Spencer Place Development Company Limited

Generic Quantitative Risk Assessment

City Block2, Spencer Place, Dublin 1

602010-R02 (00)

FINAL

MARCH 2018

EXECUTIVE SUMMARY

RSK Ireland Limited (RSK) was commissioned by Spencer Place Development Company Limited (the client) to carry out an updated Generic Quantitative Risk Assessment (GQRA) for City Block 2, Spencer Place, Dublin 1 (the site) to assist with a planning application to Dublin City Council. A site location map is presented in Figure 1.

A Ground Conditions and GQRA Report was completed by AECOM in 2015 during the disposal of the site. The development plan for the site at the time of disposal included the excavation and construction of two basement level car parks. Since the acquisition of the site the development plan has been revised. The proposed development plan does not include the construction of basement levels with the new development constructed at ground level.

Following the completion of a desk study for the site and a review of the environmental data collected during the 2015 AECOM site investigation an updated GQRA was completed to assess environmental risks at the site in the context of the revised development plan.

Results of laboratory analysis of soil samples reported concentrations of lead which exceeded the adopted GAC in TP201 at 3.8-4.5mbgl and TP202 at 2.2-3.4mbgl. These exceedences indicate the existence of a potential risk associated with the direct contact and ingestion pathway. Given the depth to these soils and the nature of the proposed works it is considered unlikely that a viable pathway is present.

There were no other exceedences of human health GAC recorded in soil samples analysed**.**

There were no exceedences of the groundwater GAC considered protective of human health noted in samples analysed.

Concentrations of arsenic, in BH9 and BH12, and zinc, in BH9, exceeded the GAC for the protection of controlled waters. Based on the limited assessment completed by AECOM it is considered unlikely that these elevated concentrations present a risk to the River Liffey. However additional assessment is required to confirm the groundwater conditions at the site and assess the risk to the River Liffey.

All other results were reported at concentrations which did not exceed the GAC for the protection of the water environment.

As part of the 2015 AECOM site investigation, a ground gas risk assessment was not undertaken at the site. There is the potential that harmful ground gases could be present in shallow soils underlying the site which could impact upon future site users. Ground gas monitoring should be completed at the site to assess the potential risk to future site users and inform the requirement for mitigation measures if necessary.

It is considered unlikely that the elevated concentrations of arsenic and zinc detected in soil and groundwater at the site present a significant risk to future site users or the environment. The

scope of the assessment completed by AECOM in 2015 was limited therefore additional assessment work should be completed at the site to confirm the findings of this updated GQRA.

Based on the conclusions of this updated GQRA report RSK recommend that an additional environmental assessment should be undertaken at the site to fully characterise the groundwater and ground gas regimes at the site. The scope of this assessment would include the following:

- installation of twelve groundwater monitoring wells to an approximate depth of 8 m bgl.
- continuous monitoring of groundwater levels over a two week period to assess groundwater flow direction and tidal influence.
- completion of six rounds of soil gas monitoring to assess vapour risk at the site.
- completion of three groundwater monitoring events to fully characterise and assess the groundwater underlying the site.
- soil samples will be collected from boreholes to allow for an assessment to inform the potential for re-use of material at the site.

RSK GENERAL NOTES

Project No.: 602010 – R02 (00)

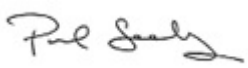
Title: Generic Quantitative Risk Assessment – City Block 2, Spencer Place, Dublin 1

Client: Spencer Place Development Company Limited

Date: 21st March 2018

Office: Dublin

Status: FINAL

Author	Paul Feely	Technical reviewer	Peter Rodgers
Signature		Signature	
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1 INTRODUCTION

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A Ground Conditions and GQRA Report was completed by AECOM in 2015 during the disposal of the site. The development plan for the site at the time of disposal included the excavation and construction of two basement level car parks. Since the acquisition of the site the development plan has been revised. The proposed development plan does not include the construction of basement levels with the new development constructed at ground level.

The purpose of this GQRA report is to review the environmental data contained within the 2015 AECOM report and identify any potentially significant risks to human health and / or controlled waters in context of the revised proposed development plan for the site. The 2015 AECOM GQRA report is presented in Appendix B.

RSK undertook an Environmental Review and Data Gap Analysis (reference 602010 R01 (00) Environmental Review and Data Gap Analysis – City Block 2, Spencer Place, Dublin 1. *dated 9 March 2018*) of the AECOM report. A number of recommendations for additional assessment to supplement the existing dataset were provided in this report.

The following report has been prepared specifically and solely for the above noted project. Initial sections of the report describe the site. The subsequent part of the report contains a description of works undertaken by Aecom, a summary of the investigation findings, a GQRA, conclusions and recommendations.

This report is subject to RSK's Service Constraints provided in Appendix A.

1.1 Scope of work

The scope of work for the GQRA included the following:

- Review of desk based information.
- Comparison of AECOM laboratory soil and groundwater results to in-house derived screening values for human health for commercial land use.
- Comparison of AECOM laboratory groundwater results to selected guidance values for Controlled Waters (groundwater) for commercial land use.
- Provision of a GQRA report summarising the findings of the desk study and GQRA screening of laboratory results.
- Recommendations for additional assessment to supplement the existing dataset.

1.2 Limitations

The comments given in this report and the opinions expressed are based on the information reviewed. However, there may be conditions pertaining at the site that have not been disclosed by the investigation and therefore could not be taken into account. Groundwater levels may fluctuate seasonally and at times be significantly different than those recorded. In addition, Made Ground can vary in thickness and nature over short distances and may be significantly different within areas not subject to the intrusive investigation.

This report is subject to the RSK Ireland Limited service constraints given in Appendix A.

2 SITE DESCRIPTION

City Block 2 is situated at the junction of Sherriff Street Upper and New Wapping Street, Spencer Dock, Dublin 1. The site is located to the east of City Block 2 at national grid reference O 176 346. The site covers an area of approximately 7,500m^2 (0.75 hectare). The site location and setting is presented in Figure 1.

The site is generally covered in stone hardstanding. Approximately 20% is covered by concrete/asphalt access roads and car parking or building footprint.

RSK understands that the proposed development will comprise multi level residential accommodation with ground floor commercial useage. The proposed development does not include the excavation and construction of basement levels.

2.1 Surrounding Land-use

Land use surrounding the site is predominately commercial and residential in nature. The site is bound to the north by Sheriff Street Upper, with an office/residential apartment complex and terraced housing beyond. The closest residential properties are approximately 20m north of the site. Railway sidings are present approximately 100m to the northeast and 150m to the north of the site. A number of terraced residential properties are located on the south eastern site boundary. Mayor Street forms the remainder of the southern site boundary. New Wapping Street forms the eastern site boundary, with a number of terraced residential properties located on the eastern side of the street. The currently undeveloped western half of City Block 2 is immediately west of the site. An access road to apartment complexes is located beyond. The closest residential properties are approximately 200m west of the site.

3 DESK STUDY REVIEW

The desk study review is detailed in the following section and summarises information obtained from the Ordinance Survey of Ireland (OSI) database located at http://map.geohive.ie/mapviewer.html.

3.1 Site Geology

The site is underlain by made ground overlying alluvial clay deposits. According to bedrock mapping compiled by the Geological Survey of Ireland (GSI), the site is underlain by the Calp, Marine Shelf Facies Formation of Carboniferous age, which is described as limestone and calcareous shale of the Tobercolleen and Lucan formations.

3.2 Hydrogeology

According to the GSI, aquifers in the Republic of Ireland are classified as follows:

- Regionally Important – An aquifer which is sufficiently productive to be able to yield enough water to boreholes or springs to supply major regional water schemes. These are divided into: extensive sand/gravel aquifers; karst aquifers; and fissured aquifers.
- Locally Important – An aquifer which is moderately productive, i.e. capable of yielding enough water to boreholes or springs to supply villages, small towns or factories. These are divided into: Sand/gravel aquifers; Bedrock aquifers which are generally moderately productive; and Bedrock aquifers which are moderately productive only in local zones.
- Poor – An aquifer which is normally capable of yielding only sufficient water from wells or springs to supply single houses, small farms or small group water schemes. These can be sub divided into: Bedrock aquifers which are generally unproductive except for local zones and Bedrock aquifers which are generally unproductive.

The GSI classifies the Marine Shelf Facies as locally important (LI). Groundwater vulnerability is identified by the geological survey of Ireland (GSI) as Low.

3.2.2 Licensed groundwater abstractions

There are no licensed ground water abstractions identified by the GSI within a 1km radius of the site.

3.3 Hydrology

The nearest surface watercourse is the River Liffey approximately 200 m to the south of the site. The river water quality status for the River Liffey at this location is classified by the EPA as “unpolluted”.

3.4 Historical Land Uses

A review of the site history was undertaken by assessing the available historical maps and land use data (available at http://map.geohive.ie/mapviewer.html).

The earliest available map dating from 1837 - 1842 indicates that the site is undeveloped. The site is bound by Wapping Street to the west. A number of residential properties are located off Sheriff Street in the northeast corner of the site. A 'Vitriol works’ (sulphuric acid works) is present approximately 20m to the southeast of the site and a ‘Vinegar Works’ is located approximately 60m west of the site.

The next available map (dating from 1888-1913) shows that the site is in use as a timber yard. The railway is now present 40m to the west and North wall station is located approximately 60m to the south west of the site. The surrounding land use to the north, south and east is predominantly residential.

Aerial photos from the period 1995 to 2015 have been reviewed however these are of poor resolution and it is difficult to make any conclusions as to land use and layout on-site and in the surrounding area. However the railway line and station to the west and south west is visible in photos dated 1995 and 2000, and is no longer present in the photo dated 2005.

3.4.1 EPA Licensed IPPC / Waste Facilities

A review of OSI data (available at http://map.geohive.ie/mapviewer.html) identifies that a waste licence held by SITA Environmental Ltd is associated with the neighbouring site to the west.

An Integrated Pollution Prevention and Control (IPPC) licensed facility is identified approximately 200m south east of the site associated with Brooks Thomas Ltd. RSK understands that the facility is no longer active.

4 AECOM SITE ASSESSMENT

The below section summarises works undertaken by AECOM during 2015 at the site. The AECOM report is presented in Appendix B.

Ground Conditions Report – Generic Quantitative Risk Assessment, Site at the Junction of Sherriff Street Upper and New Wapping Street. City Block 2, Spencer Dock, Dublin 1. (Reference 47092981, dated 21 September 2015).

AECOM completed a site investigation and Generic Quantitative Risk Assessment (GQRA) at the site during September 2015. The site investigation included the drilling and installation of six groundwater monitoring wells and excavation of eleven test pits across the site. Soil samples were collected from each borehole and test pit. Groundwater samples were collected from three of the groundwater monitoring wells for laboratory analysis. Borehole and trial pit locations are shown on Figure 2.

The GQRA reported a number of soil samples which exceeded the adopted Generic Assessment Criteria (GAC) for the protection of human health for a number of parameters including hydrocarbons, polycyclic aromatic hydrocarbons (PAHs, polychlorinated biphenyls (PCBs), semi volatile compounds (sVOCs), volatile organic compounds (VOCs) and metals. The results of laboratory analysis for groundwater samples reported concentrations of arsenic and zinc at levels which exceeded the GAC for the protection of controlled waters (River Liffey and Dublin Bay) in two monitoring wells (BH9 and BH12).

It was noted by AECOM that BH12 was installed as a potential pumping well for future dewatering operations during redevelopment of the site. As a result BH12 was drilled and installed at much wider diameter (260 mm) than a typical groundwater monitoring well (50 mm). The increased diameter of the well made it difficult to recover a representative groundwater sample as purging the well prior to sampling was not possible. The results of laboratory analysis for the groundwater sample recovered from BH12 may not be representative of the groundwater conditions at the site.

Based on the proposed development of the site at the time of the GQRA AECOM assumed that a sheet pile wall would be installed to facilitate the excavation and construction of a basement level car parking. AECOM concluded that the installation of this sheet pile wall will prevent elevated concentrations of arsenic and zinc impacting the River Liffey and Dublin Bay.

5 RESULTS OF THE INVESTIGATION

Laboratory analytical results from the AECOM investigation are summarised in the following section.

5.1 Soil Analytical Results

A summary of the concentrations of contaminants reported by the laboratory analysis of selected soil samples are presented in Table 5-1 to Table 5-3 inclusive. The laboratory report is presented within the appended AECOM GQRA report.

Contaminant of Concern	Max. Reported Concentration (mg/kg)	Location (m)	GAC Human Health – Commercial (mg/kg)*	GAC Exceedences (mg/kg)
Aliphatics EC5-EC6	<0.5	All	5,900 (558)	N
Aliphatics EC6-EC8	<0.5	All	17,400 (322)	N
Aliphatics EC8-EC10	<0.5	All	4,800 (190)	N
Aliphatics EC10-EC12	<0.2	All	22,900 (118)	N
Aliphatics EC12-EC16	<0.4	All	82,000 (59)	N
Aliphatics EC16-EC35	75.0	TP208 (2.8-3.7)	1,000,000	N
Aliphatics EC35-EC40	<7	All	1,000,000**	N
Aromatics EC8-EC10	<0.5	All	8,100 (1,503)	N
Aromatics EC10-EC12	<0.2	All	28,000 (899)	N
Aromatics EC12-EC16	15	TP207 (2.3-3.6)	37,000	N
Aromatics EC16-EC21	117	TP208 (2.8-3.7)	28,000	N
Aromatics EC21-EC35	247	TP208 (2.8-3.7)	28,000	N
Aromatics EC35-EC40	50	TP208 (2.8-3.7)	28,000**	N
Benzene	0.023	TP208 (2.8-3.7)	50	N
Toluene	0.013	TP210 (2.3-3.5)	107,000 (1,916)	N
Ethylbenzene	<0.025	All	13,000 (1,216)	N
Xylene	<0.025	All	13,600 (1,353)	N
MTBE	<0.025	All	12,100	N
Total VOCs	0.077	BH10	Various	N
Total SVOCs	<0.01	All	Various	N

* - GAC for soil SOM of 2.5% used

** - GAC applies to HC bands EC35-EC44

All – All results are below the LMDL

N - No exceedences recorded

n/a – Not applicable

Figures in brackets – RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the GAC with the corresponding solubility or vapour saturation limits given in brackets.

Table 5-1: TPH, BTEX, MTBE VOCs AND SVOCs Soil Analytical Results

Contaminant of Concern	Max. Reported Concentration (mg/kg)	Location (m)	GAC Human Health – Commercial (mg/kg)*	GAC Exceedences (mg/kg)
Naphthalene	0.34	TP209 (3.7-4.0)	3,900 (183)	N
Acenaphthylene	0.12	TP209 (3.7-4.0)	110,000	N
Acenaphthene	0.12	TP209 (3.7-4.0)	110,000	N
Fluorene	0.22	TP207 (2.3-3.6)	68,000	N
Phenanthrene	2.93	TP209 (3.7-4.0)	22,000	N
Anthracene	0.42	TP209 (3.7-4.0)	540,000	N
Fluoranthene	2.87	TP209 (3.7-4.0)	23,000	N
Pyrene	1.90	TP209 (3.7-4.0)	54,000	N
Benzo(a)anthracene	1.06	TP209 (3.7-4.0)	170	N
Chrysene	1.47	TP209 (3.7-4.0)	350	N
Benzo(b)fluoranthene	1.30	TP209 (3.7-4.0)	45	N
Benzo(k)fluoranthene	1.81	TP209 (3.7-4.0)	1,200	N
Benzo(a)pyrene	0.87	TP209 (3.7-4.0)	77	N
Indeno(123cd)pyrene	0.66	TP209 (3.7-4.0)	510	N
Dibenzo(ah)anthracene	0.19	TP209 (3.7-4.0)	3.6	N
Benzo(ghi)perylene	0.70	TP209 (3.7-4.0)	3,900	N

* - GAC for soil SOM of 2.5%

All – All results are below the LMDL N - No exceedences recorded

Figures in brackets **– RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the GAC with the corresponding solubility or vapour saturation limits given in brackets.**

Table 5-2: PAHs Soil Analytical Results

Contaminant of Concern	Max. Reported Concentration (mg/kg)	Location (m)	GAC Human Health – Commercial* (mg/kg)	GAC Exceedences (mg/kg)
Chromium VI	0.5	TP208 (2.8-3.7)	49	N
Antimony	120	TP202 (2.2-3.4)	**	n/a
Arsenic	606.9	TP202 (2.2-3.4)	640	N
Barium	310	TP207 (2.3-3.6)	**	n/a
Cadmium	87.7	TP202 (2.2-3.4)	410	N
Chromium	167.2	TP201 (3.8-4.5)	8,600	N
Copper	10,930	TP202 (2.2-3.4)	68,000	N
Lead	18,580	TP202 (2.2-3.4)	2,300	TP201 @ 3.8-4.5m (18,300), TP202 @ 2.2-3.4m (18,580)
Mercury	2.0	TP207 (2.3-3.6)	1,120	N
Molybdenum	76	TP202 (2.2-3.4)	**	n/a
Nickel	50.1	BH10	980	N
Selenium	9	BH10	12,000	N
Zinc	17,920	TP202 (2.2-3.4)	740,000	N
* - GAC for soil SOM of 2.5%			** - GAC not calculated	
All – All results are below the LMDL			N - No exceedences recorded	
n/a – Not applicable as there is no GAC				

Table 5-3: Metals Soil Analytical Results (mg/kg)

5.2.1 Soil Asbestos Analysis

Twenty two soil samples were analysed for the presence of asbestos. The laboratory reports are presented within the appended AECOM GQRA report.

Chrysotile asbestos was identified in the soils sample recovered from TP205 at depths between 4.0m below ground level (bgl) and 4.3mbgl. The asbestos was quantified as <0.001%. No asbestos was detected in any of the other samples forwarded for analysis.

5.3 Groundwater Analytical Results

The results of the laboratory analysis of the three groundwater samples taken are presented in Table 5-4 to Table 5-6 inclusive. The laboratory report is presented within the appended AECOM GQRA report.

Contaminant of Concern	Max. Reported Concentration (mg/l)	Location	GAC Human Health – Commercial (mg/l)*	GAC –Controlled Waters (mg/L)	Exceedence Location (mg/l)
Aliphatics EC5-EC6	<0.005	All	35.9	***	N
Aliphatics EC6-EC8	<0.005	All	5.37	***	N
Aliphatics EC8-EC10	<0.005	All	0.427	***	N
Aliphatics EC10-EC12	<0.005	All	0.0339	***	N
Aliphatics EC12-EC16	<0.01	All	0.000759**	***	N
Aliphatics EC16-EC21	<0.02	All	*	***	n/a
Aliphatics EC21-EC35	<0.01	All	*	***	n/a
Aromatics EC5-EC7	<0.005	All	*	***	n/a
Aromatics EC7-EC8	<0.005	All	*	***	n/a
Aromatics EC8-EC10	<0.005	All	64.6	***	N
Aromatics EC10-EC12	<0.005	All	24.5	***	N
Aromatics EC12-EC16	<0.01	All	5.75	***	N
Aromatics EC16-EC21	<0.01	All	*	***	n/a
Aromatics EC21-EC35	<0.01	All	*	***	n/a
Total TPH	<0.02	All	*	0.0075[(1)**]	N
Benzene	<0.0005	All	51.33	0.00075[(1)]	N
Toluene	<0.0005	All	107,000 (1,916)	0.525[(1)]	N
Ethylbenzene	<0.0005	All	13,000 (1,216)	0.01[(2)]	N
Xylene	<0.0015	All	13,600 (1,353)	0.01[(2)]	N
MTBE	<0.0001	All	12,100	0.01[(1)]	N
Total VOCs	<0.008	All	Various	N	N
Total SVOCs	<0.001	All	Various	N	N

Where values are in bold they have exceeded the GAC for Human Health
Where values are underlined the have exceeded the GAC for Controlled Waters
(1) S.I. 366 European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016 [(5)]
(2) EPA Interim Report Towards Setting Guideline values for the Protection of Groundwater in Ireland 2003 [(6)]
* GAC not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.

** GAC is set below the LMDL. Where the analysis indicates concentrations below the LMDL a non-exceedence of the criteria will be inferred.
*** No GAC available in legislation or guidance. N – No exceedences recorded n/a – Not applicable as there is no GAC

Table 5-4: TPH, BTEX, MTBE, VOCs and SVOCs Groundwater Analytical Results and GACs (mg/l)

Contaminant of Concern	Max. Reported Concentration (mg/l)	Location	GAC Human Health – Commercial (mg/L)	GAC – Controlled Waters (mg/L)	Exceedence Location (mg/l)
Chromium VI	<0.002	All	*	0.0075 (1)	N
Arsenic	0.4751	BH12	*	0.0075 (1)**	BH9 (0.0237) BH12 (0.4751)
Barium	0.0347	BH12	*	0.1	N
Berylium	<0.0005	All	*	*	N
Boron	0.476	BH12	*	1	N
Cadmium	0.00171	BH12	*	***	N
Chromium	0.0006	BH9	*	0.0375 (1)	N
Copper	<0.0003	All	*	0.03 (2)	N
Lead	0.0031	BH9	*	0.0075 (1)	N
Mercury	<0.0005	All	0.056	0.00075 (1)	N
Nickel	0.0009	BH9	*	0.02 (2)	N
Selenium	<0.0012	All	*	***	N
Vanadium	0.0022	BH9	*	*	N
Zinc	0.174	BH9	*	0.075 (1)	BH9 (0.174)

Where values are in bold they have exceeded the GAC for Human Health
Where values are underlined the have exceeded the GAC for Controlled Waters
(1) S.I. 366 European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016 (5)
(2) EPA Interim Report Towards Setting Guideline values for the Protection of Groundwater in Ireland 2003 (6)
* GAC not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.

** GAC is set below the LMDL. Where the analysis indicates concentrations below the LMDL a non-exceedence of the criteria will be inferred. *** No GAC available in legislation or guidance. N – No exceedences recorded n/a – Not applicable as there is no GAC

Table 5-5: Dissolved Metals Groundwater Analytical Results and GACs (mg/l)

Contaminant of Concern	Max. Reported Concentration (mg/l)	Location	GAC Human Health – Commercial (ug/L)	GAC – Protection of Water Environment (ug/L)	Exceedence Location (mg/l)
Naphthalene	<0.001	All	19,000	1.0(2)	N
Acenaphthylene	<0.0005	All	7,950	***	N
Acenaphthene	<0.001	All	4,100	***	N
Fluorene	<0.0005	All	*	***	N
Phenanthrene	<0.0005	All	*	***	N
Anthracene	<0.0005	All	*	10,000(2)	N
Fluoranthene	<0.0005	All	*	1.0(2)	N
Pyrene	<0.0005	All	*	***	N
Benzo(a)anthracene	<0.0005	All	*	***	N
Chrysene	<0.0005	All	*	***	N
Benzo(b)fluoranthene	<0.001	All	*	0.5(2)	N
Benzo(k)fluoranthene	<0.001	All	*	0.05(2)	N
Benzo(a)pyrene	<0.001	All	*	0.0075(1)	N
Indeno(123cd)pyrene	<0.001	All	*	0.05(2)	N
Dibenzo(ah)anthracene	0.00804	<0.005	*	***	N
Benzo(ghi)perylene	0.107	<0.005	*	0.05(2)	N

Where values are in bold they have exceeded the GAC for Human Health
Where values are underlined the have exceeded the GAC for Controlled Waters
(1) S.I. 366 European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016 (5)
(2) EPA Interim Report Towards Setting Guideline values for the Protection of Groundwater in Ireland 2003 (6)
* GAC not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.

** GAC is set below the LMDL. Where the analysis indicates concentrations below the LMDL a non-exceedence of the criteria will be inferred.

*** No GAC available in legislation or guidance. N – No exceedences recorded n/a – Not applicable as there is no GAC

Table 5-6: PAHs Groundwater Analytical Results and GACs (ug/l)

6 GENERIC QUANTIATIVE RISK ASSESSMENT

6.1 Human Health

6.1.1 Soil

The soil results have been compared to generic assessment criteria (GAC) derived by RSK for a commercial use. A commercial use has been selected based on the proposed development plan of commercial units at ground level, below multi-level residential units. Soils have been assessed using a GAC for soils with SOM content of 2.5% which reflects the calculated SOM results recorded during this investigation. The screening values for human health and their derivation are included in Appendix C.

Results of laboratory analysis of soil samples reported concentrations of lead which exceeded the adopted GAC in TP201 at depths between 3.8-4.5mbgl and TP202 at depths between 2.2-3.4mbgl.

There were no other exceedences of human health GAC recorded in soil samples analysed**.**

6.1.2 Groundwater

The groundwater results have been compared to generic assessment criteria (GAC) derived by RSK assuming a commercial end use. The GAC for a sandy soil with a groundwater depth of 2.5mbgl, considered most representative of site conditions have been used. The screening values for human health and their derivation are included in Appendix C.

There were no exceedences of the GAC considered protective of human health noted in samples analysed.

6.2 Controlled Waters

6.2.1 Groundwater

Where available Irish Environmental Quality Standard (EQS) values have been used which have been obtained from Statutory Instrument No. 366 '*European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016*'. These values have been supplemented by the Irish interim values presented in the EPA report '*Interim Report Towards Setting Guideline Values for the Protection of Groundwater in Ireland'* dated 2003.

Concentrations of arsenic were reported in monitoring wells BH9 and BH12 at levels which exceeded the GAC for the protection of controlled waters.

Concentrations of zinc were reported in monitoring well BH9 at levels which exceeded the GAC for the protection of controlled waters.

All other results were reported at concentrations which did not exceed the GACs for the protection of the water environment.

Based on the limited assessment completed by AECOM, RSK considers it unlikely that the elevated concentrations of arsenic and zinc pose a significant risk to controlled waters. The concentrations of zinc and arsenic reported for groundwater underlying Block 2 are likely to be localised hotspots associated with leaching of metals from the overlying made ground. The concentrations reported are likely to be representative of the groundwater conditions in the wider docklands area.

Additional assessment of groundwater conditions will be required to fully assess the risk to controlled waters and requirement for mitigation measures.

6.3 Summary of Pollutant Linkages

Table 6-1 records the potential pollutant linkages that have been identified at the site. Justifications for the identification of a potential pollutant linkage together with the likelihood are also discussed in Table 6-1.

Source	Pathway	Receptor	Linkage?
Metals, PAH, BTEX, MTBE, TPH, VOCs and SVOCs in soil	Direct Contact	Future Site Workers and Users	**Incomplete.** Lead concentrations in TP201 and TP202 exceeded the GAC considered protective of human health. Given the depth to exceeding soils it is considered unlikely that a direct contact pathway exists. Construction workers may come in to contact with impacted soils during excavation or piling works, however risks can be managed through the use of appropriate PPE and safe work practices. There are no other exceedences of the GAC considered protective of Human Health with regards to a commercial end use.
		Off-site workers and residents	
		Maintenance Workers	
		Construction Workers	
	Leaching	Groundwater	**Incomplete.** There are no significant concentrations of contaminants identified in soils on-site and no exceedences of the GAC in groundwater considered protective of Human Health with regards to a commercial end use indicating absence of pathway. Concentrations of Arsenic and Zinc have exceeded the controlled waters GAC however this is likely representative of the wider aquifer conditions as a result of historic anthropogenic inputs in area around the site
	Vapour migration along fill, services and permeable strata	Future site users	**Potentially complete.** Based on the results of soil analysis there are no exceedences of the GAC considered protective of Human Health with regards to a commercial end use. Ground gas monitoring and risk assessment has not been undertaken at the site. There is the potential that ground gases are present at the site and could impact future site users.
		Off-site workers and residents	
		Maintenance/ Construction Workers	
Asbestos in Soil	Inhalation	Future Site Workers and Users	**Incomplete.** Chrysotile asbestos was identified in the soils sample recovered from TP205 4.0mbgl-4.3mbgl. The asbestos was quantified as <0.001%. Given the quantity, depth of asbestos and nature of proposed development it is considered unlikely that a pathway exists. No asbestos was detected in any of the other samples forwarded for analysis.
		Off-site workers and residents	
		Maintenance Workers	
		Construction Workers	
Metals, PAH, BTEX, MTBE and TPH in groundwater	Direct contact and ingestion	Site workers	**Incomplete.** The GAC protective of Human health have not been exceeded and LNAPL has not been identified on-site.
		Site users	
		Off-site residents	
		Maintenance workers	
		Construction Workers	
	Migration	Locally Important Aquifer	**Potentially complete**. Exceedences of the GAC protective of controlled waters for concentrations of arsenic and zinc have been reported in BH9 and BH12. Whilst it is unlikely that these concentrations represent a risk to the River Liffey, additional assessment is required to fully assess the risk.
		River Liffey (200m south of site)	
	Vapour migration along fill, services and permeable strata	Future site users	**Incomplete.** There are no exceedences of the GAC considered protective of Human Health with regards to a commercial end use.
		Off-site workers and residents	
		Maintenance/ Construction Workers	

Table 6-1: Summary of Pollutant Linkages

Based upon the above information two potentially complete pollution linkages have been identified at the site. Additional assessment is required to fully assess the risk posed by these potentially complete pollution linkages and the requirement for mitigation measures.

7 CONCLUSIONS

Following the completion of a desk study for the site and a review of the environmental data collected during the 2015 AECOM site investigation an updated GQRA was completed to assess environmental risks at the site in the context of the revised development plan.

Results of laboratory analysis of soil samples reported concentrations of lead which exceeded the adopted GAC in TP201 at 3.8-4.5mbgl and TP202 at 2.2-3.4mbgl. These exceedences indicate the existence of a potential risk associated with the direct contact and ingestion pathway. Given the depth to these soils and the nature of the proposed works it is considered unlikely that a viable pathway is present.

There were no other exceedences of human health GAC recorded in soil samples analysed**.**

There were no exceedences of the groundwater GAC considered protective of human health noted in samples analysed.

Concentrations of arsenic, in BH9 and BH12, and zinc, in BH9, exceeded the GAC for the protection of controlled waters. Based on the limited assessment completed by AECOM it is considered unlikely that these elevated concentrations present a risk to the River Liffey. However additional assessment is required to confirm the groundwater conditions at the site and assess the risk to the River Liffey.

All other results were reported at concentrations which did not exceed the GAC for the protection of the water environment.

As part of the 2015 AECOM site investigation, a ground gas risk assessment was not undertaken at the site. There is the potential that harmful ground gases could be present in shallow soils underlying the site which could impact upon future site users. Ground gas monitoring should be completed at the site to assess the potential risk to future site users and inform the requirement for mitigation measures if necessary.

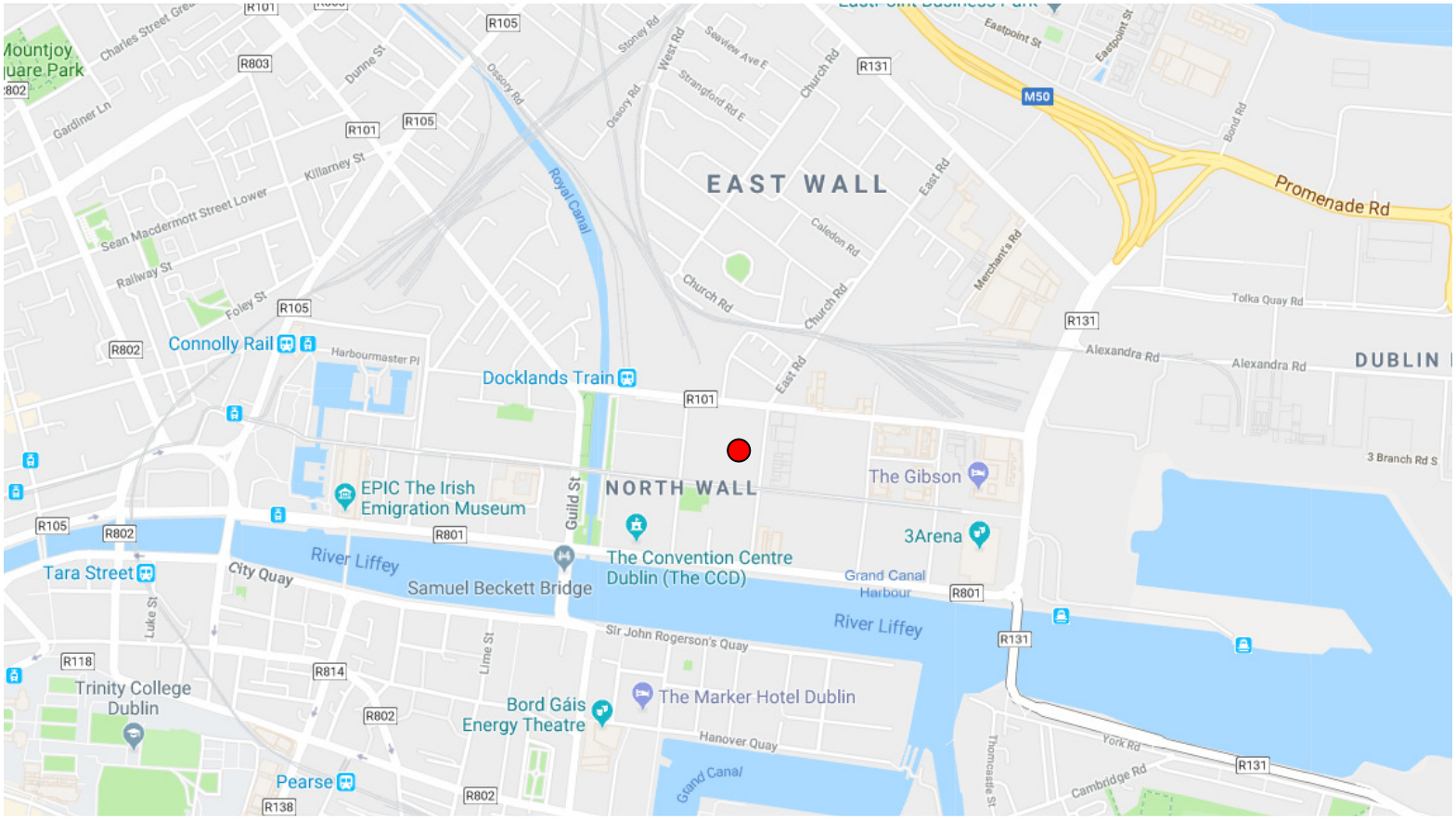
It is considered unlikely that the elevated concentrations of arsenic and zinc detected in soil and groundwater at the site present a significant risk to future site users or the environment. The scope of the assessment completed by AECOM in 2015 was limited therefore additional assessment work should be completed at the site to confirm the findings of this updated GQRA.

8 RECOMMENDATIONS

Based on the conclusions of this updated GQRA report RSK recommend that an additional environmental assessment should be undertaken at the site to fully characterise the groundwater and ground gas regimes at the site. The scope of this assessment would include the following:

- installation of twelve groundwater monitoring wells to an approximate depth of 8 m bgl.
- continuous monitoring of groundwater levels over a two week period to assess groundwater flow direction and tidal influence.
- completion of six rounds of soil gas monitoring to assess vapour risk at the site.
- completion of three groundwater monitoring events to fully characterise and assess the groundwater underlying the site.
- soil samples will be collected from boreholes to allow for an assessment to inform the potential for re-use of material at the site.

FIGURES



Job Number: 602010
Job Title: City Block 2, Spencer Dock, Dublin 1
Drawing Title: Figure 1 – Site Location Plan (copyright of Google)
Date: March 2018

Job Number: 602010
Job Name: City Block 2, Spencer Place, Dublin 1
Drawing Title: Figure 2 – Borehole and Trial Pit Location Plan (source: AECOM)
Date: March 2018

APPENDIX A

Service Constraints

RSK IRELAND LIMITED
SERVICE CONSTRAINTS

1. This report and the Environmental Site Assessment carried out in connection with the report (together the "Services") were compiled and carried out by RSK Ireland Ltd (RSK) for Spencer Place Development Company Limited (the "client") in accordance with the terms of a contract between RSK and the "client" dated March 2018. The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable Environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.

2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.

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4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK 's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date of this report, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.

5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.

6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.

7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.

8. The intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information], and it should not be inferred that other chemical species are not present.

9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (boreholes, trial pits etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for setting out and should be considered indicative only.

APPENDIX B

AECOM Ground Conditions Report

Ground Conditions Report – Generic Quantitative Risk Assessment

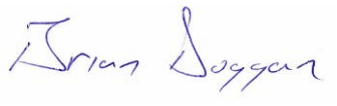
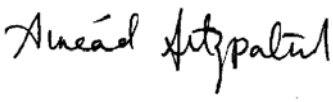
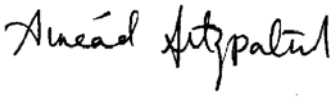
Site at the Junction of Sherriff Street Upper and New Wapping Street

City Block 2, Spencer Dock, Dublin 1

21 September 2015

47092981

Prepared by: AECOM

DOCUMENT PRODUCTION / APPROVAL RECORD				
Issue No. 1	**Name**	**Signature**	**Date**	**Position**
Prepared by	Brian Duggan		17 February 2016	Senior Environmental Scientist
Checked by	Sinead Fitzpatrick		17 February 2016	Principal Environmental Scientist
Approved by	Sinead Fitzpatrick		17 February 2016	Principal Environmental Scientist

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Limitations

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The conclusions and recommendations contained in this Report are based upon information provided by others and upon the assumption that all relevant information has been provided by those parties from whom it has been requested and that such information is accurate. Information obtained by AECOM has not been independently verified by AECOM, unless otherwise stated in the Report.

The methodology adopted and the sources of information used by AECOM in providing its services are outlined in this Report. The work described in this Report was undertaken between May and August 2015 and is based on the conditions encountered and the information available during the said period of time. The scope of this Report and the services are accordingly factually limited by these circumstances.

Where assessments of works or costs identified in this Report are made, such assessments are based upon the information available at the time and where appropriate are subject to further investigations or information which may become available.

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Unless otherwise stated in this Report, the assessments made assume that the sites and facilities will continue to be used for their current purpose without significant changes.

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EXECUTIVE SUMMARY

AECOM infrastructure and Environment Ireland Limited (AECOM) completed this Ground Conditions Report and Generic Quantitative Risk Assessment (GQRA) for the proposed development site (subject area) on the eastern half of City Block 2, in order to establish current environmental conditions of soil and groundwater underlying the subject area and identify potential significant risks to future site users or environmental receptors following the proposed site redevelopment.

This report considers the eastern portion of City Block 2, AECOM understands that the northern portion of the site will be developed with a multi-storey residential building (Block 2B). This will include a single level basement which will have a formation level of approximately 2.75m below existing ground level (-0.25m Ordnance Datum (OD)) with a basement floor level of 0.5m OD. AECOM understands that a secant or sheet pile wall is to be constructed around the perimeter of the site.

Development plans for the southern half of the site are yet to be finalised but it is assumed that a basement with a similar layout and depth would be excavated in the southern portion of the site when developed.

A summary of the desktop review is detailed below:

- Surrounding land use includes a mixture of commercial and residential properties with terraced residential houses located on the south-eastern corner of City Block 2.
- Historical maps identify that the site has been relatively undeveloped, when compared with surrounding sites, which had extensive industrial uses, but has (at times) been used as a timber yard, as cattle pens, and for storage of containers/freight. Based on the known site history, there is considered to be a potential for soil and groundwater contamination associated with its former uses, that of neighbouring sites and with importation of contaminated fill material from industrial sources during reclamation.
- The closest surface water is the River Liffey, which is located approximately 155m south of the site. The bedrock aquifer beneath the site is classified as a 'LI- Locally important aquifer' although there are no source protection zones or known groundwater abstractions wells within a 1km radius of the site.

AECOM completed an intrusive site investigation at the site between May 2015 and August 2015. The investigation involved trial pit excavation, borehole drilling, monitoring well installation, soil sampling and groundwater sampling. A GQRA was completed based on data from this site investigation; a summary of the GQRA findings is detailed below:

- A general summary of the geological profile encountered during this site investigation consisted of concrete or hard-core hard standing to a depth of approximately 0.2m bgl, underlain by made ground which contained frequent clinker and ash to a depth of approximately 2.6m bgl which was in turn underlain by natural silt to a depth of approximately 3.8m bgl. The silt was underlain by sand and gravel to a depth of approximately 8.2m bgl at which point stiff clay was encountered.
- Soil analytical results from below 2.75m bgl (-0.25m OD), which are considered representative of soil likely to remain in-situ following redevelopment work, were considered as part of this assessment. No exceedances of the Stage 2 Generic Acceptance Criteria GAC were detected for hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), semi volatile organic compounds (SVOCs). Metal concentrations in samples from below -0.25m OD are generally below the Stage 2 GAC protective of human health, but exceedances of the Stage 2 GAC were detected for arsenic, cadmium, copper and lead in a number of soil sample, asbestos in one soil sample and Volatile Organic Compounds (VOCs) (chloromethane and vinyl chloride) in two soil samples.
- Groundwater analytical results for hydrocarbons, metals, PAHs, SVOCs and VOCs were all less than the GAC protective of human health, indicating no significant risk to human health from these parameters.

- Groundwater analytical results for hydrocarbons, PAHs and VOCs were all less than the GAC protective of controlled waters but a small number of metals parameters exceeded the GAC, including arsenic and zinc.

Overall, the site was found to be typical of brownfield sites within this area of the North Dublin Docklands. It appears that the made ground beneath the site is composed of poor quality fill material that contains a number of contaminants at concentrations in excess of the GAC protective of human health for a residential end use scenario. The contamination encountered appears to be historic in nature and is likely to be associated the poor quality of fill material used in the reclamation of the site, or in the case of hydrocarbons and PAHs, associated with historic uses of the site and the surrounding area.

Concentrations of TPH, PAHs and metals were significantly higher in the near surface made ground than were detected in the underlying silt/clay/gravel. Concentrations of these parameters in groundwater were generally not significantly elevated (with the exception of metals).

The construction of a basement at the site will involve excavation of soil to a depth of approximately 2.75m below existing ground level (-0.25m OD) and installation of a pile wall around the vicinity of the site. This will remove the majority of impacted made ground and overburden from the site, leaving predominantly natural soil in-situ. As the site is to be covered by the building footprint, hard standing or imported fill the pathways for exposure to future site users to contamination contained within the underlying soil are extremely limited and are confined to the vapour migration pathway. Given that slightly elevated concentrations of volatile contaminants (chloromethane and vinyl chloride) were only detected in two soil samples in excess of the Stage 2 GAC the.potential risk from vapour intrusion in residual soils is considered low and ventilation installed in basements as part of the current design further reduce the risks. Therefore no remedial action is required but it is recommended that the building design minimise service penetrations through foundation and/or ensure these are adequately sealed to minimise ingress of malodours or vapours.

Exceedances of the GAC protective of controlled water were detected in all three groundwater samples; exceedances were confined to a small number of metals including arsenic and zinc. Excavation of impacted made ground and installation of a pile wall around the site will remove the principal source of metals within groundwater and limit horizontal migration of groundwater, thus reducing risks posed to underlying groundwater or to nearby surface water receptors.

It is expected that risks to off site residents and construction workers during construction works at the site will be suitably mitigated with the implementation of robust Environmental Control Measures (i.e. dust suppression, wheel washes) and the use of appropriate Personal Protective Equipment (PPE) by construction workers.

1. INTRODUCTION

AECOM Infrastructure & Environment Ireland Limited (AECOM), is pleased to present this Ground Conditions Report and Generic Quantitative Risk assessment (GQRA) to David Hughes and Luke Charleton of Ernst & Young Joint Receivers, acting for Spencer Dock Development Company Ltd. (In Receivership and Liquidation) and Querida Environmental Ltd (in Receivership) of a site at the junction of North Wall Quay and New Wapping Street, Spencer Dock, Dublin 1 (the site).

This report considers the eastern portion of City Block 2, the location of which is presented in Figure 1. The existing site layout presented in Figure 2. AECOM understands that the northern portion of the site will be developed with a multi-storey residential building (Block 2B). This will include a single level basement which will have a formation level of approximately 2.75m below existing ground level (-0.25m Ordnance Datum (OD)) with a basement floor level of 0.5m OD. AECOM understands that a secant or sheet pile wall is to be constructed around the perimeter of the site.

Development plans for the southern half of the site are yet to be finalised but AECOM understand that they will also consist of residential development (Block 2D), which will also have a single story basement with a formation level of approximately 2.75m below existing ground level (-0.25mOD).

2. OBJECTIVE

The objective of this assessment is to establish current environmental conditions of soil and groundwater underlying the site. The report includes a GQRA which will identify potential significant risks, if any, to future site users or environmental receptors following the proposed site redevelopment. The assessment also outlines suitable remedial measures where significant risks are identified.

3. SCOPE OF WORK

In order to achieve the objective of this report the following tasks were completed in general accordance with the UK Environment Agency/DEFRA publication Model Procedures for the Management of Land Contamination (CLR11)[1]:

- Task 1 – Preliminary Risk Assessment (PRA);
- Task 2 – Intrusive site investigation; and
- Task 3 – Generic Quantitative Risk Assessment (GQRA).

3.1 Task 1 - Preliminary Risk Assessment

In order to complete the PRA AECOM undertook an assessment of the environmental setting of the site and surrounds by completing;

- An assessment of the environmental setting of the site and surrounds by reviewing relevant geological, hydrogeological and topographical maps;
- Review of previous environmental reports pertaining to the site or nearby sites; and
- A review of the site history and that of the surrounding area based on available historical maps and aerial photographs.

The sources of publicly available information reviewed for this report include:

- Geological Survey of Ireland (GSI) Groundwater Web Maps (http://www.gsi.ie);
- Ordnance Survey Discovery Series maps;

[1] UK DEFRA and EA, 2002, CLR 11 - 'Model Procedures for the Management of Land Contamination'

- Ordnance Survey Historical maps, available online (http://www.osi.ie);
- Trinity College Glucksman Historical Map Library; various maps consulted;
- Available aerial photography, available online (http://www.osi.ie);
- Environmental Protection Agency online maps (http://www.epa.ie/);
- Office of Public Works (OPW) Flood Maps (www.floodmaps.ie); and
- National Parks and Wildlife Service (NPWS) (www.npws.ie/en/).

3.2 Task 2 - Intrusive Site Investigation

Following the completion of the PRA, an intrusive site investigation was completed between May and August 2015. The investigation work consisted of the following:

- Site walkover to mark out proposed trial pit and borehole locations;
- Excavation of 11 trial pits to a maximum depth of 4.5m below ground level (bgl);
- Drilling of six boreholes to a maximum depth of 13.7m bgl;
- Installation of groundwater monitoring wells in all boreholes;
- Collection of soil and groundwater samples from trial pits and boreholes;
- Collection of groundwater samples from monitoring wells;
- Laboratory analysis of soil and groundwater samples; and
- Completion of topographic survey of wells.

3.3 Task 3 - Generic Quantitative Risk Assessment

In accordance with the guidance presented in CLR 11 for contaminated land risk assessment, soil and groundwater laboratory data were initially compared with generic assessment criteria (GAC). GAC are conservative screening criteria protective of human health (site users) and controlled waters (groundwater and the River Liffey); for a given contaminant.

AECOM considers that the use of GAC for a screening assessment is consistent with the principles of human health and controlled waters protection in Irish EPA, UK DEFRA and UK Environment Agency guidance.

4. SITE ENVIRONMENTAL SETTING

4.1 Site Description

City Block 2 is situated at the junction of Sherriff Street Upper and New Wapping Street, Spencer Dock, Dublin 1. The site is located to the east of City Block 2 at national grid reference O 176 346 and covers an area of approximately 7,500m^2 (0.75 hectare) excluding a Dublin City Council sewage pumping station, which is located in centre of the site. The site is bound by Sheriff Street Upper to the North, New Wapping Street to the East and Mayor Street to the south.

The majority of the site is currently vacant; a construction compound occupies a portion of the site on a temporary basis. There are a number of occupied terraced residential properties in the southeast corner of City Block 2; however these are located outside the site boundary.

Existing ground levels at the site range from 2.096m OD to 2.79m OD with a mean site datum of circa 2.5m OD. The proposed development will include a single level basement constructed over the entire footprint of the northern portion of the site, which will have a formation level of approximately 2.75m below existing ground level (-0.25m Ordnance Datum) and a basement floor level of 0.5m OD. The propsed site layout is presented in Figure 4. It is assumed that a basement with a similar layout and depth would be excavated in the southern portion of the site when developed.

4.2 Adjacent Land Use

Land use adjacent to the site is summarised in the table below:

ADJACENT LAND USE	
North	The site is bound by Sheriff Street Upper, with an office/residential apartment complex and terraced housing beyond. The closest residential properties are approximately 20m north of the site.
South	A number of terraced residential properties are located on the south eastern site boundary. Mayor Street and the Red Luas line form the southern site boundary, with the currently undeveloped City Block 7 further to the south. The closest residential properties are located adjacent on the southern site boundary.
East	New Wapping Street forms the eastern site boundary, with a number of terraced residential properties located on the eastern side of the street. City Block 3 is located further to the east of the site and includes a number of disused commercial/industrial buildings and warehouses. The closest residential properties are approximately 20m east of the site.
West	The currently undeveloped western half of City Block 2 is immediately west of the site. An access road to apartment complexes is located beyond with a number of residential apartment complexes located between the road and Spencer Dock. The closest residential properties are approximately 200m west of the site.

4.3 Site Environmental Setting

A summary of the site's environmental setting and that of the surrounding area is presented in the table overleaf.

ENVIRONMENTAL SENSITIVITY AND SETTING	
Surface of site	The site is predominantly unsurfaced, or poorly surfaced with stone hardstanding. Approximately 20% is covered by concrete/asphalt access roads and car parking or building footprint.
Topography	The topography of the site is generally flat, with a slight gradient towards the south. Existing ground levels are approximately 2.5m above Ordnance Datum (AOD) at the eastern boundary. The topography of the surrounding area slopes gently to the south towards the River Liffey.
Geology	The Teagasc subsoil data maps on the GSI website identify the subsoil beneath the site as “Made Ground”. Bedrock beneath the site is identified as “Calp”, which consists of dark grey to black limestone & shale. The regional groundwater flow direction is expected to be to the south on the outgoing tide towards the River Liffey (155m south of the southern site boundary). Given the proximity of the Liffey, there may be a slight tidal influence on groundwater levels.
Hydrogeology and Aquifer Classification	The bedrock aquifer underlying the site is classified by the GSI as a ‘Locally Important Aquifer’, that is “moderately productive only in local zones”. The assigned groundwater vulnerability for the site is assigned as ‘Low ‘. A gravel aquifer is not indicated to be underlying the site on the National Draft Gravel Aquifer Map. The GSI database details two groundwater abstraction wells close to the northwest site boundary, installed to depths of 6.5m and 7.8m with well use recorded as ‘other’. The probability of well in the area being sunk into the limestone aquifer for potable water is low, due to the saline intrusion from the tidal River Liffey into the bedrock groundwater and the availability of mains water within Dublin City Centre. City Block 2 is not located within a groundwater public water supply source protection zone.
Surface Water and Flood Risk	The nearest surface water body to City Block 2 is the River Liffey, located approximately 155m to the south. The Liffey flows in an easterly direction towards Dublin Bay, and is tidal and brackish in the vicinity of the site. The EPA lists the water quality of the River Liffey upstream of Dublin City Centre as ‘Q3-4 Moderate Quality’. The tidal stretch of the River Liffey in the vicinity of City Block 2 is classified as ‘Unpolluted’ and is classified as ‘at risk of not achieving good status’ The Royal Canal is located approximately 240m west of the site. The Royal Canal is hydraulically connected with the River Liffey in the area of the site, but has poor hydraulic connection with groundwater as its base is shallow, and is typically lined with clay. According to the Office of Public Works flood maps resources, there is one record of flooding within the local area, which was a tidal flood event in February 2002. The OPW flood maps show that this affected an area from Spencer Dock approximately 50m from the western site boundary. The OPW records state that “The Local Authority who provided this Flood Information Item wishes to point out that a number of defence assets were put in place since one or more of the flood events”. Dublin City Council identified that the area in which City Block 2 is located is ”at risk but protected” (from flooding). AECOM understand that flood protection measures were constructed at Spencer Dock between 2005 and 2008. Flood protection is also incorporated into building design in the area with a minimum podium ground floor level of 4.0m OD being a requirement in the area.
Other	One EPA Industrial Emissions (IE)-licenced facility was identified on the north side of the River Liffey within 1km of the site. This refers to Brooks Thomas (IE Reg No. P0345-01), which was a timber treatment facility located on City Block 7, which is approximately 50m southeast of the site. AECOM understand that this facility is no longer active but that the licence has not been surrendered. Four licensed waste facilities are located close to the north quays of the Liffey in the vicinity of the site. The only protected areas specified by the National Parks and Wildlife Service within 1km of the site are the Royal Canal to the west of the site and the Grand Canal Dock located

ENVIRONMENTAL SENSITIVITY AND SETTING	
	south of the River Liffey, both of which are Proposed Natural Heritage Areas (002103 and 002104) – with protected species including Opposite-leaved Pond Weed (*Groenlandia Densa*). Radon maps available on the EPA web viewer indicate that the site is in an area where <1% of buildings in the 10-kilometre grid in which the site lies are estimated to be above the reference level, indicating a Low risk associated with radon gas. Under current building regulations, any building constructed on or after 1 July 1998 should incorporate radon protection measures and these regulations will be applicable to buildings constructed at the site.
Sensitive Receptors	Sensitive receptors identified within 1km of the site include: • Residential terraced houses located on Mayor Street, adjacent to the south-eastern site boundary of City Block 2; • Residential terraced houses located on New Wapping Street, approximately 15m east of the site; • Residential apartment complex on Spencer Dock, approximately 90m west of the site; • Residential apartments and terrace houses located north of Sheriff Street Upper; and • River Liffey, located 155m south of the site.
Environmental Sensitivity	The environmental sensitivity of Site is considered to be **MEDIUM**, given the proximity of residential housing and the River Liffey.

4.4 Site History

A summary of the sites history, and the potential for significant historic contamination associated with on-site and off-site activities, is outlined in the Table below.

SITE HISTORY AND POTENTIAL FOR SIGNIFICANT HISTORIC CONTAMINATION	
History of Site	Historical maps available from the Trinity Map Library and on the OSI website were reviewed in order to identify potential historical contamination sources on or near the site. The site was formerly part of the Liffey Estuary, which was reclaimed following construction of North Wall Quay. The Charles Brookings map of 1728 shows the north side of the River Liffey to be walled, but the map states that the site area is 'as yet overflowed by ye tide'. The site is shown on Rocques map of 1757 as being part of the North Lotts, which consist of agricultural plots. The Larcom map of Dublin from 1837 shows that the site is still undeveloped, but there has been development further west of the site, with construction of the Customs House and associated Dock. Historical mapping dating from 1829-1841 (6 inch mapping series) show that City Block 2 is bisected in a north south direction by Wapping Street. The majority of the site was undeveloped land, but a number of residential properties are located off Sheriff Street in the northeast corner of the site. A 'Vitriol works' (sulphuric acid works) is present on City Block 7 immediately south of Mayor Street and a 'Vinegar Works' is located approximately 60m west of the site. Mapping from 1875 shows that the site was still largely undeveloped, but shows that the terraced residential properties, which are currently present in the southeast corner of City Block 2, have been constructed. There has been significant development on City Block 7 to the south, with a 'Chemical Works and Iron Works' shown. A railway station 'London and North Western Railway Station' has been constructed on the western half of City Blocks 2 and 7, immediately west of Wapping Street, which truncates Mayor Street to a cul-de-sac. Residential properties and a church are shown north of the site on the northern side of Sheriff Street Upper. Historical maps dating from 1907 (25 inch to the mile) indicate Wapping Street to the west of the site has been removed and replaced with "New Wapping Street' which forms the current eastern site boundary. The site has been developed as a 'Timber Yard'. The station to the east has been renamed 'North Wall Station' and a number of 'cattle pens' are shown.

SITE HISTORY AND POTENTIAL FOR SIGNIFICANT HISTORIC CONTAMINATION	
	Residential properties, which still stand, have been constructed to the east of New Wapping Street' and City Block 3 has been developed as bonded stores and industry, including a vinegar works, charcoal works, saw mills and smithy. The chemical works on City Block 7 to the south of the site appears to have been demolished and have been replaced with a Hotel, which is currently present, and a post office. Mapping from 1935 no longer shows the timber yard and the only structure marked on the site is a tank on the western site boundary, with the houses in the southeast corner remaining. The layout of surrounding site is broadly similar to previous mapping, with the railway station present to the west and cattle pens now shown on City Block 7 to the south. A number of industries, including saw mills, printing works and iron works, are shown east of New Wapping Street. A soap works is located to the northeast of the site, north of Sheriff Street. The Goade Fire Plans from 1947 and 1961 do not cover the site itself but show sites to the south. Immediately south, City Block 7 is still occupied by cattle pens, a hotel and the post office is now shown as a 'Sailors Club'. To the southeast, there is a timber yard, saw mills, bonded stores, tile yard and cattle pens. Dublin Corporation Planning Base Map from circa 1985 shows the site to be largely free from buildings, with the surrounding area similar to that shown in the 1935 mapping. Aerial photographs from 1995 and 2000 show the site to be free from buildings and it appears to be used for storage of shipping containers or freight associated with the railway. Surrounding land use is similar to mapping from 1985, with the railway to the west, industry/commercial facilities to the east, residential to the north and largely undeveloped to the south. Aerial photographs from 2005 show significant alterations to land to the west, with the railway tracks and associated infrastructure between the site and Spencer Dock removed. The site itself is now vacant and no longer appears to be used for storage of containers/freight. Land to the north, east and south is similar in layout to previous years.
Potential On-site Sources of Contamination	Historical maps identify that the site has been relatively undeveloped, when compared with surrounding sites, but has (at times) been used as a timber yard, as cattle pens, and for storage of containers/freight. Based on the known site history, there is considered to be a potential for soil and groundwater contamination to be present beneath the site associated principally with its use as a timber yard and freight yard. Based on the findings of environmental assessments completed by AECOM on other sites in the North Wall area, made ground may have been imported onto the site from nearby industrial sources during reclamation, which could contain elevated concentrations of polycyclic aromatic hydrocarbons (PAHs) and metals.
Potential Off-Site Sources of Contamination	The surrounding area has been used for multiple industrial uses in the past and it is considered that several potential sources of off-site contamination may be present. These include the railway station and railway sidings to the west of the site, vinegar and vitriol works to the east and south, chemical works to the south, timber works to the north and east, iron works to the east, and soap works to the northeast. Potential contaminants associated with these works include, hydrocarbons, PAHs, metals, acids, bases and asbestos.
Potential for Contamination	Potential for historical contamination associated with onsite activities is considered to be **MODERATE,** while that associated with off-site activities is considered to be **HIGH.**

5. PRELIMINARY CONCEPTUAL SITE MODEL

A Conceptual Site Model (CSM) has been developed and is described in this section, identifying contaminant sources, contaminant migration pathways and potential receptors for the site. The CSM was developed based on the desktop study.

5.1 Pollutant Linkage Concept

In the context of land contamination, there are three essential elements to any risk:

- **A source** – a substance that is in, on or under the land and has the potential to cause harm or to cause pollution of controlled waters;
- **A receptor** – in general terms, something that could be adversely affected by a contaminant, such as people, an ecological system, property, or a water body; and
- **A pathway** – a route or means by which a receptor can be exposed to, or affected by, a contaminant.

Each of these elements can exist independently, but they create a risk only where they are linked together, so that a particular contaminant affects a particular receptor through a particular pathway. This kind of linked combination of contaminant–pathway–receptor is described as a pollutant linkage. The CSM was developed to describe viable source-pathway-receptor linkages for the site.

The desktop study was used to conceptualise the contaminant source areas as well as the pathways and receptors.

5.2 Potential Sources

The findings of the desktop study indicate that there are a number of potential sources with associated Potential Contaminants of Concern (PCOCs) at the site as outlined below.

SUMMARY OF POTENTIALLY SIGNIFICANT SOURCES OF CONTAMINATION		
Potential Source	**Contaminants of Potential Concern**	**Source Area**
Reduced quality made ground and overburden potentially contaminated with a variety of organic and inorganic contaminants.	• Hydrocarbons • Polycyclic aromatic hydrocarbons • Volatile Organic Carbon • Semi Volatile Organic Carbons • Metals • Polychlorinated biphenols • Acids and bases • Asbestos	Historical maps identify that the site has been relatively undeveloped when compared with surrounding sites, but has, at times, been used for a timber yard, cattle pens, and storage of containers/freight. The surrounding area has been used for multiple industrial uses in the past and it is considered that several potential sources of off-site contamination may be present. These include the railway station and railway sidings to the west of the site, vinegar and vitriol works to the east and south, chemical works to the south, timber works to the north and east, iron works to the east, and soap works to the northeast.
Reduced quality perched groundwater and bedrock groundwater potentially containing a variety organic and inorganic contaminants.	• Hydrocarbons • Polycyclic aromatic hydrocarbons • Volatile Organic Carbon • Semi Volatile Organic Carbons • Metals • Polychlorinated biphenols	

5.3 Potential Receptors

Human Health

The on-site human health receptor is considered to be residential (without plant uptake) as, AECOM understand that the subject area is to be redeveloped as predominantly high density residential units. Off-site receptors are also considered to be residential, due to the proximity of terraced residential housing at the southeast corner of City Block 2 and to the east of New Wapping Street.

It is expected that risks to off site residents and construction workers during construction works at the site will be suitably mitigated with the implementation of robust environmental control measures (i.e. dust suppression, wheel washes, etc.) and the use of appropriate personal protective equipment by construction workers. Further comment on the risks to construction personnel during the construction phase is beyond the scope of this report.

Controlled Waters

The following potential controlled waters receptors were identified given the environmental setting of the site:

Water Environment Receptors	Present (Y/N)	Potable Supply (Y/N)	Description/Comments
Groundwater abstraction within 500m of the site.	N	No	There are no known groundwater abstractions within 500m of the site. The probability of wells in the area being sunk into the limestone aquifer for potable water is low due to the saline nature of the water, and the availability of mains water within Dublin City Centre.
Surface water body within 500m of the site in direct hydraulic connection with groundwater from the site.	Y	No	River Liffey is located approximately 155m south of the site.
		No	Royal Canal and Spencer Dock located 240m west of the site (not considered as a receptor due to poor hydraulic connection with groundwater).
Groundwater in bedrock beneath the site.	Y	Unlikely	The bedrock aquifer underlying the site is classified by the GSI as a 'Locally Important Aquifer', that is "moderately productive only in local zones", however is known to be affected by saline intrusion from the tidal River Liffey.
Groundwater in superficial deposits beneath the site	Y	No	The superficial deposits at the site are not considered to be an aquifer.

5.4 Potential Pathways

It is assumed that future redevelopment of the site is likely to include construction of basement car parking over a large proportion of the site and/or cover with hard standing or imported fill materials covering the remainder (1m in depth, in order to break pathway with existing soils). The proposed development will itself therefore limit the pathways for exposure of site users to contamination contained within the underlying fill material; i.e. soil and dust ingestion, consumption of vegetables, dermal contact, inhalation of fugitive dust pathways are not active except for the duration of construction works.

Exposure pathways are therefore limited and are confined to the vapour migration pathway. The following potential pathways to human health and controlled waters receptors are considered viable:

Potential Pathways	
Pathways to human health receptors in a high density residential scenario	• Vapours - migration of vapours through Made Ground to above ground buildings.
Pathways to controlled waters receptors	• Leaching of CoPC from soil into perched groundwater followed by vertical migration. • Potential lateral migration of impacted groundwater.

5.5 Summary of Viable SPR Linkages

The elements of the CSM that form viable source-pathway-receptor (SPR) linkages may be summarised as follows:

RECEPTOR	SOURCE	PATHWAY								
		1) Soil and dust ingestion	2) Consumption of vegetables	3) Dermal contact	4) Inhalation of fugitive dust	5) Ingestion of groundwater	6) Inhalation of vapours	7) Leaching from unsaturated zone	8) Vertical groundwater migration	9) Horizontal groundwater migration
Residential site users (without plant uptake)	Soils						✓			
	Groundwater						✓			
Groundwater	Soils							✓		
	Groundwater								✓	✓
Surface Water	Soils							✓		
	Groundwater									✓
✓ = Pathway present		Blank = no pathway								

6. PREVIOUS ENVIRONMENTAL INVESTIGATIONS

A number of phases of site investigation work have been completed at the site, as outlined in the sections below.

6.1 Completed Investigation Work

A preliminary assessment of environmental soil and groundwater quality was carried out in March/April 2003[2] within "Block M & N" which form the northern third of the site and the "Pump Station" redevelopment footprint, which is located to the centre of the site. This investigation comprised three shell and auger boreholes (MW1, MW5 & MW6).

Environmental soil samples were collected at each of the investigation points at one metre depth intervals and selected samples were submitted for analysis. Groundwater samples were also collected from a series of monitoring wells installed across the site and samples were submitted for analysis.

A more detailed site investigation was completed in September 2005[3] to assess the environmental quality of shallow soil in the northern half of City Block 2 to determine suitable soil disposal/transfer routes for a proposed site-wide excavation. This investigation comprised excavation of 22 trial pits, to a maximum depth of 4.0 metres below ground, following a grid pattern across the site. Samples from trial pits were submitted for laboratory analysis.

Further environmental investigation and sampling work was undertaken at the site as part of the Pumping Station redevelopment work[4], which was completed between August 2011 and February 2012.

6.2 Site Investigation Findings

The top-most layer encountered across the site comprised made ground, consisting of coarse sand, fine to medium gravel and clay. Locally, cobbles and debris such as ash, bricks and concrete were found within this material. The thickness of the made ground generally varied between 2.0m and 2.5 m across the site; however, in a number of trial pits in the southeast corner the made ground was deeper with thicknesses of greater than 3.0m being observed.

In the boreholes drilled during the preliminary investigation in 2003, made ground thicknesses of up to 4.8m (at MW5) were recorded. It is possible that there are one or more localised depressions in the made ground/alluvial silt interface across the site, as the made ground thicknesses measured in three trial pits surrounding MW5 ranged from 1.7 m to 2.7m bgl.

The uppermost natural layer underlying the fill material was a soft sandy peaty silt stratum. This stratum extended below the base of the trial pits where it was observed. Based on borehole logs from the 2003 site investigation, this stratum ranges from 0.3 to 1.0m in thickness across the site, with the underlying stratum consisting of sandy medium to coarse gravel with occasional cobbles. This stratum was encountered at depths of between 4.4m and 5.1m bgl across the site. The thickness of the stratum was variable across the site, with a maximum thickness of 6.0m encountered and a minimum thickness of 4.4m.

[2] URS, May 2003; Report on Site Environmental Quality of Soil and Groundwater (Buildings M&N site), Spencer Dock Redevelopment, Dublin, Final Report rev 1 45824-023-447.

[3] URS, November 2005; Report on Environmental Assessment of Soil Block N, Spencer Dock Redevelopment, Dublin; Final Report rev 1 45078466.

[4] Spencer Dock Pump Station, Block N, Spencer Dock, Dublin 1 Environmental Close Out Report 15 February 2014 Final Issue No 1 49341885.

The deeper boreholes drilled during the 2003 site investigation terminated in glacial till ('Boulder Clay'), which underlay the gravel unit. The till consisted of a dense clay matrix with rounded cobbles and boulders. The encountered thickness of the glacial till was >1.9m and >3.5m although the thickness was not proven.

No field evidence of contamination was recorded in the borehole or window sampling logs from the 2003 site investigation. During the groundwater sampling process, a slight oily sheen was recorded at two wells.

During the 2005 site investigation, visually observable contaminants included red and white ash and clinker within the made ground stratum of the site. These materials were observed to extend across the entire site with a hydrocarbon-type odour noted in a small number of locations.

Soil analytical results between 0.0m and 4.0m bgl showed significantly elevated concentrations of a number of contaminants including a range of PAH parameters and metal parameters, including arsenic, lead and mercury. Soil analytical results between 4.0m to 13.0m bgl show less contaminated conditions compared to overlying soil.

Groundwater analytical results for hydrocarbons, PAHs and VOCs were all low but elevated concentrations of a number of metals parameters including arsenic, boron, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc were detected.

6.3 Pumping Station Excavation

The Sewage Pumping Station development included the construction of a pump house, underground storm tank, sewer system and ancillary facilities. In order to provide the required void space for the underground structure together with the need to remediate the site, approximately 11,500 m^3 of fill material and natural soils was excavated and appropriately disposed off-site. The final excavation depth varied across the footprint of the pump station development, but beneath the main section, excavation depths of up to 13 m bgl were completed, while more shallow depths (< 5 m bgl) were completed in the eastern and northern portions.

During excavation work, additional soil testing was undertaken to confirm the original waste classification of the soils completed as part of the 2005 investigation work. Upon completion of excavation work, soil validation sampling was completed, with samples taken from the sides and base of the excavation. Seventeen composite soil samples were taken from the walls around the excavation at depths ranging between 1.0-1.5m bgl (made ground) and 4.0- 4.5 m bgl (natural soils) and six composite soil samples were taken from the base of the excavation, at depths ranging between 6m bgl and 13m bgl. Results of the validation sampling indicated that residual soils were unlikely to pose a significant potential risk to controlled waters.

7. SITE INVESTIGATION METHODOLOGY

The intrusive site investigation work was carried out between May 2015 and August 2015. Site investigation work involved trial pit excavation, borehole drilling, groundwater monitoring well installation, soil and water sampling, as well as groundwater monitoring.

7.1 Health and Safety

An AECOM 'Health Safety and Environmental Plan' (HSEP) was completed prior to field works being undertaken at the site. The HSEP described the health, safety and environmental requirements for AECOM project personnel and their contractors' personnel involved in the environmental site investigation works. The HSEP included key project responsibilities, standard safe working practises, general physical and chemical hazards, a detailed hazard risk assessment, requirements for personal protective equipment (PPE), environmental management, decontamination procedures, waste management, management of change and emergency response plans. The HSEP was maintained on site at all times during the investigation, and acted as a live document. All AECOM staff and subcontractors were inducted into the HSEP and were required to sign the HSEP to confirm their understanding of the hazards and mitigation measures.

Prior to commencing intrusive works, all proposed borehole and trial pit locations were identified and agreed with the Client. No non-hazardous or hazardous waste was removed from the site by AECOM or its contractors, other than samples submitted for laboratory analysis.

7.2 Trial Pitting

Trial pitting works were carried out by Irish Geotechnical Site Investigation Limited (IGSL) and were observed and directed by an AECOM field engineer, who logged the arising's in general accordance with the BS 5930:1999 standard, as per AECOM standard field procedure FP02. Figure 3 presents trial pit locations.

Eleven trial pits (TP201 to TP211) were completed within the City Block 2 as part of this phase of investigation. Trial pits were completed to depths of between 3.5m bgl (-1.4m OD) and 4.5m bgl (-2.3m OD)

7.3 Borehole Drilling & Groundwater Well Installation

Six boreholes (BH9 to BH14) were advanced across the site by IGSL using a Dando 2000 cable percussion drilling rig, borehole locations are presented in Figure 3. Boreholes were completed to depths of between 10.5m bgl (-7.8m OD) and 13.7m bgl (-11.3m OD). After completion of drilling, monitoring wells were installed into all six boreholes.

Three boreholes (BH10, BH11 and BH13) were installed with a screened section within near surface soils which consisted predominantly of made ground and silt, the majority of which will be excavated during redevelopment, with a typical response zone between 0.5m bgl and 5.0m bgl.

Three boreholes (BH9, BH12 and BH14) were installed with a screened section within deeper natural sands and gravels which will remain in situ following redevelopment work, with a typical response zone between 5.0m and 8.5m bgl.

Wells comprised a 50 mm diameter high-density polyethylene (HDPE) standpipe, with the exception of BH12 which was installed with a 260mm well screen for use as a pumping well for dewatering during excavation of the basement. The screened section of the wells were surrounded by a washed gravel filter pack, and a bentonite seal was placed above the screened section in order to prevent the creation of a downward pathway for potential surface-derived contamination. Groundwater wells were finished at surface using flush metal covers set in a concrete pad to protect the well and prevent a trip hazard. Only the abstraction well (BH12) was completed with an upright cover.

7.4 Soil Sampling

Soil samples were collected from each borehole and trial pit. Depths of sampling were informed by field observations. Samples were taken at various intervals to provide coverage of material across the site at multiple depths with particular emphasis on soil from beneath -0.25m OD which will remain in-situ following redevelopment work.

The sampled material was visually examined for evidence of contamination and was screened on-site using a photo ionisation detector (PID) for the presence of ionisable gases (indication of the presence of volatile compounds that could be associated with petroleum hydrocarbon impact).

Samples were collected using single use nitrile gloves and were placed into clean, laboratory-supplied containers and dispatched to Jones Environmental Laboratories (JEL) based in Deeside, UK for analysis under contract, accompanied with an appropriate chain of custody and scheduled for the following analysis for GQRA purposes:

SOIL SAMPLES	
Analyte	**No. of Soil Samples**
Total Petroleum Hydrocarbon (TPH) Criteria Working Group (CWG) analysis	22
Benzene, Toluene, Ethyl-benzene & Xylene (BTEX)	22
Methyl Tert-Butyl Ether (MTBE)	22
Polycyclic Aromatic Hydrocarbons (PAHs)	22
Polychlorinated Biphenyls (PCBs)	22
Total Organic Carbon (TOC)	22
Volatile Organic Compounds (VOCs)	6
Semi Volatile Organic Compounds (SVOCs)	6
Metals (As, Ba, Cd, Cr, Cu, Mo, Hg, Ni, Pb, Se, Sb, Zn)	22
Asbestos	22

7.5 Groundwater Monitoring

Groundwater monitoring was completed on 12 August 2015. Prior to groundwater sampling, each monitoring well was gauged using an interface probe to monitor the depth to groundwater and to identify the presence or absence of non-aqueous phase liquid (NAPL). Groundwater was present in all boreholes and NAPL was not detected at any location. In-situ water quality parameters (pH, temperature, dissolved oxygen, electrical conductivity and redox potential) were recorded prior to sampling using a field meter. Monitoring wells were purged prior to sampling until field parameters stabilised so representative groundwater samples were obtained. The wells were sampled using a peristaltic pump and low flow techniques (with tubing dedicated to each well) and samples were placed directly into laboratory-supplied sample containers using single use nitrile gloves.

As part of this assessment, groundwater samples were obtained from the three deeper monitoring wells (BH9, BH12 and BH14). Wells BH9 and BH14 were developed by purging three well volumes so that materials potentially introduced during drilling were removed. Following purging of 250 litres of water from BH12 a grab sample was obtained as this well had been installed with a wide diameter 260mm casing and purging three well volumes was not feasible.

Sample bottles were stored in a chilled cool box and dispatched to Jones Environmental Laboratory in Deeside, UK for analysis, with an appropriate chain of custody documentation. Groundwater samples were analysed for the following parameters:

GROUNDWATER SAMPLES	
Analyte	**No. of Water Samples**
Total Petroleum Hydrocarbon (TPH) Criteria Working Group (CWG) analysis	3
Benzene, Toluene, Ethyl-benzene & Xylene (BTEX) Compounds	3
Methyl Tert-Butyl Ether (MTBE)	3
Polycyclic Aromatic Hydrocarbons (PAHs)	3
Polychlorinated Biphenyls (PCBs)	3
Volatile Organic Compounds (VOCs)	3
Semi Volatile Organic Compounds (VOCs)	3
Metals (As, Ba, Cd, Cr, Cu, Mo, Hg, Ni, Pb, Se, Sb, Zn)	2

8. SITE INVESTIGATION FINDINGS

8.1 Site Geology

A general summary of the geological profile encountered during this site investigation is presented in the following table.

GEOLOGICAL PROFILE				
Approx Depth (m bgl)	Approx Elevation (m OD)*	Minimum Thickness	Maximum Thickness	Description
0.0 to 0.2m	2.5 to 2.3	0.1m	0.35m	Concrete or hardcore hard standing
0.2 to 2.6m	2.3 to -0.1	1.2m	3.6m	Made Ground - typically soft, dark brown, sandy gravelly CLAY, with red brick fragments and building debris at some locations
2.6m to 3.8m	-0.1 to -1.3	0m	2.4m	Natural Silt - typically soft, dark grey or black, sandy, clayey SILT with shell fragments and occasional gravels
3.8m to 8.2m	-1.3 to -5.7	2.5m	7m	Natural Sand and Gravel – Medium dense dark grey sub angular SAND and GRAVEL
>8.2m base not proven	>-5.7	Minimum depth encountered at 5.8m bgl Maximum depth encountered at 10.2m bgl		Natural stiff to hard brown and grey gravelly CLAY

* Based on an assumed site elevation of 2.5m OD

A detailed description of ground conditions encountered during the investigation is provided in the AECOM trial pit logs and the IGSL borehole logs in Appendices A and B, respectively.

8.2 Site Hydrogeology

Groundwater levels recorded in the onsite wells as presented in the table below.

Groundwater Levels					
Monitoring Well ID	Depth to Groundwater (m btoc)	Well Depth (m btoc)	Screened Depth (m btoc)	Well Elevation, (m OD)	Water Level (m OD)
BH9	3.305	7.35	5.0-7.0	2.684	-0.621
BH10	2.76	3.62	0.5-4.0	2.282	-0.478
BH11	2.82	4.51	1.0-5.0	2.212	-0.608
BH12	4.105	11.68	5.5-8.5	2.344	-0.861
BH13	3.34	4.90	1.0-5.0	2.661	-0.579
BH14	3.100	6.55	4.0-7.0	2.361	-0.739

- m btoc = meters below top of casing
- m OD = metres Ordnance Datum
- Note: reference point used to measure water levels was top of casing

It is understood that data from surrounding sites indicate a slight tidal influence which is most pronounced immediately adjacent to the River Liffey. An assessment of groundwater flow beneath the site was inconclusive in regards to flow direction, possibly due to the presence of the pumping station and associated piling, installed into boulder clay, at the centre of the site cutting off groundwater within sand/gravel between the north and south of the site. However it is assumed that regional groundwater flow is to the south towards the River Liffey.

8.3 Field Observations

Made ground was present across the site and was encountered to depths ranging between 1.2m bgl (TP207) and 3.6m bgl (BH14). In general, made ground consisted of imported sandy clay fill material with varying contents of red brick, ash and clinker with construction debris including metal and wood throughout.

The following are the significant field observations made during the course of the environmental site investigation:

- Metallic clinker was encountered within made ground in a number of trial pits including TP201, TP202, TP203, TP204, TP205, TP206, TP207, TP210 and TP211;
- A bitumen odour was observed in trial pit TP205 in made ground at depths between 0.65m bgl and 2.1m bgl; and
- Ash was encountered within made ground in a number of trial pits including TP205 and TP209.

Groundwater pumped from the shallow monitoring wells during purging was slightly turbid while that recovered from deeper monitoring wells was generally clear with lower turbidity. No evidence (i.e. odours, staining, or iridescence) was recorded during purging of groundwater monitoring wells.

In-situ groundwater quality parameter readings are presented in Table 5 and summarised below. The measured field parameters can be summarised as follows:

- Temperature readings ranged from 13.5^{o}C (BH14) to 17.4 ^{o}C (BH9) which is generally above normal range for Irish groundwater (10 – 12 ^{o}C); however temperatures may be elevated due to higher ambient air temperatures (seasonal impacts) and the presence of shallow groundwater;
- Measured pH values in groundwater ranged from 6.39 (BH10) to 6.96 (BH13), indicating groundwater conditions generally within the range for Irish groundwater (pH 6.5 - 9.5);
- Measured electrical conductivity (EC) values ranged from 2,041 µS/cm (BH9) to 4,118 µS/cm (BH14), which is slightly elevated above the range for typical groundwater indicating potential saline intrusion from the adjacent Liffey estuary;
- Redox potential (Eh) readings ranged between 154.5 mV (BH9) and 288.13 mV (BH14) generally indicating oxidising conditions in groundwater; and
- Dissolved oxygen readings ranged from 0.62 mg/l (BH11) to 6.03mg/l (BH12), indicating slightly anaerobic to aerobic conditions.

9. GENERIC QUANTITATIVE RISK ASSESSMENT

9.1 Screening Criteria

In order to assess the quality of soils on site in terms of human health (future site users) and controlled water (groundwater and the River Liffey) risk assessment AECOM have considered the analytical results from this investigations outlined in Section 7 above.

A risk-based approach has been adopted for the assessment of data from the site. As the proposed end use is high density residential, the data has been assessed against criteria considered appropriate for a future residential end use without plant uptake (it is assumed that fruit/vegetables will not be grown on the site). This is a conservative approach which will also be protective of future commercial end users of the site and will be protective of off-site residential receptors (given the close proximity of residential properties).

Constituent concentrations in soil and groundwater at the site were deemed ‘potentially significant’ where they exceeded the ‘generic’ values. These generic values are used for initial assessment of contaminant concentrations for the purpose of providing an initial indication of impacts at a site and

evaluating the compounds that could proceed to a detailed assessment. As such, it should be noted that generic exceedances are not an indication of the requirement for remediation but, rather, an indication of the need for further assessment.

Additionally, where further risk assessment is considered necessary, use of more site-specific information in the assessment can often lead to the conclusion that the observed concentrations are present at levels which represent an acceptable level of risk, considering the actual or proposed end use of a site (although each site assessment has to be considered on an individual basis).

9.1.1 *Soil Screening Criteria*

AECOM has only considered analytical results from soil samples obtained from below -0.25m OD as soil above this level is earmarked for excavation for future basement construction, and only soil from below -0.25m OD will remain in-situ following redevelopment work.

The soils being removed will be assessed in terms of waste classification, in order to identify an appropriate disposal route. This waste classification report will be completed by AECOM under a separate cover,

The soil analytical data for soils remaining in-situ were compared with AECOM in-house Stage 2 Generic Assessment Criteria (GAC) for residential development (without plant uptake). The GAC are based on a sandy soil which is a conservative option chosen to represent gravels remaining on site following excavation work. The total organic carbon content of between 0.58% and 1.45% reflects the values encountered on site which range from 0.29% to 3.95%, with a mean value of 1.16%. This is also a conservative screening value.

If the concentrations are below the GAC, then the risks to human health are considered negligible. If the concentrations are above the GAC, a potential risk to human health is identified. AECOM considers that the GACs are consistent with the principles of human health protection in Irish Environmental Protection Agency, UK DEFRA and UK Environment Agency guidance.

Total petroleum hydrocarbons have been assessed by assuming an additive toxicological effect for each individual fraction. A hazard quotient (HQ) is calculated for each individual fraction by dividing the fraction concentration by its corresponding GAC. The HQs for each TPH fraction in an individual TPH sample are then summed to calculate the hazard index (HI) for that sample. A HI greater than 1.0 is deemed to indicate a potentially significant risk to human health.

9.1.2 *Soil Leachate Screening Criteria*

In terms of controlled waters (i.e. the underlying groundwater and nearby surface waters), there is a potential for soils to impact these via leaching. However, estimated soil GACs using a partitioning equation result in theoretical values that are likely to be very conservative. As such, greater reliance is generally placed on measured groundwater results to assess the potential risks to controlled waters in the vicinity of the site as outlined in Section 9.1.3 below.

9.1.3 *Groundwater Screening Criteria*

This assessment has only considered groundwater results from deeper groundwater monitoring wells (BH9, BH12 and BH14) as these wells are screened with a response zone in natural soils which will remain in situ following basement excavation work. Data from shallow monitoring wells wells (BH10, BH11 and BH13) was collected to represents water that would likely be discharged during dewatering activities in order to support a discharge licence application.

In terms of controlled waters, appropriate generic assessment criteria were selected based on the site's environmental setting. The closest surface water is the River Liffey, which is located approximately 155m south of the site southern boundary.

The bedrock aquifer is classified by the GSI as a 'LI - Locally important aquifer, bedrock which is moderately productive only in local zones'. GSI indicates that there are no source protection zones

within a 1km radius of the site. The probability of well in the area being sunk into the limestone aquifer for potable water is low due to the saline nature of the groundwater, and the availability of mains water within Dublin City Centre.

Based on the above analysis, the River Liffey is considered the most sensitive controlled waters receptor in the vicinity of the site. Accordingly, groundwater analytical data were assessed using the following criteria:

- European Communities Environmental Objectives (Groundwater) Regulations, 2010 (Statutory Instrument No. 9 of 2010);
- European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (Statutory Instrument No. 272 of 2009);
- European Communities Environmental Objectives (Drinking Water) Regulations, 2010 (Statutory Instrument No. 106 of 2007); and
- Environmental Protection Agency's Draft Interim Guidelines Values (IGVs) for the Protection of Groundwater, 2003[5].

In terms of human health risks, given that groundwater on site is not used for drinking, the principal risk to human health from groundwater is via vapour inhalation. Therefore, groundwater concentrations were compared against residential AECOM GAC derived for the assessment of the vapour inhalation pathway where appropriate (where AECOM GAC are unavailable, groundwater concentrations were compared against UK Drinking Water Standards or World Health Organisation guidelines for Drinking Water). The screening criteria do not provide detailed information on site-specific risks and, in a significant number of circumstances, may be viewed as being overly health protective. Nevertheless, these values are considered to be appropriate for initial screening of site conditions for the protection of human health.

9.2 Soil Analytical Results

Soil analytical results from below -0.25m OD from trial pits are presented in Table 1 while those from boreholes are presented in Table 2 in which they are screened against GAC protective of human health in a residential end use scenario, as outlined in Section 9.1.1 above. Laboratory analytical reports are presented in Appendix C.

Petroleum Hydrocarbons

The petroleum hydrocarbon analysis completed for samples obtained from the site includes Speciated Total Petroleum Hydrocarbons (TPH), BTEX & MTBE.

The petroleum hydrocarbon analytical results for all soil samples were below the Stage 2 GAC protective of human health. Hydrocarbon concentrations were generally less than the laboratory MDL, with a maximum TPH concentration of 498 mg/kg detected. In addition, the additive toxicological effect for each individual fraction was assessed by calculating a Hazard Index for each sample. As the hazard index for all samples was significantly less than 1.0 (max 0.14) there is not considered to be a potentially significant risk to human health.

PAH's

The PAH analytical results for all soil samples were below the Stage 2 GAC protective of human health. PAH concentrations were generally very low, and in many cases less than the laboratory MDL. A maximum total 17 PAH concentration of 15.72 mg/kg was detected.

[5] Environmental Protection Agency, Towards setting guideline values for the protection of groundwater in Ireland (Interim Report).

Metals (As, Ba, Cd, Cr, Cu, Mo, Hg, Ni, Pb, Sb, Zn)

Metal concentrations in samples from below -0.25m OD are generally below the Stage 2 GAC protective of human health, with all metal concentrations in 8 of the 22 samples below the Stage 2 GAC. Exceedances of the Stage 2 GAC were detected for arsenic, cadmium, copper and lead in a number of samples as summarised in the table at the end of this section.

Polychlorinated biphenyls (PCB's)

The analytical results for PCB's in all soil samples were below the Stage 2 GAC protective of human health and in all cases were less than the laboratory MDL.

VOCs and SVOCs

VOC and SVOC concentrations in samples from below -0.25m OD are generally below the Stage 2 GAC protective of human health, with all VOC and SVOC concentrations in 4 of the 6 samples below the Stage 2 GAC. Exceedances of the Stage 2 GAC were detected for chloromethane and vinyl chloride in two soil samples as summarised in the table at the end of this section.

Asbestos

Asbestos was only detected in one of the 22 sample from below -0.25m OD

SUMMARY OF SOIL EXCEEDANCES				
Parameter	**GAC protective of Human Health Residential Use mg/kg**	**No of Samples Analysed**	**No. of Exceedance**	**Maximum Concentration Detected**
Arsenic	40	22	12	TP202 2.2m-3.4m (606.9mg/kg)
Cadmium	85	22	1	TP202 2.2m-3.4m (87.7mg/kg)
Copper	7,100	22	1	TP202 2.2m-3.4m (10,930mg/kg)
Lead	310	22	9	TP202 2.2m-3.4m (18,580mg/kg)
Chloromethane	0.00304	6	2	BH10 4.0-5.0m (0.014mg/kg)
Vinyl Chloride	0.00031	6	2	BH10 4.0-5.0m (0.012mg/kg)
Asbestos	Presence	22	1	TP205 4.0-4.3m (chysotile fibres)

9.3 Groundwater Analytical Results

Groundwater analytical results are presented in Tables 3 in which they are screened against GAC protective of human health in a residential end use scenario and in Table 4 in which they are screened against GAC protective of nearby surface water and groundwater receptors as outlined in Section 9.1.3 above. Laboratory analytical reports are presented in Appendix D.

Petroleum Hydrocarbons

The petroleum hydrocarbon analysis completed for samples obtained from the site includes speciated TPH, BTEX & MTBE.

The petroleum hydrocarbon analytical results for all three groundwater samples were less than the laboratory MDL and less than the GAC protective of human health and controlled water, indicating no significant risk to human health or controlled waters from these parameters.

PAHs

PAH concentrations in all three samples were less than the laboratory MDL and less than the GAC protective of human health and controlled water, indicating no significant risk to human health or controlled waters from these parameters.

Metals

Metal concentrations in groundwater samples from each of the wells were below the Stage 2 GAC protective of human health.

Exceedances of the GAC protective of controlled water were detected in all three groundwater samples. Metals which exceeded the controlled water GAC include arsenic and zinc in which maximum concentrations of 475.1 µg/l and 174 µg/l were detected respectively which exceed their respective groundwater GAC of 7.5 µg/l and 100 µg/l.

VOCs and SVOCs

VOCs and SVOCs in all groundwater samples were below their respective GACs, and also the laboratory MDL, indicating no significant risk to human health or controlled waters from these parameters.

10. UPDATED CONCEPTUAL MODEL

Based on the information gained from the GQRA, the conceptual model developed as the preliminary conceptual site model has been reviewed and updated and is discussed in detail below.

10.1 Sources

Soil Sources

Based on the results of the GQRA, a potential risk to human health (future residential users) was identified due to elevated metals (arsenic, cadmium, copper and lead) and VOCs (chloromethane and vinyl chloride). Where exceedances were encountered the most significant exceedances were associated with samples from made ground, which is located close to the site surface (from ground level to an average depth of approximately 2.6m bgl and a maximum depth of 3.6m bgl), but were also present within underlying silt and gravels.

There is a potential for soils to impact controlled waters (i.e. the underlying groundwater and nearby surface waters) via leaching. However, as soils from the top 2.75m of the site, including the majority of made ground, are to be removed this will reduce the risk posed to nearby controlled water receptors.

Groundwater Sources

Slight risks to groundwater beneath the site and to nearby surface water receptors, including the River Liffey and Royal Canal, were identified due to elevated metal concentrations (including arsenic and zinc) within groundwater beneath the site. Excavation of soil from the top 2.75m of the site will remove the majority of made ground which is considered to be the source of metals to groundwater, thus reducing the risks posed.

10.2 Potential Receptors

Human Health

The on-site human health receptor is considered to be residential (without plant uptake), as AECOM understands that the site is to be redeveloped as predominantly high density residential units. This assessment is also considered to be protective of off-site receptors including nearby residential receptors.

Controlled Water

Controlled waters receptors present in the vicinity of the site include the River Liffey, located approximately 155m south of the site, and groundwater in bedrock beneath the site

10.3 Potential Pathways

Future redevelopment of the site is likely to include construction of basement car parking over a large proportion of the site and/or cover with hard standing or imported fill materials covering the remainder. The proposed development will itself therefore limit the pathways for exposure of site users to any contamination contained within the underlying fill material; i.e. soil and dust ingestion, dermal contact, inhalation of fugitive dust pathways are not active except for the duration of construction works. There is therefore not considered to be a viable pathway between metals and asbestos in soil remaining in-situ following redevelopment work and future human health receptors.

Exposure pathways to human health are therefore extremely limited and are confined to the vapour migration pathway which is relevant only to low levels of chloromethane and vinyl chloride detected in two soil samples.

AECOM understand that a secant pile wall will be constructed around the perimeter of the proposed development which will be embedded in natural stiff black slightly gravelly clay, encountered at an approximate depth of 8.2m bgl. The presence of stiff clay beneath the site and a secant pile wall around the majority of the site will also restrict the potential vertical pathway for water moving beneath the site and will limit the horizontal pathways for migration from within the site area to controlled waters.

10.4 Risks Assessment Procedure

By considering the sources, pathways and receptors (pollutant linkages), an assessment of the human health and environmental risks is made with reference to the significance and degree of the risk. This assessment is based on consideration of whether the source contamination can reach a receptor, and hence whether it is of major or minor significance.

The risk assessment has been undertaken with reference to BS10175:2001 and CIRIA Document C552: 'Contaminated Land Risk assessment - A Guide to Good Practice'. The risk assessment has been carried out by assessing the severity of the potential consequence, taking into account both the potential severity of the hazard and the sensitivity of the target, based on the categories given in the table below.

Potential Hazard Severity Definition	
Category	**Definition**
Severe	Acute risks to human health, catastrophic damage to buildings/property, major pollution of controlled waters.
Medium	Chronic risk to human health, pollution of sensitive controlled waters, significant effects on sensitive ecosystems or species, significant damage to buildings or structures.
Mild	Pollution of non-sensitive waters, minor damage to buildings or structures.
Minor	Requirement for protective equipment during site works to mitigate health effects, damage to non-sensitive ecosystems or species.

The likelihood of an event (probability) takes into account both the presence of the hazard and target and the integrity of the pathway, and has been assessed based on the categories given in the Table overleaf.

Probability of Risk Definition	
Category	**Definition**
High likelihood	Pollutant linkage may be present, and risk is almost certain to occur in long term, or there is evidence of harm to the receptor.
Likely	Pollutant linkage may be present, and it is probable that the risk will occur over the long term.
Low likelihood	Pollutant linkage may be present, and there is a possibility of the risk occurring, although there is no certainty that it will do so.
Unlikely	Pollutant linkage may be present, but the circumstances under which harm would occur are improbable.

The potential severity of the risk and the probability of the risk occurring have been combined in accordance with the following matrix in order to give a level of risk for each potential hazard as shown in the table below.

Level of Risk for Potential Hazard Definition				
Probability of risk	**Potential severity**			
	Severe	Medium	Mild	Minor
High	Very high	High	Moderate	Low/Moderate
Likely	High	Moderate	Low/Moderate	Low
Low	Moderate	Low/Moderate	Low	Very low
Unlikely	Low/Moderate	Low	Very low	Very low

Revised Site Conceptual Model						
Source	**Pathway**	**Receptor**	**Severity**	**Likelihood**	**Potential Risk**	**Discussion**
Soil below 2.75m bgl (-0.25m OD) remaining in-situ following redevelopment Elevated metals (arsenic, cadmium, copper and lead) in a number of soil sample, asbestos in one soil sample and VOCs (chloromethane and vinyl chloride) in two soil samples exceeded the Stage 2 GAC.	• No viable pathways identified from metals and asbestos • Vapour migration pathway present for VOCs	Future site users in a residential without plant uptake scenario	Medium	Unlikely	Low	Soil from the top 2.75m bgl to be removed from site. No viable pathways identified metals and asbestos detected in residual soil provided soil will be covered by buildings or hard standing. All exposed landscape or open areas should be capped with impermeable membrane or a surface cover of clean imported fill at least 1.0m thick. Potential risk from vapour intrusion in residual soils is considered low and therefore no remedial action required. Ventilation to be installed in basements as part of the current design across the majority of the site further reduces risk. Although the site investigation did not identify significant volatiles or malodours from the soil it is recommended that the building design minimise service penetrations through foundation and/or ensure these are adequately sealed to minimise ingress of malodours.or vapours
Leaching from soil below 2.75m bgl (-0.25m OD)	• Leaching from soil to groundwater • Vertical and horizontal migration of groundwater	Groundwater in gravel aquifer beneath the site	Mild	Low	Low	Risk to groundwater considered low due to brackish nature of groundwater beneath the site and lack of resource value. Removal of made ground will remove bulk of source and pile wall and underlying stiff clay will reduce vertical migration.
Exceedances of the GAC protective of controlled water were detected in all three groundwater samples. Exceedances were detected for arsenic and zinc		Groundwater in limestone bedrock aquifer beneath the site	Mild	Low	Low	
		Off site surface water including River Liffey and Royal Canal	Mild	Unlikely	Very low	Potential risk to surface water considered very low due to distance to receptor.. Removal of made ground will remove bulk of source and pile wall and underlying stiff clay will reduce lateral migration.

11. FINDINGS AND CONCLUSIONS

AECOM completed this Ground Conditions Report and Generic Quantitative Risk Assessment (GQRA), at the proposed development site on the eastern half of City Block 2, in order to establish current environmental conditions of soil and groundwater underlying the subject area and identify potential significant risks to future site users or environmental receptors following the proposed site redevelopment.

AECOM understands that the northern portion of the site will be developed with a multi-storey residential building (Block 2B). This will include a single level basement which will have a formation level of approximately 2.75m below existing ground level (-0.25m Ordnance Datum (OD)) with a basement floor level of 0.5m OD. AECOM understands that a secant or sheet pile wall is to be constructed around the perimeter of the site.

A summary of the desktop review is detailed below:

- Surrounding land use includes a mixture of commercial and residential with terraced residential houses located outside the site boundary on the south-eastern corner of City Block 2;
- Historical maps identify that the site has been relatively undeveloped, when compared with surrounding sites, which had extensive industrial uses, but has (at times) been used as a timber yard, as cattle pens, and for storage of containers/freight. Based on the known site history, there was considered to be a potential for soil and groundwater contamination associated with its former uses and with importation of contaminated fill material from nearby industrial sources during reclamation; and
- The closest surface water is the River Liffey, which is located approximately 155m south of the site. The bedrock aquifer beneath the site is classified as a 'LI- Locally important aquifer' although there are no source protection zones or known groundwater abstractions wells within a 1km radius of the site.

AECOM completed an intrusive site investigation at the site between May 2015 and August 2015. The investigation involved trial pit excavation, borehole drilling, monitoring well installation, soil sampling and groundwater sampling. A Generic Quantitative Risk Assessment was completed based on data from this site investigation. A summary of the GQRA findings is detailed below:

- A general summary of the geological profile encountered during this site investigation consisted of concrete or hard-core hard standing to a depth of approximately 0.2m bgl, underlain by made ground which contained frequent clinker and ash to a depth of approximately 2.6m bgl. This was in turn underlain by natural silt to a depth of approximately 3.8m bgl. The silt was underlain by sand and gravel to a depth of approximately 8.2m bgl at which point stiff clay was encountered.
- Soil analytical results from below 2.75m bgl (-0.25m OD), which are considered representative of soil likely to remain in-situ following redevelopment work. No exceedances of the Stage 2 GAC were detected for petroleum hydrocarbons, PAHs or PCBs. Metal concentrations in samples from below -0.25m OD are generally below the Stage 2 GAC protective of human health, but exceedances of the Stage 2 GAC were detected for arsenic, cadmium, copper and lead in a number of soil sample, asbestos in one soil sample and VOCs (chloromethane and vinyl chloride) in two soil samples;
- Groundwater analytical results for petroleum hydrocarbons, metals, PAHs, SVOCs and VOCs were all less than the GAC protective of human health, indicating no significant risk to human health from these parameters; and
- Groundwater analytical results for hydrocarbons, PAHs and VOCs were all less than the GAC protective of controlled waters but a small number of metals parameters exceeded the GAC, including arsenic and zinc.

Overall, the site was found to be typical of brownfield sites within this area of the North Dublin Docklands. It appears that the made ground beneath the site is composed of poor quality fill material that contains a number of contaminants at concentrations in excess of the GAC protective of human health for a residential end use scenario. The contamination encountered appears to be historic in nature and is likely to be associated with the poor quality of fill material used in the reclamation of the

site, or in the case of hydrocarbons and PAHs, associated with historic uses of the site and the surrounding area.

Concentrations of TPH, PAHs and metals were significantly higher in the near surface made ground than were detected in the underlying silt/clay/gravel. Concentrations of these parameters in groundwater were generally not significantly elevated (with the exception of metals).

The construction of a basement at the site will involve excavation of soil to a depth of approximately 2.75m below existing ground level (-0.25m OD) and installation of a pile wall around the vicinity of the site. This will remove the majority of impacted made ground and overburden from the site. As the site is to be covered by the building footprint, hard standing or imported fill (1m in thickness) the pathways for exposure to future site users to contamination contained within the underlying soil are limited and are confined to the vapour migration pathway.

Given that slightly elevated concentrations of volatile contaminants (chloromethane and vinyl chloride) were only detected in two soil samples in excess of the Stage 2 GAC the.potential risk from vapour intrusion in residual soils is considered low and ventilation installed in basements as part of the current design further reduce the risks. Therefore no remedial action is required but it is recommended that the building design minimise service penetrations through foundation and/or ensure these are adequately sealed to minimise ingress of malodours or vapours.

Exceedances of the GAC protective of controlled water were detected in all three groundwater samples; exceedances were confined to a small number of metals including arsenic and zinc. Excavation of impacted made ground and installation of a pile wall around the site into the underlying stiff clay will remove the principal source of metals within groundwater and limit vertical and horizontal migration of groundwater, thus reducing risks posed to underlying groundwater or to nearby surface water receptors.

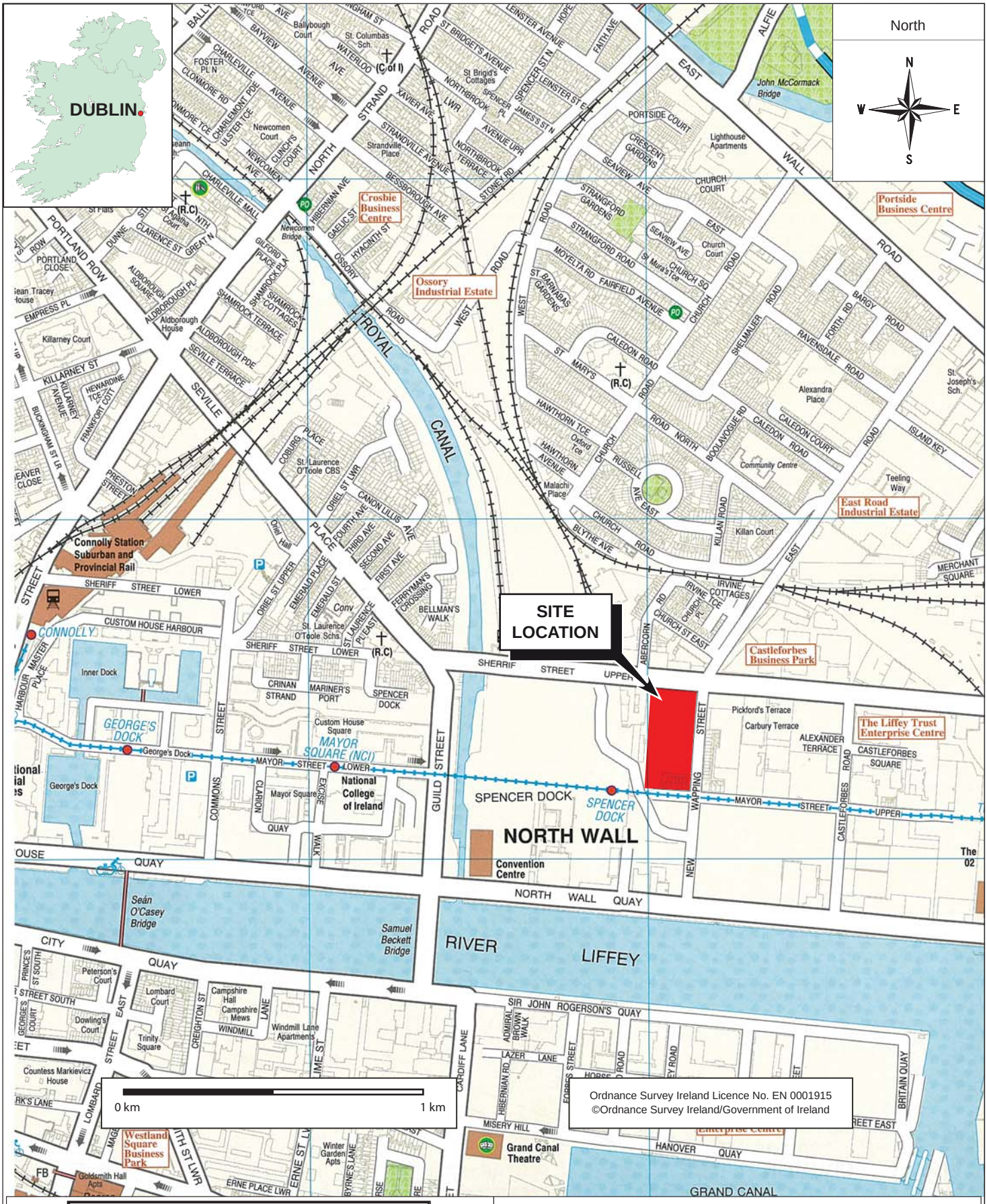
It is expected that risks to off site residents and construction workers during construction works at the site will be suitably mitigated with the implementation of robust Environmental Control Measures (i.e. dust suppression, wheel washes) and the use of appropriate Personal Protective Equipment (PPE) by construction workers.

It should be noted that that this assessment has been completed with the following assumptions:

- Removal of soil to -0.25m OD across the site and construction of a vented single level basement;
- Future residential use without gardens or growth of produce which would allow contact with existing subsurface soils; and
- The site will be covered by buildings or hard standing. All exposed landscape or open areas will be capped with impermeable membrane or a surface cover of clean imported fill at least 1.0m thick.

If they above site design characteristics change, further assessment of risk to site users and groundwater/River Liffey is recommended.

FIGURES



CLIENT

HINES IRELAND

PROJECT

CITY BLOCK 2 GQRA

DRAWING TITLE

FIGURE 1 - SITE LOCATION PLAN

AECOM

4TH FLOOR, ADELPHI PLAZA, ADELPHI CENTRE, GEORGE'S STREET UPPER, DUN LAOGHAIRE, CO. DUBLIN, IRELAND. T +353 (0)1 238 3100

DRAWN	ILLUSTRATED	CHECKED	APPROVED	DATE
SML		BD	SF/DUB	JUNE 2015

SCALE	Job No.	REV.
1:7,500	47092981	0

This drawing is not to scale, it is for illustrative purposes only

AECOM

4TH FLOOR, ADELPHI PLAZA, ADELPHI CENTRE,
GEORGE'S STREET UPPER, DUN LAOGHAIRE,
CO. DUBLIN, IRELAND. T +353 (0)1 238 3100

CLIENT

HINES IRELAND

PROJECT

CITY BLOCK 2 GQRA

DRAWING TITLE

FIGURE 2 _ SITE LOCATION

DRAWN	CHECKED	APPROVED	DATE
SML	BD	SF/DUB	JUNE 2015
SCALE	DRG NO.		
NTS	47092981		

Rev	Date	Detail	Made	Chk'd	App'd

Status: PRELIMINARY

NOTES:
- TRIAL PIT LOCATION
- BOREHOLE LOCATION

Client: HINES IRELAND

Project: CITY BLOCK 2 GQRA

Title: **FIGURE 3** _ SITE LAYOUT SHOWING TRIAL PIT AND BOREHOLE LOCATIONS

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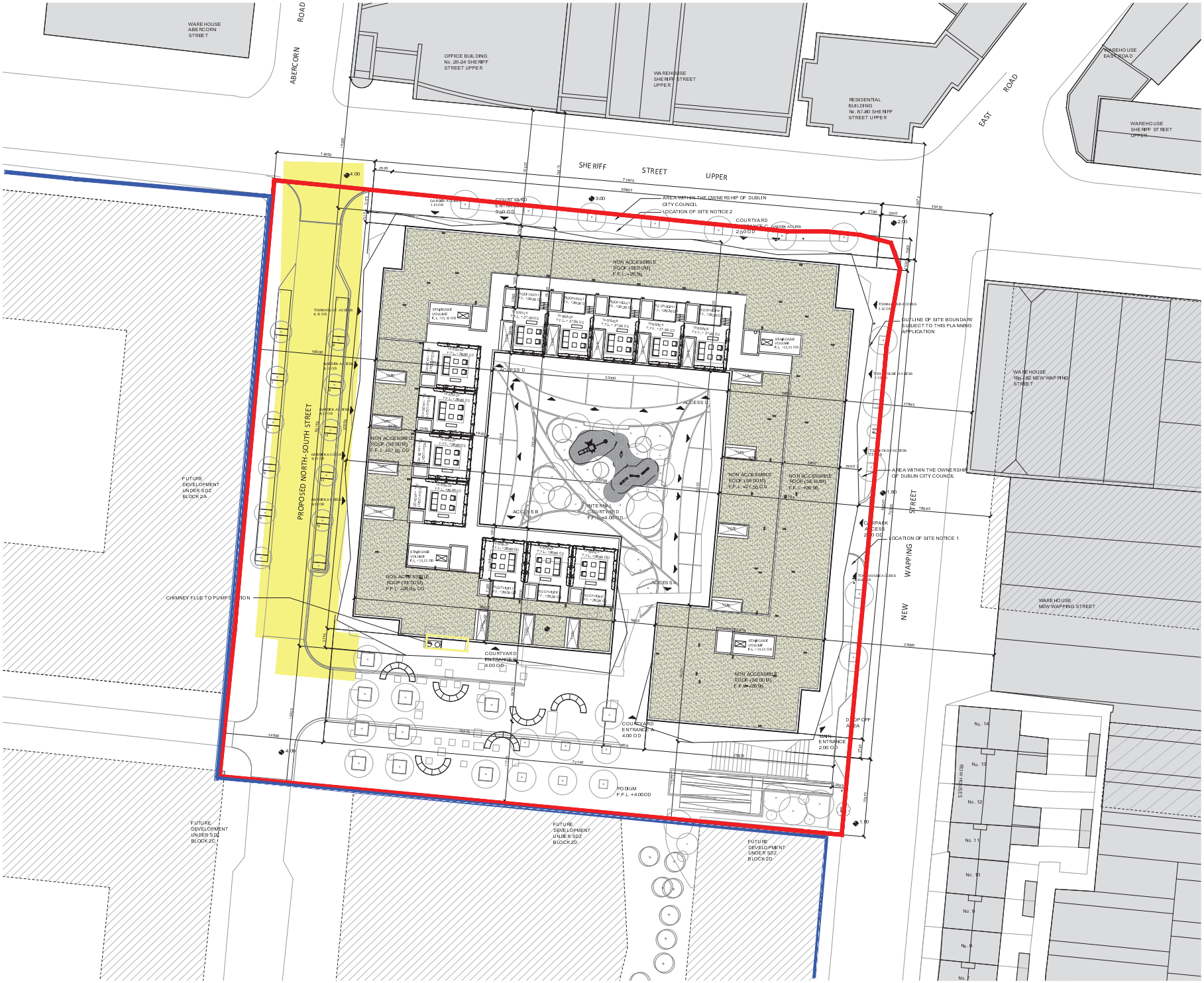
Design: DESIGN	CAD: SML
Chk'd: BD	App'd: BD
Date: 16.09.15	Scale: SCALE

Project No.	Drg No.	Stat.	Rev:
47092981	3	.	0



PROPOSED SITE PLAN

LEGEND

- EXISTING CONSTRUCTION
- FUTURE DEVELOPMENT
- OUTLINE OF SITE BOUNDARY SUBJECT TO THIS PLANNING APPLICATION
- OTHER LANDS WITHIN THE CONTROL OF THE APPLICANT AND/OR QIE
- PROPOSED WAYLEAVE
- DRAWING NUMBER / PAGE REFERENCE
- EXISTING FINISHED FLOOR LEVEL
- PROPOSED FINISHED FLOOR LEVEL

PLANNING PERMISSION

Notes :

1. ALL LEVELS (IN METERS) RELATE TO MALIN HEAD LEVELING DATUM
2. DRAWINGS PREPARED BASED ON TOPOGRAPHICAL LAYOUT RECEIVED FROM APEX SURVEY AND MURPHY SURVEYS
3. DIMENSIONS IN MILLIMETERS FIGURED DIMENSIONS ONLY TO BE USED, DO NOT SCALE FROM DRAWING. ALL DIMENSIONS TO BE CHECKED ON SITE WITH THE ARCHITECT TO BE NOTIFIED OF ANY DISCREPANCIES.
4. DRAWINGS FOR PLANNING PURPOSES ONLY. NOT TO BE USED FOR CONSTRUCTION

Revision :	Date :	Description :
A	31/07/15	Planning Permission

Drawing Title :	Rev :	Drawing No :
PROPOSED SITE PLAN	A	PP-102

Date :	Scale :	Drawn by :	Checked by :
31.07.2015	1:250@A1	AGC-TM-BD	AG-ML

Project Title :	Job No :
SPENCER DOCK RESIDENTIAL	1428

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TABLES

Table 1
Soil Analytical Results - Trial Pits
City Block 2

Location_Code	TP201	TP201	TP202	TP202	TP203	TP204	TP205	TP205	TP206	TP207	TP208	TP209	TP209	TP210	TP210	TP211
Sample_Depth_Range m BGL	2.7-3.5	3.8-4.5	2.2-3.4	3.4-3.8	3.9-4.1	3.3-4	3-4	4-4.3	2.5-3.5	2.3-3.6	2.8-3.7	2.7-4.0	3.7-4.3	2.3-3.5	3.5-4.2	3.0-4.0
Sampled_Date_Time	29/05/2015	29/05/2015	29/05/2015	29/05/2015	29/05/2015	04/06/2015	27/05/2015	27/05/2015	28/05/2015	28/05/2015	29/05/2015	04/06/2015	04/06/2015	28/05/2015	28/05/2015	28/05/2015
Lab_Report_Number	15-8159-1	15-8159-1	15-8159-1	15-8159-1	15-8159-1	15-8407	15-8159-1	15-8159-1	15-8073	15-8073	15-8159-1	15-8407	15-8407	15-8073	15-8073	15-8073
Matrix_Description	Silt	Gravel	Made Ground	Gravel	Gravel	Gravel	Silt	Gravel	Silt	Silt	Silt	Silt	Gravel	Silt	Gravel	Gravel
Sample_Elevation top m OD	0.09	-1.01	0.34	-0.86	-1.62	-0.81	-0.25	-1.25	-0.40	0.24	-0.03	-0.05	-1.05	0.13	-1.08	-0.84
Sample_Elevation bottom m OD	-0.71	-1.71	-0.86	-1.26	-1.82	-1.51	-1.25	-1.55	-1.40	-0.96	-0.94	-1.35	-1.65	-1.08	-1.78	-1.84
Sample_Elevation mean m OD	-0.308	-1.358	-0.256	-1.056	-1.718	-1.16	-0.745	-1.395	-0.904	-0.362	-0.485	-0.7	-1.35	-0.475	-1.425	-1.338

Chem_Group	ChemName	output unit	EQL	GAC_HH_RES-PL_SAND_0.58-1.45%TOC														
TPH	EPH C8-C40	mg/kg	30		387	<30	90	<30	<30	75	<30	<30	<30	871	262	386	293	249	56	91
	>C5-C6 Aliphatics	mg/kg	0.1	**20**[#5]	<0.1	<0.1	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.1	<0.5	<0.1	<0.1	<0.1	<0.1
	>C6-C8 Aliphatics	mg/kg	0.1	**44**[#5]	<0.1	<0.1	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.1	<0.5	<0.1	<0.1	<0.1	<0.1
	>C8-C10 Aliphatics	mg/kg	0.1	**11**[#5]	<0.1	<0.1	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.1	<0.5	<0.1	<0.1	<0.1	<0.1
	>C10-C12 Aliphatics	mg/kg	0.2	**52**[#5]	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	>C12-C16 Aliphatics	mg/kg	4	**430**[#5]	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
	>C16-C21 Aliphatics	mg/kg	7		<7	<7	<7	<7	<7	<7	<7	<7	<7	12	46	<7	<7	<7	<7	<7
	>C16-C35 Aliphatics	mg/kg		**37,000**[#5]	18.5[#8]	<14[#15]	<14[#15]	<14[#15]	<14[#15]	<14[#15]	<14[#15]	<14[#15]	<14[#15]	38[#8]	75[#8]	19.5[#8]	<14[#15]	<14[#15]	<14[#15]	<14[#15]
	>C21-C35 Aliphatics	mg/kg	7		15	<7	<7	<7	<7	<7	<7	<7	<7	26	29	16	<7	<7	<7	<7
	>C35-C40 Aliphatics	mg/kg	7		<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7
	>C5-C40 Aliphatics	mg/kg	26		<26	<26	<26	<26	<26	<26	<26	<26	<26	38	75	<26	<26	<26	<26	<26
	>EC5-EC7 Aromatics	mg/kg	0.1	**130**[#5]	<0.1	<0.1	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.1	<0.5	<0.1	<0.1	<0.1	<0.1
	>EC7-EC8 Aromatics	mg/kg	0.1	**310**[#5]	<0.1	<0.1	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.1	<0.5	<0.1	<0.1	<0.1	<0.1
	>EC8-EC10 Aromatics	mg/kg	0.1	**18**[#5]	<0.1	<0.1	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.1	<0.5	<0.1	<0.1	<0.1	<0.1
	>EC10-EC12 Aromatics	mg/kg	0.2	**100**[#5]	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	>EC12-EC16 Aromatics	mg/kg	4	**980**[#5]	<4	<4	<4	<4	<4	<4	<4	<4	<4	15	9	<4	5	<4	<4	<4
	>EC16-EC21 Aromatics	mg/kg	7	**1,800**[#5]	<7	<7	22	19	<7	<7	<7	<7	<7	98	117	<7	44	15	<7	<7
	>EC21-EC35 Aromatics	mg/kg	7	**1,900**[#5]	40	13	75	92	<7	<7	<7	<7	<7	232	247	49	131	95	10	<7
	>EC35-EC40 Aromatics	mg/kg	7		<7	<7	22	28	<7	<7	<7	<7	<7	32	50	15	46	10	<7	<7
	>EC5-EC40 Aromatics	mg/kg	26		40	<26	119	139	<26	<26	<26	<26	<26	377	423	64	226	120	<26	<26
	>C5-C40 Aliphatics & Aromatics	mg/kg	52		<52	<52	119	139	<52	<52	<52	<52	<52	415	498	64	226	120	<52	<52
	>C6-C10 Aliphatics	mg/kg	0.1		<0.1	<0.1	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.1	<0.5	<0.1	<0.1	<0.1	<0.1
	>C10-C25 Aliphatics	mg/kg	10		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	47	18	<10	<10	<10	<10
	>C25-C35 Aliphatics	mg/kg	10		<10	<10	<10	<10	<10	<10	<10	<10	<10	26	20	<10	<10	<10	<10	<10
	>EC6-EC10 Aromatics	mg/kg	0.1		<0.1	<0.1	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.1	<0.5	<0.1	<0.1	<0.1	<0.1
	>EC10-EC25 Aromatics	mg/kg	10		<10	<10	41	43	<10	<10	<10	<10	<10	167	175	<10	82	30	<10	<10
	>EC25-EC35 Aromatics	mg/kg	10		40	13	65	73	<10	<10	<10	<10	<10	182	200	49	106	81	<10	<10
	Mineral Oil (C8-C40)	mg/kg	30		<30	<30	<30	<30	<30	<30	<30	<30	<30	38	82	<30	<30	<30	<30	<30
BTEX	Benzene	mg/kg	0.01	**0.13**[#5]	<0.005	<0.005	<0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.025	0.023	<0.025	<0.005	<0.005	<0.005	<0.005
	Toluene	mg/kg	0.01	**320**[#5]	<0.005	<0.005	<0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.025	0.012	<0.025	<0.005	0.013	<0.005	<0.005
	Ethylbenzene	mg/kg	0.01	**29**[#5]	<0.005	<0.005	<0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.025	<0.005	<0.025	<0.005	<0.005	<0.005	<0.005
	Xylene (m & p)	mg/kg	0.01		<0.005	<0.005	<0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.025	<0.005	<0.025	<0.005	<0.005	<0.005	<0.005
	Xylene Total	mg/kg		**3.4**[#3]	<0.01[#7]	<0.01[#7]	<0.05[#7]	<0.01[#7]	<0.01[#7]	<0.01[#7]	<0.01[#7]	<0.01[#7]	<0.01[#7]	<0.05[#7]	<0.01[#7]	<0.05[#7]	<0.01[#7]	<0.01[#7]	<0.01[#7]	<0.01[#7]
	Xylene (o)	mg/kg	0.01	**31**[#5]	<0.005	<0.005	<0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.025	<0.005	<0.025	<0.005	<0.005	<0.005	<0.005
	Total BTEX	mg/kg	0.03		<0.025	<0.025	<0.125	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.125	0.035	<0.125	<0.025	<0.025	<0.025	<0.025
Oxygenates	MTBE	mg/kg	0.01	**23.4**[#6]	<0.005	<0.005	<0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.025	<0.005	<0.025	<0.005	<0.005	<0.005	<0.005
PAH	Naphthalene	mg/kg	0.04	**0.85**[#5]	<0.04	<0.04	0.05	0.11	<0.04	<0.04	<0.04	<0.04	<0.04	0.15	<0.04	<0.04	0.34	0.08	<0.04	<0.04
	Acenaphthylene	mg/kg	0.03	**1,800**[#5]	<0.03	<0.03	0.05	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.06	<0.03	<0.03	0.12	<0.03	<0.03	<0.03
	Acenaphthene	mg/kg	0.05	**1,800**[#5]	<0.05	<0.05	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.1	<0.05	<0.05	0.12	<0.05	<0.05	<0.05
	Fluorene	mg/kg	0.04	**2,100**[#5]	<0.04	<0.04	0.08	0.06	<0.04	<0.04	<0.04	<0.04	<0.04	0.22	0.05	<0.04	0.16	0.06	<0.04	<0.04
	Phenanthrene	mg/kg	0.03	**1,200**[#5]	0.04	0.1	1.25	0.73	<0.03	0.39	<0.03	0.05	0.06	2.14	0.47	0.25	2.93	0.38	<0.03	0.25
	Anthracene	mg/kg	0.04	**29,000**[#5]	<0.04	<0.04	0.15	<0.04	<0.04	0.14	<0.04	<0.04	<0.04	0.28	0.09	0.07	0.42	0.08	<0.04	0.06
	Fluoranthene	mg/kg	0.03	**1,500**[#5]	0.14	0.08	1.83	0.63	<0.03	0.33	<0.03	0.05	0.06	1.97	0.51	0.25	2.87	0.44	<0.03	0.22
	Pyrene	mg/kg	0.03	**3,700**[#5]	0.11	0.08	1.27	0.44	<0.03	0.29	<0.03	0.04	<0.03	1.37	0.4	0.16	1.9	0.38	<0.03	0.17
	Benz(a)anthracene	mg/kg	0.06	**11**[#5]	0.18	0.08	0.98	0.44	0.09	0.24	0.07	<0.06	<0.06	0.79	0.34	0.14	1.06	0.29	<0.06	0.12
	Chrysene	mg/kg	0.02	**29**[#5]	0.14	0.07	1.01	0.48	0.06	0.26	0.06	0.04	0.04	0.88	0.31	0.14	1.47	0.3	<0.02	0.1
	Benzo(a) pyrene	mg/kg	0.04	**3.1**[#5]	0.12	0.06	0.47	0.14	<0.04	0.16	0.09	0.06	<0.04	0.51	0.25	0.11	0.87	0.19	<0.04	0.06
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.04	**44**[#5]	0.08	0.05	0.34	0.11	<0.04	0.1	0.09	0.07	<0.04	0.34	0.2	0.07	0.66	0.09	<0.04	<0.04
	Dibenz(a,h)anthracene	mg/kg	0.04	**0.31**[#5]	<0.04	<0.04	0.08	<0.04	<0.04	<0.04	0.05	<0.04	<0.04	0.1	0.05	<0.04	0.19	<0.04	<0.04	<0.04
	Benzo(g,h,i)perylene	mg/kg	0.04	**350**[#5]	0.08	0.05	0.34	0.13	<0.04	0.08	0.12	0.09	<0.04	0.35	0.2	0.08	0.7	0.1	<0.04	<0.04
	Benzo(b)fluoranthene	mg/kg	0.05	**3.9**[#5]	0.15	0.07	0.85	0.34	0.06	0.18	0.12	0.09	<0.05	0.74	0.31	0.14	1.3	0.22	<0.05	0.08
	Benzo(k)fluoranthene	mg/kg	0.02	**110**[#5]	0.06	0.03	0.33	0.13	0.03	0.07	0.05	0.04	<0.02	0.29	0.12	0.05	0.51	0.08	<0.02	0.03
	Benzo(b)&(k)fluoranthene	mg/kg	0.07		0.21	0.1	1.18	0.47	0.09	0.25	0.17	0.13	<0.07	1.03	0.43	0.19	1.81	0.3	<0.07	0.11
	Benzo(j)fluoranthene	mg/kg	1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	PAHs (sum of 6)	mg/kg	0.22		0.63	0.34	4.16	1.48	<0.22	0.92	0.47	0.4	<0.22	4.2	1.59	0.7	6.91	1.12	<0.22	0.39
	PAHs (sum of 4)	mg/kg			0.37[#8]	0.2[#8]	1.86[#8]	0.71[#8]	0.13[#8]	0.43[#8]	0.38[#8]	0.29[#8]	<0.15[#15]	1.72[#8]	0.83[#8]	0.34[#8]	3.17[#8]	0.49[#8]	<0.15[#15]	0.15[#8]
	PAH 17 Total	mg/kg	0.64		1.1	0.67	9.14	3.74	<0.64	2.24	0.65	<0.64	<0.64	10.29	3.3	1.46	15.72	2.69	<0.64	1.09
	benzo(g,h,i)perylene + indeno(1,2,3-cd)pyrene	mg/kg			0.16[#8]	0.1[#8]	0.68[#8]	0.24[#8]	<0.08[#15]	0.18[#8]	0.21[#8]	0.16[#8]	<0.08[#15]	0.69[#8]	0.4[#8]	0.15[#8]	1.36[#8]	0.19[#8]	<0.08[#15]	<0.08[#15]
	Coal Tar (Bap as surrogate marker)	mg/kg		**1.2**[#5]	0.12[#8]	0.06[#8]	0.47[#8]	0.14[#8]	<0.04[#15]	0.16[#8]	0.09[#8]	0.06[#8]	<0.04[#15]	0.51[#8]	0.25[#8]	0.11[#8]	0.87[#8]	0.19[#8]	<0.04[#15]	0.06[#8]
	Coronene	mg/kg	0.04		<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.1	<0.04	<0.04	<0.04

Table 1
Soil Analytical Results - Trial Pits
City Block 2

Location_Code	TP201	TP201	TP202	TP202	TP203	TP204	TP205	TP205	TP206	TP207	TP208	TP209	TP209	TP210	TP210	TP211
Sample_Depth_Range m BGL	2.7-3.5	3.8-4.5	2.2-3.4	3.4-3.8	3.9-4.1	3.3-4	3-4	4-4.3	2.5-3.5	2.3-3.6	2.8-3.7	2.7-4.0	3.7-4.3	2.3-3.5	3.5-4.2	3.0-4.0
Sampled_Date_Time	29/05/2015	29/05/2015	29/05/2015	29/05/2015	29/05/2015	04/06/2015	27/05/2015	27/05/2015	28/05/2015	28/05/2015	29/05/2015	04/06/2015	04/06/2015	28/05/2015	28/05/2015	28/05/2015
Lab_Report_Number	15-8159-1	15-8159-1	15-8159-1	15-8159-1	15-8159-1	15-8407	15-8159-1	15-8159-1	15-8073	15-8073	15-8159-1	15-8407	15-8407	15-8073	15-8073	15-8073
Matrix_Description	Silt	Gravel	Made Ground	Gravel	Gravel	Gravel	Silt	Gravel	Silt	Silt	Silt	Silt	Gravel	Silt	Gravel	Gravel
Sample_Elevation top m OD	0.09	-1.01	0.34	-0.86	-1.62	-0.81	-0.25	-1.25	-0.40	0.24	-0.03	-0.05	-1.05	0.13	-1.08	-0.84
Sample_Elevation bottom m OD	-0.71	-1.71	-0.86	-1.26	-1.82	-1.51	-1.25	-1.55	-1.40	-0.96	-0.94	-1.35	-1.65	-1.08	-1.78	-1.84
Sample_Elevation mean m OD	-0.308	-1.358	-0.256	-1.056	-1.718	-1.16	-0.745	-1.395	-0.904	-0.362	-0.485	-0.7	-1.35	-0.475	-1.425	-1.338

Chem_Group	ChemName	output unit	EQL	GAC_HH_RES-PL_SAND_0.58-1.45%TOC														
PCBs	PCB 118	mg/kg	0.01	**0.12**[#1]	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	PCB 28	mg/kg	0.01		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.007	<0.005	<0.005	0.009	<0.005	<0.005	<0.005
	PCB 52	mg/kg	0.01		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	PCB 101	mg/kg	0.01		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	PCB 138	mg/kg	0.01		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	PCB 153	mg/kg	0.01		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	PCB 180	mg/kg	0.01		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	Total PCB 7 Congeners	mg/kg	0.04	**0.2**[#3]	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035
Metals	Antimony	mg/kg	1	**555**[#6]	3	83	120	27	3	6	3	7	3	5	5	3	2	3	2	2
	Arsenic	mg/kg	0.5	**40**[#5]	25.2	**223.7**	**606.9**	**148.2**	**180.4**	**40.9**	31.1	**86.6**	**90.2**	35.2	**176.3**	18.9	25.1	**66.4**	38.1	**110.4**
	Barium	mg/kg	1	**1,340**[#6]	46	305	81	78	29	32	43	37	51	310	106	106	41	81	69	55
	Cadmium	mg/kg	0.1	**85**[#5]	1.1	35.9	**87.7**	4.5	<0.1	0.6	1.2	2.8	0.8	0.6	1.1	1.9	1.2	9.1	2.8	3.5
	Chromium (III+VI)	mg/kg	0.5		55	167.2	38.7	82.5	146.2	120.6	127.9	7	106.9	58.2	62.2	48.3	91.8	52.2	88	105
	Copper	mg/kg	1	**7,100**[#5]	63	2031	**10,930**	625	24	8	60	293	119	66	95	80	66	185	42	294
	Lead	mg/kg	5	**310**[#4]	183	**18,300**	**18,580**	**537**	36	18	131	**432**	85	**334**	218	214	83	**443**	**479**	**714**
	Mercury	mg/kg	0.1	**56**[#5]	0.6	<0.1	1.5	0.7	1.6	0.6	0.2	<0.1	0.2	2	1.1	0.7	0.1	0.7	<0.1	<0.1
	Molybdenum	mg/kg	0.1	**673**[#6]	5.2	34.6	76	18.1	18.5	14.4	11.5	4.8	13.5	5.1	6.5	5	8.8	5.7	8.5	10
	Nickel	mg/kg	0.7	**180**[#5]	31.7	15.2	19.3	14.3	4.9	4.3	22.3	9.1	6.5	31.9	24.7	27.7	16	22.6	11.6	22
	Selenium	mg/kg	1	**430**[#5]	1	1	4	2	<1	<1	<1	<1	<1	2	1	1	<1	1	1	5
	Zinc	mg/kg	5	**40000**[#5]	917	16,460	17,920	3174	297	830	521	1073	1523	145	309	332	314	5020	964	1069
	Chromium (hexavalent)	mg/kg	0.3	**6**[#5]	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.5	<0.3	<0.3	<0.3	<0.3	<0.3
	Chromium (Trivalent)	mg/kg	0.5	**910**[#5]	55	167.2	38.7	82.5	146.2	120.6	127.9	7	106.9	58.2	61.7	48.3	91.8	52.2	88	105
Organics	TOC	%	0.02		1.82	0.31	1.61	0.4	0.37	0.9	1.98	1[#29]	0.41	3.95	3.07	3.44	1.41	2.5	0.71	0.52
Inorganics	Moisture Content 105C	%	0.1		39.2	33.2	36.1	44.1	39.2	23.4	37.9	17.8	29.8	41.7	21.3	45.2	38	23.2	14.5	19
	pH (Lab)	pH_Units	0.01		7.48	7.4	6.63	7.47	5.81	6.8	7.7	7.63	5.92	7.39	8.12	8.15	7.88	7.5	8.02	7.94
Asbestos	Asbestos Type	None			None	None	None	None	None	None	None	Chrysotile	None	None	None	None	None	None	None	None
	Asbestos Type 2	None			None	None	None	None	None	None	None	-	None	None	None	None	None	None	None	None
	Asbestos Level	None			None	None	None	None	None	None	None	Quantifiable	None	None	None	None	None	None	None	None
	Asbestos Containing Material	None			None	None	None	None	None	None	None	Fibre Bundles	None	None	None	None	None	None	None	None
	Asbestos Containing Material (2)	None			None	None	None	None	None	None	None	-	None	None	None	None	None	None	None	None

Comments
#1 USEPA RSL
#2 Dutch Serious 2009
#3 Dutch Intervention 2009
#4 Defra C4SL 12/2014
#5 AECOM (modified LQM/CIEH S4ULs)
#6 AECOM (modified EIC)
#7 ESDAT Combined. Some Analytes are missing from this Combined Compound.
#8 ESDAT Combined with Non-Detect Multiplier of 0.5.
#9 No interpretation possible
#10 Possible PAHs and humics
#11 Humics and possible PAHs
#12 Possble PAHs and humics
#13 Possible PAHs/humics
#15 ESDAT Combined.
#16 PAHs and humics
#19 Possible PAHs
#21 Humic acids
#28 PAHs
#29 NDP
GAC: Generic Assessment Criteria
(blank): No assessment criteria available
- : Not analysed

Key
GAC_HH_RES-PL_SAND_0.58-1.45%TOC Exceedance of HH Soil. Residential without Plant Uptake. Sand. TOC >=0.58 to <1.45%

Table 2
Soil Analytical Results - Boreholes
City Block 2

Location_Code	BH10	BH11	BH12	BH13	BH14	BH9
Sample_Depth_Range m BGL	4-5	4-5	4-5	4-5	4-5	4-5
Sampled_Date_Time	13/07/2015	15/07/2015	10/07/2015	21/07/2015	30/06/2015	09/07/2015
Lab_Report_Number	JEL-15-10240-1	JEL-15-10240-1	JEL-15-10042-1	JEL-15-10536-1	JEL-15-9506-1	JEL-15-9992-1
Matrix_Description	Gravel	Silt	Gravel	Silt	Gravel	Silt
Sample_Elevation top m OD	-1.718	-1.788	-1.656	-1.339	-1.639	-1.316
Sample_Elevation bottom m OD	-2.718	-2.788	-2.656	-2.339	-2.639	-2.316
Sample_Elevation mean m OD	-2.218	-2.288	-2.156	-1.839	-2.139	-1.816

Chem_Group	ChemName	output unit	EQL	GAC_HH_RES-PL_SAND_0.58-1.45%TOC						
TPH	EPH C8-C40	mg/kg	30		<30	<30	136	<30	<30	<30
	>C5-C6 Aliphatics	mg/kg	0.1	**20**[#5]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	>C6-C8 Aliphatics	mg/kg	0.1	**44**[#5]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	>C8-C10 Aliphatics	mg/kg	0.1	**11**[#5]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	>C10-C12 Aliphatics	mg/kg	0.2	**52**[#5]	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	>C12-C16 Aliphatics	mg/kg	4	**430**[#5]	<4	<4	<4	<4	<4	<4
	>C16-C21 Aliphatics	mg/kg	7		<7	<7	<7	<7	<7	<7
	>C16-C35 Aliphatics	mg/kg		**37.000**[#5]	<14[#12]	<14[#12]	<14[#12]	<14[#12]	<14[#12]	<14[#12]
	>C21-C35 Aliphatics	mg/kg	7		<7	<7	<7	<7	<7	<7
	>C35-C40 Aliphatics	mg/kg	7		<7	<7	<7	<7	<7	<7
	>C5-C40 Aliphatics	mg/kg	26		<26	<26	<26	<26	<26	<26
	>EC5-EC7 Aromatics	mg/kg	0.1	**130**[#5]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	>EC7-EC8 Aromatics	mg/kg	0.1	**310**[#5]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	>EC8-EC10 Aromatics	mg/kg	0.1	**18**[#5]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	>EC10-EC12 Aromatics	mg/kg	0.2	**100**[#5]	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	>EC12-EC16 Aromatics	mg/kg	4	**980**[#5]	<4	<4	<4	<4	<4	<4
	>EC16-EC21 Aromatics	mg/kg	7	**1.800**[#5]	<7	<7	<7	<7	<7	<7
	>EC21-EC35 Aromatics	mg/kg	7	**1.900**[#5]	<7	<7	<7	<7	<7	<7
	>EC35-EC40 Aromatics	mg/kg	7		<7	<7	<7	<7	<7	<7
	>EC5-EC40 Aromatics	mg/kg	26		<26	<26	<26	<26	<26	<26
	>C5-C40 Aliphatics & Aromatics	mg/kg	52		<52	<52	<52	<52	<52	<52
	>C6-C10 Aliphatics	mg/kg	0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	>C10-C25 Aliphatics	mg/kg	10		<10	<10	<10	<10	<10	<10
	>C25-C35 Aliphatics	mg/kg	10		<10	<10	<10	<10	<10	<10
	>EC6-EC10 Aromatics	mg/kg	0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	>EC10-EC25 Aromatics	mg/kg	10		<10	<10	<10	<10	<10	<10
	>EC25-EC35 Aromatics	mg/kg	10		<10	<10	<10	<10	<10	<10
	Mineral Oil (C8-C40)	mg/kg	30		<30	<30	<30	<30	<30	<30
BTEX	Benzene	mg/kg	0	**0.13**[#5]	0.008	0.005	<0.003	<0.003	<0.003	<0.003
	Toluene	mg/kg	0	**320**[#5]	<0.003	<0.003	0.009	<0.003	<0.003	<0.003
	Ethylbenzene	mg/kg	0	**29**[#5]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	Xylene (m & p)	mg/kg	0.01		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	Xylene Total	mg/kg		**3.4**[#3]	<0.008[#7]	<0.008[#7]	<0.008[#7]	<0.008[#7]	<0.008[#7]	<0.008[#7]
	Xylene (o)	mg/kg	0	**31**[#5]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	Total BTEX	mg/kg	0.02		<0.017	<0.017	<0.017	<0.025	<0.017	<0.017
Oxygenates	MTBE	mg/kg	0	**23.4**[#6]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chlorinated Hydrocarbons	Chloromethane	mg/kg	0	**0.00304**[#6]	**0.014**	**0.014**	<0.003	<0.003	<0.003	<0.003
	Vinyl chloride	mg/kg	0	**0.00031**[#5]	**0.012**	**0.011**	**<0.002**	**<0.002**	**<0.002**	**<0.002**
	Chloroethane	mg/kg	0	**3.06**[#6]	0.016	0.014	<0.002	<0.002	<0.002	<0.002
	1,1-dichloroethene	mg/kg	0.01	**0.0861**[#6]	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
	Dichloromethane	mg/kg	0.01	**0.687**[#6]	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007
	trans-1,2-dichloroethene	mg/kg	0	**0.0678**[#6]	0.008	0.008	<0.003	<0.003	<0.003	<0.003
	1,1-dichloroethane	mg/kg	0	**0.839**[#6]	0.009	0.008	<0.003	<0.003	<0.003	<0.003
	cis-1,2-dichloroethene	mg/kg	0	**0.0403**[#6]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	Chloroform	mg/kg	0	**0.4**[#5]	0.006	0.006	<0.003	<0.003	<0.003	<0.003
	1,1,1-trichloroethane	mg/kg	0	**3.2**[#5]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	Carbon tetrachloride	mg/kg	0	**0.0094**[#5]	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	Trichloroethene	mg/kg	0	**0.006**[#5]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	1,1,2-trichloroethane	mg/kg	0	**0.302**[#6]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	Tetrachloroethene	mg/kg	0	**0.063**[#5]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	Sum of PCE and TCE	mg/kg			<0.006[#12]	<0.006[#12]	<0.006[#12]	<0.006[#12]	<0.006[#12]	<0.006[#12]
	TCE+DCE+VC	mg/kg			0.026[#8]	0.025[#8]	<0.017[#12]	<0.017[#12]	<0.017[#12]	<0.017[#12]
	PCE+TCE+DCE+VC	mg/kg			0.0275[#8]	0.0265[#8]	<0.02[#12]	<0.02[#12]	<0.02[#12]	<0.02[#12]
VOC	2,2-dichloropropane	mg/kg	0		<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	Bromochloromethane	mg/kg	0	**150**[#1]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	1,1-dichloropropene	mg/kg	0		<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	1,2-dichloroethane	mg/kg	0	**0.0029**[#5]	**<0.004**	**<0.004**	**<0.004**	**<0.004**	**<0.004**	**<0.004**
	1,2-dichloropropane	mg/kg	0.01	**0.00785**[#6]	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
	Dibromomethane	mg/kg	0	**23**[#1]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	Bromodichloromethane	mg/kg	0	**0.29**[#1]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	cis-1,3-dichloropropene	mg/kg	0		<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	trans-1,3-dichloropropene	mg/kg	0		<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	1,3-dichloropropane	mg/kg	0	**1.600**[#1]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	Chlorodibromomethane	mg/kg	0	**0.73**[#1]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	1,1,1,2-tetrachloroethane	mg/kg	0	**0.54**[#5]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	Styrene	mg/kg	0	**12.8**[#6]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	Bromoform	mg/kg	0	**1.82**[#6]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	Isopropylbenzene	mg/kg	0	**4.12**[#6]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	1,1,2,2-tetrachloroethane	mg/kg	0	**1.4**[#5]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	1,2,3-trichloropropane	mg/kg	0	**0.0051**[#1]	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	n-propylbenzene	mg/kg	0	**14.1**[#6]	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	1,3,5-trimethylbenzene	mg/kg	0	**780**[#1]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	tert-butylbenzene	mg/kg	0.01	**7.800**[#1]	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	1,2,4-trimethylbenzene	mg/kg	0.01	**0.144**[#6]	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
	sec-butylbenzene	mg/kg	0	**7.800**[#1]	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	p-isopropyltoluene	mg/kg	0		<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	n-butylbenzene	mg/kg	0	**3.900**[#1]	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	1,2-dibromo-3-chloropropane	mg/kg	0	**0.0053**[#1]	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	Hexachlorobutadiene	mg/kg	0	**0.11**[#5]	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	1,2-Dichloroethene	mg/kg		**0.2**[#3]	0.0095[#8]	0.0095[#8]	<0.006[#12]	<0.006[#12]	<0.006[#12]	<0.006[#12]
	Trihalomethanes	mg/kg			0.0105[#8]	0.0105[#8]	<0.012[#12]	<0.012[#12]	<0.012[#12]	<0.012[#12]
PAH	Naphthalene	mg/kg	0.03	**0.85**[#5]	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027
	Acenaphthylene	mg/kg	0.03	**1.800**[#5]	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
	Acenaphthene	mg/kg	0.05	**1.800**[#5]	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Fluorene	mg/kg	0.04	**2.100**[#5]	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
	Phenanthrene	mg/kg	0.03	**1.200**[#5]	<0.03	<0.03	<0.03	<0.03	0.07	0.06
	Anthracene	mg/kg	0.04	**29.000**[#5]	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
	Fluoranthene	mg/kg	0.03	**1.500**[#5]	<0.03	<0.03	<0.03	<0.03	0.06	0.04
	Pyrene	mg/kg	0.03	**3.700**[#5]	<0.03	<0.03	<0.03	<0.03	0.05	<0.03
	Benz(a)anthracene	mg/kg	0.06	**11**[#5]	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06
	Chrysene	mg/kg	0.02	**29**[#5]	0.03	<0.02	<0.02	<0.02	0.03	<0.02
	Benzo(a) pyrene	mg/kg	0.04	**3.1**[#5]	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.04	**44**[#5]	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
	Dibenz(a,h)anthracene	mg/kg	0.04	**0.31**[#5]	0.08	0.05	<0.04	<0.04	<0.04	<0.04
	Benzo(g,h,i)perylene	mg/kg	0.04	**350**[#5]	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
	Benzo(b)fluoranthene	mg/kg	0.05	**3.9**[#5]	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Benzo(k)fluoranthene	mg/kg	0.02	**110**[#5]	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
	Benzo(b)&(k)fluoranthene	mg/kg	0.07		<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
	Benzo(j)fluoranthene	mg/kg	1		<1	<1	<1	<1	<1	<1
	PAHs (sum of 6)	mg/kg	0.22		<0.22	<0.22	<0.22	<0.22	<0.22	<0.22
	PAHs (sum of 4)	mg/kg			<0.15[#12]	<0.15[#12]	<0.15[#12]	<0.15[#12]	<0.15[#12]	<0.15[#12]
	PAH 17 Total	mg/kg	0.64		<0.64	<0.64	<0.64	<0.64	<0.64	<0.64
	benzo(g,h,i)perylene + indeno(1,2,3-cd)pyrene	mg/kg			<0.08[#12]	<0.08[#12]	<0.08[#12]	<0.08[#12]	<0.08[#12]	<0.08[#12]
	Coal Tar (Bap as surrogate marker)	mg/kg		**1.2**[#5]	<0.04[#12]	<0.04[#12]	<0.04[#12]	<0.04[#12]	<0.04[#12]	<0.04[#12]
SVOC	Coronene	mg/kg	0.04		<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
	2-methylnaphthalene	mg/kg	0.01	**230**[#1]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	4-bromophenyl phenyl ether	mg/kg	0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	4-chlorophenyl phenyl ether	mg/kg	0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Azobenzene	mg/kg	0.01	**5.6**[#1]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Bis(2-chloroethoxy) methane	mg/kg	0.01	**180**[#1]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Bis(2-chloroethyl)ether	mg/kg	0.01	**0.23**[#1]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Carbazole	mg/kg	0.01	**No criteria**[#6]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Dibenzofuran	mg/kg	0.01	**72**[#1]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Hexachlorocyclopentadiene	mg/kg	0.01	**370**[#1]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Hexachloroethane	mg/kg	0.01	**0.0767**[#6]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Table 2
Soil Analytical Results - Boreholes
City Block 2

Location_Code	BH10	BH11	BH12	BH13	BH14	BH9
Sample_Depth_Range m BGL	4-5	4-5	4-5	4-5	4-5	4-5
Sampled_Date_Time	13/07/2015	15/07/2015	10/07/2015	21/07/2015	30/06/2015	09/07/2015
Lab_Report_Number	JEL-15-10240-1	JEL-15-10240-1	JEL-15-10042-1	JEL-15-10536-1	JEL-15-9506-1	JEL-15-9992-1
Matrix_Description	Gravel	Silt	Gravel	Silt	Gravel	Silt
Sample_Elevation top m OD	-1.718	-1.788	-1.656	-1.339	-1.639	-1.316
Sample_Elevation bottom m OD	-2.718	-2.788	-2.656	-2.339	-2.639	-2.316
Sample_Elevation mean m OD	-2.218	-2.288	-2.156	-1.839	-2.139	-1.816

Chem_Group	ChemName	output unit	EQL	GAC_HH_RES-PL_SAND_0.58-1.45%TOC						
Phenolics	2-methylphenol	mg/kg	0.01	3.100[#1]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	2-nitrophenol	mg/kg	0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	2,4-dimethylphenol	mg/kg	0.01	123[#6]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	4-chloro-3-methylphenol	mg/kg	0.01	6.200[#1]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	4-methylphenol	mg/kg	0.01	6.200[#1]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	4-nitrophenol	mg/kg	0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Phenol	mg/kg	0.01	320[#5]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	2-chloronaphthalene	mg/kg	0.01	1.42[#6]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCBs	Total PCB 7 Congeners_WAC	mg/kg	0.04		<0.035	<0.035	<0.035	<0.035	<0.035	<0.035
	PCB 118	mg/kg	0.01	0.12[#1]	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	PCB 28	mg/kg	0.01		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	PCB 52	mg/kg	0.01		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	PCB 101	mg/kg	0.01		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	PCB 138	mg/kg	0.01		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	PCB 153	mg/kg	0.01		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	PCB 180	mg/kg	0.01		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	Total PCB 7 Congeners	mg/kg	0.04	0.2[#3]	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035
Amino Aliphatics	N-nitrosodi-n-propylamine	mg/kg	0.01	0.076[#1]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Anilines	2-nitroaniline	mg/kg	0.01	610[#1]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	3-nitroaniline	mg/kg	0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	4-chloroaniline	mg/kg	0.01	2.7[#1]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	4-nitroaniline	mg/kg	0.01	27[#1]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Explosives	2,4-Dinitrotoluene	mg/kg	0.01	167[#6]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	2,6-dinitrotoluene	mg/kg	0.01	74.5[#6]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Nitrobenzene	mg/kg	0.01	5.1[#1]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Halogenated Benzenes	Chlorobenzene	mg/kg	0	0.16[#5]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	Bromobenzene	mg/kg	0	0.324[#6]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	2-chlorotoluene	mg/kg	0	1.600[#1]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	4-chlorotoluene	mg/kg	0	1.600[#1]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	1,3-dichlorobenzene	mg/kg	0	0.15[#5]	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	1,4-dichlorobenzene	mg/kg	0	22[#5]	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	1,2-dichlorobenzene	mg/kg	0	8.4[#5]	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	1,2,4-trichlorobenzene	mg/kg	0.01	0.91[#5]	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007
	1,2,3-trichlorobenzene	mg/kg	0.01	0.53[#5]	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007
	Hexachlorobenzene	mg/kg	0.01	2.2[#5]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Halogenated Hydrocarbons	Dichlorodifluoromethane	mg/kg	0	87[#1]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	Bromomethane	mg/kg	0	6.8[#1]	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Trichlorofluoromethane	mg/kg	0	730[#1]	0.004	0.004	<0.002	<0.002	<0.002	<0.002
	1,2-dibromoethane	mg/kg	0	0.036[#1]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Halogenated Phenols	2-chlorophenol	mg/kg	0.01	390[#1]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	2,4-dichlorophenol	mg/kg	0.01	180[#1]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	2,4,5-trichlorophenol	mg/kg	0.01	6.200[#1]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	2,4,6-trichlorophenol	mg/kg	0.01	48[#1]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Pentachlorophenol	mg/kg	0.01	26[#5]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Phthalates	Bis(2-ethylhexyl) phthalate	mg/kg	0.01	2.670[#6]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Butyl benzyl phthalate	mg/kg	0.01	42.100[#6]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Di-n-butyl phthalate	mg/kg	0.01	445[#6]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Di-n-octyl phthalate	mg/kg	0.01	3.390[#6]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Diethylphthalate	mg/kg	0.01	1.150[#6]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Dimethyl phthalate	mg/kg	0.01	16.4[#3]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Solvents	Isophorone	mg/kg	0.01	560[#1]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Metals	Antimony	mg/kg	1	555[#6]	2	4	2	2	1	2
	Arsenic	mg/kg	0.5	40[#5]	**146.7**	**264.2**	32.8	14.2	24.1	7.5
	Barium	mg/kg	1	1.340[#6]	23	31	36	37	44	29
	Cadmium	mg/kg	0.1	85[#5]	2.1	0.8	6.4	0.4	0.8	2
	Chromium (III+VI)	mg/kg	0.5		74.8	72.9	81.5	66.3	56	83.3
	Copper	mg/kg	1	7.100[#5]	20	71	77	45	20	5
	Lead	mg/kg	5	310[#4]	92	43	**447**	49	24	17
	Mercury	mg/kg	0.1	56[#5]	<0.1	0.8	<0.1	<0.1	<0.1	<0.1
	Molybdenum	mg/kg	0.1	673[#6]	3.2	6.7	1.7	4.8	1	7.1
	Nickel	mg/kg	0.7	180[#5]	50.1	14.6	30.5	25.9	18.3	24.5
	Selenium	mg/kg	1	430[#5]	9	1	6	1	<1	2
	Zinc	mg/kg	5	40000[#5]	437	40	1726	155	79	91
	Chromium (hexavalent)	mg/kg	0.3	6[#5]	<0.3	0.4	<0.3	<0.3	<0.3	<0.3
	Chromium (Trivalent)	mg/kg	0.5	910[#5]	74.8	72.5	81.5	66.3	56	83.3
Organics	TOC	%	0.02		0.7	0.54	0.8	0.86	0.29	1.72
Inorganics	Moisture Content 105C	%	0.1		24	26.9	40.1	38.8	7.4	78.5
	pH (Lab)	pH_Units	0.01		7.61	7.42	8	7.91	8.25	8.04
Asbestos	Asbestos Type	None			None	None	None	None	None	None
	Asbestos Type 2	None			None	None	None	None	None	None
	Asbestos Level	None			None	None	None	None	None	None
	Asbestos Containing Material	None			None	None	None	None	None	None
	Asbestos Containing Material (2)	None			None	None	None	None	None	None

Comments
#1 USEPA RSL
#2 Dutch Serious 2009
#3 Dutch Intervention 2009
#4 Defra C4SL 12/2014
#5 AECOM (modified LQM/CIEH S4ULs)
#6 AECOM (modified EIC)
#7 ESDAT Combined. Some analytes are reported multiple times; the lowest non-detect or the highest detect is used. Some Analytes are missing from this Combined Compound.
#8 ESDAT Combined with Non-Detect Multiplier of 0.5.
#9 No interpretation possible
#12 ESDAT Combined.
GAC: Generic Assessment Criteria
(blank): No assessment criteria available
Sol: Unacceptable risk not achieved due to calculated target above solubility limit

Key
GAC_HH_RES-PL_SAND_0.58-1.45%TOC Exceedance of HH Soil. Residential without Plant Uptake. Sand. TOC >=0.58 to <1.45%

Table 3
Groundwater Analytical Results - Human Health
City Block 2

Location_Code	BH12	BH14	BH9
Sampled_Date_Time	12/08/2015	12/08/2015	12/08/2015
Lab_Report_Number	15-11357-2-200815	15-11357-2-200815	15-11357-1-200815
Sample_Type	Normal	Normal	Normal
Location_Type	Borehole	Borehole	Borehole
Monitoring_Zone	City Block 2	City Block 2	City Block 2
Well	BH12	BH14	BH9
Monitoring_Unit	Gravel	Gravel	Gravel

Chem_Group	ChemName	output unit	EQL	GAC_HH_RES_SAND			
TPH	>C5-C6 Aliphatics	µg/L	5	**14,700**[#3]	<5	<5	<5
	>C6-C8 Aliphatics	µg/L	5	**Sat**[#3]	<5	<5	<5
	>C8-C10 Aliphatics	µg/L	5	**426**[#3]	<5	<5	<5
	>C10-C12 Aliphatics	µg/L	5	**Sat**[#3]	<5	<5	<5
	>C12-C16 Aliphatics	µg/L	10	**Sat**[#3]	<10	<10	<10
	>C16-C21 Aliphatics	µg/L	10		<10	<10	<10
	>C16-C35 Aliphatics	µg/L		**Sat**[#3]	<20[#6]	<20[#6]	<20[#6]
	>C21-C35 Aliphatics	µg/L	10		<10	<10	<10
	>C5-C35 Aliphatics	µg/L	10		<10	<10	<10
	>EC5-EC7 Aromatics	µg/L	5	**1,560,000**[#3]	<5	<5	<5
	>EC7-EC8 Aromatics	µg/L	5	**Sat**[#3]	<5	<5	<5
	>EC8-EC10 Aromatics	µg/L	5	**14,000**[#3]	<5	<5	<5
	>EC10-EC12 Aromatics	µg/L	5	**Sat**[#3]	<5	<5	<5
	>EC12-EC16 Aromatics	µg/L	10	**Sat**[#3]	<10	<10	<10
	>EC16-EC21 Aromatics	µg/L	10	**Sat**[#3]	<10	<10	<10
	>EC21-EC35 Aromatics	µg/L	10	**Sat**[#3]	<10	<10	<10
	>EC5-EC35 Aromatics	µg/L	10		<10	<10	<10
	>C5-C35 Aliphatics & Aromatics	µg/L	10		<10	<10	<10
BTEX	Benzene	µg/L	0.5	**1,570**[#3]	<0.5	<0.5	<0.5
	Toluene	µg/L	0.5	**Sat**[#3]	<0.5	<0.5	<0.5
	Ethylbenzene	µg/L	0.5	**85,200**[#3]	<0.5	<0.5	<0.5
	Xylene (m & p)	µg/L	1		<1	<1	<1
	Xylene Total	µg/L			<1.5[#4]	<1.5[#4]	<1.5[#4]
	Xylene (o)	µg/L	0.5	**92,100**[#3]	<0.5	<0.5	<0.5
	Total BTEX	µg/L			<1.5[#4]	<1.5[#4]	<1.5[#4]
Oxygenates	MTBE	µg/L	0.1		<0.1	<0.1	<0.1
Chlorinated Hydrocarbons	Chloromethane	µg/L	3		<3	<3	<3
	Vinyl chloride	µg/L	0.1	**4.44**[#3]	<0.1	<0.1	<0.1
	Chloroethane	µg/L	3		<3	<3	<3
	1,1-dichloroethene	µg/L	3		<3	<3	<3
	Dichloromethane	µg/L	3		<3	<3	<3
	trans-1,2-dichloroethene	µg/L	3		<3	<3	<3
	1,1-dichloroethane	µg/L	3		<3	<3	<3
	cis-1,2-dichloroethene	µg/L	3		<3	<3	<3
	Chloroform	µg/L	2	**5,660**[#3]	<2	<2	<2
	1,1,1-trichloroethane	µg/L	2	**24,600**[#3]	<2	<2	<2
	Carbon tetrachloride	µg/L	2	**43.5**[#3]	<2	<2	<2
	Trichloroethene	µg/L	3	**44.7**[#3]	<3	<3	<3
	1,1,2-trichloroethane	µg/L	2		<2	<2	<2
	Tetrachloroethene	µg/L	3	**288**[#3]	<3	<3	<3
	Sum of PCE and TCE	µg/L		**10**[#1]	<6[#6]	<6[#6]	<6[#6]
	TCE+DCE+VC	µg/L			<12.1[#6]	<12.1[#6]	<12.1[#6]
	PCE+TCE+DCE+VC	µg/L			<15.1[#6]	<15.1[#6]	<15.1[#6]
VOC	2,2-dichloropropane	µg/L	1		<1	<1	<1
	Bromochloromethane	µg/L	2		<2	<2	<2
	1,1-dichloropropene	µg/L	3		<3	<3	<3
	1,2-dichloroethane	µg/L	2	**53.2**[#3]	<2	<2	<2
	1,2-dichloropropane	µg/L	2	**0.1**[#1]	**<2**	**<2**	**<2**
	Dibromomethane	µg/L	3		<3	<3	<3
	Bromodichloromethane	µg/L	2		<2	<2	<2
	cis-1,3-dichloropropene	µg/L	2		<2	<2	<2
	trans-1,3-dichloropropene	µg/L	2		<2	<2	<2
	1,3-dichloropropane	µg/L	2	**0.1**[#1]	**<2**	**<2**	**<2**
	Chlorodibromomethane	µg/L	2	**see trihalomethanes**[#1]	<2	<2	<2
	1,1,1,2-tetrachloroethane	µg/L	2	**1,750**[#3]	<2	<2	<2
	Styrene	µg/L	2		<2	<2	<2
	Bromoform	µg/L	2	**see trihalomethanes**[#1]	<2	<2	<2
	Isopropylbenzene	µg/L	3		<3	<3	<3
	1,1,2,2-tetrachloroethane	µg/L	4	**6,900**[#3]	<4	<4	<4
	1,2,3-trichloropropane	µg/L	3		<3	<3	<3
	n-propylbenzene	µg/L	3		<3	<3	<3
	1,3,5-trimethylbenzene	µg/L	3		<3	<3	<3
	tert-butylbenzene	µg/L	3		<3	<3	<3
	1,2,4-trimethylbenzene	µg/L	3		<3	<3	<3
	sec-butylbenzene	µg/L	3		<3	<3	<3
	p-isopropyltoluene	µg/L	3		<3	<3	<3
	n-butylbenzene	µg/L	3		<3	<3	<3
	1,2-dibromo-3-chloropropane	µg/L	2	**0.1**[#1]	**<2**	**<2**	**<2**
	Hexachlorobutadiene	µg/L	1	**15.5**[#3]	<1	<1	<1
	1,2-Dichloroethene	µg/L			<6[#6]	<6[#6]	<6[#6]
	Trihalomethanes	µg/L		**100**[#1]	<8[#6]	<8[#6]	<8[#6]
PAH	Naphthalene	µg/L	1	**911**[#3]	<1	<1	<1
	Acenaphthylene	µg/L	0.5	**Sat**[#3]	<0.5	<0.5	<0.5
	Acenaphthene	µg/L	1	**Sat**[#3]	<1	<1	<1
	Fluorene	µg/L	0.5	**Sat**[#3]	<0.5	<0.5	<0.5
	Phenanthrene	µg/L	0.5	**Sat**[#3]	<0.5	<0.5	<0.5
	Anthracene	µg/L	0.5	**Sat**[#3]	<0.5	<0.5	<0.5
	Fluoranthene	µg/L	0.5	**Sat**[#3]	<0.5	<0.5	<0.5
	Pyrene	µg/L	0.5	**Sat**[#3]	<0.5	<0.5	<0.5
	Benz(a)anthracene	µg/L	0.5	**Sat**[#3]	<0.5	<0.5	<0.5
	Chrysene	µg/L	0.5	**Sat**[#3]	<0.5	<0.5	<0.5
	Benzo(a) pyrene	µg/L	1	**Sat**[#3]	<1	<1	<1
	Indeno(1,2,3-c,d)pyrene	µg/L	1	**Sat**[#3]	<1	<1	<1
	Dibenz(a,h)anthracene	µg/L	0.5	**Sat**[#3]	<0.5	<0.5	<0.5
	Benzo(g,h,i)perylene	µg/L	0.5	**Sat**[#3]	<0.5	<0.5	<0.5
	Benzo(b)&(k)fluoranthene	µg/L	1		<1	<1	<1
	PAHs (sum of 4)	µg/L		**0.1**[#1]	**<1.5**[#5]	**<1.5**[#5]	**<1.5**[#5]
	benzo(g,h,i)perylene + indeno(1,2,3-cd)pyrene	µg/L			<1.5[#6]	<1.5[#6]	<1.5[#6]
	Coal Tar (Bap as surrogate marker)	µg/L		**Sat**[#3]	<1[#6]	<1[#6]	<1[#6]

Table 3
Groundwater Analytical Results - Human Health
City Block 2

Location_Code	BH12	BH14	BH9
Sampled_Date_Time	12/08/2015	12/08/2015	12/08/2015
Lab_Report_Number	15-11357-2-200815	15-11357-2-200815	15-11357-1-200815
Sample_Type	Normal	Normal	Normal
Location_Type	Borehole	Borehole	Borehole
Monitoring_Zone	City Block 2	City Block 2	City Block 2
Well	BH12	BH14	BH9
Monitoring_Unit	Gravel	Gravel	Gravel

Chem_Group	ChemName	output unit	EQL	GAC_HH_RES_SAND			
SVOC	2-methylnaphthalene	µg/L	1		<1	<1	<1
	4-bromophenyl phenyl ether	µg/L	1		<1	<1	<1
	4-chlorophenyl phenyl ether	µg/L	1		<1	<1	<1
	Azobenzene	µg/L	0.5		<0.5	<0.5	<0.5
	Bis(2-chloroethoxy) methane	µg/L	0.5		<0.5	<0.5	<0.5
	Bis(2-chloroethyl)ether	µg/L	1		<1	<1	<1
	Carbazole	µg/L	0.5		<0.5	<0.5	<0.5
	Dibenzofuran	µg/L	0.5		<0.5	<0.5	<0.5
	Hexachlorocyclopentadiene	µg/L	1		<1	<1	<1
	Hexachloroethane	µg/L	1		<1	<1	<1
	Total Methoxychlor	µg/l	0.01		<0.01	-	-
Phenolics	2-methylphenol	µg/L	0.5		<0.5	<0.5	<0.5
	2-nitrophenol	µg/L	0.5		<0.5	<0.5	<0.5
	2,4-dimethylphenol	µg/L	1		<1	<1	<1
	4-chloro-3-methylphenol	µg/L	0.5		<0.5	<0.5	<0.5
	4-methylphenol	µg/L	1		<1	<1	<1
	4-nitrophenol	µg/L	10		<10	<10	<10
	Phenol	µg/L	1	**976.000**[#3]	<1	<1	<1
	2-chloronaphthalene	µg/L	1		<1	<1	<1
Amino Aliphatics	N-nitrosodi-n-propylamine	µg/L	0.5		<0.5	<0.5	<0.5
Anilines	2-nitroaniline	µg/L	1		<1	<1	<1
	3-nitroaniline	µg/L	1		<1	<1	<1
	4-chloroaniline	µg/L	1		<1	<1	<1
	4-nitroaniline	µg/L	0.5		<0.5	<0.5	<0.5
Explosives	2,4-Dinitrotoluene	µg/L	0.5		<0.5	<0.5	<0.5
	2,6-dinitrotoluene	µg/L	1		<1	<1	<1
	Nitrobenzene	µg/L	1		<1	<1	<1
Halogenated Benzenes	Chlorobenzene	µg/L	2	**747**[#3]	<2	<2	<2
	Bromobenzene	µg/L	2		<2	<2	<2
	2-chlorotoluene	µg/L	3		<3	<3	<3
	4-chlorotoluene	µg/L	3		<3	<3	<3
	1,3-dichlorobenzene	µg/L	1	**238**[#3]	<1	<1	<1
	1,4-dichlorobenzene	µg/L	1	**37.000**[#3]	<1	<1	<1
	1,2-dichlorobenzene	µg/L	1	**13.900**[#3]	<1	<1	<1
	1,2,4-trichlorobenzene	µg/L	1	**495**[#3]	<1	<1	<1
	1,2,3-trichlorobenzene	µg/L	3	**247**[#3]	<3	<3	<3
	Hexachlorobenzene	µg/L	1	**Sat**[#3]	<1	<1	<1
Halogenated Hydrocarbons	Dichlorodifluoromethane	µg/L	2		<2	<2	<2
	Bromomethane	µg/L	1		<1	<1	<1
	Trichlorofluoromethane	µg/L	3		<3	<3	<3
	1,2-dibromoethane	µg/L	2	**0.1**[#1]	**<2**	**<2**	**<2**
Halogenated Phenols	2-chlorophenol	µg/L	1		<1	<1	<1
	2,4-dichlorophenol	µg/L	0.5		<0.5	<0.5	<0.5
	2,4,5-trichlorophenol	µg/L	0.5		<0.5	<0.5	<0.5
	2,4,6-trichlorophenol	µg/L	1		<1	<1	<1
	Pentachlorophenol	µg/L	1	**Sat**[#3]	<1	<1	<1
Phthalates	Bis(2-ethylhexyl) phthalate	µg/L	5		<5	<5	<5
	Butyl benzyl phthalate	µg/L	1		<1	<1	<1
	Di-n-butyl phthalate	µg/L	1.5		<1.5	<1.5	<1.5
	Di-n-octyl phthalate	µg/L	1		<1	<1	<1
	Diethylphthalate	µg/L	1		<1	<1	<1
	Dimethyl phthalate	µg/L	1		<1	<1	<1
Solvents	Isophorone	µg/L	0.5		<0.5	<0.5	<0.5
Metals	Arsenic (Filtered)	µg/L	0.9	**No path**[#2]	475.1	-	23.7
	Barium (Filtered)	µg/L	1.8	**No path**[#2]	34.7	-	25.5
	Beryllium (Filtered)	µg/L	0.5	**No path**[#2]	<0.5	-	<0.5
	Boron (Filtered)	µg/L	2	**No path**[#2]	476	-	168
	Cadmium (Filtered)	µg/L	0.03	**No path**[#2]	1.71	-	0.33
	Chromium (III+VI) (Filtered)	µg/L	0.2		<0.2	-	0.6
	Copper (Filtered)	µg/L	3	**No path**[#2]	<3	-	<3
	Lead (Filtered)	µg/L	0.4	**No path**[#2]	1	-	3.1
	Mercury (Filtered)	µg/L	0.5	**No path**[#2]	<0.5	-	<0.5
	Nickel (Filtered)	µg/L	0.2	**No path**[#2]	0.4	-	0.9
	Selenium (Filtered)	µg/L	1.2	**No path**[#2]	<1.2	-	<1.2
	Vanadium (Filtered)	µg/L	0.6	**No path**[#2]	<0.6	-	2.2
	Zinc (Filtered)	µg/L	1.5	**No path**[#2]	45.1	-	174
	Chromium (hexavalent)	µg/L	2	**No path**[#2]	<2	-	<2
	Chromium (Trivalent) (Filtered)	µg/L	2	**No path**[#2]	<2	-	<2

Comments
#1 WS Regs 2010 (Eng/Wal)
#2 AECOM (No path)
#3 AECOM (modified LQM/CIEH S4ULs)
#4 ESDAT Combined. Some analytes are reported multiple times; the lowest non-detect or the highest detect is used. Some Analytes are missing from this Combined Compound.
#6 ESDAT Combined. Some Analytes are missing from this Combined Compound.
#7 ESDAT Combined.
GAC: Generic Assessment Criteri Exceedance of HH GW. Residential. Sand
(blank): No assessment criteria available
Sat: Unacceptable risk not achieved due to calculated saturation of vapour pathway
Sol: Unacceptable risk not achieved due to calculated target above solubility limit
- : Not analysed

KEY

GAC_HH_RES_SAND	Exceedance of HH Water. Residential. Sand.

Table 4
Groundwater Analytical Results - Controlled Water
City Block 2

Location_Code	BH12	BH14	BH9
Sampled_Date_Time	12/08/2015	12/08/2015	12/08/2015
Lab_Report_Number	15-11357-2	15-11357-2	15-11357-1
Sample_Type	Normal	Normal	Normal
Location_Type	Borehole	Borehole	Borehole
Monitoring_Zone	City Block 2	City Block 2	City Block 2
Well	BH12	BH14	BH9
Monitoring_Unit	Gravel	Gravel	Gravel

Chem_Group	ChemName	output unit	EQL	GAC_WTV_IE_DWS	*GAC_WTV_IE_EQS -Fresh*	GAC_WTV_IE_GTV			
TPH	>C5-C6 Aliphatics	µg/L	5	**15,000**[#2]		15,000[#2]	<5	<5	<5
	>C6-C8 Aliphatics	µg/L	5	**15,000**[#2]		15,000[#2]	<5	<5	<5
	>C8-C10 Aliphatics	µg/L	5	**300**[#2]		300[#2]	<5	<5	<5
	>C10-C12 Aliphatics	µg/L	5	**300**[#2]		300[#2]	<5	<5	<5
	>C12-C16 Aliphatics	µg/L	10	**300**[#2]		300[#2]	<10	<10	<10
	>C16-C21 Aliphatics	µg/L	10	**300**[#2]		300[#2]	<10	<10	<10
	>C16-C35 Aliphatics	µg/L					<20[#20]	<20[#20]	<20[#20]
	>C21-C35 Aliphatics	µg/L	10	**300**[#2]		300[#2]	<10	<10	<10
	>C5-C35 Aliphatics	µg/L	10				<10	<10	<10
	>EC5-EC7 Aromatics	µg/L	5	**1**[#15]	*10*[#12]	0.75[#11]	<5	<5	<5
	>EC7-EC8 Aromatics	µg/L	5	**10**[#14]	*10*[#12]	10[#14]	<5	<5	<5
	>EC8-EC10 Aromatics	µg/L	5	**300**[#2]		300[#2]	<5	<5	<5
	>EC10-EC12 Aromatics	µg/L	5	**90**[#2]		90[#2]	<5	<5	<5
	>EC12-EC16 Aromatics	µg/L	10	**90**[#2]		90[#2]	<10	<10	<10
	>EC16-EC21 Aromatics	µg/L	10	**90**[#2]		90[#2]	<10	<10	<10
	>EC21-EC35 Aromatics	µg/L	10	**90**[#2]		90[#2]	<10	<10	<10
	>EC5-EC35 Aromatics	µg/L	10				<10	<10	<10
	>C5-C35 Aliphatics & Aromatics	µg/L	10	**10**[#14]	*10*[#13]	10[#14]	<10	<10	<10
BTEX	Benzene	µg/L	0.5	**1**[#15]	*10*[#12]	0.75[#11]	<0.5	<0.5	<0.5
	Toluene	µg/L	0.5	**10**[#14]	*10*[#12]	10[#14]	<0.5	<0.5	<0.5
	Ethylbenzene	µg/L	0.5	**10**[#14]	*10*[#13]	10[#14]	<0.5	<0.5	<0.5
	Xylene (m & p)	µg/L	1				<1	<1	<1
	Xylene Total	µg/L		**10**[#14]	*10*[#12]	10[#14]	<1.5[#18]	<1.5[#18]	<1.5[#18]
	Xylene (o)	µg/L	0.5	**10**[#14]	*10*[#12]	10[#14]	<0.5	<0.5	<0.5
	Total BTEX	µg/L					<1.5[#18]	<1.5[#18]	<1.5[#18]
Oxygenates	MTBE	µg/L	0.1	**30**[#14]	*5,100*[#9]	30[#14]	<0.1	<0.1	<0.1
Chlorinated Hydrocarbons	Chloromethane	µg/L	3	**20**[#3]		20[#3]	<3	<3	<3
	Vinyl chloride	µg/L	0.1	**0.5**[#15]		0.375[#11]	<0.1	<0.1	<0.1
	Chloroethane	µg/L	3	**21,000**[#5]		21,000[#5]	<3	<3	<3
	1,1-dichloroethene	µg/L	3	**30**[#14]		30[#14]	<3	<3	<3
	Dichloromethane	µg/L	3	**10**[#14]	*20*[#12]	10[#14]	<3	<3	<3
	trans-1,2-dichloroethene	µg/L	3	**30**[#14]		30[#14]	<3	<3	<3
	1,1-dichloroethane	µg/L	3	**2.7**[#5]		2.7[#5]	<3	<3	<3
	cis-1,2-dichloroethene	µg/L	3	**30**[#14]		30[#14]	<3	<3	<3
	Chloroform	µg/L	2	**12**[#14]	*2.5*[#12]	12[#14]	<2	<2	<2
	1,1,1-trichloroethane	µg/L	2	**500**[#14]	*500*[#13]	500[#14]	<2	<2	<2
	Carbon tetrachloride	µg/L	2	**2**[#14]	*12*[#12]	2[#14]	<2	<2	<2
	Trichloroethene	µg/L	3	**e sum of PCE and TCE**	*10*[#12]	see sum of PCE and TCE[#11]	<3	<3	<3
	1,1,2-trichloroethane	µg/L	2	**0.28**[#5]	*400*[#4]	0.28[#5]	<2	<2	<2
	Tetrachloroethene	µg/L	3	**e sum of PCE and TCE**	*10*[#12]	see sum of PCE and TCE[#11]	<3	<3	<3
	Sum of PCE and TCE	µg/L		**10**[#15]		7.5[#11]	<6[#20]	<6[#20]	<6[#20]
	TCE+DCE+VC	µg/L					<12.1[#20]	<12.1[#20]	<12.1[#20]
	PCE+TCE+DCE+VC	µg/L					<15.1[#20]	<15.1[#20]	<15.1[#20]
VOC	2,2-dichloropropane	µg/L	1				<1	<1	<1
	Bromochloromethane	µg/L	2	**83**[#5]		83[#5]	<2	<2	<2
	1,1-dichloropropene	µg/L	3				<3	<3	<3
	1,2-dichloroethane	µg/L	2	**3**[#15]	*10*[#12]	2.25[#11]	<2	<2	<2
	1,2-dichloropropane	µg/L	2	**0.1**[#1]		0.1[#1]	<2	<2	<2
	Dibromomethane	µg/L	3	**8**[#5]		8[#5]	<3	<3	<3
	Bromodichloromethane	µg/L	2	**0.13**[#5]		0.13[#5]	<2	<2	<2
	cis-1,3-dichloropropene	µg/L	2				<2	<2	<2
	trans-1,3-dichloropropene	µg/L	2				<2	<2	<2
	1,3-dichloropropane	µg/L	2	**0.1**[#1]		0.1[#1]	<2	<2	<2
	Chlorodibromomethane	µg/L	2	**see trihalomethanes**[#1]		see trihalomethanes[#1]	<2	<2	<2
	1,1,1,2-tetrachloroethane	µg/L	2	**0.57**[#5]		0.57[#5]	<2	<2	<2
	Styrene	µg/L	2	**20**[#3]	*50*[#7]	20[#3]	<2	<2	<2
	Bromoform	µg/L	2	**see trihalomethanes**[#1]		see trihalomethanes[#1]	<2	<2	<2
	Isopropylbenzene	µg/L	3	**450**[#5]		450[#5]	<3	<3	<3
	1,1,2,2-tetrachloroethane	µg/L	4	**0.076**[#5]		0.076[#5]	<4	<4	<4
	1,2,3-trichloropropane	µg/L	3	**0.00075**[#5]		0.00075[#5]	<3	<3	<3
	n-propylbenzene	µg/L	3	**660**[#5]		660[#5]	<3	<3	<3
	1,3,5-trimethylbenzene	µg/L	3	**120**[#5]		120[#5]	<3	<3	<3
	tert-butylbenzene	µg/L	3	**690**[#5]		690[#5]	<3	<3	<3
	1,2,4-trimethylbenzene	µg/L	3	**15**[#5]		15[#5]	<3	<3	<3
	sec-butylbenzene	µg/L	3	**2,000**[#5]		2,000[#5]	<3	<3	<3
	p-isopropyltoluene	µg/L	3				<3	<3	<3
	n-butylbenzene	µg/L	3	**1,000**[#5]		1,000[#5]	<3	<3	<3
	1,2-dibromo-3-chloropropane	µg/L	2	**0.1**[#1]		0.1[#1]	<2	<2	<2
	Hexachlorobutadiene	µg/L	1	**0.1**[#14]	*0.1*[#12]	0.1[#14]	<1	<1	<1
	1,2-Dichloroethene	µg/L		**50**[#3]		50[#3]	<6[#20]	<6[#20]	<6[#20]
	Trihalomethanes	µg/L		**100**[#15]		75[#11]	<8[#20]	<8[#20]	<8[#20]
PAH	Naphthalene	µg/L	1	**1**[#14]	*2.4*[#12]	1[#14]	<1	<1	<1
	Acenaphthylene	µg/L	0.5	**18**[#17]		18[#17]	<0.5	<0.5	<0.5
	Acenaphthene	µg/L	1	**18**[#17]		18[#17]	<1	<1	<1
	Fluorene	µg/L	0.5	**12**[#17]		12[#17]	<0.5	<0.5	<0.5
	Phenanthrene	µg/L	0.5	**4**[#17]		4[#17]	<0.5	<0.5	<0.5
	Anthracene	µg/L	0.5	**10,000**[#14]	*0.1*[#12]	10,000[#14]	<0.5	<0.5	<0.5
	Fluoranthene	µg/L	0.5	**1**[#14]	*0.1*[#12]	1[#14]	<0.5	<0.5	<0.5
	Pyrene	µg/L	0.5	**9**[#17]		9[#17]	<0.5	<0.5	<0.5
	Benz(a)anthracene	µg/L	0.5	**0.1**[#17]		0.1[#17]	<0.5	<0.5	<0.5
	Chrysene	µg/L	0.5	**1**[#17]		1[#17]	<0.5	<0.5	<0.5
	Benzo(a) pyrene	µg/L	1	**0.01**[#15]	*0.05*[#12]	0.0075[#11]	<1	<1	<1
	Indeno(1,2,3-c,d)pyrene	µg/L	1	**0.05**[#14]	*0.002*[#12]	0.05[#14]	<1	<1	<1
	Dibenz(a,h)anthracene	µg/L	0.5	**0.01**[#17]		0.01[#17]	<0.5	<0.5	<0.5
	Benzo(g,h,i)perylene	µg/L	0.5	**0.05**[#14]	*0.002*[#12]	0.05[#14]	<0.5	<0.5	<0.5
	Benzo(b)&(k)fluoranthene	µg/L	1		*0.03*[#4]		<1	<1	<1
	PAHs (sum of 4)	µg/L		**0.1**[#15]		0.1[#15]	<1.5[#19]	<1.5[#19]	<1.5[#19]
	benzo(g,h,i)perylene + indeno(1,2,3-cd)pyrene	µg/L			*0.002*[#4]		<1.5[#20]	<1.5[#20]	<1.5[#20]
	Coal Tar (Bap as surrogate marker)	µg/L					<1[#20]	<1[#20]	<1[#20]

Table 4
Groundwater Analytical Results - Controlled Water
City Block 2

Location_Code	BH12	BH14	BH9
Sampled_Date_Time	12/08/2015	12/08/2015	12/08/2015
Lab_Report_Number	15-11357-2	15-11357-2	15-11357-1
Sample_Type	Normal	Normal	Normal
Location_Type	Borehole	Borehole	Borehole
Monitoring_Zone	City Block 2	City Block 2	City Block 2
Well	BH12	BH14	BH9
Monitoring_Unit	Gravel	Gravel	Gravel

Chem_Group	ChemName	output unit	EQL	GAC_WTV_IE_DWS	*GAC_WTV_IE_EQS -Fresh*	GAC_WTV_IE_GTV			
SVOC	2-methylnaphthalene	µg/L	1	**24**[#3]		24[#3]	<1	<1	<1
	4-bromophenyl phenyl ether	µg/L	1				<1	<1	<1
	4-chlorophenyl phenyl ether	µg/L	1				<1	<1	<1
	Azobenzene	µg/L	0.5	**0.12**[#5]		0.12[#5]	<0.5	<0.5	<0.5
	Bis(2-chloroethoxy) methane	µg/L	0.5	**59**[#5]		59[#5]	<0.5	<0.5	<0.5
	Bis(2-chloroethyl)ether	µg/L	1	**0.014**[#5]		0.014[#5]	<1	<1	<1
	Carbazole	µg/L	0.5				<0.5	<0.5	<0.5
	Dibenzofuran	µg/L	0.5	**7.9**[#5]		7.9[#5]	<0.5	<0.5	<0.5
	Hexachlorocyclopentadiene	µg/L	1	**31**[#5]		31[#5]	<1	<1	<1
	Hexachloroethane	µg/L	1	**0.9**[#5]		0.9[#5]	<1	<1	<1
	Total Methoxychlor	µg/l	0.01				<0.01	-	-
Phenolics	2-methylphenol	µg/L	0.5	**930**[#5]		930[#5]	<0.5	<0.5	<0.5
	2-nitrophenol	µg/L	0.5				<0.5	<0.5	<0.5
	2,4-dimethylphenol	µg/L	1	**360**[#5]		360[#5]	<1	<1	<1
	4-chloro-3-methylphenol	µg/L	0.5	**1,400**[#5]	*40*[#4]	1,400[#5]	<0.5	<0.5	<0.5
	4-methylphenol	µg/L	1	**1,900**[#5]		1,900[#5]	<1	<1	<1
	4-nitrophenol	µg/L	10				<10	<10	<10
	Phenol	µg/L	1	**0.5**[#14]	*8*[#12]	0.5[#14]	<1	<1	<1
	2-chloronaphthalene	µg/L	1	**750**[#5]		750[#5]	<1	<1	<1
Amino Aliphatics	N-nitrosodi-n-propylamine	µg/L	0.5	**0.011**[#5]		0.011[#5]	<0.5	<0.5	<0.5
Anilines	2-nitroaniline	µg/L	1	**190**[#5]		190[#5]	<1	<1	<1
	3-nitroaniline	µg/L	1				<1	<1	<1
	4-chloroaniline	µg/L	1	**0.36**[#5]		0.36[#5]	<1	<1	<1
	4-nitroaniline	µg/L	0.5	**3.8**[#5]		3.8[#5]	<0.5	<0.5	<0.5
Explosives	2,4-Dinitrotoluene	µg/L	0.5	**0.24**[#5]		0.24[#5]	<0.5	<0.5	<0.5
	2,6-dinitrotoluene	µg/L	1	**0.048**[#5]		0.048[#5]	<1	<1	<1
	Nitrobenzene	µg/L	1	**10**[#14]		10[#14]	<1	<1	<1
Halogenated Benzenes	Chlorobenzene	µg/L	2	**1**[#14]	*1.5*[#12]	1[#14]	<2	<2	<2
	Bromobenzene	µg/L	2	**62**[#5]		62[#5]	<2	<2	<2
	2-chlorotoluene	µg/L	3	**240**[#5]		240[#5]	<3	<3	<3
	4-chlorotoluene	µg/L	3	**250**[#5]		250[#5]	<3	<3	<3
	1,3-dichlorobenzene	µg/L	1				<1	<1	<1
	1,4-dichlorobenzene	µg/L	1	**300**[#3]		300[#3]	<1	<1	<1
	1,2-dichlorobenzene	µg/L	1	**10**[#14]	*10*[#13]	10[#14]	<1	<1	<1
	1,2,4-trichlorobenzene	µg/L	1	**0.4**[#14]	*0.4*[#13]	0.4[#14]	<1	<1	<1
	1,2,3-trichlorobenzene	µg/L	3	**7**[#5]		7[#5]	<3	<3	<3
	Hexachlorobenzene	µg/L	1	**0.03**[#14]	*0.01*[#12]	0.03[#14]	<1	<1	<1
Halogenated Hydrocarbons	Dichlorodifluoromethane	µg/L	2	**200**[#5]		200[#5]	<2	<2	<2
	Bromomethane	µg/L	1	**7.5**[#5]		7.5[#5]	<1	<1	<1
	Trichlorofluoromethane	µg/L	3	**1,100**[#5]		1,100[#5]	<3	<3	<3
	1,2-dibromoethane	µg/L	2	**0.1**[#1]		0.1[#1]	<2	<2	<2
Halogenated Phenols	2-chlorophenol	µg/L	1	**200**[#14]	*50*[#4]	200[#14]	<1	<1	<1
	2,4-dichlorophenol	µg/L	0.5	**0.3**[#3]	*20*[#4]	0.3[#3]	<0.5	<0.5	<0.5
	2,4,5-trichlorophenol	µg/L	0.5	**9**[#3]		9[#3]	<0.5	<0.5	<0.5
	2,4,6-trichlorophenol	µg/L	1	**200**[#14]		200[#14]	<1	<1	<1
	Pentachlorophenol	µg/L	1	**2**[#14]	*0.4*[#12]	2[#14]	<1	<1	<1
Phthalates	Bis(2-ethylhexyl) phthalate	µg/L	5	**8**[#14]	*1.3*[#12]	8[#14]	<5	<5	<5
	Butyl benzyl phthalate	µg/L	1	**16**[#5]	*20*[#7]	16[#5]	<1	<1	<1
	Di-n-butyl phthalate	µg/L	1.5	**2**[#14]	*8*[#7]	2[#14]	<1.5	<1.5	<1.5
	Di-n-octyl phthalate	µg/L	1	**200**[#5]	*20*[#7]	200[#5]	<1	<1	<1
	Diethylphthalate	µg/L	1	**15,000**[#5]	*200*[#7]	15,000[#5]	<1	<1	<1
	Dimethyl phthalate	µg/L	1		*800*[#7]		<1	<1	<1
Solvents	Isophorone	µg/L	0.5	**78**[#5]		78[#5]	<0.5	<0.5	<0.5
Metals	Arsenic (Filtered)	µg/L	0.9	**10**[#15]	*25*[#12]	7.5[#11]	***475.1***	-	**23.7**
	Barium (Filtered)	µg/L	1.8	**100**[#14]	*100*[#13]	100[#14]	34.7	-	25.5
	Beryllium (Filtered)	µg/L	0.5	**25**[#5]		25[#5]	<0.5	-	<0.5
	Boron (Filtered)	µg/L	2	**1,000**[#15]	*2,000*[#13]	750[#11]	476	-	168
	Cadmium (Filtered)	µg/L	0.03	**5**[#15]	*0.08*[#12]	3.75[#11]	*1.71*	-	*0.33*
	Chromium (III+VI) (Filtered)	µg/L	0.2	**30**[#14]	*3.4*[#12]	30[#14]	<0.2	-	0.6
	Copper (Filtered)	µg/L	3	**2,000**[#15]	*5*[#12]	1,500[#11]	<3	-	<3
	Lead (Filtered)	µg/L	0.4	**10**[#15]	*7.2*[#12]	18.75[#11]	1	-	3.1
	Mercury (Filtered)	µg/L	0.5	**1**[#15]	*0.05*[#12]	0.75[#11]	<0.5	-	<0.5
	Nickel (Filtered)	µg/L	0.2	**20**[#15]	*20*[#12]	15[#11]	0.4	-	0.9
	Selenium (Filtered)	µg/L	1.2	**10**[#15]		10[#15]	<1.2	-	<1.2
	Vanadium (Filtered)	µg/L	0.6	**86**[#5]	*20*[#7]	86[#5]	<0.6	-	2.2
	Zinc (Filtered)	µg/L	1.5	**100**[#14]	*8*[#12]	100[#14]	*45.1*	-	***174***
	Chromium (hexavalent)	µg/L	2	**37.5**[#11]	*3.4*[#12]	37.5[#11]	<2	-	<2
	Chromium (Trivalent) (Filtered)	µg/L	2	**50**[#15]	*4.7*[#12]	37.5[#11]	<2	-	<2

Comments
#1 WS Regs 2010 (Eng/Wal)
#2 WHO Petroleum In DW 2008
#3 WHO DWG 2011
#4 WFD EQS 2010 Fresh (Eng/Wal)
#5 USEPA RSL (tapwater)
#7 SEPA WAT-SG-53 Fresh EQS - AA - 2013
#9 PNEC (EU REACH) - Freshwater
#11 Ireland GTVs 2010
#12 Ireland Freshwater EQS (AA)
#13 IGV Ireland 2003 (EQS)
#14 IGV Ireland 2003
#15 DWS Ireland 2007
#17 Calc WHO
#18 ESDAT Combined. Some analytes are reported multiple times; the lowest non-detect or the highest detect is used. Some Analytes are missing from this Combined Compound.
#19 ESDAT Combined. Some Analytes are missing from this Combined Compound.
#20 ESDAT Combined.
GAC: Generic Assessment Criteria
(blank): No assessment criteria available
- : Not analysed

KEY

GAC_WTV_IE_GTV	Exceedance of CW/WE Water. GTV - Ireland
GAC_WTV_IE_DWS	Exceedance of CW/WE Water. DWS - Ireland
GAC_WTV_IE_EQS-Fresh	Exceedance of CW/WE Water. Aquatic Toxicity - Ireland - Freshwater

Table 5
Groundwater Field Readings
City Block 2

Location_Code	BH10	BH11	BH12	BH13	BH14	BH9
Sampled_Date_Time	12/08/2015	12/08/2015	11/08/2015	12/08/2015	12/08/2015	11/08/2015
Location_Type	Borehole	Borehole	Borehole	Borehole	Borehole	Borehole
Monitoring_Zone	City Block 2	City Block 2	City Block 2	City Block 2	City Block 2	City Block 2
Monitoring_Unit	Made Ground	Made Ground	Gravel	Made Ground	Gravel	Gravel
SampleComments	Turbid initially, runs clear, NEC.	Clear, NEC.	Slightly moderate turbidity, NEC.	Clear, NEC.	Clear, NEC.	Clear, NEC.

Chem_Group	**ChemName**	**output unit**						
Field	Purge Time	s		840	378	-	420	375	1200
	Purge Volume	L		-	6	-	6	5	1.3
	Purge Rate	L/s		-	0.02	-	0.01	0.01	0
	pH	pH_Units		6.39	6.72	6.92	6.96	6.57	6.83
	Electrical Conductivity	µS/cm		2364	2410	3175	2880	4118	2041
	Temperature	oC		14.6	13.7	16.6	13.9	13.5	17.4
	Dissolved Oxygen (Filtered)	mg/L		0.64	0.62	**6.03**	2.18	0.71	0.86
	Field Redox	mV		-37.4	59	-9.3	64.7	75.4	-55.4
	Redox	mV		174.53	271.58	201.18	277.14	288.13	154.5

Appendix A – Trial Pit Logs

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TRIAL PIT LOG

Project Name and Site Location	Client	TRIAL PIT No
Spencer Dock Block 2 & 7	Hines Ireland	**TP201**

Job No	Date	Ground Level (m)	Co-Ordinates ()
47092981	Start Date 29-05-15 End Date 29-05-15	2.79	E 317,505.89 N 234,625.39

Contractor	Method / Plant Used	Sheet
IGSL	JCB 3CX	1 of 1

Depth BGL	Sample / Test Details	PID (ppm)	Water	STRATA: Legend	Depth (Thick-ness)	DESCRIPTION	COMMENTS	Instrument / Backfill
					0.15	HARDCORE. MADEGROUND		
0.5	TP201_0.3-1.3	7.5			(1.15)	Dark brown black sandy gravelly CLAY. MADEGROUND		
1.0					1.30			
1.5	TP201_1.3-2.7	3.4			(1.40)	Dark brown clayey slightly sandy GRAVEL of clinker. MADEGROUND	Red iron chippings	
2.0					2.70			
2.5	TP201_2.7-3.8				(1.10)	Soft dark brown grey sandy SILT.		
3.0					3.80			
3.5	TP201_3.8-4.5				(0.70)	Dark brown grey sandy GRAVEL.		
4.0					4.50			
4.5						EOH		

Backfill	Sample Details	Legend	GENERAL REMARKS
	Small Disturbed Sample	Made Ground (Fill); Sandy SILT/CLAY; Sandy GRAVEL; Groundwater Table; Groundwater Strike	NEC - No Evidence of Contaminaiton EOH - End of Trial Hole

		Logged By	Approved By
		T. Kilbride	B.Duggan

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TRIAL PIT LOG

Project Name and Site Location	Client	TRIAL PIT No
Spencer Dock Block 2 & 7	Hines Ireland	**TP202**

Job No	Date	Ground Level (m)	Co-Ordinates ()
47092981	Start Date 29-05-15 End Date 29-05-15	2.54	E 317,528.19 N 234,631.48

Contractor	Method / Plant Used	Sheet
IGSL	JCB 3CX	1 of 1

Depth BGL	Sample / Test Details	PID (ppm)	Water	STRATA: Legend	Depth (Thick-ness)	DESCRIPTION	COMMENTS	Instrument / Backfill
					0.15	CONCRETE. MADEGROUND		
	TP202_0.2-1.2	1.8			(0.50) 0.65	Black sandy gravelly CLAY with occasional cobbles. MADEGROUND	Occasional bricks	
0.5					(0.55) 1.20	Light brown clayey sandy GRAVEL. MADEGROUND	1.0m frequent red iron chips white yellow clicker and pockets of brown sand.	
1.0	TP202_1.2-1.9	5.9			(1.00) 2.20	Light brown sandy gravelly CLAY. MADEGROUND	Frequent bricks	
1.5								
2.0	TP202_2.2-3.4	5.6			(0.90) 3.10	Dark red GRAVEL.	Frequent man-made objects	
2.5					(0.30) 3.40	Dark grey silty slightly gravelly SAND. MADEGROUND	Very dense slow progress	
3.0	TP202_3.4-3.8	12.2			(0.40) 3.80	Grey sandy fine GRAVEL.		
3.5						EOH. Pit terminated due to instability.		

Backfill	Sample Details	Legend	GENERAL REMARKS
	Small Disturbed Sample	Made Ground (Fill); Sandy GRAVEL; Groundwater Table; Groundwater Strike	NEC - No Evidence of Contaminaiton EOH - End of Trial Hole

		Logged By	Approved By
		T. Kilbride	B.Duggan

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TRIAL PIT LOG

Project Name and Site Location	Client	TRIAL PIT No
Spencer Dock Block 2 & 7	Hines Ireland	**TP203**

Job No	Date	Ground Level (m)	Co-Ordinates ()
47092981	Start Date 29-05-15 End Date 29-05-15	2.28	E 317,548.39 N 234,634.42

Contractor	Method / Plant Used	Sheet
IGSL	JCB 3CX	1 of 1

Depth BGL	Sample / Test Details	PID (ppm)	Water	STRATA: Legend	Depth (Thick-ness)	DESCRIPTION	COMMENTS	Instrument / Backfill
					0.15	CONCRETE. MADEGROUND		
	TP203_0.2-1.4	6.4				Black becoming brown sandy gravelly CLAY. MADEGROUND	Frequent fragments of brick and debris. 1.1m red metallic clinker	
0.5					(1.25)			
1.0					1.40			
	TP203_1.4-2.9	5.7				Loose grey brown clayey slightly sandy GRAVEL with many cobbles. MADEGROUND	Frequent clinker bricks and building rubble	
1.5								
2.0					(1.30)			
2.5					2.70			
						Dark grey SILT with gravel lenses. MADEGROUND		
3.0					(0.50)			
			1		3.20	Loose grey brown clayey slightly sandy GRAVEL with many cobbles. MADEGROUND	Frequent clinker bricks and building rubble	
3.5					(0.70)			
					3.90			
	TP203_3.9-4.1	0.5				Dark grey slightly silty fine SAND.		
4.0					4.10			
						EOH		

Backfill	Sample Details	Legend	GENERAL REMARKS
	Small Disturbed Sample	Made Ground (Fill); Silty/Clayey SAND; Groundwater Table; Groundwater Strike	NEC - No Evidence of Contaminaiton EOH - End of Trial Hole

		Logged By	Approved By
		T. Kilbride	B.Duggan

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TRIAL PIT LOG

Project Name and Site Location	Client	TRIAL PIT No
Spencer Dock Block 2 & 7	Hines Ireland	**TP204**

Job No	Date	Ground Level (m)	Co-Ordinates ()
47092981	Start Date 04-06-15 End Date 04-05-15	2.49	E 317,543.23 N 234,663.35

Contractor	Method / Plant Used	Sheet
IGSL	JCB 3CX	1 of 1

Depth BGL	Sample / Test Details	PID (ppm)	Water	STRATA: Legend	Depth (Thick-ness)	DESCRIPTION	COMMENTS	Instrument / Backfill
0.00					(0.20)	CONCRETE. MADEGROUND		
					0.20			
	TP204_0.2-1.7	4.3				Black silty sandy gravelly CLAY. MADEGROUND	Frequent fragments of brick and builders rubble	
0.5								
1.0					(1.50)			
1.5								
					1.70			
	TP204_1.7-3.3	0				Soft black SILT with lenses of fine sand.		
2.0								
2.5					(1.60)			
3.0								
	TP204_3.3-4.0	0	1		3.30	Grey sandy GRAVEL. Gravel is fine to coarse.		
3.5					(0.70)			
					4.00			
4.0						EOH		

Backfill	Sample Details	Legend	GENERAL REMARKS
	Small Disturbed Sample	Made Ground (Fill); Sandy SILT/CLAY; Sandy GRAVEL; Groundwater Table; Groundwater Strike	NEC - No Evidence of Contaminaiton EOH - End of Trial Hole

		Logged By	Approved By
		T. Kilbride	B.Duggan

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TRIAL PIT LOG

Project Name and Site Location	Client	TRIAL PIT No
Spencer Dock Block 2 & 7	Hines Ireland	**TP205**

Job No	Date	Ground Level (m)	Co-Ordinates ()
47092981	Start Date 27-05-15 End Date 27-05-15	2.76	E 317,501.69 N 234,664.90

Contractor	Method / Plant Used	Sheet
IGSL	JCB 3CX	1 of 1

Depth BGL	Sample / Test Details	PID (ppm)	Water	STRATA: Legend	Depth (Thick-ness)	DESCRIPTION	COMMENTS	Instrument / Backfill
0.0					(0.35)	Gravel HARDCORE over CONCRETE. MADEGROUND		
	TP205_0.35-1.4	1.4			0.35	Loose black beoming light brown clayey sandy GRAVEL. MADEGROUND	Frequent fragments of bitumen timber and brick. 0.65m bitumen odour. 1.4m clinker. 2.1m purple red burnt ash cobble.	
0.5								
1.0								
	TP205_1.4-2.1	0.5						
1.5					(2.65)			
2.0								
	TP205_2.1-3.0	0.7						
2.5								
3.0	TP205_3.0-4.0	0.9	1		3.00	Dark brown very silty SAND with occasional gravels and cobbles beoming sandy SILT.		
3.5					(1.00)			
4.0					4.00			
	TP205_4.0-4.3	0.4			(0.30)	Grey sandy fine angular GRAVEL.		
					4.30	EOH		

Backfill	Sample Details	Legend	GENERAL REMARKS
	Small Disturbed Sample	Made Ground (Fill); Silty/Clayey SAND; Sandy GRAVEL; Groundwater Table; Groundwater Strike	NEC - No Evidence of Contaminaiton EOH - End of Trial Hole

		Logged By	Approved By
		T. Kilbride	B.Duggan

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TRIAL PIT LOG

Project Name and Site Location	Client	TRIAL PIT No
Spencer Dock Block 2 & 7	Hines Ireland	**TP206**

Job No	Date	Ground Level (m)	Co-Ordinates ()
47092981	Start Date 28-05-15 End Date 28-05-15	2.10	E 317,560.44 N 234,709.60

Contractor	Method / Plant Used	Sheet
IGSL	JCB 3CX	1 of 1

Depth BGL	Sample / Test Details	PID (ppm)	Water	STRATA: Legend	Depth (Thick-ness)	DESCRIPTION	COMMENTS	Instrument / Backfill
					0.15	CONCRETE. MADEGROUND		
					0.25	Gravel HARDCORE. MADEGROUND		
	TP206_0.3-1.0	0.0				Loose dark brown sandy GRAVEL. MADEGROUND	Frequent fragments of concrete and ceramic. 0.4m. 1.1m red metallic clicker and angular magnetic cobbles. 1.5m grey white clicker with timber	
0.5								
1.0	TP206_1.0-2.5	0.0			(1.45)			
1.5								
					1.70			
					1.80	Grey mottled sandy SILT. MADEGROUND	Damp	
					1.90	Grey SILT. MADEGROUND		
2.0						Dark red slightly sandy GRAVEL with many cobbles of purple red clicker.	Occasional bricks	
					(0.90)			
2.5	TP206_2.5-3.5	0.0	▽1					
					2.80			
					(0.30)	Dark grey silty fine SAND.		
3.0					3.10			
					(0.40)	Dark grey sandy fine GRAVEL.		
3.5					3.50			
						EOH. Pit terminated due to instability		

Backfill	Sample Details	Legend	GENERAL REMARKS
	☒ Small Disturbed Sample	☒ Made Ground (Fill) ⊠ Silty/Clayey SAND Sandy GRAVEL ▼ Groundwater Table ▽1 Groundwater Strike	NEC - No Evidence of Contaminaiton EOH - End of Trial Hole

		Logged By	T. Kilbride	Approved By	B.Duggan

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TRIAL PIT LOG

Project Name and Site Location	Client	TRIAL PIT No
Spencer Dock Block 2 & 7	Hines Ireland	**TP207**

Job No	Date	Ground Level (m)	Co-Ordinates ()
47092981	Start Date 28-05-15 End Date 28-05-15	2.54	E 317,541.80 N 234,719.82

Contractor	Method / Plant Used	Sheet
IGSL	JCB 3CX	1 of 1

Depth BGL	Sample / Test Details	PID (ppm)	Water	STRATA: Legend	Depth (Thickness)	DESCRIPTION	COMMENTS	Instrument / Backfill
					0.15	CONCRETE. MADEGROUND		
	TP207_0.2-1.35				(0.70)	Dark brown sandy gravelly CLAY. MADEGROUND	Fragemnts of brick and debris	
0.5					0.85			
					(0.40)	Light brown sandy gravelly CLAY with occasional cobbles. MADEGROUND		
1.0					1.25			
					1.35	Dark brown SILT. MADEGROUND		
	TP207_1.35-2.3				(0.95)	Dark brown gravelly SAND with many cobbles of brick.	Dry	
1.5								
2.0					2.30			
	TP207_2.3-3.6				(1.30)	Grey black silty SAND with lenses of very soft grey black mottled SILT.	Strong estuarine odour	
2.5								
3.0								
3.5			1 ▼		3.60			
					(0.70)	Dark grey black sandy angular GRAVEL.		
4.0	TP207_4.0-4.3				4.30			
						EOH		

Backfill	Sample Details	Legend	GENERAL REMARKS
	Small Disturbed Sample	Made Ground (Fill); Silty/Clayey SAND; Sandy GRAVEL; Groundwater Table; Groundwater Strike	NEC - No Evidence of Contaminaiton EOH - End of Trial Hole

		Logged By	Approved By
		T. Kilbride	B.Duggan

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TRIAL PIT LOG

Project Name and Site Location	Client	TRIAL PIT No
Spencer Dock Block 2 & 7	Hines Ireland	**TP208**

Job No	Date	Ground Level (m)	Co-Ordinates ()
47092981	Start Date 29-05-15 End Date 29-05-15	2.77	E 317,520.26 N 234,716.35

Contractor	Method / Plant Used	Sheet
IGSL	JCB 3CX	1 of 1

Depth BGL	Sample / Test Details	PID (ppm)	Water	STRATA: Legend	Depth (Thick-ness)	DESCRIPTION	COMMENTS	Instrument / Backfill
					0.10	CONCRETE. MADEGROUND		
	TP208_0.3-1.8	0.0			(1.70)	Brown black sandy gravelly CLAY with many cobbles of concrete. MADEGROUND	Frequent pieces of metal. 1.0m frequent white grey and red flecks. 1.4m concrete boulder.	
0.5								
1.0								
1.5					1.80			
	TP208_1.8-2.7	2.8			(0.90)	Red grey clayey slightly sandy GRAVEL of clinker. MADEGROUND	No odour. Very Moist	
2.0								
2.5					2.70			
	TP208_2.8-3.7				(1.00)	Stiff dark grey black sandy SILT.		
3.0								
3.5			1		3.70			
	TP208_3.7-4.3				(0.60)	Dark grey black sandy fine GRAVEL.		
4.0					4.30			
						EOH		

Backfill	Sample Details	Legend	GENERAL REMARKS
	Small Disturbed Sample	Made Ground (Fill); Sandy SILT/CLAY; Sandy GRAVEL; Groundwater Table; Groundwater Strike	NEC - No Evidence of Contaminaiton EOH - End of Trial Hole

		Logged By	Approved By
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TRIAL PIT LOG

Project Name and Site Location	Client	TRIAL PIT No
Spencer Dock Block 2 & 7	Hines Ireland	**TP209**

Job No	Date	Ground Level (m)	Co-Ordinates ()
47092981	Start Date 04-06-15 End Date 04-05-15	2.65	E 317,515.90 N 234,749.94

Contractor	Method / Plant Used	Sheet
IGSL	JCB 3CX	1 of 1

Depth BGL	Sample / Test Details	PID (ppm)	Water	STRATA: Legend	Depth (Thick-ness)	DESCRIPTION	COMMENTS	Instrument / Backfill
0.0					(0.30) 0.30	CONCRETE. MADEGROUND		
	TP209_0.3-2.0				(0.60) 0.90	Black sandy gravelly SILT. MADEGROUND	Brick fragments	
0.5								
1.0					(1.80) 2.70	Dark brown red becoming white red clayey slightly sandy GRAVEL of clinker. MADEGROUND	Pockets of white blue ash	
1.5								
2.0								
2.5								
	TP209_2.7-4.0				(1.00) 3.70	Soft black SILT.		
3.0								
3.5								
	TP209_4.0-4.5				(0.80) 4.50	Grey sandy GRAVEL.		
4.0								
4.5						EOH		

Backfill	Sample Details	Legend	GENERAL REMARKS
	Small Disturbed Sample	Made Ground (Fill); SILT/CLAY; Sandy GRAVEL; Groundwater Table; Groundwater Strike	NEC - No Evidence of Contaminaiton EOH - End of Trial Hole

		Logged By	Approved By
		T. Kilbride	B.Duggan

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TRIAL PIT LOG

Project Name and Site Location	Client	TRIAL PIT No
Spencer Dock Block 2 & 7	Hines Ireland	**TP210**

Job No	Date	Ground Level (m)	Co-Ordinates ()
47092981	Start Date 29-05-15 End Date 29-05-15	2.65	E 317,515.90 N 234,749.94

Contractor	Method / Plant Used	Sheet
IGSL	JCB 3CX	1 of 1

Depth BGL	Sample / Test Details	PID (ppm)	Water	STRATA: Legend	Depth (Thickness)	DESCRIPTION	COMMENTS	Instrument / Backfill
					0.15	CONCRETE. MADEGROUND		
0.5	TP210_0.4-1.8	0.2			(1.65)	Loose dark brown black SAND. MADEGROUND		
1.0								
1.5					1.80			
	TP210_1.8-2.3	1.7			(0.50)	Stiff grey silty slightly gravelly CLAY. MADEGROUND	1.9m red orange angular iron chippings	
2.0					2.30			
	TP210_2.3-3.5	2.6	1 ▽		(0.30)	Soft dark grey black clayey sandy SILT.	Strong estuarine odour	
2.5					2.60			
					(0.90)	Loose dark grey silty SAND.		
3.0					3.50			
3.5	TP210_3.5-4.2				(0.70)	Grey brown gravelly SAND.		
4.0					4.20			
	TP210_4.2-4.5				(0.30)	Soft dark grey CLAY.		
4.5					4.50	EOH		

Backfill	Sample Details	Legend	GENERAL REMARKS
	Small Disturbed Sample	Made Ground (Fill); Sandy SILT/CLAY; Gravelly SAND; CLAY; Groundwater Table; Groundwater Strike	NEC - No Evidence of Contaminaiton EOH - End of Trial Hole

		Logged By	Approved By
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TRIAL PIT LOG

Project Name and Site Location	Client	TRIAL PIT No
Spencer Dock Block 2 & 7	Hines Ireland	**TP211**

Job No	Date	Ground Level (m)	Co-Ordinates ()
47092981	Start Date 29-05-15 End Date 29-05-15	2.16	E 317,562.15 N 234,742.73

Contractor	Method / Plant Used	Sheet
IGSL	JCB 3CX	1 of 1

Depth BGL	Sample / Test Details	PID (ppm)	Water	STRATA: Legend	Depth (Thick-ness)	DESCRIPTION	COMMENTS	Instrument / Backfill
					0.15	CONCRETE. MADEGROUND		
0.5	TP211_0.3-1.8	209			(1.65)	Black sandy gravelly CLAY. MADEGROUND	Frequent fragments of brick waste and ceramic. 1.5m becomes dark red with metallic clinker.	
1.0								
1.5					1.80			
2.0	TP211_1.8-3.0	24.4			(1.20)	Dark grey black mottled slightly sandy SILT.	Slight estuarine odour	
2.5								
3.0	TP211_3.0-4.0	8.8	1		3.00	Grey sandy fine GRAVEL.		
3.5					(1.00)			
4.0	TP211_4.0-4.5	2.7			4.00	Dark grey slightly sandy SILT with many shell fragments and pockets of gravel.		
4.5					(0.50) 4.50	EOH		

Backfill	Sample Details	Legend	GENERAL REMARKS
	Small Disturbed Sample	Made Ground (Fill); Sandy SILT/CLAY; Sandy GRAVEL; Sandy SILT/CLAY with gravel; Groundwater Table; Groundwater Strike	NEC - No Evidence of Contaminaiton EOH - End of Trial Hole

		Logged By	Approved By
		T. Kilbride	B.Duggan

URS IRELAND LIMITED TRIAL PIT LOG SPENCER DOCK 2015.GPJ AGS3_ALL.GDT 22/6/15

Appendix B – Borehole Logs

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18489

CONTRACT	Spencer Dock , Dublin	**BOREHOLE NO.**	**BH09**
		SHEET	Sheet 1 of 2
CO-ORDINATES		**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)		**BOREHOLE DEPTH (m)**	10.50
		DATE COMMENCED	09/07/2015
		DATE COMPLETED	10/07/2015
CLIENT	Spencer Dock Development Co.	**SPT HAMMER REF. NO.**	
ENGINEER	OCSC	**ENERGY RATIO (%)**	
		BORED BY	J.O'Toole
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	MADE GROUND (Comprised of brick,stone,rubble fill)			0.90						
1	MADE GROUND (Comprised of gravelly silty/clayey fill)				AA35325	B	1.00		N = 7 (0, 0, 1, 2, 2, 2)	
2				2.90	AA35326	B	2.00		N = 3 (0, 0, 0, 1, 1, 1)	
3	Soft to firm grey SILT				AA35327	B	3.00		N = 6 (1, 1, 1, 1, 2, 2)	
4					AA35328	B	4.00		N = 9 (1, 1, 2, 2, 2, 3)	
5				5.30	AA35329	B	5.00		N = 12 (1, 2, 2, 3, 3, 4)	
	Medium dense grey silty gravelly SAND			5.50						
6	Medium dense to dense grey fine to coarse sandy GRAVEL with cobbles				AA35330	B	6.00		N = 24 (2, 3, 4, 6, 7, 7)	
7				7.80	AA35331	B	7.00		N = 40 (4, 7, 9, 9, 10, 12)	
8	Very stiff to hard black sandy gravelly CLAY with cobbles and occasional boulders				AA35332	B	8.00		N = 35 (3, 4, 7, 9, 9, 10)	
9					AA35333	B	9.00		N = 44/225 mm (8, 14, 16, 12, 16)	

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
7.9	8.2	0.5	
9.6	10.2	1	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
4.80	4.80	No	4.50	20	Seepage

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
10-07-15	7.00	5.00	7.00	50mm SP

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
09-07-15	5.50	5.50	4.00	End of 1st Day

REMARKS CAT scanned location . Hand dug inspection pit

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 18489.GPJ IGSL.GDT 10/8/15

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18489

CONTRACT Spencer Dock , Dublin

BOREHOLE NO. **BH09**
SHEET Sheet 2 of 2

CO-ORDINATES
GROUND LEVEL (m AOD)

RIG TYPE Dando 2000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 10.50

DATE COMMENCED 09/07/2015
DATE COMPLETED 10/07/2015

CLIENT Spencer Dock Development Co.
ENGINEER OCSC

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY J.O'Toole
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
10	Very stiff to hard black sandy gravelly CLAY with cobbles and occasional boulders *(continued)*				AA35334	B	10.00		(14, 25)	
				10.50						
	End of Borehole at 10.50 m									
11										
12										
13										
14										
15										
16										
17										
18										
19										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
7.9	8.2	0.5	
9.6	10.2	1	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
10-07-15	10.50	Nil	2.80	End of BH

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
10-07-15	7.00	5.00	7.00	50mm SP

REMARKS CAT scanned location . Hand dug inspection pit

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 18489.GPJ IGSL.GDT 10/8/15

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18489

CONTRACT	Spencer Dock , Dublin	**BOREHOLE NO.**	**BH10**
		SHEET	Sheet 1 of 2
CO-ORDINATES		**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)		**BOREHOLE DEPTH (m)**	11.40
		DATE COMMENCED	13/07/2015
		DATE COMPLETED	14/07/2015
CLIENT	Spencer Dock Development Co.	**SPT HAMMER REF. NO.**	
ENGINEER	OCSC	**ENERGY RATIO (%)**	
		BORED BY	J.O'Toole
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	MADE GROUND (Comprised of concrete slab)			0.20						
	MADE GROUND (Comprised of clay with red bricka nd rubble)									
1					AA35335	B	1.00		N = 10 (1, 1, 2, 2, 3, 3)	
2					AA35336	B	2.00		N = 6 (0, 0, 1, 1, 2, 2)	
				2.90						
3	Loose grey sandy GRAVEL with cobbles			3.10	AA35337	B	3.00		N = 7 (0, 0, 1, 2, 2, 2)	
	Firm grey sandy SILT									
4					AA35338	B	4.00		N = 16 (2, 2, 3, 4, 4, 5)	
				4.80						
5	Dense grey fine to coarse sandy GRAVEL with cobbles				AA35339	B	5.00		N = 69/225 mm (1, 4, 5, 56, 8)	
6					AA35340	B	6.00		N = 44 (2, 6, 9, 11, 12, 12)	
7					AA35341	B	7.00		N = 49 (4, 7, 8, 11, 14, 16)	
8					AA35342	B	8.00		N = 53 (5, 7, 11, 12, 14, 16)	
9					AA35343	B	9.00		N = 54 (4, 8, 10, 14, 18, 12)	
				9.30						
	Very stiff to hard black sandy gravelly CLAY with cobbles and occasional boulders									

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
4.9	5.1	0.75	
8.5	9	1.5	
10.3	10.5	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
4.80	4.80	No	2.50	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
14-07-15	4.00	0.50	4.00	50mm SP

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
13-07-14	7.00	7.00	2.80	End of 1st Day
14-07-15	7.00	7.00	3.00	Start of 2nd Day

REMARKS CAT scanned location . Hand dug inspection pit

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 18489.GPJ IGSL.GDT 10/8/15

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18489

CONTRACT	Spencer Dock , Dublin	**BOREHOLE NO.**	**BH10**
		SHEET	Sheet 2 of 2
CO-ORDINATES		**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)		**BOREHOLE DEPTH (m)**	11.40
		DATE COMMENCED	13/07/2015
		DATE COMPLETED	14/07/2015
CLIENT	Spencer Dock Development Co.	**SPT HAMMER REF. NO.**	
ENGINEER	OCSC	**ENERGY RATIO (%)**	
		BORED BY	J.O'Toole
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
10	Very stiff to hard black sandy gravelly CLAY with cobbles and occasional boulders *(continued)*				AA35344	B	10.00		N = 68 (6, 11, 12, 19, 12, 25)	
11				11.40						
	End of Borehole at 11.40 m									
12										
13										
14										
15										
16										
17										
18										
19										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
4.9	5.1	0.75	
8.5	9	1.5	
10.3	10.5	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
15-07-15	10.50	Nil	1.80	End of BH

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
14-07-15	4.00	0.50	4.00	50mm SP

REMARKS CAT scanned location . Hand dug inspection pit

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 18489.GPJ IGSL.GDT 10/8/15

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18489

CONTRACT	Spencer Dock , Dublin	**BOREHOLE NO.**	**BH11**
		SHEET	Sheet 1 of 2
CO-ORDINATES		**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)		**BOREHOLE DEPTH (m)**	12.00
		DATE COMMENCED	15/07/2015
		DATE COMPLETED	16/07/2015
CLIENT	Spencer Dock Development Co.	**SPT HAMMER REF. NO.**	
ENGINEER	OCSC	**ENERGY RATIO (%)**	
		BORED BY	J.O'Toole
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	MADE GROUND (Comprised of black gravelly clay with red brick and rubble)									
1					AA33345	B	1.00		N = 4 (0, 0, 1, 1, 1, 1)	
2					AA33346	B	2.00		N = 10 (1, 2, 2, 3, 2, 3)	
				2.90						
3	Medium dense grey fine to coarse slightly clayey GRAVEL				AA33347	B	3.00		N = 14 (2, 3, 3, 4, 4, 3)	
4					AA33348	B	4.00		N = 17 (1, 2, 3, 4, 5, 5)	
5					AA33349	B	5.00		N = 24 (1, 3, 4, 6, 7, 7)	
				5.50						
	Medium dense COBBLES and boulders			5.80						
6	Medium dense to dense grey slightly sandy GRAVEL with cobbles and occasional boulders (Occasional lenses/layers of fine brown blowing sand)				AA33350	B	6.00		N = 31 (2, 4, 6, 7, 8, 10)	
7					AA37801	B	7.00		N = 44 (4, 6, 9, 12, 11, 12)	
8					AA37802	B	8.00		N = 55 (6, 9, 11, 14, 14, 16)	
9					AA37803	B	9.00		N = 55 (4, 7, 12, 13, 16, 14)	

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
5.5	5.8	1.5	
7.4	7.6	0.5	
9.2	9.5	0.75	
11.6	11.8	0.5	
11.7	12	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
5.10	5.10	No	3.00	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
16-07-15	5.00	1.00	5.00	50mm SP

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS CAT scanned location . Hand dug inspection pit for services

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 18489.GPJ IGSL.GDT 10/8/15

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18489

CONTRACT	Spencer Dock , Dublin	**BOREHOLE NO.**	**BH11**
		SHEET	Sheet 2 of 2
CO-ORDINATES		**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)		**BOREHOLE DEPTH (m)**	12.00
		DATE COMMENCED	15/07/2015
		DATE COMPLETED	16/07/2015
CLIENT	Spencer Dock Development Co.	**SPT HAMMER REF. NO.**	
ENGINEER	OCSC	**ENERGY RATIO (%)**	
		BORED BY	J.O'Toole
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
10	Medium dense to dense grey slightly sandy GRAVEL with cobbles and occasional boulders (Occasional lenses/layers of fine brown blowing sand) *(continued)*				AA37804	B	10.00		N = 58 (7, 10, 10, 12, 18, 18)	
11	Hard brown/black sandy gravelly CLAY with cobbles and occasional boulders			11.10	AA37805	B	11.00		N = 40/150 mm (16, 20, 15, 25)	
12	End of Borehole at 12.00 m			12.00	AA37806	B	12.00		(16, 28)	
13										
14										
15										
16										
17										
18										
19										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
5.5	5.8	1.5	
7.4	7.6	0.5	
9.2	9.5	0.75	
11.6	11.8	0.5	
11.7	12	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
16-07-15	5.00	1.00	5.00	50mm SP

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
16-07-15	12.00	Nil	3.50	End of BH

REMARKS CAT scanned location . Hand dug inspection pit for services

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 18489.GPJ IGSL.GDT 10/8/15

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18489

CONTRACT	Spencer Dock , Dublin	**BOREHOLE NO.**	**BH12**
		SHEET	Sheet 1 of 2
CO-ORDINATES		**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)		**BOREHOLE DEPTH (m)**	11.50
		DATE COMMENCED	10/07/2015
		DATE COMPLETED	13/07/2015
CLIENT	Spencer Dock Development Co.	**SPT HAMMER REF. NO.**	
ENGINEER	OCSC	**ENERGY RATIO (%)**	
		BORED BY	P.Thomas
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	CONCRETE			0.20						
	MADE GROUND (Comprised of grey/black silty gravel with brick and concrete fragments)				AA19239	B	1.00		N = 15 (2, 3, 3, 4, 4, 4)	
1										
2				2.30	AA19240	B	2.00		N = 10 (3, 3, 5, 3, 1, 1)	
	Soft grey/black sandy SILT									
3				3.20	AA19241	B	3.00		N = 4 (1, 0, 1, 1, 1, 1)	
	Loose grey/black very silty very sandy GRAVEL									
4					AA19242	ENV B	4.00-4.50 4.00		N = 3 (1, 0, 1, 0, 1, 1)	
				5.10	AA19243	B	5.00		N = 19 (1, 2, 2, 5, 5, 7)	
5	Medium dense to dense grey slightly silty fine to coarse sandy GRAVEL with cobbles (Occasional pockets of fine blowing sand)									
6					AA19244	B	6.00		N = 30 (2, 2, 4, 5, 9, 12)	
7					AA19245	B	7.00			
8					AA19246	B	8.00		N = 27 (2, 4, 5, 5, 8, 9)	
9					AA19247	B	9.00		N = 25 (3, 4, 4, 6, 7, 8)	

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
6.4	6.9	1.25	
9.3	9.6	0.75	
11.3	11.5	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
5.10	5.10	No	4.70	20	Slow
6.50	6.50	No	1.50	20	Rapid

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
13-07-15	11.50	5.50	8.50	50mm SP

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS CAT scanned location . Hand dug pit for services .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 18489.GPJ IGSL.GDT 10/8/15

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18489

CONTRACT Spencer Dock , Dublin

BOREHOLE NO. **BH12**
SHEET Sheet 2 of 2

CO-ORDINATES
GROUND LEVEL (m AOD)

RIG TYPE Dando 2000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 11.50

DATE COMMENCED 10/07/2015
DATE COMPLETED 13/07/2015

CLIENT Spencer Dock Development Co.
ENGINEER OCSC

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY P.Thomas
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
10				10.20	AA19248	B	10.00			
	Stiff brown slightly gravelly sandy CLAY			10.50						
	Very stiff to hard lack very gravelly CLAY with cobbles and occasional boulders				AA19249	B	11.00		N = 50 (5, 8, 9, 10, 14, 17)	
11				11.50						
	End of Borehole at 11.50 m									
12										
13										
14										
15										
16										
17										
18										
19										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
6.4	6.9	1.25	
9.3	9.6	0.75	
11.3	11.5	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
13-07-15	11.50	5.50	8.50	50mm SP

REMARKS CAT scanned location . Hand dug pit for services .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 18489.GPJ IGSL.GDT 10/8/15

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18489

CONTRACT Spencer Dock , Dublin

BOREHOLE NO. **BH13**
SHEET Sheet 1 of 2

CO-ORDINATES
GROUND LEVEL (m AOD)

RIG TYPE Dando 2000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 11.50

DATE COMMENCED 16/07/2015
DATE COMPLETED 23/07/2015

CLIENT Spencer Dock Development Co.
ENGINEER OCSC

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY J.O'Toole
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	MADE GROUND (Comprised of concrete slab)			0.20						
	MADE GROUND (Comprised of gravelly clay with brick and rubble fill)									
1					AA37807	B	1.00		N = 10 (1, 1, 2, 3, 3, 2)	
2					AA37808	B	2.00		N = 12 (1, 2, 3, 2, 4, 3)	
				3.00						
3	Firm grey SILT				AA37809	B	3.00		N = 16 (2, 2, 3, 4, 4, 5)	
4					AA37810	B	4.00		N = 12 (1, 1, 2, 3, 4, 3)	
				4.80						
5	Medium dense to dense grey fine to coarse sandy GRAVEL with cobbles				AA37811	B	5.00		N = 20 (2, 4, 4, 6, 5, 5)	
6					AA37812	B	6.00		N = 24 (3, 4, 5, 6, 6, 7)	
7					AA37813	B	7.00		N = 53 (4, 7, 9, 12, 14, 18)	
				8.00						
8	Brown CLAY with cobbles and boulders				AA37814	B	8.00		N = 24/75 mm (6, 19, 24)	
				8.50						
	Coarse grey SAND with cobbles									
9					AA37815	B	9.00		N = 43 (4, 6, 7, 11, 13, 12)	

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
2.5	2.6	0.5	
7.9	8.2	1	
8.5	8.6	0.5	
9.1	9.3	0.75	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
5.20	5.20	No	3.00	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
24-07-15	11.50	0.50	11.50	50mm SP

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
21-07-15	8.00	8.00	5.20	End of 2nd day

REMARKS CAT scanned location . Hand dug inspection pit

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 18489.GPJ IGSL.GDT 10/8/15

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18489

CONTRACT Spencer Dock , Dublin

BOREHOLE NO. **BH13**
SHEET Sheet 2 of 2

CO-ORDINATES
GROUND LEVEL (m AOD)

RIG TYPE Dando 2000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 11.50

DATE COMMENCED 16/07/2015
DATE COMPLETED 23/07/2015

CLIENT Spencer Dock Development Co.
ENGINEER OCSC

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY J.O'Toole
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
10	Coarse grey SAND with cobbles *(continued)*				AA37816	B	10.00		N = 58 (6, 10, 12, 14, 16, 16)	
				10.50						
	Fine to coarse GRAVEL			10.90						
11	Stiff black sandy gravelly CLAY with cobbles				AA37817	B	11.00		N = 57 (2, 7, 11, 16, 15, 15)	
				11.50						
	End of Borehole at 11.50 m									
12										
13										
14										
15										
16										
17										
18										
19										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
2.5	2.6	0.5	
7.9	8.2	1	
8.5	8.6	0.5	
9.1	9.3	0.75	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
23-07-15	11.50	11.50	3.80	End of 3rd Day
24-07-15	11.50	Nil	2.80	End of BH

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
24-07-15	11.50	0.50	11.50	50mm SP

REMARKS CAT scanned location . Hand dug inspection pit

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 18489.GPJ IGSL.GDT 10/8/15

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18489

CONTRACT	Spencer Dock , Dublin	**BOREHOLE NO.**	**BH14**
		SHEET	Sheet 1 of 2
CO-ORDINATES		**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)		**BOREHOLE DEPTH (m)**	13.70
		DATE COMMENCED	26/06/2015
		DATE COMPLETED	30/06/2015
CLIENT	Spencer Dock Development Co.	**SPT HAMMER REF. NO.**	
ENGINEER	OCSC	**ENERGY RATIO (%)**	
		BORED BY	J.O'Toole
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	MADE GROUND (Comprised of concrete slab)			0.20						
	MADE GROUND (Comprised of gravelly clay with brick and rubble)				AA35312	B	1.00		N = 5 (0, 0, 1, 1, 1, 2)	
1				2.00						
2	MADE GROUND (Comprised of silt with rubble,brick,pipe)				AA35313	B	2.00		N = 7 (1, 1, 1, 2, 2, 2)	
3					AA35314	B	3.00		N = 12 (1, 1, 2, 3, 3, 4)	
				3.80						
4	Soft grey SILT with occasional fine gravel			4.10	AA35315	B	4.00		N = 9 (1, 1, 2, 2, 2, 3)	
	Soft grey SILT			4.80						
5	Medium dense to dense grey fine to coarse sandy GRAVEL with cobbles				AA35316	B	5.00		N = 36 (2, 6, 7, 7, 9, 13)	
6					AA35317	B	6.00		N = 45 (6, 8, 10, 10, 11, 14)	
7					AA35318	B	7.00		N = 53 (4, 9, 11, 12, 14, 16)	
				8.00						
8	Stiff brown SILT/CLAY			8.10	AA35319	B	8.00		N = 20 (2, 4, 5, 5, 5, 5)	
	Very stiff to hard black sandy gravelly CLAY with cobbles									
9					AA35320	B	9.00		N = 42 (2, 6, 9, 9, 10, 14)	

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
2.8	3	1	
5.6	5.9	0.75	
9.4	9.6	0.5	
11.4	11.8	1.25	
13.1	13.7	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
4.80	4.80	No	4.00	20	Slow

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
30-06-15	7.00	4.00	7.00	50mm SP

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS CAT scanned location.Hand dug inspection pit

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

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GEOTECHNICAL BORING RECORD

REPORT NUMBER 18489

CONTRACT	Spencer Dock , Dublin	**BOREHOLE NO.**	**BH14**
		SHEET	Sheet 2 of 2
CO-ORDINATES		**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)		**BOREHOLE DEPTH (m)**	13.70
		DATE COMMENCED	26/06/2015
		DATE COMPLETED	30/06/2015
CLIENT	Spencer Dock Development Co.	**SPT HAMMER REF. NO.**	
ENGINEER	OCSC	**ENERGY RATIO (%)**	
		BORED BY	J.O'Toole
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
10	Very stiff to hard black sandy gravelly CLAY with cobbles *(continued)*			10.50	AA35321	B	10.00		N = 31 (4, 7, 6, 7, 8, 10)	
	Dense grey silty sandy clayey GRAVEL (Possibly very gravelly CLAY			10.90						
11	Very stiff grey gravelly CLAY				AA35322	B	11.00		N = 54 (6, 16, 13, 14, 13, 14)	
12				12.50	AA35323	B	12.00		N = 35 (4, 6, 9, 8, 9, 9)	
	Hard black sandy gravelly CLAY with cobbles									
13				13.70	AA35324	B	13.00		N = 65 (8, 12, 14, 16, 18, 17)	
	End of Borehole at 13.70 m									
14										
15										
16										
17										
18										
19										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
2.8	3	1	
5.6	5.9	0.75	
9.4	9.6	0.5	
11.4	11.8	1.25	
13.1	13.7	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
30-06-15	7.00	4.00	7.00	50mm SP

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
29-06-15	12.00	12.00	3.00	End of 1st Day
30-06-15	13.50	Nil	2.80	End of BH

REMARKS CAT scanned location.Hand dug inspection pit

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 18489.GPJ IGSL.GDT 10/8/15

Appendix C – Laboratory Reports Soil Samples

Jones Environmental Laboratory

Registered Address : Unit 3 Deeside Point, Zone 3, Deeside Industrial Park, Deeside, CH5 2UA. UK

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

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

AECOM
4th Floor Adelphi Plaza
Adelphi Centre
Georges Street Upper
Dun Laoghaire, Co Dublin
Ireland

4225

Attention :	Brian Duggan
Date :	21st September, 2015
Your reference :	
Our reference :	Test Report 15/8159 Batch 1 15/8407 Batch 1 15/8073 Batch 1 15/10240 Batch 1 15
Location :	City Block 2 & 7
Date samples received :	
Status :	Final report
Issue :	1

Compiled By:

Simon Gomery BSc
Project Manager

All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: AECOM
Reference:
Location: City Block 2 & 7
Contact: Brian Duggan

Report : Solid

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

J E Job No.	15/8073	15/8073	15/8073	15/8073	15/8073	15/8159	15/8159	15/8159	15/8159	15/8159	Please see attached notes for all abbreviations and acronyms		
J E Sample No.	7-9	16-18	27-29	30-32	42-44	22-24	25-27	34-36	37-39	46-48			
Sample ID	TP206	TP207	TP210	TP210	TP211	TP201	TP201	TP202	TP202	TP203			
Depth	2.5-3.5	2.3-3.6	2.3-3.5	3.5-4.2	3.0-4.0	2.70-3.80	3.80-4.50	2.20-3.40	3.40-3.70	3.90-4.10			
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T			
Sample Date	28/05/2015	28/05/2015	28/05/2015	28/05/2015	28/05/2015	29/05/2015	29/05/2015	29/05/2015	29/05/2015	29/05/2015			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	01/06/2015	01/06/2015	01/06/2015	01/06/2015	01/06/2015	03/06/2015	03/06/2015	03/06/2015	03/06/2015	03/06/2015			
Antimony	3	5	3	2	2	3	83_{AA}	120_{AB}	27_{AA}	3	<1	mg/kg	TM30/PM15
Antimony	-	-	-	-	-	-	-	-	-	-	<1	mg/kg	TM30/PM62
Arsenic #	90.2	35.2	66.4	38.1	110.4	25.2	223.7	606.9_{AA}	148.2	180.4	<0.5	mg/kg	TM30/PM15
Arsenic	-	-	-	-	-	-	-	-	-	-	<0.5	mg/kg	TM30/PM62
Barium #	51	310	81	69	55	46	305	81	78	29	<1	mg/kg	TM30/PM15
Barium	-	-	-	-	-	-	-	-	-	-	<1	mg/kg	TM30/PM62
Cadmium #	0.8	0.6	9.1	2.8	3.5	1.1	35.9_{AA}	87.7_{AA}	4.5	<0.1	<0.1	mg/kg	TM30/PM15
Cadmium	-	-	-	-	-	-	-	-	-	-	<0.1	mg/kg	TM30/PM62
Chromium #	106.9	58.2	52.2	88.0	105.0	55.0	167.2	38.7	82.5	146.2	<0.5	mg/kg	TM30/PM15
Chromium	-	-	-	-	-	-	-	-	-	-	<0.5	mg/kg	TM30/PM62
Copper #	119	66	185	42	294_{AA}	63	2031_{AB}	10930_{AD}	625_{AA}	24	<1	mg/kg	TM30/PM15
Copper	-	-	-	-	-	-	-	-	-	-	<1	mg/kg	TM30/PM62
Lead #	85	334	443	479	714	183	18300_{AB}	18580_{AD}	537	36	<5	mg/kg	TM30/PM15
Lead	-	-	-	-	-	-	-	-	-	-	<5	mg/kg	TM30/PM62
Mercury #	0.2	2.0	0.7	<0.1	<0.1	0.6	<0.1	1.5	0.7	1.6	<0.1	mg/kg	TM30/PM15
Mercury	-	-	-	-	-	-	-	-	-	-	<0.1	mg/kg	TM30/PM62
Molybdenum #	13.5	5.1	5.7	8.5	10.0	5.2	34.6_{AA}	76.0_{AA}	18.1	18.5	<0.1	mg/kg	TM30/PM15
Molybdenum	-	-	-	-	-	-	-	-	-	-	<0.1	mg/kg	TM30/PM62
Nickel #	6.5	31.9	22.6	11.6	22.0	31.7	15.2	19.3	14.3	4.9	<0.7	mg/kg	TM30/PM15
Nickel	-	-	-	-	-	-	-	-	-	-	<0.7	mg/kg	TM30/PM62
Selenium #	<1	2	1	1	5	1	1	4	2	<1	<1	mg/kg	TM30/PM15
Selenium	-	-	-	-	-	-	-	-	-	-	<1	mg/kg	TM30/PM62
Zinc #	1523	145	5020_{AA}	964	1069	917	16460_{AB}	17920_{AB}	3174_{AA}	297	<5	mg/kg	TM30/PM15
Zinc	-	-	-	-	-	-	-	-	-	-	<5	mg/kg	TM30/PM62

Client Name: AECOM
Reference:
Location: City Block 2 & 7
Contact: Brian Duggan

Report : Solid

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

J E Job No.	15/8073	15/8073	15/8073	15/8073	15/8073	15/8159	15/8159	15/8159	15/8159	15/8159	LOD/LOR	Units	Method No.
J E Sample No.	7-9	16-18	27-29	30-32	42-44	22-24	25-27	34-36	37-39	46-48			
Sample ID	TP206	TP207	TP210	TP210	TP211	TP201	TP201	TP202	TP202	TP203			
Depth	2.5-3.5	2.3-3.6	2.3-3.5	3.5-4.2	3.0-4.0	2.70-3.80	3.80-4.50	2.20-3.40	3.40-3.70	3.90-4.10			
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T			
Sample Date	28/05/2015	28/05/2015	28/05/2015	28/05/2015	28/05/2015	29/05/2015	29/05/2015	29/05/2015	29/05/2015	29/05/2015			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	01/06/2015	01/06/2015	01/06/2015	01/06/2015	01/06/2015	03/06/2015	03/06/2015	03/06/2015	03/06/2015	03/06/2015			
PAH MS													
Naphthalene #	<0.04	0.15	0.08	<0.04	<0.04	<0.04	<0.04	0.05	0.11	<0.04	<0.04	mg/kg	TM4/PM8
Acenaphthylene	<0.03	0.06	<0.03	<0.03	<0.03	<0.03	<0.03	0.05	<0.03	<0.03	<0.03	mg/kg	TM4/PM8
Acenaphthene #	<0.05	0.10	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	<0.05	<0.05	<0.05	mg/kg	TM4/PM8
Fluorene #	<0.04	0.22	0.06	<0.04	<0.04	<0.04	<0.04	0.08	0.06	<0.04	<0.04	mg/kg	TM4/PM8
Phenanthrene #	0.06	2.14	0.38	<0.03	0.25	0.04	0.10	1.25	0.73	<0.03	<0.03	mg/kg	TM4/PM8
Anthracene #	<0.04	0.28	0.08	<0.04	0.06	<0.04	<0.04	0.15	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Fluoranthene #	0.06	1.97	0.44	<0.03	0.22	0.14	0.08	1.83	0.63	<0.03	<0.03	mg/kg	TM4/PM8
Pyrene #	<0.03	1.37	0.38	<0.03	0.17	0.11	0.08	1.27	0.44	<0.03	<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene #	<0.06	0.79	0.29	<0.06	0.12	0.18	0.08	0.98	0.44	0.09	<0.06	mg/kg	TM4/PM8
Chrysene #	0.04	0.88	0.30	<0.02	0.10	0.14	0.07	1.01	0.48	0.06	<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	<0.07	1.03	0.30	<0.07	0.11	0.21	0.10	1.18	0.47	0.09	<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	<0.04	0.51	0.19	<0.04	0.06	0.12	0.06	0.47	0.14	<0.04	<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene #	<0.04	0.34	0.09	<0.04	<0.04	0.08	0.05	0.34	0.11	<0.04	<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	<0.04	0.10	<0.04	<0.04	<0.04	<0.04	<0.04	0.08	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	<0.04	0.35	0.10	<0.04	<0.04	0.08	0.05	0.34	0.13	<0.04	<0.04	mg/kg	TM4/PM8
Coronene	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
PAH 6 Total #	<0.22	4.20	1.12	<0.22	0.39	0.63	0.34	4.16	1.48	<0.22	<0.22	mg/kg	TM4/PM8
PAH 17 Total	<0.64	10.29	2.69	<0.64	1.09	1.10	0.67	9.14	3.74	<0.64	<0.64	mg/kg	TM4/PM8
Benzo(b)fluoranthene	<0.05	0.74	0.22	<0.05	0.08	0.15	0.07	0.85	0.34	0.06	<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	<0.02	0.29	0.08	<0.02	0.03	0.06	0.03	0.33	0.13	0.03	<0.02	mg/kg	TM4/PM8
Benzo(j)fluoranthene	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	TM4/PM8
PAH Surrogate % Recovery	94	108	104	95	102	106	102	107	106	108	<0	%	TM4/PM8
Methyl Tertiary Butyl Ether #	-	-	-	-	-	-	-	-	-	-	<2	ug/kg	TM15/PM10
Benzene #	-	-	-	-	-	-	-	-	-	-	<3	ug/kg	TM15/PM10
Toluene #	-	-	-	-	-	-	-	-	-	-	<3	ug/kg	TM15/PM10
Ethylbenzene #	-	-	-	-	-	-	-	-	-	-	<3	ug/kg	TM15/PM10
p/m-Xylene #	-	-	-	-	-	-	-	-	-	-	<5	ug/kg	TM15/PM10
o-Xylene #	-	-	-	-	-	-	-	-	-	-	<3	ug/kg	TM15/PM10
Surrogate Recovery Toluene D8	-	-	-	-	-	-	-	-	-	-	<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	-	-	-	-	-	-	-	-	-	-	<0	%	TM15/PM10
EPH (C8-C40) #	<30	871	249	56	91	387	<30	90	<30	<30	<30	mg/kg	TM5/PM8
C8-C40 Mineral Oil (Calculation) - Rilta	<30	38	<30	<30	<30	<30	<30	<30	<30	<30	<30	mg/kg	TM5/PM8

Please see attached notes for all abbreviations and acronyms

Client Name: AECOM
Reference:
Location: City Block 2 & 7
Contact: Brian Duggan

Report : Solid

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

J E Job No.	15/8073	15/8073	15/8073	15/8073	15/8073	15/8159	15/8159	15/8159	15/8159	15/8159	LOD/LOR	Units	Method No.
J E Sample No.	7-9	16-18	27-29	30-32	42-44	22-24	25-27	34-36	37-39	46-48			
Sample ID	TP206	TP207	TP210	TP210	TP211	TP201	TP201	TP202	TP202	TP203			
Depth	2.5-3.5	2.3-3.6	2.3-3.5	3.5-4.2	3.0-4.0	2.70-3.80	3.80-4.50	2.20-3.40	3.40-3.70	3.90-4.10			
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T			
Sample Date	28/05/2015	28/05/2015	28/05/2015	28/05/2015	28/05/2015	29/05/2015	29/05/2015	29/05/2015	29/05/2015	29/05/2015			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	01/06/2015	01/06/2015	01/06/2015	01/06/2015	01/06/2015	03/06/2015	03/06/2015	03/06/2015	03/06/2015	03/06/2015			
TPH CWG													
Aliphatics													
>C5-C6 #	<0.1	<0.5 AA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5 AA	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>C6-C8 #	<0.1	<0.5 AA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5 AA	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>C8-C10	<0.1	<0.5 AA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5 AA	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>C10-C12 #	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	mg/kg	TM5/PM16
>C12-C16 #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	mg/kg	TM5/PM16
>C16-C21 #	<7	12	<7	<7	<7	<7	<7	<7	<7	<7	<7	mg/kg	TM5/PM16
>C21-C35 #	<7	26	<7	<7	<7	15	<7	<7	<7	<7	<7	mg/kg	TM5/PM16
>C35-C40 #	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	mg/kg	TM5/PM16
Total aliphatics C5-40	<26	38	<26	<26	<26	<26	<26	<26	<26	<26	<26	mg/kg	TM5/TM36/PM12/PM16
>C6-C10	<0.1	<0.5 AA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5 AA	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>C10-C25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	mg/kg	TM5/PM16
>C25-C35	<10	26	<10	<10	<10	<10	<10	<10	<10	<10	<10	mg/kg	TM5/PM16
Aromatics													
>C5-EC7	<0.1	<0.5 AA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5 AA	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>EC7-EC8	<0.1	<0.5 AA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5 AA	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>EC8-EC10 #	<0.1	<0.5 AA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5 AA	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>EC10-EC12	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	mg/kg	TM5/PM16
>EC12-EC16	<4	15	<4	<4	<4	<4	<4	<4	<4	<4	<4	mg/kg	TM5/PM16
>EC16-EC21	<7	98	15	<7	<7	<7	<7	22	19	<7	<7	mg/kg	TM5/PM16
>EC21-EC35	<7	232	95	10	<7	40	13	75	92	<7	<7	mg/kg	TM5/PM16
>EC35-EC40	<7	32	10	<7	<7	<7	<7	22	28	<7	<7	mg/kg	TM5/PM16
Total aromatics C5-40	<26	377	120	<26	<26	40	<26	119	139	<26	<26	mg/kg	TM5/TM36/PM12/PM16
Total aliphatics and aromatics(C5-40)	<52	415	120	<52	<52	<52	<52	119	139	<52	<52	mg/kg	TM5/TM36/PM12/PM16
>EC6-EC10	<0.1	<0.5 AA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5 AA	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>EC10-EC25	<10	167	30	<10	<10	<10	<10	41	43	<10	<10	mg/kg	TM5/PM16
>EC25-EC35	<10	182	81	<10	<10	40	13	65	73	<10	<10	mg/kg	TM5/PM16
MTBE #	<5	<25 AA	<5	<5	<5	<5	<5	<25 AA	<5	<5	<5	ug/kg	TM31/PM12
Benzene #	<5	<25 AA	<5	<5	<5	<5	<5	<25 AA	<5	<5	<5	ug/kg	TM31/PM12
Toluene #	<5	<25 AA	13	<5	<5	<5	<5	<25 AA	<5	<5	<5	ug/kg	TM31/PM12
Ethylbenzene #	<5	<25 AA	<5	<5	<5	<5	<5	<25 AA	<5	<5	<5	ug/kg	TM31/PM12
m/p-Xylene #	<5	<25 AA	<5	<5	<5	<5	<5	<25 AA	<5	<5	<5	ug/kg	TM31/PM12
o-Xylene #	<5	<25 AA	<5	<5	<5	<5	<5	<25 AA	<5	<5	<5	ug/kg	TM31/PM12
PCB 28 #	<5	7	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 52 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 101 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 118 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 138 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 153 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 180 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
Total 7 PCBs #	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	ug/kg	TM17/PM8

Please see attached notes for all abbreviations and acronyms

Client Name: AECOM
Reference:
Location: City Block 2 & 7
Contact: Brian Duggan

Report : Solid

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

J E Job No.	15/8073	15/8073	15/8073	15/8073	15/8073	15/8159	15/8159	15/8159	15/8159	15/8159			
J E Sample No.	7-9	16-18	27-29	30-32	42-44	22-24	25-27	34-36	37-39	46-48			
Sample ID	TP206	TP207	TP210	TP210	TP211	TP201	TP201	TP202	TP202	TP203			
Depth	2.5-3.5	2.3-3.6	2.3-3.5	3.5-4.2	3.0-4.0	2.70-3.80	3.80-4.50	2.20-3.40	3.40-3.70	3.90-4.10	Please see attached notes for all abbreviations and acronyms		
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T			
Sample Date	28/05/2015	28/05/2015	28/05/2015	28/05/2015	28/05/2015	29/05/2015	29/05/2015	29/05/2015	29/05/2015	29/05/2015			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	01/06/2015	01/06/2015	01/06/2015	01/06/2015	01/06/2015	03/06/2015	03/06/2015	03/06/2015	03/06/2015	03/06/2015	LOD/LOR	Units	Method No.
Natural Moisture Content	15.9	42.8	27.5	18.4	16.1	37.8	14.4	30.2	19.4	24.9	<0.1	%	PM4/PM0
Natural Moisture Content	-	-	-	-	-	-	-	-	-	-	<0.1	%	PM4/PM0
Moisture Content	13.7	30.0	21.6	15.6	13.9	27.5	12.6	23.2	16.2	19.9	<0.1	%	PM4/PM0
Hexavalent Chromium #	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	mg/kg	TM38/PM20
Chromium III	106.9	58.2	52.2	88.0	105.0	55.0	167.2	38.7	82.5	146.2	<0.5	mg/kg	NONE/NONE
Chromium III	-	-	-	-	-	-	-	-	-	-	<0.5	mg/kg	NONE/NONE
Total Organic Carbon #	0.41	3.95	2.50	0.71	0.52	1.82	0.31	1.61	0.40	0.37	<0.02	%	TM21/PM24
Loss on Ignition #	1.3	10.6	4.4	1.8	2.1	5.7	1.1	2.0	1.7	2.0	<1.0	%	TM22/PM0
pH #	5.92	7.39	7.50	8.02	7.94	7.48	7.40	6.63	7.47	5.81	<0.01	pH units	TM73/PM11
Mass of raw test portion	0.1167	0.1279	0.111	0.1029	0.1068	0.1253	0.1199	0.1219	0.1294	0.1254		kg	NONE/PM17
Mass of dried test portion	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09		kg	NONE/PM17

Client Name: AECOM
Reference:
Location: City Block 2 & 7
Contact: Brian Duggan

Report : Solid

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

J E Job No.	15/8159	15/8159	15/8159	15/8407	15/8407	15/8407	15/9506	15/9992	15/10042	15/10240			
J E Sample No.	58-60	61-63	70-72	25-27	31-33	34-36	13-15	1-4	1-4	1-4			
Sample ID	TP205	TP205	TP208	TP204	TP209	TP209	BH14-4.0-5.0	BH9	BH12	BH10			
Depth	3.00-4.00	4.00-4.30	2.80-3.70	3.30-4.00	2.70-3.70	3.70-4.00	4.00-5.00	4m - 5m	4.0-5.0		Please see attached notes for all abbreviations and acronyms		
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T			
Sample Date	27/05/2015	27/05/2015	29/05/2015	04/06/2015	04/06/2015	04/06/2015	30/06/2015	09/07/2015	10/07/2015	13/07/2015			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	03/06/2015	03/06/2015	03/06/2015	08/06/2015	08/06/2015	08/06/2015	02/07/2015	13/07/2015	14/07/2015	17/07/2015	LOD/LOR	Units	Method No.
Antimony	3	-	5	6	3	2	1	2	2	2	<1	mg/kg	TM30/PM15
Antimony	-	7	-	-	-	-	-	-	-	-	<1	mg/kg	TM30/PM62
Arsenic #	31.1	-	176.3	40.9	18.9	25.1	24.1	7.5	32.8	146.7	<0.5	mg/kg	TM30/PM15
Arsenic	-	86.6	-	-	-	-	-	-	-	-	<0.5	mg/kg	TM30/PM62
Barium #	43	-	106	32	106	41	44	29	36	23	<1	mg/kg	TM30/PM15
Barium	-	37	-	-	-	-	-	-	-	-	<1	mg/kg	TM30/PM62
Cadmium #	1.2	-	1.1	0.6	1.9	1.2	0.8	2.0	6.4	2.1	<0.1	mg/kg	TM30/PM15
Cadmium	-	2.8	-	-	-	-	-	-	-	-	<0.1	mg/kg	TM30/PM62
Chromium #	127.9	-	62.2	120.6	48.3	91.8	56.0	83.3	81.5	74.8	<0.5	mg/kg	TM30/PM15
Chromium	-	7.0	-	-	-	-	-	-	-	-	<0.5	mg/kg	TM30/PM62
Copper #	60	-	95	8	80	66	20	5	77	20	<1	mg/kg	TM30/PM15
Copper	-	293_{AA}	-	-	-	-	-	-	-	-	<1	mg/kg	TM30/PM62
Lead #	131	-	218	18	214	83	24	17	447	92	<5	mg/kg	TM30/PM15
Lead	-	432	-	-	-	-	-	-	-	-	<5	mg/kg	TM30/PM62
Mercury #	0.2	-	1.1	0.6	0.7	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM30/PM15
Mercury	-	<0.1	-	-	-	-	-	-	-	-	<0.1	mg/kg	TM30/PM62
Molybdenum #	11.5	-	6.5	14.4	5.0	8.8	1.0	7.1	1.7	3.2	<0.1	mg/kg	TM30/PM15
Molybdenum	-	4.8	-	-	-	-	-	-	-	-	<0.1	mg/kg	TM30/PM62
Nickel #	22.3	-	24.7	4.3	27.7	16.0	18.3	24.5	30.5	50.1	<0.7	mg/kg	TM30/PM15
Nickel	-	9.1	-	-	-	-	-	-	-	-	<0.7	mg/kg	TM30/PM62
Selenium #	<1	-	1	<1	1	<1	<1	2	6	9	<1	mg/kg	TM30/PM15
Selenium	-	<1	-	-	-	-	-	-	-	-	<1	mg/kg	TM30/PM62
Zinc #	521	-	309	830	332	314	79	91	1726	437	<5	mg/kg	TM30/PM15
Zinc	-	1073	-	-	-	-	-	-	-	-	<5	mg/kg	TM30/PM62

Client Name: AECOM
Reference:
Location: City Block 2 & 7
Contact: Brian Duggan

Report : Solid

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

J E Job No.	15/8159	15/8159	15/8159	15/8407	15/8407	15/8407	15/9506	15/9992	15/10042	15/10240	LOD/LOR	Units	Method No.
J E Sample No.	58-60	61-63	70-72	25-27	31-33	34-36	13-15	1-4	1-4	1-4			
Sample ID	TP205	TP205	TP208	TP204	TP209	TP209	BH14-4.0-5.0	BH9	BH12	BH10			
Depth	3.00-4.00	4.00-4.30	2.80-3.70	3.30-4.00	2.70-3.70	3.70-4.00	4.00-5.00	4m - 5m	4.0-5.0				
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T			
Sample Date	27/05/2015	27/05/2015	29/05/2015	04/06/2015	04/06/2015	04/06/2015	30/06/2015	09/07/2015	10/07/2015	13/07/2015			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	03/06/2015	03/06/2015	03/06/2015	08/06/2015	08/06/2015	08/06/2015	02/07/2015	13/07/2015	14/07/2015	17/07/2015			
PAH MS													
Naphthalene #	<0.04	<0.04	<0.04	<0.04	<0.04	0.34	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Acenaphthylene	<0.03	<0.03	<0.03	<0.03	<0.03	0.12	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM4/PM8
Acenaphthene #	<0.05	<0.05	<0.05	<0.05	<0.05	0.12	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM4/PM8
Fluorene #	<0.04	<0.04	0.05	<0.04	<0.04	0.16	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Phenanthrene #	<0.03	0.05	0.47	0.39	0.25	2.93	0.07	0.06	<0.03	<0.03	<0.03	mg/kg	TM4/PM8
Anthracene #	<0.04	<0.04	0.09	0.14	0.07	0.42	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Fluoranthene #	<0.03	0.05	0.51	0.33	0.25	2.87	0.06	0.04	<0.03	<0.03	<0.03	mg/kg	TM4/PM8
Pyrene #	<0.03	0.04	0.40	0.29	0.16	1.90	0.05	<0.03	<0.03	<0.03	<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene #	0.07	<0.06	0.34	0.24	0.14	1.06	<0.06	<0.06	<0.06	<0.06	<0.06	mg/kg	TM4/PM8
Chrysene #	0.06	0.04	0.31	0.26	0.14	1.47	0.03	<0.02	<0.02	0.03	<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	0.17	0.13	0.43	0.25	0.19	1.81	<0.07	<0.07	<0.07	<0.07	<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	0.09	0.06	0.25	0.16	0.11	0.87	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene #	0.09	0.07	0.20	0.10	0.07	0.66	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	0.05	<0.04	0.05	<0.04	<0.04	0.19	<0.04	<0.04	<0.04	0.08	<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	0.12	0.09	0.20	0.08	0.08	0.70	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Coronene	<0.04	<0.04	<0.04	<0.04	<0.04	0.10	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
PAH 6 Total #	0.47	0.40	1.59	0.92	0.70	6.91	<0.22	<0.22	<0.22	<0.22	<0.22	mg/kg	TM4/PM8
PAH 17 Total	0.65	<0.64	3.30	2.24	1.46	15.72	<0.64	<0.64	<0.64	<0.64	<0.64	mg/kg	TM4/PM8
Benzo(b)fluoranthene	0.12	0.09	0.31	0.18	0.14	1.30	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	0.05	0.04	0.12	0.07	0.05	0.51	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	TM4/PM8
Benzo(j)fluoranthene	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	TM4/PM8
PAH Surrogate % Recovery	109	127	120	108	108	105	114	97	107	106	<0	%	TM4/PM8
Methyl Tertiary Butyl Ether #	-	-	-	-	-	-	<2	<2	<2	<2	<2	ug/kg	TM15/PM10
Benzene #	-	-	-	-	-	-	<3	<3	<3	8	<3	ug/kg	TM15/PM10
Toluene #	-	-	-	-	-	-	<3	<3	9	<3	<3	ug/kg	TM15/PM10
Ethylbenzene #	-	-	-	-	-	-	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
p/m-Xylene #	-	-	-	-	-	-	<5	<5	<5	<5	<5	ug/kg	TM15/PM10
o-Xylene #	-	-	-	-	-	-	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Surrogate Recovery Toluene D8	-	-	-	-	-	-	112	101	81	103	<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	-	-	-	-	-	-	129	105	112	110	<0	%	TM15/PM10
EPH (C8-C40) #	<30	<30	262	75	386	293	<30	<30	136	<30	<30	mg/kg	TM5/PM8
C8-C40 Mineral Oil (Calculation) - Rilta	<30	<30	82	<30	<30	<30	<30	<30	<30	<30	<30	mg/kg	TM5/PM8

Please see attached notes for all abbreviations and acronyms

Client Name: AECOM
Reference:
Location: City Block 2 & 7
Contact: Brian Duggan

Report : Solid

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

J E Job No.	15/8159	15/8159	15/8159	15/8407	15/8407	15/8407	15/9506	15/9992	15/10042	15/10240	LOD/LOR	Units	Method No.
J E Sample No.	58-60	61-63	70-72	25-27	31-33	34-36	13-15	1-4	1-4	1-4			
Sample ID	TP205	TP205	TP208	TP204	TP209	TP209	BH14-4.0-5.0	BH9	BH12	BH10			
Depth	3.00-4.00	4.00-4.30	2.80-3.70	3.30-4.00	2.70-3.70	3.70-4.00	4.00-5.00	4m - 5m	4.0-5.0				
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T			
Sample Date	27/05/2015	27/05/2015	29/05/2015	04/06/2015	04/06/2015	04/06/2015	30/06/2015	09/07/2015	10/07/2015	13/07/2015			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	03/06/2015	03/06/2015	03/06/2015	08/06/2015	08/06/2015	08/06/2015	02/07/2015	13/07/2015	14/07/2015	17/07/2015			
TPH CWG													
Aliphatics													
>C5-C6 #	<0.1	<0.1	<0.1	<0.1	<0.5 AA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>C6-C8 #	<0.1	<0.1	<0.1	<0.1	<0.5 AA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>C8-C10	<0.1	<0.1	<0.1	<0.1	<0.5 AA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>C10-C12 #	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	mg/kg	TM5/PM16
>C12-C16 #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	mg/kg	TM5/PM16
>C16-C21 #	<7	<7	46	<7	<7	<7	<7	<7	<7	<7	<7	mg/kg	TM5/PM16
>C21-C35 #	<7	<7	29	<7	16	<7	<7	<7	<7	<7	<7	mg/kg	TM5/PM16
>C35-C40 #	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	mg/kg	TM5/PM16
Total aliphatics C5-40	<26	<26	75	<26	<26	<26	<26	<26	<26	<26	<26	mg/kg	TM5/TM36/PM12/PM16
>C6-C10	<0.1	<0.1	<0.1	<0.1	<0.5 AA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>C10-C25	<10	<10	47	<10	18	<10	<10	<10	<10	<10	<10	mg/kg	TM5/PM16
>C25-C35	<10	<10	20	<10	<10	<10	<10	<10	<10	<10	<10	mg/kg	TM5/PM16
Aromatics													
>C5-EC7	<0.1	<0.1	<0.1	<0.1	<0.5 AA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>EC7-EC8	<0.1	<0.1	<0.1	<0.1	<0.5 AA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>EC8-EC10 #	<0.1	<0.1	<0.1	<0.1	<0.5 AA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>EC10-EC12	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	mg/kg	TM5/PM16
>EC12-EC16	<4	<4	9	<4	<4	5	<4	<4	<4	<4	<4	mg/kg	TM5/PM16
>EC16-EC21	<7	<7	117	<7	<7	44	<7	<7	<7	<7	<7	mg/kg	TM5/PM16
>EC21-EC35	<7	<7	247	<7	49	131	<7	<7	<7	<7	<7	mg/kg	TM5/PM16
>EC35-EC40	<7	<7	50	<7	15	46	<7	<7	<7	<7	<7	mg/kg	TM5/PM16
Total aromatics C5-40	<26	<26	423	<26	64	226	<26	<26	<26	<26	<26	mg/kg	TM5/TM36/PM12/PM16
Total aliphatics and aromatics(C5-40)	<52	<52	498	<52	64	226	<52	<52	<52	<52	<52	mg/kg	TM5/TM36/PM12/PM16
>EC6-EC10	<0.1	<0.1	<0.1	<0.1	<0.5 AA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>EC10-EC25	<10	<10	175	<10	<10	82	<10	<10	<10	<10	<10	mg/kg	TM5/PM16
>EC25-EC35	<10	<10	200	<10	49	106	<10	<10	<10	<10	<10	mg/kg	TM5/PM16
MTBE #	<5	<5	<5	<5	<25 AA	<5	-	-	-	-	<5	ug/kg	TM31/PM12
Benzene #	<5	<5	23	<5	<25 AA	<5	-	-	-	-	<5	ug/kg	TM31/PM12
Toluene #	<5	<5	12	<5	<25 AA	<5	-	-	-	-	<5	ug/kg	TM31/PM12
Ethylbenzene #	<5	<5	<5	<5	<25 AA	<5	-	-	-	-	<5	ug/kg	TM31/PM12
m/p-Xylene #	<5	<5	<5	<5	<25 AA	<5	-	-	-	-	<5	ug/kg	TM31/PM12
o-Xylene #	<5	<5	<5	<5	<25 AA	<5	-	-	-	-	<5	ug/kg	TM31/PM12
PCB 28 #	<5	<5	<5	<5	<5	9	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 52 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 101 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 118 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 138 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 153 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 180 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
Total 7 PCBs #	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	ug/kg	TM17/PM8

Please see attached notes for all abbreviations and acronyms

Client Name: AECOM
Reference:
Location: City Block 2 & 7
Contact: Brian Duggan

Report : Solid

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

J E Job No.	15/8159	15/8159	15/8159	15/8407	15/8407	15/8407	15/9506	15/9992	15/10042	15/10240	LOD/LOR	Units	Method No.
J E Sample No.	58-60	61-63	70-72	25-27	31-33	34-36	13-15	1-4	1-4	1-4			
Sample ID	TP205	TP205	TP208	TP204	TP209	TP209	BH14-4.0-5.0	BH9	BH12	BH10			
Depth	3.00-4.00	4.00-4.30	2.80-3.70	3.30-4.00	2.70-3.70	3.70-4.00	4.00-5.00	4m - 5m	4.0-5.0				
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T			
Sample Date	27/05/2015	27/05/2015	29/05/2015	04/06/2015	04/06/2015	04/06/2015	30/06/2015	09/07/2015	10/07/2015	13/07/2015			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	03/06/2015	03/06/2015	03/06/2015	08/06/2015	08/06/2015	08/06/2015	02/07/2015	13/07/2015	14/07/2015	17/07/2015			
Natural Moisture Content	26.0	-	32.7	17.6	30.6	21.3	8.5	48.7	30.4	24.5	<0.1	%	PM4/PM0
Natural Moisture Content	-	17.8	-	-	-	-	-	-	-	-	<0.1	%	PM4/PM0
Moisture Content	20.6	NDP	24.7	15.0	23.4	17.6	7.9	32.8	23.3	19.7	<0.1	%	PM4/PM0
Hexavalent Chromium #	<0.3	<0.3	0.5	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	mg/kg	TM38/PM20
Chromium III	127.9	-	61.7	120.6	48.3	91.8	56.0	83.3	81.5	74.8	<0.5	mg/kg	NONE/NONE
Chromium III	-	7.0	-	-	-	-	-	-	-	-	<0.5	mg/kg	NONE/NONE
Total Organic Carbon #	1.98	NDP	3.07	0.90	3.44	1.41	0.29	1.72	0.80	0.70	<0.02	%	TM21/PM24
Loss on Ignition #	3.6	NDP	6.0	1.5	6.1	3.3	<1.0	4.9	4.1	4.3	<1.0	%	TM22/PM0
pH #	7.70	7.63	8.12	6.80	8.15	7.88	8.25	8.04	8.00	7.61	<0.01	pH units	TM73/PM11
Mass of raw test portion	0.1242	0.119	0.1097	0.1109	0.1311	0.1241	0.0964	0.1604	0.1262	0.1111		kg	NONE/PM17
Mass of dried test portion	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09		kg	NONE/PM17

Please see attached notes for all abbreviations and acronyms

Client Name: AECOM
Reference:
Location: City Block 2 & 7
Contact: Brian Duggan

Report : Solid

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

J E Job No.	15/10240	15/10536									Please see attached notes for all abbreviations and acronyms		
J E Sample No.	5-8	1-4											
Sample ID	BH11	BH13_4-5M											
Depth		4.0-5.0											
COC No / misc													
Containers	V J T	V J T											
Sample Date	15/07/2015	21/07/2015											
Sample Type	Soil	Soil											
Batch Number	1	1									LOD/LOR	Units	Method No.
Date of Receipt	17/07/2015	24/07/2015											
Antimony	4	2									<1	mg/kg	TM30/PM15
Antimony	-	-									<1	mg/kg	TM30/PM62
Arsenic #	264.2 AA	14.2									<0.5	mg/kg	TM30/PM15
Arsenic	-	-									<0.5	mg/kg	TM30/PM62
Barium #	31	37									<1	mg/kg	TM30/PM15
Barium	-	-									<1	mg/kg	TM30/PM62
Cadmium #	0.8	0.4									<0.1	mg/kg	TM30/PM15
Cadmium	-	-									<0.1	mg/kg	TM30/PM62
Chromium #	72.9	66.3									<0.5	mg/kg	TM30/PM15
Chromium	-	-									<0.5	mg/kg	TM30/PM62
Copper #	71	45									<1	mg/kg	TM30/PM15
Copper	-	-									<1	mg/kg	TM30/PM62
Lead #	43	49									<5	mg/kg	TM30/PM15
Lead	-	-									<5	mg/kg	TM30/PM62
Mercury #	0.8	<0.1									<0.1	mg/kg	TM30/PM15
Mercury	-	-									<0.1	mg/kg	TM30/PM62
Molybdenum #	6.7	4.8									<0.1	mg/kg	TM30/PM15
Molybdenum	-	-									<0.1	mg/kg	TM30/PM62
Nickel #	14.6	25.9									<0.7	mg/kg	TM30/PM15
Nickel	-	-									<0.7	mg/kg	TM30/PM62
Selenium #	1	1									<1	mg/kg	TM30/PM15
Selenium	-	-									<1	mg/kg	TM30/PM62
Zinc #	40	155									<5	mg/kg	TM30/PM15
Zinc	-	-									<5	mg/kg	TM30/PM62

Client Name: AECOM
Reference:
Location: City Block 2 & 7
Contact: Brian Duggan

Report : Solid

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

J E Job No.	15/10240	15/10536									Please see attached notes for all abbreviations and acronyms		
J E Sample No.	5-8	1-4											
Sample ID	BH11	BH13_4-5M											
Depth		4.0-5.0											
COC No / misc													
Containers	V J T	V J T											
Sample Date	15/07/2015	21/07/2015											
Sample Type	Soil	Soil											
Batch Number	1	1									LOD/LOR	Units	Method No.
Date of Receipt	17/07/2015	24/07/2015											
PAH MS													
Naphthalene #	<0.04	<0.04									<0.04	mg/kg	TM4/PM8
Acenaphthylene	<0.03	<0.03									<0.03	mg/kg	TM4/PM8
Acenaphthene #	<0.05	<0.05									<0.05	mg/kg	TM4/PM8
Fluorene #	<0.04	<0.04									<0.04	mg/kg	TM4/PM8
Phenanthrene #	<0.03	<0.03									<0.03	mg/kg	TM4/PM8
Anthracene #	<0.04	<0.04									<0.04	mg/kg	TM4/PM8
Fluoranthene #	<0.03	<0.03									<0.03	mg/kg	TM4/PM8
Pyrene #	<0.03	<0.03									<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene #	<0.06	<0.06									<0.06	mg/kg	TM4/PM8
Chrysene #	<0.02	<0.02									<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	<0.07	<0.07									<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	<0.04	<0.04									<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene #	<0.04	<0.04									<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	0.05	<0.04									<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	<0.04	<0.04									<0.04	mg/kg	TM4/PM8
Coronene	<0.04	<0.04									<0.04	mg/kg	TM4/PM8
PAH 6 Total #	<0.22	<0.22									<0.22	mg/kg	TM4/PM8
PAH 17 Total	<0.64	<0.64									<0.64	mg/kg	TM4/PM8
Benzo(b)fluoranthene	<0.05	<0.05									<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	<0.02	<0.02									<0.02	mg/kg	TM4/PM8
Benzo(j)fluoranthene	<1	<1									<1	mg/kg	TM4/PM8
PAH Surrogate % Recovery	102	113									<0	%	TM4/PM8
Methyl Tertiary Butyl Ether #	<2	-									<2	ug/kg	TM15/PM10
Benzene #	5	-									<3	ug/kg	TM15/PM10
Toluene #	<3	-									<3	ug/kg	TM15/PM10
Ethylbenzene #	<3	-									<3	ug/kg	TM15/PM10
p/m-Xylene #	<5	-									<5	ug/kg	TM15/PM10
o-Xylene #	<3	-									<3	ug/kg	TM15/PM10
Surrogate Recovery Toluene D8	101	-									<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	106	-									<0	%	TM15/PM10
EPH (C8-C40) #	<30	<30									<30	mg/kg	TM5/PM8
C8-C40 Mineral Oil (Calculation) - Rilta	<30	<30									<30	mg/kg	TM5/PM8

Client Name: AECOM
Reference:
Location: City Block 2 & 7
Contact: Brian Duggan

Report : Solid

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

J E Job No.	15/10240	15/10536									Please see attached notes for all abbreviations and acronyms		
J E Sample No.	5-8	1-4											
Sample ID	BH11	BH13_4-5M											
Depth		4.0-5.0											
COC No / misc													
Containers	V J T	V J T											
Sample Date	15/07/2015	21/07/2015											
Sample Type	Soil	Soil											
Batch Number	1	1									LOD/LOR	Units	Method No.
Date of Receipt	17/07/2015	24/07/2015											
TPH CWG													
Aliphatics													
>C5-C6 #	<0.1	<0.1									<0.1	mg/kg	TM36/PM12
>C6-C8 #	<0.1	<0.1									<0.1	mg/kg	TM36/PM12
>C8-C10	<0.1	<0.1									<0.1	mg/kg	TM36/PM12
>C10-C12 #	<0.2	<0.2									<0.2	mg/kg	TM5/PM16
>C12-C16 #	<4	<4									<4	mg/kg	TM5/PM16
>C16-C21 #	<7	<7									<7	mg/kg	TM5/PM16
>C21-C35 #	<7	<7									<7	mg/kg	TM5/PM16
>C35-C40 #	<7	<7									<7	mg/kg	TM5/PM16
Total aliphatics C5-40	<26	<26									<26	mg/kg	TM5/TM36/PM12/PM16
>C6-C10	<0.1	<0.1									<0.1	mg/kg	TM36/PM12
>C10-C25	<10	<10									<10	mg/kg	TM5/PM16
>C25-C35	<10	<10									<10	mg/kg	TM5/PM16
Aromatics													
>C5-EC7	<0.1	<0.1									<0.1	mg/kg	TM36/PM12
>EC7-EC8	<0.1	<0.1									<0.1	mg/kg	TM36/PM12
>EC8-EC10 #	<0.1	<0.1									<0.1	mg/kg	TM36/PM12
>EC10-EC12	<0.2	<0.2									<0.2	mg/kg	TM5/PM16
>EC12-EC16	<4	<4									<4	mg/kg	TM5/PM16
>EC16-EC21	<7	<7									<7	mg/kg	TM5/PM16
>EC21-EC35	<7	<7									<7	mg/kg	TM5/PM16
>EC35-EC40	<7	<7									<7	mg/kg	TM5/PM16
Total aromatics C5-40	<26	<26									<26	mg/kg	TM5/TM36/PM12/PM16
Total aliphatics and aromatics(C5-40)	<52	<52									<52	mg/kg	TM5/TM36/PM12/PM16
>EC6-EC10	<0.1	<0.1									<0.1	mg/kg	TM36/PM12
>EC10-EC25	<10	<10									<10	mg/kg	TM5/PM16
>EC25-EC35	<10	<10									<10	mg/kg	TM5/PM16
MTBE #	-	<5									<5	ug/kg	TM31/PM12
Benzene #	-	<5									<5	ug/kg	TM31/PM12
Toluene #	-	<5									<5	ug/kg	TM31/PM12
Ethylbenzene #	-	<5									<5	ug/kg	TM31/PM12
m/p-Xylene #	-	<5									<5	ug/kg	TM31/PM12
o-Xylene #	-	<5									<5	ug/kg	TM31/PM12
PCB 28 #	<5	<5									<5	ug/kg	TM17/PM8
PCB 52 #	<5	<5									<5	ug/kg	TM17/PM8
PCB 101 #	<5	<5									<5	ug/kg	TM17/PM8
PCB 118 #	<5	<5									<5	ug/kg	TM17/PM8
PCB 138 #	<5	<5									<5	ug/kg	TM17/PM8
PCB 153 #	<5	<5									<5	ug/kg	TM17/PM8
PCB 180 #	<5	<5									<5	ug/kg	TM17/PM8
Total 7 PCBs #	<35	<35									<35	ug/kg	TM17/PM8

Client Name: AECOM
Reference:
Location: City Block 2 & 7
Contact: Brian Duggan

Report : Solid

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

J E Job No.	15/10240	15/10536											
J E Sample No.	5-8	1-4											
Sample ID	BH11	BH13_4-5M											
Depth		4.0-5.0											
COC No / misc													
Containers	V J T	V J T											
Sample Date	15/07/2015	21/07/2015											
Sample Type	Soil	Soil											
Batch Number	1	1											
Date of Receipt	17/07/2015	24/07/2015											
Natural Moisture Content	25.5	33.1											
Natural Moisture Content	-	-											
Moisture Content	20.3	24.9											
Hexavalent Chromium #	0.4	<0.3											
Chromium III	72.5	66.3											
Chromium III	-	-											
Total Organic Carbon #	0.54	0.86											
Loss on Ignition #	2.6	3.6											
pH #	7.42	7.91											
Mass of raw test portion	0.1147	0.125											
Mass of dried test portion	0.09	0.09											

Please see attached notes for all abbreviations and acronyms

LOD/LOR	Units	Method No.
<0.1	%	PM4/PM0
<0.1	%	PM4/PM0
<0.1	%	PM4/PM0
<0.3	mg/kg	TM38/PM20
<0.5	mg/kg	NONE/NONE
<0.5	mg/kg	NONE/NONE
<0.02	%	TM21/PM24
<1.0	%	TM22/PM0
<0.01	pH units	TM73/PM11
	kg	NONE/PM17
	kg	NONE/PM17

Client Name: AECOM
Reference:
Location: City Block 2 & 7
Contact: Brian Duggan

Report : CEN 10:1 1 Batch

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

J E Job No.	15/8073	15/8073	15/8073	15/8073	15/8073	15/8159	15/8159	15/8159	15/8159	15/8159	Please see attached notes for all abbreviations and acronyms		
J E Sample No.	7-9	16-18	27-29	30-32	42-44	22-24	25-27	34-36	37-39	46-48			
Sample ID	TP206	TP207	TP210	TP210	TP211	TP201	TP201	TP202	TP202	TP203			
Depth	2.5-3.5	2.3-3.6	2.3-3.5	3.5-4.2	3.0-4.0	2.70-3.80	3.80-4.50	2.20-3.40	3.40-3.70	3.90-4.10			
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T			
Sample Date	28/05/2015	28/05/2015	28/05/2015	28/05/2015	28/05/2015	29/05/2015	29/05/2015	29/05/2015	29/05/2015	29/05/2015			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	01/06/2015	01/06/2015	01/06/2015	01/06/2015	01/06/2015	03/06/2015	03/06/2015	03/06/2015	03/06/2015	03/06/2015	LOD/LOR	Units	Method No.
Dissolved Antimony (A10) #	0.09	<0.02	0.36	0.06	0.08	<0.02	<0.02	0.07	0.08	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Arsenic (A10) #	0.223	0.093	0.225	0.169	1.522	0.115	0.028	0.426	0.263	5.500	<0.025	mg/kg	TM30/PM17
Dissolved Barium (A10) #	0.28	0.27	0.25	0.03	0.03	0.21	0.70	0.35	0.28	0.17	<0.03	mg/kg	TM30/PM17
Dissolved Cadmium (A10) #	<0.005	<0.005	<0.005	<0.005	0.010	<0.005	0.007	0.474	0.029	0.033	<0.005	mg/kg	TM30/PM17
Dissolved Chromium (A10) #	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	mg/kg	TM30/PM17
Dissolved Copper (A10) #	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	mg/kg	TM30/PM17
Dissolved Lead (A10) #	<0.05	<0.05	<0.05	0.11	0.09	<0.05	0.54	4.01	0.18	0.05	<0.05	mg/kg	TM30/PM17
Dissolved Molybdenum (A10) #	0.27	0.62	0.33	0.19	0.51	0.44	0.23	0.03	0.18	0.82	<0.02	mg/kg	TM30/PM17
Dissolved Nickel (A10) #	0.15	<0.02	<0.02	<0.02	<0.02	0.03	<0.02	0.82	0.07	0.15	<0.02	mg/kg	TM30/PM17
Dissolved Selenium (A10) #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
Dissolved Zinc (A10) #	26.45	0.05	0.13	0.18	0.15	0.60	2.11	102.36$_{AB}$	17.00	38.31	<0.03	mg/kg	TM30/PM17
Mercury Dissolved by CVAF #	0.0004	0.0029	0.0022	0.0005	0.0004	0.0007	0.0008	0.0004	0.0067	0.0021	<0.0001	mg/kg	TM61/PM38
Phenol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM26/PM0
Fluoride	<3	<3	4	<3	3	<3	<3	<3	<3	<3	<3	mg/kg	TM27/PM0
Chloride	100	49	106	57	210	5	51	7	8	5	<3	mg/kg	TM27/PM0
Sulphate	4535.7$_{AB}$	832.2	1649.6$_{AA}$	537.9	324.5	8568.5$_{AB}$	940.9$_{AB}$	15942.3$_{AC}$	15975.7$_{AC}$	15576.1$_{AC}$	<0.5	mg/kg	TM27/PM0
Mass of raw test portion	0.1167	0.1279	0.111	0.1029	0.1068	0.1253	0.1199	0.1219	0.1294	0.1254		kg	NONE/PM17
Leachant Volume	0.873	0.862	0.879	0.887	0.883	0.865	0.87	0.868	0.86	0.865		l	NONE/PM17
Eluate Volume	0.85	0.8	0.8	0.8	0.85	0.7	0.86	0.85	0.82	0.85		l	NONE/PM17
Dissolved Organic Carbon @ pH 7	40	190	50	40	60	60	30	<20	<20	40	<20	mg/kg	TM60/PM0
pH	6.60	8.12	8.00	8.00	7.92	7.54	7.70	7.07	7.48	5.89	<0.01	pH units	TM73/PM0
Total Dissolved Solids #	6309	2509	3969	1630	1900	12404	2360	22712	19313	10543	<100	mg/kg	TM20/PM0

Client Name: AECOM
Reference:
Location: City Block 2 & 7
Contact: Brian Duggan

Report : CEN 10:1 1 Batch

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

J E Job No.	15/8159	15/8159	15/8159	15/8407	15/8407	15/8407	15/9506	15/9992	15/10042	15/10240			
J E Sample No.	58-60	61-63	70-72	25-27	31-33	34-36	13-15	1-4	1-4	1-4			
Sample ID	TP205	TP205	TP208	TP204	TP209	TP209	BH14-4.0-5.0	BH9	BH12	BH10			
Depth	3.00-4.00	4.00-4.30	2.80-3.70	3.30-4.00	2.70-3.70	3.70-4.00	4.00-5.00	4m - 5m	4.0-5.0		Please see attached notes for all abbreviations and acronyms		
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T			
Sample Date	27/05/2015	27/05/2015	29/05/2015	04/06/2015	04/06/2015	04/06/2015	30/06/2015	09/07/2015	10/07/2015	13/07/2015			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	03/06/2015	03/06/2015	03/06/2015	08/06/2015	08/06/2015	08/06/2015	02/07/2015	13/07/2015	14/07/2015	17/07/2015	LOD/LOR	Units	Method No.
Dissolved Antimony (A10) #	<0.02	0.25	0.07	1.66	0.04	0.12	<0.02	0.05	0.04	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Arsenic (A10) #	0.093	0.100	0.215	0.322	0.226	0.080	0.406	<0.025	0.060	0.453	<0.025	mg/kg	TM30/PM17
Dissolved Barium (A10) #	<0.03	0.21	0.11	0.58	0.12	0.14	<0.03	<0.03	0.03	0.04	<0.03	mg/kg	TM30/PM17
Dissolved Cadmium (A10) #	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM30/PM17
Dissolved Chromium (A10) #	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	0.020	<0.015	mg/kg	TM30/PM17
Dissolved Copper (A10) #	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	mg/kg	TM30/PM17
Dissolved Lead (A10) #	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM30/PM17
Dissolved Molybdenum (A10) #	0.20	0.05	0.68	1.77	1.04	0.30	0.03	0.35	0.38	0.41	<0.02	mg/kg	TM30/PM17
Dissolved Nickel (A10) #	<0.02	<0.02	0.04	<0.02	<0.02	<0.02	<0.02	<0.02	0.04	0.33	<0.02	mg/kg	TM30/PM17
Dissolved Selenium (A10) #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.15	<0.03	mg/kg	TM30/PM17
Dissolved Zinc (A10) #	0.24	3.38	0.04	3.43	<0.03	0.15	0.04	<0.03	0.12	0.11	<0.03	mg/kg	TM30/PM17
Mercury Dissolved by CVAF #	<0.0001	<0.0001	0.0053	0.0156	0.0085	0.0011	0.0003	<0.0001	<0.0001	<0.0001	<0.0001	mg/kg	TM61/PM38
Phenol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM26/PM0
Fluoride	3	<3	<3	<3	<3	<3	<3	<3	8	<3	<3	mg/kg	TM27/PM0
Chloride	5	9	40	6	60	27	20	71	65	5	<3	mg/kg	TM27/PM0
Sulphate	1850.8$_{AB}$	2243.2$_{AB}$	363.0	643.3	237.4	2335.3$_{AA}$	121.0	634.2	465.6	4682.7$_{AA}$	<0.5	mg/kg	TM27/PM0
Mass of raw test portion	0.1242	0.119	0.1097	0.1109	0.1311	0.1241	0.0964	0.1604	0.1262	0.1111		kg	NONE/PM17
Leachant Volume	0.866	0.871	0.881	0.879	0.859	0.866	0.893	0.829	0.864	0.878		l	NONE/PM17
Eluate Volume	0.75	0.85	0.8	0.85	0.75	0.8	0.85	0.65	0.55	0.77		l	NONE/PM17
Dissolved Organic Carbon @ pH 7	50	30	110	40	200	40	30	40	70	30	<20	mg/kg	TM60/PM0
pH	7.92	7.47	8.12	7.15	8.19	7.93	8.27	7.84	7.89	7.81	<0.01	pH units	TM73/PM0
Total Dissolved Solids #	3600	3238	1760	1350	2239	4421	800	2269	2400	6747	<100	mg/kg	TM20/PM0

Client Name: AECOM
Reference:
Location: City Block 2 & 7
Contact: Brian Duggan

Report : CEN 10:1 1 Batch

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

J E Job No.	15/10240	15/10536									Please see attached notes for all abbreviations and acronyms		
J E Sample No.	5-8	1-4											
Sample ID	BH11	BH13_4-5M											
Depth		4.0-5.0											
COC No / misc													
Containers	V J T	V J T											
Sample Date	15/07/2015	21/07/2015											
Sample Type	Soil	Soil											
Batch Number	1	1									LOD/LOR	Units	Method No.
Date of Receipt	17/07/2015	24/07/2015											
Dissolved Antimony (A10) #	0.22	0.06									<0.02	mg/kg	TM30/PM17
Dissolved Arsenic (A10) #	6.446	<0.025									<0.025	mg/kg	TM30/PM17
Dissolved Barium (A10) #	0.08	0.06									<0.03	mg/kg	TM30/PM17
Dissolved Cadmium (A10) #	0.008	<0.005									<0.005	mg/kg	TM30/PM17
Dissolved Chromium (A10) #	<0.015	<0.015									<0.015	mg/kg	TM30/PM17
Dissolved Copper (A10) #	<0.07	<0.07									<0.07	mg/kg	TM30/PM17
Dissolved Lead (A10) #	<0.05	<0.05									<0.05	mg/kg	TM30/PM17
Dissolved Molybdenum (A10) #	0.85	0.35									<0.02	mg/kg	TM30/PM17
Dissolved Nickel (A10) #	<0.02	<0.02									<0.02	mg/kg	TM30/PM17
Dissolved Selenium (A10) #	0.07	<0.03									<0.03	mg/kg	TM30/PM17
Dissolved Zinc (A10) #	0.06	0.05									<0.03	mg/kg	TM30/PM17
Mercury Dissolved by CVAF #	0.0049	<0.0001									<0.0001	mg/kg	TM61/PM38
Phenol	<0.1	<0.1									<0.1	mg/kg	TM26/PM0
Fluoride	<3	<3									<3	mg/kg	TM27/PM0
Chloride	4	50									<3	mg/kg	TM27/PM0
Sulphate	9030.8 AB	516.5									<0.5	mg/kg	TM27/PM0
Mass of raw test portion	0.1147	0.125										kg	NONE/PM17
Leachant Volume	0.876	0.865										l	NONE/PM17
Eluate Volume	0.85	0.64										l	NONE/PM17
Dissolved Organic Carbon @ pH 7	<20	100									<20	mg/kg	TM60/PM0
pH	7.77	8.14									<0.01	pH units	TM73/PM0
Total Dissolved Solids #	13113	2600									<100	mg/kg	TM20/PM0

Client Name: AECOM
Reference:
Location: City Block 2 & 7
Contact: Brian Duggan

Report : Misc

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

J E Job No.	15/9992												
J E Sample No.	1-4												
Sample ID	BH9												
Depth	4m - 5m										Please see attached notes for all abbreviations and acronyms		
COC No / misc													
Containers	V J T												
Sample Date	09/07/2015												
Sample Type	Soil												
Batch Number	1										LOD/LOR	Units	Method No.
Date of Receipt	13/07/2015												
Sample Temperature	8.8										<0.1	Degrees C	NONE/NONE

Client Name: AECOM
Reference:
Location: City Block 2 & 7
Contact: Brian Duggan

SVOC Report : **Solid**

J E Job No.	15/9506	15/9992	15/10042	15/10240	15/10240	15/10536							
J E Sample No.	13-15	1-4	1-4	1-4	5-8	1-4							
Sample ID	BH14-4.0-5.0	BH9	BH12	BH10	BH11	BH13_4-5M							
Depth	4.00-5.00	4m - 5m	4.0-5.0			4.0-5.0					Please see attached notes for all abbreviations and acronyms		
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T							
Sample Date	30/06/2015	09/07/2015	10/07/2015	13/07/2015	15/07/2015	21/07/2015							
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil							
Batch Number	1	1	1	1	1	1							
Date of Receipt	02/07/2015	13/07/2015	14/07/2015	17/07/2015	17/07/2015	24/07/2015					LOD/LOR	Units	Method No.
SVOC MS													
Phenols													
2-Chlorophenol	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
2-Methylphenol	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
2-Nitrophenol	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
2,4-Dichlorophenol	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
2,4-Dimethylphenol	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
2,4,5-Trichlorophenol	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
2,4,6-Trichlorophenol	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
4-Chloro-3-methylphenol	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
4-Methylphenol	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
4-Nitrophenol	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Pentachlorophenol	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Phenol	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
PAHs													
2-Chloronaphthalene	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
2-Methylnaphthalene	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Phthalates													
Bis(2-ethylhexyl) phthalate	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Butylbenzyl phthalate	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Di-n-butyl phthalate	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Di-n-Octyl phthalate	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Diethyl phthalate	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Dimethyl phthalate	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Other SVOCs													
1,2-Dichlorobenzene	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
1,2,4-Trichlorobenzene	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
1,3-Dichlorobenzene	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
1,4-Dichlorobenzene	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
2-Nitroaniline	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
2,4-Dinitrotoluene	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
2,6-Dinitrotoluene	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
3-Nitroaniline	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
4-Bromophenylphenylether	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
4-Chloroaniline	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
4-Chlorophenylphenylether	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
4-Nitroaniline	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Azobenzene	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Bis(2-chloroethoxy)methane	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Bis(2-chloroethyl)ether	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Carbazole	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Dibenzofuran	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Hexachlorobenzene	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Hexachlorobutadiene	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Hexachlorocyclopentadiene	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Hexachloroethane	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Isophorone	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
N-nitrosodi-n-propylamine	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Nitrobenzene	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8

Client Name: AECOM
Reference:
Location: City Block 2 & 7
Contact: Brian Duggan

VOC Report : **Solid**

J E Job No.	15/9506	15/9992	15/10042	15/10240	15/10240	15/10536							
J E Sample No.	13-15	1-4	1-4	1-4	5-8	1-4							
Sample ID	BH14-4.0-5.0	BH9	BH12	BH10	BH11	BH13_4-5M							
Depth	4.00-5.00	4m - 5m	4.0-5.0			4.0-5.0							
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T							
Sample Date	30/06/2015	09/07/2015	10/07/2015	13/07/2015	15/07/2015	21/07/2015							
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil							
Batch Number	1	1	1	1	1	1							
Date of Receipt	02/07/2015	13/07/2015	14/07/2015	17/07/2015	17/07/2015	24/07/2015							

Please see attached notes for all abbreviations and acronyms

											LOD/LOR	Units	Method No.
VOC MS													
Dichlorodifluoromethane	<2	<2	<2	<2	<2	<2					<2	ug/kg	TM15/PM10
Methyl Tertiary Butyl Ether #	<2	<2	<2	<2	<2	<2					<2	ug/kg	TM15/PM10
Chloromethane #	<3	<3	<3	14	14	<3					<3	ug/kg	TM15/PM10
Vinyl Chloride	<2	<2	<2	12	11	<2					<2	ug/kg	TM15/PM10
Bromomethane	<1	<1	<1	<1	<1	<1					<1	ug/kg	TM15/PM10
Chloroethane #	<2	<2	<2	16	14	<2					<2	ug/kg	TM15/PM10
Trichlorofluoromethane #	<2	<2	<2	4	4	<2					<2	ug/kg	TM15/PM10
1,1-Dichloroethene (1,1 DCE) #	<6	<6	<6	<6	<6	<6					<6	ug/kg	TM15/PM10
Dichloromethane (DCM) #	<7	<7	<7	<7	<7	<7					<7	ug/kg	TM15/PM10
trans-1-2-Dichloroethene #	<3	<3	<3	8	8	<3					<3	ug/kg	TM15/PM10
1,1-Dichloroethane #	<3	<3	<3	9	8	<3					<3	ug/kg	TM15/PM10
cis-1-2-Dichloroethene #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
2,2-Dichloropropane	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
Bromochloromethane #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
Chloroform #	<3	<3	<3	6	6	<3					<3	ug/kg	TM15/PM10
1,1,1-Trichloroethane #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
1,1-Dichloropropene #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
Carbon tetrachloride #	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
1,2-Dichloroethane #	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
Benzene #	<3	<3	<3	8	5	<3					<3	ug/kg	TM15/PM10
Trichloroethene (TCE) #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
1,2-Dichloropropane #	<6	<6	<6	<6	<6	<6					<6	ug/kg	TM15/PM10
Dibromomethane #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
Bromodichloromethane #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
cis-1-3-Dichloropropene	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
Toluene #	<3	<3	9	<3	<3	<3					<3	ug/kg	TM15/PM10
trans-1-3-Dichloropropene	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
1,1,2-Trichloroethane #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
Tetrachloroethene (PCE) #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
1,3-Dichloropropane #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
Dibromochloromethane #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
1,2-Dibromoethane #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
Chlorobenzene #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
1,1,1,2-Tetrachloroethane	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
Ethylbenzene #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
p/m-Xylene #	<5	<5	<5	<5	<5	<5					<5	ug/kg	TM15/PM10
o-Xylene #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
Styrene	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
Bromoform	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
Isopropylbenzene #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
1,1,2,2-Tetrachloroethane #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
Bromobenzene	<2	<2	<2	<2	<2	<2					<2	ug/kg	TM15/PM10
1,2,3-Trichloropropane #	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
Propylbenzene #	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
2-Chlorotoluene	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
1,3,5-Trimethylbenzene #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
4-Chlorotoluene	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
tert-Butylbenzene #	<5	<5	<5	<5	<5	<5					<5	ug/kg	TM15/PM10
1,2,4-Trimethylbenzene #	<6	<6	<6	<6	<6	<6					<6	ug/kg	TM15/PM10
sec-Butylbenzene #	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
4-Isopropyltoluene #	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
1,3-Dichlorobenzene #	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
1,4-Dichlorobenzene #	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
n-Butylbenzene #	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
1,2-Dichlorobenzene #	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
1,2-Dibromo-3-chloropropane #	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
1,2,4-Trichlorobenzene #	<7	<7	<7	<7	<7	<7					<7	ug/kg	TM15/PM10
Hexachlorobutadiene	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
Naphthalene	<27	<27	<27	<27	<27	<27					<27	ug/kg	TM15/PM10
1,2,3-Trichlorobenzene #	<7	<7	<7	<7	<7	<7					<7	ug/kg	TM15/PM10
Surrogate Recovery Toluene D8	112	101	81	103	101	91					<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	129	105	112	110	106	89					<0	%	TM15/PM10

Client Name: AECOM **Matrix : Solid**
Reference:
Location: City Block 2 & 7
Contact: Brian Duggan

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	EPH Interpretation
15/8073	1	TP206	2.5-3.5	7-9	No interpretation possible
15/8073	1	TP207	2.3-3.6	16-18	Possible PAHs and humics
15/8073	1	TP210	2.3-3.5	27-29	Possible PAHs/humics
15/8073	1	TP210	3.5-4.2	30-32	No interpretation possible
15/8073	1	TP211	3.0-4.0	42-44	No interpretation possible
15/8159	1	TP201	2.70-3.80	22-24	Possible PAHs and humics
15/8159	1	TP201	3.80-4.50	25-27	No interpretation possible
15/8159	1	TP202	2.20-3.40	34-36	PAHs
15/8159	1	TP202	3.40-3.70	37-39	Possible PAHs
15/8159	1	TP203	3.90-4.10	46-48	No interpretation possible
15/8159	1	TP205	3.00-4.00	58-60	No interpretation possible
15/8159	1	TP205	4.00-4.30	61-63	No interpretation possible
15/8159	1	TP208	2.80-3.70	70-72	Possble PAHs and humics
15/8407	1	TP204	3.30-4.00	25-27	Humic acids
15/8407	1	TP209	2.70-3.70	31-33	Humics and possible PAHs
15/8407	1	TP209	3.70-4.00	34-36	PAHs and humics
15/9506	1	BH14-4.0-5.0	4.00-5.00	13-15	No interpretation possible
15/9992	1	BH9	4m - 5m	1-4	No interpretation possible
15/10042	1	BH12	4.0-5.0	1-4	No interpretation possible
15/10240	1	BH10		1-4	No interpretation possible
15/10240	1	BH11		5-8	No interpretation possible
15/10536	1	BH13_4-5M	4.0-5.0	1-4	No interpretation possible

Client Name: AECOM
Reference:
Location: City Block 2 & 7
Contact: Brian Duggan

Note:

Analysis was carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Samples are retained for not less than 6 months from the date of analysis unless specifically requested.

Opinions lie outside the scope of our UKAS accreditation.

Where the sample is not taken by a Jones Environmental Laboratory consultant, Jones Environmental Laboratory cannot be responsible for inaccurate or unrepresentative sampling.

If asbestos fibres are reported at trace levels there will not be enough fibres to quantify and will be less than 0.001%.

Signed on behalf of Jones Environmental Laboratory:

Ryan Butterworth
Asbestos Team Leader

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Date Of Analysis	Analysis	Result
15/8073	1	TP206	2.5-3.5	8	06/06/2015	**Mass of Dry Sample**	49.5 (g)
					08/06/2015	**General Description (Bulk Analysis)**	Soil/Stone
					08/06/2015	**Asbestos Containing Material**	None
					08/06/2015	**Asbestos Containing Material (2)**	None
					08/06/2015	**Asbestos Screen**	NAD
					08/06/2015	**Asbestos Screen (2)**	NAD
					08/06/2015	**Asbestos Level**	NAD
15/8073	1	TP207	2.3-3.6	17	06/06/2015	**Mass of Dry Sample**	36.2 (g)
					08/06/2015	**General Description (Bulk Analysis)**	Soil/Stone
					08/06/2015	**Asbestos Containing Material**	None
					08/06/2015	**Asbestos Containing Material (2)**	None
					08/06/2015	**Asbestos Screen**	NAD
					08/06/2015	**Asbestos Screen (2)**	NAD
					08/06/2015	**Asbestos Level**	NAD
15/8073	1	TP210	2.3-3.5	28	06/06/2015	**Mass of Dry Sample**	42.5 (g)
					08/06/2015	**General Description (Bulk Analysis)**	Soil/Stone
					08/06/2015	**Asbestos Containing Material**	None
					08/06/2015	**Asbestos Containing Material (2)**	None
					08/06/2015	**Asbestos Screen**	NAD
					08/06/2015	**Asbestos Screen (2)**	NAD
					08/06/2015	**Asbestos Level**	NAD
15/8073	1	TP210	3.5-4.2	31	06/06/2015	**Mass of Dry Sample**	46.1 (g)
					08/06/2015	**General Description (Bulk Analysis)**	Soil/Stones/Veg
					08/06/2015	**Asbestos Containing Material**	None
					08/06/2015	**Asbestos Containing Material (2)**	None
					08/06/2015	**Asbestos Screen**	NAD
					08/06/2015	**Asbestos Screen (2)**	NAD
					08/06/2015	**Asbestos Level**	NAD
15/8073	1	TP211	3.0-4.0	43	06/06/2015	**Mass of Dry Sample**	50.7 (g)
					08/06/2015	**General Description (Bulk Analysis)**	Soil/Stones/Veg
					08/06/2015	**Asbestos Containing Material**	None
					08/06/2015	**Asbestos Containing Material (2)**	None
					08/06/2015	**Asbestos Screen**	NAD
					08/06/2015	**Asbestos Screen (2)**	NAD
					08/06/2015	**Asbestos Level**	NAD

Client Name: AECOM
Reference:
Location: City Block 2 & 7
Contact: Brian Duggan

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Date Of Analysis	Analysis	Result
15/8159	1	TP201	2.70-3.80	23	09/06/2015	**Mass of Dry Sample**	42.6 (g)
					09/06/2015	**General Description (Bulk Analysis)**	soil/stones
					09/06/2015	**Asbestos Containing Material**	None
					09/06/2015	**Asbestos Containing Material (2)**	None
					09/06/2015	**Asbestos Screen**	NAD
					09/06/2015	**Asbestos Screen (2)**	NAD
					09/06/2015	**Asbestos Level**	NAD
15/8159	1	TP201	3.80-4.50	26	09/06/2015	**Mass of Dry Sample**	49.6 (g)
					09/06/2015	**General Description (Bulk Analysis)**	soil-stones
					09/06/2015	**Asbestos Containing Material**	None
					09/06/2015	**Asbestos Containing Material (2)**	None
					09/06/2015	**Asbestos Screen**	NAD
					09/06/2015	**Asbestos Screen (2)**	NAD
					09/06/2015	**Asbestos Level**	NAD
15/8159	1	TP202	2.20-3.40	35	09/06/2015	**Mass of Dry Sample**	44.0 (g)
					09/06/2015	**General Description (Bulk Analysis)**	Soil/Stones/Veg
					09/06/2015	**Asbestos Containing Material**	None
					09/06/2015	**Asbestos Containing Material (2)**	None
					09/06/2015	**Asbestos Screen**	NAD
					09/06/2015	**Asbestos Screen (2)**	NAD
					09/06/2015	**Asbestos Level**	NAD
15/8159	1	TP202	3.40-3.70	38	09/06/2015	**Mass of Dry Sample**	46.1 (g)
					09/06/2015	**General Description (Bulk Analysis)**	Soil/Stones/Veg
					09/06/2015	**Asbestos Containing Material**	None
					09/06/2015	**Asbestos Containing Material (2)**	None
					09/06/2015	**Asbestos Screen**	NAD
					09/06/2015	**Asbestos Screen (2)**	NAD
					09/06/2015	**Asbestos Level**	NAD
15/8159	1	TP203	3.90-4.10	47	09/06/2015	**Mass of Dry Sample**	44.7 (g)
					09/06/2015	**General Description (Bulk Analysis)**	soil/stones
					09/06/2015	**Asbestos Containing Material**	None
					09/06/2015	**Asbestos Containing Material (2)**	None
					09/06/2015	**Asbestos Screen**	NAD
					09/06/2015	**Asbestos Screen (2)**	NAD
					09/06/2015	**Asbestos Level**	NAD
15/8159	1	TP205	3.00-4.00	59	09/06/2015	**Mass of Dry Sample**	48.8 (g)
					09/06/2015	**General Description (Bulk Analysis)**	Soil/Stone
					09/06/2015	**Asbestos Containing Material**	None
					09/06/2015	**Asbestos Containing Material (2)**	None
					09/06/2015	**Asbestos Screen**	NAD
					09/06/2015	**Asbestos Screen (2)**	NAD
					09/06/2015	**Asbestos Level**	NAD
15/8159	1	TP205	4.00-4.30	62	09/06/2015	**Mass of Dry Sample**	51.7 (g)
					09/06/2015	**General Description (Bulk Analysis)**	Soil/Stone
					09/06/2015	**Asbestos Containing Material**	Fibre Bundles
					09/06/2015	**Asbestos Screen**	Chrysotile
					09/06/2015	**Asbestos Level**	Quantifiable

Client Name: AECOM
Reference:
Location: City Block 2 & 7
Contact: Brian Duggan

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Date Of Analysis	Analysis	Result
15/8159	1	TP205	4.00-4.30	62	30/07/2015	**Asbestos PCOM Quantification (Fibres)**	<0.001 (mass %)
					30/07/2015	**Asbestos Gravimetric & PCOM Total**	<0.001 (mass %)
15/8159	1	TP208	2.80-3.70	71	09/06/2015	**Mass of Dry Sample**	42.0 (g)
					09/06/2015	**General Description (Bulk Analysis)**	soil-sand
					09/06/2015	**Asbestos Containing Material**	None
					09/06/2015	**Asbestos Containing Material (2)**	None
					09/06/2015	**Asbestos Screen**	NAD
					09/06/2015	**Asbestos Screen (2)**	NAD
					09/06/2015	**Asbestos Level**	NAD
15/8407	1	TP204	3.30-4.00	26	09/06/2015	**Mass of Dry Sample**	48.0 (g)
					10/06/2015	**General Description (Bulk Analysis)**	soil/stones
					10/06/2015	**Asbestos Containing Material**	None
					10/06/2015	**Asbestos Containing Material (2)**	None
					10/06/2015	**Asbestos Screen**	NAD
					10/06/2015	**Asbestos Screen (2)**	NAD
					10/06/2015	**Asbestos Level**	NAD
15/8407	1	TP209	2.70-3.70	32	09/06/2015	**Mass of Dry Sample**	42.8 (g)
					10/06/2015	**General Description (Bulk Analysis)**	soil/stones
					10/06/2015	**Asbestos Containing Material**	None
					10/06/2015	**Asbestos Containing Material (2)**	None
					10/06/2015	**Asbestos Screen**	NAD
					10/06/2015	**Asbestos Screen (2)**	NAD
					10/06/2015	**Asbestos Level**	NAD
15/8407	1	TP209	3.70-4.00	35	09/06/2015	**Mass of Dry Sample**	48.0 (g)
					10/06/2015	**General Description (Bulk Analysis)**	soil-stones
					10/06/2015	**Asbestos Containing Material**	None
					10/06/2015	**Asbestos Containing Material (2)**	None
					10/06/2015	**Asbestos Screen**	NAD
					10/06/2015	**Asbestos Screen (2)**	NAD
					10/06/2015	**Asbestos Level**	NAD
15/9506	1	BH14-4.0-5.0	4.00-5.00	14	02/07/2015	**Mass of Dry Sample**	62.2 (g)
					02/07/2015	**General Description (Bulk Analysis)**	Soil/Stones
					02/07/2015	**Asbestos Containing Material**	None
					02/07/2015	**Asbestos Containing Material (2)**	None
					02/07/2015	**Asbestos Screen**	NAD
					02/07/2015	**Asbestos Screen (2)**	NAD
					02/07/2015	**Asbestos Level**	NAD
15/9992	1	BH9	4m - 5m	2	14/07/2015	**Mass of Dry Sample**	50.1 (g)
					14/07/2015	**General Description (Bulk Analysis)**	Soil/Clay/Stones
					14/07/2015	**Asbestos Containing Material**	None
					14/07/2015	**Asbestos Containing Material (2)**	None
					14/07/2015	**Asbestos Screen**	NAD
					14/07/2015	**Asbestos Screen (2)**	NAD
					14/07/2015	**Asbestos Level**	NAD
15/10042	1	BH12	4.0-5.0	2	14/07/2015	**Mass of Dry Sample**	42.3 (g)
					14/07/2015	**General Description (Bulk Analysis)**	soil-stones

Client Name: AECOM
Reference:
Location: City Block 2 & 7
Contact: Brian Duggan

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Date Of Analysis	Analysis	Result
15/10042	1	BH12	4.0-5.0	2	14/07/2015	**Asbestos Containing Material**	None
					14/07/2015	**Asbestos Containing Material (2)**	None
					14/07/2015	**Asbestos Screen**	NAD
					14/07/2015	**Asbestos Screen (2)**	NAD
					14/07/2015	**Asbestos Level**	NAD
15/10240	1	BH10		2	18/07/2015	**Mass of Dry Sample**	41.6 (g)
					20/07/2015	**General Description (Bulk Analysis)**	soil-stones
					20/07/2015	**Asbestos Containing Material**	None
					20/07/2015	**Asbestos Containing Material (2)**	None
					20/07/2015	**Asbestos Screen**	NAD
					20/07/2015	**Asbestos Screen (2)**	NAD
					20/07/2015	**Asbestos Level**	NAD
15/10240	1	BH11		6	18/07/2015	**Mass of Dry Sample**	48.6 (g)
					20/07/2015	**General Description (Bulk Analysis)**	soil-stones
					20/07/2015	**Asbestos Containing Material**	None
					20/07/2015	**Asbestos Containing Material (2)**	None
					20/07/2015	**Asbestos Screen**	NAD
					20/07/2015	**Asbestos Screen (2)**	NAD
					20/07/2015	**Asbestos Level**	NAD
15/10536	1	BH13_4-5M	4.0-5.0	3	27/07/2015	**Mass of Dry Sample**	39.4 (g)
					27/07/2015	**General Description (Bulk Analysis)**	Soil/Stone
					27/07/2015	**Asbestos Containing Material**	None
					27/07/2015	**Asbestos Containing Material (2)**	None
					27/07/2015	**Asbestos Screen**	NAD
					27/07/2015	**Asbestos Screen (2)**	NAD
					27/07/2015	**Asbestos Level**	NAD

Client Name: AECOM **Matrix : Solid**

Reference:

Location: City Block 2 & 7

Contact: Brian Duggan

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	NDP Reason
15/8159	1	TP205	4.00-4.30	61-63	Asbestos detected in sample

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

JE Job No.: 15/8159 15/8407 15/8073 15/10240 15/10042 15/10536 15/9506 15/9992

SOILS

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

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

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

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

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

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

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

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

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

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

WATERS

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

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

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

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

DEVIATING SAMPLES

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

SURROGATES

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

DILUTIONS

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

NOTE

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

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS) accredited - UK.
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range
AA	x5 Dilution
AB	x10 Dilution
AC	x20 Dilution
AD	x50 Dilution

JE Job No: 15/8159 15/8407 15/8073 15/10240 15/10042 15/10536 15/9506 15/9992

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.	PM0	No preparation is required.				
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.	PM0	No preparation is required.			AR	Yes
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.	PM0	No preparation is required.			AR	
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM16	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.			AR	Yes
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM16	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.	Yes		AR	Yes
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM5/TM36	TM005: Modified USEPA 8015B. Determination of solvent Extractable Petroleum Hydrocarbons (EPH) including column fractionation in the carbon range of C10-35 into aliphatic and aromatic fractions by GC-FID. TM036: Modified USEPA 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C5-10 by headspace GC-FID.	PM12/PM16	CWG GC-FID			AR	Yes

JE Job No: 15/8159 15/8407 15/8073 15/10240 15/10042 15/10536 15/9506 15/9992

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM15	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM15	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM16	Modified USEPA 8270. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM17	Modified US EPA method 8270. Determination of specific Polychlorinated Biphenyl congeners by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM20	Modified USEPA 8163. Gravimetric determination of Total Dissolved Solids/Total Solids	PM0	No preparation is required.	Yes		AR	Yes
TM21	Modified USEPA 415.1. Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection.	PM24	Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis.	Yes		AD	Yes
TM22	Modified USEPA 160.4. Gravimetric determination of Loss on Ignition by temperature controlled Muffle Furnace (450°C)	PM0	No preparation is required.	Yes		AD	Yes
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM0	No preparation is required.			AR	Yes
TM27	Modified US EPA method 9056.Determination of water soluble anions using Dionex (Ion-Chromatography).	PM0	No preparation is required.			AR	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.			AD	Yes

JE Job No: 15/8159 15/8407 15/8073 15/10240 15/10042 15/10536 15/9506 15/9992

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.	Yes		AD	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7	PM17	Modified method EN12457-2 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio.	Yes		AR	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7	PM62	Acid digestion of as received solid samples using Aqua Regia refluxed at 112.5 °C.			AR	Yes
TM31	Modified USEPA 8015B. Determination of Methyltertbutylether, Benzene, Toluene, Ethylbenzene and Xylene by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM31	Modified USEPA 8015B. Determination of Methyltertbutylether, Benzene, Toluene, Ethylbenzene and Xylene by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM20	Extraction of dried and ground samples with deionised water in a 2:1 water to solid ratio for anions. Extraction of as received samples with deionised water in a 2:1 water to solid ratio for ammoniacal nitrogen. Samples are extracted using an orbital shaker.	Yes		AR	Yes
TM60	Modified USEPA 9060. Determination of TOC by calculation from Total Carbon and Inorganic Carbon using a TOC analyser, the carbon in the sample is converted to CO2 and then passed through a non-dispersive infrared gas analyser (NDIR).	PM0	No preparation is required.			AR	Yes
TM61	Modified US EPA methods 245.7 and 200.7. Determination of Mercury by Cold Vapour Atomic Fluorescence.	PM38	Samples are brominated to reduce all mercury compounds to Mercury (II) which is analysed using method TM061.	Yes		AR	Yes

JE Job No: 15/8159 15/8407 15/8073 15/10240 15/10042 15/10536 15/9506 15/9992

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM65	Asbestos Bulk Identification method based on HSG 248.	PM42	Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065.			AR	Yes
TM65	Asbestos Bulk Identification method based on HSG 248.	PM42	Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065.			AR	
TM65	Asbestos Bulk Identification method based on HSG 248.	PM42	Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065.	Yes		AR	
TM73	Modified US EPA methods 150.1 and 9045D. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.			AR	Yes
TM73	Modified US EPA methods 150.1 and 9045D. Determination of pH by Metrohm automated probe analyser.	PM11	Extraction of as received solid samples using one part solid to 2.5 parts deionised water.	Yes		AR	No
NONE	No Method Code	NONE	No Method Code				
NONE	No Method Code	NONE	No Method Code			AR	Yes
NONE	No Method Code	PM17	Modified method EN12457-2 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio.				
NONE	No Method Code	PM17	Modified method EN12457-2 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio.			AR	
NONE	No Method Code	PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.			AR	

Appendix D – Laboratory Reports Groundwater Samples

ABOUT AECOM

In a complex and unpredictable world, where growing demands have to be met with finite resources, AECOM brings experience gained from improving quality of life in hundreds of places.

We bring together economists, planners, engineers, designers and project managers to work on projects at every scale. We engineer energy efficient buildings and we build new links between cities. We design new communities and regenerate existing ones. We are the first whole environments business, going beyond buildings and infrastructure.

Our Europe teams form an important part of our worldwide network of nearly 100,000 staff in 150 countries. Through 360 ingenuity, we develop pioneering solutions that help our clients to see further and go further.

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APPENDIX C

Generic Assessment Criteria for a Commercial Site Use

Generic assessment criteria for human health: commercial scenario

Background

RSK's generic assessment criteria (GAC) were initially prepared following the publication by the Environment Agency (EA) of soil guideline value (SGV) and toxicological (TOX) reports, and associated publications in 2009[1]. RSK GAC were updated following the publication of GAC by LQM/CIEH in 2009[2]. RSK GAC are periodically revised when updated information on toxicological, land use or receptor parameters is published.

Updates to the RSK GAC

In 2014, the publication of Category 4 Screening Levels (C4SL)[3,4], as part of the Defra-funded research project SP1010, included modifications to certain exposure assumptions documented within EA Science Report SC050221/SR3 (herein after referred to as SR3)[5] used in the generation of SGVs.

C4SL were published for six substances (cadmium, arsenic, benzene, benzo(a)pyrene, chromium VI and lead) for a sandy loam soil type with 6% soil organic matter, based on a low level of toxicological concern (LLTC; see Section 2.3 of research project report SP1010[3]). Where a C4SL has been published, the RSK GAC duplicates the C4SL published values using all input parameters within the SP1010 final project report[3] and associated appendices[6], and adopts them as GAC for these six substances.

For all other substances the only C4SL exposure modification relevant to a commercial end use are daily inhalation rates.

The RSK GAC have also been revised with updated toxicology published by LQM/CIEH in 2015[7] or by the USEPA[14], where a C4SL has not been published.

RSK GAC derivation for metals and organic compounds

Model selection

Soil assessment criteria (SAC) were calculated using the Contaminated Land Exposure Assessment (CLEA) tool v1.071, supporting EA guidance[5,8,9] and revised exposure scenarios published for the C4SL[3]. The SAC are also termed GAC.

Pathway selection

In accordance with SR3[5] the commercial scenario considers risks to a female worker who works from the age of 16 to 65 years. It should be noted that this end use is not suitable for a workplace nursery but may be appropriate for a sports centre or shopping centre where children are present. In accordance with Box 3.5, SR3[5] the pathways considered for production of the SAC in the commercial scenario are

- direct soil and dust ingestion
- dermal contact with soil both indoors and outdoors
- indoor air inhalation from soil and vapour and outdoor inhalation of soil and vapour.

With respect to volatilisation, the CLEA model assumes a simple linear partitioning of a chemical in the soil between the sorbed, dissolved and vapour phase[9]. The upper boundaries of this partitioning are represented by the maximum aqueous solubility and pure saturated vapour concentration of the chemical. The CLEA model estimates saturated soil concentrations where these limits are reached[9]. The CLEA software uses a traffic light system to identify when individual and/or combined assessment criteria exceed the lower of either the aqueous- or vapour-based soil saturation limits. Model output cells are flagged red where the saturated soil concentration has been exceeded and the contribution of the indoor and outdoor vapour pathway to total exposure is greater than 10%. In this case, further consideration of the following is required[9]:

- Free phase contamination may be present.
- Exposure from the vapour pathways will be over-predicted by the model, as in reality the vapour phase concentration will not increase at concentrations above saturation limits
- Where the vapour pathway contribution is greater than 90%, it is unlikely the relevant health criteria value (HCV) will be exceeded at soil concentrations at least a factor of ten higher than the relevant HCV.

Where the vapour pathway is the predominant pathway (contributes greater than 90% of exposure) or the only exposure route considered and the cell is highlighted red (SAC exceeds saturation limit), the risk based on the assumed conceptual model is likely to be negligible as the vapour risk is assumed to be tolerable at maximum possible soil concentrations. In such circumstances, the vapour pathway exposure should be considered based on the presence of free phase or non-aqueous phase liquid sources and the measured concentrations of volatile organic compounds (VOC) in the vapour phase. Screening could be considered based on setting the SAC as the modelled soil saturation limits. However, as stated within the CLEA handbook[9], this is likely to not be practical in many cases because of the very low saturation limits and, in any case, is highly conservative.

It should also be noted that for mixtures of compounds, free phase may be present where soil (or groundwater) concentrations are well below saturation limits for individual compounds.

Where the vapour pathway is only one of the exposure pathways considered, an additional approach can then be utilised as detailed within Section 4.12 of the CLEA model handbook[9], which explains how to calculate an effective assessment criterion manually.

SR3[5] states that, as a general rule of thumb, it is recognised that estimating vapour phase concentrations from dissolved and sorbed phase contamination by petroleum hydrocarbons are at least a factor of ten higher than those likely to be measured on-site. RSK has therefore applied an empirical subsurface to indoor air correction factor of 10 into the CLEA model chemical database for all petroleum hydrocarbon fractions (including BTEX, trimethylbenzenes and the polycyclic aromatic hydrocarbons (PAH) naphthalene, acenaphthene and acenaphthylene) to reduce this conservatism.

Input selection

The most up-to-date published chemical and toxicological data was obtained from EA Report SC050021/SR7[10], the EA TOX[1] reports, the C4SL SP1010 project report and associated appendices[3,6], the 2015 LQM/CIEH report[7] or the USEPA IRIS database[14]. Where a C4SL has been published, the RSK GAC have duplicated the C4SL published values using all input parameters within the SP1010 final project report[3] and associated appendices[6], and has

adopted them as GAC for these six substances. Toxicological and specific chemical parameters for aromatic hydrocarbon C_8–C_9 (styrene), 1,2,4-trimethylbenzene and methyl tertiary-butyl ether (MTBE) were obtained from the CL:AIRE Soil Generic Assessment Criteria report[11].

For TPH, aromatic hydrocarbons C_5–C_8 were not modelled, as this range comprises benzene and toluene, which are modelled separately. The aromatic C_8–C_9 hydrocarbon fraction comprises ethylbenzene, xylene and styrene. As ethylbenzene and xylene are being modelled separately, the physical, chemical and toxicological data for aromatic C_8–C_9 have been taken from styrene.

Physical parameters

For the commercial end use, the CLEA default pre-1970s three-storey office building was used. SR3[5] notes this commercial building type to be the most conservative in terms of protection from vapour intrusion. The default input building parameters presented in Table 3.10 of SR3[5] have been used.

The parameters for a sandy loam soil type were used in line with Table 4.4 of SR3[5]. This includes a value of 6% for the percentage of soil organic matter (SOM) within the soil. In RSK's experience, this is rather high for many sites. To avoid undertaking site-specific risk assessments for this SOM, RSK has produced an additional set of GAC for SOM of 1% and 2.5% for all substances using the CLEA tool.

Summary of modifications to the default CLEA SR3[5] input parameters for a commercial land use

In summary, the RSK commercial GAC were produced using the default input parameters for soil properties, the air dispersion model, building properties and the vapour model detailed in SR3[5]. Modifications to the default SR3[5] exposure scenarios based on the C4SL exposure scenarios[3] are presented in Table 2 below. The sole modification to the default commercial input parameters is the updated inhalation rate.

The final selected GAC are presented by pathway in Table 3 with the combined GAC in Table 4.

Figure 1: Conceptual model for CLEA commercial scenario

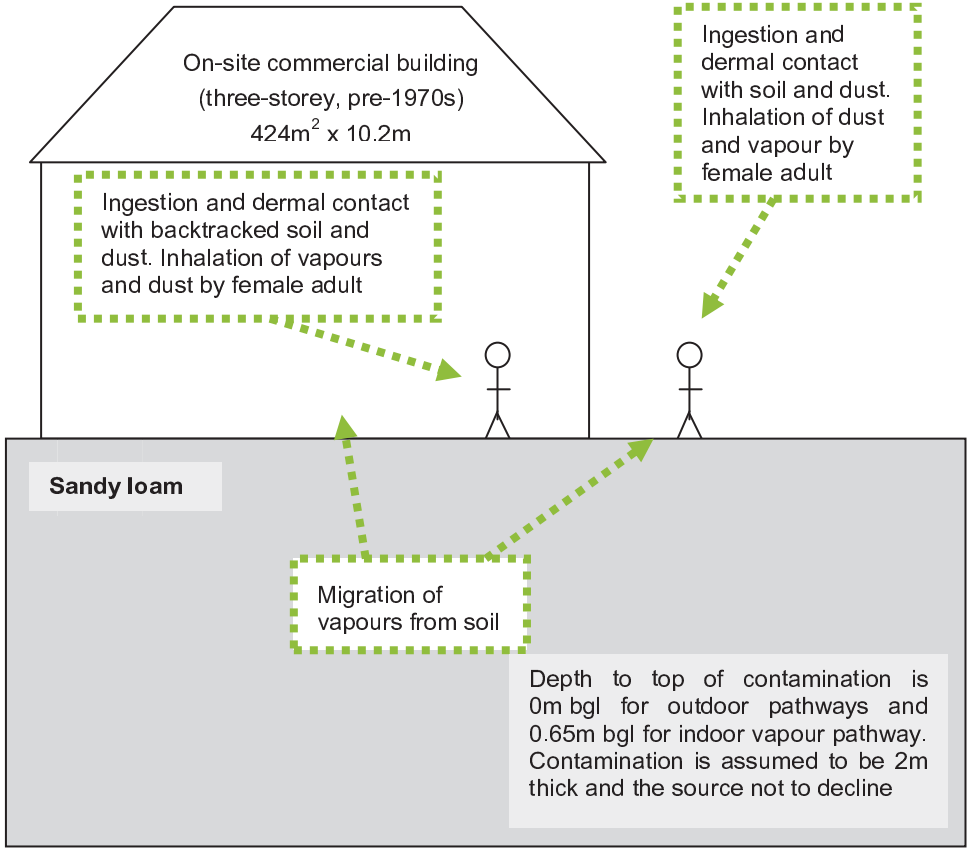

Table 1: Exposure assessment parameters for commercial scenario – inputs for CLEA model

Parameter	Value	Justification
Land use	Commercial	Chosen land use
Receptor	Female worker	Taken as female adult exposed over 49 years from age 16 to 65 years, Box 3.5, SR3[5]
Building	Office (pre-1970)	Key generic assumption given in Box 3.5, SR3[5]. Pre-1970s three-storey office building chosen as it is the most conservative in terms of protection from vapour intrusion (Section 3.4.6, SR3[5])
Soil type	Sandy loam	Most common UK soil type (Section 4.3.1, Table 4.4, SR3[5])
Start age class (AC)	17	AC corresponding to key generic assumption that the critical receptor is a working female adult exposed over a 49-year period from age 16 to 65 years. Assumption given in Box 3.5, SR3[5]
End AC	17	
SOM (%)	6	Representative of sandy loam according to EA guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents'[13]
	1	To provide SAC for sites where SOM < 6% as often observed by RSK
	2.5	
pH	7	Model default

Table 2: Commercial – modified receptor inputs

Parameter	Unit	Value	Justification
Inhalation rate (AC17)	m^3 day^{-1}	15.7	Mean value USEPA, 2011[12]; Table 3.2, SP1010[3]

References

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3. Contaminated Land: Applications in Real Environment (CL:AIRE) (2014). 'Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination', Revision 2, DEFRA research project SP1010.

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11. CL:AIRE (2009), *Soil Generic Assessment Criteria for Human Health Risk Assessment* (London: CL:AIRE).

12. USEPA (2011), *Exposure factors handbook*, EPA/600/R-090/052F (Washington, DC: Office of Research and Development).

13. Environment Agency (2009), 'Changes made to the CLEA framework documents after the three-month evaluation period in 2008', released January 2009.

14. USEPA (2010). Hydrogen cyanide and cyanide salts. Integrated Risk Information Systems (IRIS) Chemical Assessment Summary. September 2010. https://www.epa.gov/iris (accessed 9 December 2015)

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - COMMERCIAL

Table 3

Human health generic assessment criteria by pathway for commercial scenario

Compound	Notes	SAC appropriate to pathway SOM 1% (mg/kg)			Soil saturation limit (mg/kg)	SAC appropriate to pathway SOM 2.5% (mg/kg)			Soil saturation limit (mg/kg)	SAC appropriate to pathway SOM 6% (mg/kg)			Soil saturation limit (mg/kg)
		Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Metals													
Arsenic	(a,b)	6.35E+02	1.25E+03	NR	NR	6.35E+02	1.25E+03	NR	NR	6.35E+02	1.25E+03	NR	NR
Cadmium	(a)	7.73E+02	8.57E+02	4.10E+02	NR	7.73E+02	8.57E+02	4.10E+02	NR	7.73E+02	8.57E+02	4.10E+02	NR
Chromium (III) - trivalent	(c)	3.31E+05	8.57E+03	NR	NR	3.31E+05	8.57E+03	NR	NR	3.31E+05	8.57E+03	NR	NR
Chromium (VI) - hexavalent	(a,d)	9.62E+02	4.91E+01	NR	NR	9.62E+02	4.91E+01	NR	NR	9.62E+02	4.91E+01	NR	NR
Copper		1.89E+05	8.96E+04	6.83E+04	NR	1.89E+05	8.96E+04	6.83E+04	NR	1.89E+05	8.96E+04	6.83E+04	NR
Lead	(a)	2.32E+03	NR	NR	NR	2.32E+03	NR	NR	NR	2.32E+03	NR	NR	NR
Elemental Mercury (Hg^0)	(d)	NR	1.54E+01	NR	4.31E+00	NR	3.26E+01	NR	1.07E+01	NR	5.80E+01	NR	2.58E+01
Inorganic Mercury (Hg^{2+})		1.18E+03	1.97E+04	1.12E+03	NR	1.18E+03	1.97E+04	1.12E+03	NR	1.18E+03	1.97E+04	1.12E+03	NR
Methyl Mercury (Hg^{4+})		3.38E+02	2.13E+03	2.92E+02	7.33E+01	3.38E+02	3.87E+03	3.11E+02	1.42E+02	3.38E+02	7.33E+03	3.23E+02	3.04E+02
Nickel	(d)	3.06E+03	9.83E+02	NR	NR	3.06E+03	9.83E+02	NR	NR	3.06E+03	9.83E+02	NR	NR
Selenium	(b)	1.23E+04	NR	NR	NR	1.23E+04	NR	NR	NR	1.23E+04	NR	NR	NR
Zinc	(b)	7.35E+05	1.97E+08	NR	NR	7.35E+05	1.97E+08	NR	NR	7.35E+05	1.97E+08	NR	NR
Cyanide (free)		6.56E+02	7.51E+04	6.53E+02	NR	6.56E+02	7.51E+04	6.53E+02	NR	6.56E+02	7.51E+04	6.53E+02	NR
Volatile Organic Compounds													
Benzene	(a)	1.09E+03	2.79E+01	2.72E+01	1.22E+03	1.09E+03	5.19E+01	4.96E+01	2.26E+03	1.09E+03	1.08E+02	9.80E+01	4.71E+03
Toluene		4.24E+05	6.49E+04	5.63E+04	8.69E+02	4.24E+05	1.43E+05	1.07E+05	1.92E+03	4.24E+05	3.24E+05	1.84E+05	4.36E+03
Ethylbenzene		1.91E+05	5.89E+03	5.71E+03	5.18E+02	1.91E+05	1.38E+04	1.28E+04	1.22E+03	1.91E+05	3.21E+04	2.75E+04	2.84E+03
Xylene - m		3.43E+05	6.26E+03	6.15E+03	6.25E+02	3.43E+05	1.47E+04	1.41E+04	1.47E+03	3.43E+05	3.44E+04	3.12E+04	3.46E+03
Xylene - o		3.43E+05	6.73E+03	6.60E+03	4.78E+02	3.43E+05	1.57E+04	1.50E+04	1.12E+03	3.43E+05	3.65E+04	3.30E+04	2.62E+03
Xylene - p		3.43E+05	6.03E+03	5.92E+03	5.76E+02	3.43E+05	1.41E+04	1.36E+04	1.35E+03	3.43E+05	3.28E+04	3.00E+04	3.17E+03
Total xylene		3.43E+05	6.03E+03	5.92E+03	6.25E+02	3.43E+05	1.41E+04	1.36E+04	1.47E+03	3.43E+05	3.28E+04	3.00E+04	3.46E+03
Methyl tertiary-Butyl ether (MTBE)		5.72E+05	7.58E+03	7.48E+03	2.04E+04	5.72E+05	1.23E+04	1.21E+04	3.31E+04	5.72E+05	2.34E+04	2.24E+04	6.27E+04
Trichloroethene		9.53E+02	1.23E+00	1.23E+00	1.54E+03	9.53E+02	2.58E+00	2.57E+00	3.22E+03	9.53E+02	5.72E+00	5.69E+00	7.14E+03
Tetrachloroethene		1.12E+04	1.86E+01	1.86E+01	4.24E+02	1.12E+04	4.17E+01	4.16E+01	9.51E+02	1.12E+04	9.57E+01	9.49E+01	2.18E+03
1,1,1-Trichloroethane		1.14E+06	6.60E+02	6.60E+02	1.43E+03	1.14E+06	1.35E+03	1.35E+03	2.92E+03	1.14E+06	2.96E+03	2.95E+03	6.39E+03
1,1,1,2 Tetrachloroethane		1.10E+04	1.09E+02	1.08E+02	2.60E+03	1.10E+04	2.53E+02	2.47E+02	6.02E+03	1.10E+04	5.88E+02	5.59E+02	1.40E+04
1,1,2,2-Tetrachloroethane		1.10E+04	2.81E+02	2.74E+02	2.67E+03	1.10E+04	5.75E+02	5.46E+02	5.46E+03	1.10E+04	1.26E+03	1.13E+03	1.20E+04
Carbon Tetrachloride		7.62E+03	2.87E+00	2.87E+00	1.52E+03	7.62E+03	6.29E+00	6.28E+00	3.32E+03	7.62E+03	1.43E+01	1.42E+01	7.54E+03
1,2-Dichloroethane		2.29E+02	6.73E-01	6.71E-01	3.41E+03	2.29E+02	9.71E-01	9.67E-01	4.91E+03	2.29E+02	1.67E+00	1.65E+00	8.43E+03
Vinyl Chloride		2.67E+01	5.95E-02	5.94E-02	1.36E+03	2.67E+01	7.70E-02	7.67E-02	1.76E+03	2.67E+01	1.18E-01	1.17E-01	2.69E+03
1,2,4-Trimethylbenzene		NR	3.29E+02	NR	4.74E+02	NR	6.41E+02	NR	1.16E+03	NR	1.04E+03	NR	2.76E+03
1,3,5-Trimethylbenzene	(e)	NR	NR	NR	2.30E+02	NR	NR	NR	5.52E+02	NR	NR	NR	1.30E+03
Semi-Volatile Organic Compounds													
Acenaphthene		1.10E+05	2.75E+06	1.06E+05	5.70E+01	1.10E+05	5.36E+06	1.08E+05	1.41E+02	1.10E+05	8.83E+06	1.08E+05	3.36E+02
Acenaphthylene		1.10E+05	2.68E+06	1.05E+05	8.61E+01	1.10E+05	5.23E+06	1.07E+05	2.12E+02	1.10E+05	8.65E+06	1.08E+05	5.06E+02
Anthracene		5.49E+05	1.13E+07	5.23E+05	1.17E+00	5.49E+05	2.35E+07	5.36E+05	2.91E+00	5.49E+05	4.13E+07	5.42E+05	6.96E+00
Benzo(a)anthracene		2.84E+02	4.08E+02	1.67E+02	1.71E+00	2.84E+02	4.47E+02	1.74E+02	4.28E+00	2.84E+02	4.67E+02	1.76E+02	1.03E+01
Benzo(a)pyrene	(a)	7.68E+01	2.04E+02	5.58E+01	9.11E-01	7.68E+01	2.09E+02	5.61E+01	2.28E+00	7.68E+01	2.11E+02	5.63E+01	5.46E+00
Benzo(b)fluoranthene		7.13E+01	1.17E+02	4.43E+01	1.22E+00	7.13E+01	1.20E+02	4.47E+01	3.04E+00	7.13E+01	1.21E+02	4.49E+01	7.29E+00
Benzo(g,h,i)perylene		6.29E+03	1.05E+04	3.93E+03	1.54E-02	6.29E+03	1.06E+04	3.95E+03	3.85E-02	6.29E+03	1.07E+04	3.96E+03	9.23E-02
Benzo(k)fluoranthene		1.88E+03	3.11E+03	1.17E+03	6.87E-01	1.88E+03	3.17E+03	1.18E+03	1.72E+00	1.88E+03	3.21E+03	1.19E+03	4.12E+00
Chrysene		5.67E+02	8.89E+02	3.46E+02	4.40E-01	5.67E+02	9.25E+02	3.52E+02	1.10E+00	5.67E+02	9.47E+02	3.55E+02	2.64E+00
Dibenzo(a,h)anthracene		5.67E+00	9.32E+00	3.53E+00	3.93E-03	5.67E+00	9.52E+00	3.55E+00	9.82E-03	5.67E+00	9.64E+00	3.57E+00	2.36E-02
Fluoranthene		2.29E+04	1.89E+06	2.26E+04	1.89E+01	2.29E+04	2.72E+06	2.27E+04	4.73E+01	2.29E+04	3.32E+06	2.27E+04	1.13E+02
Fluorene		7.31E+04	4.55E+05	6.30E+04	3.09E+01	7.31E+04	1.06E+06	6.84E+04	7.65E+01	7.31E+04	2.24E+06	7.08E+04	1.83E+02
Indeno(1,2,3-cd)pyrene		8.10E+02	1.31E+03	5.01E+02	6.13E-02	8.10E+02	1.35E+03	5.06E+02	1.53E-01	8.10E+02	1.37E+03	5.09E+02	3.68E-01
Naphthalene		3.64E+04	1.87E+03	1.78E+03	7.64E+01	3.64E+04	4.39E+03	3.92E+03	1.83E+02	3.64E+04	9.94E+03	7.81E+03	4.32E+02
Phenanthrene		2.28E+04	5.35E+05	2.19E+04	3.60E+01	2.28E+04	1.09E+06	2.24E+04	8.96E+01	2.28E+04	1.86E+06	2.25E+04	2.14E+02
Pyrene		5.49E+04	4.47E+06	5.42E+04	2.20E+00	5.49E+04	6.46E+06	5.44E+04	5.49E+00	5.49E+04	7.91E+06	5.45E+04	1.32E+01
Phenol		1.10E+06	2.65E+04	2.59E+04	2.42E+04	1.10E+06	3.04E+04	2.96E+04	3.81E+04	1.10E+06	3.46E+04	3.35E+04	7.03E+04

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - COMMERCIAL

Table 3

Human health generic assessment criteria by pathway for commercial scenario

Compound	Notes	SAC appropriate to pathway SOM 1% (mg/kg)			Soil saturation limit (mg/kg)	SAC appropriate to pathway SOM 2.5% (mg/kg)			Soil saturation limit (mg/kg)	SAC appropriate to pathway SOM 6% (mg/kg)			Soil saturation limit (mg/kg)
		Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Total petroleum hydrocarbons													
Aliphatic hydrocarbons EC5-EC6		4.77E+06	3.19E+03	3.19E+03	3.04E+02	4.77E+06	5.86E+03	5.86E+03	5.58E+02	4.77E+06	1.21E+04	1.21E+04	1.15E+03
Aliphatic hydrocarbons >EC6-EC8		4.77E+06	7.79E+03	7.78E+03	1.44E+02	4.77E+06	1.74E+04	1.74E+04	3.22E+02	4.77E+06	3.97E+04	3.96E+04	7.36E+02
Aliphatic hydrocarbons >EC8-EC10		9.53E+04	2.02E+03	2.00E+03	7.77E+01	9.53E+04	4.91E+03	4.85E+03	1.90E+02	9.53E+04	1.17E+04	1.13E+04	4.51E+02
Aliphatic hydrocarbons >EC10-EC12		9.53E+04	9.97E+03	9.69E+03	4.75E+01	9.53E+04	2.47E+04	2.29E+04	1.18E+02	9.53E+04	5.89E+04	4.73E+04	2.83E+02
Aliphatic hydrocarbons >EC12-EC16		9.53E+04	8.26E+04	5.88E+04	2.37E+01	9.53E+04	2.04E+05	8.17E+04	5.91E+01	9.53E+04	4.81E+05	9.02E+04	1.42E+02
Aliphatic hydrocarbons >EC16-EC35	(b)	1.58E+06	NR	NR	8.48E+00	1.75E+06	NR	NR	2.12E+01	1.83E+06	NR	NR	5.09E+01
Aliphatic hydrocarbons >EC35-EC44	(b)	1.58E+06	NR	NR	8.48E+00	1.75E+06	NR	NR	2.12E+01	1.83E+06	NR	NR	5.09E+01
Aromatic hydrocarbons >EC8-EC9 (styrene)		2.29E+04	3.66E+04	1.41E+04	6.26E+02	2.29E+04	8.39E+04	1.80E+04	1.44E+03	2.29E+04	1.93E+05	2.04E+04	3.35E+03
Aromatic hydrocarbons >EC_9-EC_{10}		3.81E+04	3.55E+03	3.46E+03	6.13E+02	3.81E+04	8.66E+03	8.11E+03	1.50E+03	3.81E+04	2.05E+04	1.70E+04	3.58E+03
Aromatic hydrocarbons >EC10-EC12		3.81E+04	1.92E+04	1.62E+04	3.64E+02	3.81E+04	4.69E+04	2.79E+04	8.99E+02	3.81E+04	1.10E+05	3.42E+04	2.15E+03
Aromatic hydrocarbons >EC12-EC16		3.81E+04	2.02E+05	3.62E+04	1.69E+02	3.81E+04	4.76E+05	3.73E+04	4.19E+02	3.81E+04	1.03E+06	3.78E+04	1.00E+03
Aromatic hydrocarbons >EC16-EC21	(b)	2.82E+04	NR	NR	5.37E+01	2.83E+04	NR	NR	1.34E+02	2.84E+04	NR	NR	3.21E+02
Aromatic hydrocarbons >EC21-EC35	(b)	2.84E+04	NR	NR	4.83E+00	2.84E+04	NR	NR	1.21E+01	2.84E+04	NR	NR	2.90E+01
Aromatic hydrocarbons >EC35-EC44	(b)	2.84E+04	NR	NR	4.83E+00	2.84E+04	NR	NR	1.21E+01	2.84E+04	NR	NR	2.90E+01

Notes:

EC - equivalent carbon. GrAC - groundwater screening value. SAC - soil screening value.

The CLEA model output is colour coded depending upon whether the soil saturation limit has been exceeded.

Calculated SAC exceeds soil saturation limit and may significantly affect the interpretation of any exceedances as the contribution of the indoor and outdoor vapour pathway to total exposure is >10%.

Calculated SAC exceeds soil saturation limit but the exceedance will not affect the SAC significantly as the contribution of the indoor and outdoor vapour pathway to total exposure is <10%.

Calculated SAC does not exceed the soil saturation limit.

The SAC for organic compounds are dependant upon soil organic matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, PAHs napthalene, acenaphthene and acenaphthylene, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway (Section 10.1.1, SR3)

(a) SAC for arsenic, benzene, benzo(a)pyrene, cadmium, chromium VI and lead are derived using the C4SL toxicology data.

(b) SAC for selenium should not include the inhalation pathway as no expert group HCV has been derived; aliphatic and aromatic hydrocarbons >EC16 should not include inhalation pathway due to their non-volatile nature and inhalation exposure being minimal (oral, dermal and inhalation exposure is compared to the oral HCV); arsenic should only be based on oral contribution (rather than combined) owing to the relative small contribution from inhalation in accordance with the SGV report. The Oral SAC should be adopted for zinc and benzo(a)pyrene.

(c) SAC for CrIII should be based on the lower of the oral and inhalation SAC (see LQM/CIEH 2015 Section 6.8)

(d) SAC for elemental mercury, chromium VI and nickel should be based on the inhalation pathway only.

(e) SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used.

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - COMMERCIAL

Table 4
Human Health Generic Assessment Criteria for Commercial Scenario

Compound	SAC for Soil SOM 1% (mg/kg)	SAC for Soil SOM 2.5% (mg/kg)	SAC for Soil SOM 6% (mg/kg)
Metals			
Arsenic	640	640	640
Cadmium	410	410	410
Chromium (III) - trivalent	8,600	8,600	8,600
Chromium (VI) - hexavalent	49	49	49
Copper	68,000	68,000	68,000
Lead	2,300	2,300	2,300
Elemental Mercury (Hg^0)	15 (4)	33 (11)	58 (26)
Inorganic Mercury (Hg^{2+})	1,120	1,120	1,120
Methyl Mercury (Hg^{4+})	290 (73)	310 (142)	320
Nickel	980	980	980
Selenium	12,000	12,000	12,000
Zinc	740,000	740,000	740,000
Cyanide (free)	650	650	650
Volatile Organic Compounds			
Benzene	27	50	98
Toluene	56,000 (869)	107,000 (1,916)	184,000 (4,357)
Ethylbenzene	6,000 (518)	13,000 (1,216)	27,000 (2,844)
Xylene - m	6,200 (625)	14,100 (1,474)	31,200 (3,457)
Xylene - o	6,600 (478)	15,000 (1,120)	33,000 (2,618)
Xylene - p	5,900 (576)	13,600 (1,353)	30,000 (3,167)
Total xylene	5,900 (625)	13,600 (1,474)	30,000 (3,457)
Methyl tertiary-Butyl ether (MTBE)	7,500	12,100	22,400
Trichloroethene	1	3	6
Tetrachloroethene	20	40	90
1,1,1-Trichloroethane	700	1,300	3,000
1,1,1,2 Tetrachloroethane	110	250	560
1,1,2,2-Tetrachloroethane	270	550	1,130
Carbon Tetrachloride	2.9	6.3	14.2
1,2-Dichloroethane	0.67	0.97	1.65
Vinyl Chloride	0.06	0.08	0.12
1,2,4-Trimethylbenzene	330	640	1,040
1,3,5-Trimethylbenzene	NR	NR	NR
Semi-Volatile Organic Compounds			
Acenaphthene	110,000	110,000	110,000
Acenaphthylene	110,000	110,000	110,000
Anthracene	520,000	540,000	540,000
Benzo(a)anthracene	170	170	180
Benzo(a)pyrene	77	77	77
Benzo(b)fluoranthene	44	45	45
Benzo(g,h,i)perylene	3,900	3,900	4,000
Benzo(k)fluoranthene	1,200	1,200	1,200
Chrysene	350	350	350
Dibenzo(a,h)anthracene	3.5	3.6	3.6
Fluoranthene	23,000	23,000	23,000
Fluorene	63,000 (31)	68,000	71,000
Indeno(1,2,3-cd)pyrene	500	510	510
Naphthalene	1,800 (76)	3,900 (183)	7,800 (432)
Phenanthrene	22,000	22,000	23,000
Pyrene	54,000	54,000	54,000
Phenol	440*	690*	1,300*
Total Petroleum Hydrocarbons			
Aliphatic hydrocarbons EC_5-EC_6	3,200 (304)	5,900 (558)	12,100 (1,150)
Aliphatic hydrocarbons >EC_6-EC_8	7,800 (144)	17,400 (322)	39,600 (736)
Aliphatic hydrocarbons >EC_8-EC_{10}	2,000 (78)	4,800 (190)	11,300 (451)
Aliphatic hydrocarbons >EC_{10}-EC_{12}	9,700 (48)	22,900 (118)	47,300 (283)
Aliphatic hydrocarbons >EC_{12}-EC_{16}	59,000 (24)	82,000 (59)	90,000 (142)
Aliphatic hydrocarbons >EC_{16}-EC_{35}	1,000,000**	1,000,000**	1,000,000**
Aliphatic hydrocarbons >EC_{35}-EC_{44}	1,000,000**	1,000,000**	1,000,000**
Aromatic hydrocarbons >EC_8-EC_9 (styrene)	14,000 (626)	18,000 (1,440)	20,000 (3,350)
Aromatic hydrocarbons >EC_9-EC_{10}	3,500 (613)	8,100 (1,503)	17,000 (3,580)
Aromatic hydrocarbons >EC_{10}-EC_{12}	16,000 (364)	28,000 (899)	34,000 (2,150)
Aromatic hydrocarbons >EC_{12}-EC_{16}	36,000 (169)	37,000	38,000
Aromatic hydrocarbons >EC_{16}-EC_{21}	28,000	28,000	28,000
Aromatic hydrocarbons >EC_{21}-EC_{35}	28,000	28,000	28,000
Aromatic hydrocarbons >EC_{35}-EC_{44}	28,000	28,000	28,000
Minerals			
Asbestos	No asbestos detected with ID or <0.001% dry weight[1]		

Notes:

'-' Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.

NR - SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used

EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

* The GAC for Phenol is based on a threshold which is protective of direct contact (SC050021/Phenol SGV report)

** Denoted SAC calculated exceeds 100% contaminant, hence 100% (1,000,000mg/kg) has been taken as SAC

The SAC for organic compounds are dependent on Soil Organic Matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, PAHs napthalene, acenaphthene and acenaphthylene, BTEX and trimethylbenzene compounds were produced using an attenuation factor f air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3.

(VALUE IN BRACKETS)

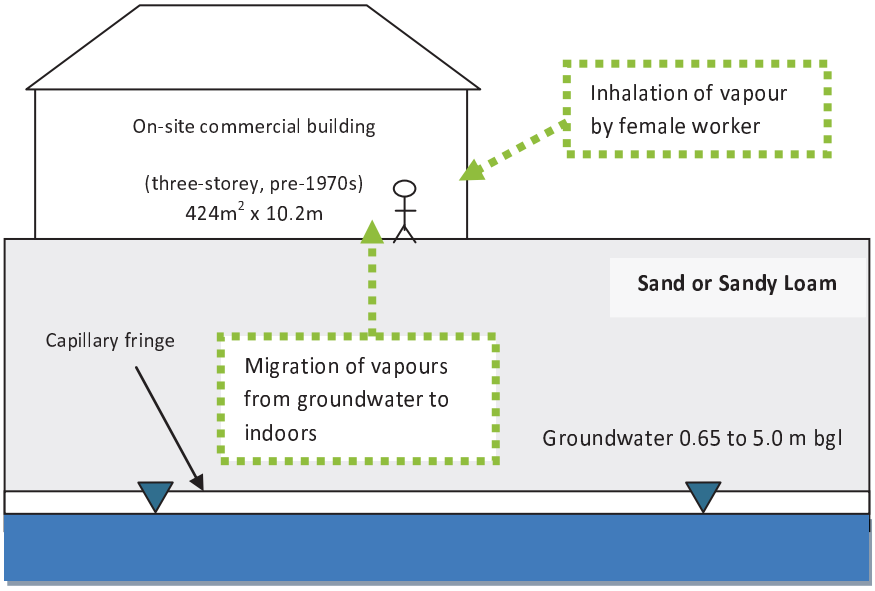
RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the SAC with the corresponding solubility or vapour saturation limits given in brackets.

Generic groundwater assessment criteria (GrAC) for human health: commercial scenario (adult receptor)

Background

Volatile organic compounds (VOC) in groundwater have the potential to pose risks to residential site end users via indoor and outdoor inhalation exposure. Due to significant dilution effects in outdoor air, inhalation risk is dominated by indoor exposure. The GrAC conceptual site model (CSM) is shown in Figure 1 (not to scale).

Figure 1: GrAC conceptual model for a generic commercial scenario



RSK GrAC derivation

Model selection

The Society for Brownfield Risk Assessment (SoBRA) published a set of generic assessment criteria for assessing vapour risk to human health from volatile contaminants in groundwater in February 2017[(1)]. The criteria were developed for a list of common VOC using the Environment Agency Contaminated Land Exposure Assessment (CLEA) tool[(2)] based on a sand soil type and a groundwater depth of 0.65 m below foundation base level. The CLEA tool is not designed to directly model VOC in groundwater and the SoBRA generic criteria are recognised as being conservative since calculations in CLEA are based on three-phase partitioning in the unsaturated zone between soil, soil vapour and soil moisture, with the latter taken by SoBRA as a groundwater equivalent. This method does not take account of the presence of a semi-saturated capillary fringe above the water table, which will serve to provide some mitigation to vertical soil vapour migration.

RSK GrAC are calculated using the RBCA Toolkit for Chemical Releases (version 2.6) with the Johnson and Ettinger model, based on the CSM in Figure 1 for a pre-1970 three storey office

building (as defined in SR3[3], Table 4.21) and which allows consideration of a capillary fringe. The capillary fringe is the subsurface layer in which groundwater seeps up from a water table by capillary action to partially fill soil pores.

The RBCA model was used in preference to the Environment Agency Contaminated Land Exposure Assessment (CLEA) tool[2], as the CLEA tool is not designed to directly model VOC in groundwater and does not take account of the presence of a semi-saturated capillary zone.

Conceptual model

In accordance with SR3[3], the commercial scenario considers risks to an adult female worker who works from the age of 16 to 65 years. It should be noted that this end use is not suitable for a workplace nursery (where children will be present for an extended period of time) but may be appropriate for a sports centre or shopping centre where children are present but for limited periods of time.

The pollutant linkage considered in production of the GrAC is the volatilisation of compounds from groundwater and subsequent vapour inhalation by the identified receptor while indoors. Figure 1 illustrates this linkage. Although the outdoor air inhalation pathway is also valid, this contributes little to the overall risks owing to the dilution in outdoor air. RBCA does not take account of the presence of non-aqueous phase chemicals but highlights when the assessment criterion exceeds the solubility limit of the pure compound.

Input selection – chemical and toxicological parameters

Key parameters used in the RBCA model are listed and justified in Table 1. The most up-to-date published chemical and toxicological data was obtained from EA Report SC050021/SR7[2], the EA TOX[5] reports, and published by Nathanial et al.,[6], as appropriate. Toxicological and specific chemical parameters for aromatic hydrocarbon C8–C9 (styrene), 1,2,4-trimethylbenzene and methyl tertiary-butyl ether (MTBE) were obtained from the CL:AIRE Soil Generic Assessment Criteria report[7].

The toxicological input parameters are associated with minimal risk, rather than low risk.

For petroleum hydrocarbon fractions, aromatic hydrocarbons C5–C8 were not modelled, as this range comprises benzene and toluene, which are modelled separately. The aromatic C8–C9 hydrocarbon fraction comprises ethylbenzene, xylenes and styrene. As ethylbenzene and xylenes are being modelled separately, the physical, chemical and toxicological data for aromatic C8–C9 have been taken from styrene.

For the Commercial GrAC, the Health Criteria Values (HCV) used in the modelling were derived using the toxicological data discussed above, amended as follows:

- An adult weighing 70kg and breathing 15.7m^3 air per day in accordance with the revised exposure parameters used in the SP1010 final project report for the Category 4 Screening Levels (C4SL) (Table 3.2[8]) and USEPA data[9]
- Background inhalation (mean daily intake(MDI)) for an adult (Age Class 17).

The amended HCV used in the derivation of the RSK GrAC are presented in Table 1.

Table 1: Amended Health Criteria Values

	Modified HCV (mg/m^3)
VOC / SVOC	Adult (Commercial)
MTBE	3.2064
Benzene	0.0062
Toluene	6.2362
Ethylbenzene	0.3301
Xylenes	0.2609
Trimethybenzenes	0.0085
TPH_Aliph EC5-EC6	11.1465
TPH_Aliph >EC6-EC8	11.1465
TPH_Aliph >EC8-EC10	0.6465
TPH_Aliph >EC10-EC12	0.6465
TPH_Aliph >EC12-EC16	0.6465
TPH_Arom >EC8-EC9 (styrene)	0.5350
TPH_Arom >EC9-EC10	0.1338
TPH_Arom >EC10-EC12	0.1338
TPH_Arom >EC12-EC16	0.1338
Acenaphthene	0.2675
Acenaphthylene	0.2675
Naphthalene	0.0037
Vinyl chloride	0.0013
Dichloroethane-1,2	0.0005
Tetrachloroethene	0.0363
Carbon tetrachloride	0.0114
Trichloroethane-1,1,1	2.6752
Trichloroethene	0.0025
Tetrachloroethane 1,1,2,2 & 1,1,1,2	0.0257
1,1,2-Trichloroethane	0.0216
1,1-dichloroethene	0.2541
Chloroethane	12.7374
Chloromethane	0.0115
Dichloromethane	0.5765

Note on Trimethylbenzenes

For trimethylbenzenes the CL:AIRE report[7] based background inhalation from non-soil sources (MDI) on a Dutch study from 1985, which is reported to have identified an average daily dose of 1,2,4-trimethylbenzene of 86 ug d^{-1} (1,3,5-trimethylbenzene was 20.5 ug d^{-1}). This dose value was based on the upper end of the identified concentration range of 1,2,4-trimethylbenzene (2.46 – 5.66 ug m^{-3}) and was used to calculate an a MDI of 1.23 ug kg^{-1} bw d^{-1} for a 70 kg adult breathing 20 m^3 of air daily.

The approach recommended in SR2[10], and also adopted for the C4SLs[8], for non-carcinogenic (threshold) compounds such as trimethylbenzenes is to subtract the MDI from the tolerable daily intake (TDI) to obtain a tolerable daily intake from soil (TDSI) in units of ug kg^{-1} bw d^{-1}. For 1,2,4-trimethylbenzene, the adult MDI from the Dutch study used in the CL:AIRE report[7] (1.23 ug kg^{-1} bw d^{-1}) is a significant proportion of the TDI (2.0 ug kg^{-1} bw d^{-1}), resulting in a low TDSI (1.0 ug

kg^{-1} bw d^{-1}) when the 50% rule is applied (i.e. TDSI = TDI * 0.5 when MDI is high relative to TDI). This TDSI equates to an Inhalation Reference Concentration (or modified Health Criteria Value) for adults of 3.4 ug m^{-3} (70 kg adult breathing 15.7 m^3 d^{-1}).

By comparison the adult inhalation modified HCV for benzene is 6.2 ug m^{-3}, which is proven human carcinogen (non-threshold compound).

The MDI for 1,2,4-trimethylbenzene is considered by RSK to be overly conservative for the following reasons:

- The Dutch 1985 study is dated and air quality has improved since this time
- The maximum value in the range (5.66 ug m^{-3}) was used in calculating the MDI
- Experience has shown that trimethylbenzenes often appear to drive inhalation risks to a greater extent than benzene, even though the latter is carcinogenic and more volatile.

As an alternative to the 1985 Dutch study, RSK have obtained automated roadside air quality monitoring data for the UK from www.uk-air.defra.gov.uk/. The average concentration of 1,2,4-trimethylbenzene measured during 2015 at Eltham, south-east London (urban) was 0.309 ug m^{-3}, significantly lower than that identified in the Dutch study and used by CL:AIRE[(7)] for calculation of a MDI. Whilst an average concentration of 1,2,4-trimethylbenzene in UK urban and rural areas is likely to be significantly below 0.0.309 ug m^{-3}, this value is considered to be suitably conservative for the calculation of a modified HCV for trimethylbenzenes in the UK.

On this basis, the HCV for 1,2,4-trimethylbenzene for adults and children was calculated as 8.5 ug m^{-3} (0.0085 mg m^{-3}) and 2.6 ug m^{-3} (0.0026 mg m^{-3}), respectively (see Table 3). Due to the paucity of toxicological data for 1,2,3-trimethylbenzene and 1,3,5-trimethylbenzene the modified HCV for 1,2,4-trimethylbenzene is considered suitable for assessing total trimethylbenzenes.

Note on aqueous solubility and the RSK GrAC

Where the modelled assessment criteria, or the modelled assessment criteria with the correction factor applied to those contaminants specified below, exceeds the aqueous solubility limit the assessment criteria defaults to this concentration and consequently the GrAC is set at the limit of solubility. These assessment criteria are shaded in red in Table 3 at the end of this document.

The theoretical aqueous solubility is the maximum amount of a single chemical that will dissolve in pure water at a specified temperature. Above this concentration, the chemical will exist in the non-aqueous phase (i.e. in its natural physical form as a solid, liquid (NAPL) or gas). If the contaminant, based on its toxicity, is not considered to pose a risk to human health at the aqueous solubility concentration then the contaminant can be considered not to pose a risk to human health. Where the GrAC is set at the aqueous solubility limit (shaded in red on Table 3), this is not a risk based assessment criteria but is indicative of the maximum amount of chemical that would be found dissolved in the water. Therefore an exceedance of the RSK GrAC set at the aqueous solubility limit is <u>not</u> indicative that there may be potential risks to human health. It should be noted that for certain contaminants (e.g. the lighter petroleum hydrocarbon fractions) the aqueous solubility is very low and may be at, or below, the laboratory method detection limit. It should also be noted that non-aqueous phase may exist where concentrations of individual compounds are well below their solubility limits where they are part of a mixture, in accordance with Raoult's Law.

Input selection - physical parameters

For the commercial scenario, the CLEA default pre-1970s three-storey office building was used. SR3[3] notes this commercial building type to be the most conservative in terms of risk from vapour intrusion. The building parameters used in the production of the RSK GACs are the default CLEA v1.06 inputs presented in Table 3.3 of SR3[3].

The RSK GrAC have been calculated for both Sand and Sandy Loam soils. The soil parameters used in the derivation of the RSK GrAC are those presented in Table 3.1 of SR3[3].

The RSK GrAC have been derived for groundwater depths of 0.65 m, 1.5 m, 2.5 m and 5.0 m below ground level, incorporating a capillary fringe (see Table 2).

Input selection - attenuation factors

In line with recommendations provided in Environment Agency SR3[3] a sub-surface to indoor attenuation factor of 10 has been applied to certain RBCA derived 'site-specific target levels'. SR3[3] states that, as a general rule of thumb, it is recognised that estimating vapour phase concentrations from dissolved and sorbed phase petroleum hydrocarbons by using partition coefficients are at least a factor of ten higher than those likely to be measured on-site. This difference is likely to be due to a number of factors, however aerobic biodegradation in the unsaturated zone is believed to be largely responsible. RSK has therefore applied this attenuation factor to all volatile petroleum hydrocarbon fractions (including BTEX, trimethylbenzenes and the polycyclic aromatic hydrocarbons (PAH) naphthalene, acenaphthene and acenaphthylene). No such attenuation factors have been applied to other non-hydrocarbon chemical species, including chlorinated hydrocarbons or fuel oxygenates such as MtBE.

Convective (volumetric) air flow through foundation cracks (Q_{soil}) is a sensitive parameter in the calculation of GrAC and has been calculated within RBCA on a soil-specific basis for Sand and Sandy Loam in a residential exposure scenario (see Table 2). This approach is less conservative than using the default Q_{soil} value recommended in SR3[3] for a Sandy Loam (150 cm^3 s^{-1}) and used in the CLEA model (version 1.071) for Sandy Loam (and Sand) soils (150 cm^3 s^{-1}) in a commercial scenario.

Table 2: Commercial scenario – RBCA inputs

Parameter	Unit	Value	Justification
Receptor – female child			
Averaging time	Years	49	From Box 3.5, SR3[3]
Receptor weight	kg	70	Female adult, Table 4.6, SR3[3]
Exposure duration	Years	49	From Box 3.5, SR3[3]
Exposure frequency	Days yr^{-1}	86.25	Weighted using occupancy period of 9 hours per day for 230 days of the year ((9hours x 230 days)/24 hours)
Soil type – sand			
Total porosity	-	0.54	CLEA value for sand. Parameters for sand from Table 4.4, SR3[3] Volumetric water content in the vadose zone is a highly sensitive parameter within the model and potentially highly variable in the field.
Volumetric water content – unsaturated (vadose) zone	-	0.24	
Volumetric air content - unsaturated (vadose) zone	-	0.30	
Dry bulk density	g cm^{-3} or kg L^{-1}	1.18	
Volumetric water content – capillary zone	-	0.35	Calculated using SR3 Equation 4.1. Value taken as the average moisture content calculated for suction heads (cm H_2O); 0 (i.e. saturated), 10, 20, 30, 40, 50 (i.e. unsaturated soil at field capacity). This is a highly sensitive parameter within the model.
Volumetric air content - capillary zone	-	0.19	Calculated from total porosity and volumetric water content of capillary zone. This is a highly sensitive parameter within the model.
Vertical hydraulic conductivity	cm d^{-1}	636	CLEA value for saturated conductivity of sandy loam, Table 4.4, SR3[3] equivalent to 7.36 E-03 cm s^{-1}
Vapour permeability	m^2	7.54 E-12	Calculated for sand using equations in Appendix 1, SR3[3]
Capillary zone thickness	m	0.25	Taken from C W Fetter, Applied Hydrogeology 4th Ed, 1994[11] and R Heath, Basic groundwater hydrology 1992[12] for a medium sand
Fraction organic carbon	%	0.0058	Equivalent to SOM = 1%. Note that GrAC are independent on FOC/SOM content since partitioning is assumed to be between aqueous and vapour phases only
Soil type – sandy loam			
Total porosity	-	0.53	CLEA value for sandy loam. Parameters for sandy loam from Table 4.4, SR3[3]. Volumetric water content in the vadose zone is a highly sensitive parameter within the model and potentially highly variable in the field.
Volumetric water content – unsaturated (vadose) zone	-	0.33	
Volumetric air content - unsaturated (vadose) zone	-	0.20	
Dry bulk density	g cm^{-3} or kg/L	1.21	
Volumetric water content – capillary zone	-	0.42	Calculated using SR3 Equation 4.1[3]. Value taken as the average moisture content calculated for suction heads (cm H_2O); 0 (i.e. saturated), 10, 20, 30, 40, 50 (i.e. unsaturated soil at field capacity). This is a highly sensitive parameter within the model.
Volumetric air content - capillary zone	-	0.11	Calculated from total porosity and volumetric water content of capillary zone. This is a highly sensitive parameter within the model.

Parameter	Unit	Value	Justification
Vertical hydraulic conductivity	cm d^{-1}	308	CLEA value for saturated conductivity of sandy loam, Table 4.4, SR3[3] equivalent to 3.56E-3 cm s^{-1}
Vapour permeability	m^2	3.05 E-12	Calculated for sandy loam using equations in Appendix 1, SR3[3]
Capillary zone thickness	m	0.4	Taken from R Heath, Basic Groundwater Hydrology 1992[12] for a fine sand. Note: C W Fetter, Applied Hydrogeology 4th Ed, 1994[11] value for fine sand is 0.5 m
Fraction organic carbon	%	0.0058	Equivalent to SOM = 1%. Note that GrAC are independent on FOC/SOM content since partitioning is assumed to be between aqueous and vapour phases only
Building – pre-1970 three storey office			
Building volume/area ratio	m	9.6	Table 3.10, SR3[3]
Foundation area	m^2	424	
Foundation perimeter	m	82.40	Based on square root of building area being 20.59m
Building air exchange rate	d^{-1}	24	Table 3.10, SR3[3] Building air exchange rate equivalent to 2.8 E-04 s^{-1}
Depth to bottom of foundation slab	m	0.15	
Foundation thickness	m	0.15	
Foundation crack fraction	-	3.89E-04	Calculated from floor crack area of 0.165m^2 and building footprint of 424m^2 in Table 4.21, SR3[3]
Volumetric water content of cracks	-	0.24 / 0.33	For sand / sandy loam, assumed equal to underlying soil type in assumption that cracks become filled with unsaturated zone soil over time. Parameters for sand and sandy loam from Table 4.4, SR3[3]
Volumetric air content of cracks	-	0.30 / 0.20	
Indoor/outdoor differential pressure	Pa	4.4	From Table 3.3, SR3[3] Equivalent to 44g/cm/s^2
Convective air flow through cracks (Q_{soil}) - Sand	m^3 s^{-1}	1.95 E-04	Soil-specific calculated parameter in RBCA equivalent (and cross checked) with equations A1, A2, A3, A8, A9 in SR3[3]. Equivalent to **195 cm^3 s^{-1}**
Convective air flow through cracks (Q_{soil}) – Sandy Loam	m^3 s^{-1}	7.7 E-05	Soil-specific calculated parameter in RBCA equivalent (and cross checked) with equations A1, A2, A3, A8, A9 in SR3[3]. Equivalent to **77 cm^3 s^{-1}**

RSK GrAC derivation outputs

The RSK GrACs are presented in Table 3.

Within the RSK GrAC the following should be noted:

- GrAC do not take account of outdoor inhalation exposure to VOC, which is considered to contribute minimally to overall inhalation exposure
- GrAC do not take account of other exposure routes potentially relevant to VOC in shallow groundwater such as direct contact or root uptake
- No biodegradation is assumed to occur in the unsaturated zone. Where aerobic conditions on site are known to exist the GrAC for hydrocarbons may therefore be conservative
- GrAC do not take account of preferential flow into buildings such as through unsealed service entries. In such circumstances GrAC may not be appropriate for use
- GrAC are based on a soil vapour intrusion CSM and are not appropriate for use when the foundation is in direct contact with contaminated groundwater

- GrAC assume that the capillary fringe is un-contaminated with VOC, which is unlikely, particularly where groundwater levels are variable
- GrAC set at the theoretical aqueous solubility limit are not considered to pose a risk to human health
- GrAC do not take into account the interaction between contaminants and the influence this may have on the theoretical aqueous solubility
- GrACs are only applicable to dissolved phase contaminants where the modelled assessment criteria is below the aqueous solubility limits

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	Table 3: RSK GrAC (ug/l)								
	COMMERCIAL								
	SAND					SANDY LOAM			
GW Depth (m)	0.65	1.5	2.5	5		0.65	1.5	2.5	5
Metals									
Elemental mercury	56	56	56	56		56	56	56	56
Methyl mercury	100000	100000	100000	100000		100000	100000	100000	100000
Volatile Organic Compounds									
Benzene	30740	40200	51330	79160		158660	193720	234960	338070
Toluene	59000	59000	59000	59000		59000	59000	59000	59000
Ethylbenzene	180000	180000	180000	180000		180000	180000	180000	180000
Xylene - m	200000	200000	200000	200000		200000	200000	200000	200000
Xylene - o	173000	173000	173000	173000		173000	173000	173000	173000
Xylene - p	200000	200000	200000	200000		200000	200000	200000	200000
Total xylene	173000	173000	173000	173000		173000	173000	173000	173000
Methyl tertiary-Butyl ether (MTBE)	12068580	16013210	20653950	32255810		48000000	48000000	48000000	48000000
Trichloroethene	820	1090	1400	2180		4410	5400	6550	9440
Tetrachloroethene	7430	9930	12870	20210		41190	50460	61360	88610
1,1,1-Trichloroethane	456280	604180	778170	1213140		1300000	1300000	1300000	1300000
1,1,1,2 Tetrachloroethane	35130	47100	61190	96410		180890	225050	277000	406880
1,1,2,2-Tetrachloroethane	231900	313430	409350	649150		844250	1131800	1470100	2315840
Carbon Tetrachloride	1200	1590	2050	3210		6600	8050	9760	14030
1,2-Dichloroethane	1290	1690	2160	3350		5860	7330	9060	13390
Vinyl Chloride	90	120	140	220		460	550	660	930
1,2,4-Trimethylbenzene	55900	55900	55900	55900		55900	55900	55900	55900
Semi-Volatile Organic Compounds									
Acenaphthene	4100	4100	4100	4100		4100	4100	4100	4100
Acenapththylene	7950	7950	7950	7950		7950	7950	7950	7950
Naphthalene	19000	19000	19000	19000		19000	19000	19000	19000
Petroleum Hydrocarbons									
Aliphatic hydrocarbons EC5-EC6	35900	35900	35900	35900		35900	35900	35900	35900
Aliphatic hydrocarbons >EC6-EC8	5370	5370	5370	5370		5370	5370	5370	5370
Aliphatic hydrocarbons >EC8-EC10	427	427	427	427		427	427	427	427
Aliphatic hydrocarbons >EC10-EC12	33.9	33.9	33.9	33.9		33.9	33.9	33.9	33.9
Aliphatic hydrocarbons >EC12-EC16	0.759	0.759	0.759	0.759		0.759	0.759	0.759	0.759
Aromatic hydrocarbons >EC8-EC9 (styrene)	290000	290000	290000	290000		290000	290000	290000	290000
Aromatic hydrocarbons >EC9-EC10	64600	64600	64600	64600		64600	64600	64600	64600
Aromatic hydrocarbons >EC10-EC12	24500	24500	24500	24500		24500	24500	24500	24500
Aromatic hydrocarbons >EC12-EC16	5750	5750	5750	5750		5750	5750	5750	5750

Notes:

Values less than 100 have not been rounded up or down; values greater than 100 have been rounded to the nearest 10.

Highlighted values exceed solubility limit for the pure compound in water (aqueous solubility); GrAC defaults to the limit of solubility.

No vadose zone biodegradation considered

Sub-surface to indoor air correction factor of 10 applied to all petroleum (non-chlorinated) hydrocarbons

All GrAC are for 1% SOM (0.0058 FOC)

GENERIC ASSESSMENT CRITERIA FOR CONTROLLED WATERS

Protection of the water environment

The water environment in the United Kingdom is protected under a number of regulatory regimes. The relevant environmental regulator is consulted where there may be a risk that pollution of 'controlled waters' may occur or may have occurred in the past.

The term 'controlled waters' refers to coastal waters, inland freshwaters and groundwater. The EU Water Framework Directive (WFD) (2000/60/EC) is implemented via domestic regulations and guidance, covering aspects of groundwater and surface water protection as well as drinking water supply policy. Domestic legislation and guidance will vary across the United Kingdom. Therefore, the relevant legislation for England, Wales, Northern Ireland and Scotland should be reviewed, alongside guidance provided by the Environment Agency (EA), Natural Resource Wales (NRW), the Scottish Environmental Protection Agency (SEPA) or the Northern Ireland Environment Agency (NIEA), as appropriate.

The main objectives of the protection and remediation of groundwater under threat from land contamination are set out within "The Environment Agency's approach to groundwater protection", version 1.0 (March 2017)[(1)] and the associated guidance "Land contamination groundwater compliance points: quantitative risk assessments (March 2017)[(1a)] that have replaced the previous guidance document "Groundwater Principles and Practice (GP3)". When assessing risks to groundwater, the following need to be considered:

- Where pollutants have not yet entered groundwater, all necessary and reasonable measures must be taken to:
    - ***prevent*** *the input of* ***hazardous*** *substances into groundwater (see description of hazardous substances below)*
    - ***limit*** *the entry of other (non-hazardous) pollutants into groundwater to avoid pollution, deterioration in the status of groundwater bodies and to prevent sustained, upward trends in pollutant concentrations in groundwater.*
- Where pollutants have already entered groundwater, the priority is to take all necessary and reasonable measures to:
    - ***minimise*** *further entry of "contaminants" where there is a defined source*
    - ***limit the pollution*** *of groundwater or any effect on the status of the groundwater body from the future expansion of the 'plume', if necessary, by actively reducing its extent.*

Within the context of groundwater risk assessments on sites affected by land contamination, "reasonable" means feasible without involving disproportionate costs. What costs are "disproportionate" depends on site-specific circumstances, which may include:

- Considerations of technical feasibility such as identified by the remedial options appraisal, this may be due to the distribution or nature of the contamination and the available remedial methods to treat the identified contamination;
- Sustainability considerations.

DEFINITIONS AND SUBSTANCE CLASSIFICATIONS

Risks to surface waters:

When assessing risks to surface waters, the following list of definitions should be understood:

Priority substances (PS) are harmful substances originally identified under the Water Framework Directive (WFD) 2000/60/EC as substances 'presenting a significant risk to or via the aquatic environment' at a European level. Member States are required to incorporate the identified **PS** into their country-wide monitoring programmes. There are currently 33 **PS** defined within the Priority Substances Directive (2013/39/EU; Annex 1), with a further 12 additional substances due to come into force from 22 December 2018. Directive 2013/39/EU has been transposed into domestic legislation for England and Wales by The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

Under the umbrella of **PS**, there is a sub-set of substances identified as being "hazardous", and these are referred to as **Priority hazardous substances (PHS).** The list of **PHS** is defined at EU level within the Priority Substances Directive (2013/39/EU). The WFD defines hazardous substances as 'substances (or groups of substances) that are toxic, persistent and liable to bio-accumulate, and other substances or groups of substances that give rise to an equivalent level of concern.' There are currently 15 **PHS**, with a further 6 additional substances due to come into force from 22 December 2018.

There is also another group of substances defined at EU level and which are referred to as **other pollutants (OP)** in Directive 2013/39/EU**.** These are additional substances which although not **priority substances**, have EQS which are identical to those laid down in the legislation which applied prior to 13 January 2009 (Directive 2008/105/EU). The **OP** are listed along with the **priority substance (PS)** within the Priority Substances Directive (2013/39/EU),and their associated EQS are also listed therein. There are 6 **OP** defined within the Priority Substances Directive (2013/39/EU).

In addition to the EU level substances, there are also a group of pollutants defined at a Member State level, referred to as **Specific pollutants (SP)**. These substances are pollutants which are released in significant quantities into water bodies in each of the individual European Member States. Under the WFD, Member States are required to set their own EQS for these substances. An indicative list of **SP** is given in Annex VIII of the WFD. Many of the substances categorised as **SP** in the UK were formerly List 2 substances under the old Groundwater Directive (80/68/EEC). The **SP** are defined within Part 2 (Table 1) of The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

Risks to groundwater:

When assessing risks to groundwater, the following definitions should be understood:

Under the requirements of the Groundwater Daughter Directive (2006/118/EU), the UK has published a list of substances it considers to be **hazardous substances** with respect to groundwater. In their advisory capacity to the government, this list has been derived by the UK Joint Agencies Groundwater Directive Advisory Group (JAGDAG), of which the Environment Agency is a member. The JAGDAG list of **hazardous substances** was published in January 2017 and the Environment Agency will use the updated list of hazardous substances from this date for all new activities that may lead to the discharge of hazardous substances to groundwater. The list is extensive and can be found in full at:

https://www.wfduk.org/sites/default/files/Media/170116%20Substance%20Determinationsfinal.pdf

Selecting the appropriate assessment criteria

When assessing the risks to controlled waters, various assessment criteria apply, depending on the nature of the assessment and the conceptual site model.

Where a surface water body is involved, then Environmental Quality Standards (EQS) are the relevant assessment criteria as they are designed to be protective of surface water ecology.

Where a public water supply or a Principal aquifer is involved, then the standards defined in The Water Supply (Water Quality) Regulations[(2)] are the primary source of assessment criteria. The Private Water Supplies Regulations[(3)] may also be applicable in some cases. For instances where there are no UK assessment criteria, then the World Health Organisation (WHO) drinking water guidelines[(4)] may be used.

This appendix presents the generic assessment criteria (GAC) that RSK considers suitable for assessing risks to controlled waters for our most commonly encountered determinants. A full list of EQS for England and Wales are included in The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

The RSK GAC for controlled waters are presented in **Table 1** and **Table 2**. In line with the Environment Agency's Remedial Targets Methodology, the GAC for controlled waters are termed 'target concentrations'.

The appropriate target concentrations should be selected with consideration to:

- the site conceptual model (i.e. the receptor at potential risk);
- whether the substance is already present in groundwater at the site;
- whether or not the substance is classified as a priority hazardous substance under the Priority Substances Directive (2013/39/EC) (see above), or as a hazardous substance according to the current list of JAGDAG determinations[(5)]; and
- background concentrations in the aquifer (if applicable).

It is important to remember that the WFD and Environment Agency guidance[(1 & 1a)] support a sustainable, risk-based approach be applied to groundwater contamination. Exceedance of any target concentration does not necessarily imply that an unacceptable risk exists or that remediation is inevitably required.

Target concentrations shaded in green are statutory values	Target concentrations shaded in orange are non-statutory values

Note: Units µg/l throughout (unless otherwise stated)

Table 1: Target concentrations for controlled waters (excluding TPH CWG fractions)

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
Metals & other inorganics						
Hazardous substance	Specific pollutant	Arsenic	-	10[2]	50[6a]	25[6a]
Non-hazardous pollutant	Priority substance	Cadmium	0.1[7]	5[2]	≤0.08, 0.08, 0.09, 0.15, 0.25 [6b]	0.2[6a]
(Not determined)	-	Chromium (total)	-	50[2]	Sum values for chromium III and VI	
(None	Specific pollutant	Chromium (III)	-	Use value for total chromium	4.7[6a]	-
Hazardous substance	Specific pollutant	Chromium (VI)			3.4[6a]	0.6[6a]

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
(Not determined)	Specific pollutant	Copper	-	2,000[2]	1 bioavailable[6a]	3.76 dissolved, where DOC ≤1mg/l[6a] 3.76µg/l + (2.677µg/l x ((DOC/2) – 0.5µg/l)) dissolved, where DOC >1mg/l[6a]
Hazardous substance	Priority substance	Lead	-	10[2]	1.2 bioavailable[6a]	1.3[6a]
Hazardous substance	**Priority hazardous substance**	Mercury	0.01[7]	1[2]	0.07[6c]	0.07[6c]
Non-hazardous pollutant	Priority substance	Nickel	-	20[2]	4.0 bioavailable[6a]	8.6[6a]
Non-hazardous pollutant	-	Selenium	-	10[2]	-	-
Non-hazardous pollutant	Specific pollutant	Zinc	-	3,000[8]	10.9 bioavailable[6a]	6.8 dissolved [6a]
None	Specific pollutant	Iron	-	200[2]	1000[6a]*1	1000[6a])*1
None	Specific pollutant	Manganese	-	50[2] (0.05mg/l)	123 bioavailable[6a] (0.123mg/l)	-
(Not determined)	-	Aluminium	-	200[2]	-	-

Substance classification		Determinant	Target concentrations (µg/l)			
			Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
Groundwater receptors[5]	Surface water receptors[6]				Freshwater	Transitional (estuaries) and coastal waters
Hazardous substance	**Priority hazardous substance**	Tributyltin compounds (Tributyltin-cation)	0.001[7]	-	0.0002[6a]	0.0002[6a]
(Not determined)	-	Sodium	-	200,000[2] (200 mg/l)	-	-
Non-hazardous pollutant	Specific pollutant	Cyanide (Hydrogen cyanide)	-	50[2] (0.05 mg/l)	1[6a] (0.001 mg/l)	1[6a] (0.001 mg/l)
Non-hazardous pollutant	-	Total ammonia[$] (ammonium (as NH_4^+) plus ammonia (NH_3)	-	500[2] (0.5 mg/l)	300[6f] (0.3 mg/l)	-
Non-hazardous pollutant	Specific pollutant	Ammonia un-ionised (NH_3)	-	-	-	21[6a] (0.021 mg/l)
Non-hazardous pollutant	Specific pollutant	Chlorine	-	-	2[6a] (0.002 mg/l)	10[6d] (0.01 mg/l)
(Not determined)	-	Chloride	-	250,000[2] (250 mg/l)	-	-
(Not determined)	-	Sulphate	-	250,000[2] (250 mg/l)	-	-
(Not determined)	-	Nitrate (as NO_3)	-	50,000[2] (50 mg/l)	-	-
(Not determined)	-	Nitrite (as NO_2)	-	500[2] (0.5 mg/l)	10[9] (0.01 mg/l)	-
Volatile organic compounds (VOC)						

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
Non-hazardous pollutant	Other pollutant	Tetrachloroethene (tetrachloroethylene)	0.1[7]	10[2]	10[6a]	10[6a]
Hazardous substance	Other pollutant	Trichloroethene (trichloroethylene)	0.1[7]	10[2]	10[6a]	10[6a]
None	Specific pollutant	Tetrachloroethane	-	-	140[6a]	-
Hazardous substance	Other pollutant	Carbon tetrachloride (tetrachloromethane)	0.1[7]	3.0[2]	12[6a]	12[6a]
Non-hazardous pollutant	Priority substance	1,2-Dichloroethane	1.0[7]	3.0[2]	10[6a]	10[6a]
Hazardous substance	**-**	Vinyl chloride (chloroethene)	-	0.5[2]	-	-
Non-hazardous pollutant	Priority substance	Dichloromethane	-	20[4]	20[6a]	20[6a]
Non-hazardous pollutant	Priority substance	Trichlorobenzenes	0.01[7]	-	0.4[6a]	0.4[(6a)]
(Not determined)	-	Trihalomethanes	-	100[2a]	-	-
Hazardous substance	Priority substance	Trichloromethane (Chloroform)	0.1[7]	(see "Trihalomethanes"above)	2.5[6a]	2.5[6a]
Non-hazardous pollutant	**Priority hazardous substance**	Di(2-ethylhexyl) phthalate (bis(2-ethylhexyl) phthalate, DEHP)	-	8[4]	1.3[6a]	1.3[6a]

Substance classification		Determinant	Target concentrations (µg/l)			
			Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
Groundwater receptors[5]	Surface water receptors[6]				Freshwater	Transitional (estuaries) and coastal waters
None	Specific pollutant	Benzyl butyl phthalate	-	-	7.5[6a]	0.75[6e]
Hazardous substance	**Priority hazardous substance**	Hexachlorobutadiene	0.005[7]	0.6[4]	0.6[6c]	0.6[6c]
Semi-volatile organic compounds (SVOC)						
(Not determined)	-	Acenaphthylene (C12-C16)	-	-	5.8[10]	
Hazardous substance	**Priority hazardous substance**	Anthracene (C16-C35)	-	-	0.1[6a]	0.1[6a]
Non-hazardous pollutant	Priority substance	Naphthalene (C10-C12)	-	-	2[6a]	2[6a]
Hazardous substance	Priority substance	Fluoranthene (C16-C35)	-	-	0.0063[6a]	0.0063[6a]
Hazardous substance(s)	**Priority hazardous substance(s)**	Benzo(a)pyrene (C16-C35)	-	0.01[2]	0.00017[6a]	0.00017[6a]
		Benzo(b)fluoranthene (C16-C35)	-	0.1[2] sum of the concentration of the four specified compounds	No EQS for these substances. B(a)P should be used as the indicator compound instead.	
		Benzo(k)fluoranthene (C16-C35)	-			

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
		Benzo(g,h,i)perylene (C16-C35)	-			
		Indeno(1,2,3-cd) pyrene (C16-C35)	-			
Non-hazardous pollutant	Specific pollutant	Phenol		-	7.7[6a]	7.7[6a]
Hazardous substance	Specific pollutant	2,4-Dichlorophenol	0.1[7]	-	4.2[6a]	0.42[6a]
Hazardous substance	Priority substance	Pentachloro-phenol (PCP)	0.1[7]	9[4]	0.4[6a]	0.4[6a]
Petroleum hydrocarbons						
Hazardous substance	-	Total petroleum hydrocarbons	-	See Table 2 for individual (non-statutory) TPH CWG fractions with respect to drinking water receptors	See individual risk driving compounds (i.e. BTEX and PAH) for specific EQS	
Hazardous substance	Priority substance	Benzene	1[7]	1[2]	10[6a]	8[6a]
Hazardous substance	Specific pollutant	Toluene	4[7]	700[4]	74[6a]	74[6a]
Hazardous substance	-	Ethylbenzene	-	300[4]	-	-
(Not determined)	-	Xylenes	3[7]	500[4]	30[11]	-

Substance classification		Determinant	Target concentrations (µg/l)			
			Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
Groundwater receptors[5]	Surface water receptors[6]				Freshwater	Transitional (estuaries) and coastal waters
Non-hazardous pollutant	-	Methyl tertiary butyl ether (MTBE)	-	15[12]	-	
Pesticides, fungicides, insecticides and herbicides						
Hazardous substance(s)	Other pollutant (Cyclodiene pesticides)	Aldrin	0.003[7]	0.03[2]	0.01[6a]	0.005[6a]
		Dieldrin	0.003[7]	0.03[2]		
		Endrin	0.003[7]	0.1[2b]		
		Isodrin*[2]	0.003[7]	0.1[2b]		
Hazardous substance	Other pollutant	DDT (total)	0.002[7]	1[4]	0.025[6a]	0.025[6a]
(Not determined) – assume to be Hazardous Substance	-	Total pesticides	-	0.5[2]	-	-
(Not determined) - assume to be Hazardous Substance	-	Other individual pesticides	-	0.1[2]		

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
Hazardous substance	Specific pollutant	Carbendazim	-	-	0.15[6a]	-
Hazardous substance	Specific pollutant	Chlorothalonil	-	-	0.035[6a]	-
Hazardous substance	Specific pollutant (until 22/12/18, after which it becomes a Priority substance)	Cypermethrin	-	-	0.0001[6a] From 22/12/18: 8.0E-5[6a]	0.0001[6a] From 22/12/18: 8.0E-6[6a]
Hazardous substance	Specific pollutant	Dimethoate	0.01[7]	-	0.48[6a]	0.48[6a]
(Not determined)	Specific pollutant	Glyphosate	-	-	196[6a]	196[6a]
Hazardous substance	Specific pollutant	Linuron		-	0.5[6a]	0.5[6a]
Non-hazardous pollutant	Specific pollutant	Mecoprop	0.04[7]	-	18[6a]	18[6a]
Non-hazardous pollutant	Specific pollutant	Methiocarb	-	-	0.01[6a]	-
Non-hazardous pollutant	Specific pollutant	Pendimethalin	-	20[4]	0.3[6a]	-

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
Hazardous substance	Specific pollutant	Permethrin	0.001[7]	-	0.001[6a]	0.0002[6a]
Hazardous substance	Priority substance	Alachlor	-	20[4]	0.3[6a]	0.3[6a]
Hazardous substance	Priority substance	Atrazine	0.03[7]	100[4]	0.6[6a]	0.6[6a]
Hazardous substance	Priority substance	Diuron	-	-	0.2[6a]	0.2[6a]
Hazardous substance	**Priority hazardous substance**	Endosulphan	0.005[7]	-	0.005[6a]	0.0005[6a]
Non-hazardous pollutant	Priority substance	Isoproturon	-	9[4]	0.3[6a]	0.3[6a]
Hazardous substance	Priority substance	Simazine	0.03[7]	2[4]	1[6a]	1 [6a]
Hazardous substance	**Priority hazardous substance**	Trifluralin	0.01[7]	20[4]	0.03[6a]	0.03[6a]
(Not determined)	From 22/12/18: Priority substance	Dichlorovos	-	-	From 22/12/18: 6.0E-4[6a]	From 22/12/18: 6.0E-5[6a]
Hazardous substance	From 22/12/18: Priority substance	Heptachlor and heptachlor epoxide	-	0.03[2]	From 22/12/18: 2.0E-7[6a]	From 22/12/18: 1.0E-08[6a]
Miscellaneous						

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
None	Specific pollutant	Triclosan (antibacterial agent)	-	-	0.1[6a]	0.1[6a]
Hazardous substance	**From 22/12/18: Priority hazardous substance**	Perfluoro-octane sulfonic acid (and its derivatives) (PFOS)	-	-	From 22/12/18: 6.5E-4[6a]	From 22/12/18: 1.3E-4[6a]
Hazardous substance	**From 22/12/18: Priority hazardous substance**	Hexabromo cyclododecane (HBCDD)	-	-	From 22/12/18: 0.0016[6a]	From 22/12/18: 0.0016[6a]

Notes:

'-' A target concentration is not available.

$Please note that total ammonia (NH_4^+ and NH_3) is equivalent to ammoniacal nitrogen in laboratory reports

*1 Please note that although iron is listed in the 2015 Direction as 1.000 µg/l, the EQS remains at 1mg/l in Scotland and it is assumed this is an error and should read either 1,000 or 1000µg/l.

*2 Please note that although Isodrin is not listed in name within the group of "Cyclodiene pesticides" in Table 1 of Schedule 3 Part 3 of the 2015 Direction[6], the CAS number for Isodrin (465-73-6) **is** listed and therefore it is assumed that it has been missed off the named list of substances.

*3 Total petroleum hydrocarbons is used for consistency, but is an analytical method-defined measurement for a mixture of hydrocarbons subject to environmental analysis[11].

"Bioavailable" in relation to copper, zinc, nickel and manganese (but not lead) is the generic EQSbioavailable[6a] derived from the Metal Bioavailability Assessment Tool (M-BAT) developed by the Water Framework Directive UK Technical Advisory Group (WFDTAG). Exceedance of this value should prompt a site-specific assessment using the M-BAT with pH, DOC and Ca to derive a site-specific EQS termed the $PNEC_{dissolved}$. http://www.wfduk.org/resources/rivers-lakes-metal-bioavailability-assessment-tool-m-bat.

For zinc, if there is an exceedance of the EQSbioavailable in an initial GQRA, Tier 2 required that the EQS for zinc should also have the ambient background concentration of zinc added as well

Table 2: World Health Organization (WHO) guide values for TPH CWG fractions in drinking water[13] (as referenced in CL:AIRE, 2017[11])

TPH CWG fraction	WHO guide value for drinking water[13] (µg/l)
Aliphatic fractions:	
Aliphatic EC5-EC6	15,000
Aliphatic >EC6-EC8	15,000
Aliphatic >EC8-EC10	300
Aliphatic >EC10-EC12	300
Aliphatic >EC12-EC16	300
Aliphatic >EC16-EC21	-
Aliphatic >EC21-EC35	-
Aromatic fractions:	
Aromatic EC5-EC6	10 (benzene)
Aromatic >EC6-EC8	700 (toluene)
Aromatic >EC8-EC10	300 (ethyl benzene) 500 (xylenes)
Aromatic >EC10-EC12	90
Aromatic >EC12-EC16	90
Aromatic >EC16-EC21	90
Aromatic >EC21-EC35	90
Reference: World Health Organisation (WHO), 2008. Petroleum products in drinking-water. Background document for development of WHO guidelines for drinking water quality. WHO/SDE/WSH/05.08/123. World Health Organisation, Geneva[13].	

References

1. Environment Agency (2017), 'The Environment Agency's approach to groundwater protection', version 1.0, March 2017 (formerly contained within GP3) [accessed 29 March 2017]. https://www.gov.uk/government/collections/groundwater-protection

1a. Environment Agency (2017), 'Land contamination groundwater compliance points: quantitative risk assessments', March 2017 (formerly contained within GP3) [accessed 29 March 2017]. https://www.gov.uk/government/collections/groundwater-protection

2. The Water Supply (Water Quality) Regulations 2016 (SI 2016/619)
    - 2a. Sum of chloroform, bromoform, dibromochloromethane and bromodichloromethane
    - 2b. Standard applies to individual pesticides except aldrin, dieldrin, heptachlor and heptachlor epoxide, for which a separate standard is defined.
3. The Private Water Supplies (England) Regulations 2016. SI 2016 / 618
4. WHO (2011), *Guidelines for drinking-water quality*, 4th edn
5. JAGDAG hazard substance determinations: This list contains substances that are determined to be hazardous substances or non-hazardous pollutants for the purposes of the groundwater directive 2006/118/EC. The absence of an assessment or substance from the list means an assessment has not been done yet and is presented as 'Not yet determined'; if a substance has been assessed but does not fall into either category it is presented as 'None'. For further details on how substances are assessed, see the Joint Agencies Groundwater Directive Advisory Group (JAGDAG) 'Methodology for the determination of hazardous substances in groundwater for the purposes of the groundwater directive 2006/118/EC' which is available from the JAGDAG website. The methodology is a UK –wide framework that sets criteria for how to assess whether a substance is a hazardous substances in groundwater. The list of substances can be found at:

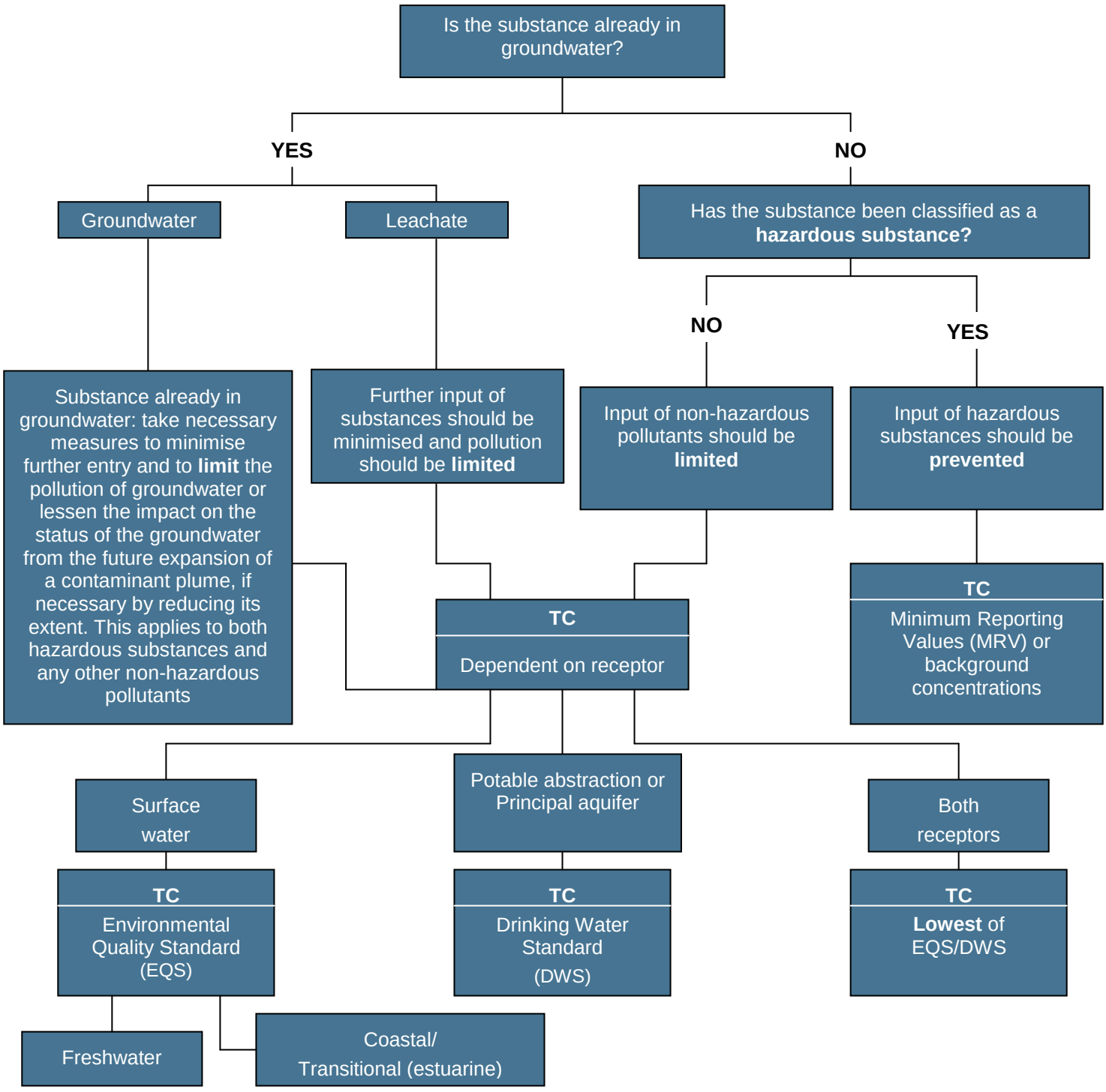
   https://www.wfduk.org/sites/default/files/Media/170116%20Substance%20Determinationsfinal.pdf

6. The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.
    - 6a. The EQS for these substances are based on a "long term mean" or an "annual average (AA)" EQS.
    - 6b. For cadmium and its compounds the EQS values vary depending on the hardness of the water as specified in five class categories (Class 1: < 40 mg CaCO3/l, Class 2: 40 to < 50 mg CaCO3/l, Class 3: 50 to < 100 mg CaCO3/l, Class 4: 100 to < 200 mg CaCO3/l and Class 5: ≥ 200 mg CaCO3/l).
    - 6c. The EQS for Mercury and hexachlorobutadiene are based on a "maximum acceptable concentration (MAC)" EQS in absence of an "annual average (AA)" EQS.
    - 6d. The EQS for chlorine in saltwater is based on the 95th percentile concentration of total residual oxidant, which refers to the sum of all oxidising agents existing in water, expressed as available chlorine.
    - 6e. The recommended saltwater standard is derived using a safety factor of 100. Where the standard is failed, it is recommended that supporting evidence of ecological damage should be obtained before committing to expensive action.
    - 6f. EQS for total ammonia is as per Schedule 3, Part 1, Table 7 of of the above directions. EQS applies to river types 1, 2 and 4 and 6 (namely upland and low alkalinity). The EQS for a lowland and high alkalinity rivers (types 3, 5 and 7) is 600µg/l (0.6mg/l).

Additional information on the Metal Bioavailability Assessment Tool (M-BAT) is available at http://www.wfduk.org/resources/rivers-lakes-metal-bioavailability-assessment-tool-m-bat

7. Minimum reporting values listed at https://www.gov.uk/government/publications/values-for-groundwater-risk-assessments/hazardous-substances-to-groundwater-minimum-reporting-values (updated 13 January 2017; accessed 29 March 2017). Note target concentration for xylenes is 3 μg/l each for o-xylene and m/p xylene as it may not be possible to separate m- and p-xylene; 135 tcb, 124 tcb, 123 tcb each to 0.01 μg/l)
8. The Surface Waters (Abstraction for Drinking Water) (Classification) Regulations 1996 (as amended). SI 1996 / 3001
9. Council Directive on the Quality of Fresh Waters Needing Protection or Improvement in Order to Support Fish Life (Freshwater Fish Directive) (78/659/EEC)
10. WRc plc (2002), R&D Technical Report P45.
11. CL:AIRE, 2017. Petroleum Hydrocarbons in Groundwater: Guidance on assessing petroleum hydrocarbons using existing hydrogeological risk assessment methodologies. V1.1.
12. Drinking Water Inspectorate (London, UK). Environmental Information Request on MTBE in drinking water. Ref. DWI 1/10/18; dated 28 November 2006. Value is based on the odour threshold for MTBE, which is lower than a health-based guideline value
13. World Health Organisation (WHO), 2008. Petroleum products in drinking-water. Background document for development of WHO guidelines for drinking water quality. WHO/SDE/WSH/05.08/123. World Health Organisation, Geneva. [accessed 29 March 2017] http://www.who.int/water_sanitation_health/dwq/chemicals/petroleumproducts_2add_june2008.pdf

FLOW CHART TO ASSIST WITH SELECTION OF TARGET CONCENTRATIONS



TC = Target concentration

When leachate is being assessed the 'compliance point' is the groundwater body. Therefore dilution within the groundwater body may be applied with caution before comparing with the TC.

When directly assessing a receptor, e.g., a river, the appropriate TC should be selected.