedule 22 requirement to prevent the entry of hazardous substances into groundwater.

6.5.4 Non-hazardous pollutants were identified within the source leachate testing; however, the Alluvium is expected to prevent the infiltration of these substances into the underlying Chalk aquifer to concentrations that could lead to pollution. This aligns with Schedule 22 provisions requiring the prevention or limitation of indirect inputs of non-hazardous pollutants to groundwater.

6.5.5 Groundwater monitoring has detected several determinands in the Chalk aquifer that may be associated with the historical PFA waste. Although exceedances of compliance limits have occurred at BHC3D and BHC5D, no corresponding down-gradient impacts have been observed, indicating that these exceedances are localised rather than indicative of wider aquifer deterioration. Furthermore, the chemical signatures may reflect deterioration of the relevant monitoring standpipes, consistent with the behaviour previously observed at BHC4. It is noted that compliance limits were removed for BHC3D and BHC5D in the latest permit variation.

6.5.6 In accordance with Schedule 22, a risk-based programme of groundwater monitoring will continue to be undertaken, incorporating the agreed control levels and compliance limits through requisite surveillance. As site activities will remain unchanged under the new permit, the existing monitoring strategy remains appropriate and proportionate.

7 Reference documents

Document tile	Link/ reference
[1] Tilbury Landfill Environmental Setting and Installation Design Report	HE540039-BMJ-EAC-TA_SNZ_ZZ-RP-GS-000005
[2] Tilbury Landfill Management Systems and Procedures	HE540039-BMJ-EAC-TA_SNZ_ZZ-RP-GS-000013
[3] Tilbury Landfill Dust and Emissions Management Plan	HE540039-BMJ-EAC-TA_SNZ_ZZ-RP-GS-000008
[4] Tilbury Landfill Closure and Aftercare Management Plan	HE540039-BMJ-EAC-TA_SNZ_ZZ-RP-GS-000007
[5] Tilbury Landfill Site Operating and Waste Acceptance Procedures	HE540039-BMJ-EAC-TA_SNZ_ZZ-RP-GS-000015
[6] Tilbury Landfill Stability Risk Assessment	HE540039-BMJ-EAC-TA_SNZ_ZZ-RP-GS-000010
[7] Tilbury Landfill Environmental Risk Assessment	HE540039-BMJ-EAC-TA_SNZ_ZZ-RP-GS-000006
[8] Environmental Management Plan 2, North Portal Surface Works - Work no. 5/CA5 (in part) and Utilities	HE540039-BMJ-EGN-TA_S07_ZZ-PL-ZZ-000001
[9] Environmental Report – Tilbury B Power Station Ash Disposal Site – Hydrogeological Risk Assessment Report. Ref No. ENV/EEA/165/04 Nov 2004	RWE npower HRA Nov 2004.pdf (Version 1)
[10] Tilbury Ash Disposal Site - Hydrogeological Risk Assessment Review. Ref:427-01526-00022 May 2017	170523_427-01526-00022_Ash_Fields_HRAR_to_EA.pdf
[11] Atkins. Tideway Central Site Conditioning Agent & Grease – Spoil Deposition Risk Assessment Rev. 4.0, March 2019	N/A
[12] Notice of variation and consolidation with introductory note. 09/12/2025 Variation Application Number EPR/GP3733DZ/V007. Permit Number EPR/GP3733DZ	Application Variation - Permit V007 09122025 (003).pdf
[13] Guidelines for drinking-water quality - Fourth edition incorporating the first and second addenda. ISBN 978-92-4-004506-4	Guidelines for drinking-water quality: fourth edition incorporating the first and second addenda
[14] The Environmental Permitting (England and Wales) Regulations 2016	https://www.legislation.gov.uk/uksi/2016/1154/

8 Abbreviations

Abbreviation	Explanation
ALV	Alluvium
AMJV	Arup Motts Joint Venture
BMJV	Bouygues-Murphy Joint Venture
CHK	Chalk
DCO	Development Consent Order
Diss	Dissolved
DWS	Drinking Water Standards
EQS	Environmental Quality Standards
HRA	Hydrogeological Risk Assessment
IVL	Ingrebourne Valley Limited
LOD	Limit of Detection
MGR	Made Ground
mOD / mAOD	metres above ordnance datum
m bgl	metres below ground level
NH	National Highways
Q1 Q2 Q3 Q4	Quarter 1 – January to March Quarter 2 – April to June Quarter 3 – July to September Quarter 4 – October to December
PFA	Pulverised Fuel Ash
RTD	River Terrace Deposits
RZ	Monitoring borehole screened section response zone
LTC	Lower Thames Crossing: a proposed new crossing of the Thames estuary linking the county of Kent with the county of Essex, at or east of the existing Dartford Crossing.
SPZ	Source Protection Zone
WHO	World Health Organisation

Appendices

Appendix A – Groundwater quality results

A.1 Alluvium groundwater quality sampling results

Figure A.1 Aluminium as mg/l in Alluvium installation

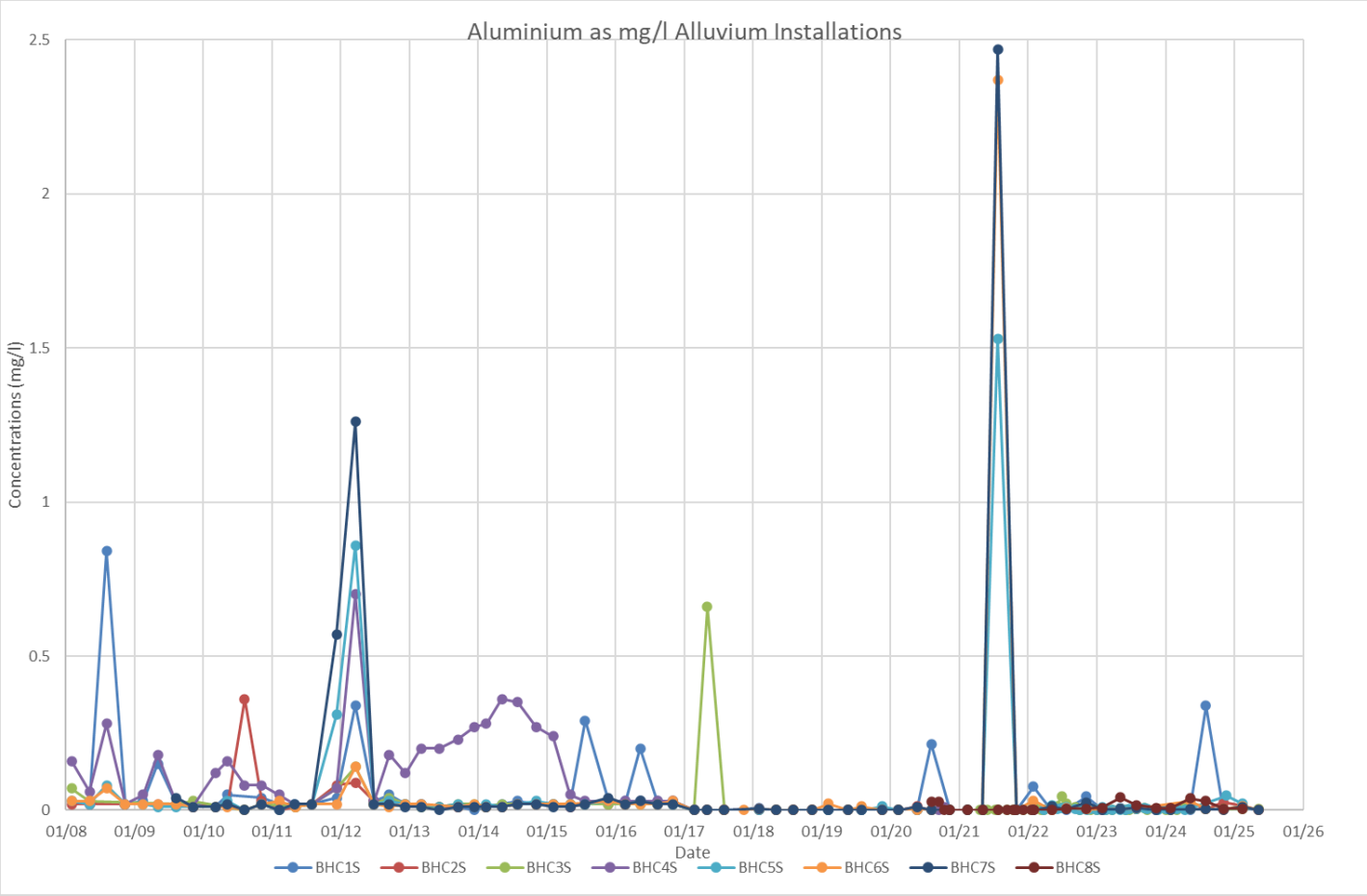


Figure A.2 Ammoniacal Nitrogen as mg/l in Alluvium Installation

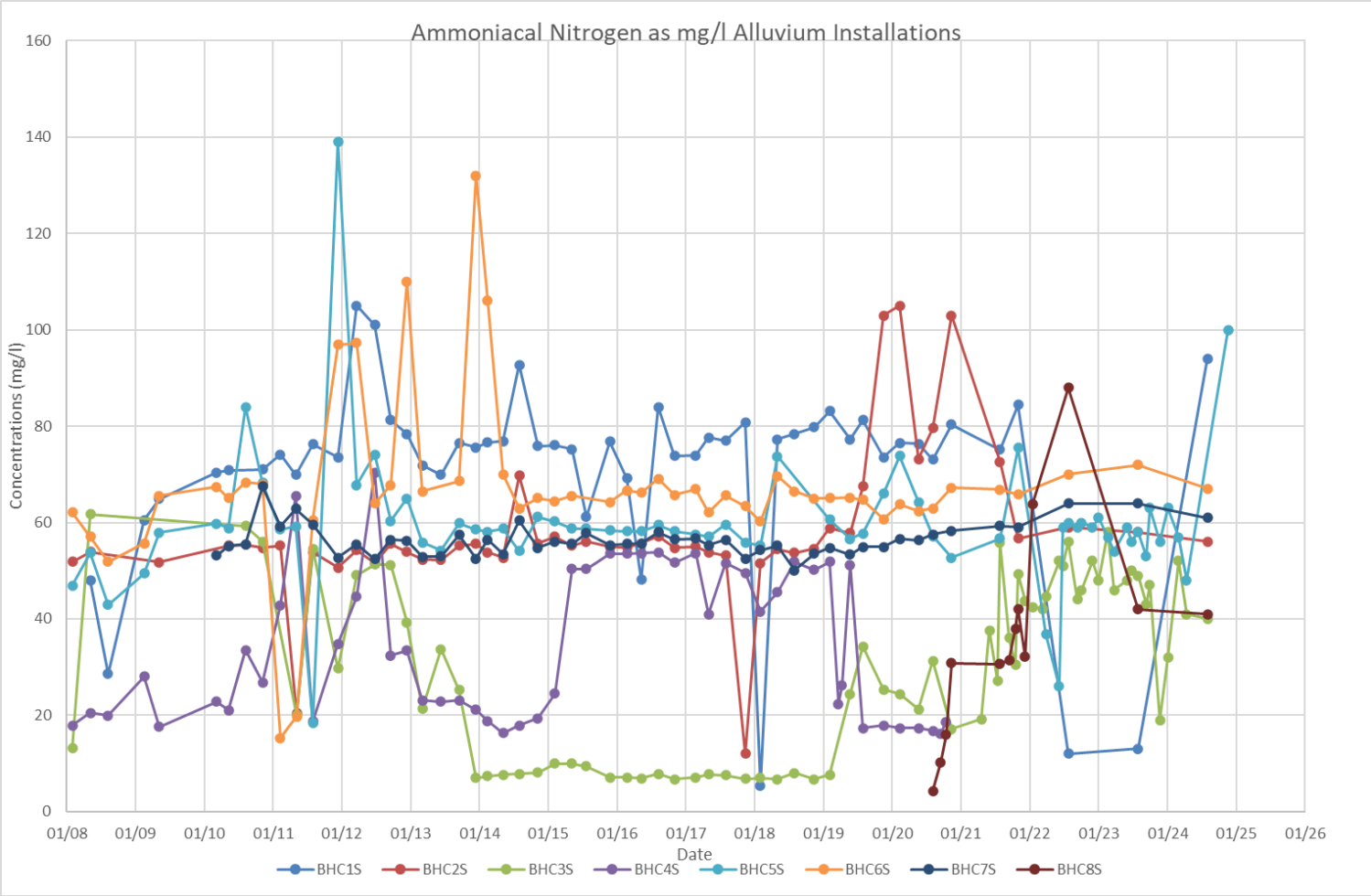


Figure A.3 Arsenic as mg/l in Alluvium Installation

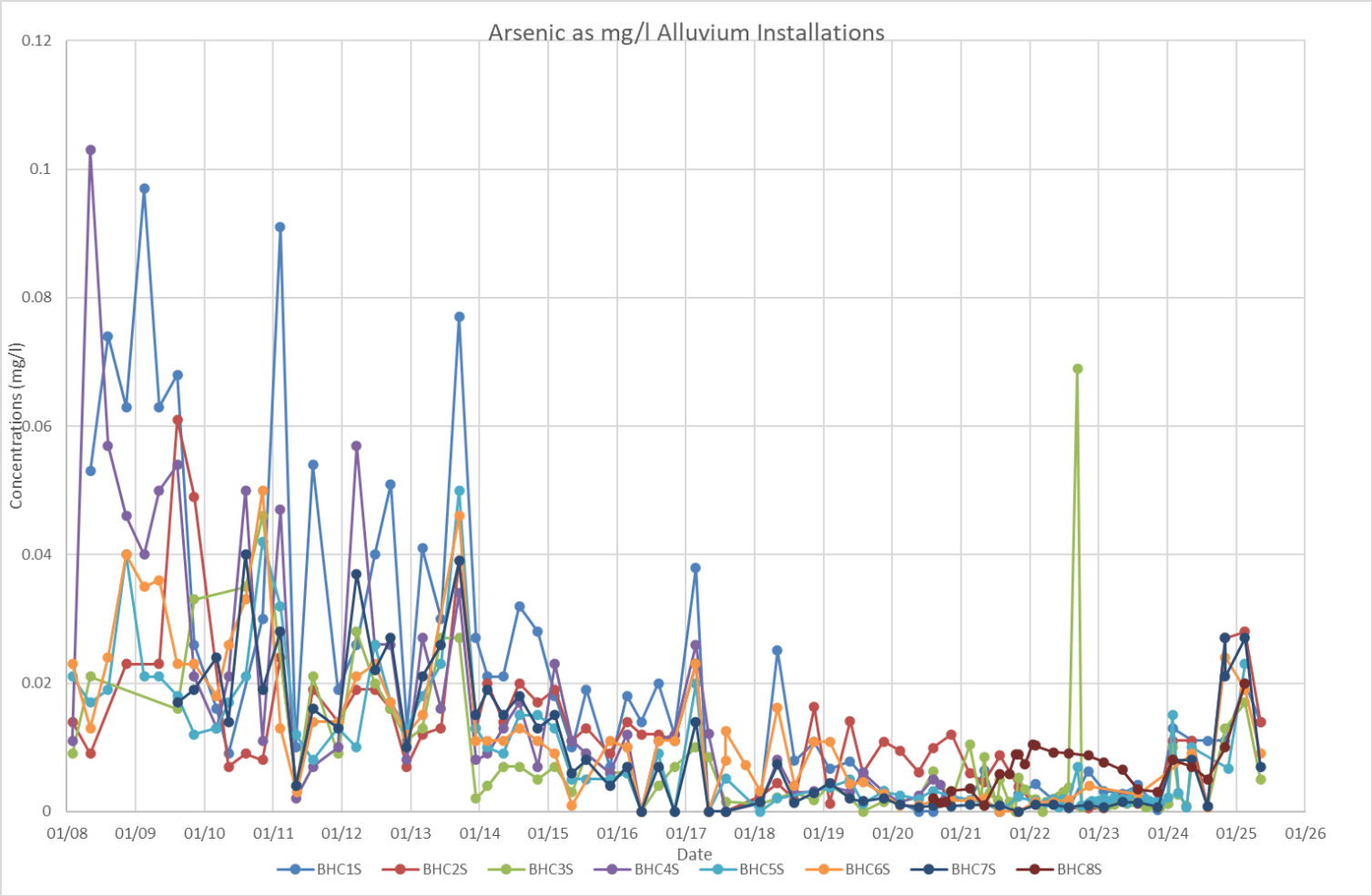


Figure A.4 Boron as mg/l in Alluvium Installation

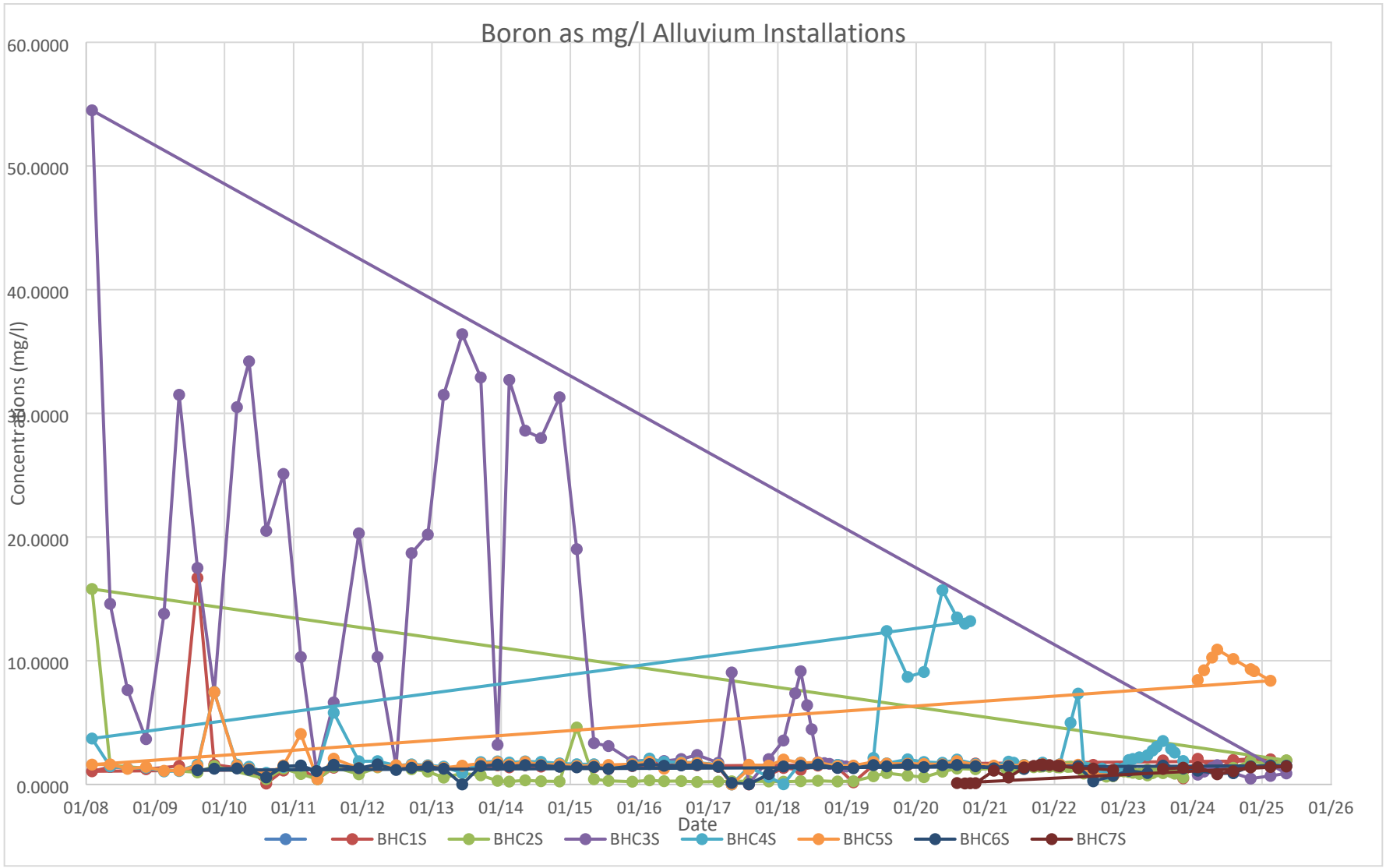


Figure A.5 Chromium as mg/l in Alluvium Installation

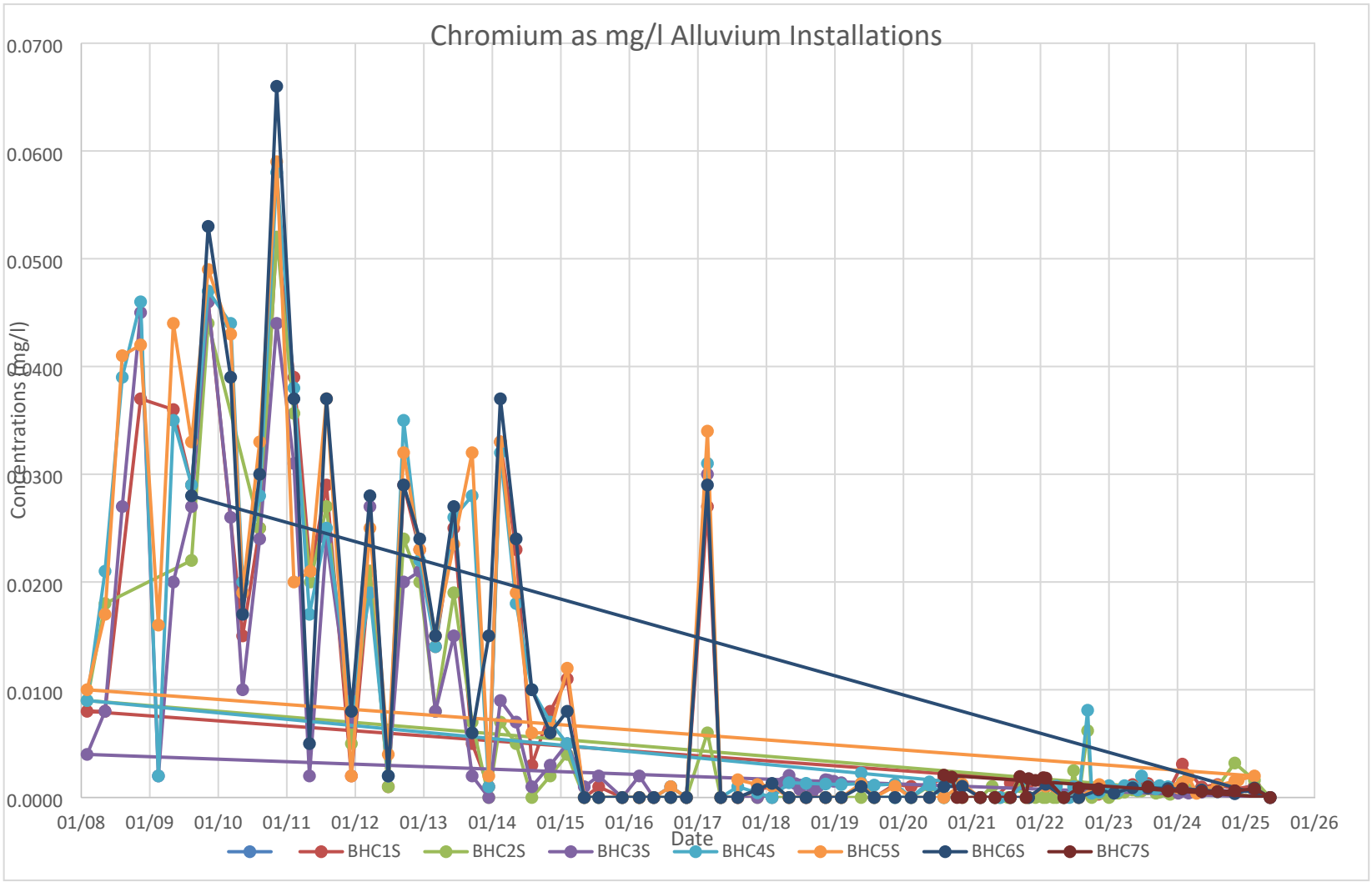


Figure A.6 Iron as mg/l in Alluvium Installation

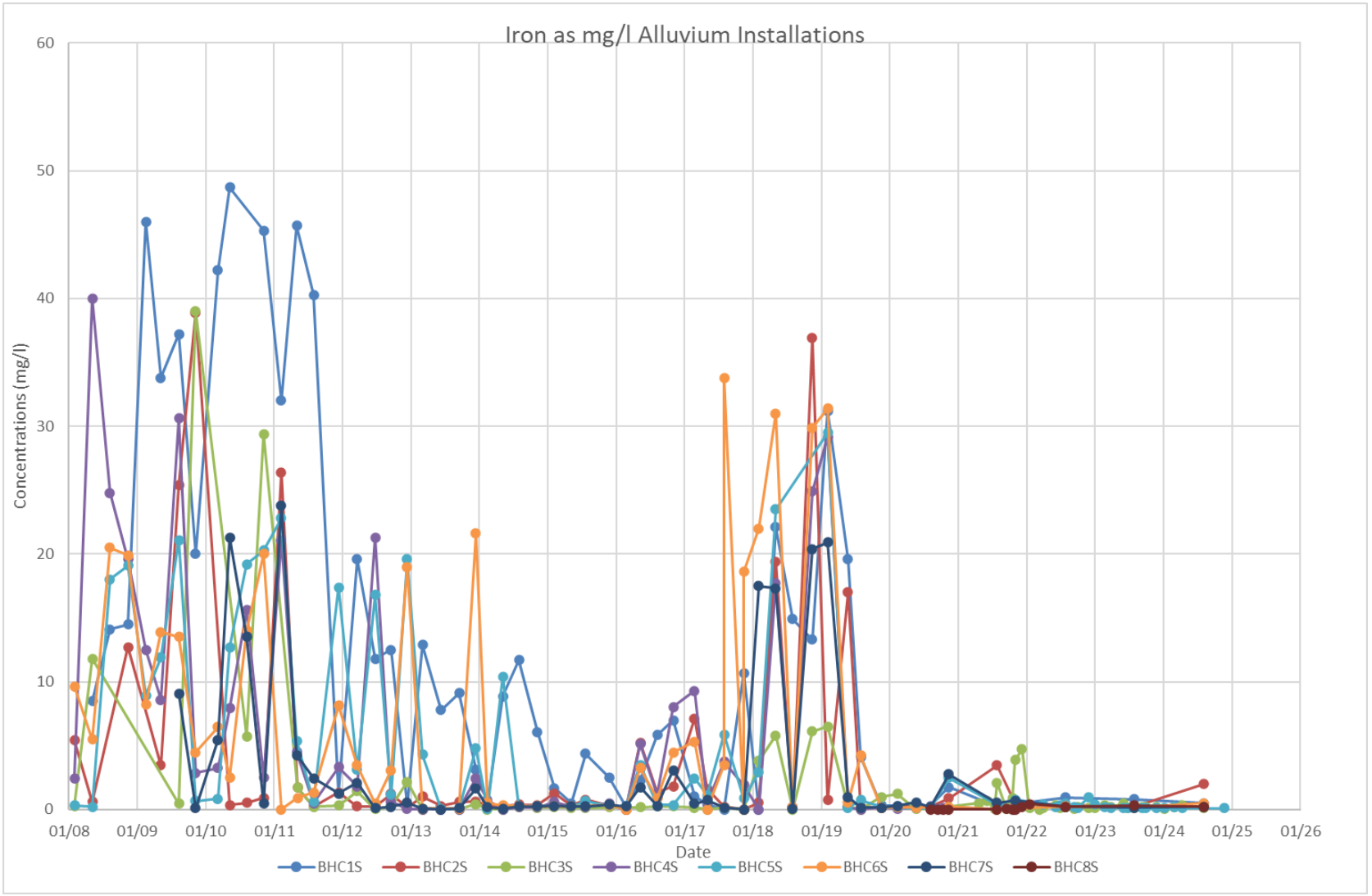


Figure A.7 Manganese as mg/l in Alluvium Installation

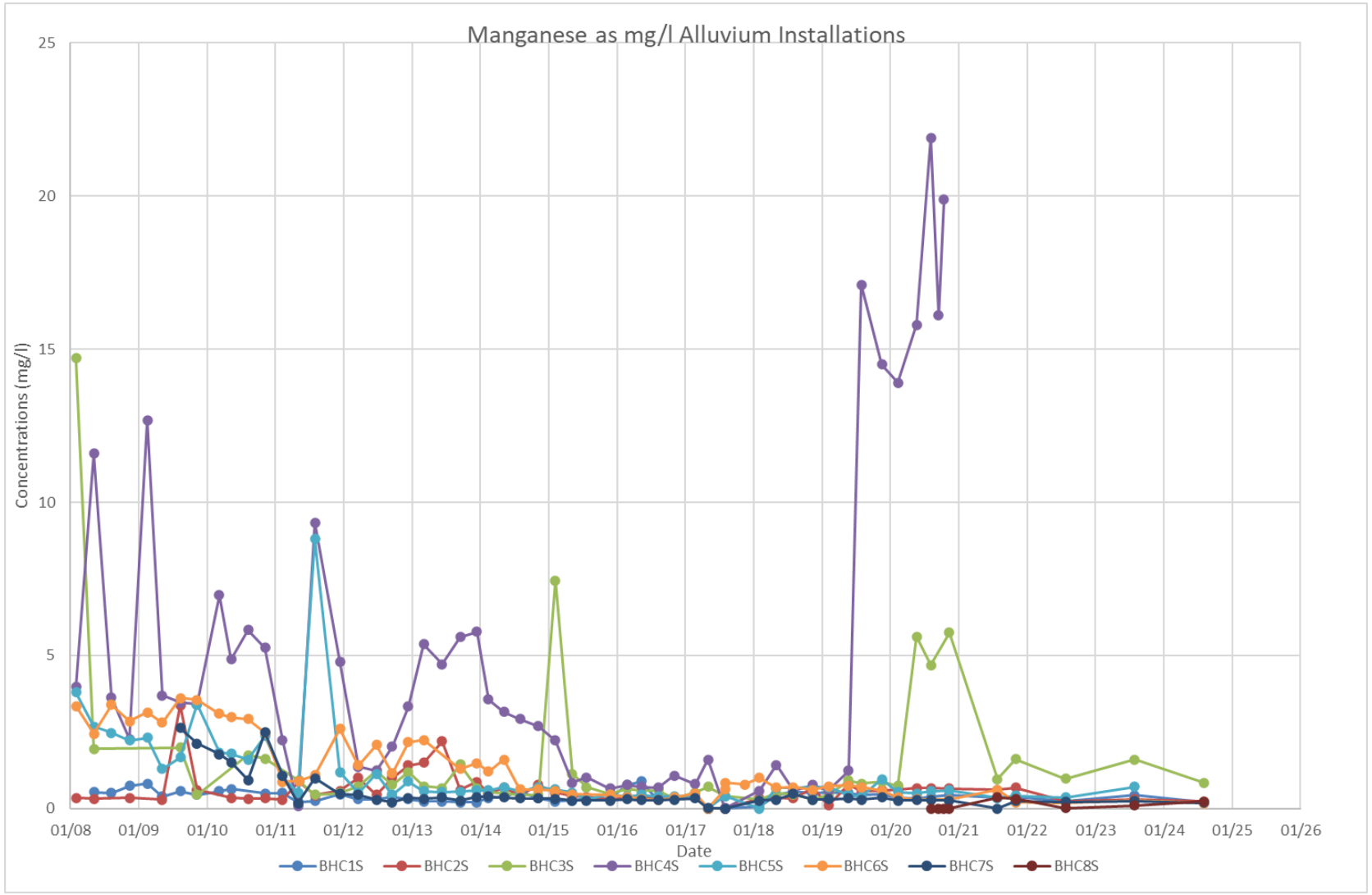


Figure A.8 Molybdenum as mg/l in Alluvium Installation

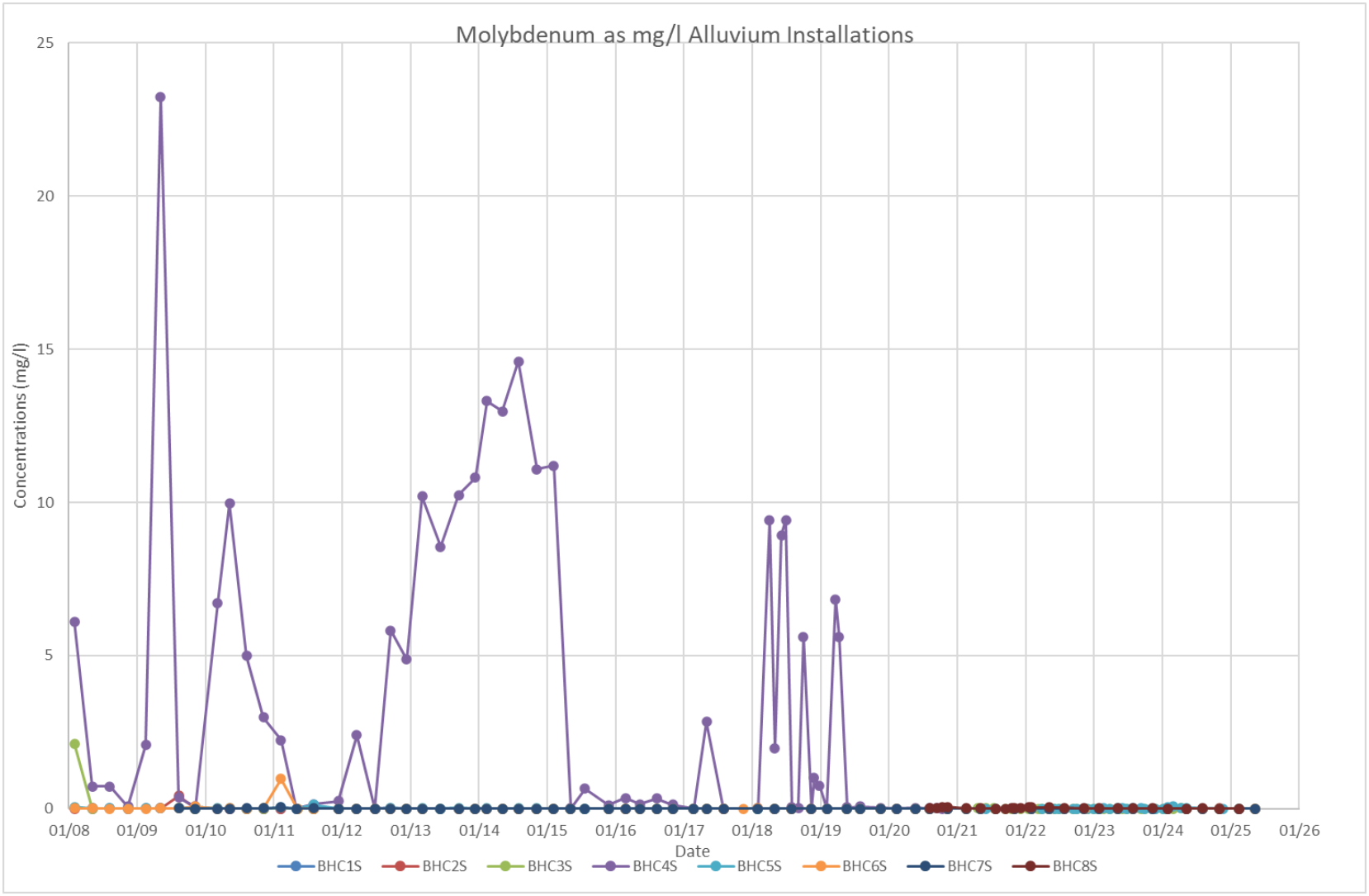


Figure A.9 Nickel as mg/l in Alluvium Installation

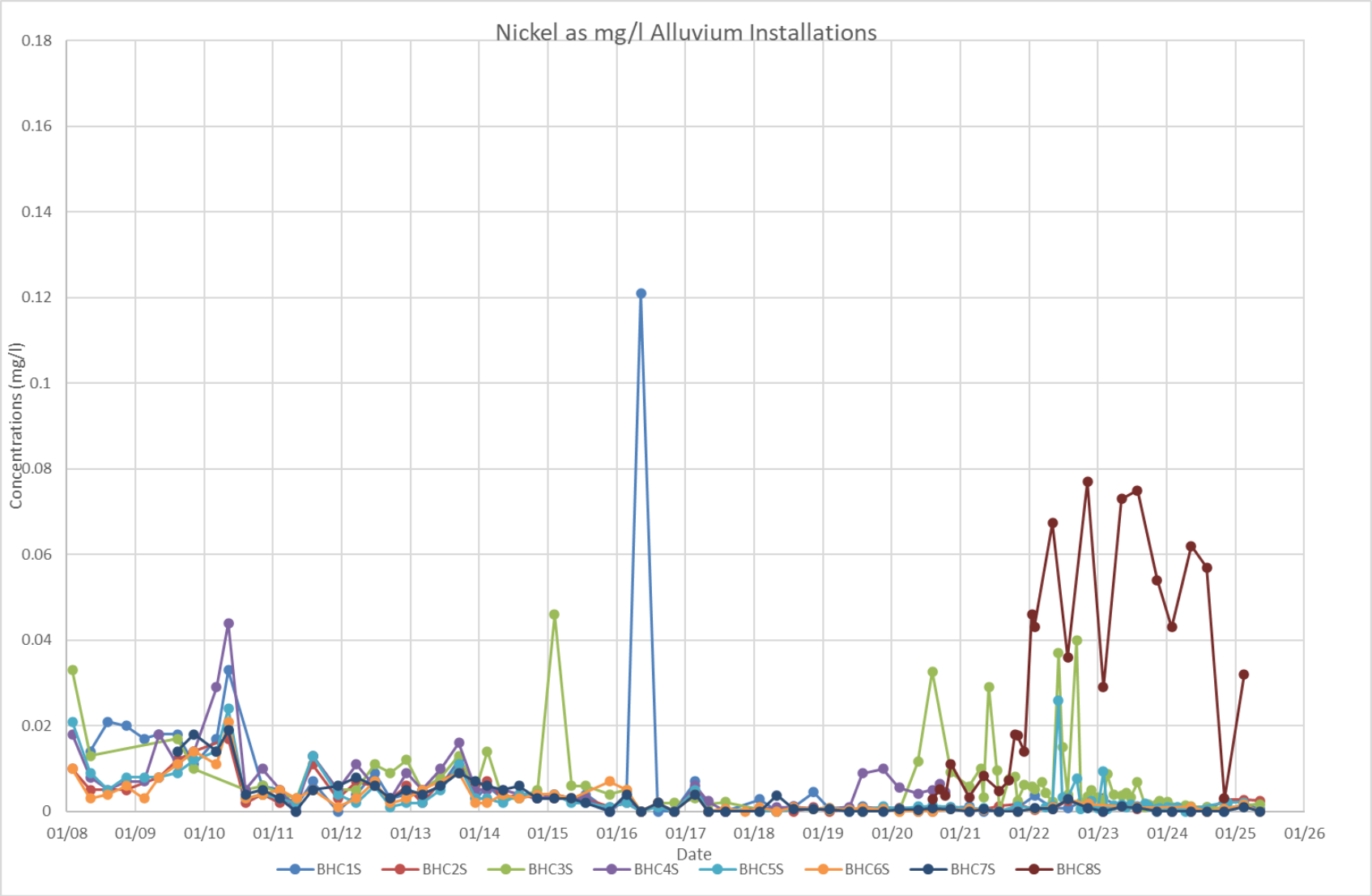
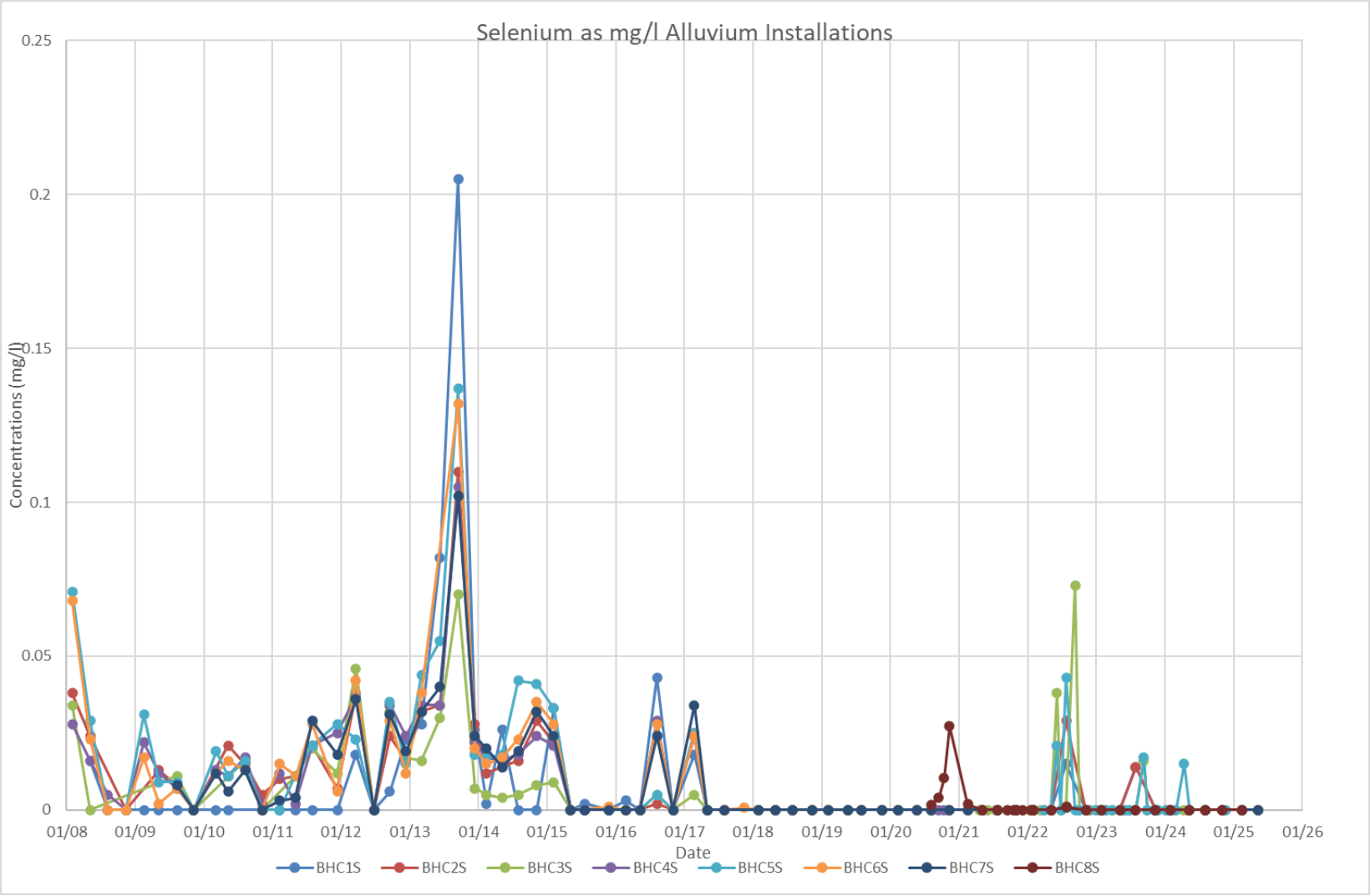


Figure A.10 Selenium as mg/l in Alluvium Installation



A.2 Chalk groundwater quality sampling results

Figure A.11 Aluminium as mg/l in Chalk Installation

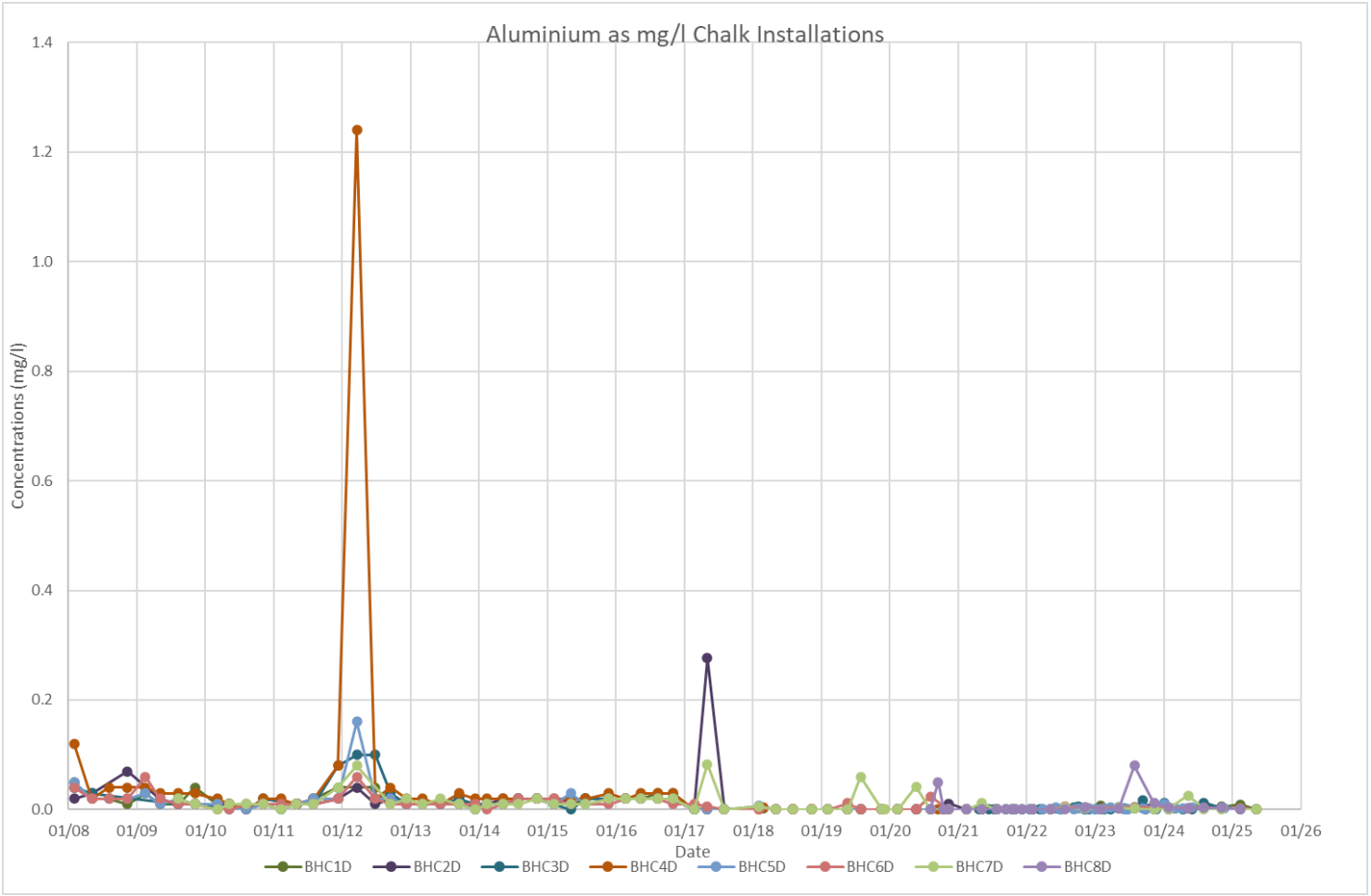


Figure A.12 Ammoniacal Nitrogen as mg/l in Chalk Installation

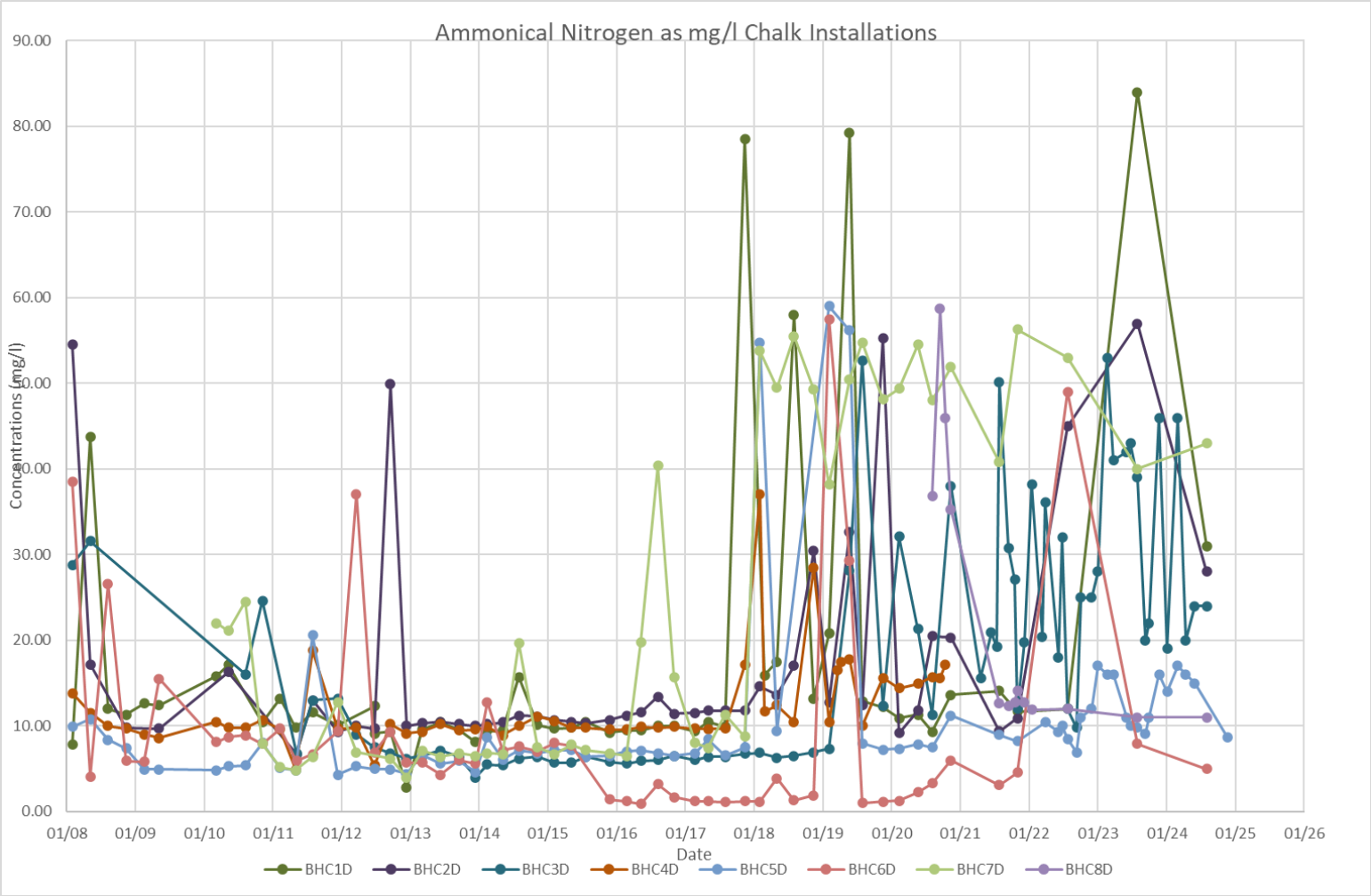


Figure A.13 Arsenic as mg/l in Chalk Installation

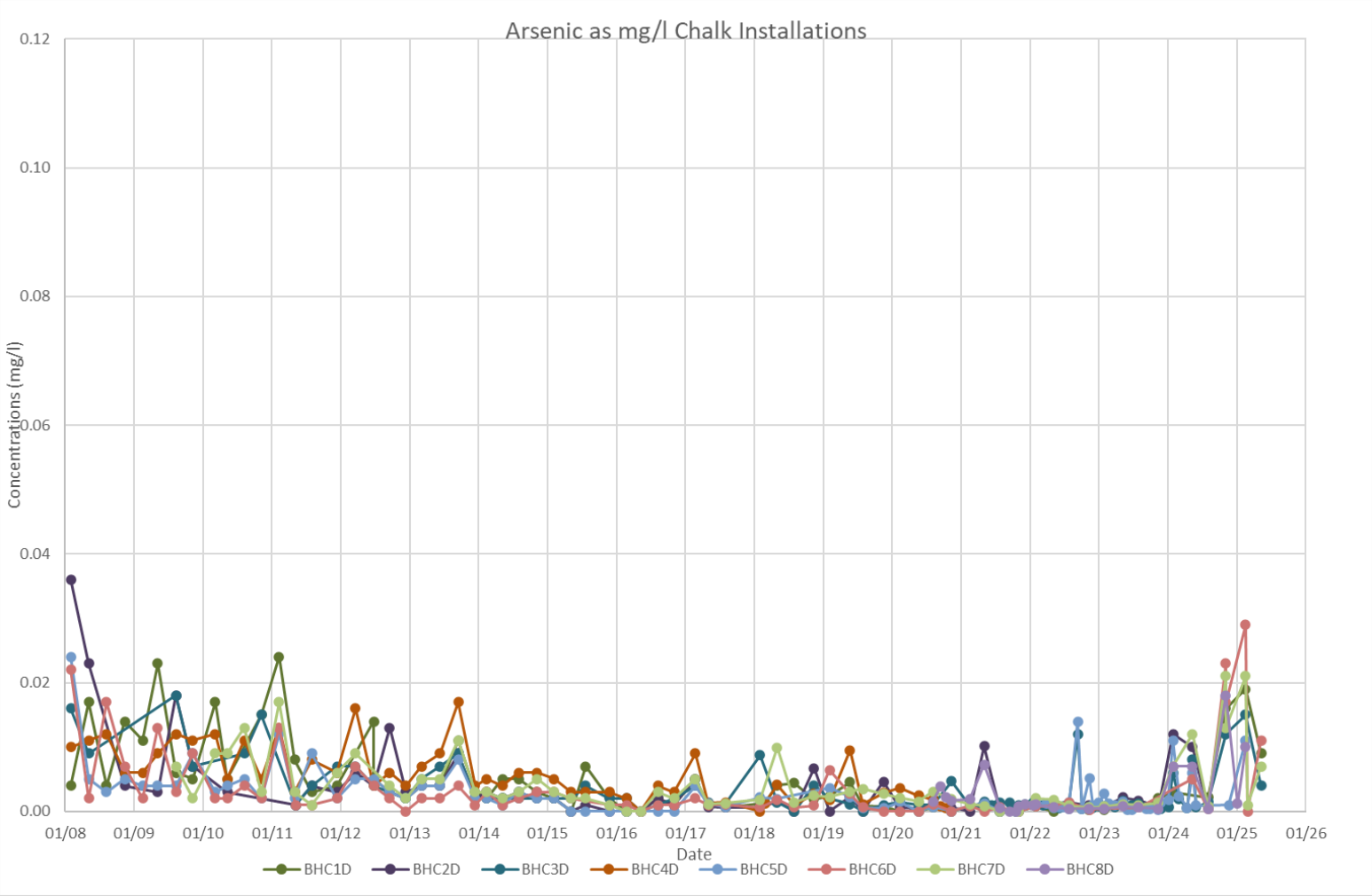


Figure A.14 Boron as mg/l in Chalk Installation

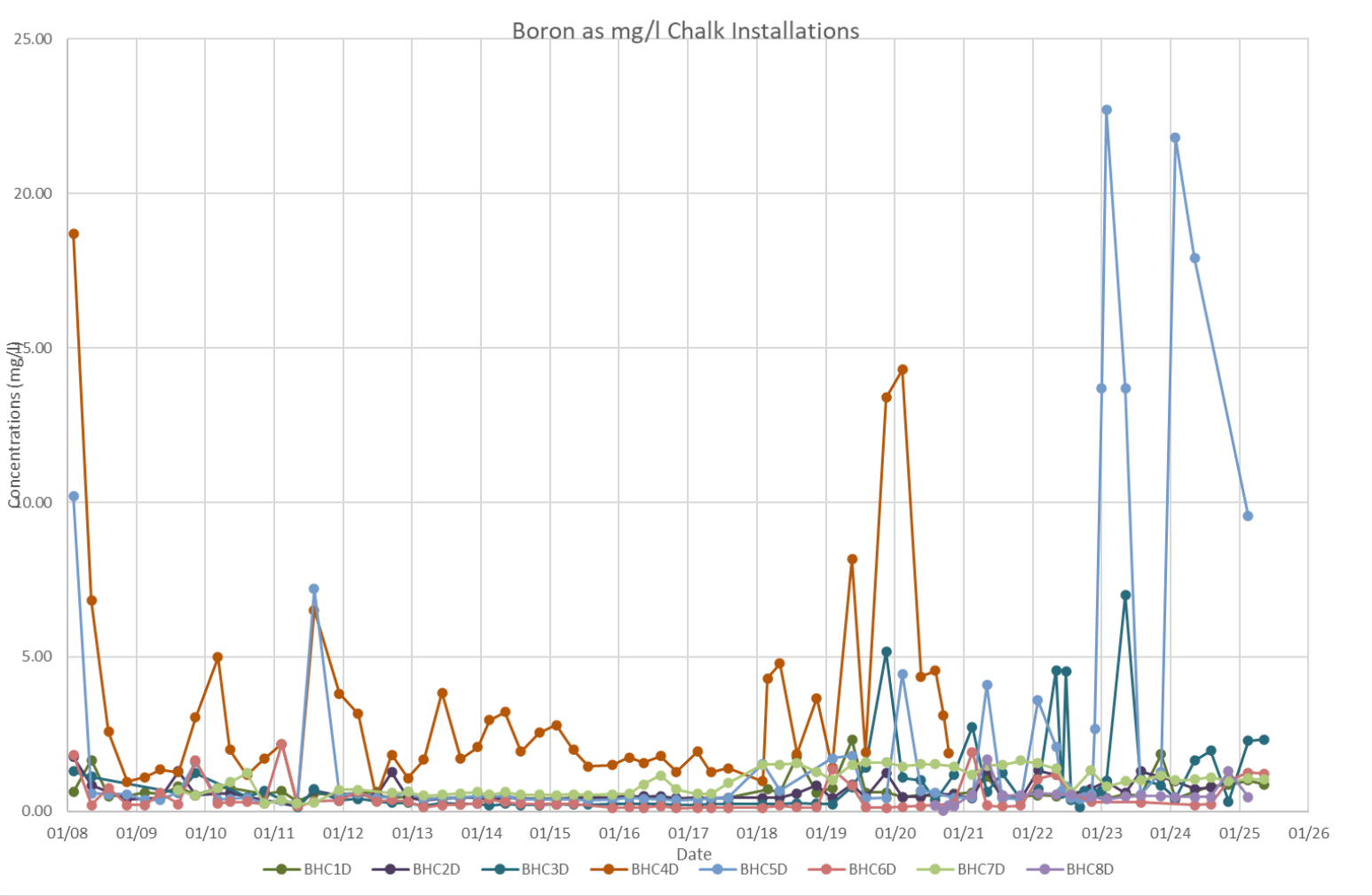


Figure A.15 Chromium as mg/l in Chalk Installation

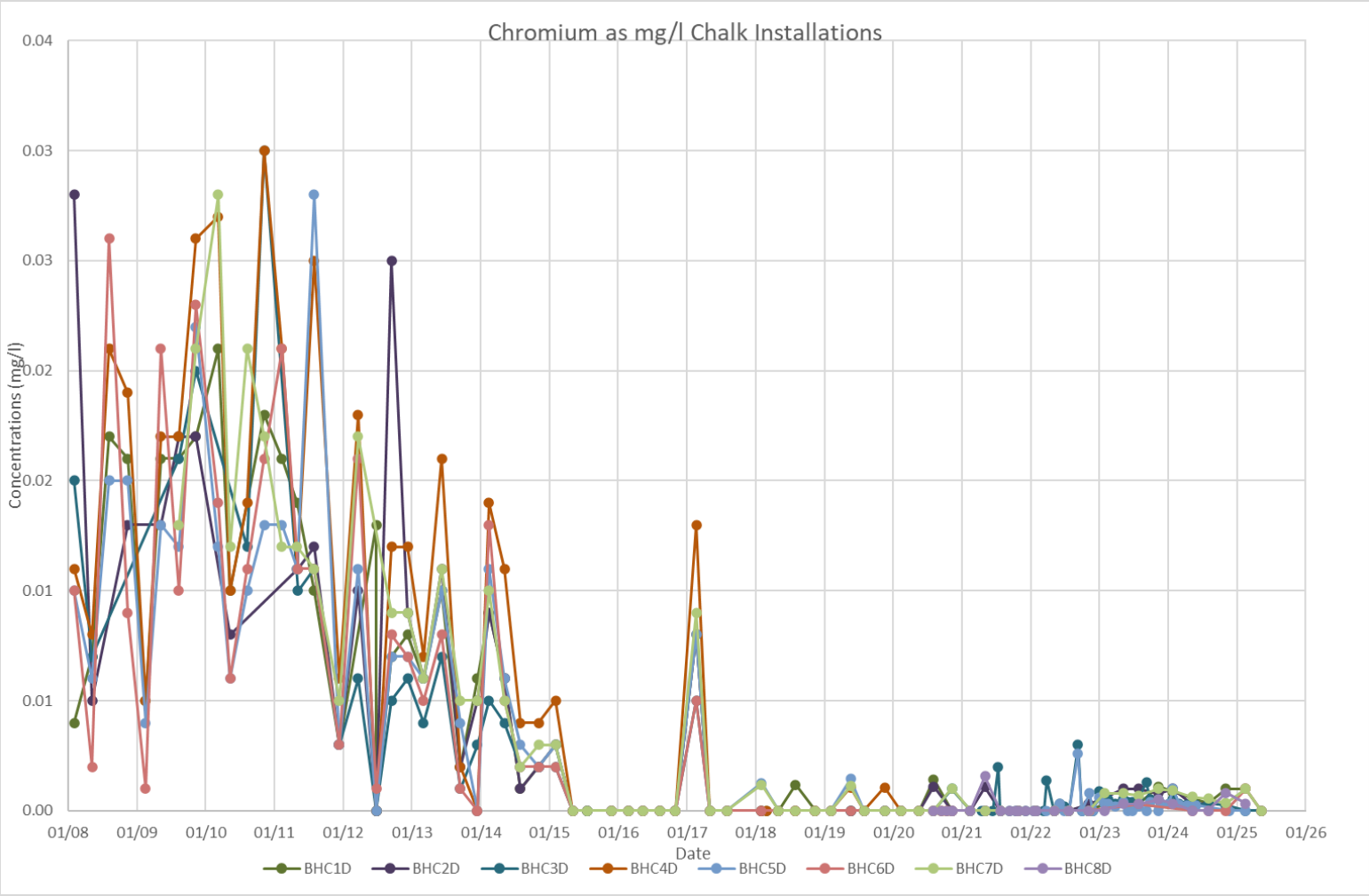


Figure A.16 Iron as mg/l in Chalk Installation

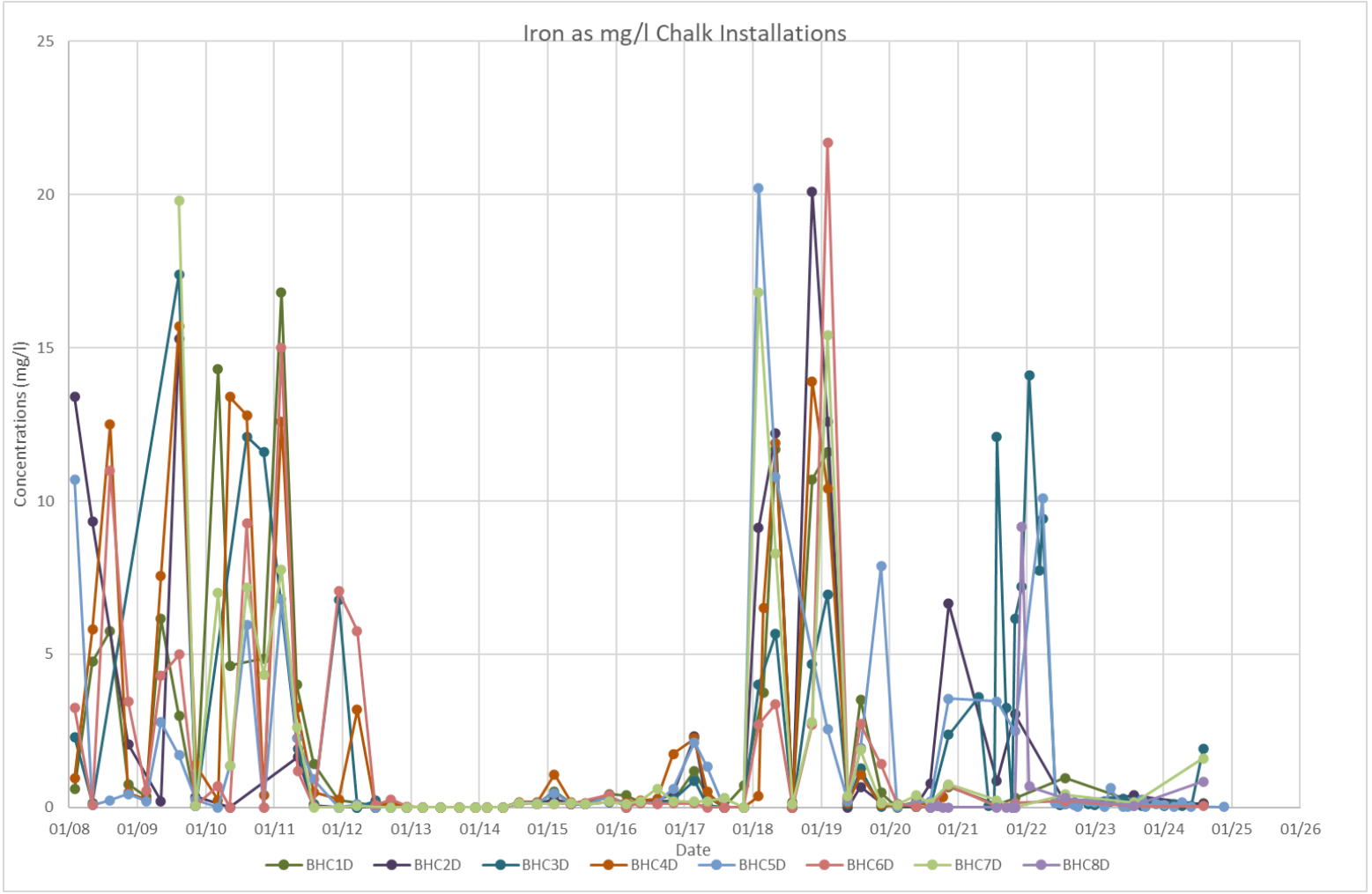


Figure A.17 Manganese as mg/l in Chalk Installation

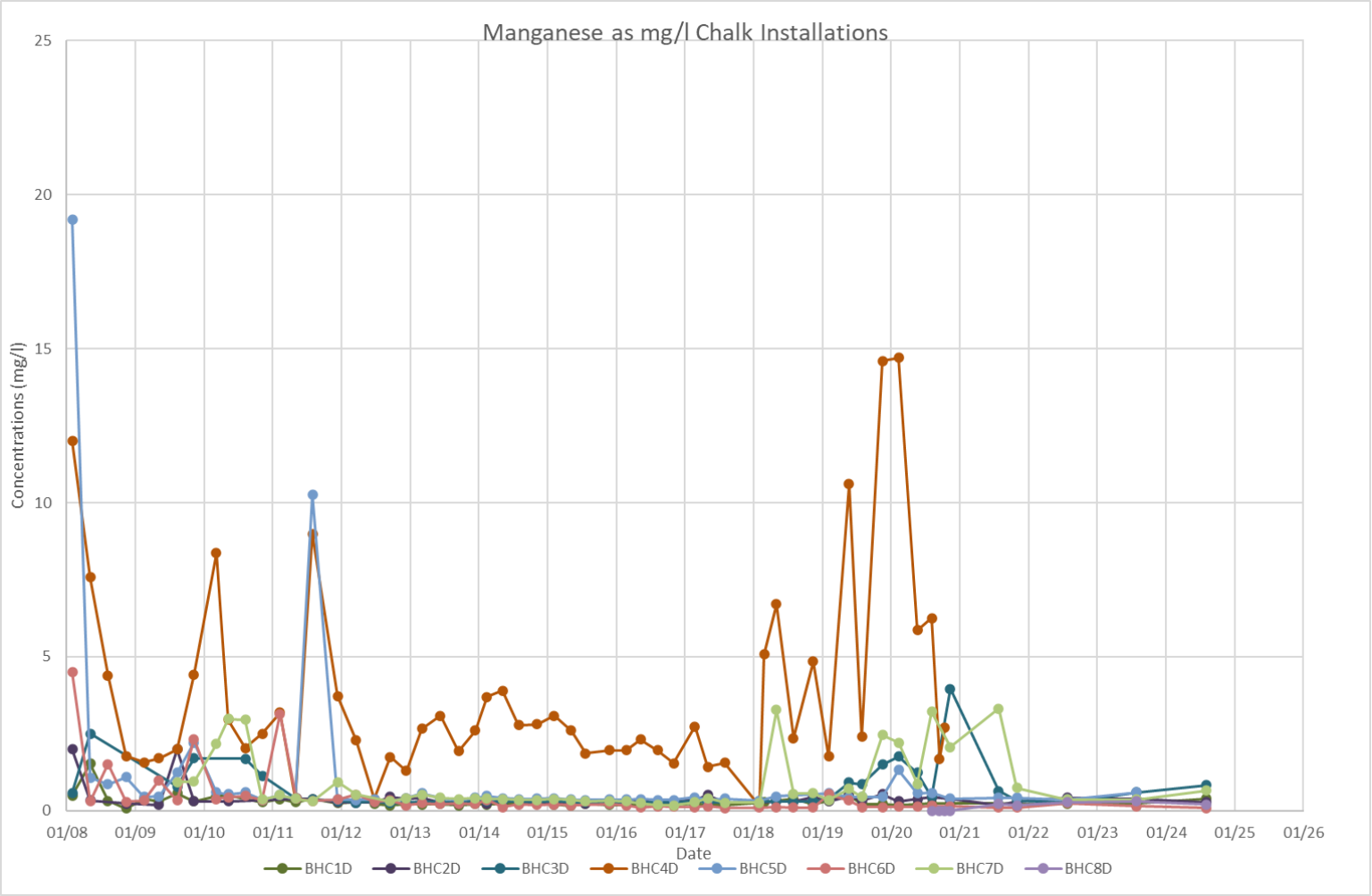


Figure A.18 Molybdenum as mg/l in Chalk Installation

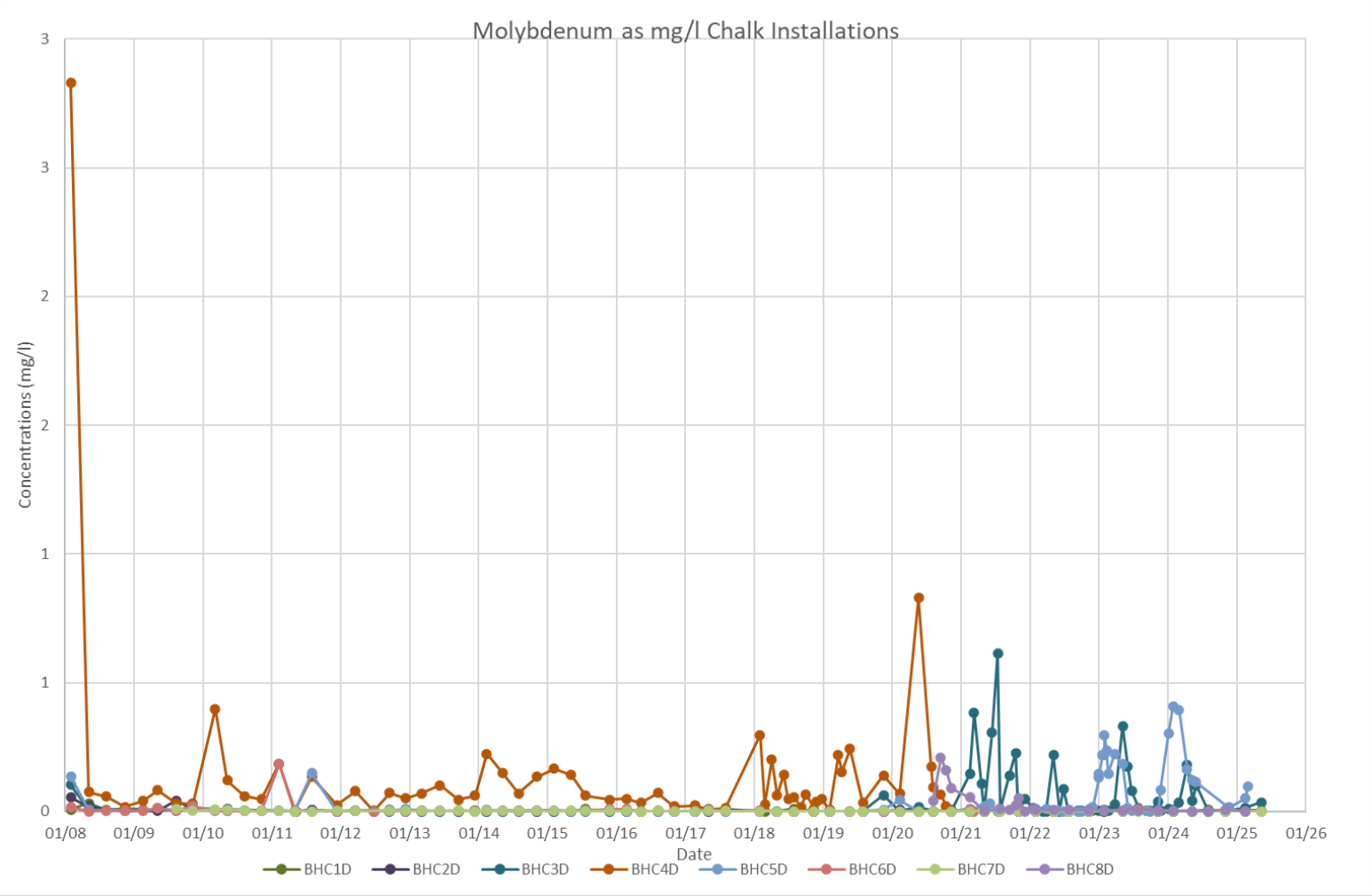


Figure A.19 Nickel as mg/l in Chalk Installation

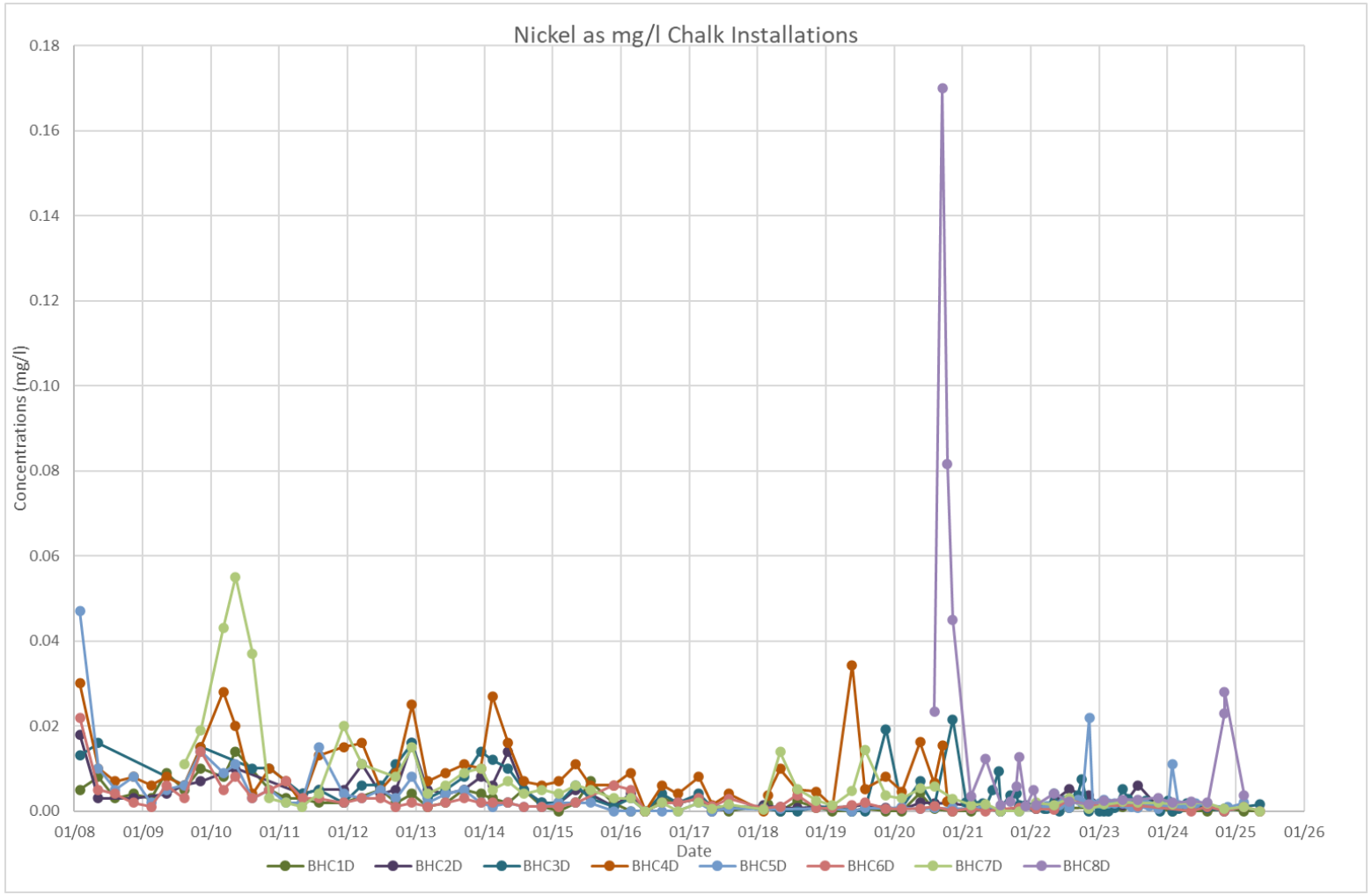
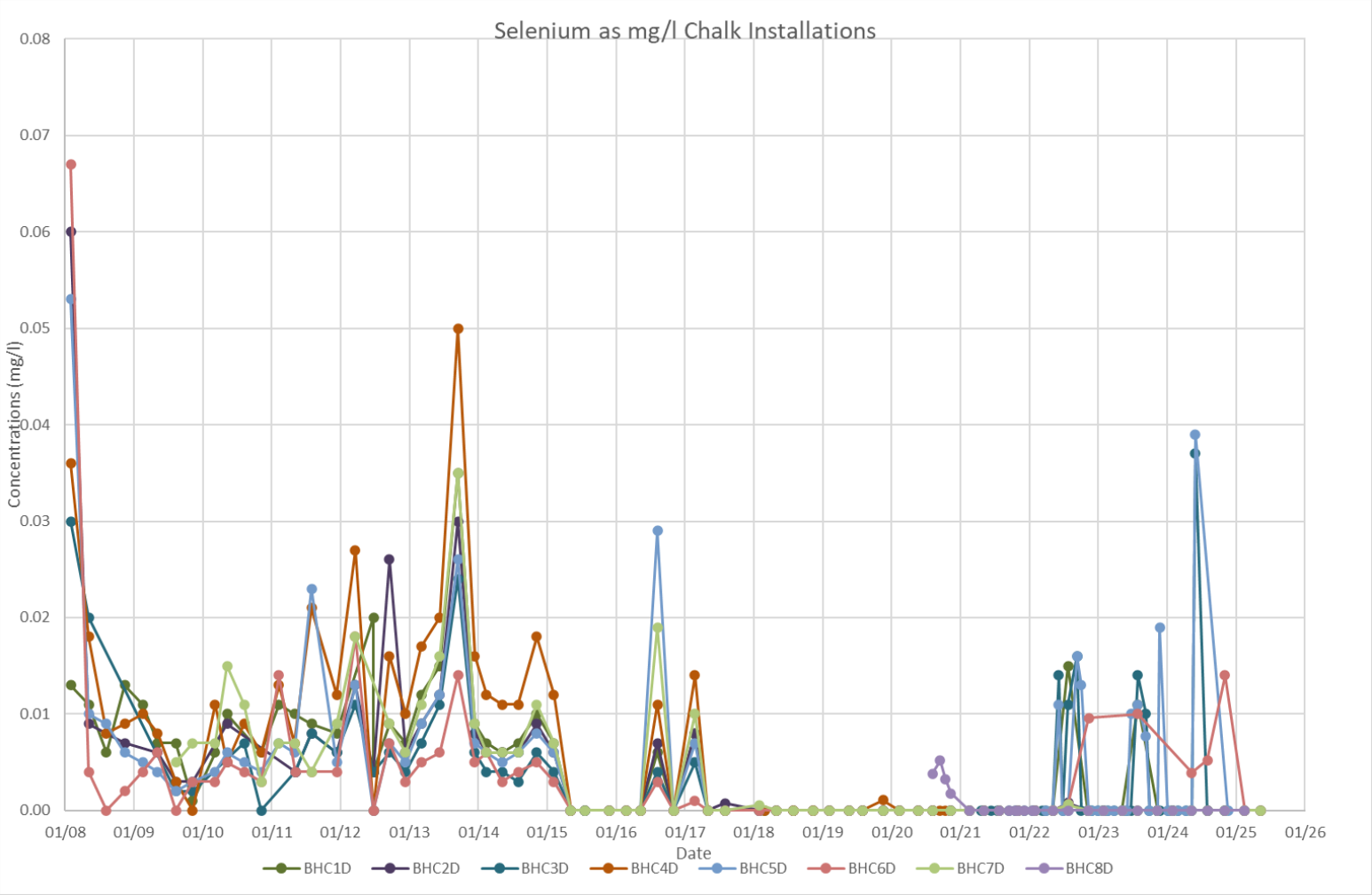


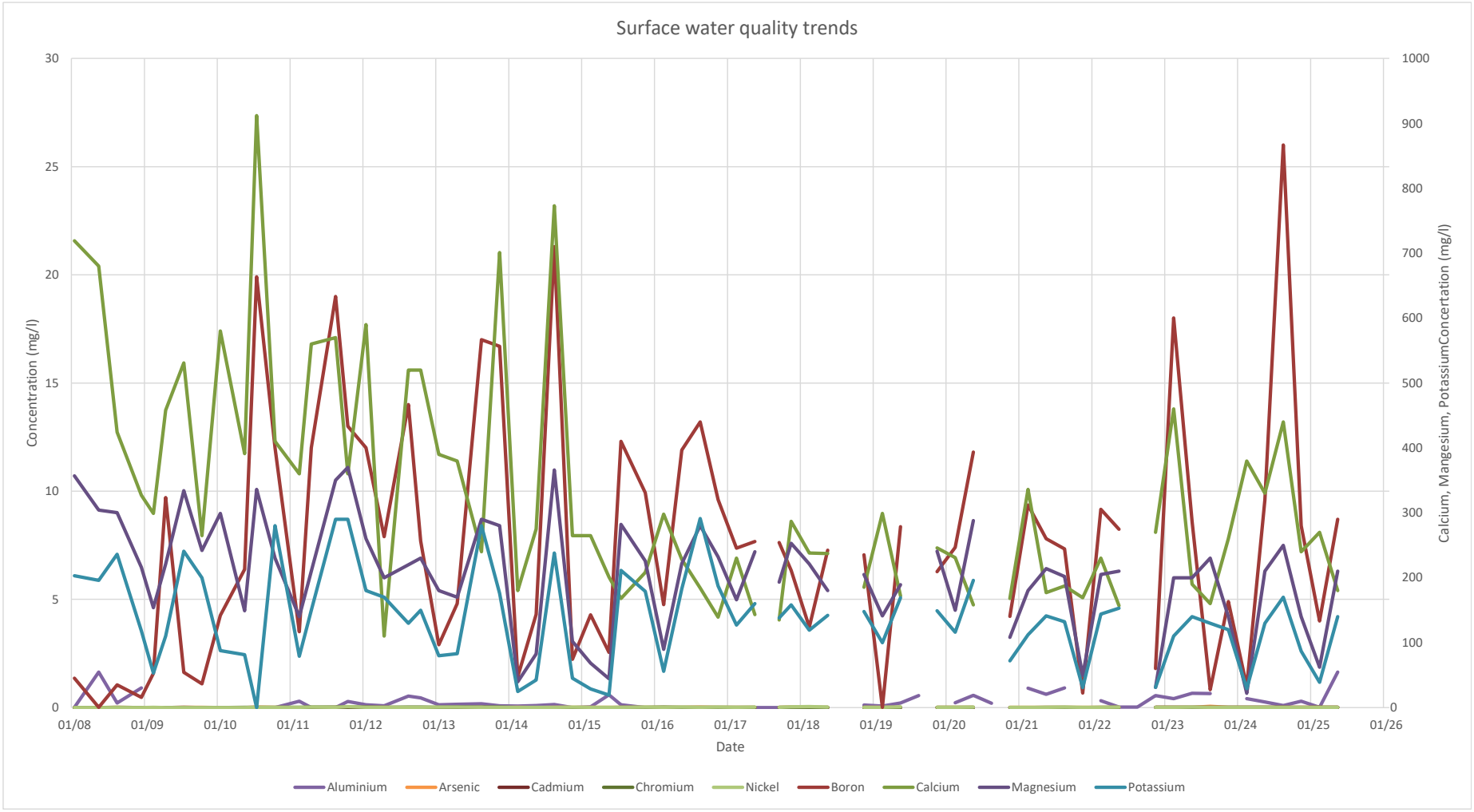
Figure A.20 Selenium as mg/l in Chalk Installation



Appendix B – Surface water quality graphs

Lower Thames Crossing -
Tunnels and Approaches Package

Surface water quality key parameters trends
Downstream



Appendix C - 2004 Hydrogeological Risk Assessment

RWE npower

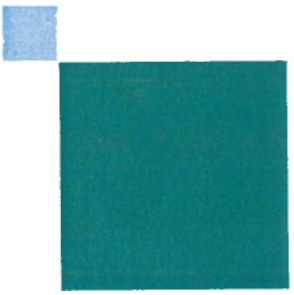
RWE

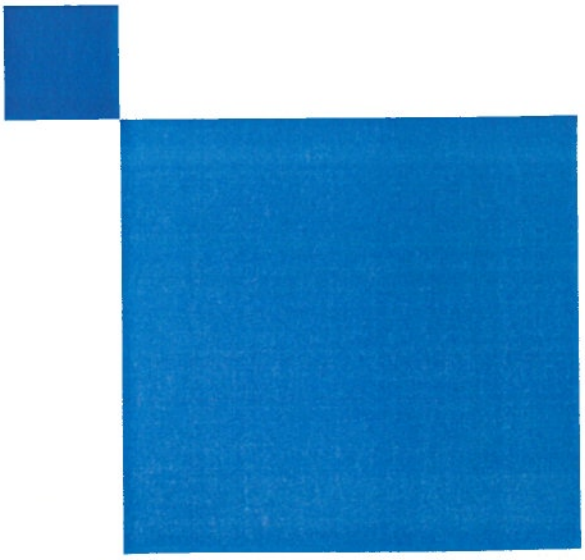
Environment Report

Tilbury B Power Station Ash Disposal Site – Hydrogeological Risk Assessment Report

Reference Number: ENV/EEA/165/04
Date: November 2004
Issue: 1.0
Author: Mark Jones

Other Information: UNRESTRICTED





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Tilbury B Power Station Ash Disposal Site – Hydrogeological Risk Assessment Report

Prepared for:

Client Contact :	Dave Churton
Contract No. :	JUV2077

Prepared by: M.A. Jones Mark Jones	

Reviewed by: Steve Waygood	Approved by: A. Cocks Alan Cocks 05/11/2004

Summary

Hydrogeological risk assessment is required to support an application for a permit for the Tilbury Ash Disposal Site to operate under the Pollution Prevention and Control (PPC) regime. This report has been completed using a template prepared by the Environment Agency. It is intended to meet the requirements of Section 1.4 of Part B of the PPC permit application form for the landfill sector.

The landfill activity undertaken at the site involves the tipping of pulverised fuel ash (PFA) produced by the Tilbury B Power Station in a 'shallow' land-raising operation that raises the existing ground level by no more than 20 feet above Ordnance Datum. Tilbury ash disposal site accepts a single waste stream – PFA from the adjacent Tilbury Power Station.

Although it is classified as a non-hazardous waste, the combination of low solubility, low permeability, pozzolanic behaviour and consistent particle size means that PFA from Tilbury produces no or very little leachate. Its physical and chemical properties mean that the quality of eluates from laboratory leaching tests is generally comparable with in-situ groundwater quality. In particular, it contains no measurable quantities of List I substances and limited concentrations of List II substances. Those List II substances that occur with significant concentrations in laboratory tests are certain metals and anions.

The site is located in a relatively insensitive area, on 15-20 metres of alluvium consisting predominantly of clays and peat. The hydraulic conductivity of the alluvium is probably of the order of 10^{-10} m/s. The quality of both surface and shallow ground waters is very poor, being subject to intrusion and mixing from saline water from the Thames estuary immediately to the south. Groundwater within the alluvium is not abstracted and it is inconceivable that it would be. The site does however overlie the chalk which is designated as a major aquifer. The quality of water in the chalk in the

nearest abstraction is relatively poor, being saline and not meeting drinking water or environmental quality standards. The site does not lie within any Source Protection Zone.

Quantitative risk assessment has demonstrated that, even using grossly conservative assumptions and parameterisations and using a simple model, there is no risk of pollution of the chalk aquifer by List II substances. Similarly there is no risk of polluting any surface water receptors. These conclusions confirm that the current operations are fully compliant with the requirements of the Landfill Regulations 2002 and the Groundwater Regulations 2000, with no need to collect leachate, install any artificial liner or further prevent infiltration.

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Tables

Drawings

Dwg No	HRA1	**Scale**	1:7,500	**Title**	Site Layout
Detail		Site operational areas Installation boundary			
Dwg No	HRA2	**Scale**		**Title**	Schematic conceptual hydrogeological model
Detail					
Dwg No	HRA3	**Scale**		**Title**	Hydrogeological Map
Detail		Regional geology and hydrogeology Locations of abstractions			
Dwg No	HRA4	**Scale**	1:10,000	**Title**	Surface Geology Map and Geological Cross-Section of the Tilbury Ash Disposal Site Area
Detail		Surface geology Schematic geological cross section			
Dwg No	HRA5	**Scale**	1:7,500	**Title**	Location of Existing Surface Water and Groundwater Monitoring Points
Detail		Surface water monitoring points Groundwater monitoring boreholes			

1. Introduction

1.1. Report Context

RWE Npower plc ("RWE npower") operates an ash disposal site ("the site") associated with Tilbury Power Station. As part of the UK's implementation of the Landfill Directive, this site is required to apply for a permit to continue operating under IPPC by 9th November 2004. This report documents the results of a hydrogeological risk assessment for the landfill. This risk assessment has been prepared by RWE npowerOne's Environment Department and the report has been completed using the template prepared by the Environment Agency (EA, 2003). It is intended to meet the requirements of Section 1.4 of Part B of the PPC permit application form for the landfill sector.

The landfill activity undertaken at the site involves the tipping of pulverised fuel ash (PFA) produced by Tilbury B Power Station in a 'shallow' land-raising operation that raises the existing ground level by no more than 20 feet (about 6 metres) above Ordnance Datum. The site, which is on an area of land known locally as the East Tilbury Marshes, is divided into six operational areas - Area A1, Area A2, Area A3, Area B, Area C1 and Area C2. These areas, which are shown relative to one another and the power station in Drawing HRA1, are separated from one another by surface drains which run across East Tilbury Marshes and are currently covered by four Waste Management Licences:

1. Licence EA/WML/71185 for Area A3;
2. Licence EA/WML/71186 for Area C2;
3. Licence 193/91 for Areas A1, A2 and C1; and,
4. Licence 38/78 for Area B.

A more detailed description of the site, operations and overall conceptual model is provided in the accompanying "Conceptual Model, Environmental Setting and Installation Design Report" (the "ESID Report") (Jones & Waygood, 2004).

1.2. Conceptual Hydrogeological Site Model

The conceptual model of the Tilbury Ash Disposal Site has been developed in detail in the ESID report (Jones & Waygood 2004). The aspects that are key to the hydrogeological risk assessment are summarised in this section. The conceptual model is summarised schematically in Figure HRA2.

1.2.1. Sources

The application is for a "proposed development" consisting of continuing operation of the six existing areas of the Tilbury ash disposal site, as shown in Drawing ESID1 and reproduced here as Drawing HRA1. Although the whole site is considered as the installation for the purposes of this application, the majority of the site's remaining capacity, as of the Landfill PPC Application date, is in Area C2. Future disposal will therefore largely be to Area C2, although some minimal activity is likely to be undertaken to 'complete' the other areas.

The development of the site involves disposal of PFA by landfilling/land raising on land within the specified areas. Prior to any disposal being undertaken, topsoil is stripped from the operational area and piled away from the tipping operations. Conditioned PFA, which is transported to the operational area by truck using a dedicated rubble and compacted PFA haul road, is then laid in lifts of approximately 3 metres and initial compaction achieved using the tipping and levelling vehicles. Final compaction is achieved using a 10 tonne vibrating roller and, once the final height of 20 feet aOD

(about 6 metres aOD) is achieved, the topsoil is replaced, to the original depth as far as is practicable. The nature of PFA when properly placed in this way is such that once tipping operations are complete and the site top soiled, the resulting land raising is a permanent feature essentially improves the land condition and which requires no maintenance other than the normal management of vegetation. For operations at Tilbury, the ash disposal areas have historically been returned to agricultural use once operations are complete. As a result, no further action is needed to protect the finished surface. Further details of the disposal activities are given in the Working Plans for Areas A3 and C2 which are given in Appendix B of the ESID report (Jones & Waygood, 2004).

As with the existing Waste Management Licences, the proposed development of the Tilbury ash disposal site will only involve the disposal of pulverised fuel ash (PFA) produced by Tilbury B Power Station. PFA is a by-product of the combustion of hard, bituminous coal in the power station boilers and is the fraction of the incombustible matter in coal which leaves the boilers entrained in the flue gases and is captured by the electrostatic precipitators. Whilst some of the PFA produced by Tilbury B Power Station is marketed into the construction industry, it is the remainder which, following conditioning" with approximately 18% water, is landfilled at the Tilbury ash disposal site. "Conditioning" serves two purposes: it reduces the risk of dust blow in transit; and secondly, it facilitates the formation of a consolidated deposit by lubricating the spherical particles allowing them to pack effectively.

Table ESID2 (reproduced here as Table HRA1) gives data on the quantities of ash produced by Tilbury B Power Station in recent years. It is estimated that similar annual quantities are likely to be produced into the foreseeable future. The table also includes the quantities of ash that have been deposited at the Tilbury ash disposal site over the same period. Whilst it is anticipated that similar proportions of the annual ash make are likely to require disposal in the future, the actual amounts will depend on the success of ash marketing activities.

Year	1998	1999	2000	2001	2002	2003
Quantity PFA Produced (ktonnes)	146	151	101	203	259	238
Quantity PFA Disposed (ktonnes)	90	102	42	139	147	102

Table HRA1: Quantities of PFA produced and disposed by Tilbury B Power Station between 1998 and 2003.

The nature of the combustion process in pulverized fuel-fired boilers, such as those at Tilbury B Power Station, means that the resulting PFA has a number of unique characteristics. In particular:

- the coal grinding process produces fine-grade PFA particles of reasonably consistent size;
- the high temperature combustion releases and destroys the hydrocarbons;
- the ash is molten before solidifying into spherical PFA particles.

The result is that ash from pulverised fuel combustion is significantly different in its physical and chemical properties from ash produced by other methods of combustion. In particular:

- PFA particles are spherical and this, together with their particle size distribution (1 to 100 µm, with most approximately 20 µm in diameter), mean that with

sufficient water it can be easily and efficiently compacted;
- compacted PFA has a low permeability to water (between about 1 x 10^{-7} m s^{-1} and 1 x 10^{-8} m s^{-1} according to Studds & Cross, 2001);
- PFA has relatively low density (typically 1300-1700 kg m^{-3}) compared to many similar materials;
- PFA is pozzolanic - in the presence of lime and water, it forms stable cementitious compounds;
- PFA contains only trace quantities of organic materials because the main organic content has been removed during combustion.

In terms of chemical composition, PFA is composed largely of alumino-silicate mineral phases, which, due to rapid cooling from a molten state, take a predominantly non-crystalline, 'glassy' form. Tables ESID3-ESID5 and the associated discussion in the ESID report document the composition of PFA from Tilbury power station in detail. In addition to the major inorganic constituents, there is also a range of more minor constituents in PFA which come from the trace elements present in the inherent and adventitious matter associated with the coal. Many of the trace element concentrations are of a similar order to those found in soils and natural minerals.

As described in the ESID report, the combustion process which produces PFA results in the removal of the main organic carbon content of the parent coal. As a result, PFA contains no significant quantities of any organic compounds that can be regarded as a threat to the environment. PFA does have a remnant, unburnt inorganic fraction which is quantified by testing the loss on ignition (LOI); the average LOI of Tilbury PFA samples collected between August '03 and July '04 was 15.6%.

Turning to leaching characteristics, PFA is widely reported as having very low solubility (Woolley *et al.*, 2000). This is because most of the solid elemental inventory is held within the largely insoluble "glassy" alumino silicate matrix. Typically, a maximum of around 2% of PFA has been found to be soluble in repeated laboratory tests and eluates are dominated by calcium sulphate (gypsum). Most of the metals and metalloids present in the ash are either retained in the glass beads or firmly adhered to them, resulting in a very low leaching potential. PFA eluates are also alkaline, which materially assists in retaining metals because their solubility tends to reduce with increasing pH.

A considerable body of work has been carried out to investigate the leaching behaviour of PFA and Tables ESID6 to ESID9 (reproduced here as Tables HRA2 to HRA5) give the data obtained from Tilbury PFA from standard leaching tests. These data show that:

- Irrespective of the test conditions, the eluates from the PFA produced from the coals typically burnt to date at Tilbury are alkaline and are dominated by calcium and sulphate. Although potassium and sodium are the next most concentrated species in the eluates, their concentrations are typically less than a third of the corresponding calcium ones. Other elements, such as aluminium, iron, silicon and potassium, which are typically present in the solid matrix at concentrations above 1% (by weight), are shown by the data in Tables HRA2 to HRA4 to be largely insoluble in water under the prevailing test conditions.
- Few of the eluates contain any other elements at concentrations above 1 mg l-1; in many cases elements are present at concentrations below the analytical method detection limit.
- The eluate analysis results in Tables HRA2 to HRA4 show that the leachate from PFA does not contain the List I substances cadmium and mercury at concentrations above the analytical method detection limit.

- Whilst some of the eluates contain List II substances, concentrations are typically comparable with the 1989 and 2000 Drinking Water Standards for most metals and inorganic determinands. For those species present at higher concentrations, they are typically within a factor of five of the Standards.
- Analysis of the multi-stage eluate data presented in Table HRA5 shows that the concentration of most of the components of PFA eluates decrease rapidly with repeated leaching.
- Data presented in the ESID report shows that, when the eluate data are converted from a mg l^{-1} basis to a mg kg^{-1} basis, the majority of constituents of PFA are only sparingly soluble in water. The only elements which are soluble at more than a 1% level are boron, calcium, molybdenum, sodium, antimony and selenium. Of these, only boron, calcium and molybdenum show a solubility of over 10%.

Analysis Date		1994	Mar-96	Apr-96	Jun-96	Sep-96	Sep-97
Analyte		Concentration (mg/l)					
Aluminium	Al	3.89	4.2	11.56	-	-	-
Arsenic	As	0.05	<0.1	<0.01	<0.1	<0.1	<0.1
Boron	B	10.2	6	6.86	1.8	8.3	3.4
Barium	Ba	-	0.2	0.07	-	-	-
Calcium	Ca	546	216	378.8	-	-	-
Cadmium	Cd	<0.01	<0.1	<0.05	<0.1	<0.1	<0.005
Cobalt	Co	<0.05	<0.1	<0.05	-	-	-
Chromium	Cr	0.11	<0.1	0.16	<0.1	<0.1	0.14
Copper	Cu	<0.01	<0.1	<0.05	<0.1	<0.1	<0.01
Iron	Fe	0.01	<0.1	<0.05	-	-	-
Mercury	Hg	<0.05	<0.01	0.0002	<0.01	<0.1	<0.001
Potassium	K	22	9.1	6	-	-	-
Manganese	Mn	<0.01	<0.1	<0.05	-	-	-
Molybdenum	Mo	<0.05	0.5	0.86	0.2	<0.1	-
Magnesium	Mg	4	0.8	<0.05	-	-	-
Sodium	Na	195	15	7	-	-	-
Nickel	Ni	<0.02	<0.1	<0.05	<0.1	<0.1	<0.01
Phosphorus	P	-	<0.1	-	-	-	-
Phosphate	PO_4^{3-}	<0.1	-	0.52	-	-	-
Lead	Pb	0.03	<0.2	<0.05	<0.2	<0.2	<0.01
Antimony	Sb	<0.05	<0.01	0.28	-	-	-
Selenium	Se	<0.1	0.126	<0.1	<0.01	<0.1	<0.01
Tin	Sn	0.06	<0.1	<0.05	-	-	-
Silicon	Si	-	0.6	1.5	-	-	-
Titanium	Ti	0.02	<0.1	<0.05	-	-	-
Vanadium	V	1.07	0.4	0.78	<0.1	<0.1	0.5
Zinc	Zn	<0.01	<0.1	<0.05	<0.1	<0.1	<0.01
Bromide	Br^-	-	-	0.63	-	-	-
Chloride	Cl^-	28	1.6	<5	-	-	15
Cyanide	CN^-	-	<0.1	-	-	-	-
Fluoride	F-	5.6	1.4	3.65	0.18	1.53	-
Sulphate	SO_4^{2-}	1000	510	527	-	-	340
Nitrite	NO_2^-	-	<0.1	-	-	-	-
Nitrate	NO_3^-	-	<0.1	-	-	-	-
Sulphide	S_2^{2-}	-	-	-	-	-	
Ammonium	NH_4^+	-	-	-	-	-	-
Ammonia (as N)	NH_3	-	-	-	-	-	-
Phenols		-	<0.1	-	-	-	-
TOC		-	3	-	-	-	-
pH	pH	10.1	10.1	11	11	11.6	9.7
Elect Cond	mS/cm	2.25	0.947	1.24	1.22	1.79	0.645

Table HRA2. Composition of eluates obtained following the batch leaching of Tilbury PFA in demineralised water for 24 hours at a liquid-to-solid ratio of 10:1 [i.e. the method set out in the NRA draft procedure (NRA, 1994), DIN 38414-S4 (DIN, 1984) or British Standard BS EN 12457-2:2002 (BSI, 2002a)].

Analysis Date		Jan-99	Mar-00	May-01	2002	2002	2004
Analyte		Concentration / (mg/l)					
Aluminium	Al	3.62	8.1	0.17	14.12	3.08	7.3
Arsenic	As	0.01	<0.01	<0.01	<0.002	<0.002	0.03
Boron	B	2.73	3.3	1.08	3.15	2.28	6.88
Barium	Ba	0.68	0.15	0.11	0.28	0.58	0.59
Calcium	Ca	253	211	149	231.1	128.5	240
Cadmium	Cd	<0.0004	<0.004	<0.004	<0.0004	<0.0004	<0.002
Cobalt	Co	<0.001	<0.01	<0.01	<0.001	<0.001	<0.01
Chromium	Cr	0.11	0.08	0.32	0.041	0.024	0.16
Copper	Cu	<0.005	<0.02	<0.02	<0.005	<0.005	<0.01
Iron	Fe	<0.001	<0.08	<0.08	<0.001	<0.001	<0.08
Mercury	Hg	<0.00005	<0.001	<0.001	<0.00005	<0.00005	<0.0002
Potassium	K	7	0.59	4.3	11.6	4.2	6.2
Manganese	Mn	0.002	0.03	<0.01	0.001	0.005	<0.01
Molybdenum	Mo	0.48	0.51	0.44	0.76	0.115	0.42
Magnesium	Mg	<0.05	0.25	<0.06	<0.05	<0.05	<0.06
Sodium	Na	29	0.28	12	12	7.2	6.9
Nickel	Ni	<0.01	<0.01	0.02	<0.01	<0.01	0.02
Phosphorus	P	<0.05	0.8	0.16	<0.05	<0.05	<0.1
Phosphate	PO_4^{3-}	-	-	-	-	-	-
Lead	Pb	<0.005	<0.01	<0.01	<0.005	<0.005	<0.01
Antimony	Sb	0.01	<0.05	<0.05	<0.005	<0.005	<0.05
Selenium	Se	0.16	0.12	<0.01	<0.005	<0.005	0.06
Tin	Sn	<0.005	<0.1	<0.1	<0.005	<0.005	<0.1
Silicon	Si	1.29	0.42	0.7	2.32	2.38	1.33
Titanium	Ti	<0.05	<0.1	<0.1	<0.05	<0.05	<0.1
Vanadium	V	0.29	0.44	<0.01	0.019	0.048	0.18
Zinc	Zn	<0.005	<0.02	<0.02	<0.005	<0.005	<0.01
Bromide	Br^-	-	-	-	-	-	-
Chloride	Cl^-	<0.01	4.6	3.4	<5	<5	<0.5
Cyanide	CN^-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fluoride	F^-	1.37	1.5	1	<0.5	0.6	<1
Sulphate	SO_4^{2-}	-	465	344	446	182	457
Nitrite	NO_2^-	<0.05	<0.5	<0.5	0.07	<0.05	<0.5
Nitrate	NO_3^-	2.4	2.2	<1	0.4	<0.3	
Sulphide	S_2^{2-}	-	-	<0.05	<0.05	<0.05	<0.05
Ammonium	NH_4^+	-	2.4	-	<0.2	0.5	-
Ammonia (as N)	NH_3	-	-	0.4	-	-	0.4
Phenols		-	<0.00075	-	<0.01	<0.01	<0.05
TOC		2	4.2	1.2	1	1	0.6
pH	pH	11.53	11.2	12.1	(8.06)	(7.87)	11.2
Elect Cond	mS/cm	1.329	0.955	3.42	1.026	0.621	1.209

Table HRA2 (cont.) Composition of eluates obtained following the batch leaching of Tilbury PFA in demineralised water for 24 hours at a liquid-to-solid ratio of 10:1 [i.e. the method set out in the NRA draft procedure (NRA, 1994), DIN 38414-S4 (DIN, 1984) or British Standard BS EN 12457-2:2002 (BSI, 2002a)].

Analysis Date		Apr-96
Analyte		Concentration (mg/l)
Aluminium	Al	4.45
Arsenic	As	<0.01
Boron	B	21.24
Barium	Ba	0.09
Calcium	Ca	788.7
Cadmium	Cd	<0.05
Cobalt	Co	<0.05
Chromium	Cr	0.59
Copper	Cu	<0.05
Iron	Fe	<0.05
Mercury	Hg	<0.0001
Potassium	K	20
Manganese	Mn	<0.05
Molybdenum	Mo	3.67
Magnesium	Mg	0.11
Sodium	Na	22
Nickel	Ni	<0.05
Phosphorus	P	-
Phosphate	PO_4^{3-}	<0.01
Lead	Pb	<0.05
Antimony	Sb	<0.05
Selenium	Se	<0.1
Tin	Sn	<0.05
Silicon	Si	1.66
Titanium	Ti	0.1
Vanadium	V	0.97
Zinc	Zn	<0.05
Bromide	Br^-	0.95
Chloride	Cl^-	<5
Cyanide	CN^-	-
Fluoride	F^-	0.71
Sulphate	SO_4^{2-}	1649
Nitrite	NO_2^-	-
Nitrate	NO_3^-	-
Sulphide	S_2^{2-}	-
Ammonium	NH_4^+	-
Ammonia (as N)	NH_3	-
Phenols		-
TOC		-
pH	pH	10.8
Elect Cond	mS/cm	2.54

Table HRA3. Composition of eluate obtained following the batch leaching of Tilbury PFA in demineralised water for 24 hours at a liquid-to-solid ratio of 2:1 [i.e. the method set out in British Standard BS EN 12457-1:2002 (BSI, 2002b)].

Analysis Date		Apr-96		Feb-03		Feb-03	
L:S Ratio		L:S=2	L:S=2-10	L:S=2	L:S=2-10	L:S=2	L:S=2-10
Analyte		Concentration (mg/l)					
Aluminium	Al	21.65	9.36	2.44	2.82	5.23	3.47
Arsenic	As	<0.01	0.04	0.0105	0.0058	0.017	0.0113
Boron	B	22.9	3.79	4.17	2.23	17.3	2.24
Barium	Ba	0.13	0.08	0.194	0.377	0.112	0.604
Calcium	Ca	1094	221.5	756	156	611	169
Cadmium	Cd	<0.05	<0.05	-	-	-	-
Cobalt	Co	<0.05	<0.05	0.0019	0.0003	0.001	0.00031
Chromium	Cr	0.59	0.1	0.599	0.164	0.484	0.095
Copper	Cu	<0.05	<0.05	0.0057	0.0031	0.0045	0.0031
Iron	Fe	<0.05	<0.05	0.324	0.015	0.033	0.014
Mercury	Hg	<0.0001	<0.0001	0.00033	0.00046	0.00149	<0.0002
Potassium	K	24	3	40	5.16	19.6	2.32
Manganese	Mn	<0.05	<0.05	-	-	-	-
Molybdenum	Mo	3.93	0.42	1.08	0.228	1.77	0.247
Magnesium	Mg	0.59	<0.05	0.69	0.14	0.09	0.03
Sodium	Na	21	2	48.1	5.77	34	3.72
Nickel	Ni	<0.05	<0.05	-	-	-	-
Phosphorus	P	-	-	<0.5	<0.5	<0.5	<0.5
Phosphate	PO_4^{3-}	<0.01	0.02	-	-	-	-
Lead	Pb	<0.05	<0.05	0.002	<0.0001	<0.0001	<0.0001
Antimony	Sb	<0.05	0.05	<0.01	0.0051	<0.01	0.0025
Selenium	Se	<0.1	<0.1	0.046	0.019	0.037	0.016
Tin	Sn	<0.05	<0.05	0.017	<0.01	<0.01	<0.01
Silicon	Si	0.53	2.18	7.25	4.96	2.38	3.6
Titanium	Ti	<0.05	<0.05	0.058	<0.002	0.006	<0.002
Vanadium	V	1.06	0.76	0.083	0.065	0.178	0.108
Zinc	Zn	<0.05	<0.05	0.071	0.02	0.054	0.017
Bromide	Br^-	0.74	<0.01	-	-	-	-
Chloride	Cl^-	<5	<5	36.8	4.06	11.1	1
Cyanide	CN^-	-	-	<0.02	<0.02	<0.02	<0.02
Fluoride	F^-	<0.01	<0.01	0.36	0.47	0.86	0.75
Sulphate	SO_4^{2-}	2000	318	1790	291	1470	240
Nitrite	NO_2^-	-	-	<0.01	<0.01	<0.01	<0.01
Nitrate	NO_3^-	-	-	0.028	<0.01	0.21	<0.01
Sulphide	S_2^{2-}	-	-	<0.01	<0.01	<0.01	<0.01
Ammonium	NH_4^+	-	-	0.05	<0.05	1.57	0.15
Ammonia (as N)	NH_3	-	-	-	-	-	-
Phenols		-	-	0.54	<0.1	0.36	<0.1
TOC		-	-	-	-	-	-
pH	pH	10.6	11	11.3	11.49	11.5	11.73
Elect Cond	mS/cm	3.03	0.97	2.97	0.936	2.33	1.06

Table HRA4. Composition of eluates obtained following the batch leaching of Tilbury PFA in demineralised water for 24 hours at a liquid-to-solid ratio of 2:1 (6 hours) and 2-10:1 (18 hours) [i.e. the method set out in British Standard BS EN 12457-3:2002 (BSI, 2002c)].

Analysis Date		1994		
		Cycle		
		1	2	3
Analyte		Concentration (mg/l)		
Aluminium	Al	3.89	3.06	<0.01
Arsenic	As	0.05	<0.04	<0.04
Boron	B	10.2	1.5	1.03
Barium	Ba	-	-	-
Calcium	Ca	546	94	<1
Cadmium	Cd	<0.01	<0.01	<0.01
Cobalt	Co	<0.05	<0.05	<0.05
Chromium	Cr	0.11	0.05	<0.02
Copper	Cu	<0.01	<0.01	<0.01
Iron	Fe	0.01	<0.01	<0.01
Mercury	Hg	<0.05	<0.05	<0.05
Potassium	K	22	3	<1
Manganese	Mn	<0.01	<0.01	<0.01
Molybdenum	Mo	<0.05	<0.05	<0.05
Magnesium	Mg	4	1	<1
Sodium	Na	195	15	<1
Nickel	Ni	<0.02	<0.02	<0.02
Phosphorous	P	<0.1	<0.1	<0.1
Phosphate	PO_4^{3-}	-	-	-
Lead	Pb	0.03	<0.03	<0.03
Antimony	Sb	<0.05	0.07	<0.05
Selenium	Se	<0.1	0.3	0.2
Tin	Sn	0.06	<0.05	<0.05
Silicon	Si	-	-	-
Titanium	Ti	0.02	<0.02	<0.02
Vanadium	V	1.07	0.97	0.92
Zinc	Zn	<0.01	<0.01	<0.01
Bromide	Br^-	-	-	-
Chloride	Cl^-	28	26	4
Cyanide	CN^-	-	-	-
Fluoride	F^-	5.6	0.4	0.3
Sulphate	SO_4^{2-}	1000	155	24
Nitrite	NO_2^-	-	-	-
Nitrate	NO_3^-	-	-	-
Sulphide	S_2^{2-}	-	-	-
Ammonium	NH_4^+	-	-	-
Ammonia (as N)	NH_3	-	-	-
Phenols		-	-	-
TOC		-	-	-
pH		10.1	10.4	10.5
Elect Cond	mS/cm	2.25	0.44	0.17

Table HRA5. Composition of eluates obtained following the repeated batch leaching of Tilbury PFA in demineralised water for 24 hours at a liquid-to-solid ratio of 10:1 [i.e. repeated leaching using the method set out in the NRA draft procedure (NRA, 1994), DIN 38414-S4 (DIN, 1984) or British Standard BS EN 12457-2:2002 (BSI, 2002a)].

As a result of the physical and chemical properties described in this Section and more fully in the ESID report, it is concluded that the disposal activities at the Tilbury ash disposal site are unlikely to result in the release of any significant amounts of leachate. Any leachate that is produced will not contain any List I substance in a quantity or concentration that will pose any risk to groundwater. Whilst the leachate could contain List II substances, they are present in quantities and at concentrations which are unlikely to pose a risk of pollution to groundwater.

Although the possible presence of List II substances in any potential leachate means that the Groundwater Regulations apply to the site, the nature of the waste being deposited and its environmental setting means that the risk to groundwater from the disposal operations is minimal as considered in more detail below. The concentrations of any potential contaminants are generally comparable to the appropriate water quality standards and comparable with background groundwater quality. In addition, water balance considerations, measurements at other sites and consideration of critical moisture contents in PFA show that there will be little if any leachate generated within the PFA. As a result, leachate is not collected from the Tilbury ash disposal site and it is considered that the collection of leachate from the Tilbury ash disposal site is not necessary in the future.

1.2.2. Pathways

The geology and hydrogeology of the site and its surroundings have been presented in detail in Sections 3.2 and 3.5 of the ESID report (Jones & Waygood, 2004). The geology of the area has been proved in a series of intrusive investigations including the 1962 investigation for construction of the current power station and several subsequent investigations for civil engineering works near the river. In summary, the land occupied by the Tilbury ash disposal site lies in the regional geological setting of the southern margin of the synclinal London basin. The stratigraphy of the area comprises Cretaceous deposits of Lower Greensand and Gault clay overlain by chalk. The Chalk, which has a total thickness of up to 280 m in the eastern London basin, dips to the north and rises to the south to form the North Downs. Tertiary sands and clays overlie the Chalk. These are in turn overlain by about 20 m of Quaternary deposits of Pleistocene sands and gravels and, most recently, floodplain alluvium consisting of soft grey or blue-grey clay and fine silty sand with peat and lignite fragments. Soils in the area are pelo-alluvial gley soils. The site setting within the regional geology is illustrated in Drawing HRA3.

The British Geological Survey has carried out a review of data relevant to the site stored in their geological archives on behalf of RWE npower. This is included in its entirely in Appendix D of the ESID report (Jones & Waygood, 2004). Synthesis of the results from all the investigations confirms the general regional understanding. The site itself is immediately underlain by between 15 and 20 m of alluvium, comprising clays, silts, silty clay and peat. The alluvium is underlain by about 5 m of sands and gravels. The bedrock is the Chalk which lies at least 20 m below ground level. A surface map and schematic cross-section of the geology is provided in Drawing ESID6 reproduced here as Drawing HRA4. The locations of additional key boreholes used in interpreting the geology are shown in Drawing HRA5.

The principal aquifer in the area around the Tilbury ash disposal site is the Chalk, which forms part of a regional groundwater system extending beneath the entire London basin and cropping out to form the North Downs. The Groundwater Vulnerability map for the Thames Estuary (Sheet 40) classifies the Chalk as a highly permeable major aquifer,

but overlain by lower permeability drift deposits (NRA, 1995). Soils above the aquifer are classified as being of high leaching potential and ones that readily transmit liquid discharges. This 'worst case' classification is, however, based on a lack of data rather than specifically on the characteristics of the superficial deposits.

Hydrogeological properties of the Chalk in the London Basin and the North Downs have been extensively documented by Allen *et al.* (1997), befitting its significance as the most important aquifer in southern England. Its transmissivity varies both laterally and vertically in a complex manner. The permeability of the Chalk matrix is essentially negligible; it is an aquifer because of secondary permeability resulting from dissolution of geological features such as joints, bedding planes and fault-related fractures. This dissolution is understood to be driven by variation of the water table and subsequent weathering in parts of the Chalk that are near to the surface. Consequently, enhanced permeability is generally assumed to be limited to a zone of weathering near chalk surfaces which have been near to the surface at some point in their geological history. This zone typically ranges in depth between 10 and 100 m.

Allen *et al.* (1997) summarise all the available aquifer properties data for the Chalk in the area around Tilbury. They conclude that, for chalk in the area of the North Downs, transmissivity data are log-normally distributed with a range between 52 and 7400 m^2/d, a geometric mean of 720 m^2/d and a median value of 670 m^2/d. In the London basin, the data range from 1 to 4300 m^2/d, with a geometric mean of 160 m^2/d and median of 230 m^2/d. They also point out that the data for the North Downs are "probably unrepresentative of the true aquifer properties due to a significant lack of low transmissivity values." Porosity values for the Chalk vary widely depending particularly on the degree of secondary porosity. Allen *et al.* (1997) also present storage data; neither porosity nor storage data are relevant to the Hydrogeological Risk Assessment for Tilbury ash disposal site and are not considered further in this report.

The mineralogy of the alluvium has been investigated by analysing solid samples from three recent shallow boreholes at the site (Boreholes 1, 3 & 4), the locations of which are shown in Drawing HRA5. These results are reported and discussed in Section 4 of the ESID report (Jones & Waygood, 2004). Hydrogeological data for the alluvium around the site are very sparse, reflecting its very limited groundwater resource value. Jones *et al.* (2000) state that Quaternary clays in the Thames Basin area generally have a hydraulic conductivity of the order of 10^{-3} m/d (about 10^{-8} m/s). In places the hydraulic conductivity may reach 10^{-2} m/d (about 10^{-7} m/s). These values are consistent with the generally accepted *in-situ* permeability of clays. The alluvium is likely to be heterogeneous on a regional scale, with hydraulic properties controlled by lithology and the depositional environment. Evidence from water strikes in boreholes indicates that, where permeable features are intercepted, the flow decreases rapidly implying that the supply of water is limited. If more permeable lenses are present, these observations confirm that their hydraulic continuity is very limited.

Norwest Holst (2002) carried out a range of geotechnical testing on samples from boreholes on land and under the Thames for the recent Tilbury jetty extension. For one of the boreholes beneath the river (their borehole 412 located at TQ 65811 75276), the permeability of alluvium was tested as part of a consolidation test. The results for four samples showed a permeability ranging between 6.06×10^{-10} m s^{-1} to 5.47×10^{-11} m s^{-1}. Although this borehole is below the river itself, the material is interpreted as being the same as the alluvium beneath the ash disposal site.

The generally flat topography of the area in the vicinity of the site means that the tidal

range of water levels in the river is likely to be the most significant driver for flow. The most significant topographical features are in fact made ground due to flood defences, historical landfilling and landfilling of PFA. The low-lying nature of the East Tilbury Marshes and their vicinity to the River Thames means that groundwater is present in the Tertiary and Quaternary deposits immediately beneath the ash disposal site. Water levels in the surface ditches which cross the area vary with the season and with the tidal state of the River Thames. The deposits are therefore likely to be in hydraulic continuity with the river and, as a result, any leachate that might potentially be produced by the site will be diluted, dispersed and attenuated within these deposits. Mass transfer will tend to be lateral and any leachate diluted in shallow groundwater is likely to enter the river. The vertical flow rate is likely to be very small and the impact on the Chalk aquifer, through 15-20 m of low permeability material, is likely to be negligible. In this respect, the superficial deposits can be regarded as a substantial natural geologic barrier between the ash deposits and the Chalk aquifer.

There are limited data on groundwater levels in the superficial deposits beneath the site. Given their low permeability and surface elevation close to river level, water is expected to be encountered close to the surface. This was confirmed in Boreholes 1, 3 & 4 drilled in late 2003. Water levels monitored in September 2004 in these boreholes are summarised in Table ESID6 reproduced here as Table HRA6. The water level is seen to be between 3 and 5 m below surface. The borehole logs for these three boreholes are included in Appendix A. The water levels are difficult to interpret in terms of flow in the superficials, because of differences in topography (whether the boreholes are through 5 m of PFA or into undisturbed ground) and because they represent instantaneous measurements that might change depending on the state of the tide. The observations suggest that the raised topography of the PFA mound may influence flow on a local basis, which is therefore likely to be away from the mound.

		BH1	BH3	BH4
Borehole elevation	m aOD	0.72	5.22	4.92
Water level relative to ground	m bgl	3.4	5.4	3.0
Water level relative to OD	m aOD	-2.68	-0.18	1.92

Table HRA6. Observed water levels in monitoring boreholes shown in Drawing HRA3, sampled September 2004.

A deeper borehole (TQ67NE274 in the BGS borehole archive, also shown in Drawing HRA5) drilled into the Chalk in 1978 struck water at 16.3 m bgl, very near the base of the alluvium.

These observations indicate that there is groundwater near the surface in the clay. The water level in saturated clays is generally accepted to be different from a conventional water table in an aquifer because the water is generally held tightly within the clay matrix. At Tilbury, there are no abstractions from the superficial deposits and it is inconceivable that there will be abstractions in the future. The ground waters present near the surface do not represent a groundwater resource for abstraction because the low permeability would not sustain any significant abstraction and because the quality is in any case poor, as discussed in Section 3.5.3 of the ESID report (Jones & Waygood, 2004). Temporal variability will be limited to changes in river level, precipitation/infiltration and to ash emplacement.

There is likely to be interaction between the shallow ground waters and surface water conduits (drainage ditches and the River Thames). For both surface waters and ground

waters on the site, the dominant feature is the proximity to the Thames which will significantly influence flow and quality. Observed groundwater levels are below the base of the drainage ditches. The ditches might therefore recharge shallow groundwater, although it is possible that at times of high rainfall (or high tide) groundwater might discharge into the ditches. Topographically driven flow is likely to be small due to the overall flatness of the area and the hydraulic gradient is likely to vary, controlled by the difference between the ground water level and the level of the Thames.

In the Chalk aquifer, flow is generally interpreted as being down dip from the outcrop of the Chalk in the North Downs of Kent towards the north. This is likely to be influenced locally by abstractions, the nearest of which is to the west of the ash disposal site at Tilbury Power Station. There are further abstractions to the north at Low Street (documented in Table ESID12 of Jones & Waygood, 2004) and shown in Drawing HRA3. The Hydrogeological Map of the Dartford (Kent) District (Institute of Geological Sciences, 1968) contours water levels in the Chalk but at low resolution. The hydraulic gradient in the Chalk beneath Tilbury is uncertain but could be interpreted as being to the north with a value around 0.003, although where this is used later in the quantitative risk assessment it is given a wide range of variability and subject to a sensitivity study.

In summary, the hydrogeological conceptual model of the site is that the alluvium acts as an aquiclude to confine the underlying more permeable aquifers and to inhibit recharge from surface. It will therefore also act to attenuate any leakage from ash deposited in the site. Water within the shallow superficial deposits is of poor quality in a low permeability environment and it is inconceivable that the small area down gradient between the ash disposal site and the Thames could represent an abstractable resource in the future. Its potential as a pathway to surface water in drainage ditches, the River Thames to the South, and the Chalk aquifer beneath is considered quantitatively below.

1.2.3. Receptors

According to records obtained from the Environment Agency and summarised in Table ESID12 of Jones & Waygood (2004) and in Drawing HRA3, the closest groundwater abstraction borehole to Tilbury Power Station is the station's own make-up borehole located at TQ 6576 7601. The next closest abstractions are a set of boreholes at Polwicks (TQ 670 778) that are used for general farm supply, domestic supply and spray irrigation. These are close to boreholes at Low Street (TQ 672 778) that are, again, owned by RWE npower. The site does not lie in or near any source protection zone.

The closest significant potable water abstraction to the ash disposal area is 3.8 km north-north-east of the power station at Linford (TQ 671 792). This borehole is licensed to take up to 6364 m^3 per day. CEGB pumping tests at Low Street have shown that the source at Linford is hydraulically isolated from the aquifer to the south and that the abstraction is supported by a combination of local recharge and the inflow of good quality chalk groundwater from the area to the east of the borehole. The 'Total Catchment' of the Linford abstraction does not include any of the ash disposal areas.

To the best of our knowledge, all of the boreholes in the vicinity of the power station abstract water from the Chalk aquifer (borehole 1 at Low Street, for example, has casing down to a depth of 23.5 m bgl). There are no identified abstractions from any other aquifers in the area.

Other potential receptors are surface water bodies that accept discharge from the

alluvium. These include the drainage ditches and the River Thames. The drainage ditches do not contain any permanent water, and the quality of water within them is monitored. The Thames estuary is tidal, the water quality is saline and the flow rate within it is many orders of magnitude greater than any possible discharge from groundwater.

The conceptual hydrogeological model of the site is illustrated schematically in Drawing HRA2.

2. Hydrogeological Risk Assessment

2.1. The Nature of the Hydrogeological Risk Assessment

The potential risks posed by the site, the sensitivity of the surrounding environment, the degree of uncertainty and the likelihood of hazards being realised have been discussed in detail in the ESID report (Jones & Waygood, 2004). Criteria for assessing the appropriate level of risk assessment are presented in Section 3.2.1 of the Guidance on Hydrogeological Risk Assessment for Landfills (LFTGN01), (Environment Agency, 2003) and in particular in Table 3.1 of LFTGN01. Consideration of these criteria indicates that the appropriate assessment for Tilbury ash disposal site is a simple hydrogeological risk assessment, because:

- Feasible but low-hazard source-pathway-receptor linkages have been identified in the ESID report and summarised in Section 1.2 above;
- The environmental setting is relatively insensitive and the hazards are relatively low, notably because the site lies on at least 15 m of clay, groundwater beneath the site is of poor quality and subject to saline intrusion, and the only permanent surface water body to which groundwater discharges is the Thames estuary which is tidal and saline;
- The source, pathway and receptor terms have been defined with sufficient certainty that they can be assessed with confidence using conservative inputs, models and assumptions. In particular, the source is a single homogeneous source of PFA produced by Tilbury Power Station;
- In comparison with LFTGN01 Table 3.1, the site is a non-hazardous waste site on low-permeability strata with no surface waters or abstractions other than the River Thames and abstractions from the deep Chalk aquifer which is protected by 15+ m of clay.

2.2. The Proposed Assessment Scenarios

There are two distinct scenarios for consideration:

1. the operational phase, when ash is being actively added to the site, the ash water content consists of around 18% conditioning water, and a surface of PFA is exposed;
2. the post-operational phase, when the ash has been compacted, covered with a layer of top soil and returned to agricultural use.

Although these scenarios are considered separately, in hydrogeological terms they are similar, the main difference being the potential for evapotranspiration in the post-operational phase to act to reduce infiltration into the waste. There are no distinct failure or accident scenarios that have not been considered in the Stability Risk Assessment (Jones, 2004). In particular, the absence of active management of leachate and of an engineered containment system means that no accidents can prevent these operating. Flooding in considered separately in Section 3.4 of the ESID report (Jones & Waygood,

2004), but the main consequence of flooding is a possible compromise of stability, in the worst case causing ash to be mixed directly with surface water.

2.2.1. Lifecycle Phases

As stated in the previous section, the risk assessment considers two scenarios. The hydrogeological conceptual model for both is essentially that described in Section 1.2. The only difference is a small reduction in potential infiltration due to top soiling and planting.

2.3. The Priority Contaminants to be Modelled

The only waste material to be disposed of is PFA. Extensive data relating to eluates from leachate testing of PFA from Tilbury are reported in the ESID report (Jones & Waygood, 2004) and repeated in Section 1.2.1 of this report. A substantial body of data exists that demonstrates that leachate from PFA does not contain any significant List I substances under the Groundwater Directive.

It is generally accepted that leachate from PFA might contain some quantities of certain List II substances in concentrations that cannot immediately be dismissed, specifically arsenic, boron, chromium, molybdenum, selenium, nickel and sulphate. These are all considered explicitly in the quantitative risk assessment.

The batch leaching test data presented in the ESID report are quite variable, but in general show limited potential for List II substances to be dissolved under the test conditions. The test conditions are intended to be more aggressive than conditions in the field. For clarity, Table HRA7 compares the most recent results of 10:1 liquid to solid batch leaching tests on Tilbury PFA (from Table HRA2) with the results of groundwater monitoring immediately below the ash on site.

		Batch Leaching Tests		Groundwater sampling						
				BH1	BH3	BH4	BH1	BH3	BH3	BH4
Date of sample		2004	mean 1999 to 2004	May 04	May 04	May 04	Sept 04	Sept 04	Sept 04	Sept 04
Determinand										
Aluminium	µg/l	7300	6065				21	14	10	12
Antimony	µg/l	<50	<50	< 30	< 30	< 30	<5	<5	<5	<5
Arsenic	µg/l	30	<=30	34	74	53	36	46	44	11
Barium	µg/l	590	398	180	160	150	166	381	378	138
Boron	µg/l	6880	3237	3100	5000	4000	3139	3569	3655	2921
Cadmium	µg/l	<0.002	ND	< 5.0	< 5.0	< 5.0	<0.4	<0.4	<0.4	<0.4
Calcium	µg/l	240000	202100	120000	240000	120000	382300	253700	250900	336600
Chromium	µg/l	160	123	51	80	75	9	13	13	5
Cobalt	µg/l	<10	ND				2	2	<1	6
Copper	µg/l	<10	ND	23	27	30	4	2	2	2
Iron	µg/l	<80	ND	60	< 10	420	92	942	1323	158
Lead	µg/l	<1	ND	< 10	< 10	< 10	<1	<1	<1	<1
Magnesium	µg/l	<60	250	480000	570000	510000	385300	437900	442700	327800
Manganese	µg/l	5	8	20	260	< 10	2801	459	445	3316
Molybdenum	µg/l	420	454	< 10	80	50	50	16	13	9
Nickel	µg/l	20	<20	11	< 10	< 10	8	5	5	13
Selenium	µg/l	60	<=160	< 2.0	< 2.0	< 2.0	34	34	32	23
Tin	µg/l	<100	ND	20	100	20	1	1	<1	<1
Vanadium	µg/l	180	164	60	20	50	26	28	22	<1
Zinc	µg/l	<10	ND	28	20	35	51	48	54	58
Mercury	µg/l	<0.2	ND	< 1.0	< 1.0	< 1.0	<0.05	<0.05	<0.05	<0.05
Potassium	mg/l	6.2	5.65				37.5	6.8	6.9	213.8
Sodium	mg/l	6.9	11.23	3300	4100	3800	3825	4050	3375	2850
Nitrate	mg/l		1.04				<0.3	<0.3	<0.3	<0.3
Sulphate	mg/l	457	378.8				348	24	28	682
Chloride	mg/l	<0.5	<5	2400	2600	2100	6163	7041	6918	4872
Fluoride	mg/l	0.5	0.83				0.8	0.8	0.8	0.8
Ammonia as N	mg/l	0.4	0.4	29	28	16	23.5	25.9	26.1	21.3
pH	pH units	11.2	10.3	7.9	7.9	7.6	7.71	7.96	8.12	7.92
Electrical Conductivity @ 20°C	mS/cm	1.21	1.43	15	17	16	18.15	18.52	18.26	13.77

Table HRA7. Comparison of quality of eluates from PFA batch leaching tests at a L:S ratio of 10:1 with groundwater monitoring data at the site. "ND" stands for all measurements below detection limit, although this detection limit might be different for different samples or tests. For determinands with some values below detection in some tests, the mean of the leaching test results is calculated using half the detection limit unless this would be misleading. In cases in which most measurements are below detection, the mean value is given as "less than" the largest value.

The following conclusions can be drawn from Table HRA7:

- It is clear that Tilbury PFA cannot be the source of the observed concentrations of iron, magnesium, manganese, zinc, potassium, sodium, chloride or ammonia, nor the principle source of the observed high electrical conductivity. This is consistent with ground waters being impacted significantly by saline river water.
- Tilbury PFA is unlikely to be the source of the observed concentrations of arsenic, calcium, cobalt or copper.
- Tilbury PFA is an obvious possible source of the observed concentrations of aluminium, chromium, molybdenum, nickel, selenium and vanadium. It is also likely to contribute to the observed concentrations of boron although it might not be the only source.
- Tilbury PFA is a possible source or contributing source for the observed concentrations of barium, sulphate and fluoride.

Of the substances that PFA might be contributing, those whose concentrations exceed screening values (UK Drinking Water Standard or Environmental Quality Standard as documented later in Table HRA9) in at least one groundwater sample are boron, chromium, selenium and sulphate.

2.4. Review of Technical Precautions

2.4.1. Technical Requirements of the Landfill Regulations 2002 and the Groundwater Regulations 2000

The Landfill Regulations 2002 reflect the very detailed requirements of the Landfill Directive and impose specific requirements for landfills, depending on the category of waste (hazardous, non-hazardous or inert) to be deposited therein. However, some of the requirements can be relaxed by the Environment Agency where it is satisfied on the basis of risk assessments that no environmental hazard would result. Currently coal fly ash is classified as non-hazardous waste, although extensive investigations by the former CEGB and by its successor companies indicate that the environmental risks posed by a deposit of compacted conditioned PFA, once in place, have more in common with inert wastes than with the general run of non-hazardous wastes.

Applications for a PPC permit for a landfill requires, amongst other things, risk assessments to support the applicant's proposals. It is noted that the Regulations normally require the following for a non-hazardous landfill:

- Arrangements to control rainwater entering the landfill body and prevent surface water or groundwater from entering into land-filled waste;
- Arrangements to collect contaminated water and leachate and treat it as necessary so that it can be discharged.
- A geological barrier comprising a mineral layer at least 1 metre thick with permeability not greater than 1.0×10^{-9} m/s, or a barrier giving at least equivalent protection. Where the natural geology does not provide this, it can be completed artificially and reinforced by other means to provide the level of protection required.
- An artificial bottom sealing liner and a leachate drainage layer;
- Top sealing over the land-filled material, where prevention of leachate formation is necessary.

The Landfill Regulations allow for certain of these requirements to be relaxed where appropriate. This can only be done on the basis of a site-specific risk assessment as

reported below. The characteristics of PFA and of the clay underlying the site mean that some relaxation of the requirements for leachate collection and top sealing are justified in this case on the basis of risk assessment. These are essentially that:

- Mounded PFA deposited under the conditions prevailing at Tilbury produces very limited or no leachate;
- Eluates from laboratory leaching tests demonstrate that the eluates from PFA contain no significant quantities of List I substances, and some List II substances in concentrations that are generally comparable with water quality standards;
- The adverse environmental impact of PFA has been demonstrated to be very small over many years of its disposal and its use in civil engineering projects;
- There is a natural geological barrier at the site consisting of 15-20 metres of clay, with a permeability of the order of 10^{-10} m/s, protecting the underlying Chalk aquifer.

The requirements of the Groundwater Regulations (2000) are essentially:

- To prevent discharge to groundwater of List I substances;
- To prevent pollution of groundwater by discharge of List II substances.

The regulations achieve these requirements by controlling indirect and direct discharges to groundwater, by demanding 'prior investigation' before such discharges are authorised.

Tilbury ash disposal site is compliant with the Groundwater Regulations essentially because:

- There are no direct or indirect discharges of List I substances in any measurable quantities;
- There are no direct discharges to groundwater of List II substances;
- Indirect discharges of List II substances occur in quantities that are well below the levels that would result in pollution of groundwater;
- This hydrogeological risk assessment represents the 'prior investigation' required to authorise indirect discharges of List II substances.

2.5. Numerical Modelling

2.5.1. Justification for Modelling Approach and Software

The conceptual model underlying software typically used for hydrogeological risk assessment (e.g. LandSim) is not ideally suited to representing the unique characteristics of PFA disposal sites as conceptualised in the ESID report and summarised above. The risk assessment required for the site is a simple risk assessment based on extremely pessimistic assumptions and parameterisations. The most pessimistic of these are as follows:

- We employ a simple "plug flow" conceptualisation of groundwater movement, with no allowance for dispersion or mixing within the shallow groundwater system;
- Infiltration and generation of leachate is assumed to occur to a very pessimistic extent, when the reality is that infiltration is very limited;
- We assume a constant worst case source term, without allowing for decline of concentrations with time;

- We take a worst case combination of parameters to characterise vertical flow through the clay, in particular the largest conceivable values of hydraulic conductivity and of hydraulic gradient;
- We take a worst case combination of parameters within the Chalk, in particular when assessing dilution of List II substances we use the lowest conceivable values of hydraulic conductivity and of hydraulic gradient;
- We assume unretarded transport of potential contaminants with no allowance for sorption or decay in the geosphere;
- We consider impact at the base of the clay without allowing for either lateral or longitudinal dispersion within the Chalk aquifer;
- Our comparison is with overly protective water quality standards – drinking water quality standards and EQSs which are more than sufficient to protect the relatively poor water quality near the site.

The approach we employ is, wherever possible, consistent with the conceptualisations and methodologies inherent in R&D Publication 20 (Environment Agency, 1999) and LandSim and ConSim. Calculations are analytical and implemented simply in a spreadsheet. The resulting confidence levels have not been quantified in a probabilistic way but far exceed the 95% confidence levels typically used for assessment using LandSim.

We consider the potential movement of leachate from the deposited PFA vertically through the clay to the underlying Chalk, driven by the maximum difference in piezometric head at the surface compared with that in the chalk. On entry to the chalk aquifer, we consider dilution but no further dispersion or retardation to the receptor.

We also consider horizontal flow to the nearest surface water receptor, the Thames. Again we consider only dilution upon entry to the river.

2.5.2. Model Parameterisation

Model parameters have been chosen to be very protective of the environment, based wherever possible on site-specific data and otherwise on generally accepted published data. The risk assessment does not rely on retardation or sorption of contaminants within the geosphere. The parameters are summarised in Section 2.6 and Table HRA8.

Material	Range of values from data	Values used in "Conservative but Plausible" scenario	Values used in Absolute Worst Case scenario
PFA			
Infiltration rate [mm/year]	0-65	50	120
Alluvium			
Hydraulic Conductivity [m/s]	$10^{-7} - 10^{-11}$	10^{-8}	10^{-7}
Vertical head difference to base of formation [m]	0 - 5	5	5
Thickness [m]	15-20	15	15
Chalk			
Transmissivity [m^2/d]	1-7400	720	1
Aquifer width [km]	2	2	2
Hydraulic Gradient	0.003	0.001	0.0001

Table HRA8. Summary of parameters for Risk Assessment calculations

2.5.3. Sensitivity Analysis

When considering potential impact on groundwater resources, we employ two calculations: one which is extremely conservative but which uses mean values of hydrogeological parameters, so as to establish a "protective but plausible" case; and a second which uses the most protective conceivable hydrogeological parameters. These are documented in Table HRA8.

2.5.4. Model Validation

The approach adopted minimises model assumptions, and rather relies on site-specific field data wherever possible. The main assumption is the validity of Darcy's law. The pessimism inherent in the model is confirmed by comparison of selected determinand concentrations with those sampled from the nearest groundwater abstractions.

2.5.5. Accidents and their Consequences

Accident scenarios relating to flooding have been considered above (section 2.2). There are no accident scenarios that need to be quantified, largely because there is no liner system, leachate collection or other active engineering measures that could be damaged.

2.6. Emissions to Groundwater

As discussed in section 2.2, there are two distinct scenarios:

- Active land raising operations, during which the ash is deposited with 18% moisture content. The working surface is exposed to precipitation.
- The post-operational phase, during which the PFA is top-soiled and revegetated.

Of these, the first scenario is of short duration because the land is returned to agriculture as soon as practicable. It is also the more pessimistic because potential infiltration (and consequently the potential for leachate generation) is greater. The implicit assumption for our worst case assessment of impact on groundwater is that the

concentrations of List II substances are essentially leached directly into the underlying groundwater. Parameters used within the calculations are summarised in Table HRA8.

2.6.1. Leakage Rates from the Potential Source

Experience at Tilbury and at other sites operated by the electricity generating sector has shown that mounded PFA deposits (deposited essentially dry) do not produce any significant quantity of leachate. This is due to the combined effects of low permeability of consolidated PFA and high suction forces in operation within the deposit. In addition, PFA is pozzolanic which means that it will tend to form a cement when mixed with water. Cemented PFA is of even lower permeability than consolidated 'fresh' PFA and will therefore further reduce the potential water infiltration through the mound. The hydraulic conductivity of cementitious layers observed at some PFA disposal sites is likely to be orders of magnitude lower than that of the un-cemented PFA.

Previous and recent site investigations on PFA mounds have indicated the following hydraulic properties:

- The hydraulic conductivity of PFA is likely to be between 10^{-7}m/s and 10^{-8} m/s.
- At some sites (e.g. Barlow associated with Drax Power Station), a very low permeability cementitious layer has been encountered close to surface which is likely to have a permeability orders of magnitude lower than that of uncemented PFA.
- The moisture content of PFA deposited in shallow layers accords with emplacement levels and is significantly below the levels required to allow the downward percolation of water.

The combined effects of the low permeability and high suction forces is to tend to form a natural barrier to infiltration and movement of water through the deposit. Further, following capping and revegetation, studies at other sites (notably Barlow) have indicated that evapotranspiration processes combined with the low *in-situ* permeability results in a very small potential infiltration, if any.

Data obtained from the Met Office show that the total precipitation at the nearest meteorological station to Tilbury Power Station (Gravesend) was 774 mm in 2002 and 429 mm in 2003. For the first three quarters of 2004, 428 mm of precipitation has been recorded. The long term mean annual precipitation (1994-2003) is 649 mm. Climate change is expected to result in generally warmer weather with more severe storms, which would tend to reduce hydraulically effective rainfall. Data from the Met Office Rainfall and Evaporation Calculation Service (MORECS) shows that, for 2003, actual evaporation for the 40 km^2 square including Tilbury was in the range 420-449 mm. Therefore for 2003, infiltration was at most 9 mm and possibly 0. Furthermore, some of this would have run off the mound and entered the surface drains. For the London basin, it is often assumed that about 50% of the hydraulically effective rainfall actually recharges groundwater (Lerner *et al.*, 1990, p.73), which implies that the actual infiltration for Tilbury in 2003 was probably between 0 and 5 mm. The average hydraulically effective rainfall for the same MORECS square for 1994-2003 was 130 mm/year and the Actual Evaporation was 130 mm. The long term average infiltration to shallow surface deposits across the 40 km^2 square is thus unlikely to exceed 65 mm and infiltration into the PFA at the site is likely to be significantly lower than this.

Given the low permeability of the PFA and the surrounding superficials and the lack of general data on groundwater flow within the superficials, it is difficult to construct a

detailed water balance for the site. PFA is deposited with 18% moisture. Silts have a similar particle size distribution to that of PFA and typically have critical moisture content between 27% and 42%. Below the critical moisture content, water is entirely held by capillary forces and the relative permeability of the material is 0. Above the critical moisture threshold, the relative permeability is greater than zero but, at moisture content less than saturation, the bulk effective hydraulic conductivity remains below that of the fully saturated material. This analogy suggests that, provided its moisture content remains similar to that which it is deposited with, mounded PFA may not produce any leachate at all. Even if the moisture content is above the critical moisture content, the bulk hydraulic conductivity will still be less that the saturated range of 10^{-7} – 10^{-8} m/s, even in the absence of low-permeability cementitious layers.

At the other extreme, it is generally assumed that a municipal waste landfill capped with clay could conservatively expect to transmit infiltration of around 50 mm/year – the default distribution within LandSim for a capped and landscaped landfill is a normal distribution with a mean of 50 mm and a standard deviation of 10 mm. In summary, it is likely that the total infiltration to PFA at Tilbury is between 0 and 65 mm/year, with the upper value being quite conservative. For the purposes of this risk assessment we will use the upper value, although this is not critical to the conclusions of the risk assessment. For the absolutely worst case calculations, we employ a value of 120 mm/year, which is the value of effective rainfall calculated by Radian (1993) for the area around the site.

2.6.2. Potential Flow Rate through the Superficial Deposits

Making the pessimistic assumption that leachate is produced by the PFA deposited at Tilbury, we can calculate the likely hydraulic travel time through the superficials to the base of the clay, the nearest location at which it could impact exploitable groundwater. We can also compute the hydraulic travel time to the other potential receptor, the Thames to the south.

In either case, the specific discharge is given by Darcy's law (Q=kiA where k is the hydraulic conductivity ,i is the hydraulic gradient and A is the cross-sectional flow area). The specific discharge is of course limited by the infiltration rate. For vertical flow, the measured hydraulic conductivity of the alluvium is around 10^{-10} m/s (Norwest Holst (2002), the likely bulk hydraulic conductivity of the clay is 10^{-8} m/s (Jones *et al.*, 2000) but we can pessimistically assume the unlikely value of 10^{-7} m/s. The head at the base of the PFA possibly fluctuates due to river tides, but the highest measured head in the three boreholes within the PPC boundary (Boreholes 1, 3 & 4) is 3 m bgl (Section 1.2.2). This is consistent with a general observation that the water table is likely to be a few metres below ground, because it is constrained by the river water level and because the superficial deposits have low permeability. The head towards the top of the Chalk aquifer is less certain, but according to the IGS Hydrogeological Map is likely to be between 5 and 0 m aOD. The BGS geological report (included as Appendix D of Jones & Waygood, 2004) gives a value of 4 m bgl. Again this is reasonable given observations of the piezometric head in the Chalk. The hydraulic head difference is therefore likely to be between 5 m and 0 m downwards. There may therefore be no potential for downward flow at all, but the conservative assumption is that the head gradient is 5/15 = 0.333.

For an infiltration rate of 0.05 m/y, the flow rate is limited by the infiltration rather than the permeability, which gives a specific discharge of 1.6×10^{-9} m/s and (assuming a porosity of 0.3) an average macroscopic flow rate of 5×10^{-9} m/s. This implies a hydraulic travel time through the clay of around 90 years. The volumetric flow rate

(assuming an area of 76 ha) is then 10^{-3} m^3/s. In the worst case, an infiltration rate of 0.12 m/y gives a specific discharge of 3.8×10^{-9} m/s implying an average macroscopic flow rate of 1.2×10^{-8} m/s and a hydraulic travel time around 38 years.

The maximum tidal range at Tilbury in the last decade was 8 m. This equates to a water level range of +4 m to -4 m aOD. The horizontal head difference driving flow towards the river is likely to be between 7 m and -1 m. The shortest distance between the edge of the site and the river is 28 m. Therefore the likely specific discharge is 1.5×10^{-9} m/s and the most pessimistic is 3.5×10^{-8} m/s, giving hydraulic travel times of 180 years and, very conservatively, 7 years.

In reality, the clays and peats in the superficial deposits are likely to significantly retard some potential contaminants. However retardation is not invoked for this risk assessment.

2.6.3. Dilution within the Chalk Aquifer and River

In order to assess the likely magnitude of pollution of the Chalk aquifer in the unlikely event that leachate from the PFA were to enter it, we now estimate the range of flow rates within the Chalk. It is then possible to compute the dilution factor using the conceptual model embodied in LandSim. As discussed in Section 1.2.2, the mean hydraulic transmissivity for the Chalk quoted by Allen *et al.* (1997) is around 720 m^2/d. The hydraulic gradient is uncertain as discussed in section 1.2.2, but might be around 0.003. It would be unlikely for the hydraulic gradient to be less than 10^{-4}. If we assume that the aquifer being impacted is limited to the width of the site (which is at most 2 km), then using the most likely combination of values gives a likely (but still conservative) volumetric discharge of 1.4×10^{3} m^3/s. Using the extremely conservative combination of values gives 2.9×10^{-3} m^3/s.

Taking the most likely specific discharge through the clay, and the most likely specific discharge in the chalk gives a dilution ratio of 8×10^{-7}. The smallest conceivable dilution ratio is 9.5×10^{-3}. The likelihood of its being anywhere near this low is tiny. To put the conservatism of these results into context, the dilution factor using realistic parameters from Table HRA8 is around 3×10^{-9}.

Dilution within the river has not been quantified but will be greater than in the Chalk, because flow in the river is clearly much greater than specific discharge in the Chalk aquifer.

2.6.4. Potential Discharge of List I Substances

PFA from Tilbury Power Station is the only waste material to be disposed of at the site. There are no discernable concentrations of List I substances in eluate collected from batch leaching tests on PFA from Tilbury power station, as documented in the ESID report (Jones & Waygood, 2004) and summarised above in Section 1.2. The conditions prevailing in the tests that have been carried out are designed to be more aggressive than those prevailing in the field. Consequently there can be no discernable discharge of List I substances.

2.6.5. Potential Discharge of List II Substances

Section 2.3 has discussed the List II substances in groundwater that might be sourced at least in part from Tilbury PFA. To assess their potential impact, we consider screening concentrations based on Drinking Water standards or Environmental Quality Standards. There are three classes of substances:

1. Those which are present in groundwater at concentrations that exceed the screening values and which also could be sourced from Tilbury PFA are boron, chromium, molybdenum, selenium and sulphate.
2. Additional List II substances that are present in eluates from leaching tests on Tilbury PFA in concentrations exceeding the screening value, but which are not present in significant concentrations in groundwater samples, are aluminium, nickel and vanadium.
3. List II substances that are present in eluates from PFA leaching tests at concentrations above their respective screening value, but which are present at significantly higher concentrations in groundwater samples, are arsenic and ammonia.

We consider the substances in classes 1 and 2 in more detail below. For clarity we give no further consideration to other substances, although it can be demonstrated that PFA does not pose any significant risk to ground waters or surface waters through release of these substances.

In principle, the appropriate quality standards should be different for each receptor and should reflect the sensitivity of the receptor. For simplicity we take the lowest value from drinking water or environmental quality standards, although these are clearly over protective of water at Tilbury – there are no drinking water abstractions, the groundwater is clearly poorer than drinking water, and the existing ground and surface waters fail to meet environmental quality standards. The standards adopted on this basis are documented in Table HRA9.

Substance	Quality Standard [mg/l]	Source
Boron	1	UK Drinking Water Standard
Chromium	0.015	Saltwater EQS
Molybdenum	0.07	WHO Health Guideline
Selenium	0.01	UK Drinking Water Standard
Sulphate	250	UK Drinking Water Standard
Aluminium	0.2	UK Drinking Water Standard
Nickel	0.02	UK Drinking Water Standard
Vanadium	0.1	Saltwater EQS
Arsenic	0.01	UK Drinking Water Standard
Ammonia	0.021	Saltwater EQS

Table HRA9. Summary of most stringent quality standards for selected priority substances for Tilbury ash disposal site risk assessment.

A summary of the quality of Tilbury PFA eluate from batch leaching tests at a liquid to solid ratio of 10:1 and of ground waters sampled from immediately beneath the emplaced PFA, compared with these very stringent standards, is provided in Table HRA10.

Substance	Screening Value [mg/l]		Mean value from 10:1 L:S batch leaching tests	Exceedance factor for eluate	Maximum value from samples of ground waters on site	Exceedance factor for ground water sample
Boron	1	UK Drinking Water Standard	3.24	3.24	5	5
Chromium	0.015	Saltwater EQS	0.123	8.17	0.08	5.33
Molybdenum	0.07	WHO Health guideline	0.454	6.49	80	1143
Selenium	0.01	UK Drinking Water Standard	0.16	16	0.034	3.4
Sulphate	250	UK Drinking Water Standard	379	1.52	682	2.73
Aluminium	0.2	UK Drinking Water Standard	6.07	30.3	0.021	0.105
Nickel	0.02	UK Drinking Water Standard	0.02	1	0.13	6.5
Vanadium	0.1	Saltwater EQS	0.164	1.64	0.06	0.6
Arsenic	0.01	UK Drinking Water Standard	0.03	3	0.74	74
Ammonia	0.021	Saltwater EQS	0.4	19.0	29	1381

Table HRA10. Comparison of priority List II substances with stringent quality standards

The largest potential exceedance of a quality standard by eluate from PFA leaching tests in Table HRA10 is by a factor of around 30 (for aluminium). The absolute worst case concentration entering the aquifer beneath the superficial alluvium for each of these substances is summarised in Table HRA11, based on the dilution factors calculated in Section 2.6.2. It can be seen that all concentrations are substantially less than the respective quality standard.

Substance	Screening Value [mg/l]		Mean value from 10:1 L:S batch leaching tests	Concentration in chalk - conservative but plausible	Concentration in chalk - absolute worst case	Factor of safety – absolute worst case
Boron	1	UK Drinking Water Standard	3.24	2.6E-06	3.1E-02	33
Chromium	0.015	Saltwater EQS	0.12	9.8E-08	1.2E-03	13
Molybdenum	0.07	WHO Health guideline	0.45	3.6E-07	4.3E-03	16
Selenium	0.01	UK Drinking Water Standard	0.16	1.3E-07	1.5E-03	6.6
Sulphate	250	UK Drinking Water Standard	379	3.0E-04	3.6E+00	69
Aluminium	0.2	UK Drinking Water Standard	6.07	4.9E-06	5.8E-02	3.5
Nickel	0.02	UK Drinking Water Standard	0.020	1.6E-08	1.9E-04	105
Vanadium	0.1	Saltwater EQS	0.16	1.3E-07	1.6E-03	64
Arsenic	0.01	UK Drinking Water Standard	0.030	2.4E-08	2.9E-04	35
Ammonia	0.021	Saltwater EQS	0.40	3.2E-07	3.8E-03	5.5

Table HRA11. Worst case concentrations entering the Chalk aquifer

Table HRA11 demonstrates the very small risk posed to the Chalk aquifer by the PFA source term. The calculations are extraordinarily pessimistic, probably by at least six orders of magnitude. The quality standards chosen are extremely stringent, since the water quality in the aquifer (or the Thames) is significantly worse than the standards in Table HRA9. Even so, there is essentially no risk of pollution of the aquifer. The flow in the Thames is obviously larger than that in the Chalk, so there is equally essentially no risk of any pollution of the river either.

2.6.6. Surface Water Management

Current practice for surface water management is described in the ESID report (Jones & Waygood, 2004). Monitoring of surface water and ground waters and the risk assessment to groundwater above indicates that no additional management measures are required.

2.7. Hydrogeological Completion Criteria

It is clear from the discussion above that the site does not pose any risk to the environment or to human health, given the proposed waste type and the current management activities (i.e. compaction, covering with topsoil and revegetation). We conclude that these are appropriate to allow completion with no unacceptable environmental consequences.

3. Requisite Surveillance

3.1. Leachate Monitoring

Tilbury ash disposal site is expected to produce at most very small quantities of leachate. Experience at other PFA disposal sites indicates that it is not practical to sample actual leachate from within PFA. Instead, we propose that a combination of waste compliance testing and monitoring of surface and shallow ground waters is a more appropriate method to monitor the quality of discharges from the waste. Boreholes

1, 3 & 4 at the edge of the ash mound sample quality of ground waters from immediately below the waste which will include the impact of leachate from PFA.

3.2. Groundwater Monitoring

Schedule 3 of the Landfill Regulations (2002) requires that "sampling measurements taken must be sufficient to provide information on groundwater likely to be affected by the discharge from the landfill, with at least one measuring point in the groundwater inflow region and two in the outflow region." The combination of low permeability and poor *in-situ* water quality means that the Tilbury ash disposal site does not fit conveniently into the monitoring framework outlined in the Environment Agency's (2002) Guidance on Monitoring. In particular, it is difficult to identify clear "inflow" and "outflow" regions, due to the low topography and the transient effect of river tides. Furthermore, the risk assessment identifies no real risk of pollution of chalk groundwater or surface water receptors.

The most appropriate form of monitoring is therefore considered to be a continuation of the sampling programme from Boreholes 1, 3 & 4 surrounding the site. Significant changes in the quality of groundwater can provide a warning of potential impacts on the receptors. An alternative is to sample one or more of the existing abstractions from the Chalk. This would act as an indicator of any immediate impact and to build confidence in the risk assessment, although the risk assessment results are so robust that it is hard to imagine the conclusions changing as a result of monitoring the chalk.

R&D Publication 20 (Environment Agency, 1999) provides a methodology to derive the level of remediation required to protect groundwater and surface water from the effects of contaminated soil and groundwater. The methodology is based on a tiered source-pathway-receptor approach and leads to the derivation of site-specific remediation criteria based on an assessment of the potential impact at the identified receptor. This assessment requires the establishment of target concentrations which are to be met at one or more compliance points. Within the tiered risk assessment process explained, the target concentration is the concentration of a species at a compliance point which should not be exceeded. In most cases it will be set as equivalent to a water quality standard or to background water quality. In this respect, it should typically relate to the present or intended use of the groundwater.

The results of applying this methodology to setting pollution thresholds in the superficials based on the most stringent quality standards for the Chalk aquifer immediately below the site are documented in Table HRA12.

Substance	Screening Value [mg/l]		Pollution threshold under pessimistic but plausible scenario [mg/l]	Pollution threshold under absolute worst case [mg/l]	Existing ground water quality
Boron	1	UK Drinking Water Standard	1.25E+06	105	5
Chromium	0.015	Saltwater EQS	1.88E+04	1.6	0.08
Molybdenum	0.07	WHO Health guideline	8.75E+04	7.4	0.08
Selenium	0.01	UK Drinking Water Standard	1.25E+04	1.1	0.034
Sulphate	250	UK Drinking Water Standard	3.13E+08	26316	682
Aluminium	0.2	UK Drinking Water Standard	2.50E+05	21.1	0.021
Nickel	0.02	UK Drinking Water Standard	2.50E+04	2.1	0.13
Vanadium	0.1	Saltwater EQS	1.25E+05	10.5	0.06
Arsenic	0.01	UK Drinking Water Standard	1.25E+04	1.1	0.74
Ammonia	0.021	Saltwater EQS	2.63E+04	2.2	29

Table HRA12. Possible derivation of compliance concentrations using the R&D Report 20 methodology

The pollution thresholds using the plausible scenario are protective of groundwater because of conservative assumptions implicit in the assessment. For the plausibly pessimistic scenario, the concentrations to be achieved are clearly never going to be reached. The pollution thresholds using the worst case scenario assumptions are grossly over-conservative. However they do at least provide values for some substances which could be achieved.

We suggest that groundwater monitoring at Boreholes 1, 3 & 4 within the site boundary is carried out initially on a quarterly basis and the results assessed to determine any adverse trends in quality. The determinands should include aluminium, boron, chromium, molybdenum, nickel, selenium, sulphate, vanadium and arsenic. There is no value in analysing for ammonia because the existing groundwater concentrations are already significantly higher than any possible leachate from PFA. The List I substances cadmium and mercury could also be included in the list of determinands. Trigger levels and control levels should be set to identify adverse trends and on the basis of Table HRA12.

3.3. Surface Water Monitoring

Schedule 3 of the Landfill Regulations (2002) requires that "monitoring of surface water (if present) shall take place at at least two points, one upstream from the landfill and one downstream." The surface water ditches which cross the East Tilbury Marshes are used, in places, to delineate the individual areas of the Tilbury ash disposal site and, as discussed in Section 1.2.3, are a potential receptor for run-off water from the site. The potential impact of the landfill operations on the ditches is probably most significant around the northernmost areas and for this reason, as described in Section 2.5 of the ESID Report (Jones & Waygood, 2004), surface water monitoring is already in place around Area C2 in accordance with Waste Management Licence EA/WML/71186. Monitoring is undertaken quarterly at two points, which are shown in Drawing HRA5, and the samples analysed for aluminium, arsenic, boron, calcium, cadmium, chromium, potassium, magnesium, nickel and antimony. Annual average values are calculated and compared with a set of trial 'trigger' levels that were agreed during the Licence

discussions based on either freshwater EQS values or Drinking Water Maximum Admissible concentrations. However, as is discussed in the ESID Report (Jones & Waygood, 2004), it has not always been possible to collect samples due to very low water levels and those monitoring results that have been obtained to date are extremely difficult to explain, with exceedences of the trial 'trigger' values at an 'upstream' location which should be unaffected by the ash disposal operations. In this respect, it has been concluded that the quality of water in the surface water ditches around the ash disposal area is affected in a complex fashion by a number of factors and that, irrespective of its design, surface water monitoring may not be effective to characterise the environmental impact of the ash disposal activities beyond the background impacts of the river itself (Waygood, 2003).

Despite these conclusions, some surface water monitoring is considered appropriate given the landfill activities that are taking place at the Tilbury ash disposal site. However, as is discussed in Waygood (2003), it is recommended that the existing monitoring results are discussed before a decision is made on the location of the monitoring points.

Given the discussion in Sections 1.2.1 and 2.6.5 of this report, quarterly analysis of surface water for the suite of determinands listed in the previous paragraph is still considered appropriate, although the addition of molybdenum, selenium, sulphate and vanadium could be suggested. However, as the results to date have shown that the trial 'trigger' levels are inappropriate, it is suggested that trigger levels and control levels are set to identify adverse trends in surface water quality, rather than compare it with unachievable water quality criteria.

4. Conclusions

4.1. Summary of Hydrogeological Risk Assessment

Tilbury ash disposal site accepts a single waste stream – PFA from the adjacent Tilbury Power Station. PFA is classified as a non-hazardous waste, and consequently the site needs to meet the requirements for a non-hazardous waste landfill under the Landfill Regulations 2002.

Although it is classified as a non-hazardous waste, extensive investigations by the former CEGB and by its successor companies indicate that the environmental risks posed by a deposit of compacted conditioned PFA, once in place, have more in common with inert wastes than with the general run of non-hazardous wastes. Its combination of low permeability, pozzolanic behaviour and particle size means that it produces no or very little leachate. Its physical and chemical properties mean that the quality of eluates from laboratory leaching tests is generally comparable with groundwater quality. In particular, it contains no measurable quantities of List I substances and limited concentrations of List II substances. Those List II substances that occur with significant concentrations in laboratory tests are certain metals and anions.

The site is located in a relatively insensitive area, on 15-20 metres of alluvium consisting predominantly of clays and peat. The hydraulic conductivity of the alluvium is probably of the order of 10^{-10} m/s. The water quality is very poor, being subject to saline water from the Thames estuary immediately to the south. Groundwater within the alluvium is not abstracted and it is inconceivable that it would be. The site does however overlie the Chalk which is designated as a major aquifer. The quality of water in the Chalk in the nearest abstraction is relatively poor, being saline and not meeting

drinking water or environmental quality standards. The site does not lie within any source protection zone.

Quantitative risk assessment has demonstrated that, even using grossly conservative assumptions and parameterisations and using an extremely simple model, there is no risk of pollution of the Chalk aquifer by List II substances. Similarly there is clearly no risk of polluting any surface water receptors.

4.2. Compliance with the Landfill Regulations 2002

The technical requirements of the Landfill Regulations 2002, which set out specific requirements for landfills depending on the category of waste they accept, are discussed in Section 2.4.1. The characteristics of PFA and of the clay underlying the site mean that some relaxation of the requirements for leachate collection and top sealing are justified in this case on the basis of risk assessment. These are essentially that:

- The PFA deposited under the conditions prevailing at Tilbury produces very limited or no leachate;
- Eluates from laboratory leaching tests demonstrate that the eluates from PFA contain no significant quantities of List I substances, and some List II substances in concentrations that are generally comparable with water quality standards;
- There is a natural geological barrier at the site consisting of 15-20 metres of clay, with a permeability of the order of 10^{-10} m/s, protecting the underlying Chalk aquifer.
- Groundwater monitoring of the superficials and the Chalk, and surface water monitoring, demonstrate that any leachate from the existing ash deposits is not remotely likely to impact groundwater or surface water receptors.
- Further monitoring of groundwater and surface water in line with the Landfill Regulations is proposed in Section 3.

It is therefore considered that landfilling operations at Tilbury are fully compliant with the requirements of the Landfill Directive and the Landfill Regulations 2002, as amended in 2004.

4.3. Compliance with the Groundwater Regulation 1998

The requirements of the Groundwater Regulations (2000) are essentially:

- To prevent discharge to groundwater of List I substances;
- To prevent pollution of groundwater by discharge of List II substances.

The regulations achieve these requirements by controlling indirect and direct discharges to groundwater, by demanding 'prior investigation' before such discharges are authorised.

Tilbury ash disposal site is compliant with the Groundwater Regulations essentially because:

- There are no direct or indirect discharges of List I substances in any measurable quantities;
- There are no direct discharges to groundwater of List II substances;
- Indirect discharges of List II substances occur in quantities that are well below the levels that would result in pollution of groundwater;

- This hydrogeological risk assessment represents the 'prior investigation' required to authorise indirect discharges of List II substances.
- Quantitative risk assessment using an extremely conservative approach demonstrates that there is no risk of pollution by List II substances of groundwater or surface water receptors.

The site is therefore fully compliant with the Groundwater Directive and the Groundwater Regulations 2000.

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Drawing HRA1. Site Layout.

77200
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AREA C2
AREA C1
AREA A3
AREA B
AREA A2
AREA A1

TILBURY ST CHADS WARD
THURROCK
WALTON COMMON
EAST TILBURY MARSHES
TILBURY POWER STATION
River Thames
Gravesend Reach

N

LANDFILL IPPC SITE BOUNDARY

50 0 100 200
SCALE IN METERS

KBB	CJD	28.10.04	A
Drawn	Checked	Date	Revision

RWE
Computer Aided Design Group
Windmill Hill Business Park, Whitehill Way,
Swindon, Wilts. SN5 6PB
Tel. 01793 893391 Fax. 01793 893331

Size of original	Scale of original
A3	1:7500

Site
TILBURY POWER STATION

TILBURY POWER STATION CURRENT ASH DISPOSAL SITES

Drawing number
UKP/TLB/0169/A

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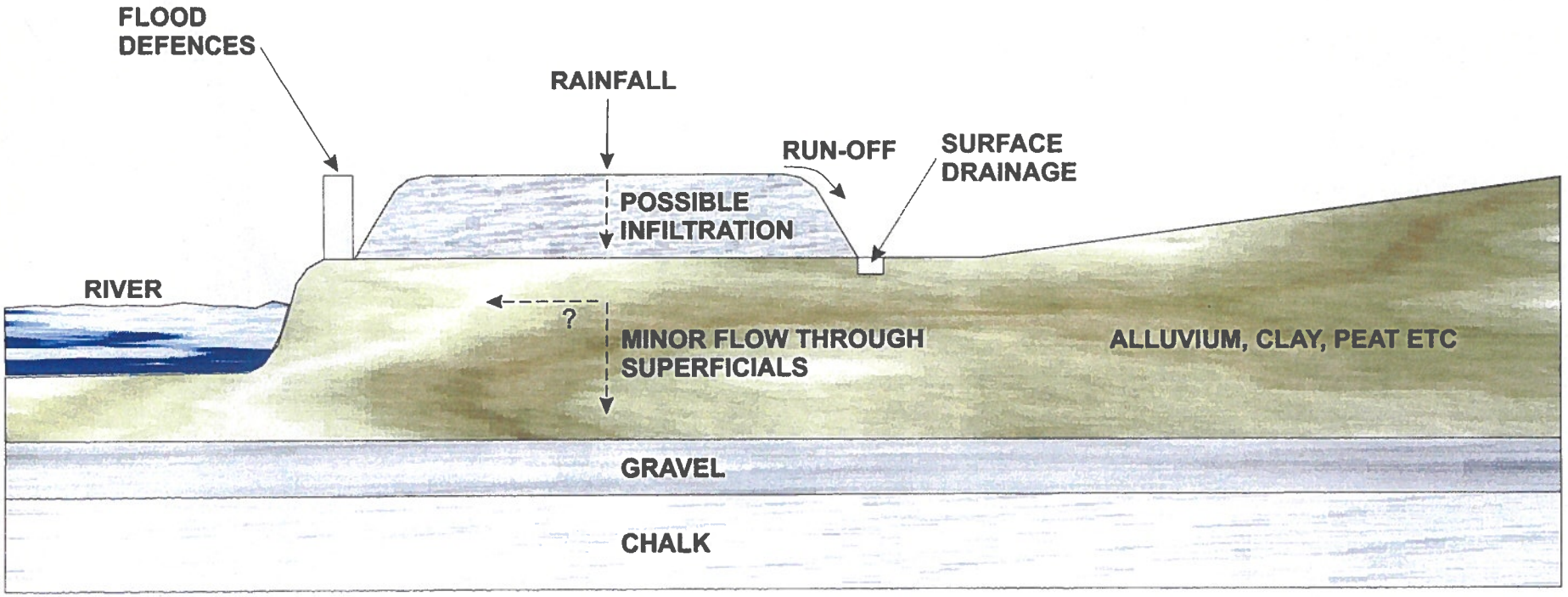
Drawing HRA2. Schematic Conceptual Hydrogeological Model



KBB	RJP	03.11.04	A
Drawn	Checked	Date	Revision

RWE Innogy RWE
Computer Aided Design Group
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Tel. 01793 892384 Fax. 01793 892324

Size of original	Scale of original	
A4	N.T.S	

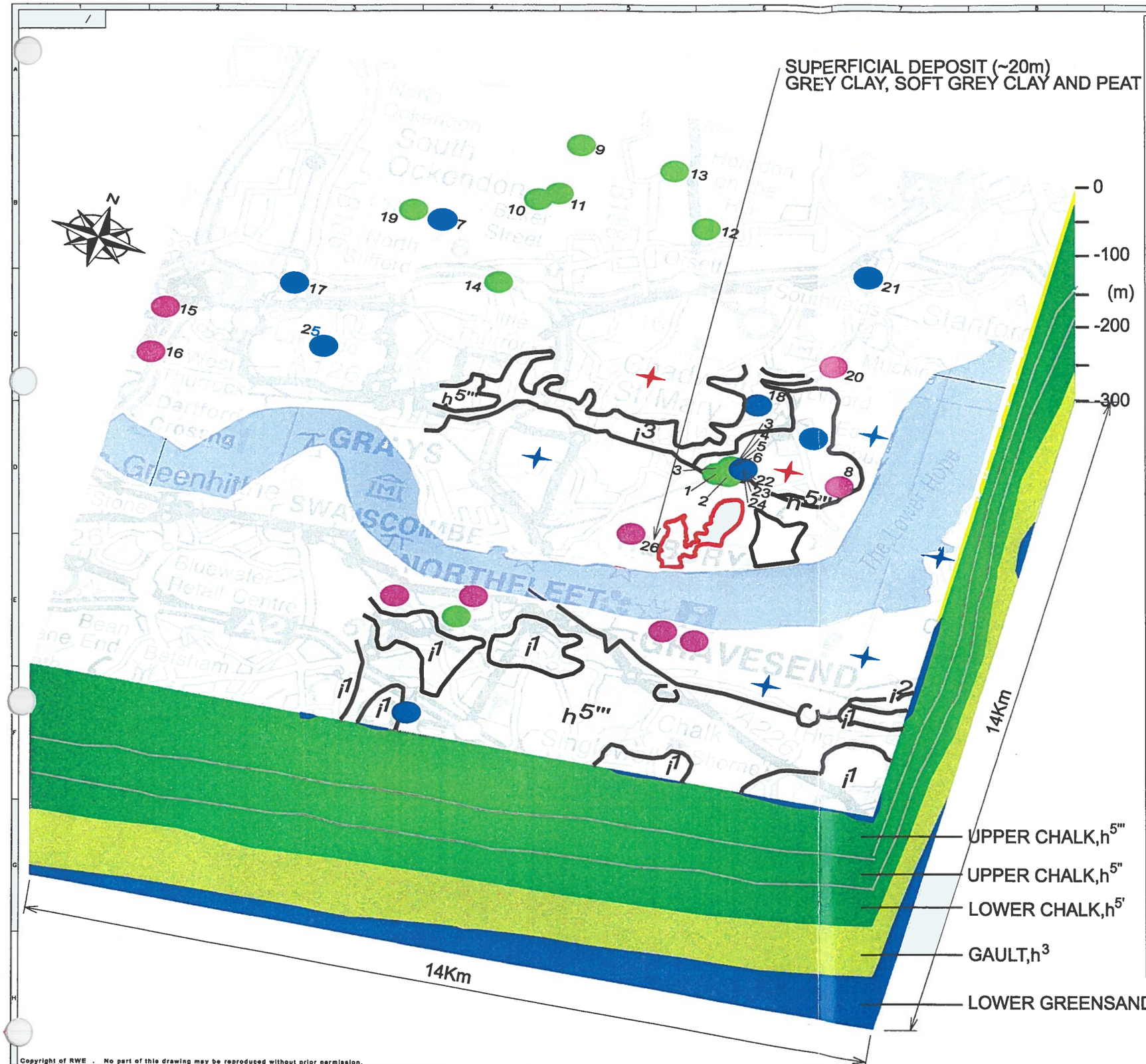
Site
TILBURY POWER STATION

SCHEMATIC CONCEPTUAL HYDROGEOLOGICAL MODEL

PRELIMINARY

Drawing number
UKP/TLB/0177/P1

Drawing HRA3. Hydrogeological Map



GROUNDWATER ABSTRACTIONS

- PUBLIC AND PRIVATE SUPPLIES
- AGRICULTURAL SUPPLIES
- INDUSTRIAL SUPPLIES

GRID REFERENCES

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5	567000	177800
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23	567200	177800
24	567200	177800
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AQUIFER / NON - AQUIFER IDENTIFICATION

- SUPERFICIAL MINOR AQUIFER
- AQUIFER - FISSURE FLOW
- NON - AQUIFER
- AQUIFER - INTERGRANULAR FLOW

GEOLOGICAL FORMATIONS AND CODES - SUPERFICIAL DEPOSITS

- ALLUVIUM - SILTS AND CLAYS WITH SAND AND GRAVEL
- RIVER TERRACE - SANDS AND GRAVELS, WITH SILTS AND CLAYS

GEOLOGICAL BOUNDARIES

- OUTCROP BOUNDARY

KBB Drawn	CJD Checked	02.11.04 Date	A Revision

RWE
Computer Aided Design Group
Windmill Hill Business Park, Whitehill Way,
Swindon, Wilts. SN5 6PB
Tel. 01793 893391 Fax. 01793 893331

Size of original	Scale of original
A3	N.T.S

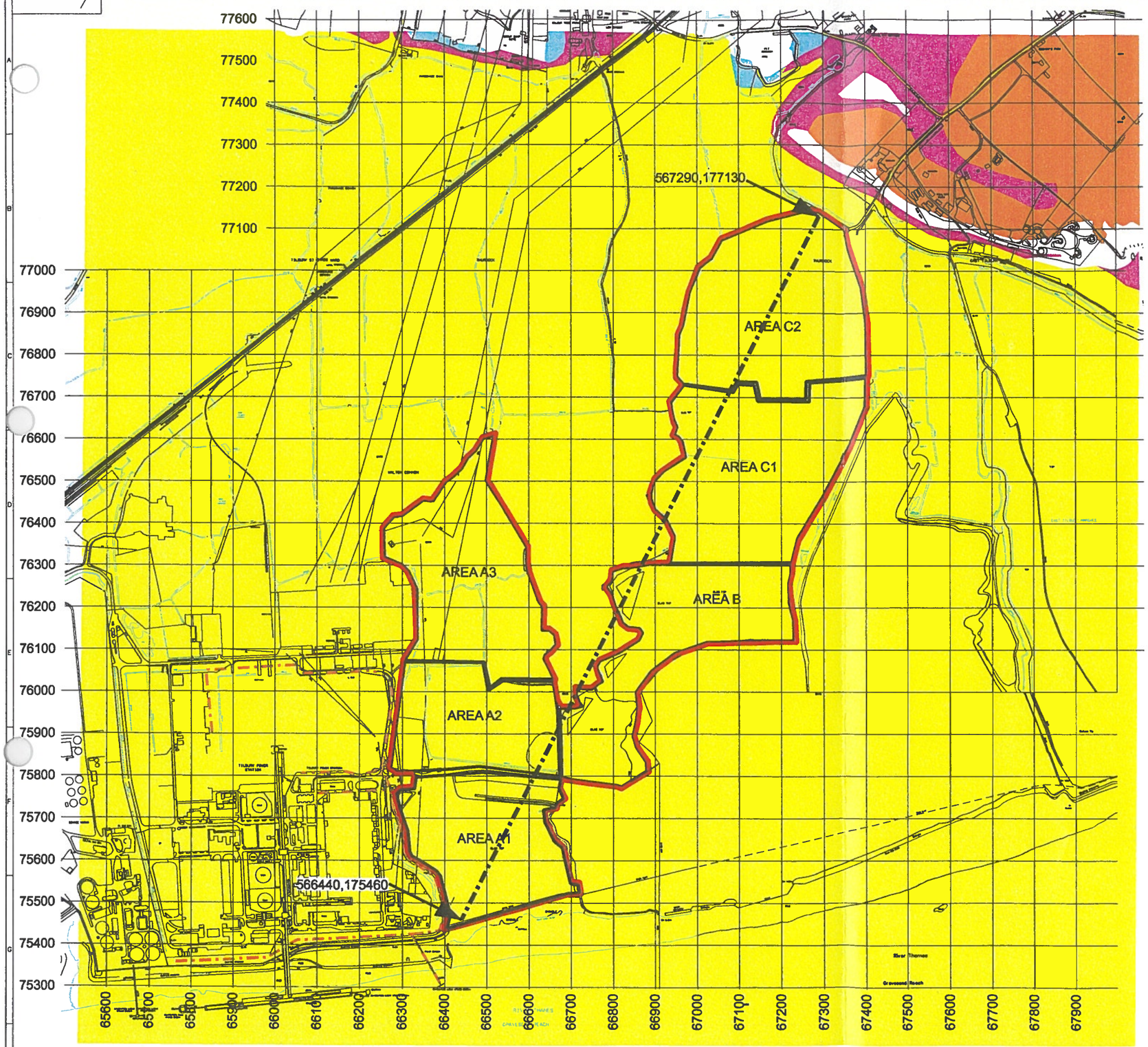
Site
TILBURY
POWER STATION

HYDROGEOLOGICAL
MAP

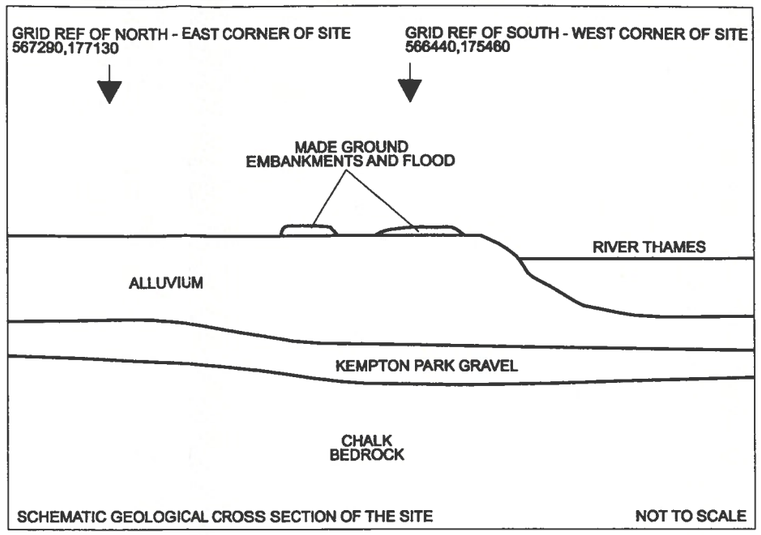
Drawing number
UKP/TLB/0175/A

...\tlb\tlb0175\01753dmodel.dgn 04/11/2004 17:41:03

Drawing HRA4. Surface Geology Map and Geological Cross-Section of the Tilbury Ash Disposal Site Area



MAP COLOUR	COMPUTER CODE	ROCK NAME	ROCK TYPE
	ALV	ALLUVIUM	CLAY, SILTY, PEATY, SANDY
	HEAD	HEAD (UNDIFFERENTIATED)	CLAY, SILTY, SAND AND GRAVEL
	TRD	TIDAL RIVER OR CREEK DEPOSITS	CLAY AND SILT
	LHGR	LYNCH HILL GRAVEL FORMATION	SAND AND GRAVEL
	TPGR	TAPLOW GRAVEL FORMATION	SAND AND GRAVEL



SCHEMATIC GEOLOGICAL CROSS SECTION OF THE SITE — NOT TO SCALE

N

LANDFILL IPPC SITE BOUNDARY

0 100 200
SCALE IN METERS

KBB	MHP	27.10.04	A
Drawn	Checked	Date	Revision

RWE
Computer Aided Design Group
Windmill Hill Business Park, Whitehill Way,
Swindon, Wilts. SN5 6PB
Tel. 01793 893391 Fax. 01793 893331

Size of original	Scale of original	
A3	1:10000	

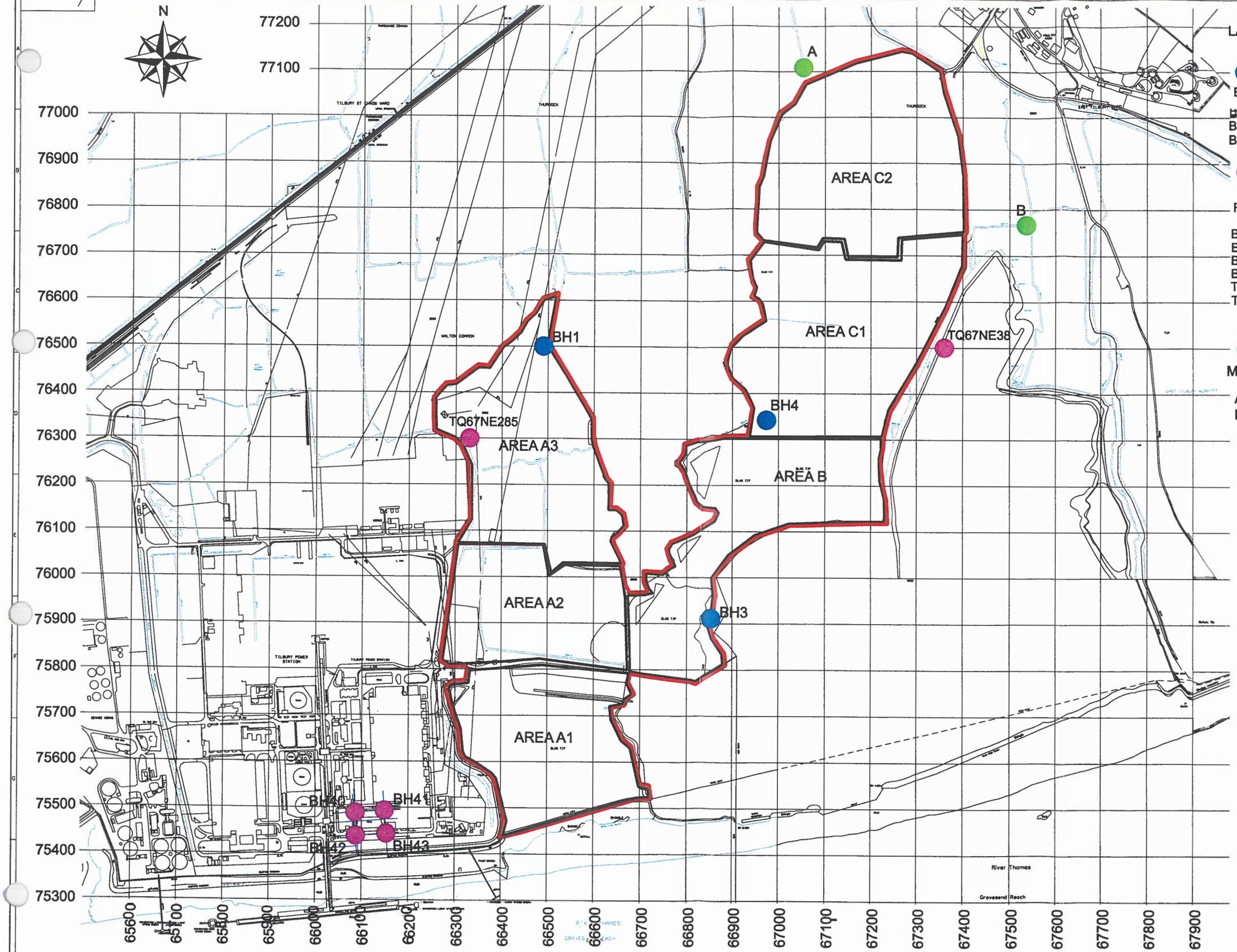
Site
TILBURY
POWER STATION

SUPERFICIAL DEPOSITS

Drawing number
UKP/TLB/0174/A

...\ukp\tlb\tlb0174a\tlb0174a.dgn 04/11/2004 17:20:58

Drawing HRA5. Existing Surface Water and Groundwater Monitoring Points.



LANDFILL IPPC SITE BOUNDARY

GROUND WATER MONITORING BOREHOLE LOCATIONS

BH1 : 566490,176500
BH3 : 566853,175911
BH4 : 566974,176342

OLD SITE INVESTIGATION BOREHOLES REFERENCED IN TEXT

BH40 : 566086,175488
BH41 : 566149,175493
BH42 : 566087,175438
BH43 : 566152,175443
TQ67NE285 : 566330,176300
TQ67NE38 : 567360,176500

SURFACE WATER MONITORING SITES

A : 567053,177109
B : 567535,176767

50 0 100 200
SCALE IN METERS

KBS	C/D	28.10.04	A
Drawn	Checked	Date	Revision

RWE
Computer Aided Design Group
WindmillHill BusinessPark, Whitehill Way,
Swindon, Wilts. SN5 6PB
Tel. 01793 893391 Fax. 01793 893331

Size of original	Scale of original	
A3	1:7500	

Site

TILBURY POWER STATION

TILBURY POWER STATION ASH DISPOSAL SITE BOREHOLES AND SURFACE WATER MONITORING POINTS

Drawing number

UKP/TLB/0178/A

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Appendix A. Borehole Logs

Cable Percussion Borehole Log Sheet

BH No: 1

Site: **Tilbury Power Station**

Job Number: **P1223**

Client: RWE Innogy

Rig Type: Dando 2000

Start Date: 18/12/2003

Finish Date: 18/12/2003

Vertical Scale: 1:50

Sheet 1 of 1

C J Associates

Depth (m)	Sample Ref.	Standard Penetration Tests (SPT's) Test type	Blow Counts Seat.	Blow Counts Test Drive	Blow Counts N-value	Pen. (mm) Seat	Pen. (mm) Test	U100 Blows / % recovery	Depth (m)	Thickness (m)	Legend	Description of Strata	Reduced Level (m. O.D.)
									0.10	(0.10)		TOPSOIL (Drillers Description)	
												Soft to firm brown CLAY. (Drillers description).	
1.00	D1									(1.90)			
									2.00			Soft grey SILT (Drillers description).	
										(8.00)			
									10.00			END OF BOREHOLE	

Hole Progress with Time (Depths in m. below G.L.)				
Date	Hole depth	Casing depth	Depth to water	Remarks
18/12/2003	10.00	10.00	6.00	End of BH

Chiselling		
From (m)	To (m)	Time (hrs)

Casing Record	
Depth (m)	Dia. (mm)
10.00	150

Groundwater Strikes (depths in m. below G.L.)				
Strike	Casing	Water (20mins)	Sealed	Remarks
6.00	-	-	-	

General Remarks:

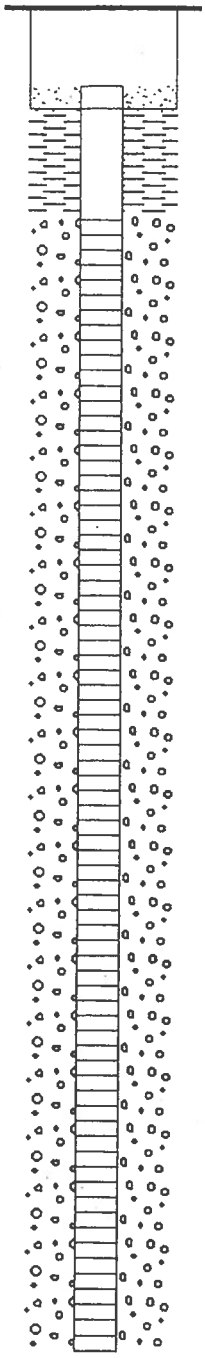
Drilled By: PK
Logged By: RS

50mm diameter standpipe Installation Details

Site:	**Tilbury Power Station**	BH No:	1
Job Number:	**P1223**	Date:	18/12/2003
Client:	RWE Innogy	Vertical Scale	1:60

C.J. associates

Depth (m)		Depth	Backfill Materials	Water Level Observations (See table below)
0.00	Upright Steel Security Cover	0.00m		
		0.20m	Concrete Bentonite Seal	
1.00		1.00m	Gravel Filter	
2.00				
3.00				
4.00				
5.00				
6.00				
7.00				
8.00				
9.00				
10.00	Tip Depth: 10.00m	10.00m		
11.00				



Water Observation Date	Time (Hrs:Mins)	Depth to Water (m)	Remarks

General Remarks:

Cable Percussion Borehole Log Sheet

Site: **Tilbury Power Station**
Job Number: **P1223**
Client: RWE Innogy
Rig Type: Dando 2000

BH No: 3
Start Date: 17/12/2003
Finish Date: 17/12/2003
Vertical Scale: 1:50
Sheet 1 of 1

C J Associates

Depth (m)	Sample Ref.	Standard Penetration Tests (SPT's) Test type	Blow Counts Seat.	Test Drive	N-value	Pen. (mm) Seat	Test	U100 Blows / % recovery	Depth (m)	Thickness (m)	Legend	Description of Strata	Reduced Level (m. O.D.)
1.00	D1											MADE GROUND: (Ash fill - Drillers description).	
										(5.40)			
									5.40	(0.20)		PEAT (Drillers description).	
									5.60			Soft grey SILT (Drillers description).	
										(4.40)			
									10.00			END OF BOREHOLE	

Hole Progress with Time (Depths in m. below G.L.)					Chiselling			Casing Record		Groundwater Strikes (depths in m. below G.L.)				
Date	Hole depth	Casing depth	Depth to water	Remarks	From (m)	To (m)	Time (hrs)	Depth (m)	Dia. (mm)	Strike	Casing	Water (20mins)	Sealed	Remarks
/2003	10.00	10.00	8.00	End of BH				5.80 10.00	200 150	8.00	-	-	-	

General Remarks: 4.5hrs waiting for permit

Drilled By: PK
Logged By: RS

50mm diameter standpipe Installation Details

Site: **Tilbury Power Station**

Job Number: **P1223**

Client: RWE Innogy

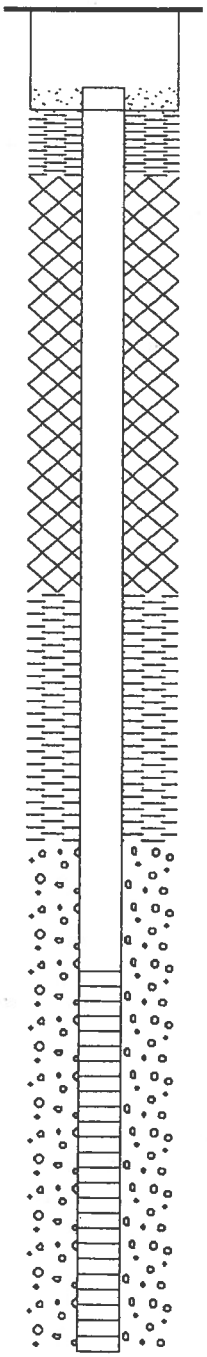
BH No: **3**

Date: 17/12/2003

Vertical Scale 1:60

C.J. associates

Depth (m)		Depth	Backfill Materials	Water Level Observations (See table below)
0.00	Upright Steel Security Cover	0.00m		
		0.20m	Concrete Bentonite Seal	
1.00		0.70m	Arisings	
2.00				
3.00				
4.00		4.00m	Bentonite Seal	
5.00				
6.00		6.00m	Gravel Filter	
7.00				
8.00				
9.00				
10.00	Tip Depth: 10.00m	10.00m		
11.00				



Water Observation Date	Time (Hrs:Mins)	Depth to Water (m)	Remarks

General Remarks:

Cable Percussion Borehole Log Sheet

Site: **Tilbury Power Station**
Job Number: **P1223**
Client: RWE Innogy
Rig Type: Dando 2000

BH No: **4**
Start Date: 18/12/2003
Finish Date: 18/12/2003
Vertical Scale: 1:50
Sheet 1 of 2

C J Associates

Depth (m)	Sample Ref.	Standard Penetration Tests (SPT's) Test type	Blow Counts Seat.	Test Drive	N-value	Pen. (mm) Seat	Test	U100 Blows / % recovery	Depth (m)	Thickness (m)	Legend	Description of Strata	Reduced Level (m. O.D.)
										(5.70)		MADE GROUND: (Ash fill - Drillers description).	
									5.70	(3.30)		Soft grey SILT (Drillers description).	
									9.00	(0.60)		PEAT (Drillers description).	
10.00	D1								9.60	(0.90)		Soft grey SILT (Drillers description). (Continued on next sheet)	

Hole Progress with Time (Depths in m. below G.L.)					Chiselling			Casing Record		Groundwater Strikes (depths in m. below G.L.)				
te	Hole depth	Casing depth	Depth to water	Remarks	From (m)	To (m)	Time (hrs)	Depth (m)	Dia. (mm)	Strike	Casing	Water (20mins)	Sealed	Remarks
2003	10.50	10.00	8.00	End of BH				6.00 10.00	200 150	8.00	-	-	-	

General Remarks:

Drilled By: PK
Logged By: RS

Cable Percussion Borehole Log Sheet

Site: **Tilbury Power Station**
Job Number: **P1223**
Client: RWE Innogy
Rig Type: Dando 2000

BH No: **4**
Start Date: 18/12/2003
Finish Date: 18/12/2003
Vertical Scale: 1:50
Sheet 2 of 2

C J Associates

Depth (m)	Sample Ref.	Standard Penetration Tests (SPT's)						U100 Blows / % recovery	Depth (m)	Thickness (m)	Legend	Description of Strata	Reduced Level (m. O.D.)
		Test type	Blow Counts: Seat.	Blow Counts: Test Drive	Blow Counts: N-value	Pen. (mm): Seat	Pen. (mm): Test						
									10.50			Soft grey SILT (Drillers description).	
												END OF BOREHOLE	

Hole Progress with Time (Depths in m. below G.L.)					Chiselling			Casing Record		Groundwater Strikes (depths in m. below G.L.)				
te	Hole depth	Casing depth	Depth to water	Remarks	From (m)	To (m)	Time (hrs)	Depth (m)	Dia. (mm)	Strike	Casing	Water (20mins)	Sealed	Remarks

General Remarks:

Drilled By: PK
Logged By: RS

50mm diameter standpipe Installation Details

Site: **Tilbury Power Station**

Job Number: **P1223**

Client: RWE Innogy

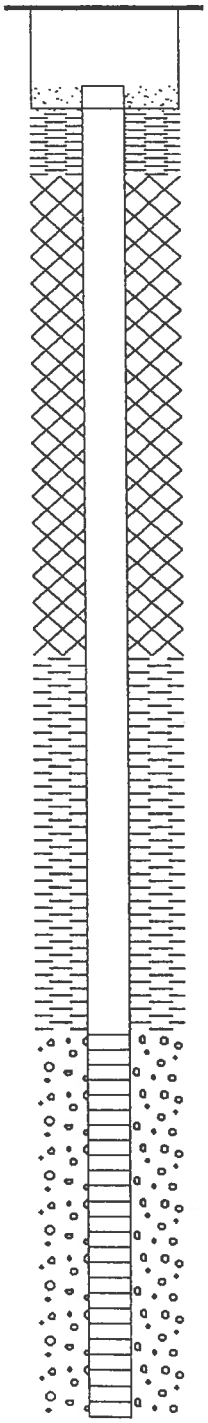
BH No: **4**

Date: 18/12/2003

Vertical Scale 1:60

C.J. associates

Depth (m)		Depth	Backfill Materials	Water Level Observations (See table below)
0.00	Upright Steel Security Cover	0.00m		
		0.20m	Concrete Bentonite Seal	
		0.70m	Arisings	
1.00				
2.00				
3.00				
4.00				
		4.50m	Bentonite Seal	
5.00				
6.00				
7.00				
		7.50m	Gravel Filter	
8.00				
9.00				
10.00				
	Tip Depth: 10.50m	10.50m		
11.00				



Water Observation Date	Time (Hrs:Mins)	Depth to Water (m)	Remarks

General Remarks:

Appendix D - 2017 Hydrogeological Risk Assessment Review

Tilbury Ash Disposal Site

Hydrogeological Risk Assessment Review

SLR Ref:427-01526-00022
Version No: 1
May 2017

CONTENTS

TABLES

APPENDICES

DRAWINGS

1.0 INTRODUCTION

SLR Consulting (SLR) has been appointed by Ingrebourne Valley (IV) to prepare a review of the Hydrogeological Risk Assessment (HRA) for Tilbury Ash Disposal Site in support of a proposed Permit Variation.

Tilbury Ash Disposal Site was developed as a land raise for the deposition of Pulverised Fuel Ash (PFA) from the adjacent Tilbury B power station. The site comprises of seven areas; Area A1 – A3, B1 and C1 – C3, located to the north-east of the power station.

The site was run by RWE npower under Environmental Permit Variation (EPR) EPR/GP3739BQ) until the closure of the power station in 2013. The site has received no waste since the mothballing of the power station. Ingrebourne Valley assumed control of the landfill site in 2017 with the proposal of restoring the site to its currently permitted level using imported inert wastes.

The purpose of this document is to support the proposed Permit Variation to include the importation of inert wastes, as well as providing the six yearly review of the Hydrogeological Risk Assessment, as outlined within permit condition 3.2.3 which states:

The operator shall submit to the Environment Agency a review of the Hydrogeological Risk Assessment:

- *between nine and six months prior to the fourth anniversary of the granting of the permit; and*
- *between nine and six months prior to every subsequent four years after the fourth anniversary of the granting of the permit.*

It is noted that EA guidance[1] has subsequently reduced the frequency for undertaking the HRA review to every six years.

The Environmental Permit for Tilbury Ash Disposal Site (EPR GP3739BQ) was determined and granted on 5th April 2007 and the first HRA review submitted in September 2010.

This HRA Review Report provides a review of the conceptual site model as well as the parameters used in the 2010 Hydrogeological Risk Assessment Review (HRAR) and determines whether they are still appropriate. This HRAR has the following objectives:

- to review whether the landfill continues to comply with the requirements of Schedule 22 (Groundwater Activities) of the Environmental Permitting Regulations, 2010; and
- to review whether it is appropriate to amend the technical precautions and/or the programme of requisite surveillance that are currently used at the site.

For ease of reference monitoring locations are shown on Drawing HRAR 1.

[1] Environment Agency (1st Feb 2016) [Online Guidance] *Groundwater Risk Assessment for your Environmental Permit, https://www.gov.uk/guidance/groundwater-risk-assessment-for-your-environmental-permit#generic-quantitative-risk-assessment*

1.1 Site History and Permitting History

The disposal of ash to Tilbury Ash Disposal Site commenced shortly after the construction of the power station in 1968 and continued until its closure in 2013. The site was historically covered by four separate Waste Management Licences (WML), as follows:

- Licence EA/WML/71185 for Area A3 (Jan 1978);
- Licence EA/WML/71186 for Area C2 (Nov 1991);
- Licence 193/91 for Areas A1, A2 and C1 (June 2001); and;
- Licence 38/78 for Area B (June 2001)

Tilbury Ash Disposal Site was subsequently granted a PPC Permit (GP3739BQ) which incorporated all areas previously authorised through the waste management licensing regime on 5th April 2007. The original PPC application was submitted in November 2004, which included an Hydrogeological Risk Assessment (Original HRA)[2]. Further clarifying information was requested by the Environment Agency (EA) between 2005 and 2006 including a Schedule 4 Notice for further information regarding the Original HRA. A Schedule 4 Response was submitted in November 2006[3]. The site permit was subsequently granted on 5th April 2007.

A PPC Permit Variation Application[4] was submitted in June 2007 for the extension of the landfill site to include an extension in Area C3. This report included an addendum to the Original HRA. A Variation Notice (XP3236UR) was granted by the Agency in June 2009.

A second PPC Permit Variation Application[5] was submitted in July 2009 to increase the restoration height of the landfill from 6m to 9m, this included an addendum to the HRA. Variation Notice GP3739BQ/V003 was granted by the Agency in March 2010.

A Hydrogeological Risk Assessment Review was undertaken by RWE npower in September 2010 (2010 HRAR)[6] which reviewed the "Original HRA" and subsequent addendums.

Since submission of the 2010 HRAR there has been one further Permit Variation (GP3739BQ/V004) relating to a name change, from RWE npower to RWE Generation. The variation did not affect the working of the site.

Ingrebourne Valley propose to vary the existing permit to allow for importation of inert waste to allow for the full restoration of the site.

[2] RWE npower (Nov 2004) *Tilbury B Power Station Ash Disposal Site – Hydrogeological Risk Assessment Report*, Ref: ENV/EEA/165/04

[3] RWE npower (Nov 2006) *Landfill Permit Application: Schedule 4 Response*, Ref GP3739BQ

[4] RWE npower (Jun 2007) *Tilbury Landfill Permit Variation Application,* Ref: ENV/229/2007

[5] RWE npower (Apr 2009) *Tilbury Landfill Permit Variation Application*, Ref: ENV/323/2009

[6] RWE npower (Sep 2010) *Review of Hydrogeological Risk Assessment for Tilbury Ash Disposal Site, GP3739BQ*, Ref: ENV/427/2010

2.0 REVIEW OF CONCEPTUAL HYDROGEOLOGICAL SITE MODEL

This section presents a review of the conceptual site model that was developed for the previous HRAs for the site. It is structured in a source-pathway-receptor manner so as to aid understanding.

2.1 Landfill Source

With regards to the landfill source, it is considered that the three areas that require review relate to site design and construction, leachate management and leachate quality. These elements are considered in more detail below.

2.1.1 Site Design and Construction

Tilbury Ash Disposal Site was developed as a land raise. Prior to any disposal being undertaken topsoil was stripped and stockpiled away from the tipping operations. Conditioned PFA was laid in lifts of approximately 3 metres and initially compacted using the tipping and levelling vehicles. Final compaction was achieved using a 10 tonne vibrating roller.

The site is permitted to be restored to a maximum elevation of 9mAOD. At present the site has been filled to an elevation of between 1.5mAOD and 6mAOD across Areas A1, A2, A3, B, C1 and C2. No filling has taken place across Area C3 to date. The proposed variation aims to restore the site to the currently permitted level using inert wastes. Once the restoration elevation has been reached the site will be restored to grassland using the topsoils previously stripped from the landfill areas.

The site does not have an engineered barrier, instead benefitting from the natural barrier provided by the underlying low permeability Alluvium deposits.

2.1.2 Leachate Management

No active leachate management is undertaken on site due to the nature of the PFA waste which has been accepted to site. Once compacted, PFA has a low permeability (c. $1x10^{-7}$m/s to $1x10^{-8}$m/s) and a low density (1300 – 1700kg/m^3)[2] consequently it is considered that the PFA waste will generate little to no leachate.

The proposed variation will authorise the importation of inert wastes. This waste stream is considered to be similar to that of PFA in that it is not considered likely to generate significant leachate and therefore there will continue to be no requirement to manage leachate.

2.1.3 Leachate Quality and Priority Contaminants

<u>Existing Waste Stream</u>

Detailed assessments of the potential quality of any leachate generated from the PFA were undertaken within the Original HRA, Schedule 4 response and 2010 HRAR. These were based on a combination of data from leaching analysis undertaken on samples of the PFA between 1994 and 2010.

No additional data is available for the PFA, however given the extensive amount of data available and the limited amount of filling which has taken place since the 2010 HRAR these are considered to remain an accurate reflection of the potential leachate source from the current site. The monitoring data available for the PFA is summarised in Table 2-1 and

compared against the relevant UK Drinking Water Standard (DWS) or estuarine Environmental Quality Standard (EQS) and the pollution threshold[7] as calculated within the Original HRA for key determinands.

Table 2-1
Comparison of PFA Eluate Results against Pollution Thresholds

Determinand (mg/l) (unless stated)	Pollution Threshold (from Original HRA)	UK DWS (or EQS where footnote ref)	1996 – 2010 PFA Eluate Results (See Appendix A)		
			Min	Mean	Max
Aluminium	21.10	0.20	0.17	**7.58**	**18.0**
Ammonia (as N)	2.20	0.39	**0.40**	**2.01**	**5.74**
Antimony		0.005	<0.001	**0.030**	**0.28**
Arsenic	1.10	0.01	<0.002	**0.027**	**0.08**
Barium		-	0.07	1.30	10.90
Boron	105	1.0	**1.08**	**5.43**	**11.2**
Cadmium		0.005	<0.0004	-	**<0.1**
Calcium		-	128.5	519.7	2840
Chloride		250	<0.01	6.16	28.0
Chromium	1.60	0.05	**<0.1**	**0.30**	**1.58**
Cobalt		0.1[m]	<0.001	0.011	0.02
Copper		2.0	<0.001	0.155	**2.35**
Fluoride		1.50	<0.5	**7.94**	**104**
Iron		0.20	<0.001	0.024	0.029
Lead		0.01	<0.001	**0.025**	**0.030**
Magnesium		-	<0.05	0.576	4.00
Manganese		0.05	<0.01	0.011	0.03
Mercury		0.001	<0.00004	**0.0051**	**<0.1**
Molybdenum	7.40	0.07[w]	<0.05	**0.857**	**4.15**
Nickel	2.10	0.02	<0.001	0.017	**0.02**
Nitrite		0.5	<0.04	0.2	**<0.5**
Nitrate		50	<0.1	1.09	2.70
Phenols		0.046[m]	<0.00075	-	**<0.10**
Phosphorus		-	<0.01	0.129	0.80
Potassium		-	0.59	16.21	69.9
Selenium	1.10	0.01	<0.005	**0.063**	**0.18**
Silicon		-	0.14	1.09	2.38
Sodium		200	0.28	41.58	195
Sulphate	26,316	250	182	**1006**	**4920**
Tin		0.01[a]	<0.005	**0.033**	**0.06**
Titanium		-	<0.05	0.036	0.02
Vanadium	10.50	0.1[a]	<0.01	**0.281**	**1.07**
Zinc		0.0158[a]	<0.005	**0.017**	**0.0275**[1]
Sulphide		-	<0.02	-	<0.05
Conductivity (uS/cm)		2500	0.621	516.3	**3790**
pH (pH Units)		6.5 – 9.5	7.87	**10.59**	**12.1**

[a] – annual average EQS; [m] – maximum allowable EQS; [w] - WHO standard used as no available DWS/EQS
[1] excludes outlier of 56.2mg/l. Results in **Bold** exceed UK DWS or EQS Standard

[7] Pollution thresholds were calculated in the Original HRA to estimate the maximum concentration which could be accepted within the source term prior to pollution occurring within the chalk groundwater

A review of the available data indicates that the PFA eluate results are all well below the Original HRA pollution thresholds, the only exception being maximum eluate concentrations for ammoniacal nitrogen, however it is noted that ammoniacal nitrogen has been recorded within both the Alluvium and Chalk aquifers at concentrations significantly higher than in the PFA eluate.

Proposed Inert Waste Stream

The Permit Variation proposes the inclusion of inert waste streams which will include generic inert wastes from across London and south-east England and also potentially wastes from the proposed nearby Thames Tideway Tunnel and Northern Line Extension Projects which will comprise of predominantly excavated London clay.

To assess the potential source term from the Inert waste stream data from waste sites across south-east England collated by SLR has been used as representative of the leachate strength at site. The data is based on a total of 401 Waste Acceptance Criteria (WAC) tests at sites in the following areas throughout south-east England:

- West London (57 Samples)
- East Anglia (171 Samples)
- Kent (173 Samples)

In addition data has been collected for a series of 67 cross-rail clay (CRC) samples, these are considered to be representative of the clays which would be encountered by the Lower Thames tunnel. The range of values for both potential source terms are outlined in Table 2-2.

Table 2-2
Typical Concentrations for Waste Acceptance Criteria Tests for Possible Waste Stream at Tilbury Ash Disposal Site

Determinand (mg/l unless stated)	UK DWS / EQS	Standard Waste Stream WAC Results[1]			CRC Waste Stream WAC Test Results [2]		
		Min	Mean	Max	Min	Mean	Max
Antimony	0.005	0.00027	0.0043	**0.075**	0.00055	0.0033	**0.0076**
Arsenic	0.01	0.000111	0.0048	**0.0462**	<0.001	0.0025	**0.014**
Barium	-	0.0037	0.0154	0.193	0.028	0.535	10.70
Cadmium	0.005	<0.0001	0.00044	**0.026**	<0.0001	0.00017	0.0033
Chloride	250	0.72	9.61	135.6	10.1	19.52	130
Chromium	0.05	0.00036	0.0069	**0.088**	<0.001	0.0028	0.008
Copper	2.0	0.0012	0.0134	0.088	0.003	0.0089	0.074
Fluoride	1.50	0.10	0.714	**6.66**	0.20	0.507	**2.10**
Lead	0.01	0.00001	0.0049	**0.025**	<0.004	**0.0122**	**0.049**
Mercury	0.001	0.000005	0.00055	**0.0124**	<0.0001	0.00063	**0.002**
Molybdenum	0.07[w]	0.00057	0.0306	**6.12**	<0.001	0.0083	**0.10**
Nickel	0.02	0.00039	0.0112	**0.154**	<0.02	0.0065	0.019
Phenols	0.046[m]	<0.015	0.045	0.653	<0.05	-	<0.10
Selenium	0.01	0.000195	0.0066	**0.075**	0.003	**0.012**	**0.10**
Sulphate	250	0.50	98.99	**1106**	120	**420.1**	**950.3**
Zinc	0.0158[a]	0.00021	0.0278	**1.18**	0.014	0.116	**0.344**
Total Dissolved Solids (TDS)	-	21.2	250.4	2940	330	730.7	1367.7
Dissolved Organic Carbon (DOC)	-	0.50	8.07	95.6	6.10	13.43	29.20

Results in **Bold** exceed UK DWS or EQS Standard. [w] - WHO standard used as no available DWS/EQS;

[1] Standard WAC data from 401 representative samples from sites across London, East Anglia and Kent (compiled by SLR);
[2] Cross rail clay (CRC) WAC data (67 samples); [m] – maximum allowable EQS; [a] – annual average EQS

A review of Table 2-2 indicates that the maximum recorded concentrations for most determinands have exceeded the DWS or relevant EQS, however these are generally isolated readings and the vast majority of averages are well below their respective limits.

Comparison with the PFA results indicates that the inert samples typically have a lower concentration of most key determinands than the PFA.

Revised Source Term

To assess the potential risk to groundwater from the new combined source of PFA and inert wastes the relevant risk factors have been calculated. Risk factors are calculated as the maximum recorded concentration divided by the most stringent environmental standard (typically DWS). The calculated risk factors are summarised in Table 2-3.

Table 2-3
Risk Factors

Determinand	Pollution Threshold (from Original HRA)	DWS / EQS	Max Concentration (mg/l)			Risk Factor
			PFA	Typical Inert	CRC	
Aluminium	21.1	0.20	**18.0**	-		90
Ammonia (as N)	2.20	0.39	**5.74**	-		14.7
Antimony		0.005	**0.28**	0.075	**0.0076**	56
Arsenic	1.10	0.003	**0.08**	0.046	**0.014**	26.66
Boron	105	1.0	**11.2**	-	-	11.2
Cadmium		0.005	<0.1	**0.026**	0.0033	5.2
Calcium		-	**2840**	-	-	11.36
Chloride		250	28.0	**135.6**	130	0.54
Chromium	1.60	0.05	**1.78**	0.088	0.008	35.6
Copper		2.0	**2.35**	0.088	0.074	1.175
Fluoride		1.50	5.6	**6.66**	2.10	4.44
Iron		0.20	**0.029**	-	-	1.45
Lead		0.01	0.03	0.025	**0.049**	4.9
Manganese		0.05	**0.03**	-	-	0.6
Mercury		0.001	<0.1	**0.0124**	0.002	12.4
Molybdenum	7.40	0.07[w]	4.15	**6.12**	0.10	87.4
Nickel	2.10	0.02	0.02	**0.154**	<0.019	7.7
Nitrate		50	**2.70**	-	-	0.054
Selenium	1.10	0.01	**0.18**	0.075	0.10	18
Sodium		200	**195**	-	-	0.975
Sulphate	26,316	250	**4920**	1106	950.3	19.68
Vanadium	10.5	0.1[a]	**1.07**	-	-	10.7
Zinc		0.025[a]	0.0275	**1.18**	0.344	47.2
Sulphide		-	**<0.05**	-	-	-

[m] - WHO standard used as no available DWS / EQS; [a] – annual average estuarine EQS; **Bold** indicates highest max

A review of Table 2-3 indicates that the determinands with the highest risk factors are aluminium (90), molybdenum (87.4), vanadium (53.5), zinc (47.2) chromium (35.6), arsenic (26.66) and sulphate (19.7), all of which were assessed during the Original HRA except mercury, which has high retardation hence is unlikely to impact groundwater quality.

Comparison with that assessment demonstrates none of the maximum recorded concentrations within either the PFA or WAC data are significantly higher than the worst case calculated pollution thresholds except ammoniacal nitrogen in the PFA (as discussed in relation to Table 2-1 above) which has higher concentrations in background groundwater.

The above assessment demonstrates that the only determinands recorded at a higher maximum concentration in the inert waste streams than the PFA are cadmium, chloride, fluoride, lead, mercury, molybdenum and nickel. Most of these recorded relatively low risk factors which do not warrant further assessment. The following is noted:

- the maximum molybdenum concentration of 6.12mg/l in inert waste is higher than the PFA (4.15mg/l) and results in a risk factor of 87.4, however the concentration is below the pollution threshold calculated within the Original HRA and does not therefore increase the risk to the site;
- mercury has a risk factor of 12.40 but is highly retarded hence is unlikely to impact groundwater quality;
- the maximum zinc concentration of 1.18mg/l in the inert waste is higher than the PFA waste, however the previous modelling assessed several other metals with similar characteristics, including aluminium, molybdenum and vanadium (all of which have higher concentrations and were found to be acceptable);
- all the other determinands with higher concentrations in inert waste than PFA have a risk factor of less than 10 and are considered low risk.

Following the review of the existing and proposed waste streams it is considered that the strength of any leachate generated by the inert waste stream will be comparable to or weaker than the existing waste stream and therefore the assessment undertaken in the Original HRA remains applicable. The review also confirms that the determinands previously modelled continue to represent the greatest risk to surface water and groundwater from the site and therefore the previous modelling remains applicable.

2.2 Pathways

2.2.1 Geology

Tilbury Ash Disposal Site is located on superficial Alluvium overlying River Terrace Deposits with Chalk bedrock present at depth.

The Alluvium is described as *"soft grey or blue-grey CLAY and fine silty sand with peat and lignite fragments*". Borehole logs from groundwater monitoring boreholes installed as part of the Schedule 4 response indicate that the Alluvium has been recorded at thicknesses of between 11.7m (BHC2) and 17.8m (BHC1).

The River Terrace deposits are described as *"dark grey slightly sandy GRAVEL"* and were recorded at thicknesses of between 1.5m (BHC3) and 7.5m (BHC2).

The Chalk bedrock is located a minimum of 20m below ground level. The chalk has a total thickness of up to 280m in the eastern London basin, dipping in a northerly direction and outcropping approximately 2.5km to the south as the North Downs.

2.2.2 Hydrogeological Setting

The EA Classify the superficial Alluvium as a "Secondary (Undifferentiated)" Aquifer[8], which "*has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type"*

The Alluvium is therefore considered to have the potential to be water bearing but this is dependent upon local geological conditions. Previous site investigations indicate that the Alluvium beneath the site generally comprises "*soft grey clay"* with occasional bands of *"spongy brown fibrous peat".* Several boreholes also recorded bands of *"slightly sandy clay",* although these bands appear to be discontinuous in nature. Given the nature of the Alluvium beneath the site it is therefore considered that these deposits should be considered 'Unproductive Strata'.

Permeability testing of the Alluvium was undertaken as part of the Schedule 4 response[3] and recorded permeability values of between $1.2x10^{-9}$m/s and $9.8x10^{-12}$m/s, with an average of $2.7x10^{-10}$m/s.

The underlying River Terrace Deposits are classified by the EA as a 'Secondary A' Aquifer, described as *"permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers"*. Site investigations indicate that groundwater within the sands and gravels is likely to be in hydraulic continuity with the underlying Chalk, which has recorded confined groundwater, well above the top of the River Terrace Deposits.

The Chalk bedrock is classified as a regionally important 'Principal Aquifer'. Groundwater flow is principally through secondary flow resulting from dissolution of geological features such as joints, bedding planes and fault-related fractures[9]. Enhanced permeability is generally assumed to be limited to a zone of weathering near chalk surfaces, typically ranging in depth between 10-50m below the water table.

The chalk of the North Downs has been assessed through several investigations throughout the 1970s and 1980s. Aquifer properties from these investigations are outlined within the British Geological Survey (BGS) report 'Physical Properties of Major Aquifers in England and Wales'[9]. Transmissivity values for the Chalk range from $52m^2$/day to $7,400m^2$/day with a geometric mean of $720m^2$/day. Storage coefficients range from $1x10^{-5}$ to 0.06 with a geometric mean of 0.0031.

The site geological and hydrogeological setting is summarised in Table 2-4.

Table 2-4
Summary of Geological and Hydrogeological Site Setting

Age	Strata	Thickness (m)	Geology	Hydrogeological Status
ua ter na	Alluvium	11.7 – 17.8m	*soft grey or blue-grey CLAY and fine silty sand*	**Unproductive Strata**

[8] Environment Agency (What's in your backyard), Accessed 14/10/16, http://apps.environment-agency.gov.uk/wiyby/

[9] British Geological Survey / Environment Agency (1997) *The Physical Properties of major aquifers in England and Wales*, Ref: WD/97/34

Age	Strata	Thickness (m)	Geology	Hydrogeological Status
			with peat and lignite fragments	Hydraulic Conductivity: $1.2x10^{-9}$m/s to $9.8x10^{-12}$m/s
	River Terrace Deposits	1.5 – 7.5m	*Dark grey slightly sandy GRAVEL*	**Secondary A Aquifer**
Upper Cretaceous	Seaford Chalk / Newhaven Chalk	Up to 280m	*Chalk with flints. With discrete marl seams, nodular chalk, sponge-rich and flint seams throughout*	**Principal Aquifer** Transmissivity: 52 – 7400m^2/d Storage Coefficient: $1x10^{-5}$ – 0.06

2.2.3 Groundwater Levels and Flow

Groundwater levels are monitored on a quarterly basis from seven boreholes installed within both the alluvium and underlying Chalk, monitoring locations are shown on Drawing HRAR 1.

Groundwater level data for the period 2008 to 2016 are summarised in Table 2-5 and hydrographs are included within Appendix B.

Table 2-5
Groundwater Levels (2008 – 2016)

Strata Monitoring	BHID	Count	Groundwater Dip (mBGL)			Groundwater Level (mAOD)		
			Min	Mean	Max	min	Mean	Max
Alluvium	BHC1 (s)	23	0.36	1.23	3.22	4.87	6.86	7.73
	BHC2 (s)	23	0.00	1.92	3.92	4.13	6.21	8.05
	BHC3 (s)	21	4.24	4.98	5.44	0.13	0.59	1.33
	BHC4 (s)	24	4.08	4.73	5.20	0.31	0.78	1.43
	BHC5 (s)	24	2.80	3.38	4.22	0.86	1.70	2.28
	BHC6 (s)	22	2.35	3.65	4.82	1.67	2.84	4.14
	BHC7 (s)	24	0.00	0.41	1.00	1.01	1.60	2.01
Chalk	BHC1 (d)	23	7.32	8.20	9.12	-1.03	-0.11	0.77
	BHC2 (d)	19	7.44	7.88	8.45	-0.40	0.17	0.61
	BHC3 (d)	21	4.25	5.03	5.89	-0.32	0.54	1.32
	BHC4 (d)	24	4.89	5.23	5.48	0.03	0.28	0.62
	BHC5 (d)	24	4.30	4.60	5.00	0.08	0.48	0.78
	BHC6 (d)	23	4.98	5.41	6.00	0.49	1.08	1.51
	BHC7 (d)	23	0.81	1.28	1.71	0.30	0.73	1.20

Review of the available monitoring data indicates that groundwater levels within the Chalk are confined by the overlying Alluvium, with water levels typically recorded at between +1mOD and -1mOD. Groundwater flow is thought to be in a predominantly southerly or south-westerly direction across the site with flow towards the River Thames.

Based on the monitoring data boreholes BHC6 and BHC7 can be classified as background boreholes with BHC1, BHC2 and BHC3 down-gradient. It is however noted that most boreholes have been installed through the PFA waste and could therefore potentially be affected by vertical migration. The only borehole not to be directly overlain by PFA waste is BHC7 which is located within an as yet un-filled area, however the monitoring data indicates that groundwater levels within BHC6 and BHC5 are regularly above those in BHC7 suggesting that locally groundwater flow beneath the site could be towards this borehole.

Groundwater levels within the Alluvium are typically located within c.1m of the natural ground surface, as shown by the levels within boreholes BHC3, BHC4, BHC5 and BHC7.

The monitoring data from BHC1 and BHC2, and to a lesser extent BHC6, indicates water levels above natural ground elevations, indicating that the wells are likely to be monitoring water within both the Alluvium and the PFA waste. This suggests that the low permeability of the Alluvium is restricting infiltration. There is little seasonal variation in groundwater levels recorded within the Alluvium, further suggesting that no real recharge is taking place and groundwater flow is negligible.

2.2.4 Groundwater Quality

Groundwater quality is monitored on a quarterly basis within both the Alluvium and Chalk. The assessment undertaken within the Original HRA did not take into account background groundwater due to the highly saline nature of the groundwater within both the Chalk and Alluvium. Instead the assessment was based on the most relevant Environmental Quality Standard (EQS) or Drinking Water Standard (DWS) as these were generally lower than the surrounding water quality.

Alluvium Groundwater Quality

Given that there are no identifiable up-gradient or down-gradient boreholes within the alluvial deposits the water quality for all seven monitoring locations is summarised in Table 2-6, below. As discussed in section 2.2.3 above, it is noted that boreholes BHC1s, BHC2s and BHC6s are likely to be monitoring water within both the Alluvium and the PFA waste. Summary statistics for individual boreholes along with representative chemographs are included within Appendix C. Concentrations in bold exceed DWS.

Table 2-6
Groundwater Quality within Alluvium (2008 – 2016)

Determinand (mg/l)	UK DWS	EQS (Estuarine)	Count	GW Concentration (mg/l)			Mean Concn in PFA
				Min	Mean	Max (BH Recorded)	
pH units	6.5–9.5	-	206	6.5	7.07	7.8 (6s)	10.59
Conductivity uS/cm	2500	-	211	1000	**23653.5**	**41200 (1s)**	516.3
Total Alkalinity as CaCO3	-	-	206	193	2404.3	15700 (3s)	-
Chloride	250	-	211	**1380**	**7567.3**	**15100 (1s)**	6.16
Fluoride	1.5	15[m]	206	<0.3	0.426	**3.2 (1s)**	7.94
Bromide	-	-	206	<10	74.71	1010 (5s)	-
Total Sulphate	250	-	211	<3	**255.8**	**3160 (4s)**	1006
Calcium (Dissolved)	-	-	211	<1	339.4	1110 (4s)	519.7
Magnesium (Diss)	-	-	211	<1	527.4	1050 (1s)	0.576
Barium (Dissolved)	-	-	211	<0.01	0.175	**1.21 (1s)**	1.30
Sodium (Dissolved)	200	-	211	<1	**3916.5**	**12600 (1s)**	41.58
Potassium (Diss)	-	-	211	<1	183.14	545 (4s)	16.21
Nickel (Dissolved)	0.02	0.034[m]	211	<0.001	0.0073	**0.046 (3s)**	0.017
Chromium (Dissolved)	0.05	-	211	<0.001	0.0183	**0.066 (7s)**	0.30
Cadmium (Dissolved)	.005	0.001[m]	211	<.0001	0.00012	0.0039 (4s)	ND
Copper (Dissolved)	2.0	0.006	211	<0.001	0.00386	0.078 (1s)	0.155
Lead (Dissolved)	0.01	0.014[m]	211	<0.001	0.00120	**0.066 (1s)**	0.025

Zinc (Dissolved)	-	0.025[a]	211	<0.002	0.0124	**0.26 (1s)**	3.32
Manganese (Diss)	0.05	-	211	**0.081**	**1.61**	**14.7 (3s)**	0.011
Iron (Dissolved)	0.20	1.0[a]	211	<0.01	**7.21**	**48.7 (1s)**	0.024
Aluminium (Diss)	0.20	-	211	<0.01	0.065	**1.26 (7s)**	7.58
Arsenic (Dissolved)	0.01	0.025[a]	211	0.001	**0.022**	**0.103 (4s)**	0.027
Boron (Dissolved)	1.0	7.0[a]	211	<0.01	**4.33**	**54.5 (4s)**	5.43
Mercury (Dissolved)	.001	0.00007[m]	211	<.0001	.000068	0.0007 (4s)	ND
Selenium (Dissolved)	0.01	-	211	<0.001	**0.0181**	**0.205 (1s)**	0.063
Vanadium (Dissolved)	-	0.10[a]	211	<0.001	0.0084	0.044 (4s)	0.281
Molybdenum (Diss)	.07[w]	-	211	<0.001	**0.865**	**23.23 (4s)**	0.857
Cobalt (Dissolved)	-	0.1[m]	211	<0.001	0.0035	0.039 (3s)	0.011
Tin (Dissolved)	-	0.01[a]	210	<0.001	0.00068	**0.014 (3s)**	0.033
Thallium (Dissolved)	-	-	191	<0.001	0.0005	<0.001 (N/A)	-
Antimony (Dissolved)	.005	-	211	<0.001	0.00053	0.003 (1s)	0.03
Ammoniacal N	0.39	0.6[g]	192	7	**53.30**	**139 (5s)**	2.01
Nitrate as N	50	-	206	<0.2	0.171	1.9 (6s)	1.09
Chromium VI	0.05	0.032[m]	117	<0.01	0.023	**0.36 (1s)**	-
Total Oxidised N	-	-	206	<0.2	0.172	1.9 (6s)	-
Phosphate as P	-	-	206	<0.01	0.621	8.49 (6s)	0.129
Total Organic Carbon	-	-	206	1.9	32.11	150 (6s)	-
Silicon (Dissolved)	-	-	210	<0.1	20.97	278 (7s)	1.09
Beryllium (Dissolved)	-	-	210	<0.01	0.0054	<0.01 (N/A)	-

[w] - WHO value used as no DWS/EQS; [m] – maximum allowable EQS; [a] – annual av EQS; [g]– 95%le EQS for Good River

A review of Table 2-6 and Appendix C indicates that the Alluvium groundwater exhibits notable impact from saline intrusion with highly elevated average concentrations of sodium (3,916mg/l) and chloride (7,567mg/l) in addition to high concentrations of magnesium (527mg/l), calcium (339mg/l), potassium (183mg/l) and bromide (74.7mg/l).

It is also noted that a number of concentrations have been significantly elevated at borehole BHC4s (particularly in 2014) compared with other boreholes eg sulphate (mean 1416mg/l compared with typical mean of 256mg/l), aluminium (mean 0.15 mg/l compared with typical 0.065mg/l), boron (mean 18.3mg/l compared with typical 4.3mg/l) and molybdenum (mean 5.39mg/l compared with typical 0.86mg/l). The elevated aluminium concentrations may be due to impacts from the PFA, however the mean and maximum concentrations of boron, molybdenum and sulphate at BHC4s are all higher than the mean and maximum concentrations respectively in the PFA, hence the cause of the exceedances may include saline intrusion as seawater contains elevated boron and sulphate.

Other significant exceedances of Drinking Water Standards or estuarine Environmental Quality Standards (EQS) have been as follows:

- hazardous metals including arsenic and mercury have been recorded above detection limit within the Alluvium, although it is noted that most results for mercury are below the detection limit and all results are below the DWS for mercury. Arsenic records comparable concentrations across the site including within BHC7s, which has had no filling of PFA waste above it to date. Hence it is considered likely that, rather than

deriving from the PFA, the arsenic present in the Alluvium is likely to be related to thick layers of organic clay as exist at the marshes near the site[10];

- non-hazardous metals including manganese, iron, boron and selenium have been recorded at most Alluvium boreholes above their respective DWS during the review period. Review of the chemographs (included as Appendix C) indicates that there is significant variation in concentrations of these determinands but typically no observable trend. It is therefore difficult to attribute the results to landfilling activities. It is noted that the concentrations of manganese and iron in groundwater across the site are significantly higher than those in the PFA and therefore are unlikely to derive from landfilling activity – organic clay typically contains elevated concentrations of these metals. Elevated boron concentrations could derive from saline intrusion, while elevated selenium concentrations could be[11] related to thick layers of organic clay at the site;
- ammoniacal nitrogen has been recorded in all Alluvium boreholes at concentrations of 7 – 139mg/l, well above the concentrations in the PFA (0.40 – 5.74mg/l) and also well above its DWS of 0.39. These results are also therefore considered to be reflective of non-landfill sources – ammoniacal nitrogen concentrations are typically[12] naturally elevated in both alluvial clays and marshes;
- review of which boreholes the highest concentrations were recorded in indicates that the maximum concentrations are typically recorded in either borehole BHC1s (the highest concentration for 13 determinands were recorded in this borehole) or BHC4s (nine determinands). The results in BHC1s are likely to reflect its location on the southern edge of the site; adjacent to the River Thames, and therefore indicates impact from saline intrusion. The results in BHC4s are likely to be reflective of impacts from the PFA

The review above indicates that the natural water quality of the alluvium is poor and impacted by saline intrusion as well as naturally elevated concentrations of several determinands due to the clayey Alluvium and marshes.

It is however noted that there are several determinands elevated in groundwater in the Alluvium which could potentially be attributed to leakage from the PFA, including aluminium, boron, selenium, molybdenum and sulphate. This is consistent with the previous HRAs which assessed all of these determinands with regards to potential impacts on Chalk groundwater and surface waters.

It should be noted that the presence of these determinands within the alluvium is not an indication of a failure of the site, as the Alluvium is acting as the site geological barrier and therefore the results reflect the attenuation of these determinands as they migrate through the geological barrier.

Chalk Groundwater Quality

Groundwater quality within the Chalk aquifer has been monitored from seven boreholes across the site on a quarterly basis. Groundwater level monitoring data indicates groundwater flow is likely to be in a southerly or south-westerly direction, however due to the fact that most boreholes have been drilled through the PFA waste it is considered that all

[10] *Source and Behaviour of Arsenic in Natural Waters*, P Smedley & D Kinniburgh, BGS, 2002

[11] *Fixation of Selenium by Clay Minerals and Iron Oxides,* A. Hamdy and G. Gissel-Nielsen, 2007, Journal of Plant Nutrition and Soil Science

[12] *Microbial Nitrogen Cycling at Saltwater-Freshwater Interface*, A Santoro, Hydrogeology Journal 2010

boreholes have the potential to receive contaminants via vertical migration through the overlying Alluvium. Groundwater quality data 2008 – 2016 combined for all boreholes are outlined in Table 2-7 and chemographs are included as Appendix D. Concentrations in bold exceed DWS.

Table 2-7
Combined Chalk Groundwater Quality (2008 – 2016)

Determinand	UK DWS	EQS (Saltwater)	Count	Concentration (mg/l)		
				Min	Mean	Max (BH Recorded)
pH units	6.5 – 9.5	-	209	6.6	7.25	8.1 (6d)
Conductivity uS/cm @ 25C	2500	-	209	1350	**7786.5**	**30300 (2d)**
Total Alkalinity as CaCO3	-	-	209	91	950.2	15060 (7d)
Chloride as Cl	250	-	209	239	**2201.5**	**10500 (2d)**
Fluoride as F	1.5	15[m]	209	<0.3	0.450	**7.3 (6d)**
Bromide as Br	-	-	209	<2.5	29.61	532 (1d)
Sulphate (Dissolved)	250	-	209	<3	96.19	**1830 (4d)**
Calcium (Dissolved)	-	-	209	<1	192.5	949 (5d)
Magnesium (Dissolved)	-	-	209	<1	146.5	759 (1d)
Barium (Dissolved)	-	-	209	<0.01	0.111	**1.16 (1d)**
Sodium (Dissolved)	200	-	209	<1	**1184**	**6740 (2d)**
Potassium (Dissolved)	-	-	209	<1	60.67	211 (4d)
Nickel (Dissolved)	0.02	0.034[m]	209	<0.001	0.0071	**0.055 (7d)**
Chromium (Dissolved)	0.05	-	209	<0.001	0.0086	0.03 (4d)
Cadmium (Dissolved)	0.005	0.0015[m]	209	<0.0001	0.000059	0.0004 (4d)
Copper (Dissolved)	2.0	0.006[a]	209	<0.001	0.0014	0.049 (1d)
Lead (Dissolved)	0.01	0.014[m]	209	<0.001	0.00053	0.003 (4d)
Zinc (Dissolved)	-	0.0195[a]	209	<0.002	0.0162	0.774 (7d)
Manganese (Dissolved)	0.05	-	209	**0.077**	**1.10**	**19.2 (5d)**
Iron (Dissolved)	0.20	1.0[a]	209	<0.01	**1.99**	**19.8 (7d)**
Aluminium (Dissolved)	0.20	-	209	<0.01	0.026	**1.24 (4d)**
Arsenic (Dissolved)	0.01	0.025[a]	209	<0.001	0.0057	**0.036 (2d)**
Boron (Dissolved)	1.0	7.0[a]	209	0.12	0.956	**18.7 (4d)**
Mercury (Dissolved)	0.001	0.00007[m]	209	<0.0001	0.000052	0.0003 (3d)
Selenium (Dissolved)	0.01	-	209	<0.001	0.0086	**0.067 (6d)**
Vanadium (Dissolved)	-	0.10[a]	209	<0.001	0.0033	0.014 (2d)
Molybdenum (Dissolved)	0.07[w]	-	209	<0.001	0.033	2.83 (4d)
Cobalt (Dissolved)	-	0.1[m]	209	<0.001	0.0023	0.026 (5d)
Tin (Dissolved)	-	0.01[a]	208	<0.001	0.00065	0.014 (1d)
Thallium (Dissolved)	-	-	189	<0.001	-	<0.001 (N/A)
Antimony (Dissolved)	0.005	-	209	<0.001	0.00052	0.003 (1d)
Ammoniacal Nitrogen as N	0.39	-	195	**1.2**	**10.17**	**54.5 (2d)**
Nitrate as N	50	-	209	<0.2	0.23	7.2 (1d)
Chromium VI	0.05	0.032[m]	117	<0.01	0.0091	**0.15 (7d)**
Total Oxidised Nitrogen as N	-	-	209	<0.2	0.27	7.2 (1d)
Phosphate as P	-	-	209	<0.01	0.044	0.83 (6d)

Total Organic Carbon	-	-	209	1.5	6.63	33 (1d)
Silicon (Dissolved)	-	-	208	2.7	8.62	25 (2d)
Beryllium (Dissolved)	-	-	208	<0.01	-	<0.01 (N/A)

[m] – maximum allowable concentration EQS; [a] – annual average EQS; [w] - WHO value used as no DWS/EQS;

The Chalk groundwater shows similar chemistry to the Alluvium and is demonstrably saline in nature with high concentration of sodium (average of 1184mg/l), chloride (2201mg/l), magnesium (146.5mg/l), potassium (60.7mg/l) and calcium (192.5mg/l) which are all reflective of saline groundwaters.

The assessment above indicates that the key determinands to be monitored (i.e. those elevated in both Alluvium groundwater and the PFA which cannot be attributed to either external sources or the natural groundwater chemistry) are chromium, aluminium, selenium, molybdenum and sulphate. Each of these determinands are summarised in further detail below.

- chromium concentrations have remained well below the UK DWS of 0.05mg/l throughout the review period;
- aluminium concentrations have typically remained well below the DWS of 0.1mg/l, the only exception being an isolated reading of 0.16mg/l in BHC5d in March 2012, this is considered to be an outlier;
- selenium concentrations have been elevated across the site, with no notable trends within the data. The DWS of 0.01mg/l has been exceeded on at least one occasion in all of the boreholes across the site. The highest concentrations are typically recorded in BHC4d. Overall concentrations are similar to those within the overlying Alluvium, and could be[13] related to thick layers of organic clay at the site;
- molybdenum concentrations have typically been recorded well below the DWS with concentrations typically below 0.005mg/l. The only exception being BHC4d which has recorded concentrations of up to 0.4mg/l. This is the same location which has recorded elevated concentrations within the Alluvium of up to 23.2mg/l, suggesting a potential leakage from the PFA into the underlying aquifer. Review of the other borehole data however does not indicate that there is any deteriorating water quality across the wider chalk aquifer;
- sulphate concentrations have typically been recorded below the DWS of 250mg/l, with the exception of eight isolated readings recorded prior to 2012. Concentrations are typically higher in BHC5d, BHC4d and BHC7d than the other boreholes; potentially an indicator of a minor impact on water quality from the PFA waste, however it is noted that there is no indication of a rising trend within the data and concentrations have remained below the DWS for the past four years.

The monitoring data suggest that the PFA is potentially having a minor impact on Chalk groundwater quality within the vicinity of BHC4d, where slightly elevated concentrations of molybdenum and sulphate have historically been recorded. It is however noted that the data do not suggest that the water quality is deteriorating within this borehole and there is no indication that there is any impact on water quality further down-gradient; concentrations within BHC1d and BHC2d which are down-gradient of the entire site remain well below the DWS.

[13] *Fixation of Selenium by Clay Minerals and Iron Oxides,* A. Hamdy and G. Gissel-Nielsen, 2007, Journal of Plant Nutrition and Soil Science

2.2.5 Surface Water Quality

Surface Water quality is monitored from a single monitoring point located down-stream of the site (Point B). The Environmental Permit requires an up-gradient location to also be monitored (Point A), however due to variable ditch levels around the site this monitoring point was typically dry and inaccessible. Monitoring of Point A was therefore discontinued in 2008. Surface water quality monitoring data for 2008 – 2016 is summarised in Table 2-8 and chemographs are included as Appendix E.

Table 2-8
Surface Water Quality Monitoring Data

Determinand	EQS (Saltwater)	Count	Concentration (mg/l)		
			Min	Mean	Max
pH (pH units)	-	33	7.4	7.8	8.5
Conductivity (uS/cm)	-	33	1760	8018.18	18800
Aluminium	-	33	<0.007	0.12	0.59
Antimony (ug/l)	-	33	<0.0016	1.09	8.7
Arsenic	0.025[a]	33	<0.001	0.0034	0.02
Barium		32	<0.004	0.044	0.15
Boron	7[a]	33	0.013	7.67	21.3
Cadmium (ug/l)	1.5[m]	33	<0.3	0.46	<1.5
Calcium	-	33	110	422.12	912
Chloride	-	33	268	2166.55	4670
Chromium	-	33	<0.0008	0.01	0.02
Copper	0.006[a]	33	<0.0005	0.0042	0.01
Fluoride	15[m]	32	<1.1	0.54	1.29
Lead	0.014[m]	33	<0.0006	0.006	0.04
Magnesium	-	33	39.4	222.5	370
Mercury (ug/l)	0.07[m]	33	<0.002	0.02	<0.1
Molybdenum	-	33	<0.005	0.36	1.24
Nickel	0.034[m]	33	<0.0007	0.009	0.05
Phosphate (ortho)	-	33	<0.03	0.37	2.62
Potassium	-	33	<0.18	142.7	290
Sodium	-	33	<0.5	1196.7	2770
Sulphate	-	33	209	1320.3	2660
Sulphide	-	33	<0.01	0.04	0.47
Zinc	0.0195[a]	33	<0.005	0.018	0.13

[m] – maximum allowable concentration EQS; [a] – annual average EQS

Review of Table 2-8 indicates that surface water quality is typically comparable to groundwater quality in the Alluvium, has concentrations of boron, sodium, chloride, magnesium, calcium, potassium and sulphate almost as elevated, again likely due to saline ingress.

It is also noted that because it has not been possible to collect surface water quality samples from up-stream of the site it is not possible to identify whether the site is impacting water quality within the perimeter ditches. The 2010 HRAR stated[6]:

"The improvement condition response (ref: GP3739BQ/IC2/1) assessing sample suitability and availability (previously discussed in section 3) was submitted to the EA on the 02/07/08. The improvement condition response concluded that variable ditch levels across the site and

the poor suitability of the monitoring locations were not conducive to representative/meaningful sampling of water entering and leaving site. As ongoing monitoring of alluvial and chalk groundwater is in place in order to check and review water quality below the site, it was recommended that no further monitoring of the surface water ditches should be carried out".

Given the above and the continued difficulties with collecting representative water quality samples it is proposed that surface water quality monitoring is discontinued.

2.3 Receptors

The receptors identified within the Original HRA included the Chalk aquifer underlying the site and the surface watercourses in the immediate vicinity of the landfill, including the River Thames estuary. These receptors are considered to remain applicable.

The Original HRA identified the closest groundwater abstraction borehole to the site as being that at Tilbury Power Station. A review of the EA website mapping indicates that this borehole is no longer licensed and therefore assumed to no longer be in use. The closest potable abstraction was located approximately 3.8km north-east of the power station at Linford. A review of the EA website indicated that this remains the closest licensed abstraction. The site is not located within a Source Protection Zone.

2.4 Summary of Conceptual Site Model

The sites conceptual site model has been reviewed and assessed as follows:

- the site has been developed as a land raise, receiving only Pulverised Fuel Ash (PFA) to date. The Permit Variation proposes using inert wastes to complete filling and restoration to the currently permitted level of 9mAOD;
- there is no engineered geological barrier, however the underlying Alluvium has been demonstrated to be in excess of 10m thick with permeabilities ranging between $1.20x10^{-9}$ and $9.8x10^{-12}$m/s and therefore complies with the Landfill Directive for both non-hazardous and inert wastes;
- review of leachate data from Tilbury PFA and comparison against typical WAC data for inert wastes indicates that the potential leachate generated from the inert waste has lower concentrations of key determinands than the PFA and therefore the previous modelling remains appropriate as a worst case assessment of the site;
- groundwater level and quality monitoring data confirm the findings of the Original HRA, Schedule 4 and 2010 HRAR and indicate that there is limited groundwater flow within the Alluvium which is acting as an aquiclude, confining the underlying Chalk. Groundwater quality data confirm that the local groundwater in the Chalk is highly saline with typically elevated concentrations of sodium, chloride, potassium, calcium, magnesium and other metals.
- the review of the water quality monitoring identified several potential indicator determinands recorded within the Alluvium which could potentially be attributed to leakage from the PFA. The groundwater quality data for the Chalk indicates that although there is potentially a minor impact on water quality within BHC4d there is no indication of the PFA having an impact on the wider Chalk aquifer.

3.0 HYDROGEOLOGICAL RISK ASSESSMENT

The Original HRA included a quantitative assessment of the potential impact of PFA waste on both the chalk and surface water receptors. The assessment was based on leakage from the PFA, flow rate through the superficial deposits and dilution within the Chalk aquifer and / or the River Thames.

The assessment was based upon worst case values to estimate the maximum potential discharge of a range of key determinands including boron, chromium, molybdenum, selenium, sulphate, aluminium, nickel, vanadium, arsenic and ammonia.

The results of the risk assessment indicated that even taking a highly conservative approach the risk to the underlying Chalk aquifer from the PFA was very low.

A review of the site setting and landfill construction indicates that the Original HRA assessment can still be considered worst case and does not need updating to reflect the potential impact from the PFA waste or the proposed Inert waste.

The proposed permit variation will replace the PFA waste source with inert wastes to include general inert materials from across eastern London and east Anglia and clays excavated from the proposed Thames Tideway Tunnel and Northern Line Extension projects.

Given the nature of the proposed wastes many of the assumptions made for the PFA waste remain applicable. The inert waste is likely to be very low permeability, given that it will be predominantly excavated clays, with little potential for generating leachate. A comparison of the potential leachate strength has also indicated that the concentrations of all key determinands previously modelled are lower than those recorded within the PFA while other determinands which are recorded at potentially elevated concentrations are lower than the respective groundwater quality.

Given the above it is considered that the assessment undertaken within the Original HRA continues to accurately reflect the risks posed by the landfilling activities going forward. No further quantitative modelling of the site is therefore proposed.

4.0 REQUISITE SURVEILLANCE

4.1 Leachate Monitoring Schedule

Due to the nature of the PFA emplaced at Tilbury Ash Disposal Site the waste is not considered to have the potential to generate leachate in any significant quantities and therefore leachate levels and quality are not monitored. The proposed inert wastes will also not have the potential to generate leachate and therefore there will be no need to monitor leachate levels or quality going forward

4.2 Groundwater Monitoring Schedule

Groundwater levels and quality are currently monitored on a quarterly basis by a series of seven boreholes installed within each of the Alluvium and Chalk groundwater.

The Alluvium is not considered to be an aquifer but rather acts as the site geological barrier and monitoring of the Alluvium is considered to be representative of any leachate leaking through the base of the PFA.

The assessment of groundwater quality in section 2.2.4 above confirmed that the water quality of the Alluvium is highly influenced by the natural chemistry of the clay lithology as well as the impact from saline intrusion.

Given the above it is proposed that in the future alluvium is only monitored for key determinands, i.e. potential indicators of leakage from the PFA and proposed inert waste.

It is proposed that monitoring of the Chalk aquifer is undertaken on a quarterly basis for key determinands and on an annual basis for all other non-hazardous and hazardous substances.

Table 4-1
Proposed Groundwater Monitoring Schedule

Locations	Frequency	Measurement and Analytical Suite
<u>Alluvium</u> BHC1s BHC2s BHC3s BHC4s BHC5s BHC6s BHC7s	Quarterly	Water level (mAOD) Aluminium, Antimony, Arsenic, Boron, Chromium, Molybdenum, Mercury, Nickel, Selenium, Sulphate, Vanadium
<u>Chalk</u> BHC1d BHC2d BHC3d BHC4d BHC5d BHC6d BHC7d	Quarterly	Water level (mAOD) Aluminium, Antimony, Arsenic, Boron, Chromium, Molybdenum, Mercury, Nickel, Selenium, Sulphate, Vanadium
	Annual	pH, Electrical Conductivity, Total Alkalinity, Chloride, Fluoride, Bromide, Calcium (Diss), Magnesium (Diss), Barium (Diss), Sodium (Diss), Potassium (Diss), Cadmium (Diss), Copper (Diss), Lead (Diss), Zinc (Diss), Manganese (Diss), Iron (Diss), Cobalt (Diss), Tin (Diss), Thallium (Diss), Antimony (Diss), Ammoniacal Nitrogen, TON, TOC, Phosphate

All Groundwater Monitoring Wells listed above	Annual	Base of Monitoring Point

4.2.1 Control Levels and Compliance Limits

Proposed control and trigger levels (now known as compliance limits) were outlined within the Schedule 4 response, however these were not included within the Environmental Permit (GP3739BQ) or any subsequent permit variations.

Suitable control levels and compliance limits have been proposed based on groundwater quality monitoring data to date and relevant EQS / DWS standards. The proposed control levels and compliance limits for the Chalk aquifer are proposed for the key indicator species as discussed within Section 2.2.4. It is not considered appropriate to set compliance limits for groundwater in the Alluvium as it is not considered a receptor.

The proposed control level and compliance limits are outlined in Table 4-2 and have been set to assess any potential deterioration from the current baseline water quality, given that it is not possible to determine "background" groundwater quality. The limits have been set as follows:

- control levels set at the mean concentration to date plus 2 x standard deviation;
- compliance Limits have been set at the relevant DWS, or where water quality to date has exceeded the relevant standard it has been set at mean concentration plus 3 x standard deviation

Table 4-2
Proposed Control Levels and Compliance Limits

Determinand	Borehole(s)	UK DWS (mg/l)	Mean Concentration in Chalk (mg/l)	Proposed Control Level (mg/l)	Proposed Compliance Limit (mg/l)
Aluminium	BHC1d	0.20	0.026	0.20	0.28[b]
Chromium	BHC2d	0.05	0.0086	0.023	0.05[a]
Nickel	BHC3d	0.02	0.007	0.022	0.03[b]
Selenium	BHC4d BHC5d BHC6d BHC7d	0.01	0.0086	0.028	0.038[bc]
Molybdenum	BHC1d BHC2d BHC3d BHC5d BHC6d BHC7d	0.07[w]	0.006	0.05	0.07[a]
	BHC4d		0.088	0.244	0.322[b]
Sulphate	BHC1d BHC2d BHC3d BHC6d	250	22.1	85.0	250[a]
	BHC4d BHC5d BHC7d		159.5	375	485[b]

Note: [a] compliance limit set at appropriate DWS ; [w] - WHO value used as no DWS
[b] compliance limit set at mean groundwater quality to date + 3x standard deviation
[c] exceeded on one occasion in 2013, likely to be laboratory error

4.3 Surface Water Monitoring Schedule

As detailed within Section 2.2.5, due to the nature of the drains around the landfill site it has not been possible to monitor up-stream water quality and there is often little to no surface water flow within the location classified as the down-stream monitoring point. It is therefore not possible to appropriately assess surface water quality around the site and the extensive groundwater quality monitoring is considered sufficient to assess the risk posed from the landfill site.

It is therefore proposed that the requirement for surface water quality monitoring is removed from the monitoring schedule.

5.0 CONCLUSIONS

5.1 Compliance with Schedule 10 (Landfill) of the Environmental Permitting Regulations, 2010

The results of this risk assessment have established the following:

- the development continues to pose a potential hazard to ground and surface water quality. The previously undertaken risk assessment remains applicable and confirms that the risk to groundwater and surface water receptors is low.
- the site continues to comply with the relevant requirements of Schedule 10 of the Environmental Permitting Regulations 2010.

5.2 Compliance with Schedule 22 (Groundwater Activities) of the Environmental Permitting Regulations 2010

The results of this risk assessment have established the following:

- the development continues to pose a potential hazard to ground and surface water quality. Consequently, it continues to fall within the scope of the Environmental Permitting Regulations 2010;
- this assessment forms a review of the “prior investigation” that must be carried out for this type of development;
- the proposed and installed technical precautions continue to prevent the discernible discharge of Hazardous Substances to groundwater throughout the site’s lifecycle;
- the proposed and installed technical precautions continue to limit the introduction of Non-Hazardous Pollutants into groundwater so as to avoid pollution throughout the site’s lifecycle;
- the following essential and technical precautions have been identified as part of the hydrogeological risk assessment review:
    - a risk-based programme of groundwater monitoring and the implementation of control levels and compliance limits.

The site therefore continues to comply with the relevant requirements Schedule 22 (Groundwater Activities) of the Environmental Permitting Regulations 2010

6.0 CLOSURE

This report has been prepared by SLR Consulting Limited with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

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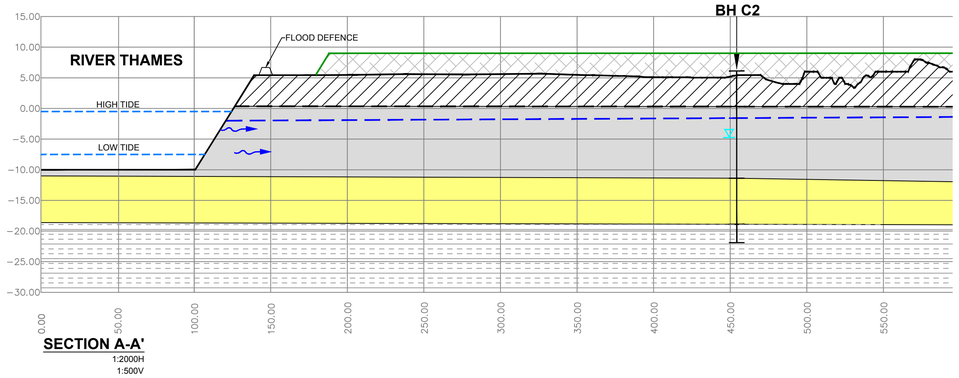
HRA1

Scale 1:10,000 @ A3

Date OCTOBER 2016

01526.00022.18.HRA1.0_Environmental Monitoring.dwg



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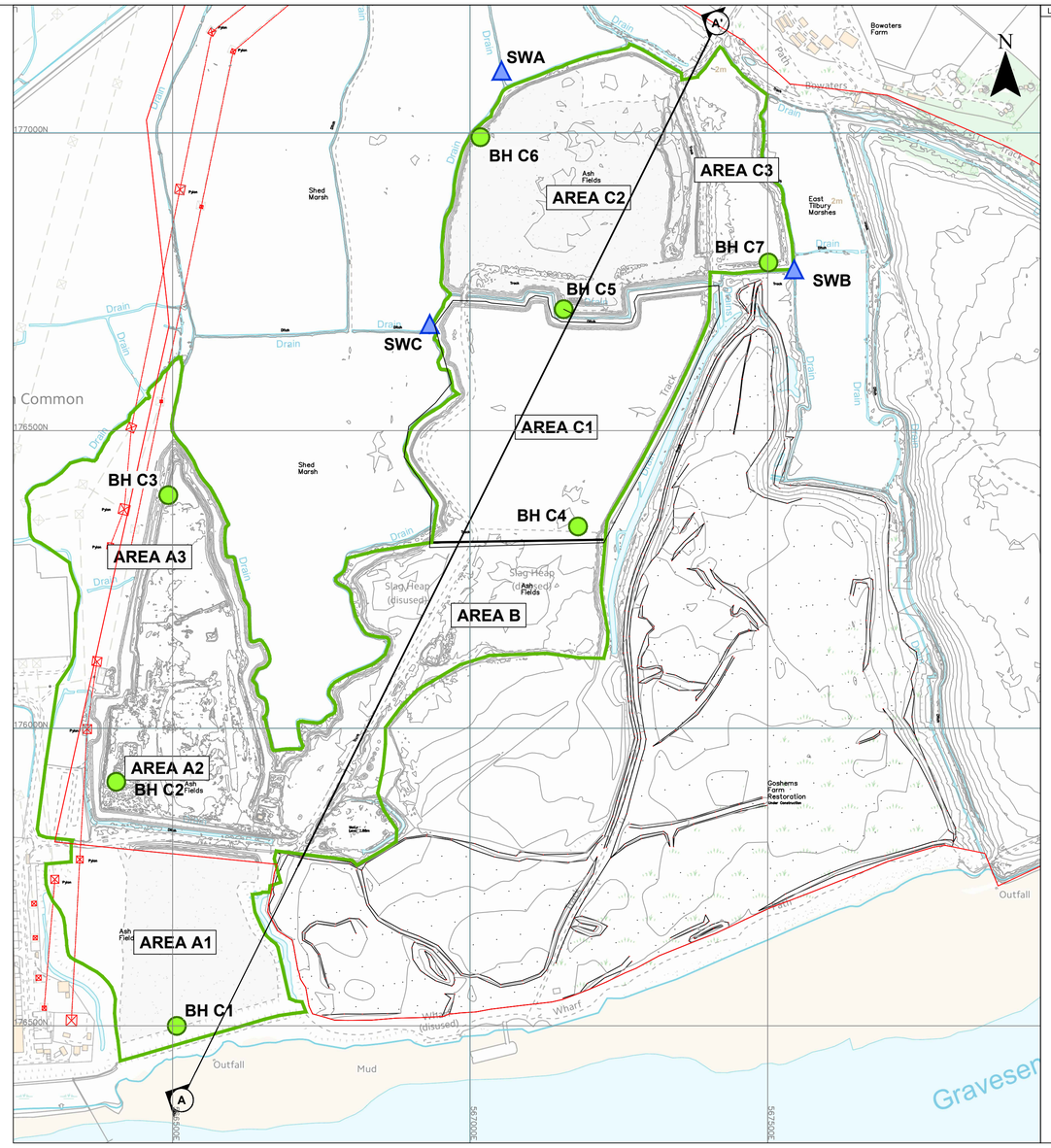

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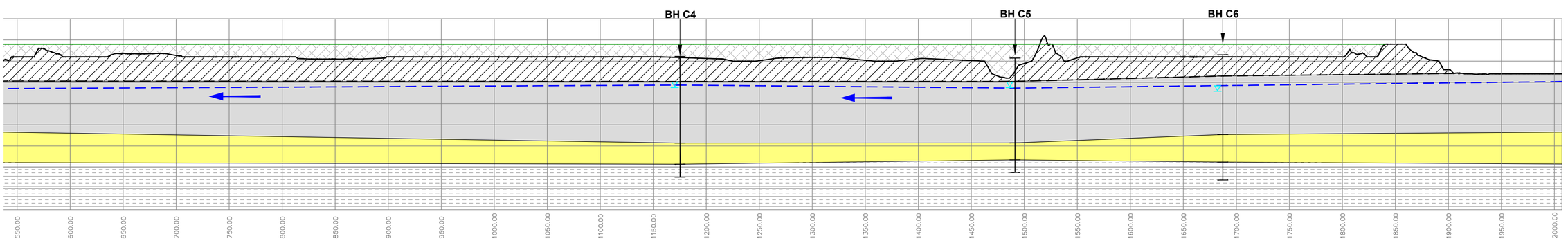
- PRE-DEVELOPMENT GROUND LEVEL (APPROXIMATE)
- PULVERISED FUEL ASH
- INERT WASTE
- ALLUVIUM
- RIVER TERRACE DEPOSITS
- CHALK
- POTENTIOMETRIC SURFACE IN CHALK
- ALLUVIUM GROUNDWATER LEVEL (NOVEMBER 2015)



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HRA2

Scale: 1:5,000 @ A1
Date: OCTOBER 2016

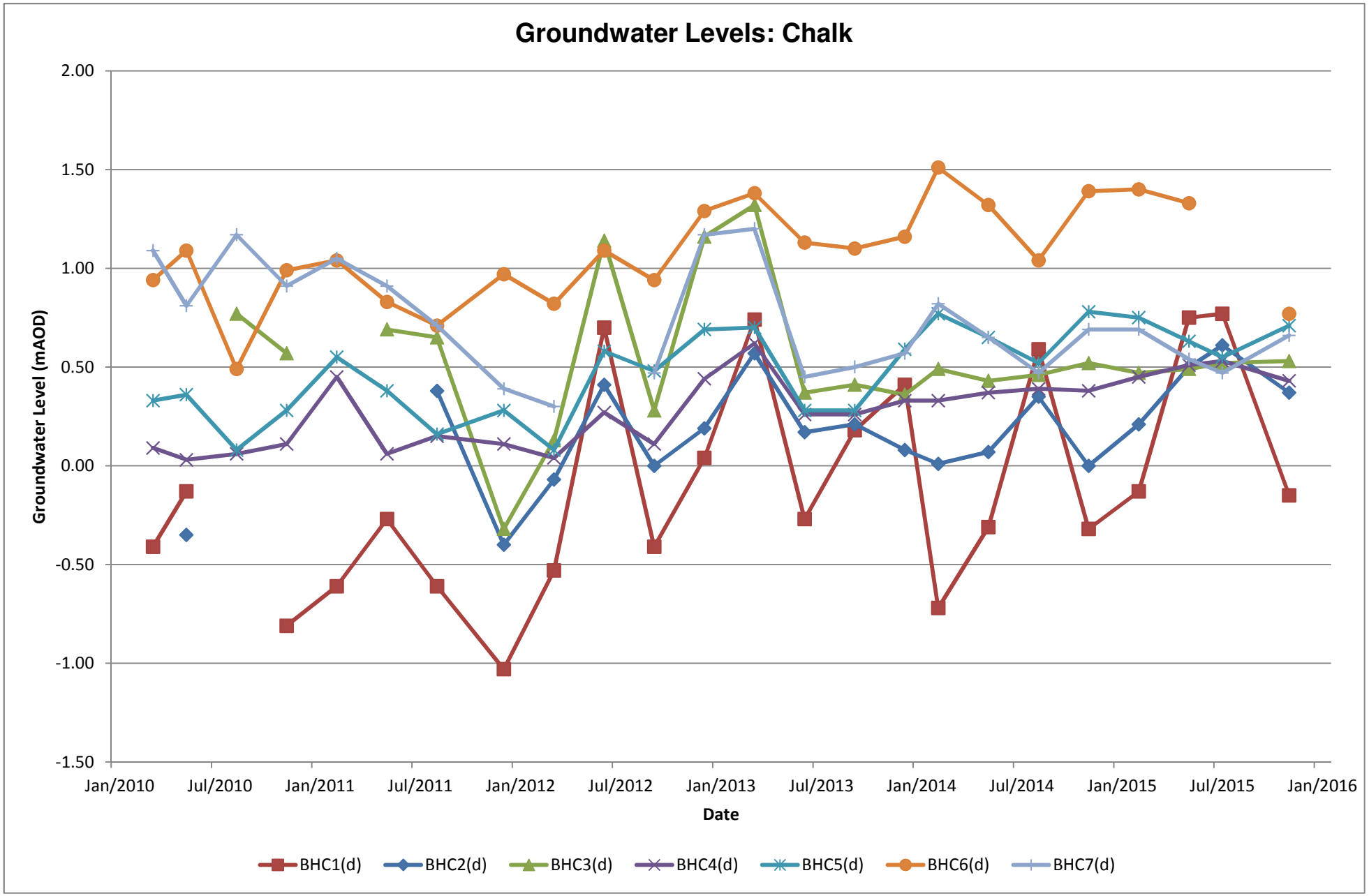
01526.00022.18.HRA2.0_.dwg

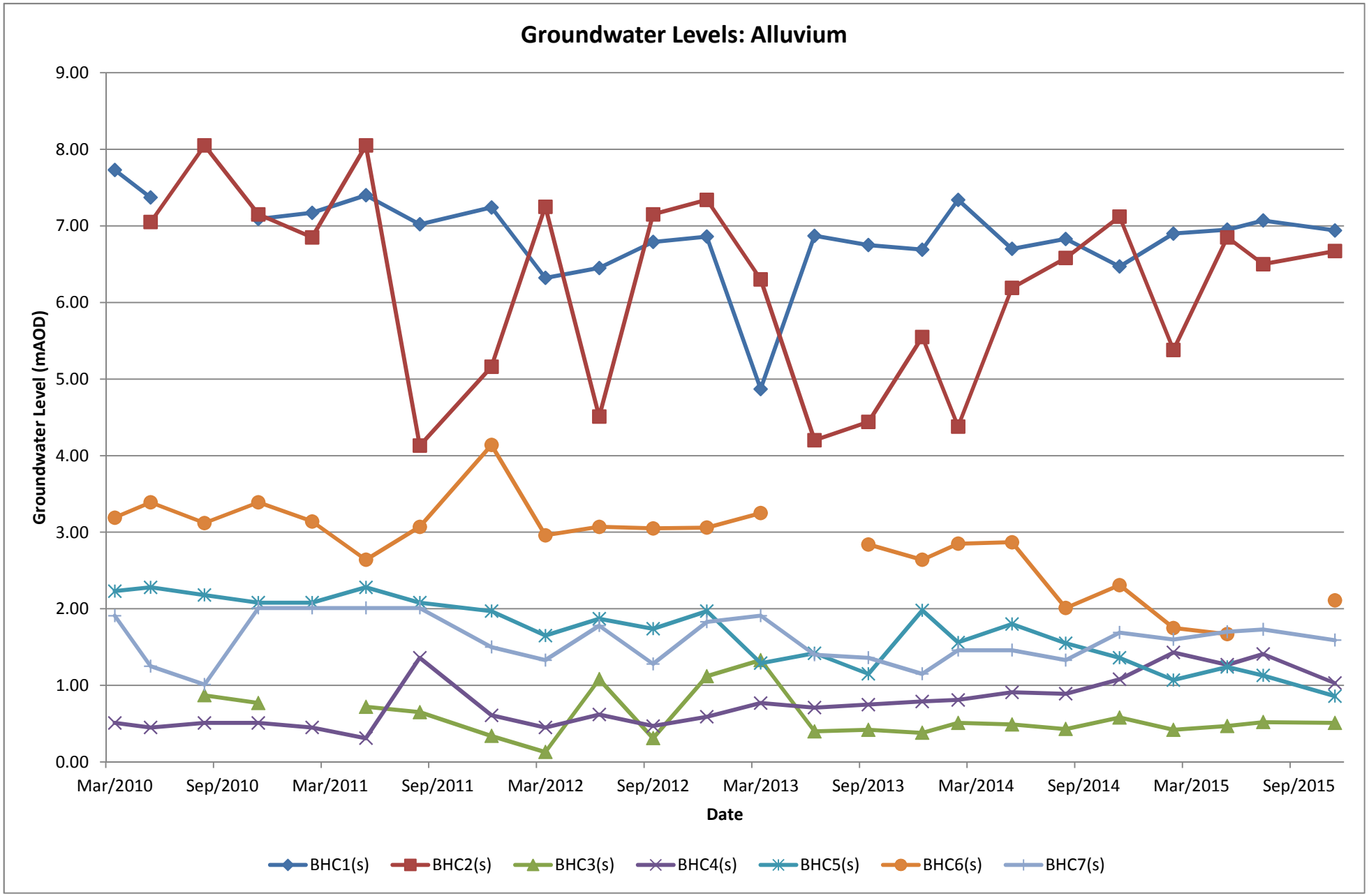
Analysis Date		1994	Mar-96	Apr-96	Jun-96	Sep-96	Sep-97	Jan-99	Mar-00	May-01	2002	2002	2004
Analyte		**Concentration (mg/l)**											
Aluminium	Al	3.89		11.56	-	-	-	3.62	8.1	0.17	14.12	3.08	7.3
Arsenic	As	0.05	<0.1	<0.01	<0.1	<0.1	<0.1	0.01	<0.01	<0.01	<0.002	<0.002	0.03
Boron	B	10.2	6	6.86	1.8	8.3	3.4	2.73	3.3	1.08	3.15	2.28	6.88
Barium	Ba	-	0.2	0.07	-	-	-	0.68	0.15	0.11	0.28	0.58	0.59
Calcium	Ca	546	216	378.8	-	-	-	253	211	149	231.1	128.5	240
Cadmium	Cd	<0.01	<0.1	<0.05	<0.1	<0.1	<0.005	<0.0004	<0.004	<0.004	<0.0004	<0.0004	<0.002
Cobalt	Co	<0.05	<0.1	<0.05	-	-	-	<0.001	<0.01	<0.01	<0.001	<0.001	<0.01
Chromium	Cr	0.11	<0.1	0.16	<0.1	<0.1	0.14	0.11	0.08	0.32	0.041	0.024	0.16
Copper	Cu	<0.01	<0.1	<0.05	<0.1	<0.1	<0.01	<0.005	<0.02	<0.02	<0.005	<0.005	<0.01
Iron	Fe	0.01	<0.1	<0.05	-	-	-	<0.001	<0.08	<0.08	<0.001	<0.001	<0.08
Mercury	Hg	<0.05	<0.01	0.0002	<0.01	<0.1	<0.001	<0.00005	<0.001	<0.001	<0.00005	<0.00005	<0.0002
Potassium	K	22	9.1	6	-	-	-	7	0.59	4.3	11.6	4.2	6.2
Manganese	Mn	<0.01	<0.1	<0.05	-	-	-	0.002	0.03	<0.01	0.001	0.005	<0.01
Molybdenum	Mo	<0.05	0.5	0.86	0.2	<0.1	-	0.48	0.51	0.44	0.76	0.115	0.42
Magnesium	Mg	4	0.8	<0.05	-	-	-	<0.05	0.25	<0.06	<0.05	<0.05	<0.06
Sodium	Na	195	15	7	-	-	-	29	0.28	12	12	7.2	6.9
Nickel	Ni	<0.02	<0.1	<0.05	<0.1	<0.1	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	0.02
Phosphorus	P	-	<0.1	-	-	-	-	<0.05	0.8	0.16	<0.05	<0.05	<0.1
Phosphate	PO_4^{3-}	<0.1	-	0.52	-	-	-	-	-	-	-	-	-
Lead	Pb	0.03	<0.2	<0.05	<0.2	<0.2	<0.01	<0.005	<0.01	<0.01	<0.005	<0.005	<0.01
Antimony	Sb	<0.05	<0.01	0.28	-	-	-	0.01	<0.05	<0.05	<0.005	<0.005	<0.05
Selenium	Se	<0.1	0.126	<0.1	<0.01	<0.1	<0.01	0.16	0.12	<0.01	<0.005	<0.005	0.06
Tin	Sn	0.06	<0.1	<0.05	-	-	-	<0.005	<0.1	<0.1	<0.005	<0.005	<0.1
Silicon	Si	-	0.6	1.5	-	-	-	1.29	0.42	0.7	2.32	2.38	1.33
Titanium	Ti	0.02	<0.1	<0.05	-	-	-	<0.05	<0.1	<0.1	<0.05	<0.05	<0.1
Vanadium	V	1.07	0.4	0.78	<0.1	<0.1	0.5	0.29	0.44	<0.01	0.019	0.048	0.18
Zinc	Zn	<0.01	<0.1	<0.05	<0.1	<0.1	<0.01	<0.005	<0.02	<0.02	<0.005	<0.005	<0.01
Bromide	Br^-	-	-	0.63	-	-	-	-	-	-	-	-	-
Chloride	Cl^-	28	1.6	<5	-	-	15	<0.01	4.6	3.4	<5	<5	<0.5
Cyanide	CN^-	-	<0.1	-	-	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

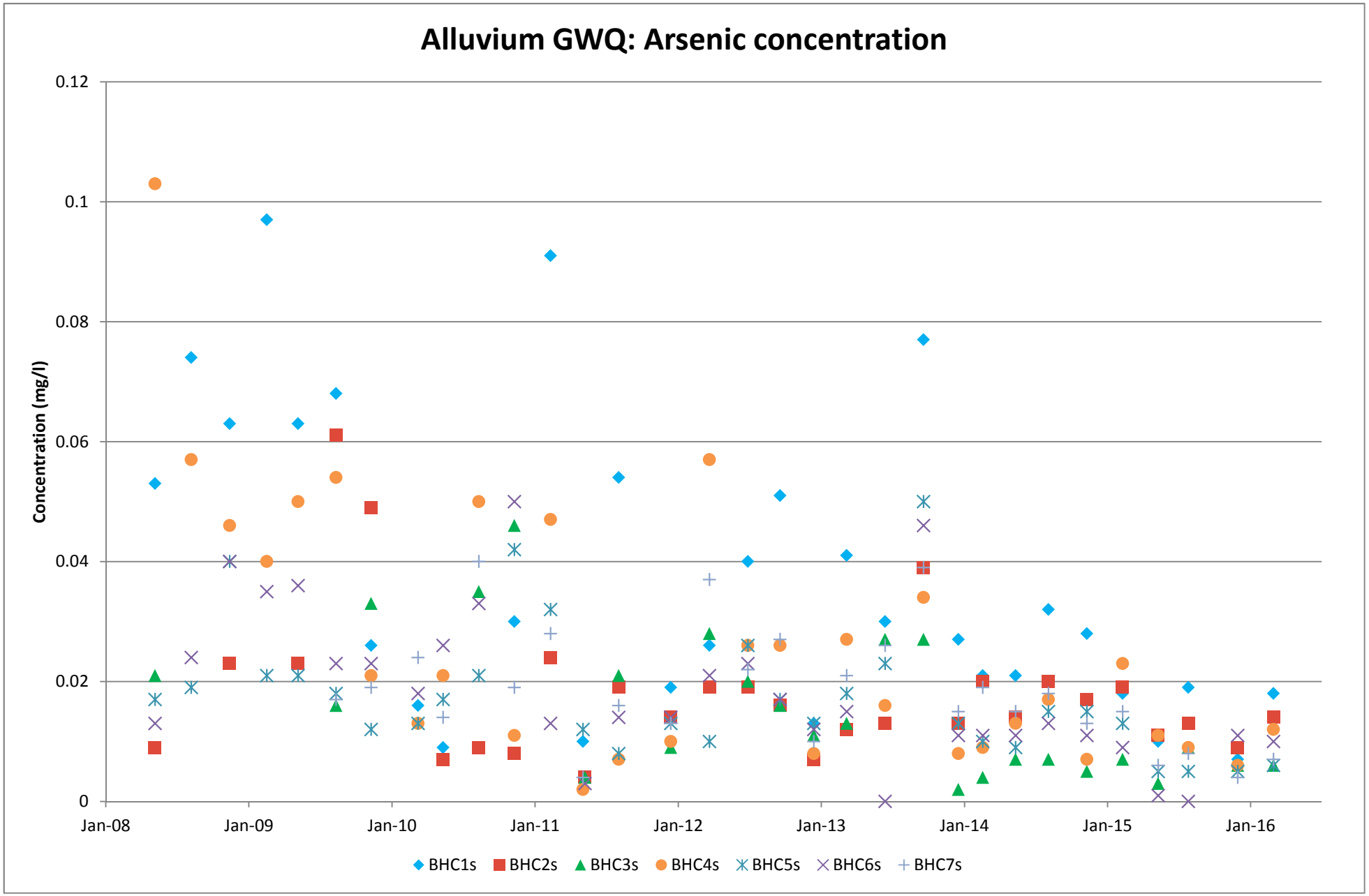
Analysis Date		**1994**	**Mar-96**	**Apr-96**	**Jun-96**	**Sep-96**	**Sep-97**	**Jan-99**	**Mar-00**	**May-01**	**2002**	**2002**	**2004**
Analyte		**Concentration (mg/l)**											
Fluoride	F-	5.6	1.4	3.65	0.18	1.53	-	1.37	1.5	1	<0.5	0.6	<1
Sulphate	SO_4^{2-}	1000	510	527	-	-	340	-	465	344	446	182	457
Nitrite	NO_2^-	-	<0.1	-	-	-	-	<0.05	<0.5	<0.5	0.07	<0.05	<0.5
Nitrate	NO_3^-	-	<0.1	-	-	-	-	2.4	2.2	<1	0.4	<0.3	-
Sulphide	S_2^{2-}	-	-	-	-	-	-	-	-	<0.05	<0.05	<0.05	<0.05
Ammonium	NH_4^+	-	-	-	-	-	-	-	2.4	-	<0.2	0.5	-
Ammonia (as N)	NH_3	-	-	-	-	-	-	-	-	0.4	-	-	0.4
Phenols		-	<0.1	-	-	-	-	-	<0.00075	-	<0.01	<0.01	<0.05
TOC		-	3	-	-	-	-	2	4.2	1.2	1	1	0.6
pH	pH	10.1	10.1	11	11	11.6	9.7	11.53	11.2	12.1	8.06	7.87	11.2
Elect Cond	mS/cm	2.25	0.947	1.24	1.22	1.79	0.645	1.329	0.955	3.42	1.026	0.621	1.209

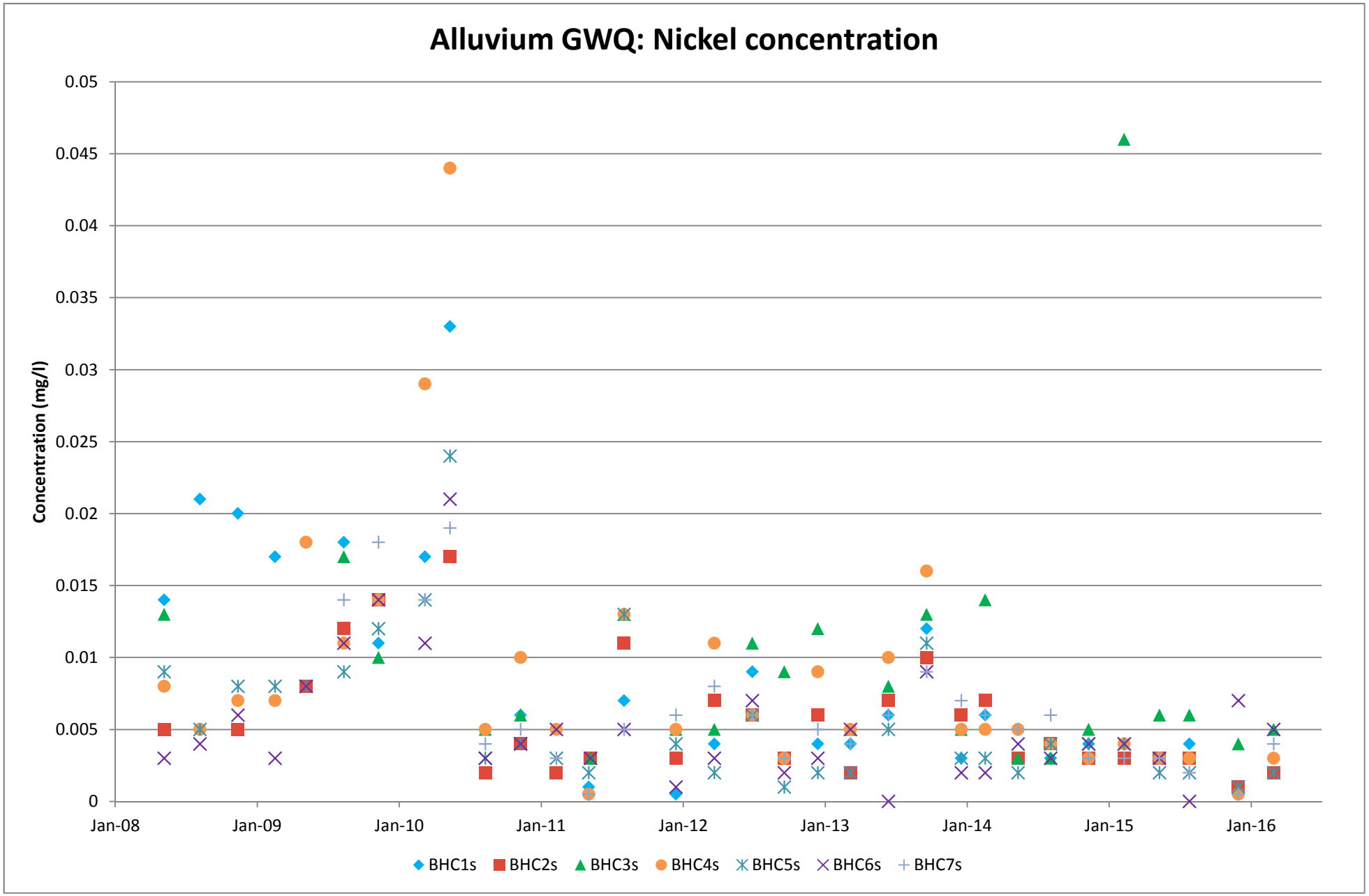
Analysis Date		**2004*** **	**2005**** **	**2007** **	**2008***	**2009***	**Notes**
Analyte		**mg/l**					
Aluminium	Al	18	11.9	16.5	-	0.258	
Arsenic	As	0.08	0.027	0.025	<0.0158	0.0085	
Boron	B	4	10.4	-	-	11.2	
Barium	Ba	0.65	0.45	10.9	-	0.921	
Calcium	Ca	267	351.3	2840	944	-	
Cadmium	Cd	<0.002	0.0008	0.007	<0.0028	0.00389	
Cobalt	Co	<0.01	<0.001	<0.001	0.02	-	
Chromium	Cr	0.18	0.171	1.78	1.15	0.531	
Copper	Cu	<0.01	<0.001	0.031	<0.06	2.35	
Iron	Fe	<0.08	0.029	<0.03	<0.06	<0.03	
Mercury	Hg	<0.0002	<0.00005	<0.00010	<0.00005	<0.00004	
Potassium	K	37	6.9	69.9	25.9	-	
Manganese	Mn	<0.01	<0.01	<0.01	<0.02	<0.01	
Molybdenum	Mo	<0.20	0.47	4.15	2.26	2.38	
Magnesium	Mg	<0.06	0.45	<3	<0.6	-	
Sodium	Na	56	7.2	124	-	68.9	
Nickel	Ni	<0.01	<0.001	<0.050	0.001	<0.005	
Phosphorus	P	<0.01	<0.01	-	<0.3	-	
Phosphate	PO_4^{3-}	-	-	-	-	-	
Lead	Pb	<0.01	<0.001	0.027	0.002	<0.002	
Antimony	Sb	<0.005	0.007	<0.001	<0.02	<0.001	
Selenium	Se	0.18	0.025	0.106	-	0.0562	
Tin	Sn	-	-	-	-	-	
Silicon	Si	0.14	0.19	-	-	-	
Titanium	Ti	-	-	-	-	-	
Vanadium	V	0.18	0.181	0.34	0.196	0.0478	
Zinc	Zn	0.01	0.012	-	0.0275	0.022	excludes outlier of 56.2mg/l (2007)
Bromide	Br^-	-	-	-	-	-	
Chloride	Cl^-	-	1	<20	<20	<10	
Cyanide	CN^-	-	-	-	-	-	

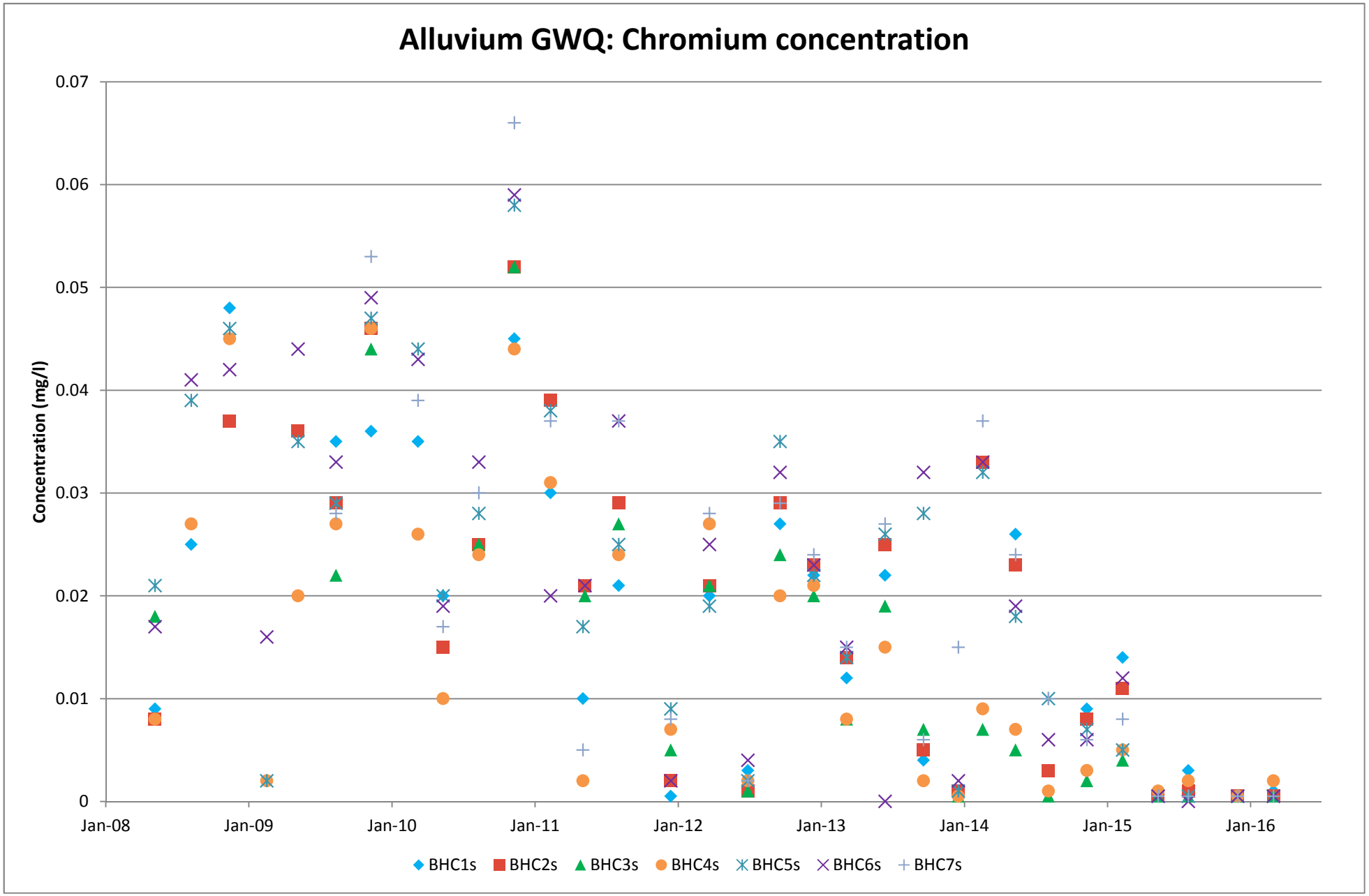
Analysis Date		**2004*** **	**2005**** **	**2007** **	**2008***	**2009***	**Notes**
Analyte		**mg/l**					
Fluoride	F-	1.6	<0.5		1.85	1.77	
Sulphate	SO_4^{2-}	673	750	4920	1960	1510	
Nitrite	NO_2^-	-	<0.05	<0.040	-	<0.10	
Nitrate	NO_3^-	-	0.3	2.7	-	-	
Sulphide	S_2^{2-}	-	<0.05	<0.02	-	-	
Ammonium	NH_4^+	-	-	-	-	-	
Ammonia (as N)	NH_3	-	1.5	-	-	5.74	
Phenols		-	-	-	-	-	
TOC		-	-	-	-	-	
pH	pH	11.2	8.95	11.6	10.8	12.1	
Elect Cond	mS/cm	1577	1358	1520	-	3790	

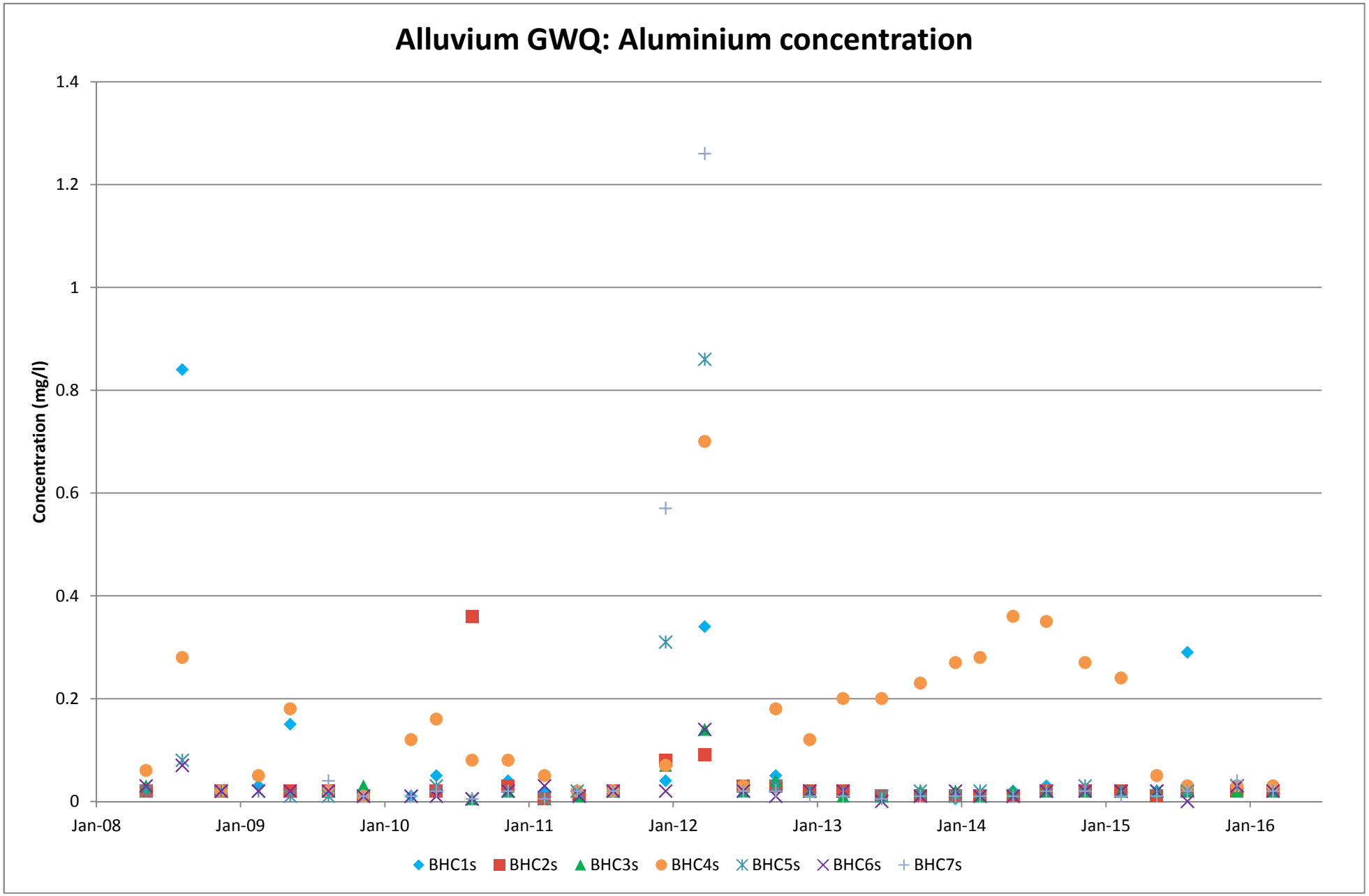

Groundwater Levels: Chalk
Groundwater Level (mAOD)
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
Jan/2010
Jul/2010
Jan/2011
Jul/2011
Jan/2012
Jul/2012
Jan/2013
Jul/2013
Jan/2014
Jul/2014
Jan/2015
Jul/2015
Jan/2016
Date
BHC1(d)
BHC2(d)
BHC3(d)
BHC4(d)
BHC5(d)
BHC6(d)
BHC7(d)

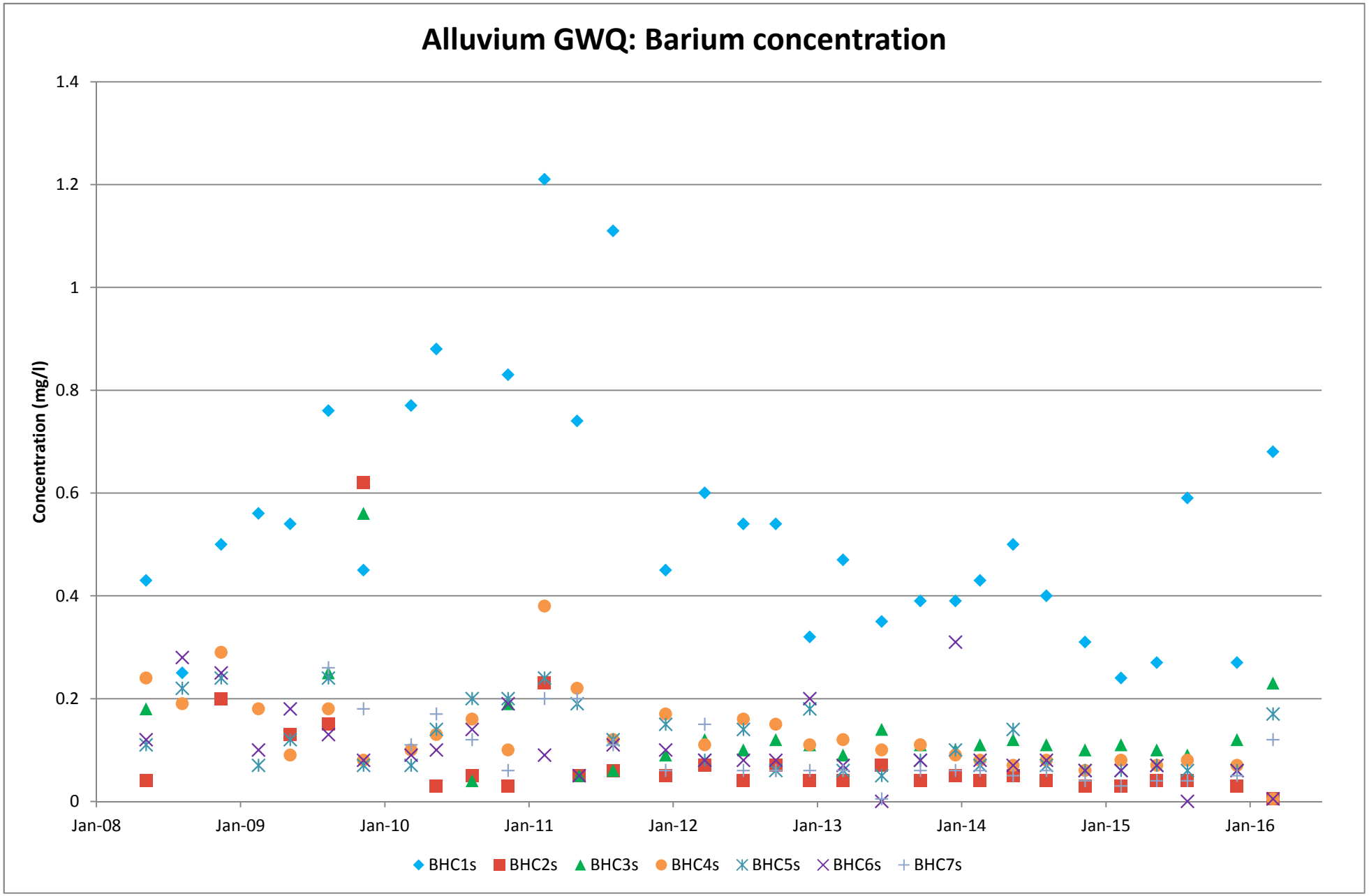

Groundwater Levels: Alluvium
Groundwater Level (mAOD)
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Mar/2010
Sep/2010
Mar/2011
Sep/2011
Mar/2012
Sep/2012
Mar/2013
Sep/2013
Mar/2014
Sep/2014
Mar/2015
Sep/2015
Date
BHC1(s)
BHC2(s)
BHC3(s)
BHC4(s)
BHC5(s)
BHC6(s)
BHC7(s)

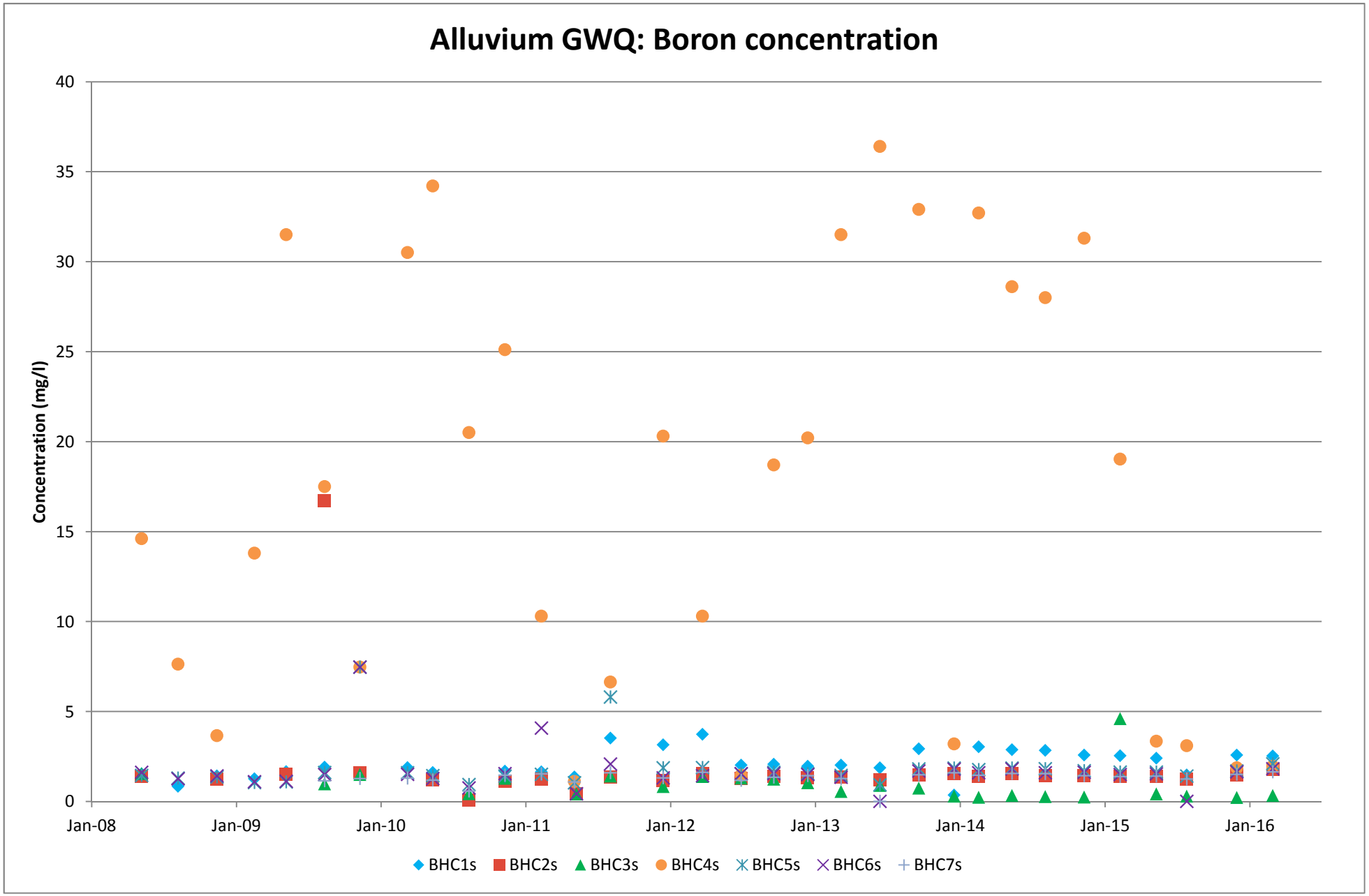

Alluvium GWQ: Arsenic concentration
Concentration (mg/l)
0.12
0.1
0.08
0.06
0.04
0.02
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
BHC1s
BHC2s
BHC3s
BHC4s
BHC5s
BHC6s
BHC7s

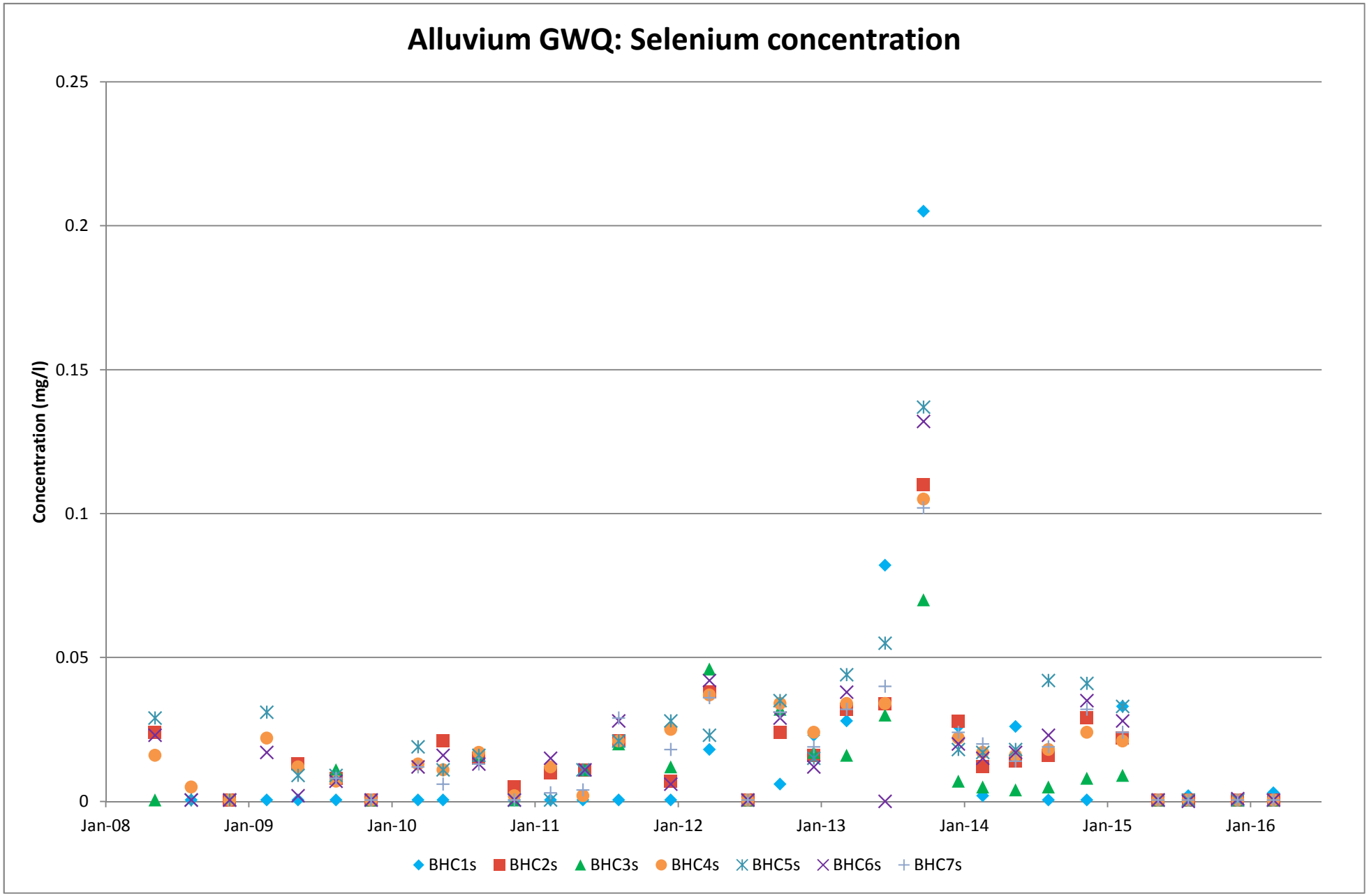

Alluvium GWQ: Nickel concentration
Concentration (mg/l)
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
BHC1s
BHC2s
BHC3s
BHC4s
BHC5s
BHC6s
BHC7s

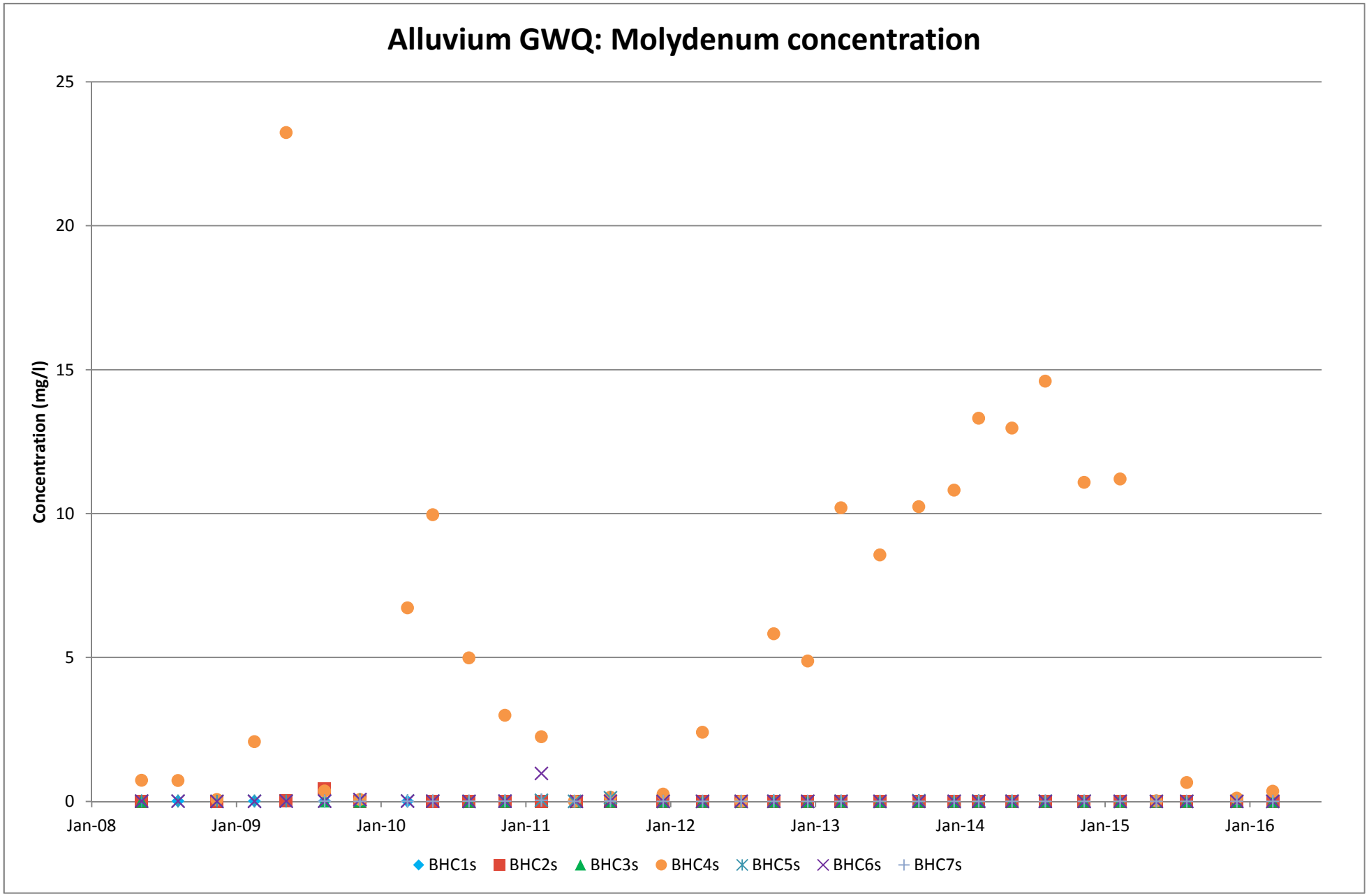

Alluvium GWQ: Chromium concentration
Concentration (mg/l)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
BHC1s
BHC2s
BHC3s
BHC4s
BHC5s
BHC6s
BHC7s

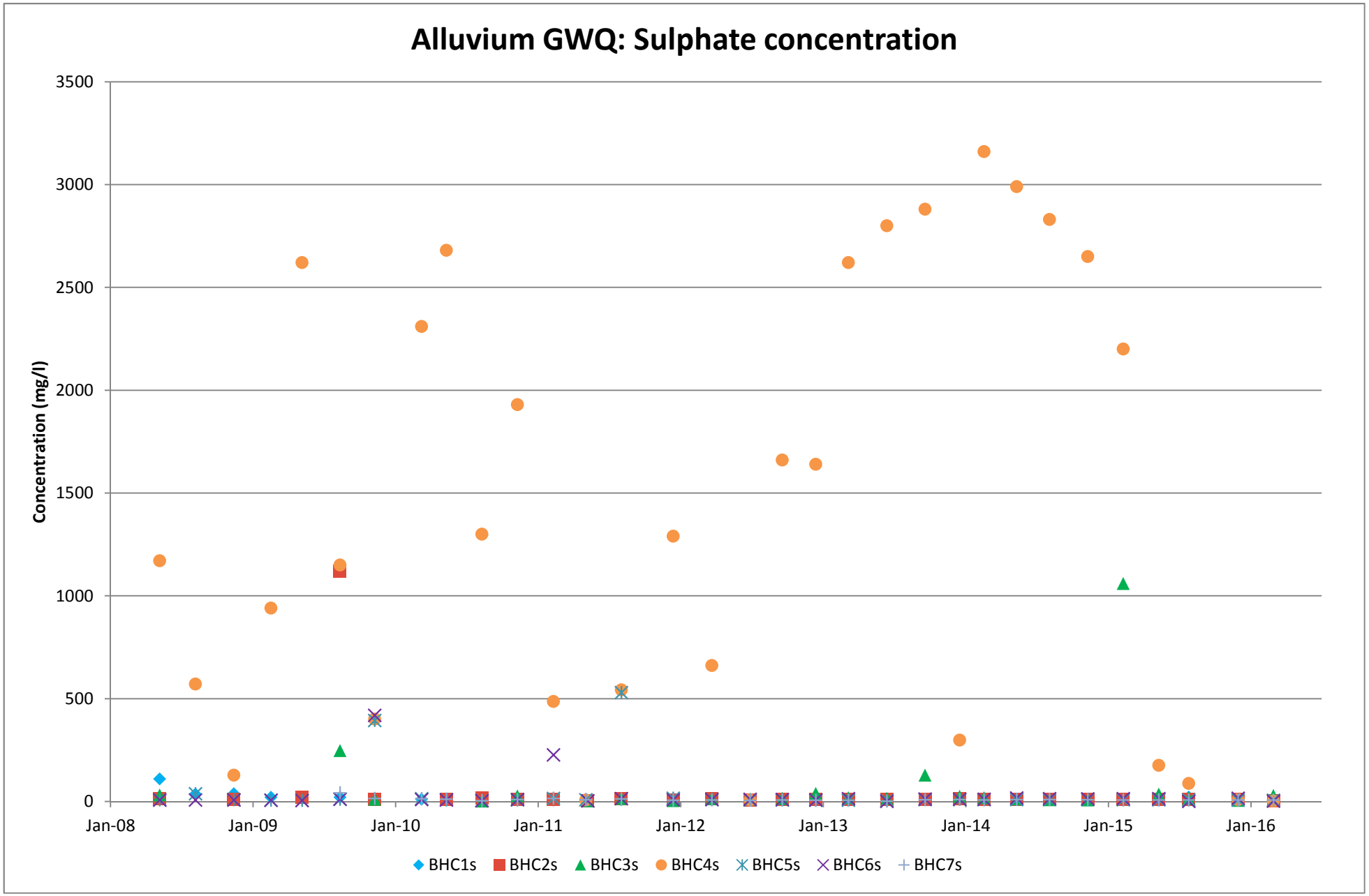

Alluvium GWQ: Aluminium concentration
Concentration (mg/l)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
BHC1s
BHC2s
BHC3s
BHC4s
BHC5s
BHC6s
BHC7s

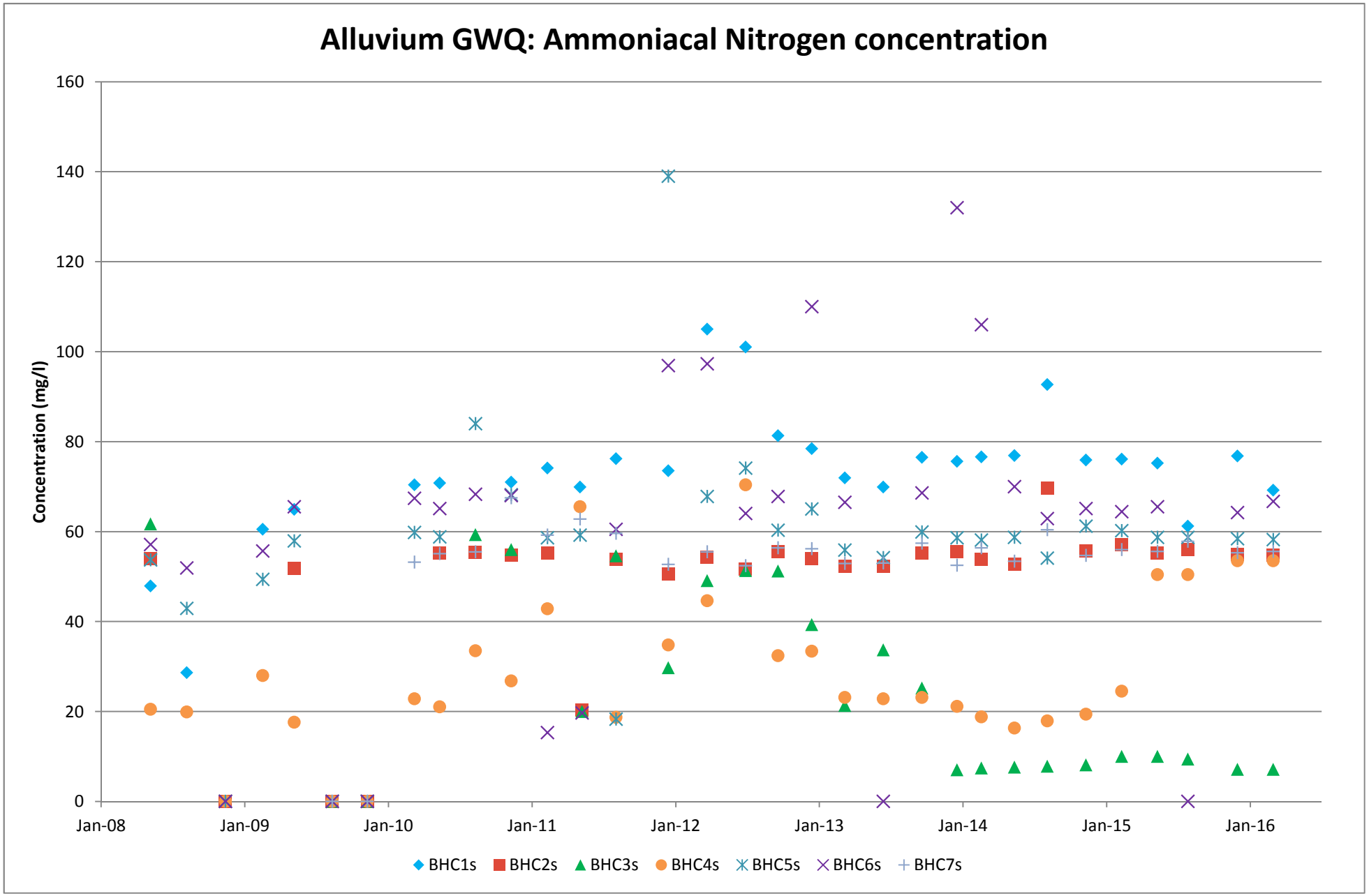

Alluvium GWQ: Barium concentration
Concentration (mg/l)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
BHC1s
BHC2s
BHC3s
BHC4s
BHC5s
BHC6s
BHC7s

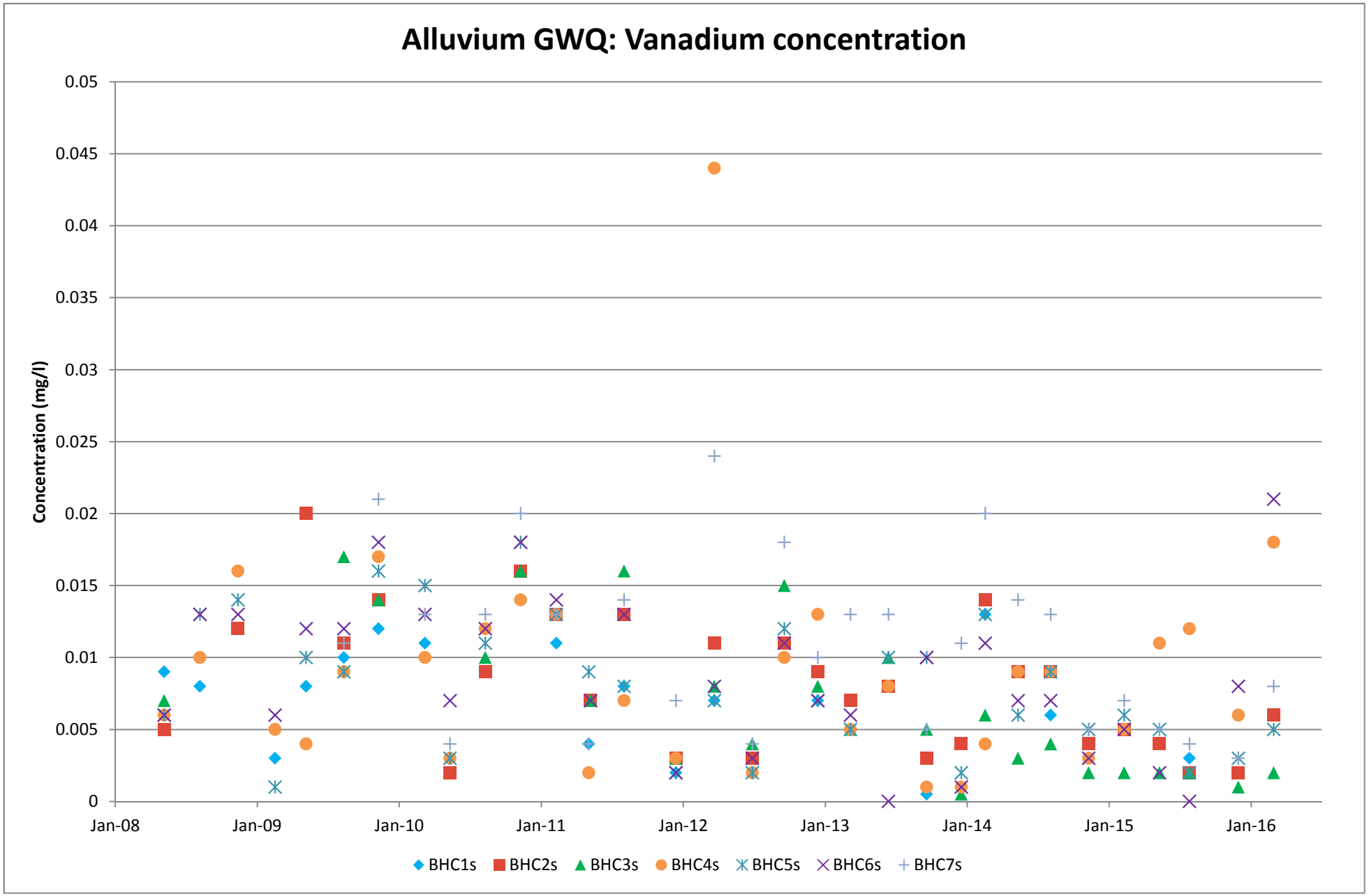

Alluvium GWQ: Boron concentration
Concentration (mg/l)
40
35
30
25
20
15
10
5
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
BHC1s
BHC2s
BHC3s
BHC4s
BHC5s
BHC6s
BHC7s


Alluvium GWQ: Selenium concentration
Concentration (mg/l)
0.25
0.2
0.15
0.1
0.05
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
BHC1s
BHC2s
BHC3s
BHC4s
BHC5s
BHC6s
BHC7s


Alluvium GWQ: Molydenum concentration
Concentration (mg/l)
25
20
15
10
5
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
BHC1s
BHC2s
BHC3s
BHC4s
BHC5s
BHC6s
BHC7s


Alluvium GWQ: Sulphate concentration
Concentration (mg/l)
3500
3000
2500
2000
1500
1000
500
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
BHC1s
BHC2s
BHC3s
BHC4s
BHC5s
BHC6s
BHC7s

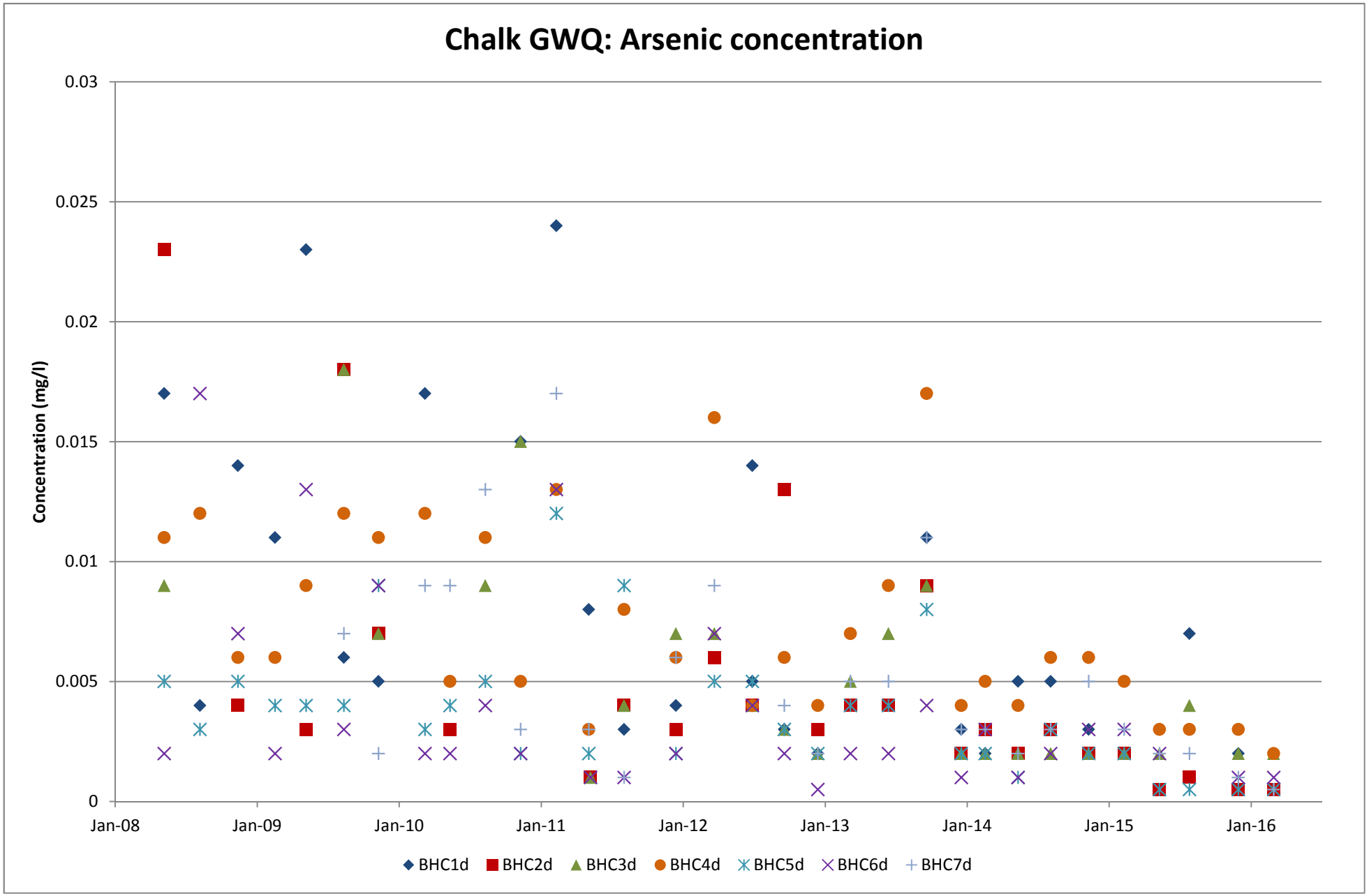

Alluvium GWQ: Ammoniacal Nitrogen concentration
Concentration (mg/l)
160
140
120
100
80
60
40
20
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
BHC1s
BHC2s
BHC3s
BHC4s
BHC5s
BHC6s
BHC7s

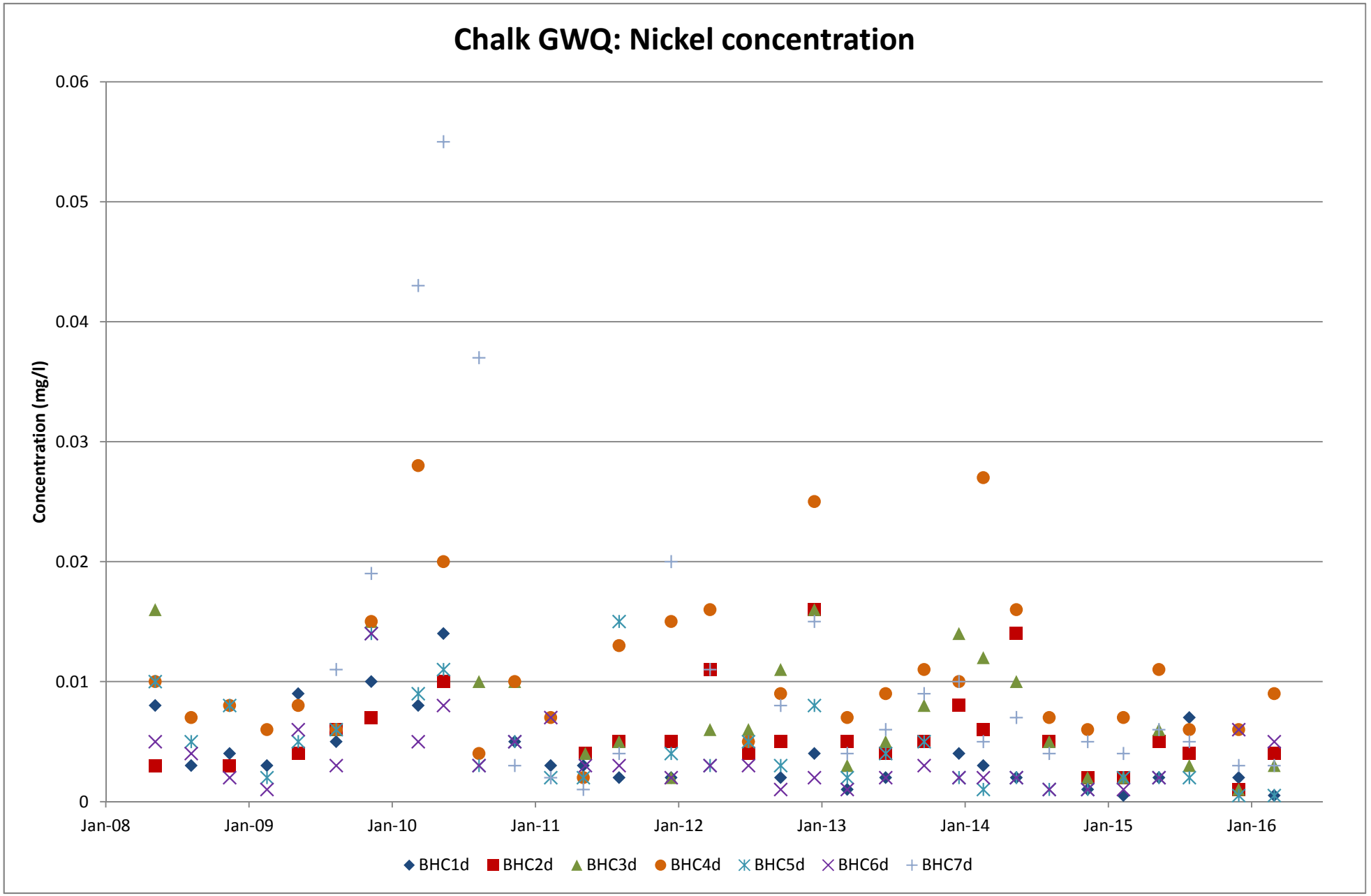

Alluvium GWQ: Vanadium concentration
Concentration (mg/l)
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
BHC1s
BHC2s
BHC3s
BHC4s
BHC5s
BHC6s
BHC7s

BHID	Analyte:	pH units	Conductivity uS/cm @ 25C	Total Alkalinity as CaCO3	Chloride as Cl w	Fluoride as F	Bromide as Br	Total Sulphur as SO4 (Dissolved)	Calcium as Ca (Dissolved) a	Magnesium as Mg (Dissolved) a	Barium as Ba (Dissolved) a	Sodium as Na (Dissolved) a	Potassium as K (Dissolved) a	Nickel as Ni (Dissolved)
	Units:		uS/cm	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
BHC1s	Count	30	31	30	31	30	30	31	31	31	31	31	31	31
	Min	6.5	16700	1290	6290	<1	13	4	195	115	0.24	760	29	<0.001
	Mean	7.01	32909.7	3123.83	12765.8	0.64	103.1	14.10	392.5	894.0	0.5410	6862.39	251.06	0.0085
	Max	7.5	41200	10800	15100	3.2	755	109	556	1050	1.21	12600	356	0.033
BHC2s	Count	29	30	29	30	29	29	30	30	30	30	30	30	30
	Min	6.6	8620	1177	2720	<0.5	8.55	<3	<1	<1	<0.01	<1	<1	0.001
	Mean	7.06	20604	3018.6897	6283	0.452	68.43	46.92	241.45	422.28	0.081	3309.7	137.68	0.0057
	Max	7.6	38000	15600	15000	2.4	418	1120	703	986	0.62	7820	327	0.017
BHC3s	Count	26	26	26	26	26	26	26	26	26	26	26	26	26
	Min	6.6	4640	340	1380	<0.3	<10	<3	106	76	0.04	70.8	30	0.003
	Mean	7.12	15135.4	1773.0	4566.2	0.338	46.82	115.9	250.0	308.0	0.133	2459.7	96.73	0.01019
	Max	7.8	38200	15700	14800	0.6	290	1230	866	989	0.56	7890	203	0.046
BHC4s	Count	32	33	32	33	32	32	33	33	33	33	33	33	33
	Min	6.6	9940	271	4290	<0.5	11.6	<3	9	17	<0.01	101	3	<0.001
	Mean	7.01	23213.3	1668.9	6638.2	0.3375	73.51	1415.8	646	464.4	0.129	3414.3	322.09	0.0089
	Max	7.5	34100	8337	9720	0.8	526	3160	1110	739	0.38	4920	545	0.044
BHC5s	Count	32	33	32	33	32	32	33	33	33	33	33	33	33
	Min	6.6	13600	287	4710	<1	1	4	207	79	0.05	427	111	0.001
	Mean	7.00	26418.2	2483.3	8367.3	0.38	92.68	36.76	314.33	599.55	0.120	4123.7	163.3	0.00615
	Max	7.6	37800	3166	9360	0.9	1010	529	551	763	0.24	5270	210	0.024
BHC6s	Count	30	31	30	31	30	30	31	31	31	31	31	31	31
	Min	6.6	1000	193	2760	<1	<10	<3	<1	<1	<0.01	<1	<1	0.001
	Mean	7.17	23148.7	2429.6	7183.5	0.43	79.59	29.60	247.56	485.48	0.11	3691.73	147.37	0.0056
	Max	7.8	33800	3880	8040	0.9	674	419	545	667	0.31	5240	206	0.021
BHC7s	Count	27	27	27	27	27	27	27	27	27	27	27	27	27
	Min	6.7	12000	228	5630	<1	6.01	<3	<1	<1	<0.01	<1	<1	<0.001
	Mean	7.10	22355.6	2302.6	6514.1	0.396	51.46	9.39	234.69	471.70	0.092	3229.94	134.35	0.0063
	Max	7.7	33500	4290	8850	0.7	330	42	321	713	0.26	4790	189	0.019

BHID	Chromium as Cr (Dissolved)	Cadmium as Cd (Dissolved)	Copper as Cu (Dissolved)	Lead as Pb (Dissolved)	Zinc as Zn (Dissolved)	Manganese as Mn (Dissolved)	Iron as Fe (Dissolved) a	Aluminium as Al (Dissolved) a	Arsenic as As (Dissolved)	Boron as B (Dissolved) a	Mercury as Hg (Dissolved)	Selenium as Se (Dissolved)	Vanadium as V (Dissolved)	Molybdenum as Mo (Dissolved)	Cobalt as Co (Dissolved)
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
BHC1s	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	<0.001	<0.0001	<0.001	<0.001	<0.002	0.207	0.26	<0.01	0.007	0.35	<0.0001	<0.001	<0.001	<0.001	<0.001
	0.018	0.00012	0.0098	0.0045	0.021	0.414	17.52	0.073	0.037	2.09	7.42E-05	0.0155	0.0069	0.0048	0.0053
	0.048	0.0015	0.078	0.066	0.26	0.82	48.7	0.84	0.097	3.73	0.0006	0.205	0.016	0.025	0.028
BHC2s	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
	<0.001	<0.0001	<0.001	<0.001	<0.002	0.288	<0.01	<0.01	0.004	0.07	<0.0001	<0.001	0.002	<0.001	0.001
	0.0182	6.67E-05	0.0027	0.0005	0.0094	0.730	4.21	0.0335	0.018	1.81	0.000055	0.0184	0.0080	0.0159	0.00270
	0.052	0.0003	0.031	0	0.152	3.38	38.9	0.36	0.061	16.7	0.0002	0.11	0.02	0.419	0.011
BHC3s	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
	<0.001	<0.0001	<0.001	<0.001	<0.002	0.435	<0.01	<0.01	0.002	0.22	<0.0001	<0.001	<0.001	<0.001	<0.001
	0.0132	7.69E-05	0.0032	-	0.0096	1.70	3.62	0.0279	0.0151	1.48	-	0.0137	0.0067	0.0842	0.0051
	0.052	0.0005	0.047	<0.001	0.103	14.7	39	0.14	0.046	15.8	<0.0001	0.07	0.017	2.12	0.039
BHC4s	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33
	<0.001	<0.0001	<0.001	<0.001	<0.002	0.081	<0.01	0.01	0.002	1.11	<0.0001	<0.001	0.001	<0.001	<0.001
	0.0143	0.00037	0.0032	0.0009	0.0092	3.98	6.94	0.15	0.0258	18.30	0.00011	0.0177	0.0090	5.39	0.00195
	0.046	0.0039	0.034	0.014	0.175	12.68	40	0.7	0.103	54.5	0.0007	0.105	0.044	23.23	0.008
BHC5s	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33
	<0.001	<0.0001	<0.001	<0.001	<0.002	0.307	0.02	<0.01	0.005	0.92	<0.0001	<0.001	<0.002	<0.001	<0.001
	0.0208	0.000058	0.0038	-	0.0104	1.49	7.33	0.055	0.0176	1.90	5.30E-05	0.0224	0.0079	0.0160	0.0027
	0.058	0.0002	0.043	<0.001	0.076	8.8	22.8	0.86	0.05	7.46	0.0001	0.137	0.018	0.131	0.012
BHC6s	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	<0.001	<0.0001	<0.001	<0.001	<0.002	0.378	<0.01	<0.01	0.001	0.43	<0.0001	<0.001	0.001	<0.001	<0.001
	0.0225	6.45E-05	0.0023	-	0.0125	1.93	6.42	0.024	0.020	1.74	7.90E-05	0.0198	0.0090	0.0385	0.0036
	0.059	0.0003	0.02	<0.001	0.142	3.604	21.6	0.14	0.05	7.46	0.0005	0.132	0.021	0.972	0.014
BHC7s	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
	<0.001	<0.0001	<0.001	<0.001	<0.002	0.171	<0.01	<0.01	0.004	<0.01	<0.0001	<0.001	0.003	<0.001	<0.001
	0.0205	0.000061	0.0016	0.00085	0.0149	0.727	3.277	0.082	0.018	1.32	0.00005	0.0181	0.0110	0.0046	0.0034
	0.066	0.0003	0.009	0.01	0.149	2.627	23.8	1.26	0.04	1.64	<0.0001	0.102	0.024	0.042	0.011

BHID	Tin as Sn (Dissolved)	Thallium as Tl (Dissolved)	Antimony as Sb (Dissolved)	Ammoniacal Nitrogen as N	Nitrate as N	Chromium VI as Cr	Total Oxidised Nitrogen as N	Phosphate as P	Total Organic Carbon	Silicon as Si (Dissolved) a	Beryllium as Be (Dissolved) a
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
BHC1s	30	28	31	28	30	17	30	30	30	30	30
	<0.001	<0.001	<0.001	28.6	<0.2	<0.01	<0.2	<0.01	14	7.2	<0.01
	-	-	0.00066	73.14	0.187	0.047	0.19	0.290	43.60	16.32	0.005
	<0.001	<0.001	0.003	105	1.4	0.36	1.4	1.43	140	23.6	<0.01
BHC2s	30	27	30	27	29	17	29	29	29	30	30
	<0.001	<0.001	<0.001	20.4	<0.2	<0.01	<0.2	<0.01	13	0.3	<0.01
	0.00072	-	-	53.46	0.15	0.036	0.152	0.802	38.45	28.15	0.0075
	0.007	<0.001	<0.001	69.7	0.8	0.32	0.8	4.88	100	42.3	<0.01
BHC3s	26	23	26	24	26	17	26	26	26	26	26
	<0.001	<0.001	<0.001	7	<0.2	<0.01	<0.2	<0.01	2.4	7.3	<0.01
	0.0010	-	-	26.96	0.23	0.010	0.231	0.197	13.00	15.32	-
	0.014	<0.001	<0.001	61.7	1.5	0.08	1.5	2.15	51	33.2	<0.01
BHC4s	33	30	33	30	32	17	32	32	32	33	33
	<0.001	<0.001	<0.001	16.3	<0.2	<0.01	<0.2	<0.01	1.9	5.8	<0.01
	0.00076	-	0.0005303	31.51	0.12	0.0074	0.116	0.317	17.07	13.55	-
	0.009	<0.001	0.001	70.4	0.3	0.03	0.3	3.4	50	29.7	<0.01
BHC5s	33	30	33	30	32	17	32	32	32	33	33
	<0.001	<0.001	<0.001	18.3	<0.2	<0.01	<0.2	<0.01	16	3.2	<0.01
	0.0006	-	-	60.63	0.2	0.015	0.2	0.88	34.50	23.58	-
	0.004	<0.001	<0.001	139	1.7	0.12	1.6	6.82	91	34.5	<0.01
BHC6s	31	28	31	28	30	15	30	30	30	31	31
	<0.001	<0.001	<0.001	15.3	<0.2	<0.01	<0.2	<0.01	11	7.8	<0.01
	0.00068	-	-	68.73	0.18	0.021	0.183	1.127	44.97	17.55	-
	0.006	<0.001	<0.001	132	1.9	0.13	1.9	8.49	150	32.6	<0.01
BHC7s	27	25	27	25	27	17	27	27	27	27	27
	<0.001	<0.001	<0.001	52.4	<0.2	<0.01	<0.2	<0.01	15	<0.1	<0.01
	-	-	-	56.28	0.137	0.023	0.137	0.692	31.63	33.39	0.005
	<0.001	<0.001	<0.001	67.5	1.1	0.12	1.1	3.33	58	278	<0.01


Chalk GWQ: Arsenic concentration
Concentration (mg/l)
0.03
0.025
0.02
0.015
0.01
0.005
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
BHC1d
BHC2d
BHC3d
BHC4d
BHC5d
BHC6d
BHC7d


Chalk GWQ: Nickel concentration
Concentration (mg/l)
0.06
0.05
0.04
0.03
0.02
0.01
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
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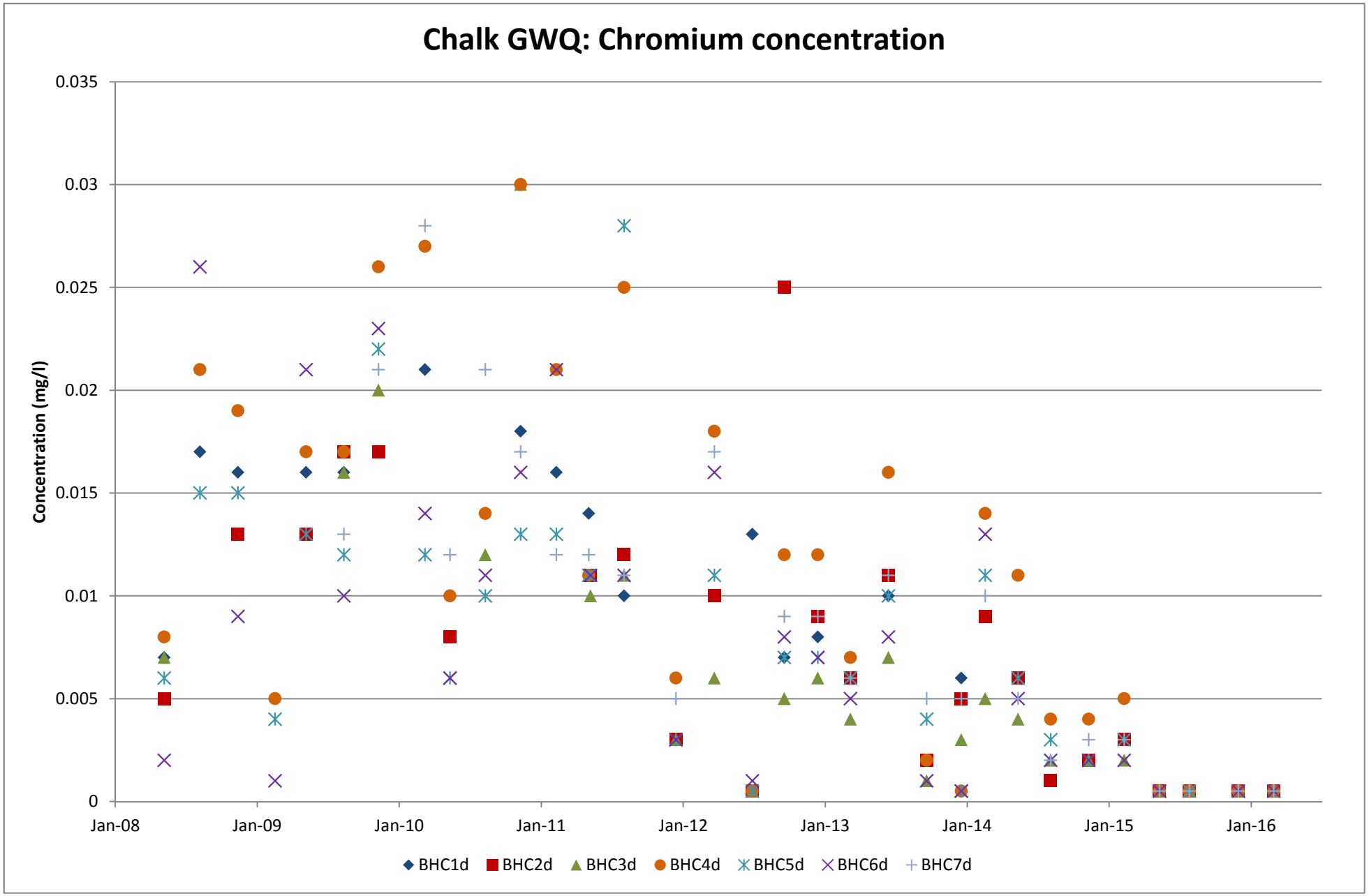
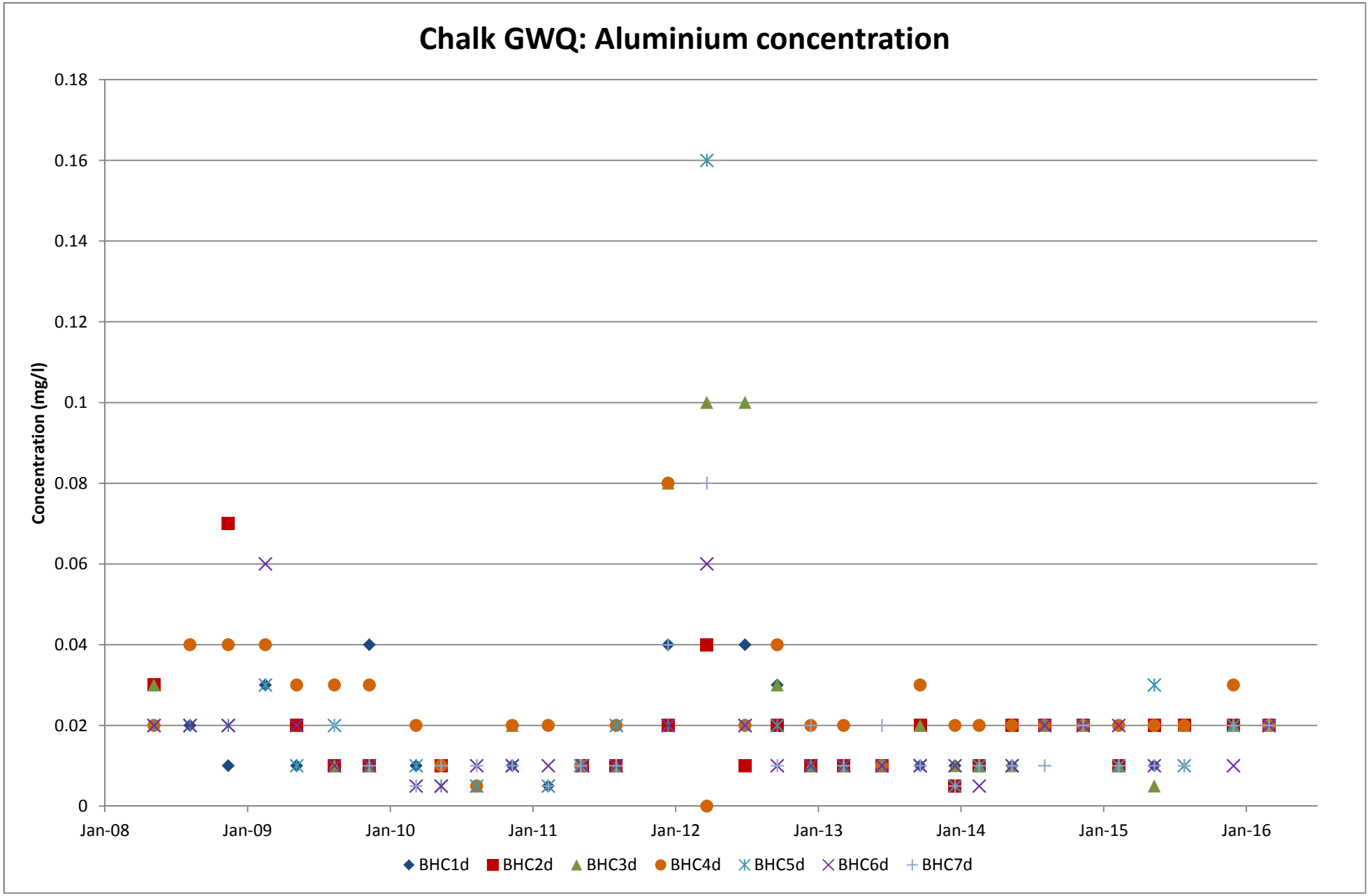
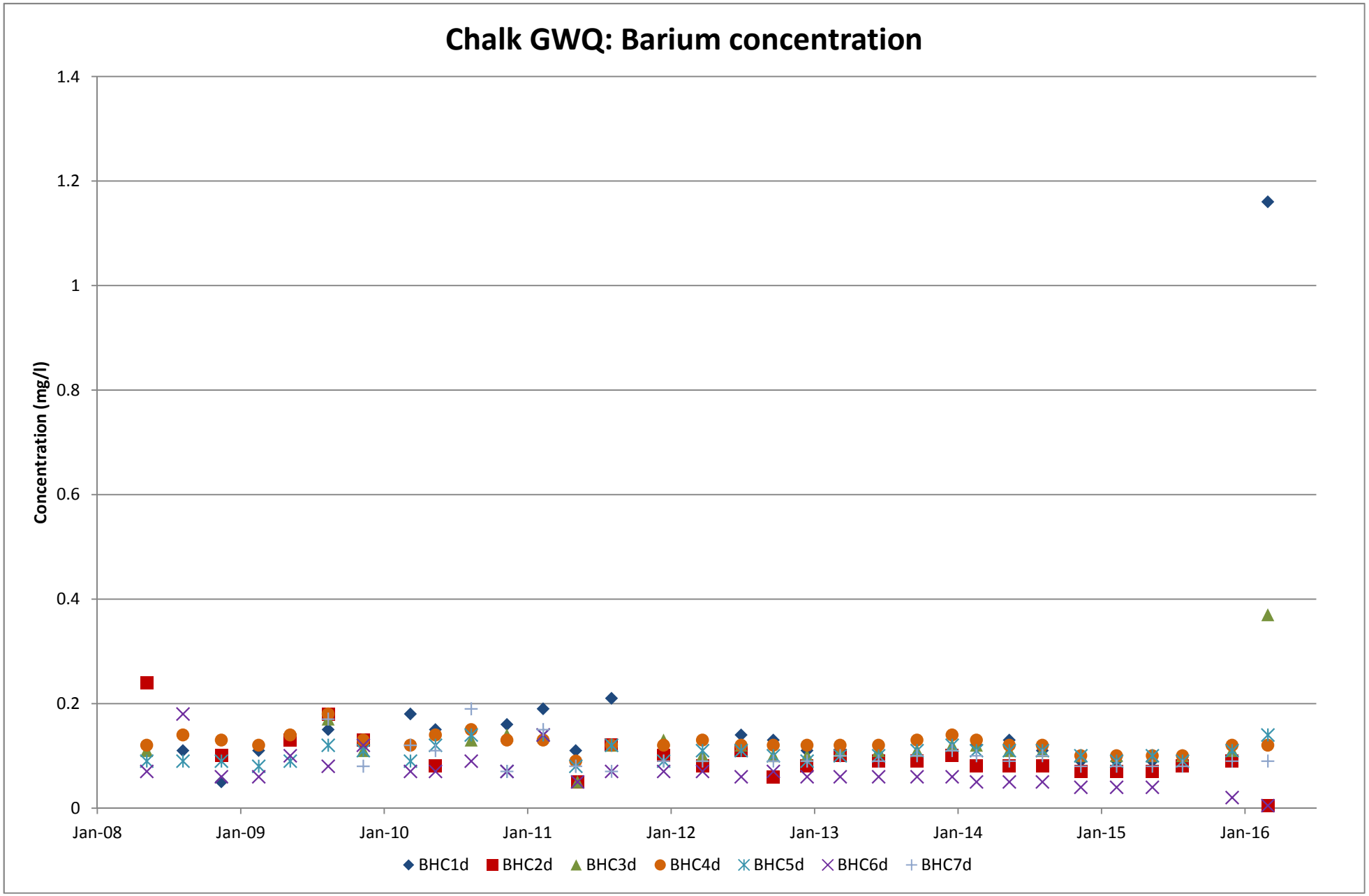
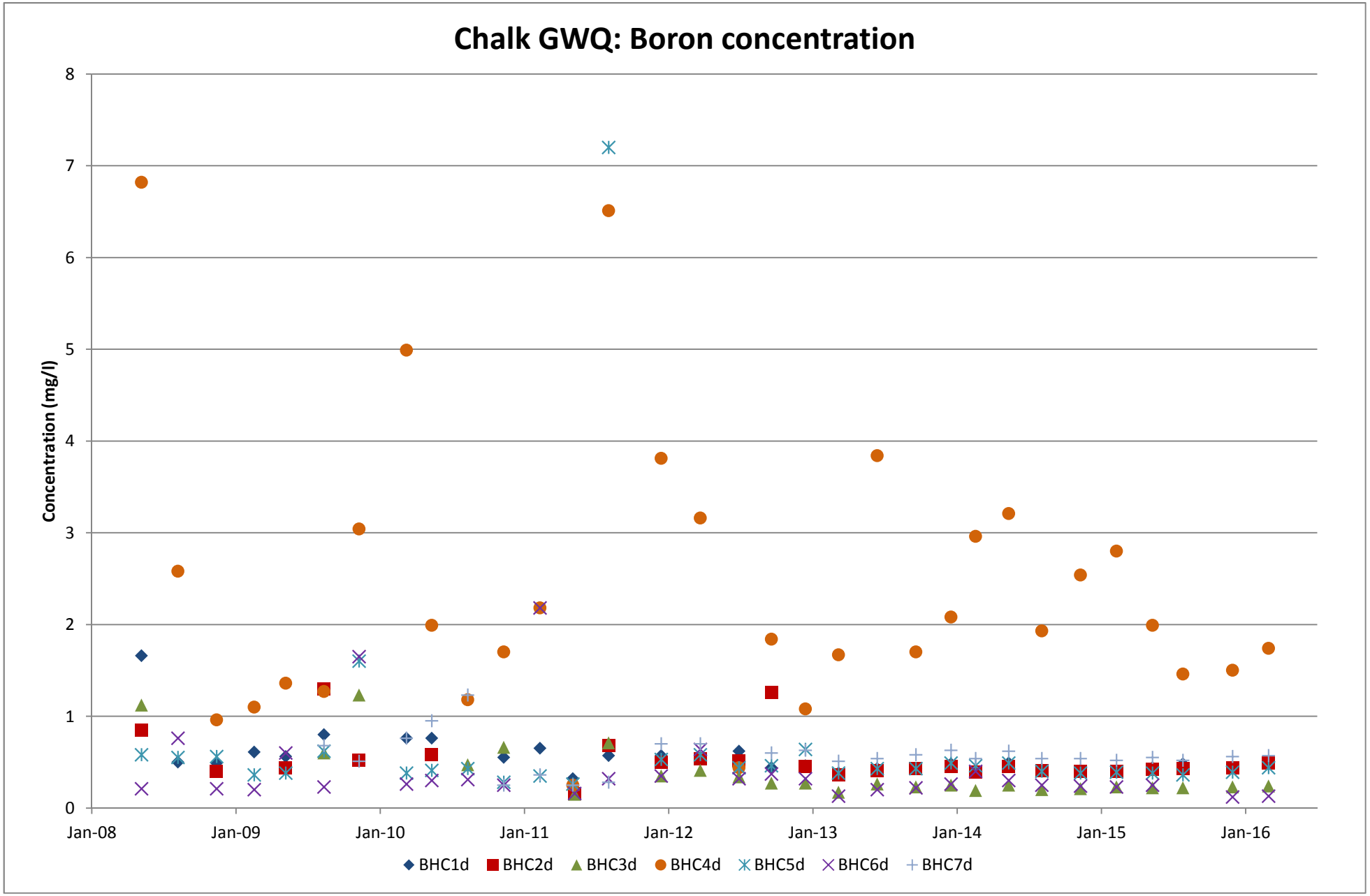
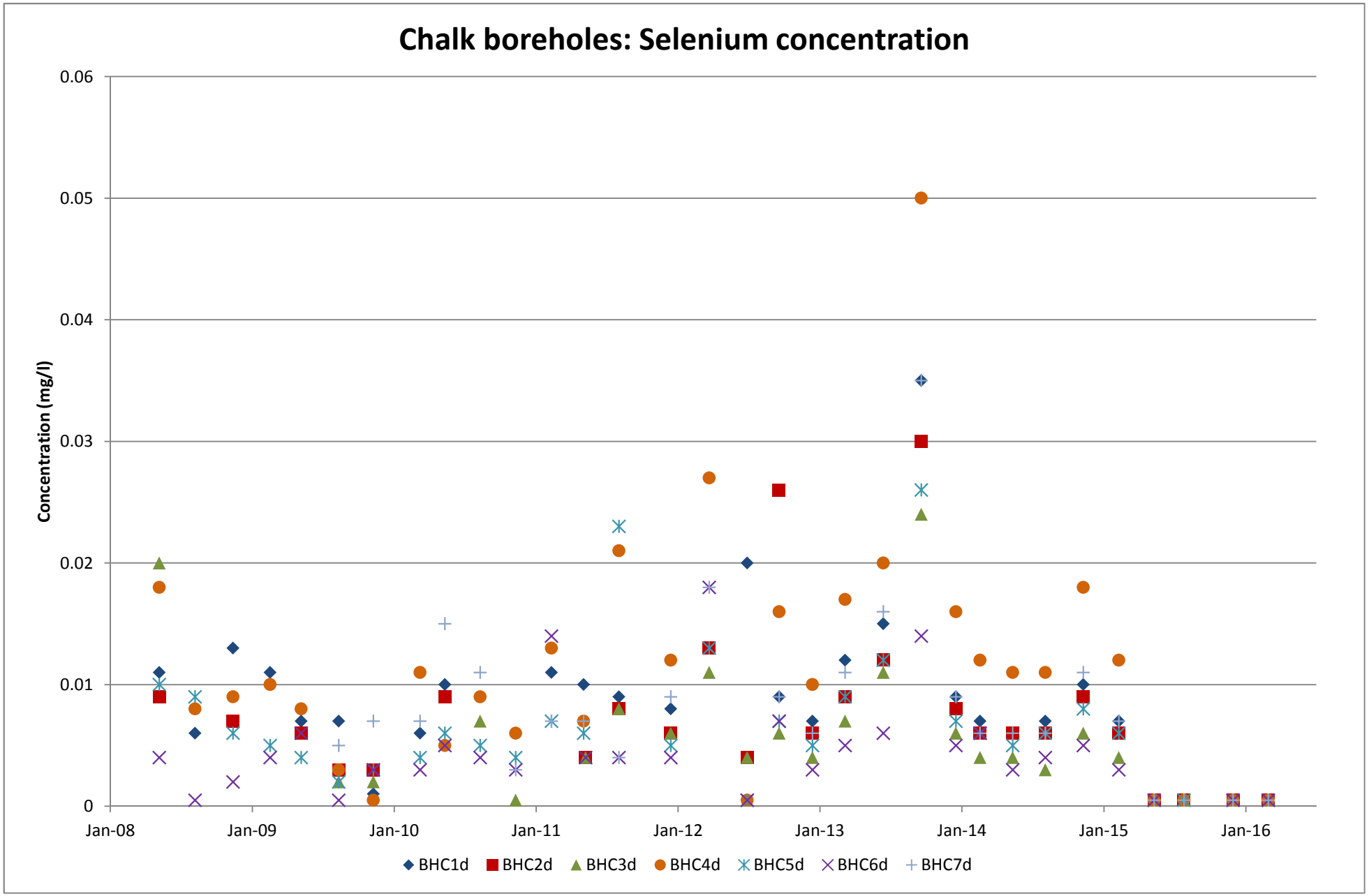
Jan-16
BHC1d
BHC2d
BHC3d
BHC4d
BHC5d
BHC6d
BHC7d

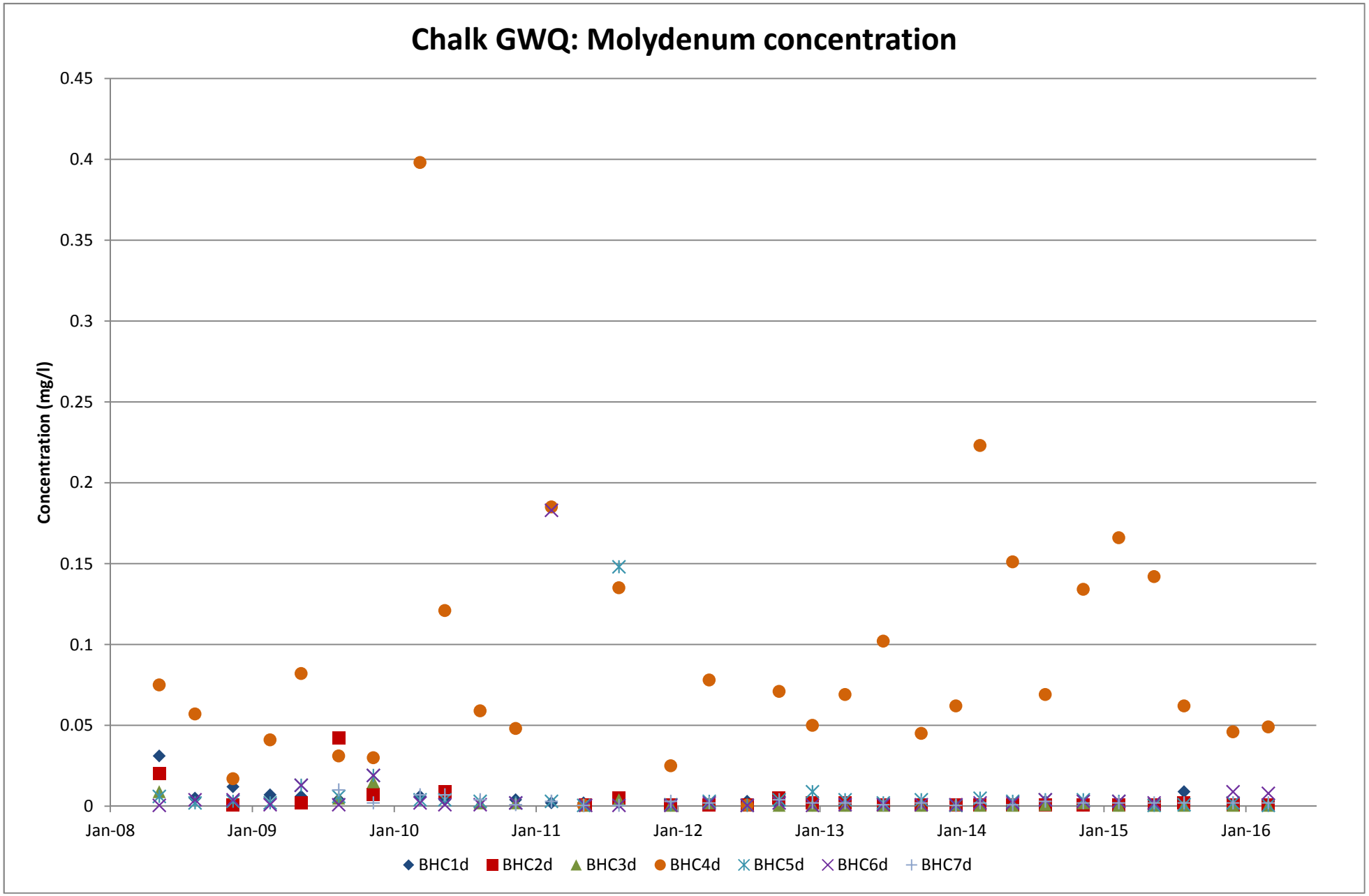

Chalk GWQ: Chromium concentration
Concentration (mg/l)
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
BHC1d
BHC2d
BHC3d
BHC4d
BHC5d
BHC6d
BHC7d

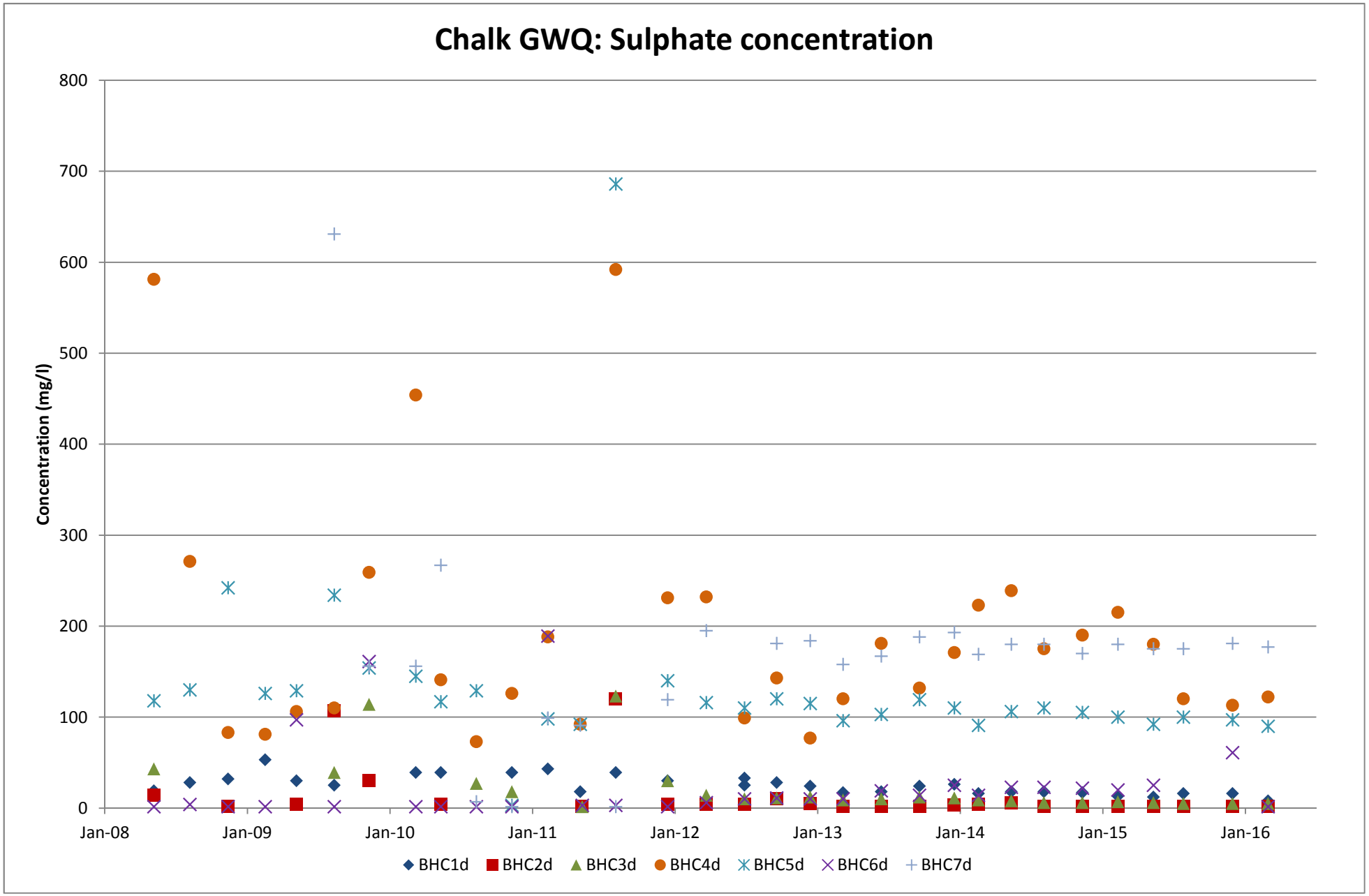

Chalk GWQ: Aluminium concentration
Concentration (mg/l)
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
BHC1d
BHC2d
BHC3d
BHC4d
BHC5d
BHC6d
BHC7d

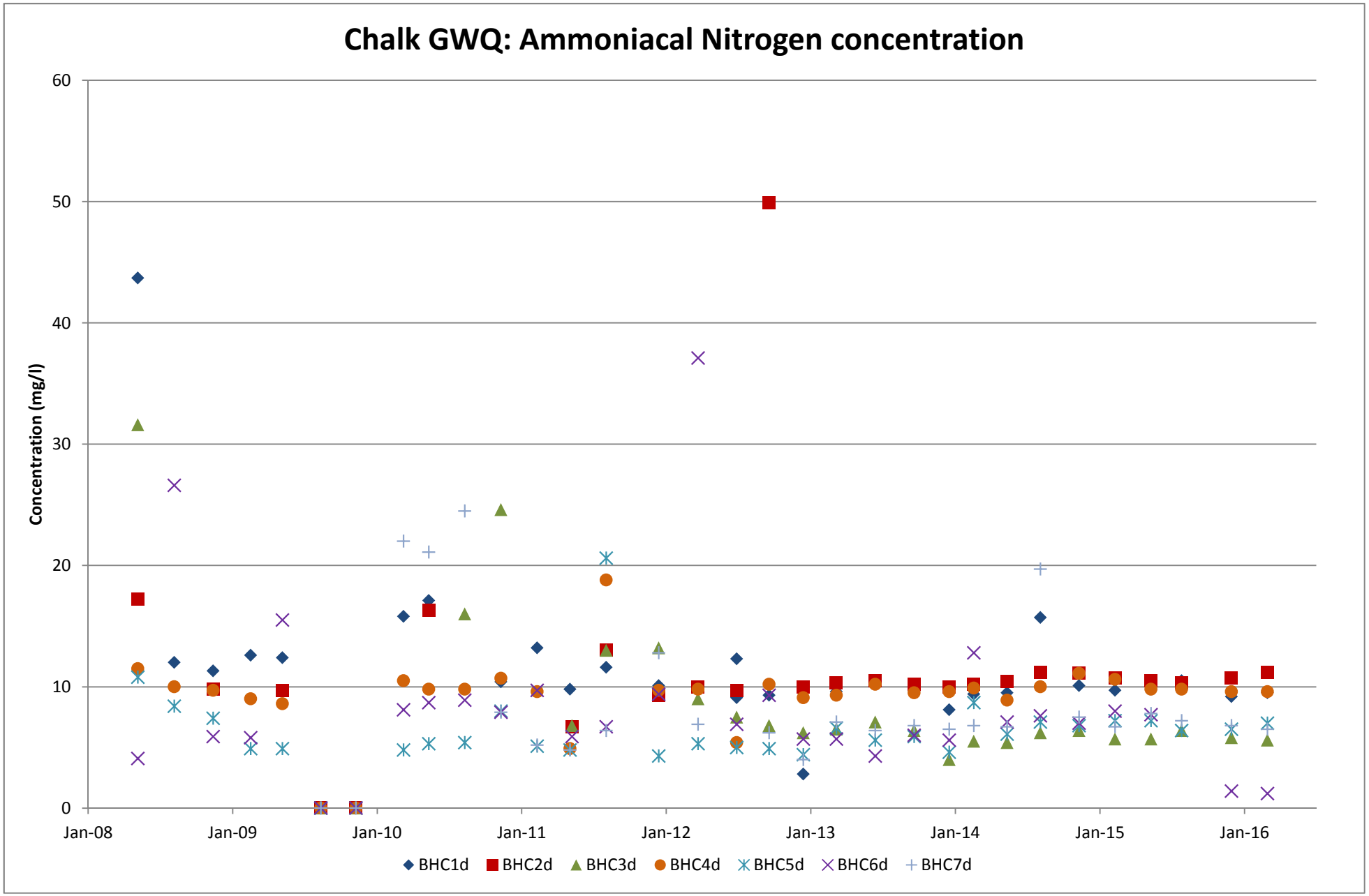

Chalk GWQ: Barium concentration
Concentration (mg/l)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
BHC1d
BHC2d
BHC3d
BHC4d
BHC5d
BHC6d
BHC7d

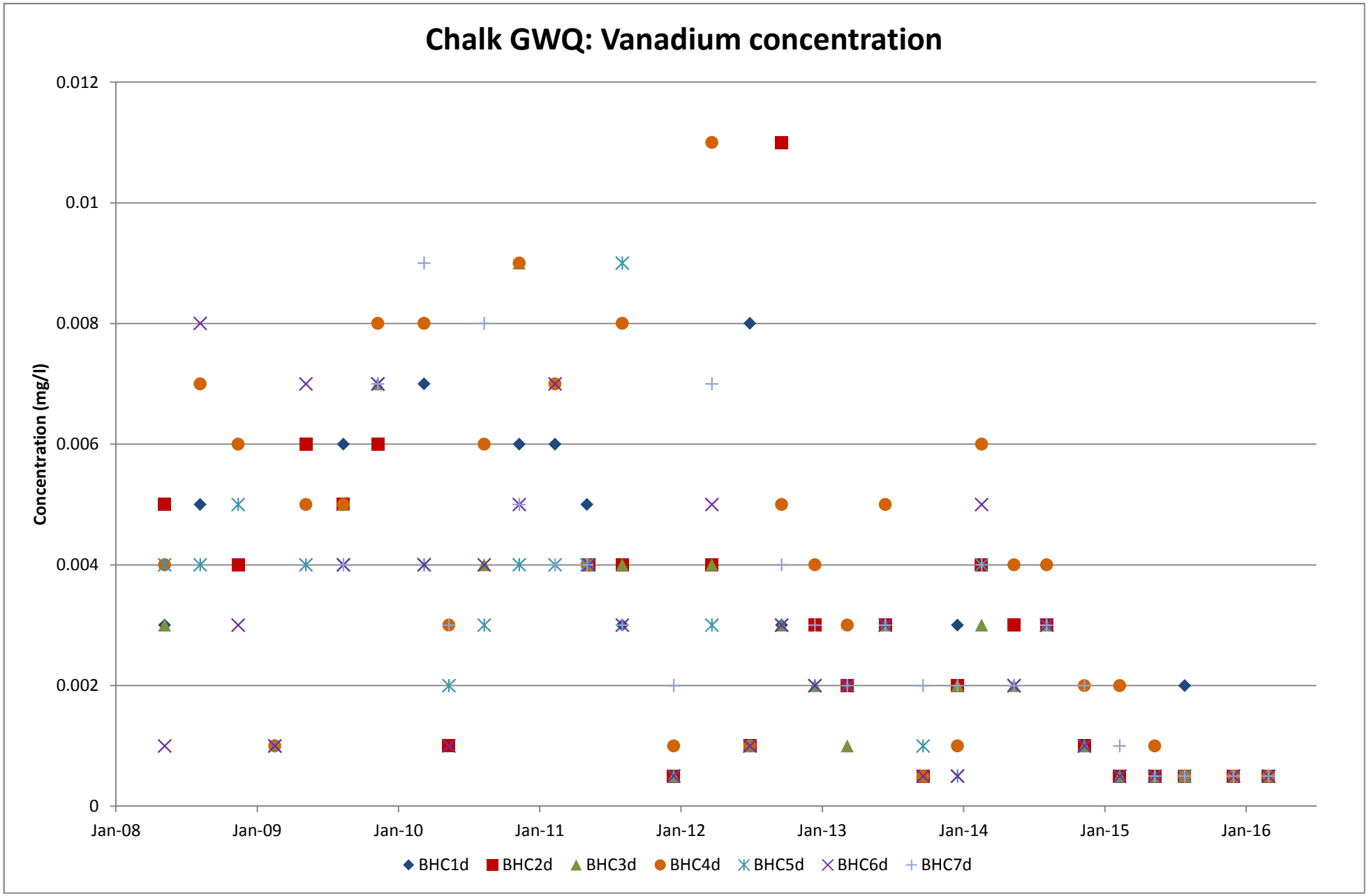

Chalk GWQ: Boron concentration
Concentration (mg/l)
0
1
2
3
4
5
6
7
8
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
BHC1d
BHC2d
BHC3d
BHC4d
BHC5d
BHC6d
BHC7d


Chalk boreholes: Selenium concentration
Concentration (mg/l)
0.06
0.05
0.04
0.03
0.02
0.01
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
BHC1d
BHC2d
BHC3d
BHC4d
BHC5d
BHC6d
BHC7d


Chalk GWQ: Molydenum concentration
Concentration (mg/l)
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
BHC1d
BHC2d
BHC3d
BHC4d
BHC5d
BHC6d
BHC7d


Chalk GWQ: Sulphate concentration
Concentration (mg/l)
800
700
600
500
400
300
200
100
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
BHC1d
BHC2d
BHC3d
BHC4d
BHC5d
BHC6d
BHC7d


Chalk GWQ: Ammoniacal Nitrogen concentration
Concentration (mg/l)
60
50
40
30
20
10
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
BHC1d
BHC2d
BHC3d
BHC4d
BHC5d
BHC6d
BHC7d

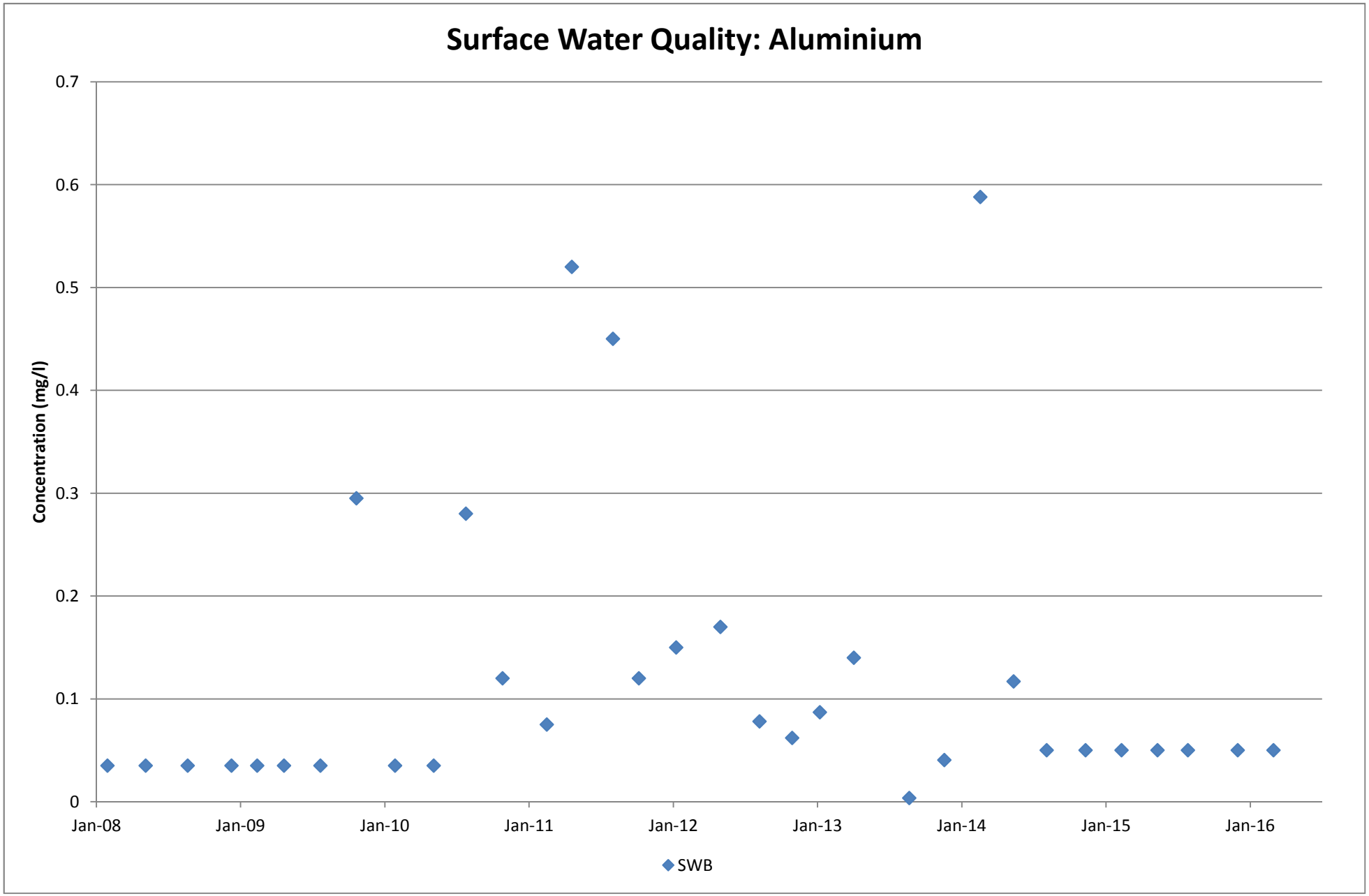

Chalk GWQ: Vanadium concentration
Concentration (mg/l)
0.012
0.01
0.008
0.006
0.004
0.002
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
BHC1d
BHC2d
BHC3d
BHC4d
BHC5d
BHC6d
BHC7d

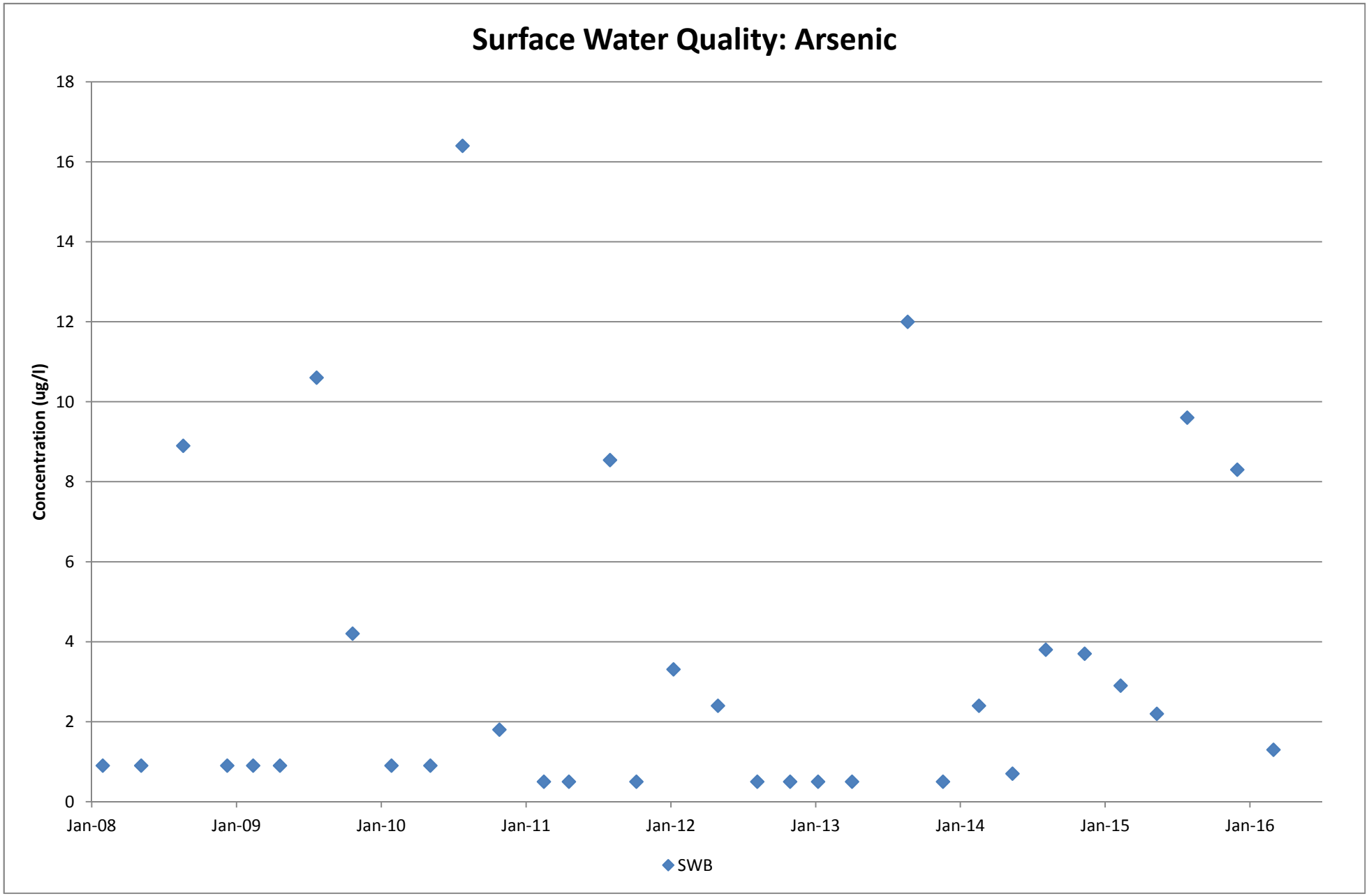
BHID	Analyte:	pH units	Conductivity uS/cm @ 25C	Total Alkalinity as CaCO3	Chloride as Cl w	Fluoride as F	Bromide as Br	Total Sulphate as SO4 (Dissolved) a	Calcium as Ca (Dissolved) a	Magnesium as Mg (Dissolved) a	Barium as Ba (Dissolved) a	Sodium as Na (Dissolved) a	Potassium as K (Dissolved) a
			uS/cm	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
BHC1d	Count	32	32	32	32	32	32	32	32	32	32	32	32
	Min	6.7	4660	417	1200	<0.5	<2.5	4	85	91	0.05	121	42
	Mean	7.2125	9159.0625	899.9375	2734.0625	0.4875	48.6203125	24.90625	174.5625	171.875	0.156875	1513.4375	65.21875
	Max	7.9	27300	5717	9290	5.7	532	53	392	759	1.16	6510	179
BHC2d	Count	27	27	27	27	27	27	27	27	27	27	27	27
	Min	6.7	3230	374	983	<0.5	2.25	<3	<1	<1	<0.01	<1	<1
	Mean	7.28888889	8100.74074	1003.44444	2375.66667	0.32222222	25.9340741	14.3703704	152.574074	147.574074	0.10462963	1284.72963	56.6851852
	Max	7.8	30300	7174	10500	0.6	227	120	257	674	0.36	6740	148
BHC3d	Count	26	26	26	26	26	26	26	26	26	26	26	26
	Min	6.8	3410	212	972	<0.3	<5	<3	103	54	0.05	63.1	25
	Mean	7.28461538	6635	817.115385	1843.15385	0.47692308	20.5138462	22.1730769	173.923077	110.846154	0.12230769	974.35	45.9230769
	Max	7.9	22400	6968	5540	5.4	125	123	239	355	0.37	4120	134
BHC4d	Count	33	33	33	33	33	33	33	33	33	33	33	33
	Min	6.6	4690	91	1500	<0.5	1.84	73	123	68	0.06	158	33
	Mean	7.06969697	10405.7576	882.878788	3004.54545	0.35757576	31.7857576	240.909091	327.818182	218.575758	0.12212121	1523.54545	84.6060606
	Max	7.6	20500	1640	4790	1.6	168	1830	845	413	0.18	2520	211
BHC5d	Count	33	33	33	33	33	33	33	33	33	33	33	33
	Min	6.6	3320	360	924	<0.3	<5	3	124	68	0.06	93	33
	Mean	7.26666667	6756.36364	941.454545	1801.63636	0.38787879	29.7839394	157.181818	198.121212	121.848485	0.10242424	989.484848	55.6666667
	Max	7.9	22200	9580	5040	2.5	419	864	949	492	0.14	2660	172
BHC6d	Count	32	32	32	32	32	32	32	32	32	32	32	32
	Min	6.7	1350	274	239	0.2	<3	<3	<1	<1	<0.01	<1	<1
	Mean	7.321875	5354.6875	678.4375	1399.25	0.7375	21.9171875	25.71875	136.265625	100.484375	0.06734375	746.8125	44.578125
	Max	8.1	22700	2120	7550	7.3	214	189	316	380	0.18	3730	132
BHC7d	Count	26	26	26	26	26	26	26	26	26	26	26	26
	Min	6.8	4300	201	706	<0.5	<3	<3	122	67	0.07	121	32
	Mean	7.31923077	7898.46154	1520.73077	2199.15385	0.34807692	25.6030769	168.538462	165.192308	146.115385	0.09961538	1237.19231	69.7307692
	Max	7.9	15900	15060	4170	0.6	160	631	268	319	0.19	2550	135

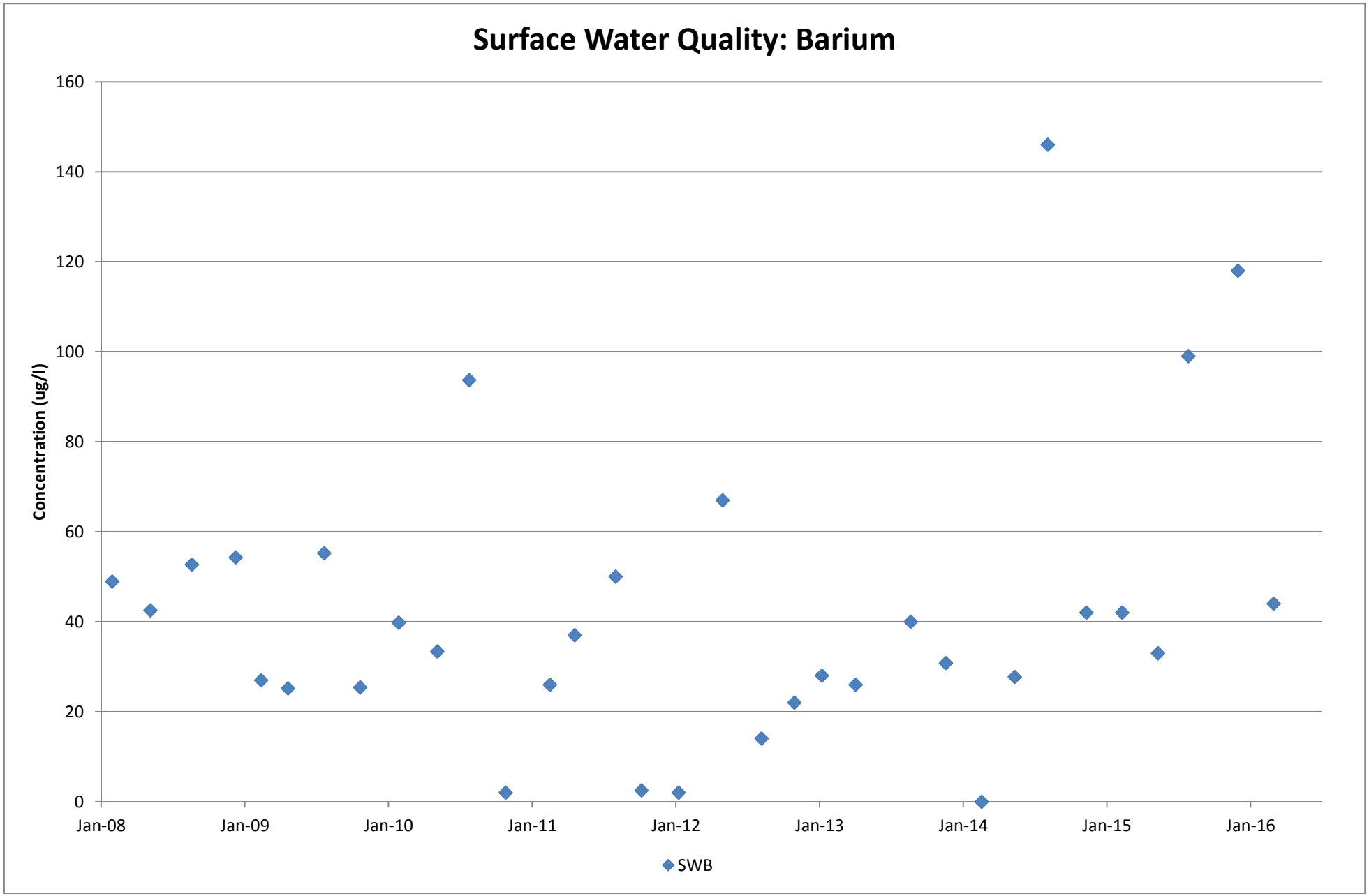
BHID	Analyte:	Nickel as Ni (Dissolved)	Chromium as Cr (Dissolved)	Cadmium as Cd (Dissolved)	Copper as Cu (Dissolved)	Lead as Pb (Dissolved)	Zinc as Zn (Dissolved)	Manganese as Mn (Dissolved)	Iron as Fe (Dissolved) a	Aluminium as Al (Dissolved) a	Arsenic as As (Dissolved)	Boron as B (Dissolved) a	Mercury as Hg (Dissolved)
		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
BHC1d	Count	32	32	32	32	32	32	32	32	32	32	32	32
	Min	<0.001	<0.001	<0.0001	<0.001	<0.001	<0.002	0.077	<0.01	<0.01	<0.001	0.32	<0.0001
	Mean	0.00421875	0.00829688	5.15625E-05	0.00214063	0.00054688	0.003125	0.3153125	2.1765625	0.01796875	0.00728125	0.5525	5.15625E-05
	Max	0.014	0.021	0.0001	0.049	0.002	0.013	1.53	16.8	0.05	0.024	1.66	0.0001
BHC2d	Count	27	27	27	27	27	27	27	27	27	27	27	27
	Min	0.001	<0.001	<0.0001	<0.001	<0.001	<0.002	0.194	<0.01	<0.01	<0.001	0.16	<0.0001
	Mean	0.00614815	0.00809259	6.11111E-05	0.00181481	-	0.00955556	0.4232963	1.61666667	0.01833333	0.00598148	0.57148148	0.00005
	Max	0.018	0.028	0.0003	0.026	<0.001	0.075	1.998	15.3	0.07	0.036	1.76	0
BHC3d	Count	26	26	26	26	26	26	26	26	26	26	26	26
	Min	0.001	<0.001	<0.0001	<0.001	<0.001	<0.002	0.241	<0.01	<0.01	0.001	0.15	<0.0001
	Mean	0.00746154	0.00667308	6.15385E-05	0.00115385	-	0.009	0.55123077	2.05980769	0.02461538	0.00557692	0.41423077	6.15385E-05
	Max	0.016	0.03	0.0003	0.013	<0.001	0.037	2.5	17.4	0.1	0.018	1.29	0.0003
BHC4d	Count	33	33	33	33	33	33	33	33	33	33	33	33
	Min	0.002	<0.001	<0.0001	<0.001	<0.001	<0.002	0.377	<0.01	<0.01	0.002	0.25	<0.0001
	Mean	0.01139394	0.01139394	6.81818E-05	0.00156061	0.00057576	0.01045455	3.27987879	2.83878788	0.02681818	0.00739394	2.86	5.15152E-05
	Max	0.03	0.03	0.0004	0.015	0.003	0.057	12	15.7	1.24	0.017	18.7	0.0001
BHC5d	Count	33	33	33	33	33	33	33	33	33	33	33	33
	Min	<0.001	<0.001	<0.0001	<0.001	<0.001	<0.002	0.309	<0.01	<0.01	<0.001	0.26	<0.0001
	Mean	0.00581818	0.00806061	5.45455E-05	0.00106061	0.0005	0.01130303	1.42093939	1.07030303	0.02	0.00430303	0.97666667	-
	Max	0.047	0.028	0.0002	0.009	0	0.073	19.2	10.7	0.16	0.024	10.2	<0.0001
BHC6d	Count	32	32	32	32	32	32	32	32	32	32	32	32
	Min	0.001	<0.001	<0.0001	<0.001	<0.001	<0.002	0.11	<0.01	<0.01	<0.001	0.12	<0.0001
	Mean	0.0040625	0.00834375	6.25E-05	0.0010625	0.0005	0.02478125	0.6345625	2.12484375	0.01671875	0.00439063	0.44375	-
	Max	0.022	0.026	0.0003	0.011	0	0.497	4.49	15	0.06	0.022	2.18	<0.0001
BHC7d	Count	26	26	26	26	26	26	26	26	26	26	26	26
	Min	0.001	<0.001	<0.0001	<0.001	<0.001	<0.002	0.302	<0.01	<0.01	<0.001	0.25	<0.0001
	Mean	0.01153846	0.00919231	5.19231E-05	0.00103846	0.00055769	0.04934615	0.71619231	1.965	0.01557692	0.00501923	0.58153846	-
	Max	0.055	0.028	0.0001	0.003	0.002	0.774	2.98	19.8	0.08	0.017	1.23	<0.0001

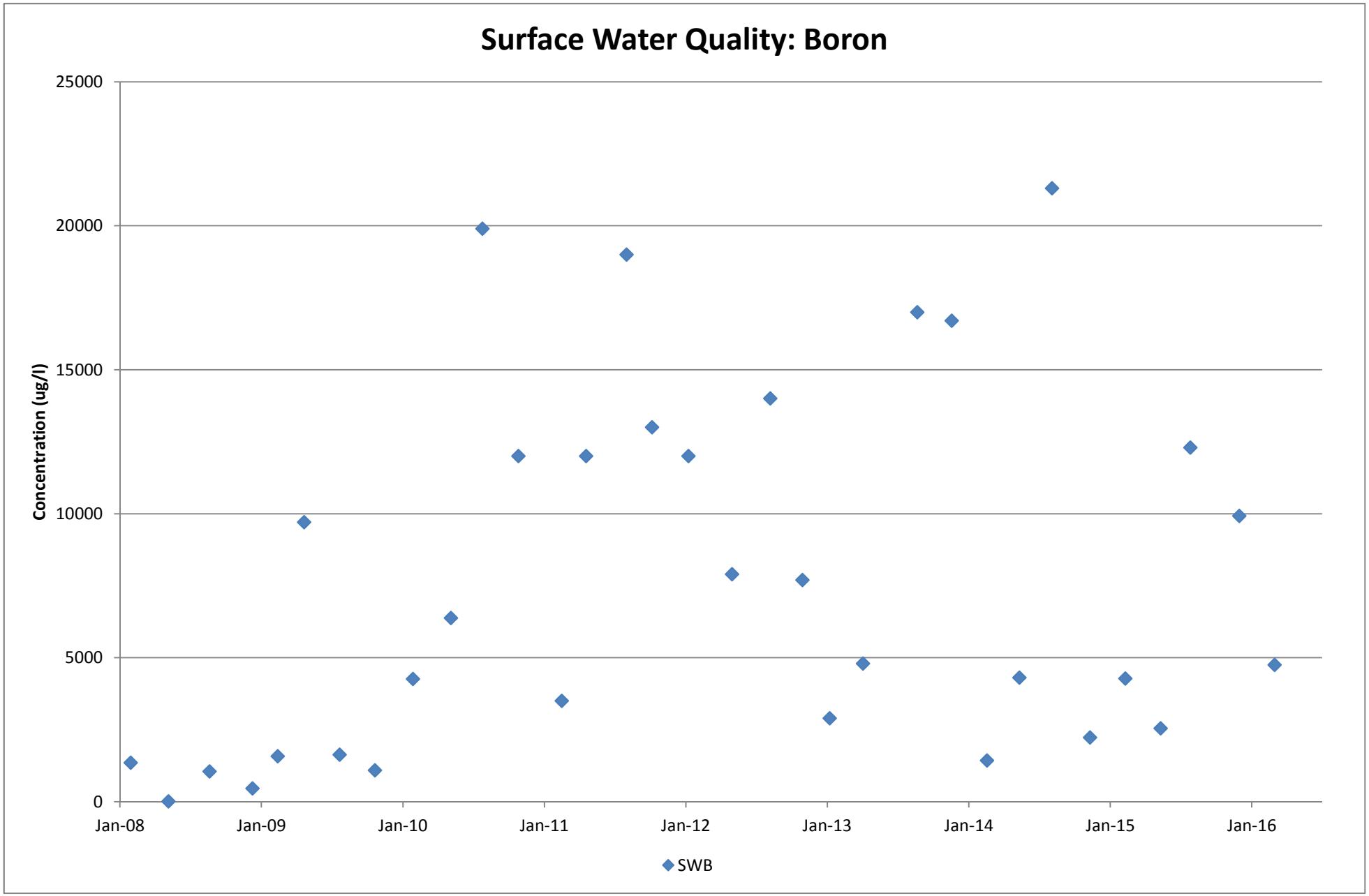
BHID	Analyte:	Selenium as Se (Dissolved)	Vanadium as V (Dissolved)	Molybdenum as Mo (Dissolved)	Cobalt as Co (Dissolved)	Tin as Sn (Dissolved)	Thallium as Tl (Dissolved)	Antimony as Sb (Dissolved)	Ammoniacal Nitrogen as N	Nitrate as N	Chromium VI as Cr	Total Oxidised Nitrogen as N	Phosphate as P
		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
BHC1d	Count	32	32	32	32	31	29	32	30	32	17	32	32
	Min	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	2.8	<0.2	<0.01	<0.2	<0.01
	Mean	0.00871875	0.00317188	0.003875	0.00090625	0.00093548	-	0.00057813	11.7466667	0.375	-	0.4125	0.02984375
	Max	0.035	0.008	0.031	0.002	0.014	<0.001	0.003	43.7	7.2	<0.01	7.2	0.11
BHC2d	Count	27	27	27	27	27	24	27	25	27	17	27	27
	Min	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	6.7	<0.2	<0.01	<0.2	<0.01
	Mean	0.00955556	0.00331481	0.00592593	0.00146296	0.00074074	-	0.00051852	14.136	0.15185185	0.01529412	0.16296296	0.03907407
	Max	0.06	0.014	0.054	0.006	0.007	<0.001	0.001	54.5	0.9	0.11	0.9	0.28
BHC3d	Count	26	26	26	26	26	23	26	24	26	17	26	26
	Min	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	4	<0.2	<0.01	<0.2	<0.01
	Mean	0.00675	0.00294231	0.00592308	0.00246154	0.00063462	-	0.00051923	10.0083333	0.26538462	-	0.32307692	0.03307692
	Max	0.03	0.012	0.103	0.006	0.004	<0.001	0.001	31.6	3.7	<0.01	3.7	0.19
BHC4d	Count	33	33	33	33	33	30	33	31	33	17	33	33
	Min	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	4.9	<0.2	<0.01	<0.2	<0.01
	Mean	0.01209091	0.00415152	0.17133333	0.00428788	0.00060606	-	-	9.96129032	0.18787879	-	0.19090909	0.04742424
	Max	0.05	0.011	2.83	0.015	0.004	<0.001	<0.001	18.8	1.7	<0.01	1.6	0.81
BHC5d	Count	33	33	33	33	33	30	33	31	33	17	33	33
	Min	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	4.3	<0.2	<0.01	<0.2	<0.01
	Mean	0.00801515	0.00295455	0.01219697	0.00236364	0.00054545	-	-	6.77096774	0.17272727	0.01	0.23939394	0.03045455
	Max	0.053	0.01	0.148	0.026	0.002	<0.001	<0.001	20.6	1.3	0.09	1.8	0.37
BHC6d	Count	32	32	32	32	32	29	32	30	32	16	32	32
	Min	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	1.2	<0.2	<0.01	<0.2	<0.01
	Mean	0.00653125	0.00292188	0.00909375	0.00140625	0.00057813	-	0.00051563	9.83666667	0.278125	0.0071875	0.353125	0.0703125
	Max	0.067	0.008	0.183	0.011	0.003	<0.001	0.001	38.5	2.5	0.04	2.5	0.83
BHC7d	Count	26	26	26	26	26	24	26	24	26	16	26	26
	Min	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	4	<0.2	<0.01	<0.2	<0.01
	Mean	0.00834615	0.00330769	0.00267308	0.00290385	-	-	-	9.34583333	0.16153846	0.01625	0.20384615	0.06057692
	Max	0.035	0.009	0.01	0.013	<0.001	<0.001	<0.001	24.5	1.7	0.15	2.2	0.76

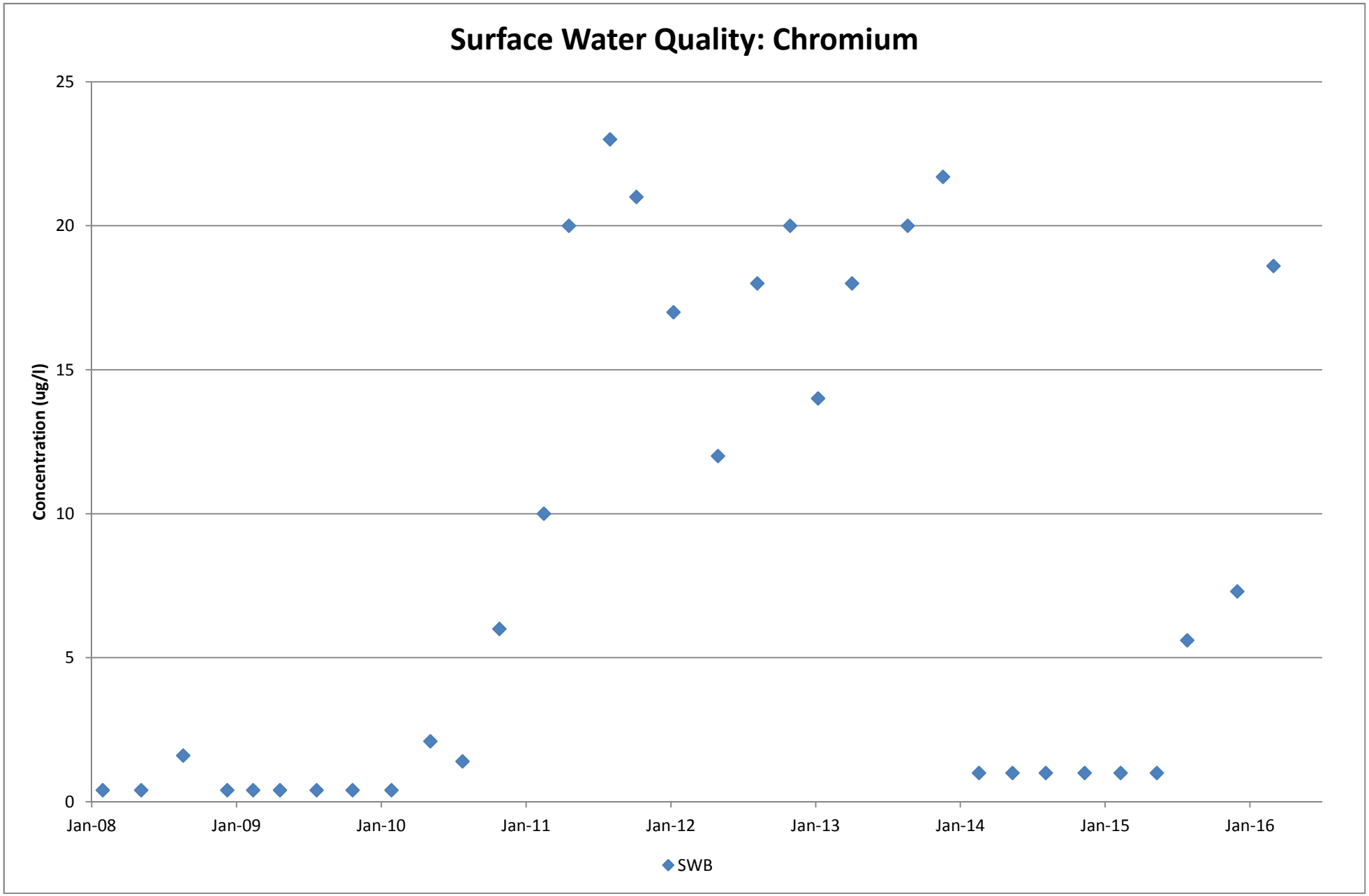
BHID	Analyte:	Total Organic Carbon	Silicon as Si (Dissolved) a	Beryllium as Be (Dissolved) a
		mg/l	mg/l	mg/l
BHC1d	Count	32	31	31
	Min	2.8	6.7	<0.01
	Mean	6.375	8.79354839	0.005
	Max	33	10.4	0
BHC2d	Count	27	27	27
	Min	2.7	4.9	<0.01
	Mean	6.86666667	9.89259259	0.005
	Max	32	25	<0.01
BHC3d	Count	26	26	26
	Min	1.5	4.8	<0.01
	Mean	5.41923077	9.77307692	0.005
	Max	26	18	<0.01
BHC4d	Count	33	33	33
	Min	2.5	5.6	<0.01
	Mean	8.75757576	9.31515152	0.005
	Max	27	13.1	0
BHC5d	Count	33	33	33
	Min	1.8	5.4	<0.01
	Mean	5.30606061	7.33030303	0.005
	Max	26	14.4	0
BHC6d	Count	32	32	32
	Min	1.6	2.7	<0.01
	Mean	7.553125	6.909375	0.005
	Max	28	14.9	0
BHC7d	Count	26	26	26
	Min	2.8	5.5	<0.01
	Mean	5.74615385	8.78076923	0.005
	Max	17	21.2	0

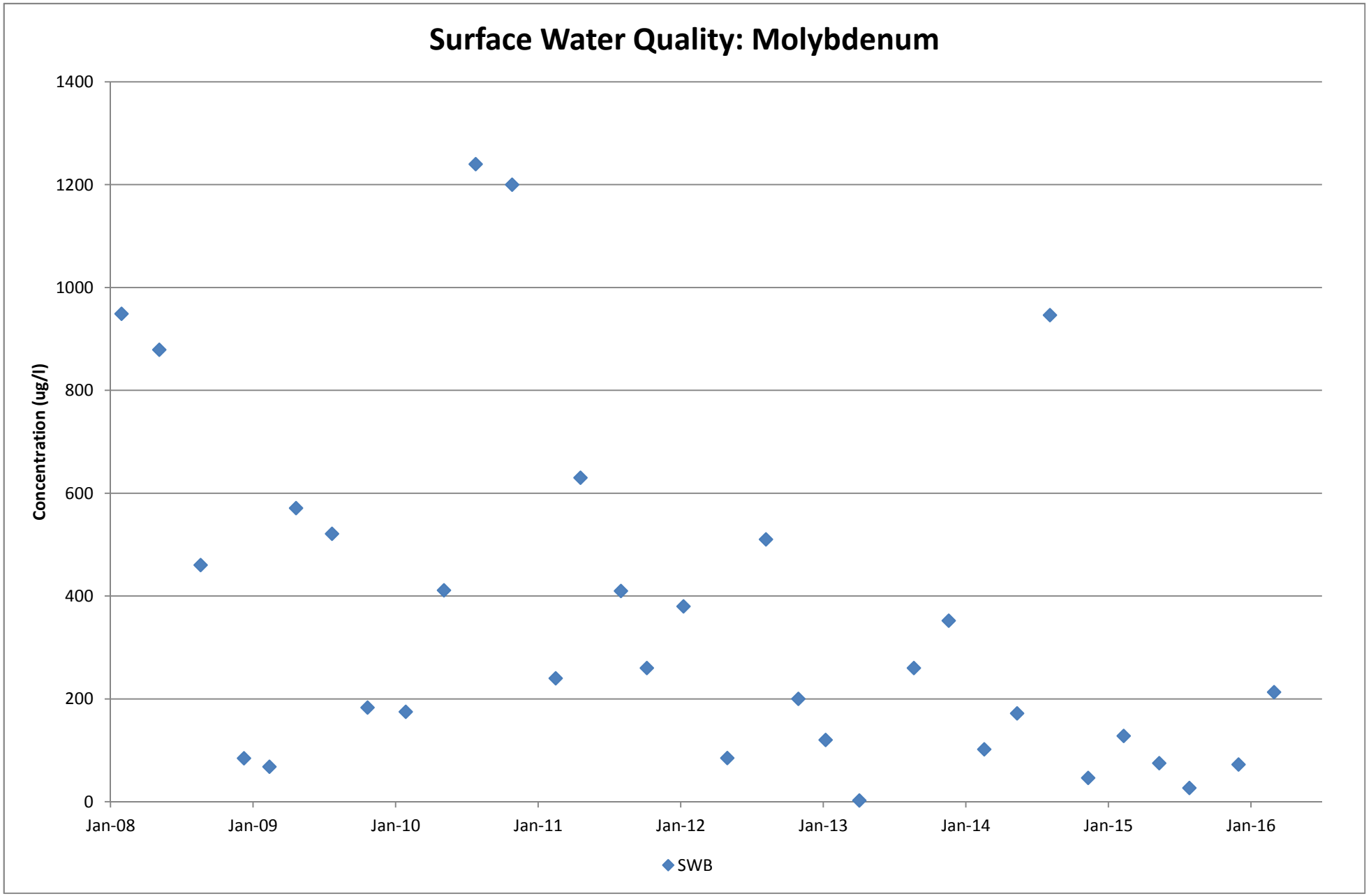

Surface Water Quality: Aluminium
Concentration (mg/l)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
SWB

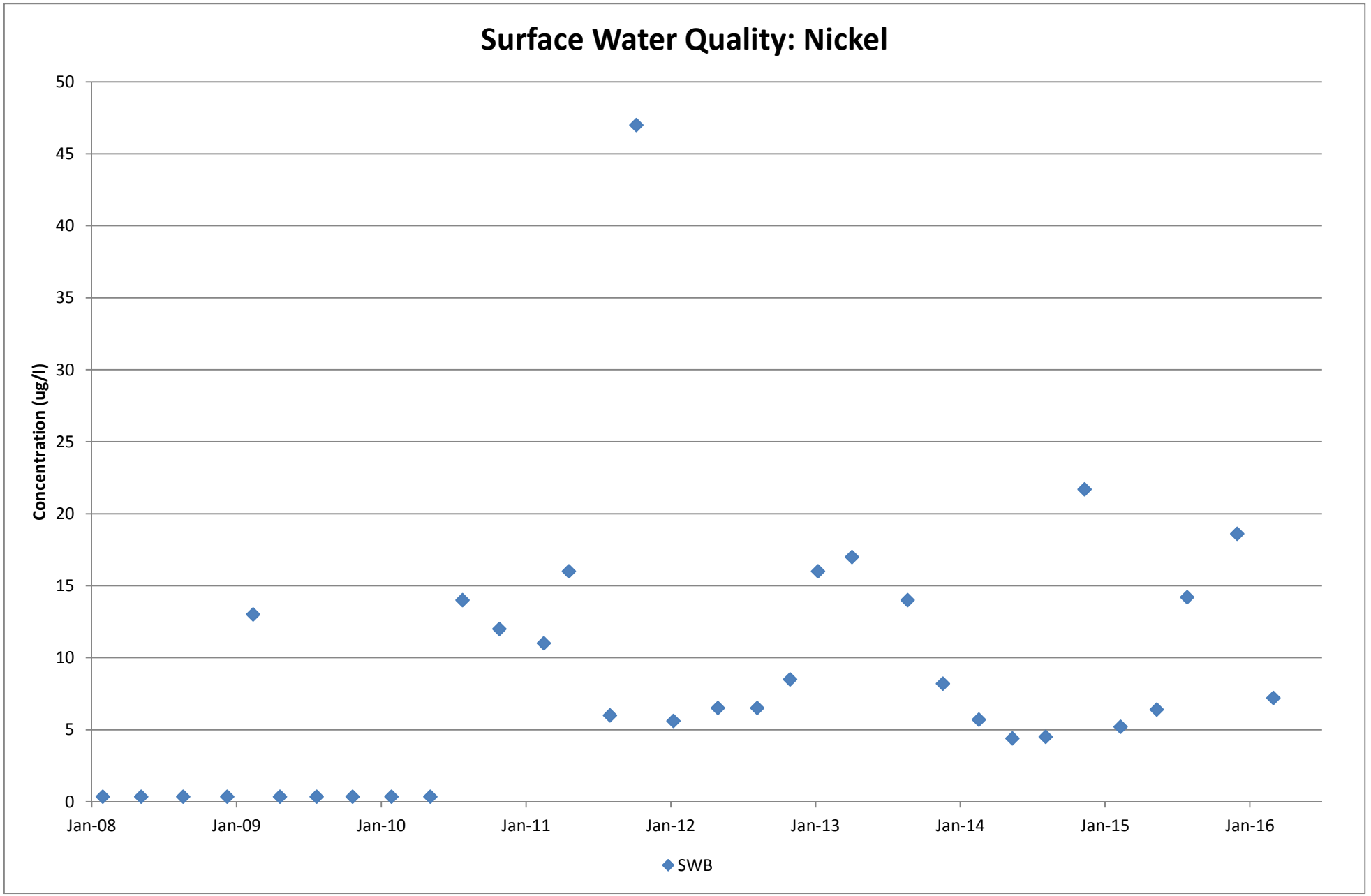

Surface Water Quality: Arsenic
Concentration (ug/l)
18
16
14
12
10
8
6
4
2
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
SWB

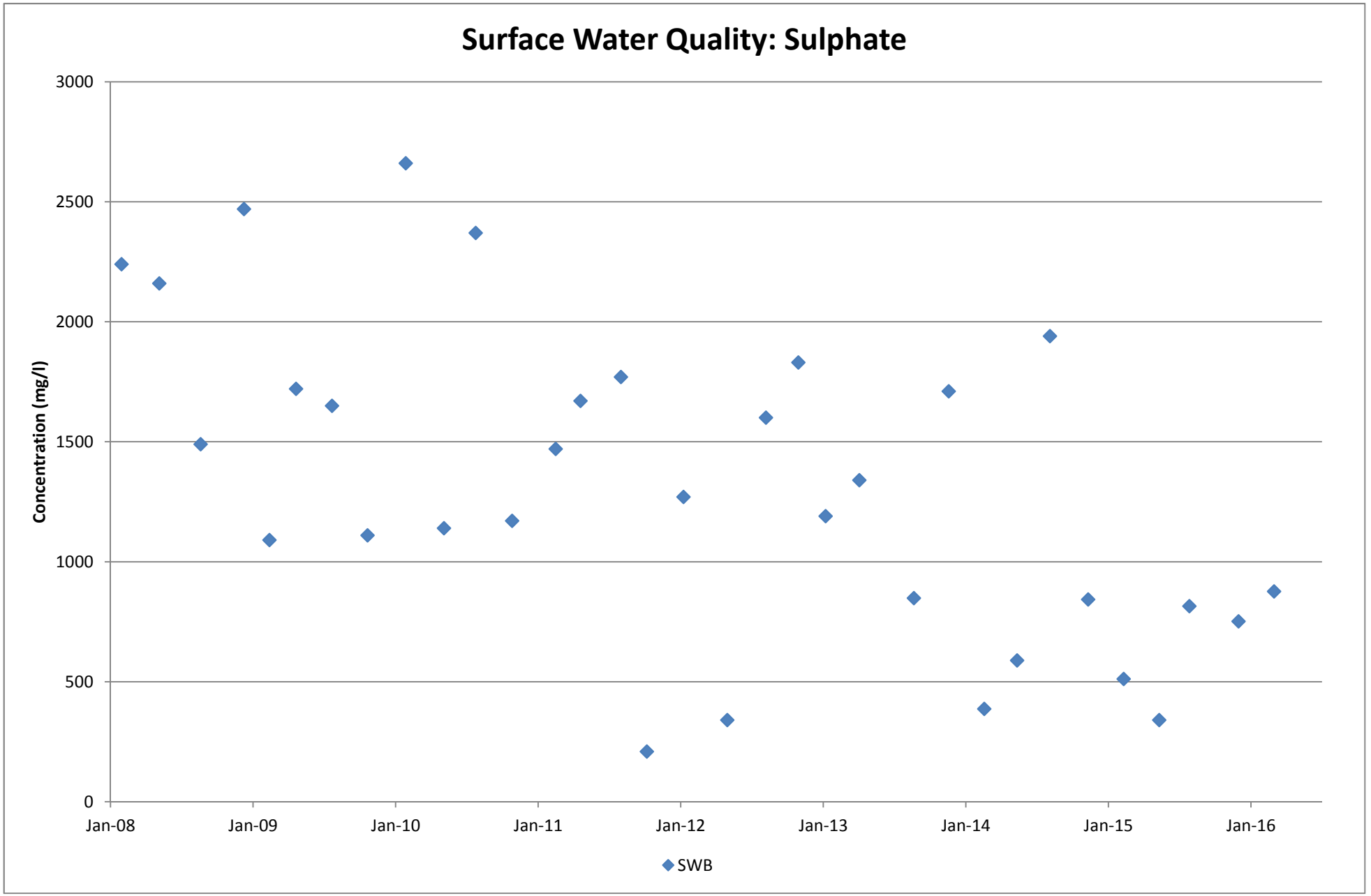

Surface Water Quality: Barium
Concentration (ug/l)
160
140
120
100
80
60
40
20
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
SWB


Surface Water Quality: Boron
Concentration (ug/l)
25000
20000
15000
10000
5000
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
SWB


Surface Water Quality: Chromium
Concentration (ug/l)
25
20
15
10
5
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
SWB


Surface Water Quality: Molybdenum
Concentration (ug/l)
1400
1200
1000
800
600
400
200
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
SWB


Surface Water Quality: Nickel
Concentration (ug/l)
50
45
40
35
30
25
20
15
10
5
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
SWB


Surface Water Quality: Sulphate
Concentration (mg/l)
3000
2500
2000
1500
1000
500
0
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
SWB

Appendix E - 2019 Soil conditioning agent and grease – Spoil deposition risk assessment

SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group

Tideway Central

Soil Conditioning Agent and Grease - Spoil Deposition Risk Assessment

Ferrovial Agroman Laing O'Rourke

March 2019

Notice

This document and its contents have been prepared and are intended solely as information for Ferrovial Agroman Laing O'Rourke and use in relation to controlled waters risk assessment of soil conditioning agents and greases within excavated material from Tideway Central.

Atkins Limited assumes no responsibility to any third party in respect of or arising out of or in connection with this document and/or its contents.

This document has 237 pages including the cover, not including appendices.

Document history

Revision	Purpose	Originated	Checked	Reviewed	Authorised	Date
Rev 1.0	Draft Submission	KF/AC	HDM	JE	JS	April 2018
Rev 2.0	Draft Submission	KF	KB/JR	JE	JS	September 2018
Rev 3.0	Final	KF	KB	MG	JE	November 2018
Rev 4.0	Update	KB	DC	DC	JE	March 2019

Client signoff

Client	Ferrovial Agroman Laing O'Rourke
Project	Tideway Central
Job number	5152111
Client signature / date	

Contents

Appendix C. Rainham Landfill Data

Tables

Figures

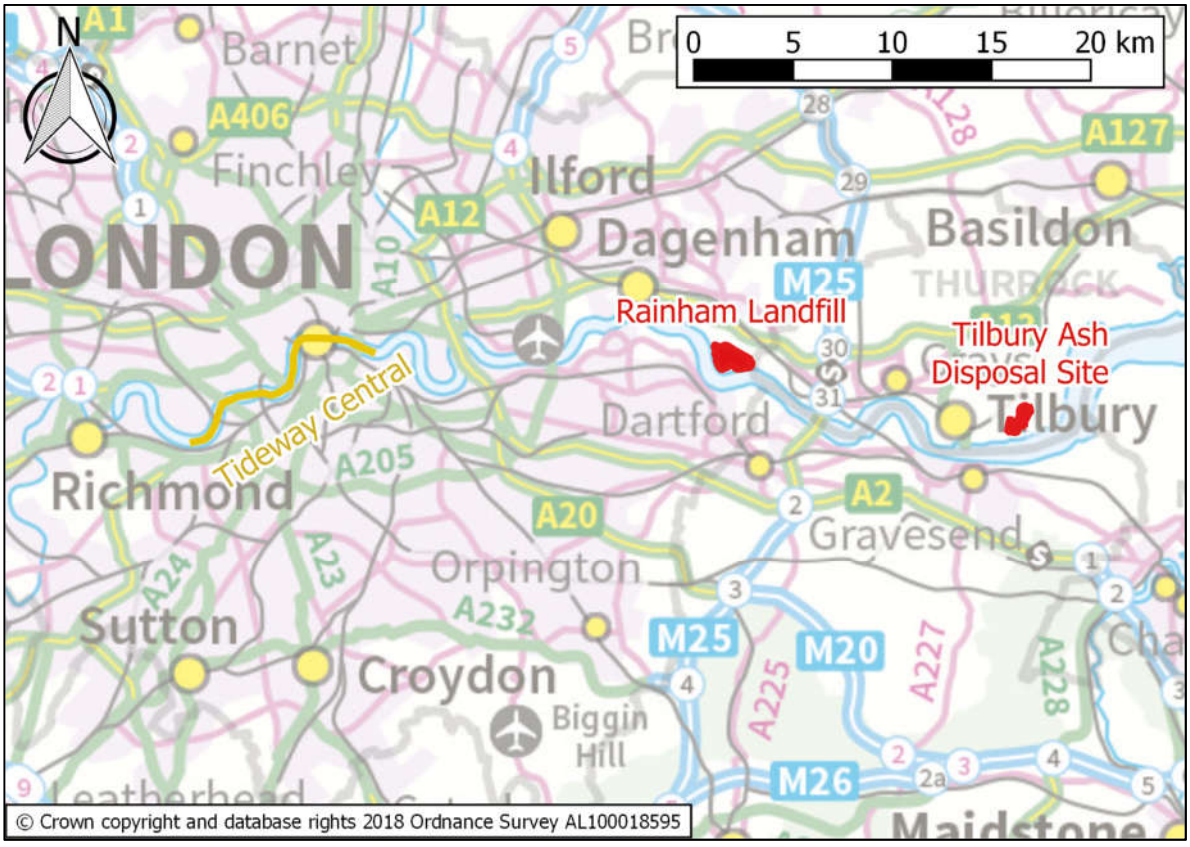
1. Introduction

1.1. Background

Ferrovial Agroman Laing O'Rourke (FLO) are constructing the central section of the Tideway Tunnel (Tideway Central). Tideway Central is a 12.7 km long tunnel, with an excavated diameter of approximately 8.8 m, to be constructed using a tunnel boring machine (TBM). Two facilities are being considered for deposition of material arisings (Tideway Spoil) from the tunnelling, a site operated by Ingrebourne Valley Limited (herein referred to as 'Tilbury Ash Disposal Site'), and Rainham Landfill, operated by Veolia. The Tilbury Ash Disposal Site is an inert waste landfill facility located on the north bank of the River Thames, approximately 2.5 km east of Tilbury. Rainham Landfill is an inert and non-hazardous waste landfill facility 1.5 km south of Rainham. Landfill locations are shown in Figure 1-1.

The bulk of excavated material will comprise London Clay Formation, Lambeth Group, Thanet Formation or White Chalk Subgroup. In addition, soil conditioning agents and greases (for bearing lubrication) are used by the TBM as part of the tunnelling process and will therefore constitute a minor component of the excavated material.

Figure 1-1 - Location of waste facilities and Tideway Central



1.2. Scope

The scope of this assessment is to evaluate potential risk to controlled waters from soil conditioning agents or greases (herein jointly referred to as 'products'), associated with excavated material (designated as a solid as per the Landfill Directive 1999/31/EC 1999) from Tideway Central. Specifically, this report considers three depositional scenarios at two potential waste facilities (Tilbury Ash Disposal Site and Rainham Landfill). Two depositional scenarios have been considered for Rainham Landfill, depending on whether waste is deposited in a lined cell or not. A single depositional scenario has been considered for Tilbury Ash Disposal Site as all waste will be placed in an unlined cell and capped once placement is complete.

A conceptual site model (CSM) is developed for each depositional scenario, in Section 2. This is followed by a review of available ecotoxicology data and anticipated concentrations of products in the excavated

material, in Section 3 Where a potential pollutant linkage is identified, the risk has been quantitatively assessed in Section 4.

Products from five manufacturers (BASF, Mapei, TNL18, Condat and Imerys) are being considered for use by FLO and these are summarised in Table 1-1**Error! Reference source not found.** below.

Table 1-1 - Assessed Products

Manufacturer	Product Name
Soil Conditioning Agents	
BASF	MasterRoc SLF 41 MasterRoc SLP 1 MasterRoc ACP 143
Mapei	Polyfoamer FP Mapedrill M1 Mapedisp FLS Polyfoamer FLS Eco 100 Plus
TNL18	Actisoyl 100 Actisoyl CC
Condat	CLB F5/M TFA34 CLB F5/AC TFA 7
Imerys	Talc Slurry
Greases	
Condat	HBW EP2

1.3. Limitations

The findings of this risk assessment are subject to the following limitations:

- This assessment has been undertaken for site specific conditions at the Tilbury Ash Disposal Site and Rainham Landfill, consideration of potential risks posed at any other site is outside the scope of this report.
- This assessment is specific to the products specified in Table 1-1 and does not constitute formal waste classification for the excavated material.
- Product model parameters have been derived from third party documentation including, materials safety data sheets (MSDS), confidential reports, environmental risk assessments and European Chemicals Agency (ECHA) profiles; Atkins has assumed that third party data provided are correct.
- Only risks to controlled waters have been considered in this report; risks to human health or occupational health are outside the scope of this assessment.

Atkins has received confidential third-party data relating to products and signed non-disclosure agreements to protect manufacturers' intellectual property in relation to these data. Therefore, names and some parameters of the active ingredients have not been presented.

Decisions on which products should be used in the construction of Tideway Central tunnel are the result of additional considerations which are outside the scope of this report. Inclusion of any products or manufacturers in this report does not constitute endorsement by Atkins or FLO.

2. Depositional site settings

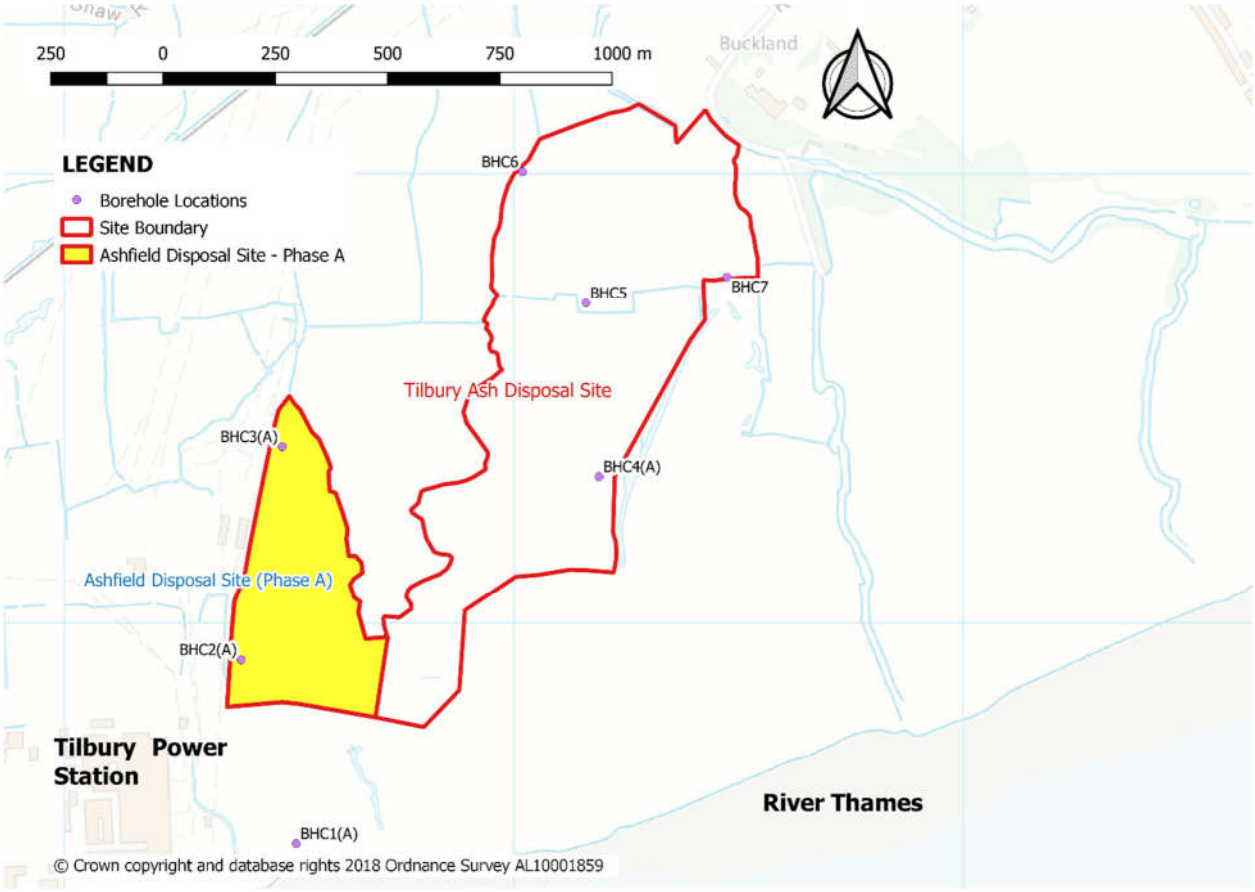
2.1. Tilbury Ash Disposal Site

2.1.1. Site location

The Tilbury Ash Disposal Site waste facility comprises 65.3 hectares, located approximately 2.5 km east of Tilbury on the north bank of the River Thames estuary in south-east England. Figure 2-1 shows the site layout and position relative to Tilbury and the River Thames.

Tilbury power station borders the site to the west and historical landfill activities at the site include the deposition of pulverised fuel ash (PFA). Deposits of PFA are currently being excavated from the site for re-use off site; this is expected to be completed prior to the deposition of Tideway Spoil at the site. As per the Environment Agency's requests, the area will be flattened and approximately 300 mm of PFA will remain over the site. Operational landfills are located to the south and west of the site, while fields to the north are used as agricultural land.

Figure 2-1 - Tilbury Ash Disposal Site including Phase A layout and ground investigation locations



Geology

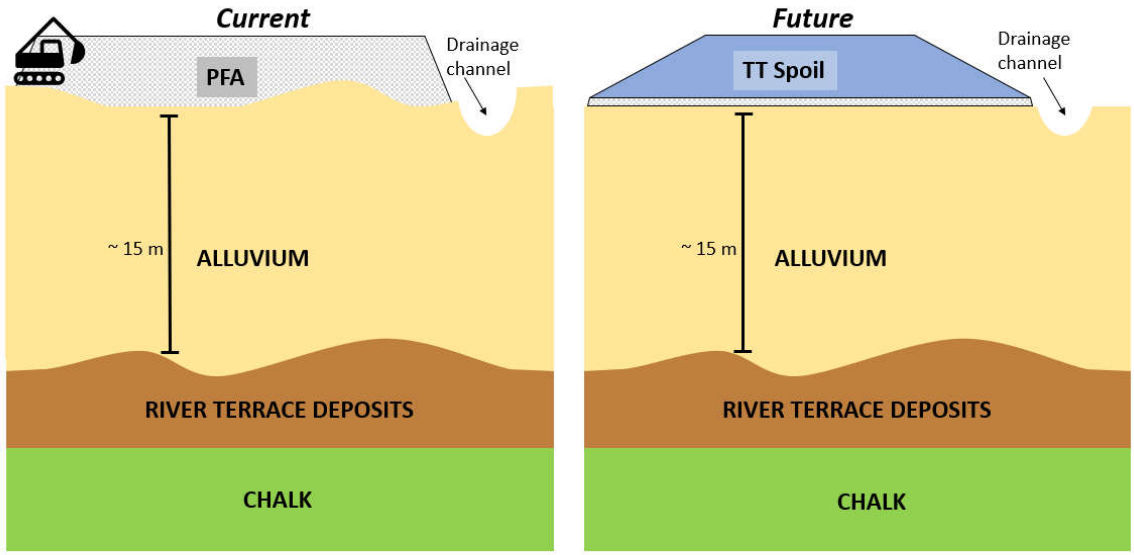
Borehole logs from a 2006 ground investigation at the site (supplied by Ingrebourne Valley Limited and from BGS borehole logs (2018)) identified a PFA layer (3.4 m to 5.4 m thick) above a thick layer (up to 17.8 m thick) of Alluvium and a variable thickness (1.5 m to 7.5 m) of River Terrace Deposits. The PFA was of a silt to sand particle size, while the Alluvium was described as clay with a peat component. Table 2-1 provides a summary of the geology encountered on site, including the base of each unit in metres above Ordnance Datum (m AOD). The distribution and depths of the ten borehole logs reviewed provide a suitable characterisation of natural geology under the site.

Table 2-1 - Tilbury Ash Disposal Site: summary of geology encountered

Unit	Base of Unit (m AOD)	Thickness (m)	Description
Made Ground: General	4.2 to 7.5	0.3 to 0.8	Sandy gravelly CLAY (variable), with anthropogenic material including: brick, concrete, metal, glass and plastic.
Made Ground: Pulverised Fuel Ash	-1.1 to 3.9	3.4 to 5.4	Black silty SAND, comprising fine to medium ash (PFA).
Alluvium	-16.6 to -9.5	11.7 to 17.8	CLAY with layers of PEAT.
River Terrace Deposits	-19.5 to -17.0	1.5 to 7.5	SAND and GRAVEL.
White Chalk Subgroup	Not proven (>23.7)	Not proven	Weak, low-density CHALK

As previously stated, the majority of the PFA layer is being excavated and sold for re-use off site. Following excavation the area will be flattened and approximately 300 mm of PFA will remain over the Alluvium (shown in Figure 2-2).

Figure 2-2 - Schematic geological cross section at Tilbury Ash Disposal Site



(Not to scale and vertical exaggeration)

2.1.2. Hydrogeology

The Environment Agency (2017) designate the geology encountered on site as follows:

- Alluvium — Secondary Undifferentiated Aquifer;
- River Terrace Deposits — Secondary A Aquifer; and
- White Chalk Subgroup — Principal Aquifer.

According to the Environment Agency, a Secondary Undifferentiated Aquifer is where "the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type". Based on the findings of on-site intrusive investigation and BGS borehole logs (2018), the Alluvium locally is predominantly a clay/peat lithology. Atkins therefore considers the Alluvium underlying the site to be unproductive strata (formerly 'non-aquifer').

In addition, on penetrating the base of the Alluvium during the 2006 ground investigation at the Tilbury Ash Disposal Site, a water strike in the River Terrace Deposits underlying the Alluvium rose from -1.7 m AOD to 14.2 m AOD. This suggests the Alluvium is acting as a confining layer for groundwater in the underlying River Terrace Deposits; further evidence that the Alluvium on site is of sufficient thickness and low permeability to restrict vertical water movement.

2.1.3. Hydrology

The tidal River Thames is located approximately 300 m to the south of the Tilbury Ash Disposal Site. The tidal range of the River Thames at the Tilbury area is typically between 0 m AOD and 7 m AOD (UK Hydrographic Office, 2018).

The Tilbury Ash Disposal Site itself is located between West Tilbury Marshes and East Tilbury Marshes. A network of drainage channels is present on site and across the marshes, generally running north to south, towards the River Thames. While a detailed evaluation of surface water flow within the Tilbury Ash Disposal Site is not available, surface water within the site drains to a system of drains and interceptors before eventually discharging to the River Thames.

2.1.4. Conceptual site model

Tideway Spoil is planned to be deposited over a thin layer (~300 mm) of PFA within the Tilbury Ash Disposal Site, it is Atkins understanding that the Tideway Spoil will be placed such that the slope down to the drainage channel is at approximately 30°. Tideway Spoil will be capped with a minimum of 1 m low permeable clay cap and 2 m restoration soils on closure of the site.

The large thickness of low permeability Alluvium below the current PFA base (>15 m) will limit the vertical groundwater migration pathway for leachate in the Tideway Spoil to the River Terrace Deposits (Secondary A Aquifer) and White Chalk Subgroup (Principal Aquifer) at depth.

Based on the proposed site characterisation, there is considered to be two plausible potential pathways in which products/components could potentially reach the River Thames, these are presented below:

- AF1 - Soil erosion and/or flooding of the spoil material into surface water bodies (drainage channels and subsequently the River Thames) prior to capping of the spoil; and
- AF2 - Leaching of contaminants from spoil prior to capping of the spoil, vertical migration through the unsaturated zone and subsequent lateral migration in the saturated zone (PFA) into surface water bodies (drainage channels and subsequently the River Thames).

Surface discharges are expected to be managed under the 'release to environment' section of the waste facilities environmental permit and therefore the pathway in which ecotoxic components reach the surface discharges via soil erosion of spoil and discharge directly to controlled waters has not been assessed further. Therefore, for the purposes of this assessment one depositional scenario (AF1) has been considered for the Tilbury Ash Disposal Site waste facility.

2.2. Rainham Landfill

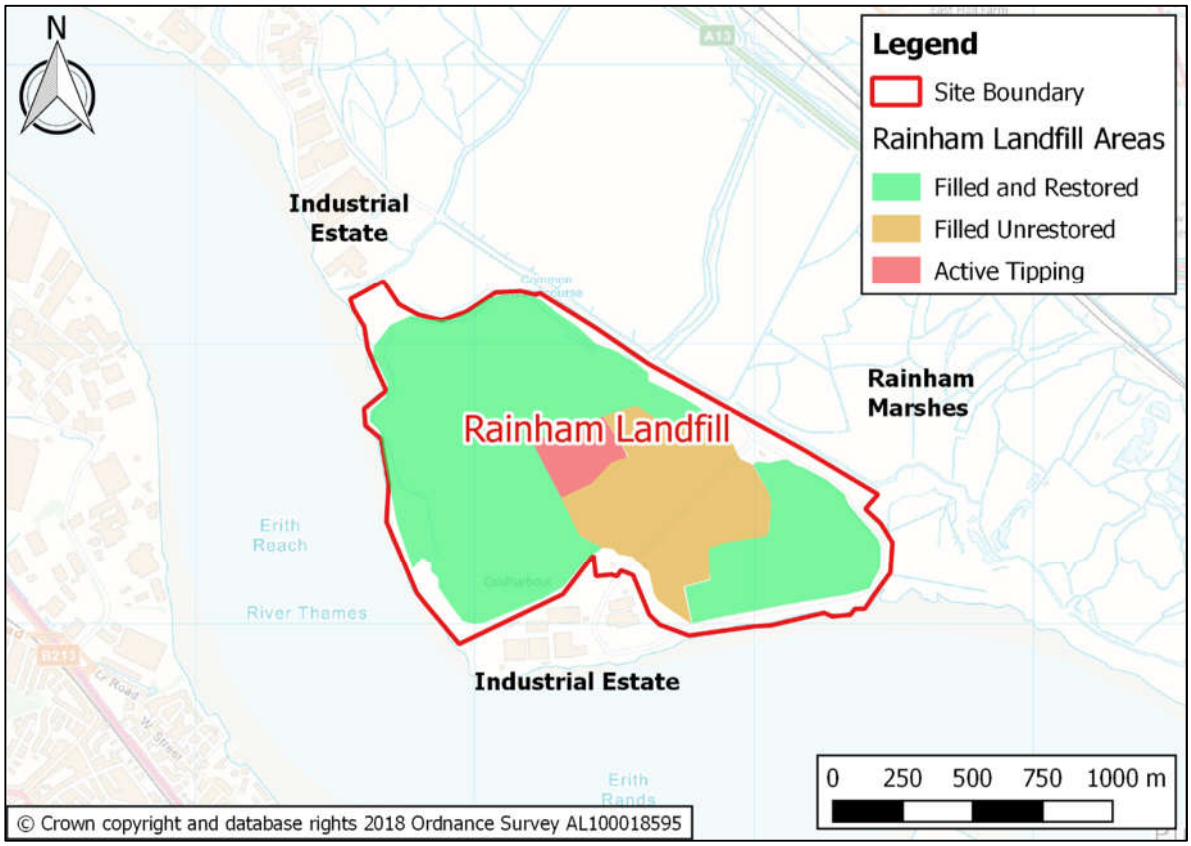
2.2.1. Site location

Rainham Landfill (the 'site') covers an area of 177 hectares and is located approximately 2 km south of the town of Rainham and on the northern bank of the River Thames. It can accept up to 1.5 million tonnes of waste per annum. Veolia has indicated that Rainham Landfill contains the following areas:

- Areas of filled landfill that have been restored and landscaped (green in Figure 2-3);
- Areas that have been filled and are awaiting restoration and landscaping (orange in Figure 2-3); and
- Unfilled areas where tipping is actively taking place (red in Figure 2-3).

Rainham Marshes Nature Reserve (forming part of a site of special scientific interest (SSSI)) is located to the north and north-east of the site. Industrial parks are located to the south and north-west of the site. The River Thames is located to the west and south of the site.

Figure 2-3 - Rainham Landfill site layout and areas



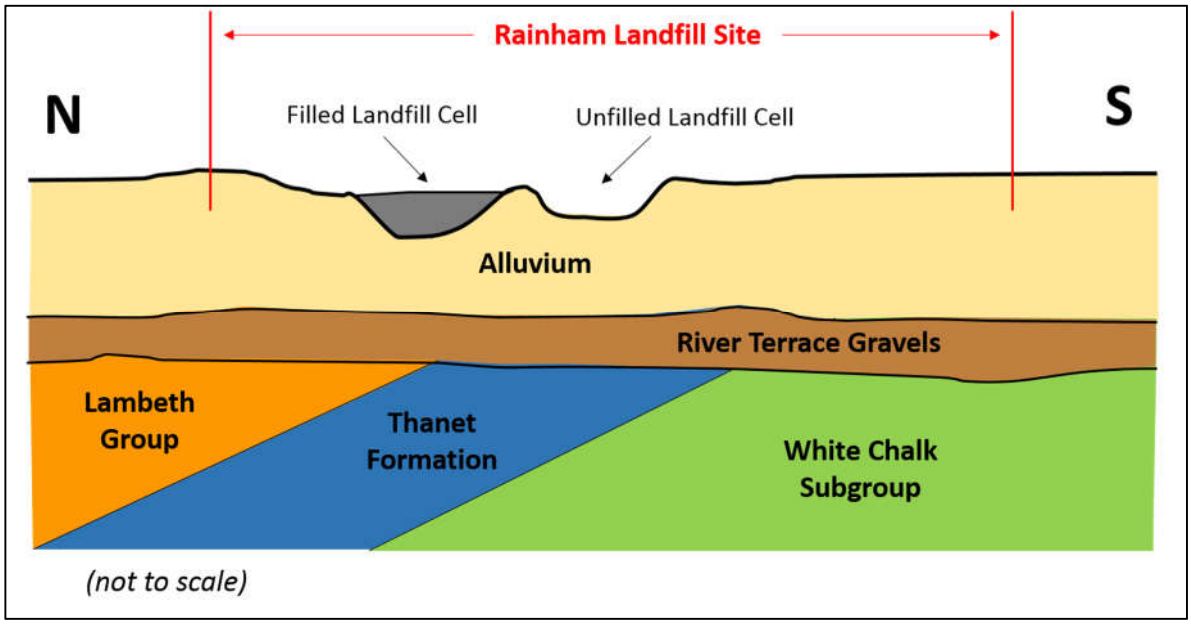
2.2.2. Geology

Published geology indicates the site is underlain by superficial deposits of Alluvium (BGS, 2018) and River Terrace Deposits. The bedrock dips to the north and the superficial deposits are underlain by White Chalk Subgroup in the south, Thanet Formation in the centre and the Lambeth Group in the north of the site (Figure 2-4). The Thickness of Lambeth Group, Thanet Formation and White Chalk Subgroup vary across the site.

British Geological Survey (BGS) borehole logs (BGS, 2018) and the Rainham Hydrogeological Risk Assessment (Golder Associates, 2015) indicate the base of the Alluvium (silty clay with high peat content) is approximately 15 metres below ground level (m bgl). The River Terrace Deposits comprise gravels and coarse sand and are approximately 5 m thick.

Rainham Landfill contains several filled landfill cells, some containing up to 10 m of landfill material (including domestic waste and ash).

Figure 2-4 - Schematic geological cross section at Rainham Landfill



2.2.3. Hydrogeology

The Environment Agency (2017) designate the geology encountered on site as follows:

- Alluvium — Secondary Undifferentiated Aquifer;
- River Terrace Deposits — Secondary A Aquifer;
- Lambeth Group — Secondary A Aquifer;
- Thanet Sands — Secondary A Aquifer; and
- White Chalk Subgroup — Principal Aquifer.

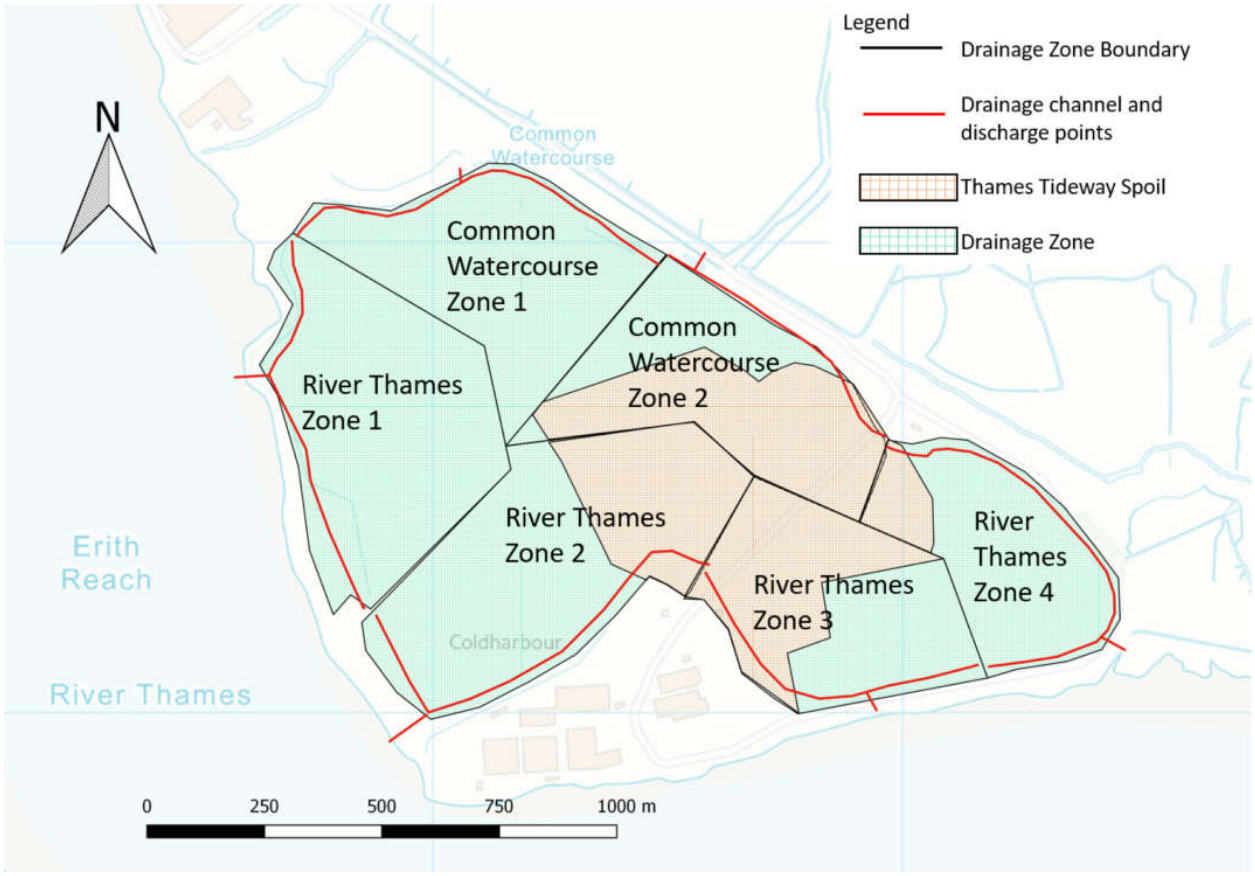
Based on the findings of BGS borehole logs (2018), the Alluvium locally is similar to that at the Tilbury Ash Disposal Site, predominantly a clay/peat lithology. Atkins therefore considers the Alluvium underlying the site to be unproductive strata (formerly 'non-aquifer').

2.2.4. Hydrology

The tidal River Thames forms the southern boundary of the site, with the tidal range of the River Thames being similar to that at the Tilbury Ash Disposal Site, typically between 0 m AOD and 7 m AOD (UK Hydrographic Office, 2018). A smaller tributary to the River Thames, the Common Watercourse, runs parallel to the northern boundary of the site. The site is located south-west of Rainham Marshes Nature Reserve.

A series of six drainage zones drain into six channels located around the circumference of the site, as shown in Figure 2-5. Two of the drainage zones discharge to the Common Watercourse, which itself discharges into the River Thames, and four drainage zones discharge to the River Thames directly. Tideway Spoil will be deposited within four of the six drainage zones these are identified in Figure 2-5 below, the proposed area spans the water divide and therefore discharge to both the River Thames and Common Watercourse is possible.

Figure 2-5 - Rainham Landfill drainage plan



2.2.5. Conceptual site model

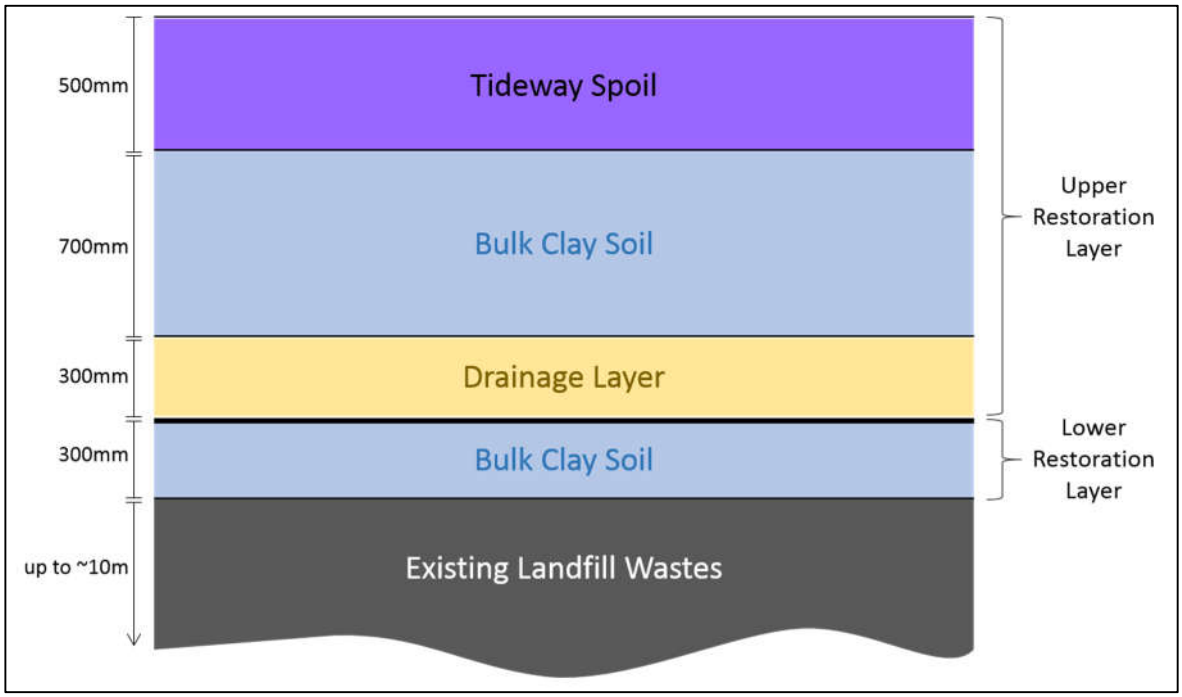
Two depositional scenarios have been considered for the Rainham Landfill waste facility:

- RL1 considering the spoil is deposited above the drainage layer of a filled landfill cell, where it will form the upper 500 mm of the capping; and
- RL2 considering the spoil is deposited in a clay-lined landfill cell.

2.2.5.1. RL1 – Deposition on top of a filled landfill cell

Under this depositional scenario, Tideway Spoil will be placed in the upper restoration layer, on top of filled cells at Rainham Landfill (orange in Figure 2-5). The soil restoration profile is shown schematically in Figure 2-6, comprising a 300 mm lower restoration layer and a 1500 mm upper restoration layer. The base of the upper restoration layer includes 300 mm of high-permeability material, which acts as a drainage layer. Due to the geotechnical properties of the Tideway Spoil, it is likely to only be used in the top 500 mm of the upper restoration layer.

Figure 2-6 – Schematic Rainham Landfill soil restoration profile



The clay-lined landfill cells and capping layers are designed to prevent pollution of the Secondary A and Principal Aquifers underlying the site at depth by landfill leachate. Therefore, due to this and the drainage layer at the base of the upper restoration layer, it is considered unlikely that a viable pathway will exist for downward migration of leachate in the Tideway Spoil, placed on top of the filled landfill cells and capping layer, to the underlying aquifers.

However, under this depositional scenario, Tideway Spoil will be placed above the drainage layer, which is designed to encourage the lateral migration of infiltration to identified surface water drainage channels and subsequently into the River Thames and Common Watercourse controlled waters receptors. While this design reduces the likelihood of vertical migration of leachate in the Tideway Spoil to the underlying aquifers, it does increase the likelihood of lateral migration to the River Thames and the Common Watercourse.

Atkins therefore considers there to be a potential pollutant linkage for ecotoxic products in the Tideway Spoil leachate to migrate through the drainage layer to the River Thames. This pollutant linkage is assessed further in Section 4.4.

2.2.5.2. RL2 – Deposition in a clay-lined landfill cell

If the Tideway Spoil is deposited in an unfilled cell or as part of the lower restoration layer, it would form part of the landfill body. Therefore, Tideway Spoil would be isolated from any surface receptors and groundwater receptors, subject to Rainham Landfill's hydrogeological risk assessment (Golder Associates, 2015)

As such, no potential pollutant linkages have been identified between the source (ecotoxic products/compounds) and the receptor (the River Thames). It is therefore considered that the risk to controlled waters from products contained in Tideway Spoil deposited in a clay-lined landfill cell is low.

3. Products assessed

3.1. Ecotoxicology

Atkins has undertaken a review of MSDS (Appendix A), ECHA database records (ECHA, 2018), environmental risk assessments and toxicological declarations provided to Atkins by manufacturers (BMG Engineering, 2013a; 2013b; Condat, 2016).

3.1.1. Initial assessment as per CLP Regulations 1272/2008

An initial assessment has been undertaken to assess if the product contains any components which pose a risk based on the CLP Regulations (1272/2008). The regulations ensure that substances or mixtures that display properties which have the potential to lead to a 'hazardous'[1] classification. The classification is based on toxicological data (i.e. evidence that there is a risk to either human health or the environment). For the purposes of this assessment, if the product is classified as 'hazardous' based on CLP 1272/2008, irrespective if the risk is to human health or the environment, the product has been considered as potentially posing a risk. Where no risk is identified, as per CLP 1272/2008, the product has not been considered further in this assessment.

3.1.2. Applicable Environmental Standards

Where a product/component is classified as hazardous under the CLP Regulations 1272/2008, environmental standards for each product or compound have been adopted by reference to published no effect concentrations (NOECs). A NOEC is the highest tested concentration in a long-term ecotoxicology study with no statistically significant adverse effects observed. NOECs have been used to evaluate the ecotoxicity of products or, where no data were available for the product, their constituent components. As this assessment relates to controlled waters, only ecotoxicological information relevant to aquatic species has been considered. Where a range of NOEC values are available for different aquatic species, the lowest NOEC value has been selected.

The initial screening exercise and NOEC values obtained for product / compounds are presented in Table 3-1 below.

Table 3-1 - Assessment of Risk based on CLP Regulations 1272/2008

Manufacturer	Product Name	Is the product classified under CLP Regulations 1272/2008 – i.e. does it pose a risk to the environment	Component Identifier or Product	Applied NOEC (mg/l)	Discussion / Reference
Soil Conditioning Agents					
BASF	MasterRoc SLF 41	Yes	A	7,350	NOEC has been calculated from a PNEC of 73500 mg/l (BMG, 2007) using an assessment factor of 100 (REACH, 2017).
			B	1.2	(ECHA, 2018)
	MasterRoc SLP 1	No			
	MasterRoc ACP 143	Yes	A	1.2	(ECHA, 2018)
Mapei	Polyfoamer FP	Yes	ALL	12.5	(Mapei, 2018)

[1] This classification differs from The Water Framework Directive definition of a Hazardous substance as classified by JAGDAG. The CLP 1272/2008 states that if a mixture contains a component that could present a hazard then it should be classified/labelled as hazardous. The classification under CLP 1272/2008 is considered conservative.

	Mapedrill M1	Yes	A	1,000	Mapedrill M1 MSDS (Appendix A2)
	Mapedisp FLS	No			
	Polyfoamer FLS	Yes	A	1.2	(ECHA, 2018)
			B	0.039	(ECHA, 2018)
			C	208	(ECHA, 2018)
			D	0.022	(ECHA, 2018)
	Eco 100 Plus	Yes	A	0.51	Collocated from the LC50 obtained from (ECHA, 2018) using an assessment factor of 0.1 (REACH, 2017).
TNL18	Actisoyl 100	Yes	A	1.2	(ECHA, 2018)
			B	0.95	(ECHA, 2018)
			C	429	(ECHA, 2018)
			D	0.14	(ECHA, 2018)
			F	0.03	(Acrylic Acid, 2002)
			G	0.081	Collocated from the LC50 obtained from (ECHA, 2018) using an assessment factor of 0.1 (REACH, 2017).
	Actisoyl CC	Yes	A	1.2	(ECHA, 2018)
			B	0.95	(ECHA, 2018)
			C	429	(ECHA, 2018)
			D	0.14	(ECHA, 2008)
			E	6	(COATEX SAS, 2010)
Condat	CLB F5/M	Yes	All	12.5	Condat CLB F5/M MSDS (Appendix A.4)
	TFA34	No			
	CLB F5/AC	Yes	All	10	Condat CLB F5/AC MSDS (Appendix A.4)
	TFA 7	No			
Imerys	Talc Slurry	Yes	A	0.11	(ECHA, 2018)
Greases					
Condat	HBW	No			
	EP2	No			

3.1.3. JAGDAG Classification

The Water Framework Directive (WFD) (European Union, 2000) states that a hazardous substance is a 'substances or groups of substances that are toxic, persistent and liable to bioaccumulate, and other substances or groups of substances which give rise to an equivalent level of concern.' A non-hazardous pollutant is not defined by the WFD but are taken to be any potential pollutant other than a hazardous substance. The Joint Agencies Groundwater Directive Advisory Group (JAGDAG) are responsible for advising on the determination of the status of substances (Hazardous / Non-hazardous). Table 3-2 indicates if any of the known components within the assessed products have been classed as hazardous or non-hazardous pollutants by the Joint Agencies Groundwater Directive Advisory Group (JAGDAG).

Table 3-2 - JAGDAG Classification

Manufacturer	Product	Component (coded)	JAGDAG Designation
BASF	MasterRoc SLF 41	N	Not Listed
		O	Not Listed
	MasterRoc SLP 1	A	Not Listed
	MasterRoc ACP 143	C	Not Listed
		D	Not Listed
		E	Not Listed
		F	Not Listed
Mapei	Polyfoamer FP	A	Not Listed
	Mapedrill M1	A	Not Listed
	Mapedisp FLS	Product	Not Listed
	Polyfoamer FLS	A	Not Listed
		B	Non-Hazardous Pollutant
		C	Not Listed
		D	Non-Hazardous Pollutant
	Eco 100 Plus	A	Not Listed
TNL18	Actisoyl 100	A	Not Listed
		B	Not Listed
		C	Not Listed
		D	Not Listed
		F	Not Listed
		G	Not Listed
	Actisoyl CC	A	Not Listed
		B	Not Listed
		C	Not Listed
		D	Not Listed
		E	Not Listed
Condat	CLB F5/M	A	Not Listed
		B	Not Listed
		C	Not Listed
		D	Not Listed
	TFA 34	Product	does not meet the criteria for classification according to regulations (EC) 1272/2008
	CLB F5/AC	A	Not Listed
		B	Not Listed
		C	Not Listed
		D	Not Listed
	TFA 7	Product	does not meet the criteria for classification according to regulations (EC) 1272/2008
Imerys	Talc	A	Not Listed
		B	Not Listed
		C	Not Listed
		D	Not Listed
		E	Not Listed

3.2. Spoil leachate soil conditioning agent concentrations

To assess the potential risk posed by a product/component to controlled waters by comparison with the NOEC, the anticipated concentration in the Tideway Spoil has been calculated. Concentrations of products/components have been derived in three stages; these are shown graphically in Figure 3-1 and are summarised in Sections 3.2.1 to 3.2.4.

3.2.1. Initial concentration in product (C0)

Where sufficient data are available, the products have been assessed as whole products. In these cases, the initial concentration (C0) is equivalent to the product density in mg/l.

In other cases, the individual ecotoxic compounds, as identified in the relevant MSDS documentation, have been assessed. Initial concentrations of ecotoxic components have been derived by multiplying the component-product mass ratio (often in % or parts per million) by the product density (in mg/l).

To protect commercially sensitive compositional information, product compositional information is routinely provided as ranges rather than single values in the MSDS. Atkins has therefore had to adopt a conservative position by assuming the upper-end of the published range. In some instances, more accurate compositional information has been provided to Atkins by the manufacturer under a non-disclosure agreement. Although, for reasons of commercial confidentiality, this information has not been included in this report or its appendices, it has been used to refine the calculations.

3.2.2. Concentrations of compounds/products in foam liquid (C1)

Water is added to the products to make the foaming solutions; this is the first dilution factor (DF1) applied. The amount of water added depends on the product used and the type of geology encountered. FLO and/or the manufacturer have provided the anticipated concentrations of products that will be used for the foaming solution, based on their experience of tunnelling in the London geology and trials carried out for FLO specifically for the Tideway Central works. Typically, this will be about 3% product 97% water for clay strata (e.g. London Clay) and 2% product 98% water for sand strata (e.g. Lambeth Group/Thanet Sands).

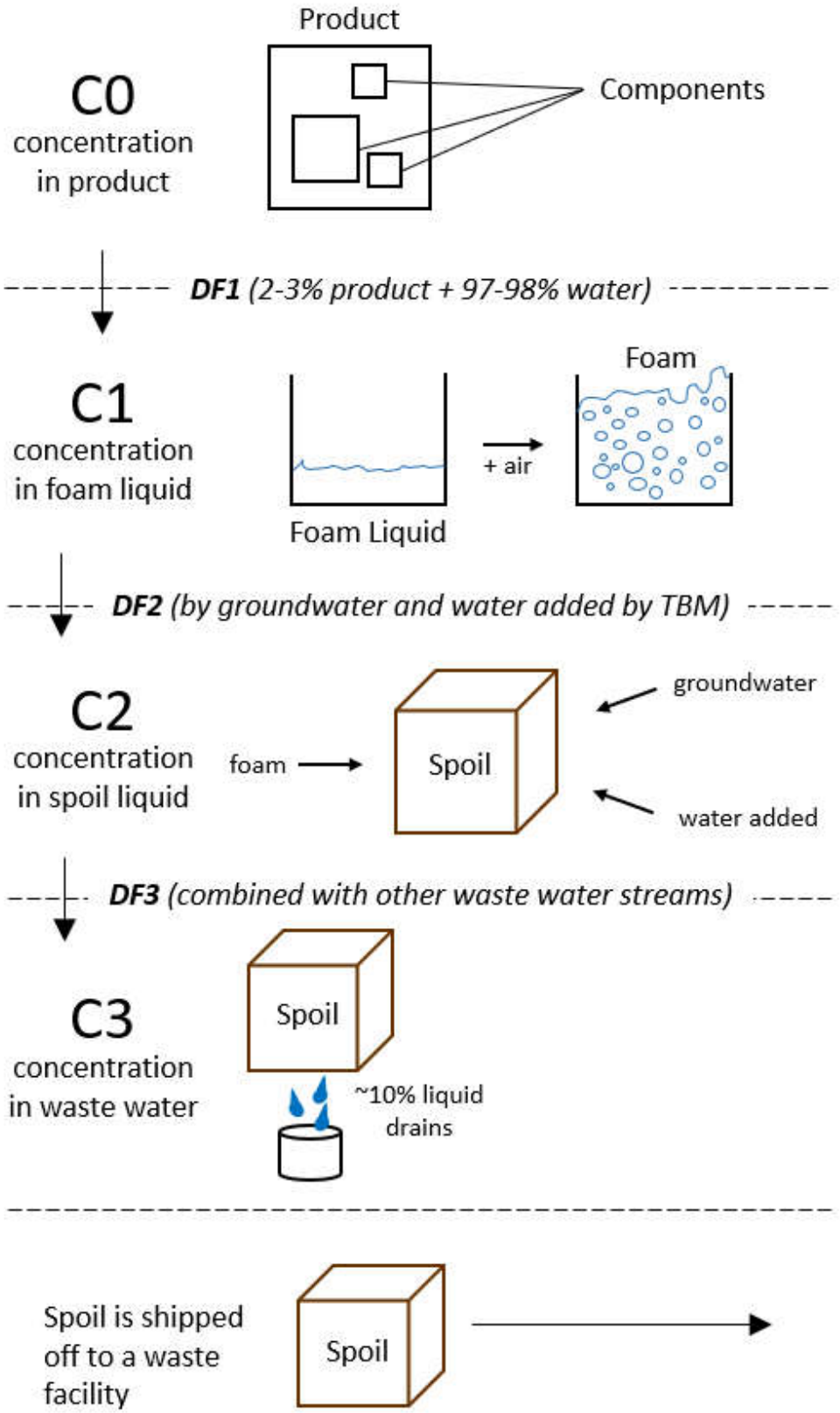
3.2.3. Concentrations of compounds/products in spoil liquid content (C2)

In addition to the foam, water is added at the TBM head to improve the tunnelling progress and help remove the spoil. The excavated material also contains some residual groundwater. These additional water inputs do not contain products and therefore act as the second stage of dilution (DF2). The amount of added water and groundwater contained in the spoil is dependent on the geology. Based on data provided by FLO, moisture contents of 26% and 20% have been used to represent the amount of groundwater in the London Clay and Lambeth Group/Thanet Formation respectively. The amount of water added has been estimated from data provided by FLO as 20% and 10% for the London Clay and Lambeth Group/Thanet Formation respectively. The anticipated concentrations of products/components in the spoil liquid are presented in Table 4-1 below**Error! Reference source not found.**.

3.2.4. Concentrations of compounds/products in spoil shipped to a waste facility (C3)

Based on previous FLO tunnelling projects, it has been assumed that of the total liquid content in the spoil (foam, groundwater and water added), 90% is retained within the solid spoil sent for disposal and 10% of the liquid content ends up in the waste water treatment plant at the launch shaft site (C3).

Figure 3-1 - Derivation of spoil leachate concentrations



4. Quantitative risk assessment

4.1. Preliminary risk assessment

Three CSMs, one for each of the depositional scenarios considered, were developed in Section 2:

1. AF1 – deposition following excavation of PFA at the Tilbury Ash Disposal Site;
2. RL1 – deposition on top of a filled cell at Rainham Landfill; and
3. RL2 – deposition in a clay-lined cell at Rainham Landfill.

No potential pollutant linkages were identified for RL2. Atkins therefore consider the risk posed to controlled waters from the products listed in **Error! Reference source not found.**, by deposition of spoil from Tideway Central under this scenario, to be low, therefore no further risk assessment has been undertaken of RL2.

Potential pollutant linkages were identified for AF1 and RL1. Atkins has therefore undertaken a detailed quantitative risk assessment for deposition of products in spoil from Tideway Central to Tilbury Ash Disposal Site and as a capping layer at Rainham Landfill.

4.2. Generic quantitative risk assessment

An initial screen of the spoil leachate concentrations has been undertaken by comparing the C3 concentration with the NOEC values presented in Table 4-1.

This is a conservative assessment because it does not consider processes of biodegradation, dilution and dispersion in the environment, which will lower the concentrations discharging into the identified surface water receptors. Products/components that are anticipated in the spoil at concentrations below the NOEC are considered to pose a low risk to the environment; where the concentration is above the NOEC, these products/components were taken forward to detailed quantitative risk assessment, with additional fate and transport processes considered which is specific to the deposition site.

A summary of ecotoxic products/compounds, relevant NOECs and their anticipated concentration in the Tideway Spoil (C3) is presented in Table 4-1 below**Error! Reference source not found.**. The results of the conservative generic quantitative risk assessment identify only three compounds that do not pose an unacceptable risk to controlled waters. However, the products as a whole, which contain those specific compounds, did not pass due to exceedance of NOEC values for other components. Therefore, based on the generic quantitative risk assessment all products in this stage of the assessment assessed are considered to pose a potential risk to controlled waters receptors. All products have been taken forward to detailed quantitative analysis where additional fate and transport processes were considered for the two depositional environments.

Table 4-1 - Summary of products/component ecotoxicity and spoil leachate concentrations

Manufacturer	Product Name	Applied NOEC (mg/l)	Concentration in Spoil Liquid less 10% loss (C3)	<NOEC
Soil Conditioning Agents				
BASF	MasterRoc SLF 41	7,350	0.24	Y
		1.2	348	N
	MasterRoc ACP 143	1.2	555	N
Mapei	Polyfoamer FP	12.5	3,580	N
	Mapedrill M1	1,000	3,191	N
	Polyfoamer FLS	1.2	367	N
		0.039	0.4	N
		208	0.08	Y
		0.022	0.06	N
	Eco 100 Plus	0.51	603.30	N

Manufacturer	Product Name	Applied NOEC (mg/l)	Concentration in Spoil Liquid less 10% loss (C3)	<NOEC
TNL18	Actisoyl 100	1.2	348	N
		0.95	348	N
		429	174	Y
		0.14	28	N
		0.03	3.5	N
		0.081	3.5	N
	Actisoyl CC	1.2	597	N
		0.95	478	N
		429	299	Y
		0.14	48	N
		6	597	N
Condat	CLB F5/M	12.5	3,511	N
	CLB F5/AC	10	6,033	N
Imerys	Talc Slurry	0.11	383	N

4.3. Detailed quantitative risk assessment – AF1

4.3.1. Degradation along the pathway

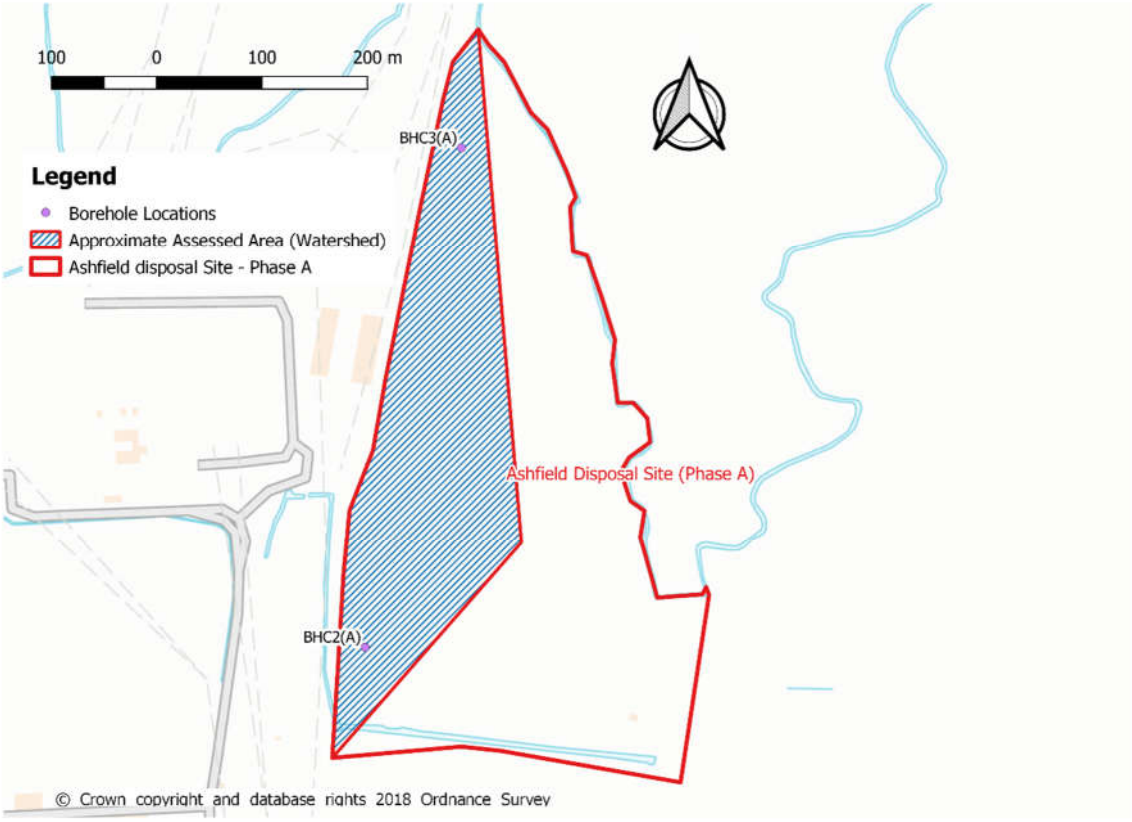
Based on the understanding of the Tilbury Ash Disposal Site waste facility Tideway Spoil will be placed over a thin layer of PFA. Outside the batter slopes, where negligible infiltration will occur, spoil leachate will travel vertically from the spoil into the more permeable PFA where it will flow horizontally towards the drainage channels that surround the landfill. Biodegradation rates for each of the products/components have been taken from MSDS, ECHA profiles or third-party risk assessments.

The saturated zone migration pathways has been limited to the distance of the base of battered edges of the spoil deposit only. These batters are constructed with a 30 ° slope which will result in negligible infiltration. On this basis there is a 15 m migration pathway for attenuation to occur within the saturated zone between source leachate discharging to the PFA layer and the toe of the batter prior to discharge to the surface water drain.

The physical parameters presented in Table 4-2 have been used to calculate the unretarded travel time from the base of the spoil through the PFA layer beneath the batter slope. The flux of discharge along the edges of the landfill area has been estimated based on the volume of infiltration across the whole landfill and adjusted to reflect the anticipated watershed within Phase A, where Tideway Spoil will be deposited. Infiltration and the physical properties of the Tideway Spoil masses as a whole will be similar across the Ashfield Depositional site and therefore the parameters presented in Table 4-2 and the calculated travel time and degradation of any product/compound leachate from the spoil will be similar prior to entry into the drainage ditches.

A schematic has been produced showing the watershed of the western side of the land fill that will discharge to the western drainage ditch. The parameters associated with this zone were used to define travel times presented in Table 4-2 and the result of this calculation is considered to be similar to the eastern and southern discharges from the landfill.

Figure 4-1 – Schematic showing assessed area



The saturated unretarded travel time calculated, has been used to derive the concentration immediately prior to entry to the drainage ditch (CA1), taking into account biodegradation within the aquifer. A saturated zone attenuation factor (AF) was calculated for each product/component (based on

biodegradation half-life and unretarded travel time). The attenuation factor (AF) has been applied to the concentration C3 to obtain concentration CA1.

Table 4-2 - Physical Aquifer Properties

Aquifer Property	Symbol	Value	Unit	Reasoning
Infiltration	In	53	mm/year	The infiltration rate (53 mm/year) has been calculated based a conservative assumption of effective rainfall of 150 mm/year (Environment Agency, 2008) minus a loss of 75% due to run off. The 75% run-off coefficient has been derived based on an empirical relationship from the National Coal Board (National Coal Board, 1982), assuming a clay loam soil, bare earth and the slope of 0.01 across the top of the Tideway Spoil mass prior to capping.
Lateral Pathway	dh	15	m	The edges of the spoil will be place at an angle of 30% (slope of 0.58) based on the National Coal Board (National Coal Board, 1982) run-off graph no infiltration will occur on the batter slopes. Assuming that the Tideway Spoil will be at least 9 m high than any infiltration which infiltrates the mass of spoil will be at a distance of 15 m or greater from any drainage ditch.
Ash Horizontal Conductivity	K	1.0×10^{-5}	m/s	(Fetter, 2000) (fine sands)
Area of watershed for a ditch (as per figure X).	A	36,710	m^2	Area calculated from google earth for the catchment to the western drainage ditch.
Area of 'discharge' of PFA aquifer	A	180	m^2	Cross sectional area of the PFA at the toe of the western edge of the spoil, based on length of 600 m and a thickness of 0.3 m.
Hydraulic gradient	i	3.40×10^{-2}	-	Hydraulic gradient calculated using Darcy's Law Q=KAi
Effective porosity	Φ	0.26	-	Porosity of fine sand (0.26-0.53) reported in the ConSim Manual. Lower level used to represent effective porosity.
Travel Time	t	132.9	Days	Calculated based on groundwater velocity and distance to receptor.

4.3.2. Dilution in the drainage channels from runoff

Any effective rainfall that does not infiltrate into the Tideway Spoil will result in runoff into the drainage channels that surround the site providing further dilution to any contaminant concentrations which leaches out of the spoil. Based on the National Coal Board (National Coal Board, 1982) run-off graph 35% of effective rainfall will infiltrate across the flat section of the mass whereas 100% will run off across the bunds with an average of 28% calculated across the whole spoil deposit. A dilution factor (DFA1) of 0.28 has therefore been applied to concenration CA1 to obtain an assessed concenration of potential contaminants within the drainage channels surrounding the facility CA2.

Concentrations CA1 and CA2, with comparison to applicable NOEC values are presented in Table 4-3 below.

Table 4-3 - Summary of product/component ecotoxicity and discharge concentrations for RF1

Manufacturer	Product Name	Applied NOEC (mg/l)	Maximum concentration of leachate within landfill at discharge edge **(CA1)** mg/l	CA1 <NOEC	Concentration in the drainage ditch after dilution from runoff from landfill area **(CA2)** mg/l	CA2 <NOEC
Soil Conditioning Agents						
BASF	MasterRoc SLF 41	7350	8.20E-02	Y	3.12E-02	Y
		1.2	7.46E-01	Y	2.84E-01	Y
	MasterRoc ACP 143	1.2	1.19E+00	Y	4.53E-01	Y
Mapei	Polyfoamer FP	12.5	7.69E+00	Y	2.92E+00	Y
	Mapedrill M1	1000	6.85E+00	Y	2.60E+00	Y
	Polyfoamer FLS	1.2	7.89E-01	Y	3.00E-01	Y
		0.039	8.44E-04	Y	3.21E-04	Y
		208	1.66E-04	Y	6.29E-05	Y
		0.022	5.86E-04	Y	2.23E-04	Y
	Eco 100 Plus	0.51	1.30E+00	N	4.92E-01	Y
TNL18	Actisoyl 100	1.2	7.47E-01	Y	2.84E-01	Y
		0.95	7.47E-01	Y	2.84E-01	Y
		429	3.73E-01	Y	1.42E-01	Y
		0.14	5.97E-02	Y	2.27E-02	Y
		0.03	7.47E-03	Y	2.84E-03	Y
		0.081	7.47E-03	Y	2.84E-03	Y
	Actisoyl CC	1.2	1.28E+00	N	4.88E-01	Y
		0.95	1.03E+00	N	3.90E-01	Y
		429	6.41E-01	Y	2.44E-01	Y
		0.14	1.03E-01	Y	3.90E-02	Y
		6	1.28E+00	Y	4.88E-01	Y
Condat	CLB F5/M	12.5	7.54E+00	Y	2.87E+00	Y
	CLB F5/AC	10	1.30E+01	N	4.92E+00	Y
Imerys	Talc Slurry	0.11	3.81E-02	Y	1.45E-02	Y

4.3.3. Results

The results of the quantitative assessment for AF1 are presented in Table 4-3 above. Comparison of the derived CA1 and CA2 concentration has been made to the applicable NOEC to evaluate potential risk to the identified controlled waters receptors. The assessment indicates that the for the majority of products/compounds the CA1 concentrations are below the NOEC at the edge of the spoil mass, however following dilution from runoff into the same drainage ditches the assessed concenration from all products/compound are below the NOEC value. This indicates that the placement of Tideway Spoil at Ashfield's is considered to pose a low to negligible risk to identified controlled waters receptors.

4.4. Detailed quantitative risk assessment – RL1

4.4.1. Degradation in the unsaturated zone – attenuation factor (AF)

Based on the soil restoration profile shown in Figure 2-6, it has been assumed that the unsaturated zone pathway extends from the base of the Tideway Spoil (0.5 m bgl) to the top of the drainage layer (1.2 m bgl). The thickness of the unsaturated zone pathway is therefore 0.7 m. Travel times through the unsaturated zone have been derived in accordance with the methodology presented in the ConSim Manual (Golder Associates, 2003). Biodegradation rates for each of the products/components have been taken from MSDS, ECHA profiles or third-party risk assessments.

The infiltration rate (60 mm/year) has been calculated based on a conservative assumption of effective rainfall of 150 mm/year (Environment Agency, 2008) minus a loss of 60% due to run-off. The 60% run-off coefficient has been derived based on an empirical relationship developed by the National Coal Board (National Coal Board, 1982), assuming a clay loam soil, a grassed tip land use and an average ground slope of 0.05 (based on a 10 m elevation drop over 200 m). The effective wetted porosity in the unsaturated zone has been assumed to be 24% (Environment Agency, 2015), giving an estimated travel time of 920 days. Using this value as an unretarded travel time through the unsaturated zone an attenuation factor (AF) was calculated for each product/component (based on biodegradation half-life). The attenuation factor (AF) has been applied to the concentration C3 to obtain concentration CR4, which is the concentration within the discharge into the drainage layer directly beneath the Tideway Spoil at Rainham.

This process assumes no retardation of the products/components due to sorption within the soil and hence represents a conservatively low estimate of travel time within the unsaturated zone. In reality, slower transport due to retardation would allow more degradation to occur.

4.4.2. Results

The results of the quantitative assessment are presented in Table 4-4 below. Comparison of the derived CR4 concentration has been made to the applicable NOEC to evaluate potential risk to the identified controlled waters receptors. It should be noted that as per Figure 2-5 Tideway Spoil will not be used across the whole site as a restoration layer therefore further dilution will occur within the drainage layer prior to discharge to any drainage ditch and subsequently to either the Common Water Course or the River Thames. Therefore, the use of Tideway Spoil in the upper restoration layer is considered to pose a low to negligible risk to identified controlled water receptors.

4.4.3. Results

Table 4-4 - Summary of product/component ecotoxicity and discharge concentration for RL1

Manufacturer	Product Name	Applied NOEC (mg/l)	Concentration at discharge to drainage channel (CR4)	CR4 <NOEC
Soil Conditioning Agents				
BASF	MasterRoc SLF 41	7350	1.55E-04	Y
		1.2	1.01E-03	Y
	MasterRoc ACP 143	1.2		Y
Mapei	Polyfoamer FP	12.5	1.93E-16	Y
	Mapedrill M1	1000	1.24E-15	Y
	Polyfoamer FLS	1.2	1.11E-15	Y
		0.039		Y
		208	1.28E-16	Y
		0.022	1.37E-19	Y
	Eco 100 Plus	0.51	2.68E-20	Y
TNL18	Actisoyl 100	1.2	8.41E-16	Y
		0.95	2.10E-16	Y
		429	1.21E-16	Y
		0.14	1.21E-16	Y
		0.03	6.04E-17	Y
		0.081	9.66E-18	Y
	Actisoyl CC	1.2	1.21E-18	Y
		0.95	1.21E-18	Y
		429	2.08E-16	Y
		0.14	1.66E-16	Y
		6	1.04E-16	Y
Condat	CLB F5/M	12.5	1.66E-17	Y
	CLB F5/AC	10	2.08E-16	Y
Imerys	Talc Slurry	0.11	1.22E-15	Y

5. Conclusions

Excavated material (spoil) resulting from the construction of Tideway Central will contain quantities of soil conditioning agents and greases (products) used as part of the tunnel boring operation. Deposition of these products as part of the spoil has been considered for the following three depositional scenarios at two waste facilities:

1. AF1 – deposition following excavation of PFA at the Tilbury Ash Disposal Site;
2. RL1 – deposition on top of a filled cell at Rainham Landfill; and
3. RL2 – deposition in a clay-lined cell at Rainham Landfill.

Based on available ecotoxicological, geological and usage rate information all products assessed are considered to pose a low to negligible risk to controlled water receptors within the scenarios assessed.

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Abbreviations List

Abbreviation List

%	percentage
~	Approximately
<	Less then
>	Greater then
°	Degrees
2000/60/EC	Water framework directive
AF	Atenuation Factor
BGS	British Geological Society
BGS	British Geological Society
C0	initial concentration
C1	Concentrations of compounds/products in foam liquid
C2	Concentrations of compounds/products in spoil liquid content
C3	Concentrations of compounds/products in spoil shipped to a waste facility
CA1	Maximum concentration of leachate within landfill at discharge edge – Ashfield's CSM
CA2	Concentration in the drainage ditch after dilution from runoff from landfill area -Ashfield's CSM
CLP 1272/2008	Classification, labelling and packaging of substances and mixtures Regulations
CSM	conceptual site model
DF1	first dilution factor
DF2	second stage of dilution
DF3	third stage of dilution
DFA1	Dilution of CA1 with runoff into drainage ditches
ECHA	European Chemicals Agency
FLO	Ferrovial Agroman Laing O'Rourke
JAGDAG	Joint Agencies Groundwater Directive Advisory Group
km	kilometres
LC50	50% lethal concentration
m	meters
m bgl	metres below ground level
m AOD	metres above Ordnance Datum
mg/l	milligrams per litre
mm	millimetres
mm/year	millimetres per year
MSDS	materials safety data sheets
NOEC	no effect-concentration
PFA	pulverised fuel ash

PNEC	predicted no-effect concentration
RL1	Rainham Landfill conceptual site model 1
RL2	Rainham Landfill conceptual site model 2
SSSI	site of special scientific interest
TBM	tunnel boring machine

Appendix A. Materials Safety Data Sheets

A.1. BASF – MasterRoc SLF 41

Safety data sheet

BASF Safety data sheet according to Regulation (EC) No. 1907/2006
Date / Revised: 12.09.2013 Version: 2.0
Product: **MasterRoc SLF 41 also Meyco SLF 41**
(ID no. 30593770/SDS_GEN_GB/EN)
Date of print 14.09.2013

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

MasterRoc SLF 41 also Meyco SLF 41

1.2. Relevant identified uses of the substance or mixture and uses advised against

1.3. Details of the supplier of the safety data sheet

Company:
BASF SE
67056 Ludwigshafen
GERMANY

Contact address:
BASF plc
PO Box 4, Earl Road, Cheadle Hulme,
Cheadle, Cheshire
SK8 6QG, UNITED KINGDOM

Telephone: +44 161 485-6222
E-mail address: product-safety-north@basf.com

1.4. Emergency telephone number

International emergency number:
Telephone: +49 180 2273-112

SECTION 2: Hazards Identification

2.1. Classification of the substance or mixture

According to Directive 67/548/EEC or 1999/45/EC

Possible Hazards:
Irritating to eyes and skin.

2.2. Label elements

According to Directive 67/548/EEC or 1999/45/EC

Directive 1999/45/EC ('Preparation Directive')

Hazard symbol(s)

Xi Irritant.

R-phrase(s)

R36/38	Irritating to eyes and skin.

S-phrase(s)

S2	Keep out of the reach of children.
S24	Avoid contact with skin.
S46	If swallowed, seek medical advice immediately and show this container or label.

2.3. Other hazards

According to Regulation (EC) No 1272/2008 [CLP]

If applicable information is provided in this section on other hazards which do not result in classification but which may contribute to the overall hazards of the substance or mixture.

SECTION 3: Composition/Information on Ingredients

3.1. Substances

Not applicable

3.2. Mixtures

Chemical nature

Preparation based on: aqueous solution, anionic surfactants

Hazardous ingredients (GHS)
according to Regulation (EC) No. 1272/2008

Alcohols, C12-14, ethoxylated, sulfates, sodium salts (> 1 < 2.5 mol EO)

Content (W/W): >= 10 % - < 50 %	Skin Corr./Irrit. 2
CAS Number: 68891-38-3	Eye Dam./Irrit. 2
EC-Number: 500-234-8	Aquatic Chronic 3
	H319, H315, H412

Hazardous ingredients
according to Directive 1999/45/EC

Alcohols, C12-14, ethoxylated, sulfates, sodium salts (> 1 < 2.5 mol EO)
Content (W/W): >= 10 % - < 50 %
CAS Number: 68891-38-3
EC-Number: 500-234-8
Hazard symbol(s): Xi
R-phrase(s): 36/38

For the classifications not written out in full in this section, including the indication of danger, the hazard symbols, the R phrases, and the hazard statements, the full text is listed in section 16.

SECTION 4: First-Aid Measures

4.1. Description of first aid measures

First aid personnel should pay attention to their own safety. Remove contaminated clothing.

If inhaled:
If difficulties occur after vapour/aerosol has been inhaled, remove to fresh air and seek medical attention.

On skin contact:
After contact with skin, wash immediately with plenty of water and soap. Under no circumstances should organic solvent be used. If irritation develops, seek medical attention.

On contact with eyes:
Wash affected eyes for at least 15 minutes under running water with eyelids held open, consult an eye specialist.

On ingestion:
Rinse mouth immediately and then drink plenty of water, seek medical attention. Do not induce vomiting unless told to by a poison control center or doctor.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms: The most important known symptoms and effects are described in the labelling (see section 2) and/or in section 11.

4.3. Indication of any immediate medical attention and special treatment needed

Treatment: Treat according to symptoms (decontamination, vital functions), no known specific antidote.

SECTION 5: Fire-Fighting Measures

5.1. Extinguishing media

Suitable extinguishing media:
foam, water spray, dry powder, carbon dioxide

Unsuitable extinguishing media for safety reasons:
water jet

5.2. Special hazards arising from the substance or mixture
carbon monoxide, Carbon dioxide, harmful vapours, nitrogen oxides, fumes/smoke, carbon black

5.3. Advice for fire-fighters
Special protective equipment:
Wear a self-contained breathing apparatus.

Further information:
The degree of risk is governed by the burning substance and the fire conditions. Contaminated extinguishing water must be disposed of in accordance with official regulations.

SECTION 6: Accidental Release Measures

6.1. Personal precautions, protective equipment and emergency procedures
Use personal protective clothing. Do not breathe vapour/aerosol/spray mists. Handle in accordance with good building materials hygiene and safety practice.

6.2. Environmental precautions
Contain contaminated water/firefighting water. Do not discharge into drains/surface waters/groundwater.

6.3. Methods and material for containment and cleaning up
For small amounts: Pick up with inert absorbent material (e.g. sand, earth etc.). Dispose of contaminated material as prescribed.
For large amounts: Pump off product.

6.4. Reference to other sections
Information regarding exposure controls/personal protection and disposal considerations can be found in section 8 and 13.

SECTION 7: Handling and Storage

7.1. Precautions for safe handling
Avoid aerosol formation. Avoid inhalation of mists/vapours. Avoid skin contact. No special measures necessary provided product is used correctly.

Protection against fire and explosion:
The product does not contribute to the spreading of flames, nor is it self combustible, not explosive. Take precautionary measures against static discharges.

7.2. Conditions for safe storage, including any incompatibilities
Segregate from oxidants. Segregate from foods and animal feeds.

Suitable materials for containers: Stainless steel 1.4404, High density polyethylene (HDPE)
Further information on storage conditions: Keep only in the original container in a cool, well-ventilated place. Protect from direct sunlight. Store protected against freezing.

7.3. Specific end use(s)

For the relevant identified use(s) listed in Section 1 the advice mentioned in this section 7 is to be observed.

SECTION 8: Exposure Controls/Personal Protection

8.1. Control parameters

Components with occupational exposure limits

The substances without values are not listed in the occupational exposure regulations for the validity area of this safety data sheet.

8.2. Exposure controls

Personal protective equipment

Respiratory protection:
Wear respiratory protection if ventilation is inadequate. Combination filter for gases/vapours of organic, inorganic, acid inorganic and alkaline compounds (e.g. EN 14387 Type ABEK).

Hand protection:
Suitable chemical resistant safety gloves (EN 374) also with prolonged, direct contact (Recommended: Protective index 6, corresponding > 480 minutes of permeation time according to EN 374): E.g. nitrile rubber (0.4 mm), chloroprene rubber (0.5 mm), butyl rubber (0.7 mm) and other Manufacturer's directions for use should be observed because of great diversity of types.

Eye protection:
Safety glasses with side-shields (frame goggles) (e.g. EN 166)

Body protection:
Body protection must be chosen depending on activity and possible exposure, e.g. apron, protecting boots, chemical-protection suit (according to EN 14605 in case of splashes or EN ISO 13982 in case of dust).

General safety and hygiene measures
Avoid contact with the skin, eyes and clothing. In order to prevent contamination while handling, closed working clothes and working gloves should be used. Handle in accordance with good building materials hygiene and safety practice. When using, do not eat, drink or smoke. Hands and/or face should be washed before breaks and at the end of the shift. At the end of the shift the skin should be cleaned and skin-care agents applied. Gloves must be inspected regularly and prior to each use. Replace if necessary (e.g. pinhole leaks).

SECTION 9: Physical and Chemical Properties

9.1. Information on basic physical and chemical properties

Form:	suspension
Colour:	clear
Odour:	characteristic

pH value:	approx. 6.5 - 7.5 (20 °C)
Information on: Water	
Melting point:	*0 °C*

Information on: Water	
Boiling point:	*100 °C*

Flash point:	
	A flash point determination is unnecessary due to the high water content.
Evaporation rate:	
	not determined
Flammability:	not flammable
Ignition temperature:	
	not applicable
Information on: Water	
Vapour pressure:	*23.4 hPa* *(20 °C)* *Literature data.*

Density:	approx. 1.035 - 1.045 g/cm3 (approx. 20 °C)
Relative vapour density (air):	
	not determined
Solubility in water:	soluble (20 °C)
Thermal decomposition:	No decomposition if stored and handled as prescribed/indicated.
Viscosity, dynamic:	approx. > 150 mPa.s (approx. 20 °C)
Explosion hazard:	not explosive

9.2. Other information

Miscibility with water:	
	(20 °C) miscible in all proportions
Hygroscopy:	Non-hygroscopic

Other Information:
If necessary, information on other physical and chemical parameters is indicated in this section.

SECTION 10: Stability and Reactivity

10.1. Reactivity
No hazardous reactions if stored and handled as prescribed/indicated.

Corrosion to metals: Corrosive effects to metal are not anticipated.

10.2. Chemical stability

The product is stable if stored and handled as prescribed/indicated.

10.3. Possibility of hazardous reactions

The product is stable if stored and handled as prescribed/indicated.

10.4. Conditions to avoid

See MSDS section 7 - Handling and storage.

10.5. Incompatible materials

Substances to avoid:
strong acids, strong bases, strong oxidizing agents

10.6. Hazardous decomposition products

No hazardous decomposition products if stored and handled as prescribed/indicated.

SECTION 11: Toxicological Information

11.1. Information on toxicological effects

Acute toxicity

Assessment of acute toxicity:
Virtually nontoxic after a single ingestion. Based on available Data, the classification criteria are not met.

Irritation

Assessment of irritating effects:
Eye contact causes irritation. Skin contact causes irritation. The product has not been tested. The statement has been derived from the properties of the individual components.

Experimental/calculated data:
Skin corrosion/irritation: Irritant.

Serious eye damage/irritation: Irritant.

Respiratory/Skin sensitization

Experimental/calculated data:
Skin sensitizing effects were not observed in animal studies.

Germ cell mutagenicity

Assessment of mutagenicity:
The chemical structure does not suggest a specific alert for such an effect. Based on available Data, the classification criteria are not met.

Carcinogenicity

Assessment of carcinogenicity:
The chemical structure does not suggest a specific alert for such an effect. Based on available Data, the classification criteria are not met.

Reproductive toxicity

Assessment of reproduction toxicity:
The chemical structure does not suggest a specific alert for such an effect. Based on available Data, the classification criteria are not met.

Developmental toxicity

Assessment of teratogenicity:
The chemical structure does not suggest a specific alert for such an effect. Based on available Data, the classification criteria are not met.

Repeated dose toxicity and Specific target organ toxicity (repeated exposure)

Assessment of repeated dose toxicity:
After repeated exposure the prominent effect is local irritation.

Other relevant toxicity information

Based on our experience and the information available, no adverse health effects are expected if handled as recommended with suitable precautions for designated uses. The product has not been tested. The statements on toxicology have been derived from the properties of the individual components.

SECTION 12: Ecological Information

12.1. Toxicity

Assessment of aquatic toxicity:
Based on available Data, the classification criteria are not met. There is a high probability that the product is not acutely harmful to aquatic organisms.

12.2. Persistence and degradability

Elimination information:
Readily biodegradable (according to OECD criteria).

12.3. Bioaccumulative potential

Assessment bioaccumulation potential:
No data available.
Discharge into the environment must be avoided.

12.4. Mobility in soil

Assessment transport between environmental compartments:

No data available.

12.5. Results of PBT and vPvB assessment

The product does not fulfill the criteria for PBT (Persistent/bioaccumulative/toxic) and vPvB (very persistent/very bioaccumulative).

12.6. Other adverse effects

12.7. Additional information

Other ecotoxicological advice:
Do not discharge product into the environment without control. The product has not been tested. The statements on ecotoxicology have been derived from the properties of the individual components.

SECTION 13: Disposal Considerations

13.1. Waste treatment methods

Observe national and local legal requirements.
Residues should be disposed of in the same manner as the substance/product.

The UK Environmental Protection (Duty of Care) Regulations (EP) and amendments should be noted (United Kingdom).

This product and any uncleaned containers must be disposed of as hazardous waste in accordance with the 2005 Hazardous Waste Regulations and amendments (United Kingdom)

Waste key:
16 03 05¤ organic wastes containing dangerous substances

Contaminated packaging:
Contaminated packaging should be emptied as far as possible; then it can be passed on for recycling after being thoroughly cleaned.

SECTION 14: Transport Information

Land transport

ADR

	Not classified as a dangerous good under transport regulations
UN number:	Not applicable
UN proper shipping name:	Not applicable
Transport hazard class(es):	Not applicable
Packing group:	Not applicable
Environmental hazards:	Not applicable

Special precautions for user	None known

RID

	Not classified as a dangerous good under transport regulations
UN number:	Not applicable
UN proper shipping name:	Not applicable
Transport hazard class(es):	Not applicable
Packing group:	Not applicable
Environmental hazards:	Not applicable
Special precautions for user	None known

Inland waterway transport

ADN

	Not classified as a dangerous good under transport regulations
UN number:	Not applicable
UN proper shipping name:	Not applicable
Transport hazard class(es):	Not applicable
Packing group:	Not applicable
Environmental hazards:	Not applicable
Special precautions for user	None known
Transport in inland waterway vessel:	Not evaluated

Sea transport

IMDG

	Not classified as a dangerous good under transport regulations
UN number:	Not applicable
UN proper shipping name:	Not applicable
Transport hazard class(es):	Not applicable
Packing group:	Not applicable
Environmental hazards:	Not applicable
Special precautions for user	None known

Air transport

IATA/ICAO

	Not classified as a dangerous good under transport regulations
UN number:	Not applicable
UN proper shipping name:	Not applicable
Transport hazard class(es):	Not applicable

Packing group:	Not applicable
Environmental hazards:	Not applicable
Special precautions for user	None known

14.1. UN number
See corresponding entries for “UN number” for the respective regulations in the tables above.

14.2. UN proper shipping name
See corresponding entries for “UN proper shipping name” for the respective regulations in the tables above.

14.3. Transport hazard class(es)
See corresponding entries for “Transport hazard class(es)” for the respective regulations in the tables above.

14.4. Packing group
See corresponding entries for “Packing group” for the respective regulations in the tables above.

14.5. Environmental hazards
See corresponding entries for “Environmental hazards” for the respective regulations in the tables above.

14.6. Special precautions for user
See corresponding entries for “Special precautions for user” for the respective regulations in the tables above.

14.7. Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code

Regulation:	Not evaluated
Shipment approved:	Not evaluated
Pollution name:	Not evaluated
Pollution category:	Not evaluated
Ship Type:	Not evaluated

SECTION 15: Regulatory Information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

The data should be considered when making any assessment under the Control of Substances Hazardous to Health Regulations (COSHH), and related guidance, for example, 'COSHH Essentials' (United Kingdom).

This product is classified under the Chemicals (Hazard Information and Packaging) Regulations, (CHIP) (United Kingdom).

15.2. Chemical Safety Assessment

Chemical Safety Assessment not required

SECTION 16: Other Information

Full text of the classifications, including the indication of danger, the hazard symbols, the R phrases, and the hazard statements, if mentioned in section 2 or 3:

Xi	Irritant.
36/38	Irritating to eyes and skin.
Skin Corr./Irrit.	Skin corrosion/irritation
Eye Dam./Irrit.	Serious eye damage/eye irritation
Aquatic Chronic	Hazardous to the aquatic environment - chronic
H319	Causes serious eye irritation.
H315	Causes skin irritation.
H412	Harmful to aquatic life with long lasting effects.

If you have any queries relating to this MSDS, it's contents or any other product safety related questions, please write to the following e-mail address: product-safety-north@basf.com

The data contained in this safety data sheet are based on our current knowledge and experience and describe the product only with regard to safety requirements. The data do not describe the product's properties (product specification). Neither should any agreed property nor the suitability of the product for any specific purpose be deduced from the data contained in the safety data sheet. It is the responsibility of the recipient of the product to ensure any proprietary rights and existing laws and legislation are observed.

Vertical lines in the left hand margin indicate an amendment from the previous version.

A.2. BASF – MasterRock SLP 1

Safety data sheet

1. Identification of the substance/mixture and of the company/undertaking

Product identifier

MasterRoc SLP 1 also MEYCO SLF P1

Relevant identified uses of the substance or mixture and uses advised against

Relevant identified uses: Product for construction chemicals

Details of the supplier of the safety data sheet

Company:
BASF SE
67056 Ludwigshafen
GERMANY

Contact address:
BASF plc
PO Box 4, Earl Road, Cheadle Hulme,
Cheadle, Cheshire
SK8 6QG, UNITED KINGDOM

Telephone: +44 161 485-6222
E-mail address: product-safety-north@basf.com

Emergency telephone number

International emergency number:
Telephone: +49 180 2273-112

2. Hazards Identification

Label elements

According to Directive 67/548/EEC or 1999/45/EC

Directive 1999/45/EC ('Preparation Directive')

The product does not require a hazard warning label in accordance with EC Directives.

Classification of the substance or mixture

According to Directive 67/548/EEC or 1999/45/EC

Possible Hazards:
No specific dangers known, if the regulations/notes for storage and handling are considered.

Other hazards

According to Regulation (EC) No 1272/2008 [CLP]

Other Hazards (GHS):
No specific dangers known, if the regulations/notes for storage and handling are considered.

3. Composition/Information on Ingredients

Mixtures

Chemical nature

Polymer, aqueous solution

4. First-Aid Measures

Description of first aid measures

First aid personnel should pay attention to their own safety. Remove contaminated clothing.

If inhaled:
If difficulties occur after vapour/aerosol has been inhaled, remove to fresh air and seek medical attention.

On skin contact:
After contact with skin, wash immediately with plenty of water and soap. If irritation develops, seek medical attention.

On contact with eyes:
Wash affected eyes for at least 15 minutes under running water with eyelids held open, consult an eye specialist.

On ingestion:
Rinse mouth immediately and then drink plenty of water, seek medical attention. Do not induce vomiting unless told to by a poison control center or doctor.

Most important symptoms and effects, both acute and delayed

Symptoms: No significant symptoms are expected due to the non-classification of the product.

Indication of any immediate medical attention and special treatment needed

Treatment: Treat according to symptoms (decontamination, vital functions), no known specific antidote.

5. Fire-Fighting Measures

Extinguishing media
Suitable extinguishing media:
foam, water spray, dry powder, carbon dioxide

Unsuitable extinguishing media for safety reasons:
water jet

Special hazards arising from the substance or mixture
carbon monoxide, carbon dioxide, harmful vapours, nitrogen oxides, fumes/smoke, carbon black

Advice for fire-fighters
Special protective equipment:
Wear a self-contained breathing apparatus.

Further information:
The degree of risk is governed by the burning substance and the fire conditions. Contaminated extinguishing water must be disposed of in accordance with official regulations.

6. Accidental Release Measures

Forms slippery surfaces with water.

Personal precautions, protective equipment and emergency procedures
Use personal protective clothing. Do not breathe vapour/aerosol/spray mists. Sources of ignition should be kept well clear. Handle in accordance with good building materials hygiene and safety practice.

Environmental precautions
Contain contaminated water/firefighting water. Do not discharge into drains/surface waters/groundwater.

Methods and material for containment and cleaning up
For small amounts: Pick up with inert absorbent material (e.g. sand, earth etc.). Dispose of contaminated material as prescribed.
For large amounts: Pump off product.

Reference to other sections
Information regarding exposure controls/personal protection and disposal considerations can be found in section 8 and 13.

7. Handling and Storage

Precautions for safe handling
Avoid aerosol formation. Avoid inhalation of mists/vapours. Avoid skin contact. No special measures necessary provided product is used correctly.

Protection against fire and explosion:
No special precautions necessary.

Conditions for safe storage, including any incompatibilities

Segregate from foods and animal feeds.

Suitable materials for containers: High density polyethylene (HDPE)
Further information on storage conditions: Keep only in the original container in a cool, dry, well-ventilated place away from ignition sources, heat or flame. Store protected against freezing. Protect from direct sunlight.

Protect from temperatures below: 5 °C
Protect from temperatures above: 35 °C

Specific end use(s)

For the relevant identified use(s) listed in Section 1 the advice mentioned in this section 7 is to be observed.

8. Exposure Controls/Personal Protection

Control parameters

Components with workplace control parameters

The substances without values are not listed in the occupational exposure regulations for the validity area of this safety data sheet.

Exposure controls

Personal protective equipment

Respiratory protection:
Wear respiratory protection if ventilation is inadequate. Combination filter for gases/vapours of organic, inorganic, acid inorganic and alkaline compounds (e.g. EN 14387 Type ABEK).

Hand protection:
impermeable gloves
Synthetic rubber gloves
Manufacturer's directions for use should be observed because of great diversity of types.

Eye protection:
Safety glasses with side-shields (frame goggles) (e.g. EN 166)

Body protection:
light protective clothing

General safety and hygiene measures
In order to prevent contamination while handling, closed working clothes and working gloves should be used. Handle in accordance with good building materials hygiene and safety practice. When using, do not eat, drink or smoke. Hands and/or face should be washed before breaks and at the end of the shift. At the end of the shift the skin should be cleaned and skin-care agents applied. Gloves must be inspected regularly and prior to each use. Replace if necessary (e.g. pinhole leaks).

9. Physical and Chemical Properties

Information on basic physical and chemical properties

Form:	liquid
Colour:	colourless to yellowish
Odour:	characteristic
pH value:	7.5 - 9.5 (20 °C)
boiling temperature:	> 100 °C
Flash point:	Non-flammable.
Ignition temperature:	not applicable
Density:	1.003 - 1.007 g/cm3 (20 °C)
Solubility in water:	soluble (20 °C)
Thermal decomposition:	No decomposition if stored and handled as prescribed/indicated.

Other information

Bulk density:
not applicable
Other Information:
If necessary, information on other physical and chemical parameters is indicated in this section.

10. Stability and Reactivity

Reactivity
No hazardous reactions if stored and handled as prescribed/indicated.

Corrosion to metals: No corrosive effect on metal.

Chemical stability
The product is stable if stored and handled as prescribed/indicated.

Possibility of hazardous reactions
The product is stable if stored and handled as prescribed/indicated.

Conditions to avoid
See MSDS section 7 - Handling and storage.

Incompatible materials

Substances to avoid:
strong acids, strong bases, strong oxidizing agents

Hazardous decomposition products

No hazardous decomposition products if stored and handled as prescribed/indicated.

11. Toxicological Information

Information on toxicological effects

Acute toxicity

Assessment of acute toxicity:
Virtually nontoxic after a single ingestion. The product has not been tested. The statement has been derived from products of a similar structure or composition.

Experimental/calculated data:
LD50 rat (oral): > 5,000 mg/kg

Irritation

Assessment of irritating effects:
Not irritating to eyes and skin. No irritation is expected under intended use and appropriate handling.

Respiratory/Skin sensitization

Assessment of sensitization:
The product has not been tested. The statement has been derived from the properties of the individual components.

Germ cell mutagenicity

Assessment of mutagenicity:
The chemical structure does not suggest a specific alert for such an effect. The product has not been tested. The statement has been derived from the properties of the individual components.

Carcinogenicity

Assessment of carcinogenicity:
The chemical structure does not suggest a specific alert for such an effect.

Reproductive toxicity

Assessment of reproduction toxicity:
The chemical structure does not suggest such an effect. The product has not been tested. The statement has been derived from the properties of the individual components.

Developmental toxicity

Assessment of teratogenicity:
The chemical structure does not suggest such an effect. The product has not been tested. The statement has been derived from the properties of the individual components.

Repeated dose toxicity and Specific target organ toxicity (repeated exposure)

Assessment of repeated dose toxicity:
No reliable data was available concerning repeated dose toxicity.

Other relevant toxicity information

Based on our experience and the information available, no adverse health effects are expected if handled as recommended with suitable precautions for designated uses. The product has not been tested. The statements on toxicology have been derived from products of a similar structure and composition.

12. Ecological Information

Toxicity

Assessment of aquatic toxicity:
At the present state of knowledge, no negative ecological effects are expected. There is a high probability that the product is not acutely harmful to aquatic organisms. The product has not been tested. The statement has been derived from products of a similar structure or composition.

Toxicity to fish:
LC50 (96 h) > 1,000 mg/l, Pimephales promelas

Persistence and degradability

Assessment biodegradation and elimination (H2O):
Inherently biodegradable. The insoluble fraction can be removed by mechanical means in suitable waste water treatment plants.

Bioaccumulative potential

Assessment bioaccumulation potential:
No data available concerning bioaccumulation.

Mobility in soil (and other compartments if available)

Assessment transport between environmental compartments:
No data available.

Results of PBT and vPvB assessment

The product does not fulfill the criteria for PBT (persistent/bioaccumulative/toxic) or vPvB (very persistent/very bioaccumulative).

Additional information

Other ecotoxicological advice:
There is a high probability that the product is not acutely harmful to aquatic organisms. Do not discharge product into the environment without control. The product has not been tested. The statement has been derived from the properties of the individual components.

13. Disposal Considerations

Waste treatment methods

Observe national and local legal requirements.
Residues should be disposed of in the same manner as the substance/product.

The UK Environmental Protection (Duty of Care) Regulations (EP) and amendments should be noted (United Kingdom).

Waste key:
16 03 06 organic wastes other than those mentioned in 16 03 05

Contaminated packaging:
Contaminated packaging should be emptied as far as possible; then it can be passed on for recycling after being thoroughly cleaned.

14. Transport Information

Land transport

ADR

Not classified as a dangerous good under transport regulations

RID

Not classified as a dangerous good under transport regulations

Inland waterway transport
ADN

Not classified as a dangerous good under transport regulations

Sea transport
IMDG

Not classified as a dangerous good under transport regulations

Air transport
IATA/ICAO

Not classified as a dangerous good under transport regulations

15. Regulatory Information

Safety, health and environmental regulations/legislation specific for the substance or mixture

The data should be considered when making any assessment under the Control of Substances Hazardous to Health Regulations (COSHH), and related guidance, for example, 'COSHH Essentials' (United Kingdom).

16. Other Information

Due to the merger of Degussa Construction chemicals and BASF Group all Material Safety Data Sheets have been reassessed on the basis of consolidated information. This may have resulted in changes of the Material Safety Data Sheets. In case you have questions concerning such changes please contact us under the address mentioned in Section I.

Vertical lines in the left hand margin indicate an amendment from the previous version.

If you have any queries relating to this MSDS, it's contents or any other product safety related questions, please write to the following e-mail address: product-safety-north@basf.com

The data contained in this safety data sheet are based on our current knowledge and experience and describe the product only with regard to safety requirements. The data do not describe the product's properties (product specification). Neither should any agreed property nor the suitability of the product for any specific purpose be deduced from the data contained in the safety data sheet. It is the responsibility of the recipient of the product to ensure any proprietary rights and existing laws and legislation are observed.

Annex: Exposure Scenarios

A.3. BASF – MasterRoc ACP 143

Safety data sheet

BASF Safety data sheet according to Regulation (EC) No. 1907/2006
Date / Revised: 10.05.2011 Version: 2.0
Product: **MasterRoc ACP 143 also RHEOSOIL 143**
(ID no. 30599117/SDS_GEN_GB/EN)
Date of print 20.07.2013

1. Identification of the substance/mixture and of the company/undertaking

Product identifier

MasterRoc ACP 143 also RHEOSOIL 143

Relevant identified uses of the substance or mixture and uses advised against

Relevant identified uses: Product for construction chemicals

Details of the supplier of the safety data sheet

Company:
BASF SE
67056 Ludwigshafen
GERMANY

Contact address:
BASF plc
PO Box 4, Earl Road, Cheadle Hulme,
Cheadle, Cheshire
SK8 6QG, UNITED KINGDOM

Telephone: +44 161 485-6222
E-mail address: product-safety-north@basf.com

Emergency telephone number

International emergency number:
Telephone: +49 180 2273-112

2. Hazards Identification

Label elements

According to Directive 67/548/EEC or 1999/45/EC

Directive 1999/45/EC ('Preparation Directive')

Hazard symbol(s)

Xi	Irritant.	

R-phrase(s)

R36/38	Irritating to eyes and skin.

S-phrase(s)

S2	Keep out of the reach of children.
S36/37/39	Wear suitable protective clothing, gloves and eye/face protection.
S24/25	Avoid contact with skin and eyes.
S26	In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

Classification of the substance or mixture

According to Directive 67/548/EEC or 1999/45/EC

Possible Hazards:
Irritant.
Irritating to eyes and skin.
Further possible risks to man and the environment, eg as a result of decomposition and/or reaction products, are to be taken from the corresponding sections of this safety data sheet.

Other hazards

According to Regulation (EC) No 1272/2008 [CLP]

Other Hazards (GHS):
If applicable information is provided in this section on other hazards which do not result in classification but which may contribute to the overall hazards of the substance or mixture.

3. Composition/Information on Ingredients

Mixtures

Chemical nature

anionic surfactants
in water

Hazardous ingredients
according to Directive 1999/45/EC

sodium lauyl ether sulfate
Content (W/W): >= 15 % - < 30 %
CAS Number: 68585-34-2
EC-Number: 500-223-8
Hazard symbol(s): Xi
R-phrase(s): 38, 41

For the classifications not written out in full in this section, including the indication of danger, the hazard symbols, the R phrases, and the hazard statements, the full text is listed in section 16.

4. First-Aid Measures

Description of first aid measures

First aid personnel should pay attention to their own safety. Remove contaminated clothing.

If inhaled:
If difficulties occur after vapour/aerosol has been inhaled, remove to fresh air and seek medical attention.

On skin contact:
After contact with skin, wash immediately with plenty of water and soap. Under no circumstances should organic solvent be used. If irritation develops, seek medical attention.

On contact with eyes:
Wash affected eyes for at least 15 minutes under running water with eyelids held open, consult an eye specialist.

On ingestion:
Rinse mouth immediately and then drink plenty of water, seek medical attention. Do not induce vomiting unless told to by a poison control center or doctor.

Most important symptoms and effects, both acute and delayed

Symptoms: The most important known symptoms and effects are described in the labelling (see section 2) and/or in section 11.

Indication of any immediate medical attention and special treatment needed

Treatment: Treat according to symptoms (decontamination, vital functions), no known specific antidote.

5. Fire-Fighting Measures

Extinguishing media

Suitable extinguishing media:
foam, water spray, dry powder, carbon dioxide

Unsuitable extinguishing media for safety reasons:
water jet

Special hazards arising from the substance or mixture

carbon monoxide, carbon dioxide, harmful vapours, nitrogen oxides, fumes/smoke, carbon black

Advice for fire-fighters

Special protective equipment:
Wear a self-contained breathing apparatus.

Further information:
The degree of risk is governed by the burning substance and the fire conditions. Contaminated extinguishing water must be disposed of in accordance with official regulations.

6. Accidental Release Measures

Personal precautions, protective equipment and emergency procedures
Use personal protective clothing. Do not breathe vapour/aerosol/spray mists. Handle in accordance with good building materials hygiene and safety practice.

Environmental precautions
Contain contaminated water/firefighting water. Do not discharge into drains/surface waters/groundwater.

Methods and material for containment and cleaning up
For small amounts: Pick up with inert absorbent material (e.g. sand, earth etc.). Dispose of contaminated material as prescribed.
For large amounts: Pump off product.

Reference to other sections
Information regarding exposure controls/personal protection and disposal considerations can be found in section 8 and 13.

7. Handling and Storage

Precautions for safe handling
Avoid aerosol formation. Avoid inhalation of mists/vapours. Avoid skin contact. No special measures necessary provided product is used correctly.

Protection against fire and explosion:
The product does not contribute to the spreading of flames, nor is it self combustible, not explosive. Take precautionary measures against static discharges.

Conditions for safe storage, including any incompatibilities

Suitable materials for containers: High density polyethylene (HDPE)
Further information on storage conditions: Keep only in the original container in a cool, well-ventilated place. Protect from direct sunlight. Store protected against freezing.

Specific end use(s)
For the relevant identified use(s) listed in Section 1 the advice mentioned in this section 7 is to be observed.

8. Exposure Controls/Personal Protection

Control parameters

Components with workplace control parameters

The substances without values are not listed in the occupational exposure regulations for the validity area of this safety data sheet.

Exposure controls

Personal protective equipment

Respiratory protection:
Wear respiratory protection if ventilation is inadequate. Combination filter for gases/vapours of organic, inorganic, acid inorganic and alkaline compounds (e.g. EN 14387 Type ABEK).

Hand protection:
Suitable chemical resistant safety gloves (EN 374) also with prolonged, direct contact (Recommended: Protective index 6, corresponding > 480 minutes of permeation time according to EN 374): E.g. nitrile rubber (0.4 mm), chloroprene rubber (0.5 mm), butyl rubber (0.7 mm) and other Manufacturer's directions for use should be observed because of great diversity of types.

Eye protection:
Safety glasses with side-shields (frame goggles) (e.g. EN 166)

Body protection:
Body protection must be chosen depending on activity and possible exposure, e.g. apron, protecting boots, chemical-protection suit (according to EN 14605 in case of splashes or EN ISO 13982 in case of dust).

General safety and hygiene measures
Avoid contact with the skin, eyes and clothing. In order to prevent contamination while handling, closed working clothes and working gloves should be used. Handle in accordance with good building materials hygiene and safety practice. When using, do not eat, drink or smoke. Hands and/or face should be washed before breaks and at the end of the shift. At the end of the shift the skin should be cleaned and skin-care agents applied. Gloves must be inspected regularly and prior to each use. Replace if necessary (e.g. pinhole leaks).

9. Physical and Chemical Properties

Information on basic physical and chemical properties

Form:	liquid
Colour:	dark brown
Odour:	characteristic
pH value:	6 - 8 (20 °C)
Boiling point:	not applicable
Flash point:	The product has not been tested.
Flammability:	Not flammable
Ignition temperature:	not applicable
Vapour pressure:	No data available.
Density:	1.040 - 1.044 g/cm3 (20 °C)
Solubility in water:	miscible
Thermal decomposition:	No decomposition if stored and handled as prescribed/indicated.
Viscosity, dynamic:	approx. < 200 mPa.s (DIN EN ISO 2555) (approx. 20 °C)

Other information

Bulk density:
not applicable
Other Information:
If necessary, information on other physical and chemical parameters is indicated in this section.

10. Stability and Reactivity

Reactivity
No hazardous reactions if stored and handled as prescribed/indicated.

Corrosion to metals: No corrosive effect on metal.

Chemical stability
The product is stable if stored and handled as prescribed/indicated.

Possibility of hazardous reactions
The product is stable if stored and handled as prescribed/indicated.

Conditions to avoid
See MSDS section 7 - Handling and storage.

Incompatible materials

Substances to avoid:
strong acids, strong bases, strong oxidizing agents

Hazardous decomposition products

No hazardous decomposition products if stored and handled as prescribed/indicated.

11. Toxicological Information

Information on toxicological effects

Irritation

Assessment of irritating effects:
Eye contact causes irritation. Skin contact causes irritation. The product has not been tested. The statement has been derived from the properties of the individual components.

Experimental/calculated data:
Skin corrosion/irritation rabbit: Irritant.

Serious eye damage/irritation rabbit: Irritant.

Respiratory/Skin sensitization

Assessment of sensitization:
A sensitizing effect on particularly sensitive individuals cannot be excluded. The product has not been tested. The statement has been derived from the properties of the individual components.

Carcinogenicity

Assessment of carcinogenicity:
The product has not been tested. The statement has been derived from the properties of the individual components.

Reproductive toxicity

Assessment of reproduction toxicity:
The product has not been tested. The statement has been derived from the properties of the individual components.

Developmental toxicity

Assessment of teratogenicity:
The product has not been tested. The statement has been derived from the properties of the individual components.

Repeated dose toxicity and Specific target organ toxicity (repeated exposure)

Assessment of repeated dose toxicity:
The product has not been tested. The statement has been derived from the properties of the individual components.

Other relevant toxicity information

Based on our experience and the information available, no adverse health effects are expected if handled as recommended with suitable precautions for designated uses. The product has not been tested. The statements on toxicology have been derived from the properties of the individual components.

12. Ecological Information

Toxicity

Assessment of aquatic toxicity:
At the present state of knowledge, no negative ecological effects are expected. There is a high probability that the product is not acutely harmful to aquatic organisms.

Toxicity to fish:
LC50 (96 h) approx. 100 mg/l, Oncorhynchus mykiss

Persistence and degradability

Assessment biodegradation and elimination (H2O):
Readily biodegradable (according to OECD criteria).

Elimination information:
> 60 % (28 d) (OECD Guideline 301 F) Readily biodegradable (according to OECD criteria).

Bioaccumulative potential

Assessment bioaccumulation potential:
The product has not been tested. The statement has been derived from the properties of the individual components.

Mobility in soil (and other compartments if available)

Assessment transport between environmental compartments:
The product has not been tested. The statement has been derived from the properties of the individual components.

Results of PBT and vPvB assessment

The product does not fulfill the criteria for PBT (persistent/bioaccumulative/toxic) or vPvB (very persistent/very bioaccumulative).

Additional information

Other ecotoxicological advice:
Do not discharge product into the environment without control. Do not discharge substance/product into sewer system. The product has not been tested. The statements on ecotoxicology have been derived from products of a similar structure and composition.

13. Disposal Considerations

Waste treatment methods

Observe national and local legal requirements.
Residues should be disposed of in the same manner as the substance/product.

The UK Environmental Protection (Duty of Care) Regulations (EP) and amendments should be noted (United Kingdom).

This product and any uncleaned containers must be disposed of as hazardous waste in accordance with the 2005 Hazardous Waste Regulations and amendments (United Kingdom)

Contaminated packaging:
Contaminated packaging should be emptied as far as possible; then it can be passed on for recycling after being thoroughly cleaned.

14. Transport Information

Land transport

ADR

Not classified as a dangerous good under transport regulations

RID

Not classified as a dangerous good under transport regulations

Inland waterway transport
ADN

Not classified as a dangerous good under transport regulations

Sea transport
IMDG

Not classified as a dangerous good under transport regulations

Air transport
IATA/ICAO

Not classified as a dangerous good under transport regulations

15. Regulatory Information

Safety, health and environmental regulations/legislation specific for the substance or mixture

The data should be considered when making any assessment under the Control of Substances Hazardous to Health Regulations (COSHH), and related guidance, for example, 'COSHH Essentials' (United Kingdom).
This product is classified under the Chemicals (Hazard Information and Packaging) Regulations, (CHIP) (United Kingdom).

16. Other Information

In addition to the information given in the safety data sheet we refer to the product specific 'Technical Information'.

Full text of the classifications, including the indication of danger, the hazard symbols, the R phrases, and the hazard statements, if mentioned in section 2 or 3:

Xi	Irritant.
38	Irritating to skin.
41	Risk of serious damage to eyes.

Vertical lines in the left hand margin indicate an amendment from the previous version.

If you have any queries relating to this MSDS, it's contents or any other product safety related questions, please write to the following e-mail address: product-safety-north@basf.com

The data contained in this safety data sheet are based on our current knowledge and experience and describe the product only with regard to safety requirements. The data do not describe the product's properties (product specification). Neither should any agreed property nor the suitability of the product for any specific purpose be deduced from the data contained in the safety data sheet. It is the responsibility of the recipient of the product to ensure any proprietary rights and existing laws and legislation are observed.

Annex: Exposure Scenarios

A.4. Mapei – Polyfoamer FP

Safety Data Sheet
POLYFOAMER FP

Safety Data Sheet dated 9/7/2013, version 1

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Trade name: POLYFOAMER FP

1.2. Relevant identified uses of the substance or mixture.

Foaming agent

Uses advised against:

==

1.3. Details of the supplier of the safety data sheet

Supplier:

MAPEI S.p.A. -Via Cafiero 22 - Milan -ITALY

Competent person responsible for the safety data sheet:

sicurezza@mapei.it

1.4. Emergency telephone number

MAPEI S.p.A. - Tel. +(39)02376731 - (office hours)

Poison Centre - Ospedale di Niguarda - Milan - Tel. +39/02/66101029

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Directive criteria, 67/548/CE, 1999/45/EC and following amendments thereof:

Properties / Symbols:

This product is not a hazardous article and need not be labelled according to EC Directive 67/548, 99/45 as amended.

Adverse physicochemical, human health and environmental effects:

No other hazards

2.2. Label elements

Special Provisions:

Safety data sheet available for professional user on request.

Special provisions according to Annex XVII of REACH and subsequent amendments:

None

2.3. Other hazards

vPvB Substances: None - PBT Substances: None

Other Hazards:

The product is not classified dangerous according to the "Preparations Directive" (1999/45/CE); in fact it is a water based preparation in which there are no dangerous components. The below mentioned crystalline silica, that originally is in the shape of inhalable powder with specific exposure limits, after its mixture into the preparation doesn't involve any exposure risk.

No other hazards

SECTION 3: Composition/information on ingredients

3.1. Substances

N.A.

3.2. Mixtures

Hazardous components within the meaning of EEC directive 67/548 and CLP regulation and corresponding classification:

10% - 20% alcohols, C12-14, ethoxylated, sulfates, sodium salts
CAS: 68891-38-3, EC: 500-234-8
Xi; R36/38
3.3/2 Eye Irrit. 2 H319
3.2/2 Skin Irrit. 2 H315

SECTION 4: First aid measures

4.1. Description of first aid measures

In case of skin contact:

Wash with plenty of water and soap.

In case of eyes contact:

In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
Wash immediately with water for at least 10 minutes.

In case of Ingestion:

A suspension of activated charcoal in water, or petrolium jelly may be administered.
Wash the mouth thoroughly and drink plenty of water. In case of disease consult a physician immediately and present this safety-data sheet.

In case of Inhalation:

Remove casualty to fresh air and keep warm and at rest.

4.2. Most important symptoms and effects, both acute and delayed

No specific hazards are encountered under normal product use.

4.3. Indication of any immediate medical attention and special treatment needed

Treatment:
(see paragraph 4.1)

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media:
None in particular.
Extinguishing media which must not be used for safety reasons:
None in particular.

5.2. Special hazards arising from the substance or mixture

The product does not present a fire hazard
Do not inhale explosion and combustion gases.
Burning produces heavy smoke.
The original ingredients or unidentified toxic and/or irritant compounds may be present in the combustion fumes.

5.3. Advice for firefighters

Use suitable breathing apparatus .
Collect contaminated fire extinguishing water separately. This must not be discharged into drains.
Move undamaged containers from immediate hazard area if it can be done safely.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Wear personal protection equipment.
Remove persons to safety.
See protective measures under point 7 and 8.

6.2. Environmental precautions

Limit leakages with earth or sand.
Do not allow to enter into soil/subsoil. Do not allow to enter into surface water or drains.
In case of gas escape or of entry into waterways, soil or drains, inform the responsible

authorities.

6.3. Methods and material for containment and cleaning up

Suitable material for taking up: absorbing material, organic, sand

Wash with plenty of water.

Retain contaminated washing water and dispose it.

6.4. Reference to other sections

See also section 8 and 13

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Avoid contact with skin and eyes, inhaltion of vapours and mists.

Do not eat or drink while working.

See also section 8 for recomened protective equipment.

7.2. Conditions for safe storage, including any incompatibilities

Keep away from food, drink and feed.

Incompatible materials:

None in particular.

Instructions as regards storage premises:

Adequately ventilated premises.

Store above 5℃.

7.3. Specific end use(s)

None in particular

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

No occupational exposure limit available

DNEL Exposure Limit Values

N.A.

PNEC Exposure Limit Values

N.A.

8.2. Exposure controls

Eye protection:

Not needed for normal use. Anyway, operate according good working practices.

Protection for skin:

No special precaution must be adopted for normal use.

Protection for hands:

The use of LLPDE (0,06 mm), nitrile (0,4) or butyl (0,5 mm) gloves is suggested.

Latex gloves are not recommended.

Respiratory protection:

Not needed for normal use.

Personal Protective Equipment should comply with relevant CE standards (as EN 374 for gloves and EN 166 for goggles), correctly maintained and stored. Consult the supplier to check the suitability of equipment against specific chemicals and for user information.

Thermal Hazards:

None

Environmental exposure controls:

None

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance:	liquid
Colour:	colorless
Odour:	light yellow
Odour threshold:	N.A.
pH:	8-11
Melting point / freezing point:	N.A.
Initial boiling point and boiling range:	> 100 °C
Solid/gas flammability:	N.A.
Upper/lower flammability or explosive limits:	N.A.
Vapour density:	N.A.
Flash point:	== °C
Evaporation rate:	N.A.
Vapour pressure:	N.A.
Relative density:	1,01 g/cm³ (23°C)
Vapour density (air=1):	N.A.
Solubility in water:	soluble
Solubility in oil:	N.A.
Viscosity:	== mPa.s (23°C)
Auto-ignition temperature:	N.A.
Explosion limits(by volume):	N.A.
Decomposition temperature:	N.A.
Partition coefficient (n-octanol/water):	N.A.
Explosive properties:	N.A.
Oxidizing properties:	N.A.

9.2. Other information

Miscibility:	N.A.
Fat Solubility:	N.A.
Conductivity:	N.A.
Substance Groups relevant properties	N.A.

SECTION 10: Stability and reactivity

10.1. Reactivity

Stable under normal conditions

10.2. Chemical stability

Stable under normal conditions

10.3. Possibility of hazardous reactions

None

10.4. Conditions to avoid

Stable under normal conditions.

10.5. Incompatible materials

None in particular.

10.6. Hazardous decomposition products

None.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Route(s) of entry:

Ingestion:	Yes
Inhalation:	No
Contact:	No

Toxicological information related to the product:

There is no toxicological data available on the mixture. Consider the individual concentration of each component to assess toxicological effects resulting from exposure to the mixture.

Toxicological information of the mixture:
N.A.
Toxicological information of the main substances found in the mixture:
alcohols, C12-14, ethoxylated, sulfates, sodium salts - CAS: 68891-38-3
LD 50 oral rat: > 2000 mg/kg
LD 50 skin rat: > 2000 mg/kg

Corrosive/Irritating Properties:
Eye:
The product can cause a temporary irritation by contact.
Sensitizing Properties:
No effects are known.
Cancerogenic Effects:
No effects are known.
Mutagenic Effects:
No effects are known.
Teratogenic Effects:
No effects are known.
If not differently specified, the information required in Regulation 453/2010/EC listed below must be considered as N.A.:
a) acute toxicity;
b) skin corrosion/irritation;
c) serious eye damage/irritation;
d) respiratory or skin sensitisation;
e) germ cell mutagenicity;
f) carcinogenicity;
g) reproductive toxicity;
h) STOT-single exposure;
i) STOT-repeated exposure;
j) aspiration hazard.

SECTION 12: Ecological information

12.1. Toxicity
Not available data on the mixture
Aquatic toxicity: the preparation is not to be considered toxic to the aquatic environment based on components.
LC50>100mg/l - aquatic species (calculated data following 1999/45/EC Directive).
Biodegradability: The product is readily and rapidly degradable (biodegradation value >60%, OECD 301 D).
Adopt good industrial practices, so that the product is not released into the environment.
N.A.
12.2. Persistence and degradability
N.A.
12.3. Bioaccumulative potential
N.A.
12.4. Mobility in soil
N.A.
12.5. Results of PBT and vPvB assessment
Wassergefärdungsklasse (WGK): 1
vPvB Substances: None - PBT Substances: None
12.6. Other adverse effects
Not available data on the mixture

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Recover if possible. In so doing, comply with the local and national regulations currently in force.
91/156/EEC, 91/689/EEC, 94/62/EC and subsequent amendments.
The suggested European waste code is just based on the composition of the product.
According to the specific process or application field a different waste code may be necessary.

SECTION 14: Transport information

14.1. UN number

Not classified as dangerous in the meaning of transport regulations.

UN Number:	==

14.2. UN proper shipping name

N.A.

14.3. Transport hazard class(es)

Rail/Road(RID/ADR):	no dangerous good
ADR-Upper number:	NA
Air (ICAO/IATA):	no dangerous good
Sea (IMO/IMDG):	no dangerous good

N.A.

14.4. Packing group

N.A.

14.5. Environmental hazards

ADR Enverinmental Pollutant:

Marine pollutant:	No

N.A.

14.6. Special precautions for user

N.A.

14.7. Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code

No

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

Dir. 67/548/EEC (Classification, packaging and labelling of dangerous substances)
Dir. 99/45/EC (Classification, packaging and labelling of dangerous preparations)
Dir. 98/24/EC (Risks related to chemical agents at work)
Dir. 2000/39/EC (Occupational exposure limit values)
Dir. 2006/8/EC
Regulation (EC) n. 1907/2006 (REACH)
Regulation (EC) n. 1272/2008 (CLP)
Regulation (EC) n. 790/2009 (ATP 1 CLP)
Regulation (EU) n. 453/2010 (Annex I)
Regulation (EU) n. 286/2011 (ATP 2 CLP)

Restrictions related to the product or the substances contained according to Annex XVII Regulation (EC) 1907/2006 (REACH) and subsequent modifications:

None

REACH Regulation (1907/2006)

REACH Regulatio n°1907/2006 (REACH) – Art. 59 (Su bstances in “Candidate List”): N.A.
CLP Regulation n°1272/2008 (CLP) and s.m.i.
Directive n°1999/45/CE (Dangerous Preparation) an d s.m.i.
Directive n°67/548/CEE (Substances) and s.m.i.

Directive 2000/39/CE and s.m.i. (Professional threshold limit)

Directive 105/2003/CE (Seveso III): N.A.

ADR Agreement – IMDG Code – IATA Regulation
Wassergefährdungsklasse:

VOC (2004/42/EC) : N.A. g/l

15.2. Chemical safety assessment

No

SECTION 16: Other information

Text of phrases referred to under heading 3:
R36/38 Irritating to eyes and skin.

H319 Causes serious eye irritation.
H315 Causes skin irritation.

This document was prepared by a competent person who has received appropriate training.
Main bibliographic sources:
NIOSH - Registry of toxic effects of chemical substances
ECDIN - Environmental Chemicals Data and Information Network - Joint Research Centre, Commission of the European Communities
SAX'S - Dangerous properties of industrial materials
Istituto Superiore di Sanità - Inventario Nazionale Sostanze Chimiche
The information contained herein is based on our state of knowledge at the above-specified date. It refers solely to the product indicated and constitutes no guarantee of particular quality.
This MSDS cancels and replaces any preceding release.

ADR:	European Agreement concerning the International Carriage of Dangerous Goods by Road.
CAS:	Chemical Abstracts Service (division of the American Chemical Society).
CLP:	Classification, Labeling, Packaging.
DNEL:	Derived No Effect Level.
EINECS:	European Inventory of Existing Commercial Chemical Substances.
GefStoffVO:	Ordinance on Hazardous Substances, Germany.
GHS:	Globally Harmonized System of Classification and Labeling of Chemicals.
IATA:	International Air Transport Association.
IATA-DGR:	Dangerous Goods Regulation by the “International Air Transport Association” (IATA).
ICAO:	International Civil Aviation Organization.
ICAO-TI:	Technical Instructions by the “International Civil Aviation Organization” (ICAO).
IMDG:	International Maritime Code for Dangerous Goods.
INCI:	International Nomenclature of Cosmetic Ingredients.
KSt:	Explosion coefficient.

LC50:	Lethal concentration, for 50 percent of test population.
LD50:	Lethal dose, for 50 percent of test population.
LTE:	Long-term exposure.
PNEC:	Predicted No Effect Concentration.
RID:	Regulation Concerning the International Transport of Dangerous Goods by Rail.
STE:	Short-term exposure.
STEL:	Short Term Exposure limit.
STOT:	Specific Target Organ Toxicity.
TLV:	Threshold Limiting Value.
TWA	Threshold Limit Value for the Time Weighted Average 8 hour day. (ACGIH Standard).
OEL:	European threshold limit value
VLE:	Threshold Limiting Value.
WGK:	German Water Hazard Class.
N.A.:	N.A.
N.D.:	

A.5. Mapei – Mapedrill M1

Safety Data Sheet
MAPEDRILL M 1

Safety Data Sheet dated 9/1/2017, version 3

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier
Trade name: MAPEDRILL M 1

1.2. Relevant identified uses of the substance or mixture and uses advised against
Recommended use:
Emulsion anyonic polymer
Uses advised against:
==

1.3. Details of the supplier of the safety data sheet
Supplier:
MAPEI SPAIN S.A.-- Street_ Valencia 11- Pol. CanOller
08130 - Santa Perpetua de Mogoda - Barcelona
Competent person responsible for the safety data sheet:
sicurezza@mapei.it

1.4. Emergency telephone number
MAPEI SPAIN S.A.- tel: +34-93-3435050
fax:+34-93-3024229
www.mapei.es (office hours)
Poison center: phone: 91.562.04.20

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture
EC regulation criteria 1272/2008 (CLP)

The product is not classified as dangerous according to Regulation EC 1272/2008 (CLP).

Adverse physicochemical, human health and environmental effects:
No other hazards

2.2. Label elements

Hazard pictograms:
None
Hazard Statements:
None
Precautionary Statements:
None
Special Provisions:
EUH210 Safety data sheet available on request.

The product is not classified as dangerous according to Regulation EC 1272/2008 (CLP).

Special provisions according to Annex XVII of REACH and subsequent amendments:
None
2.3. Other hazards
vPvB Substances: None - PBT Substances: None
Other Hazards:
No other hazards

SECTION 3: Composition/information on ingredients

3.1. Substances
N.A.

3.2. Mixtures

Hazardous components within the meaning of the CLP regulation and related classification:
>= 25% - < 50% idrocarbuti, C12-C15, n-alcani, isoalcani, ciclici, <2% aromatici
REACH No.: 01-2119453414-43-XXXX, CAS: 920-107-4
3.10/1 Asp. Tox. 1 H304

SECTION 4: First aid measures

4.1. Description of first aid measures
In case of skin contact:
Wash with plenty of water and soap.
In case of eyes contact:
In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
Wash immediately with water for at least 10 minutes.
In case of Ingestion:
Do not under any circumstances induce vomiting. OBTAIN A MEDICAL EXAMINATION IMMEDIATELY.
A suspension of activated charcoal in water, or petrolium jelly may be administered.
Wash the mouth thoroughly and drink plenty of water. In case of disease consult a physician immediately and present this safety-data sheet.
In case of Inhalation:
Remove casualty to fresh air and keep warm and at rest.
4.2. Most important symptoms and effects, both acute and delayed
No specific hazards are encountered under normal product use.
4.3. Indication of any immediate medical attention and special treatment needed
Treatment:
(see paragraph 4.1)

SECTION 5: Firefighting measures

5.1. Extinguishing media
Suitable extinguishing media:
Water.
CO2 or Dry chemical fire extinguisher.
Extinguishing media which must not be used for safety reasons:
None in particular.
5.2. Special hazards arising from the substance or mixture
The product does not present a fire hazard
Do not inhale explosion and combustion gases.
The original ingredients or unidentified toxic and/or irritant compounds may be present in the

combustion fumes.

5.3. Advice for firefighters

Use suitable breathing apparatus .

Collect contaminated fire extinguishing water separately. This must not be discharged into drains.

Move undamaged containers from immediate hazard area if it can be done safely.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Wear personal protection equipment.

Remove all sources of ignition.

Remove persons to safety.

See protective measures under point 7 and 8.

6.2. Environmental precautions

Limit leakages with earth or sand.

Do not allow to enter into soil/subsoil. Do not allow to enter into surface water or drains.

Retain contaminated washing water and dispose it.

In case of gas escape or of entry into waterways, soil or drains, inform the responsible authorities.

Suitable material for taking up: absorbing material, organic, sand

6.3. Methods and material for containment and cleaning up

After the product has been recovered, rinse the area and materials involved with water.

Suitable material for taking up: absorbing material, organic, sand

Wash with plenty of water.

Retain contaminated washing water and dispose it.

6.4. Reference to other sections

See also section 8 and 13

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Avoid contact with skin and eyes, inhalation of vapours and mists.

Do not eat or drink while working.

See also section 8 for recommended protective equipment.

7.2. Conditions for safe storage, including any incompatibilities

Keep away from food, drink and feed.

Incompatible materials:

None in particular.

Instructions as regards storage premises:

Adequately ventilated premises.

Store above 5℃.

7.3. Specific end use(s)

None in particular

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

No occupational exposure limit available

DNEL Exposure Limit Values

N.A.

PNEC Exposure Limit Values

N.A.

8.2. Exposure controls

Eye protection:

Not needed for normal use. Anyway, operate according good working practices.

Protection for skin:
No special precaution must be adopted for normal use.
Not needed for normal use.
Respiratory protection:
Not needed for normal use.

Personal Protective Equipment should comply with relevant CE standards (as EN 374 for gloves and EN 166 for goggles), correctly maintained and stored. Consult the supplier to check the suitability of equipment against specific chemicals and for user information.

Thermal Hazards:
None
Environmental exposure controls:
None

Appropriate engineering controls:
None

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance:	liquid
Colour:	white
Odour:	typical
Odour threshold:	N.A.
pH:	7,5
Melting point / freezing point:	< 5 °C
Initial boiling point and boiling range:	> 100 °C
Solid/gas flammability:	N.A.
Upper/lower flammability or explosive limits:	N.A.
Vapour density:	N.A.
Flash point:	> 100 °C
Evaporation rate:	N.A.
Vapour pressure:	2.3 kPa (23°C)
Relative density:	1,0-1.1 g/cm³ (23°C)
Vapour density (air=1):	N.A.
Solubility in water:	completely miscible
Solubility in oil:	N.A.
Viscosity:	1200 mPa.s (23°C)
Viscosity mm2/s :	>20,5
Auto-ignition temperature:	N.A.
Explosion limits(by volume):	N.A.
Decomposition temperature:	> 150
Partition coefficient (n-octanol/water):	N.A.
Explosive properties:	N.A.
Oxidizing properties:	N.A.

9.2. Other information

Miscibility:	N.A.
Fat Solubility:	N.A.
Conductivity:	N.A.
Substance Groups relevant properties	N.A.

SECTION 10: Stability and reactivity

10.1. Reactivity

Stable under normal conditions
10.2. Chemical stability
Stable under normal conditions
10.3. Possibility of hazardous reactions
None
10.4. Conditions to avoid
Stable under normal conditions.
10.5. Incompatible materials
None in particular.
10.6. Hazardous decomposition products
None.

SECTION 11: Toxicological information

11.1. Information on toxicological effects
Route(s) of entry:
Ingestion: Yes
Inhalation: No
Contact: No
There is no toxicological data available on the mixture. Consider the individual concentration of each component to assess toxicological effects resulting from exposure to the mixture.
Toxicological information on main components of the mixture:
Toxicological information of the mixture:
MAPEDRILL M 1
a) acute toxicity:
Test: LD50 - Route: Oral - Species: Rat > 5000 mg/kg
Test: LD50 - Route: Skin - Species: Rat > 5000 mg/kg
c) serious eye damage/irritation:
Test: Eye Irritant : Negative
Toxicological information of the main substances found in the mixture:
idrocarbuti, C12-C15, n-alcani, isoalcani, ciclici, <2% aromatici - CAS: 920-107-4
a) acute toxicity:
Test: LD50 - Route: Oral - Species: Rat > 5000 mg/kg
Test: LD50 - Route: Skin - Species: Rabbit > 5000 mg/kg
Test: LC50 - Route: Inhalation - Species: Rat = 4951 mg/m3 - Duration: 4h
g) reproductive toxicity:
Test: map1 - Route: Oral - Species: Rat = 300 mg/l
i) STOT-repeated exposure:
Test: map1 - Route: Oral - Species: Rat = 3000 mg/kg - Notes: 90 d

Corrosive/Irritating Properties:
Eye:
The product can cause a temporary irritation by contact.
Cancerogenic Effects:
No effects are known.
Mutagenic Effects:
No effects are known.
Teratogenic Effects:
No effects are known.
If not differently specified, the information required in Regulation (EU)2015/830 listed below must be considered as N.A.:
a) acute toxicity
b) skin corrosion/irritation
c) serious eye damage/irritation
d) respiratory or skin sensitisation
e) germ cell mutagenicity

f) carcinogenicity
g) reproductive toxicity
h) STOT-single exposure
i) STOT-repeated exposure
j) aspiration hazard

SECTION 12: Ecological information

12.1. Toxicity
Adopt good industrial practices, so that the product is not released into the environment.
Biodegradability: no data available on the preparation.
MAPEDRILL M 1
a) Aquatic acute toxicity:
Endpoint: LC50 - Species: Fish > 100 mg/l - Duration h: 96
Endpoint: EC50 - Species: Daphnia > 100 mg/l - Duration h: 48
idrocarburi, C12-C15, n-alcani, isoalcani, ciclici, <2% aromatici - CAS: 920-107-4
a) Aquatic acute toxicity:
Endpoint: NOEC - Species: Daphnia > 1000 mg/l - Notes: 21 d
b) Aquatic chronic toxicity:
Endpoint: NOEC - Species: Fish > 1000 mg/l - Notes: 28 d
c) Bacteria toxicity:
Endpoint: EC50 - Species: 19126 > 1000 mg/l - Duration h: 48

12.2. Persistence and degradability
N.A.

12.3. Bioaccumulative potential
N.A.

12.4. Mobility in soil
N.A.

12.5. Results of PBT and vPvB assessment
vPvB Substances: None - PBT Substances: None

12.6. Other adverse effects
None
Not available data on the mixture

SECTION 13: Disposal considerations

13.1. Waste treatment methods
Recover if possible. In so doing, comply with the local and national regulations currently in force.
91/156/EEC, 91/689/EEC, 94/62/EC and subsequent amendments.

SECTION 14: Transport information

14.1. UN number
Not classified as dangerous in the meaning of transport regulations.
UN Number: ==

14.2. UN proper shipping name
N.A.

14.3. Transport hazard class(es)
Rail/Road(RID/ADR): no dangerous good
ADR-Upper number: NA
Air (ICAO/IATA): no dangerous good
Sea (IMO/IMDG): no dangerous good
N.A.

14.4. Packing group
N.A.

14.5. Environmental hazards

Marine pollutant: No
N.A.

14.6. Special precautions for user
N.A.

14.7. Transport in bulk according to Annex II of Marpol and the IBC Code
No

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture
Dir. 98/24/EC (Risks related to chemical agents at work)
Dir. 2000/39/EC (Occupational exposure limit values)
Regulation (EC) n. 1907/2006 (REACH)
Regulation (EC) n. 1272/2008 (CLP)
Regulation (EC) n. 790/2009 (ATP 1 CLP) and (EU) n. 758/2013
Regulation (EU) 2015/830
Regulation (EU) n. 286/2011 (ATP 2 CLP)
Regulation (EU) n. 618/2012 (ATP 3 CLP)
Regulation (EU) n. 487/2013 (ATP 4 CLP)
Regulation (EU) n. 944/2013 (ATP 5 CLP)

Restrictions related to the product or the substances contained according to Annex XVII Regulation (EC) 1907/2006 (REACH) and subsequent modifications:
Restrictions related to the product:
No restriction.
Restrictions related to the substances contained:
No restriction.

Legislative Decree no. 81 of the 9th of April 2008 Title XI "Dangerous substances - Chapter I - Protection against chemical agents"
Directive 2000/39/CE and s.m.i. (Professional threshold limit)
Legislative Decree no. 152 of the 3rd of April 2006 and subsequent modifications and additions. (Environmental regulations)
Directive 105/2003/CE (Seveso III): N.A.
ADR Agreement – IMDG Code – IATA Regulation
VOC (2004/42/EC) : N.A. g/l

TSCA (USA) : ALL INGREDIENTS LISTED OR EXEMPTED
DSL/NDSL (CANADA) : ALL INGREDIENTS LISTED ON DSL OR EXEMPTED

Provisions related to directive EU 2012/18 (Seveso III):
N.A.

15.2. Chemical safety assessment
No

SECTION 16: Other information

Text of phrases referred to under heading 3:
H304 May be fatal if swallowed and enters airways.

Paragraphs modified from the previous revision:

SECTION 16: Other information

This document was prepared by a competent person who has received appropriate training.
Main bibliographic sources:
NIOSH - Registry of toxic effects of chemical substances
ECDIN - Environmental Chemicals Data and Information Network - Joint Research Centre, Commission of the European Communities

The information contained herein is based on our state of knowledge at the above-specified date. It refers solely to the product indicated and constitutes no guarantee of particular quality.
It is the duty of the user to ensure that this information is appropriate and complete with respect to the specific use intended.
This MSDS cancels and replaces any preceding release.

ADR:	European Agreement concerning the International Carriage of Dangerous Goods by Road.
CAS:	Chemical Abstracts Service (division of the American Chemical Society).
CLP:	Classification, Labeling, Packaging.
DNEL:	Derived No Effect Level.
EINECS:	European Inventory of Existing Commercial Chemical Substances.
GefStoffVO:	Ordinance on Hazardous Substances, Germany.
GHS:	Globally Harmonized System of Classification and Labeling of Chemicals.
IATA:	International Air Transport Association.
IATA-DGR:	Dangerous Goods Regulation by the “International Air Transport Association” (IATA).
ICAO:	International Civil Aviation Organization.
ICAO-TI:	Technical Instructions by the “International Civil Aviation Organization” (ICAO).
IMDG:	International Maritime Code for Dangerous Goods.
INCI:	International Nomenclature of Cosmetic Ingredients.
KSt:	Explosion coefficient.
LC50:	Lethal concentration, for 50 percent of test population.
LD50:	Lethal dose, for 50 percent of test population.
LTE:	Long-term exposure.
PNEC:	Predicted No Effect Concentration.
RID:	Regulation Concerning the International Transport of Dangerous Goods by Rail.
STE:	Short-term exposure.
STEL:	Short Term Exposure limit.
STOT:	Specific Target Organ Toxicity.
TLV:	Threshold Limiting Value.
TWATLV:	Threshold Limit Value for the Time Weighted Average 8 hour day. (ACGIH Standard).
OEL:	Substance with a Union workplace exposure limit.
VLE:	Threshold Limiting Value.
WGK:	German Water Hazard Class.
TSCA:	United States Toxic Substances Control Act Inventory
DSL:	DSL - Canadian Domestic Substances List
N.A.:	Not available

A.6. Mapei - Mapedisp FLS

Safety Data Sheet
MAPEDISP FLS/10

Safety Data Sheet dated 8/5/2015, version 2
SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier
Trade name: MAPEDISP FLS/10

1.2. Relevant identified uses of the substance or mixture and uses advised against
Recommended use:
acrylic polimer solution
Uses advised against:
==

1.3. Details of the supplier of the safety data sheet
Supplier:
MAPEI S.p.A. - Via Cafiero, 22 - 20158 Milano
Tel: +39-02-376731
Fax: +39-02-37673.214
Competent person responsible for the safety data sheet:
sicurezza@mapei.it

1.4. Emergency telephone number
MAPEI S.p.A. - Tel. +(39)02376731 - (office hours)
Poison Centre - Ospedale di Niguarda - Milan - Tel. +39/02/66101029

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture
Adverse physicochemical, human health and environmental effects:
No other hazards

2.2. Label elements

Symbols:
None
Hazard Statements:
None
Precautionary Statements:
None
Special Provisions:
None

The product is not classified as dangerous according to Regulation EC 1272/2008 (CLP).
Special provisions according to Annex XVII of REACH and subsequent amendments:
None
2.3. Other hazards
vPvB Substances: None - PBT Substances: None

Other Hazards:
No other hazards

SECTION 3: Composition/information on ingredients

3.1. Substances
N.A.

3.2. Mixtures

Hazardous components within the meaning of EEC directive 67/548 and CLP regulation and corresponding classification:
None

SECTION 4: First aid measures

4.1. Description of first aid measures
In case of skin contact:
Wash with plenty of water and soap.
In case of eyes contact:
In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
Wash immediately with water for at least 10 minutes.
In case of Ingestion:
A suspension of activated charcoal in water, or petrolium jelly may be administered.
Wash the mouth thoroughly and drink plenty of water. In case of disease consult a physician immediately and present this safety-data sheet.
In case of Inhalation:
Remove casualty to fresh air and keep warm and at rest.
4.2. Most important symptoms and effects, both acute and delayed
No specific hazards are encountered under normal product use.
4.3. Indication of any immediate medical attention and special treatment needed
Treatment:
(see paragraph 4.1)

SECTION 5: Firefighting measures

5.1. Extinguishing media
Suitable extinguishing media:
None in particular.
Extinguishing media which must not be used for safety reasons:
None in particular.
5.2. Special hazards arising from the substance or mixture
The product does not present a fire hazard
Do not inhale explosion and combustion gases.
The original ingredients or unidentified toxic and/or irritant compounds may be present in the combustion fumes.
5.3. Advice for firefighters
Use suitable breathing apparatus .
Collect contaminated fire extinguishing water separately. This must not be discharged into drains.
Move undamaged containers from immediate hazard area if it can be done safely.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Wear personal protection equipment.
Remove persons to safety.
See protective measures under point 7 and 8.

6.2. Environmental precautions

Limit leakages with earth or sand.
Do not allow to enter into soil/subsoil. Do not allow to enter into surface water or drains.
Retain contaminated washing water and dispose it.
In case of gas escape or of entry into waterways, soil or drains, inform the responsible authorities.
Suitable material for taking up: absorbing material, organic, sand

6.3. Methods and material for containment and cleaning up

Suitable material for taking up: absorbing material, organic, sand
Wash with plenty of water.
Retain contaminated washing water and dispose it.

6.4. Reference to other sections

See also section 8 and 13

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Avoid contact with skin and eyes, inhalation of vapours and mists.
Do not eat or drink while working.
See also section 8 for recommended protective equipment.
Fine dust may form explosive mixture with air. Keep away from open flames, heat and sparks.
Do not remove shrink film in hazardous locations (because of risk of static charging/discharge)

7.2. Conditions for safe storage, including any incompatibilities

Keep away from food, drink and feed.
Incompatible materials:
None in particular.
Instructions as regards storage premises:
Adequately ventilated premises.
Store above 5°C.

7.3. Specific end use(s)

None in particular

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

No occupational exposure limit available

DNEL Exposure Limit Values

N.A.

PNEC Exposure Limit Values

N.A.

8.2. Exposure controls

Eye protection:

Not needed for normal use. Anyway, operate according good working practices.

Protection for skin:

No special precaution must be adopted for normal use.

Protection for hands:

Not needed for normal use.

Respiratory protection:

Not needed for normal use.
In case of insufficient ventilation use mask with B type filters (EN 14387).

Personal Protective Equipment should comply with relevant CE standards (as EN 374 for gloves and EN 166 for goggles), correctly maintained and stored. Consult the supplier to check the suitability of equipment against specific chemicals and for user information.

Thermal Hazards:
None
Environmental exposure controls:
None

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance:	liquid
Colour:	light yellow
Odour:	typical
Odour threshold:	N.A.
pH:	7-8
Melting point / freezing point:	N.A.
Initial boiling point and boiling range:	N.A.
Solid/gas flammability:	N.A.
Upper/lower flammability or explosive limits:	N.A.
Vapour density:	N.A.
Flash point:	c.a. 100 °C
Evaporation rate:	N.A.
Vapour pressure:	N.A.
Relative density:	N.A.
Vapour density (air=1):	N.A.
Solubility in water:	soluble
Solubility in oil:	insoluble
Viscosity:	100-800 mPa.s (23°C)
Auto-ignition temperature:	N.A.
Explosion limits(by volume):	N.A.
Decomposition temperature:	N.A.
Partition coefficient (n-octanol/water):	N.A.
Explosive properties:	N.A.
Oxidizing properties:	N.A.

9.2. Other information

Miscibility:	N.A.
Fat Solubility:	N.A.
Conductivity:	N.A.
Substance Groups relevant properties	N.A.

SECTION 10: Stability and reactivity

10.1. Reactivity
Stable under normal conditions
10.2. Chemical stability
Stable under normal conditions
10.3. Possibility of hazardous reactions
None
10.4. Conditions to avoid
Stable under normal conditions.
10.5. Incompatible materials
None in particular.
10.6. Hazardous decomposition products
None.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Route(s) of entry:

Ingestion: Yes
Inhalation: No
Contact: No

Toxicological information related to the product:

There is no toxicological data available on the mixture. Consider the individual concentration of each component to assess toxicological effects resulting from exposure to the mixture.

Toxicological information of the product:

N.A.

Toxicological information of the main substances found in the mixture:

MAPEDISP FLS/10 -

LD50/oral/rat > 2000 mg/kg

Corrosive/Irritating Properties:

Eye:

The product can cause a temporary irritation by contact.

Sensitizing Properties:

No effects are known.

Cancerogenic Effects:

No effects are known.

Mutagenic Effects:

No effects are known.

Teratogenic Effects:

No effects are known.

If not differently specified, the information required in Regulation 453/2010/EC listed below must be considered as N.A.:

a) acute toxicity
b) skin corrosion/irritation
c) serious eye damage/irritation
d) respiratory or skin sensitisation
e) germ cell mutagenicity
f) carcinogenicity
g) reproductive toxicity
h) STOT-single exposure
i) STOT-repeated exposure
j) aspiration hazard

SECTION 12: Ecological information

12.1. Toxicity

Adopt good industrial practices, so that the product is not released into the environment.
Not available data on the mixture
Aquatic toxicity: the preparation is not to be considered toxic to the aquatic environment based on components.
LC50>100mg/l - aquatic species (calculated data following 1999/45/EC Directive).
Biodegradability: not readily biodegradable
Biodegradability: no data available on the preparation.
N.A.

12.2. Persistence and degradability

N.A.

12.3. Bioaccumulative potential

N.A.

12.4. Mobility in soil

N.A.

12.5. Results of PBT and vPvB assessment

vPvB Substances: None - PBT Substances: None

12.6. Other adverse effects

Not available data on the mixture

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Recover if possible. In so doing, comply with the local and national regulations currently in force. 91/156/EEC, 91/689/EEC, 94/62/EC and subsequent amendments.

Disposal of not hardened product (EC waste code) : 16 10 02

The suggested European waste code is just based on the composition of the product.

According to the specific process or application field a different waste code may be necessary.

SECTION 14: Transport information

14.1. UN number

Not classified as dangerous in the meaning of transport regulations.

UN Number: ==

14.2. UN proper shipping name

N.A.

14.3. Transport hazard class(es)

Rail/Road(RID/ADR): no dangerous good

ADR-Upper number: NA

Air (ICAO/IATA): no dangerous good

Sea (IMO/IMDG): no dangerous good

N.A.

14.4. Packing group

N.A.

14.5. Environmental hazards

Marine pollutant: No

N.A.

14.6. Special precautions for user

N.A.

14.7. Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code

N.A.

No

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

Dir. 67/548/EEC (Classification, packaging and labelling of dangerous substances)
Dir. 99/45/EC (Classification, packaging and labelling of dangerous preparations)
Dir. 98/24/EC (Risks related to chemical agents at work)
Dir. 2000/39/EC (Occupational exposure limit values)
Dir. 2006/8/EC
Regulation (EC) n. 1907/2006 (REACH)
Regulation (EC) n. 1272/2008 (CLP)
Regulation (EC) n. 790/2009 (ATP 1 CLP) and (EU) n. 758/2013
Regulation (EU) n. 453/2010 (Annex I)
Regulation (EU) n. 286/2011 (ATP 2 CLP)

Restrictions related to the product or the substances contained according to Annex XVII Regulation (EC) 1907/2006 (REACH) and subsequent modifications:

Restrictions related to the product:

No restriction.

Restrictions related to the substances contained:

No restriction.

Directive n° 1999/45/CE (Dangerous Preparation) and s.m.i.
Legislative Decree no. 81 of the 9th of April 2008 Title XI "Dangerous substances - Chapter I - Protection against chemical agents"
Directive 2000/39/CE and s.m.i. (Professional threshold limit)
Legislative Decree no. 152 of the 3rd of April 2006 and subsequent modifications and additions. (Environmental regulations)
Directive 105/2003/CE (Seveso III): N.A.
ADR Agreement – IMDG Code – IATA Regulation
Wassergefärdungsklasse (WGK): 2
VOC (2004/42/EC) : N.A. g/l

Directive 2003/105/CE ('Activities linked to risks of serious accidents') and subsequent amendments.
Regulation (EC) nr 648/2004 (detergents).

15.2. Chemical safety assessment

No

SECTION 16: Other information

Paragraphs modified from the previous revision:

SECTION 1: Identification of the substance/mixture and of the company/undertaking
SECTION 2: Hazards identification
SECTION 5: Firefighting measures
SECTION 8: Exposure controls/personal protection
SECTION 11: Toxicological information
SECTION 12: Ecological information
SECTION 15: Regulatory information

This document was prepared by a competent person who has received appropriate training.
Main bibliographic sources:

NIOSH - Registry of toxic effects of chemical substances
ECDIN - Environmental Chemicals Data and Information Network - Joint Research Centre, Commission of the European Communities
SAX'S - Dangerous properties of industrial materials
Insert here further consulted bibliography

The information contained herein is based on our state of knowledge at the above-specified date. It refers solely to the product indicated and constitutes no guarantee of particular quality.
It is the duty of the user to ensure that this information is appropriate and complete with respect to the specific use intended.
This MSDS cancels and replaces any preceding release.

ADR:	European Agreement concerning the International Carriage of Dangerous Goods by Road.
CAS:	Chemical Abstracts Service (division of the American Chemical Society).
CLP:	Classification, Labeling, Packaging.
DNEL:	Derived No Effect Level.
EINECS:	European Inventory of Existing Commercial Chemical Substances.
GefStoffVO:	Ordinance on Hazardous Substances, Germany.
GHS:	Globally Harmonized System of Classification and Labeling of Chemicals.
IATA:	International Air Transport Association.
IATA-DGR:	Dangerous Goods Regulation by the “International Air Transport Association” (IATA).
ICAO:	International Civil Aviation Organization.
ICAO-TI:	Technical Instructions by the “International Civil Aviation Organization” (ICAO).
IMDG:	International Maritime Code for Dangerous Goods.
INCI:	International Nomenclature of Cosmetic Ingredients.
KSt:	Explosion coefficient.
LC50:	Lethal concentration, for 50 percent of test population.
LD50:	Lethal dose, for 50 percent of test population.
LTE:	Long-term exposure.
PNEC:	Predicted No Effect Concentration.
RID:	Regulation Concerning the International Transport of Dangerous Goods by Rail.
STE:	Short-term exposure.
STEL:	Short Term Exposure limit.
STOT:	Specific Target Organ Toxicity.
TLV:	Threshold Limiting Value.
TWATLV:	Threshold Limit Value for the Time Weighted Average 8 hour day. (ACGIH Standard).
OEL:	European threshold limit value
VLE:	Threshold Limiting Value.
WGK:	German Water Hazard Class.
TSCA:	United States Toxic Substances Control Act Inventory
DSL:	DSL - Canadian Domestic Substances List

A.7. Mapei – Polyfoamer FLS

Safety Data Sheet
POLYFOAMER FLS

Safety Data Sheet dated 16/5/2015, version 2

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier
Trade name: POLYFOAMER FLS

1.2. Relevant identified uses of the substance or mixture and uses advised against
Recommended use:
Foaming agent
Uses advised against:
==

1.3. Details of the supplier of the safety data sheet
Supplier:
MAPEI S.p.A. -Via Cafiero 22 - Milan -ITALY
Competent person responsible for the safety data sheet:
sicurezza@mapei.it

1.4. Emergency telephone number
MAPEI S.p.A. - Tel. +(39)02376731 - (office hours)
Poison Centre - Ospedale di Niguarda - Milan - Tel. +39/02/66101029

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture
Adverse physicochemical, human health and environmental effects:
No other hazards

2.2. Label elements

Symbols:

Warning
Hazard Statements:
H315 Causes skin irritation.
H319 Causes serious eye irritation.
Precautionary Statements:
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P332+P313 If skin irritation occurs: Get medical advice/attention.
P337+P313 If eye irritation persists: Get medical advice/attention.
P362+P364 Take off contaminated clothing and wash it before reuse.
Special Provisions:
None

Contents:
octhilinone (ISO); 2-octyl-2H-isothiazol-3-one: May produce an allergic reaction.

Special provisions according to Annex XVII of REACH and subsequent amendments:
None

2.3. Other hazards
vPvB Substances: None - PBT Substances: None

Other Hazards:
The product is not classified dangerous according to the "Preparations Directive" (1999/45/CE); in fact it is a water based preparation in which there are no dangerous components. The below mentioned crystalline silica, that originally is in the shape of inhalable powder with specific exposure limits, after its mixture into the preparation doesn't involve any exposure risk.
No other hazards

SECTION 3: Composition/information on ingredients

3.1. Substances
N.A.

3.2. Mixtures

Hazardous components within the meaning of the CLP regulation and related classification:
>= 10% - < 20% alcohols, C12-14, ethoxylated, sulfates, sodium salts
CAS: 68891-38-3, EC: 500-234-8
3.3/2 Eye Irrit. 2 H319
3.2/2 Skin Irrit. 2 H315

214 ppm glutaral; glutaraldehyde; 1,5-pentanedial
REACH No.: 01-2119455549-26-XXXX, Index number: 605-022-00-X, CAS: 111-30-8, EC: 203-856-5
3.2/1B Skin Corr. 1B H314
3.4.1/1-1A-1B Resp. Sens. 1,1A,1B H334
3.4.2/1-1A-1B Skin Sens. 1,1A,1B H317
4.1/A1 Aquatic Acute 1 H400 M=10.
3.1/3/Oral Acute Tox. 3 H301
3.1/3/Inhal Acute Tox. 3 H331

42 ppm methanol
Index number: 603-001-00-X, CAS: 67-56-1, EC: 200-659-6
2.6/2 Flam. Liq. 2 H225
3.8/1 STOT SE 1 H370
3.1/3/Oral Acute Tox. 3 H301
3.1/3/Dermal Acute Tox. 3 H311
3.1/3/Inhal Acute Tox. 3 H331

SECTION 4: First aid measures

4.1. Description of first aid measures
In case of skin contact:
Wash with plenty of water and soap.
In case of eyes contact:
In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

Wash immediately with water for at least 10 minutes.
In case of Ingestion:
Do not under any circumstances induce vomiting. OBTAIN A MEDICAL EXAMINATION IMMEDIATELY.
A suspension of activated charcoal in water, or petrolium jelly may be administered.
In case of Inhalation:
Remove casualty to fresh air and keep warm and at rest.
4.2. Most important symptoms and effects, both acute and delayed
No specific hazards are encountered under normal product use.
4.3. Indication of any immediate medical attention and special treatment needed
Treatment:
(see paragraph 4.1)

SECTION 5: Firefighting measures

5.1. Extinguishing media
Suitable extinguishing media:
None in particular.
Water.
Extinguishing media which must not be used for safety reasons:
None in particular.
5.2. Special hazards arising from the substance or mixture
Do not inhale explosion and combustion gases.
Burning produces heavy smoke.
The original ingredients or unidentified toxic and/or irritant compounds may be present in the combustion fumes.
5.3. Advice for firefighters
Use suitable breathing apparatus .
Collect contaminated fire extinguishing water separately. This must not be discharged into drains.
Move undamaged containers from immediate hazard area if it can be done safely.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures
Wear personal protection equipment.
Remove persons to safety.
See protective measures under point 7 and 8.
6.2. Environmental precautions
Limit leakages with earth or sand.
Do not allow to enter into soil/subsoil. Do not allow to enter into surface water or drains.
Retain contaminated washing water and dispose it.
In case of gas escape or of entry into waterways, soil or drains, inform the responsible authorities.
Suitable material for taking up: absorbing material, organic, sand
6.3. Methods and material for containment and cleaning up
Suitable material for taking up: absorbing material, organic, sand
Wash with plenty of water.
Retain contaminated washing water and dispose it.
6.4. Reference to other sections
See also section 8 and 13

SECTION 7: Handling and storage

7.1. Precautions for safe handling
Avoid contact with skin and eyes, inhalation of vapours and mists.
Do not eat or drink while working.

See also section 8 for recommended protective equipment.
Fine dust may form explosive mixture with air. Keep away from open flames, heat and sparks.
Do not remove shrink film in hazardous locations (because of risk of static charging/discharge)

7.2. Conditions for safe storage, including any incompatibilities

Always keep the containers tightly closed.
Keep away from food, drink and feed.
Incompatible materials:
None in particular.
Instructions as regards storage premises:
Adequately ventilated premises.

7.3. Specific end use(s)

None in particular

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

glutaral; glutaraldehyde; 1,5-pentanedial - CAS: 111-30-8

ACGIH - STE mg/m3: C 0,05 ppm - Notes: (SEN), A4 - URT, skin and eye irr, CNS impair

methanol - CAS: 67-56-1

SUVA - LTE mg/m3: 260 mg/m3, 200 ppm - STE mg/m3: 1040 mg/m3, 800 ppm
NDS - LTE mg/m3: 100 mg/m3
NDSCh - LTE mg/m3: 300 mg/m3
EU - LTE mg/m3(8h): 260 mg/m3, 200 ppm - Notes: Bold-type: Indicative Occupational Exposure Limit Values [2,3] and Limit Values for Occupational Exposure [4] (for references see bibliography)
ACGIH - LTE mg/m3(8h): 200 ppm - STE mg/m3: 250 ppm - Notes: Skin BEI - Headache, eye dam, dizziness, nausea

DNEL Exposure Limit Values

glutaral; glutaraldehyde; 1,5-pentanedial - CAS: 111-30-8

Worker Industry: 0.25 mg/m3 - Exposure: Human Inhalation - Frequency: Long Term, local effects

PNEC Exposure Limit Values

glutaral; glutaraldehyde; 1,5-pentanedial - CAS: 111-30-8

Target: Fresh Water - Value: 0.0025 mg/l
Target: Marine water - Value: 0.00025 mg/l
Target: Freshwater sediments - Value: 5.27 mg/kg
Target: Marine water sediments - Value: 0.527 mg/kg
Target: Soil (agricultural) - Value: 0.03 mg/kg

8.2. Exposure controls

Eye protection:

Not needed for normal use. Anyway, operate according good working practices.

Protection for skin:

No special precaution must be adopted for normal use.

Protection for hands:

Not needed for normal use.

Respiratory protection:

Not needed for normal use.
In case of insufficient ventilation use mask with B type filters (EN 14387).

Personal Protective Equipment should comply with relevant CE standards (as EN 374 for gloves and EN 166 for goggles), correctly maintained and stored. Consult the supplier to check the suitability of equipment against specific chemicals and for user information.

Thermal Hazards:

None

Environmental exposure controls:
None

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance:	liquid
Colour:	colorless
Odour:	light yellow
Odour threshold:	N.A.
pH:	9,5
Melting point / freezing point:	N.A.
Initial boiling point and boiling range:	> 100 °C
Solid/gas flammability:	N.A.
Upper/lower flammability or explosive limits:	N.A.
Vapour density:	N.A.
Flash point:	== °C
Evaporation rate:	N.A.
Vapour pressure:	N.A.
Relative density:	1,01 g/cm³ (23°C)
Vapour density (air=1):	N.A.
Solubility in water:	soluble
Solubility in oil:	N.A.
Viscosity:	== mPa.s (23°C)
Auto-ignition temperature:	N.A.
Explosion limits(by volume):	N.A.
Decomposition temperature:	N.A.
Partition coefficient (n-octanol/water):	N.A.
Explosive properties:	N.A.
Oxidizing properties:	N.A.

9.2. Other information

Miscibility:	N.A.
Fat Solubility:	N.A.
Conductivity:	N.A.
Substance Groups relevant properties	N.A.

SECTION 10: Stability and reactivity

10.1. Reactivity
Stable under normal conditions
10.2. Chemical stability
Stable under normal conditions
10.3. Possibility of hazardous reactions
None
10.4. Conditions to avoid
Stable under normal conditions.
10.5. Incompatible materials
None in particular.
10.6. Hazardous decomposition products
None.

SECTION 11: Toxicological information

11.1. Information on toxicological effects
Route(s) of entry:
Ingestion: Yes

Inhalation: No
Contact: No
Toxicological information related to the product:
There is no toxicological data available on the mixture. Consider the individual concentration of each component to assess toxicological effects resulting from exposure to the mixture.
Toxicological information on main components of the mixture:
Toxicological information of the mixture:
N.A.
Toxicological information of the main substances found in the mixture:
glutaral; glutaraldehyde; 1,5-pentanedial - CAS: 111-30-8
a) acute toxicity:
Test: LC50 - Route: Inhalation - Species: Rat = 0.48 mg/l - Duration: 4h
Test: LD50 - Route: Oral - Species: Rat 143-158 mg/kg
b) skin corrosion/irritation:
Test: LD50 - Route: Skin - Species: Rat > 2000 mg/kg
alcohols, C12-14, ethoxylated, sulfates, sodium salts - CAS: 68891-38-3
LD 50 oral rat: > 2000 mg/kg
LD 50 skin rat: > 2000 mg/kg

Corrosive/Irritating Properties:
Eye:
The product can cause a temporary irritation by contact.
Sensitizing Properties:
No effects are known.
Cancerogenic Effects:
No effects are known.
Mutagenic Effects:
No effects are known.
Teratogenic Effects:
No effects are known.
If not differently specified, the information required in Regulation 453/2010/EC listed below must be considered as N.A.:
a) acute toxicity
b) skin corrosion/irritation
c) serious eye damage/irritation
d) respiratory or skin sensitisation
e) germ cell mutagenicity
f) carcinogenicity
g) reproductive toxicity
h) STOT-single exposure
i) STOT-repeated exposure
j) aspiration hazard

SECTION 12: Ecological information

12.1. Toxicity
Adopt good industrial practices, so that the product is not released into the environment.
Not available data on the mixture
Aquatic toxicity: the preparation is not to be considered toxic to the aquatic environment based on components.
LC50>100mg/l - aquatic species (calculated data following 1999/45/EC Directive).
Biodegradability: not readily biodegradable
Biodegradability: The product is readily and rapidly degradable (biodegradation value >60%, OECD 301 D).

glutaral; glutaraldehyde; 1,5-pentanedial - CAS: 111-30-8
a) Aquatic acute toxicity:
Endpoint: LC50 - Species: Fish = 9.4 mg/l - Duration h: 96
Endpoint: EC50 - Species: Daphnia = 5.75 mg/l - Duration h: 48
Endpoint: LC50 - Species: Algae = 0.6 mg/l - Duration h: 72

12.2. Persistence and degradability
N.A.

12.3. Bioaccumulative potential
N.A.

12.4. Mobility in soil
N.A.

12.5. Results of PBT and vPvB assessment
List of substances dangerous for the environment and corresponding classification:
214 ppm glutaral; glutaraldehyde; 1,5-pentanedial
CAS: 111-30-8
R50 Very toxic to aquatic organisms.
LC50 (Fish): 9.4 mg/l (96 hr)
EC50 (Daphnia): 5.75 mg/l (48 hr)
LC50 (Algae): 0.6 mg/l (72 hr)
32 ppm octhilinone (ISO); 2-octyl-2H-isothiazol-3-one
CAS: 26530-20-1
R50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
EC50 (Daphnia): 0.32 mg/l (48 hr)
EC50 (Algae): 0.031 mg/l (72 hr)
LC50 (Fish): 0.047 mg/l (96 hr)
vPvB Substances: None - PBT Substances: None

12.6. Other adverse effects
None
Not available data on the mixture

SECTION 13: Disposal considerations

13.1. Waste treatment methods
Recover if possible. In so doing, comply with the local and national regulations currently in force. 91/156/EEC, 91/689/EEC, 94/62/EC and subsequent amendments.

SECTION 14: Transport information

14.1. UN number
UN Number: ==

14.2. UN proper shipping name
N.A.

14.3. Transport hazard class(es)
Rail/Road(RID/ADR): no dangerous good
ADR-Upper number: NA
Air (ICAO/IATA): no dangerous good
Sea (IMO/IMDG): no dangerous good
N.A.

14.4. Packing group
N.A.

14.5. Environmental hazards
Marine pollutant: No
N.A.

14.6. Special precautions for user

N.A.

14.7. Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code

N.A.

No

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

Dir. 98/24/EC (Risks related to chemical agents at work)
Dir. 2000/39/EC (Occupational exposure limit values)
Dir. 2006/8/EC
Regulation (EC) n. 1907/2006 (REACH)
Regulation (EC) n. 1272/2008 (CLP)
Regulation (EC) n. 790/2009 (ATP 1 CLP) and (EU) n. 758/2013
Regulation (EU) n. 453/2010 (Annex I)
Regulation (EU) n. 286/2011 (ATP 2 CLP)
Regulation (EU) n. 618/2012 (ATP 3 CLP)
Regulation (EU) n. 487/2013 (ATP 4 CLP)
Regulation (EU) n. 944/2013 (ATP 5 CLP)

Restrictions related to the product or the substances contained according to Annex XVII Regulation (EC) 1907/2006 (REACH) and subsequent modifications:

Restrictions related to the product:

Restriction 3
Restriction 40

Restrictions related to the substances contained:

No restriction.

Legislative Decree no. 81 of the 9th of April 2008 Title XI "Dangerous substances - Chapter I - Protection against chemical agents"
Directive 2000/39/CE and s.m.i. (Professional threshold limit)
Legislative Decree no. 152 of the 3rd of April 2006 and subsequent modifications and additions. (Environmental regulations)
Directive 105/2003/CE (Seveso III): N.A.
ADR Agreement – IMDG Code – IATA Regulation
VOC (2004/42/EC) : N.A. g/l

15.2. Chemical safety assessment

No

SECTION 16: Other information

Text of phrases referred to under heading 3:

H319 Causes serious eye irritation.
H315 Causes skin irritation.

H314 Causes severe skin burns and eye damage.
H334 May cause allergy or asthma symptoms or breathing difficulties if inhaled.
H317 May cause an allergic skin reaction.
H400 Very toxic to aquatic life.
H301 Toxic if swallowed.
H331 Toxic if inhaled.
H225 Highly flammable liquid and vapour.
H370 Causes damage to organs.
H311 Toxic in contact with skin.

Paragraphs modified from the previous revision:

SECTION 3: Composition/information on ingredients
SECTION 8: Exposure controls/personal protection
SECTION 11: Toxicological information
SECTION 12: Ecological information
SECTION 15: Regulatory information

This document was prepared by a competent person who has received appropriate training.
Main bibliographic sources:

NIOSH - Registry of toxic effects of chemical substances
ECDIN - Environmental Chemicals Data and Information Network - Joint Research Centre, Commission of the European Communities
SAX'S - Dangerous properties of industrial materials
Istituto Superiore di Sanità - Inventario Nazionale Sostanze Chimiche

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It is the duty of the user to ensure that this information is appropriate and complete with respect to the specific use intended.
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ADR:	European Agreement concerning the International Carriage of Dangerous Goods by Road.
CAS:	Chemical Abstracts Service (division of the American Chemical Society).
CLP:	Classification, Labeling, Packaging.
DNEL:	Derived No Effect Level.
EINECS:	European Inventory of Existing Commercial Chemical Substances.
GefStoffVO:	Ordinance on Hazardous Substances, Germany.
GHS:	Globally Harmonized System of Classification and Labeling of Chemicals.
IATA:	International Air Transport Association.
IATA-DGR:	Dangerous Goods Regulation by the “International Air Transport Association” (IATA).
ICAO:	International Civil Aviation Organization.
ICAO-TI:	Technical Instructions by the “International Civil Aviation Organization” (ICAO).
IMDG:	International Maritime Code for Dangerous Goods.
INCI:	International Nomenclature of Cosmetic Ingredients.
KSt:	Explosion coefficient.
LC50:	Lethal concentration, for 50 percent of test population.
LD50:	Lethal dose, for 50 percent of test population.
LTE:	Long-term exposure.
PNEC:	Predicted No Effect Concentration.
RID:	Regulation Concerning the International Transport of Dangerous Goods by Rail.

STE:	Short-term exposure.
STEL:	Short Term Exposure limit.
STOT:	Specific Target Organ Toxicity.
TLV:	Threshold Limiting Value.
TWATLV:	Threshold Limit Value for the Time Weighted Average 8 hour day. (ACGIH Standard).
OEL:	European threshold limit value
VLE:	Threshold Limiting Value.
WGK:	German Water Hazard Class.
TSCA:	United States Toxic Substances Control Act Inventory
DSL:	DSL - Canadian Domestic Substances List

A.8. Mapei – Eco 100 Plus

Safety Data Sheet
POLYFOAMER ECO 100 PLUS

Safety Data Sheet dated 29/7/2016, version 1

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier
Trade name: POLYFOAMER ECO 100 PLUS

1.2. Relevant identified uses of the substance or mixture and uses advised against
Recommended use:
Foaming agent
Uses advised against:
==

1.3. Details of the supplier of the safety data sheet
Supplier:
MAPEI S.p.A. - Via Cafiero, 22 - 20158 Milano
Tel: +39-02-376731
Fax: +39-02-37673.214
Competent person responsible for the safety data sheet:
sicurezza@mapei.it

1.4. Emergency telephone number
MAPEI S.p.A. - Tel. +(39)02376731 - (office hours)
Poison Centre - Ospedale di Niguarda - Milan - Tel. +39/02/66101029

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture
EC regulation criteria 1272/2008 (CLP)

The product is not classified as dangerous according to Regulation EC 1272/2008 (CLP).

Adverse physicochemical, human health and environmental effects:
No other hazards

2.2. Label elements

Hazard pictograms:
None
Hazard Statements:
None
Precautionary Statements:
None
Special Provisions:
EUH210 Safety data sheet available on request.

The product is not classified as dangerous according to Regulation EC 1272/2008 (CLP).
Special provisions according to Annex XVII of REACH and subsequent amendments:

None

2.3. Other hazards

vPvB Substances: None - PBT Substances: None

Other Hazards:

No other hazards

SECTION 3: Composition/information on ingredients

3.1. Substances

N.A.

3.2. Mixtures

Hazardous components within the meaning of the CLP regulation and related classification:

>= 5% - < 10% sodium laureth sulfate

CAS: 9004-82-4

3.3/2 Eye Irrit. 2 H319

SECTION 4: First aid measures

4.1. Description of first aid measures

In case of skin contact:

Wash with plenty of water and soap.

In case of eyes contact:

In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
Wash immediately with water for at least 10 minutes.

In case of Ingestion:

Do not under any circumstances induce vomiting. OBTAIN A MEDICAL EXAMINATION IMMEDIATELY.
A suspension of activated charcoal in water, or petrolium jelly may be administered.
Wash the mouth thoroughly and drink plenty of water. In case of disease consult a physician immediately and present this safety-data sheet.

In case of Inhalation:

Remove casualty to fresh air and keep warm and at rest.

4.2. Most important symptoms and effects, both acute and delayed

No specific hazards are encountered under normal product use.

4.3. Indication of any immediate medical attention and special treatment needed

Treatment:
(see paragraph 4.1)

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media:
None in particular.
Water.
Carbon dioxide (CO2).
Extinguishing media which must not be used for safety reasons:
None in particular.

5.2. Special hazards arising from the substance or mixture

The product does not present a fire hazard
Do not inhale explosion and combustion gases.
The original ingredients or unidentified toxic and/or irritant compounds may be present in the

combustion fumes.

5.3. Advice for firefighters

Use suitable breathing apparatus .

Collect contaminated fire extinguishing water separately. This must not be discharged into drains.

Move undamaged containers from immediate hazard area if it can be done safely.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Wear personal protection equipment.

Remove all sources of ignition.

Remove persons to safety.

See protective measures under point 7 and 8.

6.2. Environmental precautions

Limit leakages with earth or sand.

Do not allow to enter into soil/subsoil. Do not allow to enter into surface water or drains.

Retain contaminated washing water and dispose it.

In case of gas escape or of entry into waterways, soil or drains, inform the responsible authorities.

Suitable material for taking up: absorbing material, organic, sand

6.3. Methods and material for containment and cleaning up

After the product has been recovered, rinse the area and materials involved with water.

Suitable material for taking up: absorbing material, organic, sand

Wash with plenty of water.

Retain contaminated washing water and dispose it.

6.4. Reference to other sections

See also section 8 and 13

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Avoid contact with skin and eyes, inhalation of vapours and mists.

Do not eat or drink while working.

See also section 8 for recommended protective equipment.

7.2. Conditions for safe storage, including any incompatibilities

Keep away from food, drink and feed.

Incompatible materials:

None in particular.

Instructions as regards storage premises:

Adequately ventilated premises.

Store above 5℃.

7.3. Specific end use(s)

None in particular

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

No occupational exposure limit available

DNEL Exposure Limit Values

N.A.

PNEC Exposure Limit Values

N.A.

8.2. Exposure controls

Eye protection:

Not needed for normal use. Anyway, operate according good working practices.

Protection for skin:
No special precaution must be adopted for normal use.
Not needed for normal use.
Respiratory protection:
Not needed for normal use.

Personal Protective Equipment should comply with relevant CE standards (as EN 374 for gloves and EN 166 for goggles), correctly maintained and stored. Consult the supplier to check the suitability of equipment against specific chemicals and for user information.

Thermal Hazards:
None
Environmental exposure controls:
None

Appropriate engineering controls:
None

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance:	liquid
Colour:	light yellow
Odour:	typical
Odour threshold:	N.A.
pH:	8,5
Melting point / freezing point:	N.A.
Initial boiling point and boiling range:	100 ℃
Solid/gas flammability:	N.A.
Upper/lower flammability or explosive limits:	N.A.
Vapour density:	N.A.
Flash point:	>100 ℃
Evaporation rate:	N.A.
Vapour pressure:	N.A.
Relative density:	1.01-1.07 g/cm³ (23℃)
Vapour density (air=1):	N.A.
Solubility in water:	N.A.
Solubility in oil:	N.A.
Viscosity:	N.A.
Auto-ignition temperature:	N.A.
Explosion limits(by volume):	N.A.
Decomposition temperature:	N.A.
Partition coefficient (n-octanol/water):	N.A.
Explosive properties:	N.A.
Oxidizing properties:	N.A.

9.2. Other information

Miscibility:	N.A.
Fat Solubility:	N.A.
Conductivity:	N.A.
Substance Groups relevant properties	N.A.

SECTION 10: Stability and reactivity

10.1. Reactivity
Stable under normal conditions

10.2. Chemical stability
Stable under normal conditions
10.3. Possibility of hazardous reactions
None
10.4. Conditions to avoid
Stable under normal conditions.
10.5. Incompatible materials
None in particular.
10.6. Hazardous decomposition products
None.

SECTION 11: Toxicological information

11.1. Information on toxicological effects
Route(s) of entry:

Ingestion:	Yes
Inhalation:	No
Contact:	Yes

There is no toxicological data available on the mixture. Consider the individual concentration of each component to assess toxicological effects resulting from exposure to the mixture.
Toxicological information on main components of the mixture:
Toxicological information of the mixture:
N.A.
Toxicological information of the main substances found in the mixture:
sodium laureth sulfate - CAS: 9004-82-4
a) acute toxicity:
Test: LD50 - Route: Oral - Species: Rat > 2000 mg/kg

Corrosive/Irritating Properties:
Eye:
The product can cause a temporary irritation by contact.
Sensitizing Properties:
No effects are known.
Cancerogenic Effects:
No effects are known.
Mutagenic Effects:
No effects are known.
Teratogenic Effects:
No effects are known.
If not differently specified, the information required in Regulation (EU)2015/830 listed below must be considered as N.A.:
a) acute toxicity
b) skin corrosion/irritation
c) serious eye damage/irritation
d) respiratory or skin sensitisation
e) germ cell mutagenicity
f) carcinogenicity
g) reproductive toxicity
h) STOT-single exposure
i) STOT-repeated exposure
j) aspiration hazard

SECTION 12: Ecological information

12.1. Toxicity
Adopt good industrial practices, so that the product is not released into the environment.

Not available data on the mixture
Biodegradability: no data available on the preparation.
sodium laureth sulfate - CAS: 9004-82-4
a) Aquatic acute toxicity:
Endpoint: LC50 - Species: Fish = 7.1 mg/l - Duration h: 96
Endpoint: EC50 - Species: Daphnia = 7.7 mg/l - Duration h: 48
Endpoint: EC50 - Species: Algae = 12 mg/l - Duration h: 72

12.2. Persistence and degradability
N.A.

12.3. Bioaccumulative potential
N.A.

12.4. Mobility in soil
N.A.

12.5. Results of PBT and vPvB assessment
vPvB Substances: None - PBT Substances: None

12.6. Other adverse effects
None
Not available data on the mixture

SECTION 13: Disposal considerations

13.1. Waste treatment methods
Recover if possible. In so doing, comply with the local and national regulations currently in force.
91/156/EEC, 91/689/EEC, 94/62/EC and subsequent amendments.

SECTION 14: Transport information

14.1. UN number
Not classified as dangerous in the meaning of transport regulations.
UN Number: ==

14.2. UN proper shipping name
N.A.

14.3. Transport hazard class(es)
Rail/Road(RID/ADR): no dangerous good
ADR-Upper number: NA
Air (ICAO/IATA): no dangerous good
Sea (IMO/IMDG): no dangerous good
N.A.

14.4. Packing group
N.A.

14.5. Environmental hazards
Marine pollutant: No
N.A.

14.6. Special precautions for user
N.A.

14.7. Transport in bulk according to Annex II of Marpol and the IBC Code
==

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture
Dir. 98/24/EC (Risks related to chemical agents at work)
Dir. 2000/39/EC (Occupational exposure limit values)
Regulation (EC) n. 1907/2006 (REACH)
Regulation (EC) n. 1272/2008 (CLP)
Regulation (EC) n. 790/2009 (ATP 1 CLP) and (EU) n. 758/2013
Regulation (EU) 2015/830

Regulation (EU) n. 286/2011 (ATP 2 CLP)
Regulation (EU) n. 618/2012 (ATP 3 CLP)
Regulation (EU) n. 487/2013 (ATP 4 CLP)
Regulation (EU) n. 944/2013 (ATP 5 CLP)

Restrictions related to the product or the substances contained according to Annex XVII Regulation (EC) 1907/2006 (REACH) and subsequent modifications:

Restrictions related to the product:

No restriction.

Restrictions related to the substances contained:

Restriction 55

Legislative Decree no. 81 of the 9th of April 2008 Title XI "Dangerous substances - Chapter I - Protection against chemical agents"
Directive 2000/39/CE and s.m.i. (Professional threshold limit)
Legislative Decree no. 152 of the 3rd of April 2006 and subsequent modifications and additions. (Environmental regulations)
Directive 105/2003/CE (Seveso III): N.A.
ADR Agreement – IMDG Code – IATA Regulation
VOC (2004/42/EC) : N.A. g/l

Provisions related to directive EU 2012/18 (Seveso III):

N.A.

15.2. Chemical safety assessment

No

SECTION 16: Other information

Text of phrases referred to under heading 3:

H319 Causes serious eye irritation.

This document was prepared by a competent person who has received appropriate training.
Main bibliographic sources:

NIOSH - Registry of toxic effects of chemical substances
ECDIN - Environmental Chemicals Data and Information Network - Joint Research Centre, Commission of the European Communities

The information contained herein is based on our state of knowledge at the above-specified date. It refers solely to the product indicated and constitutes no guarantee of particular quality.
It is the duty of the user to ensure that this information is appropriate and complete with respect to the specific use intended.
This MSDS cancels and replaces any preceding release.

ADR:	European Agreement concerning the International Carriage of Dangerous Goods by Road.
CAS:	Chemical Abstracts Service (division of the American Chemical Society).
CLP:	Classification, Labeling, Packaging.
DNEL:	Derived No Effect Level.
EINECS:	European Inventory of Existing Commercial Chemical Substances.
GefStoffVO:	Ordinance on Hazardous Substances, Germany.
GHS:	Globally Harmonized System of Classification and Labeling of Chemicals.
IATA:	International Air Transport Association.
IATA-DGR:	Dangerous Goods Regulation by the “International Air Transport Association” (IATA).
ICAO:	International Civil Aviation Organization.
ICAO-TI:	Technical Instructions by the “International Civil Aviation Organization”

	(ICAO).
IMDG:	International Maritime Code for Dangerous Goods.
INCI:	International Nomenclature of Cosmetic Ingredients.
KSt:	Explosion coefficient.
LC50:	Lethal concentration, for 50 percent of test population.
LD50:	Lethal dose, for 50 percent of test population.
LTE:	Long-term exposure.
PNEC:	Predicted No Effect Concentration.
RID:	Regulation Concerning the International Transport of Dangerous Goods by Rail.
STE:	Short-term exposure.
STEL:	Short Term Exposure limit.
STOT:	Specific Target Organ Toxicity.
TLV:	Threshold Limiting Value.
TWATLV:	Threshold Limit Value for the Time Weighted Average 8 hour day. (ACGIH Standard).
OEL:	Substance with a Union workplace exposure limit.
VLE:	Threshold Limiting Value.
WGK:	German Water Hazard Class.
TSCA:	United States Toxic Substances Control Act Inventory
DSL:	DSL - Canadian Domestic Substances List

A.9. TNL18 – Actisoyl 100

MATERIAL SAFETY DATA SHEET

Product:

ACTISOYL 100

Date: 08/04/14 Version1.0_GB

1 - IDENTIFICATION OF THE MIXTURE AND OF THE COMPANY

1.1 PRODUCT IDENTIFIER	**ACTISOYL 100**
1.2 RELEVANT IDENTIFIED USES OF THE MIXTURE AND USES ADVISED AGAINST	Ground conditioning product
1.3 DETAILS OF THE SUPPLIER OF THE SAFETY DATA SHEET	**TNL18** **Espace St Germain, bâtiment le Saxo** **30 avenue du Général Leclerc** **F-38200 VIENNE, FRANCE** **Tel : + 33 615 426 227** Email : **msds@tnl18.com**
1.4 EMERGENCY TELEPHONE NUMBER	Poison Control Centre (INRS): + 33 1 45 42 59 59 (24h per day, 7days per week) TNL18: + 33 615 426 227 (during normal opening hours: week 8.30 am – 5.30 pm)

2 – HAZARDS IDENTIFICATION

2.1 CLASSIFICATION OF THE MIXTURE

Classification according to Directive 1999/45/EC

Xi, R36

Most important adverse effects

. Physical and chemical hazards	No particular hazard anticipated.
. Health hazard	Local irritating effects.
. Environmental hazards	No particular hazard anticipated.

2.2 LABEL ELEMENTS

Labelling according to Directive 1999/45/EC

. Symbol	 Xi
. Danger indication	Irritant
. Risk phrase	R 36: irritating to eyes
. Safety phrase	S 26: in case of contact with eyes, rinse immediately with plenty of water and seek medical advice S 39: wear eye/face protection.
2.3 OTHER HAHAZARDS	-

For the wording of the listed risk phrases, please refer to section 16.

3 - COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENTS CONTRIBUTING TO HAZARDS

Chemical name	**N°CAS**	**N°CE**	**Classification 1999/45**	**CLP classification**	**Concentration range (% w/w)**
2-Methylpentane-2,4-diol	107-41-5	203-489-0	Xi; R36-38	H315, H319	1 ≤ C < 20%
Hexan-1-ol	111-27-3	203-852-3	Xi ; R22	H302	0,1 ≤ C < 10%
Alkylether sulfate C12-14, sodium salt	68891-38-3	500-234-8	Xi ; R38, R41	H315, H318	1 ≤ C < 10%
Sulfuric acid, mono-C12-14-alkyl esters, sodium salts	85586-07-8	287-809-4	Xn ; R22, R38, R41	H302, H315, H318	0,1 ≤ C < 10%

For the wording of the listed risk phrases, please refer to section 16.
For Occupational Exposure Limits, please refer to section 8.

4 - FIRST AID MEASURES

4.1 DESCRIPTION OF FIRST AID MEASURES: If unwell or necessary, seek medical advice. Calm the victim and maintain in a comfortable position.

. Inhalation: Take the person into the open air if unwell.

. Contact with skin: After contact with the skin, rinse with plenty of water.

. Contact with eyes: In the event of contact with the eyes, rinse immediately with plenty of water including under eyelashes for at least 10 minutes. Remove contact lenses if present and easy to do. Continue to rinse. Consult an eye specialist if irritation persists.

. Ingestion: Rinse the mouth. Drink small amounts of water. DO NOT induce vomiting. Seek medical advice and show this document or the label of the product.

4.2 MOST IMPORTANT SYMPTOMS AND EFFECTS, BOTH ACUTE AND DELAYED

. Contact with eyes: Irritation, redness, tears.

4.3 INDICATION OF ANY IMMEDIATE MEDICAL ATTENTION AND SPECIAL TREATMENT NEEDED

Treat symptomatically. Clear water point recommended at the workplace.
Contact poison centre if big amount have been ingested.

5 – FIREFIGHTING MEASURES

5.1 EXTINGUISHING MEDIA

. Suitable extinguishing media: Dry powder – Sprayed water - Foam – CO_2

. Unsuitable extinguishing media: None known.

5.2 SPECIAL HAZARDS ARISING FROM THE MIXTURE: In case of fire, the increase in the pressure can lead to the explosion of the packaging. Do not inhale fumes. Expected release of carbon monoxide and carbon dioxides.

5.3 ADVICE FOR FIREFIGHTERS: Use of a self-contained respirator and a protective garment against chemicals.

6 – ACCIDENTAL RELEASE MEASURES

6.1 PERSONAL PRECAUTIONS, PROTECTIVE EQUIPMENT AND EMERGENCY PROCEDURES	Take back unnecessary people. Avoid contact with skin and eyes. Goggles, gloves and protective garment.
6.2 ENVIRONMENTAL PRECAUTIONS	Avoid entry into soil or ground/surface waters. In case of contaminates, inform appropriate authorities in accordance with local regulations.
6.3 METHODS AND MATERIAL FOR CONTAINMENT AND CLEANING UP	Large spill: contain and absorb spillage with non-combustible neutral absorbents: sand, vermiculite, earth, diatom earth. Place in sealed container and send off for destruction according to local regulations. Small spill: contain and absorb spillage with textile absorbing material. Clean with water.
6.4 REFERENCE TO OTHER SECTIONS	See sections 7, 8, 12 and 13.

7 - HANDLING AND STORAGE

7.1 PRECAUTIONS FOR SAFE HANDLING

. Precaution	Do not eat, drink and smoke during use. Avoid contact with eyes. Wash hands after use.
. Use advice	Keep the packing well closed. Make sure that ventilation is adequate.

7.2 CONDITIONS FOR SAFE STORAGE, INCLUDING ANY INCOMPATIBILITIES

. Precautions	Always keep the product in the same kind of labelled package as the original one. Keep the packing upright to prevent leakage.
. Storage conditions	Store in closed packages, in dry, cool (10-40°C) and well ventilated premises. Store sheltered from direct sunlight. Keep off from freezing.
. Recommended packing	Same kind as original one.
. Unsuitable packing	Avoid non protected metallic packing.
7.3 SPECIFIC END USE(S)	-

8 - EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 CONTROL PARAMETERS

National Occupational Exposure Limits for *2-Methylpentane-2,4-diol* : *Ceiling Limit Value

	Limit value eight hours		Limit value short term	
Country	**ppm**	**mg/m³**	**ppm**	**mg/m³**
Australia			25*	121*
Canada Ontario			25*	
Denmark	25	125	25	125
Ireland			25*	125*
New Zealand			25	121*
Singapore			25	121
South Korea			25*	125*
Sweden			25*	120*
USA NIOSH			25*	125*
UK	25	123	25	123

8 - EXPOSURE CONTROLS/PERSONAL PROTECTION

8.2 EXPOSURE CONTROLS

INDIVIDUAL PROTECTION MEASURES, SUCH AS PERSONAL PROTECTIVE EQUIPMENT

. Eye / face protection	Wear safety goggles or face shield.
. Hand protection	Gloves recommended.
. Skin protection	Protective garment recommended.
. Respiratory protection	Sufficient ventilation should be provided to maintain levels below exposure limits. Wear respiratory equipment in case of intensive use or use in confined area.
. Thermal hazards	Not relevant, based on expected use.
ENVIRONMENTAL EXPOSURE CONTROLS	See sections 6 and 7.

9 - PHYSICAL AND CHEMICAL PROPERTIES

9.1 INFORMATION ON BASIC PHYSICAL AND CHEMICAL PROPERTIES

. Appearance	Colourless liquid
. Odour	Characteristic
. Odour threshold	Not determined
. pH	8
. Melting point/freezing point	Not determined
. Initial boiling point and boiling range	Not determined
. Flash point	Not determined
. Evaporation rate	Not applicable to mixtures; no data on components
. Flammability (solid, gas)	Non applicable
. Upper/lower flammability or explosive limits	Not applicable to mixtures; no data on components
. Vapour pressure	Not applicable to mixtures; no data on components
. Vapour density	Not applicable to mixtures; no data on components
. Relative density	1.01
. Solubility(ies)	Soluble in water
. Partition coefficient: n-octanol/water	Not applicable to mixtures; no data on components
. Auto-ignition temperature	Not determined
. Decomposition temperature	Not determined
. Viscosity	Not determined
. Explosive properties	Not anticipated based on chemical structure of components
. Oxidising properties	Not determined

9.2 OTHER INFORMATION No data is available.

10 - STABILITY AND REACTIVITY

10.1 REACTIVITY	Not determined
10.2 CHEMICAL STABILITY	Stable under handling and storage conditions recommended in section 7.
10.3 POSSIBILITY OF HAZARDOUS REACTIONS	Under handling and storage conditions recommended in section 7, no hazardous reaction.
10.4 CONDITIONS TO AVOID	Not determined
10.5 INCOMPATIBLE MATERIALS	Not determined
10.6 HAZARDOUS DECOMPOSITION PRODUCTS	Under handling and storage conditions recommended in section 7, no hazardous decomposition products. See section 5 for combustion products.

11 - TOXICOLOGICAL INFORMATION

No experimental study is available on the mixture. Classification is based on the conventional method (calculation) based on available information on components.

11.1 INFORMATION ON TOXICOLOGICAL EFFECTS

. Acute toxicity	Not anticipated based on available data on components.
. Irritation	Irritating to eyes.
. Corrosivity	Not classified
. Sensitisation	Not classified
. Repeated dose toxicity	Not classified
. Carcinogenicity	Not classified
. Mutagenicity	Not classified
. Toxicity for reproduction	Not classified

12 - ECOLOGICAL INFORMATION

Do not pour down the drain or river.

12.1 TOXICITY	Not classified
12.2 PERSISTENCE AND DEGRADABILITY	Not applicable to mixtures
12.3 BIOACCUMULATIVE POTENTIAL	Not applicable to mixtures
12.4 MOBILITY IN SOIL	Not applicable to mixtures; no data on components.
12.5 RESULTS OF PBT AND VPVB ASSESSMENT	Not applicable to mixtures; no data on components.
12.6 OTHER ADVERSE EFFECTS	-

13 - DISPOSAL CONSIDERATIONS

13.1 WASTE TREATMENT METHODS

. General advise	This material and its container must be disposed of as hazardous waste. Do not pour down the drain.

Continued page 6/7

13 - DISPOSAL CONSIDERATIONS

. Unused product	Discard according to the local regulations.
. Contaminated packaging	The waste products and worn-out packages must be discarded according to the local regulations. The packaging must be completely empty before elimination.

14 - TRANSPORT INFORMATION

The product is not dangerous and the regulations ADR for road transport, RID for rail, IMDG for maritime transport and ICAO/IATA for air transport do not apply.

15 - REGULATORY INFORMATION

15.1 SAFETY, HEALTH AND ENVIRONMENTAL REGULATIONS/LEGISLATION SPECIFIC FOR THE MIXTURE
None

15.2 CHEMICAL SAFETY ASSESSMENT

None

16 - OTHER INFORMATION

Abbreviations and acronyms used in the safety data sheet:

CLP: Classification, Labelling and Packaging

OEL: Occupational Exposure Limit

PBT/vPvB: Persistent, Bioaccumulative and Toxic/Very Persistent and Very Bioaccumulative

Key literature references and sources for data:

Supplier's MSDS

Wording of the risk phrases listed in section 3:

R 22	Harmful if swallowed
R 36	Irritating to eyes
R 38	Irritating to skin
R 41	Risk of serious damage to eyes
H 302	Harmful if swallowed
H 315	Causes skin irritation
H 318	Causes serious eye damage
H 319	Causes serious eye irritation

Advice on any training appropriate for workers to ensure protection of human health and the environment

Comply with national implementation of Council Directive 98/24/EC of 7 April 1998 on the protection of the health and safety of workers from the risks related to chemical agents at work.

Continued page 7/7

16 - OTHER INFORMATION

This material safety data sheet answers to the Directives/Regulations and adaptation of the European Community (EC) n°: 67/548, 1999/45, 1907/2006, 1272/2008, 453/2010.
This document applies to the product AS IT IS in conformity with the specifications of the technical data sheet supplied by TNL18.
In the case of combinations or mixtures, make sure that no new risk can occur.
The information contained in these sheets has been given in good faith and is based on our most recent knowledge regarding the product concerned at the time of publication. The user is always responsible of taking the necessary measures in order to answer to the requirements of laws and of local regulations.
Users' attention is drawn to the risks that may be run when a product is used for purposes other than those for which it is intended. These sheets must be used and reproduced solely for preventive and safety purposes. The list of legislative, statutory and administrative texts is not to be considered exhaustive. It is for the consignee of the product to refer to all of the official documents regarding the use, holding and handling of the product, for which he alone is responsible.

End of document - Number of pages: 7

A.10. TNL18 – Actisoyl CC

MATERIAL SAFETY DATA SHEET

Product:

ACTISOYL CC

Date: 08/04/14 Version1.0_GB

1 - IDENTIFICATION OF THE MIXTURE AND OF THE COMPANY

1.1 PRODUCT IDENTIFIER	**ACTISOYL CC**
1.2 RELEVANT IDENTIFIED USES OF THE MIXTURE AND USES ADVISED AGAINST	Ground conditioning product
1.3 DETAILS OF THE SUPPLIER OF THE SAFETY DATA SHEET	**TNL18** **Espace St Germain, bâtiment le Saxo** **30 avenue du Général Leclerc** **F-38200 VIENNE, FRANCE** **Tel : + 33 615 426 227** Email : **msds@tnl18.com**
1.4 EMERGENCY TELEPHONE NUMBER	Poison Control Centre (INRS): + 33 1 45 42 59 59 (24h per day, 7days per week) TNL18: + 33 615 426 227 (during normal opening hours: week 8.30 am – 5.30 pm)

2 – HAZARDS IDENTIFICATION

2.1 CLASSIFICATION OF THE MIXTURE

Classification according to Directive 1999/45/EC

Xi, R41

Most important adverse effects

. Physical and chemical hazards	No particular hazard anticipated.
. Health hazard	Local irritating effects.
. Environmental hazards	No particular hazard anticipated.

2.2 LABEL ELEMENTS

Labelling according to Directive 1999/45/EC

. Symbol	 Xi
. Danger indication	Irritant
. Risk phrase	R 41: risk of serious damage to eyes
. Safety phrase	S 26: in case of contact with eyes, rinse immediately with plenty of water and seek medical advice S 39: wear eye/face protection.

2.3 OTHER HAHAZARDS No data is available.

For the wording of the listed risk phrases, please refer to section 16.

3 - COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENTS CONTRIBUTING TO HAZARDS

Chemical name	N°CAS	N°CE	Classification 1999/45	CLP classification	Concentration range (% w/w)
2-Methylpentane-2,4-diol	107-41-5	203-489-0	Xi; R36-38	H315, H319	1 ≤ C < 20%
Hexan-1-ol	111-27-3	203-852-3	Xi ; R22	H302	1 ≤ C < 10%
Alcohol	112-72-1	204-000-3	Xi ; R36	H319	0,1 ≤ C < 20%
Alkylether sulfate C12-14, sodium salt	68891-38-3	500-234-8	Xi ; R38, R41	H315, H318	1 ≤ C ≤ 10%
Sulfuric acid, mono-C12-14-alkyl esters, sodium salts	85586-07-8	287-809-4	Xn ; R22, R38, R41	H302, H315, H318	1 ≤ C < 10%

For the wording of the listed risk phrases, please refer to section 16.
For Occupational Exposure Limits, please refer to section 8.

4 - FIRST AID MEASURES

4.1 DESCRIPTION OF FIRST AID MEASURES — If unwell or necessary, seek medical advice. Calm the victim and maintain in a comfortable position.

. Inhalation — Take the person into the open air if unwell.

. Contact with skin — After contact with the skin, rinse with plenty of water. Seek medical advice in case of irritation.

. Contact with eyes — In the event of contact with the eyes, rinse immediately with plenty of water including under eyelashes for at least 10 minutes. Remove contact lenses if present and easy to do. Continue to rinse. Consult an eye specialist.

. Ingestion — Rinse the mouth. Drink small amounts of water. DO NOT induce vomiting. Seek medical advice and show this document or the label of the product.

4.2 MOST IMPORTANT SYMPTOMS AND EFFECTS, BOTH ACUTE AND DELAYED

. Contact with eyes — Pain or severe irritation, redness, tears.

4.3 INDICATION OF ANY IMMEDIATE MEDICAL ATTENTION AND SPECIAL TREATMENT NEEDED

Treat symptomatically. Clear water point recommended at the workplace.
Contact poison centre if big amount have been ingested.

5 – FIREFIGHTING MEASURES

5.1 EXTINGUISHING MEDIA	
. Suitable extinguishing media	Dry powder – Sprayed water - Foam – CO_2
. Unsuitable extinguishing media	None known.
5.2 SPECIAL HAZARDS ARISING FROM THE MIXTURE	In case of fire, the increase in the pressure can lead to the explosion of the packaging. Do not inhale fumes. Expected release of carbon monoxide and carbon dioxides.
5.3 ADVICE FOR FIREFIGHTERS	Use of a self-contained respirator and a protective garment against chemicals.

6 – ACCIDENTAL RELEASE MEASURES

6.1 PERSONAL PRECAUTIONS, PROTECTIVE EQUIPMENT AND EMERGENCY PROCEDURES	Take back unnecessary people. Goggles, gloves and protective garment. Avoid contact with skin and eyes.
6.2 ENVIRONMENTAL PRECAUTIONS	Avoid entry into soil or ground/surface waters. In case of contaminates, inform appropriate authorities in accordance with local regulations.
6.3 METHODS AND MATERIAL FOR CONTAINMENT AND CLEANING UP	Large spill: contain and absorb spillage with non-combustible neutral absorbents: sand, vermiculite, earth, diatom earth. Place in sealed container and send off for destruction according to local regulations. Small spill: contain and absorb spillage with textile absorbing material. Clean with water.
6.4 REFERENCE TO OTHER SECTIONS	See sections 7, 8, 12 and 13.

7 - HANDLING AND STORAGE

7.1 PRECAUTIONS FOR SAFE HANDLING	
. Precaution	Do not eat, drink and smoke during use. Avoid contact with skin, eyes and protective garment. Wash hands after use. Wash contaminated clothing before reuse.
. Use advice	Keep the packing well closed. Make sure that ventilation is adequate.
7.2 CONDITIONS FOR SAFE STORAGE, INCLUDING ANY INCOMPATIBILITIES	
. Precautions	Always keep the product in the same kind of labelled package as the original one. Keep the packing upright to prevent leakage.
. Storage conditions	Store in closed packages, in dry, cool (10-40°C) and well ventilated premises. Store sheltered from direct sunlight. Keep off from freezing.
. Recommended packing	Same kind as original one.
. Unsuitable packing	Avoid non protected metallic packing.
7.3 SPECIFIC END USE(S)	-

8 - EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 CONTROL PARAMETERS

National Occupational Exposure Limits for *2-Methylpentane-2,4-diol* :

	Limit value eight hours		Limit value short term	
Country	**ppm**	**mg/m³**	**ppm**	**mg/m³**
Australia			25*	121*
Canada Ontario			25*	
Denmark	25	125	25	125
Ireland			25*	125*
New Zealand			25	121*
Singapore			25	121
South Korea			25*	125*
Sweden			25*	120*
USA NIOSH			25*	125*
UK	25	123	25	123

*Ceiling Limit Value

8.2 EXPOSURE CONTROLS

INDIVIDUAL PROTECTION MEASURES, SUCH AS PERSONAL PROTECTIVE EQUIPMENT

. Eye / face protection	Wear safety goggles or face shield.
. Hand protection	Wear protective gloves (nitrile).
. Skin protection	Protective garment recommended.
. Respiratory protection	Sufficient ventilation should be provided to maintain levels below exposure limits. Wear respiratory equipment in case of intensive use or use in confined area.
. Thermal hazards	Not relevant, based on expected use.
ENVIRONMENTAL EXPOSURE CONTROLS	See sections 6 and 7.

9 - PHYSICAL AND CHEMICAL PROPERTIES

9.1 INFORMATION ON BASIC PHYSICAL AND CHEMICAL PROPERTIES

. Appearance	Colourless liquid
. Odour	Characteristic
. Odour threshold	Not determined
. pH	8
. Melting point/freezing point	Not determined
. Initial boiling point and boiling range	Not determined
. Flash point	Not determined
. Evaporation rate	Not applicable to mixtures; no data on components

Continued page 5/7

9 - PHYSICAL AND CHEMICAL PROPERTIES (continued)

. Flammability (solid, gas)	Non applicable
. Upper/lower flammability or explosive limits	Not applicable to mixtures; no data on components
. Vapour pressure	Not applicable to mixtures; no data on components
. Vapour density	Not applicable to mixtures; no data on components
. Relative density	1.03
. Solubility(ies)	Soluble in water
. Partition coefficient: n-octanol/water	Not applicable to mixtures; no data on components
. Auto-ignition temperature	Not determined
. Decomposition temperature	Not determined
. Viscosity	Not determined
. Explosive properties	Not anticipated based on chemical structure of components
. Oxidising properties	Not determined
9.2 OTHER INFORMATION	No data is available.

10 - STABILITY AND REACTIVITY

10.1 REACTIVITY	Not determined
10.2 CHEMICAL STABILITY	Stable under handling and storage conditions recommended in section 7.
10.3 POSSIBILITY OF HAZARDOUS REACTIONS	Under handling and storage conditions recommended in section 7, no hazardous reaction.
10.4 CONDITIONS TO AVOID	Not determined
10.5 INCOMPATIBLE MATERIALS	Not determined
10.6 HAZARDOUS DECOMPOSITION PRODUCTS	Under handling and storage conditions recommended in section 7, no hazardous decomposition products. See section 5 for combustion products.

11 - TOXICOLOGICAL INFORMATION

No experimental study is available on the mixture. Classification is based on the conventional method (calculation) based on available information on components.

11.1 INFORMATION ON TOXICOLOGICAL EFFECTS

. Acute toxicity	Not anticipated based on available data on components.
. Irritation	Severely irritating to eyes. Risk of serious damage to eyes.
. Corrosivity	Not classified
. Sensitisation	Not classified
. Repeated dose toxicity	Not classified
. Carcinogenicity	Not classified
. Mutagenicity	Not classified
. Toxicity for reproduction	Not classified

12 - ECOLOGICAL INFORMATION

Do not pour down the drain or river.

12.1 TOXICITY	Not classified
12.2 PERSISTENCE AND DEGRADABILITY	Not applicable to mixtures
12.3 BIOACCUMULATIVE POTENTIAL	Not applicable to mixtures
12.4 MOBILITY IN SOIL	Not applicable to mixtures; no data on components.
12.5 RESULTS OF PBT AND VPVB ASSESSMENT	Not applicable to mixtures; no data on components.
12.6 OTHER ADVERSE EFFECTS	-

13 - DISPOSAL CONSIDERATIONS

13.1 WASTE TREATMENT METHODS

. General advise	This material and its container must be disposed of as hazardous waste. Do not pour down the drain.
. Unused product	Discard according to the local regulations.
. Contaminated packaging	The waste products and worn-out packages must be discarded according to the local regulations. The packaging must be completely empty before elimination.

14 - TRANSPORT INFORMATION

The product is not dangerous and the regulations ADR for road transport, RID for rail, IMDG for maritime transport and ICAO/IATA for air transport do not apply.

15 - REGULATORY INFORMATION

15.1 SAFETY, HEALTH AND ENVIRONMENTAL REGULATIONS/LEGISLATION SPECIFIC FOR THE MIXTURE
None

15.2 CHEMICAL SAFETY ASSESSMENT

None

16 - OTHER INFORMATION

Abbreviations and acronyms used in the safety data sheet:

CLP: Classification, Labelling and Packaging

OEL: Occupational Exposure Limit

PBT/vPvB: Persistent, Bioaccumulative and Toxic/Very Persistent and Very Bioaccumulative

Continued page 7/7

16 - OTHER INFORMATION

Key literature references and sources for data:
Supplier's MSDS

Wording of the risk phrases listed in section 3:

R 22	Harmful if swallowed
R 36	Irritating to eyes
R 38	Irritating to skin
R 41	Risk of serious damage to eyes
H 302	Harmful if swallowed
H 315	Causes skin irritation
H 318	Causes serious eye damage
H 319	Causes serious eye irritation

Advice on any training appropriate for workers to ensure protection of human health and the environment
Comply with national implementation of Council Directive 98/24/EC of 7 April 1998 on the protection of the health and safety of workers from the risks related to chemical agents at work.

This material safety data sheet answers to the Directives/Regulations and adaptation of the European Community (EC) n°: 67/548, 1999/45, 1907/2006, 1272/2008, 453/2010.
This document applies to the product AS IT IS in conformity with the specifications of the technical data sheet supplied by TNL18.
In the case of combinations or mixtures, make sure that no new risk can occur.
The information contained in these sheets has been given in good faith and is based on our most recent knowledge regarding the product concerned at the time of publication. The user is always responsible of taking the necessary measures in order to answer to the requirements of laws and of local regulations.
Users' attention is drawn to the risks that may be run when a product is used for purposes other than those for which it is intended. These sheets must be used and reproduced solely for preventive and safety purposes. The list of legislative, statutory and administrative texts is not to be considered exhaustive. It is for the consignee of the product to refer to all of the official documents regarding the use, holding and handling of the product, for which he alone is responsible.

End of document - Number of pages: 7

A.11. Condat – CLB F5/M

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Trade name or designation of the mixture CLB F5/M

Registration number -

Synonyms None.

Product code C00854

1.2. Relevant identified uses of the substance or mixture and uses advised against

Identified uses See Technical Data Sheet.

Uses advised against Not available.

1.3. Details of the supplier of the safety data sheet

Supplier

Company name CONDAT

Address 104 Avenue Frédéric Mistral - B.P. 16
CHASSE SUR RHONE
FR

Division Products Regulatory Affairs Department

Telephone Tel.: 33 (0)4 78.07.38.38
Fax: 33 (0)4 78.07.38.00

e-mail arp@condat.fr

Contact person Products Regulatory Affairs Department

1.4. Emergency telephone number

Emergency telephone number:

24H/24H [China] :	86 4001 2001 74
24H/24H [Australia] :	+ 61 1 800 686 951
24H/24H [Asia-Pacific] :	1-760-476-3960
24H/24H [Europe] :	1-760-476-3961
24H/24H [USA-Canada-Mexico] :	1-866-519-4752
24H/24H [Americas] :	1-760-476-3962
24H/24H [Middle East&Africa] :	1-760-476-3959
Emergency phone (Access code):	333637

General in EU 112 (Available 24 hours a day. SDS/Product information may not be available for the Emergency Service.)

National Poisons Control Center ORFILA number (INRS): + 33 (0) 1 45 42 59 59 (Available 24 hours a day. SDS/Product information may not be available for the Emergency Service.)

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

The mixture has been assessed and/or tested for its physical, health and environmental hazards and the following classificatior applies.

Classification according to Directive 67/548/EEC or 1999/45/EC as amended

Classification Xi;R38-41

The full text for all R-phrases is displayed in section 16.

Classification according to Regulation (EC) No 1272/2008 as amended

Health hazards

Skin corrosion/irritation	Category 2	H315 - Causes skin irritation.
Serious eye damage/eye irritation	Category 1	H318 - Causes serious eye damage.

Hazard summary

Specific hazards Under normal conditions of intended use: None known.

Main symptoms Substance causes severe eye irritation; injury may be permanent.

2.2. Label elements

Label according to Regulation (EC) No. 1272/2008 as amended

Contains: 2,4-Pentanediol, 2-methyl-, Alcohols, C10-18, Alcohols, C12-14, rthoxylated, sulfates, sodium salts, Mono-C10-16-alkyl, sodium sulfate

Hazard pictograms

Signal word Danger

Hazard statements

H315 Causes skin irritation.
H318 Causes serious eye damage.

Precautionary statements

Prevention

P264 Wash thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.

Response

P302 + P352 IF ON SKIN: Wash with plenty of soap and water.
P305 + P351 + P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present anc easy to do. Continue rinsing.
P310 Immediately call a POISON CENTRE or doctor/physician.
P332 + P313 If skin irritation occurs: Get medical advice/attention.

Storage Store away from incompatible materials.

Disposal Not applicable.

Supplemental label information Danemark, Code Number : 00-3 (1993)

2.3. Other hazards Not assigned.

SECTION 3: Composition/information on ingredients

3.2. Mixtures

General information

Chemical name	%	CAS-No. / EC No.	REACH Registration No.	INDEX No.	Notes
2,4-Pentanediol, 2-methyl-	5 - < 10	107-41-5 203-489-0	01-2119539582-35-XXXX	603-053-00-3	

Classification: **DSD:** Xi;R36/38

CLP: Skin Irrit. 2;H315, Eye Irrit. 2;H319

Chemical name	%	CAS-No. / EC No.	REACH Registration No.	INDEX No.	Notes
Alcohols, C12-14, rthoxylated, sulfates, sodium salts	5 - < 10	68891-38-3 500-234-8	01-2119488639-16-XXXX	-	
Classification:	**DSD:** Xi;R38-41				
	CLP: Skin Irrit. 2;H315, Eye Dam. 1;H318, Aquatic Chronic 3;H412				
Mono-C10-16-alkyl, sodium sulfate	5 - < 10	68585-47-7 271-557-7	-	-	
Classification:	**DSD:** Xn;R22, Xi;R38-41				
	CLP: Acute Tox. 4;H302, Skin Irrit. 2;H315, Eye Dam. 1;H318, Aquatic Chronic 3;H412				
Alcohols, C10-18	1 - < 3	85711-71-3 288-332-4	-	-	
Classification:	**DSD:** Xi;R36, N;R50				
	CLP: Eye Irrit. 2;H319, Aquatic Acute 1;H400				

CLP: Regulation No. 1272/2008. "-" = Not available or this substance does not meet the criteria for classification according to Regulation (EC) 1272/2008 as amended.
DSD: Directive 67/548/EEC.
M: M-factor
vPvB: very persistent and very bioaccumulative substance.
PBT: persistent, bioaccumulative and toxic substance.
#: This substance has been assigned Community workplace exposure limit(s).

Composition comments Occupational Exposure Limits for constituents are listed in Section 8. The full text for all R- and H-phrases is displayed in section 16.

SECTION 4: First aid measures

General information Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

4.1. Description of first aid measures

Inhalation Remove to fresh air. Move to fresh air. Call a physician if symptoms develop or persist.

Skin contact Take off contaminated clothing and wash before reuse. Wash with plenty of soap and water. If skir irritation occurs: Get medical advice/attention.

Eye contact Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention immediately.

Ingestion Rinse mouth thoroughly. If swallowed, do NOT induce vomiting. Get medical attention if symptoms occur.

4.2. Most important symptoms and effects, both acute and delayed Skin irritation. Substance causes severe eye irritation; injury may be permanent.

4.3. Indication of any immediate medical attention and special treatment needed Provide general supportive measures and treat symptomatically. Keep victim under observation. Symptoms may be delayed.

SECTION 5: Firefighting measures

General fire hazards No unusual fire or explosion hazards noted. None known.

5.1. Extinguishing media

Suitable extinguishing media	Not applicable, non-combustible. Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
Unsuitable extinguishing media	Not applicable, non-combustible.
5.2. Special hazards arising from the substance or mixture	See also section 10.
5.3. Advice for firefighters	
Special protective equipment for firefighters	None (non-combustible). Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Special fire fighting procedures	In case of fire and/or explosion do not breathe fumes.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

For non-emergency personnel	Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Wear appropriate protective equipment and clothing during clean-up. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Ensure adequate ventilation. Local authorities should be advised if significant spillages cannot be contained. For personal protection, see section 8.
For emergency responders	Keep unnecessary personnel away. Use personal protection recommended in Section 8 of the MSDS.
6.2. Environmental precautions	Local authorities should be advised if significant spillages cannot be contained. Prevent further leakage or spillage if safe to do so. Avoid discharge into drains, water courses or onto the ground.
6.3. Methods and material for containment and cleaning up	This product is miscible in water. Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Cover with plastic sheet to prevent spreading. Absorb in vermiculite, dry sand or earth and place into containers. Following product recovery, flush area with water. Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination. Never return spills in original containers for re-use.
6.4. Reference to other sections	See Section 8 for personal protective equipment. For waste disposal, see section 13.

SECTION 7: Handling and storage

7.1. Precautions for safe handling	Do not breathe vapour. Do not get this material in contact with eyes. Avoid contact with skin. Avoid prolonged exposure. Wear appropriate personal protective equipment. Observe good industrial hygiene practices. Wash hands thoroughly after handling. Wash hands after handling. Handle in accordance with good industrial hygiene and safety practices. Adequate ventilation should be provided so that exposure limits are not exceeded.
7.2. Conditions for safe storage, including any incompatibilities	Storage temperature: between 5°C and 50°C. Store in a cool, dry place out of direct sunlight. Store in closed original container in a dry place. Store away from incompatible materials (see Section 10 of the MSDS). Keep from freezing.
7.3. Specific end use(s)	Not available.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Occupational exposure limits

France. Threshold Limit Values (VLEP) for Occupational Exposure to Chemicals in France, INRS ED 984

Components	Type	Value
2,4-Pentanediol, 2-methyl- (CAS 107-41-5)	VLE	125 mg/m3
		25 ppm

Belgium. Exposure Limit Values.

Components	Type	Value
2,4-Pentanediol, 2-methyl- (CAS 107-41-5)	TWA	123 mg/m3
		25 ppm

Switzerland. SUVA Grenzwerte am Arbeitsplatz

Components	Type	Value
2,4-Pentanediol, 2-methyl- (CAS 107-41-5)	STEL	98 mg/m3
		20 ppm
	TWA	49 mg/m3
		10 ppm

Biological limit values No biological exposure limits noted for the ingredient(s).

Recommended monitoring procedures Follow standard monitoring procedures.

Derived no-effect level (DNEL)

Components	Type	Route	Value	Form
2,4-Pentanediol, 2-methyl- (CAS 107-41-5)	Consumer	Dermal	1 mg/kg/day	LT; SE
		Inhalation	49 mg/m3	ST; LE
		Inhalation	3,5 mg/m3	LT; SE
		Inhalation	25 mg/m3	LT; LE
		Oral	1 mg/kg/day	LT; SE
	Professional	Dermal	2 mg/kg/day	LT; SE
		Inhalation	98 mg/m3	ST; LE
		Inhalation	49 mg/m3	LT; LE
		Inhalation	14 mg/m3	LT; SE
Alcohols, C12-14, rthoxylated, sulfates, sodium salts (CAS 68891-38-3)	Consumer	Dermal	1650 mg/kg/day	
		Inhalation	52 mg/m3	
		Oral	15 mg/kg/day	
	Industry	Dermal	2750 mg/kg/day	
		Inhalation	175 mg/m3	

Predicted no effect concentrations (PNECs)

Components	Type	Route	Value	Form
2,4-Pentanediol, 2-methyl- (CAS 107-41-5)	Not applicable	Oral	100 mg/kg/day	Secondary Poisoning
		Soil	1,79 mg/kg/day	Sediments
		Soil	0,179 mg/kg/day	Marine sediments
		Soil	0,11 mg/kg/day	
		Water	20 mg/l	wastewater treatment
		Water	0,429 mg/l	Fresh water
		Water	0,0429 mg/l	Sea water

Components	Type	Route	Value	Form
Alcohols, C12-14, rthoxylated, sulfates, sodium salts (CAS 68891-38-3)	Not applicable	Not applicable	10000 mg/kg/day	STP.
		Not applicable	0,9168 mg/kg/day	Fresh water sediment.
		Not applicable	0,0917 mg/kg/day	Sea water sediment.
		Soil	7,5 mg/kg/day	
		Water	0,24 mg/kg/day	Fresh water.
		Water	0,024 mg/kg/day	Sea water.

8.2. Exposure controls

Appropriate engineering controls Ensure adequate ventilation, especially in confined areas. Eye wash facilities and emergency shower must be available when handling this product.

Individual protection measures, such as personal protective equipment

General information Use personal protective equipment as required. Personal protection equipment should be chosen according to the CEN standards and in discussion with the supplier of the personal protective equipment.

Eye/face protection Wear safety glasses with side shields (or goggles) and a face shield.

Skin protection

- Hand protection Use protective gloves made of: Nitrile. Polyvinyl chloride (PVC).

- Other Wear appropriate chemical resistant clothing.

Respiratory protection In case of insufficient ventilation, wear suitable respiratory equipment.

Thermal hazards Wear appropriate thermal protective clothing, when necessary.

Hygiene measures Keep away from food and drink. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

Environmental exposure controls Environmental manager must be informed of all major releases.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance

Physical state Liquid.

Form Liquid.

Colour Colourless. - Yellow

Odour Slight.
Alcoholic.

Odour threshold Not available.

pH 8 - 9

Melting point/freezing point Not available.

Initial boiling point and boiling range Not available.

Flash point Not applicable.

Evaporation rate Not available.

Upper/lower flammability or explosive limits

Flammability limit - lower (%) Not applicable.

Flammability limit - upper (%)	Not applicable.
Vapour pressure	Not available.
Vapour density	Not available.
Relative density	1,02
Relative density temperature	20 °C (68 °F)
Solubility(ies)	Soluble
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not available.
Explosive properties	Not available.
Oxidizing properties	Not available.
9.2. Other information	
pH in aqueous solution	7 - 8 @5%

SECTION 10: Stability and reactivity

10.2. Chemical stability	Material is stable under normal conditions.
10.3. Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use.
10.4. Conditions to avoid	Contact with incompatible materials. Avoid frost.
10.5. Incompatible materials	Strong acids. Strong oxidising agents.
10.6. Hazardous decomposition products	Carbon oxides. No hazardous decomposition products are known. Under common conditions of use (see technical data sheet) Development of hazardous combustion gases or vapours possible in the event of fire. Sulphur compounds.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity	Not classified.
Skin corrosion/irritation	Causes skin irritation.
Serious eye damage/eye irritation	Causes serious eye damage.
Respiratory sensitisation	Not classified.
Skin sensitisation	Not classified.
Germ cell mutagenicity	Not classified.
Carcinogenicity	Not classified.
Reproductive toxicity	Not classified.
Specific target organ toxicity - single exposure	Not classified.
Specific target organ toxicity - repeated exposure	Not classified.
Aspiration hazard	Not classified.
Mixture versus substance information	No information available.

Other information Not available.

SECTION 12: Ecological information

12.1. Toxicity Not classified as an environmental hazard.

Product		Species	Test results
CLB F5/M (CAS Mixture)			
Acute			
Algae	IC50	Algae	45 mg/l, 72 Hours
Crustacea	EC50	Daphnia	71,6 mg/l, 48 Hours
Fish	LC50	Fish	20 - 45 mg/l, 96 Hours
Chronic			
Algae	NOEC	Algae	12,5 mg/l, 72 Hours, Growth rate
Crustacea	NOEC	Daphnia	25 mg/l, 48 Hours
Fish	NOEC	Fish	20 mg/l, 96 Hours

* Estimates for product may be based on additional component data not shown.

12.2. Persistence and degradability Readily biodegradable.

12.3. Bioaccumulative potential No data available.

Bioconcentration factor (BCF) Not available.

12.4. Mobility in soil No data available.

Mobility in general This product is miscible in water.

12.5. Results of PBT and vPvB assessment Not available.

12.6. Other adverse effects No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Residual waste Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).

Contaminated packaging Empty containers should be taken to an approved waste handling site for recycling or disposal. Since emptied containers may retain product residue, follow label warnings even after container is emptied.

EU waste code Unused product : Aqueous solution @ 5 % : 16 03 05*
16 03 06
Waste codes should be assigned by the user based on the application for which the product was used.

Disposal methods/information Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Do not discharge into drains, water courses or onto the ground. Dispose of contents/container in accordance with local/regional/national/international regulations.

Special precautions Dispose in accordance with all applicable regulations.

SECTION 14: Transport information

ADR

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

14.7. Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable.

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

EU regulations

Regulation (EC) No. 1005/2009 on substances that deplete the ozone layer, Annex I

Not listed.

Regulation (EC) No. 1005/2009 on substances that deplete the ozone layer, Annex II

Not listed.

Regulation (EC) No. 850/2004 On persistent organic pollutants, Annex I as amended

Not listed.

Regulation (EC) No. 689/2008 concerning the export and import of dangerous chemicals, Annex I, part 1 as amended

Not listed.

Regulation (EC) No. 689/2008 concerning the export and import of dangerous chemicals, Annex I, part 2 as amended

Not listed.

Regulation (EC) No. 689/2008 concerning the export and import of dangerous chemicals, Annex I, part 3 as amended

Not listed.

Regulation (EC) No. 689/2008 concerning the export and import of dangerous chemicals, Annex V as amended

Not listed.

Regulation (EC) No. 166/2006 Annex II Pollutant Release and Transfer Registry

Not listed.

Regulation (EC) No. 1907/2006, REACH Article 59(1) Candidate List as currently published by ECHA

Not listed.

Authorisations

Regulation (EC) No. 1907/2006, REACH Annex XIV Substances subject to authorization, as amended

Not listed.

Restrictions on use

Regulation (EC) No. 1907/2006, REACH Annex XVII Substances subject to restriction on marketing and use as amended

Not listed.

Directive 2004/37/EC: on the protection of workers from the risks related to exposure to carcinogens and mutagens at work

Not listed.

Directive 92/85/EEC: on the safety and health of pregnant workers and workers who have recently given birth or are breastfeeding

Not listed.

Other EU regulations

Directive 96/82/EC (Seveso II) on the control of major-accident hazards involving dangerous substances

Not listed.

Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work

2,4-Pentanediol, 2-methyl- (CAS 107-41-5)

Directive 94/33/EC on the protection of young people at work

Not listed.

Other regulations	The product is classified and labelled in accordance with EC directives or respective national laws This Safety Data Sheet complies with the requirements of Regulation (EC) No 1907/2006.
National regulations	Follow national regulation for work with chemical agents.
15.2. Chemical safety assessment	No Chemical Safety Assessment has been carried out.

SECTION 16: Other information

List of abbreviations	Not available.
References	Not available.
Information on evaluation method leading to the classification of mixture	The classification for health and environmental hazards is derived by a combination of calculatior methods and test data, if available.
Full text of any statements or R-phrases and H-statements under Sections 2 to 15	R22 Harmful if swallowed. R36 Irritating to eyes. R36/38 Irritating to eyes and skin. R38 Irritating to skin. R41 Risk of serious damage to eyes. R50 Very toxic to aquatic organisms. H302 Harmful if swallowed. H315 Causes skin irritation. H318 Causes serious eye damage. H319 Causes serious eye irritation. H400 Very toxic to aquatic life. H412 Harmful to aquatic life with long lasting effects.
Revision information	This document has undergone significant changes and should be reviewed in its entirety
Training information	Follow training instructions when handling this material.

A.12. Condat – TFA34

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Trade name or designation of the mixture	TFA 34 NewGeneration
Registration number	-
Synonyms	None.
Product code	C00829

1.2. Relevant identified uses of the substance or mixture and uses advised against

Identified uses	See Technical Data Sheet.
Uses advised against	Not available.

1.3. Details of the supplier of the safety data sheet

Supplier

Company name	CONDAT
Address	Avenue Frédéric Mistral - B.P. 16 38670 CHASSE-SUR-RHONE FR
Division	Products Regulatory Affairs Department
Telephone	Tel.: 33 (0)4 78.07.38.38 Fax: 33 (0)4 78.07.38.00
e-mail	arp@condat.fr
Contact person	Products Regulatory Affairs Department

1.4. Emergency telephone number Emergency Tel. (Office hours): 33 (0) 4 78 07 37 18

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

The mixture has been assessed and/or tested for its physical, health and environmental hazards and the following classificatior applies.

Classification according to Regulation (EC) No 1272/2008 as amended

This mixture is not classified as hazardous according to the criteria for classification of the Regulation (EC) 1272/2008 as amended.

2.2. Label elements

Label according to Regulation (EC) No. 1272/2008 as amended

Hazard pictograms	None.
Signal word	None.
Hazard statements	The mixture does not meet the criteria for classification.

Precautionary statements

Prevention	Observe good industrial hygiene practices.
Response	Wash hands after handling.
Storage	Store away from incompatible materials.
Disposal	Not available.

Supplemental label information None.

2.3. Other hazards Not assigned.

SECTION 3: Composition/information on ingredients

3.2. Mixtures

The components are not hazardous or are below required disclosure limits.

List of abbreviations and symbols that may be used above

CLP: Regulation No. 1272/2008. "-" = Not available or this substance does not meet the criteria for classification according to Regulation (EC) 1272/2008 as amended.
M: M-factor
vPvB: very persistent and very bioaccumulative substance.
PBT: persistent, bioaccumulative and toxic substance.
#: This substance has been assigned Community workplace exposure limit(s).

Composition comments Occupational Exposure Limits for constituents are listed in Section 8. The full text for all H-statements is displayed in section 16.

SECTION 4: First aid measures

General information Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

4.1. Description of first aid measures

Inhalation Under normal conditions of intended use, this material is not expected to be an inhalation hazard.

Skin contact Wash off with soap and water. Get medical attention if irritation develops and persists.

Eye contact Flush eyes with water as a precaution. Get medical attention if irritation develops and persists.

Ingestion Rinse mouth. Get medical attention if symptoms occur.

4.2. Most important symptoms and effects, both acute and delayed Direct contact with eyes may cause temporary irritation.

4.3. Indication of any immediate medical attention and special treatment needed Treat symptomatically.

SECTION 5: Firefighting measures

General fire hazards No unusual fire or explosion hazards noted.

5.1. Extinguishing media

Suitable extinguishing media Water fog. Foam. Dry sand. Dry chemicals. Carbon dioxide (CO2). Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media Do not use water jet as an extinguisher, as this will spread the fire.

5.2. Special hazards arising from the substance or mixture See also section 10.

5.3. Advice for firefighters

Special protective equipment for firefighters Self-contained breathing apparatus and full protective clothing must be worn in case of fire.

Special fire fighting procedures In case of fire and/or explosion do not breathe fumes.

Specific methods In the event of fire and/or explosion do not breathe fumes.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

For non-emergency personnel	Keep unnecessary personnel away. Wear appropriate protective equipment and clothing during clean-up. For personal protection, see section 8.
For emergency responders	Keep unnecessary personnel away. Use personal protection recommended in Section 8 of the SDS.
6.2. Environmental precautions	Local authorities should be advised if significant spillages cannot be contained. Prevent further leakage or spillage if safe to do so.
6.3. Methods and material for containment and cleaning up	This product is miscible in water. Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Cover with plastic sheet to prevent spreading. Absorb in vermiculite, dry sand or earth and place into containers. Scrub the area with detergent and water. Following product recovery, flush area with water. Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination. Never return spills to original containers for re-use. In case of spills, beware of slippery floors and surfaces.
6.4. Reference to other sections	See Section 8 for personal protective equipment. For waste disposal, see section 13 of the SDS.

SECTION 7: Handling and storage

7.1. Precautions for safe handling	To avoid thermal decomposition, do not overheat. Wash hands after handling. Handle ir accordance with good industrial hygiene and safety practices. Adequate ventilation should be provided so that exposure limits are not exceeded.
7.2. Conditions for safe storage, including any incompatibilities	Store in closed original container in a dry place. Store away from incompatible materials (see Section 10 of the SDS).
7.3. Specific end use(s)	Not available.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Occupational exposure limits	No exposure limits noted for ingredient(s).
Biological limit values	No biological exposure limits noted for the ingredient(s).
Recommended monitoring procedures	Follow standard monitoring procedures.
Derived no-effect level (DNEL)	Not available.
Predicted no effect concentrations (PNECs)	Not available.
Exposure guidelines	Occupational Exposure Limits are not relevant to the current physical form of the product.

8.2. Exposure controls

Appropriate engineering controls	Ensure adequate ventilation, especially in confined areas.

Individual protection measures, such as personal protective equipment

General information	Personal protection equipment should be chosen according to the CEN standards and in discussion with the supplier of the personal protective equipment.

Eye/face protection	If contact is likely, safety glasses with side shields are recommended.
Skin protection	
- Hand protection	Protective gloves are recommended. Suitable gloves can be recommended by the glove supplier.
- Other	Normal work clothing (long sleeved shirts and long pants) is recommended.
Respiratory protection	In case of insufficient ventilation, wear suitable respiratory equipment.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
Hygiene measures	Wash hands after handling. Handle in accordance with good industrial hygiene and safety practices.
Environmental exposure controls	Environmental manager must be informed of all major releases.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance	
Physical state	Liquid.
Form	Liquid. Gel. Viscous. Paste.
Colour	Blonde. to Light brown.
Odour	Characteristic.
Odour threshold	Not available.
pH	6.2
Melting point/freezing point	Not available.
Initial boiling point and boiling range	Not available.
Flash point	Not available.
Evaporation rate	Not available.
Flammability (solid, gas)	Not applicable.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Vapour pressure	Not available.
Vapour density	Not available.
Relative density	1.092
Relative density temperature	20 °C (68 °F)
Solubility(ies)	
Solubility (water)	Partly soluble in water.
Solubility (other)	Not available.
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not available.
Explosive properties	Not available.
Oxidising properties	Not oxidising.

9.2. Other information

Kinematic viscosity	Not applicable.
Kinematic viscosity temperature	40 °C (104 °F)
pH in aqueous solution	7.84 @ 2 % H2O

SECTION 10: Stability and reactivity

10.1. Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
10.2. Chemical stability	Material is stable under normal conditions.
10.3. Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use.
10.4. Conditions to avoid	Keep away from heat, sparks and open flame. Contact with incompatible materials.
10.5. Incompatible materials	Strong oxidising agents.
10.6. Hazardous decomposition products	Carbon oxides. Decomposition may yield acrolein.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity	Under normal conditions of intended use, this material is not expected to be an inhalation hazard. Not classified.
Skin corrosion/irritation	Not classified.
Serious eye damage/eye irritation	Not classified.
Respiratory sensitisation	Not classified.
Skin sensitisation	Not classified.
Germ cell mutagenicity	Not classified.
Carcinogenicity	Not classified.
Reproductive toxicity	Not classified.
Specific target organ toxicity - single exposure	Not classified.
Specific target organ toxicity - repeated exposure	Not classified.
Aspiration hazard	Not classified.
Mixture versus substance information	No information available.
Other information	Not available.

SECTION 12: Ecological information

12.1. Toxicity	Not classified as an environmental hazard.
12.2. Persistence and degradability	No data is available on the degradability of this product.
12.3. Bioaccumulative potential	
Bioconcentration factor (BCF)	Not available.
12.4. Mobility in soil	No data available.
Mobility in general	This product is miscible in water.

12.5. Results of PBT and vPvB assessment	Not available.
12.6. Other adverse effects	No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Residual waste	Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).
Contaminated packaging	Since emptied containers may retain product residue, follow label warnings even after container is emptied. Empty containers should be taken to an approved waste handling site for recycling or disposal.
EU waste code	Unused product : 16 03 06 Waste codes should be assigned by the user based on the application for which the product was used.
Disposal methods/information	Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Do not discharge into drains, water courses or onto the ground.
Special precautions	Dispose in accordance with all applicable regulations.

SECTION 14: Transport information

ADR

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

14.7. Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	Not applicable.

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

EU regulations

Regulation (EC) No. 1005/2009 on substances that deplete the ozone layer, Annex I and II, as amended

Not listed.

Regulation (EC) No. 850/2004 On persistent organic pollutants, Annex I as amended

Not listed.

Regulation (EC) No. 689/2008 concerning the export and import of dangerous chemicals, Annex I, part 1 as amended

Not listed.

Regulation (EC) No. 689/2008 concerning the export and import of dangerous chemicals, Annex I, part 2 as amended

Not listed.

Regulation (EC) No. 689/2008 concerning the export and import of dangerous chemicals, Annex I, part 3 as amended

Not listed.

Regulation (EC) No. 689/2008 concerning the export and import of dangerous chemicals, Annex V as amended

Not listed.

Regulation (EC) No. 166/2006 Annex II Pollutant Release and Transfer Registry, as amended

Not listed.

Regulation (EC) No. 1907/2006, REACH Article 59(10) Candidate List as currently published by ECHA

Not listed.

Authorisations

Regulation (EC) No. 1907/2006, REACH Annex XIV Substances subject to authorization, as amended

Not listed.

Restrictions on use

Directive 2004/37/EC: on the protection of workers from the risks related to exposure to carcinogens and mutagens at work, as amended

Not listed.

Directive 92/85/EEC: on the safety and health of pregnant workers and workers who have recently given birth or are breastfeeding, as amended

Not listed.

Regulation (EC) No. 1907/2006, REACH Annex XVII Substances subject to restriction on marketing and use as amended

Not listed.

Other EU regulations

Directive 2012/18/EU on major accident hazards involving dangerous substances

Not listed.

Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work, as amended

Not listed.

Directive 94/33/EC on the protection of young people at work, as amended

Not listed.

Other regulations	The product is classified and labelled in accordance with EC directives or respective national laws This Safety Data Sheet complies with the requirements of Regulation (EC) No 1907/2006, as amended.
National regulations	Follow national regulation for work with chemical agents.
15.2. Chemical safety assessment	No Chemical Safety Assessment has been carried out.

SECTION 16: Other information

List of abbreviations	Not available.
References	Not available.
Information on evaluation method leading to the classification of mixture	The classification for health and environmental hazards is derived by a combination of calculatior methods and test data, if available.
Full text of any H-statements not written out in full under Sections 2 to 15	None.
Revision information	This document has undergone significant changes and should be reviewed in its entirety
Training information	Follow training instructions when handling this material.

A.13. Condat – CLB F5/AC

SAFETY DATA SHEET

Product :	**CLB F5/AC**	
Code : C00856	Version : 2.2	Revision : 26-April-2016

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Trade name or designation of the mixture CLB F5/AC

Registration number -

Synonyms None.

Product code C00856

1.2. Relevant identified uses of the substance or mixture and uses advised against

Identified uses See Technical Data Sheet.

Uses advised against Not available.

1.3. Details of the supplier of the safety data sheet

Supplier

Company name CONDAT

Address Avenue Frédéric Mistral - B.P. 16
38670 CHASSE-SUR-RHONE
FR

Division Products Regulatory Affairs Department

Telephone Tel.: 33 (0)4 78.07.38.38
Fax: 33 (0)4 78.07.38.00

e-mail arp@condat.fr

Contact person Products Regulatory Affairs Department

1.4. Emergency telephone number

Emergency Tel. (Office hours): 33 (0) 4 78 07 37 18

Emergency Tel. (France) ORFILA (INRS) :
+ 33 (0)1 45 42 59 59

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

The mixture has been assessed and/or tested for its physical, health and environmental hazards and the following classificatior applies.

Classification according to Directive 67/548/EEC or 1999/45/EC as amended

Classification Xi;R38-41

The full text for all R-phrases is displayed in section 16.

Classification according to Regulation (EC) No 1272/2008 as amended

Health hazards

Skin corrosion/irritation	Category 2	H315 - Causes skin irritation.
Serious eye damage/eye irritation	Category 1	H318 - Causes serious eye damage.

Hazard summary

Specific hazards Under normal conditions of intended use: None known.

Main symptoms Substance causes severe eye irritation; injury may be permanent.

2.2. Label elements

Label according to Regulation (EC) No. 1272/2008 as amended

Contains: 2,4-Pentanediol, 2-methyl-, Alcohols, C12-14, rthoxylated, sulfates, sodium salts, Mono-C10-1 6-alkyl, sodium sulfate

Hazard pictograms

Signal word Danger

Hazard statements

H315 Causes skin irritation.
H318 Causes serious eye damage.

Precautionary statements

Prevention

P264 Wash thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.

Response

P302 + P352 IF ON SKIN: Wash with plenty of soap and water.
P305 + P351 + P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present anc easy to do. Continue rinsing.
P310 Immediately call a POISON CENTRE or doctor/physician.
P332 + P313 If skin irritation occurs: Get medical advice/attention.

Storage Store away from incompatible materials.

Disposal Not applicable.

Supplemental label information Not applicable.

2.3. Other hazards Not assigned.

SECTION 3: Composition/information on ingredients

3.2. Mixtures

General information

Chemical name	%	CAS-No. / EC No.	REACH Registration No.	INDEX No.	Notes
2,4-Pentanediol, 2-methyl-	5 - < 10	107-41-5 203-489-0	01-2119539582-35-XXXX	603-053-00-3	
Classification:	**DSD:** Xi;R36/38				
	CLP: Skin Irrit. 2;H315, Eye Irrit. 2;H319				
Alcohols, C12-14, rthoxylated, sulfates, sodium salts	5 - < 10	68891-38-3 500-234-8	01-2119488639-16-XXXX	-	
Classification:	**DSD:** Xi;R38-41				
	CLP: Skin Irrit. 2;H315, Eye Dam. 1;H318, Aquatic Chronic 3;H412				
Mono-C10-16-alkyl, sodium sulfate	5 - < 10	68585-47-7 271-557-7	-	-	
Classification:	**DSD:** Xn;R22, Xi;R38-41				
	CLP: Acute Tox. 4;H302, Skin Irrit. 2;H315, Eye Dam. 1;H318, Aquatic Chronic 3;H412				

Chemical name	%	CAS-No. / EC No.	REACH Registration No.	INDEX No.	Notes
Alcohols, C10-18	< 1	85711-71-3 288-332-4	-	-	

Classification: **DSD:** Xi;R36, N;R50

CLP: Eye Irrit. 2;H319, Aquatic Acute 1;H400

CLP: Regulation No. 1272/2008. "-" = Not available or this substance does not meet the criteria for classification according to Regulation (EC) 1272/2008 as amended.
DSD: Directive 67/548/EEC.
M: M-factor
vPvB: very persistent and very bioaccumulative substance.
PBT: persistent, bioaccumulative and toxic substance.
#: This substance has been assigned Community workplace exposure limit(s).

Composition comments Occupational Exposure Limits for constituents are listed in Section 8. The full text for all R- and H-phrases is displayed in section 16.

SECTION 4: First aid measures

General information Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

4.1. Description of first aid measures

Inhalation Remove to fresh air. Move to fresh air. Call a physician if symptoms develop or persist.

Skin contact Take off contaminated clothing and wash before reuse. Wash with plenty of soap and water. If skir irritation occurs: Get medical advice/attention.

Eye contact Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention immediately.

Ingestion Rinse mouth thoroughly. If swallowed, do NOT induce vomiting. Get medical attention if symptoms occur.

4.2. Most important symptoms and effects, both acute and delayed Skin irritation. Substance causes severe eye irritation; injury may be permanent.

4.3. Indication of any immediate medical attention and special treatment needed Provide general supportive measures and treat symptomatically. Keep victim under observation. Symptoms may be delayed.

SECTION 5: Firefighting measures

General fire hazards No unusual fire or explosion hazards noted. None known.

5.1. Extinguishing media

Suitable extinguishing media Not applicable, non-combustible. Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media Not applicable, non-combustible.

5.2. Special hazards arising from the substance or mixture See also section 10.

5.3. Advice for firefighters

Special protective equipment for firefighters None (non-combustible). Self-contained breathing apparatus and full protective clothing must be worn in case of fire.

Special fire fighting procedures	In case of fire and/or explosion do not breathe fumes.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

For non-emergency personnel	Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Wear appropriate protective equipment and clothing during clean-up. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Ensure adequate ventilation. Local authorities should be advised if significant spillages cannot be contained. For personal protection, see section 8.
For emergency responders	Keep unnecessary personnel away. Use personal protection recommended in Section 8 of the MSDS.
6.2. Environmental precautions	Local authorities should be advised if significant spillages cannot be contained. Prevent further leakage or spillage if safe to do so. Avoid discharge into drains, water courses or onto the ground.
6.3. Methods and material for containment and cleaning up	This product is miscible in water. Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Cover with plastic sheet to prevent spreading. Absorb in vermiculite, dry sand or earth and place into containers. Following product recovery, flush area with water. Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination. Never return spills in original containers for re-use.
6.4. Reference to other sections	See Section 8 for personal protective equipment. For waste disposal, see section 13.

SECTION 7: Handling and storage

7.1. Precautions for safe handling	Do not breathe vapour. Do not get this material in contact with eyes. Avoid contact with skin. Avoid prolonged exposure. Wear appropriate personal protective equipment. Observe good industrial hygiene practices. Wash hands thoroughly after handling. Wash hands after handling. Handle in accordance with good industrial hygiene and safety practices. Adequate ventilation should be provided so that exposure limits are not exceeded.
7.2. Conditions for safe storage, including any incompatibilities	Storage temperature: between 5°C and 50°C. Store in a cool, dry place out of direct sunlight. Store in closed original container in a dry place. Store away from incompatible materials (see Section 10 of the MSDS). Keep from freezing.
7.3. Specific end use(s)	Not available.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Occupational exposure limits

UK. EH40 Workplace Exposure Limits (WELs)

Components	Type	Value
2,4-Pentanediol, 2-methyl- (CAS 107-41-5)	STEL	123 mg/m3 25 ppm
	TWA	123 mg/m3 25 ppm

France. Threshold Limit Values (VLEP) for Occupational Exposure to Chemicals in France, INRS ED 984

Components	Type	Value
2,4-Pentanediol, 2-methyl- (CAS 107-41-5)	VLE	125 mg/m3

France. Threshold Limit Values (VLEP) for Occupational Exposure to Chemicals in France, INRS ED 984

Components	Type	Value
		25 ppm

Biological limit values No biological exposure limits noted for the ingredient(s).

Recommended monitoring procedures Follow standard monitoring procedures.

Derived no-effect level (DNEL)

Components	Type	Route	Value	Form
2,4-Pentanediol, 2-methyl- (CAS 107-41-5)	Consumer	Dermal	1 mg/kg/day	LT; SE
		Inhalation	49 mg/m3	ST; LE
		Inhalation	3.5 mg/m3	LT; SE
		Inhalation	25 mg/m3	LT; LE
		Oral	1 mg/kg/day	LT; SE
	Professional	Dermal	2 mg/kg/day	LT; SE
		Inhalation	98 mg/m3	ST; LE
		Inhalation	49 mg/m3	LT; LE
		Inhalation	14 mg/m3	LT; SE
Alcohols, C12-14, rthoxylated, sulfates, sodium salts (CAS 68891-38-3)	Consumer	Dermal	1650 mg/kg/day	
		Inhalation	52 mg/m3	
		Oral	15 mg/kg/day	
	Industry	Dermal	2750 mg/kg/day	
		Inhalation	175 mg/m3	

Predicted no effect concentrations (PNECs)

Components	Type	Route	Value	Form
2,4-Pentanediol, 2-methyl- (CAS 107-41-5)	Not applicable	Oral	100 mg/kg/day	Secondary Poisoning
		Soil	1.79 mg/kg/day	Sediments
		Soil	0.179 mg/kg/day	Marine sediments
		Soil	0.11 mg/kg/day	
		Water	20 mg/l	wastewater treatment
		Water	0.429 mg/l	Fresh water
		Water	0.0429 mg/l	Sea water
Alcohols, C12-14, rthoxylated, sulfates, sodium salts (CAS 68891-38-3)	Not applicable	Not applicable	10000 mg/kg/day	STP.
		Not applicable	0.9168 mg/kg/day	Fresh water sediment.
		Not applicable	0.0917 mg/kg/day	Sea water sediment.
		Soil	7.5 mg/kg/day	
		Water	0.24 mg/kg/day	Fresh water.
		Water	0.024 mg/kg/day	Sea water.

8.2. Exposure controls

Appropriate engineering controls Ensure adequate ventilation, especially in confined areas. Eye wash facilities and emergency shower must be available when handling this product.

Individual protection measures, such as personal protective equipment

General information Use personal protective equipment as required. Personal protection equipment should be chosen according to the CEN standards and in discussion with the supplier of the personal protective equipment.

Eye/face protection Wear safety glasses with side shields (or goggles) and a face shield.

Skin protection	
- Hand protection	Use protective gloves made of: Nitrile. Polyvinyl chloride (PVC).
- Other	Wear appropriate chemical resistant clothing.
Respiratory protection	In case of insufficient ventilation, wear suitable respiratory equipment.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
Hygiene measures	Keep away from food and drink. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.
Environmental exposure controls	Environmental manager must be informed of all major releases.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance	
Physical state	Liquid.
Form	Liquid.
Colour	Colourless. - Yellow
Odour	Slight. Alcoholic.
Odour threshold	Not available.
pH	8 - 9
Melting point/freezing point	0 °C (32 °F)
Initial boiling point and boiling range	100 °C (212 °F)
Flash point	Not applicable.
Evaporation rate	Not available.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not applicable.
Flammability limit - upper (%)	Not applicable.
Vapour pressure	Not available.
Vapour density	Not available.
Relative density	1.04
Relative density temperature	20 °C (68 °F)
Solubility(ies)	Soluble
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not available.
Explosive properties	Not available.
Oxidizing properties	Not available.

9.2. Other information

pH in aqueous solution 7 - 8 @5%

SECTION 10: Stability and reactivity

10.2. Chemical stability Material is stable under normal conditions.

10.3. Possibility of hazardous reactions No dangerous reaction known under conditions of normal use.

10.4. Conditions to avoid Contact with incompatible materials. Avoid frost.

10.5. Incompatible materials Strong acids. Strong oxidising agents.

10.6. Hazardous decomposition products Carbon oxides. No hazardous decomposition products are known. Under common conditions of use (see technical data sheet) Development of hazardous combustion gases or vapours possible in the event of fire. Sulphur compounds.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity Not classified.

Product	Species	Test results
CLB F5/AC (CAS Mixture)		
Acute		
Oral		
LD50	Rat	> 2500 mg/kg

* Estimates for product may be based on additional component data not shown.

Skin corrosion/irritation Causes skin irritation.

Serious eye damage/eye irritation Causes serious eye damage.

Respiratory sensitisation Not classified.

Skin sensitisation Not classified.

Germ cell mutagenicity Not classified.

Carcinogenicity Not classified.

Reproductive toxicity Not classified.

Specific target organ toxicity - single exposure Not classified.

Specific target organ toxicity - repeated exposure Not classified.

Aspiration hazard Not classified.

Mixture versus substance information No information available.

Other information Not available.

SECTION 12: Ecological information

12.1. Toxicity Not classified as an environmental hazard.

Product		Species	Test results
CLB F5/AC (CAS Mixture)			
Algae	IC50	Algae	142 mg/l, 72 Hours, Growth rate
	NOEC	Algae	15.6 mg/l, 72 Hours, Growth rate

Product		Species	Test results
Crustacea	EC50	Daphnia	48.8 mg/l, 48 Hours
	NOEC	Daphnia	25 mg/l, 48 Hours
Fish	LC50	Fish	10 - 48.8 mg/l, 96 Hours
	NOEC	Fish	10 mg/l, 96 Hours

* Estimates for product may be based on additional component data not shown.

12.2. Persistence and degradability Readily biodegradable.

12.3. Bioaccumulative potential No data available.

Bioconcentration factor (BCF) Not available.

12.4. Mobility in soil No data available.

Mobility in general This product is miscible in water.

12.5. Results of PBT and vPvB assessment Not available.

12.6. Other adverse effects No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Residual waste Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).

Contaminated packaging Empty containers should be taken to an approved waste handling site for recycling or disposal. Since emptied containers may retain product residue, follow label warnings even after container is emptied.

EU waste code 16 03 06 Unused product : Aqueous solution @ 5 % : 16 03 05*

Waste codes should be assigned by the user based on the application for which the product was used.

Disposal methods/information Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Do not discharge into drains, water courses or onto the ground. Dispose of contents/container in accordance with local/regional/national/international regulations.

Special precautions Dispose in accordance with all applicable regulations.

SECTION 14: Transport information

ADR

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

14.7. Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable.

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

EU regulations

Regulation (EC) No. 1005/2009 on substances that deplete the ozone layer, Annex I

Not listed.

Regulation (EC) No. 1005/2009 on substances that deplete the ozone layer, Annex II

Not listed.

Regulation (EC) No. 850/2004 On persistent organic pollutants, Annex I as amended

Not listed.

Regulation (EC) No. 689/2008 concerning the export and import of dangerous chemicals, Annex I, part 1 as amended

Not listed.

Regulation (EC) No. 689/2008 concerning the export and import of dangerous chemicals, Annex I, part 2 as amended

Not listed.

Regulation (EC) No. 689/2008 concerning the export and import of dangerous chemicals, Annex I, part 3 as amended

Not listed.

Regulation (EC) No. 689/2008 concerning the export and import of dangerous chemicals, Annex V as amended

Not listed.

Regulation (EC) No. 166/2006 Annex II Pollutant Release and Transfer Registry

Not listed.

Regulation (EC) No. 1907/2006, REACH Article 59(1) Candidate List as currently published by ECHA

Not listed.

Authorisations

Regulation (EC) No. 1907/2006, REACH Annex XIV Substances subject to authorization, as amended

Not listed.

Restrictions on use

Regulation (EC) No. 1907/2006, REACH Annex XVII Substances subject to restriction on marketing and use as amended

Not listed.

Directive 2004/37/EC: on the protection of workers from the risks related to exposure to carcinogens and mutagens at work

Not listed.

Directive 92/85/EEC: on the safety and health of pregnant workers and workers who have recently given birth or are breastfeeding

Not listed.

Other EU regulations

Directive 96/82/EC (Seveso II) on the control of major-accident hazards involving dangerous substances

Not listed.

Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work

2,4-Pentanediol, 2-methyl- (CAS 107-41-5)

Directive 94/33/EC on the protection of young people at work

Not listed.

Other regulations The product is classified and labelled in accordance with EC directives or respective national laws This Safety Data Sheet complies with the requirements of Regulation (EC) No 1907/2006.

National regulations Follow national regulation for work with chemical agents.

15.2. Chemical safety assessment No Chemical Safety Assessment has been carried out.

SECTION 16: Other information

List of abbreviations Not available.

References Not available.

Information on evaluation method leading to the classification of mixture The classification for health and environmental hazards is derived by a combination of calculatior methods and test data, if available.

Full text of any statements or R-phrases and H-statements under Sections 2 to 15

R22 Harmful if swallowed.
R36 Irritating to eyes.
R36/38 Irritating to eyes and skin.
R38 Irritating to skin.
R41 Risk of serious damage to eyes.
R50 Very toxic to aquatic organisms.
H302 Harmful if swallowed.
H315 Causes skin irritation.
H318 Causes serious eye damage.
H319 Causes serious eye irritation.
H400 Very toxic to aquatic life.
H412 Harmful to aquatic life with long lasting effects.

Revision information None.

Training information Follow training instructions when handling this material.

A.14. Condat – TFA 7

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Trade name or designation of the mixture TFA 7

Registration number -

Synonyms None.

Product code C00824

1.2. Relevant identified uses of the substance or mixture and uses advised against

Identified uses See Technical Data Sheet.

Uses advised against Not available.

1.3. Details of the supplier of the safety data sheet

Supplier

Company name CONDAT

Address Avenue Frédéric Mistral - B.P. 16
38670 CHASSE-SUR-RHONE
FR

Division Products Regulatory Affairs Department

Telephone Tel.: 33 (0)4 78.07.38.38
Fax: 33 (0)4 78.07.38.00

e-mail arp@condat.fr

Contact person Products Regulatory Affairs Department

1.4. Emergency telephone number

Emergency Tel. (Office hours): 33 (0) 4 78 07 37 18

Emergency Tel. (France) ORFILA (INRS) :
+ 33 (0)1 45 42 59 59

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

The mixture has been assessed and/or tested for its physical, health and environmental hazards and the following classificatior applies.

Classification according to Directive 67/548/EEC or 1999/45/EC as amended

This preparation does not meet the criteria for classification according to Directive 1999/45/EC as amended

Classification according to Regulation (EC) No 1272/2008 as amended

This mixture does not meet the criteria for classification according to Regulation (EC) 1272/2008 as amended.

Hazard summary

Specific hazards Under normal conditions of intended use: None known.

Main symptoms See section 11 for additional information on health hazards.

2.2. Label elements

Label according to Regulation (EC) No. 1272/2008 as amended

Hazard pictograms None.

Signal word None.

Hazard statements The mixture does not meet the criteria for classification.

Precautionary statements

Prevention Observe good industrial hygiene practices.

Response Wash hands after handling.

Storage Store away from incompatible materials.

Disposal	Dispose of waste and residues in accordance with local authority requirements.
Supplemental label information	Not applicable.
2.3. Other hazards	Not assigned.

SECTION 3: Composition/information on ingredients

3.2. Mixtures

The components are not hazardous or are below required disclosure limits.

Composition comments	Occupational Exposure Limits for constituents are listed in Section 8.

SECTION 4: First aid measures

General information	Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

4.1. Description of first aid measures

Inhalation	Remove to fresh air. Move to fresh air. Call a physician if symptoms develop or persist.
Skin contact	Rinse skin with water/shower. Get medical attention if irritation develops and persists.
Eye contact	Rinse with water. Get medical attention if irritation develops and persists.
Ingestion	Rinse mouth. If swallowed, do NOT induce vomiting. Get medical attention if symptoms occur.
4.2. Most important symptoms and effects, both acute and delayed	Direct contact with eyes may cause temporary irritation.
4.3. Indication of any immediate medical attention and special treatment needed	Treat symptomatically.

SECTION 5: Firefighting measures

General fire hazards	No unusual fire or explosion hazards noted. None known.

5.1. Extinguishing media

Suitable extinguishing media	Water spray, foam, dry powder or carbon dioxide. Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
Unsuitable extinguishing media	None.
5.2. Special hazards arising from the substance or mixture	See also section 10.

5.3. Advice for firefighters

Special protective equipment for firefighters	None. Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Special fire fighting procedures	In case of fire and/or explosion do not breathe fumes.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

For non-emergency personnel	Keep unnecessary personnel away. Wear appropriate protective equipment and clothing during clean-up. Do not touch or walk through spilled material. Local authorities should be advised if significant spillages cannot be contained. For personal protection, see section 8.
For emergency responders	Keep unnecessary personnel away. Use personal protection recommended in Section 8 of the MSDS.

6.2. Environmental precautions	Local authorities should be advised if significant spillages cannot be contained. Prevent further leakage or spillage if safe to do so.
6.3. Methods and material for containment and cleaning up	This product is miscible in water. Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Cover with plastic sheet to prevent spreading. Absorb in vermiculite, dry sand or earth and place into containers. Following product recovery, flush area with water. Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination. Never return spills in original containers for re-use. In case of spills, beware of slippery floors and surfaces.
6.4. Reference to other sections	See Section 8 for personal protective equipment. For waste disposal, see section 13.

SECTION 7: Handling and storage

7.1. Precautions for safe handling	Avoid contact with skin and eyes.
7.2. Conditions for safe storage, including any incompatibilities	Storage temperature: between 0°C and 35°C. Store in closed original container in a dry place. Store away from incompatible materials (see Section 10 of the MSDS). Keep from freezing.
7.3. Specific end use(s)	Not available.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Occupational exposure limits	No exposure limits noted for ingredient(s).
Biological limit values	No biological exposure limits noted for the ingredient(s).
Recommended monitoring procedures	Follow standard monitoring procedures.
Derived no-effect level (DNEL)	Not available.
Predicted no effect concentrations (PNECs)	Not available.

8.2. Exposure controls

Appropriate engineering controls	Ensure adequate ventilation, especially in confined areas.

Individual protection measures, such as personal protective equipment

General information	Personal protection equipment should be chosen according to the CEN standards and in discussion with the supplier of the personal protective equipment.
Eye/face protection	Chemical goggles are recommended.
Skin protection	
- Hand protection	Rubber gloves. Use protective gloves made of:
- Other	Normal work clothing (long sleeved shirts and long pants) is recommended.
Respiratory protection	In case of inadequate ventilation use suitable respirator.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
Hygiene measures	Wash hands after handling. Handle in accordance with good industrial hygiene and safety practices.
Environmental exposure controls	Environmental manager must be informed of all major releases.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance	
Physical state	Liquid.
Form	Liquid.
Colour	Colourless. - Light yellow.
Odour	Not available.
Odour threshold	Not available.
pH	6 - 9
Melting point/freezing point	0 °C (32 °F)
Initial boiling point and boiling range	Not available.
Flash point	Not applicable.
Evaporation rate	Not available.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not applicable.
Flammability limit - upper (%)	Not applicable.
Vapour pressure	Not available.
Vapour density	Not available.
Relative density	1.3
Relative density temperature	20 °C (68 °F)
Solubility(ies)	Soluble
Partition coefficient (n-octanol/water)	1
Auto-ignition temperature	Not applicable.
Decomposition temperature	Not available.
Viscosity	Not available.
Explosive properties	Not available.
Oxidizing properties	Not available.

9.2. Other information

VOC (Weight %)	0%

SECTION 10: Stability and reactivity

10.2. Chemical stability	Material is stable under normal conditions.
10.3. Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use. Not known.
10.4. Conditions to avoid	Contact with incompatible materials. Avoid frost.
10.5. Incompatible materials	Oxidizing agents.
10.6. Hazardous decomposition products	At thermal decomposition temperatures, carbon monoxide and carbon dioxide. Nitrogen oxides (NOx).

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity :

Product	Species	Test results
TFA 7 (CAS Mixture)		
Acute		
Oral		
LD50	Rat	> 2000 mg/kg

* Estimates for product may be based on additional component data not shown.

Skin corrosion/irritation	Not classified.
Serious eye damage/eye irritation	May cause minor irritation on eye contact.
Respiratory sensitisation	Not classified.
Skin sensitisation	Not classified.
Germ cell mutagenicity	Not classified.
Carcinogenicity	Not classified.
Reproductive toxicity	Not classified.
Specific target organ toxicity - single exposure	Not classified.
Specific target organ toxicity - repeated exposure	Not classified.
Aspiration hazard	Not classified.
Mixture versus substance information	No information available.
Other information	Not available.

SECTION 12: Ecological information

12.1. Toxicity Not expected to be harmful to aquatic organisms.

Product		Species	Test results
TFA 7 (CAS Mixture)			
Algae	IC50	Algae	> 100 mg/l, 72 Hours, (OECD 201)
Crustacea	LC50	Daphnia	> 100 mg/l, 48 Hours, (OECD 202)
Fish	LC50	Fish	> 100 mg/l, 96 Hours, (OECD 203)

* Estimates for product may be based on additional component data not shown.

12.2. Persistence and degradability	Not readily degradable.
12.3. Bioaccumulative potential	The product is not bioaccumulating.
Partition coefficient n-octanol/water (log Kow)	
1	
Bioconcentration factor (BCF)	Not available.
12.4. Mobility in soil	No data available.

Mobility in general	This product is miscible in water.
12.5. Results of PBT and vPvB assessment	Not available.
12.6. Other adverse effects	No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Residual waste	Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).
Contaminated packaging	Empty containers should be taken to an approved waste handling site for recycling or disposal. Since emptied containers may retain product residue, follow label warnings even after container is emptied.
EU waste code	Unused product : 07 07 99 Waste codes should be assigned by the user based on the application for which the product was used.
Disposal methods/information	Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Do not discharge into drains, water courses or onto the ground.
Special precautions	Dispose in accordance with all applicable regulations.

SECTION 14: Transport information

ADR

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IATA DGR 57th Edition 2016

IMDG

Not regulated as dangerous goods.

14.7. Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	This substance/mixture is not intended to be transported in bulk.

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

EU regulations

Regulation (EC) No. 1005/2009 on substances that deplete the ozone layer, Annex I

Not listed.

Regulation (EC) No. 1005/2009 on substances that deplete the ozone layer, Annex II

Not listed.

Regulation (EC) No. 850/2004 On persistent organic pollutants, Annex I as amended

Not listed.

Regulation (EC) No. 689/2008 concerning the export and import of dangerous chemicals, Annex I, part 1 as amended

Not listed.

Regulation (EC) No. 689/2008 concerning the export and import of dangerous chemicals, Annex I, part 2 as amended

Not listed.

Regulation (EC) No. 689/2008 concerning the export and import of dangerous chemicals, Annex I, part 3 as amended

Not listed.

Regulation (EC) No. 689/2008 concerning the export and import of dangerous chemicals, Annex V as amended

Not listed.

Regulation (EC) No. 166/2006 Annex II Pollutant Release and Transfer Registry

Not listed.

Regulation (EC) No. 1907/2006, REACH Article 59(1) Candidate List as currently published by ECHA

Not listed.

Authorisations

Regulation (EC) No. 1907/2006, REACH Annex XIV Substances subject to authorization, as amended

Not listed.

Restrictions on use

Regulation (EC) No. 1907/2006, REACH Annex XVII Substances subject to restriction on marketing and use as amended

Not listed.

Directive 2004/37/EC: on the protection of workers from the risks related to exposure to carcinogens and mutagens at work

Not listed.

Directive 92/85/EEC: on the safety and health of pregnant workers and workers who have recently given birth or are breastfeeding

Not listed.

Other EU regulations

Directive 96/82/EC (Seveso II) on the control of major-accident hazards involving dangerous substances

Not listed.

Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work

Not listed.

Directive 94/33/EC on the protection of young people at work

Not listed.

Other regulations	The product is classified and labelled in accordance with EC directives or respective national laws This Safety Data Sheet complies with the requirements of Regulation (EC) No 1907/2006. The product does not need to be labelled in accordance with EC directives or respective national laws.
National regulations	Follow national regulation for work with chemical agents.
15.2. Chemical safety assessment	No Chemical Safety Assessment has been carried out.

SECTION 16: Other information

List of abbreviations	Not available.
References	Not available.
Information on evaluation method leading to the classification of mixture	The classification for health and environmental hazards is derived by a combination of calculatior methods and test data, if available.
Full text of any statements or R-phrases and H-statements under Sections 2 to 15	None.
Revision information	SECTION 14: Transport information: IATA supplemental information
Training information	Follow training instructions when handling this material.

A.15. Condat – HBW

SAFETY DATA SHEET

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Trade name or designation of the mixture HBW NewGeneration

Registration number -

Synonyms None.

Product code C03672

1.2. Relevant identified uses of the substance or mixture and uses advised against

Identified uses See Technical Data Sheet.

Uses advised against Not available.

1.3. Details of the supplier of the safety data sheet

Supplier

Company name CONDAT

Address Avenue Frédéric Mistral - B.P. 16
38670 CHASSE-SUR-RHONE
FR

Division Products Regulatory Affairs Department

Telephone Tel.: 33 (0)4 78.07.38.38
Fax: 33 (0)4 78.07.38.00

e-mail arp@condat.fr

Contact person Products Regulatory Affairs Department

1.4. Emergency telephone number Emergency Tel. (Office hours): 33 (0) 4 78 07 37 18

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

The mixture has been assessed and/or tested for its physical, health and environmental hazards and the following classificatior applies.

Classification according to Regulation (EC) No 1272/2008 as amended

This mixture is not classified as hazardous according to the criteria for classification of the Regulation (EC) 1272/2008 as amended.

2.2. Label elements

Label according to Regulation (EC) No. 1272/2008 as amended

Hazard pictograms None.

Signal word None.

Hazard statements The mixture does not meet the criteria for classification.

Precautionary statements

Prevention Observe good industrial hygiene practices.

Response Wash hands after handling.

Storage Store away from incompatible materials.

Disposal Not available.

Supplemental label information None.

2.3. Other hazards Not assigned.

SECTION 3: Composition/information on ingredients

3.2. Mixtures

The components are not hazardous or are below required disclosure limits.

List of abbreviations and symbols that may be used above

CLP: Regulation No. 1272/2008. "-" = Not available or this substance does not meet the criteria for classification according to Regulation (EC) 1272/2008 as amended.
M: M-factor
vPvB: very persistent and very bioaccumulative substance.
PBT: persistent, bioaccumulative and toxic substance.
#: This substance has been assigned Community workplace exposure limit(s).

Composition comments Occupational Exposure Limits for constituents are listed in Section 8. The full text for all H-statements is displayed in section 16.

SECTION 4: First aid measures

General information Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

4.1. Description of first aid measures

Inhalation Under normal conditions of intended use, this material is not expected to be an inhalation hazard.

Skin contact Wash off with soap and water. Get medical attention if irritation develops and persists.

Eye contact Flush eyes with water as a precaution. Get medical attention if irritation develops and persists.

Ingestion Rinse mouth. If swallowed, do NOT induce vomiting. Get medical attention if symptoms occur.

4.2. Most important symptoms and effects, both acute and delayed Direct contact with eyes may cause temporary irritation.

4.3. Indication of any immediate medical attention and special treatment needed Treat symptomatically.

SECTION 5: Firefighting measures

General fire hazards No unusual fire or explosion hazards noted. None known.

5.1. Extinguishing media

Suitable extinguishing media Foam. Dry chemical, CO2, or water spray. Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media Not relevant.

5.2. Special hazards arising from the substance or mixture None known. See also section 10.

5.3. Advice for firefighters

Special protective equipment for firefighters Self-contained breathing apparatus and full protective clothing must be worn in case of fire.

Special fire fighting procedures In case of fire and/or explosion do not breathe fumes. Cool containers exposed to heat with water spray and remove container, if no risk is involved.

Specific methods In the event of fire and/or explosion do not breathe fumes.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

For non-emergency personnel	Keep unnecessary personnel away. Wear appropriate protective equipment and clothing during clean-up. Do not touch or walk through spilled material. For personal protection, see section 8.
For emergency responders	Keep unnecessary personnel away. Use personal protection recommended in Section 8 of the SDS.
6.2. Environmental precautions	Local authorities should be advised if significant spillages cannot be contained. Prevent further leakage or spillage if safe to do so.
6.3. Methods and material for containment and cleaning up	The product is immiscible with water and will sediment in water systems. Stop the flow of material, if this is without risk. Scrub the area with detergent and water. Small Dry Spills: With clean shovel place material into clean, dry container and cover loosely; move containers from spill area.
6.4. Reference to other sections	See Section 8 for personal protective equipment. For waste disposal, see section 13 of the SDS.

SECTION 7: Handling and storage

7.1. Precautions for safe handling	To avoid thermal decomposition, do not overheat. Do not breathe dust. Avoid prolonged or repeated contact with skin. Wash hands after handling. Handle in accordance with good industrial hygiene and safety practices. Adequate ventilation should be provided so that exposure limits are not exceeded.
7.2. Conditions for safe storage, including any incompatibilities	Store in closed original container in a dry place. Store away from incompatible materials (see Section 10 of the SDS).
7.3. Specific end use(s)	Not available.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Occupational exposure limits	No exposure limits noted for ingredient(s).
Biological limit values	No biological exposure limits noted for the ingredient(s).
Recommended monitoring procedures	Follow standard monitoring procedures.
Derived no-effect level (DNEL)	Not available.
Predicted no effect concentrations (PNECs)	Not available.
Exposure guidelines	Occupational Exposure Limits are not relevant to the current physical form of the product.

8.2. Exposure controls

Appropriate engineering controls	Ensure adequate ventilation, especially in confined areas.

Individual protection measures, such as personal protective equipment

General information	Personal protection equipment should be chosen according to the CEN standards and in discussion with the supplier of the personal protective equipment.
Eye/face protection	Chemical goggles are recommended.
Skin protection	
- Hand protection	Use protective gloves made of: Nitrile. Polyvinyl chloride (PVC). Suitable gloves can be recommended by the glove supplier.
- Other	Normal work clothing (long sleeved shirts and long pants) is recommended.

Respiratory protection	In case of insufficient ventilation, wear suitable respiratory equipment.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
Hygiene measures	Wash hands after handling. Handle in accordance with good industrial hygiene and safety practices.
Environmental exposure controls	Environmental manager must be informed of all major releases.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance	
Physical state	Solid.
Form	Solid. Paste.
Colour	Black.
Odour	Slight.
Odour threshold	Not available.
pH	Not applicable.
Melting point/freezing point	0 °C (32 °F) / < 0 °C (< 32 °F)
Initial boiling point and boiling range	Not available.
Flash point	> 125.0 °C (> 257.0 °F) Base oil
Evaporation rate	Not available.
Flammability (solid, gas)	Not available.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Vapour pressure	Not available.
Vapour density	Not available.
Relative density	1.2
Relative density temperature	25 °C (77 °F)
Solubility(ies)	
Solubility (water)	Insoluble
Solubility (other)	Not available.
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not applicable.
Decomposition temperature	Not available.
Viscosity	Not applicable.
Explosive properties	Not available.
Oxidising properties	Not oxidising.
9.2. Other information	No relevant additional information available.

SECTION 10: Stability and reactivity

10.1. Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
10.2. Chemical stability	Material is stable under normal conditions.

10.3. Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use.
10.4. Conditions to avoid	Avoid temperatures exceeding the decomposition temperature. Contact with incompatible materials.
10.5. Incompatible materials	Strong oxidising agents. Chlorine.
10.6. Hazardous decomposition products	Carbon oxides. Decomposition may yield acrolein.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity	Under normal conditions of intended use, this material is not expected to be an inhalation hazard. Ingestion of large amounts may produce gastrointestinal disturbances including irritation, nausea, and diarrhoea.
Skin corrosion/irritation	Not classified.
Serious eye damage/eye irritation	Not classified.
Respiratory sensitisation	Not classified.
Skin sensitisation	Not classified.
Germ cell mutagenicity	Not classified.
Carcinogenicity	Not classified.
Reproductive toxicity	Not classified.
Specific target organ toxicity - single exposure	Not classified.
Specific target organ toxicity - repeated exposure	Not classified.
Aspiration hazard	Not classified.
Mixture versus substance information	No information available.
Other information	Not available.

SECTION 12: Ecological information

12.1. Toxicity	Not classified as an environmental hazard.
12.2. Persistence and degradability	Not available.
12.3. Bioaccumulative potential	
Bioconcentration factor (BCF)	Not available.
12.4. Mobility in soil	No data available.
Mobility in general	The product is immiscible with water and will sediment in water systems.
12.5. Results of PBT and vPvB assessment	Not available.
12.6. Other adverse effects	No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Residual waste	Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).
Contaminated packaging	Since emptied containers may retain product residue, follow label warnings even after container is emptied. Empty containers should be taken to an approved waste handling site for recycling or disposal.
EU waste code	Unused product : 08 04 10 Waste codes should be assigned by the user based on the application for which the product was used.
Disposal methods/information	Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Do not discharge into drains, water courses or onto the ground.
Special precautions	Dispose in accordance with all applicable regulations.

SECTION 14: Transport information

ADR

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IATA DGR 57th Edition 2016

IMDG

Not regulated as dangerous goods.

14.7. Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	Not applicable.

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

EU regulations

Regulation (EC) No. 1005/2009 on substances that deplete the ozone layer, Annex I and II, as amended

Not listed.

Regulation (EC) No. 850/2004 On persistent organic pollutants, Annex I as amended

Not listed.

Regulation (EC) No. 689/2008 concerning the export and import of dangerous chemicals, Annex I, part 1 as amended

Not listed.

Regulation (EC) No. 689/2008 concerning the export and import of dangerous chemicals, Annex I, part 2 as amended

Not listed.

Regulation (EC) No. 689/2008 concerning the export and import of dangerous chemicals, Annex I, part 3 as amended

Not listed.

Regulation (EC) No. 689/2008 concerning the export and import of dangerous chemicals, Annex V as amended

Not listed.

Regulation (EC) No. 166/2006 Annex II Pollutant Release and Transfer Registry, as amended

Not listed.

Regulation (EC) No. 1907/2006, REACH Article 59(10) Candidate List as currently published by ECHA

Not listed.

Authorisations

Regulation (EC) No. 1907/2006, REACH Annex XIV Substances subject to authorization, as amended

Not listed.

Restrictions on use

Directive 2004/37/EC: on the protection of workers from the risks related to exposure to carcinogens and mutagens at work, as amended

Not listed.

Directive 92/85/EEC: on the safety and health of pregnant workers and workers who have recently given birth or are breastfeeding, as amended

Not listed.

Regulation (EC) No. 1907/2006, REACH Annex XVII Substances subject to restriction on marketing and use as amended

Not listed.

Other EU regulations

Directive 2012/18/EU on major accident hazards involving dangerous substances

Not listed.

Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work, as amended

Not listed.

Directive 94/33/EC on the protection of young people at work, as amended

Not listed.

Other regulations	The product is classified and labelled in accordance with EC directives or respective national laws This Safety Data Sheet complies with the requirements of Regulation (EC) No 1907/2006, as amended.
National regulations	Follow national regulation for work with chemical agents.
15.2. Chemical safety assessment	No Chemical Safety Assessment has been carried out.

SECTION 16: Other information

List of abbreviations	Not available.
References	Not available.
Information on evaluation method leading to the classification of mixture	The classification for health and environmental hazards is derived by a combination of calculation methods and test data, if available.
Full text of any H-statements not written out in full under Sections 2 to 15	None.
Revision information	This document has undergone significant changes and should be reviewed in its entirety.
Training information	Follow training instructions when handling this material.

A.16. Condat – EP2

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Trade name or designation of the mixture GR 217 EP2

Registration number -

Synonyms None.

Product code C31011

1.2. Relevant identified uses of the substance or mixture and uses advised against

Identified uses See Technical Data Sheet.

Uses advised against Not available.

1.3. Details of the supplier of the safety data sheet

Supplier

Company name CONDAT

Address Avenue Frédéric Mistral - B.P. 16
38670 CHASSE-SUR-RHONE
FR

Division Products Regulatory Affairs Department

Telephone Tel.: 33 (0)4 78.07.38.38
Fax: 33 (0)4 78.07.38.00

e-mail arp@condat.fr

Contact person Products Regulatory Affairs Department

1.4. Emergency telephone number

Emergency Tel. (Office hours): 33 (0) 4 78 07 37 18

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

The mixture has been assessed and/or tested for its physical, health and environmental hazards and the following classificatio applies.

Classification according to Directive 67/548/EEC or 1999/45/EC as amended

This preparation does not meet the criteria for classification according to Directive 1999/45/EC as amended

Classification according to Regulation (EC) No 1272/2008 as amended

This mixture is not classified as hazardous according to the criteria for classification of the Regulation (EC) 1272/2008 a amended.

Hazard summary

Physical hazards Not classified for physical hazards.

Health hazards Not classified for health hazards.

Environmental hazards Not classified for hazards to the environment.

Specific hazards Under normal conditions of intended use: None known.

Main symptoms See section 11 for additional information on health hazards.

2.2. Label elements

Label according to Regulation (EC) No. 1272/2008 as amended

Hazard pictograms None.

Signal word None.

Hazard statements The mixture does not meet the criteria for classification.

Precautionary statements

Prevention	Observe good industrial hygiene practices.
Response	Wash hands after handling.
Storage	Store away from incompatible materials.
Disposal	Dispose of waste and residues in accordance with local authority requirements.
Supplemental label information	Danemark, Code Number : 00-1 (1993)
2.3. Other hazards	Not assigned.

SECTION 3: Composition/information on ingredients

3.2. Mixtures

The components are not hazardous or are below required disclosure limits

List of abbreviations and symbols that may be used above

CLP: Regulation No. 1272/2008. "-" = Not available or this substance does not meet the criteria for classification according to Regulation (EC) 1272/2008 as amended.
DSD: Directive 67/548/EEC.
M: M-factor
vPvB: very persistent and very bioaccumulative substance.
PBT: persistent, bioaccumulative and toxic substance.
#: This substance has been assigned Community workplace exposure limit(s).

Composition comments Occupational Exposure Limits for constituents are listed in Section 8. The full text for all R- and H-phrases is displayed in section 16.

SECTION 4: First aid measures

General information Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

4.1. Description of first aid measures

Inhalation	Under normal conditions of intended use, this material is not expected to be an inhalation hazard.
Skin contact	Wash off with soap and water. Get medical attention if irritation develops and persists.
Eye contact	Flush eyes with water as a precaution. Get medical attention if irritation develops and persists.
Ingestion	Rinse mouth. If swallowed, do NOT induce vomiting. Get medical attention if symptoms occur.
4.2. Most important symptoms and effects, both acute and delayed	Direct contact with eyes may cause temporary irritation.
4.3. Indication of any immediate medical attention and special treatment needed	Treat symptomatically.

SECTION 5: Firefighting measures

General fire hazards No unusual fire or explosion hazards noted.

5.1. Extinguishing media

Suitable extinguishing media	Foam. Dry chemicals. Carbon dioxide (CO2). Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
Unsuitable extinguishing media	Do not use water jet as an extinguisher, as this will spread the fire.
5.2. Special hazards arising from the substance or mixture	Combustible. See also section 10.

5.3. Advice for firefighters

Special protective equipment for firefighters	Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Special fire fighting procedures	In case of fire and/or explosion do not breathe fumes. Cool containers exposed to heat with water spray and remove container, if no risk is involved.
Specific methods	In the event of fire and/or explosion do not breathe fumes.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

For non-emergency personnel	Keep unnecessary personnel away. Wear appropriate protective equipment and clothing during clean-up. For personal protection, see section 8.
For emergency responders	Keep unnecessary personnel away. Use personal protection recommended in Section 8 of the SDS.
6.2. Environmental precautions	Local authorities should be advised if significant spillages cannot be contained. Prevent further leakage or spillage if safe to do so.
6.3. Methods and material for containment and cleaning up	The product is immiscible with water and will spread on the water surface. Stop the flow of material, if this is without risk. Scrub the area with detergent and water. Small Dry Spills: With clean shovel place material into clean, dry container and cover loosely; move containers from spill area.
6.4. Reference to other sections	See Section 8 for personal protective equipment. For waste disposal, see section 13 of the SDS.

SECTION 7: Handling and storage

7.1. Precautions for safe handling	To avoid thermal decomposition, do not overheat. Avoid prolonged or repeated contact with skin Wash hands after handling. Handle in accordance with good industrial hygiene and safety practices. Adequate ventilation should be provided so that exposure limits are not exceeded.
7.2. Conditions for safe storage, including any incompatibilities	Keep away from heat and sources of ignition. Store in closed original container in a dry place. Store away from incompatible materials (see Section 10 of the SDS).
7.3. Specific end use(s)	Not available.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Occupational exposure limits

UK. EH40 Workplace Exposure Limits (WELs)

Components	Type	Value	Form
Graphite (CAS 7782-42-5)	TWA	4 mg/m3	Respirable dust.
		10 mg/m3	Inhalable dust.

Biological limit values	No biological exposure limits noted for the ingredient(s).
Recommended monitoring procedures	Follow standard monitoring procedures.
Derived no-effect level (DNEL)	Not available.
Predicted no effect concentrations (PNECs)	Not available.
Exposure guidelines	Occupational Exposure Limits are not relevant to the current physical form of the product.

8.2. Exposure controls

Appropriate engineering controls	Ensure adequate ventilation, especially in confined areas.

Individual protection measures, such as personal protective equipment

General information	Personal protection equipment should be chosen according to the CEN standards and in discussion with the supplier of the personal protective equipment.
Eye/face protection	If contact is likely, safety glasses with side shields are recommended.
Skin protection	
- Hand protection	Protective gloves are recommended.
- Other	Normal work clothing (long sleeved shirts and long pants) is recommended.
Respiratory protection	In case of insufficient ventilation, wear suitable respiratory equipment.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
Hygiene measures	Wash hands after handling. Handle in accordance with good industrial hygiene and safety practices.
Environmental exposure controls	Environmental manager must be informed of all major releases.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance	
Physical state	Solid.
Form	Solid. Paste.
Colour	Black
Odour	Mild.
Odour threshold	Not available.
pH	Not applicable.
Melting point/freezing point	Not available.
Initial boiling point and boiling range	Not available.
Flash point	> 250.0 °C (> 482.0 °F) Open cup Base oil
Evaporation rate	Not available.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Vapour pressure	Not available.
Vapour density	Not available.
Relative density	0.92
Relative density temperature	20 °C (68 °F)
Solubility(ies)	
Solubility (water)	Insoluble.
Solubility (other)	Not available.
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.

Viscosity	Not available.
Explosive properties	Not available.
Oxidising properties	Not available.
9.2. Other information	
Dropping point	>= 160 °C (>= 320 °F) NFT 60 132

SECTION 10: Stability and reactivity

10.1. Reactivity	Strong oxidising agents.
10.2. Chemical stability	Material is stable under normal conditions.
10.3. Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use.
10.4. Conditions to avoid	Avoid temperatures exceeding the decomposition temperature. Avoid temperatures exceeding the flash point. Eliminate all sources of ignition. Contact with incompatible materials.
10.5. Incompatible materials	Strong oxidising agents.
10.6. Hazardous decomposition products	Carbon oxides.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity	Under normal conditions of intended use, this material is not expected to be an inhalation hazard. Ingestion of large amounts may produce gastrointestinal disturbances including irritation, nausea, and diarrhoea.
Skin corrosion/irritation	Not classified.
Serious eye damage/eye irritation	Not classified.
Respiratory sensitisation	Not classified.
Skin sensitisation	Not classified.
Germ cell mutagenicity	Not classified.
Carcinogenicity	Not classified.
Reproductive toxicity	Not classified.
Specific target organ toxicity - single exposure	Not classified.
Specific target organ toxicity - repeated exposure	Not classified.
Aspiration hazard	Not classified.
Mixture versus substance information	No information available.
Other information	Not available.

SECTION 12: Ecological information

12.1. Toxicity	Not classified as an environmental hazard.
12.2. Persistence and degradability	Based on testing of similar formulations and/or the components: Ultimately biodegradable (aerobic) : >60% biodegradation after 28 days OECD Test Guideline 301 B
12.3. Bioaccumulative potential	No data available.

Partition coefficient n-octanol/water (log Kow)	Not available.
Bioconcentration factor (BCF)	Not available.
12.4. Mobility in soil	No data available.
Mobility in general	The product is immiscible with water and will spread on the water surface
12.5. Results of PBT and vPvB assessment	Not available.
12.6. Other adverse effects	No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Residual waste	Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).
Contaminated packaging	Empty containers should be taken to an approved waste handling site for recycling or disposal. Since emptied containers may retain product residue, follow label warnings even after container is emptied.
EU waste code	Unused product : 16 03 06 Waste codes should be assigned by the user based on the application for which the product was used.
Disposal methods/information	Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Do not discharge into drains, water courses or onto the ground.
Special precautions	Dispose in accordance with all applicable regulations.

SECTION 14: Transport information

ADR

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

14.7. Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	Not applicable.

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

EU regulations

Regulation (EC) No. 1005/2009 on substances that deplete the ozone layer, Annex I and II, as amended

Not listed.

Regulation (EC) No. 850/2004 On persistent organic pollutants, Annex I as amended

Not listed.

Regulation (EC) No. 689/2008 concerning the export and import of dangerous chemicals, Annex I, part 1 as amended

Not listed.

Regulation (EC) No. 689/2008 concerning the export and import of dangerous chemicals, Annex I, part 2 as amended

Not listed.

Regulation (EC) No. 689/2008 concerning the export and import of dangerous chemicals, Annex I, part 3 as amended

Not listed.

Regulation (EC) No. 689/2008 concerning the export and import of dangerous chemicals, Annex V as amended

Not listed.

Regulation (EC) No. 166/2006 Annex II Pollutant Release and Transfer Registry, as amended

Not listed.

Regulation (EC) No. 1907/2006, REACH Article 59(10) Candidate List as currently published by ECHA

Not listed.

Authorisations

Regulation (EC) No. 1907/2006, REACH Annex XIV Substances subject to authorization, as amended

Not listed.

Restrictions on use

Directive 2004/37/EC: on the protection of workers from the risks related to exposure to carcinogens and mutagens at work, as amended

Not listed.

Directive 92/85/EEC: on the safety and health of pregnant workers and workers who have recently given birth or are breastfeeding, as amended

Not listed.

Regulation (EC) No. 1907/2006, REACH Annex XVII Substances subject to restriction on marketing and use as amended

Not listed.

Other EU regulations

Directive 2012/18/EU on major accident hazards involving dangerous substances

Not listed.

Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work, as amended

Not listed.

Directive 94/33/EC on the protection of young people at work, as amended

Not listed.

Other regulations	The product is classified and labelled in accordance with EC directives or respective national laws This Safety Data Sheet complies with the requirements of Regulation (EC) No 1907/2006
National regulations	Follow national regulation for work with chemical agents.
15.2. Chemical safety assessment	No Chemical Safety Assessment has been carried out.

SECTION 16: Other information

List of abbreviations	Not available.
References	Not available.
Information on evaluation method leading to the classification of mixture	The classification for health and environmental hazards is derived by a combination of calculatior methods and test data, if available.
Full text of any statements or R-phrases and H-statements under Sections 2 to 15	None.

Revision information	SECTION 12: Ecological information: 12.2. Persistence and degradability
Training information	Follow training instructions when handling this material.

A.17. Imerys – Talc Slurry

Safety Data Sheet

In compliance with Regulation (EC) 1907/2006, Regulation (EC) 1272/2008 and Regulation (EU) 2015/830

Version: 1
Date: 26/04/2018

SECTION 1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY / UNDERTAKING

1.1 Product identifier:

Substance name: Talc
Synonyms: Talcum, steatite, soapstone, French chalk, hydrous magnesium silicate.
Chemical name and formula: $Mg_3Si_4O_{10}(OH)_2$

Trade names:

E 8023

CAS: 14807-96-6
EINECS: 238-877-9
Molecular weight: 379.3

REACH Registr. n°: Exempted in accordance with Annex V.7.

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses: Functional mineral for use in industrial applications.

Use advised against: None

1.3 Details of the supplier of the safety data sheet

- Company name: Imerys Talc Europe
- Address: 2 place Edouard Bouillères
31100 Toulouse
France
- Phone No.: +33 5 61 50 20 20
- E-mail of responsible person for SDS in the Member State or in the EU: msds.talceurope@imerys.com

1.4 Emergency telephone number

National centre for Prevention and Treatment of Intoxications n°: see annex 2

Emergency phone number at the Company: +1 303 623 5716
Available outside office hours: Yes

Other information (e.g. language of the phone service): -

SECTION 2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

Regulation EC 1272/2008: **No classification**

2.2 Label elements

- Pictogram None
- Signal word None
- Hazard statement None
- Precautionary statements None

2.3 Other hazards:

Repeated and prolonged exposure to large amounts of talc dust can cause lung injury (pneumoconiosis). Risk of injury is dependent on the duration and level of exposure.
Depending on the type of handling and use (e.g. grinding, drying, etc), airborne respirable crystalline silica (quartz - cristobalite) may be generated. Prolonged and/or massive inhalation of respirable crystalline silica dust may cause lung fibrosis, commonly referred to as silicosis. Principal symptoms of silicosis are cough and breathlessness. Occupational exposure to respirable crystalline silica should be monitored and controlled. These products should be handled with care to avoid dust generation.
This product is an inorganic substance and does not meet the criteria for PBT or vPvB in accordance with Annex XIII of REACH.
No other hazards identified.

SECTION 3. COMPOSITION / INFORMATION ON INGREDIENTS

3.1 Substances

-

3.2 Mixtures

Talc is a substance of Unknown or Variable composition, Complex reaction products or Biological materials (UVCB, type 4) according to REACH & CLP Regulations.

Name	CAS	EC number	Concentration range (weight %)	Classification according to Regulation (EC) 1272/2008
Talc	14807-96-6	238-877-9	> 80%	Not classified
Chlorite	1318-59-8	215-285-9	< 15%	Not classified
Dolomite	16389-88-1	240-440-2	< 3%	Not classified
Quartz	14808-60-7	238-878-4	< 1%	Not classified
Additive	-	-	< 1%	Eye Damage / Cat 1 / H318 Aquatic Chronic / Cat 3 / H412 Skin irritation / Cat 2 / H315

The product contains below 1% (w/w) fine fraction of quartz (CAS: 14808-60-7).

SECTION 4. FIRST-AID MEASURES

4.1 Description of first aid measures

Following eye contact: Rinse with copious quantities of water and seek medical attention if irritation persists.

Following skin contact: No special first aid measures necessary.

Following inhalation: No special first aid measures. Remove to fresh air and get medical attention in case of serious respiratory problems.

Following ingestion: No first aid measures required.

4.2 Most important symptoms and effects both acute and delayed:
Symptoms of acute accidental exposure would be non-specific and similar to those of a massive inhalation of any dust without toxic effects. These symptoms may include coughing, expectoration, sneezing, and difficulty in breathing due to upper respiratory tract irritation.

4.3 Indication of immediate medical attention and special treatment needed:
No specific actions are required

SECTION 5. FIRE-FIGHTING MEASURES

5.1 Extinguishing media:

5.1.1. Suitable extinguishing media:
All extinguishing media can be used.

5.1.2. Unsuitable extinguishing media
No restriction on the extinguishing media to be used.

5.2 Special hazards arising from the substance or mixture:
The product is not flammable, combustible or explosive. No hazardous thermal decomposition.

5.3 Advice for fire-fighters:
No specific fire-fighting protection is required. Use an extinguishing agent suitable for the surrounding fire.

SECTION 6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures:
Avoid airborne dust generation. If the generation of dust is likely, respiratory personal protective equipment should be worn in compliance with national legislation, see EN 143:2000.

6.2 Environmental precautions:
No special requirements. Contain spillage and clean up as indicated below.

IMERYS

6.3 Methods and material for containment and cleaning up:
Dry product should be cleaned with a shovel or vacuum cleaner (with high-efficiency particulate air filter) while wearing personal protective equipment in compliance with national legislation. Washing the floor with water is not recommended since it may cause the floor to become slippery. However, if talc is already wet, and only in this case, the floor should be thoroughly flushed with water to remove all slipperiness.

6.4 Reference to others sections:
See sections 8 and 13

SECTION 7. HANDLING AND STORAGE

7.1 Precautions for safe handing:

7.1.1. Protective measures:
Avoid airborne dust generation. Provide appropriate exhaust ventilation at places where airborne dust is generated. In case of insufficient ventilation, wear suitable respiratory protective equipment. Handle packaged products carefully to prevent accidental bursting.

7.1.2. Advice on general occupational hygiene:
Do not to eat, drink and smoke in work areas; wash hands after use; remove contaminated clothing and protective equipment before entering eating areas.

7.2 Conditions for safe storage, including any incompatibilities:

Technical measures/ Precautions
Keep the product dry and in closed containers.

7.3 Specific end use(s): If you require advice on specific uses, please contact your supplier

SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters:
Follow workplace regulatory exposure limits for all types of airborne dust (e. g. total dust, respirable dust and respirable crystalline silica). The OEL (Occupational Exposure Limit) for talc measured as an 8 hours TWA (Time Weighted Average) for a number of European countries is included in Annex 1. For the equivalent limits in other countries, please consult a competent occupational hygienist or the local regulatory authority. A European Binding OEL (Occupational Exposure Limit) for respirable crystalline silica dust is set at 0.1 mg/m³ in the Directive (EU) 2017/2398, measured as an 8-hour TWA (Time Weighted Average).

8.2 Exposure controls

8.2.1 Appropriate engineering controls:
Minimise airborne dust generation. Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below specified exposure limits. If user operations generate dust, use ventilation to keep exposure to airborne particles below the exposure limit. Apply organisational measures, e.g. by isolating personnel from dusty areas. Remove and wash soiled clothing.

8.2.2 Individual protection measures, such as personal protective equipment:

8.2.2.1. Eye protection:
Wear safety glasses with side-shields in circumstances where there is a risk of dust generation which could lead to mechanical irritation of the eye.

8.2.2.2. Skin protection:
No specific requirement. For hands, see below

Hand protection:
Protective gloves are not necessary but recommended for those prone to skin irritation or dryness.

8.2.2.3.Respiratory protection:
In case of prolonged overexposure to high airborne dust concentrations, wear respiratory protective equipment that complies with the requirements of national legislation. The use of half or full face masks with filters against particles of category 2 or 3 (FP2 – FP3) is recommended. See EN 143:2000 – Respiratory protective devices. Particle filters.

8.2.3 Environmental exposure controls
Avoid wind dispersal

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance: Solid. White, off white to light grey powder.

Odour: Odourless

Odour threshold: Not applicable

pH: 9-9.5 (10% wt in water dispersion)

Melting point: >1300°C

Boiling point: not applicable (solid with a melting point > 1300°C)

Flash point: not applicable (inorganic solid with a melting point > 1300°C)

Evaporation rate: not applicable (solid with a melting point > 1300°C)

Flammability (solid, gas): Not flammable.

Explosive limits: Not explosive. (void of any chemical structures commonly associated with explosive properties). Limits do not apply.

Vapour pressure: not applicable (solid with a melting point > 1300°C)

Vapour density: not applicable

Relative density: 2.58-2.83

Solubility (ies):

Solubility in water: Negligible
Solubility in hydrofluoric acid: Yes

Partition coefficient: not applicable (inorganic substance)

Auto-ignition temperature: not auto flammable

Decomposition temperature: >1000°C

Viscosity: not applicable (solid with a melting point > 1300°C)

Explosive properties: no explosive properties predicted from the structure

Oxidising properties: no oxidising properties predicted from the structure

9.2 Other information: No other information

SECTION 10. STABILITY AND REACTIVITY

10.1 Reactivity: Inert, not reactive

10.2 Chemical stability: Chemically stable.

10.3 Possibility of hazardous reactions: No hazardous reaction.

10.4 Conditions to avoid: None.

10.5 Incompatible materials: None known.

10.6 Hazardous decomposition products: None.

SECTION 11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Toxicity endpoints	Outcome of the effects assessment
Acute toxicity	Talc is not acutely toxic. Oral LD_{50} > 5000 mg/kg bw (Weir, 1974) Dermal no data available Inhalation no data available
Skin corrosion/irritation	Talc is not irritating to skin (*in vivo*, OECD 404, rabbit). Classification for Irritation/corrosion is not warranted
Serious eye damage/irritation	No data available
Respiratory or skin sensitization	No data available
Germ cell mutagenicity	Talc is not genotoxic (in vitro study results OECD 471) From the strains tested talc appears to have no mutagenic effects Classification for mutagenicity is not warranted.
Carcinogenicity	In 2006, IARC concluded that inhaled talc not containing asbestos or asbestiform fibers is not classifiable as a human carcinogen (Group 3). IARC ruled that there is limited evidence that the use of talc based body powder for perineal dusting is a possible risk factor for ovarian cancer (Group 2B) - IARC Monograph Volume 93 published in 2010. This is not a route of exposure relevant to workers and applies only to one specific use of talc.
Reproductive toxicity	No data available Oral exposure to talc has no effect on the development of the foetus, or maternal, or foetal survival (OECD 414, rabbit)
STOT Single exposure	No data available
STOT Repeated exposure	No organ toxicity observed in repeated dose toxicity tests Oral: no adverse effect observed in animal study (Wagner JC et al., 1977) Inhalation: no classification for Specific Target Organ toxicity by inhalation upon repeat dose exposure is warranted. Any effects are likely to be non-specific particle effects rather than a specific intrinsic fibrogenic activity of the mineral. Dermal: toxicity via the dermal route is not considered as relevant. Therefore, classification of talc for toxicity upon prolonged exposure by oral route, by dermal route or inhalation is not warranted.
Aspiration hazard	No aspiration hazard envisaged

SECTION 12. ECOLOGICAL INFORMATION

12.1 Toxicity: No data available on this product. No specific adverse effects known.

12.2 Persistence and degradability: No data available on this product. Products are an inorganic substance and therefore are not considered biodegradable.

12.3 Bioaccumulative potential: Not relevant for inorganic substances

12.4 Mobility in soil: Negligible

12.5 Results of PBT and vPvB assessment: Not relevant

12.6 Other adverse effects: No other adverse effects are identified.

SECTION 13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods
Disposal of this product should be in accordance with local and national legislation.
Where possible, recycling is preferable to disposal. Can be disposed of in compliance with local regulations.
Dust formation from residues in packaging should be avoided and suitable worker protection assured. Store used packaging in enclosed receptacles. The re-use of packaging is not recommended. Recycling and disposal of packaging should be carried out by an authorized waste management company. Recycling and disposal of packaging should be carried out in compliance with local regulations.

SECTION 14. TRANSPORT INFORMATION

14.1 UN number: Not relevant

14.2 UN proper shipping name: Not relevant

14.3 Transport hazard class(es):
ADR: not classified
IMDG: not classified
ICAO/IATA: not classified
RID: not classified
DOT: not classified

14.4 Packing group: Not applicable

14.5 Environmental hazards: Not relevant

14.6 Special precautions for user: No special precautions.

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC code: Not relevant

SECTION 15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislations specific for the substance or mixture

International legislation/requirements:

Industrial Safety and Health Law: This product does not contain harmful or controlled hazardous substances under ISHL. Contains <1% silica.

Toxic Chemical Control Act: This product does not contain chemical substances regulated as toxic, observational, restricted or banned under TCCA.

Dangerous Substance Management Law: This product does not contain chemical substances regulated under DSML.

Waste Management Law: Ensure to dispose of in accordance with the waste treatment standards prescribed in Waste Management Law.

Other regulations based on domestic or foreign laws: The following inventories have been investigated as to the publicly available portion of the lists:

MINERAL	CAS No.	EINECS (EU)	AICS (Australia)	CEPA (DSL/NDSL) (Canada)	KECI Korean Gazette No. (Korea)	ENCS/ISHL (Japan)
Talc	14807-96-6	238-877-9	Yes	Yes (DSL)	KE-32773	(1)-468

MINERAL	IECSC (China)	PICCS (Philippines)	TSCA (USA)	Swiss ID No. (Switzerland)	NZIoC (New Zealand)	CSNN (Taiwan)
Talc	Yes	Yes	Yes	G-6939	Yes	Yes

15.2 Chemical safety assessment

Exempted from REACH registration in accordance with Annex V.7. of Regulation (EC) 1907/2006

SECTION 16. OTHER INFORMATION

Data are based on our latest knowledge but do not constitute a guarantee for any specific product features and do not establish a legally valid contractual relationship.

16.1. Revision

-

16.2. Abbreviations

LD50: Medial lethal dose
PBT: Persistent bioaccumulative toxic
vPvB: Very persistent very bioaccumulative

OEL: Occupational exposure level
SDS: Safety data sheet
STOT: Specific target organ toxicity

16.3. Key literature references

1. Baan, R, Straif K, Secretan B, Ghissassi FE and Cogliano V. (2006), On behalf of the WHO International Agency for Research on cancer Monograph Working Group. Carcinogenicity of carbon black, titanium dioxide and talc. The Lancet Oncology. 7:295-296.

2. Wild, P.; "Lung cancer risk and talc not containing asbestiform fibers: a review of the epidemiological evidence". Occup. Environ. Med. 2006; 63, 4-9.

3. Cohrssen, B. and Powell C.H. (2001). Talc. In Patty's Toxicology, 5th ed., Bingham, E., Cohrssen, B., and Powell, C.H., eds., John Wiley & Sons, Inc. NY. pp. 519-538.

4. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans Volume 93 (2010) Carbon Black, Titanium Dioxide, and Talc.

5. Wild, P. and coll; „Effects of talc dust on respiratory health: results of a longitudinal survey of 378 French and Austrian talc workers", Occup. Environ. Med. 2008; 65, 261-267.

6. USEPA 1992. Health Assessment Document for Talc, Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, U.S. Environmental Protection Agency, Research Triangle Park, NC. EPA 600/8-91/217, March 1992.

7. P. Leophonte and coll. "La pathologie respiratoire chronique des travailleurs du talc", Rev. Fr. Mal. Resp., 1980, 8, 43-45

8. S. Endo-Capron and coll. "In vitro response of rat pleural mesothelial cells to talc samples in genotoxicity assays (sister chromatid exchanges and DNA repair)" Toxic in vitro, 1993, 7, 7-14.

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10.P. Wild and coll. "A cohort mortality and nested case-control study of French and Austrian talc workers" Occup. Environ. Med 2002, 59, 98-105.

11.M. Coggiola and coll. "An Update of a Mortality Study of Talc Miners and Millers in Italy", Am. J Indust. Med. 2003, 44, 63-69

16.4. Relevant H-statements
None.

16.5. Social Dialogue on Respirable Crystalline Silica: A multi-sectoral social dialogue agreement on Workers Health Protection through the Good Handling and Use of Crystalline Silica and Products Containing it was signed on 25 April 2006. This autonomous agreement, which receives the European Commission's financial support, is based on a Good Practices Guide. The requirements of the Agreement came into force on 25 October 2006. The Agreement was published in the Official Journal of the European Union (2006/C 279/02). The text of the Agreement and its annexes, including the Good Practices Guide, are available from **http://www.nepsi.eu** and provide useful information and guidance for the handling of products containing respirable crystalline silica. Literature references are available on request from EUROSIL, the European Association of Industrial Silica Producers.

Disclaimer

This safety data sheet (SDS) is based on the legal provisions of the REACH Regulation (EC 1907/2006; article 31 and Annex II), as amended. Its contents are intended as a guide to the appropriate precautionary handling of the material. It is the responsibility of recipients of this SDS to ensure that the information contained therein is properly read and understood by all people who may use, handle, dispose or in any way come in contact with the product. Information and instructions provided in this SDS are based on the current state of scientific and technical knowledge at the date of issue indicated. It should not be construed as any guarantee of technical performance, suitability for particular applications, and does not establish a legally valid contractual relationship. This version of the SDS supersedes all previous versions.

Only the original English version is authoritative.

End of the Safety Data Sheet

Annex 1

Occupational Exposure Limits in mg/m³ 8 hours TWA – Respirable dust – in EU 27[1] + Norway & Switzerland

Country/Authority *(see caption p. 3)*	(inert) dust INHALABLE	(inert) dust RESPIRABLE	Quartz	Talc
Austria/I	10	5	0,15	2
Belgium/II	10	3	0,1	2
Bulgaria/III		4	0,07	3
Cyprus/IV		/	10k/Q[2]	/
Czech Republic/V			0,1	2
Denmark/VI	10	5	0,1	
Estonia			0,1	
Finland/VII	10	/	0,05	2
France/VIII	10	5	0,1	
Germany/IX	10	0,5[3]	/[4]	/
Greece/X	10	5	0,1	2
Hungary			0,15	2
Ireland/XI	10	4	0.1	0,8
Italy/XII	10	3	0,05[5]	2
Lithuania/XIII		10	0,1	1
Luxembourg/XIV	10	6	0,15	2
Malta[6]/ XV		/	/	
Netherlands/ XVI	10	5	0,075	0,25
Norway/ XVII	10	5	0,1	2
Poland/XVIII	2	0,3	0,3	1
Portugal/ XIX	10	5	0,025	2
Romania/ XX		10	0,1	2
Slovakia	10		0,1	2
Slovenia			0,15	2
Spain/XXI	10	3	0,05	2
Sweden/XXII		5	0,1	1
Switzerland/XXIII		6	0,15	2
UK/XXIV	10	4	0,1	1

[1] Missing information for Latvia and Croatia. As of 16 January 2018, a European Binding Occupational Exposure Limit is set for respirable crystalline silica dust at 0.1 mg/m³ in Directive 2017/2398.
[2] Q : quartz percentage – K=1
[3] Defined for a density of 1 g/cm³, i.e. for minerals with a common density of 2,5 g/cm³, a calculated OEL of 1,25 mg/m³ applies.
[4] Germany has no more OEL for quartz, cristobalite and tridymite. Employers are obliged to minimize exposure as much as possible, and to follow certain protective measures.
[5] Inspection authorities use the ACGIH recommended limit value of 0.025 mg/m³.
[6] When needed, Maltese authorities refer to values from the UK for OELVs which do not exist in the Maltese legislation.

Caption

Country		Adopted by/Law denomination	OEL Name (if specific)
Austria	**I**	Bundesministerium für Arbeit und Soziales	Maximale ArbeitsplatzKoncentration (MAK)
Belgium	**II**	Ministère de l'Emploi et du Travail	
Bulgaria	**III**	Ministry of Labour and Social Policy and Ministry of Health. Ordinance n°13 of 30/12/2003	Limit Values
Cyprus	**IV**	Department of Labour Inspection. Control of factory atmosphere and dangerous substances in factories, Regulations of 1981.	
Czech Republic	**V**	Governmental Directive n°361/2007	Přípustný expoziční limit (PEL) (=Permissible exposure limit)
Denmark	**VI**	Direktoratet fot Arbeidstilsynet	Threshold Limit Value
Finland	**VII**	National Board of Labour Protection	Occupational Exposure Standard
France	**VIII**	Ministère du Travail	Valeur limite de Moyenne d'Exposition
Germany	**IX**	Bundesministerium für Arbeit	Maximale ArbeitsplatzKoncentration (MAK)
Greece	**X**	Legislation for mining activities	
Ireland	**XI**	2011 Code of Practice for the Safety, Health & Welfare at Work (CoP)	
Italy	**XII**	Associazone Italiana Degli Igienisti Industriali	Threshold Limit Values (based on ACGIH TLVs)
Lithuania	**XIII**	Dėl Lietuvos higienos normos HN 23:2001	Ilgalaikio poveikio ribinė vertė (IPRV)
Luxembourg	**XIV**	Bundesministerium für Arbeit	Maximale ArbeitsplatzKoncentration (MAK)
Malta	**XV**	OHSA – LN120 of 2003, www.ohsa.org.mt	OELVs
Netherlands	**XVI**	Ministerie van Sociale Zaken en Werkgelegenheid	Publieke grenswaarden http://www.ser.nl/en/oel_database.aspx
Norway	**XVII**	Direktoratet for Arbeidstilsynet	Administrative Normer (8hTWA) for Forurensing I ArbeidsmiljØet
Poland	**XVIII**	Regulation of the Minister of Labour and Social – 29.11.2002	Limit values
Portugal	**XIX**	Instituto Portuges da Qualidade, Hygiene & Safety at Workplace NP1796:2007	Valores Limite de Exposição (VLE)
Romania	**XX**	Government Decision n° 355/2007 regarding workers' health surveillance. Government Decision n° 1093/2006 regarding carcinogenic agents (in Annex 3: Quartz, Cristobalite, Tridymite).	OEL
Spain	**XXI**	Instrucciones de Técnicas Complementarias (ITC)	Valores Limites
Sweden	**XXII**	National Board of Occupational Safety and Health	Yrkeshygieniska Gränsvärden
Switzerland	**XXIII**		Valeur limite de Moyenne d'Exposition
United Kingdom	**XXIV**	Health & Safety Executive	Workplace Exposure Limits (WEL)

Source : IMA-Europe. Date : February 2018

Annex 2

National Poison centres

Country	Name of poison centre	Emergency telephone	E-mail address	Hours of operation	Available to the public
Algeria	Centre Anti-Poisons d'Alger	+213 21 97 98 98	cnt@ibnsina.ands.dz	24hrs	Yes
Austria	Vergiftungsinformationszentrale (Poisons Information Centre)	+43 1 406 43 43	viz@meduniwien.ac.at	24hrs	Yes
Belgium	Centre Antipoisons-Antigifcentrum	+32 70 245 245	info@poisoncentre.be	24hrs	Yes
Bulgaria	National Toxicological Information Centre at National Clinical Toxicology Centre	887 088 440			
Croatia	Poison Control Centre Zagreb	+358 1 2348 342	rturk@imi.hr	24hrs	Yes
Czech Republic	Toxicological Information Centre	+420 22 49 192 93	daniela.pelclova@LF1.cuni.cz	24hrs	Yes
Denmark	Poison Information Center	+45 82 12 12 12	PIC@bbh.regionh.dk	24hrs	Yes
Estonia	Estonian Poison Information Centre	16662	info@16662.ee		Yes
Finland	Finnish Poison Information Centre	+358 9 471977	myrkytys@hus.fi	24hrs	Yes
France	Centre antipoison et de toxicovigilance de Paris	+33 1 40 05 48 48	cap.paris@lrb.aphp.fr	24hrs	Yes
Germany	Clinical Toxicology and Berlin Poison Information Centre	+49 30 192 40	mail@giftnotruf.de	24hrs	Yes
Great Britain	National Poisons Information Service (Birmingham Unit)	In England and Wales: NHS 111 - dial 111 ; In Scotland: NHS 24 - dial 111 ; In N Ireland: Contact your local GP or pharmacist during normal hours or www.gpoutofhours.hscni.net/ for GP services Out-of-Hours.			
Greece	Poisons Information Centre	+30 21 07 79 37 77	poison-ic@aglaiakyriakou.gr	24hrs	Yes
Hungary	Health Toxicological Information Service	+36 80 20 11 99	ettsz@okbi.antsz.hu	24hrs	Yes
Ireland	Poisons Information Centre of Ireland	+353 1 809 2166	npicdublin@beaumont.ie	24hrs	Yes
Israel	Israel Poison Information Center	+972 4 854 19 00	ipic@rambam.health.gov.il	24hrs	Yes
Italy	Poison Centre - Catholic University School of Medicine	+39 06 305 43 43	cav@rm.unicatt.it	24hrs	Yes
Lithuania	Lithuania Poisons Control and Information Bureau	+370 5 236 20 52 +370 687 533 78	akib@sam.lt	24hrs	Yes
Luxembourg		+32 (0)70 245 245			
Morocco	Centre Anti Poison et de Pharmacovigilance du Maroc	+212 537 68 64 64	capm@capm.ma	24hrs	Yes
Northern Ireland	Regional Medicines and Poisons Information Centre NI	844 892 0111	nirdic.nirdic@belfasttrust.hscni.net	24hrs	Yes
Norway	Department for Poisons Information	+47 22 59 13 00	postmottak.giftinfo@helsedir.no	24hrs	Yes
Poland	Warsaw Poison Information and Control Centre	+48 22 619 66 54	oit.warszawa@praski.waw.pl	24hrs	Yes
Portugal	CIAV - Centro de Informações Antivenenos	808 250 143	ciav.tox@inem.pt	24hrs	Yes
Romania	TOXAPEL - Paediatric Poison Centre	+402 212 106 282		24hrs	Yes
Russian Federation	Research and Applied Toxicology Center of Federal Medico-Biological Agency	+7 495 628 1687	rtiac@mail.ru rtiac2003@yahoo.com	24hrs	Yes
Sénégal	Centre Anti Poison du Sénégal	+221 818 00 15 15	capsminsante@gmail.com	24hrs	Yes
Serbia	National Poison Control Centre	+381 11 3608 440	ncktvma@eunet.rs	24hrs	Yes
Slovakia	National Toxicological Information Center	+421 2 54 774 166	ntic@ntic.sk	24hrs	Yes
Slovenia	Poison Control Centre Ljubljana				No
South Africa	Bloemfontein Poison Control and Medicine Information Centre	+27 824 910 160	vanjaarsveldmfpc.md@ufs.ac.za	24hrs	Yes
Spain	Instituto Nacional de Toxicologia	+34 91 562 0420	sit@mju.es	24hrs	Yes
Sweden	Giftinformationscentralen (Swedish Poisons Information Centre)	+46 8 33 12 31 / 112	giftinformation@apoteket.se	24hrs	Yes
Switzerland	Swiss Toxicological Information Centre	+41 44 251 51 51 (in Switzerland dial 145)	info@toxi.ch	24hrs	Yes
The Netherlands	National Poisons Information Centre	030-274 8888			
Tunisia	Centre Anti-Poisons de Tunis	+216 1 335 500		24hrs	Yes
Turkey	Toxicology Department and Poisons Centre	+90 0312 433 70 01 or 0 800 314 7900	zehir@saglik.gov.tr	24hrs	Yes
United Arab Emirates	Health Poison and Drug Information Center	800 424	pdic@haad.ae	7:00-15:00 Sund.-Thurs.	Yes

IMERYS

Appendix B. Tilbury Ash Disposal Site Data

B.1. Borehole Logs

Borehole Log

Drilled SG **Logged** AP **Checked** KW	**Start** 25/08/2006 **End** 30/08/2006	**Equipment, Methods and Remarks** Inspection pit to 1.20m then cable tool boring to 29.00m.	**Depth from** / **to** / **Diameter** / **Casing Depth** 0.00m / 10.50m / 200mm / 10.50m 10.50m / 29.00m / 150mm / 29.00m	**Ground Level** - **Coordinates** - **National Grid** - **Chainage** 0.000	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
2.00	B 3			
Depth	**Type & No**	**Records**	**Date Casing**	**Time Water**

Strata

Description	Depth/*Level* (Thickness)	Legend	Backfill/ Instruments
Brown clayey sandy GRAVEL. Sand is fine to coarse, gravel is angular fine to coarse of concrete, brick, flint, chalk and plastic. Occasional cobbles of concrete. (MADE GROUND)	(0.80)		
	0.80		
Black silty SAND. Sand is fine of ash. (MADE GROUND)	(3.40)		
	4.20		
Soft grey mottled brown CLAY. (ALLUVIUM)	(1.00)		
	5.20		
Very soft grey CLAY. (ALLUVIUM)			
6.80-7.10 m Spongy brown fibrous PEAT.			
Stratum continues to 17.20 m			

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
None observed (see Key Sheet)			

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Tilbury Power Station

Project No. G6076

Carried out for RWE NPower

Borehole

BHC1

Borehole Log

Drilled SG **Logged** AP **Checked** KW	**Start** 25/08/2006 **End** 30/08/2006	**Equipment, Methods and Remarks** Inspection pit to 1.20m then cable tool boring to 29.00m.	**Depth from**	**to**	**Diameter**	**Casing Depth**	**Ground Level** - **Coordinates** - **National Grid** -		
			0.00m	10.50m	200mm	10.50m			
			10.50m	29.00m	150mm	29.00m	**Chainage** 0.000		

Samples and Tests					Strata			
Depth	**Type & No**	**Records**	**Date Casing**	**Time Water**	**Description (Continued from Sheet 1)**	**Depth/*Level*/ (Thickness)**	**Legend**	**Backfill/ Instruments**
					Very soft grey CLAY. (ALLUVIUM)			
						(12.00)		
		*			13.80-14.00 m Spongy brown fibrous PEAT.			
						17.20		
					Soft grey CLAY. (ALLUVIUM)			
18.20	D 26				18.00-19.10 m Spongy brown fibrous PEAT.			
19.20	D 27					(4.80)		
Depth	**Type & No**	**Records**	**Date Casing**	**Time Water**	Stratum continues to 22.00 m			

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
None observed (see Key Sheet)			

Depth Related Remarks *

From	to (m)	
14.00	22.80	Water added to aid drilling

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Tilbury Power Station
Project No. G6076
Carried out for RWE NPower

Borehole
BHC1
Sheet 2 of 3

Borehole Log

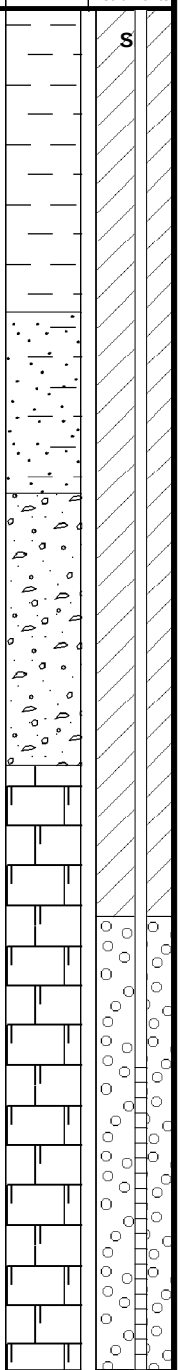
Drilled SG **Logged** AP **Checked** KW	**Start** 25/08/2006 **End** 30/08/2006	**Equipment, Methods and Remarks** Inspection pit to 1.20m then cable tool boring to 29.00m.	**Depth from**	**to**	**Diameter**	**Casing Depth**	**Ground Level** - **Coordinates** - **National Grid** - **Chainage** 0.000	
			0.00m	10.50m	200mm	10.50m		
			10.50m	29.00m	150mm	29.00m		

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
20.20	D 28			
20.20	U NR	No recovery		
21.20	D 29			
22.20	D 30			
23.20	D 31			
24.20	D 32			
25.20	D 33			
26.20	D 34			
27.20	D 35			
28.20	D 36			
29.00	D 37			

Strata

Description (Continued from Sheet 2)	Depth/*Level* (Thickness)
Soft grey CLAY. (ALLUVIUM)	
Grey clayey SAND. Sand fine to coarse. Occasional cobbles of flint. (RIVER TERRACE DEPOSITS)	22.00 (1.20)
Grey GRAVEL. Gravel is angular to subangular fine to coarse of flint. (RIVER TERRACE DEPOSITS)	23.20 (1.80)
Recovered as white silty GRAVEL. Gravel is subangular fine to coarse of very weak CHALK. (UPPER CHALK)	25.00 (4.00)
EXPLORATORY HOLE ENDS AT 29.00 m	29.00



Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
None observed (see Key Sheet)			

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used
22.80 -24.00	60 mins	

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Tilbury Power Station
Project No. G6076
Carried out for RWE NPower

Borehole
BHC1
Sheet 3 of 3

Borehole Log

Drilled SG **Logged** PM **Checked** KW	**Start** 24/08/2006 **End** 25/08/2006	**Equipment, Methods and Remarks** Hand dug inspection pit to 1.20m then cable tool boring to 18.00m.	**Depth from** / **to** / **Diameter** / **Casing Depth** 0.00m / 4.50m / 200mm / 4.50m 4.50m / 18.00m / 150mm	**Ground Level** - **Coordinates** - **National Grid** - **Chainage** 0.000	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
0.00	B 1			
1.00	B 2			
2.00	B 3			
3.00	B 4			
4.00	B 5			
4.20	D 6			
5.20	D 7			
5.20-5.65	U 8			
5.70	D 9			
6.20	D 10			
7.20	D 11			
8.20	D 12			
9.20	D 13			

Strata

Description	Depth/*Level* (Thickness)	Legend	Backfill/ Instruments
Firm dark brown sandy gravelly CLAY. Sand is fine to coarse, gravel is angular to subrounded fine to coarse of brick, glass and flint. (MADE GROUND)	(0.80)		
Compact dark grey black sandy SILT. Sand is fine to medium of ash. (MADE GROUND)	0.80 (3.40)		
Firm grey mottled brown CLAY. (ALLUVIUM)	4.20 (1.00)		
Firm becoming soft dark grey CLAY. (ALLUVIUM)	5.20		
6.90-7.20 m Dark brown spongy fibrous PEAT.			
Stratum continues to 18.00 m			

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
None observed (see Key Sheet)			

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Tilbury Power Station
Project No. G6076
Carried out for RWE NPower

Borehole
BHC1A
Sheet 1 of 2

Borehole Log

Drilled SG **Logged** PM **Checked** KW	**Start** 24/08/2006 **End** 25/08/2006	**Equipment, Methods and Remarks** Hand dug inspection pit to 1.20m then cable tool boring to 18.00m.	**Depth from / to / Diameter / Casing Depth** 0.00m / 4.50m / 200mm / 4.50m 4.50m / 18.00m / 150mm	**Ground Level** - **Coordinates** - **National Grid** - **Chainage** 0.000

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.20 10.20-10.65	D 14 U 15			
10.70	D 16			
11.20	D 17			
12.20	D 18			
13.20	D 19			
14.20	D 20			
15.20 15.20-15.65	D 21 U 22			
15.70	D 23			
16.20	D 24			
17.20	D 25			

Strata

Description (Continued from Sheet 1)

Firm becoming soft dark grey CLAY.
(ALLUVIUM)

(12.80)

14.00-14.20 m Dark brown spongy fibrous PEAT.

17.00-17.80 m Dark brown spongy fibrous PEAT.

18.00

EXPLORATORY HOLE ENDS AT 18.00 m

Depth (Level) (Thickness)	Legend	Backfill/ Instruments

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

None observed (see Key Sheet)

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

402.24 18/10/2006 13:23:11

Project Tilbury Power Station
Project No. G6076
Carried out for RWE NPower

Borehole
BHC1A
Sheet 2 of 2

Borehole Log

Drilled BR **Logged** AP **Checked** KW	**Start** 18/09/2006 **End** 19/09/2006	**Equipment, Methods and Remarks** Dando 175 Inspection pit to 1.20m then cable tool drilling to 28.00m.	**Depth from** / **to** / **Diameter** / **Casing Depth** 0.00m / 6.00m / 250mm / 6.00m 6.00m / 6.50m / 200mm / 6.50m 6.50m / 28.00m / 150mm / 28.00m	**Ground Level** - **Coordinates** - **National Grid** - **Chainage** 0.000	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
0.00	B 1			
1.00	B 2			
2.00	B 3			
3.00	B 4			
4.00	B 5			
5.00	B 6			
5.80	D 1			
6.00-6.45	U 2			
6.40	D 3			
6.50	D 4			
7.50	D 5			
8.50	D 6			
9.50	D 7			

Strata

Description	Depth/*Level* (Thickness)	Legend	Backfill/ Instruments
Brown very clayey gravelly SAND. Sand is fine to coarse, gravel is subangular to rounded fine to coarse of flint. (MADE GROUND)	(0.50)		1 2
Compact black sandy SILT. Sand is fine to medium of ash. (MADE GROUND)	0.50 (5.30)		
Firm to stiff dark grey CLAY. (ALLUVIUM) 5.80 m Mottled brown 6.50-7.50 m Occasional fragments of wood and reeds.	5.80 (5.60)		
Stratum continues to 11.40 m			

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
None observed (see Key Sheet)			

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Tilbury Power Station
Project No. G6076
Carried out for RWE NPower

Borehole
BHC2
Sheet 1 of 3

Borehole Log

Drilled BR **Logged** AP **Checked** KW	**Start** 18/09/2006 **End** 19/09/2006	**Equipment, Methods and Remarks** Dando 175 Inspection pit to 1.20m then cable tool drilling to 28.00m.	**Depth from**	**to**	**Diameter**	**Casing Depth**	**Ground Level** - **Coordinates** - **National Grid** - **Chainage** 0.000	
			0.00m	6.00m	250mm	6.00m		
			6.00m	6.50m	200mm	6.50m		
			6.50m	28.00m	150mm	28.00m		

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.50	D 8			
11.40	D 9			
12.00	D 10			
13.00	D 11			
14.00	D 12			
15.00	D 13			
16.00	D 14			
16.00-16.45	U NR	5 blows No recovery		
16.50	D 15			
17.50	D 16			
18.50	D 17			
19.50	D 18			

Strata

Description (Continued from Sheet 1)	Depth/*Level* (Thickness)	Legend	Backfill/ Instruments
Firm to stiff dark grey CLAY. (ALLUVIUM) 10.50 m Pockets of spongy dark brown fibrous PEAT.			1 2
Soft grey CLAY. (ALLUVIUM)	11.40		
	(6.10)		
Dark grey slightly sandy GRAVEL. Sand is fine to coarse, gravel is subangular to rounded fine to coarse of flint. (RIVER TERRACE DEPOSITS)	17.50		
	(2.00)		
Light brown grey SAND AND GRAVEL. Sand is fine to coarse, gravel is subangular	19.50		
Stratum continues to 25.00 m			

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
None observed (see Key Sheet)			

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Tilbury Power Station
Project No. G6076
Carried out for RWE NPower

Borehole
BHC2

Borehole Log

Drilled BR **Logged** AP **Checked** KW	**Start** 18/09/2006 **End** 19/09/2006	**Equipment, Methods and Remarks** Dando 175 Inspection pit to 1.20m then cable tool drilling to 28.00m.	**Depth from**	**to**	**Diameter**	**Casing Depth**	**Ground Level** - **Coordinates** - **National Grid** - **Chainage** 0.000	
			0.00m	6.00m	250mm	6.00m		
			6.00m	6.50m	200mm	6.50m		
			6.50m	28.00m	150mm	28.00m		

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
20.50	D 19			
21.50	D 20			
22.50	D 21			
23.50	D 22			
24.50	D 23			
25.00	D 24			
26.00	D 25			
27.00	D 26			
28.00	D 27			

Strata

Description (Continued from Sheet 2)	Depth/*Level* (Thickness)	Legend	Backfill/ Instruments
to rounded fine to coarse of flint. (RIVER TERRACE DEPOSITS)	(5.50)		1
Recovered as off white silty GRAVEL. Gravel is subangular coarse of very weak white CHALK. (UPPER CHALK)	25.00 (3.00)		
EXPLORATORY HOLE ENDS AT 28.00 m	28.00		

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
None observed (see Key Sheet)			

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Tilbury Power Station
Project No. G6076
Carried out for RWE NPower

Borehole
BHC2
Sheet 3 of 3

Borehole Log

Drilled SG **Logged** AP **Checked** KW	**Start** 30/08/2006 **End** 31/08/2006	**Equipment, Methods and Remarks** Hand dug inspection pit to 1.20m then cable tool boring to 8.00m. Borehole terminated at 8.00m due to perched water.	**Depth from** 0.00m **to** 8.00m **Diameter** 200mm **Casing Depth** 8.00m	**Ground Level** - **Coordinates** - **National Grid** - **Chainage** 0.000

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
0.00	B 1			
1.00	B 2			
2.00	B 3			
3.00	B 4			
4.00	B 5			
5.00	B 6			
5.50	D 7			

Strata

Description	Depth/*Level* (Thickness)	Legend	Backfill/ Instruments
Dark brown very clayey gravelly SAND. Sand is fine to coarse, gravel is angular to subrounded fine to coarse of flint, glass and brick. (MADE GROUND)	(0.80)		
	0.80		
Compact dark grey black very sandy SILT. Sand is fine to medium of ash. (MADE GROUND)	(4.70)		
	5.50		1
Firm brown mottled grey CLAY. (ALLUVIUM)	(2.50)		1
6.50-7.00 m Driller reports a peat layer.			
	8.00		
EXPLORATORY HOLE ENDS AT 8.00 m			

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	5.50	Rose to 5.20 m after 20 minutes. Perched water	-

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Tilbury Power Station
Project No. G6076
Carried out for RWE NPower

Borehole
BHC2A
Sheet 1 of 1

Borehole Log

Drilled BR **Logged** AP **Checked** KW	**Start** 19/09/2006 **End** 21/09/2006	**Equipment, Methods and Remarks** Dando 175 Inspection pit to 1.20m then cable tool boring to 26.00m.	**Depth from**	**to**	**Diameter**	**Casing Depth**	**Ground Level** - **Coordinates** - **National Grid** -		
			0.00m	6.00m	250mm	6.00m			
			6.00m	18.00m	200mm	18.00m			
			18.00m	26.00m	150mm	23.00m	**Chainage** 0.000		

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
0.00	B 1			
1.00	B 2			
2.00	B 3			
3.00	B 4			
4.00	B 5			
5.00	B 6			
6.00	D 1			
6.50-6.95	U 2			
6.90	D 3			
6.90	D 4			
8.00	D 5			
9.00	D 9			

Strata

Description	Depth/*Level* (Thickness)	Legend	Backfill/ Instruments
Firm to stiff dark brown sandy gravelly CLAY. Sand is fine to coarse, gravel is subangular to subrounded fine to coarse of flint and brick. (MADE GROUND)	(0.60)		D S
	0.60		
Compact dark grey to black sandy SILT. Sand is fine to medium of ash. (MADE GROUND)	(5.40)		
	6.00		
Stiff brown CLAY. (ALLUVIUM)	(1.00)		
6.90 m	7.00		
Soft dark grey CLAY. (ALLUVIUM) Occasional pockets of fibrous wood and reeds.			
Stratum continues to 21.50 m			

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
None observed (see Key Sheet)			

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Tilbury Power Station
Project No. G6076
Carried out for RWE NPower

Borehole
BHC3
Sheet 1 of 3

Borehole Log

Drilled BR **Logged** AP **Checked** KW	**Start** 19/09/2006 **End** 21/09/2006	**Equipment, Methods and Remarks** Dando 175 Inspection pit to 1.20m then cable tool boring to 26.00m.	**Depth from**	**to**	**Diameter**	**Casing Depth**	**Ground Level** - **Coordinates** - **National Grid** - **Chainage** 0.000	
			0.00m	6.00m	250mm	6.00m		
			6.00m	18.00m	200mm	18.00m		
			18.00m	26.00m	150mm	23.00m		

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.00	D 7			
11.00	D 8			
12.00-12.45	U 10			
12.00	D 9			
12.40	D 11			
12.40	D 12			
13.00	D 13			
14.00	D 14			
15.00	D 15			
16.00	D 16			
17.00	D 17			
18.00	D 18			
19.00	D 19			

Strata

Description (Continued from Sheet 1)

Soft dark grey CLAY. (ALLUVIUM)

10.00-11.00 m Frequent pockets of spongy brown fibrous PEAT

12.00 m Occasional fragments of wood and reeds.

12.40 m Firm dark grey CLAY.

13.00 m Becoming very soft.

Depth/*Level* (Thickness)	Legend	Backfill/ Instruments
(14.50)		D S

Stratum continues to 21.50 m

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

None observed (see Key Sheet)

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Tilbury Power Station

Project No. G6076

Carried out for RWE NPower

Borehole

BHC3

Borehole Log

Drilled BR **Logged** AP **Checked** KW	**Start** 19/09/2006 **End** 21/09/2006	**Equipment, Methods and Remarks** Dando 175 Inspection pit to 1.20m then cable tool boring to 26.00m.	**Depth from**	**to**	**Diameter**	**Casing Depth**	**Ground Level** - **Coordinates** - **National Grid** - **Chainage** 0.000	
			0.00m	6.00m	250mm	6.00m		
			6.00m	18.00m	200mm	18.00m		
			18.00m	26.00m	150mm	23.00m		

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
20.00	D 20			
21.00	D 21			
21.50	D 22			
22.50	D 23			
23.00	D 24			
24.50	D 25			
25.50	D 26			

Strata

Description (Continued from Sheet 2)	Depth/*Level* (Thickness)	Legend	Backfill/ Instruments
Soft dark grey CLAY. (ALLUVIUM)			D
Dark grey slightly sandy GRAVEL. Sand is fine to coarse, gravel is subangular to subrounded fine to coarse of flint. (RIVER TERRACE DEPOSITS)	21.50 (1.50)		
Recovered as off white to light grey silty GRAVEL. Gravel is subangular fine to coarse of very weak low density CHALK. (UPPER CHALK)	23.00 (3.00)		
EXPLORATORY HOLE ENDS AT 26.00 m	26.00		

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
None observed (see Key Sheet)			

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Tilbury Power Station

Project No. G6076

Carried out for RWE NPower

Borehole

BHC3

Borehole Log

Drilled SG **Logged** AP **Checked** KW	**Start** 31/08/2006 **End** 31/08/2006	**Equipment, Methods and Remarks** Hand dug inspection pit to 1.20m then cable tool boring to 6.00m.	**Depth from** 0.00m **to** 6.00m **Diameter** 200mm **Casing Depth** 4.50m	**Ground Level** - **Coordinates** - **National Grid** - **Chainage** 0.000

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
0.00	B 1			
1.00	B 2			
2.00	B 3			
3.00	B 4			
4.00	B 5			
5.00	B 6			
5.50	D 7			

Strata

Description	Depth/*Level* (Thickness)	Legend	Backfill/ Instruments
Stiff brown very sandy gravelly CLAY. Sand is fine to coarse, gravel is angular to subrounded fine to coarse of flint. (MADE GROUND)	(0.70)		
	0.70		
Compact dark grey black sandy SILT. Sand is fine to medium of ash. (MADE GROUND)	(4.80)		1
			1
Firm brown mottled grey CLAY. (ALLUVIUM)	5.50		
	(0.50)		
EXPLORATORY HOLE ENDS AT 6.00 m	6.00		

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	5.00	Rose to 4.40 m after 30 minutes. Perched water	-

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Tilbury Power Station

Project No. G6076

Carried out for RWE NPower

Borehole

BHC3A

Sheet 1 of 1

Borehole Log

Drilled BR **Logged** AP **Checked** KW	**Start** 25/09/2006 **End** 27/09/2006	**Equipment, Methods and Remarks** Dando 175 Inspection pit to 1.20m then cable tool boring to 28.00m.	**Depth from**	**to**	**Diameter**	**Casing Depth**	**Ground Level** - **Coordinates** - **National Grid** - **Chainage** 0.000	
			0.00m	5.50m	250mm	5.50m		
			5.50m	17.00m	200mm	17.00m		
			17.00m	28.00m	150mm	27.50m		

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
0.00	B 1			
1.00	B 2			
2.00	B 3			
3.00	B 4			
4.00	B 5			
5.00	D 1			
5.00	B 6			
6.00-6.45	U NR	5 blows No recovery		
6.50	D 2			
6.50	D 3			
7.50	D 4			
8.50	D 5			
9.50	D 6			

Strata

Description	Depth/*Level* (Thickness)	Legend	Backfill/ Instruments
Firm to stiff dark brown sandy gravelly CLAY. Sand is fine to coarse, gravel is subangular to subrounded fine to coarse of flint, brick, metal and concrete. (MADE GROUND)	(0.40) 0.40		D S
Compact dark grey to black slightly sandy SILT. Sand is fine of ash. (MADE GROUND)	(5.10)		
Firm grey mottled brown CLAY. (ALLUVIUM)	5.50 (0.50)		
Soft to very soft grey CLAY. (ALLUVIUM)	6.00		
8.50-9.50 m Frequent pockets of spongy brown fibrous PEAT.			
Stratum continues to 17.00 m			

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
None observed (see Key Sheet)			

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Tilbury Power Station

Project No. G6076

Carried out for RWE NPower

Borehole

BHC4

Borehole Log

Drilled BR **Logged** AP **Checked** KW	**Start** 25/09/2006 **End** 27/09/2006	**Equipment, Methods and Remarks** Dando 175 Inspection pit to 1.20m then cable tool boring to 28.00m.	**Depth from**	**to**	**Diameter**	**Casing Depth**	**Ground Level** - **Coordinates** - **National Grid** - **Chainage** 0.000	
			0.00m	5.50m	250mm	5.50m		
			5.50m	17.00m	200mm	17.00m		
			17.00m	28.00m	150mm	27.50m		

Samples and Tests

Strata

Depth	Type & No	Records	Date Casing	Time Water	Description (Continued from Sheet 1)	Depth/*Level* (Thickness)	Legend	Backfill/ Instruments
					Soft to very soft grey CLAY. (ALLUVIUM)			D S
10.50	D 7							
11.00-11.45	U NR	5 blows No recovery						
11.50	D 8					(11.00)		
12.50	D 9				12.50 m Occasional pockets of spongy brown fibrous PEAT.			
13.50	D 10							
14.50	D 11							
15.50	D 12							
16.50-16.95	U NR	7 blows No recovery						
17.00	D 13				Soft grey slightly sandy CLAY. Sand is fine. (ALLUVIUM)	17.00		
18.00	D 14					(3.00)		
19.00	D 15							
Depth	**Type & No**	**Records**	**Date Casing**	**Time Water**				

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
None observed (see Key Sheet)			

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

402.24 18/10/2006 13:24:06

Project Tilbury Power Station

Project No. G6076

Carried out for RWE NPower

Borehole

BHC4

Borehole Log

Drilled BR **Logged** AP **Checked** KW	**Start** 25/09/2006 **End** 27/09/2006	**Equipment, Methods and Remarks** Dando 175 Inspection pit to 1.20m then cable tool boring to 28.00m.	**Depth from**	**to**	**Diameter**	**Casing Depth**	**Ground Level** - **Coordinates** - **National Grid** - **Chainage** 0.000
			0.00m	5.50m	250mm	5.50m	
			5.50m	17.00m	200mm	17.00m	
			17.00m	28.00m	150mm	27.50m	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
20.00	D 16			
21.00	D 17			
22.00	D 18			
23.00	D 19			
24.00	D 20			
25.00	D 21			
26.00	D 22			
27.00	D 23			
28.00	D 24			

Strata

Description (Continued from Sheet 2)	Depth/*Level* (Thickness)	Legend	Backfill/ Instruments
Dark grey slightly sandy GRAVEL. Sand is fine to coarse, gravel is subangular to subrounded medium to coarse of flint. (RIVER TERRACE DEPOSITS)	20.00 (1.00)		D
Grey brown very sandy GRAVEL. Sand is fine to coarse, gravel is subangular to subrounded fine to coarse of flint. (RIVER TERRACE DEPOSITS)	21.00 (4.00)		
Recovered as off white slightly silty GRAVEL. Gravel is subangular medium to coarse of very weak low density CHALK. (UPPER CHALK)	25.00 (3.00)		
EXPLORATORY HOLE ENDS AT 28.00 m	28.00		

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

None observed (see Key Sheet)

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Tilbury Power Station

Project No. G6076

Carried out for RWE NPower

Borehole

BHC4

Borehole Log

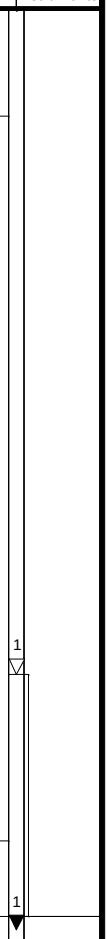
Drilled SG **Logged** PM **Checked** KW	**Start** 31/08/2006 **End** 31/08/2006	**Equipment, Methods and Remarks** Hand dug inspection pit to 1.20m then cable tool boring to 6.00m.	**Depth from** 0.00m **to** 6.00m **Diameter** 200mm **Casing Depth** 4.50m	**Ground Level** - **Coordinates** - **National Grid** - **Chainage** 0.000

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
0.00	B 1			
1.00	B 2			
2.00	B 3			
3.00	B 4			
4.00	B 5			
5.00	B 6			
6.00	D 7			

Strata

Description	Depth/*Level* (Thickness)	Legend	Backfill/ Instruments
Stiff dark brown sandy gravelly CLAY. Sand is fine to coarse, gravel is angular to subrounded fine to coarse of brick, concrete and flint. (MADE GROUND)	(0.70)		
	0.70		
Compact dark grey black sandy SILT. Sand is fine to medium of ash. (MADE GROUND)	(4.80)		
	5.50		
Firm brown mottled grey CLAY. (ALLUVIUM)	(0.50)		
EXPLORATORY HOLE ENDS AT 6.00 m	6.00		



Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	6.00	Rose to 4.40 m after 20 minutes.	-

Depth Related Remarks *

From to (m)

Chiselling

Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Tilbury Power Station

Project No. G6076

Carried out for RWE NPower

Borehole

BHC4A

Sheet 1 of 1

Borehole Log

Drilled BR **Logged** AP **Checked** KW	**Start** 27/09/2006 **End** 29/09/2006	**Equipment, Methods and Remarks** Dando 175 Inspection pit to 1.20m then cable tool boring to 27.50m.	**Depth from**	**to**	**Diameter**	**Casing Depth**	**Ground Level** - **Coordinates** - **National Grid** - **Chainage** 0.000	
			0.00m	5.50m	250mm	5.50m		
			5.50m	18.00m	200mm	18.00m		
			18.00m	27.00m	150mm	27.00m		

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
0.00	B 1			
1.00	B 2			
2.00	B 3			
3.00	B 4			
4.00	B 5			
5.00	B 6			
5.50	D 1			
6.00	D 2			
6.40	D 3			
6.40	D 4			
7.00	D 5			
8.00	D 6			
9.00	D 7			

Strata

Description	Depth/*Level* (Thickness)	Legend	Backfill/ Instruments
Stiff dark brown sandy gravelly CLAY. Sand is fine to coarse, gravel is angular to subrounded fine to coarse of flint and brick. (MADE GROUND)	(0.30) 0.30		D S
Compact dark grey to black slightly sandy SILT. Sand is fine of ash. (MADE GROUND)	(5.20)		
Very stiff orange brown CLAY. (ALLUVIUM)	5.50 (0.50)		
Soft dark grey CLAY. (ALLUVIUM)	6.00		
7.00 m Occasional pocket of spongy dark brown fibrouns PEAT.			
8.00 m Occasional pockets of fibrous reeds.			
Stratum continues to 20.00 m			

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

None observed (see Key Sheet)

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Tilbury Power Station

Project No. G6076

Carried out for RWE NPower

Borehole

BHC5

Borehole Log

Drilled BR **Logged** AP **Checked** KW	**Start** 27/09/2006 **End** 29/09/2006	**Equipment, Methods and Remarks** Dando 175 Inspection pit to 1.20m then cable tool boring to 27.50m.	**Depth from**	**to**	**Diameter**	**Casing Depth**	**Ground Level** - **Coordinates** - **National Grid** -	
			0.00m	5.50m	250mm	5.50m		
			5.50m	18.00m	200mm	18.00m		
			18.00m	27.00m	150mm	27.00m	**Chainage** 0.000	

Samples and Tests

Strata

Depth	Type & No	Records	Date Casing	Time Water	Description (Continued from Sheet 1)	Depth/*Level* (Thickness)	Legend	Backfill/ Instruments
10.00	D 8				Soft dark grey CLAY. (ALLUVIUM)			D S
11.00	D 9							
12.00	D 10							
12.40	D 11							
12.40	D 12							
13.00	D 13				13.00 m Becoming very soft.	(14.00)		
14.00	D 14							
15.00	D 15							
16.00	D 16							
17.00	D 17							
17.50	D 18							
17.50	D 19							
18.00	D 20							
19.00	D 21							
Depth	**Type & No**	**Records**	**Date Casing**	**Time Water**				

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
None observed (see Key Sheet)			

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Tilbury Power Station

Project No. G6076

Carried out for RWE NPower

Borehole

BHC5

Borehole Log

Drilled BR **Logged** AP **Checked** KW	**Start** 27/09/2006 **End** 29/09/2006	**Equipment, Methods and Remarks** Dando 175 Inspection pit to 1.20m then cable tool boring to 27.50m.	**Depth from**	**to**	**Diameter**	**Casing Depth**	**Ground Level** - **Coordinates** - **National Grid** - **Chainage** 0.000	
			0.00m	5.50m	250mm	5.50m		
			5.50m	18.00m	200mm	18.00m		
			18.00m	27.00m	150mm	27.00m		

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
20.00	D 22			
21.00	D 23			
22.00	D 24			
23.00	D 25			
24.00	D 26			
25.00	D 27			
26.00	D 28			
27.00	D 29			

Strata

Description (Continued from Sheet 2)	Depth/Level (Thickness)	Legend	Backfill/ Instruments
Dark grey clayey sandy GRAVEL. Sand is fine to coarse, gravel is angular to subangular fine to coarse of flint. (RIVER TERRACE DEPOSITS)	20.00 (1.00)		D
Orange brown sandy GRAVEL. Sand is fine to coarse, gravel is subangular to rounded fine to coarse of flint. (RIVER TERRACE DEPOSITS)	21.00 (3.00)		
Recovered as off white silty GRAVEL. Gravel is subangular fine to coarse of very weak low density CHALK. (UPPER CHALK)	24.00 (3.00)		
EXPLORATORY HOLE ENDS AT 27.00 m	27.00		

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
None observed (see Key Sheet)			

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Tilbury Power Station

Project No. G6076

Carried out for RWE NPower

Borehole

BHC5

Borehole Log

Drilled SG **Logged** AP **Checked** KW	**Start** 31/08/2006 **End** 04/09/2006	**Equipment, Methods and Remarks** Inspection pit to 1.20m then cable tool boring to 29.50m.	**Depth from** / **to** / **Diameter** / **Casing Depth** 0.00m / 10.00m / 200mm / 10.00m 10.00m / 29.50m / 150mm / 29.50m	**Ground Level** - **Coordinates** - **National Grid** - **Chainage** 0.000	

Samples and Tests

Strata

Depth	Type & No	Records	Date Casing	Time Water	Description	Depth/*Level* (Thickness)	Legend	Backfill/ Instruments
0.00	B 1				Firm to stiff dark brown sandy gravelly CLAY. Sand is fine to coarse, gravel is subangular fine to medium of flint. (MADE GROUND)	(0.80)		1 2
1.00	B 2				Black very silty SAND/Very sandy SILT. Sand is fine of ash. (MADE GROUND)	0.80		
2.00	B 3							
3.00	B 4					(4.20)		
4.00	B 5							
5.00	B 6				Stiff orange mottled brown CLAY. (ALLUVIUM)	5.00 (1.00)		
6.00	D 7				Soft grey CLAY. Occasional fine gravel size fragments of reeds and wood. (ALLUVIUM)	6.00		
7.00 7.00-7.45	D 8 U 9							1
7.50	D 10							
8.00	D 11							
9.00	D 12							
Depth	**Type & No**	**Records**	**Date Casing**	**Time Water**	Stratum continues to 18.80 m			

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Tilbury Power Station

Project No. G6076

Carried out for RWE NPower

Borehole

BHC6

Borehole Log

Drilled SG **Logged** AP **Checked** KW	**Start** 31/08/2006 **End** 04/09/2006	**Equipment, Methods and Remarks** Inspection pit to 1.20m then cable tool boring to 29.50m.	**Depth from** / **to** / **Diameter** / **Casing Depth** 0.00m / 10.00m / 200mm / 10.00m 10.00m / 29.50m / 150mm / 29.50m	**Ground Level** - **Coordinates** - **National Grid** - **Chainage** 0.000	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.00	D 13			
11.00	D 14			
12.00	D 15			
12.00-12.45	U 16			
12.50	D 17			
13.00	D 18			
14.00	D 19			
15.00	D 20			
16.00	D 21			
17.00	D 22			
17.00-17.45	U 23			
17.50	D 24			
19.00	D 25			

Strata

Description (Continued from Sheet 1)

Soft grey CLAY. Occasional fine gravel size fragments of reeds and wood. (ALLUVIUM)

12.00 m Plastic dark brown grey clayey PEAT.

13.00 m Plastic dark brown grey clayey PEAT

16.00 m Frequent wood fragments.

Dark grey very clayey SAND. Sand is fine to coarse. (RIVER TERRACE DEPOSITS)

Stratum continues to 20.30 m

Depth/Level (Thickness)	Legend	Backfill/ Instruments
(12.80)		1 2
18.80		
(1.50)		1

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	20.00	Rose to 7.50 m after 20 minutes.	-

Depth Related Remarks *

From / to (m)

Chiselling

Depths (m) / Time / Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Tilbury Power Station

Project No. G6076

Carried out for RWE NPower

Borehole BHC6

Borehole Log

Drilled SG **Logged** AP **Checked** KW	**Start** 31/08/2006 **End** 04/09/2006	**Equipment, Methods and Remarks** Inspection pit to 1.20m then cable tool boring to 29.50m.	**Depth from** / **to** / **Diameter** / **Casing Depth** 0.00m / 10.00m / 200mm / 10.00m 10.00m / 29.50m / 150mm / 29.50m	**Ground Level** - **Coordinates** - **National Grid** - **Chainage** 0.000	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
20.00	D 26			
21.00	D 27			
22.00	D 28			
23.00	D 29			
24.00	D 30			
25.00	D 31			
26.00	D 32			
27.00	D 33			
28.00	D 34			
29.00	D 35			

Strata

Description (Continued from Sheet 2)	Depth/*Level* (Thickness)	Legend	Backfill/ Instruments
Dark grey very clayey SAND. Sand is fine to coarse. (RIVER TERRACE DEPOSITS)	20.30		2
Dark brown slightly clayey gravelly SAND. Sand is fine to coarse, gravel is subangular to rounded fine to coarse of flint. (RIVER TERRACE DEPOSITS)	(0.90) 21.20		
Dark grey slightly sandy GRAVEL. Sand is fine to coarse, gravel is angular to subangular fine to coarse of flint. Occasional cobbles of flint. (RIVER TERRACE DEPOSITS)	(0.80) 22.00		
Brown SAND and GRAVEL. Sand is fine to coarse, gravel is angular to subangular fine to coarse of flint. (RIVER TERRACE DEPOSITS)	(3.30) 25.30		
Recovered as off white slightly silty GRAVEL. Gravel is angular to subangular fine to coarse of very weak chalk. (UPPER CHALK)	(2.20) 27.50		
Recovered as off white very silty GRAVEL. Gravel is subangular to subrounded. fine to coarse of very weak CHALK. (UPPER CHALK)	(2.00) 29.50		
EXPLORATORY HOLE ENDS AT 29.50 m			

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	20.00	Rose to 7.50 m after 20 minutes.	-

Depth Related Remarks *

From / to (m)

Chiselling

Depths (m)	Time	Tools used
20.30 -21.20	60 mins	
22.00 -23.00	120 mins	

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Tilbury Power Station

Project No. G6076

Carried out for RWE NPower

Borehole

BHC6

Appendix C. Rainham Landfill Data

C.1. Borehole Logs

British Geological Survey
Expert | Impartial | Innovative

Gateway to the Earth

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Search onshore borehole records

TQ57NW 514 PLA 1902
5225 7938

Boring method	Shell and Auger	Location TQ 53 79	Record of BOREHOLE 2 (sheet 1 of 3)
Boring diameter (mm)	200 to 17.00m 150 to 23.00m		
Casing diameter (mm)	200 to 17.00m 150 to 21.00m	Orientation	Ground level (m.O.D.) 3.95
Boring equipment	Pilcon Wayfarer 20		Date commenced 18.4.75

Samples and in situ tests Depth (m)	Type	Casing Depth (m)	Water Depth (m)			Date and Depth (m)	DESCRIPTION OF STRATA	O.D. Level (m.O.D.)	Legend
			—			18/4	FILL (silty clay)		
1.00	U	1.00							
1.45	D					1/20		1.75	
2.00	BD						Dark grey fine sandy clayey SILT		
2.00	W							0.15	
2.50	Ut	2.50							
2.50	BD		2.70*			2.80		1.15	
3.00	D								
3.00	U	3.00					Soft grey organic silty CLAY with brown lithorelicts		
3.45	D								
4.00	BD					3.80 3.95		-N.11	
4.50	U	4.50							
4.95	D					4.80		-0.85	
5.50	BD						Very soft light, occasionally dark, grey organic silty CLAY		
6.00	U	6.00							
6.45	D								
7.00	BD								
7.00	W					7.20		-3.25	
7.50	U	7.50					Soft black claycy PEAT		
7.95	D								
8.50	BD					8.80		-4.85	
9.00	U	9.00					Very soft black silty CLAY with some peat		
10.00	BD		7.00			10.00		-6.05	

REMARKS

For explanation of symbols and abbreviations see Notes, pages (i) and (ii)

LAB Ref. No. SI 11204

HAVERING POWER STATION

Fig. 2

TQ 57 NW S14

Boring method							Location		Record of BOREHOLE 2	
Boring diameter (mm)									(sheet 2 of 3)	
Casing diameter (mm)							Orientation		Ground level (m.O.D.) 3.95	
Boring equipment									Date commenced	
Samples and in situ tests		Casing Depth (m)	Water Depth (m)			Date and Depth (m)	DESCRIPTION OF STRATA		O.D. Level (m.O.D.)	Legend
Depth (m)	Type									
			7.00			19/4				
11.00 11.00	S 15 D	11.00								
							Medium dense grey, occasionally green-grey, fine to coarse SAND with some fine to medium gravel			
12.50 12.50	C 11 BD	12.50								
14.00 14.00	C 17 BD	14.00								
									-10.05	
							14.00			
							Medium dense sandy fine to coarse GRAVEL with some cobbles			
15.50 15.50	C 26 BD	15.50								
									-13.05	
17.00-17.30 17.00	C 88‡ BD	17.00	2.50 1.30			17.00 22/4 17.30	Very dense silty sandy fine to medium, occasionally coarse, GRAVEL		-13.35	
18.50-18.80 18.50	S 59‡ BD	18.50					Very dense grey silty fine, occasionally medium, SAND with some green and black fine to medium flint gravel			
20.00-20.30	S 66‡	20.00								

REMARKS

For explanation of symbols and abbreviations see Notes, pages (i) and (ii)

LAB Ref. No.		
S/11204	HAVERING POWER STATION	Fig. 2 (CONT'D

WIMPEY LABORATORIES LIMITED

TQ 57 NW 514

PLA 1902 cont

Boring method							Location	Record of BOREHOLE 2	
Boring diameter (mm)								(sheet 3 of 3)	
Casing diameter (mm)							Orientation	Ground level (m.O.D.) 3.95	
Boring equipment								Date commenced	
Samples and in situ tests		Casing Depth (m)	Water Depth (m)			Date and Depth (m)	DESCRIPTION OF STRATA	O.D. Level (m.O.D.)	Legend
Depth (m)	Type								
20.00	BD						(See sheet 2)		
						20.80		-16.85	
20.80	BD								
21.00	S 39	21.00							
21.00	D								
21.50	U	21.00					Hard rubbly, becoming jointed, white CHALK with occasional flints		
						22.00			
21.95	D		7.00						
			7.00			23/4			
22.50	S 34	22.00							
22.50	BD								
			–			23.00		-19.05	
			P4.35			8/5	END OF BOREHOLE		

REMARKS Borehole was backfilled with bentonite from 23.00m to 22.50m, sand to 21.50m, bentonite to 21.00m and cement grout to ground level.

For explanation of symbols and abbreviations see Notes, pages (i) and (ii)

LAB Ref. No.

Fig. 2

TQ57NW 515 PLA 1903

Boring method	Shell and Auger	Location TQ 53 79	Record of BOREHOLE 3
Boring diameter (mm)	200 to 10.00m 150 to 36.00m	5241 7975	(sheet 1 of 4)
Casing diameter (mm)	200 to 10.00m 150 to 33.00m	Orientation	Ground level (m.O.D.) 5.75
Boring equipment	Pilcon Wayfarer 20		Date commenced 11.4.75

Samples and in situ tests Depth (m)	Type	Casing Depth (m)	Water Depth (m)			Date and Depth (m)	DESCRIPTION OF STRATA	O.D. Level (m.O.D.)	Legend
			—			11/4			
1.00-1.30	U	NIL					FILL (brown clay with some PEAT and occasional rags, glass and brick fragments)		
1.30	D								
1.50	BD								
2.60	W		2.60*			2.60		3.15	
3.00-3.30	U	1.50							
3.30	D								
3.50	BD								
4.50	U	4.50					Very soft brown and light grey silty CLAY with occasional peat		
4.95	D								
5.00	BD								
6.00	U	6.00							
6.45	D								
6.50	BD					6.50		-0.75	
7.50	U	7.50					Very soft to soft dark grey silty CLAY with some peat		
7.95	D								
8.00	BD								
9.00	U	9.00	NIL			9.00		-3.25	
			NIL			12/4			
9.45	D						Soft black occasionally brown clayey PEAT		
9.50	BD								

REMARKS

For explanation of symbols and abbreviations see Notes, pages (i) and (ii)

LAB Ref. No.		Fig.
S/ 11204	HAVERING POWER STATION	3

WIMPEY LABORATORIES LIMITED

7957NW 515

PLA 1903 cont.

Boring method							Location	Record of BOREHOLE 3 (sheet 2 of 4)
Boring diameter (mm)								
Casing diameter (mm)							Orientation	Ground level (m.O.D.) 5.75
Boring equipment								Date commenced

Samples and in situ tests		Casing Depth (m)	Water Depth (m)			Date and Depth (m)	DESCRIPTION OF STRATA	O.D. Level (m.O.D.)	Legend
Depth (m)	Type								
10.50	U	10.00					(See sheet 1)		
10.95 11.00	D BD					11.00		-5.25	
							Very soft dark grey silty CLAY with some peat		
12.00	U	10.00							
12.45 12.50	D BD					12.50		-6.75	
							Grey clayey silty fine SAND		
			NIL			13.00		-7.25	
			6.50			14/4			
13.50 13.50	C 13 BD	13.50							
15.00 15.00	C 13 BD	15.00					Medium dense grey-brown silty fine to coarse SAND and fine to medium, occasionally coarse, GRAVEL		
16.50	C 21	16.50							
						17.00		-11.25	
							Very dense grey-brown fine to coarse SAND with fine, occasionally medium to coarse, GRAVEL		
18.00 18.00	C 52 BD	18.00							
						19.10		-13.35	
19.50 19.50	C 107 BD	19.50					Very dense grey silty fine to medium, occasionally coarse, SAND with some fine to medium gravel		

REMARKS

For explanation of symbols and abbreviations see Notes, pages (i) and (ii)

LAB Ref. No.		Fig.
S/ 11204	HAVERING POWER STATION	3 (CONT'D)

WIMPEY LABORATORIES LIMITED

TQ 57 NW 515

PLA 1903 cont.

Boring method		Location	Record of BOREHOLE 3 (sheet 3 of 4)
Boring diameter (mm)			
Casing diameter (mm)		Orientation	Ground level (m.O.D.) 5.75
Boring equipment			Date commenced

Samples and in situ tests Depth (m)	Type	Casing Depth (m)	Water Depth (m)			Date and Depth (m)	DESCRIPTION OF STRATA	O.D. Level (m.O.D.)	Legend
						20.50	(See sheet 2)	-14.75	
21.50-21.80 21.50	S 69‡ BD	21.50							
23.00-23.80	S 99‡	23.00							
			10.00 10.00			23.50 15/4			
24.50-24.80 24.50	S 72‡ BD	24.50					Dense to very dense grey silty fine, occasionally medium to coarse from 23.00m to 27.50m, SAND with some bands of clay, fine gravel and traces of chalk below 32.50m	-21.25	
26.00-26.30 26.00	S 75‡ BD	26.00							
27.50-27.80 27.50	S 79‡ BD	27.50							
29.00-29.30 29.00	S 92‡ BD	29.00							

23.00
20.50
2.5
-14.75
-16.75

-16.75

-26.25

REMARKS

For explanation of symbols and abbreviations see Notes, pages (i) and (ii)

LAB Ref. No.		Fig.
S/ 11204	HAVERING POWER STATION	3 (CONT'D)

TQ57AW 515 PLA 1903 con

Boring method							Location		Record of BOREHOLE 3	
Boring diameter (mm)									(sheet 4 of 4)	
Casing diameter (mm)							Orientation		Ground level (m.O.D.) 5.75	
Boring equipment									Date commenced	
Samples and in situ tests		Casing Depth (m)	Water Depth (m)			Date and Depth (m)	DESCRIPTION OF STRATA		O.D. Level (m.O.D.)	Legend
Depth (m)	Type									
30.50-30.80 30.50	S 82 BD	30.00					(See sheet 3)			
32.00 32.00	S 76 BD	30.00								
			10.00			32.50				
			9.50			17/4				
33.50-33.65 33.50	S 51• BD	33.00								
						33.70			-27.95	
						34.00	Very dense coarse flint GRAVEL and COBBLES		-28.25	
34.50-34.80	S 50•	33.00								
35.00	U	33.00					Hard white jointed CHALK with some soft remoulded chalk at top			
35.45	D									
36.00-36.08	S 50•	33.50	—			36.05			-30.30	
							END OF BOREHOLE			

REMARKS After withdrawing casing water level stood at 2.50m below ground level.
Borehole was backfilled with sand/cement grout from 36.00m to ground level.

For explanation of symbols and abbreviations see Notes, pages (i) and (ii)

LAB Ref. No.		Fig.
S/ 11204	HAVERING POWER STATION	3 (CONT'D)

HUMPHREY LABORATORIES LIMITED

Eastern RS.
Thames E.A.

271

TQ57 NW

TQ530 795

TQ57NW 499

TQ57/130A

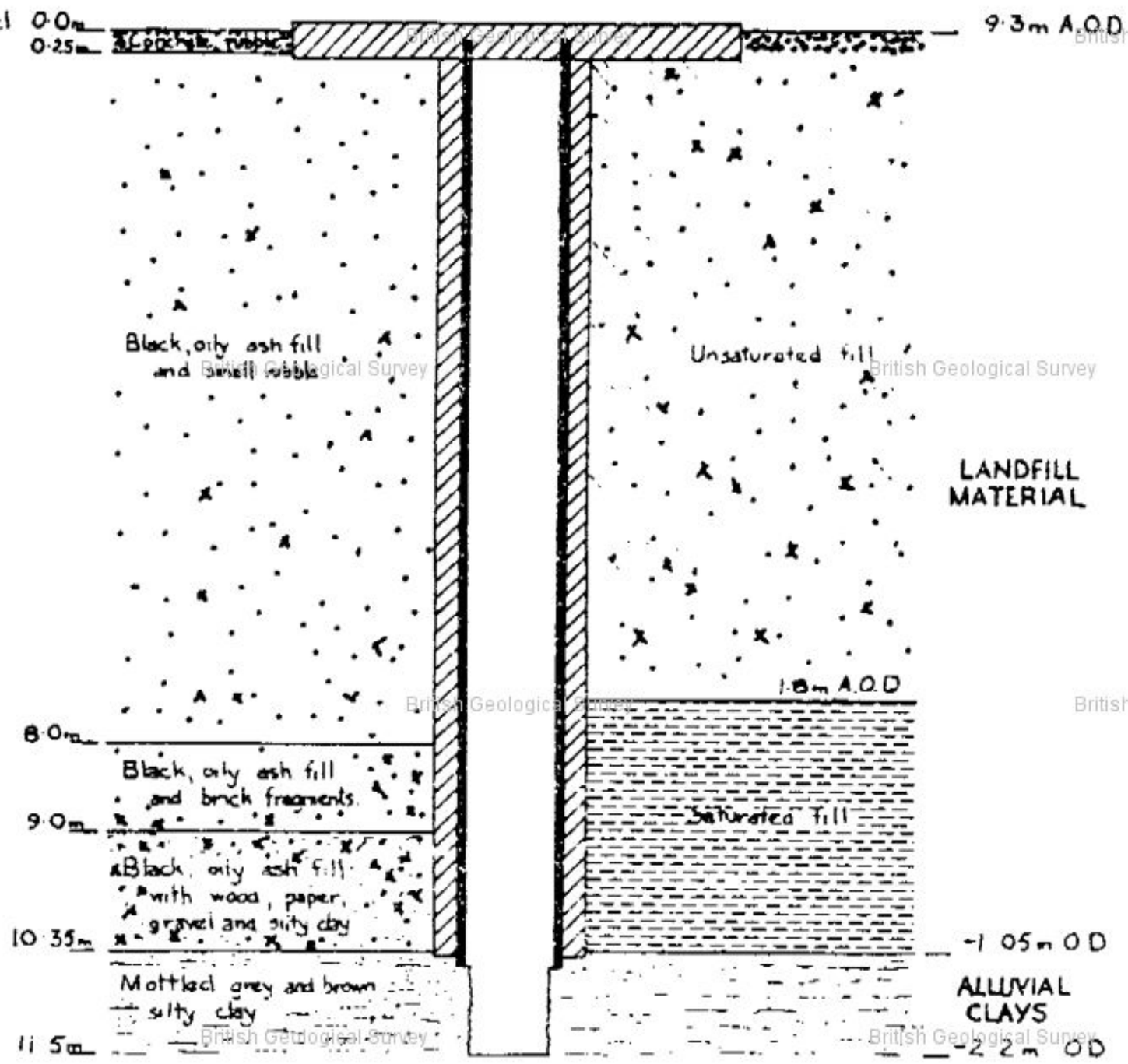

Figure 15. Rainham - Borehole A1.

Drilled June/July 1975 information from WRC Jan 97

Eastern h S
Thames EA

271

TQ57NW 500
TQ57/130B

TQ57NW

TQ529 796

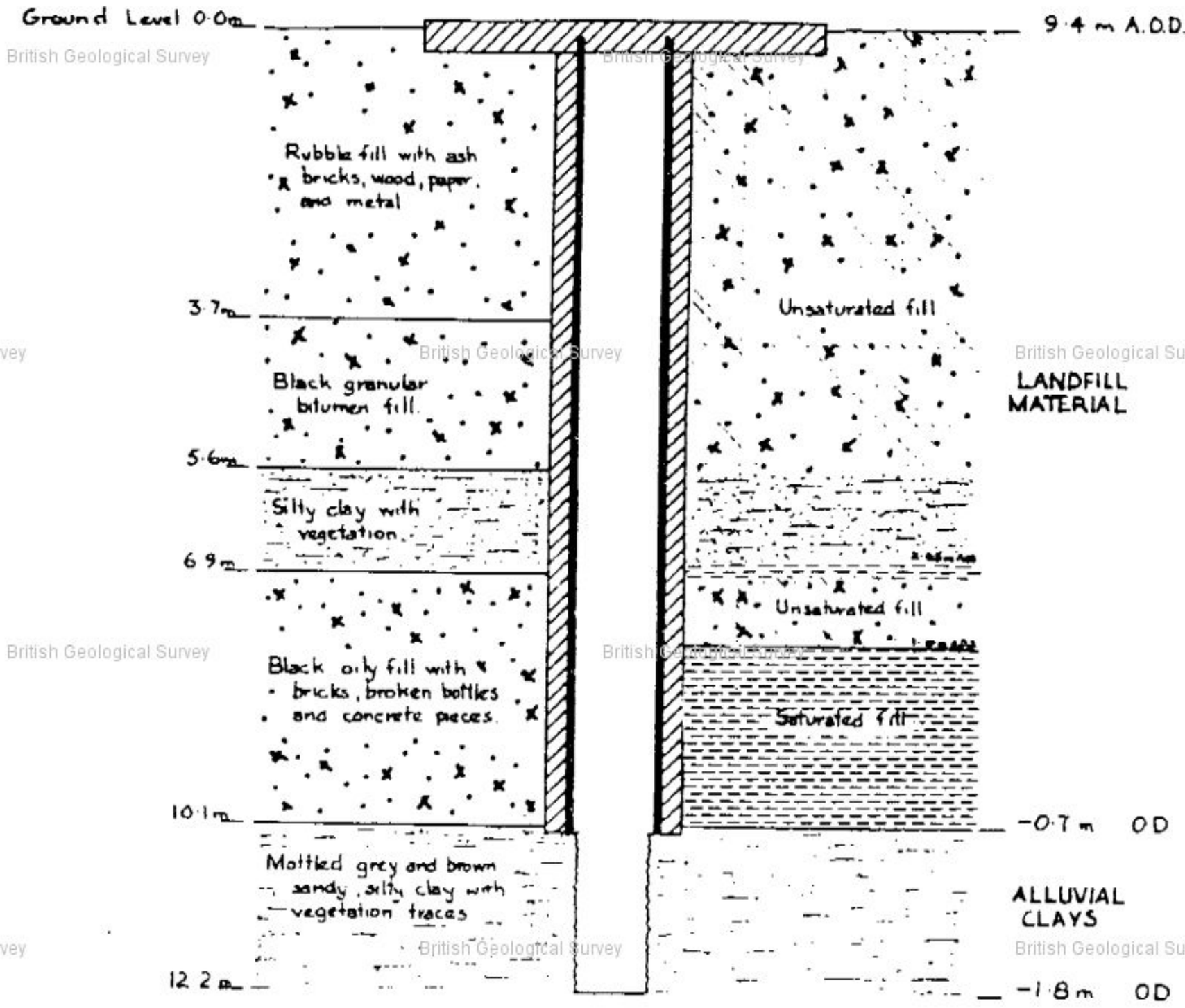

Figure 16. Rainham - Borehole A2.

Drilled June/July 1975

information from W.R.C Jan 97

Eastern LS
Trianes E.A.

TQ57NW S01-S02

TQ 528 795

271

TQ57NW

TQ 57NW S01

TQ57/130C

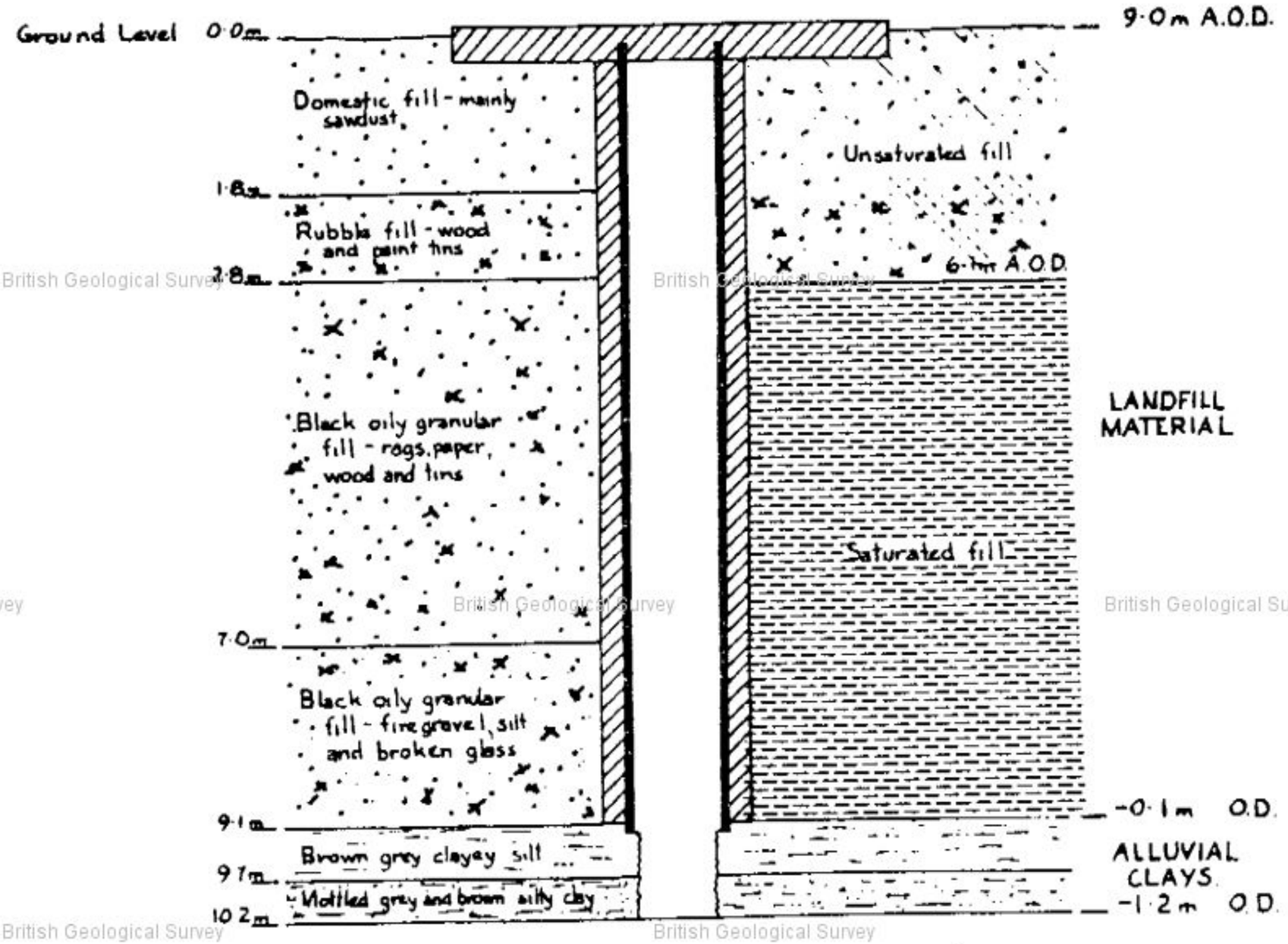

Figure 17. Rainham - Borehole A3.

TQ57NW S02

TQ 528 794

D.

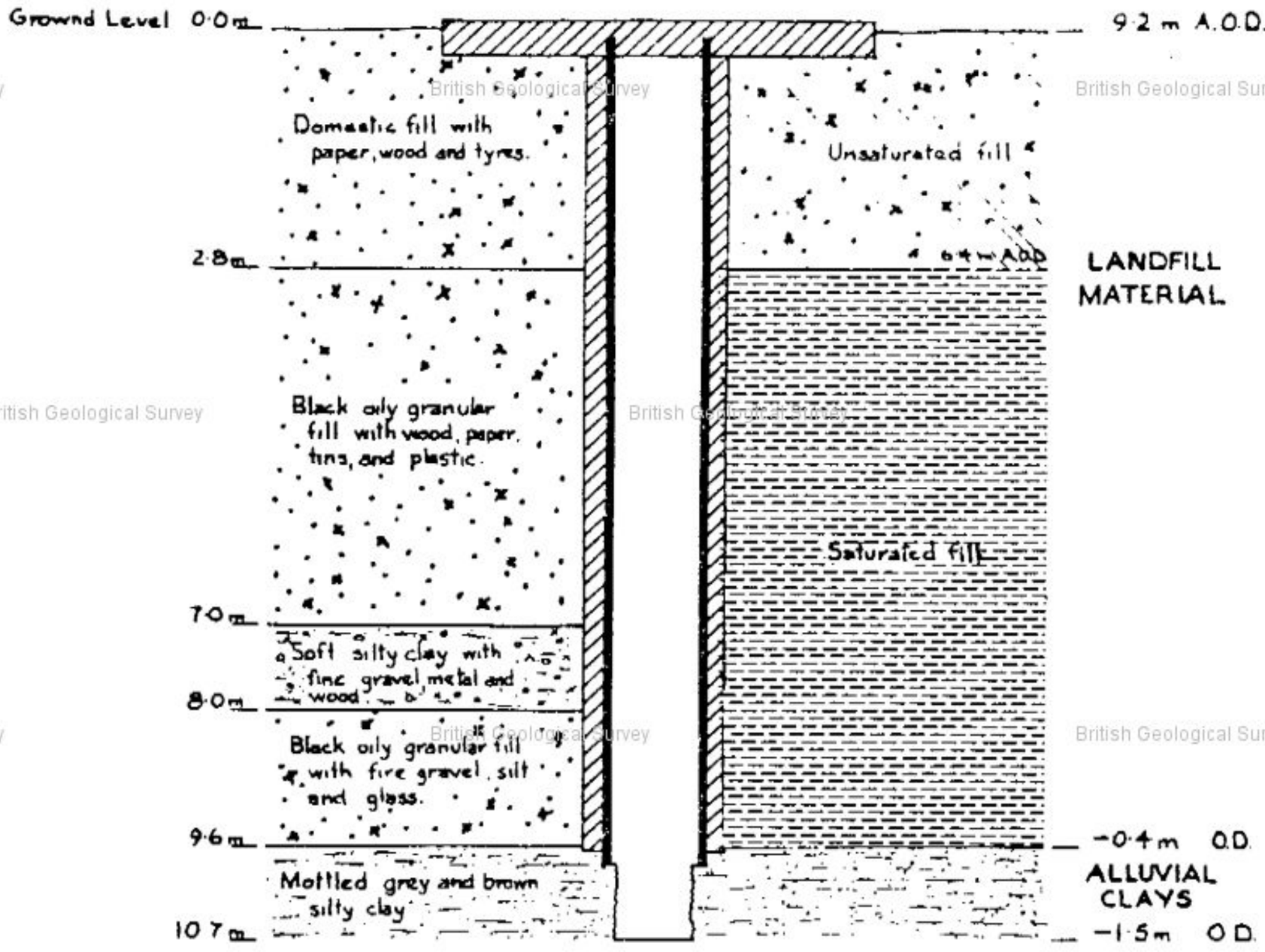

Figure 18. Rainham - Borehole A4.

Drilled June/July 1975 information from WRC Jan 97

Eastern LS
Trianes E.A.

TQ57NW S01-S02

TQ 528 795

271

TQ57NW

TQ 57NW S01

TQ57/130C

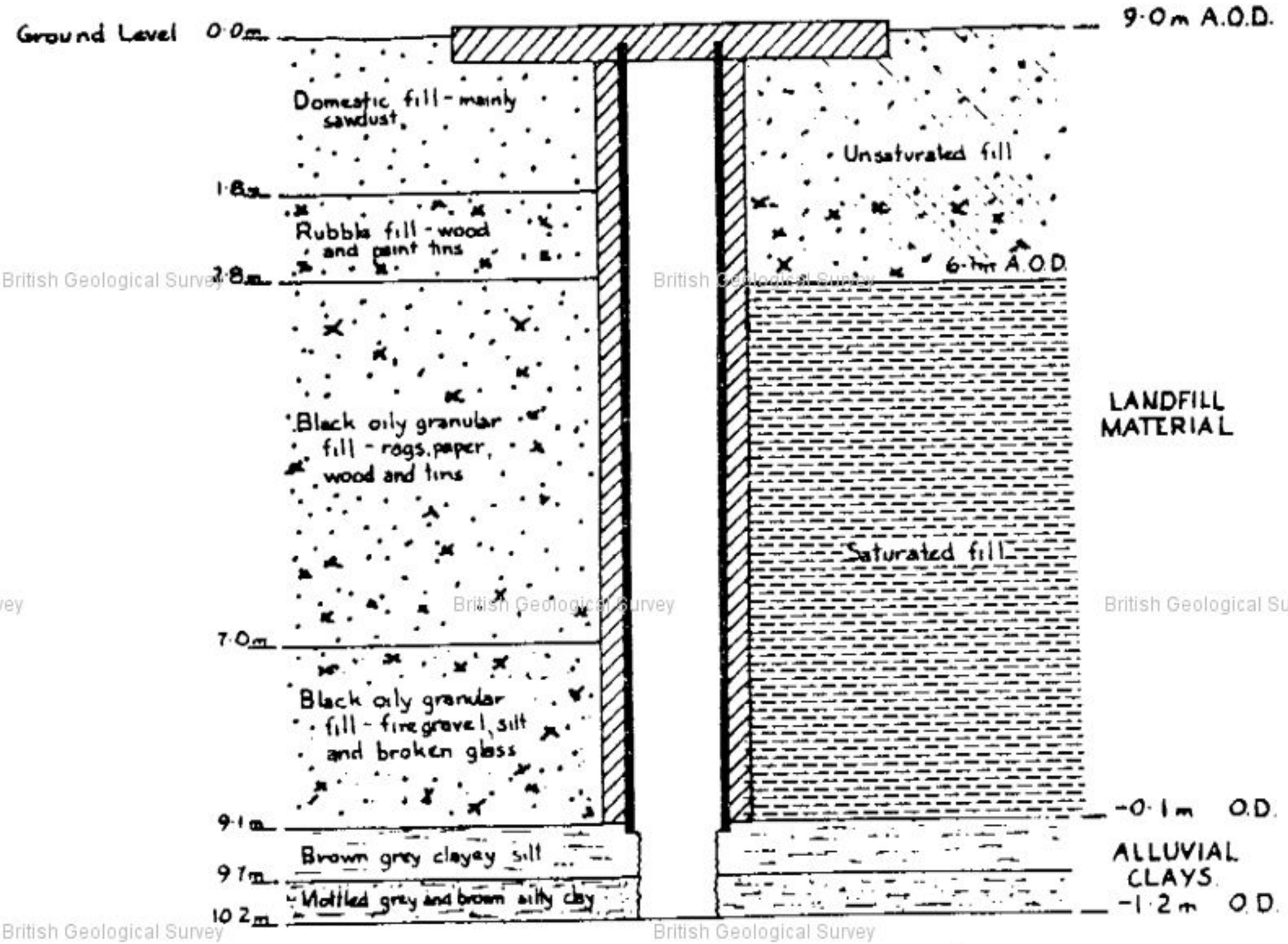

Figure 17. Rainham - Borehole A3.

TQ57NW S02

TQ 528 794

D.

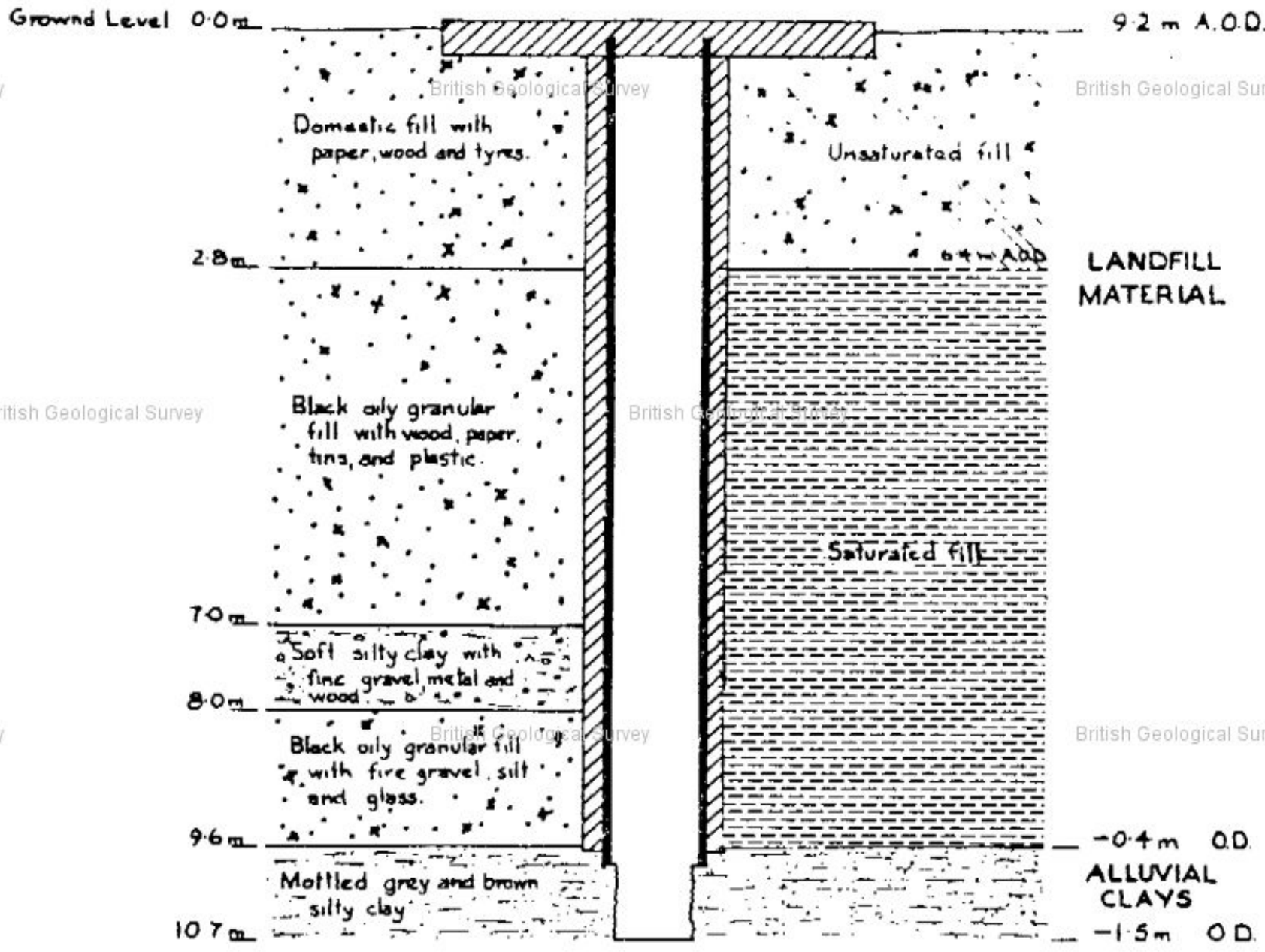

Figure 18. Rainham - Borehole A4.

Drilled June/July 1975 information from WRC Jan 97

Eastern KS

271

TQ57NW 503

Thames E.A.

TQ57NW.

TQ57/130E

TQ529 793

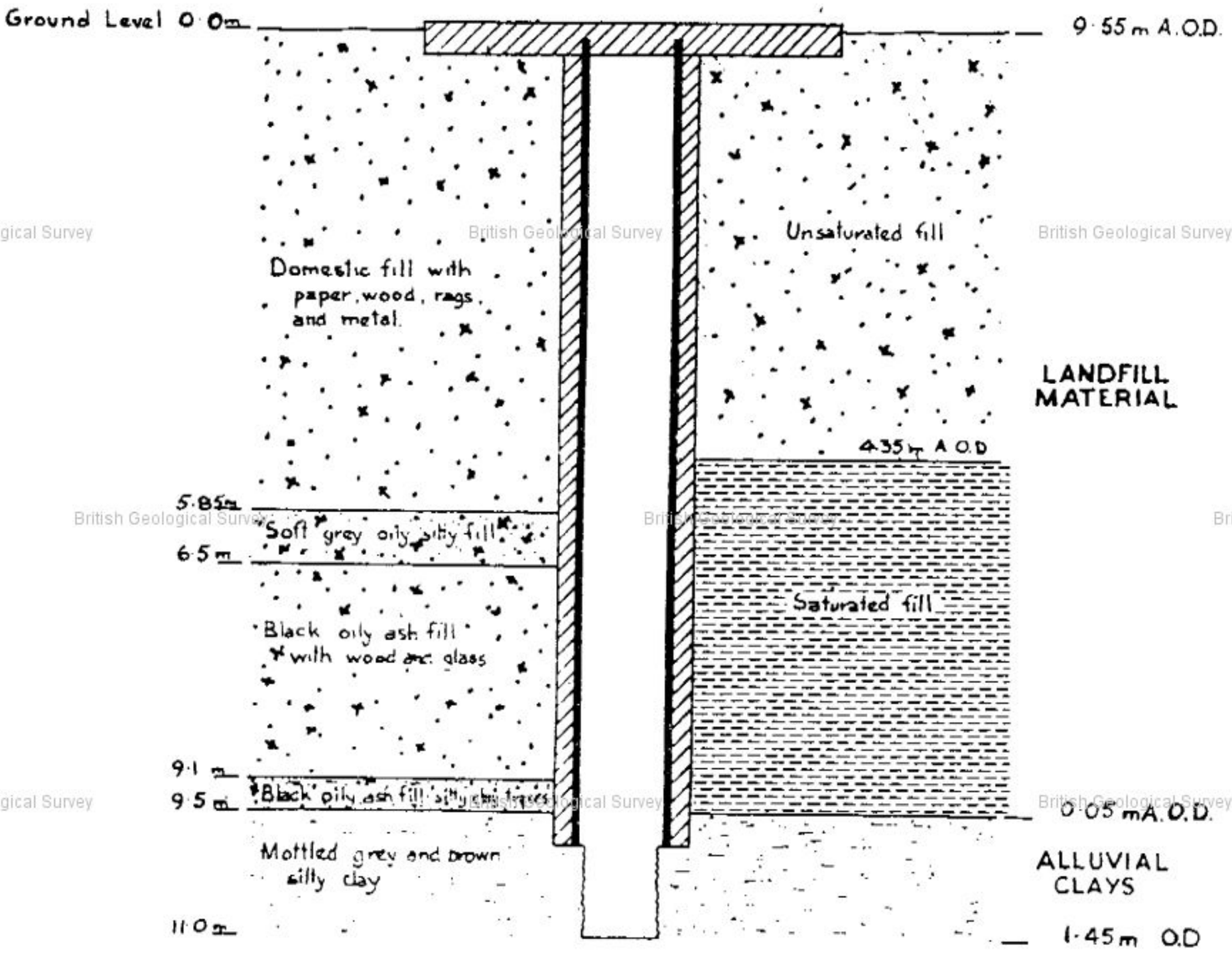

Figure 19. Rainham - Borehole A5.

Drilled June/July 1975

Information from WRC Jan 97

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