



4041



Integral Geotechnique
Integral House
7 Beddau Way
Castlegate Business Park
CF83 2AX

t: 2920807991

e: roger@integralgeotec.com

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404

f: 01923 237404

e: reception@i2analytical.com

Analytical Report Number : 25-031162

Project / Site name:	Earlswood Training Centre	Samples received on:	13/06/2025
Your job number:	14050 RJH	Samples instructed on/ Analysis started on:	13/06/2025
Your order number:		Analysis completed by:	01/07/2025
Report Issue Number:	1	Report issued on:	01/07/2025
Samples Analysed:	2 water samples		

Signed:

Elaine Guy
Customer Services Advisor
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :	soils	- 4 weeks from reporting
	leachates	- 2 weeks from reporting
	waters	- 2 weeks from reporting
	asbestos	- 6 months from reporting
	air	- once the analysis is complete

Excel copies of reports are only valid when accompanied by this PDF certificate.

Retention period for records and reports is minimum 6 years from the date of issue of the final report.

Some records may be kept for longer according to other legal/best practice requirements.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 25-031162
Project / Site name: Earlswood Training Centre

Lab Sample Number	581126	581127
Sample Reference	RSC 01	RMD 01
Sample Number	None Supplied	None Supplied
Water Matrix	Surface water	Surface water
Depth (m)	None Supplied	None Supplied
Date Sampled	11/06/2025	11/06/2025
Time Taken	930	1005
Analytical Parameter (Water Analysis)	Units	Test Limit of detection
		Test Accreditation Status

General Inorganics

pH (L099)	pH Units	N/A	ISO 17025	8.1	8.1
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10
Sulphate as SO ₄	µg/l	45	ISO 17025	2300000	2290000
Total Sulphur	µg/l	15	NONE	770000	760000
Sulphide	µg/l	5	NONE	< 5.0	< 5.0
Dissolved Organic Carbon (DOC)	mg/l	0.1	ISO 17025	0.94	0.81
Total Organic Carbon (TOC)	mg/l	0.1	ISO 17025	1.02	0.82
Hardness - Total	mgCaCO ₃ /l	1	ISO 17025	5420	5380

Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	35	18
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Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01

Total PAH

Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16
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Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	0.15	ISO 17025	1.48	1.55
Beryllium (dissolved)	µg/l	0.1	ISO 17025	< 0.1	< 0.1
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.03	0.02
Chromium (dissolved)	µg/l	0.2	ISO 17025	12	20
Copper (dissolved)	µg/l	0.5	ISO 17025	18	15
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2 #	< 0.2 #
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05 #	< 0.05 #
Nickel (dissolved)	µg/l	0.5	ISO 17025	4.6	7.1
Selenium (dissolved)	µg/l	0.6	ISO 17025	1.5	1.8
Vanadium (dissolved)	µg/l	0.2	ISO 17025	1.1	1.1
Zinc (dissolved)	µg/l	0.5	ISO 17025	26	38

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Analytical Parameter (Water Analysis)	Units	Test Limit of detection
		Test Accreditation Status

Boron (dissolved)	µg/l	10	ISO 17025	3300	3400
Calcium (dissolved)	mg/l	0.012	ISO 17025	350	350
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0

Petroleum Hydrocarbons

TPH - Aliphatic >EC5 - EC6 _{HS 1D AL}	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH - Aliphatic >EC6 - EC8 _{HS 1D AL}	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH - Aliphatic >EC8 - EC10 _{HS 1D AL}	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH - Aliphatic >EC10 - EC12 _{EH 1D AL MS}	µg/l	10	NONE	< 10	12
TPH - Aliphatic >EC12 - EC16 _{EH 1D AL MS}	µg/l	10	NONE	< 10	48
TPH - Aliphatic >EC16 - EC21 _{EH 1D AL MS}	µg/l	10	NONE	< 10	25
TPH - Aliphatic >EC21 - EC35 _{EH 1D AL MS}	µg/l	10	NONE	< 10	50
TPH - Aliphatic >EC5 - EC35 _{HS+EH 1D AL MS}	µg/l	10	NONE	< 10	140
TPH - Aliphatic >EC16 - EC35 _{EH 1D AL MS}	µg/l	10	NONE	< 10	75
TPH - Aliphatic >EC35 - EC44 _{EH 1D AL MS}	µg/l	10	NONE	< 10	< 10

TPH - Aromatic >EC5 - EC7 _{HS 1D AR}	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH - Aromatic >EC7 - EC8 _{HS 1D AR}	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH - Aromatic >EC8 - EC10 _{HS 1D AR}	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH - Aromatic >EC10 - EC12 _{EH 1D AR MS}	µg/l	10	NONE	< 10	< 10
TPH - Aromatic >EC12 - EC16 _{EH 1D AR MS}	µg/l	10	NONE	< 10	< 10
TPH - Aromatic >EC16 - EC21 _{EH 1D AR MS}	µg/l	10	NONE	< 10	< 10
TPH - Aromatic >EC21 - EC35 _{EH 1D AR MS}	µg/l	10	NONE	< 10	< 10
TPH - Aromatic >EC5 - EC35 _{HS+EH 1D AR MS}	µg/l	10	NONE	< 10	< 10
TPH - Aromatic >EC35 - EC40 _{EH 1D AR MS}	µg/l	10	NONE	< 10	< 10
TPH - Aromatic >EC35 - EC44 _{EH 1D AR MS}	µg/l	10	NONE	< 10	< 10
TPH - Aromatic >EC40 - EC44 _{EH 1D AR MS}	µg/l	10	NONE	< 10	< 10
TPH - Aromatic >EC5 - EC44 _{HS+EH 1D AR MS}	µg/l	10	NONE	< 10	< 10

TPH (>EC5 - EC10) _{HS 1D TOTAL}	µg/l	10	NONE	< 10	< 10
TPH (>EC10 - EC20) _{EH 1D TOTAL MS}	µg/l	10	NONE	< 10	65
TPH (>EC20 - EC44) _{EH 1D TOTAL MS}	µg/l	10	NONE	< 10	55
TPH Total >EC5 - EC44 _{HS+EH 1D TOTAL MS}	µg/l	10	NONE	< 10	120

VOCs

MTBE (Methyl Tertiary Butyl Ether)	µg/l	3	ISO 17025	< 3.0	< 3.0
Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0

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Sample Number	None Supplied	None Supplied
Water Matrix	Surface water	Surface water
Depth (m)	None Supplied	None Supplied
Date Sampled	11/06/2025	11/06/2025
Time Taken	930	1005
Analytical Parameter (Water Analysis)	Units	Test Limit of detection
		Test Accreditation Status

PFAS

NetFOSA (ethyl perfluorooctanesulfonamide) - Semiquantitative	µg/l	0.05	NONE	< 0.05	< 0.05
FOSA (Perfluorooctanesulfonamide) - Semiquantitative - CAS No 375-13-6	µg/l	0.05	NONE	< 0.05	< 0.05
FOSAA (Perfluorooctanesulfonamidoacetic acid) - CAS No 27619-91-1	µg/l	0.05	NONE	< 0.05	< 0.05
8:2FTCA (8:2 Fluorotelomer carboxylic acid) - Semiquantitative	µg/l	0.05	NONE	< 0.05	< 0.05
10:2FTCA (10:2 Fluorotelomer carboxylic acid) - Semiquantitative	µg/l	0.05	NONE	< 0.05	< 0.05
6:2FTCA (6:2 Fluorotelomer carboxylic acid) - Semiquantitative	µg/l	0.05	NONE	< 0.05	< 0.05
8:2FTOH (8:2 Fluorotelomer alcohol)	µg/l	0.05	NONE	< 0.05	< 0.05
10:2FTOH (10:2 Fluorotelomer alcohol)	µg/l	0.05	NONE	< 0.05	< 0.05
4:2FTOH (4:2 Fluorotelomer alcohol)	µg/l	0.05	NONE	< 0.05	< 0.05
6:2FTOH (6:2 Fluorotelomer alcohol)	µg/l	0.05	NONE	< 0.05	< 0.05
8:2FTS (8:2 Fluorotelomer sulfonic acid) - CAS No 39108-34-1	µg/l	0.05	NONE	< 0.05	< 0.05
4:2FTS (4:2 Fluorotelomer sulfonic acid) - CAS No 757124-7	µg/l	0.05	NONE	< 0.05	< 0.05
6:2FTS (6:2 Fluorotelomer sulfonic acid) - CAS No 27619-91-1	µg/l	0.05	NONE	< 0.05	< 0.05
8:2FTUCA (8:2 Fluorotelomer unsaturated carboxylic acid) - CAS No 375-13-6	µg/l	0.05	NONE	< 0.05	< 0.05
10:2FTUCA (10:2 Fluorotelomer unsaturated carboxylic acid) - CAS No 375-13-6	µg/l	0.05	NONE	< 0.05	< 0.05
6:2FTUCA (6:2 Fluorotelomer unsaturated carboxylic acid) - CAS No 375-13-6	µg/l	0.05	NONE	< 0.05	< 0.05
NetFOSAA (ethyl perfluorooctanesulfonamidoacetic acid) - CAS No 27619-91-1	µg/l	0.05	NONE	< 0.05	< 0.05
NetFOSE (ethyl perfluorooctanesulfonamido ethanol) - CAS No 375-13-6	µg/l	0.05	NONE	< 0.05	< 0.05
NMeFOSAA (methyl perfluorooctanesulfonamido acetic acid) - CAS No 27619-91-1	µg/l	0.05	NONE	< 0.05	< 0.05
NMeFOSA (methyl perfluorooctanesulfonamide) - CAS No 375-13-6	µg/l	0.05	NONE	< 0.05	< 0.05
NMeFOSE (methyl perfluorooctanesulfonamido ethanol) - CAS No 375-13-6	µg/l	0.05	NONE	< 0.05	< 0.05
PFBA (Perfluorobutanoic acid) - CAS No 375-22-4	µg/l	0.05	NONE	< 0.05	< 0.05
PFBS (Perfluorobutanesulfonic acid) - CAS No 375-73-5	µg/l	0.05	NONE	< 0.05	< 0.05
PFDA (Perfluorodecanoic acid) - CAS No 335-76-2	µg/l	0.05	NONE	< 0.05	< 0.05
PFDoS (Perfluorododecanesulfonic acid) - CAS No 79780-39-1	µg/l	0.05	NONE	< 0.05	< 0.05
PFDoA (Perfluorododecanoic acid) - CAS No 307-55-1	µg/l	0.05	NONE	< 0.05	< 0.05
PFDS (Perfluorododecanesulfonic acid) - CAS No 335-77-3	µg/l	0.05	NONE	< 0.05	< 0.05
PFHpA (Perfluoroheptanoic acid) - CAS No 375-85-9	µg/l	0.05	NONE	< 0.05	< 0.05
PFHpS (Perfluoroheptanesulfonic acid) - CAS No 375-92-8	µg/l	0.05	NONE	< 0.05	< 0.05
PFHxA (Perfluorohexanoic acid) - CAS No 307-24-4	µg/l	0.05	NONE	< 0.05	< 0.05
PFHxS (Perfluorohexanesulfonic acid) - CAS No 355-46-4	µg/l	0.05	NONE	< 0.05	< 0.05
PFNA (Perfluorononanoic acid) - CAS No 375-95-1	µg/l	0.05	NONE	< 0.05	< 0.05
PFNS (Perfluoronananesulfonic acid) - CAS No 68259-12-1	µg/l	0.05	NONE	< 0.05	< 0.05
PFOA (Perfluorooctanoic acid) - CAS No 335-67-1	µg/l	0.05	NONE	< 0.05	< 0.05
PFOS (Perfluorooctanesulfonic acid) - CAS No 1763-23-1	µg/l	0.05	NONE	< 0.05	< 0.05
PFPeA (Perfluoropentanoic acid) - CAS No 2706-90-3	µg/l	0.05	NONE	< 0.05	< 0.05
PFUdA (Perfluoroundecanoic acid) - CAS No 2058-94-8	µg/l	0.05	NONE	< 0.05	< 0.05
PFUDS (Perfluoroundecanesulfonic acid) - CAS No 749786-1	µg/l	0.05	NONE	< 0.05	< 0.05
PFPeS (Perfluoropentanesulfonic acid) - CAS No 2706-91-4	µg/l	0.05	NONE	< 0.05	< 0.05

Subcontracted Analysis

Low Level PFOA (Subcontracted)	N/A	N/A	NONE	See Attached	See Attached
Low Level PFOS (Subcontracted)	N/A	N/A	NONE	See Attached	See Attached

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number : 25-031162
Project / Site name: Earlswood Training Centre

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters Heating/Cooling (PrW) DI Process Water (DI PrW)
Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited matrices: SW, PW, GW, except B - SW, GW, Hg - SW, PW, Al - SW, PW	In-house method based on USEPA Method 6020 & 200.8 for the determination of trace elements in water by ICP-MS	L012B	W	ISO 17025
Sulphide in water	Determination of sulphide in water by ion selective electrode	In-house method	L029-PL	W	NONE
Dissolved Organic Carbon in water	Determination of dissolved organic carbon in water by TOC/DOC NDIR Analyser. Accredited matrices: SW, PW, GW, FSE, LL	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037B	W	ISO 17025
Total Organic Carbon in water	Determination of total organic carbon in water by TOC/DOC NDIR Analyser. Accredited matrices: SW, PW, GW, FSE, LL	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037B	W	ISO 17025
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited matrices: SW, PW, GW, FSE, LL; PrW, DI PrW (Al, Cu, Fe, Zn)	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L039B	W	ISO 17025
Sulphate in water	Determination of sulphate in water after filtration by acidification followed by ICP-OES. Accredited matrices: SW, PW, GW, PrW, DI PrW, FSE, LL	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L039B	W	ISO 17025
Total Sulphur in water	Determination of total sulphur in water by acidification followed by ICP-OES	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L039B	W	NONE
Total Hardness of water	Determination of total hardness of water by calculation from calcium and magnesium. Accredited matrices: SW, PW, GW, FSE, LL	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L045B	W	ISO 17025
Total Petroleum Hydrocarbons with carbon banding in water by GC-MS	Determination of total petroleum hydrocarbons in water by GC-MS with carbon banding aliphatic and aromatic	In-house method	L070B	W	NONE
Total Petroleum Hydrocarbons in water by GC-MS	Determination of total petroleum hydrocarbons in water by GC-MS. Accredited matrices (TPH C12 - C35): SW, PW, GW	In-house method	L070B	W	NONE
BTEX and/or Volatile Organic Compounds in water	Determination of volatile organic compounds in water by headspace GC-MS. Accredited matrices: SW, PW, GW	In-house method based on USEPA 8260	L073B	W	ISO 17025
Hexavalent chromium in water	Determination of hexavalent chromium in water by acidification, addition of 1,5-diphenylcarbazide, followed by colorimetry. Accredited matrices: SW, PW, GW, FSE, LL	In-house method by continuous flow analyser	L080-PL	W	ISO 17025
Monohydric phenols in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW, PW, GW, FSE, LL	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080-PL	W	ISO 17025
Total cyanide in water	Determination of total cyanide in water by distillation followed by colorimetry. Accredited matrices: SW, PW, GW, FSE, LL	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080-PL	W	ISO 17025
Total Petroleum Hydrocarbons in water by HS-GC-MS	Determination of total petroleum hydrocarbons in water by headspace GC-MS. Accredited matrices: SW, PW, GW	In-house method	L088-PL	W	ISO 17025
pH of water at 20°C (automated)	Determination of pH of water by electrochemical measurement. Accredited matrices: SW, PW, GW, FSE, LL	In-house method	L099-PL	W	ISO 17025

Analytical Report Number : 25-031162
Project / Site name: Earlswood Training Centre

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters Heating/Cooling (PrW) DI Process Water (DI PrW)
Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Speciated PAHs and/or Semi-volatile organic compounds in water	Determination of semi-volatile organic compounds (including PAHs) in water by extraction in dichloromethane followed by GC-MS. Accredited matrices (PAHs): SW, PW, GW	In-house method based on USEPA 8270	L102B	W	ISO 17025
PFAS in water	Determination of PFAS in water by LC-MS/MS	In-house method	L117B	W	NONE
Subcontracted analysis (water)	Subcontracted analysis - see attached subcon report.	Subcontracted analysis - see attached subcon report.			NONE

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL' or 'B' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30°C.
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
-	Operator - underscore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

Quality control parameter failure associated with individual result applies to calculated sum of individuals.
The result for sum should be interpreted with caution

#- Quality control parameter failure associated with this result; other checks applied prior to reporting the data have been accepted. The result should be considered as deviating and should be interpreted with caution. The result is not accredited.



TEST REPORT

Report Number: 2025-1810

Customer Name : i2 Analytical UK

Customer Address : 7 Woodshots Meadow
Croxley Green Business Park
Watford, WD18 SYS

Order Number : PO_S_C7837

Additional Reference: 25-031162

Issue : 0

Date of Receipt : 18/06/2025

Date of Analysis : 19/06/2025

Date of Report : 25/06/2025

Sample Type : Surface water

Customer Sample Identifier : 581127 RMD01 11/06/2025

Sample Condition : Non-Conforming*

Comments:

Any opinions or interpretations are outside the laboratory's scope of accreditation. The results included within the report are representative of the samples submitted for analysis and are expressed on as received basis, unless otherwise stated. This certificate shall not be reproduced, except in full, without the prior written approval of VLS. ***Sample's temperature outside of acceptable range.**

Approved by : Karolina Pettit
Position : Director

Signature : *K. Pettit*

Results PFAS

Sample Type : Surface water
Test Report Number : 2025-1810
Customer Sample Identifier : 581127 RMD01 11/06/2025
Sample Condition : Non-Conforming*
Test Method : VLS SOP 021

Target Analyte Name	Abbreviation	CAS Reg No	MDLs	Units	Conc.
Linear Perfluorooctanoic acid	PFOA Linear	335-67-1	0.65	ng/l	ND
Branched Perfluorooctanoic acid	PFOA Branched	-	0.65	ng/l	ND
Perfluorooctanoic acid Total	PFOA Total	-	0.65	ng/l	ND
Linear Perfluorooctanesulfonic acid	PFOS Linear	1763-23-1	0.65	ng/l	ND
Branched Perfluorooctanesulfonic acid	PFOS Branched	-	0.65	ng/l	ND
Perfluorooctanesulfonic acid Total	PFOS Total	-	0.65	ng/l	ND

ND - not detected



TEST REPORT

Report Number: 2025-1809

Customer Name : i2 Analytical UK

Customer Address : 7 Woodshots Meadow
Croxley Green Business Park
Watford, WD18 SYS

Order Number : PO_S_C7837

Additional Reference: 25-031162

Issue : 0

Date of Receipt : 18/06/2025

Date of Analysis : 19/06/2025

Date of Report : 25/06/2025

Sample Type : Surface water

Customer Sample Identifier : 581126 RSC01 11/06/2025

Sample Condition : Non-Conforming*

Comments:

Any opinions or interpretations are outside the laboratory's scope of accreditation. The results included within the report are representative of the samples submitted for analysis and are expressed on as received basis, unless otherwise stated. This certificate shall not be reproduced, except in full, without the prior written approval of VLS. ***Sample's temperature outside of acceptable range.**

Approved by : Karolina Pettit
Position : Director

Signature : *K. Pettit*

Results PFAS

Sample Type : Surface water
Test Report Number : 2025-1809
Customer Sample Identifier : 581126 RSC01 11/06/2025
Sample Condition : Non-Conforming*
Test Method : VLS SOP 021

Target Analyte Name	Abbreviation	CAS Reg No	MDLs	Units	Conc.
Linear Perfluorooctanoic acid	PFOA Linear	335-67-1	0.65	ng/l	ND
Branched Perfluorooctanoic acid	PFOA Branched	-	0.65	ng/l	ND
Perfluorooctanoic acid Total	PFOA Total	-	0.65	ng/l	ND
Linear Perfluorooctanesulfonic acid	PFOS Linear	1763-23-1	0.65	ng/l	ND
Branched Perfluorooctanesulfonic acid	PFOS Branched	-	0.65	ng/l	ND
Perfluorooctanesulfonic acid Total	PFOS Total	-	0.65	ng/l	ND

ND - not detected

APPENDIX H

GROUNDWATER MONITORING RESULTS

Groundwater Quality Monitoring Results											
Site:		Earlswood Training Centre			Job No:		14050				
Date:		14.05.25			Weather:		Sunny				
Name of Engineer:		RH									
Sample No.	Water level (mbgl)	Well Base Level (mbgl)	pH (pH Units)	Temperature (C)	Conductivity (uS/cm)	Total dissolved solids (ppm)	Salinity (PSU)	Oxygen Reduction Potential (mV)	Disolved Oxygen (%)	Comments	
WS 203	0.83	2.72	7.91	12.80	741	341	0.41			Slow Recharge	
WS 205	0.84	3.02	7.88	13.09	659	312	0.39			Medium Recharge	
WS 206	0.75	3.11	8.02	12.00	612	311	0.42			Medium Recharge	
Notes:											
1. Instrument Used: HI Multiparameter											
2. Typical Accuracy: Water											
Temperature		+/- 0.15 C		DO		+/- 1%		PSU		+/- 2% or +/- 0.01 PSU	
pH		+/- 0.01 pH		Conductivity		+/- 1% or +/- 1uS/cm		Resistivity		+/- 1% or +/- 1mg/L	
ORP		+/- 1mV									
3. N/R = No Reading Taken											
Intégral Géotechnique											

Groundwater Quality Monitoring Results																												
Site:		Earlswood Training Centre			Job No:		14050																					
Date:		04.06.25			Weather:		Sunny																					
Name of Engineer:		RH																										
Sample No.	Water level (mbgl)	Well Base Level (mbgl)	pH (pH Units)	Temperature (C)	Conductivity (uS/cm)	Total dissolved solids (ppm)	Salinity (PSU)	Oxygen Reduction Potential (mV)	Disolved Oxygen (%)	Comments																		
WS 203	0.86	2.72	8.02	12.45	658	311	0.39			Slow Recharge																		
WS 205	0.85	3.02	7.69	12.59	596	287	0.38			Medium Recharge																		
WS 206	0.79	3.11	8.23	11.79	784	365	0.41			Medium Recharge																		
Notes:																												
1. Instrument Used: HI Multiparameter																												
2. Typical Accuracy: Water																												
<table><tr><td>Temperature</td><td>+/- 0.15 C</td><td>DO</td><td>+/- 1%</td><td>PSU</td><td>+/- 2% or +/- 0.01 PSU</td></tr><tr><td>pH</td><td>+/- 0.01 pH</td><td>Conductivity</td><td>+/- 1% or +/- 1uS/cm</td><td>Resistivity</td><td>+/- 1% or +/- 1mg/L</td></tr><tr><td>ORP</td><td>+/- 1mV</td><td colspan="4"></td></tr></table>											Temperature	+/- 0.15 C	DO	+/- 1%	PSU	+/- 2% or +/- 0.01 PSU	pH	+/- 0.01 pH	Conductivity	+/- 1% or +/- 1uS/cm	Resistivity	+/- 1% or +/- 1mg/L	ORP	+/- 1mV				
Temperature	+/- 0.15 C	DO	+/- 1%	PSU	+/- 2% or +/- 0.01 PSU																							
pH	+/- 0.01 pH	Conductivity	+/- 1% or +/- 1uS/cm	Resistivity	+/- 1% or +/- 1mg/L																							
ORP	+/- 1mV																											
3. N/R = No Reading Taken																												
Intégral Géotechnique																												

Groundwater Quality Monitoring Results													
Site:		Earlswood Training Centre			Job No:		14050						
Date:		11.06.25			Weather:		Cloudy						
Name of Engineer:		RH											
Sample No.	Water level (mbgl)	Well Base Level (mbgl)	pH (pH Units)	Temperature (C)	Conductivity (uS/cm)	Total dissolved solids (ppm)	Salinity (PSU)	Oxygen Reduction Potential (mV)	Disolved Oxygen (%)	Comments			
WS 203	0.84	2.72	7.63	12.11	712	335	0.40			Slow Recharge Medium Recharge Medium Recharge			
WS 205	0.87	3.02	8.09	12.26	627	291	0.38						
WS 206	0.81	3.11	7.93	11.85	711	315	0.40						
Notes:													
1. Instrument Used:		HI Multiparameter											
2. Typical Accuracy:		Water											
		Temperature		+/- 0.15 C		DO		+/- 1%		PSU		+/- 2% or +/- 0.01 PSU	
		pH		+/- 0.01 pH		Conductivity		+/- 1% or +/- 1uS/cm		Resistivity		+/- 1% or +/- 1mg/L	
		ORP		+/- 1mV									
3. N/R		= No Reading Taken											
Intégral Géotechnique													

APPENDIX I

SUMMARY OF CHEMICAL RESULTS – SOILS

SUMMARY OF LABORATORY SOIL TEST RESULTS

METALS AND SEMI-METALS

Job No.: 14050
 Site: Earlswood Training Facility
 Soil Type: Made Ground
 Soil Organic Matter: 1%

No.	Location	Depth (m)	Arsenic (mg/kg)	Boron (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Chromium (VI) (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (Elemental) (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)
1	WS203	0.40	150	1.1	0.79	< 0.2	460	< 1.8	190	1200	7.3	25	28	730	180
2	WS201	0.90	130	1.1	1.7	< 0.2	21	< 1.8	710	3000	12	90	43	46	630
3	WS202	0.50	500	1	2	< 0.2	23	< 1.8	1000	5200	15	55	60	63	230
4	WS204	0.60	15	0.3	0.16	< 0.2	4.3	< 1.8	37	40	< 0.3	6.3	14	12	66
Screening Criteria Value			640.0	240000.0	12.0	190.0	-	33.0	68000.0	200.0	58.0	980.0	12000.0	9000.0	730000.0
Source of Screening Criteria Value			S4UL	S4UL	S4UL	S4UL	-	S4UL	S4UL	C4SL	S4UL	S4UL	S4UL	S4UL	S4UL



SUMMARY OF LABORATORY SOIL TEST RESULTS

INORGANIC CHEMICALS & OTHERS

Job No.: 14050
 Site: Earlswood Training Facility
 Soil Type: Made Ground
 Soil Organic Matter: 1%

No.	Location	Depth (m)	Cyanide (mg/kg)	Loss on ignition, dried solids (%)	Moisture content at 30 C (%)	Phenol (mg/kg)	pH (pH units)	Water Soluble Sulphate (g/l)	Sulphate Total as SO4 (mg/kg)	Sulphide (mg/kg)	Total Sulphur (mg/kg)	TOC by Ignition in O2 (%)	Equivalent SOM (%)	Asbestos in Soil	Asbestos Quantification (%)
1	WS203	0.40	< 1.0	6.5	5.7	< 1.0	11.2	0.315	3700	14	2700	2.9	4.99	Not-detected	#N/A
2	WS201	0.90	< 1.0	13	19	< 1.0	7.9	0.126	1400	33	2000	3.8	6.54	Not-detected	#N/A
3	WS202	0.50	< 1.0	16	29	< 1.0	8.4	0.102	21000	2.8	10000	4.4	7.57	Not-detected	#N/A
4	WS204	0.60	< 1.0	0.5	19	< 1.0	9	0.0284	140	< 1.0	71	0.2	0.34	Not-detected	#N/A
Screening Criteria Value			34.0	-	-	440.0	-	-	-	-	-	-	-	-	0.001
Source of Screening Criteria Value			ATRISK	-	-	S4UL	-	-	-	-	-	-	-	-	IOM

SUMMARY OF LABORATORY SOIL TEST RESULTS

POLYAROMATIC HYDROCARBONS (PAH)

Job No.: 14050
Site: Earlswood Training Facility
Soil Type: Made Ground
Soil Organic Matter: 1%

No.	Location	Depth (m)	Acenaphthene (mg/kg)	Acenaphthylene (mg/kg)	Anthracene (mg/kg)	Benzo(a)anthracene (mg/kg)	Benzo(a)pyrene (mg/kg)	Benzo(b)fluoranthene (mg/kg)	Benzo(ghi)perylene (mg/kg)	Benzo(k)fluoranthene (mg/kg)	Chrysene (mg/kg)	Dibenzo(ah)anthracene (mg/kg)	Fluoranthene (mg/kg)	Fluorene (mg/kg)	Indeno(123cd)pyrene (mg/kg)	Naphthalene (mg/kg)	Phenanthrene (mg/kg)	Pyrene (mg/kg)
1	WS203	0.40	0.07	0.1	0.15	0.44	0.84	1.2	0.88	0.3	0.75	0.21	0.91	0.08	0.78	0.23	0.61	0.85
2	WS201	0.90	0.22	0.26	0.81	3.9	3.6	4.8	1.6	2.4	5.3	0.44	11	0.76	1.6	0.92	7.5	8
3	WS202	0.50	0.24	0.06	0.33	1.8	1.3	2	0.73	0.82	2.2	0.24	3.5	0.22	0.66	1.2	2.6	2.9
4	WS204	0.60	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Screening Criteria Value			84000.0	83000.0	52000.0	170.0	35.0	44.0	3900.0	1200.0	350.0	3.50	23000.0	63000.0	500.0	190.0	22000.0	54000.0
Source of Screening Criteria Value			S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL



SUMMARY OF LABORATORY SOIL TEST RESULTS

PETROLEUM HYDROCARBONS

Job No.: 14050
Site: Earlswood Training Facility
Soil Type: Made Ground
Soil Organic Matter: 1%

No.	Location	Depth (m)	Aliphatic C5-C6 (mg/kg)	Aliphatic C6-C8 (mg/kg)	Aliphatic C8-C10 (mg/kg)	Aliphatic C10- C12 EPH (mg/kg)	Aliphatic C12- C16 EPH (mg/kg)	Aliphatic C16-C35 EPH (mg/kg)	Aliphatic C35- C44 EPH (mg/kg)	Aromatic C5-C7 (mg/kg)	Aromatic C7-C8 (mg/kg)	Aromatic C8-C10 (mg/kg)	Aromatic C10- C12 EPH (mg/kg)	Aromatic C12- C16 EPH (mg/kg)	Aromatic C16- C21 EPH (mg/kg)	Aromatic C21- C35 EPH (mg/kg)	Aromatic C35- C40 EPH (mg/kg)
1	WS203	0.40	< 0.010	< 0.010	< 0.010	< 1.0	< 2.0	51	40	< 0.010	< 0.010	< 0.020	< 1.0	3.2	< 10	43	45
2	WS201	0.90	< 0.010	< 0.010	< 0.010	2.5	< 2.0	84	13	< 0.010	< 0.010	< 0.020	< 1.0	4.1	28	54	15
3	WS202	0.50	< 0.010	< 0.010	< 0.010	1	< 2.0	14	< 8.4	< 0.010	< 0.010	< 0.020	1.7	2.5	< 10	< 10	< 10
4	WS204	0.60	< 0.010	< 0.010	< 0.010	< 1.0	< 2.0	< 10	< 8.4	< 0.010	< 0.010	< 0.020	< 1.0	< 2.0	< 10	< 10	< 10
Screening Criteria Value			3200.0	7800.0	2000.0	9700.0	59000.0	1600000.0	1600000.0	27.0	56000.0	3500.0	16000.0	36000.0	28000.0	28000.0	28000.0
Source of Screening Criteria Value			S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL



APPENDIX J

SUMMARY OF GROUNDWATER TEST RESULTS

Groundwater Results (Round 1)							
Determinand	Unit	Borehole			Generic Assessment Criteria		
		WS203	WS205	WS206	MAC-EQS (Inland Surface Waters >200mg/l CaCo3)	AA-EQS (Freshwater >250mg/l CaCO3)	UK DWS (or best equivalent)
Inorganic Determinands							
pH	pH Units	7.5	7.8	7.7	-	6.0 - 8.5	-
Total Cyanide	µg/l	< 10	< 10	< 10	5.00	1.00	50.00
Sulphate as SO4	µg/l	14300	16300	16700	-	400000.00	250000.00
Total Sulphur	µg/l	4800	5400	5600	-	-	-
Sulphide	µg/l	< 5.0	< 5.0	< 5.0	-	-	-
Dissolved Organic Carbon (DOC)	mg/l	7.16	9.99	2.14			
Total Organic Carbon (TOC)	mg/l	7.33	11	2.52			
Hardness	mgCaCO3/l	91.8	175	216	-	-	-
Total Phenols							
Total Phenols	µg/l	< 10	< 10	< 10	46.00	7.70	0.50
Metals / Metalloids							
Boron (dissolved)	µg/l	19	110	22	-	2000.00	1000.00
Calcium (dissolved)	mg/l	32	61	80	-	-	-
Arsenic (dissolved)	µg/l	4.32	51.5	13.5	-	50.00	10.00
Beryllium (dissolved)	µg/l	< 0.1	< 0.1	< 0.1	-	-	-
Cadmium (dissolved)	µg/l	0.03	< 0.02	< 0.02	1.50	0.25	5.00
Chromium (dissolved)	µg/l	0.3	< 0.2	< 0.2	-	-	50.00
Copper (dissolved)	µg/l	3.2	0.8	1.4	-	1.00	2000.00
Lead (dissolved)	µg/l	1.6	15	< 0.2	14.00	1.20	10.00
Mercury (dissolved)	µg/l	< 0.05	< 0.05	< 0.05	0.07	-	1.00
Nickel (dissolved)	µg/l	3.6	2.1	1.5	34.00	4.00	20.00
Selenium (dissolved)	µg/l	0.7	< 0.6	4.7	-	-	10.00
Vanadium (dissolved)	µg/l	0.9	1.8	0.8	-	60.00	-
Zinc (dissolved)	µg/l	28	3.4	1.9	-	10.00	5000.00
Polyaromatic Hydrocarbons							
Naphthalene	µg/l	< 0.01	< 0.01	< 0.01	130.00	2.00	-
Acenaphthylene	µg/l	< 0.01	< 0.01	< 0.01	-	10.00	-
Acenaphthene	µg/l	< 0.01	< 0.01	< 0.01	-	10.00	-
Fluorene	µg/l	< 0.01	< 0.01	< 0.01	-	-	-
Phenanthrene	µg/l	< 0.01	< 0.01	< 0.01	-	-	-
Anthracene	µg/l	< 0.01	< 0.01	< 0.01	0.10	0.10	-
Fluoranthene	µg/l	< 0.01	< 0.01	< 0.01	0.12	0.01	-
Pyrene	µg/l	< 0.01	< 0.01	< 0.01	-	-	-
Benzo(a)anthracene	µg/l	< 0.01	< 0.01	< 0.01	-	-	-
Chrysene	µg/l	< 0.01	< 0.01	< 0.01	-	-	-
Benzo(b)fluoranthene	µg/l	< 0.01	< 0.01	< 0.01	0.02	-	-
Benzo(k)fluoranthene	µg/l	< 0.01	< 0.01	< 0.01	0.02	-	-
Benzo(a)pyrene	µg/l	< 0.01	< 0.01	< 0.01	0.27	0.00	0.01
Indeno(1,2,3-cd)pyrene	µg/l	< 0.01	< 0.01	< 0.01	-	-	-
Dibenzo(ah)anthracene	µg/l	< 0.01	< 0.01	< 0.01	-	-	-
Benzo(ghi)perylene	µg/l	< 0.01	< 0.01	< 0.01	0.01	-	-
Petroleum Hydrocarbons							
Aliphatic VPH >C5 - C6	µg/l	< 1.0	< 1.0	< 1.0	10.00	10.00	10.00
Aliphatic VPH >C6 - C8	µg/l	< 1.0	< 1.0	< 1.0	10.00	10.00	10.00
Aliphatic VPH >C8 - 10	µg/l	< 1.0	< 1.0	< 1.0	10.00	10.00	10.00
Aliphatic EPH >C10 - C12	µg/l	< 10	< 10	< 10	10.00	10.00	10.00
Aliphatic EPH >C12 - C16	µg/l	< 10	< 10	< 10	10.00	10.00	10.00
Aliphatic EPH >C16 - C21	µg/l	< 10	< 10	< 10	10.00	10.00	10.00
Aliphatic EPH >C21 - C35	µg/l	< 10	< 10	< 10	10.00	10.00	10.00
Aliphatic EPH >C35 - C44	µg/l	< 10	< 10	< 10	-	-	-
Aliphatic EPH (C5 - C35)	µg/l	< 10	< 10	< 10	-	-	-
Aromatic VPH >C5 - C7	µg/l	< 1.0	< 1.0	< 1.0	10.00	10.00	10.00
Aromatic VPH >C7 - C8	µg/l	< 1.0	6.1	< 1.0	10.00	10.00	10.00
Aromatic VPH >C8 - C10	µg/l	< 1.0	< 1.0	< 1.0	10.00	10.00	10.00
Aromatic EPH >C10 - C12	µg/l	< 10	< 10	< 10	10.00	10.00	10.00
Aromatic EPH >C12 - C16	µg/l	< 10	< 10	< 10	10.00	10.00	10.00
Aromatic EPH >C16 - C21	µg/l	< 10	< 10	< 10	10.00	10.00	10.00
Aromatic EPH >C21 - C35	µg/l	< 10	< 10	< 10	10.00	10.00	10.00
Aromatic EPH >C35 - C44	µg/l	< 10	< 10	< 10	-	-	-
Aromatic EPH (C5 - C44)	µg/l	< 10	< 10	< 10	-	-	-
TPH C5 - C44	µg/l	< 10	< 10	< 10	10.00	10.00	10.00
PFAS							
PFOS	ng/l	5.3	36.3	1.98	36.00	0.65000	

Results exceeding the AA-EQS value, or the most conservative EQS/UKDWS guideline value where AA-EQS values are unavailable are highlighted in **red bold type**

Results exceeding the EQS threshold but below site specific PNEC highlighted **blue bold type**

Sources:

MAC-EQS and AA-EQS values sourced from the Environment Agency/Water Framework Directive

Drinking Water Standards sourced from The Water Supply (Water Quality) Regulations 2018 Water, England and Wales: 2018 No.647 (W.121)

Groundwater Results (Round 2)							
Determinand	Unit	Borehole			Generic Assessment Criteria		
		WS203	WS205	WS206	MAC-EQS (Inland Surface Waters >200mg/l CaCo3)	AA-EQS (Freshwater >250mg/l CaCO3)	UK DWS (or best equivalent)
Inorganic Determinands							
pH	pH Units	7.1	7.5	7.7	-	6.0 - 8.5	-
Total Cyanide	µg/l	< 10	< 10	< 10	5.00	1.00	50.00
Sulphate as SO4	µg/l	1620	12000	16200	-	400000.00	250000.00
Total Sulphur	µg/l	540	4000	5400	-	-	-
Sulphide	µg/l	< 5.0	15	< 5.0	-	-	-
Dissolved Organic Carbon (DOC)	mg/l	4.13	5.2	1.51			
Total Organic Carbon (TOC)	mg/l	4.35	5.42	1.62			
Hardness	mgCaCO3/l	302	274	199	-	-	-
Total Phenols							
Total Phenols	µg/l	< 10	< 10	< 10	46.00	7.70	0.50
Metals / Metalloids							
Boron (dissolved)	µg/l	99	120	23	-	2000.00	1000.00
Calcium (dissolved)	mg/l	100	97	74	-	-	-
Arsenic (dissolved)	µg/l	18.4	62.1	5.29	-	50.00	10.00
Beryllium (dissolved)	µg/l	< 0.1	< 0.1	< 0.1	-	-	-
Cadmium (dissolved)	µg/l	< 0.02	< 0.02	< 0.02	1.50	0.25	5.00
Chromium (dissolved)	µg/l	< 0.2	< 0.2	< 0.2	-	-	50.00
Copper (dissolved)	µg/l	1.8	1.8	1.6	-	1.00	2000.00
Lead (dissolved)	µg/l	0.3	6.4	< 0.2	14.00	1.20	10.00
Mercury (dissolved)	µg/l	< 0.05	< 0.05	< 0.05	0.07	-	1.00
Nickel (dissolved)	µg/l	1.4	1.5	1.4	34.00	4.00	20.00
Selenium (dissolved)	µg/l	< 0.6	< 0.6	2.3	-	-	10.00
Vanadium (dissolved)	µg/l	0.2	1.1	0.6	-	60.00	-
Zinc (dissolved)	µg/l	1.4	2.4	2.6	-	10.00	5000.00
Polyaromatic Hydrocarbons							
Naphthalene	µg/l	< 0.01	1.4	< 0.01	130.00	2.00	-
Acenaphthylene	µg/l	< 0.01	< 0.01	< 0.01	-	10.00	-
Acenaphthene	µg/l	< 0.01	0.21	< 0.01	-	10.00	-
Fluorene	µg/l	0.06	0.08	< 0.01	-	-	-
Phenanthrene	µg/l	0.2	0.21	0.03	-	-	-
Anthracene	µg/l	< 0.01	< 0.01	< 0.01	0.10	0.10	-
Fluoranthene	µg/l	0.11	0.21	< 0.01	0.12	0.01	-
Pyrene	µg/l	0.09	0.22	0.02	-	-	-
Benzo(a)anthracene	µg/l	0.07	< 0.01	< 0.01	-	-	-
Chrysene	µg/l	0.08	< 0.01	< 0.01	-	-	-
Benzo(b)fluoranthene	µg/l	< 0.01	< 0.01	< 0.01	0.017	-	-
Benzo(k)fluoranthene	µg/l	< 0.01	< 0.01	< 0.01	0.017	-	-
Benzo(a)pyrene	µg/l	< 0.01	< 0.01	< 0.01	0.27	0.00017	0.01000
Indeno(1,2,3-cd)pyrene	µg/l	< 0.01	< 0.01	< 0.01	-	0.0008	-
Dibenzo(ah)anthracene	µg/l	< 0.01	< 0.01	< 0.01	-	-	-
Benzo(ghi)perylene	µg/l	< 0.01	0.07	< 0.01	0.01	-	-
Petroleum Hydrocarbons							
Aliphatic VPH >C5 - C6	µg/l	< 1.0	< 1.0	< 1.0	10.00	10.00	10.00
Aliphatic VPH >C6 - C8	µg/l	< 1.0	< 1.0	< 1.0	10.00	10.00	10.00
Aliphatic VPH >C8 - 10	µg/l	< 1.0	< 1.0	< 1.0	10.00	10.00	10.00
Aliphatic EPH >C10 - C12	µg/l	< 10	43	< 10	10.00	10.00	10.00
Aliphatic EPH >C12 - C16	µg/l	< 10	160	< 10	10.00	10.00	10.00
Aliphatic EPH >C16 - C21	µg/l	32	170	< 10	10.00	10.00	10.00
Aliphatic EPH >C21 - C35	µg/l	330	130	< 10	10.00	10.00	10.00
Aliphatic EPH >C35 - C44	µg/l	< 10	< 10	< 10	-	-	-
Aliphatic EPH (C5 - C35)	µg/l	370	500	< 10	-	-	-
Aromatic VPH >C5 - C7	µg/l	< 1.0	< 1.0	< 1.0	10.00	10.00	10.00
Aromatic VPH >C7 - C8	µg/l	< 1.0	< 1.0	< 1.0	10.00	10.00	10.00
Aromatic VPH >C8 - C10	µg/l	< 1.0	< 1.0	< 1.0	10.00	10.00	10.00
Aromatic EPH >C10 - C12	µg/l	< 10	< 10	< 10	10.00	10.00	10.00
Aromatic EPH >C12 - C16	µg/l	< 10	< 10	< 10	10.00	10.00	10.00
Aromatic EPH >C16 - C21	µg/l	< 10	< 10	< 10	10.00	10.00	10.00
Aromatic EPH >C21 - C35	µg/l	< 10	< 10	< 10	10.00	10.00	10.00
Aromatic EPH >C35 - C44	µg/l	< 10	< 10	< 10	-	-	-
Aromatic EPH (C5 - C44)	µg/l	< 10	< 10	< 10	-	-	-
TPH C5 - C44	µg/l	370	500	< 10	10.00	10.00	10.00
PFAS							
PFOS	ng/l	4.08	23.2	ND	36.00	0.65000	

Results exceeding the AA-EQS value, or the most conservative EQS/UKDWS guideline value where AA-EQS values are unavailable are highlighted in **red bold type**

Results exceeding the EQS threshold but below site specific PNEC highlighted **blue bold type**

Sources:

MAC-EQS and AA-EQS values sourced from the Environment Agency/Water Framework Directive

Drinking Water Standards sourced from The Water Supply (Water Quality) Regulations 2018 Water, England and Wales: 2018 No.647 (W.121)

Groundwater Results (Round 3)							
Determinand	Unit	Borehole			Generic Assessment Criteria		
		WS203	WS205	WS206	MAC-EQS (Inland Surface Waters >200mg/l CaCo3)	AA-EQS (Freshwater >250mg/l CaCO3)	UK DWS (or best equivalent)
Inorganic Determinands							
pH	pH Units	7.3	7.6	7.5	-	6.0 - 8.5	-
Total Cyanide	µg/l	< 10	< 10	< 10	5.00	1.00	50.00
Sulphate as SO4	µg/l	7700	18200	19100	-	400000.00	250000.00
Total Sulphur	µg/l	2600	6100	6400	-	-	-
Sulphide	µg/l	< 5.0	19	< 5.0	-	-	-
Dissolved Organic Carbon (DOC)	mg/l	3.51	4.65	1.41			
Total Organic Carbon (TOC)	mg/l	3.53	4.66	1.45			
Hardness	mgCaCO3/l	136	179	253	-	-	-
Total Phenols							
Total Phenols	µg/l	< 10	< 10	< 10	46.00	7.70	0.50
Metals / Metalloids							
Boron (dissolved)	µg/l	53	110	25.00	-	2000.00	1000.00
Calcium (dissolved)	mg/l	46	63	94.00	-	-	-
Arsenic (dissolved)	µg/l	12.3	35.2	5.76	-	50.00	10.00
Beryllium (dissolved)	µg/l	< 0.1	< 0.1	< 0.1	-	-	-
Cadmium (dissolved)	µg/l	0.04	< 0.02	< 0.02	1.50	0.25	5.00
Chromium (dissolved)	µg/l	0.8	0.4	0.70	-	-	50.00
Copper (dissolved)	µg/l	6	1.5	3.40	-	1.00	2000.00
Lead (dissolved)	µg/l	3.8	1.6	< 0.2	14.00	1.20	10.00
Mercury (dissolved)	µg/l	< 0.05	< 0.05	< 0.05	0.07	-	1.00
Nickel (dissolved)	µg/l	2.7	1.5	2.10	34.00	4.00	20.00
Selenium (dissolved)	µg/l	0.9	0.6	3.20	-	-	10.00
Vanadium (dissolved)	µg/l	0.5	1.2	1.10	-	60.00	-
Zinc (dissolved)	µg/l	3.6	8.6	23.00	-	10.00	5000.00
Polyaromatic Hydrocarbons							
Naphthalene	µg/l	< 0.01	< 0.01	< 0.01	130.00	2.00	-
Acenaphthylene	µg/l	< 0.01	< 0.01	< 0.01	-	10.00	-
Acenaphthene	µg/l	< 0.01	0.11	< 0.01	-	10.00	-
Fluorene	µg/l	< 0.01	< 0.01	< 0.01	-	-	-
Phenanthrene	µg/l	< 0.01	< 0.01	< 0.01	-	-	-
Anthracene	µg/l	< 0.01	< 0.01	< 0.01	0.10	0.10	-
Fluoranthene	µg/l	< 0.01	< 0.01	< 0.01	0.12	0.01	-
Pyrene	µg/l	< 0.01	< 0.01	< 0.01	-	-	-
Benzo(a)anthracene	µg/l	< 0.01	< 0.01	< 0.01	-	-	-
Chrysene	µg/l	< 0.01	< 0.01	< 0.01	-	-	-
Benzo(b)fluoranthene	µg/l	< 0.01	< 0.01	< 0.01	0.017	-	-
Benzo(k)fluoranthene	µg/l	< 0.01	< 0.01	< 0.01	0.017	-	-
Benzo(a)pyrene	µg/l	< 0.01	< 0.01	< 0.01	0.27	0.00017	0.01
Indeno(1,2,3-cd)pyrene	µg/l	< 0.01	< 0.01	< 0.01	0.0008	-	-
Dibenzo(ah)anthracene	µg/l	< 0.01	< 0.01	< 0.01	-	-	-
Benzo(ghi)perylene	µg/l	< 0.01	< 0.01	< 0.01	0.01	-	-
Petroleum Hydrocarbons							
Aliphatic VPH >C5 - C6	µg/l	< 1.0	< 1.0	< 1.0	10.00	10.00	10.00
Aliphatic VPH >C6 - C8	µg/l	< 1.0	< 1.0	< 1.0	10.00	10.00	10.00
Aliphatic VPH >C8 - C10	µg/l	< 1.0	< 1.0	< 1.0	10.00	10.00	10.00
Aliphatic EPH >C10 - C12	µg/l	16	23	18.00	10.00	10.00	10.00
Aliphatic EPH >C12 - C16	µg/l	65	150	55.00	10.00	10.00	10.00
Aliphatic EPH >C16 - C21	µg/l	48	380	20.00	10.00	10.00	10.00
Aliphatic EPH >C21 - C35	µg/l	490	1200	< 10	10.00	10.00	10.00
Aliphatic EPH >C35 - C44	µg/l	30	40	< 10	-	-	-
Aliphatic EPH (C5 - C35)	µg/l	620	1700	93.00	-	-	-
Aromatic VPH >C5 - C7	µg/l	< 1.0	< 1.0	< 1.0	10.00	10.00	10.00
Aromatic VPH >C7 - C8	µg/l	< 1.0	< 1.0	< 1.0	10.00	10.00	10.00
Aromatic VPH >C8 - C10	µg/l	< 1.0	< 1.0	< 1.0	10.00	10.00	10.00
Aromatic EPH >C10 - C12	µg/l	< 10	< 10	< 10	10.00	10.00	10.00
Aromatic EPH >C12 - C16	µg/l	< 10	< 10	< 10	10.00	10.00	10.00
Aromatic EPH >C16 - C21	µg/l	< 10	< 10	< 10	10.00	10.00	10.00
Aromatic EPH >C21 - C35	µg/l	< 10	< 10	< 10	10.00	10.00	10.00
Aromatic EPH >C35 - C44	µg/l	< 10	< 10	< 10	-	-	-
Aromatic EPH (C5 - C35)	µg/l	< 10	< 10	< 10	-	-	-
TPH C5 - C44	µg/l	620	2200	100.00	10.00	10.00	10.00
PFAS							
PFOS	ng/l	5.75	28	ND	36.00	0.65000	

Results exceeding the AA-EQS value, or the most conservative EQS/UKDWS guideline value where AA-EQS values are unavailable are highlighted in **red bold type**

Results exceeding the EQS threshold but below site specific PNEC highlighted **blue bold type**

Sources:

MAC-EQS and AA-EQS values sourced from the Environment Agency/Water Framework Directive

Drinking Water Standards sourced from The Water Supply (Water Quality) Regulations 2018 Water, England and Wales: 2018 No.647 (W.121)

Metal Bioavailability Assessment Tool

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Calculate

Clear Data

INPUT DATA											RESULTS (Copper)				RESULTS (Zinc)			
ID	Location	Waterbody	Date	Measured Cu Concentration (dissolved) (µg l ⁻¹)	Measured Zn Concentration (dissolved) (µg l ⁻¹)	Measured Mn Concentration (dissolved) (µg l ⁻¹)	Measured Ni Concentration (dissolved) (µg l ⁻¹)	pH	DOC	Ca	Site-specific PNEC Dissolved Copper (µg l ⁻¹)	BioF	Bioavailable Copper Concentration (µg l ⁻¹)	Risk Characterisation Ratio	Site-specific PNEC Dissolved Zinc (µg l ⁻¹)	BioF	Bioavailable Zinc Concentration (µg l ⁻¹)	Risk Characterisation Ratio
1	WS203 R1	Shallow GW		3.2	28			7.5	7.16	32	31.87	0.03	0.10	0.10	33.27	0.33	9.17	0.84
2	WS205 R1	Shallow GW		0.8	3.4			7.8	9.99	61	37.73	0.03	0.02	0.02	45.53	0.24	0.81	0.07
3	WS206 R1	Shallow GW		1.4	1.9			7.7	2.14	80	7.48	0.13	0.19	0.19	19.24	0.57	1.08	0.10
4	WS203 R2	Shallow GW		1.8	1.4			7.1	4.13	100	17.74	0.06	0.10	0.10	23.69	0.46	0.64	0.06
5	WS205 R2	Shallow GW		1.8	2.4			7.5	5.2	97	23.16	0.04	0.08	0.08	27.60	0.39	0.95	0.09
6	WS206 R2	Shallow GW		1.6	2.6			7.7	1.51	74	5.08	0.20	0.31	0.31	17.21	0.63	1.65	0.15
7	WS203 R3	Shallow GW		6	3.6			7.3	3.51	46	14.95	0.07	0.40	0.40	21.55	0.51	1.82	0.17
8	WS205 R3	Shallow GW		1.5	8.6			7.6	4.65	63	19.45	0.05	0.08	0.08	26.11	0.42	3.59	0.33
9	WS206 R3	Shallow GW		3.4	23			7.5	1.41	94	5.37	0.19	0.63	0.63	17.85	0.61	14.04	1.29

Pb Screening Tool 1.0

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Calculate

Clear Data

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APPENDIX K

SUMMARY OF SURFACE WATER TEST RESULTS

Surface Water Results (Round 1)						
Determinand	Unit	Location		Generic Assessment Criteria		
		RSC 01	RMD 01	MAC-EQS (Inland Surface Waters >200mg/l CaCO3)	AA-EQS (Freshwater >250mg/l CaCO3)	UK DWS (or best equivalent)
Inorganic Determinands						
pH	pH Units	8.1	8.1	-	6.0 - 8.5	-
Total Cyanide	µg/l	< 10	< 10	5.00	1.00	50.00
Sulphate as SO4	µg/l	2470000	2050000	-	400000.00	250000.00
Total Sulphur	µg/l	820000	680000	-	-	-
Sulphide	µg/l	< 5.0	< 5.0	-	-	-
Dissolved Organic Carbon (DOC)	mg/l	0.78	0.75	-	-	-
Total Organic Carbon (TOC)	mg/l	0.85	0.84	-	-	-
Hardness	mgCaCO3/l	5680	5780	-	-	-
Total Phenols						
Total Phenols	µg/l	230	69	46.00	7.70	0.50
Metals / Metalloids						
Boron (dissolved)	µg/l	3700	3300	-	2000.00	1000.00
Calcium (dissolved)	mg/l	370	370	-	-	-
Arsenic (dissolved)	µg/l	1.86	1.73	-	50.00	10.00
Beryllium (dissolved)	µg/l	< 0.1	< 0.1	-	-	-
Cadmium (dissolved)	µg/l	<0.1	<0.1	1.50	0.25	5.00
Chromium (dissolved)	µg/l	2.5	<1	-	-	50.00
Copper (dissolved)	µg/l	8.4	9.2	-	1.00	2000.00
Lead (dissolved)	µg/l	<1	<1	14.00	1.20	10.00
Mercury (dissolved)	µg/l	<0.25	<0.25	0.07	-	1.00
Nickel (dissolved)	µg/l	3.2	<2.5	34.00	4.00	20.00
Selenium (dissolved)	µg/l	<3	<3	-	-	10.00
Vanadium (dissolved)	µg/l	1.4	1.2	-	60.00	-
Zinc (dissolved)	µg/l	9	8.6	-	10.00	5000.00
Polyaromatic Hydrocarbons						
Naphthalene	µg/l	< 0.01	< 0.01	130.00	2.00	-
Acenaphthylene	µg/l	< 0.01	< 0.01	-	10.00	-
Acenaphthene	µg/l	< 0.01	< 0.01	-	10.00	-
Fluorene	µg/l	< 0.01	< 0.01	-	-	-
Phenanthrene	µg/l	< 0.01	< 0.01	-	-	-
Anthracene	µg/l	< 0.01	< 0.01	0.10	0.10	-
Fluoranthene	µg/l	< 0.01	< 0.01	0.12	0.01	-
Pyrene	µg/l	< 0.01	< 0.01	-	-	-
Benzo(a)anthracene	µg/l	< 0.01	< 0.01	-	-	-
Chrysene	µg/l	< 0.01	< 0.01	-	-	-
Benzo(b)fluoranthene	µg/l	< 0.01	< 0.01	0.02	-	-
Benzo(k)fluoranthene	µg/l	< 0.01	< 0.01	0.02	-	-
Benzo(a)pyrene	µg/l	< 0.01	< 0.01	0.27	0.00	0.01
Indeno(1,2,3-cd)pyrene	µg/l	< 0.01	< 0.01	-	-	-
Dibenzo(ah)anthracene	µg/l	< 0.01	< 0.01	-	-	-
Benzo(ghi)perylene	µg/l	< 0.01	< 0.01	0.01	-	-
Total PAH	µg/l	< 0.16	< 0.16	-	1.00	0.10
Petroleum Hydrocarbons						
Aliphatic VPH >C5 - C6	µg/l	< 1.0	< 1.0	10.00	10.00	10.00
Aliphatic VPH >C6 - C8	µg/l	< 1.0	< 1.0	10.00	10.00	10.00
Aliphatic VPH >C8 - 10	µg/l	< 1.0	< 1.0	10.00	10.00	10.00
Aliphatic EPH >C10 - C12	µg/l	< 10	< 10	10.00	10.00	10.00
Aliphatic EPH >C12 - C16	µg/l	< 10	< 10	10.00	10.00	10.00
Aliphatic EPH >C16 - C21	µg/l	< 10	< 10	10.00	10.00	10.00
Aliphatic EPH >C21 - C35	µg/l	< 10	< 10	10.00	10.00	10.00
Aliphatic EPH >C35 - C44	µg/l	< 10	< 10	-	-	-
Aliphatic EPH (C5 - C35)	µg/l	< 10	< 10	-	-	-
Aromatic VPH >C5 - C7	µg/l	< 1.0	< 1.0	10.00	10.00	10.00
Aromatic VPH >C7 - C8	µg/l	< 1.0	< 1.0	10.00	10.00	10.00
Aromatic VPH >C8 - C10	µg/l	< 1.0	< 1.0	10.00	10.00	10.00
Aromatic EPH >C10 - C12	µg/l	< 10	< 10	10.00	10.00	10.00
Aromatic EPH >C12 - C16	µg/l	< 10	< 10	10.00	10.00	10.00
Aromatic EPH >C16 - C21	µg/l	< 10	< 10	10.00	10.00	10.00
Aromatic EPH >C21 - C35	µg/l	< 10	< 10	10.00	10.00	10.00
Aromatic EPH >C35 - C44	µg/l	< 10	< 10	-	-	-
Aromatic EPH (C5 - C44)	µg/l	< 10	< 10	-	-	-
TPH C5 - C44	µg/l	< 10	< 10	10.00	10.00	10.00
PFAS						
PFOS	ng/l	<0.65	<0.65	36.00	0.65000	

Results exceeding the AA-EQS value, or the most conservative EQS/UKDWS guideline value where AA-EQS values are unavailable are highlighted in **red bold type**

Results exceeding the EQS threshold but below site specific PNEC highlighted **blue bold type**

Sources:

MAC-EQS and AA-EQS values sourced from the Environment Agency/Water Framework Directive

Drinking Water Standards sourced from The Water Supply (Water Quality) Regulations 2018 Water, England and Wales: 2018 No.647 (W.121)

Surface Water Results (Round 2)						
Determinand	Unit	Borehole		Generic Assessment Criteria		
		RSC 01	RMD 01	MAC-EQS (Inland Surface Waters >200mg/l CaCo3)	AA-EQS (Freshwater >250mg/l CaCO3)	UK DWS (or best equivalent)
Inorganic Determinands						
pH	pH Units	8	8	-	6.0 - 8.5	-
Total Cyanide	µg/l	< 10	< 10	5.00	1.00	50.00
Sulphate as SO4	µg/l	1380000	1390000	-	400000.00	250000.00
Total Sulphur	µg/l	460000	460000	-	-	-
Sulphide	µg/l	< 5.0	< 5.0	-	-	-
Dissolved Organic Carbon (DOC)	mg/l	2.25	1.79			
Total Organic Carbon (TOC)	mg/l	2.44	1.91			
Hardness	mgCaCO3/l	3370	3550	-	-	-
Total Phenols						
Total Phenols	µg/l	72	62	46.00	7.70	0.50
Metals / Metalloids						
Boron (dissolved)	µg/l	1700	1700	-	2000.00	1000.00
Calcium (dissolved)	mg/l	210	220	-	-	-
Arsenic (dissolved)	µg/l	1.5	1.51	-	50.00	10.00
Beryllium (dissolved)	µg/l	< 0.1	< 0.1	-	-	-
Cadmium (dissolved)	µg/l	0.03	0.03	1.50	0.25	5.00
Chromium (dissolved)	µg/l	0.4	0.2	-	-	50.00
Copper (dissolved)	µg/l	9.9	9.5	-	1.00	2000.00
Lead (dissolved)	µg/l	< 0.2	< 0.2	14.00	1.20	10.00
Mercury (dissolved)	µg/l	0.11	0.06	0.07	-	1.00
Nickel (dissolved)	µg/l	1.2	1.1	34.00	4.00	20.00
Selenium (dissolved)	µg/l	< 0.6	< 0.6	-	-	10.00
Vanadium (dissolved)	µg/l	1	0.9	-	60.00	-
Zinc (dissolved)	µg/l	9.2	7.7	-	10.00	5000.00
Polyaromatic Hydrocarbons						
Naphthalene	µg/l	< 0.01	< 0.01	130.00	2.00	-
Acenaphthylene	µg/l	< 0.01	< 0.01	-	10.00	-
Acenaphthene	µg/l	< 0.01	< 0.01	-	10.00	-
Fluorene	µg/l	< 0.01	< 0.01	-	-	-
Phenanthrene	µg/l	< 0.01	< 0.01	-	-	-
Anthracene	µg/l	< 0.01	< 0.01	0.10	0.10	-
Fluoranthene	µg/l	< 0.01	< 0.01	0.12	0.01	-
Pyrene	µg/l	< 0.01	< 0.01	-	-	-
Benzo(a)anthracene	µg/l	< 0.01	< 0.01	-	-	-
Chrysene	µg/l	< 0.01	< 0.01	-	-	-
Benzo(b)fluoranthene	µg/l	< 0.01	< 0.01	0.017	-	-
Benzo(k)fluoranthene	µg/l	< 0.01	< 0.01	0.017	-	-
Benzo(a)pyrene	µg/l	< 0.01	< 0.01	0.27	0.00017	0.01000
Indeno(1,2,3-cd)pyrene	µg/l	< 0.01	< 0.01	-	0.0008	-
Dibenzo(ah)anthracene	µg/l	< 0.01	< 0.01	-	-	-
Benzo(ghi)perylene	µg/l	< 0.01	< 0.01	0.01	-	-
Total PAH	µg/l	< 0.16	< 0.16	-	1.00000	0.10
Petroleum Hydrocarbons						
Aliphatic VPH >C5 - C6	µg/l	< 1.0	< 1.0	10.00	10.00	10.00
Aliphatic VPH >C6 - C8	µg/l	< 1.0	< 1.0	10.00	10.00	10.00
Aliphatic VPH >C8 - 10	µg/l	< 1.0	< 1.0	10.00	10.00	10.00
Aliphatic EPH >C10 - C12	µg/l	< 10	< 10	10.00	10.00	10.00
Aliphatic EPH >C12 - C16	µg/l	< 10	< 10	10.00	10.00	10.00
Aliphatic EPH >C16 - C21	µg/l	< 10	< 10	10.00	10.00	10.00
Aliphatic EPH >C21 - C35	µg/l	< 10	< 10	10.00	10.00	10.00
Aliphatic EPH >C35 - C44	µg/l	< 10	< 10	-	-	-
Aliphatic EPH (C5 - C35)	µg/l	< 10	< 10	-	-	-
Aromatic VPH >C5 - C7	µg/l	< 1.0	< 1.0	10.00	10.00	10.00
Aromatic VPH >C7 - C8	µg/l	< 1.0	< 1.0	10.00	10.00	10.00
Aromatic VPH >C8 - C10	µg/l	< 1.0	< 1.0	10.00	10.00	10.00
Aromatic EPH >C10 - C12	µg/l	< 10	< 10	10.00	10.00	10.00
Aromatic EPH >C12 - C16	µg/l	< 10	< 10	10.00	10.00	10.00
Aromatic EPH >C16 - C21	µg/l	< 10	< 10	10.00	10.00	10.00
Aromatic EPH >C21 - C35	µg/l	< 10	< 10	10.00	10.00	10.00
Aromatic EPH >C35 - C44	µg/l	< 10	< 10	-	-	-
Aromatic EPH (C5 - C44)	µg/l	< 10	< 10	-	-	-
TPH C5 - C44	µg/l	< 10	< 10	10.00	10.00	10.00
PFAS						
PFOS	ng/l	<0.65	0.79	36.00	0.65000	ND

Results exceeding the AA-EQS value, or the most conservative EQS/UKDWS guideline value where AA-EQS values are unavailable are highlighted in **red bold type**

Results exceeding the EQS threshold but below site specific PNEC highlighted **blue bold type**

Sources:

MAC-EQS and AA-EQS values sourced from the Environment Agency/Water Framework Directive

Drinking Water Standards sourced from The Water Supply (Water Quality) Regulations 2018 Water, England and Wales: 2018 No.647 (W.121)

Surface Water Results (Round 3)						
Determinand	Unit	Location		Generic Assessment Criteria		
		RSC 01	RMD 01	MAC-EQS (Inland Surface Waters >200mg/l CaCO3)	AA-EQS (Freshwater >250mg/l CaCO3)	UK DWS (o best equivalent)
Inorganic Determinands						
pH	pH Units	8.1	8.1	-	6.0 - 8.5	-
Total Cyanide	µg/l	< 10	< 10	5.00	1.00	50.00
Sulphate as SO4	µg/l	2300000	2290000	-	400000.00	250000.00
Total Sulphur	µg/l	770000	760000	-	-	-
Sulphide	µg/l	< 5.0	< 5.0	-	-	-
Dissolved Organic Carbon (DOC)	mg/l	0.94	0.81			
Total Organic Carbon (TOC)	mg/l	1.02	0.82			
Hardness	mgCaCO3/l	5420	5380	-	-	-
Total Phenols						
Total Phenols	µg/l	35	18	46.00	7.70	0.50
Metals / Metalloids						
Boron (dissolved)	µg/l	3300	3400	-	2000.00	1000.00
Calcium (dissolved)	mg/l	350	350	-	-	-
Arsenic (dissolved)	µg/l	1.48	1.55	-	50.00	10.00
Beryllium (dissolved)	µg/l	< 0.1	< 0.1	-	-	-
Cadmium (dissolved)	µg/l	0.03	0.02	1.50	0.25	5.00
Chromium (dissolved)	µg/l	12	20	-	-	50.00
Copper (dissolved)	µg/l	18	15	-	1.00	2000.00
Lead (dissolved)	µg/l	< 0.2	< 0.2	14.00	1.20	10.00
Mercury (dissolved)	µg/l	< 0.05	< 0.05	0.07	-	1.00
Nickel (dissolved)	µg/l	4.6	7.1	34.00	4.00	20.00
Selenium (dissolved)	µg/l	1.5	1.8	-	-	10.00
Vanadium (dissolved)	µg/l	1.1	1.1	-	60.00	-
Zinc (dissolved)	µg/l	26	38	-	10.00	5000.00
Polyaromatic Hydrocarbons						
Naphthalene	µg/l	< 0.01	< 0.01	130.00	2.00	-
Acenaphthylene	µg/l	< 0.01	< 0.01	-	10.00	-
Acenaphthene	µg/l	< 0.01	< 0.01	-	10.00	-
Fluorene	µg/l	< 0.01	< 0.01	-	-	-
Phenanthrene	µg/l	< 0.01	< 0.01	-	-	-
Anthracene	µg/l	< 0.01	< 0.01	0.10	0.10	-
Fluoranthene	µg/l	< 0.01	< 0.01	0.12	0.01	-
Pyrene	µg/l	< 0.01	< 0.01	-	-	-
Benzo(a)anthracene	µg/l	< 0.01	< 0.01	-	-	-
Chrysene	µg/l	< 0.01	< 0.01	-	-	-
Benzo(b)fluoranthene	µg/l	< 0.01	< 0.01	0.017	-	-
Benzo(k)fluoranthene	µg/l	< 0.01	< 0.01	0.017	-	-
Benzo(a)pyrene	µg/l	< 0.01	< 0.01	0.27	0.00017	0.01
Indeno(1,2,3-cd)pyrene	µg/l	< 0.01	< 0.01	0.0008	-	-
Dibenzo(ah)anthracene	µg/l	< 0.01	< 0.01	-	-	-
Benzo(ghi)perylene	µg/l	< 0.01	< 0.01	0.01	-	-
Total PAH	µg/l	< 0.16	< 0.16	-	1.00000	0.10
Petroleum Hydrocarbons						
Aliphatic VPH >C5 - C6	µg/l	< 1.0	< 1.0	10.00	10.00	10.00
Aliphatic VPH >C6 - C8	µg/l	< 1.0	< 1.0	10.00	10.00	10.00
Aliphatic VPH >C8 - 10	µg/l	< 1.0	< 1.0	10.00	10.00	10.00
Aliphatic EPH >C10 - C12	µg/l	< 10	12	10.00	10.00	10.00
Aliphatic EPH >C12 - C16	µg/l	< 10	48	10.00	10.00	10.00
Aliphatic EPH >C16 - C21	µg/l	< 10	25	10.00	10.00	10.00
Aliphatic EPH >C21 - C35	µg/l	< 10	50	10.00	10.00	10.00
Aliphatic EPH >C35 - C44	µg/l	< 10	< 10	-	-	-
Aliphatic EPH (C5 - C35)	µg/l	< 10	140	-	-	-
Aromatic VPH >C5 - C7	µg/l	< 1.0	< 1.0	10.00	10.00	10.00
Aromatic VPH >C7 - C8	µg/l	< 1.0	< 1.0	10.00	10.00	10.00
Aromatic VPH >C8 - C10	µg/l	< 1.0	< 1.0	10.00	10.00	10.00
Aromatic EPH >C10 - C12	µg/l	< 10	< 10	10.00	10.00	10.00
Aromatic EPH >C12 - C16	µg/l	< 10	< 10	10.00	10.00	10.00
Aromatic EPH >C16 - C21	µg/l	< 10	< 10	10.00	10.00	10.00
Aromatic EPH >C21 - C35	µg/l	< 10	< 10	10.00	10.00	10.00
Aromatic EPH >C35 - C44	µg/l	< 10	< 10	-	-	-
Aromatic EPH (C5 - C44)	µg/l	< 10	< 10	-	-	-
TPH C5 - C44	µg/l	< 10	120	10.00	10.00	10.00
PFAS						
PFOS	ng/l	<0.65	<0.65	36.00	0.65000	

Results exceeding the AA-EQS value, or the most conservative EQS/UKDWS guideline value where AA-EQS values are unavailable are highlighted in **red bold type**

Results exceeding the EQS threshold but below site specific PNEC highlighted **blue bold type**

Sources:

MAC-EQS and AA-EQS values sourced from the Environment Agency/Water Framework Directive

Drinking Water Standards sourced from The Water Supply (Water Quality) Regulations 2018 Water, England and Wales: 2018 No.647 (W.121)

APPENDIX L

ENVIRONMENT AGENCY RTM WORKSHEETS

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	Arsenic			
Target Concentration	C _T	5.00E-02	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks	Equations in HRA publication
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Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	6.21E-02	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	1.00E+100	days	Max measured on site
Calculated decay rate	λ	6.93E-101	days ⁻¹	Physical & chemical properties datasheet
Width of plume in aquifer at source (perpendicular to flow)	Sz	4.00E+01	m	Site width
Plume thickness at source	Sy	1.00E+00	m	Based on laboratory testing of soils
Saturated aquifer thickness	da	4.00E+00	m	Max known thickness
Bulk density of aquifer materials	ρ	1.60E+00	g/cm ³	Assumed
Effective porosity of aquifer	n	1.60E-01	fraction	Worst case
Hydraulic gradient	i	2.00E-02	fraction	Measured from site data
Hydraulic conductivity of aquifer	K	4.00E-02	m/d	Measured from site data
Distance to compliance point	x	2.00E+02	m	Measure from site boundary
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	No offset
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	No offset
Time since pollutant entered groundwater	t	1.00E+100	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	5.00E+02	l/kg	see options
Longitudinal dispersivity	ax	2.00E+01	m	see options
Transverse dispersivity	az	2.00E+00	m	see options
Vertical dispersivity	ay	2.00E-01	m	see options

Calculated Parameters

Groundwater flow velocity	v	5.00E-03	m/d
Retardation factor	Rf	5.00E+03	fraction
Decay rate used	λ	1.39E-104	d ⁻¹
Rate of contaminant flow due to retardation	u	1.00E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	2.88E-03	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	2.16E+01	

Remedial Targets

Remedial Target	1.00E+00	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	200	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	2.88E-03	mg/l
		1.0E+100	days

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

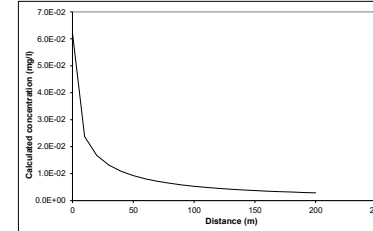
Entry if specify partition coefficient (option)	Kd	5.00E+02	l/kg
Entry for non-polar organic chemicals (option)	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)	K _{oc,ion}		l/kg
Sorption coefficient for related species	K _{oc,r}		l/kg
Sorption coefficient for ionised species	pH		fraction
acid dissociation constant	pKa		fraction
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	5.00E+02	l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value Xu & Eckstein	m
Longitudinal dispersivity	ax	0.00E+00	2.00E+01	6.21E+00
Transverse dispersivity	az	0.00E+00	2.00E+00	6.21E-01
Vertical dispersivity	ay	0.00E+00	2.00E-01	6.21E-02
Note values of dispersivity must be > 0				
For calculated value, assumes $\alpha_x = 0.1 \times x$, $\alpha_z = 0.01 \times z$, $\alpha_y = 0.001 \times y$				
Xu & Eckstein (1995) report $\alpha_x = 0.83(\log_{10} x)^{0.414}$; $\alpha_z = 10 \times y$, $\alpha_y = \alpha x / 100$ are assumed				

Note values of dispersivity must be > 0
For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414}; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source. Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc then an alternative solution should be used.

Site being assessed:	Earlswood Training Facility
Completed by:	Lawn Williams
Date:	#####
Version:	1

Calculated concentrations for distance-concentration graph

Ogata Banks From calculation sheet

Distance	Concentration
	mg/l
0	6.2E-02
10.0	2.37E-02
20.0	1.67E-02
30.0	1.31E-02
40.0	1.09E-02
50.0	9.26E-03
60.0	8.07E-03
70.0	7.15E-03
80.0	6.42E-03
90.0	5.82E-03
100.0	5.33E-03
110.0	4.91E-03
120.0	4.55E-03
130.0	4.24E-03
140.0	3.97E-03
150.0	3.74E-03
160.0	3.53E-03
170.0	3.34E-03
180.0	3.17E-03
190.0	3.02E-03
200.0	2.88E-03

R&D Publication 20 Remedial Targets Worksheet, Release 3.2



Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Zinc		from Level 1
Target Concentration	C _T	1.00E-02	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks	Equations in HRA publication
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Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction	
--	--

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only	
--	--

Source of parameter value	Variable	Value	Unit	Source
Initial contaminant concentration in groundwater at plume core	C ₀	2.30E-02	mg/l	Max measured on site
Half life for degradation of contaminant in water	t _{1/2}	1.00E+100	days	Physical & chemical properties datasheet
Calculated decay rate	λ	6.93E-101	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	4.00E+01	m	Site width
Plume thickness at source	Sy	1.00E+00	m	Based on laboratory testing of soils
Saturated aquifer thickness	da	4.00E+00	m	Max known thickness
Bulk density of aquifer materials	ρ	1.60E+00	g/cm ³	Assumed
Effective porosity of aquifer	n	1.60E-01	fraction	Worst case
Hydraulic gradient	i	2.00E-02	fraction	Measured from site data
Hydraulic conductivity of aquifer	K	4.00E-02	m/d	Measured from site data
Distance to compliance point	x	2.00E+02	m	Measure from site boundary
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	No offset
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	No offset
Time since pollutant entered groundwater	t	1.00E+100	days	time variant options only
Parameters values determined from options				
Partition coefficient	Kd	3.80E+01	l/kg	see options
Longitudinal dispersivity	ax	2.00E+01	m	see options
Transverse dispersivity	az	2.00E+00	m	see options
Vertical dispersivity	ay	2.00E-01	m	see options

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	v	5.00E-03 m/d
Retardation factor	Rf	3.81E+02
Decay rate used	λ	1.82E-103 d ⁻¹
Rate of contaminant flow due to retardation	u	1.31E-05 m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	1.07E-03 mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	2.16E+01

Remedial Targets

Remedial Target	Value	Unit	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	200	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	1.07E-03 mg/l	Ogata Banks
		1.0E+100 days	

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)	Kd	3.80E+01	l/kg
Entry for non-polar organic chemicals (option)	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)	K _{oc,ion}		l/kg
Sorption coefficient for related species	K _{oc,r}		l/kg
Sorption coefficient for ionised species	pH		l/kg
pH value	pKa		fraction
acid dissociation constant	foc		fraction
Fraction of organic carbon in aquifer	Kd	3.80E+01	l/kg
Soil water partition coefficient			

Define dispersivity (click brown cell and use pull down list)

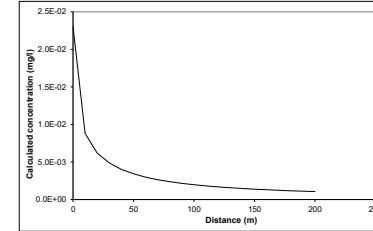
Dispersivities 10%, 1%, 0.1% of pathway length

	Enter value	Calc value Xu & Eckstein	m
Longitudinal dispersivity	ax 0.00E+00	2.00E+01	6.21E+00
Transverse dispersivity	az 0.00E+00	2.00E+00	6.21E-01
Vertical dispersivity	ay 0.00E+00	2.00E-01	6.21E-02

NOTE: Values of dispersivity must be > 0

For calculated value, assumes $\alpha_x = 0.1 \times$, $\alpha_z = 0.01 \times$, $\alpha_y = 0.001 \times$
Xu & Eckstein (1995) report $\alpha_x = 0.83(\log_{10} \alpha_x)^{2.414}$; $\alpha_z = 10 \times$, $\alpha_y = \alpha_x/100$ are assumed

Note values of dispersivity must be > 0
For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414}; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source. Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc then an alternative solution should be used.

Site being assessed:	Earlswood Training Facility
Completed by:	Lawn Williams
Date:	#####
Version:	1

Calculated concentrations for distance-concentration graph

Ogata Banks	From calculation sheet
Distance	Concentration
	mg/l
0	2.3E-02
10.0	8.79E-03
20.0	6.19E-03
30.0	4.87E-03
40.0	4.02E-03
50.0	3.43E-03
60.0	2.99E-03
70.0	2.65E-03
80.0	2.38E-03
90.0	2.16E-03
100.0	1.97E-03
110.0	1.82E-03
120.0	1.69E-03
130.0	1.57E-03
140.0	1.47E-03
150.0	1.38E-03
160.0	1.31E-03
170.0	1.24E-03
180.0	1.17E-03
190.0	1.12E-03
200.0	1.07E-03

R&D Publication 20 Remedial Targets Worksheet, Release 3.2



Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	Lead			
Target Concentration	C _T	1.20E-03	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks	Equations in HRA publication
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Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.50E-02	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	1.00E+100	days	Max measured on site
Calculated decay rate	λ	6.93E-101	days ⁻¹	Physical & chemical properties datasheet
Width of plume in aquifer at source (perpendicular to flow)	Sz	4.00E+01	m	Site width
Plume thickness at source	Sy	1.00E+00	m	Based on laboratory testing of soils
Saturated aquifer thickness	da	4.00E+00	m	Max known thickness
Bulk density of aquifer materials	ρ	1.60E+00	g/cm ³	Assumed
Effective porosity of aquifer	n	1.60E-01	fraction	Worst case
Hydraulic gradient	i	2.00E-02	fraction	Measured from site data
Hydraulic conductivity of aquifer	K	4.00E-02	m/d	Measured from site data
Distance to compliance point	x	2.00E+02	m	Measure from site boundary
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	No offset
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	No offset
Time since pollutant entered groundwater	t	1.00E+100	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	5.80E+02	l/kg	see options
Longitudinal dispersivity	ax	2.00E+01	m	see options
Transverse dispersivity	az	2.00E+00	m	see options
Vertical dispersivity	ay	2.00E-01	m	see options

Calculated Parameters

Groundwater flow velocity	v	5.00E-03	m/d
Retardation factor	Rf	5.80E+03	fraction
Decay rate used	λ	1.19E-104	d ⁻¹
Rate of contaminant flow due to retardation	u	8.62E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	6.95E-04	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	2.16E+01	

Remedial Targets

Remedial Target	2.59E-02	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	200	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	6.95E-04	mg/l
		1.0E+100	days

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)	Kd	5.80E+02	l/kg
Entry for non-polar organic chemicals (option)	foc		fraction
Entry for ionic organic chemicals (option)	Koc		l/kg
Sorption coefficient for related species	K _{oc,1}		l/kg
Sorption coefficient for ionised species	K _{oc,2}		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	5.80E+02	l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

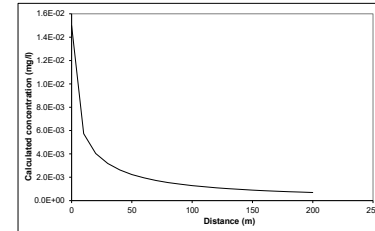
		Enter value	Calc value Xu & Eckstein	m
Longitudinal dispersivity	ax	0.00E+00	2.00E+01	6.21E+00
Transverse dispersivity	az	0.00E+00	2.00E+00	6.21E-01
Vertical dispersivity	ay	0.00E+00	2.00E-01	6.21E-02

Note values of dispersivity must be > 0

For calculated value, assumes $\alpha_x = 0.1 \times x$, $\alpha_z = 0.01 \times x$, $\alpha_y = 0.001 \times x$

Xu & Eckstein (1995) report $\alpha_x = 0.83(\log_{10} x)^{2.414}$, $\alpha_z = \alpha_{10}$, $\alpha_y = \alpha_{100}$ are assumed

Note values of dispersivity must be > 0
For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414}; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source. Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc then an alternative solution should be used.

Site being assessed:	Earlwood Training Facility
Completed by:	Lawn Williams
Date:	#####
Version:	1

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
0	1.5E-02
10.0	5.73E-03
20.0	4.04E-03
30.0	3.18E-03
40.0	2.62E-03
50.0	2.24E-03
60.0	1.95E-03
70.0	1.73E-03
80.0	1.56E-03
90.0	1.41E-03
100.0	1.29E-03
110.0	1.19E-03
120.0	1.10E-03
130.0	1.02E-03
140.0	9.60E-04
150.0	9.03E-04
160.0	8.52E-04
170.0	8.06E-04
180.0	7.65E-04
190.0	7.29E-04
200.0	6.95E-04

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note



Input Parameters (using pull down menu)

Variable Value Unit Source

Contaminant
Target Concentration
 C_T Aliphatic C10-C12
1.00E-02 mg/l from Level 1
from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks Equations in HRA publication

Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C_0	4.30E-02	mg/l	Source of parameter value
Half life for degradation of contaminant in water	$t_{1/2}$	2.10E+01	days	Max measured on site
Calculated decay rate	λ	3.30E-02	days ⁻¹	Physical & chemical properties datasheet
Width of plume in aquifer at source (perpendicular to flow)	S_z	4.00E+01	m	Site width
Plume thickness at source	S_y	1.00E+00	m	Based on laboratory testing of soils
Saturated aquifer thickness	d_a	4.00E+00	m	Max known thickness
Bulk density of aquifer materials	ρ	1.60E+00	g/cm ³	Assumed
Effective porosity of aquifer	n	1.60E-01	fraction	Worst case
Hydraulic gradient	i	2.00E-02	fraction	Measured from site data
Hydraulic conductivity of aquifer	K	4.00E-02	m/d	Measured from site data
Distance to compliance point	x	2.00E+02	m	Measure from site boundary
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	No offset
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	No offset
Time since pollutant entered groundwater	t	1.00E+100	days	time variant options only
Parameters values determined from options				
Partition coefficient	K_d	3.77E+03	l/kg	see options
Longitudinal dispersivity	α_x	2.00E+01	m	see options
Transverse dispersivity	α_z	2.00E+00	m	see options
Vertical dispersivity	α_y	2.00E-01	m	see options

Calculated Parameters Variable

Groundwater flow velocity	v	5.00E-03	m/d
Retardation factor	R_f	3.77E+04	fraction
Decay rate used	λ	8.76E-07	d ⁻¹
Rate of contaminant flow due to retardation	u	1.33E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.32E-51	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	1.30E+49	

Remedial Targets

Remedial Target	1.30E+47	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	200	m	
Concentration of contaminant at compliance point after	C_{ED}/C_0 3.32E-51 1.0E+100	mg/l days	Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

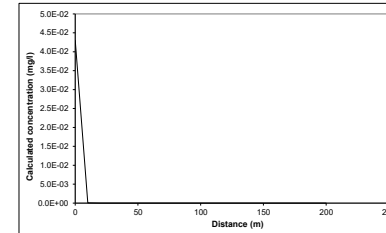
Entry for non-polar organic chemicals (option)

Soil water partition coefficient	K_d		l/kg
Fraction of organic carbon in aquifer	f_{oc}	1.50E-02	fraction
Organic carbon partition coefficient	K_{oc}	2.51E+05	l/kg
Sorption coefficient for related species	$K_{oc,i}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	f_{oc}		fraction
Soil water partition coefficient	K_d	3.77E+03	l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

Longitudinal dispersivity	α_x	Enter value 0.00E+00	Calc value Xu & Eckstein 2.00E+01	6.21E+00	m
Transverse dispersivity	α_z	0.00E+00	2.00E+00	0.21E-01	m
Vertical dispersivity	α_y	0.00E+00	2.00E-01	0.21E-02	m
Note values of dispersivity must be > 0					
For calculated value, assumes $\alpha_x = 0.1 * x$, $\alpha_z = 0.01 * x$, $\alpha_y = 0.001 * x$					
Xu & Eckstein (1995) report $\alpha_x = 0.83(\log_{10}x)^{2.414}$, $\alpha_z = \alpha_x/10$, $\alpha_y = \alpha_x/100$ are assumed					



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source. Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc then an alternative solution should be used.

Site being assessed:	Earlswood Training Facility
Completed by:	Lowri Williams
Date:	#####
Version:	1

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet
Distance Concentration

Distance	Concentration
0	4.3E-02
10.0	6.71E-05
20.0	1.93E-07
30.0	6.20E-10
40.0	2.09E-12
50.0	7.28E-15
60.0	2.59E-17
70.0	9.38E-20
80.0	3.44E-22
90.0	1.27E-24
100.0	4.76E-27
110.0	1.79E-29
120.0	6.78E-32
130.0	2.58E-34
140.0	9.88E-37
150.0	3.79E-39
160.0	1.46E-41
170.0	5.65E-44
180.0	2.19E-46
190.0	8.51E-49
200.0	3.32E-51

R&D Publication 20 Remedial Targets Worksheet, Release 3.2



Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Variable	Value	Unit	Source
Contaminant Target Concentration	Aliphatic C12-C16 1.00E-02	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks	Equations in HRA publication
--------------------	------------------------------

Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction	
--	--

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only	
--	--

Variable	Value	Unit	Source
Initial contaminant concentration in groundwater at plume core	1.60E-01	mg/l	Max measured on site
Half life for degradation of contaminant in water	5.00E+01	days	Physical & chemical properties datasheet
Calculated decay rate	1.39E-02	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	4.00E+01	m	Site width
Plume thickness at source	1.00E+00	m	Based on laboratory testing of soils
Saturated aquifer thickness	4.00E+00	m	Max known thickness
Bulk density of aquifer materials	1.60E+00	g/cm ³	Assumed
Effective porosity of aquifer	1.60E-01	fraction	Worst case
Hydraulic gradient	2.00E-02	fraction	Measured from site data
Hydraulic conductivity of aquifer	4.00E-02	m/d	Measured from site data
Distance to compliance point	2.00E+02	m	Measure from site boundary
Distance (lateral) to compliance point perpendicular to flow direction	0.00E+00	m	No offset
Distance (depth) to compliance point perpendicular to flow direction	0.00E+00	m	No offset
Time since pollutant entered groundwater	1.00E+100	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	7.52E+04	l/kg see options
Longitudinal dispersivity	ax	2.00E+01	m see options
Transverse dispersivity	az	2.00E+00	m see options
Vertical dispersivity	ay	2.00E-01	m see options

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	v	5.00E-03 m/d
Retardation factor	Rf	7.52E+05
Decay rate used	λ	1.84E-08 d ⁻¹
Rate of contaminant flow due to retardation	u	6.65E-09 m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	4.25E-33 mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	3.77E+31

Remedial Targets

Remedial Target	Value	Unit	Source
Ogata Banks	3.77E+29	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point	200	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	4.25E-33 mg/l	Ogata Banks
		1.0E+100 days	

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)	Kd		l/kg
Soil water partition coefficient			
Entry for non-polar organic chemicals (option)	foc	1.50E-02	fraction
Fraction of organic carbon in aquifer			
Organic carbon partition coefficient	Koc	5.01E+06	l/kg
Entry for ionic organic chemicals (option)	K _{oc,ion}		l/kg
Sorption coefficient for related species	K _{oc,ion}		l/kg
Sorption coefficient for ionised species	pH		
pH value	pKa		
acid dissociation constant	foc		fraction
Fraction of organic carbon in aquifer			
Soil water partition coefficient	Kd	7.52E+04	l/kg

Define dispersivity (click brown cell and use pull down list)

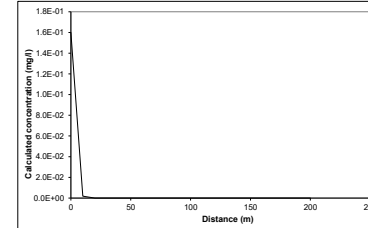
Dispersivities 10%, 1%, 0.1% of pathway length

	Enter value	Calc value Xu & Eckstein	m
Longitudinal dispersivity	ax 0.00E+00	2.00E+01	6.21E+00
Transverse dispersivity	az 0.00E+00	2.00E+00	6.21E-01
Vertical dispersivity	ay 0.00E+00	2.00E-01	6.21E-02

NOTE
Value values of dispersivity must be > 0

For calculated value, assumes $\alpha_x = 0.1 \times x$, $\alpha_z = 0.01 \times x$, $\alpha_y = 0.001 \times x$
Xu & Eckstein (1995) report $\alpha_x = 0.83(\log_{10} x)^{2.414}$, $\alpha_z = \alpha_{10}$, $\alpha_y = \alpha_{100}$ are assumed

Note values of dispersivity must be > 0
For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414}; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source. Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc then an alternative solution should be used.

Site being assessed:	Earlswood Training Facility
Completed by:	Lown Williams
Date:	#####
Version:	1

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
0	1.6E-01 mg/l
10.0	1.88E-03
20.0	4.08E-05
30.0	9.85E-07
40.0	2.50E-08
50.0	6.56E-10
60.0	1.76E-11
70.0	4.79E-13
80.0	1.32E-14
90.0	3.89E-16
100.0	1.04E-17
110.0	2.94E-19
120.0	8.39E-21
130.0	2.41E-22
140.0	6.93E-24
150.0	2.00E-25
160.0	5.82E-27
170.0	1.69E-28
180.0	4.94E-30
190.0	1.45E-31
200.0	4.25E-33

R&D Publication 20 Remedial Targets Worksheet, Release 3.2



Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Variable Value Unit Source

Contaminant
Target Concentration
 C_T Aliphatic C16-C21
1.00E-02 mg/l from Level 1
from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks Equations in HRA publication

Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C_0	3.80E-01	mg/l	Source of parameter value
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+03	days	Max measured on site
Calculated decay rate	λ	6.93E-04	days ⁻¹	Physical & chemical properties datasheet
Width of plume in aquifer at source (perpendicular to flow)	S_z	4.00E+01	m	Site width
Plume thickness at source	S_y	1.00E+00	m	Based on laboratory testing of soils
Saturated aquifer thickness	d_a	4.00E+00	m	Max known thickness
Bulk density of aquifer materials	ρ	1.60E+00	g/cm ³	Assumed
Effective porosity of aquifer	n	1.60E-01	fraction	Worst case
Hydraulic gradient	i	2.00E-02	fraction	Measured from site data
Hydraulic conductivity of aquifer	K	4.00E-02	m/d	Measured from site data
Distance to compliance point	x	2.00E+02	m	Measure from site boundary
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	No offset
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	No offset
Time since pollutant entered groundwater	t	1.00E+100	days	time variant options only
Parameters values determined from options				
Partition coefficient	K_d	9.46E+06	l/kg	see options
Longitudinal dispersivity	α_x	2.00E+01	m	see options
Transverse dispersivity	α_z	2.00E+00	m	see options
Vertical dispersivity	α_y	2.00E-01	m	see options

Calculated Parameters Variable

Groundwater flow velocity	v	5.00E-03	m/d
Retardation factor	R_f	9.46E+07	fraction
Decay rate used	λ	7.32E-12	d ⁻¹
Rate of contaminant flow due to retardation	u	5.28E-11	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	7.35E-08	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	5.17E+06	

Remedial Targets

Remedial Target	5.17E+04	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	200	m	
Concentration of contaminant at compliance point after	C_{ED}/C_0 7.35E-08 1.0E+100	mg/l days	Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

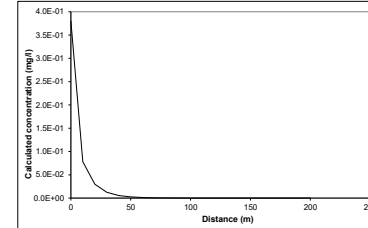
Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)
Soil water partition coefficient
Entry for non-polar organic chemicals (option)
Fraction of organic carbon in aquifer
Organic carbon partition coefficient
Entry for ionic organic chemicals (option)
Sorption coefficient for related species
Sorption coefficient for ionised species
pH value
acid dissociation constant
Fraction of organic carbon in aquifer
Soil water partition coefficient
 K_d 9.46E+06 l/kg
 f_{oc} 1.50E-02 fraction
 K_{oc} 6.31E+08 l/kg
 K_{ow} l/kg
 K_{ow} l/kg
pH
pKa
 f_{oc} fraction

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

Longitudinal dispersivity
Transverse dispersivity
Vertical dispersivity
Note values of dispersivity must be > 0
For calculated value, assumes $\alpha_x = 0.1 * x$, $\alpha_z = 0.01 * x$, $\alpha_y = 0.001 * x$
Xu & Eckstein (1995) report $\alpha_x = 0.83(\log_{10})^{2.414}$, $\alpha_z = \alpha_x/10$, $\alpha_y = \alpha_x/100$ are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source. Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc then an alternative solution should be used.

Site being assessed: Earlswood Training Facility
Completed by: Lowri Williams
Date: #####
Version: 1

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet
Distance Concentration

Distance	Concentration
0	3.8E-01
10.0	7.82E-02
20.0	2.97E-02
30.0	1.26E-02
40.0	5.88E-03
50.0	2.56E-03
60.0	1.20E-03
70.0	5.73E-04
80.0	2.77E-04
90.0	1.35E-04
100.0	6.66E-05
110.0	3.30E-05
120.0	1.65E-05
130.0	8.28E-06
140.0	4.17E-06
150.0	2.11E-06
160.0	1.07E-06
170.0	5.47E-07
180.0	2.80E-07
190.0	1.43E-07
200.0	7.35E-08

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Variable	Value	Unit	Source
Contaminant	Aliphatic C21-C35		from Level 1
Target Concentration	1.00E-02	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks Equations in HRA publication

Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.20E+00	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	9.25E+02	days	Max measured on site
Calculated decay rate	λ	7.49E-04	days ⁻¹	Physical & chemical properties datasheet
Width of plume in aquifer at source (perpendicular to flow)	Sz	4.00E+01	m	Site width
Plume thickness at source	Sy	1.00E+00	m	Based on laboratory testing of soils
Saturated aquifer thickness	da	4.00E+00	m	Max known thickness
Bulk density of aquifer materials	ρ	1.60E+00	g/cm ³	Assumed
Effective porosity of aquifer	n	1.60E-01	fraction	Worst case
Hydraulic gradient	i	2.00E-02	fraction	Measured from site data
Hydraulic conductivity of aquifer	K	4.00E-02	m/d	Measured from site data
Distance to compliance point	x	2.00E+02	m	Measure from site boundary
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	No offset
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	No offset
Time since pollutant entered groundwater	t	1.00E+100	days	time variant options only
Parameters values determined from options				
Partition coefficient	Kd	9.46E+06	l/kg	see options
Longitudinal dispersivity	ax	2.00E+01	m	see options
Transverse dispersivity	az	2.00E+00	m	see options
Vertical dispersivity	ay	2.00E-01	m	see options

Calculated Parameters

Groundwater flow velocity	v	5.00E-03	m/d
Retardation factor	Rf	9.46E+07	fraction
Decay rate used	λ	7.92E-12	d ⁻¹
Rate of contaminant flow due to retardation	u	5.28E-11	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	1.23E-07	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	9.75E+06	

Remedial Targets

Remedial Target	9.75E+04	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	200	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	1.23E-07	mg/l
		1.0E+100	days

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer

Organic carbon partition coefficient

Entry for ionic organic chemicals (option)

Sorption coefficient for related species

Sorption coefficient for ionised species

pH value

acid dissociation constant

Fraction of organic carbon in aquifer

Soil water partition coefficient

Kd

foc

Koc

K_{oc,ion}

K_{oc,i}

pH

pKa

foc

Kd

foc

Kd

foc

Kd

foc

Kd

foc

Kd

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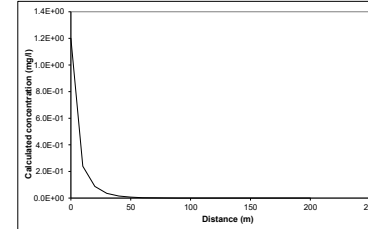
foc

Kd

foc

Kd

foc



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source. Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc then an alternative solution should be used.

Site being assessed:	Earlswood Training Facility
Completed by:	Lowri Williams
Date:	#####
Version:	1

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
0	1.2E+00
10.0	2.39E-01
20.0	8.79E-02
30.0	3.60E-02
40.0	1.55E-02
50.0	6.90E-03
60.0	3.14E-03
70.0	1.45E-03
80.0	6.78E-04
90.0	3.21E-04
100.0	1.53E-04
110.0	7.36E-05
120.0	3.56E-05
130.0	1.73E-05
140.0	8.45E-06
150.0	4.14E-06
160.0	2.04E-06
170.0	1.01E-06
180.0	4.98E-07
190.0	2.47E-07
200.0	1.23E-07

R&D Publication 20 Remedial Targets Worksheet, Release 3.2



Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	Fluoranthene		
Target Concentration	1.00E-05	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks Equations in HRA publication

Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	2.10E-04	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	1.00E+02	days	Max measured on site
Calculated decay rate	λ	6.93E-03	days ⁻¹	Physical & chemical properties datasheet
Width of plume in aquifer at source (perpendicular to flow)	Sz	4.00E+01	m	Site width
Plume thickness at source	Sy	1.00E+00	m	Based on laboratory testing of soils
Saturated aquifer thickness	da	4.00E+00	m	Max known thickness
Bulk density of aquifer materials	ρ	1.60E+00	g/cm ³	Assumed
Effective porosity of aquifer	n	1.60E-01	fraction	Worst case
Hydraulic gradient	i	2.00E-02	fraction	Measured from site data
Hydraulic conductivity of aquifer	K	4.00E-02	m/d	Measured from site data
Distance to compliance point	x	2.00E+02	m	Measure from site boundary
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	No offset
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	No offset
Time since pollutant entered groundwater	t	1.00E+100	days	time variant options only
Parameters values determined from options				
Partition coefficient	Kd	7.74E-02	l/kg	see options
Longitudinal dispersivity	ax	2.00E+01	m	see options
Transverse dispersivity	az	2.00E+00	m	see options
Vertical dispersivity	ay	2.00E-01	m	see options

Calculated Parameters

Groundwater flow velocity	v	5.00E-03	m/d
Retardation factor	Rf	1.77E+00	fraction
Decay rate used	λ	3.91E-03	d ⁻¹
Rate of contaminant flow due to retardation	u	2.82E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	1.54E-26	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	1.36E+22	

Remedial Targets

Remedial Target	1.36E+17	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	200	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	1.54E-26	mg/l
		1.0E+100	days

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

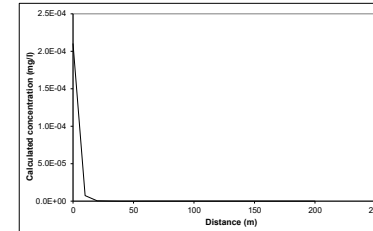
Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)	Kd		l/kg
Soil water partition coefficient			
Entry for non-polar organic chemicals (option)	foc	1.50E-02	fraction
Fraction of organic carbon in aquifer			
Organic carbon partition coefficient	Koc	5.16E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	K _{oc,1}		l/kg
Sorption coefficient for ionised species	K _{oc,2}		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	7.74E-02	l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein	m
Transverse dispersivity	az	0.00E+00	2.00E+01	6.21E+00	m
Vertical dispersivity	ay	0.00E+00	2.00E+00	6.21E-01	m
		2.00E+00	2.00E-01	6.21E-02	m
Note values of dispersivity must be > 0					
For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x					
Xu & Eckstein (1995) report ax = 0.83(log ₁₀ x) ^{2.414} ; az = ax/10, ay = ax/100 are assumed					



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source. Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc then an alternative solution should be used.

Site being assessed:	Earlswood Training Facility
Completed by:	Lawn Williams
Date:	#####
Version:	1

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	2.1E-04
10.0	7.32E-06
20.0	4.70E-07
30.0	3.37E-08
40.0	2.54E-09
50.0	1.98E-10
60.0	1.57E-11
70.0	1.27E-12
80.0	1.04E-13
90.0	8.59E-15
100.0	7.17E-16
110.0	6.03E-17
120.0	5.10E-18
130.0	4.33E-19
140.0	3.70E-20
150.0	3.18E-21
160.0	2.73E-22
170.0	2.36E-23
180.0	2.04E-24
190.0	1.77E-25
200.0	1.54E-26

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note



Input Parameters (using pull down menu)

Contaminant	PFOS		from Level 1
Target Concentration	C _T	3.00E-06	mg/l from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks Equations in HRA publication

Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	3.60E-05	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	9.90E+99	days	Max measured on site
Calculated decay rate	λ	7.00E-101	days ⁻¹	Physical & chemical properties datasheet
Width of plume in aquifer at source (perpendicular to flow)	S _Z	2.00E+01	m	Site width based on potential onsite source
Plume thickness at source	S _y	1.00E+00	m	Based on laboratory testing of soils
Saturated aquifer thickness	da	4.00E+00	m	Max known thickness
Bulk density of aquifer materials	ρ	1.60E+00	g/cm ³	Assumed
Effective porosity of aquifer	n	1.60E-01	fraction	Worst case
Hydraulic gradient	i	2.00E-02	fraction	Measured from site data
Hydraulic conductivity of aquifer	K	4.00E-02	m/d	Measured from site data
Distance to compliance point	x	2.00E+02	m	Measure from site boundary
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	No offset
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	No offset
Time since pollutant entered groundwater	t	1.00E+100	days	time variant options only

Parameters values determined from options

Partition coefficient	K _d	1.46E+03	l/kg	see options
Longitudinal dispersivity	ax	2.00E+01	m	see options
Transverse dispersivity	az	2.00E+00	m	see options
Vertical dispersivity	ay	2.00E-01	m	see options

Calculated Parameters

Groundwater flow velocity	v	5.00E-03	m/d
Retardation factor	R _f	1.46E+04	fraction
Decay rate used	λ	4.80E-105	d ⁻¹
Rate of contaminant flow due to retardation	u	3.42E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	8.86E-07	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	4.07E+01	

Remedial Targets

Remedial Target	1.22E-04	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	200	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	8.86E-07	mg/l Ogata Banks
		1.0E+100	days

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)	K _d		l/kg
Soil water partition coefficient	foc		fraction
Entry for non-polar organic chemicals (option)	K _{oc}		l/kg
Fraction of organic carbon in aquifer	K _{oc,1}	0.00E+00	l/kg
Organic carbon partition coefficient	K _{oc,2}	1.46E+03	l/kg
Entry for ionic organic chemicals (option)	pH	8.50E+00	
Sorption coefficient for related species	pKa	3.00E-01	
pH value	foc	1.50E-02	fraction
acid dissociation constant	K _d	1.46E+03	l/kg
Fraction of organic carbon in aquifer			
Soil water partition coefficient			

Define dispersivity (click brown cell and use pull down list)

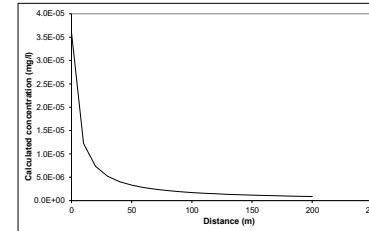
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value Xu & Eckstein	m
Longitudinal dispersivity	ax	0.00E+00	2.00E+01	6.21E+00
Transverse dispersivity	az	0.00E+00	2.00E+00	6.21E-01
Vertical dispersivity	ay	0.00E+00	2.00E-01	6.21E-02

Note values of dispersivity must be > 0

For calculated value, assumes $ax = 0.1 \times x$, $az = 0.01 \times x$, $ay = 0.001 \times x$

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; $az = ax/10$, $ay = ax/100$ are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source. Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc then an alternative solution should be used.

Site being assessed:	Earlswood Training Facility
Completed by:	Lawn Williams
Date:	#####
Version:	1

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	3.6E-05
10.0	1.22E-05
20.0	7.33E-06
30.0	5.22E-06
40.0	4.06E-06
50.0	3.32E-06
60.0	2.80E-06
70.0	2.43E-06
80.0	2.14E-06
90.0	1.91E-06
100.0	1.73E-06
110.0	1.58E-06
120.0	1.45E-06
130.0	1.35E-06
140.0	1.25E-06
150.0	1.17E-06
160.0	1.10E-06
170.0	1.04E-06
180.0	9.81E-07
190.0	9.31E-07
200.0	8.86E-07

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant		6.2FTS		from Level 1
Target Concentration	C _T	1.00E-04	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks Equations in HRA publication

Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.20E-03	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	9.90E+99	days	Max measured on site
Calculated decay rate	λ	7.00E-101	days ⁻¹	Physical & chemical properties datasheet
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.00E+01	m	Site width based on potential onsite source
Plume thickness at source	Sy	1.00E+00	m	Based on laboratory testing of soils
Saturated aquifer thickness	da	4.00E+00	m	Max known thickness
Bulk density of aquifer materials	ρ	1.60E+00	g/cm ³	Assumed
Effective porosity of aquifer	n	1.60E-01	fraction	Worst case
Hydraulic gradient	i	2.00E-02	fraction	Measured from site data
Hydraulic conductivity of aquifer	K	4.00E-02	m/d	Measured from site data
Distance to compliance point	x	2.00E+02	m	Measure from site boundary
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	No offset
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	No offset
Time since pollutant entered groundwater	t	1.00E+100	days	time variant options only
Parameters values determined from options				
Partition coefficient	Kd	9.47E+02	l/kg	see options
Longitudinal dispersivity	ax	2.00E+01	m	see options
Transverse dispersivity	az	2.00E+00	m	see options
Vertical dispersivity	ay	2.00E-01	m	see options

Calculated Parameters

Groundwater flow velocity	v	5.00E-03	m/d
Retardation factor	Rf	9.47E+03	fraction
Decay rate used	λ	7.39E-105	d ⁻¹
Rate of contaminant flow due to retardation	u	5.28E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	2.95E-05	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	4.07E+01	

Remedial Targets

Remedial Target	4.07E-03	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	200	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	2.95E-05	mg/l
		1.0E+100	days

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)

Soil water partition coefficient

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer

Organic carbon partition coefficient

Entry for ionic organic chemicals (option)

Sorption coefficient for related species

Sorption coefficient for ionised species

pH value

acid dissociation constant

Fraction of organic carbon in aquifer

Soil water partition coefficient

Kd

K_{oc}

K_{ow}

pKa

foc

K_d

K_d

K_d

K_d

K_d

K_d

K_d

K_d

K_d

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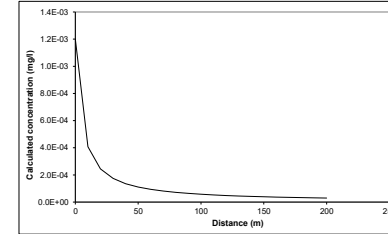
K_d

K_d

K_d

K_d

K_d



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source. Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc then an alternative solution should be used.

Site being assessed:	Earlswood Training Facility
Completed by:	Lowri Williams
Date:	#####
Version:	1

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
0	1.2E-03
10.0	4.07E-04
20.0	2.44E-04
30.0	1.74E-04
40.0	1.35E-04
50.0	1.11E-04
60.0	9.34E-05
70.0	8.09E-05
80.0	7.14E-05
90.0	6.38E-05
100.0	5.77E-05
110.0	5.27E-05
120.0	4.85E-05
130.0	4.49E-05
140.0	4.18E-05
150.0	3.91E-05
160.0	3.67E-05
170.0	3.46E-05
180.0	3.27E-05
190.0	3.10E-05
200.0	2.95E-05

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant				
Target Concentration	C _T	8.2FTS 1.00E-04	mg/l	from Level 1 from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks Equations in HRA publication

Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.10E-04	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	9.90E+99	days	Max measured on site
Calculated decay rate	λ	7.00E-101	days ⁻¹	Physical & chemical properties datasheet
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.00E+01	m	Site width based on potential onsite source
Plume thickness at source	Sy	1.00E+00	m	Based on laboratory testing of soils
Saturated aquifer thickness	da	4.00E+00	m	Max known thickness
Bulk density of aquifer materials	ρ	1.60E+00	g/cm ³	Assumed
Effective porosity of aquifer	n	1.60E-01	fraction	Worst case
Hydraulic gradient	i	2.00E-02	fraction	Measured from site data
Hydraulic conductivity of aquifer	K	4.00E-02	m/d	Measured from site data
Distance to compliance point	x	2.00E+02	m	Measure from site boundary
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	No offset
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	No offset
Time since pollutant entered groundwater	t	1.00E+100	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	1.00E-02	l/kg	see options
Longitudinal dispersivity	ax	2.00E+01	m	see options
Transverse dispersivity	az	2.00E+00	m	see options
Vertical dispersivity	ay	2.00E-01	m	see options

Calculated Parameters

Groundwater flow velocity	v	5.00E-03	m/d	
Retardation factor	Rf	1.10E+00	fraction	
Decay rate used	λ	6.37E-101	d ⁻¹	
Rate of contaminant flow due to retardation	u	4.55E-03	m/d	
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	2.71E-06	mg/l	
Attenuation factor (one way vertical dispersion, CO/CED)	AF	4.07E+01		

Remedial Targets

Remedial Target	4.07E-03	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	200	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	2.71E-06 1.0E+100	mg/l days Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)

Entry for ionic organic chemicals (option)

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer

Organic carbon partition coefficient

Entry for ionic organic chemicals (option)

Sorption coefficient for related species

Sorption coefficient for ionised species

pH value

acid dissociation constant

Fraction of organic carbon in aquifer

Soil water partition coefficient

Kd

K_{oc}

K_{ow}

pKa

foc

K_{oc}

K_{ow}

pH

pKa

foc

Kd

K_{oc}

K_{ow}

pH

pKa

foc

Kd

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K_{oc}

K_{ow}

pH

pKa

foc

Kd

K_{oc}

K_{ow}

pH

FIGURES

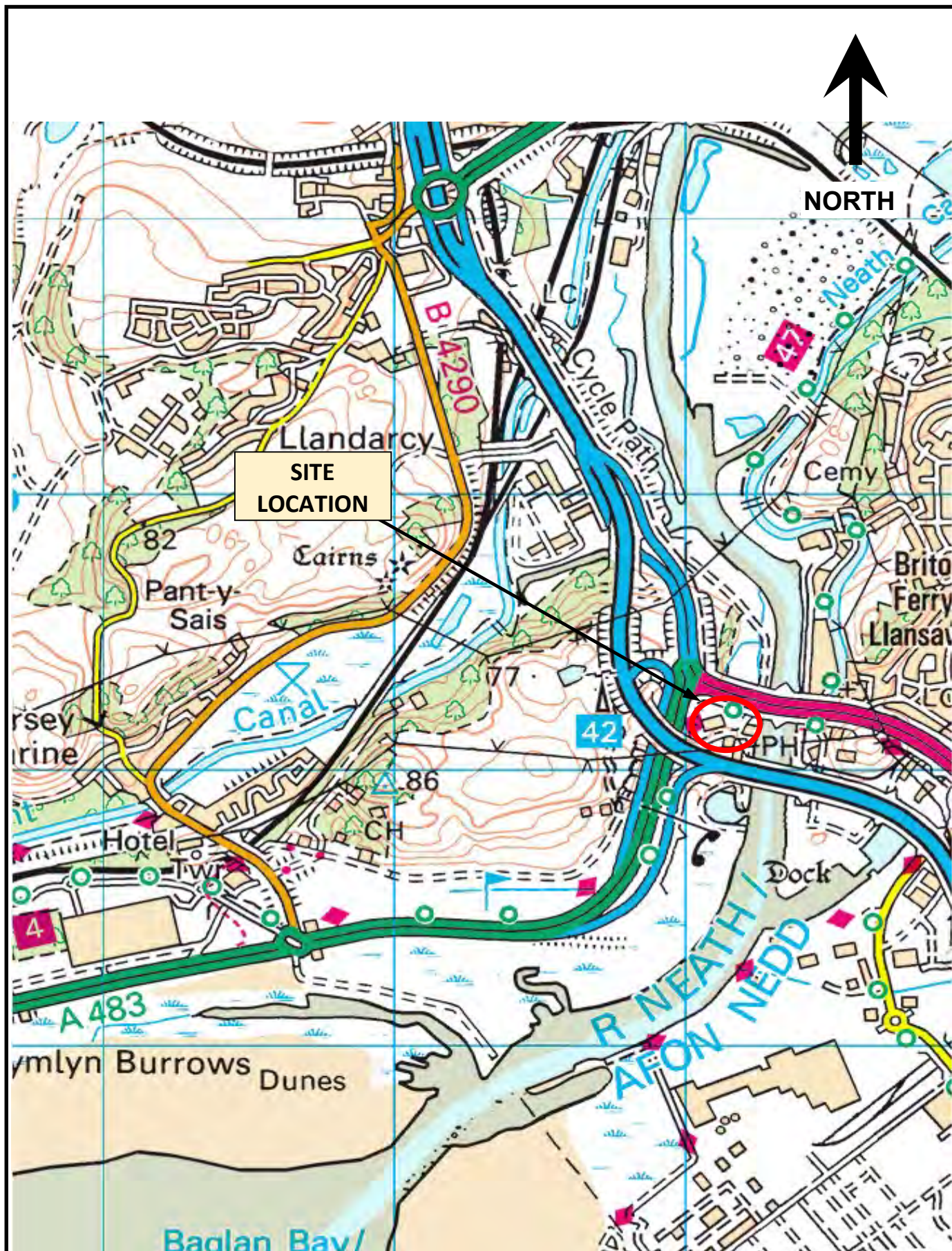


Figure 1: Site Location

Earlswood Training Centre, Jersey Marine, Neath

Intégral
Géotechnique

Intégral House
7 Beddau Way
Castlegate Business Park
Caerphilly
CF83 2AX
Tel: 029 2080 7991
Fax: 029 2086 2176



Figure 2a: Surface Water Sample Locations

Key

- Made Ground
- Superficial Soils
- Groundwater

Contaminant Pathways

- P1 - Dermal contact with made ground/dust
- P2 - Ingestion of soil
- P3 - Inhalation of dust
- P4 - Inhalation of vapours indoor/outdoor
- P5 - Leaching from made ground
- P6 - Transportation in groundwater
- P7 - Construction materials durability
- P8 - Migration and accumulation of gas in enclosed spaces

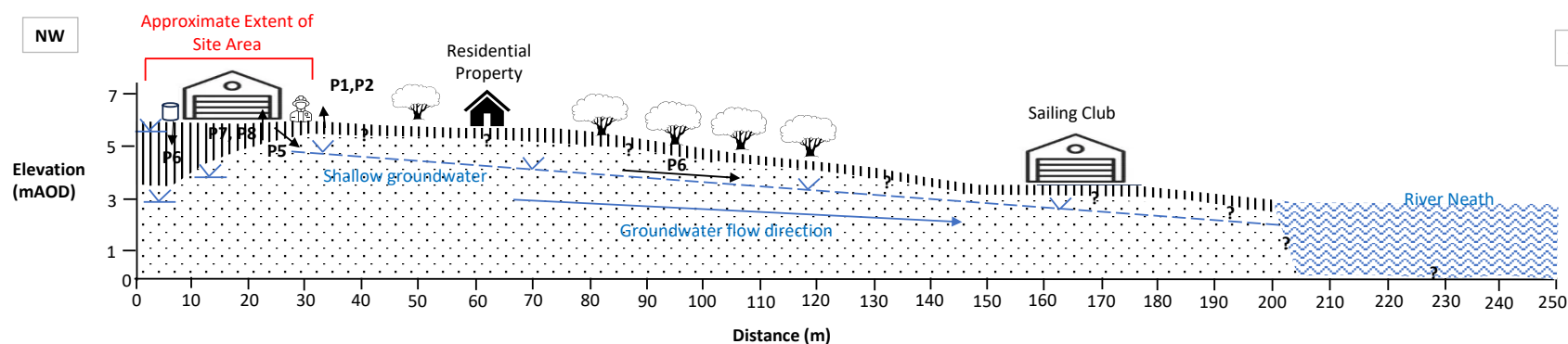


Figure 3: Conceptual Site Model

Earlswood Training Centre, Jersery Marine, Neath

Intégral
Géotechnique

Intégral House
7 Beddau Way
Castlegate Business Park
Caerphilly
CF83 2AX
Tel: 029 2080 7991