Welsh Government

M4 Corridor around Newport

Land Contamination Assessment Report Annex D
CL-10 Made Ground

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1 Introduction

1.1 Background

1.1.1 This report relates to an area of land potentially affected by contamination (CL-10) known as 'Made Ground' herein referred to as the 'Site'.

1.1.2 The Site is located at approximate chainage 7,400 (see Figure 1).

1.2 Reporting Context

1.2.1 The Site has been assessed as part of ground investigations and monitoring associated with the wider works for the M4 Corridor around Newport (M4CaN) (hereafter referred to as the 'Scheme') and informs the baseline for the environmental impact assessment (EIA) for the Scheme. The EIA is reported in the M4CaN Environmental Statement (ES) of which this document is an appendix to the chapter on Geology and Soils.

1.2.2 In 2014, a Preliminary Sources Study Report (2014 PSSR) was prepared as an initial land contamination appraisal (Ove, Arup & Partners, 2014) as part of DMRB Stage 2 Assessments for a number of potential route options. This identified a number of individual areas that may have been affected by contamination as a result of historical activities. In addition, this report draws upon the 2015 Supplementary Ground Investigation Works undertaken on behalf of the Welsh Government (Geotechnical Engineering, 2015). This report relates to the area defined in the Site Location Plan Figure 1.

1.2.3 The overarching rationale and approach for the assessment of areas of land along the proposed new section of motorway with potential contamination is detailed in the Land Contamination Assessment Report (Appendix 11.1 of the ES).

1.3 Objectives

1.3.1 The key objectives of this report are as follows:

- Undertake a risk assessment of the Site and determine whether potential risks to human health or controlled waters could exist based upon the Scheme.
- Identify the need for further assessment and investigation in order to refine potential land contamination risks and inform the need for remediation/mitigation.
- To provide information to support the Ground Investigation Report (GIR) and Geotechnical Design Report (GDR) required under DMRB HD22/08 (Highways Agency, 2008).

1.4 Report Structure

1.4.1 The subsequent report structure is as follows:

- Section 2: Site Location and Description – This section summarises the Site description.
- Section 3: The Scheme – This section details the new section of motorway alignment and associated features at the Site.
- Section 4: Site History – This section summarises the history of the Site based on historical maps and historical land photographs.
- Section 5: Environmental Setting – This section summarises the Site description, published geology, hydrology and hydrogeology and any relevant environmental information presented in the 2014 PSSR.
- Section 6: Scope of Ground Investigation Work – This section describes the previous and supplementary ground investigation data available for the Site.
- Section 7: Ground Conditions – This section describes the main findings of the intrusive site investigation including the ground conditions encountered and visual or olfactory evidence of contamination identified.
- Section 8: Contamination Assessment – This section describes the findings of the Tier 1 and Tier 2 contamination risk assessment based upon potential contamination sources, potential receptors and potential contaminant linkages and presents the human health and controlled waters assessments.
- Section 9: Refined Conceptual Site Model – This section presents the Conceptual Site Model (CSM) for the Site and identifies potential contaminant linkages based upon the findings of the data presented within Sections 2 to7.
- Section 10: Conclusions and Recommendations – This section provides conclusions concerning the likelihood of land contamination associated with the Site affecting the Scheme and requirements for remediation/mitigation.

2 Site Location and Description

2.1.1 The Site is located adjacent to the B4239 approximately one mile south from Duffryn with the Site centre point at National Grid Reference (NGR) ST 301 839. The location and layout of the Site is presented on Figure 1.

2.1.2 The Site comprises a strip of land approximately 50 m long and 7 m wide on the west side of the B4239. The Site comprises an area of Made Ground identified during a walk over survey as part of the 1995 PSSR.

2.1.3 A walkover survey carried out in January 2014 and in May 2015 observed that the Site was covered with hedgerow with a ditch running through the middle, parallel to the road. Abandoned reinforced concrete blocks were noted at the northern extent of the hedgerow. Fragments of large diameter concrete pipes were scattered in the field some 10 m to the west of the Site. Typical photos of the Site are included in Appendix 5.

2.1.4 A review of historical aerial photography from 1949 to 1998 has been undertaken but no evidence was found regarding any disposal of material partly due to the small size of the Site in small scale photography and possibly due to absence of continuous records.

3 The Scheme

3.1.1 The Site is situated at approximate chainage 7,400. Refer to Figure 1 for the location of the Site in relation to the Scheme.

3.1.2 An approximately 3 m high embankment is proposed at this location. The Site is also located adjacent to the proposed overbridge of Lighthouse Road, which is likely to comprise a piled foundation.

3.1.3 Subject to the engineering properties of the encountered Made Ground materials, it is currently proposed that all material will remain *in situ*. This will be subject to the findings of a piling risk assessment and the materials being assessed as suitable for reuse.

4 Site History

4.1.1 The 2014 PSSR historical searches were based on Ordnance Survey plans, literature reviews, information provided by Natural Resources Wales (NRW) (formerly Environment Agency Wales), Newport City Council and aerial photographic interpretation.

4.1.2 This is supplemented by a review of historical maps obtained in 2015 from Welsh Government. Relevant extracts are presented in Appendix 6.

4.1.3 A summary of the Site's history is presented in Table 1 below.

Table 1: Summary of Site History

Date	Use	Source of Information
1843 - 1893	The Site comprises a ditch and a hedge and part of an agricultural field, parallel to a road. A gateway in the hedgerow is present in the centre of the Site. The Site is surrounded by agricultural fields and drainage ditches. A road runs north – south along the Site's eastern boundary. Fair Orchard Farm is located approximately 30 m to the south-east and Pheasant House is located approximately 75 m to the north.	1:10,560 Historical Mapping
1891 - 1912	No significant change.	1:10,560 Historical Mapping
1904 - 1939	No significant change.	1:10,560 Historical Mapping
1964 - 1965	No significant change.	1:10,560 Historical Mapping
1970 - 1973	No significant change. A mast is now present in the field approximately 20 m to the west and Fair Orchard Farm has expanded to approximately 20 m east.	1:10,000 Historical Mapping
1979	No significant change.	Aerial Photography
1981 - 1989	No significant change.	1:10,000 Historical Mapping
1985 - 1996	No significant change.	1:10,000 Historical Mapping
1997	Site described as having **Made Ground.** No detailed description of the material or ground surface.	Walkover survey during 1995 (PSSR 2015)

Date	Use	Source of Information
2006	The **ground appears disturbed** on the Site around the access gate to the B4239 and into the field to the west. Storage of materials identified in the field 10 m to the west of the Site - possibly three sections of large diameter concrete pipe. St Brides Bangers racing track is located 175 m to the north-east. A number of old railway carriages and caravans presumably associated with the racing track are present approximately 100 m north-east.	Aerial Photography
2009 - 2010	The ground around the access gate to the B4239 is disturbed and cattle are identified within the field. The racing track is overgrown and vegetated. Fair Orchard Farm is expanding further east.	Aerial Photography
2014	No significant change. A cattle trough and feed store are located within the field beyond the western boundary of the Site. The racing track is back in use and Fair Orchard Farm has additional outbuildings.	Aerial Photography
2015	Site covered by a hedgerow with **abandoned reinforced concrete blocks** laid out on the northern extent. The Site surface was level with the surrounding field (there was no noticeable heap of material). Fragments of large diameter **concrete pipes** were scattered in the field some 10 m to the west of the Site.	2015 walkover survey

Notes: Potential sources of contamination have been underlined. Those within the temporary and permanent land take are shown in **bold**.

4.1.4 The information presented above supplements the information published in the 2014 PSSR. Relevant extracts of the photographs are presented in Appendix 6.

4.1.5 The presence of large concrete pipe fragments indicates the possibility that the Made Ground may be associated within the laying of a water/sewerage mains pipe.

4.1.6 Historically the Site is located in an area which may have been bombed during World War II which is discussed in the Explosive Ordnance Threat Assessment Report (Bactec, 2014). This categorises the Site as medium risk with respect to unexploded ordnance.

5 Environmental Setting

5.1 Geology

5.1.1 British Geological Society (BGS) data indicates that the Site is underlain by Tidal Flat Deposits overlying bedrock of the Mercia Mudstone Group.

5.2 Hydrology

5.2.1 This Site is surrounded by a flat low lying area (less than 10 mAOD) with a complex system of drainage channels and ditches running along plot boundaries. On site is a drainage ditch running north – south (flow direction unknown).

5.3 Hydrogeology

5.3.1 NRW classifies the Mercia Mudstone Group as a Secondary B Aquifer. Tidal Flat Deposits in the locale have been classified as a Secondary (undifferentiated) Aquifer.

5.3.2 The Site does not lie within a groundwater source protection zone.

5.4 Environmental Information

5.4.1 The 2014 PSSR indicates that NRW records do not identify any pollution incidents, sewage discharge, abstraction licence, landfills/waste management facilities within 300 m radius of the Site.

5.4.2 No further environmental information relevant to this Site has been identified.

6 Scope of Investigations

6.1 General

6.1.1 No previous ground investigations have been undertaken at this Site. However a number of holes were advanced within 40 m of the Site. These have been considered in order to support understanding of ground conditions beneath the Site and inform on the groundwater quality and gas regime if relevant.

6.2 Scope of Works

6.2.1 Table 2 details the various intrusive investigations undertaken in the near vicinity of the Site.

Table 2: Site Investigation Summary (Off Site)

Date	Contractor	Boreholes	Location from Site	Sampling
1997	Norwest Holst	BHE3, BHE3A	30 m north-west	None
2008	Norwest Holst	SBHE04CP, SBHE04RC	25 m south-west	Soil and groundwater
2015	Geotechnical Engineering	BH408, BH409	30 m north-west and 40 m north-east	Soil and groundwater

6.2.2 The well construction details of the above off site boreholes are summarised in Table 3.

Table 3: Summary of Off Site Borehole Construction Details

Borehole ID	Diameter (mm)	Total Drilled Depth (m)	Top of Slotted Well Casing / Gravel Pack (mbGL)	Base of Slotted Well Casing / Gravel Pack (mbGL)	Targeted Geology
BHE3A	No data	30.6	23	29.5	Mercia Mudstone
SBHE04RC	19	30.25	16.8	17.4	Mercia Mudstone
BH408	35	23	0.5	5	Tidal Flat Deposits
	50		8	12	Glaciofluvial Deposits

6.3 Surface Water Quality Monitoring

6.3.1 Surface water monitoring in the vicinity of the Site has been undertaken by RPS in 2015, as summarised in Table 4. Location 7.4 was sampled during the first quarterly round (Q1). The surface water quality sampling was located approximately 350 m to the south-west of the Site, on Morfa Gronw Reen.

6.3.2 The results for these samples are reported within the Baseline Water Environment Report (Appendix 16.2 of the ES).

Table 4: Surface Water Monitoring Locations

Surface Water Monitoring Point ID	Date of Sampling	Water Body	Position	Field Observations
7.4 / Q1	5th June 2015	Morfa Gronw Reen	Approximately 350 m south-west of the Site.	-

6.4 Field Testing

6.4.1 Monitoring of Volatile Organic Compounds (VOCs) was undertaken on three soil samples from BH408 at 0.2-0.5 mbGL, 0.5-1.0 mbGL and 1.0-1.2 mbGL, and two soil samples from BH409 at 0.5-0.7 mbGL and 1.0-1. mbGL

6.5 Groundwater Monitoring

6.5.1 A summary of the groundwater sampling, groundwater/monitoring and ground gas monitoring are shown in Table 5.

Table 5: Summary of Monitoring Rounds (Off Site)

Location Ref.	Number and Date of Rounds	Monitoring Details	Notes
BHE3A	**5 no**. 15th November 1997, 25th November 1997, 3rd December 1997, 12th December 1997, 18th December 1997	Groundwater level	-
SBHE04RC(19mm)	**6 no**. 31st January 2008, 25th February 2008, 7th March 2008, 20th March 2008, 4th April 2008, 18th April 2008	Groundwater level	-
BH408	**3 no**. 9th March 2015, 16th March 2015, 6th May 2015	Groundwater level / sampling, Soil gas	Dual installation. Gas monitoring from 35 mm shallow install only.

6.6 Laboratory Chemical Testing

6.6.1 No analytical data is available for the Site.

6.6.2 A summary of the contamination results from the selected off site boreholes are shown in Table 6. For the purpose of this report, only the groundwater analytical data have been considered.

Table 6: Summary of Previous Investigation Sampling (Off Site)

Site Investigation Date	No. of Water Samples	Suites of Testing
2015	3	Metals, PAH, TPH, pH, cyanide, organic matter (soil only), sulphate (soil only), sulphur (soil only), nitrate (soil only), BTEX (water only), PCBs (water only), phenols (water only)

6.6.3 The available data set has been tabulated and is presented in Appendix 3 with supporting laboratory certificates available in the site investigation report (Geotechnical Engineering, 2015).

6.6.4 The available data relates to samples taken from wells installed within the groundwater of the Tidal Flat Deposits and Glaciofluvial Deposits.

6.6.5 The available information is summarised in Table 7.

Table 7: Summary of Analytical Groundwater Data

Groundwater Unit	Number of Groundwater Analyses per Analytical Suites (number of well locations) – 2015 data					
	Metals & Inorganics	Polycyclic Aromatic Hydrocarbons	Total Petroleum Hydrocarbon	Phenol	BTEX	Polychlorinated Biphenyl
Groundwater (Tidal Flat Deposits)	2 (1)	2 (1)	1 (1)	1 (1)	1 (1)	1 (1)
Groundwater (Glaciofluvial Deposits)	3 (1)	3 (1)	2 (1)	1(1)	2 (1)	1 (1)

Surface Water Analysis

6.6.6 The laboratory analytical results for surface water samples collected during the 2015 investigation phase is summarised in Table 8. The available data set has been tabulated in a table format and is presented in Appendix 4 with supporting laboratory certificates available in the Baseline Water Environment report (Chapter 16.2 of the ES).

Table 8: Summary of Analytical Surface Water Data

Surface Water System	Number of Water Analysis per Analytical Suite (number of locations) – 2015 data				
	Metals & Inorganics	Water Quality Parameters	Polycyclic Aromatic Hydrocarbons	Total Petroleum Hydrocarbon	BTEX
Morfa Gronw Reen	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)

7 Ground Conditions

7.1 Geological Sequence Summary

7.1.1 The geological logs for exploratory holes excavated on or in close proximity of the Site are provided in Appendix 1. The observed sequence of natural material is consistent with that described in the 2014 PSSR report and summarised in the following sections. Information from the Supplementary Ground Investigation (Geotechnical Engineering, 2015) has also been used.

7.1.2 In general, a thin veneer of Topsoil was encountered overlying Tidal Flat Deposits, typically very soft and soft bluish grey silty clays. A granular material (sands/gravels/cobbles), considered to represent Glaciofluvial Deposits, was found to at depth below 7.9 to 8.6 mbGL.

7.1.3 Below the Glaciofluvial Deposits the Mercia Mudstone Group was encountered at depths of 11.3 to 13.2 mbGL. The Mercia Mudstone was typically described as very stiff / hard fissured reddish brown gravelly clay. A very weak to weak fractured weathered mudstone was encountered within BHE3.

7.1.4 The general geological sequence identified during the off site ground investigations are summarised in Table 9. With the exception of the unknown details and thickness of Made Ground, the geological sequence beneath the Site is anticipated to be similar to that described below.

Table 9: Summary of Geological Sequence

Unit	Description	Thickness Range (m)	Basal Depth (mbGL)
Topsoil	-	0.05 - 0.3	0.05 - 0.3
Superficial Deposits (Tidal Flat Deposits)	Very soft silty clay, organic in places.	7.9 - 8.3	7.9 - 8.6
Superficial Deposits (Glaciofluvial Deposits)	Sand, gravel and cobbles	3.3 - 5.1	11.3 - 13.2
Mercia Mudstone (Mudstone)	Very stiff gravelly clay or very weak to weak fractured mudstone	>10.55 - >17.4	Unproven

7.2 Visual and Olfactory Evidence of Contamination (Off Site)

7.2.1 No visual or olfactory evidence of contamination was identified during the various drilling within these selected off site locations.

7.2.2 PID monitoring was undertaken on three soil samples from BH408 and two soil samples from BH409. The PID meter recorded low levels of between 0.3 and 1.7 ppm within the Tidal Flat Deposits indicating the presence of low level naturally occurring VOCs.

7.2.3 Full details and observations noted during the drilling are presented on the exploratory logs attached in Appendix 1.

7.3 Gas Monitoring (Off Site)

7.3.1 The gas monitoring collected during each of the two monitoring rounds is summarised on the field data sheets provided in Appendix 2. The maximum gas concentrations are presented in Table 10.

Table 10: Summary of Gas Monitoring Data (Off site)

Location ID	Flow (l/hr)	VOCs (ppm)	CH_4 (%/vol)	Peak LEL (%)	CO_2 (%/vol)	O_2 (%/vol)	CO (ppm)	H_2S (ppm)
	Max	Max	Max	Max	Max	Min	Max	Maximum
BH408	0.0	2.7	0.0	0.0	0.4	19.5	28	25

7.4 Groundwater

Groundwater Encountered During Investigation (Off Site)

7.4.1 All water strikes encountered during the investigation of the selected off site boreholes are detailed on the geological logs provided in Appendix 1. These are summarised in Table 11.

Table 11: Summary of Groundwater Strike Data

(Off Site) Location	Strike Depth (mbGL)	Geological Formation	Level after 20 minutes (mbGL)
BHE3	8.6	Tidal Flat Deposits	3.7
SBHE04CP	2.8	Estuarine Alluvium	2.8
SBHE04RC	10.3 17.0	Fluvial Alluvium Mercia Mudstone	-
BH408	0.7	Tidal Flat Deposits	-

Groundwater Level During Monitoring Rounds (Off Site)

7.4.2 Groundwater levels recorded during subsequent monitoring rounds of the selected off site boreholes are provided in Table 12.

Table 12: Summary of Groundwater Level During Monitoring Rounds

Location	Installation	Depths of Response Zone (mbGL) and Geological Formation	No. Measurements	Minimum Depth (mbGL)	Maximum Depth (mbGL)	Comments
BH408	Shallow	0.5 - 5 (Tidal Flat Deposits)	3	0.48	2.58	Slow recharge
	Deep	8 - 12 (Glaciofluvial Deposits)	3	2.58	4.33	-
BHE3A	No data	23 - 29.5 (Mercia Mudstone)	5	3.42	3.61	-
SBHE04RC	19 mm	16.8-17.4 (Mercia Mudstone)	6	1.80	2.59	-

Groundwater Summary

7.4.3 The main groundwater body, as seen from off site boreholes, is within the granular Glaciofluvial Deposits and/or the Mercia Mudstone, confined by the overlying Tidal Flat Deposits. This demonstrates the latter to represent an aquitard to the groundwater flow. Groundwater is in sub-artesian pressure rising to within the Tidal Flat Deposits to levels of between 1.8 m and 4.33 mbGL.

7.4.4 A perched groundwater table is indicated (BH408) within the upper formation of the Tidal Flat Deposits. This is considered to represent a discrete body with little vertical or lateral flow.

7.4.5 The above groundwater regime correlates with the one seen elsewhere along the low lying areas of the Scheme corridor and is considered to be representative of the conditions beneath the Site.

8 Contamination Assessment

8.1 Introduction

8.1.1 The following sections provide details of the assessment of land contamination at the Site.

8.1.2 The outline Conceptual Site Model (CSM) presented within the 2014 PSSR has been reviewed and updated based on data from the Supplementary Ground Investigation (Geotechnical Engineering, 2015) and the proposed Scheme. The main alterations to the 2014 PSSR CSM are summarised as follows:

- Representation of sub-artesian pressure of the deep groundwater within the Glaciofluvial Deposits and/or Mercia Mudstone.
- Proposed band drain to be used to accelerate surcharging soft soils and new ditch considered as new pathways.
- Proposed piling for the Lighthouse Road overbridge.
- Update of the source-pathway-receptor linkages taking account of above and more detailed assessments.

8.2 Preliminary Risk Assessments

Potential Sources

8.2.1 Construction waste including concrete blocks and pipe section were identified within the field. These are laid above ground level and believed to be surplus materials associated with water/sewerage pipe works.

8.2.2 The 2014 PSSR also states the 1997 walkover survey identified the presence of Made Ground although further details are not available.

8.2.3 The Site is level with its surroundings and given there is no evidence of specific land activity from the available environmental and historical information; it is considered the Made Ground, if present, is likely to be superficial and mainly represented by the presence of concrete material above ground level.

8.2.4 These are likely to be considered as unsuitable earthworks material and would be removed as part of the preparation of formation during the construction phase.

8.2.5 In addition to the above sources, the quality of surface waters, perched groundwater and the deeper aquifer within the Glaciofluvial Deposits and Mercia Mudstone bodies may influence or impact the quality of other watercourses. Surface water, perched groundwater and deeper aquifer are therefore, regarded as a source of possible contaminants as well as receptors.

Potential Receptors

8.2.6 Receptors during the construction and the operational stages of the Scheme have been considered:

Construction

- Construction workers during site development works.

- General public/site neighbours (farm buildings located some 20 m east of the construction works).
- Groundwater within the Glaciofluvial Deposits and/or Mercia Mudstone.
- Surface water features (drainage ditches).

Operational

- General public end users.
- General public/site neighbours (farm buildings located some 20 m east of the permanent land take).
- Maintenance workers.
- Groundwater within the Glaciofluvial Deposits and/or Mercia Mudstone.
- Nearby surface waters including the reens and existing and/or proposed surface water ditches within the Site and bordering the surrounding fields.

Potential Pathways

8.2.7 Pathways during the construction and the operational stages of the Scheme have been considered:

- Dermal contact, ingestion, inhalation pathways of potentially contaminated soils possible during construction and maintenance works.
- Dermal contact, ingestion, inhalation of dust pathways possible for general public end users and Site neighbours/general public in the nearby farm building.
- Contaminated surface water run-off into existing/new drainage system.
- Vertical migration of impacted perched water within the Made Ground and/or leachate from the Made Ground into Glaciofluvial Deposits and/or Mercia Mudstone aquifer due to band drain/pile installation.
- Vertical migration of groundwater within Glaciofluvial Deposits and/or Mercia Mudstone possibly recharging perched groundwater due to band drain/pile installation.
- Leaching of contaminants from the Made Ground to shallow groundwater and migration to land drainage (surface waters).

8.3 Risk Evaluation

8.3.1 Source-pathway-receptor linkages were considered in the 2014 PSSR using the historical data available up to 2008. With review of the other data described herein, the following risk evaluation has been reconsidered and included:

- Proposed 1.5 m embankment and overlying hardstanding (carriageway) is to be constructed at the Site which is to cover most of the motorway corridor reducing pathways from any contamination in shallow soils left *in situ* to motorway users.
- Tidal Flat Deposits are classified as non-productive and overlie a secondary aquifer associated with the Glaciofluvial Deposits and/or Mercia Mudstone.

- The low permeability Tidal Flat Deposits (of over 8 m thickness) separates the Made Ground and deeper aquifer. The main groundwater body is identified as being confined by the Tidal Flat Deposits.
- Perched groundwater within the Tidal Flat Deposits is not considered as a water resource due to its anticipated low vertical hydraulic continuity with the aquifer beneath, low permeability and storage capacity. This is considered as pore waters and not as an aquifer.
- Hardstanding cover which is proposed in some areas of the new motorway corridor is likely to limit infiltration thus reducing leaching. However the proposed use of band drains could create pathways from any potentially contaminated soils within or under the motorway embankment to the secondary aquifer.
- Made Ground is anticipated to be of very limited thickness and only in discrete areas (if at all present) with much represented by relicts of concrete construction material on the surface. On this basis, perched water within the Made Ground is not anticipated to be present.
- Motorway users will be within open environment with no proposed structures or other confined spaces.
- Risk of ground gas emission from the Made Ground is considered negligible given the anticipated thickness and composition. A ground gas risk assessment is included within Section 8.6. Risk associated with ground gas has not been considered further in the Conceptual Site Model.

8.4 Human Health Risk Assessment

8.4.1 No chemical analysis is available for the soils on the Site.

8.5 Controlled Waters Screening Assessment

8.5.1 In the absence of on site data and for the purpose of this report, nearby available groundwater analytical data has been considered. This aims to identify the local groundwater quality within the vicinity of the Site in order to identify any obvious contamination fingerprint that could be associated with any potential contamination from the Site itself.

8.5.2 The rationale and approach for the screening assessment is detailed in the Land Contamination Assessment Report (Appendix 11.1 of the ES) and the groundwater chemical results are presented in Appendix 4. All exceedances to the relevant screening criteria are summarised in Table 13 and 14 for groundwater and surface waters.

8.5.3 Where an Environmental Quality Standard (EQS) is dependent on water hardness, i.e. some heavy metals, the hardness of the surface water receptor should normally be used. The Baseline Water Environment Report (Appendix 16.2 of the ES) indicates surface water to be generally moderately hard with hardness concentrations within a range of 100 to 150 mg/l as calcium carbonate. Therefore EQSs within this water hardness range have been used for screening purposes.

Soil Leachate Results

8.5.4 No chemical analysis is available for soils on the Site.

Groundwater Results (Off Site)

8.5.5 Groundwater analysis results have been assessed from samples collected during a number of monitoring rounds in 2015 from the off site borehole BH408. The groundwater samples were taken from the groundwater within the Glaciofluvial Deposits and the perched groundwater within the Tidal Flat Deposits.

8.5.6 A summary of the exceedances of the screening criteria from all available ground results relating to the Site is presented in Table 13 and discussed below.

Table 13: Groundwater Screening Exceedances (Off Site)

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS Screening Criteria (Total Number of Results)	No. Exceeded DWS Screening Criteria (Total Number of Results)
Perched Groundwater (Tidal Flat Deposits)						
Nickel	µg/l	3.4 - 5.8	4	20	1 (2)	0 (2)
Ammonical Nitrogen as N	mg/l	1.3	0.6	-	1 (1)	-
Aquifer (Glaciofluvial Deposits)						
Boron	µg/l	740 - 1100	2000	1000	0 (3)	1 (3)
Mercury	µg/l	<0.5 - 0.56	0.07	1	1 (3)	0 (3)
Ammonical Nitrogen as N	mg/l	5.6	0.6	-	1 (1)	-

Notes: DWS - Drinking Water Standard, EQS - Environmental Quality Standard.

8.5.7 The water quality observed for the perched and deep groundwaters at the off site borehole BH408 are seen to have marginally enhanced levels of ammoniacal nitrogen, mercury and nickel when compared to the Environmental Quality Standards criteria.

8.5.1 When compared against Drinking Water Standards, only boron is identified in marginal exceedance within the aquifer in the Glaciofluvial Deposits.

8.5.2 Given the chloride concentrations are below the DWS, the groundwater appears to be fresh water. The quality status seen is similar between the two bodies.

Surface Water Results

8.5.3 A summary of the surface water screening assessment undertaken near the Site is presented in Table 14. This includes the results for the one monitoring location, situated on Morfa Gronw Reen as identified in Table 4.

8.5.4 The results for this sample location are presented within the Baseline Water Environment Report (Appendix 16.2 of the ES).

Table 14: Surface Water Screening Exceedances - Q1 / 7.4

Parameter	Unit	No. Analyses	No. Analyses Above LOD	Concentration	EQS	No. Analyses Exceeding EQS	DWS	No. Analyses Exceeding DWS	CCW Trigger Levels	No. Analyses Exceeding CCW Trigger Levels
Phosphorus	mg/l	1	1	1100	120	1	-	-	-	-
Ammoniacal Nitrogen	mg/l	1	1	2.434	0.6	1	-	-	1	1

8.5.5 Water quality within Morfa Gronw Reen is generally observed to be good with only a small number of exceedances for some parameters above their respective EQS. Of note, phosphorus is seen to exceed its EQS in addition to ammoniacal Nitrogen. Exceedances for ammoniacal nitrogen are also recorded within the groundwater quality data at borehole BH408.

8.5.6 Given the chloride concentrations are below the DWS, the surface water appears to be fresh water.

8.5.7 The sample was analysed for Total Petroleum Hydrocarbons (TPH), organics and Polycyclic Aromatic Hydrocarbons (PAH), all of which were recorded below their respective laboratory Limit of Detection (LOL).

8.5.8 Although the surface water quality of Morfa Gronw Reen is considered to be in keeping with the water quality expected in the reen system and of good quality, it is considered that a tortuous hydraulic linkage exists between the Site and the surface water sample locations, particularly at times of negligible flow during the summer penning level.

8.6 Ground Gas Risk Assessment

8.6.1 The only ground gas data available relates to off site borehole BH408. This has a response zone within the Tidal Flat Deposits between depths of 0.5 and 5.0 mbGL. Of the three rounds available, the following comments may be made:

- No monitoring was undertaken during low barometric pressure (less than 1000 mb), with the lowest conditions being 1009 mb. As such, worst atmospheric conditions for potential ground gas generation may have not been monitored.
- Gas flow was recorded as absent during all monitoring rounds.
- Methane was recorded as zero during all monitoring rounds.
- Carbon dioxide is recorded generally as zero and up to 0.4 % within one monitoring round, well below the Workplace Exposure Limit of 5 %.
- Traces of volatile organic compounds of up to 2.7 ppm have been recorded.
- A single elevated concentration of hydrogen sulphide and carbon monoxide was recorded during one monitoring round before rapidly returning to zero. This elevated result is considered anomalous.
- Oxygen has been recorded as ambient during all monitoring rounds.

8.6.2 The gas regime in the vicinity of the Site does not appear to be abnormal. A gas risk assessment has been undertaken and is set out within the Land Contamination Assessment Report (Appendix 11.1 of the ES).

8.7 Summary

8.7.1 The off site perched groundwater within the Tidal Flat Deposits has elevated boron and ammoniacal nitrogen above the DWS and EQS respectively.

8.7.2 The off site deep groundwater within the Glaciofluvial Deposits and/or Mercia Mudstone has been identified to have elevated mercury, nickel and ammoniacal nitrogen above the EQS.

8.7.3 The off site groundwaters (perched and aquifer) quality status are in general keeping with the baseline quality seen within this area of Newport (Appendix 16.2 of the ES). The current limited information indicates no obvious effect on groundwater from the land use of the Site.

8.7.4 Surface water sampling points nearest to the Site from Morfa Gronw Reen are of good quality although a tortuous hydraulic continuity is identified between the reen and the site.

8.7.5 An abnormal ground gas regime has not been recorded in the single available off site gas monitoring installation.

9 Refined Conceptual Site Model

9.1.1 The incorporation of data from the 2015 Supplementary Ground Investigation has enabled the original CSM presented in the 2014 PSSR to be updated. Relevant Pollutant (source-pathway-receptor) linkages are considered within the refined CSM. The assessment is based on the Scheme during construction and operational phases.

9.1.2 A CSM representing general ground conditions, overall layout and relevant source-pathway-receptors (each of which having a specific alpha-numerical symbol attached) are presented in Figure 2 and is described in Table 15.

Table 15: Conceptual Site Model

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
On Site Anticipated superficial Made Ground to include mainly concrete material	**Construction**					
	Construction workers (B)	Direct dermal (1)	Unlikely	Low	Very low	Construction workers will possibly be exposed to Made Ground materials during Site construction works; however exposure duration will be short term only. Prior to construction, a specific risk assessment will be required in line with Construction (Design and Management) (CDM) Regulations 2015 requirements and other relevant health and safety (H&S) guidance. This will enable safe methodology and appropriate level of Personal Protective Equipment (PPE) to be put in place. As such all risks will be duly considered and suitably mitigated to protect construction workers. Current data identifies Made Ground to be present mainly at the surface and comprising concrete material. Contamination status is anticipated to be low. Data is based on limited information and the provision and implementation of a suitable verification sampling inspection strategy during construction to confirm risks. Dust suppression measures are recommended during construction works.
		Ingestion (3)	Unlikely	Low	Very low	
		Inhalation of soil dust (2)	Unlikely	Low	Very low	
	Off site general public during construction works (C)	Direct dermal (1)	Unlikely	Low	Very low	During construction there is the possibility of dermal contact and inhalation of soil dust, short term exposure only. Dust suppression measures are recommended during construction works. Data for the Made Ground is unknown and the provision and implementation of a suitable verification sampling inspection strategy during construction to confirm risks is recommended.
		Ingestion (3)	Unlikely	Low	Very low	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
		Inhalation of soil dust (2)	Unlikely	Low	Very low	
	Surface waters (E)	Saturated flow within perched groundwater (4)	Unlikely	Low	Very low	Perched (shallow) groundwater is likely to be intercepted by the land drainage. The quality of perched groundwater may become affected by contamination during the construction works, particularly in the area excavation (new drains). Increase in water flux from Tidal Flat Deposits during surcharge loading via the band drains. Perched groundwater is likely to have low flow and may be absent seasonally. Groundwater qualities (perched and deep) status identified off site are in keeping with the baseline, indicating no obvious off site effect from the Site. Data is based on limited information and the provision and implementation of a suitable verification sampling inspection strategy during construction to confirm risks is recommended.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
		Contaminated surface water run-off (5)	Low	Low	Low	During construction if the Made Ground is excavated some material might enter the adjacent drainage ditch that forms part of the wider network of reens and ditches of the Gwent Levels SSSI. Surface water run-off may further deteriorate the quality of surface water. Construction process to adopt surface water control and management. Low leaching potential anticipated from soil materials. Data based on limited information and the provision and implementation of a suitable verification sampling inspection strategy during construction to confirm risks is recommended.
	Deeper groundwater within granular superficial deposits (Da)	Leaching/migration (4) if contaminant in the Made Ground	Unlikely	Low	Very low	Current data set identifies Made Ground to be present at the surface within the motorway corridor and limited leachability (mainly concrete blocks) is anticipated. Increased vertical pathways between possible contaminant and receptor with construction of band drains/piles. Data based on limited information and the provision and implementation of a suitable verification sampling inspection strategy during construction to confirm risks is recommended.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
Groundwater aquifer from the Glaciofluvial Deposits and/or Mercia Mudstone	Surface water (land drainage) (E)	Band Drain/pile (4)	Likely	Moderate	Moderate	Aquifer and perched groundwater quality shown to have elevated, albeit limited, metals and inorganics. Potentiometric surface of the Aquifer potentially near base of land drainage. Band drains/piles to create vertical pathways connecting aquifer with land drains. Surface waters are of better quality than the groundwater. A foundations (piling) risk assessment is required to minimise risk to controlled waters and the adoption of control measures during construction.
On site Anticipated superficial Made Ground to include mainly concrete material	**Operational**					
	Maintenance workers (B)	Direct dermal (1)	Unlikely	Low	Very low	Made Ground to be largely encapsulated by the embankment (or removed during construction) and therefore the exposure to contamination will be limited outside the motorway embankment. Areas outside the motorway hardstanding are likely to receive topsoil cover and vegetation establishment, reducing potential of exposure. Made Ground material beyond the likely motorway corridor currently has established vegetation cover, reducing potential of exposure. Exposure duration will be short term only. Site specific risk assessment will be required in line with health and safety guidance. This will enable safe methodology and appropriate level of PPE to be put in place. As such, all risks will be duly considered and suitably mitigated. Current contamination status is not foreseen to represent abnormal constraints to maintenance
		Ingestion (3)	Unlikely	Low	Very low	
		Inhalation of soil dust (2)	Unlikely	Low	Very low	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
						workers health and safety over and above those typical of a brownfield site.
	Future motorway users (A) & off site users (C)	Dermal contact with dust (1)	Unlikely	Low	Very low	Made Ground to be largely encapsulated by the embankment and therefore the exposure to contamination will be limited outside the motorway corridor. Exposure duration will be short term only for motorway users. Off site receptors some 40 m from proposed earthworks. Areas outside the motorway hardstanding are likely to receive topsoil cover and vegetation establishment, reducing potential of exposure. Made Ground material beyond the likely motorway corridor currently has established vegetation cover, reducing potential of exposure.
		Ingestion of dust (3)	Unlikely	Low	Very low	
		Inhalation of soil dust (2)	Unlikely	Low	Very low	
	Groundwater - aquifer (Da) from the Glaciofluvial Deposits and/or Mercia Mudstone	Leaching/migration (4) of contamination in Made Ground	Unlikely	Low	Very low	The current data identifies Made Ground to be present at the surface within the motorway corridor and limited leachability (mainly concrete blocks) is anticipated. Increased vertical pathways between possible contaminant and receptor with band drain/pile installation. Hard/vegetative cover will reduce infiltration and thus leaching potential.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
	Surface water (land drainage) (E)	Saturated flow within perched groundwater (4)	Likely	Moderate	Moderate	Ephemeral perched (shallow) groundwater is likely to be intercepted by the land drainage. Surface waters are of better quality than the groundwater. Hardstanding will reduce infiltration and thus reduce leaching potential. Groundwater quality status identified off site is in keeping with the baseline, indicating no obvious off site effect.
Groundwater aquifer from the Glaciofluvial Deposits and/or Mercia Mudstone	Surface water (land drainage) (E)	Band drain/pile (4)	Likely	Moderate	Moderate	Aquifer and perched groundwater quality shown to have elevated, albeit limited, metals and inorganics. Potentiometric surface of the Aquifer potentially near base of land drainage. Band drains/piles to create vertical pathways connecting aquifer with land drains. Surface waters are of better quality than the groundwater.

10 Conclusions and Recommendations

10.1 Conclusions

10.1.1 The proposed earthworks include the construction of a 3 m high embankment over the northern half of the Site.

10.1.2 Whilst no intrusive investigation was undertaken within the Site, limited thickness of Made Ground is anticipated and likely to comprise of superficial concrete material. Potential sources of contamination are considered to be limited.

10.1.3 The off site groundwaters (perched and aquifer) quality status are similar to each other and in general keeping with the baseline quality seen within this area of Newport. The current limited information indicates no obvious effect on groundwater from the Site land use.

10.1.4 Installation of band drains/piles may provide new pathways which may lead to groundwater within the Tidal Flat Deposits entering the currently confined aquifer within the Glaciofluvial Depostis and Mercia Mudstone.

10.1.5 Data indicates the deep aquifer may have enhanced levels of limited metals and inorganic contaminants which may reduce surface water quality if the band drain/pile pathways allow direct or indirect linkage. Further consideration and risk assessment should be given to the potential effects of the band drains/piles and whether specific precautions or mitigation measures should be implemented prior to construction.

10.1.6 Post construction, the embankment and topsoil cover outside the motorway corridor will remove linkages of concerns from possible contamination sources to end users and maintenance workers. Topsoil materials placed at the surface will need to be checked for contamination.

10.1.7 Surface water sampling points nearest to the Site from Morfa Gronw Reen are of good quality although a tortuous hydraulic continuity is identified.

10.1.8 In order to confirm the low to moderate risks associated with the Site in relation to both construction and operational phases, intrusive investigation including testing of soils, soil leachate and possible gas and groundwater is to be undertaken.

10.2 Recommendations

10.2.1 Upon review and assessment of the additional ground investigation information, any contamination identified that could cause an unacceptable risk to the identified receptors will require appropriate remedial mitigation measures. These measures would be identified within a remediation strategy for the Scheme. A remediation strategy for the Scheme should be developed for the Site that includes:

- Refining potential human health and controlled waters risks using data from the proposed additional ground investigation.
- Dealing with unexpected contamination (discovery strategy).

- Verification sampling strategy to confirm suitability of soils for retention/reuse.
- Control measures (over and above good practice construction management) to prevent risks to construction workers and the general public during construction.
- Verification testing requirements for material used as topsoil.

10.2.2 The remediation strategy should include a remediation options appraisal, remediation implementation plan and remediation verification plan.

10.2.3 The remediation strategy should be supported by a Scheme wide Materials Management Plan prepared in accordance with CL:AIRE Code of Practice (CL:AIRE, 2011).

11 References

CL:AIRE (2011) The Definition of Waste: Development Industry Code of Practice, ISBN 978-1-905046-23-2.

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Highways Agency (2008) Design Manual for Roads and Bridges. Vol. 4. Geotechnics and Drainage. Section 1. Earthworks; Part 2. HD22/08. Managing Geotechnical Risk.

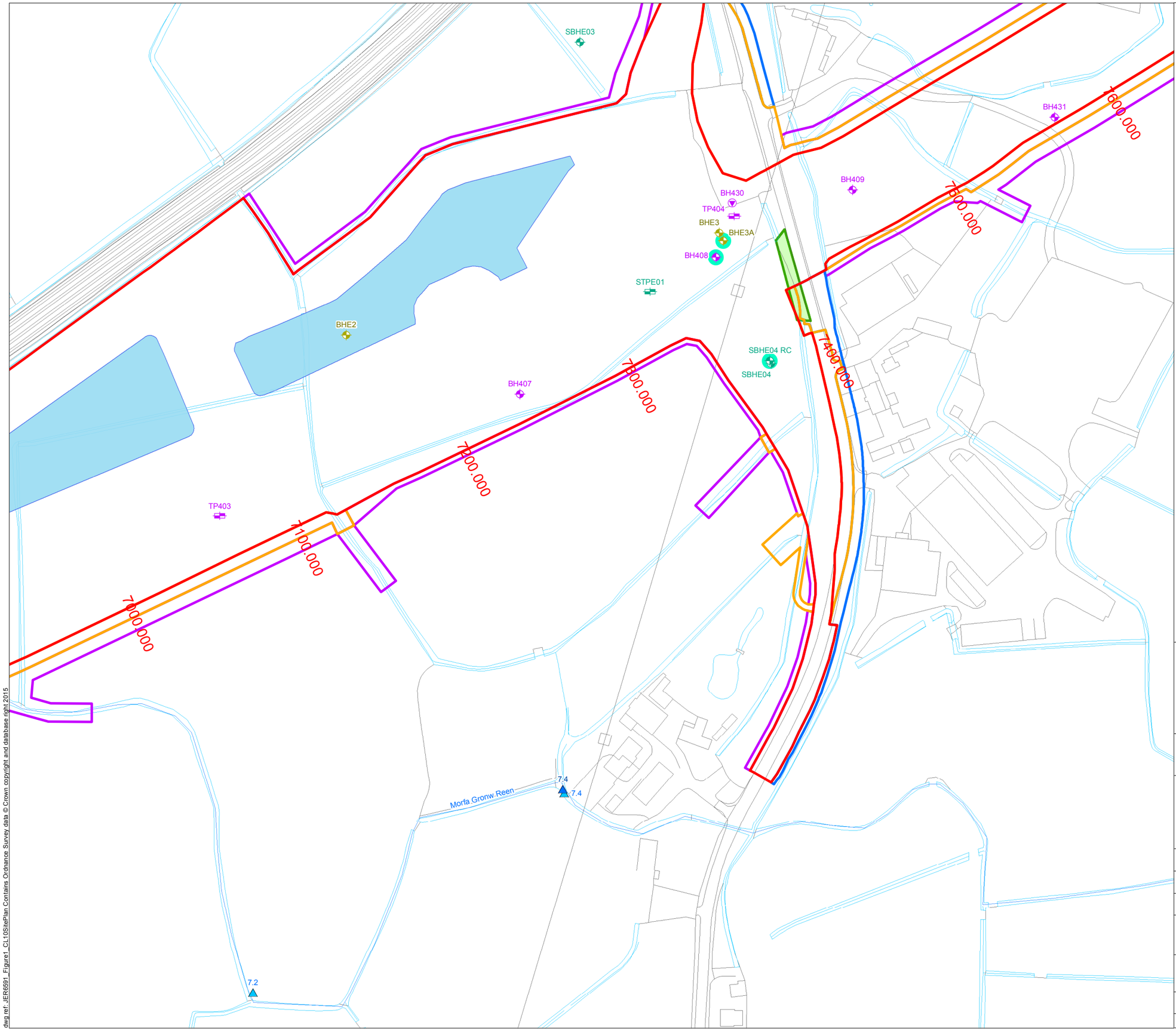
Bactec (2014) Explosive Ordnance Threat Assessment in respect of M4 Corridor around Newport for Hyder Consulting (UK) Limited, 5750TA

12 Glossary

BF	Blast Furnace
BGS	British Geological Survey
BOD	Biochemical Oxygen Demand
BOS	Basic Oxygen Slag
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CAT	Cable Avoidance Tool
CDM	Construction Design Management
CH_4	Methane
CLEA	Contaminated Land Exposure Assessment
CO_2	Carbon Dioxide
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CSM	Conceptual Site Model
DMRB	Design Manual for Roads and Bridges
DO	Dissolved Oxygen
DQRA	Detailed Quantitative Risk Assessment
DWS	Drinking Water Standard
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
ES	Environmental Statement
ESG	Environmental Scientifics Group
EQS	Environmental Quality Standard
FTIR	Fourier Transform Infrared (spectroscopy)
GAC	Generic Assessment Criteria
GDR	Geotechnical Design Report
GIR	Ground Investigation Report
GRO	Gasoline Range Organics
LEL	Lower Explosive Limit
LOD	Limit of Detection
mAOD	Metres Above Ordnance Datum

mb	Millibars
mbGL	Metres below Ground Level
MTBE	Methyl Tert-butyl Ether
NRW	Natural Resources Wales
ORP	Oxidation Reduction Potential
O_2	Oxygen
OS	Ordnance Survey
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCSM	Preliminary Conceptual Site Model
PID	Photo Ionisation Detector
PPE	Personnel Protection Equipment
SGVs	Soil Guideline Values
SSAC	Site Specific Assessment Criteria
SSSI	Site of Special Scientific Interest
SVOCs	Semi-Volatile Organic Compounds
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbon
TPH CWG	Total Petroleum Hydrocarbon Criteria Working Group
UKAS	United Kingdom Accreditation Service
VOCs	Volatile Organic Compounds
WFD	Water Framework Directive
UXO	Unexploded Ordnance Survey

Figures



Legend

- Proposed Water Treatment Area (WTA)
- Potential Area of Land Contamination based on 2014 PSSR

Investigation Locations

2015 (RPS)

- Surface Water Monitoring Location - Q2
- Surface Water Monitoring Location - Q1

2015 (Geotechnical Engineering)

- Borehole
- Dynamic Probe (Proposed Borehole)
- Trial Pit

2007 (Norwest Holst)

- Borehole
- Trial Pit

1997 (Norwest Holst)

- Borehole
- Monitoring Well Installation

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Welsh Government

Appendix 11.1 Annex D CL-10

Site Plan for CL-10

Figure: 1	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Scale: A3 @ 1:2,000

0 30 60 m

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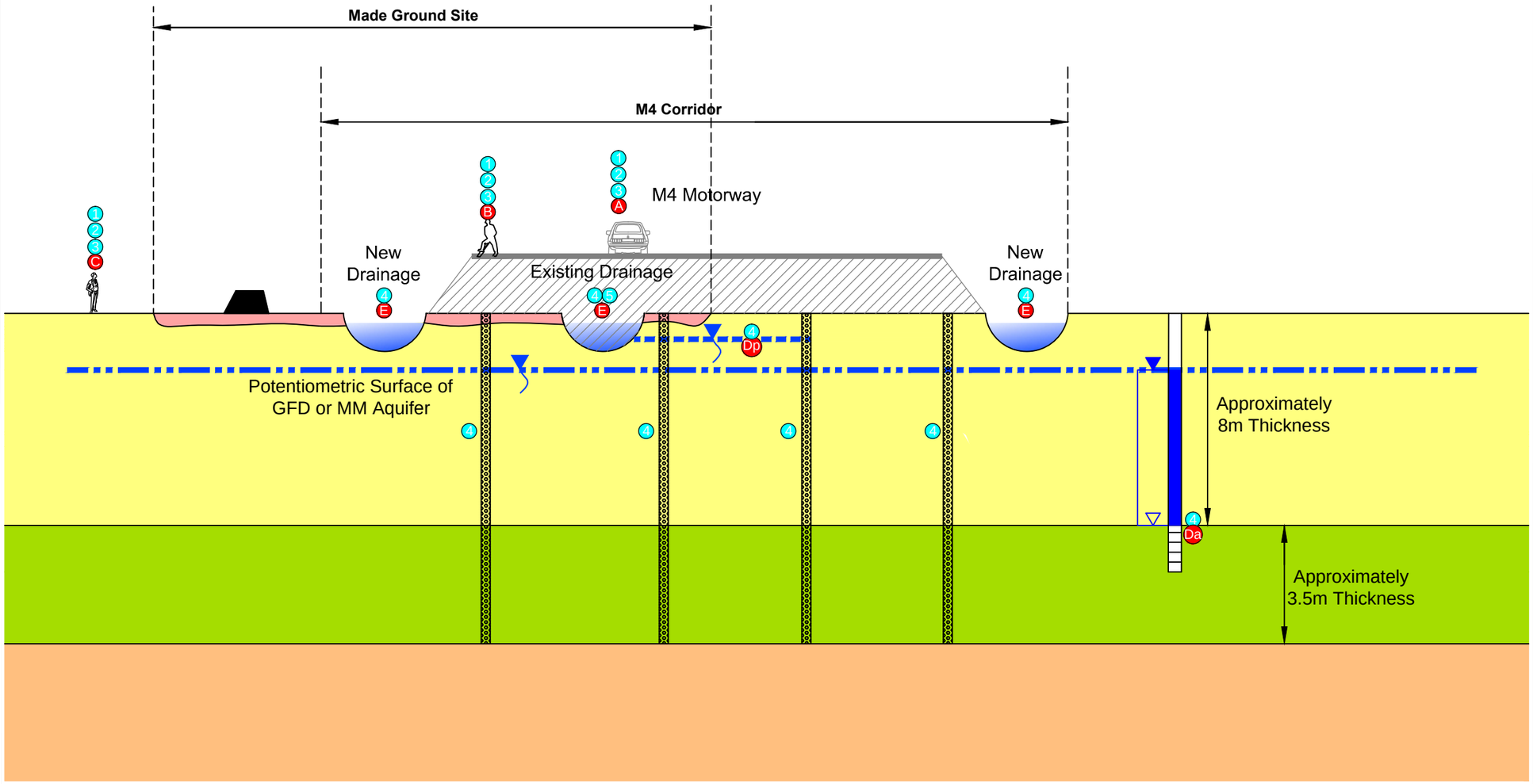
dwg ref: JER6591_Figure1_CL10SitePlan

dwg ref: JER6591_Figure1_CL10SitePlan Contains Ordnance Survey data © Crown copyright and database right 2015

CL- 10 Made Ground



Ground conditions based on available information

Legend

- Visually Identified Concrete Material (Above Ground)
- Made Ground - MG
- Tidal Flat Deposits - TFD
- Glaciofluvial Deposits - GFD
- Mercia Mudstone - MM
- Proposed Embankment
- Perched Groundwater (TFD)
- Groundwater (GFD and MM)
- Proposed Band Drain
- Water Strike
- Rest Water Level
- Gas Migration Pathway

Potential Receptors

- A Humans On-Site (M4 User)
- B Humans On-Site (Construction/Maintenance)
- C Humans Off-Site (Site Neighbours)
- Da Groundwater (Aquifer)
- Dp Groundwater (Perched)
- E Surface Water

Potential Pathways

- 1 Dermal Contact with Dust
- 2 Inhalation of Dust
- 3 Ingestion
- 4 Leaching / Migration
- 5 Surface Run Off

Potential Sources of Contamination

Possible contamination present on site associated with :

On-Site

- Potential for contamination to be present on site associated with shallow Made Ground and superficial concrete material
- Groundwater

NOTE
Drawing refined from PSSR Drawing Reference M4-OA-17-00DR-Z-XX-0160 (April 2014)

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Appendix 11.1 Annex D CL-10

Conceptual Site Model for CL-10

Figure: 2	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Not to Scale

dwg ref:JER6591_Figure2_CL10ConceptualSiteModel

dwg ref: JER6591_Figure2_CL10ConceptualSiteModel

Appendices

A1 Appendix 1

Exploratory Records

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Borehole No.
BHE3
Header

Contract No.	F10895	Method	Cable Percussion	Coordinates	330037.8 E
Project	M4 Relief Road Magor to Castleton Stage 2				183960.7 N
		Drilling Rig	Pilcon	Ground Level	6.40m AOD
Client	Welsh Office	Driller	A.M	Orientation	Vertical
		Logged by	C.D	Date Started	04/11/1997
Consultant	Ove Arup and Partners			Date Completed	05/11/1997

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
04/11/1997	1800	5.00	5.00	Dry	
05/11/1997	0800	5.00	5.00	Dry	
05/11/1997	1200	10.70	10.70	3.70	

DRILLING DETAILS

Hardbore from depth	Hardbore to depth	Chiselling hours	Remarks
8.75	9.00	0.50	
9.40	9.68	0.75	
9.80	10.15	0.50	
10.50	10.70	1.00	

CASING

Hole diameter	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
150	10.70	150	10.70

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
05/11/1997	0000	8.60	3.70	15.0	fast	0.00	0.00

GENERAL NOTES

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.90	S	N=10 (2,2,2,3,3,2)
4.00	S	N=3 (1,0,1,1,1,0)
7.50	S	N=1 (0,0,0,0,0,1)
8.10	S	N=10 (1,1,1,1,1,7)
9.00	C	94/225mm (6,11,18,26,50)
10.50	C	50/75mm (7,32,50)

* Seating blows only.

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

Form	CP HEADER
Version	2.00
Revised	25/06/1997

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Borehole No.
BHE3
Sheet 1 of 2

Contract No.	F10895	Method	Cable Percussion	Coordinates	330037.8 E
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon		183960.7 N
		Driller	A.M	Ground Level	6.40m AOD
Client	Welsh Office	Logged by	C.D	Orientation	Vertical
				Date Started	04/11/1997
Consultant	Ove Arup and Partners			Date Completed	05/11/1997

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
TOPSOIL		0.30	6.10	B	0.30 - 0.80				
Firm becoming soft to firm greyish brown slightly sandy CLAY with occaisonal thin laminations and rootlets. (Estuarine Alluvium)				D U	0.85 - 1.25 0.85	(13)			
				D	1.25				
---at 1.90m becoming mottled bluish grey				B D	1.90 - 2.80 1.90	S10	S	1.90	2.35
		2.80	3.60						
Very soft dark greyish brown CLAY. (Estuarine Alluvium)				D U	2.90 3.00 - 3.45	(8)			
				D	3.45				
---at 4.00m becoming slightly sandy				D	4.00	S3	S	4.00	4.45
		4.70	1.70						
Very soft to soft dark grey very silty CLAY with occasional gravel size pockets of very silty fine sandy CLAY. (Estuarine Alluvium)				D V	5.50 5.50				
				D	6.00				
				U	6.50 - 6.95	(4)			
				D	6.95				
				B D	7.50 - 8.05 7.50	S1	S	7.50	7.95
---from 8.05m slightly organic with occasional sub-rounded coarse gravel and cobbles of sandstone and mudstone				B D	8.10 - 8.60 8.10	S10	S	8.10	8.55
		8.60	-2.20	W	8.60				
Dense to very dense grey sub-rounded slightly clayey silty sandy GRAVEL and COBBLES. (Fluvial Alluvium)				B D	8.90 - 9.50 9.00	C94/225mm	C	9.00	9.38

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH CP LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Borehole No.
BHE3
Sheet 2 of 2

Contract No.	F10895	Method	Cable Percussion	Coordinates	330037.8 E
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon		183960.7 N
		Driller	A.M	Ground Level	6.40m AOD
Client	Welsh Office	Logged by	C.D	Orientation	Vertical
				Date Started	04/11/1997
Consultant	Ove Arup and Partners			Date Completed	05/11/1997

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
Dense to very dense grey sub-rounded slightly clayey silty sandy GRAVEL and COBBLES. (Fluvial Alluvium)		10.70	-4.30	B D	10.50 - 10.70 10.50	C50/75mm	C	10.50 10.73	
Cable Percussion boring complete at 10.70 m.									

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH CP LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHE3A
Header

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	330039.9 E 183956.5 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Dando	Ground Level	6.40m AOD
Client	Welsh Office	Drillers	A.M/H.J	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	06/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	16/11/1997
		Core bit	Geocube		

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
06/11/1997	1800	11.00	11.00	Dry	
10/11/1997	0800	11.00	11.00	3.50	
10/11/1997	1800	15.45	13.40	0.00	
15/11/1997	0800	15.45	15.40	2.20	
15/11/1997	1800	27.10	15.40	0.00	
16/11/1997	0800	27.10	15.40	0.00	
16/11/1997	1800	30.60	15.40	0.00	

CABLE PERCUSSION DETAILS

Hard strata from depth	Hard strata to depth	Hours	Remarks
8.10	8.28	0.75	
9.05	9.30	0.50	
10.80	11.00	1.00	
11.55	11.75	0.67	
11.93	12.20	1.00	
12.30	12.42	0.75	
15.00	15.30	1.00	

CASING

Hole diameter	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
150	15.45	150	13.40

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

ROTARY DRILLING DETAILS

From depth	To depth	Flush type	Flush return	Core diameter
15.45	30.60	air	100%	92

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
9.80	S	N=13 (2,3,3,3,4,3)
11.55	S	79/150mm*
13.50	S	N=32 (3,4,6,9,8,9)
15.30	S	78/150mm*

* Seating blows only.

GENERAL NOTES

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, hard strata time in hours

Form	COMBINED HEADER
Version	2.00
Revised	26/06/1997

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHE3A
Sheet 1 of 4

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	330039.9 E 183956.5 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Dando	Ground Level	6.40 m AOD
Client	Welsh Office	Drillers	A.M/H.J	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	06/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	16/11/1997
		Core Bit	Geocube		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
TOPSOIL		0.05	6.35				
Firm laminated CLAY (drillers description). (Estuarine Alluvium)		2.86	3.54				
Dark firm silty CLAY (drillers description). (Estuarine Alluvium)		4.60	1.80				
Soft grey CLAY (drillers description). (Estuarine Alluvium)		8.10	-1.70				
Dark coarse SAND and GRAVEL with large cobbles (drillers description). (Fluvial Alluvium)		9.70	-3.30	B 9.80 - 10.80 D 9.80 - 10.30		S13 9.80 10.25	

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHE3A
Sheet 2 of 4

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	330039.9 E 183956.5 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Dando	Ground Level	6.40 m AOD
Client	Welsh Office	Drillers	A.M/H.J	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	06/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	16/11/1997
		Core Bit	Geocube		

Description of Strata	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
Soft to firm dark grey CLAY with occasional sub-angular fine and medium gravel of sandstone and mudstone. (Fluival Alluvium)	10.80	-4.40				
Dense greyish brown sandy sub-angular to sub-rounded siliceous GRAVEL occasional cobbles. (Fluvial Alluvium)	13.20	-6.80	B 11.00 - 12.00 D 11.55		S79/150mm*11.55 11.70	
Reddish brown mottled greyish green thinly laminated highly to completely weathered MUDSTONE, very weak to weak. (Mercia Mudstone Group) ---from 15.00m weak to moderately weak	15.45	-9.05	D 13.50 D 15.30		S32 13.50 13.95 S78/150mm*15.30 15.45	
Reddish brown occasionally mottled greyish green medium to thickly sub-horizontally bedded thinly laminated highly to completely weathered MUDSTONE, very weak to weak with closely to medium spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group) ---from 15.45 to 16.15m completely fractured ---from 16.15 to 16.50m no recovery ---from 17.00 to 17.25m steep inclined fracture (70°) planar rough tight ---from 17.35 to 17.60m steep inclined fracture (70°) planar rough tight ---from 17.60 to 17.70m inclined fracture (55°) planar rough tight to open (soft weathered calcite infill) ---from 17.75 to 17.80m completely fractured			15.45 - 16.50 16.50 - 17.80 17.80 - 19.30	TCR / SCR / RQD / FI 67 / 62 / 0 / NI, NA 100 / 100 / 31 / NI, 7, NI 80 / 44 / 15 / 3, NI, 2, NA NI		

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHE3A
Sheet 3 of 4

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	330039.9 E 183956.5 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Dando	Ground Level	6.40 m AOD
Client	Welsh Office	Driller	A.M/H.J	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	06/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	16/11/1997
		Core bit	Geocube		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown occasionally mottled greyish green medium to thickly sub-horizontally bedded thinly laminated highly to completely weathered MUDSTONE, very weak to weak with closely to medium spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group)				~~19.30 - 20.80~~	~~100~~	~~80~~	~~35~~	6		
---from 21.30 to 22.00m completely fractured				20.80 - 22.40	100	56	28	7 NI 3		
---from 22.00m weak										
---from 22.80 to 23.00m sub-vertical fracture (70°) planar rough tight to open occasionally weathered calcite infill				22.40 - 24.00	100	91	33	7 NI 3		
---from 23.45 to 23.60m completely fractured										
---from 23.90m occasionally calcareous										
---from 24.00 to 24.60m completely fractured				24.00 - 25.50	100	90	20	NI 5		
---from 24.70 to 25.50m occasionally calcitic										
---from 25.50 to 26.46m completely fractured				25.50 - 27.10	100	38	19	NI 3 NI		
---from 26.00 to 26.10m occasionally calcitic										
---from 27.00 to 27.10m completely fractured				27.10 - 28.60	100	87	20	3 NI 7 7		
---at 27.05m occasionally calcareous										
---from 27.10 to 27.50m sub-vertical fracture irregular rough tight to open (calcite infill)										
---from 28.25 to 28.60m completely fractured										
---from 28.60 to 29.80m completely fractured				28.60 - 30.10	100	43	0	NI NI		
---from 29.35m occasionally calcareous										
		29.80	-23.40							

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	1.00
Revised	20/09/96

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHE3A
Sheet 4 of 4

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	330039.9 E 183956.5 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Dando	Ground Level	6.40 m AOD
Client	Welsh Office	Driller	A.M/H.J	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	06/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	16/11/1997
		Core bit	Geocube		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown mottled greyish green thinly to medium bedded slightly to moderately weathered slightly sandy MUDSTONE, moderately strong to strong completely fractured. (Mercia Mudstone Group)		30.60	-24.20							
Borehole complete at 30.60 m.										

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	1.00
Revised	20/09/96

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHE04 CP
Header

Contract No.	F15056	Method	Cable Percussion	Coordinates	330066.04 E
Project	New M4 - Second Preliminary Ground Investigation				183889.28 N
		Drilling Rig	Dando 2000	Ground Level	6.51m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	MS	Orientation	Vertical
		Logged by	DH	Date Started	14/11/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	19/11/2007

PROGRESS						BORING DETAILS			
Date	Time	Hole depth	Casing depth	Water depth	Remarks	Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks
14/11/2007	1730	8.05	7.50	7.60	End of Shift	9.90	10.30	1.00	Chiselling
15/11/2007	0730	8.05	7.50	2.20	Start of Shift	10.30	11.00	1.50	Chiselling
15/11/2007	1730	11.50	11.50	2.00	End of Shift	11.00	11.50	1.00	Chiselling
16/11/2007	0730	11.50	11.50	2.00	Start of Shift	11.50	12.00	1.33	Chiselling
16/11/2007	1730	14.70	14.10	2.00	End of Shift	13.00	13.50	1.00	Chiselling
						14.70	15.00	1.00	Chiseling

CASING				WATER STRIKES							
Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.	Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
200	14.70	200	14.70	14.11/2007		2.80	2.80	20	Seepage	2.50	NR

GENERAL NOTES

1. Service inspection pit hand excavated from GL to 1.20m.
2. Cable Percussive boring complete at 14.70m.
3. Borehole grouted upon completion.

SPT DETAILS

Depth	Type	Incremental blow count/penetration	Casing	Water Depth
1.80	S	N=4 (1,0,1,1,1,1)	0.00	DRY
3.45	S	N=0 (0,0,0,0,0,0)	3.60	3.40
5.60	S	N=0 (0,0,0,0,0,0)	5.60	5.40
7.60	S	N=30 (0,0,7,7,8,8)	7.50	7.40
9.00	S	N=4 (1,1,2,2,0,0)	9.00	2.00
11.00	S	N=36 (13,8,10,12,8,6)	11.00	2.00
13.15	S	N=4 (1,1,1,1,1,1)	13.10	2.00
14.55	S	50/150mm (12,13,25,25)	14.15	2.00
14.65	S	50/150mm (12,13,25,25)	14.15	2.00
15.00	S	50/160mm (9,12,18,25,7)	14.70	2.80

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes, chiselling time in hours.

Form	ARIAL CPHEADER
Version	3.05
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHE04 CP
Sheet 1 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	330066.04 E
Project	New M4 - Second Preliminary Ground Investigation				183889.28 N
		Drilling Rig	Dando 2000	Ground Level	6.51m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	MS	Orientation	Vertical
		Logged by	DH	Date Started	14/11/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	19/11/2007

Description of Strata	Depth Below G.L.	Datum Level	Sampling		SPT N & (Ublows)	SPT type & depth		Install-ation
Light brown TOPSOIL.	0.20	6.31						
Very soft grey silty slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone and mudstone. (Estuarine Alluvium)			D1	1.00				
			B2	1.00 - 1.20				
			U3	1.20 - 1.65				
Soft to firm silty CLAY with rare organic material. (Estuarine Alluvium)	1.80	4.71	D4	1.80 - 2.25	S4	S	1.80	
			B5	1.80 - 2.25			2.33	
			W18	2.20				
			D6	2.50 - 3.00				
			U7	3.00 - 3.45	(12)			
			D8	3.45 - 3.60	S0	S	3.45	
Very soft very low strength grey silty CLAY. (Estuarine Alluvium)	3.60	2.91	D9	3.60 - 4.05			4.05	
			D10	4.50 - 5.00				
			U11	5.00 - 5.45	(19)			
			D12	5.45 - 5.60				
Very soft grey silty slightly gravelly CLAY. Gravel is rounded fine to medium of mudstone and sandstone. (Organic odour) (Estuarine Alluvium)	5.60	0.91	D13	5.60 - 6.05	S0	S	5.60	
							6.20	
			D14	6.50 - 7.00				
			U15	7.00 - 7.45	(50)			
			D16	7.45 - 7.60				
Medium dense to dense grey clayey coarse SAND and subangular to rounded fine to coarse GRAVEL of sandstone, limestone, quartz and quartzite. With frequent coarse gravel sized pockets of silt. (Fluvial Alluvium)	7.60	-1.09	D17	7.60 - 8.05	S30	S	7.60	
							8.20	
	8.05	-1.54						
Dense grey sandy subangular to rounded fine to coarse GRAVEL of mudstone, siltstone and quartz with high cobble content, cobbles are subrounded of siltstone. (Fluvial Alluvium)			B19	8.50 - 9.00				
			D20	8.50 - 9.00				
	9.00	-2.49	D21	9.00 - 9.45	S4	S	9.00	
							9.45	
Soft grey locally dark grey sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse of mudstone, sandstone and quartz (Organic odour). (Fluvial Alluvium)			B22	9.45 - 9.90				
			D23	9.45 - 9.90				
	9.90	-3.39	B24	9.90 - 10.30				

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHE04 CP
Sheet 2 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	330066.04 E
Project	New M4 - Second Preliminary Ground Investigation				183889.28 N
		Drilling Rig	Dando 2000	Ground Level	6.51m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	MS	Orientation	Vertical
		Logged by	DH	Date Started	14/11/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	19/11/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (Ublows)	SPT type & depth		Install-ation
				D25	9.90 - 10.30				
9.00m - 9.90m : Remaining Detail : 9.45m - 9.45m : ---from 9.45m becomes slightly sandy with occasional organic material		10.30	-3.79	B26	10.30 - 11.00				
9.90m - 10.30m : Very dense subrounded medium to coarse slightly sandy GRAVEL and subangular to subrounded COBBLES with rare subangular boulders of siltstone. (Fluvial Alluvium)				D27	11.00 - 11.45	S36	S	11.00 11.45	
Dense light yellowish grey subangular to subrounded COBBLES of limestone and quartzite with occasional subrounded boulders of limestone and quartzite. (Fluvial Alluvium)		11.50	-4.99	B28	11.50 - 12.50				
Dense greyish brown slightly gravelly fine to coarse SAND with high cobble content and low boulder content. Gravel is subangular to rounded fine to coarse of limestone, sandstone, siltstone, quartz and quartzite. Cobbles and boulders are subangular of limestone. (Fluvial Alluvium)		12.80	-6.29	D29	12.80 - 13.00				
				UF	13.00 - 13.15	(100)			
				D30	13.00 - 13.50	S4	S	13.15 13.60	
Greyish brown gravelly fine to coarse SAND with high cobble content and occasional cobble sized fragments of reddish brown slightly sandy gravelly clay. Gravel is subangular to rounded fine to coarse of sandstone, limestone, siltstone, quartz and quartzite. Cobbles are subangular of limestone. (Fluvial Alluvium)		13.50	-6.99	B31	13.50 - 14.50				
				D32	14.00 - 14.50				
Reddish brown slightly clayey subangular to rounded fine to coarse GRAVEL and subangular to subrounded COBBLES with occasional coarse gravel sized pockets of reddish brown slightly sandy slightly gravelly clay. Gravel is of sandstone, siltstone, limestone and quartz. Cobbles are of limestone and sandstone. (Fluvial Alluvium) ---from 14.00m clayey		14.50	-7.99	UF	14.50 - 14.65	(100)	S	14.55	
				D33	14.50 - 14.65	S50/150mm	S	14.65 14.85	
		14.70	-8.19	D34	14.55 - 14.85	S50/150mm		14.95	
						S50/160mm	S	15.00 15.31	
Very stiff reddish brown locally speckled green slightly sandy gravelly CLAY. Gravel is angular fine to coarse (Weathered Mudstone). (Mercia Mudstone Group) ---from 14.65m locally mottled green									
Cable Percussion boring complete at 15.00 m.									

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - ROTARY

Hole ID.

SBHE04 RC

Header

Contract No.	F15056	Method	Rotary Coring	Coordinates	330065.43 E
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	Dando Tractor R4		183891.07 N
		Driller	SL	Ground Level	6.53m AOD
Client	Transport Wales, Welsh Assembly Government	Logged by	DH	Orientation	Vertical
		Core barrel	T6116	Date Started	25/11/2007
Consultant	Ove Arup & Partners Ltd	Core bit	TC	Date Completed	26/11/2007

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
25/11/2007	1730	20.50	14.50	3.40	End of Shift
26/11/2007	0730	20.50	14.50	2.70	Start of Shift
26/11/2007	1730	30.25	14.50	3.35	End ofHole

DRILLING DETAILS

From depth	To depth	Flush type	Flush return	Core diameter
0.00	14.50	Air/Mist	100%	0.00*
14.50	30.25	Air/Mist	100%	92.0

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
121	30.25	121	14.50

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
25/11/2007		10.30	NR	NR	Seepage	10.30	NR
25/11/2007		17.00	NR	NR	NR	14.50	NS

GENERAL NOTES

1. Rotary Openhole drilling from GL to 14.50m.
2. Rotary Coring complete at 30.25m.
3. 19mm piezometer installed, tip at 17.20m, response zone from 16.80m to 17.40m.
4. 0.00* indicates openhole drilling.

SPT DETAILS

Depth	Type	Incremental blow count/penetration	Casing	Water Depth
15.50	S	100/280mm (10,15,19,23,32,26)	14.50	NR
17.50	S	100/240mm (9,16,28,30,31,11)	14.50	NR

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes.

Form	ARIAL ROTARY HEADER
Version	3.06
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - ROTARY

Hole ID.
SBHE04 RC
Sheet 1 of 4

Contract No.	F15056	Method	Rotary Coring	Coordinates	330065.43 E
Project	New M4 - Second Preliminary Groun	Drilling Rig	Dando Tractor R4		183891.07 N
	Investigation	Driller	SL	Ground Level	6.53m AOD
Client	Transport Wales, Welsh Assembly Government	Logged by	DH	Orientation Date	Vertical
		Core barrel	T6116	Started Date	25/11/2007
Consultant	Ove Arup & Partners Ltd	Core bit	TC	Completed	26/11/2007

Description of Strata	Legend	Drilled Length	Datum Level	Coring and Sampling	TCR	SCR	RQD	IF	SPT N & depth	Install-ation
Soft blue silty CLAY. (Drillers description).										
		5.30	1.23							
Soft brown CLAY. (Drillers description).										
		8.30	-1.77							
SAND and GRAVEL. (Drillers description).										

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL ROTARY LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - ROTARY

Hole ID.
SBHE04 RC
Sheet 2 of 4

Contract No.	F15056	Method	Rotary Coring	Coordinates	330065.43 E
Project	New M4 - Second Preliminary Groun	Drilling Rig	Dando Tractor R4		183891.07 N
	Investigation	Driller	SL	Ground Level	6.53m AOD
Client	Transport Wales, Welsh Assembly Government	Logged by	DH	Orientation Date	Vertical
		Core barrel	T6116	Started Date	25/11/2007
Consultant	Ove Arup & Partners Ltd	Core bit	TC	Completed	26/11/2007

Description of Strata	Drilled Length	Datum Level
SAND and GRAVEL. (Drillers description).		
GRAVEL and COBBLES. (Drillers description).	10.30	-3.77
MARL. (Drillers description). (Mercia Mudstone Group)	13.30	-6.77
Extremely weak to very weak reddish brown mottled greenish grey MUDSTONE. Discontinuities 1) 0-10 deg closely to medium spaced undulating rough locally clay infilled. (Mercia Mudstone Group) ---from 14.50m to 14.75m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 14.75m to 14.99m recovered as non intact core (soft gravelly clay. Gravel sized fragments are angular fine to medium) ---14.99m to 15.50m Azssumed zone of core loss. ---from 15.50m to 16.66m recovered as non intact core (firm to stiff gravelly clay. Gravel sized fragments are angular fine to medium) ---from 16.66m to 16.92m 1 No discontinuity 70-85 deg undulating rough infilled with gypsum ---from 17.50m to 17.80m recovered as non intact core (soft to very soft gravelly clay. Gravel sized fragments are angular fine to medium) ---from 17.99m to 19.10m assumed zone of core loss ---from 19.60m to 19.98m recovered as non intact core	14.50	-7.97

Coring and Sampling		TCR	SCR	RQD	IF	SPT N & depth	Install-ation
14.50	15.50	49	0	0			
15.50	17.50	97	15	0	NI 20 60	15.50 15.93 S100/280mm	
17.50	20.50	63	24	17	NI 80 500	17.50 17.88 S100/240mm	

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL ROTARY LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - ROTARY

Hole ID.
SBHE04 RC
Sheet 3 of 4

Contract No.	F15056	Method	Rotary Coring	Coordinates	330065.43 E
Project	New M4 - Second Preliminary Groun	Drilling Rig	Dando Tractor R4		183891.07 N
	Investigation	Driller	SL	Ground Level	6.53m AOD
Client	Transport Wales, Welsh Assembly Government	Logged by	DH	Orientation Date	Vertical
		Core barrel	T6116	Started Date	25/11/2007
Consultant	Ove Arup & Partners Ltd	Core bit	TC	Completed	26/11/2007

Description of Strata	Legend	Drilled Length	Datum Level	Coring and Sampling		TCR	SCR	RQD	IF	SPT N & depth	Install-ation
Remaining Detail : 19.60m - 19.98m : (soft to firm gravelly clay. Gravel sized fragments are angular fine to medium) ---from 20.09m to 20.30m recovered as non intact core (clayey coarse sand sized fragments and angular fine to coarse gravel sized fragments) ---from 20.50m to 21.04m recovered as non intact core (clayey coarse sand sized fragments and angular fine to coarse gravel sized fragments)				20.50	22.45	78	50	50	NI 300 380		
---from 20.02m to 22.03m recovered as non intact core (clayey angular fine gravel sized fragments) ---from 22.03m to 22.45m Assumed zone of core loss ---from 22.45m to 22.72m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 22.89m to 22.91m 1 No discontinuity 0-10 deg undulating rough infilled with angular fine to medium gravel sized fragments ---from 23.20m to 23.62m recovered as non intact core (soft gravelly clay. Gravel sized fragments are angular fine to coarse)				22.45	24.45	100	50	43			
---from 24.33m to 24.39m 1 No discontinuity 40-60 deg undulating stepped infilled with gypsum ---from 24.39m to 24.45m recovered as non intact core (clayey angular fine to coarse gravel sized fragments) ---from 24.45m to 24.75m recovered as non intact core (very soft gravelly clay. Gravel sized fragments are angular to subangular fine to coarse)				24.45	26.40	99	76	37	NI 100 220		
---from 26.06m to 26.17m recovered as non intact core (firm gravelly clay. Gravel sized fragments are angular fine to medium) ---from 26.49m to 26.90m recovered as non intact core (clayey angular fine to coarse gravel sized fragments) ---from 26.99m to 27.07m recovered as non intact core (soft gravelly clay. Gravel sized fragments are angular fine) ---from 27.13m to 27.34m recovered as non intact core (soft slightly gravelly clay. Gravel sized fragments are angular fine to medium) ---from 27.40m to 27.48m 1 No discontinuity 40-50 deg undulating rough infilled with gypsum ---from 27.70m to 28.05m 2 No discontinuities 40-50 deg very closely spaced planar infilled with gypsum ---from 28.16m to 28.23m recovered as non intact core (clayey coarse sand sized fragments and angular fine to medium gravel sized fragments) ---from 28.30m to 28.67m recovered as non intact core (coarse sand sized fragments and angular fine to coarse gravel sized fragments) ---from 28.77m to 28.92m recovered as non intact core (coarse sand sized fragments and angular fine to medium				26.40	29.00	96	40	27	NI NI NI NI 30 250		
				29.00	30.25	100	18	8			

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL ROTARY LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - ROTARY

Hole ID.
SBHE04 RC
Sheet 4 of 4

Contract No.	F15056	Method	Rotary Coring	Coordinates	330065.43 E
Project	New M4 - Second Preliminary Groun	Drilling Rig	Dando Tractor R4		183891.07 N
	Investigation	Driller	SL	Ground Level	6.53m AOD
Client	Transport Wales, Welsh Assembly Government	Logged by	DH	Orientation Date	Vertical
		Core barrel	T6116	Started Date	25/11/2007
Consultant	Ove Arup & Partners Ltd	Core bit	TC	Completed	26/11/2007

Description of Strata	Legend	Drilled Length	Datum Level	Coring and Sampling	TCR	SCR	RQD	IF	SPT N & depth	Install-ation
Remaining Detail : 28.77m - 28.92m : gravel sized fragments)		30.25	-23.72							
Detail 29.00m - 30.00m : ---from 29.00m to 30.00m recovered as non intact core (coarse sand sized fragments and angular fine to coarse gravel sized fragments)										
---from 30.20m to 30.25m recovered as non intact core (angular coarse gravel sized fragments)										
Rotary drilling complete at 30.25 m.										

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL ROTARY LOG
Version	3.09
Revised	17/12/2007

Geotechnical Engineering Limited

BOREHOLE LOG

BH408

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	1 of 3
Start Date	20 January 2015	Easting	330035.9	Scale	1 : 50
End Date	22 January 2015	Northing	183947.5 Ground level 6.40mOD	Depth	23.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
20/01/15 1030hrs	1B	0.20 - 0.50						Grass over soft dark grey mottled light brown silty CLAY with rare rootlets. (TFD)			
	2D*	0.20 - 0.50		Vo 1.7							
	3B	0.50 - 0.70									
20/01/15 1100hrs	4D*	0.50 - 1.00		Vo 1.1							
	5B	0.70 - 1.00									
0.70m	6D*	1.00 - 1.20		Vo 0.9					1.00	5.40	
21/01/15 0930hrs 0.00m	7UT	1.00 - 1.45	Nil					Very soft light brownish grey silty CLAY with frequent rootlets. (TFD)			
	10X	1.00 - 2.00	Nil	S 4							
	9D	1.50 - 1.95									
	8D	1.45 - 1.50									
	11D*	1.30 - 1.50									
	UT	2.00 - 2.45	Nil								
	13X	2.00 - 3.00									
	12D	2.50 - 2.95	Nil	S<1							
	14D*	2.30 - 2.50									
									3.00	3.40	
	UT	3.00 - 3.45	Nil					Very soft bluish grey silty CLAY. (TFD)			
	16X	3.00 - 4.00									
	15D	3.50 - 3.95	Nil	S 1							
	17UT	4.00 - 4.45	4.00								
	20X	4.00 - 5.00									
	18D	4.45 - 4.50									
	19D	4.50 - 4.95	4.00	S<1							
	UT	5.00 - 5.45	5.00								
	23X	5.00 - 6.00									
	21D	5.45 - 5.50									
	22D	5.50 - 5.95	5.00	S<1							
	UT	6.00 - 6.45	5.00								
	25X	6.00 - 6.50									
	24D	6.50 - 6.95	5.00	S 7							
	26X	6.50 - 8.00									
									7.50	-1.10	
								Firm to stiff brownish grey slightly gravelly sandy silty CLAY. Gravel is subangular and subrounded fine and medium sandstone. (RTD)			
	27D	8.00 - 8.45	8.00	S 15					8.00		
								Continued Next Page	{8.00}	-1.60	

EQUIPMENT: Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.00m. Dynamic sampled (113mm) 1.00-10.00m. Waterflush rotary core drilled (116mm) 10.00-23.00m.

CASING: 140mm diam to 12.50m.

BACKFILL: On completion, borehole backfilled with bentonite pellets 23.00-12.00m. A slotted standpipe (50mm) was installed to 12.00m, granular response zone 12.00-8.00m and bentonite seal 8.00-5.00m. A second slotted standpipe (35mm) was installed to 5.00m, granular response zone 5.00-0.50m, bentonite seal 0.50-0.20m, concrete and stopcock cover 0.20-0.00m.

REMARKS: Dynamic sampling carried out to recover dropped core: 10.50-11.00m (recovered 0.50m) and 11.00-12.50m (recovered 0.60m). Downhole magnetometry for UXO risk mitigation undertaken 0.00-9.50m. No anomalies encountered. Permeability test undertaken at 5.00m- 6.00m.

MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
0.70	Nil	0.70	20	

AGS

CONTRACT	CHECKED
30238	EC

Geotechnical Engineering Ltd, Tel. 01452 527743 30238 YODA.GPJ TRIALJH.GPJ GEOTECH.GLB 16/07/2015 15:30:26 MC SF

Geotechnical Engineering Limited

BOREHOLE LOG

BH408

CLIENT	WELSH GOVERNMENT						
SITE	M4 CORRIDOR AROUND NEWPORT					Sheet	2 of 3
Start Date	20 January 2015	Easting	330035.9			Scale	1 : 50
End Date	22 January 2015	Northing	183947.5	Ground level	6.40mOD	Depth	23.00 m

progress date/time water depth
water strike (m) casing (m) rose to (m) time to rise (m)

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Geotechnical Engineering Limited

BOREHOLE LOG

BH408

CLIENT	WELSH GOVERNMENT					Sheet	3 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	20 January 2015	Easting	330035.9			Depth	23.00 m
End Date	22 January 2015	Northing	183947.5	Ground level	6.40mOD		

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	If	instru -ment	description	depth (m)	reduced level (m)	legend
	37C	18.50	20.00	12.50		100						
	38C	20.00	21.50	12.50		100						
	39C	21.50	23.00	12.50		100						
22/01/15 1730hrs												
									Borehole completed at 23.00m.	23.00	-16.60	
										{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
					30238	EC

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Geotechnical Engineering Limited

BOREHOLE LOG

BH409

CLIENT	WELSH GOVERNMENT					Sheet	1 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	19 January 2015	Easting	330110.6			Depth	23.00 m
End Date	22 January 2015	Northing	183984.5	Ground level	6.40mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
19/01/15 1600hrs								Grass over soft becoming very soft dark grey locally mottled light brown and black organic silty CLAY with rare plant fragments (up to 2mm). (TFD)			
	1B	0.50 - 0.70									
	2D*	0.50 - 0.70		Vo 0.3							
19/01/15 1645hrs Dry	3B	1.00 - 1.20									
	4D*	1.00 - 1.20		Vo 0.4							
20/01/15 0840hrs Dry	5UT	1.20 - 1.65									
	8X	1.20 - 2.20									
	6D	1.65 - 1.70									
	7D	1.70 - 2.15	Nil	S 1							
	9D*	2.00 - 2.20									
	10UT	2.20 - 2.65	2.20								
	13X	2.20 - 3.20									
	11D	2.65 - 2.70									
	12D	2.70 - 3.15	2.20	S<1							
	14D*	3.00 - 3.20									
	15UT	3.20 - 3.65	3.20								
	18X	3.20 - 4.20									
	16D	3.65 - 3.70									
	17D	3.70 - 4.15	3.20	S 1							
	19UT	4.20 - 4.65	4.20								
	22X	4.20 - 5.20									
	20D	4.65 - 4.70									
	21D	4.70 - 5.15	4.20	S 1							
	23UT	5.20 - 5.65	5.20								
	26X	5.20 - 6.70									
	24D	5.65 - 5.70									
	25D	5.70 - 6.15	5.20	S 1							
	27UT	6.70 - 7.15	6.70								
	30X	6.70 - 8.20									
	28D	7.15 - 7.20									
	29D	7.20 - 7.65	6.70	S 1					7.30	-0.90	
								Very soft dark grey organic clayey SILT. (TFD)			
20/01/15 1645hrs 2.36m									7.90	-1.50	
								Continued Next Page	{8.00}		

EQUIPMENT: Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Dynamic sampled (113mm) 1.20-11.20m and 12.20-12.50m. Waterflush rotary core drilled (116mm) 11.20-12.20m and 12.50-23.00m.

CASING: 140mm diam to 12.70m.

BACKFILL: On completion, hole backfilled with bentonite pellets 23.00-0.80m and granular fill 0.80-0.00m.

REMARKS: Downhole magnetometry for UXO risk mitigation undertaken 0.00-8.20m. No anomalies encountered. Falling head permeability test undertaken 2.20-3.20m.

MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks	CONTRACT	CHECKED
				Groundwater not encountered prior to use of water flush.	30238	EC

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Geotechnical Engineering Limited

BOREHOLE LOG

BH409

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	2 of 3
Start Date	19 January 2015	Easting	330110.6	Scale	1 : 50
End Date	22 January 2015	Northing	183984.5 Ground level 6.40mOD	Depth	23.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
		8.20 - 8.65	8.20	C 26				Medium dense dark brownish grey clayey sandy subangular and subrounded fine and medium sandstone GRAVEL with rare subrounded sandstone cobbles. (RTD)			
21/01/15 0820hrs 2.05m	31X	8.20 - 9.70						Medium dense becoming very dense dark brownish grey clayey sandy subangular and subrounded fine and medium sandstone GRAVEL with rare subrounded sandstone cobbles. (RTD)			
		9.70 - 10.06	9.70	C*71					9.70	-3.30	
	32X	9.70 - 11.00						9.70 - 12.35m: Becoming very dense. Very dense dark brownish grey clayey sandy subangular and subrounded fine and medium sandstone GRAVEL with rare subrounded sandstone cobbles. (RTD)			
		11.00 - 11.28	11.00	C*86							
	33X	11.00 - 11.20									
	34C	11.20 - 12.20			65	NA		11.20 - 12.20m: Limited recovery.			
	35X	12.20 - 12.50							12.35	-5.95	
		12.50 - 12.84	12.20	C*81				Stiff fissured reddish brown sandy gravelly CLAY. Gravel is subangular and subrounded fine and medium lithorelicts of mudstone and sandstone. (MMG) (Grade IVa)	12.45	-6.05	
	36C	12.50 - 14.00			100	NA					
		14.00 - 14.36	12.70	C*73				Very stiff fissured reddish brown gravelly to very gravelly CLAY with rare greenish grey reduction spots (up to 20mm). Gravel is subangular and subrounded fine and medium lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° very closely spaced and locally infilled with gypsum (up to 2mm). (MMG) (Grade III)			
	37C	14.00 - 15.50			100						
		15.50 - 15.79	12.70	C*107							
	38C	15.50 - 17.00			100						
	39C	17.00 - 18.50			100						
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks
				Groundwater not encountered prior to use of water flush.

AGS

CONTRACT	CHECKED
30238	EC

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Geotechnical Engineering Limited

BOREHOLE LOG

BH409

CLIENT	WELSH GOVERNMENT					Sheet	3 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	19 January 2015	Easting	330110.6			Depth	23.00 m
End Date	22 January 2015	Northing	183984.5	Ground level	6.40mOD		

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
21/01/15 1710hrs 0.11m												
22/01/15 0850hrs 1.11m	40C	18.50	20.00			100						
	41C	20.00	21.50			100						
	42C	21.50	23.00			100						
22/01/15 1125hrs												
									Borehole completed at 23.00m.	23.00	-16.60	
										{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks
				Groundwater not encountered prior to use of water flush.

AGS

CONTRACT	CHECKED
30238	EC

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A2 Appendix 2

Tabulated Gas and Groundwater Monitoring

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH408	09/03/15 12:00:00	1023	0								0.0	9		27 litres purged, base depth 5.00m.
BH408	09/03/15 12:01:00										0.0			
BH408	09/03/15 12:02:00										0.0			
BH408	09/03/15 12:03:00										0.0			
BH408	09/03/15 12:04:00										0.0			
BH408	09/03/15 12:05:00			0.0	0.0	20.1	0.0	0	0	2.7				
BH408	09/03/15 12:06:00			0.0	0.0	20.2	0.0	0	0	0.9				
BH408	09/03/15 12:07:00			0.0	0.0	20.1	0.0	0	0	0.5				
BH408	09/03/15 12:08:00			0.0	0.0	20.1	0.0	0	0	0.4				
BH408	09/03/15 12:09:00			0.0	0.0	20.1	0.0	0	0	0.3				
BH408	09/03/15 12:10:00			0.0	0.0	20.1	0.0	0	0	0.3				
BH408	09/03/15 12:11:00			0.0	0.0	20.1	0.0	0	0	0.2				
BH408	09/03/15 12:12:00			0.0	0.0	20.1	0.0	0	0	0.2				
BH408	09/03/15 12:13:00			0.0	0.0	20.1	0.0	0	0	0.1				
BH408	09/03/15 12:14:00			0.0	0.0	20.0	0.0	0	0	0.1			0.49	
BH408	16/03/15 12:00:00	1025	0								0.0	8		10 litres pured, base depth 5.00m. Only purged 10 litres as install was running dry and slow recharge.
BH408	16/03/15 12:01:00										0.0			

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH408	16/03/15 12:02:00										0.0			
BH408	16/03/15 12:03:00										0.0			
BH408	16/03/15 12:04:00										0.0			
BH408	16/03/15 12:05:00			0.0	0.0	20.0	0.0	0	0	0.3				
BH408	16/03/15 12:06:00			0.0	0.0	20.0	0.0	0	0	0.2				
BH408	16/03/15 12:07:00			0.0	0.0	20.0	0.0	0	0	0.1				
BH408	16/03/15 12:08:00			0.0	0.0	19.9	0.0	25	28	0.0				
BH408	16/03/15 12:09:00			0.0	0.0	19.9	0.0	0	0	0.0				
BH408	16/03/15 12:10:00			0.0	0.0	20.0	0.0	0	0	0.0				
BH408	16/03/15 12:11:00			0.0	0.0	20.0	0.0	0	0	0.0				
BH408	16/03/15 12:12:00			0.0	0.0	20.0	0.0	0	0	0.0				
BH408	16/03/15 12:13:00			0.0	0.0	19.9	0.0	0	0	0.0				
BH408	16/03/15 12:14:00			0.0	0.0	20.0	0.0	0	0	0.0			0.48	Slow recharge.
BH408	06/05/15 09:42:00	1009	0								0.0	14		
BH408	06/05/15 09:43:00										0.0			
BH408	06/05/15 09:44:00										0.0			
BH408	06/05/15 09:45:00										0.0			
BH408	06/05/15 09:46:00										0.0			

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT **30238**

CHECKED **EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH408	06/05/15 09:47:00			0.4	0.0	19.5	0.0	0	0	0.1				
BH408	06/05/15 09:48:00			0.4	0.0	19.5	0.0	0	0	0.1				
BH408	06/05/15 09:49:00			0.4	0.0	19.6	0.0	0	0	0.1				
BH408	06/05/15 09:50:00			0.3	0.0	19.6	0.0	0	0	0.1				
BH408	06/05/15 09:51:00			0.3	0.0	19.7	0.0	0	0	0.1				
BH408	06/05/15 09:52:00			0.3	0.0	19.8	0.0	0	0	0.1				
BH408	06/05/15 09:53:00			0.3	0.0	19.8	0.0	0	0	0.1				
BH408	06/05/15 09:54:00			0.3	0.0	19.8	0.0	0	0	0.0				
BH408	06/05/15 09:55:00			0.3	0.0	19.8	0.0	0	0	0.0				
BH408	06/05/15 09:56:00			0.2	0.0	19.8	0.0	0	0	0.0				
BH408	06/05/15 09:57:00												2.58	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH408	09/03/15 12:14:00												2.58	56 litres purged, base depth 12.00m.
BH408	16/03/15 12:14:00												2.79	55 litres purged, base depth 12.00m.
BH408	06/05/15 09:58:00												4.33	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Deep install.

CONTRACT **30238**

CHECKED **EC**

A3 Appendix 3

Tabulated Groundwater Laboratory Data

M4CAN
Groundwater Analysis Results & Screening Assessment
CL-10
08/07/2015

Screening Values & Assessment

EQS	Environmental Quality Standards
DWS	Drinking Water Standard
	Exceeds EQS
X	Exceeds DWS
X	Laboratory detection level higher than screening criterion
N/A	Not Available

Monitoring Round	Units	Screening Criteria		1	2		3		No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
Location				BH408	BH408	BH408	BH408	BH408							
Location Type				BH											
Depth				2.4	2.42	2.79	2.81	3.11							
Installation Details		EQS	DWS	N/A	N/A	N/A	N/A	N/A							
Date sampled				02/03/2015	09/03/2015		16/03/2015								
Metals															
Arsenic	ug/l	50	10	3.7	5.1	3.9	6.4	1.7	5	5	6.4	1.7	BH408 @ 2.81mbGL	0	0
Boron	ug/l	2000	1000	580	740	310	1100	870	5	5	1100	310	BH408 @ 2.81mbGL	0	1
Cadmium	ug/l	0.15	5	<0.08	<0.08	<0.08	<0.08	<0.08	5	0	None > LOD	None > LOD		0	0
Chromium	ug/l		50	<1	12	2.3	23	8.6	5	4	23	2.3	BH408 @ 2.81mbGL		0
Copper	ug/l	10	2000	<1	<1	<1	4.7	3.3	5	2	4.7	3.3	BH408 @ 2.81mbGL	0	0
Lead	ug/l	1.2	10	<1	<1	<1	<1	<1	5	0	None > LOD	None > LOD		0	0
Mercury	ug/l	0.07	1	0.56	<0.5	<0.5	<0.5	<0.5	5	1	0.56	0.56	BH408 @ 2.4mbGL	1	0
Nickel	ug/l	4	20	1.4	2.1	3.4	2.6	5.8	5	5	5.8	1.4	BH408 @ 3.11mbGL	1	0
Selenium	ug/l		10	6.3	4.5	2.1	6.7	4.5	5	5	6.7	2.1	BH408 @ 2.81mbGL		0
Zinc	ug/l	75		<1	<1	<1	1.5	0	5	2	1.5	0	BH408 @ 2.81mbGL	0	
Non-Metal Inorganics															
Total Alkalinity as CaCO3	mg/l				840	710			2	2	840	710	BH408 @ 2.42mbGL		
Chloride	mg/l	250	250		150	52			2	2	150	52	BH408 @ 2.42mbGL	0	0
Ammoniacal Nitrogen as N	mg/l	0.6			5.6	1.3			2	2	5.6	1.3	BH408 @ 2.42mbGL	2	
Total Cyanide	mg/l	0.001	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	0	None > LOD	None > LOD		0	0
Free Cyanide	mg/l			<0.05	<0.05	<0.05	<0.05	<0.05	5	0	None > LOD	None > LOD			
pH Value	pH units	6-9	6.5-10	8.4	8.6	8.1	8.6	8.4	5	5	8.6	8.1	BH408 @ 2.42 / BH408 @ 2.81mbGL	0	0
Phenols															
Phenol	ug/l	7.7							0	0	None > LOD	None > LOD		0	
Phenols	mg/l	0.0077			<0.03	<0.03			2	0	None > LOD	None > LOD		0	
BTEX															
Benzene	ug/l	10	1	<1	<1	<1			3	0	None > LOD	None > LOD		0	0
Toluene	ug/l	50		<1	<1	<1			3	0	None > LOD	None > LOD		0	
Ethyl benzene	ug/l	20		<1	<1	<1			3	0	None > LOD	None > LOD		0	
m & p Xylene	ug/l	30		<1	<1	<1			3	0	None > LOD	None > LOD		0	
o Xylene	ug/l	30		<1	<1	<1			3	0	None > LOD	None > LOD		0	
TPH															
Aliphatics C5-C6	ug/l			<0.1	<0.1	<0.1			3	0	None > LOD	None > LOD			
Aliphatics >C6-C8	ug/l			<0.1	<0.1	<0.1			3	0	None > LOD	None > LOD			
Aliphatics >C8-C10	ug/l			<0.1	<0.1	<0.1			3	0	None > LOD	None > LOD			
Aliphatics >C10-C12	ug/l			4.3	<0.1	<0.1			3	1	4.3	4.3	BH408 @ 2.4mbGL		
Aliphatics >C12-C16	ug/l			83	<0.1	<0.1			3	1	83	83	BH408 @ 2.4mbGL		
Aliphatics >C16-C21	ug/l			21	<0.1	<0.1			3	1	21	21	BH408 @ 2.4mbGL		
Aliphatics >C21-C35	ug/l			810	<0.1	<0.1			3	1	810	810	BH408 @ 2.4mbGL		
Aliphatics >C35-44	ug/l			31	<0.1	<0.1			3	1	31	31	BH408 @ 2.4mbGL		
Aromatics >C5-C7	ug/l			<0.1	<0.1	<0.1			3	0	None > LOD	None > LOD			
Aromatics >C7-C8	ug/l			<0.1	<0.1	<0.1			3	0	None > LOD	None > LOD			
Aromatics >EC8-EC10	ug/l			<0.1	<0.1	<0.1			3	0	None > LOD	None > LOD			
Aromatics >EC10-EC12	ug/l			4.2	<0.1	<0.1			3	1	4.2	4.2	BH408 @ 2.4mbGL		
Aromatics >EC12-EC16	ug/l			35	<0.1	<0.1			3	1	35	35	BH408 @ 2.4mbGL		
Aromatics >EC16-EC21	ug/l			16	<0.1	<0.1			3	1	16	16	BH408 @ 2.4mbGL		
Aromatics >EC21-EC35	ug/l			67	<0.1	<0.1			3	1	67	67	BH408 @ 2.4mbGL		
Aromatics >C35-44	ug/l			11	<0.1	<0.1			3	1	11	11	BH408 @ 2.4mbGL		
Total Aliphatic TPH	ug/l			950	<5	<5			3	1	950	950	BH408 @ 2.4mbGL		
Total Aromatic TPH	ug/l			130	<5	<5			3	1	130	130	BH408 @ 2.4mbGL		
Total petroleum hydrocarbons	ug/l			1100	<10	<10			3	1	1100	1100	BH408 @ 2.4mbGL		
PAH															
Acenaphthene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD			
Acenaphthylene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD			
Anthracene	ug/l	0.1		<0.1	<0.1	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD		0	
Benz(a)anthracene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD			
Benzo(a)pyrene	ug/l	0.00017	0.01	<0.1	<0.1	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD		0	0
Benzo(b)fluoranthene	ug/l	0.017	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD		0	0
Benzo(ghi)perylene	ug/l	0.0082	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD		0	0
Benzo(k)fluoranthene	ug/l	0.017	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD		0	0
Chrysene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD			
Dibenzo(ah)anthracene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD			
Fluoranthene	ug/l	0.0063		<0.1	<0.1	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD		0	
Fluorene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD			
Indeno(123cd)pyrene	ug/l	N/A	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD		0	0
Naphthalene	ug/l	2		<0.1	<0.1	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD		0	
Phenanthrene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD			
Pyrene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD			
PAH 16 Total	ug/l			<2	<2	<2	<2	<2	5	0	None > LOD	None > LOD			
PCBs															
Pcb-101 2,2',4,5,5' - Pentachlorobiphenyl	ug/l				<0.01	<0.01			2	0	None > LOD	None > LOD			
Pcb-118 2,3',4,4',5 - Pentachlorobiphenyl	ug/l				<0.01	<0.01			2	0	None > LOD	None > LOD			
Pcb-138 2,2',3,4,4',5' - Hexachlorobiphenyl	ug/l				<0.01	<0.01			2	0	None > LOD	None > LOD			
Pcb-153 2,2',4,4',5,5' - Hexachlorobiphenyl	ug/l				<0.01	<0.01			2	0	None > LOD	None > LOD			
Pcb-180 2,2',3,4,4',5,5' - Heptachlorobiphenyl	ug/l				<0.01	<0.01			2	0	None > LOD	None > LOD			
Pcb-28 2,4,4' - Trichlororbiphenyl	ug/l				<0.01	<0.01			2	0	None > LOD	None > LOD			
Pcb-52 2,2',5,5' - Tetrachlorobiphenyl	ug/l				<0.01	<0.01			2	0	None > LOD	None > LOD			

A4 Appendix 4

Tabulated Surface Water Data

M4CAN
Surface Water Sample Analysis &
Screening Assessment
CL-10
14/07/2015

Notes

EQS calcium carbonate 200-250mg/l for heavy metals: chromium, copper, lead, nickel and zinc
NDP - No determination possible

Screening Values and Assessment

EQS	Environmental Quality Standards
MRV	Minimum Reporting values
	Exceeds EQS
100	Exceeds DWS
<10	Laboratory detection level higher than screening criterion
BOL/ITA	Exceeds CCW

Monitoring Round / Location	Units	Screening Criteria			Q1 / 7.4	No. Analyses	No. Analyses Above LOD	No. Data Exceeding EQS	No. Data Exceeding DWS	No. Data Exceeding CCW
Date Sampled					**26/05/2015**					
		EQS	**DWS**	**CCW**						
Metals & Non-Metal Inorganics										
Hardness Total	mg/l					0	0			
Arsenic Dissolved	ug/l	50	10		3.04	1	1	0	0	
Calcium Dissolved	ug/l			300000	41.7	1	1			0
Cadmium Dissolved	ug/l	0.15	5	5	***<0.1***	1	0	0	0	0
Chromium Dissolved	ug/l		50		1.33	1	1		0	
Copper Dissolved	ug/l	10	2000		1.27	1	1	0	0	
Lead Dissolved	ug/l	1.2	10	250	0.306	1	1	0	0	0
Magnesium Dissolved	ug/l					0	0			
Nickel Dissolved	ug/l	4	20	100	2.03	1	1	0	0	0
Selenium Dissolved	ug/l		10		1.14	1	1		0	
Cadmium Total	ug/l	0.15	5	5		0	0	0	0	0
Zinc Total	ug/l	75		1000		0	0	0	0	0
BOD	mg/l	5		18	2.4	1	1	0		0
Nitrate as N	mg/l		50	1		0	0		0	0
Nitrate as NO3	mg/l		50	1	***<0.03***	1	0		0	0
Nitrite as N	mg/l		0.1521739	1		0	0		0	0
Nitrite as NO2	mg/l		0.5	1	***<0.05***	1	0		0	0
Nitrogen, Total Oxidised as N	mg/l		50	2		0	0		0	0
Phosphate, Ortho as P	mg/l			1		0	0			0
Phosphorus (tot.unfilt)	ug/l	120			1100	1	1	1		
Chloride	mg/l	250	250	300	58.3	1	1	0	0	0
Sulphate	mg/l	400	250	300	42.7	1	1	0	0	
Sulphate as SO4	mg/l	400	250	300		0	0	0	0	0
Sulphide	mg/l					0	0			
Ammoniacal Nitrogen as N	mg/l	0.6		1	***2.34***	1	1	1		1
Dissolved Oxygen (Saturation)	%	60				0	0	0		
Dissolved Oxygen	mg/l				2.27	1	1	0		
pH Value	pH units	6-9	6.5-10	6.8-8.5		0	0	0	0	0
Organics										
GRO (C5-C12)	ug/l				***<50***	1	0			
MTBE	ug/l				***<3***	1	0			
Benzene	ug/l	10	1		<7	1	0	0	0	
Toluene	ug/l	50			***<4***	1	0	0		
Ethyl benzene	ug/l	20			***<5***	1	0	0		
m & p Xylene	ug/l	30			***<8***	1	0	0		
o Xylene	ug/l	30			***<3***	1	0	0		
TPH										
Aliphatics C5-C6	ug/l				***<10***	1	0			
Aliphatics >C6-C8	ug/l				***<10***	1	0			
Aliphatics >C8-C10	ug/l				***<10***	1	0			
Aliphatics >C10-C12	ug/l				***<10***	1	0			
Aliphatics >C12-C16 Aqueous	ug/l				***<10***	1	0			
Aliphatics >C16-C21 Aqueous	ug/l				***<10***	1	0			
Aliphatics >C21-C35 Aqueous	ug/l				***<10***	1	0			
Total Aliphatics C12-C35 Aqueous	ug/l				***<10***	1	0			
Aromatics >C5-C7	ug/l				***<10***	1	0			
Aromatics >C7-C8	ug/l				***<10***	1	0			
Aromatics >EC8-EC10	ug/l				***<10***	1	0			
Aromatics >EC10-EC12	ug/l				***<10***	1	0			
Aromatics >EC12-EC16 Aqueous	ug/l				***<10***	1	0			
Aromatics >EC16-EC21 Aqueous	ug/l				***<10***	1	0			
Aromatics >EC21-EC35 Aqueous	ug/l				***<10***	1	0			
Total Aromatics C12-C35 Aqueous	ug/l				***<10***	1	0			
TPH >C6-C8	ug/l					0	0			
TPH >C8-C10	ug/l					0	0			
TPH >C10-C16	ug/l					0	0			
TPH >C16-C24	ug/l					0	0			
TPH >C24-C40	ug/l					0	0			
TPH >C6-C40	ug/l					0	0			
PAHs										
Acenaphthene	ug/l				***<0.015***	1	0			
Acenaphthylene	ug/l				***0.0176***	1	1			
Anthracene	ug/l	0.1			***<0.015***	1	0	0		
Benzo(a)anthracene	ug/l				***<0.017***	1	0			
Benzo(a)pyrene	ug/l	0.00017	0.01		<0.009	1	0	0	0	
Benzo(b)fluoranthene	ug/l	0.017	0.1		<0.023	1	0	0	0	
Benzo(k)fluoranthene	ug/l	0.017	0.1		<0.027	1	0	0	0	
Benzo(ghi)perylene	ug/l	0.0082	0.1		<0.016	1	0	0	0	
Indeno(1,2,3-cd)pyrene	ug/l		0.1		***<0.014***	1	0		0	
Chrysene	ug/l				***<0.013***	1	0			
Dibenzo(a,h)anthracene	ug/l				***<0.016***	1	0			
Fluoranthene	ug/l	0.0063			<0.017	1	0	0		
Fluorene	ug/l				***<0.014***	1	0			
Naphthalene	ug/l	2			***<0.1***	1	0	0		
Phenanthrene	ug/l				***<0.022***	1	0			
Pyrene	ug/l				***<0.015***	1	0			
Total PAHs (USEPA 16)	ug/l				***<0.344***	1	0			
VOCs										
Ethylbenzene	ug/l	20			***<5***	1	0	0		
m,p xylenes	ug/l	30			***<8***	1	0	0		
Methyl tert-butyl ether (MTBE)	ug/l				***<3***	1	0			
O-Xylene	ug/l	30			***<3***	1	0	0		
Toluene	ug/l	50			***<4***	1	0	0		

Parameter	Unit	No. Analyses	No. Analyses Above LOD	Minimum Concentration	Maximum Concentration
Copper	ug/l	5	3	0.909	6
Lead	ug/l	5	2	0.306	0.446
Nickel	ug/l	5	2	2.03	2.71
Cadmium	ug/l	3	2	0.5	0.5
Zinc	ug/l	3	3	23	260
BOD	mg/l	5	4	2	45
Sulphate	mg/l	5	5	7	42.7
Phosphorus	mg/l	2	2	932	1100
Chloride	mg/l	5	5	12	61.8
Ammoniacal Nitrogen	mg/l	5	5	0.06	2.48
pH	pH units	3	3	7.4	7.5
Dissolved Oxygen	%	3	3	5.1	48.1

Location & Round with Max. Concentration	EQS	No. Analyses Exceeding EQS
E1 / R5	10	0
Q1 / 7.2	1.2	0
Q1 / 7.2	4	0
E2 / R5	0.15	2
E4 / R5	75	1
E4 / R5	5	0
Q1 / 7.4	400	0
Q1 / 7.4	120	2
Q1 / 7.2	250	0
E4 / R5	0.6	2
E1 / R5	6-9	0
E2 / R5	60	3

A5 Appendix 5

Site Walkover Photographs

Plate 01: CL10 – View Looking South

Plate 02: CL10 – View Looking North

Client:	Welsh Government
Project:	M4CaN
Job Ref:	JER6591 Checked By: Date: May 2015

A6 Appendix 6

Relevant Extract of Additional Aerial Photography

Plate 01: Extract of 2014 High Resolution Aerial Photograph showing disturbed ground and storage of large concrete pipes of Site.

Client:	Welsh Government
Project:	M4CaN
Job Ref: JER6591 Checked By:	Date: Oct 2015

Welsh Government

M4 Corridor around Newport

Land Contamination Assessment Report Annex D
CL-13 Docks Way Landfill Site Land Contamination Assessment Report

M4CaN-DJV-EGT-ZG_GEN-RP_EN-0012

At Issue | March 2016

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Appendix 4 Tabulated Soil Leachate Data
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Appendix 6 Tabulated Surface Water Data
Appendix 7 Additional Gas Monitoring Data from Newport City Council
Appendix 8 Relevant Extract of Additional Environmental Data

1 Introduction

1.1 Background

1.1.1 This report relates to an area of land potentially affected by contamination (CL13) known as the 'Docks Way Landfill Site' herein referred to as the Site.

1.1.2 The Site is located between chainage 8,350 and 9,000 (see Figure 1), upon a part active, part restored landfill.

1.2 Reporting Context

1.2.1 The Site has been assessed as part of ground investigations and monitoring associated with the wider works for the M4 Corridor around Newport (M4CaN) (hereafter referred to as the 'Scheme'). This report informs the baseline for the environmental impact assessment (EIA) for the Scheme. The EIA is reported in the M4CaN Environmental Statement (ES) of which this document is an appendix to the chapter on Geology and Soils.

1.2.2 In 2014, a Preliminary Sources Study Report (PSSR) was prepared as an initial land contamination appraisal (Ove Arup & Partners, 2014) as part of Design Manual for Roads and Bridges (DMRB) Stage 2 Assessments for this Scheme. This identified a number of individual areas that may have been affected by contamination as a result of historical activities at the site. In addition, this report draws upon the 2015 Supplementary Ground Investigation Works undertaken on behalf of the Welsh Government (Geotechnical Engineering, 2015). This report relates to the area defined on the Site Plan shown in Figure 1.

1.2.3 The overarching rationale and approach for the assessment of areas of land along the Scheme with potential contamination is detailed in the Land Contamination Assessment Report (Appendix 11.1 of the ES).

1.3 Objectives

1.3.1 The key objectives of this report are as follows.

- Undertake a risk assessment of the site and determine whether potential risks to human health or controlled waters could exist based upon the Scheme.
- Identify the need for further assessment or investigation in order to refine potential land contamination risks and inform the need for remediation/mitigation.
- To provide information to support the Ground Investigation Report (GIR) and Geotechnical Design Report (GDR) required under DMRB HD22/08 (Highways Agency, 2008).

1.4 Report Structure

1.4.1 The remainder of this report is structured as follows.

- Section 2: Site Location and Description – This section summarises the Site's descrition.
- Section 3: The Scheme – This section details the new section of motorway alignment and associated features at the Site.
- Section 4: Site History – This section summarises the history of the Site based on historical maps and historical land photographs.
- Section 5: Environmental Setting – This section summarises the Site description, published geology, hydrology and hydrogeology and any relevant environmental information presented in the 2014 PSSR.
- Section 6: Scope of Investigation Works – This section describes the previous and supplementary investigations undertaken at the Site.
- Section 7: Ground Conditions– This section describes the main findings of the intrusive site investigation including the ground conditions encountered and any significant visual or olfactory evidence of contamination identified.
- Section 8: Contamination Assessment – This section describes the findings of the Tier 1 and Tier 2 contamination risk assessment based upon potential contamination sources, potential receptors and potential contaminant linkages and presents the human health and controlled waters assessments.
- Section 9: Refined Conceptual Site Model – This section presents the Conceptual Site Model (CSM) for the Site and identifies potential contaminant linkages, based upon the findings of the data presented within Sections 2 to 7.
- Section 10: Conclusions and Recommendations - This section provides conclusions concerning the likelihood of land contamination associated with the Site affecting the Scheme and requirements for remediation/mitigation.
- Section 11: References – This section details the key reference documents referred to within the text.
- Section 12: Glossary – This section details the key terms and acronyms used throughout the report.

2 Site Location and Desciption

2.1.1 The Docks Way Landfill Site (CL-13) is a partially closed, partially active Newport City Council operated landfill facility. It is located 3 km south of the city centre of Newport, Monmouthshire, and is centred on National Grid Reference ST 305 853. It covers an area of approximately 55 hectares. It is bounded by the River Ebbw to the west and south west and the Newport Docks to the east and south east. The Southern Distributor Road (SDR, A4042) marks the northern extent of the Site.

2.1.2 The Site is operated by Newport City Council and is split into two parts, Area 1 to the north and Area 2 to the south. A cut-off wall was constructed in 2006 to separate Area 1 from the newly constructed Area 2. Each area is described below.

Area 1

2.1.3 Area 1 is an unlined dilute and disperse landfill approximately 26.5 hectares and was landfilled from 1987 under a waste management licence (EAWML30058). However, pre-licence waste disposal was taking place in this part of the Site since 1939. It stopped receiving waste in 2005 and is now fully restored including engineered capping over the entire waste mass. There is no engineered peripheral and base system. The final domed landform has been restored to approximately 40 m above ordnance datum (AOD).

2.1.4 The waste management licence authorised the acceptance of inert, household, commercial and industrial waste for the landfill as well as bonded asbestos containing materials (chrysotile cement sheet) and special waste. It has been reported that historically, the landfilling took place over a wider area outside the current disposal facility boundaries and in particular further to the north (current location of the SDR) and to the east. Along the western site boundary the land was raised using demolition type materials as part of a flood defence system for the Site.

2.1.5 The base of the landfill is reported to be at 5 to 8 m AOD (Peter Brett Associates, 2011) indicating a total waste mass thickness of up to 35 m.

Area 2

2.1.6 Area 2 is an engineered containment landfill and has been receiving waste since 2007 under the Pollution Prevention Control Permit (Number DP3733BK, Variation Notice Number MP3730MJ).

2.1.7 It was proposed that waste would be deposited within five independent cells until the Stage 1 disposal landform was achieved. This would then be followed by Stage 2 disposal within the same cells to reach the final landform across Area 2.

2.1.8 Area 2 has been split into the following cells.

- Cell 1: Stage 1 of disposal has been completed and the cell has been temporarily restored with a polyethylene membrane and landfill gas collection system. Waste was received between 2007 and 2010.
- Cell 2: Currently active, waste disposal commenced in 2010.

- Cell 3 to Cell 5: No waste disposal has taken place as it is understood the final engineering relating to these areas could be amended.

2.1.9 The base of the landfill within Cells 3, 4 and 5 is reported to be at 1 to 5 m AOD (Peter Brett Associates, 2014)

2.1.10 Some landfilling activities took place prior to the construction of the landfill, in the 1970s to 1990s, particularly in the north-western part of Area 2, where previous investigations encountered up to 6.5 m of Made Ground including refuse type materials.

2.1.11 A site walkover survey undertaken in January 2014 indicated that within Area 1 the landform has been achieved as noted above and the area is covered in vegetation and localised standing water. Area 2, Cell 1, comprised a mound of waste materials temporarily restored with a polyethylene membrane and a network of gas extraction pipes. Cell 2 was being actively filled at the time of the visit, with the waste level approximately 1 to 2 m lower than Cell 1. Areas between Cells 1 and 2 and Area 1 were covered with an abundance of vegetation.

2.1.12 As discussed in more detail in the Section 3 of this report, the proposed motorway alignment crosses the southern tip of Area 2. This includes part of the peripheral access road which runs around the cells and an area of informal hardstanding.

2.1.13 The Site is bounded to the west by the River Ebbw and to the south and east by Newport Docks (CL-14). The southern section of the docks includes an in-filled historical River Ebbw channel. Details related to Newport Docks can be found in the Land Contamination Assessment Report CL-14 (Annex D of Appendix 11.1 of the ES).

2.1.14 The Site layout is shown in Figure 1.

3 The Scheme

3.1.1 The Site is situated at approximate chainage 8,350 to 9,000 shown on Figure 1.

3.1.2 The route of the new section of motorway would be constructed on a viaduct south of the Site across much of the docks area which would be supported by piers founded on piles. The new section of motorway would also include a section of piled embankment (2 to 5 m high) to support the Southern Distributor Road link road along the eastern boundary of the Site.

3.1.3 The only area where the alignment impinges upon the landfill permit boundary is the southern tip of Area 2 where piers of the viaduct are proposed. This is outside the engineered waste disposal cells, thus no permitted landfilling has taken place in that area.

3.1.4 The land take associated with the new section of motorway does not include other parts of the Site.

4 Site History

4.1 Site History

4.1.1 The 2014 PSSR historical searches were based on Ordnance Survey plans, literature reviews, Natural Resources Wales (NRW) (formerly Environment Agency Wales), Newport City Council and aerial photographic interpretation.

4.1.2 This is supplemented from the review of historical maps obtained in 2015 from Welsh Government. Relevant extracts are presented in Appendix 8.

4.1.3 A summary of the Site's history is presented in Table 1 below.

Table 1: Site History

Date	Land Use	Source of information
1843 - 1893	The Site comprises the meandering channel of the River Ebbw and its floodplain. To the west, south and north lay agricultural fields. To the east lies Alexandra Docks and associated infrastructure including the railway. A feeder channel to the docks runs east-west approximately 10 m from the northern boundary.	1:10,560 Historical Mapping
1891 - 1912	No significant change	1:10,560 Historical Mapping
1904 - 1939	The railway lines associated with Alexandra Docks have expanded and now run along the Site's south-eastern boundary. Allotments are present 100 m north. The Great Western Railway runs north-south approximately 200 m to the west. Residential development is present 150 m to the north-west.	1:10.560 Historical Mapping
1964 – 1965	No significant change	1:10,560 Historical Mapping
1969	The channel of the **River Ebbw has been straightened** in Area 1 and now runs through the south of the Site and then along its western boundary. The previous route of the channel is visible and appears to still contain some water.	Aerial Photography
1970 - 1973	The channel of the River Ebbw has straightened and now runs through the south of the Site and then along its western boundary. Maes-glas Pill runs north-south along the Site's eastern boundary. The Timber Float to the east has been infilled and the railway lines rerouted/dismantled.	1:10.000 Historical Mapping
1971	The northern area of Area 1 appears to be bare ground with a number of **earthworks and tracks**. The majority of the previous River Ebbw channel appears infilled.	Aerial Photography

Date	Land Use	Source of information
1979	The north of the area of bare ground/earthworks has extended to the south. The entirety of the previous **River Ebbw channel has been infilled** within Area 1.	Aerial Photography
1981 - 1989	The A48 has been constructed to the north of the site.	1:10,000 Historical Mapping
1985 - 1996	A number of small buildings have been built in the north western corner of the site and the northern area is roughly vegetated with a track looping from the buildings to the eastern boundary. The River Ebbw meanders are still present in Area 2 of the site.	1:10,000 Historical Mapping
1991	The **channel of the River Ebbw has been straightened** in Area 2 and now runs along the western boundary. The previous route of the channel is visible on the Site and contains water. **Landfill activity** has extended to the south to cover the entirety of Area 1. A small pond is identified in the north-western area of Area 1.	Aerial Photography
1998	The majority of Area 1 appears to be sparsely vegetated however earthworks are continuing in the centre of Area 1.	Aerial Photography
2006	**Landfilling** activities are occurring across the whole Site. A number of buildings/machinery are present along the western boundary. A pond is located in the north-east. The northern part of Area 1 appears partly vegetated and partly bare ground. The south of Area 2 comprises the cut-off meander from the River Ebbw in the eastern part and three large **settlement ponds/lagoons/landfill cells** in the western part. Maes-glas Industrial Estate has been developed approximately 100 m to the north.	Aerial Photography
2009 - 2010	The north of Area 1 is now fully vegetated and has a track running north-south through the centre. The south of the site now has three **settlement lagoons/ponds/landfill cells in the southern tip and the western corner is being actively landfilled**. Earthworks and ponds from the River Ebbw meander remain in the eastern area of Area 2.	Aerial Photography
2014	Vegetation in Area 1 has matured. The **southern and eastern part of Area 2 is being actively landfilled**. The western corner of Area 2 has been covered in polythene lining, though still below ground level and vegetation has been left to grow around the cells.	Aerial Photography

Note: Potential contamination sources are underlined in the table above. Those within the temporary and permanent land take are shown in **bold**.

4.1.4 The sources of information presented above supplement those used in the 2014 PSSR. Relevant extracts of photographs are presented in Appendix 8.

4.1.5 Historically the Site is known to have been bombed during World War II which is described in detail within the 2014 PSSR (Ove, Arup and Partners, 2014) and the Explosive Ordnance Threat Assessment Report (Bactec, 2014). There is thus a risk from unexploded ordnance at the Site which is categorised as a medium-high risk site.

5 Environmental Setting

5.1 Geology

5.1.1 British Geological Survey (BGS) data indicates that the Site is underlain by Tidal Flat Deposits and Glaciofluvial Deposits predominantly overlying bedrock of the Mercia Mudstone Group. In the north-west corner of the Site a strip of Penarth Group (mudstone) and the Blue Lias Formation consisting of interbedded limestone and mudstones underlies the Tidal Flat Deposits.

5.1.2 Made Ground deposits associated with the landfilling and land reclamation are present across the Site.

5.2 Hydrology

5.2.1 The main hydrological feature of the Site is the River Ebbw which defines the western Site boundary. It is considered as a water course of high sensitivity (Appendix 16.2 of the ES). In addition, there are a number of small surface water features within the Site boundary as detailed below.

- A small pond (North Pond) in the north-western part of Area 1.
- A pond (Oxbow Pond, part of the abandoned meander of the River Ebbw formed by construction of the earth dams) in the north-eastern part of Area 2.
- Two other ponds, remains of the former meander of the River Ebbw, to be dewatered as part of the landfill extension works in Area 2.
- Maes Glas Pill stream has been culverted into a 1.8 m diameter pipeline crossing beneath the northern part of Area 1. Historically, it ran along the eastern and southern edges of Area 1 before discharging into the River Ebbw. The abandoned culvert has been sealed and potentially removed.

5.2.2 The surface run-off of the landfill is captured by the Surface Water Management System which discharges directly into the River Ebbw via a single discharge point. It comprises a drainage ditch running along the perimeter of the capped waste area in Area 1 including the drainage system incorporated into the cut-off wall structure and capped Cell 1 of Area 2.

5.2.3 In addition, a storm drainage collecting run-off from the docks area runs along the eastern boundary of Area 2 prior to discharging the River Ebbw.

5.3 Hydrogeology

5.3.1 NRW classifies the Mercia Mudstone Group as a Secondary B Aquifer. The Tidal Flat Deposits are classified as unproductive (negligibly permeable) strata.

5.3.2 The Site does not lie within a groundwater Source Protection Zone (SPZ), however parts of the south and central parts of the Site lie within a groundwater vulnerability zone, classified as a minor aquifer with high leaching potential.

5.3.3 The hydrogeological conceptual site model derived for the Site (Peter Brett Associates, 2004 and 2005) identified the following water bodies within the area of the Site.

Area 1

5.3.4 Discontinuous water within the waste mass perched over the alluvial deposits with monitored levels at some 5 to 9 m AOD, some 1 to 2 m above the base of deposited waste. In addition, leachate monitoring indicates a discontinuous perched leachate body within the waste with measured levels up to 30 m AOD. No evidence of tidal influence on perched waters has been identified.

5.3.5 Groundwater contained within the Glaciofluvial Deposits is likely to be in hydraulic continuity with the River Ebbw. The typical monitored levels were found to be at 2 to 3 m AOD, some 2 to 5 m above the top of the strata suggesting that the water is confined by the alluvial clays. Monitoring also identified tidal influence in proximity to the River Ebbw, at events of high tide levels appear to affect the hydraulic gradient and alter flow direction. Groundwater monitoring also indicate the general groundwater flow to be in a south-eastern direction towards the Usk Estuary.

Area 2

5.3.6 Groundwater contained within the Glaciofluvial Deposits is as detailed above. Groundwater was generally encountered at lower elevation beneath Area 2, at between 1 and 2.7 m AOD, which is in line with the expected groundwater flow direction from north to south.

5.4 Environmental Information

5.4.1 NRW reports the following information within the study area.

- One significant impact pollutant incident in relation to an accidental spillage into the River Ebbw on the western Site boundary has been recorded and three minor impact pollutant incidents have been recorded within the Site boundary.
- Two minor impact pollutant incidents and one no impact pollutant incident has also been recorded within 300 m of the Site boundary.
- There are two discharge consents within the north-east, one within the west and two within the south-east of the Site.
- Within 300 m of the Site, six discharge consents have been recorded, three north of the Site, one east, one west and one southwest in the River Ebbw.
- No abstraction licences are recorded within the Site boundary.
- Two historic landfill sites and one authorised landfill site have been recorded within the Site boundary as detailed in Tables 2 and 3 below.

Table 2: Authorised landfills within Site boundary

Landfill name	Location	Material type	Date waste first and last received
Docks Way Landfill	South of the Site	Household, commercial and industrial waste	Unknown

Table 3: Historic landfills within Site boundary

Landfill name	Location	Material type	Date waste first and last received
Docks Way Phase 1	North of the Site	Inert, industrial, commercial, household	Dec 1980 – unknown
Maesglas Tip	North of the Site	Commercial, liquid sludge	April 1967 – unknown

- Three historic are recorded within 300 m of the Site to the west as detailed in Table 4.

Table 4: Historic landfills within 300 m of Site

Landfill name	Location	Material type	Date waste first and last received
Old Coal Sidings	South of the Site	Inert and industrial waste	Dec 1970 – Dec 1983
South Dock	South of the Site	Inert and industrial waste	Jan 1976 – Dec 1990
Docks Way Phase 1	West of the Site	Inert, industrial, commercial, household	Dec 1958 - 1980

5.4.2 Residual levels of potential contamination associated with the minor historical pollution incidents are unlikely to be present. However, the active and historical landfills are considered to represent potentially significant contamination sources.

6 Scope of Investigations

6.1 Objectives

6.1.1 Numerous phases of intrusive ground investigation associated with the new section of motorway alignment have been undertaken within the Docks Way Landfill Site. A number of other investigations specific to the landfill (such as installation of monitoring wells to support permit requirements) have been undertaken and where information is relevant and available (to include both borehole records and location) these have been used to inform understanding of the ground conditions at the site.

6.2 Scope of Works

6.2.1 The various intrusive ground investigations undertaken within the Site area are summarised in Table 5.

Table 5: Site Investigation Summary – Onsite

Date	Contractor	Site Location	Boreholes	Trial Pits	Sampling
1994	Structural Soils	South-east (Area 2)	SS94/04 SS94/07 SS94/08	-	None
1996	Exploration Associates	South-east (Area 2)	EA3 EA5 EA7	-	None
1997	Norwest Holst	South-west (Area 2)	BHF2	-	Soil
2000	Exploration Associates	South-west (Area 2)	CH9	-	Soil, leachate
2002	Exploration Associates	North-west (Area 1)	-	TP44	Soil
2003	CJ Associates	North-east & Area 2 Area 1 and Area 2 Peripheral Monitoring Boreholes	GP03_03A GP03_06 GP03_13 GW03	-	Gas
			GW03_02 GW03_05 GW03_09		Groundwater
2004	G.W Drilling	Area 1 Peripheral Monitoring Boreholes	NCC1 NCC2 NCC3 NCC5 (Re-drilled as WS07_07) NCC6 (Re-drilled as WS07_08)	-	Gas
2005	Unknown	Area 2	GP05_14	-	Gas

Date	Contractor	Site Location	Boreholes	Trial Pits	Sampling
		Peripheral Monitoring Boreholes	GP05_15 GP05_16 GP05_17 GP05_18 GP05_20 GP05_21 GP05_22		
2006	Unknown	Area 2 Peripheral Monitoring Boreholes	GP06_08A GP06_24 GP06_25	-	Gas
			GW06_13 GW06_14a GW06_34 GW06_37 GW06_39		Groundwater
2007	Unknown	Area 1 and Area 2 Peripheral Monitoring Boreholes	GP07_05	-	Gas
			GW07_07 GW07_40		Groundwater
2008	Norwest Holst	South-west (Area 2)	SBHF02ACP & SBHF02RC	-	None
2009	CJ Associates	Area 1 and Area 2 Peripheral Monitoring Boreholes	GP09_09	-	Gas
			GW09_31, GW09_32 GW09_35 GW09_36		Groundwater
2011	Peter Brett Associates	Area 2 south-east	PBA2/101 PBA2/102 PBA2/103 PBA2/104 PBA2/105 PBA2/106 PBA2/107 PBA2/108 PBA2/109 PBA2/110 PBA2/111 PBA2/112	-	None
2012	CJ Associates	Area 1 and Area 2 Peripheral Monitoring Boreholes	GP12_23 GP12_26 GP12_27	-	Gas
			GW12_30 GW12_33 GW12_38		Groundwater

Date	Contractor	Site Location	Boreholes	Trial Pits	Sampling
2012	Unknown	Area 1 Monitoring Boreholes	LF11_01 LF11_02 LF11_03 LF11_04 LF11_05 LF11_06 LF11_07	-	Leachate
Unknown	Unknown	Area 1 and Area 2 Monitoring Boreholes	GP07_05 LF03_01 LF03_03 LF03_04 LF08_07 C1 - Well A C1 - Well B C1 - Well E C1 - Well D C2 - SubCell A C2 - SubCell B C2 - SubCell C	-	Leachate

6.2.2 The well construction details of all boreholes installed on the Site (for which borehole logs are available) are summarised in Table 6.

Table 6: Summary of Borehole Construction Details – Onsite

Borehole ID	Diameter (mm)	Total Drilled Depth (m)	Top of Slotted Well Casing / Gravel Pack (m bGL)	Base of Slotted Well Casing / Gravel Pack (m bGL)	Targeted Geology
BHF2	19	40.3	15.5	17.5	Glaciofluvial Deposits
SBHF02ACP	19	17.75	16.7	17.3	Glaciofluvial Deposits
SS94/04	unknown	16	11.5	12.0	Glaciofluvial Deposits
SS94/07	unknown	10.6	10.3	10.6	Glaciofluvial Deposits
SS94/08	unknown	13.5	11.6	12.0	Glaciofluvial Deposits
EA7	50	16.7	0.5	2.0	Made Ground
	19		13.5	14.0	Glaciofluvial Deposits
EA3	19	18	8.7	14.0	Glaciofluvial Deposits
EA5	19	20	15.5	16.5	Glaciofluvial Deposits
Peripheral Gas Monitoring Boreholes – Area 1					
GP03_01	unknown	9.5	1.3	9.0	Made Ground (waste)
GP03_02	unknown	6.0	0.9	6.0	Made Ground (waste)

Borehole ID	Diameter (mm)	Total Drilled Depth (m)	Top of Slotted Well Casing / Gravel Pack (m bGL)	Base of Slotted Well Casing / Gravel Pack (m bGL)	Targeted Geology
GP03_03A	unknown	14.5	1.4	13.1	Made Ground (fill) / TFD
GP03_13	unknown	15.5	0.9	14.6	Made Ground (waste) / TFD
GP09_09	50	6.5	1.3	4.3	Made Ground (waste)
GP12_26	unknown	9.2	0.8	8.0	Made Ground (fill)
GP12_27	unknown	6.5	0.8	5.2	Made Ground (fill & waste)
NCC1	unknown	6.0	0.9	4.0	Made Ground (ash)
NCC2	unknown	7.0	0.9	5.0	Made Ground (fill & waste)
NCC3	unknown	5.0	0.9	4.0	Made Ground (fill & waste)
NCC5 (Re-drilled as WS07_07)	unknown	6.0 (5.0)	0.9 (1.0)	4.5 (4.7)	Made Ground (fill & waste)
WS07_08 (NCC6 re-drill)	unknown	4.0	1.0	4.0	Made Ground (fill & waste)
Peripheral Gas Monitoring Boreholes – Area 2					
GP03_06	unknown	9.0	1.5	8.0	Made Ground (fill) / TFD
GP05_14	50	6.0	1.0	6.0	Made Ground (fill) / clay (TFD?)
GP05_15	50	6.0	1.0	6.0	Made Ground (fill, ash, slag) / clay (TFD?)
GP05_16	50	6.0	1.0	6.0	Made Ground (fill/colliery spoil) / clay (TFD?)
GP05_17	50	6.0	1.0	6.0	Made Ground (fill) / clay (TFD?)
GP05_20	50	6.0	1.0	6.0	Made Ground (fill) / clay (TFD?)
GP05_21	50	6.0	0.5	6.0	Made Ground (fill) / clay (TFD?)
GP05_22	50	6.0	1.0	6.0	Clay (TFD?)
GP12_23	unknown	5.7	0.8	5.7	Made Ground (fill)
Peripheral Groundwater Monitoring Boreholes – Area 2					
GW09_31	50	13.0	11.0	13.0	Glaciofluvial Deposits
GW12_30	unknown	13.0	9.7	13.0	Glaciofluvial Deposits

Borehole ID	Diameter (mm)	Total Drilled Depth (m)	Top of Slotted Well Casing / Gravel Pack (m bGL)	Base of Slotted Well Casing / Gravel Pack (m bGL)	Targeted Geology
GW12_33	unknown	17.1	13.2	17.1	Glaciofluvial Deposits
GW12_38	unknown	12.0	8.9	12.0	Glaciofluvial Deposits

6.2.3 In addition to the monitoring details above, analytical and/or gas data have been made available for boreholes with unknown installation details. These are listed in the Table 7 below.

Table 7: Summary of Boreholes with Unknown Construction Details

Borehole ID	Diameter if Known (mm)	Total Drilled Depth if Known (m)	Borehole Information
Peripheral Gas Monitoring Boreholes – Area 1			
GP07_05			No Logs available
NCC6			No Logs available
Peripheral Gas Monitoring Boreholes – Area 2			
GP06_08A			No Logs available
GP06_24			No Logs available
GP06_25			No Logs available
GP09_18			No Logs available
Peripheral Groundwater Monitoring Boreholes –Area 1			
GW03_02			No Logs available. Understood to have been installed within Glaciofluvial Deposits
GW03_05			No Logs available. Understood to have been installed within Glaciofluvial Deposits
GW07_07			No Logs available. Understood to have been installed within Glaciofluvial Deposits
Peripheral Groundwater Monitoring Boreholes – Area 2			
GW03_09		20.2	Log identifies Made Ground comprising brick, concrete & ash. Installation details not known. Understood to have been installed within Glaciofluvial Deposits.
GW06_13			No Logs available. Understood to have been installed within Glaciofluvial Deposits
GW06_14a			No Logs available. Understood to have been installed within Glaciofluvial Deposits
GW06_34			No Logs available. Understood to have been installed within Glaciofluvial Deposits
GW06_37			No Logs available. Understood to have been installed within Glaciofluvial Deposits
GW06_39			No Logs available. Understood to have been installed within Glaciofluvial Deposits
GW07_40			No Logs available. Understood to have been installed within Glaciofluvial Deposits
GW09_32	50	18.8	Log identifies Made Ground comprising brick & rubble. Installation details not known. Understood to have been installed within Glaciofluvial Deposits.
GW09_35			No Logs available. Understood to have been installed within Glaciofluvial Deposits

Borehole ID	Diameter if Known (mm)	Total Drilled Depth if Known (m)	Borehole Information
GW09_36			No Logs available. Understood to have been installed within Glaciofluvial Deposits
Leachate Wells – Area 1			
GP07_05			No Logs available
LF03_01			No Logs available
LF03_03			No Logs available
LF03_04			No Logs available
LF11_01			No Logs available
LF11_02			No Logs available
LF11_03			No Logs available
LF11_04			No Logs available
LF11_05			No Logs available
LF11-06			No Logs available
LF11-07			No Logs available
Leachate Wells – Area 2			
LF08_07			No Logs available
C1 – Well A			No Logs available
C1 – Well B			No Logs available
C1 – Well D			No Logs available
C1 – Well E			No Logs available
C2 - SubCell A			No Logs available
C2 - SubCell B			No Logs available
C2 - SubCell C			No Logs available

6.2.4 A number of offsite boreholes have also been considered in the assessment of groundwater conditions at the Site. Table 8 shows a summary of intrusive works that have been used.

Table 8: Site Investigation Summary - Offsite

Date	Contractor	Offsite Location	Boreholes	Trial Pits	Sampling
1997	Norwest Holst	15 m south-east	BHF3	-	-
2015	Geotechnical Engineering Limited	Within 100 m south (east of the River Ebbw)	BH412, BH413, BH414, BH415	TP405	Ground water

6.2.5 The well construction details of the boreholes installed offsite are summarised in the Table 9 below.

Table 9: Summary of Borehole Construction Details – Offsite

Borehole ID	Diameter (mm)	Total Drilled Depth (m)	Top of Slotted Well Casing / Gravel Pack (m bGL)	Base of Slotted Well Casing / Gravel Pack (m bGL)	Targeted Geology
BH412	35	35	1	3	Made Ground
	50		15	20	Glaciofluvial Deposits
BH413	35	40	1	4.5	Made Ground
	50		15	18	Glaciofluvial Deposits / Mercia Mudstone Group
BH415	35	40	13	17	Glaciofluvial Deposits
	50		20	40	Mercia Mudstone Group

6.3 Surface Water Quality Monitoring

6.3.1 No surface water monitoring records are available in the vicinity of Newport Docks.

6.3.2 Surface water quality data monitoring has been undertaken by NRW as detailed in Table 10. Data is provided for the period 2010 and 2015.

Table 10: Surface Water Monitoring Locations

Surface Water Location ID	Location Description
41076 - Twenty Acres Reen below bsc whitehead: docksway culvert	Located 470 m north of the site on Twenty Acres Reen
45397 - Cefn Adda Reen bridge d/s Mendalgeif Holder Station	Located 240 m north of the site on Cefn Adda Reen.

6.4 Compliance Testing

6.4.1 As part of the monitoring programme for Area 1 and Area 2, the quality of groundwater, surface water and leachate are monitored. The results are reported to NRW on a monthly and quarterly basis. The analysis of potential trends in contamination levels is undertaken annually in the form of an Annual Environmental Review. The reports covering the year 2014 have been made available for both Areas 1 and 2 (Peter Brett Associates LLP, 2015a and 2015b). The reports do not provide tabulated monitoring results, instead these results are displayed graphically. Consequently, only approximate concentrations of leachate quality monitoring can be reported.

6.4.2 Additionally Newport City Council (NCC) has provided field monitoring data as part of their ongoing monitoring programme in line with the Environmental Permit

for the Site. The data which includes gas, leachate and groundwater monitoring covering the period from August 2014 to August 2015 has been reviewed.

6.4.3 The findings of the Annual Review Reports for Area 1 and Area 2 and review of the NCC raw data are summarised below.

Area 1

Groundwater

6.4.4 Three compliance monitoring wells (two up-gradient and one down-gradient wells) were monitored over a 12 month period. The 201 groundwater analysis results indicated the below.

- Elevated levels of ammoniacal nitrogen were not recorded above the specific control levels and compliance limits. A maximum of 117 mg/l was recorded (GW03_05). Concentrations are reported as being relatively consistent over the last 12 months and consistent with the overall dataset (January 2014 - December 2014).
- Elevated levels of arsenic were not recorded above specific control levels and compliance limits. A maximum of 33.3 µg/l was recorded (GW03_02).
- Elelvated levels of nickel were not recorded above specific control levels and compliance limits in GW03_05 and GW07_07 with stable trends indicated in the last 12 months. GW03_02 generally recorded slightly higher concentrations than previous years, with three exceedances (between 4.8 µg/l and 7.5 µg/l) of the 4.6 µg/l compliance limit.
- Petroleum hydrocarbons were not recorded above specific control levels and compliance limits in GW03_05 and GW07_07. Concentrations in GW03_02 rose throughout 2013, exceeding the compliance limit on two occasions. During the last 12 months, the concentrations have been recorded above the compliance limit on one occasion.

6.4.5 Groundwater levels within the two up-gradient boreholes are indicated to be between approximately 9 to 11 m bGL. Geological logs are not available for these boreholes, however it is understood that the wells within the Glaciofluvial Deposits are screened as indicated within the Annual Environmental Review report (Peter Brett Associates, 2015). Logs available for boreholes on adjacent sites indicate that groundwater levels are sub-artesian resting within the Tidal Flat Deposits.

6.4.6 Groundwater levels within the down-gradient borehole, also understood to be screened within the Glaciofluvial Deposits, are at approximately 4 to 4.7 m bGL.

Leachate Levels

6.4.7 Leachate levels are monitored on a monthly basis in nine leachate monitoring wells, LF03/01, LF03/03 and LF11/01 to LF11/07. Leachate levels monitored indicate the presence of a number of discrete leachate bodies within the waste mass, with leachate levels lying at between 23 m AOD in LF03/03, and from 6 to 14 m AOD in LF11 series wells. Previous data has indicated leachate levels at between 23 to 26 m AOD in LF03/04 and around 13 m AOD in GP03/02. The well locations are provided within Figure 2 of the 2014 Annual Report (Peter Brett Associates, 2015a).

Leachate Quality

6.4.8 Leachate quality is monitored on a quarterly basis in four leachate wells LF03/02, LF11/02, LF11/04 and LF11/07.

6.4.9 The 2014 monitoring results are reported to indicate a generally stable trend in concentrations with the following concentrations of key determinants:

- arsenic <75 µg/l;
- benzene ≤10 µg/l;
- mercury <0.01 µg/l;
- naphthalene <0.01 µg/l;
- o-xylene 10 to 25 µg/l;
- phenols <0.2 µg/l;and
- nickel 100 to 500 µg/l.

Landfill Gas

6.4.10 For the period August 2014 to August 2015 landfill gas monitoring for Area 1 was undertaken at 6 monthly intervals at 13 purpose built monitoring wells located around Area 1.

6.4.11 Methane was measured between 0.1 % up to 76 % v/v. Concentrations ranged between 1.2 % and 67.5 % v/v excluding the NCC boreholes located on the eastern boundary of Area 1. The majority of concentrations within the NCC boreholes are recorded as ≤ 0.5 % with the exception of NCC6 (reported maximum 76 % v/v).

6.4.12 Carbon dioxide was measured between 1 % and 24 % v/v.

6.4.13 Low gas flows of ≤ 0.3 l/hr were recorded.

Area 2

Groundwater

6.4.14 Groundwater monitoring is undertaken in 14 compliance monitoring wells within the underlying gravel aquifer.

6.4.15 The 2014 groundwater monitoring results indicated the below.

- Ammoniacal nitrogen concentrations were generally measured up to 20 mg/l in both up- and down-gradient wells. No exceedances of the compliance limits were recorded. Concentrations are reported as being relatively consistent over the last 12 months (January 2014 - December 2014).
- Arsenic concentrations were generally measured at up to 40 µg/l in the majority of wells; however higher concentrations of up to 750 µg/l were measured. A rising trend was indicated in both up- and down-gradient wells with some exceedances of the compliance limit.
- Nickel typically measured concentrations up to 8 µg/l, however exceedances were recorded above the specific compliance and/or control limit in both up- and down-gradient wells.

- Petroleum hydrocarbon concentrations were generally measured at <1,000 µg/l.
- Locally, benzene was detected at concentrations up to approximately 2.1 µg/l.
- Naphthalene has previously been recorded at concentrations up to 3.5 µg/l. Concentrations have been typically at or below the method detection limit.

6.4.16 Groundwater levels are indicated to be between approximately 5 to 8 m bGL. Geological logs are not available for these boreholes however it is understood that many of the wells are screened within the Glaciofluvial Deposits as indicated within the Annual Environmental Review Report (Peter Brett Associates, 2015). Logs available for boreholes in close proximity indicate that groundwater levels are sub-artesian resting within the Tidal Flat Deposits.

6.4.17 Groundwater levels within GW06_39 located between Areas 1 and 2 south of the cut-off wall are recorded in the range 2 to 2.6 m bGL. It is unknown which geological stratum these levels reside in.

Leachate Levels

6.4.18 Leachate head level monitoring is currently being undertaken on a monthly basis in Cell 1. The leachate head level has been recorded at between 1.16 and 5.05 m above the base of the cell. In June 2014 a single measurement of 4.25 m above the base of the cell was reported for C2B (Cell 2).

Leachate Quality

6.4.19 Leachate quality is monitored on a quarterly basis in leachate wells in Cells 1 and 2.

6.4.20 Limited data is available for 2014. The 2012 monitoring indicated the following approximate concentrations for key determinands:

- ammoniacal nitrogen 400 and 1000 mg/l;
- arsenic 15 to 60 µg/l;
- benzene 4 to 9 µg/l;
- naphthalene 1 to 2 µg/l;
- xylenes up to 50 µg/l;
- EPH 1 to 4 mg/l;
- nickel 60 to 100 µg/l; and
- potassium 200 to 600 mg/l.

Landfill Gas

6.4.21 For the period August 2014 to August 2015 landfill gas monitoring for Area 2 was undertaken at monthly intervals at 13 purpose built monitoring wells located around Area 2.

6.4.22 Methane was generally not recorded at concentrations above the screening criterion of 1 % with the exception of boreholes located along the northern boundary of Area 2, on the southern side of the cut-off wall between Areas 1 and

2, where methane was measured up to 93.1 % v/v and on the western boundary alongside the River Ebbw at 17.4 % v/v. A more marginal exceedance of 1.2 % v/v was recorded for a borehole located on the eastern boundary

6.4.23 Carbon dioxide was measured at concentrations between 0.3 % v/v and 8.4 % v/v.

6.4.24 Generally negligible flows were recorded with the exception of a borehole located on the southern side of the cut-off wall (GP06_24) in which the maximum methane concentration was recorded with a maximum flow of 17.2 l/hr and a borehole located north-west of Cell 1 (GP05_22) with a maximum flow of 7.8 l/hr.

6.5 Groundwater Monitoring

6.5.1 A summary of the groundwater sampling, groundwater monitoring and ground gas monitoring rounds undertaken both on and offsite are shown in Tables 11 and 12 .

Table 11: Summary of Monitoring Rounds – Onsite

Location Ref.	Number and date of rounds	Monitoring details	Notes
BHF2	5 no.	Groundwater level	-
SBHF02A CP	6 no.	Groundwater level	-

Table 12: Summary of Monitoring Rounds - Offsite

Location Ref.	Number and date of rounds	Monitoring details	Notes
BH412	3 no.: 20th April 2015, 23rd April 2015, 8th May 2015	Soil gas Groundwater - levels and sampling	Gas monitoring from 35 mm shallow installation only.
BH413	4 no.: 27th April 2015, 5th May 2015	Soil gas Groundwater - levels and Sampling	Gas monitoring from 35 mm shallow installation only.
BH415	4 no.: 20th April 2015, 27th April 2015, 5th May 2015	Soil gas Groundwater - levels and Sampling	Gas monitoring from 35 mm shallow installation only.

6.5.2 The data obtained for the compliance boreholes monitored on a monthly basis on behalf of the Newport City Council are summarised within the field testing section of this report.

6.6 Laboratory Chemical Testing

6.6.1 A summary of all laboratory analysis undertaken on soils, leachate and groundwater from the previous site investigations is provided in Table 13.

6.6.2 For the purpose of meeting the requirements of the DMRB HD22/08 (Highway Agency, 2008), the historical data used to support the PSSR and the additional 2015 information (Geotechnical Engineering, 2015) have been differentiated in the following sections.

Table 13: Summary of Previous Investigation Sampling

Site Investigation Date	No. of Soil Samples	No. of Leachate Samples	No. of Water Samples	Suites of Testing
1997	1	0	0	Metals, PAH, pH, mineral oil and phenols
2008	2	1	0	Metals, PAH, TPH, mineral oil and pH
2015	N/A	N/A	11*	Metals, inorganics, phenols, BTEX, TPH, PAH, VOCs, SVOCs, PCBs

Note: * All groundwater analyses relates to offsite boreholes.

Soil Analysis

6.6.3 The following sections summarise the laboratory analytical results for soil samples collected onsite during the various intrusive investigation phases. The available data set has been tabulated and is presented in Appendix 3 with the supporting laboratory certificates available in the relevant original ground investigation reports.

6.6.4 The available information is summarised below in Table 14.

Table 14: Summary of Analytical Soil Data – Onsite

Formation Unit	Number of Soil Analysis per Analytical Suite - Historical data			
	Metals & Inorganics	PAH	TPH	Phenols
Made Ground	3	3	3	1

Soil Leaching Analysis

6.6.5 One sample of Made Ground was sampled for leachate analysis. The available information is presented in Appendix 4 and summarised in Table 15.

Table 15: Summary of Soil Leaching Analytical Data – Onsite

Formation Unit	Number of Soil Leachate Analysis per Analytical Suite - Historical data						
	Metals & inorganics	PAH	TPH	Phenol	BTEX	VOCs	SVOCs
Made Ground	1	0	1	0	0	0	0

Groundwater Analysis

6.6.6 The following sections summarise the laboratory analytical results for groundwater samples collected during the various intrusive investigation phases. The available data has been tabulated and is presented in Appendix 5 with the supporting laboratory certificates available in the relevant original reports.

6.6.7 Given the gap in the onsite data, groundwater data from nearby offsite well installations has been considered. Data relating to boreholes BH412, BH413 and BH415 within 100 m south of the site has been utilised.

6.6.8 Within BH415, both the deep and shallow installations sample the groundwater within the Glaciofluvial Deposits/Mercia Mudstone and as such these samples have been considered as one groundwater body.

6.6.9 The available information is summarised in Table 16 below.

Table 16: Summary of Analytical Groundwater Data – Offsite

Groundwater Unit	Number of Groundwater Analysis per Analytical Suite (number of well locations) – 2015 Data							
	Metals & Inorganics	PAH	TPH	Phenols	BTEX	PCBs	VOCs	SVOCs
Groundwater (Glaciofluvial Deposits / Mercia Mudstone)	11 (3)	11 (3)	11 (3)	9 (3)	11 (3)	5 (3)	9 (3)	9 (3)

6.7 Gap Analysis of Available Data

6.7.1 Onsite groundwater quality monitoring data was made available by Newport City Council from compliance wells used in support of the landfill permit. The data was provided in graphical form covering part of the analytical suite.

6.7.2 The data available for soil and leachate quality is limited to Area 2 end tip which is within the proposed land take, however the data dates back to 2000. Additionally no asbestos analysis has been undertaken. .

6.7.3 The land take is to include the new section of motorway, proposed SDR link road and associated junction exclude largely the Site and is mainly confined within the adjacent Newport Docks (CL-14). All ground investigation gaps associated with the docks have been considered within the Land Contamination Assessment Report, CL-14 (Annex D of Appendix 11.1 of the ES).

7 Ground Conditions

7.1 General

7.1.1 The geological logs for all available exploratory holes excavated on or in close proximity to the site are provided in Appendix 1. The observed geological sequence is consistent with that discussed in the 2014 PSSR report and is summarised in the following sections. Information from the Supplementary Ground Investigation (Geotechnical Engineering, 2015) and the borehole records obtained through Newport City Council have also been used.

7.1.2 Generally the Made Ground encountered at the Site can be divided into waste materials (commonly including refuse type materials) and Made Ground (typically containing less man-made inclusions).

Waste Material

7.1.3 The information made available associated with the waste material within the landfill is limited to boreholes GP03_01 and GP03_02; both located in the north of Area 1. The waste is described as brown black clay with refuse, paper, plastic, rags, metal, brick and concrete. The waste mass was found to be capped with 0.4 to 0.6 m of clay.

7.1.4 The waste mass of the landfill within Area 2 is anticipated to be similar to that described for Area 1 with perhaps a lesser degree of degradation.

7.1.5 Along the eastern boundary of Area 1 (outside the permitted area and immediately beyond which the new link road is being proposed), all peripheral boreholes (NCC1-5) have identified the presence of waste material to typically 4-5 m bGL. This was described generally as clay, brick, wood and some refuse. This was found to overlie the Tidal Flat Deposits. The waste mass was capped by 1.5 m of clay at NCC4 and NCC5, with refuse material encountered directly below ground level in NCC2 and NCC3.

7.1.6 Borehole GP12_26 on the periphery but within the permitted area of Area 1 encountered a relatively thin horizon of landfill waste (0.8 m) at a depth of 8 m. This is overlain by reworked clay/silts separated by two geosynthetic liners. No other similar capping was encountered onsite and it is considered that this is associated with the construction of the cut-off wall between Areas 1 and 2.

7.1.7 Borehole GW03_05 (north-east corner of Area 1 on the periphery and within the permitted boundary) identified 8.3 m thickness of mixed concrete, brick and wood material representing waste material (without refuse type material) from Area 1.

7.1.8 Waste material, to 4.3 m bGL, was also encountered outside the formal landfilling area and permited boundary at GP09_09, located along the River Ebbw.

7.1.9 The available borehole records confirm that waste material has been placed beyond the landfill boundary and the permit boundary of Area 1, which could affect the proposed SDR link road.

7.1.10 No evidence of waste material outside Cells 1 to 5 of Area 2 has been identified.

Made Ground

7.1.11 Made Ground was generally encountered in all exploratory locations outside the landfill mass of Area 2 but within the permit boundary of the Site. The thickness of the Made Ground varied generally between 2.5 and 4 m south and east, and 1 to 3 m west of both Areas 1 and 2. This generally comprised clay and gravel material with brick, slag, ash and concrete fragments with no recorded presence of refuse type material.

7.1.12 The Made Ground described above is considered to be consistent both in thickness and composition to the material found beneath Newport Docks (Annex D of Appendix 11.1 of the ES).

7.1.13 In the southern tip of Area 2 Made Ground (included within the land take) was encountered up to 2 m bGL depth and comprised cohesive and granular material with some concrete/brick.

Superficial Deposits

7.1.14 Unconsolidated superficial deposits were encountered beneath the Made Ground at all locations. These Tidal Flat Deposits comprised generally firm bluish grey clays (organic in places) becoming soft or very soft with depth. No peat deposits were identified in the available borehole records.

7.1.15 A granular material (gravel and cobbles) considered to represent Glaciofluvial Deposits was found to underlie the predominantly cohesive Tidal Flat Deposits beneath typically 12-15 m bGL. The base of the Glaciofluvial Deposits was encountered generally at 17-21 m bGL.

Solid Geology

7.1.16 Below the Glaciofluvial Deposits the Mercia Mudstone Group was encountered typically a red brown mudstone commonly weathered to a very stiff reddish brown clay.

Geological Sequence Summary

7.1.17 The general geological sequence identified during the previous ground investigations and available information from Newport City Council for Area 1 is summarised in Table 17.

Table 17: Summary of Geological Sequence – Outside Landfill Areas 1 & 2

Unit	Description	Thickness Range (m)	Basal Depth (m bGL)
Waste Material (Area 1 only)	Clay, brick, wood and some refuse	3-5	4.5-5
Made Ground (Area 2 only)	Clay and gravel material with brick, slag ash and concrete fragments	1.1-4.8	1.1-4.8
Superficial Deposits (Tidal Flat Deposits)	Silty clay	6.9-12.7	11.4-15
Superficial Deposits (Glaciofluvial Deposits)	Gravels and cobbles	2.2-8.5	17-20.8

Unit	Description	Thickness Range (m)	Basal Depth (m bGL)
Mercia Mudstone (Mudstone)	Stiff and very stiff red brown clay becoming mudstone	>23	>40

7.1.18 The previous ground investigations and available information from Newport City Council provides limited information to the thickness and composition of the waste mass in Areas 1 and 2. The geological sequence within the waste mass from Areas 1 and 2 are summarised in Table 18. In the absence of information, the composition, elevation and depths of the unit has been assumed based on nearby information.

Table 18: Summary of Geological Sequence – Waste Mass within Landfill Areas 1 & 2

Unit	Area	Description	Top of unit (mAOD)	Base of unit (m AOD)	Thickness Range (m)
Waste Mass	Area 1	Brown black clay with refuse, paper, plastic, rags, metal, brick and concrete	Up to 40 (restoration)	5 to 8	32 to 35
	Area 2 (based on Cell 3-5 information)	Not known	About 20 (Exsiting top of waste)	0.8 to 6.94	13 to 19
Superficial Deposits (Tidal Flat Deposits)	Area 1	Silty clay (assumed)	5 to 8	About -2.5 to -3.5 (assumed)	About 8 to 12 (assumed)
	Area 2 (based on Cell 3-5 information)	Silty Clay	0.8 to 6.94	-2.74 to 0.27	2.0 to 8.3
Superficial Deposits (Glaciofluvial Deposits)	Area 1	Gravels and cobbles (assumed)	About -2.6 to -3.6 (assumed)	About -9 to -10 (assumed)	About 6 (assumed)
	Area 2 (based on Cell 3-5 information)	Gravel and cobbles	-2.74 to 0.27	About -7 to -10 (assumed)	About 2 to 8.5 (assumed)

7.2 Gas Monitoring

7.2.1 Gas monitoring data is available from the 2015 offsite boreholes and is summarised on the field data sheets provided in Appendix 2. The maximum gas concentrations (minimum for oxygen) are presented in Table 19 below.

Table 19: Summary of Gas Monitoring Data (Offsite)

Location ID	Flow (l/hr)	VOCs (ppm)	CH_4 (%/vol)	Peak LEL (%)	CO_2 (%/vol)	O_2 (%/vol)	CO (ppm)	H_2S (ppm)
	Max.	Max.	Max.	Max.	Max.	Min.	Max.	Max.
BH412	0.0	4.5	1.0	19	4.4	7.0	0.0	0.0
BH413	1.6	0.1	48.1	#	5.4	0.1	27	0.0
BH415	0.0	2.5	0.4	7.0	0.3	19.3	1.0	0.0

# denotes result exceeding capacity of gas monitoring equipment

7.2.2 As discussed in Section 6.4 ongoing gas monitoring is undertaken in line with the Environmental Permit. The gas monitoring of compliance wells located at the periphery of Area 1 and Area 2 is summarised within Table 20.

Table 20: Summary of Gas Monitoring Data (Peripheral Boreholes)

Site Area	Location ID	Flow (l/hr)	CH_4 (%/vol)	CO_2 (%/vol)	O_2 (%/vol)	CO (ppm)	H_2S (ppm)
		Max.	Max.	Max.	Min.	Max.	Max.
1	GP07_05	0.1	1.2	5.3	10.7	0	1
	GP12_26	0.3	46.7	18.7	2.6	6	0
	GP09_09	0.3	31	19.5	0.2	2	1
	NCC_2	0.2	0.5	11	1.1	0	1
	NCC_3	0.2	0.5	5	15	0	1
	NCC_5 (re-drilled as WS07_07)*	0.2	0.4	5.8	12.4	0	1
	NCC_6 (re-drilled as WS07-08)*	0.1	76	13	0	1	1
	NCC_1	0.2	0.5	9.3	10.5	0	0
	GP03_03A	0.2	20.1	17.9	0.4	6	1
	GP03_13	0.2	67.5	22.4	0.2	1	4
	GP03_02	0.2	23.5	13.7	5.7	1	3
	GP12_27	0.2	37.3	16.7	0.2	5	1
	GP03_01	0.2	58.1	23	0.4	2	9
2	GP06_24	17.2	93.1	5.9	0.2	4	2
	GP06_25	0.5	40.3	3.5	9.8	1	1
	GP03_06	0.6	0.4	1.8	18.6	0	1
	GP05_14	0.7	1.2	0.3	20	0	1
	GP05_15	0.3	0.4	8.4	9.4	1	1
	GP05_16	0.3	0.4	6.9	8.8	1	1
	GP05_17	0.3	0.4	9	5.7	1	1
	GP09_18	0.4	0.4	2.4	18	1	1
	GP05_20	-1.7	17.4	5.5	0.9	1	0
	GP05_21	0.2	0.4	6	1	1	1
	GP05_22	7.8	0.4	1.8	11	3	1
	GP12_23	0.3	0.4	0.7	19.1	1	1
	GP06_08A	0.2	0.7	1.6	18.3	1	1

Notes: *Anecdotal evidence suggests that the gas monitoring results for these holes relate to the re-drill locations.

7.3 Groundwater

Groundwater Encountered During Investigation

7.3.1 Groundwater strikes were encountered during the advancement of most onsite exploratory locations and those selected offsite boreholes are detailed on the geological logs provided in Appendix 1. These are summarised below in Table 21 and Table 22.

Table 21: Summary of Groundwater Level Data During Investigation – Onsite

Location	Strike Depth (m bGL)	Geological Formation	Level after 20 minutes (m bGL)
BHF2	0.5	Made Ground	0.5
	10.9	Tidal Flat Deposits	9.0
SBHF02A CP	13.05	Tidal Flat Deposits	8.3
GW03/09	12	Glaciofluvial Deposits	9
GW03/17	1.3	Made Ground	1.3
GW03/22	0.6	Made Ground	nr
GW09/30	10.3	Glaciofluvial Deposits	nr
GW09/31	10.3	Glaciofluvial Deposits	nr
GW09/32	16.1	Glaciofluvial Deposits	nr
SS94/04	11.4	Glaciofluvial Deposits	7.8
SS94/07	0.4	Made Ground	0.4
	7.1	Tidal Flat Deposits	nr
SS94/08	3.8	Made Ground	3.8
EA3	8.7	Glaciofluvial Deposits	7.6
EA5	2	Made Ground	2
EA7	12	Glaciofluvial Deposits	9.7
	8	Tidal Flat Deposits	8
	13.1	Glaciofluvial Deposits	8.5
PBA2/101	0.3	Tidal Flat Deposits	nr
PBA2/102	1.1	Tidal Flat Deposits	nr
PBA2/103	0.4	Tidal Flat Deposits	nr
PBA2/104	0.35	Tidal Flat Deposits	nr
PBA2/105	0.3	Tidal Flat Deposits	nr
PBA2/106	0.4	Tidal Flat Deposits	nr
PBA2/107	0.45	Tidal Flat Deposits	nr
PBA2/108	0.6	Tidal Flat Deposits	nr
PBA2/109	0.5	Tidal Flat Deposits	nr

Location	Strike Depth (m bGL)	Geological Formation	Level after 20 minutes (m bGL)
PBA2/110	0.55	Tidal Flat Deposits	nr
PBA2/111	1.5	Tidal Flat Deposits	nr
PBA2/112	0.1	Tidal Flat Deposits	nr

Notes: nr = not reported.

Table 22: Summary of Groundwater Level Data During Investigation - Offsite

Location	Strike Depth (m bGL)	Geological Formation	Level after 20 minutes (m bGL)	Comments
BH412	3	Made Ground	2.8	-
	13.6	Tidal Flat Deposits	10.4	-
BH413	2.24	Made Ground	2.24	-
BH415	1	Made Ground	0.8	-
	2.95	Made Ground	1.1	-

Groundwater Level During Monitoring Rounds

7.3.2 The entire groundwater level data set gathered on and offsite is provided in Appendix 2 and summarised in Table 23 and Table 24.

Table 23: Summary of Groundwater Level Data During Monitoring – Onsite

Location	Installation Diameter (mm)	Depth of response zone (m bGL) and Geological Formation	No. Measurements	Min Depth (m bGL)	Max Depth (m bGL)
BHF2	19	15.5-17.5 Glaciofluvial Deposits	5	6.92	7.81
SBHF02A CP	19	16.7-17.3 Glaciofluvial Deposits	6	5.60	9.00

Table 24: Summary of Groundwater Level Data During Monitoring – Offsite

Location	Installation Diameter (mm)	Depth of response zone (m bGL) and Geological Formation	No. Measurements	Min Depth (m bGL)	Max Depth (m bGL)
BH412	35	1 - 3 Made Ground	3	2.83	Dry
	50	15 - 20 Glaciofluvial Deposits	3	8.79	10.57
BH413	35	1 - 4.5 Made Ground	4	2.24	3.38
	50	15 - 18 Glaciofluvial Deposits / Mercia Mudstone Group	4	7.79	9.28
BH415	35	13 - 17 Glaciofluvial Deposits	4	6.08	7.77
	50	20 - 40 Mercia Mudstone Group	4	6.51	8.06

Groundwater Summary

7.3.3 The main groundwater body is within the granular Glaciofluvial Deposits and/or the Mercia Mudstone which is confined by the overlying Tidal Flat Deposits. This indicates that the latter represents an aquitard for vertical groundwater flow. Hydrostatic levels of the confined aquifer are at 7 to 11 m bGL (0 to 2.64 m AOD).

7.3.4 A discontinuous perched groundwater is also observed within the upper formation of the Tidal Flat Deposits. This is considered to represent discrete bodies with limited vertical or lateral flow.

7.3.5 A shallow perched water body was also identified by the intrusive works within the Made Ground. The extent of perched water bodies within the Made Ground is anticipated to be strongly influenced by rainfall events.

7.3.6 The groundwater regime detailed above is consistent with the hydrogeological model detailed in the Baseline Water Environment Report (Appendix 16.2 of the ES).

7.3.7 A perched leachate is also anticipated within the waste mass, although levels are not known. Within Area 2, the levels are influenced by ongoing leachate management.

8 Contamination Assessment

8.1 Introduction

8.1.1 The following sections provide details of the assessment of land contamination at the site.

8.1.2 The Conceptual Site Model (CSM) presented within the 2014 PSSR has been reviewed and updated based on data from the supplementary ground investigation (Geotechnical Engineering, 2015) and the revised design of the Scheme. The main alterations to the 2014 PSSR model are summarised as follows:

- change in the alignment of the new section of motorway, which avoids the landfill mass of both Area 1 and Area 2; and
- update of the source-pathway-receptor linkages taking account of the above and more detailed assessments.

8.2 Preliminary Risk Assessments

Potential Sources

8.2.1 The current design avoids the landfill mass of Area 1 and Area 2, however, filling outside of Area 1 is known to have occurred. The following potential sources of contamination are considered.

- Landfill waste/leachate outside of Area 1.
- Made Ground within the southern tip of Area 2.
- Infilled historical River Ebbw channels.
- Ground gases including landfill gas.

8.2.2 The waste materials deposited within the landfill include unlicensed waste landfilled prior to the 1980s. The waste management licence authorised disposal of asbestos. Landfill leachate continues to be produced and landfill gas is extracted for energy purposes.

Potential Receptors

8.2.3 Receptors during the construction and the operational stages of the Scheme that have been considered.

Construction

- Construction workers during site development works.
- General public/site neighbours adjacent to construction works.
- Groundwater within the Glaciofluvial Deposits and/or Mercia Mudstone.
- The River Ebbw.

Operational

- Maintenance workers, mainly from exposure to Made Ground materials outside the Scheme area.
- General public end users are not considered potential receptors as the Made Ground within the Scheme area will be encapsulated by the embankment.
- Main groundwater within the Glaciofluvial Deposits and/or Mercia Mudstone.
- The River Ebbw.

Potential Pathways

8.2.4 Pathways during the construction and the operational stages of the Scheme that have been considered as below.

- Dermal contact, ingestion, inhalation pathways of potentially contaminated soils possible during development and maintenance works.
- Leaching of contaminants from the Made Ground to shallow groundwater and migration to surface waters.
- Surface water run-off into the existing/new drainage system and direct discharge into the receiving surface water body i.e. the River Ebbw.
- Lateral migration of impacted perched water within the Made Ground and/or leachate from the Made Ground into the existing/new drainage system.
- Vertical migration of impacted perched water within the Made Ground and/or leachate from the Made Ground into perched or main groundwater bodies.
- Vertical or lateral migration of ground gas associated with Made Ground/waste sources.
- Creation of new pathways with installation of piles through the Made Ground, Tidal Flat Deposits and into the Glaciofluvial Deposits and/or Mercia Mudstone.

8.3 Risk Evaluation

8.3.1 Source-pathway-receptor linkages were considered in the 2014 PSSR using the historical data available up to 2008. With review of the data described herein, the following risk evaluation is made.

- The new section of motorway is to avoid the waste mass of Area 2. The SDR link is however likely to encroach upon areas of uncontrolled waste tipping beyond the boundaries of Area 1.
- The proposed embankment is to cover most of the motorway corridor reducing pathways to motorway users. However, remaining areas (outside embankments) are to remain uncapped although these are likely to receive vegetation cover.
- Superficial deposits are classified as non-productive and overlie a Secondary B Aquifer associated with the mudstone.
- The cohesive TDF (of over 10 m thickness) separate the Made Ground and Aquifer. The main groundwater body identified is confined by the TFD.

- Perched groundwater within the TFD is not considered a resource with anticipated low vertical hydraulic continuity with the aquifer beneath.
- Hardstanding is likely to limit infiltration reducing leaching, however piles will create pathways to groundwater at depth. Pathways may increase the influx of water within the Made Ground, given the recorded sub-artesian pressures.
- Elevated ground gases including methane, carbon dioxide and hydrogen sulphide as well as trace VOCs.
- Motorway users will be within an open environment with no proposed structures or other confined spaces.
- Risk of increased gas emissions due to induced consolidation of the Made Ground and waste materials from the proposed surcharge loading.

8.4 Human Health Risk Assessment

8.4.1 The rationale and approach for the human health (Tier 2) screening assessment is detailed in the Land Contamination Assessment Report (Appendix 11.1 of the ES). Soil chemical analysis results and the findings of the generic Tier 2 human health risk assessment are presented in Appendix 3. All exceedances within Made Ground are summarised in Table 25.

Table 25: Summary of Human Health Soil Screening Exceedances (Made Ground)

Determinant	Units	Range	Screening Criteria	No. Samples Exceeding Screening Criteria (Total Number of Results)	Location of Exceedances
pH	pH units	8.0 - 9.6	6-9	2 (3)	BHF2, CH9
Chromium	mg/kg	34.4 - 41	33	3 (3)	BHF2, CH9
PAH (total)	mg/kg	8.1 - 372	1.1	3 (3)	BHF2, CH9

8.4.2 Alkaline soil conditions have been identified within the Made Ground which includes concrete and limestone gravel.

8.4.3 Although exceedances of chromium are identified within the Made Ground, the criterion relates to the hexavalent form and this is considered to be a conservative approach. Further speciation may confirm chromium relates to a lesser toxic form.

8.4.4 For the total PAH analysis, the most stringent criterion applicable for any PAH compound has been used for screening purposes (i.e. dibenzo(ah)anthracene).

8.5 Controlled Waters Screening Assessment

8.5.1 The rationale and approach for the controlled waters (Tier 1) screening assessment is detailed in the Land Contamination Assessment Report (Appendix 11.1 of the ES) and the groundwater chemical results are presented in Appendix 5. All exceedances of the relevant generic criteria are summarised in Table 26 for groundwater and Table 27 for surface water.

8.5.2 Where an Environmental Quality Standard (EQS) is dependent on water hardness (i.e. some heavy metals), the hardness of the surface water receptor would normally be used. The Baseline Water Environment Report (Appendix 16.2 of the ES) indicates surface water to be generally moderately hard with hardness in a range of 100 to 150 mg/l as calcium carbonate. Therefore EQSs within this water hardness range have been used for screening purposes.

Soil Leachate Results

8.5.3 One soil sample was subjected to leachate analysis. All contaminates tested were below the applied screening criteria, although TPH FTIR was elevated with a concentration of 400 µg/l.

Groundwater Results - Offsite

8.5.4 Seventeen groundwater samples from boreholes offsite and down gradient of the site were subjected to groundwater analysis. Many groundwater results were below the applied screening criteria with the exception of those tabulated below.

Table 26: Controlled Waters Screening Exceedances – Offsite

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS (Total Number of Results)	Location of Exceedances	No. Exceeded DWS (Total Number of Results)	Location of Exceedances
Aquifer (Glaciofluvial Deposits / Mercia Mudstone)								
Arsenic	µg/l	6 - 41	50	10	0 (11)	-	6 (11)	BH413, BH415
Boron	µg/l	220 - 3800	2000	1000	3 (11)	BH412, BH413	6 (11)	BH412, BH413, BH415
Chromium	µg/l	<1 - 100	-	50	-	-	3 (11)	BH413, BH415
Copper	µg/l	3.3 - 31	10	2000	6 (11)	BH412, BH413, BH415	0 (11)	-
Lead	µg/l	<1 - 3.3	1.2	10	1 (11)	BH412	0 (11)	-
Mercury	µg/l	<0.5 - 0.75	0.07	1	3 (11)	BH415	0 (11)	-
Nickel	µg/l	1.6 - 7.8	4	20	4 (11)	BH411, BH412, BH413, BH415	0 (11)	-
Selenium	µg/l	3.2 - 64	-	10	-	-	9 (11)	BH412, BH413, BH415
Chloride	mg/l	840 - 2400	250	250	11 (11)	BH412, BH413, BH415	11 (11)	BH412, BH413, BH415

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS (Total Number of Results)	Location of Exceedances	No. Exceeded DWS (Total Number of Results)	Location of Exceedances
Ammoniacal Nitrogen as N	mg/l	0.93 - 10	0.6	-	11 (11)	BH412, BH413, BH415	11 (11)	BH412, BH413, BH415

8.5.5 The groundwater screening assessment includes data from two or three rounds of monitoring undertaken in 2015. The groundwater samples were predominantlly obtained from the Glaciofluvial Deposits (and Merica Mudtsone for BH415 only).

8.5.6 The following comments may be made when considering EQS critiera.

- Exceedances of boron, copper, lead, mercury and nickel are identified within the Glaciofluvial Deposits.
- Exceedances of copper, mercury and nickel are identified wihin the Mercia Mudstone.
- Widespread elevated choride concentrations within the Glaciofluvial Deposits and Mercia Mudstone indicate the water within the aquifers are affected by saline intrusion.
- Widespread elevated ammoniacal nitrogen within the Glaciofluvial Deposits and Mercia Mudstone.

8.5.7 Within the Glaciofluvial Despoits and Mercia Mudstone, arsenic, boron, selenium and chloride are identified exceeding DWS criteria. However, as the groundwater is saline and not used for potable watr supply, the exceedances are considered tolerable.

8.5.8 All BTEX, MTBE, TPH, PAHs, phenols, VOCs, SVOCs and PCBs were at or below the laboratory limit of detection with the exception of a total TPH concentration of 3300 µg/l reported for the initial monitoring round of BH412 (20/04/15). The elevated TPH concentrations in the water sample collected from the installation in BH412 was taken from perched water in the Made Ground. No visual or olfactory evidence of contamination was noted at this location, although slightly elevated VOCs were detected during the first and second gas and groundwater monitoring rounds in 2015. These elevated concentrations are considered in the CL-14 Report presented in Annex D of Appendix 11.1 of the ES.

8.5.9 It is of note that the compliance monitoring onsite described within Secion 6.4 has also identified groundwater within the Glaciofluvial Deposits as having elevated metals above specific compliance limits and/or control limits (nickel up gradient of Area 1 and arsenic and nickel up and down gradient of Area 2). The exceedances are indicated to be above the relevant EQSs / DWSs.

Surface Water

8.5.10 A summary of the exceedances identified during the surface water quality screening assessment undertaken for the Site is presented in Table 27. This includes the results for the two NRW monitoring locations identified in Table 4,

both of which are situated to north of the site, on Twenty Acres Reen and Cefn Adda Reen.

8.5.11 The results for all the sample locations are presented in the Baseline Water Environment Report (Appendix 16.2 of the ES) and the full screening assessment provided in Appendix 6.

Table 27: Summary of Surface Water Screening Exceedances

Parameter	Unit	No. Analyses	No. Analyses Above LOD	Minimum Concentration	Maximum Concentration	Location & Round with Maximum Concentration	EQS	No. Analyses Exceeding EQS	DWS	No. Analyses Eceeding DWS	CCW Trigger Levels	No. Analyses Exceeding CCW Trigger Levels
Calcium	mg/l	79	79	2.13	825	41076 / 01/12/2014	-	-	-	-	330	1
Iron	µg/l	64	64	34.4	3,700	41076 / 12/03/2012	1,000	3	200	22	-	-
Zinc (Total)	µg/l	78	78	6.82	1950	41076 / 16/11/2010	75	41	-	-	1,000	1

8.5.12 The analytical suite for these locations is limited to eight parameters and has been completed by NRW on a monthly basis for location 41076 and quarterly for location 45397.

8.5.13 The quality for Twenty Acres Reen is generally good with respect to the parameters provided in the NRW data set. There are frequent exceedances above the respective EQS for zinc (total) and three exceedances of the EQS for iron.

8.5.14 Water quality within Cefn Adda Reen is better than that of Twenty Acres Reen, with fewer exceedances for zinc (total) and no exceedances above their EQS of the other parameters within the data set.

8.6 Ground Gas Risk Assessment

OffSite Boreholes

8.6.1 The ground gas data available relates to three offsite boreholes, BH412, BH413 and BH415. Boreholes BH412 and BH413 are located just beyond the southern boundary of the Site with BH415 located approximately 130 m to the south-east.

8.6.2 The response zones of these boreholes, BH412, BH413 and BH415 are within the Made Ground (1 to 3 and 1 to 4.5 m bGL) and Glaciofluvial Deposits (13 to 17 m bGL) respectively. Boreholes BH413 and BH415 were monitored on four occasions and borehole BH412 on three. Of the available data the following comments can be made.

- The third monitoring round for BH413 and BH415 was undertaken during low barometric pressure (less than 1000 mb), with the lowest conditions being 996 mb. As such it can be considered that worst case atmospheric conditions may have been monitored.
- Gas flow was generally recorded as absent, with the exception of the second monitoring round for BH412 and the fourth monitoring round for BH413, both of which had a peak flow of 1.6 l/hr.
- Methane has been recorded in all three boreholes. In BH412 concentrations of up to 1 % are recorded in the first monitoring round, subsequently recorded as/decreasing to zero in the following monitoring rounds. BH413 records high levels in all four monitoring rounds with a maximum concentration of 48.1 % with no reduction noted over time. Low levels are identified in BH415 with a maximum of 0.4 % during the first monitoring round decreasing to zero in the final monitoring round.
- Carbon dioxide is identified within all boreholes, at low levels within BH415 (maximum concentration 0.3 %) and in the other two boreholes it is identified at up to 4.4 % and 5.4 % respectively. These concentrations are generally just above the screening criterion of 5 %.
- Trace Volatile Organic Compounds of up to 4.5 ppm has been recorded.
- Hydrogen sulphide concentrations were recorded as zero throughout.
- Carbon monoxide concentrations were recorded as zero in borehole BH412. In BH415 a maximum of 1 ppm was recorded and in BH413 it was recorded as present in all monitoring rounds with a maximum concentration of 27 ppm below the screening criteria of 30 ppm.

- Oxygen has been recorded to be at ambient concentrations in BH415 between 19.3 and 20.9 %. Low levels of oxygen of between 0.1 and 17.3 % are identified within the other boreholes.

8.6.3 On the basis of the above, an abnormal gas regime has been identified within the Made Ground and underlying natural strata in close proximity to the southern boundary of the Site.

8.6.4 The following observations have been made in regard to the targeted strata within the boreholes:

- BH412 - installed within Made Ground including slag and brick;
- BH413 - installed within Made Ground including brick gravel; and
- BH415 - installed within Glaciofluvial Deposits.

8.6.5 A gas risk assessment has been undertaken and is set out within the Land Contamination Assessment Report (Appendix 11.1 of the ES).

OnSite Boreholes

Area 1

8.6.6 The ground gas data for the period August 2014 to August 2015 is available for 13 compliance boreholes located on the periphery of Area 1.

8.6.7 The response zones of these boreholes are within the Made Ground. Of the available data the below comments can be made.

- Gas flow was negligible within all boreholes at ≤ 0.3 l/hr.
- Methane was recorded within all boreholes with maximum concentrations ranging between 0.4 and 76 % v/v. Methane concentrations of > 1 % limit were recorded within all boreholes with the exception of the NCC boreholes located on the eastern boundary save NCC6 in which the maximum methane concentration was recorded.
- Maximum carbon dioxide concentrations were identified within all boreholes at > 5 % v/v. A maximum concentration of 23 % v/v was recorded within GP03/01 located in the northwestern part of the Site.
- Hydrogen sulphide was either recorded as absent or at levels below 5 ppm. A maximum concentration of 9 ppm was recorded within GP03/01 on one occasion and either absent or ≤ 2 ppm on all other occasions.
- Carbon monoxide was either recorded as absent or at levels up to a maximum of 6 ppm recorded in GP12/26 and GP03/03A, below the Workplace Exposure Limit of 30 ppm.
- Oxygen was recorded at depleted levels within all boreholes with a range of between zero recorded within NCC6 (WS07_08) on one occasion and 15 % v/v in Area 2.

Area 2

8.6.8 The ground gas data for the period August 2014 to August 2015 is available for 13 compliance boreholes located on the periphery of Area 2.

8.6.9 The response zones of these boreholes are within the Made Ground. Of the available data the below comments can be made.

- Gas flow was generally recorded at levels ≤ 0.7 % l/hr with higher flows recorded within two boreholes (GP05_22 and GP06_24).
- Methane concentrations were recorded in all boreholes with maximum concentrations typically at ≤ 0.4 % v/v. Concentrations of > 1 % were recorded for GP06_24, GP06_25, GP05_20 and GP05_14 at 93.1 %, 40.3 %, 17.4 % and 1.2 % respectively. GP06_24 and GP06_25 are located between Areas 1 and 2 on the south side of the cut-off wall.
- Carbon dioxide concentrations were recorded within all boreholes. Maximum concentrations of > 5 % v/v were recorded within GP06_24, GP05_15, GP05_16, GP05_20 and GP05_21 up to a maximum of 9 % in GP05_17.
- Hydrogen sulphide was either recorded as absent or at levels below 5 ppm (maximum of 2 ppm).
- Carbon monoxide was either recorded as absent or at levels below the Workplace Exposure Limit of 30 ppm (maximum of 4 ppm).
- Oxygen was recorded at depleted levels in the majority of borehole down to 0.2 % v/v in GP06_24.

8.7 Summary

8.7.1 Limited or inappropriate soils testing data is available for the site however alkaline soils are indicated.

8.7.2 Exceedances of EQSs and DWSs are identified within the underlying aquifer as indicated within on and offsite boreholes. TPH was encountered within offsite borehole BH412 during the initial 2015 monitoring round but was not encountered above LOD in subsequent rounds. The aquifer water quality is considered to be at background levels for this area of Newport which is associated with heavy industrial legacy. As such the Site may not be the sole cause for water quality deterioration although its contribution may not be ruled out.

8.7.3 Elevated ground gases have been recorded within some compliance boreholes advanced on the periphery of Area 1 and Area 2 within, and in the vicinity of, the proposed SDR link with methane concentrations recorded up to 76 % (WS07_08). These concentrations are indicated to be associated with wells constructed within Made Ground containing waste materials. Negligible flows were recorded within these boreholes.

8.7.4 Elevated ground gases have not been recorded within compliance boreholes advanced on the southern perimeter of Area 2 (north of the route alignment) where predominantly granular Made Ground was encountered. However, elevated concentrations have been recorded within boreholes located within the route alignment., for example 48.1 % v/v relatively low flows of 1.6 l/hr was recorded in BH413. It is of note that methane concentrations within BH413 remained consistently high.

9 Refined Conceptual Site Model

9.1.1 The incorporation of data from the 2015 Supplementary Ground Investigation has enabled the original CSM presented in the 2014 PSSR to be updated. The assessment is based on the Scheme during its construction and operational phases.

9.1.2 A CSM representing general ground conditions, overall Scheme layout and relevant source-pathway-receptors (each of which having a specific alpha-numerical symbol attached) are presented in Figure 2 and described in Table 28.

Table 28: Site Conceptual Model

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
OnSite Waste potentially including asbestos, landfill leachate, landfill gas and possible UXO risk.	**Construction**					
	Construction Workers (B)	Direct dermal (1)	Likely	Moderate	Moderate	Construction workers will possibly be exposed to waste/Made Ground materials during site construction works; however exposure duration will be short term only. Prior to construction, a specific risk assessment will be required in line with CDM and health and safety legislation. This will enable safe methods of work and appropriate levels of PPE to be put in place. As such all risks will be duly considered and suitably mitigated to protect construction workers. Uncontrolled tipping is indicated to have occurred beyond the landfill boundary of Area 1 encroaching upon the proposed SDR. Given the age of the tipping this waste may contain asbestos. A construction mat will be placed over the length and width of the proposed embankment to enable piling installation as well as general construction. This will break dermal, ingestion and inhalation pathways once placed. Ground gas data from the waste identify elevated concentrations of methane, carbon dioxide and trace VOCs. Generally negligible flows were recorded. Surcharge by embankment may temporarily increase gas flux. Construction to be largely within open space. Any earthworks within confined space would require
		Ingestion (3)	Likely	Moderate	Moderate	
		Inhalation of soil dust (2)	Likely	Moderate	Moderate	
		Inhalation of asbestos fibres.	Likely	High	High	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
		Inhalation of ground gas / VOCs (2)	Likely	High	High	specific risk assessment, control measures and appropriate PPE. Gap in the data has been identified and further investigations are required to delineate any potential contamination and confirm the risks.
	Surface water (River Ebbw) (E)	Saturated flow within perched groundwater (4)	Likely	Moderate	Moderate	Perched (shallow) groundwater is likely to be intercepted by the land drainage. The quality of perched groundwater was shown to have been impacted by contamination and therefore the quality of surface water is likely to have been impacted by contamination as well., Earthworks may lead to increased mobilisation of contaminants therefore increasing the risk to surface water. High sensitivity of the surface water receptor (River Ebbw). Gaps in the data have been identified and further investigations are required to delineate any potential contamination and confirm the risks.
		Contaminated surface water run-off (5)	Likely	Moderate	Moderate	Surface water run-off from the construction area may deteriorate the quality of surface water and thus construction process will need to adopt surface water control and management.
	Deeper groundwater within Tidal Flat Deposits / Mercia Mudstone (Da)	Leaching / migration (4) of contaminants in Made Ground	Likely	Moderate	Moderate	Perched groundwater quality is shown to contain elevated metals and inorganics. New pathways to be created with piling. A foundations work risk assessment is required to confirm the absence of risk to controlled waters. Gaps in the data have been identified and further investigations are required to delineate any potential contamination and confirm the risks.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
Peat	Construction Workers (B)	Inhalation of soil gas / explosion (2)	Unlikely	High	Moderate to low	No peat identified within the available exploratory boreholes although Tidal Flat Deposits known to comprise thick organic deposits elsewhere along the Scheme. High methane concentrations associated with peat/organic clays but with low or absent flux. Peat overlain by low permeability cohesive soils. Flux likely to increase during surcharge loading. New pathways to be created with piling. Construction to be largely within open space. Any earthworks within confined space would require specific risk assessment, control measures and PPE. Piling could result in explosive risks during operations and risk assessment and gas mitigation controls will be needed.
<u>OnSite</u> Waste potentially including asbestos, landfill leachate, landfill gas and possible UXO risk.	**Operational**					
	Maintenance Workers (B)	Direct dermal (1)	Unlikely	Moderate	Low	Made Ground to be largely encapsulated by the embankment/pier and therefore the exposure to contamination will be limited outside the motorway embankment. Areas outside the motorway hardstanding are likely to receive topsoil cover and vegetation establishment,
		Ingestion (3)	Unlikely	Moderate	Low	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
		Inhalation of soil dust (2)	Unlikely	Moderate	Low	reducing potential of exposure. Exposure duration will be short term only. Site specific risk assessment will be required in line with health and safety guidance. This will enable safe methodology and appropriate levels of PPE to be put in place. As such all risks will be duly considered and suitably mitigated. Limited data set however current data suggests limited exceedances to the selected screening criteria. Maintenance work to be largely within open space. Any earthworks within confined space would require specific risk assessment, control measures and PPE.
		Inhalation of fibres.	Unlikely	High	Moderate to low	
		Inhalation of soil gas or vapours (2)	Unlikely	Moderate	Low	
	Future Motorway users (A) & Offsite users (C)	Dermal contact with dust (1)	Unlikely	Low	Very low	Made Ground to be largely encapsulated by the embankment and therefore the exposure to contamination will be limited outside the motorway corridor. Exposure duration will be short term only for motorway users. Offsite receptors some 40 m from proposed earthworks. Limited potential for lateral gas migration given the presence of low permeability Tidal Flat Deposits to shallow depth.
		Ingestion of dust (3)	Unlikely	Low	Very low	
		Inhalation of soil dust (2)	Unlikely	Low	Very low	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
		Inhalation of soil gas or vapours (2)	Unlikely	Low	Very low	Screening criteria considered conservative when considering exposure and pathway mechanisms. Gap in the data has been identified and further investigations are required to delineate any potential contamination and confirm the risks.
	Groundwater - Aquifer (Da) within the Tidal Flat Deposits and/or Mercia Mudstone	Leaching/ migration (4) if contamination in Made Ground	Unlikely	Low	Very low	Aquifer quality shown to be impacted by metal and inorganic contaminants. New pathways to be created with piling. A foundations work risk assessment is required to confirm the absence of risk to controlled waters.
	Surface water (land drainage) (E)	Saturated flow within perched groundwater (4)	Likely	Moderate	Moderate	Ephemeral perched (shallow) groundwater/leachate is likely to be intercepted by the land drainage. The quality of perched groundwater have become impacted by contamination during the construction works, particularly in the area of excavation (new drains). Hardstanding will reduce infiltration and thus reduce leaching potential. Gap in the data has been identified and further investigations are required to delineate any potential contamination and confirm the risks.
		Surface water run-off (5)	Unlikely	Moderate	Low	Surface water run-off to be captured by designed drainage system.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
Peat	Maintenance Workers (B)	Inhalation of soil gas / explosion (2)	Unlikely	High	Moderate to Low	No peat identified within the available exploratory boreholes although Tidal Flat Deposits known to comprise thick organic deposits elsewhere along the Scheme. Peat is likely to be associated with high methane concentrations identified in offsite boreholes but with low or absent flux. Peat overlain by low permeability cohesive soils. Flux likely to have stabilised now surcharge loading completed.
	Motorway users (A)	Inhalation of soil gas / explosion (2)	Unlikely	High	Moderate to low	No peat identified within the available exploratory boreholes although Tidal Flat Deposits known to comprise thick organic deposits elsewhere along the Scheme. Peat is likely to be associated with high methane concentrations identified in offsite boreholes but with low or absent flux. Peat overlain by low permeability cohesive soils. Flux likely to have stabilised now surcharge loading completed.Limited potential for lateral gas migration given the presence of low permeability Tidal Flat Deposits to shallow depth. Motorway to be built on raised embankment providing a further barrier to migration gases.

10 Conclusions and Recommendations

10.1 Conclusions

10.1.1 Ground investigations have been undertaken at the Site to assess risks from land contamination associated with the construction and operation of the Scheme including human health and controlled waters risks.

10.1.2 Previous ground investigation is both limited in coverage and contains extremely limited chemical analysis data. The main untested area relates to the eastern part of Area 1 where uncontrolled tipping is known to have occurred (confirmed by borehole records) which may have contained asbestos materials. Therefore, this represents a high risk in relation to human health especially during the construction phase which is likely to require specific mitigation measures to prevent inhalation pathways of dust / fibres to offsite and workforce receptors.

10.1.3 Elevated ground gases associated with waste materials within Area 1 and potentially landfill gas migration from Area 2 will require further site specific assessment.

10.1.4 Impacted perched groundwaters/leachate are likely to be in continuity with land drainage and will require a suitable water management strategy to prevent potential impact to surface waters from contaminant run-offs.

10.1.5 During the operational phase, the embankment will cover part of the Site which will significantly limit the infiltration of rainwater through the soils and potentially leaching any soil contaminants into the groundwater. However, perched groundwater/leachate within the Made Ground materials could remain beneath the embankment.

10.1.6 Adoption piles beneath the embankment may provide new pathways which may lead to groundwater within the Tidal Flat Deposits, and possibly any water bodies within the Made Ground, to enter the currently confined aquifer within the Glaciofluvial Deposits and Mercia Mudstone.

10.1.7 The perched groundwater and deep aquifer are identified to be impacted with metals and inorganic contaminants which may reduce surface water quality if the piles pathways allow direct or indirect linkage. Further consideration and risk assessment will be undertaken to mitigate the potential impact of the piles and to allow specific mitigation measures to be implemented.

10.1.8 Post construction, the embankment itself and topsoil and subsoil cover along the motorway corridor will break potential human health pathways to end users and maintenance workers. However, topsoil materials placed at the surface will need to be checked for contamination and will be required to be of suitable thickness to mitigate any residual risks from contamination.

10.1.9 Surface water quality recorded in two reens north of the site is generally of good quality though there is evidence of impact from certain heavy metals.

10.2 Recommendations

10.2.1 Only limited ground investigation is available, and given the high risk associated with potential contamination at the Site, it is recommended that further ground

investigation is undertaken to verify the risks levels described in the report. Upon completion this report shall be reviewed and updated accordingly once the findings of the additional investigation are made available. The additional investigation will include:

- trial pits and boreholes to collect soil samples;
- installation of groundwater monitoring wells to collect groundwater samples and gas monitoring.

Part of the investigation will be to investigate the presence of any historically deposited waste along the proposed link road to be constructed immediately adjacent to the existing Docks Way Landfill.

10.2.2 Upon review and assessment of the additional ground investigation information, any contamination identified that could cause an unacceptable risk to the identified receptors will require appropriate remedial mitigation measures to be implemented. These measures would be identified within a remedial strategy for the Scheme. The remediation strategy is anticipated to include, but is not limited to the below.

- Addressing potential human health and controlled water risk identified by the proposed additional ground investigation.
- Monitoring and detailed risk assessment of ground gases.
- Dealing with unexpected contamination.
- Verification sampling strategy to confirm suitability for soils for reuse.
- Control measures (over and above good practice construction management) to prevent risks to construction workers and the general public during construction.
- Verification of material used as topsoil/capping for suitability of use.

10.2.3 The remediation strategy would include a remediation options appraisal, remediation implementation plan and remediation verification plan. The remediation strategy would support a Scheme wide Material Management Plan prepared in accordance with CL:AIRE Code of Practice (CL:AIRE, 2011).

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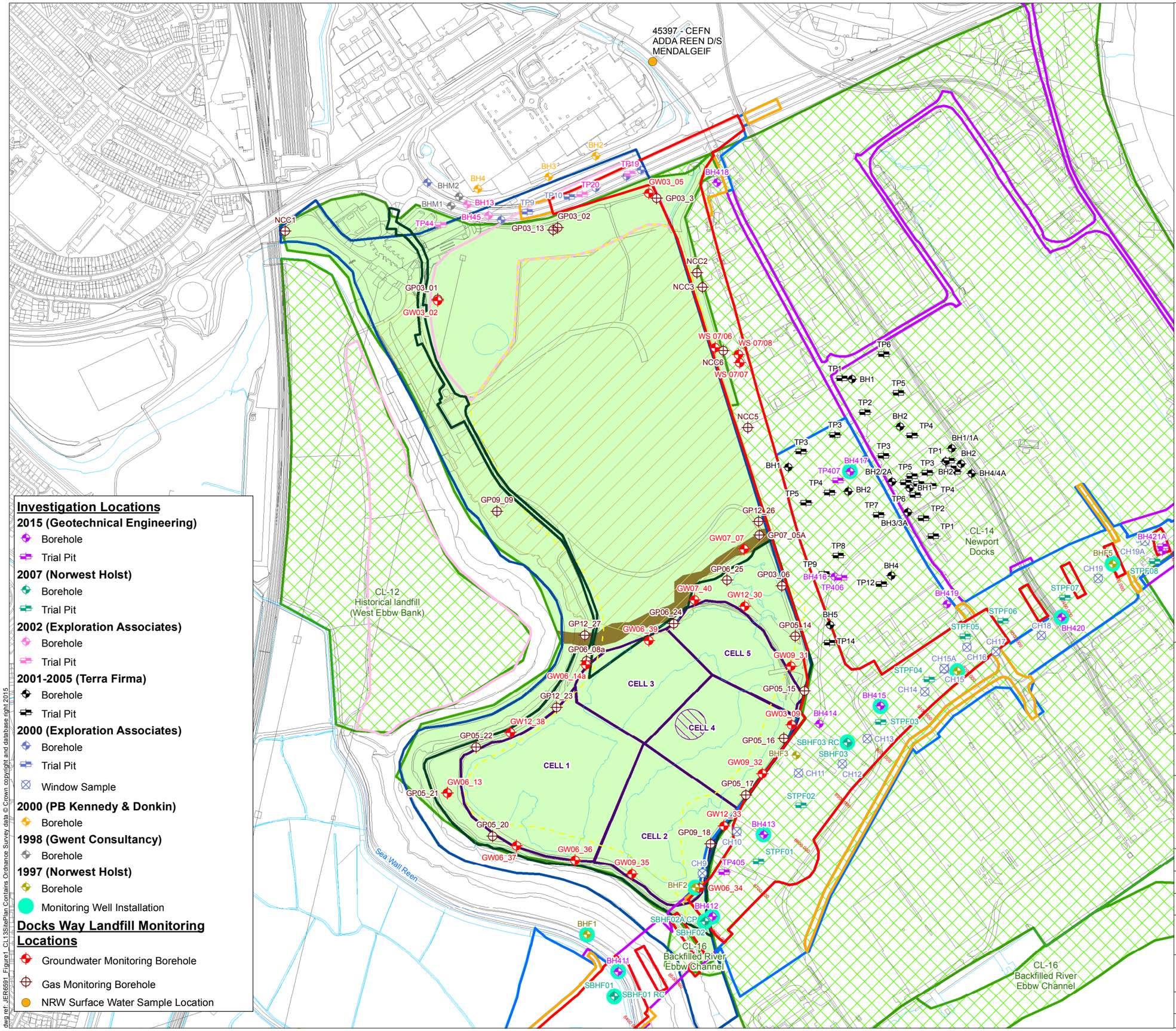
12 Glossary

BF	Blast Furnace
BGS	British Geological Survey
BOD	Biochemical Oxygen Demand
BOS	Basic Oxygen Slag
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CAT	Cable Avoidance Tool
CDM	Construction Design Management
CH_4	Methane
CLEA	Contaminated Land Exposure Assessment
CO_2	Carbon Dioxide
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CSM	Conceptual Site Model
DMRB	Design Manual for Roads and Bridges
DO	Dissolved Oxygen
DQRA	Detailed Quantitative Risk Assessment
DWS	Drinking Water Standard
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
ES	Environmental Statement
ESG	Environmental Scientifics Group
EQS	Environmental Quality Standard
FTIR	Fourier Transform Infrared (spectroscopy)
GAC	Generic Assessment Criteria
GDR	Geotechnical Design Report
GIR	Ground Investigation Report
GRO	Gasoline Range Organics
LEL	Lower Explosive Limit
LOD	Limit of Detection
mAOD	Metres Above Ordnance Datum

mb	Millibars
m bGL	Metres below Ground Level
MTBE	Methyl Tert-butyl Ether
NRW	Natural Resources Wales
ORP	Oxidation Reduction Potential
O_2	Oxygen
OS	Ordnance Survey
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCSM	Preliminary Conceptual Site Model
PID	Photo Ionisation Detector
PPE	Personnel Protection Equipment
SGVs	Soil Guideline Values
SSAC	Site Specific Assessment Criteria
SSSI	Site of Special Scientific Interest
SVOCs	Semi-Volatile Organic Compounds
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbon
TPH CWG	Total Petroleum Hydrocarbon Criteria Working Group
UKAS	United Kingdom Accreditation Service
VOCs	Volatile Organic Compounds
WFD	Water Framework Directive
UXO	Unexploded Ordnance Survey

Figures



Legend

- Permanent Highway Land within Fenceline (including Water Treatment Areas)
- Other Permanent Land Take
- Temporary Construction Land
- Easement Only
- Potential Area of Land Contamination based on 2014 PSSR
- Other Potential Area of Land Contamination
- Docks Way Area 2 Landfill Permit Boundary
- Active Landfill Boundary (NRW)
- Active Landfill Cell
- Landfill Cut-Off Wall
- Historical Landfill Boundary - Docks Way Phase 1
- Historical Landfill Boundary - Docks Way
- Historical Landfill Boundary - Maesglas Tip
- Historical Landfill Boundary - Land adjoining Timber Terminal South Docks

Investigation Locations

2015 (Geotechnical Engineering)
- Borehole
- Trial Pit

2007 (Norwest Holst)
- Borehole
- Trial Pit

2002 (Exploration Associates)
- Borehole
- Trial Pit

2001-2005 (Terra Firma)
- Borehole
- Trial Pit

2000 (Exploration Associates)
- Borehole
- Trial Pit
- Window Sample

2000 (PB Kennedy & Donkin)
- Borehole

1998 (Gwent Consultancy)
- Borehole

1997 (Norwest Holst)
- Borehole
- Monitoring Well Installation

Docks Way Landfill Monitoring Locations

- Groundwater Monitoring Borehole
- Gas Monitoring Borehole
- NRW Surface Water Sample Location

Llywodraeth Cymru
Welsh Government

Appendix 11.1 Annex D CL-13

Site Plan for CL-13

Figure: 1	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Scale: A3 @ 1:6,000
0 100 200 m

N

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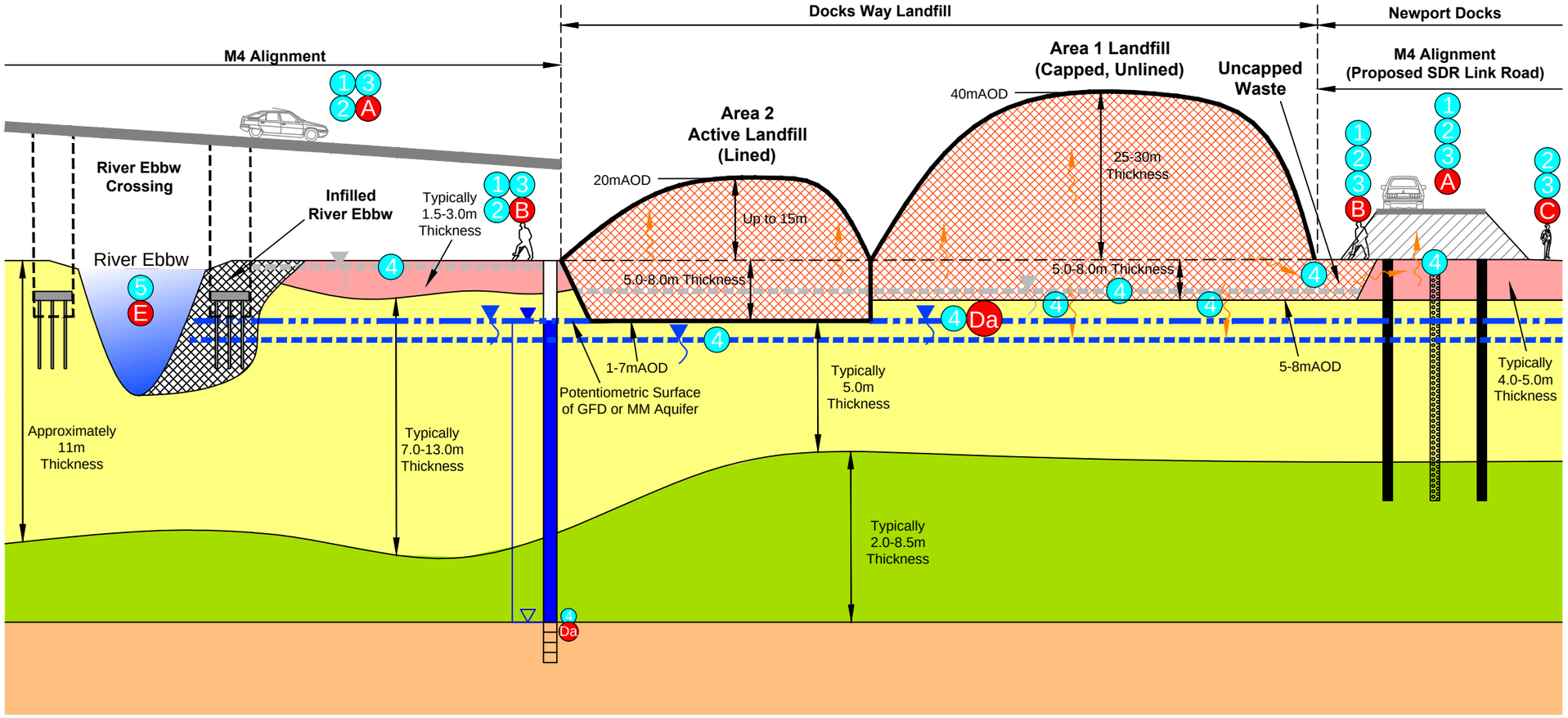
dwg ref: JER6591_Figure1_CL13SitePlan

dwg ref: JER6591_Figure1_CL13SitePlan Contains Ordnance Survey data © Crown copyright and database right 2015

CL-13 Docks Way Landfill



Ground conditions based on available information

Legend

- Landfill Material
- Infilled Ground
- Made Ground - MG
- Tidal Flat Deposits - TFD
- Glaciofluvial Deposits - GFD
- Mercia Mudstone - MM
- Proposed Pile for River Crossing
- Proposed Embankment
- Proposed Pile
- Proposed Band Drain
- Landfill Liner
- Perched Water (MG)
- Perched Groundwater (TFD)
- Groundwater (GFD and MM)
- Water Strike
- Rest Water Level
- Gas Migration Pathway

Potential Receptors

- A Humans On-Site (M4 User)
- B Humans On-Site (Construction/Maintenance)
- C Humans Off-Site (site neighbours)
- Da Groundwater (Aquifer)
- E Surface Water

Potential Pathways

- 1 Dermal Contact
- 2 Inhalation
- 3 Ingestion
- 4 Leaching / Migration
- 5 Surface Run Off

Potential Sources of Contamination

Possible contamination present on site associated with :

On-Site

- Docks Way Landfill
- Made Ground

Off-Site

- Newport Docks

NOTE
Drawing refined from PSSR Drawing Reference M4-OA-17-00DR-Z-XX-0127 (January 2014)

Llywodraeth Cymru
Welsh Government

Appendix 11.1 Annex D CL-13

Conceptual Site Model for CL-13

Figure: 2	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB
Not to Scale	

dwg ref:JER6591_Figure2_CL13ConceptualSiteModel

dwg ref: JER6591_Figure2_CL13ConceptualSiteModel

Appendices

A1 Appendix 1

Exploratory Hole Records

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF2
Sheet 1 of 9

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331008.1 E 184732.7 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Dando	Ground Level	8.80 m AOD
Client	Welsh Office	Drillers	C.A/H.J	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	04/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	13/11/1997
		Core Bit	Geocube		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring			Blow count to drive U100	SPT N & depth		Install-ation
MADE GROUND: Brown gravelly sandy clay, concrete and brick fill.				B	0.20	- 1.00				
				D	0.50					
				W	0.50					
---at 1.00m becoming very clayey				B	1.00	- 1.45		C7	1.00	
		1.20	7.60						1.45	
Soft to firm grey sandy CLAY with much sub-angular to sub-rounded gravel. (Esturarine Alluvium)				D	1.75					
				U	2.00	- 2.50	(150)			
				B	2.50	- 2.95		C9	2.50	
		2.60	6.20						2.95	
Soft brown mottled grey slightly sandy CLAY with occasional thin laminations of bluish grey silt. (Estuarine Alluvium)				D	3.25					
				U	3.50	- 3.95	(8)			
		3.70	5.10							
Very soft dark greyish brown CLAY. (Estuarine Alluvium)				D	4.00					
---from 4.00 to 9.45m slightly sandy				D	4.25					
---from 4.50 to 9.45m occasional sub-angular gravel				B	4.50	- 4.95		S1	4.50	
									4.95	

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF2
Sheet 2 of 9

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331008.1 E 184732.7 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Dando	Ground Level	8.80 m AOD
Client	Welsh Office	Drillers	C.A/H.J	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	04/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	13/11/1997
		Core Bit	Geocube		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring			Blow count to drive U100	SPT N & depth		Install-ation
Very soft dark greyish brown CLAY. (Estuarine Alluvium)				D	5.25					
				U	5.50	- 5.95	(4)			
				D	6.00					
				D	6.25					
---at 6.25 to 8.00m becoming slightly organic				B D	6.50 6.50	- 6.95		S1/450mm	6.50 6.95	
				D	7.25					
				U	7.50	- 7.95	(4)			
				D	8.00					
				D	8.50					
				B D	9.00 9.00	- 9.95		S1	9.00 9.45	
				D	10.00					

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF2
Sheet 3 of 9

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331008.1 E 184732.7 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Dando	Ground Level	8.80 m AOD
Client	Welsh Office	Drillers	C.A/H.J	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	04/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	13/11/1997
		Core Bit	Geocube		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
Very soft dark greyish brown CLAY. (Estuarine Alluvium)				D 10.00			
				U 10.50 - 10.95	(5)		
				D 11.00			
		12.00	-3.20	D 12.00			
Dense dark grey organic very clayey slightly silty sandy sub-rounded siliceous GRAVEL and occasional cobbles. (Fluvial Alluvium)				W 12.00 B 12.10 - 12.55		C29 12.10 12.55	
				D 13.00			
---from 13.50m very dense				B 13.50 - 13.95		C61 13.50 13.95	
				D 14.50			
				B 15.00 - 15.43		C50/60mm 15.00	

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No. **BHF2**
Sheet 4 of 9

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331008.1 E 184732.7 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Dando	Ground Level	8.80 m AOD
Client	Welsh Office	Drillers	C.A/H.J	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	04/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	13/11/1997
		Core Bit	Geocube		

Description of Strata	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth
Dense dark grey organic very clayey slightly silty sandy sub-rounded siliceous GRAVEL and occasional cobbles. (Fluvial Alluvium)	15.20	-6.40	B 15.00 - 15.43		C50/60mm 15.00 15.21
Very dense greyish brown sandy sub-rounded siliceous GRAVEL and occasional cobbles. (Fluival Alluvium)			D 16.00		
			B 16.50 - 16.95		C132 16.50 16.95
	17.50	-8.70	D 17.50		
Reddish brown mottled greyish green thinly laminated highly weathered MUDSTONE, weak to moderately weak. (Mercia Mudstone Group)			U 17.60 - 17.95	(170)	
			D 18.00		
---from 18.50m moderately to highly weathered moderately weak			B 18.50		
			B 18.70 - 18.90		S85/100mm 18.70
			D 18.70		18.95
			D 19.00		S50/90mm 19.00
---from 19.00 to 19.15m highly weathered very weak completely fractured	19.10	-10.30	19.00 - 19.25	TCR 50, SCR 20, RQD 0, NI 2	19.24
Reddish brown thinly sub-horizontally bedded moderately weathered very sandy MUDSTONE, moderately weak with very closely spaced sub-horizontal discontinuities planar rough tight. (Mercia Mudstone Group)	19.35	-10.55	19.25 - 19.50	64, 20, 0, NI 2 NA	
MUDSTONE As Sheet 5				15	

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF2
Sheet 5 of 9

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331008.1 E 184732.7 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Dando	Ground Level	8.80 m AOD
Client	Welsh Office	Driller	C.A/H.J	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	04/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	13/11/1997
		Core bit	Geocube		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Purplish brown very thinly to thinly sub-horizontally bedded moderately weathered silty MUDSTONE, moderately weak to moderately strong with medium to widely spaced thin beds of green fine to medium cross laminated silty sandstone slightly weathered strong and extremely closely to very closely spaced horizontal to sub-horizontal discontinuities planar rough tight. (Mercia Mudstone Group)		20.10	-11.30	19.50 - 20.80	100	35	8	6		
Green very thinly to thinly sub-horizontally bedded slightly weathered silty SANDSTONE, strong with very closely spaced sub-horizontal discontinuities planar rough tight. (Mercia Mudstone Group)		20.45	-11.65					3		
Purplish brown very thinly to thinly sub-horizontally bedded moderately to highly weathered silty MUDSTONE, moderately weak with widely spaced very thin to thin beds of green fine to medium grained slightly weathered silty sandstone with extremely closely to very closely spaced sub-horizontal discontinuities planar rough tight. (Mercia Mudstone Group) ---from 21.10 to 22.00m highly weathered very weak completely fractured				20.80 - 21.90	100	14	0	15 NI		
				21.90 - 23.20	100	52	24	NI NI NI NI		
Reddish brown thinly to medium sub-horizontally bedded moderately weathered silty MUDSTONE, moderately weak with widely spaced thin beds of green fine to medium grained cross laminated slightly weathered very silty with very closely to closely spaced sub-horizontal discontinuities planar rough tight. (Mercia Mudstone Group) ---from 23.20 to 23.40m completely fractured ---from 24.00 to 24.40m moderately to highly weathered weak completely fractured		22.85	-14.05	23.20 - 24.50	100	48	23	5 NI 3 NI 5 NI 0		
Reddish brown thinly to medium horizontally bedded moderately to highly weathered silty MUDSTONE, weak completely fractured. (Mercia Mudstone Group)		24.54	-15.74					NI NI		

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	1.00
Revised	20/09/96

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF2

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331008.1 E 184732.7 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Dando	Ground Level	8.80 m AOD
Client	Welsh Office	Driller	C.A/H.J	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	04/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	13/11/1997
		Core bit	Geocube		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown thinly to medium horizontally bedded moderately to highly weathered silty MUDSTONE, weak completely fractured. (Mercia Mudstone Group)		25.14	-16.34					1		
Reddish brown very thinly to thinly sub-horizontally bedded moderately to highly weathered silty MUDSTONE, weak completely fractured. (Mercia Mudstone Group) ---from 25.14m with closely spaced undulating fractures ---from 25.14 to 26.10m extremely to very closely spaced sub-horizontal discontinuities planar rough tight				24.50 - 26.10	91	25	0	20		
---from 26.80 to 27.10m extremely to very closely spaced sub-horizontal discontinuities planar rough tight				26.10 - 27.70	94	13	0	NI 10 NI		
				27.70 - 29.30	90	13	0	NI		
		29.64	-20.84					NI		
Reddish brown very thinly sub-horizontally bedded moderately weathered silty MUDSTONE, moderately weak with extremely to very closely spaced sub-horizontal to inclined discontinuities planar rough tight. (Mercia Mudstone Group)										

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	1.00
Revised	20/09/96

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF2
Sheet 7 of 9

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331008.1 E 184732.7 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Dando	Ground Level	8.80 m AOD
Client	Welsh Office	Driller	C.A/H.J	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	04/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	13/11/1997
		Core bit	Geocube		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown very thinly sub-horizontally bedded moderately weathered silty MUDSTONE, moderately weak with extremely to very closely spaced sub-horizontal to inclined discontinuities planar rough tight. (Mercia Mudstone Group)				29.30 - 30.90	93	9	0	>25		
		30.80	-22.00							
Reddish brown occasionally mottled green medium to thickly bedded moderately weathered silty MUDSTONE, moderately weak with medium to widely spaced discontinuities planar rough tight. (Mercia Mudstone Group)								NI		
---from 30.90 to 31.10m completely fractured				30.90 - 32.50	98	78	56	2		
---from 32.40 to 32.50m completely fractured								NI		
---from 32.50 to 32.80m completely fractured								NI		
---from 32.80m closely spaced horizontal to sub-horizontal discontinuities				32.50 - 34.00	100	37	16	5		
---from 33.40 to 33.65m moderately to highly weathered weak completely fractured								NI		
								5		
---from 34.00m extremely to very closely sub-horizontal to inclined discontinuities planar rough tight								5		
---from 34.00 to 34.20m slightly weathered				34.00 - 34.40	50	45	0	NA		
---from 34.40 to 34.65m completely fractured								NI		
								5		

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	1.00
Revised	20/09/96

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF2

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331008.1 E 184732.7 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Dando	Ground Level	8.80 m AOD
Client	Welsh Office	Driller	C.A/H.J	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	04/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	13/11/1997
		Core bit	Geocube		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown occasionally mottled green medium to thickly bedded moderately weathered silty MUDSTONE, moderately weak with medium to widely spaced discontinuities planar rough tight. (Mercia Mudstone Group)				34.40 - 35.90	100	47	15	5		
---from 35.35 to 35.80m completely fractured								NI		
								1		
---from 35.90 to 36.15m slightly weathered moderately strong completely fractured								NI		
---from 36.15m moderately to highly weathered weak				35.90 - 37.30	88	58	29	10		
---from 37.30 to 37.55m highly weathered weak completely fractured								NI		
				37.30 - 38.80	88	80	47	6		
				38.80 - 40.30	100	81	17	18		

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	1.00
Revised	20/09/96

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF2

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331008.1 E 184732.7 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Dando	Ground Level	8.80 m AOD
Client	Welsh Office	Driller	C.A/H.J	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	04/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	13/11/1997
		Core bit	Geocube		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown occasionally mottled green medium to thickly bedded moderately weathered silty MUDSTONE, moderately weak with medium to widely spaced discontinuities planar rough tight. (Mercia Mudstone Group)		40.30	-31.50							
Borehole complete at 40.30 m.										

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	1.00
Revised	20/09/96

Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
0.00-0.50	TO		07/02 0000 DRY	
0.50-1.00	B			
1.00-1.50	TO			
1.50-2.00	TO			
2.00-2.50	B			
3.00		NIL	DRY	

Strata

Description	Depth (Thickness)	Level
	G.L.	9.80
MADE GROUND: Moderately compact brown grey and red brown sandy very silty clayey angular to sub-angular fine to coarse gravel of coal, brick,concrete,slag,sandstone and limestone with some cobbles of sub-rounded sandstone	(1.50)	
Firm brown mottled grey very silty CLAY	1.50	8.30
no recovery 2.50m - 3.00m	(1.50)	
End of Borehole.	3.00	6.80

Legend

Equipment: Hand Held Window Sampler

Borehole Dia (mm) Casing Dia (mm)
80 to 1.00m
60 to 3.00m

Groundwater
No. Struck Behaviour Sealed

No groundwater encountered

Ground Level 9.80 m OD
Coordinates 331020.20 mE
184756.13 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks

See key sheet and appendices for explanations.

Form 1/0

Borehole Record

Exploration Associates

Project
M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

Contract 150006

Borehole CH9(1 of 1)

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - ROTARY

Hole ID.
SBHF02 RC
Sheet 1 of 4

Contract No.	F15056	Method	Rotary Coring	Coordinates	331023.86 E
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	T30		184673.66 N
		Driller	CB DH	Ground Level	9.18m AOD
Client	Transport Wales, Welsh Assembly Government	Logged by	T6116	Orientation	Vertical
		Core barrel	TC	Date Started	06/12/2007
Consultant	Ove Arup & Partners Ltd	Core bit		Date Completed	09/12/2007

Description of Strata	Legend	Drilled Length	Datum Level	Coring and Sampling	TCR	SCR	RQD	IF	SPT N & depth	Install-ation
FILL. (Driller's description)		2.50	6.68							
Grey/brown CLAY. (Driller's description)		5.50	3.68							
Dark grey CLAY. (Driller's description)										

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL ROTARY LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - ROTARY

Hole ID.
SBHF02 RC
Sheet 2 of 4

Contract No.	F15056	Method	Rotary Coring	Coordinates	331023.86 E
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	T30		184673.66 N
		Driller	CB DH	Ground Level	9.18m AOD
		Logged by	T6116	Orientation	Vertical
Client	Transport Wales, Welsh Assembly Government	Core barrel	TC	Date Started	06/12/2007
Consultant	Ove Arup & Partners Ltd	Core bit		Date Completed	09/12/2007

Description of Strata	Legend	Drilled Length	Datum Level	Coring and Sampling		TCR	SCR	RQD	IF	SPT N & depth	Install-ation
Dark grey CLAY. (Driller's description)											
		13.50	-4.32								
Claybound GRAVELS. (Driller's description)											
		15.00	-5.82								
SAND and GRAVELS/Cobbles. (Driller's description)											
		17.30	-8.12								
Soft MARL/GRAVELS. (Driller's description)											
		17.80	-8.62								
Zone of core loss. MARL. (Driller's description)				17.80	18.80	0	NA	NA	NA		
		18.80	-9.62							18.80 18.99 S100/40mm	
Extremely weak to very weak reddish brown mottled grey locally grey and greenish grey MUDSTONE. Discontinuities: 1) 0-10 deg very closely to closely spaced undulating rough locally clay infilled. 2) 40 - 60 deg medium to widely spaced undulating rough locally gypsum infilled. (Mercia Mudstone Group)				18.80	19.80	50	0	0			

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL ROTARY LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - ROTARY

Hole ID.
SBHF02 RC
Sheet 3 of 4

Contract No.	F15056	Method	Rotary Coring	Coordinates	331023.86 E
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	T30		184673.66 N
		Driller	CB DH	Ground Level	9.18m AOD
		Logged by	T6116	Orientation	Vertical
Client	Transport Wales, Welsh Assembly Government	Core barrel	TC	Date Started	06/12/2007
Consultant	Ove Arup & Partners Ltd	Core bit		Date Completed	09/12/2007

Description of Strata	Legend	Drilled Length	Datum Level	Coring and Sampling	TCR	SCR	RQD	IF	SPT N & depth	Install-ation
Remaining Detail : 18.81m - 19.30m : ---from 18.80m to 19.30m recovered as non intact core (angular fine to coarse gravel sized fragments of grey mudstone) Detail 19.30m - 19.80m : ---from 19.30m to 19.80m assumed zone of core loss ---from 19.80m to 19.92m recovered as non intact core (angular fine to coarse gravel sized fragments of greenish grey mudstone) ---from 19.97m to 20.09m recovered as non intact core (angular fine to coarse gravel sized fragments of greenish grey mudstone) ---from 20.09m to 20.65m recovered as non intact core (angular fine to coarse sand sized fragments) ---from 20.65m to 20.80m assumed zone of core loss ---from 20.80m to 23.02m recovered as non intact core (gravelly clay. Gravel sized fragments are angular fine to coarse)				19.80 20.80	85	6	0	NI NI 60	20.80 20.88 S100/50mm	
				20.80 22.30	100	0	0			
				22.30 23.80	100	26	15	NI 40 150		
---from 23.08m to 23.30m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 23.45m to 23.47m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 23.63m to 23.80m recovered as non intact core (angular to subangular fine to coarse gravel sized fragments) ---from 23.95m to 24.19m recovered as non intact core (clayey angular fine to coarse gravel sized fragments) ---from 24.46m to 24.53m recovered as non intact core (angular to subangular fine to coarse gravel sized fragments) ---from 24.72m to 24.78m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 24.90m to 25.30m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 25.38m to 25.51m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 25.58m to 25.73m recovered as non intact core (angular to subrounded fine to coarse gravel sized fragments) ---from 25.80m to 25.87m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 25.90m to 26.05m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 26.25m to 26.40m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 26.45m to 26.48m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 26.55m to 26.65m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 26.70m to 26.80m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 26.80m to 28.30m recovered as non intact core (gravelly clay. Gravel sized fragments are angular fine to coarse) ---from 28.51m to 28.90m recovered as non intact core (angular to subangular fine to coarse gravel sized fragments) ---from 29.22m to 29.30m recovered as non intact core (gravelly clay. Gravel sized fragments are angular fine) ---from 29.55m to 29.60m recovered as non intact core				23.80 25.30	100	25	0	NI NI 80		
				25.30 26.80	100	35	0			
				26.80 28.30	100	0	0	NI NI NI		
				28.30 29.80	87	51	39	NI 120 220		

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL ROTARY LOG
Version	3.09
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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - ROTARY

Hole ID.
SBHF02 RC
Sheet 4 of 4

Contract No.	F15056	Method	Rotary Coring	Coordinates	331023.86 E
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	T30		184673.66 N
		Driller	CB DH	Ground Level	9.18m AOD
		Logged by	T6116	Orientation	Vertical
Client	Transport Wales, Welsh Assembly Government	Core barrel	TC	Date Started	06/12/2007
Consultant	Ove Arup & Partners Ltd	Core bit		Date Completed	09/12/2007

Description of Strata	Legend	Drilled Length	Datum Level	Coring and Sampling		TCR	SCR	RQD	IF	SPT N & depth	Install-ation
Remaining Detail : 29.55m - 29.60m : (gravelly clay. Gravel sized fragments are angular fine to coarse) Detail 29.60m - 29.80m : ---from 29.60m to 29.80m assumed zone of core loss Detail 29.80m - 29.99m : ---from 29.80m to 29.99m recovered as non intact core (clayey angular fine to coarse gravel sized fragments) ---from 30.03m to 30.27m recovered as non intact core (clayey angular fine to coarse gravel sized fragments) ---from 30.31m to 30.92m recovered as non intact core (gravelly clay. Gravel sized fragments are angular fine to medium) ---from 31.10m to 31.30m recovered as non intact core (gravelly clay. Gravel sized fragments are fine to coarse with occasional angular fine to coarse gravel pieces of white gypsum) ---from 31.30m to 31.34m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 31.40m to 31.49m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 31.60m to 31.76m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 31.92m to 32.15m recovered as non intact core (gravelly clay. Gravel sized fragments are angular fine to medium) ---from 32.30m to 32.71m recovered as non intact core (gravelly clay. Gravel sized fragments are angular fine to coarse) ---from 32.80m to 36.73m recovered as non intact core (gravelly clay. Gravel sized fragments are angular to subangular fine to coarse)				29.80	31.30	100	17	0			
				31.30	32.80	94	37	0			
				32.80	34.30	100	0	0	NI NI 100		
				34.30	35.80	81	0	0			
				35.80	37.10	85	13	8			
---from 36.90m to 37.10m assumed zone of core loss ---from 37.10m to 37.20m recovered as non intact core (angular coarse gravel sized fragments) ---from 37.25m to 37.45m recovered as non intact core (angular coarse gravel sized fragments) ---from 37.45m to 37.83m recovered as non intact core (angular coarse gravel sized fragments) ---from 37.90m to 37.96m recovered as non intact core (angular coarse gravel sized fragments) ---from 38.21m to 38.42m recovered as non intact core (angular coarse gravel sized fragments) ---from 38.50m to 39.15m recovered as non intact core (angular to subangular fine to coarse gravel sized fragments) ---from 39.30m to 39.68m recovered as non intact core (angular fine to coarse gravel sized fragments)				37.10	38.50	94	33	0	NI 50 100		
				38.50	40.00	100	17	7			

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL ROTARY LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - ROTARY

Hole ID.
SBHF02 RC
Sheet 4+ of 4

Contract No.	F15056	Method	Rotary Coring	Coordinates	331023.86 E
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	T30		184673.66 N
		Driller	CB DH	Ground Level	9.18m AOD
		Logged by	T6116	Orientation	Vertical
Client	Transport Wales, Welsh Assembly Government	Core barrel	TC	Date Started	06/12/2007
Consultant	Ove Arup & Partners Ltd	Core bit		Date Completed	09/12/2007

Description of Strata	Legend	Drilled Length	Datum Level	Coring and Sampling	TCR	SCR	RQD	IF	SPT N & depth	Install-ation
Remaining Detail : 39.80m - 39.85m : ---from 39.80m to 39.85m recovered as non intact core (angular coarse gravel sized fragments)		40.00	-30.82							
Rotary drilling complete at 40.00 m.										

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL ROTARY LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHF02A CP
Header

Contract No.	F15056	Method	Cable Percussion	Coordinates	331024.11 E
Project	New M4 - Second Preliminary Ground Investigation				184677.11 N
		Drilling Rig	Dando 2000	Ground Level	9.17m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	SJ	Orientation	Vertical
		Logged by	DH	Date Started	12/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	18/12/2007

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
12/12/2007	1730	7.05	6.00	DRY	End of Shift
13/12/2007	0730	7.05	6.00	DRY	Start of Shift
13/12/2007	1730	14.45	14.00	9.30	End of Shift
14/12/2007	0730	14.45	14.00	7.50	Start of Shift
14/12/2007	1730	16.45	16.45	7.50	End of Shift
17/12/2007	0730	16.45	17.30	8.30	Start of Shift
17/12/2007	1730	17.30	17.30	7.00	End of Shift
18/12/2007	0730	17.30	17.30	8.50	Start of Shift
18/12/2007	1000	17.30	17.30	8.00	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks
14.70	14.70	1.00	Chiselling
16.00	16.30	1.00	Chiselling
16.50	16.90	1.00	Chiselling
16.90	17.30	1.00	Chiselling
17.30	17.30	0.75	Chiselling

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
200	17.30	200	17.30

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
13/12/2007		13.05	8.30	20	Fast	12.00	NR

GENERAL NOTES

1. Service inspection pit hand excavated from GL to 1.20m.
2. Insitu permeability testing carried out from 15.00m to 16.00m.
3. Cable Percussive boring complete at 17.75m.
4. 1 No 19mm piezometer, tip at 17.00m, response zone 16.70m to 17.30m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration	Casing	Water Depth
1.20	S	N=7 (5,2,1,2,2,2)	2.00	DRY
2.60	S	N=4 (1,1,1,1,1,1)	2.00	DRY
4.60	S	N=2 (1,0,1,0,1,0)	4.00	DRY
6.60	S	N=4 (1,1,1,1,1,1)	8.00	DRY
8.60	S	N=2 (1,0,1,0,1,0)	8.00	DRY
10.60	S	N=4 (1,1,1,1,1,1)	12.00	8.30
12.60	S	N=14 (1,1,1,1,4,8)	14.00	8.30
14.00	S	N=42 (1,2,6,8,8,20)	14.00	8.30
16.00	S	N=47 (9,9,12,10,15,10)	16.00	7.50
17.30	S	N=49 (9,15,8,9,12,20)	17.30	8.50

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes, chiselling time in hours.

Form	ARIAL CP HEADER
Version	3.05
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHF02A CP
Sheet 1 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	331024.11 E
Project	New M4 - Second Preliminary Ground Investigation				184677.11 N
		Drilling Rig	Dando 2000	Ground Level	9.17m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	SJ	Orientation	Vertical
		Logged by	DH	Date Started	12/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	18/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Brown slightly sandy slightly gravelly clay. Sand sized fragments are fine to coarse. Gravel sized fragments are angular to subangular fine to medium of mudstone, brick, timber and ash.				D1	1.20 - 1.65	S7	S	1.20 1.65	
		2.00	7.17	B2	2.00	(20)			
Very soft to soft low strength grey mottled orangish brownslightly gravelly silty CLAY. Gravel is angular to subangular fine to medium of sandstone. (Estuarine Alluvium)				D3	2.00				
				U4	2.00 - 2.45				
				D5	2.45 - 2.60				
				D6	2.60 - 3.05	S4	S	2.60 3.05	
				D7	3.05 - 4.00				
				D8	3.05 - 4.00				
				U9	4.00 - 4.45	(40)			
---from 4.45m becomes stained brown				D10	4.60 - 5.05	S2	S	4.60 5.13	
				D11	4.60 - 5.05				
				B12	5.05 - 6.00				
				D13	5.91 - 6.00				
				U14	6.00 - 6.45	(30)			
				D15	6.45 - 6.60				
				D16	6.60 - 7.05	S4	S	6.60 7.05	
				B17	7.05 - 8.00				
				D18	8.00				
				W32	8.30				
				D19	8.60	S2	S	8.60 9.13	
				D20	8.60 - 9.05				
				D21	9.05 - 10.00				
				D22	9.05 - 10.00				
				D23	9.05 - 10.00				

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHF02A CP
Sheet 2 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	331024.11 E
Project	New M4 - Second Preliminary Ground Investigation				184677.11 N
		Drilling Rig	Dando 2000	Ground Level	9.17m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	SJ	Orientation	Vertical
		Logged by	DH	Date Started	12/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	18/12/2007

Description of Strata	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth	
Very soft to soft low strength grey mottled orangish brownslightly gravelly silty CLAY. Gravel is angular to subangular fine to medium of sandstone. (Estuarine Alluvium)			U24	10.00 - 10.45	(40)		
	10.45	-1.28	D25	10.45 - 10.60			
---10.21m with extremely closely to closely spaced thin laminations of brown fine to medium sand.			D26	10.60 - 11.05	S4	S	10.60 11.05
Firm to stiff high strength greyish brown slightly sandy silty CLAY. Sand is fine to medium. (Estuarine Alluvium)			B27	11.05 - 12.00			
			D28	11.05 - 12.00			
			U29	12.00 - 12.45	(60)		
			D30	12.15 - 12.60			
Firm dark grey slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is rounded to subangular fine to coarse of mudstone, siltstone and sandstone. (Estuarine Alluvium)	12.60	-3.43	D31	12.60 - 13.05	S14	S	12.60 13.05
			B33	13.05 - 14.00			
			D34	13.05 - 14.00			
			D35	14.00 - 14.45	S42	S	14.00 14.45
Dense sandy grey subrounded to rounded fine to coarse GRAVEL of mudstone, siltstone and sandstone. (Fluvial Alluvium)	14.50	-5.33	D36	14.50 - 15.00			
			B37	14.50 - 15.00			
---from 16.00m with high cobble content, cobbles are subrounded of sandstone			D38	16.00 - 16.45	S47	S	16.00 16.45
Very stiff reddish brown slightly gravelly CLAY. Gravel sized fragments are angular fine to medium (Weathered Mudstone). (Mercia Mudstone Group)	17.30	-8.13	D39	17.30 - 17.75	S49	S	17.30 17.75
Cable Percussion boring complete at 17.75 m.	17.75	-8.58					

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
Version	3.09
Revised	17/12/2007

Geotechnical Engineering Limited

BOREHOLE LOG

BH411

CLIENT	WELSH GOVERNMENT					Sheet	1 of 4
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	9 March 2015	Easting	330881.9			Depth	30.00 m
End Date	19 March 2015	Northing	184595.3	Ground level	6.55mOD		

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
09/03/15 1430hrs	1B	0.20	0.40						Topsoil (100mm) over dark brown and black slightly sandy angular and subangular fine to coarse slag GRAVEL. (MG)	0.40	6.15	
	2D*	0.50	0.60		Vo 0.1				Brown and orangish brown sandy very gravelly CLAY. Gravel is angular to subrounded fine to coarse mudstone, slag and brick. (MG)			
	3B	0.60	0.90									
09/03/15 1630hrs Dry	4B	1.00	1.20						1.00 - 1.40m: Gravelly.			
	5D*	1.00	1.10		Vo 0.3							
	6D	1.20	1.65	1.20	S 4							
10/03/15 0800hrs 1.10m	7B	1.20	1.70							1.40	5.15	
	8D	1.40							Firm greyish brown slightly sandy silty CLAY with rare rootlets (up to 1mm diam). (TFD)			
	9D*	1.50	1.60		Vo 0.4							
	10UT	1.70	2.15	1.70								
	12D*	2.00	2.10		Vo 0.4							
	11D	2.20										
	13D	2.20	2.65	2.20	S 6					2.30	4.25	
	14B	2.20	2.70						Soft greenish grey mottled dark greenish grey slightly sandy silty CLAY. (TFD)			
	15D	2.40										
	16D*	2.50	2.60		Vo 0.5							
	17UT	2.70	3.15	2.60								
	19D*	3.00	3.10		Vo 0.4					3.10	3.45	
	18D	3.20							Soft greenish grey slightly sandy silty CLAY with frequent fragments of fibrous organic material (up to 30mm). (TFD)			
	20D	3.20	3.65	3.00	S 3							
	21B	3.20	3.70									
	22D*	3.50	3.60		Vo 0.4				3.50m: Driller notes peat.	3.70	2.85	
	23D	3.60							Firm bluish grey slightly sandy clayey SILT with frequent fragments of fibrous organic material (up to 20mm). (TFD)			
	24D	3.70	4.15	3.50	S 8							
	25B	3.70	4.20									
	26D*	4.00	4.10		Vo 0.3							
	27D	4.00		4.00								
	28UT	4.20	4.65		Vo 0.1							
	30D*	4.50	4.60							4.70	1.85	
	29D	4.70		4.50	S 7				Soft bluish grey silty CLAY with frequent fragments of fibrous organic material (up to 20mm). (TFD)			
	31D	4.70	5.15									
	32B	4.70	5.20									
	33D*	5.00	5.10									
	34B	5.40	5.80									
	35D	5.50										
		5.80		4.50	V 4							
	36D*	6.00	6.10						5.80m: Extremely low strength.			
	37P	6.00	7.00			P/S						
										6.70	-0.15	
									Soft brownish grey and dark brown peaty CLAY. (TFDP)			
	38D*	7.00	7.10									
	39D	7.50	7.95	7.00	S 6							
	40B	7.50	8.00									
									Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig and Comacchio MC205 rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Cable percussion (200mm) 1.20-2.30m and (150mm) 2.30-15.00m. Waterflush rotary core drilled (116mm) 15.00-30.00m. CASING: 200mm to 1.50m, 150mm diam to 14.70m and 140mm diam to 17.50m. BACKFILL: On completion, borehole backfilled with bentonite pellets 30.00-14.00m. A slotted standpipe (50mm) was installed to 14.00m, granular response zone 14.00-9.50m and bentonite seal 9.50-8.00m. A second slotted standpipe (35mm) was installed to 8.00m, granular response zone 8.00-3.00m, bentonite seal 3.00-0.20m, concrete and raised cover 0.20-0.00m.

REMARKS: Hole advanced by chiselling 9.90-10.30m (1hr), 10.80-11.10m (1hr), 12.70-13.30m (2hrs 30mins), 13.50-14.20m (2hrs 30mins), and 14.60-15.00m (1hr). Downhole magnetometry for UXO risk mitigation undertaken 0.00-9.50m. No anomalies encountered. Bentonite seal for aquifer protection installed during drilling 2.30-1.00m, prior to reduction in casing diameter. Falling head permeability test undertaken 8.50-9.00m. MMG = Mercia Mudstone Group. Weathering Grade after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
0.30	Nil	0.30	20	

AGS

CONTRACT	CHECKED
30238	EC

Geotechnical Engineering Limited

BOREHOLE LOG

BH411

CLIENT	WELSH GOVERNMENT					Sheet	2 of 4
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	9 March 2015	Easting	330881.9			Depth	30.00 m
End Date	19 March 2015	Northing	184595.3	Ground level	6.55mOD		

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	41D*	8.00	8.10							8.20	-1.65	
	P	8.30	8.70						Soft bluish grey slightly gravelly very sandy CLAY. Gravel is subangular and subrounded fine and medium sandstone. (RTD)			
	42D	8.30										
	43B	8.30	8.70									
10/03/15 1700hrs Dry												
11/03/15 0800hrs 8.70m										9.20	-2.65	
		9.50	9.95	9.50	C 41				Dense greenish grey sandy rounded and well rounded medium and coarse sandstone and quartz GRAVEL with a medium rounded and well rounded sandstone cobble content. (RTD)			
	44B	9.50	9.90									
										10.50	-3.95	
									Dense brownish grey gravelly fine to coarse SAND. Gravel is subangular to well rounded fine to coarse sandstone and quartz. (RTD)			
		11.00	11.45	11.00	C 37							
	45B	11.10	11.50									
										12.00	-5.45	
									Very dense brownish grey sandy gravelly rounded and well rounded sandstone and quartz COBBLES. Gravel is rounded and well rounded fine to coarse sandstone and quartz. (RTD)			
		12.50	12.88	12.50	C*77							
	46B	12.50	12.70									
										13.00	-6.45	
11/03/15 1700hrs 8.00m	47B	13.30	13.50						Brownish grey sandy rounded and well rounded fine to coarse sandstone and quartz GRAVEL with a low well rounded sandstone cobble content. (RTD)			
12/03/15 0800hrs 6.10m												
		14.00	14.45	14.00	C 20							
	48B	14.00	14.50							14.20	-7.65	
	49D	14.30							Firm reddish brown mottled bluish grey slightly sandy silty CLAY. (MMG) (Grade IVb)			
	50D	14.50	14.76	14.00	S*144					14.50	-7.95	
	51B	14.50	15.00						Firm reddish brown mottled bluish grey slightly sandy silty CLAY with frequent subangular tabular fine gravel sized extremely weak mudstone lithorelicts. (MMG) (Grade IVa)			
12/03/15 1200hrs 7.20m	52D	15.00	15.14	14.70	S*652					15.00	-8.45	
16/03/15 0830hrs 6.40m	53C	15.00	16.50	15.00		73	NA		Stiff and very stiff fissured reddish brown slightly gravelly CLAY with frequent light greenish grey reduction spots (up to 20mm). Gravel is angular and subangular fine to coarse lithorelicts of very stiff clay and extremely weak mudstone. (MMG) (Grade III)			
	54C	16.50	18.00	15.50		90						
16/03/15 1650hrs 6.10m												
									Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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BOREHOLE LOG

BH411

CLIENT	WELSH GOVERNMENT					Sheet	3 of 4
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	9 March 2015	Easting	330881.9			Depth	30.00 m
End Date	19 March 2015	Northing	184595.3	Ground level	6.55mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
17/03/15 0830hrs 3.45m	55C	18.00 - 19.50	15.50		75						
	56C	19.50 - 21.00	17.50		93						
	57C	21.00 - 22.50	17.50		96			21.10 - 21.30m: Angular and subangular coarse gravel sized mudstone lithorelicts.			
	58C	22.50 - 24.00	17.50		93						
17/03/15 1700hrs NR								23.70 - 23.85m: 10mm 70° vein of gypsum.			
18/03/15 0830hrs 6.40m	59C	24.00 - 25.50	17.50		96						
	60C	25.50 - 27.00	17.50		95						
	61C	27.00 - 28.50	17.50		89						
								Continued Next Page	{28.00}		

water strike (m) casing (m) rose to (m) time to rise (m) remarks

AGS

CONTRACT **30238**

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BOREHOLE LOG

BH411

CLIENT	WELSH GOVERNMENT					Sheet	4 of 4
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	9 March 2015	Easting	330881.9			Depth	30.00 m
End Date	19 March 2015	Northing	184595.3	Ground level	6.55mOD		

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
18/03/15 1645hrs 6.80m												
19/03/15 0830hrs 6.50m	62C	28.50	30.00	17.50		93						
19/03/15 1400hrs 6.50m										30.00	-23.45	
		30.00	30.30	17.50	C*100				Borehole completed at 30.00m.			
										{38.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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BOREHOLE LOG

BH412

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	1 of 4
Start Date	17 February 2015	Easting	331036.1	Scale	1 : 50
End Date	25 February 2015	Northing	184685.1 Ground level 10.50mOD	Depth	35.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
17/02/15 0800hrs	1B	0.00 - 0.50						MADE GROUND comprising black TARMACADAM. (MG)	0.10	10.40	
	2D*	0.00 - 0.50		Vo 0.5				Light grey sandy angular and subangular fine to coarse crystalline GRAVEL. (MG)	0.50	10.00	
	3B	0.50 - 1.20						Soft dark brownish grey slightly sandy gravelly CLAY. Gravel is subangular and subrounded fine to coarse slag and brick. (MG)			
	4D*	0.50 - 1.00		Vo 0.6							
		1.20 - 1.65	1.20	C 8				1.20 - 1.65m: Loose very clayey very sandy subangular and subrounded fine to coarse slag and brick gravel.			
	5B	1.20 - 1.65									
	6D*	1.20 - 1.70		Vo 0.7							
	7D	1.65 - 2.10	1.50	S 3							
	8B	1.65 - 2.10									
	9D*	1.70 - 2.20		Vo 1.2							
	10D	2.10 - 2.55	2.10	S 9							
	11B	2.10 - 2.55									
	12D*	2.20 - 2.70		Vo 3.5							
	13D	2.55 - 3.00	2.50	S 9							
17/02/15 1700hrs 2.80m	14B	2.55 - 3.00							2.80	7.70	
	15B	2.90 - 3.00						Soft dark grey mottled brown sandy gravelly CLAY with medium sandstone cobble content. Gravel is subangular and subrounded fine to coarse sandstone. (MG)			
	16D*	2.90 - 3.20		Vo 2.2							
18/02/15 1345hrs 2.90m	17D	3.00 - 3.45	2.90	S 3					3.40	7.10	
	18B	3.40 - 3.50						Soft to firm light grey mottled dark grey slightly sandy slightly gravelly silty CLAY. Gravel is subangular and subrounded fine mudstone and sandstone. (TFD)			
	19D	3.50 - 3.95	3.40	S 11							
	20B	3.90 - 4.00									
	21UT	4.00 - 4.45							4.20	6.30	
	22B	4.40 - 4.50						Firm brown mottled grey slightly sandy slightly gravelly silty CLAY. Gravel is subangular fine to coarse mudstone. (TFD)			
	23D*	4.40 - 4.60									
	24D	4.50 - 4.95	4.40	S 5							
	25B	4.90 - 5.00							4.90	5.60	
	26D*	4.90 - 5.10						Soft brownish grey slightly sandy CLAY. (TFD)			
	27UT	5.00 - 5.45									
									6.10	4.40	
	28B	6.40 - 6.50						Very soft and soft brownish grey slightly sandy CLAY. (TFD)			
	29D*	6.40 - 6.70									
	30D	6.50 - 6.95	6.40	S 3							
18/02/15 1700hrs NR	31B	7.90 - 8.00									

Continued Next Page {8.00}

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Cable percussion (200mm) 1.20-6.00m and (150mm) 6.00-20.50m. Waterflush rotary core drilled (116mm) 20.50-35.00m. CASING: 200mm diam to 6.00m 150mm diam to 20.50m. BACKFILL: On completion, borehole backfilled with bentonite seal 35.00-20.00m. A slotted standpipe (50mm) with geo-sock was installed to 20.00m, granular response zone 20.00-15.00m and bentonite seal 15.00-3.00m. A second slotted standpipe (35mm) with geo-sock was installed to 3.00m, granular response zone 3.00-1.00m, bentonite seal 1.00-0.20m, concrete and stopcock cover 0.20-0.00m. REMARKS: Hole advanced by chiselling 15.50-16.00m (1.5hr), 16.80-17.30m (1hr), 17.50 yielding no penetration (1hr), 17.50-18.00m (1hr), 18.50-19.00m (1hr), 20.40-20.50m (1hr). Downhole magnetometry for UXO risk mitigation undertaken 0.00-14.80m. No anomalies encountered. Falling head permeability test undertaken at 11.00m- 12.00m. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
3.00	2.50	2.80	20	Seepage.

AGS

CONTRACT	CHECKED
30238	EC

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BOREHOLE LOG

BH412

CLIENT	WELSH GOVERNMENT					Sheet	2 of 4
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	17 February 2015	Easting	331036.1			Depth	35.00 m
End Date	25 February 2015	Northing	184685.1	Ground level	10.50mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
19/02/15 0800hrs Dry	32UT	8.00 - 8.45	8.00								
	33D	8.45 - 8.60									
	34B	8.00 - 9.50									
	35D	9.50 - 9.95	9.50	S 1							
	36B	9.50 - 11.00									
	37UT	11.00 - 11.40	11.00								
	38D	11.40 - 11.60									
	39B	11.00 - 12.50									
	40D	12.50 - 12.95	12.50	S 1							
	41B	12.50 - 13.20									
	42UT	13.20 - 13.60	13.00								
	43D	13.60 - 13.80									
	44B	13.20 - 13.80	13.60	S 28							
	45D	13.80 - 14.25									
	46B	13.80 - 14.80									
								Stiff grey mottled brown gravelly CLAY. Gravel is subangular and subrounded fine sandstone. (RTD)	13.80	-3.30	
19/02/15 1545hrs 10.80m		14.80 - 15.23	14.80	C*54					14.80	-4.30	
	47B	14.80 - 16.30						Dense to very dense grey slightly sandy subangular and subrounded fine to coarse sandstone GRAVEL with a low subangular sandstone cobble content. (RTD)			
20/02/15 0830hrs 9.40m											
		16.30 - 16.75	16.30	C 47							
	48B	16.30 - 17.50						16.30 - 17.50m: Very sandy.			
20/02/15 1230hrs NR		17.50 - 17.68	17.50	C*313					17.50	-7.00	
23/02/15 0800hrs 6.75m	49B	17.50 - 19.00						Very dense brown locally slightly clayey gravelly fine to coarse SAND with low subangular sandstone cobble content. Gravel is subrounded fine to coarse sandstone.			
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks
13.60	13.00	10.40	20	Fast inflow.

AGS

CONTRACT	CHECKED
30238	EC

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BOREHOLE LOG

BH412

CLIENT	WELSH GOVERNMENT					Sheet	3 of 4
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	17 February 2015	Easting	331036.1			Depth	35.00 m
End Date	25 February 2015	Northing	184685.1	Ground level	10.50mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
								(RTD)			
	50B	19.00 - 19.45 19.00 - 19.40	19.00	C 29				19.00m: Dense.			
	51B	19.40 - 19.85 19.40 - 20.00	19.40	C 29		NI		Extremely weak and very weak purplish brown and reddish brown locally mottled light greenish grey MUDSTONE recovered as slightly sandy very clayey angular and subangular fine to coarse mudstone gravel. (MMG) (Grade II)	19.40	-8.90	
23/02/15 1600hrs 11.95m	52D 53B 54D	20.00 - 20.32 20.00 - 20.40 20.40 - 20.52 20.40 - 20.50	20.00 20.00	S*88 C*366					20.50	-10.00	
24/02/15 1130hrs 9.22m	55C	20.50 - 22.00	20.50		100 6 0	NI		Extremely weak thinly laminated to very thinly bedded reddish brown MUDSTONE. Fractures are subhorizontal to 20° extremely closely spaced planar smooth. (MMG) (Grade II) 20.85 - 21.40m: Locally light greenish grey.	21.40	-10.90	
						NA		Stiff fissured reddish brown gravelly CLAY with frequent light greenish grey reduction spots (up to 20mm). Gravel is subangular fine to coarse mudstone lithorelicts. (MMG) (Grade III)	22.00	-11.50	
	56C	22.00 - 23.50	20.50		96 4 0	NI		21.90 - 22.00m: Light greenish grey.			
						NA		Extremely weak thinly laminated to very thinly bedded reddish brown MUDSTONE. Fractures are subhorizontal to 20° extremely closely spaced planar smooth. (MMG) (Grade II) 22.00 - 22.20m: Recovered non intact. 22.70 - 22.90m: 70° to subvertical fracture planar smooth.	22.90	-12.40	
	57C	23.50 - 25.00	20.50		86			Stiff fissured reddish brown gravelly CLAY with frequent light greenish grey reduction spots (up to 20mm). Gravel is subangular fine to coarse mudstone lithorelicts. (MMG) (Grade III) 23.70 - 23.90m: Tending to extremely weak mudstone. 24.75 - 25.10m: Tending to extremely weak mudstone.			
	58C	25.00 - 26.50	20.50		97 0 0				25.50	-15.00	
24/02/15 1530hrs 4.20m						NI		Extremely weak thinly laminated reddish brown MUDSTONE with frequent light greenish grey reduction spots (up to 20mm). Fractures are subhorizontal to 20° and subvertical extremely closely and very closely spaced planar smooth. (MMG) (Grade I/II)			
25/02/15 0830hrs 5.10m	59C	26.50 - 28.00	20.50		93 27 0	NI 20 40			27.40	-16.90	
						NA		Stiff fissured reddish brown gravelly CLAY with frequent light greenish grey reduction spots (up to 20mm). Gravel is subangular fine to coarse mudstone lithorelicts. (MMG)			
								Continued Next Page	{28.00}		

water strike (m) casing (m) rose to (m) time to rise (m) remarks

AGS

CONTRACT **30238**

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BOREHOLE LOG

BH412

CLIENT	WELSH GOVERNMENT					Sheet	4 of 4
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	17 February 2015	Easting	331036.1			Depth	35.00 m
End Date	25 February 2015	Northing	184685.1	Ground level	10.50mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	60C	28.00 - 29.50	20.50		96 5 0			(Grade III)	29.20	-18.70	
	61C	29.50 - 30.50	20.50		60 3 0	NI NI 70		Extremely weak thinly laminated reddish brown MUDSTONE with frequent light greenish grey reduction spots (up to 20mm). Fractures are subhorizontal to 20° and subvertical extremely closely spaced planar smooth. (MMG) (Grade I/II)	30.50	-20.00	
	62C	30.50 - 32.00	20.50		100 0 0	NA		Very stiff fissured reddish brown gravelly CLAY with frequent light greenish grey reduction spots (up to 20mm). Gravel is subangular fine to coarse mudstone lithorelicts. (MMG) (Grade III)	31.70	-21.20	
	63C	32.00 - 33.50	20.50		95 0 0	NI		Extremely weak thinly laminated reddish brown MUDSTONE with rare light greenish grey reduction spots (up to 20mm) locally tending to claybound angular and subangular fine to coarse gravel sized mudstone lithorelicts. Fractures are subhorizontal to 20° and subvertical extremely closely spaced planar smooth. (MMG) (Grade I/II)	33.50	-23.00	
25/02/15 1530hrs 4.82m	64C	33.50 - 35.00	20.50		100	NA		Very stiff fissured reddish brown gravelly CLAY with frequent light greenish grey reduction spots (up to 20mm). Gravel is subangular fine to coarse mudstone lithorelicts. (MMG) (III)	35.00	-24.50	
								Borehole completed at 35.00m.	{38.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
					30238	EC

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BOREHOLE LOG

BH413

CLIENT	WELSH GOVERNMENT					Sheet	1 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	21 January 2015	Easting	331120.3				
End Date	5 February 2015	Northing	184819.6	Ground level	9.90mOD	Depth	40.00 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
21/01/15 1300hrs	1B	0.20	0.40						Dark and light grey sandy subangular fine and medium limestone GRAVEL. (MG)	0.40	9.50	
	2D*	0.20	0.30		Vo 0.2				Dark and light grey sandy subangular fine to coarse crystalline rock and brick GRAVEL with rare plant fragments (up to 20mm). (MG)	0.80	9.10	
	3B	0.40	0.80						Loose and medium dense dark and light grey sandy subangular fine to coarse crystalline rock, limestone and brick GRAVEL with low subangular limestone cobble content. (MG) 1.20 - 1.65m: Locally very dense			
	4D*	0.40	0.50		Vo 0.7							
	5B	0.80	1.20									
21/01/15 1430hrs Dry	6D*	0.80	1.20		Vo 0.4							
	7D	1.20	1.65	1.20	S 52							
26/01/15 0900hrs Dry	8B	1.20	1.70									
	9D	1.70	2.15	1.20	S 9							
	10B	1.70	2.15									
	11D*	1.70										
	12D	2.15	2.60	2.15	S 13							
	13B	2.15	2.60									
	14D*	2.15										
	15D	2.60	3.05	2.60	S 8							
	16B	2.60	3.00									
	17D*	2.60										
	18D	3.00	3.45	3.00	S 4							
26/01/15 1550hrs 3.25m	19B	3.00	3.50									
	20D*	3.05										
	21D	3.50	3.95	3.50	S 11							
27/01/15 0815hrs 2.60m	22B	3.50	4.00									
	23D*	3.50										
	24D	4.00	4.45	4.00	S 8							
	25B	4.00	4.50									
	26D*	4.00										
	27D	4.50	4.95	4.50	S 9							
	28B	4.50	5.00									
	29D*	4.50										
	30UT	5.00	5.45	5.00					Soft light grey mottled black and light brown organic silty CLAY. (TFD)	5.00	4.90	
	31D	5.45	5.50									
	32B	5.50	6.50									
	33D*	5.50										
	34D	6.50	6.95	6.50	S<1				6.50 - 12.00m: Very soft. Very soft light grey mottled black and light brown organic silty CLAY. (TFD)	6.50	3.40	
	35B	7.00	7.50									
	36D*	7.00										
									Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Cable percussion (200mm) 1.20 - 5.00m and (150mm) 5.00-19.00m and Pioneer 19.00 - 40.00m. Waterflush rotary core drilled (116mm) 19.00-40.00m.

CASING: (200mm) 0.00-5.00m and (150mm) 5.00-18.50m. BACKFILL: On completion, borehole backfilled with bentonite 40.00-18.00m. A slotted standpipe (50mm) was installed to 18.00m, granular response zone 18.00-15.00m, bentonite seal 15.00-4.50m. A second slotted standpipe (35mm) was installed to 4.50m, granular response zone 4.50-1.00m, bentonite seal 4.50-1.00m, bentonite seal 1.00-0.20m, concrete and stopcock cover 0.20-0.00m. REMARKS: Downhole magnetometry for UXO risk mitigation undertaken 0.00-1.20m. No anomalies encountered. Bentonite seal for aquifer protection installed during drilling at 5.00m, prior to reduction in casing diameter. Permeability test undertaken at 7.00m- 8.00m. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
2.24		2.24	20	

AGS

CONTRACT	CHECKED
30238	EC

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BOREHOLE LOG

BH413

CLIENT	WELSH GOVERNMENT					Sheet	2 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	21 January 2015	Easting	331120.3			Depth	40.00 m
End Date	5 February 2015	Northing	184819.6	Ground level	9.90mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	37UT	8.00 - 8.45	8.00								
	38B	8.45 - 8.50									
	39D*	8.45									
	40B	8.50 - 9.00									
	41D	9.50 - 9.95	9.50	S<1							
	42B	10.50 - 11.00									
	43UT	11.00 - 11.45	11.00								
	44D	11.45 - 11.50									
	45B	12.00 - 12.50						Firm dark grey mottled black slightly sandy slightly gravelly organic silty CLAY. Gravel is subangular and subrounded fine and medium sandstone. (RTD)	12.00	-2.10	
	46D	12.50 - 12.95	12.50	S 12							
	47B	13.50 - 14.00									
		14.00 - 14.45	14.00	C 15				Medium dense becoming dense dark grey sandy subangular and subrounded fine to coarse sandstone GRAVEL. (RTD)	14.00	-4.10	
	48B	15.00 - 15.50									
		15.50 - 15.95	15.50	C 47				15.50 - 17.00m: Dense.			
	49B	16.50 - 17.00									
		17.00 - 17.45	17.00	C 31				Stiff fissured reddish brown sandy gravelly CLAY. Gravel is subangular and subrounded fine and medium lithorelicts of extremely weak mudstone. (MMG) (Grade III)	17.00	-7.10	
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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Geotechnical Engineering Limited

BOREHOLE LOG

BH413

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	3 of 5
Start Date	21 January 2015	Easting	331120.3	Scale	1 : 50
End Date	5 February 2015	Northing	184819.6 Ground level 9.90mOD	Depth	40.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
27/01/15 1615hrs 7.35m	50B	18.00 - 18.50									
	51D	18.50 - 18.60	18.50	S*158							
28/01/15 0830hrs 7.25m	52B	18.55 - 19.00						18.55 - 19.30m: Reddish brown mudstone recovered as slightly sandy gravelly clay. Gravel is angular and subangular fine to coarse mudstone. 19.00 - 19.30m: Limited recovery			
28/01/15 1205hrs 7.35m		19.00 - 19.09	18.50	C*170							
	53C	19.00 - 20.50			66	NA			19.30	-9.40	
04/02/15 0800hrs 7.10m						NI		Weak reddish brown MUDSTONE recovered non intact as subangular fine to coarse gravel. (MMG) (Grade II)			
						NA		Very stiff fissured reddish brown gravelly CLAY with rare greenish grey reduction spots (up to 10mm). Gravel is subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced planar rough infilled with sand sized gypsum crystals and stained black. (MMG) (Grade III)	20.05	-10.15	
		20.50 - 20.68	18.50	C*150							
	54C	20.50 - 22.00			100 50 42				20.95	-11.05	
						NI 165 580		Extremely weak thinly laminated to very thinly bedded reddish brown MUDSTONE with rare greenish grey reduction spots (up to 5mm). Fractures are subhorizontal to 20° very closely spaced locally closely spaced planar rough infilled with sand sized gypsum and stained black. (MMG) (Grade II)	22.00	-12.10	
	55C	22.00 - 23.50			100	NA		Very stiff fissured reddish brown gravelly CLAY with rare greenish grey reduction spots (up to 10mm). Gravel is subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced planar rough infilled with sand sized gypsum crystals and stained black. (MMG) (Grade III) 22.10 - 26.90m: 20° fissures locally infilled with greenish grey clay and sand sized gypsum crystals (up to 3mm).			
	56C	23.50 - 25.00			100						
	57C	25.00 - 26.50			100						
	58C	26.50 - 28.00			100						
								27.60m: White angular fine and medium gravel sized gypsum crystals			
								Continued Next Page	{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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BOREHOLE LOG

BH413

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	4 of 5
Start Date	21 January 2015	Easting	331120.3	Scale	1 : 50
End Date	5 February 2015	Northing	184819.6 Ground level 9.90mOD	Depth	40.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	59C	28.00 - 29.50			100 53 33				28.60	-18.70	
04/02/15 1700hrs 7.01m						NI 100 350		Extremely weak thinly laminated to very thinly bedded reddish brown MUDSTONE with rare greenish grey reduction spots (up to 30mm). Fractures are subhorizontal to 20° closely spaced locally medium spaced planar rough infilled with sand sized gypsum and stained black. (MMG) (Grade II)			
05/02/15 0800hrs 7.23m	60C	29.50 - 31.00			100 40 33				31.00	-21.10	
	61C	31.00 - 32.50			100	NA		Very stiff fissured reddish brown gravelly CLAY with rare greenish grey reduction spots (up to 30mm). Gravel is subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced planar rough infilled with sand sized gypsum crystals and stained black. (MMG) (Grade III)			
	62C	32.50 - 34.00			100				34.00	-24.10	
	63C	34.00 - 35.50			100 20 0	NI 50 250		Extremely weak thinly laminated to very thinly bedded reddish brown MUDSTONE with rare greenish grey reduction spots (up to 5mm). Fractures are subhorizontal to 20° very closely spaced locally medium spaced planar rough infilled with sand sized gypsum and stained black. (MMG) (Grade II)	34.80	-24.90	
						NA		Very stiff fissured reddish brown gravelly CLAY with rare greenish grey reduction spots (up to 30mm). Gravel is subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced planar rough infilled with sand sized gypsum crystals and stained black. (MMG) (Grade III)	35.30	-25.40	
	64C	35.50 - 37.00			100 17 0	50 100 300			35.65	-25.75	
						NA		Extremely weak thinly laminated to very thinly bedded reddish brown MUDSTONE with rare greenish grey reduction spots (up to 5mm). Fractures are subhorizontal to 20° very closely to medium spaced locally medium spaced planar rough infilled with sand sized gypsum and stained black. (MMG) (Grade II)			
	65C	37.00 - 38.50			100			Very stiff fissured reddish brown gravelly CLAY with rare greenish grey reduction spots (up to 30mm). Gravel is subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical closely spaced planar rough infilled with sand sized gypsum crystals and stained black. (MMG) (Grade			

Continued Next Page

{38.00}

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks

AGS

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BOREHOLE LOG

BH413

CLIENT	WELSH GOVERNMENT					Sheet	5 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	21 January 2015	Easting	331120.3			Depth	40.00 m
End Date	5 February 2015	Northing	184819.6	Ground level	9.90mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
						NI 100 350		III) 36.35m: 20° fissure infilled with greenish grey clay and sand sized gypsum crystals up to 3mm	38.15	-28.25	
	66C	38.50 - 40.00			100 46 46			Extremely weak thinly laminated to very thinly bedded reddish brown locally mottled greenish grey MUDSTONE with rare greenish grey reduction spots (up to 5mm). Fractures are subhorizontal to 20° very closely and closely spaced locally medium spaced planar rough infilled with sand sized gypsum and stained black. (MMG) (Grade II)			
05/02/15 1600hrs 7.89m									40.00	-30.10	
								Borehole completed at 40.00m.			
									{48.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
					30238	EC

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BOREHOLE LOG

BH415

CLIENT	WELSH GOVERNMENT					Sheet	1 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	28 January 2015	Easting	331311.4				
End Date	9 February 2015	Northing	185030.5	Ground level	9.15mOD	Depth	40.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
28/01/15 1500hrs	1B	0.20 - 0.50						MADE GROUND comprising reinforced CONCRETE. (MG)	0.20	8.95	
	2D*	0.20 - 0.50		Vo 5.1				Black mottled red and grey clayey sandy angular fine to coarse slag, brick and limestone GRAVEL with low subangular cobble content. (MG)			
28/01/15 1700hrs Dry	3B	0.50 - 0.80									
	4D*	0.50 - 0.80		Vo 7.1							
	5B	0.80 - 1.00									
29/01/15 0840hrs Dry	6D*	0.80 - 1.00		Vo 5.3							
	7D	1.00 - 1.45	Nil	S 4				1.00 - 1.95m: Loose.			
	8B	1.00 - 1.50						1.00 - 2.50m: Loose to very loose.			
	9D*	1.00 - 1.60		Vo 14.2							
	10D	1.50 - 1.95	1.50	S 4							
	11B	1.50 - 2.00									
	12D*	1.50 - 1.60									
	13B	1.60 - 2.00							2.00	7.15	
	14D*	1.60 - 2.00		Vo 9.2				Soft dark grey mottled black sandy gravelly CLAY with a low subangular slag, brick and sandstone cobble content. Gravel is angular fine and medium slag, brick and sandstone. (MG)			
	15D	2.00 - 2.45	2.00	S 4							
	16B	2.00 - 2.50									
	17D*	2.00 - 2.50		Vo 24.1							
	18D	2.50 - 2.95	2.50	S 4							
	19B	2.50 - 3.00									
	20D*	2.50 - 3.00		Vo 7.6					3.00	6.15	
	21D	3.00 - 3.45	2.80	S 15				Firm dark grey mottled brown locally black organic silty CLAY. (TFD)			
	22B	3.00 - 3.50									
	23D*	3.00 - 3.50		Vo 4.6							
	24UT	3.50 - 3.95	3.50								
	26D*	3.50 - 4.00									
	25D	3.95 - 4.00									
	27D	4.00 - 4.45	4.00	S 8							
	28B	4.00 - 4.50									
	29D*	4.00 - 4.50							4.50	4.65	
29/01/15 1245hrs 1.15m	30UT	4.50 - 4.95	4.00					Very soft dark grey locally mottled black organic silty CLAY. (TFD)			
	32D*	4.50 - 5.00									
	31D	4.95 - 5.00									
02/02/15 0800hrs NR	33D	5.00 - 5.45	4.00	S 4							
	34D*	5.00 - 5.50		Vo 0.7							
02/02/15 1555hrs 1.25m											
03/02/15 0805hrs 3.25m	35B	6.00 - 6.50									
	36D*	6.00 - 6.50		Vo 9.8							
	37UT	6.50 - 6.95	6.00								
	38D	6.95 - 7.10									
	39D*	7.00 - 7.50		Vo 2.5							
	40B	7.50 - 8.00									
	41D	8.00 - 8.45	8.00	S 2							

Continued Next Page {8.00}

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.

METHOD: Surface hard standing broken out with hydraulic breaker 0.00-0.20m. Hand dug inspection pit 0.20-0.80m. Cable percussion (200mm) 0.80-5.00m and (150mm) 5.00-19.00m. Rotary core drilled (123mm PQ3 wireline) 19.00-40.00m using a water flush. CASING: 200mm diam to 4.00m, 150mm diam to 18.50m and 114mm diam to 40.00m.

BACKFILL: On completion, a slotted standpipe (50mm) with geosock was installed to 40.00m, granular response zone 40.00-20.00m, and bentonite seal 20.00-17.00m. A second slotted standpipe (35mm) with geosock was installed to 17.00m, granular response zone 17.00-13.00m, bentonite seal 13.00-0.30m, concrete and stopcock cover 0.30-0.00m. REMARKS: Hole advanced by chiselling 16.50-17.00m (1hr), 18.70-19.00m (45mins). Downhole magnetometry for UXO risk mitigation undertaken 0.00-15.50m. No anomalies encountered.

Bentonite seal for aquifer protection installed during drilling 4.00-5.00m, prior to reduction in casing diameter. Permeability test undertaken at 7.00-8.00m. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOG SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
1.00	0.00	0.80	20	Slow.
2.95	2.80	1.10	20	Medium.

AGS

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BOREHOLE LOG

BH415

CLIENT	WELSH GOVERNMENT					Sheet	2 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	28 January 2015	Easting	331311.4				
End Date	9 February 2015	Northing	185030.5	Ground level	9.15mOD	Depth	40.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	42D*	8.00 - 8.50									
	43B	8.50 - 9.00									
	44UT	9.50 - 9.95	9.50								
	45D	9.95 - 10.10									
	46B	10.50 - 11.00									
	47D	11.00 - 11.45	11.00	S 3							
	48B	11.50 - 12.00									
	49UT	12.50 - 12.95	12.50								
	50D	12.95 - 13.10						Soft grey gravelly silty CLAY with a low subangular sandstone cobble content. Gravel is subangular fine and medium sandstone. (RTD)	13.00	-3.85	
	51B	13.25 - 13.50									
	52B	13.50 - 14.00									
	53D	14.00 - 14.45	14.00	S 4							
	54B	14.80 - 15.00						Very medium dense dark grey sandy subrounded and subangular fine to coarse sandstone GRAVEL with a medium subrounded sandstone cobble content. (RTD)	14.80	-5.65	
		15.50 - 15.74	15.50	C*63				Very dense dark grey sandy subrounded and subangular fine to coarse sandstone GRAVEL with a medium subrounded sandstone cobble content. (RTD)			
03/02/15 1615hrs 1.75m											
04/02/15 0800hrs 1.75m	55B	16.50 - 17.00	16.50								
		17.00 - 17.35	17.00	C*64							
								Very stiff fissured reddish brown mottled greenish grey sandy gravelly CLAY. Gravel is subangular fine and medium lithorelicts of extremely weak mudstone. (MMG)	17.50	-8.35	
								Continued Next Page	{18.00}		

water strike (m) casing (m) rose to (m) time to rise (m) remarks

AGS

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BOREHOLE LOG

BH415

CLIENT	WELSH GOVERNMENT					Sheet	3 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	28 January 2015	Easting	331311.4				
End Date	9 February 2015	Northing	185030.5	Ground level	9.15mOD	Depth	40.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	56B	18.20 - 18.33 18.20 - 18.70	18.00	C*115				(Grade IVa)	18.20	-9.05	
04/02/15 1235hrs 3.75m	57B	18.70 - 18.80 18.70 - 19.00 19.00 - 19.05	18.50 18.50	C*156 C*333				Very stiff fissured reddish brown mottled greenish grey sandy gravelly CLAY. Gravel is subangular fine and medium lithorelicts of extremely weak mudstone. (MMG) (Grade III)	19.00	-9.85	
05/02/15 1245hrs 5.00m	58C	19.00 - 19.90	19.00		100 22 0	NA NI		Hard fissured reddish brown mottled greenish grey sandy gravelly CLAY. Gravel is subangular fine and medium lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced planar rough. (MMG) (Grade III)	19.70	-10.55	
	59C	19.90 - 21.40	19.90		100 80 0			Extremely weak and very weak thinly laminated to very thinly bedded reddish brown locally mottled greenish grey MUDSTONE. Fractures are subhorizontal to 20° and subvertical very closely spaced planar rough and infilled with greenish grey clay up to 2mm. (MMG) (Grade II)	21.40	-12.25	
	60C	21.40 - 22.90	21.40		100	NA		Very stiff fissured reddish brown mottled greenish grey sandy gravelly CLAY with rare greenish grey reduction spots (up to 10mm). Gravel is subangular fine and medium lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced planar rough. (MMG) (Grade III)			
	61C	22.90 - 24.40	22.90		100						
	62C	24.40 - 25.90	24.40		33			24.40 - 25.90m: Limited recovery.			
05/02/15 1655hrs 5.20m											
06/02/15 0815hrs 5.00m	63C	25.90 - 27.20	25.90		100						
	64C	27.20 - 28.70	27.20		100			27.20 - 28.70m: Fissures locally infilled up to 3mm with fine and medium sand sized gypsum.			
								Continued Next Page	{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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BOREHOLE LOG

BH415

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	4 of 5
Start Date	28 January 2015	Easting	331311.4	Scale	1 : 50
End Date	9 February 2015	Northing	185030.5 Ground level 9.15mOD	Depth	40.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	65C	28.70 - 30.20	28.70		100			28.70 - 30.20m: Rare fine and medium sand sized gypsum crystals 28.70 - 31.70m: Rare fine and medium sand sized gypsum crystals.			
	66C	30.20 - 31.70	30.20		100			30.20 - 31.70m: Rare fine and medium sand sized gypsum crystals			
	67C	31.70 - 33.20	31.70		100						
	68C	33.20 - 34.70	33.20		100			32.90 - 33.20m: Locally tending to extremely weak mudstone. 33.20 - 34.70m: Locally tending to extremely weak mudstone with reddish brown clay laminae.			
	69C	34.70 - 36.00	34.70		30			34.70 - 36.00m: Limited recovery.	34.90	-25.75	
06/02/15 1620hrs 5.10m								Very stiff fissured reddish brown sandy gravelly CLAY with rare greenish grey reduction spots up to 5mm. Gravel is subangular fine and medium lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced planar rough. (MMG) (Grade III)	36.00	-26.85	
09/02/15 1005hrs 5.12m	70C	36.00 - 37.60	36.00		100 42 18	NI 100 200		Extremely weak and very weak locally tending to weak thinly laminated to very thinly bedded reddish brown MUDSTONE with rare greenish grey reduction spots (up to 10mm). Fractures are subhorizontal to 20° and subvertical extremely closely to medium closely spaced planar rough and locally infilled (up to 2mm) with greenish grey clay. (MMG) (Grade II) 36.50 - 36.70m: Vertical fractures infilled with greenish grey clay (up to 3mm).			
	71C	37.60 - 38.70	37.60		100 12 12			37.80 - 37.90m: Locally mottled greenish grey.			
								Continued Next Page	{38.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks

AGS

CONTRACT	CHECKED
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BOREHOLE LOG

BH415

CLIENT	WELSH GOVERNMENT					Sheet	5 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	28 January 2015	Easting	331311.4				
End Date	9 February 2015	Northing	185030.5	Ground level	9.15mOD	Depth	40.00 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	72C	38.70	40.00	38.70		76 23 10	NI 30 110		39.10m: 20° fracture infilled with 3mm greenish grey clay.	39.20	-30.05	
09/02/15 1310hrs 4.85m									Weak and medium strong thinly laminated to very thinly bedded reddish brown mottled white MUDSTONE with rare greenish grey reduction spots(up to 5mm). Fractures are subhorizontal to 20° and subvertical extremely closely to closely spaced planar rough. (MMG) (Grade I)	40.00	-30.85	
									Borehole completed at 40.00m.			
										{48.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
					30238	EC

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Cable Percussion Borehole Log Sheet

Site: **Docksway , Newport**
Job Number: **AA0324**
Client: Newport City Council
Rig Type: Dando 2000

BH No: **GP12_23**
Start Date: 30/03/2012
Finish Date: 30/03/2012
Vertical Scale: 1:50
Sheet 1 of 1

CJA
C J Associates

Depth (m)	Sample Ref.	Standard Penetration Tests (SPTs) Test type	Blow Counts Seat.	Test Drive	N-value	Pen. (mm) Seat	Test	U100 Blows / % recovery	Depth (m)	Thickness (m)	Legend	Description of Strata	Reduced Level (m O.D.)
0.50	D1											MADE GROUND: Hardcore / rubble infill (Driller's description).	
1.00	D2												
										(2.70)			
									2.70			END OF BOREHOLE	

Hole Progress with Time (Depths in m. below G.L.)				
Date	Hole depth	Casing depth	Depth to water	Remarks
	2.70	1.65		

Chiselling		
From (m)	To (m)	Time (hrs)
0.50	0.80	
0.90	1.00	
4.00	2.70	

Casing Record	
Depth (m)	Dia. (mm)
1.65	

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

General Remarks: Borehole terminated due to obstruction

Drilled By: AN
Logged By:

Cable Percussion Borehole Log Sheet

Site: **Docksway , Newport**
Job Number: **AA0324**
Client: Newport City Council
Rig Type: Dando 2000

BH No: **GP12_23A**
Start Date: 30/03/2012
Finish Date: 30/03/2012
Vertical Scale: 1:50
Sheet 1 of 1

CJA
C J Associates

Depth (m)	Sample Ref.	Standard Penetration Tests (SPT's) Test type	Blow Counts Seat.	Test Drive	N-value	Pen. (mm) Seat	Test	U100 Blows / % recovery
0.50	D1							
1.00	D2							
2.70	D3							
3.50	D4							
4.50	D5							
5.50	D6							

Depth (m)	Thickness (m)	Legend	Description of Strata	Reduced Level (m O.D.)
	(1.10)		MADE GROUND: hardcore / rubble infill (Driller's description).	
1.10	(1.60)		MADE GROUND: clay / rubble infill (Driller's description).	
2.70	(3.00)		Blue / grey silt / clay (Driller's description).	
5.70			END OF BOREHOLE	

Hole Progress with Time (Depths in m. below G.L.)				
Date	Hole depth	Casing depth	Depth to water	Remarks
	5.70	1.65		

Chiselling		
From (m)	To (m)	Time (hrs)
0.80	1.00	

Casing Record	
Depth (m)	Dia. (mm)
1.65	

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

General Remarks:

Drilled By: AN
Logged By:

Monitoring Pipe Installation Details

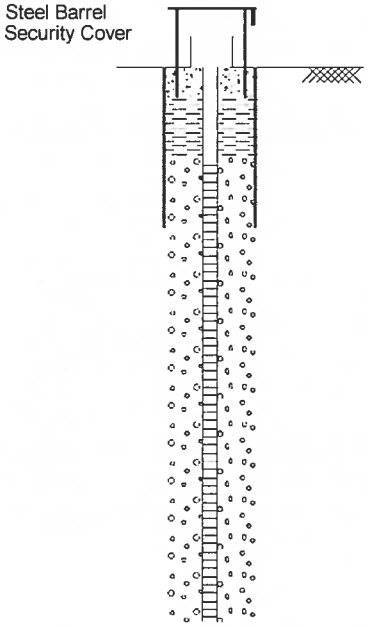
BH No: **GP12_23A**

CJA

C J Associates

Site:	Docksway , Newport		
Job Number:	AA0324		
Client:	Newport City Council	Vertical Scale:	1:75
Engineer:	Peter Brett Associates	Final BH Depth:	5.70m

Depth (m)	Pipe Details	Depth	Backfill
0.00	Steel Barrel Security Cover	0.00m	<---- CONCRETE
			<---- BENTONITE SEAL
			<---- GRAVEL



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Installation Type:		Installation Date:
Co-ordinates:	Ground Level:	Cover Level:
General Remarks:		

Cable Percussion Borehole Log Sheet

Site: **Docksway , Newport**
Job Number: **AA0324**
Client: Newport City Council
Rig Type: Dando 2000

BH No: **GP12_26**
Start Date: 28/03/2012
Finish Date: 28/03/2012
Vertical Scale: 1:50
Sheet 1 of 1

CJA
C J Associates

Depth (m)	Sample Ref.	Standard Penetration Tests (SPT's) Test type	Blow Counts Seat.	Test Drive	N-value	Pen. (mm) Seat	Test	U100 Blows / % recovery
0.50	D1							
1.50	D2							
2.50	D3							
3.00	D4							

Depth (m)	Thickness (m)	Legend	Description of Strata	Reduced Level (m O.D.)
0.20	(0.20)		Grass / topsoil (Driller's description).	
	(2.80)		MADE GROUND: hardcore / rubble infill (Driller's description).	
3.00	(1.00)		MADE GROUND: reworked silt / clay (Driller's description).	
4.00	(0.60)		MADE GROUND: wet landfill material with domestic refuse (Driller's description).	
4.60			END OF BOREHOLE	

Hole Progress with Time (Depths in m. below G.L.)				
Date	Hole depth	Casing depth	Depth to water	Remarks
	4.60	4.45	2.10	

Chiselling		
From (m)	To (m)	Time (hrs)
4.00	4.60	

Casing Record	
Depth (m)	Dia. (mm)
4.45	

Groundwater Strikes (depths in m. below G.L.)				
Strike	Casing	Water (20mins)	Sealed	Remarks
4.00	1.65	2.10		

General Remarks:

Drilled By: AN
Logged By:

Cable Percussion Borehole Log Sheet

Site: **Docksway , Newport**
Job Number: **AA0324**
Client: Newport City Council
Rig Type: Dando 2000

BH No: **GP12_26A**
Start Date: 28/03/2012
Finish Date: 29/03/2012
Vertical Scale: 1:50
Sheet 1 of 1

CJA
C J Associates

Depth (m)	Sample Ref.	Standard Penetration Tests (SPT's) Test type	Blow Counts Seat.	Test Drive	N-value	Pen. (mm) Seat	Test	U100 Blows / % recovery
0.50	D1							
1.50	D2							

Depth (m)	Thickness (m)	Legend	Description of Strata	Reduced Level (m O.D.)
0.20	(0.20)		Grass / topsoil (Driller's description).	
	(1.70)		MADE GROUND: Hardcore / rubble infill (Driller's description).	
1.90	(0.20)		MADE GROUND: metal sheeting (Driller's description).	
2.10	(0.60)		MADE GROUND: Hardcore / rubble infill (Driller's description).	
2.70			END OF BOREHOLE	

Hole Progress with Time (Depths in m. below G.L.)				
Date	Hole depth	Casing depth	Depth to water	Remarks
	1.60 2.70	1.65		

Chiselling		
From (m)	To (m)	Time (hrs)
0.70 1.90	0.90 2.10	

Casing Record	
Depth (m)	Dia. (mm)
1.65	

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

General Remarks:

Drilled By: AN
Logged By:

Cable Percussion Borehole Log Sheet

Site: **Docksway , Newport**
Job Number: **AA0324**
Client: Newport City Council
Rig Type: Dando 2000

BH No: **GP12_26B**
Start Date: 29/03/2012
Finish Date: 29/03/2012
Vertical Scale: 1:50
Sheet 1 of 1

CJA
C J Associates

Depth (m)	Sample Ref.	Standard Penetration Tests (SPT's) Test type	Blow Counts Seat.	Test Drive	N-value	Pen. (mm) Seat	Test	U100 Blows / % recovery
0.50	D1							
1.00	D2							
2.50	D3							
3.50	D4							
4.50	D5							
5.50	D6							
6.20	D7							
7.50	D8							
8.00	D9							
8.80	D10							

Depth (m)	Thickness (m)	Legend	Description of Strata	Reduced Level (m O.D.)
0.20	(0.20)		Grass / topsoil (Driller's description).	
	(0.80)		MADE GROUND: hardcore / rubble infill (Driller's description).	
1.00	(0.00)		MADE GROUND: geosynthetic lining material (Driller's description).	
	(5.20)		MADE GROUND: reworked silt / clay (Driller's description).	
6.20	(0.00)		MADE GROUND: geosynthetic lining material (Driller's description).	
	(1.80)		MADE GROUND: blue / grey silt / clay - possible infill? (Driller's description).	
8.00	(0.80)		MADE GROUND: landfill material with domestic waste (Driller's description).	
8.80	(0.40)		Blue / grey silt / clay (Driller's description).	
9.20	(0.00)		Gravel (Driller's description).	

END OF BOREHOLE

Hole Progress with Time (Depths in m. below G.L.) Date	Hole depth	Casing depth	Depth to water	Remarks
	9.20	9.20	5.14	

Chiselling From (m)	To (m)	Time (hrs)
8.20	8.40	
8.60	8.70	

Casing Record Depth (m)	Dia. (mm)
3.15	
9.20	

Groundwater Strikes (depths in m. below G.L.) Strike	Casing	Water (20mins)	Sealed	Remarks
3.20	1.65	3.03	6.50	
8.00	7.65	3.54		

General Remarks:

Drilled By: AN
Logged By:

Monitoring Pipe Installation Details

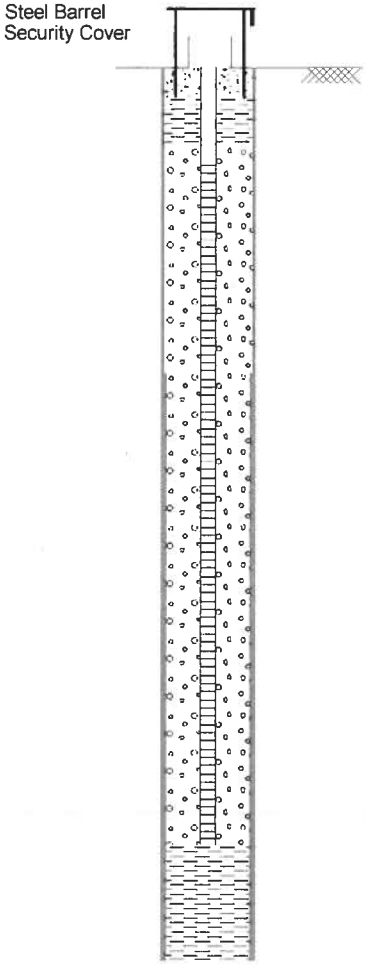
BH No: **GP12_26B**

CJA

C J Associates

Site:	Docksway , Newport		
Job Number:	AA0324		
Client:	Newport City Council	Vertical Scale:	1:75
Engineer:	Peter Brett Associates	Final BH Depth:	9.20m

Depth (m)	Pipe Details	Depth	Backfill
0.00	Steel Barrel Security Cover	0.00m	<---- CONCRETE
			<---- BENTONITE SEAL
1.00			<---- GRAVEL
2.00			
3.00			
4.00			
5.00			
6.00			
7.00			
8.00			<---- BENTONITE SEAL
9.00			
10.00			
11.00			
12.00			
13.00			
14.00			
15.00			



Installation Type:		Installation Date:
Co-ordinates:	Ground Level:	Cover Level:
General Remarks:		

Cable Percussion Borehole Log Sheet

Site: **Docksway , Newport**
Job Number: **AA0324**
Client: Newport City Council
Rig Type: Dando 2000

BH No: **GP12_27**
Start Date: 30/03/2012
Finish Date: 30/03/2012
Vertical Scale: 1:50
Sheet 1 of 1

CJA
C J Associates

Depth (m)	Sample Ref.	Standard Penetration Tests (SPT's) Test type	Blow Counts Seat.	Test Drive	N-value	Pen. (mm) Seat	Test	U100 Blows / % recovery
0.50	D1							
1.50	D2							
2.20	D3							
3.50	D4							
4.50	D5							
5.20	D6							

Depth (m)	Thickness (m)	Legend	Description of Strata	Reduced Level (m O.D.)
	(1.10)		MADE GROUND: hardcore / rubble infill (Driller's description).	
1.10	(1.60)		MADE GROUND: silt / clay - possible infill? (Driller's description).	
2.70	(2.50)		MADE GROUND: landfill material with domestic waste (Driller's description).	
5.20	(1.30)		Gravel (Driller's description).	
6.50			END OF BOREHOLE	

Hole Progress with Time (Depths in m. below G.L.)				
Date	Hole depth	Casing depth	Depth to water	Remarks
	6.50	3.15	4.20	

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

Casing Record	
Depth (m)	Dia. (mm)
3.15	

Groundwater Strikes (depths in m. below G.L.)				
Strike	Casing	Water (20mins)	Sealed	Remarks
4.50	1.65	4.22		

General Remarks:

Drilled By: AN
Logged By:

Monitoring Pipe Installation Details

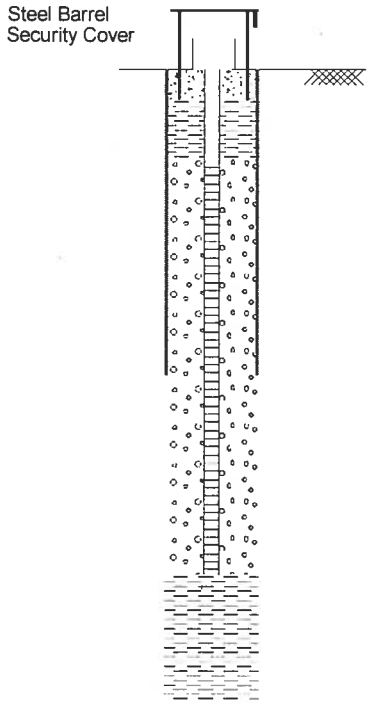
BH No: **GP12_27**

CJA

C J Associates

Site:	Docksway , Newport		
Job Number:	AA0324		
Client:	Newport City Council	Vertical Scale:	1:75
Engineer:	Peter Brett Associates	Final BH Depth:	6.50m

Depth (m)	Pipe Details	Depth	Backfill
0.00	Steel Barrel Security Cover	0.00m	<---- CONCRETE
			<---- BENTONITE SEAL
1.00			<---- GRAVEL
2.00			
3.00			
4.00			
5.00			<---- BENTONITE SEAL
6.00			
7.00			
8.00			
9.00			
10.00			
11.00			
12.00			
13.00			
14.00			
15.00			



Installation Type:		Installation Date:
Co-ordinates:	Ground Level:	Cover Level:
General Remarks:		

Cable Percussion Borehole Log Sheet

Site: **Docksway , Newport**
Job Number: **AA0324**
Client: Newport City Council
Rig Type: Dando 2000

BH No: **GW12_30**
Start Date: 27/03/2012
Finish Date: 28/03/2012
Vertical Scale: 1:50
Sheet 1 of 2

C J Associates

Depth (m)	Sample Ref.	Standard Penetration Tests (SPT's) Test type	Blow Counts Seat.	Test Drive	N-value	Pen. (mm) Seat	Test	U100 Blows / % recovery	Depth (m)	Thickness (m)	Legend	Description of Strata	Reduced Level (m O.D.)
0.50	D1									(1.40)		MADE GROUND: clay / rubble infill (Driller's description).	
1.40	D2								1.40	(0.10)		MADE GROUND: hardcore / rubble infill (Driller's description).	
									1.50			Blue / grey silt / clay (Driller's description).	
2.70	D3												
3.50	D4												
4.50	D5												
5.50	D6									(8.20)			
6.50	D7												
7.50	D8												
8.50	D9												
9.70	D10								9.70			Dense rounded river gravel with (Continued on next sheet)	

Hole Progress with Time (Depths in m. below G.L.)

Date	Hole depth	Casing depth	Depth to water	Remarks
			6.91 4.87	

Chiselling

From (m)	To (m)	Time (hrs)
1.20	1.40	

Casing Record

Depth (m)	Dia. (mm)
1.65	

Groundwater Strikes (depths in m. below G.L.)

Strike	Casing	Water (20mins)	Sealed	Remarks
5.20	1.65	4.98		

General Remarks:

Drilled By: AN
Logged By:

Cable Percussion Borehole Log Sheet

Site: **Docksway , Newport**
Job Number: **AA0324**
Client: Newport City Council
Rig Type: Dando 2000

BH No: **GW12_30**
Start Date: 27/03/2012
Finish Date: 28/03/2012
Vertical Scale: 1:50
Sheet 2 of 2

CJA
C J Associates

Depth (m)	Sample Ref.	Standard Penetration Tests (SPT's) Test type	Blow Counts Seat.	Test Drive	N-value	Pen. (mm) Seat	Test	U100 Blows / % recovery	Depth (m)	Thickness (m)	Legend	Description of Strata	Reduced Level (m O.D.)
10.50	D11											occasional large cobbles (Driller's description).	
11.50	D12									(3.30)			
12.50	D13												
									13.00			END OF BOREHOLE	

Hole Progress with Time (Depths in m. below G.L.)				
Date	Hole depth	Casing depth	Depth to water	Remarks
	11.60 13.00	11.60 13.00		

Chiselling		
From (m)	To (m)	Time (hrs)
10.20 12.70	10.50 12.90	

Casing Record	
Depth (m)	Dia. (mm)
13.00	

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

General Remarks:

Drilled By: AN
Logged By:

Monitoring Pipe Installation Details

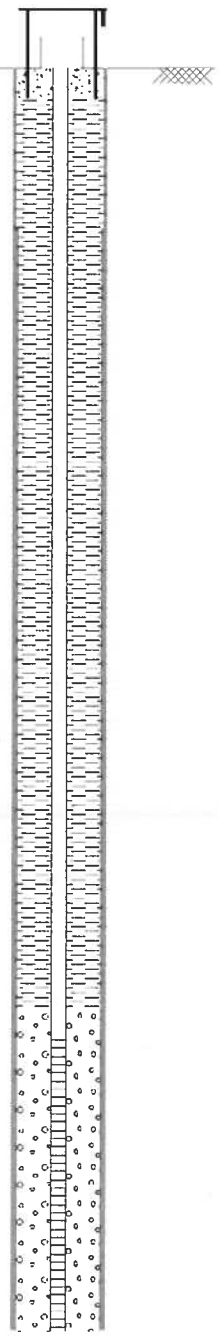
BH No: **GW12_30**

CJA

C J Associates

Site:	Docksway , Newport		
Job Number:	AA0324		
Client:	Newport City Council	Vertical Scale:	1:75
Engineer:	Peter Brett Associates	Final BH Depth:	13.00m

Depth (m)	Pipe Details	Depth	Backfill
0.00	Steel Barrel Security Cover	0.00m	<---- CONCRETE <---- BENTONITE SEAL
1.00			
2.00			
3.00			
4.00			
5.00			
6.00			
7.00			
8.00			
9.00			
10.00			<---- GRAVEL
11.00			
12.00			
13.00			
14.00			
15.00			



Installation Type:		Installation Date:
Co-ordinates:	Ground Level:	Cover Level:
General Remarks:		

Cable Percussion Borehole Log Sheet

Site: **Docksway , Newport**
Job Number: **AA0324**
Client: Newport City Council
Rig Type: Dando 2000

BH No: **GW12_33**
Start Date: 23/03/2012
Finish Date: 26/03/2012
Vertical Scale: 1:50
Sheet 1 of 2

C J Associates

Depth (m)	Sample Ref.	Standard Penetration Tests (SPT's) Test type	Blow Counts Seat.	Test Drive	N-value	Pen. (mm) Seat	Test	U100 Blows / % recovery
0.50	D1							
1.50	D2							
2.70	D3							
3.50	D4							
4.50	D5							
5.50	D6							
6.50	D7							
7.50	D8							
8.50	D9							
9.50	D10							

Depth (m)	Thickness (m)	Legend	Description of Strata	Reduced Level (m O.D.)
	(1.50)		MADE GROUND: clay / rubble infill (Driller's description).	
1.50	(1.20)		MADE GROUND: hardcore / rubble infill (Driller's description).	
2.70	(10.50)		Blue / grey silt / clay (Driller's description).	

(Continued on next sheet)

Hole Progress with Time (Depths in m. below G.L.)

Date	Hole depth	Casing depth	Depth to water	Remarks
			9.93	

Chiselling

From (m)	To (m)	Time (hrs)
1.40	1.70	
2.20	2.40	

Casing Record

Depth (m)	Dia. (mm)
3.15	

Groundwater Strikes (depths in m. below G.L.)

Strike	Casing	Water (20mins)	Sealed	Remarks
	3.15			

General Remarks:

Drilled By: AN
Logged By:

Cable Percussion Borehole Log Sheet

Site: **Docksway , Newport**
Job Number: **AA0324**
Client: Newport City Council
Rig Type: Dando 2000

BH No: **GW12_33**
Start Date: 23/03/2012
Finish Date: 26/03/2012
Vertical Scale: 1:50
Sheet 2 of 2

C J Associates

Depth (m)	Sample Ref.	Standard Penetration Tests (SPT's) Test type	Blow Counts Seat.	Test Drive	N-value	Pen. (mm) Seat	Test	U100 Blows / % recovery
10.50	D11							
11.50	D12							
12.50	D13							
13.20	D14							
14.50	D15							
15.50	D16							
16.50	D17							

Depth (m)	Thickness (m)	Legend	Description of Strata	Reduced Level (m O.D.)
			Blue / grey silt / clay (Driller's description).	
13.20	(3.90)		Dense rounded river gravel with occasional large cobbles (Driller's description).	
17.10			END OF BOREHOLE	

Hole Progress with Time (Depths in m. below G.L.)

Date	Hole depth	Casing depth	Depth to water	Remarks
	14.00 17.10	14.00 17.10	10.23	

Chiselling

From (m)	To (m)	Time (hrs)
14.20 15.10 16.60	14.40 15.30 17.00	

Casing Record

Depth (m)	Dia. (mm)
17.10	

Groundwater Strikes (depths in m. below G.L.)

Strike	Casing	Water (20mins)	Sealed	Remarks
13.20		11.21		

General Remarks:

Drilled By: AN
Logged By:

Monitoring Pipe Installation Details

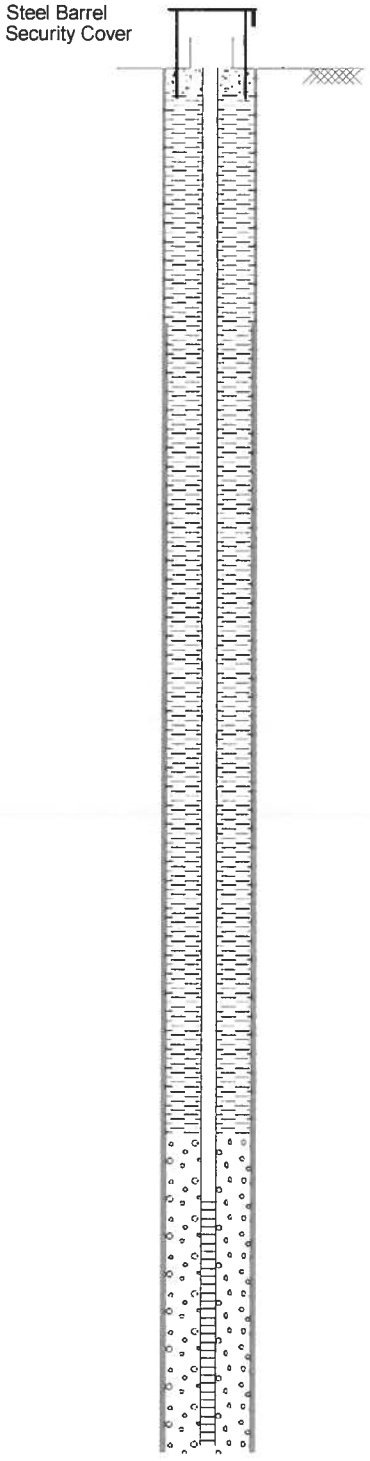
BH No: **GW12_33**

CJA

C J Associates

Site:	Docksway , Newport		
Job Number:	AA0324		
Client:	Newport City Council	Vertical Scale:	1:90
Engineer:	Peter Brett Associates	Final BH Depth:	17.10m

Depth (m)	Pipe Details	Depth	Backfill
0.00	Steel Barrel Security Cover	0.00m	<---- CONCRETE <---- BENTONITE SEAL
1.00			
2.00			
3.00			
4.00			
5.00			
6.00			
7.00			
8.00			
9.00			
10.00			
11.00			
12.00			
13.00			<---- GRAVEL
14.00			
15.00			
16.00			
17.00			
18.00			



Installation Type:		Installation Date:
Co-ordinates:	Ground Level:	Cover Level:
General Remarks:		

Cable Percussion Borehole Log Sheet

Site: **Docksway , Newport**
Job Number: **AA0324**
Client: Newport City Council
Rig Type: Dando 2000

BH No: **GW12_38**
Start Date: 02/04/2012
Finish Date: 03/04/2012
Vertical Scale: 1:50
Sheet 1 of 2

C J Associates

Depth (m)	Sample Ref.	Standard Penetration Tests (SPT's) Test type	Blow Counts Seat.	Test Drive	N-value	Pen. (mm) Seat	Test	U100 Blows / % recovery
0.50	D1							
1.50	D2							
2.20	D3							
3.50	D4							
4.50	D5							
5.50	D6							
6.50	D7							
7.50	D8							
8.50	D9							
9.50	D10							

Depth (m)	Thickness (m)	Legend	Description of Strata	Reduced Level (m O.D.)
	(2.40)		MADE GROUND: hardcore / rubble infill (Driller's description).	
2.40	(6.50)		Blue / grey silt / clay (Driller's description).	
8.90			Rounded river gravel with occasional large cobbles (Driller's description).	

(Continued on next sheet)

Hole Progress with Time (Depths in m. below G.L.)

Date	Hole depth	Casing depth	Depth to water	Remarks
	10.00		6.84 7.14	

Chiselling

From (m)	To (m)	Time (hrs)
0.30 1.20	0.50 1.40	

Casing Record

Depth (m)	Dia. (mm)
1.65	

Groundwater Strikes (depths in m. below G.L.)

Strike	Casing	Water (20mins)	Sealed	Remarks
8.90	1.65	7.12		

General Remarks:

Drilled By: AN
Logged By:

Cable Percussion Borehole Log Sheet

Site: **Docksway , Newport**
Job Number: **AA0324**
Client: Newport City Council
Rig Type: Dando 2000

BH No: **GW12_38**
Start Date: 02/04/2012
Finish Date: 03/04/2012
Vertical Scale: 1:50
Sheet 2 of 2

CJA
C J Associates

Depth (m)	Sample Ref.	Standard Penetration Tests (SPT's) Test type	Blow Counts Seat.	Test Drive	N-value	Pen. (mm) Seat	Test	U100 Blows / % recovery	Depth (m)	Thickness (m)	Legend	Description of Strata	Reduced Level (m O.D.)
10.50	D11									(3.10)		Rounded river gravel with occasional large cobbles (Driller's description).	
11.50	D12												
									12.00			END OF BOREHOLE	

Hole Progress with Time (Depths in m. below G.L.)				
Date	Hole depth	Casing depth	Depth to water	Remarks
	12.00	11.00 12.00		

Chiselling		
From (m)	To (m)	Time (hrs)
10.90 11.20 11.80	11.00 11.40 11.90	

Casing Record	
Depth (m)	Dia. (mm)
12.00	

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

General Remarks:

Drilled By: AN
Logged By:

Monitoring Pipe Installation Details

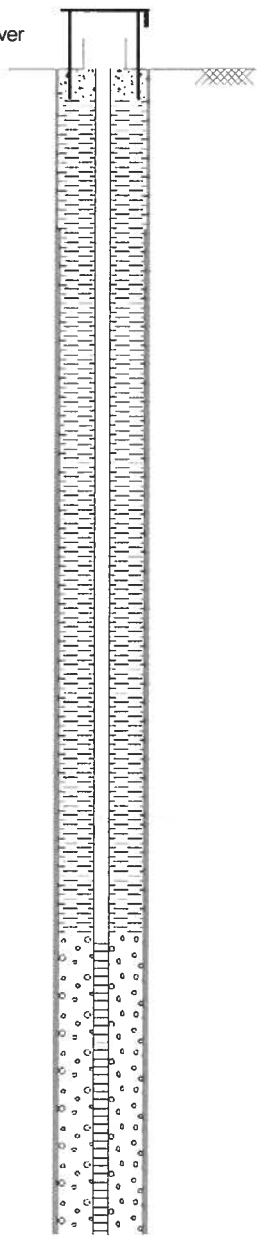
BH No: **GW12_38**

CJA

C J Associates

Site:	Docksway , Newport		
Job Number:	AA0324		
Client:	Newport City Council	Vertical Scale:	1:75
Engineer:	Peter Brett Associates	Final BH Depth:	12.00m

Depth (m)	Pipe Details	Depth	Backfill
0.00	Steel Barrel Security Cover	0.00m	<---- CONCRETE <---- BENTONITE SEAL
1.00			
2.00			
3.00			
4.00			
5.00			
6.00			
7.00			
8.00			
9.00			<---- GRAVEL
10.00			
11.00			
12.00			
13.00			
14.00			
15.00			



Installation Type:		Installation Date:
Co-ordinates:	Ground Level:	Cover Level:
General Remarks:		

Daily Report Sheet Rotary

Site: – DOCKSWAY – NEWPORT

Job Number: – X0349

Client: – NEWPORT CITY COUNCIL

Date: – MON 12-10-2009

Rig: – COMACCHIO 300

BH GW09/30

Sheet 1 of 2

KING ROAD AVENUE
AVONMOUTH
BRISTOL BS11 9HF
Tel: 0117 982 1473
Fax: 0117 982 8200
C.J. associates

TIME RECORD	Total Hours	Start Time	Finish Time
Transport		Dayworks	
Rig Moving		Running Casing/Pulling Casing	
Open Hole Drilling		Repairs & Maintenance	
Core Drilling		Other	

DRILLING RECORD

Run No	From	To	Drilled	Recovery	Chked	Number	Location
WAITING FOR DOZER ½ HR							
DOZER PULLING COMPRESSOR TO							
BH POSITION							
O/H GL – 13.00 WITH SIMMITREX							
D1	1.00	–1.50	D2	2.00	– 2.50		
D3	3.00	– 3.50	D4	4.00	– 4.50		
D5	5.00	– 5.50	D6	6.00	– 6.50		
D7	7.00	–7.50	D8	8.00	– 8.50		
D9	9.00	– 9.50	D10	10.00	–10.50		
D11	11.00	–11.50	D12	12.00	–12.50		
50mm PIPE INSTALLATION DETAILS							
FOR BH. GW09/30 SEE SHEET							
2 OF 2							
TRACKED RIG TO BH GW09/15A							
(45MINS)							

STRATA & PENETRATION TESTS

From	To	Description of Strata
GL	0.50	BROWN SILTY CLAY FILL
0.50	9.00	GREY SILTY CLAYS
9.00	11.00	GREY SANDY SILTY GRAVELS
11.00	13.00	GREY BROWN SANDS + GRAVELS
		Depth at end of day

Water Record

Depth Struck	Depth +20mins
10.30	

Daily Water Level Record	Depth Hole	Depth Water
Start of am shift		
End of am shift		
Start of pm shift		
End of pm shift B/H	13.00	5.30
After pulling casing		
After 24hrs		

CORE BOXES USED

Flush Record AIR 400/170cfm COMPRESSOR

Open Hole Type	Open Hole Return	Coring Type	Coring Return
AIR	GOOD		

BENTONITE USED

Bit Record

Type & Size	Number	Depth Drilled

CASING RECORD

Size	From	To
SIMMITREX	GL	13.00

Water added to assist boring YES

If so depth? 1.20 – 10.50

Crew G HADDOCK A EVANS

Signature of driller

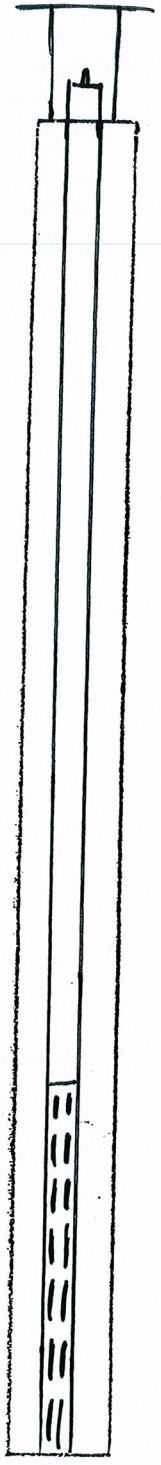
Verified by Client

SEE SHEET 2 of 2

50mm
Standpipe Installation
Site DOCKSWAY - NEWPORT
Job Number X0349
Client NEWPORT CITY COUNCIL

Borehole No GW09/30
Date MON 12.10.2009

C.J. associates



— GL
CONCRETE
— 0.40

BENTONITE
SEAL

— 10.50

GRAVEL

▽ 13.00

GL - 11.00 PLAIN PIPE.
11.00 - 13.00 SLOTTED PIPE.

UPRIGHT COVER AND GAS BUNG FITTED.

Daily Report Sheet Rotary

Site: – DOCKSWAY – NEWPORT

Job Number: – X0349

Client: – NEWPORT CITY COUNCIL

Date: – TUES 13.10.2009

Rig: – COMACCHIO 300

BH GW09/15A

Sheet 1 of 2

KING ROAD AVENUE
AVONMOUTH
BRISTOL BS11 9HF
Tel: 0117 982 1473
Fax: 0117 982 8200
C.J. associates

TIME RECORD	Total Hours	Start Time	Finish Time
Transport		Dayworks	
Rig Moving		Running Casing/Pulling Casing	
Open Hole Drilling		Repairs & Maintenance	
Core Drilling		Other	

DRILLING RECORD

Run No	From	To	Drilled	Recovery	Chked	Number	Location
DUG INSPECTION PIT FOR SERVICES							
TO 1.20 (1¼ HRS)							
SET RIG UP OVER TRIAL PIT							
O/H GL – 16.95 WITH SIMMITREX							
D1	0.80	1.00	D2	2.00 – 2.50			
D3	3.00 – 3.50		D4	4.00 – 4.50			
D5	5.00 – 5.50		D6	6.00 – 6.50			
D7	7.00 – 7.50		D8	8.00 – 8.50			
D9	9.00 – 9.50		D10	10.00 – 10.50			
D11	11.00 – 11.50		D12	12.00 – 12.50			
D13	13.00 – 13.50		D14	14.00 – 14.50			
D15	15.00 – 15.50		D16	16.00 – 16.50			
50mm PIPE INSTALLATION DETAILS							
FOR BH GW09/15A SEE SHEET 2 of 2							
DIGGING INSPECTION PIT AT							
BH GP09/09 FROM GL – 0.80 (40 mins)							

STRATA & PENETRATION TESTS

From	To	Description of Strata
GL	0.40	COMPACT REDISH BROWN STONEY FILL
0.40	0.80	RED STONEY MARL FILL
0.80	1.70	GREY SILTY CLAY FILL
1.70	4.30	REFUSE TIP MATERIAL
4.30	11.80	GREY SILTY CLAYS
11.80	14.20	GREY GRAVELLEY SILTY CLAYS
14.20	16.95	SANDS + GRAVELS.
		Depth at end of day

Water Record

Depth Struck	Depth +20mins
13.70	

CORE BOXES USED

Flush Record AIR 400/170cfm COMPRESSOR

Open Hole Type	Open Hole Return	Coring Type	Coring Return
AIR	GOOD		

BENTONITE USED

Bit Record

Type & Size	Number	Depth Drilled

Daily Water Level Record	Depth Hole	Depth Water
Start of am shift		
End of am shift		
Start of pm shift		
End of BH	16.95	9.35
After pulling casing		
After 24hrs		

CASING RECORD

Size	From	To
SIMMITREX	GL	16.95

Water added to assist boring YES

If so depth? 1.50 – 14.70

Crew G HADDOCK A EVANS

Signature of driller

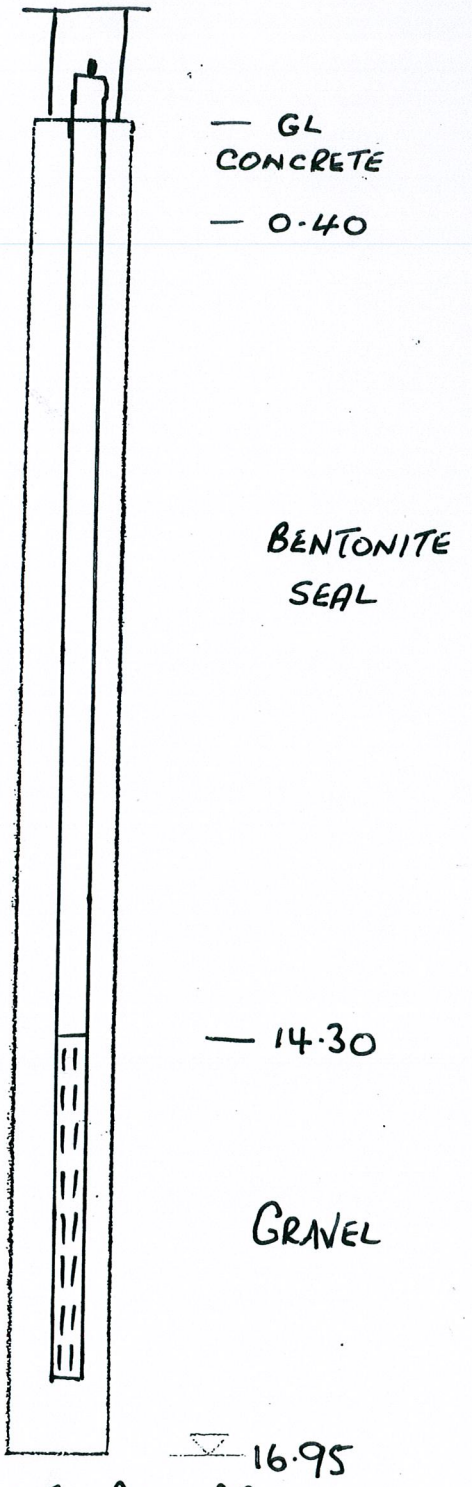
Verified by Client

50mm
Standpipe Installation

Site DOCKSWAY – NEWPORT
Job Number X0349
Client NEWPORT CITY COUNCIL

Borehole No GW09/15A
Date TUES 13.10.2009

C.J. associates



GL – 14.50 PLAIN PIPE
14.50 – 16.65 SLOTTED PIPE.

UPRIGHT COVER AND GAS BUNG FITTED

Daily Report Sheet Rotary

Site: – DOCKSWAY – NEWPORT
Job Number: – X0349
Client: – NEWPORT CITY COUNCIL
Date: – WED 14.10.2009
Rig: – COMACCHIO 300

BH GP09/09

Sheet 1 of 2

KING ROAD AVENUE
AVONMOUTH
BRISTOL BS11 9HF
Tel: 0117 982 1473
Fax: 0117 982 8200
C.J. associates

TIME RECORD	Total Hours	Start Time	Finish Time
Transport		Dayworks	
Rig Moving		Running Casing/Pulling Casing	
Open Hole Drilling		Repairs & Maintenance	
Core Drilling		Other	

DRILLING RECORD

Run No	From	To	Drilled	Recovery	Chked	Number	Location
CONTINUING DIGGING INSPECTION PIT							
FROM 0.80 – 1.20 20 MINS							
D1	0.90	1.10					
MOVED RIG ONTO POSITION AND SET UP							
OVER INSPECTION PIT							
O/H GL – 6.50 WITH SIMMITREX							
D2	2.00	2.50	D3	3.00	–	3.50	
D4	4.00	– 4.50	D5	5.00	–	5.50	
D6	6.00	– 6.50					
50mm PIPE INSTALLATION DETAILS							
FOR BH GP09/09 SEE SHEET 2 of 2							
WORKS CARRIED OUT TO BH'S PREVIOUSLY DRILLED							
GW03/13 GAS BUNG FITTED							
GW06/34 GAS BUNG FITTED							
GW03/09 GAS BUNG FITTED							
GW06/39 GAS BUNG FITTED							
GW06/33 NEW UPRIGHT COVER AND GAS BUNG FITTED.							
GP07/05	"	"	"	"	"	"	"
GW03/06A	"	"	"	"	"	"	"

STRATA & PENETRATION TESTS

From	To	Description of Strata
GL	1.30	MARL FILL
1.30	2.70	REFUSE TIP MATERIAL
2.70	4.30	AS ABOVE WITH SILTS
4.30	6.50	GREY SILTY CLAYS.
		Depth at end of day

Water Record

Depth Struck	Depth +20mins

CORE BOXES USED NONE

Flush Record AIR 400/170 cfm COMPLESSOR

Open Hole Type	Open Hole Return	Coring Type	Coring Return
AIR	GOOD		

BENTONITE USED

Bit Record

Type & Size	Number	Depth Drilled

Daily Water Level Record	Depth Hole	Depth Water
Start of am shift	0.80	0.63
End of am shift		
Start of pm shift		
End of BH shift	6.50	DRY
After pulling casing		
After 24hrs		

CASING RECORD

Size	From	To
SIMMITREX	GL	6.50

Water added to assist boring YES

If so depth? 1.80 – 6.00

Crew G HADDOCK A EVANS

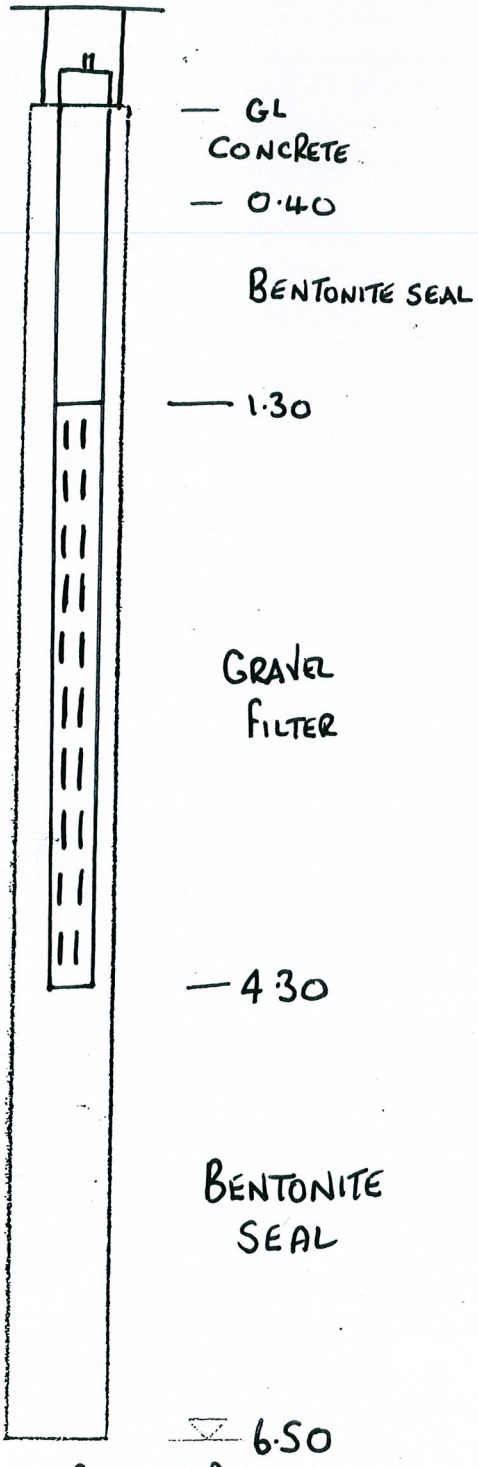
Signature of driller

Verified by Client

50mm
Standpipe installation
Site DOCKSWAY - NEWPORT
Job Number X0349
Client NEWPORT CITY COUNCIL

Borehole No GP09/09
Date WED 14.10.2009

C.J. associates



GL - 1.30 PLAIN PIPE.
1.30 - 4.30 SLOTTED PIPE.

UPRIGHT COVER AND GAS BUNG FITTED.

Job No	Ground Level (m Approx)		
14739-079	12.50		
Client: Newport City Council	Coordinates (NGR): 331061.0 , 185627.0	All dimensions in metres Scale 1:27.5	Sheet 1 of 1

SAMPLES/TESTS/PROGRESS							STRATA			
Sample Depth (m)	Sample Type	Test Depth (m)	Test Type	Test Result	Window Run (Size(mm))	Water	Legend	Depth (Thickness) (m)	DESCRIPTION	Instrument/ Backfill
								0.10	Topsoil	
								(0.90) 1.00	MADE GROUND: Soft to firm, brown/black, sandy, gravelly clay. Gravel is angular to sub-angular and consists of mudtsone and bricks. With wood also noted.	
						1 ▼ 1 ▽		(3.50) 4.50	MADE GROUND: Dark brown/black, silty, clayey gravel. Gravel is angular to sub-angular and consists of glass and brick. With wood, paper and plastic also noted.	
								(0.50) 5.00	Soft to firm, blue/Grey CLAY. ALLUVIAL DEPOSITS.	
									End of Borehole at 5m	

GENERAL REMARKS:

Drilling to 5.0m, casing installed to 4.7m due to sides collapsing in.

WATER:

Strike: 2.4 m

Standing: 2.7 m

Flow:

Contractor	Method/ Plant Used	Logged By	Checked By
Southern Ground Testing	Terrier Rig	LE	DW

PBA STD WS LOG 14739-079.GPJ AGS3_ALL.GDT 14/5/07

Job No	Ground Level (m) (approx)		
14739-079	12.50	All dimensions in metres Scale 1:22.5	Sheet 1 of 1
Client Newport City Council	Coordinates (NGR) 331061.0 , 185646.0		

SAMPLES/TESTS/PROGRESS						Water	STRATA			Instrument/ Backfill
Sample Depth (m)	Sample Type	Test Depth (m)	Test Type	Test Result	Window Run (Size(mm))		Legend	Depth (Thickness) (m)	DESCRIPTION	
								0.10	Grass covered topsoil.	
								(0.20) 0.30	MADE GROUND: Grey/brown, gravel. Gravel is angular to sub-angular of concrete.	
								(1.70) 2.00	MADE GROUND: Soft, red/brown, sandy, gravelly clay. Gravel is angular to sub-angular and consists of brick and glass. With some wood also noted.	
						1 1		(2.00) 4.00	MADE GROUND: Dark grey/black, sandy, clayey, gravel. Gravel is angular to sub-angular and consists of brick, mudstone and glass. With wood, plastic and metal noted.	
									End of Borehole at 4m	

GENERAL REMARKS:

Refusal at 4.0m.

WATER:

Strike: 2.8 m

Standing: 3.1 m

Flow:

Contractor	Method/ Plant Used	Logged By	Checked By
Southern Ground Testing	Terrier Rig	LE	DW

A2 Appendix 2

Gas and Groundwater Monitoring Data

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH411	23/04/15 11:00:00	1025	-0.86								0.0	13		11 litres purged, base depth 8.00m.
BH411	23/04/15 11:01:00										0.0			
BH411	23/04/15 11:02:00										0.0			
BH411	23/04/15 11:03:00										0.0			
BH411	23/04/15 11:04:00										0.0			
BH411	23/04/15 11:05:00			3.5	39.1	10.3	#	0	0	0.0				
BH411	23/04/15 11:06:00			2.5	27.0	13.6	#	0	0	0.0				
BH411	23/04/15 11:07:00			2.0	21.9	15.0	#	0	0	0.0				
BH411	23/04/15 11:08:00			1.9	21.2	15.3	#	0	0	0.0				
BH411	23/04/15 11:09:00			1.8	19.4	15.9	#	0	0	0.0				
BH411	23/04/15 11:10:00			1.3	15.2	16.8	#	0	0	0.0				
BH411	23/04/15 11:11:00			1.5	17.9	16.3	#	0	0	0.0				
BH411	23/04/15 11:12:00			1.4	14.4	17.0	#	0	0	0.0				
BH411	23/04/15 11:13:00			1.2	15.3	17.1	#	0	0	0.0				
BH411	23/04/15 11:14:00			1.2	13.9	17.3	#	0	0	0.0			5.49	
BH411	30/04/15 11:30:00	1014	-1.16								1.6	7		3 litres purged, base depth 8.00m.
BH411	30/04/15 11:31:00										1.2			
BH411	30/04/15 11:32:00										1.2			

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH411	30/04/15 11:33:00										1.2			
BH411	30/04/15 11:34:00										1.2			
BH411	30/04/15 11:35:00			5.1	65.2	4.7	#	0	0	0.0				
BH411	30/04/15 11:36:00			3.9	44.3	8.9	#	0	0	0.0				
BH411	30/04/15 11:37:00			3.3	37.5	10.6	#	0	0	0.0				
BH411	30/04/15 11:38:00			3.1	34.6	11.5	#	0	0	0.0				
BH411	30/04/15 11:39:00			2.8	31.4	12.4	#	0	0	0.0				
BH411	30/04/15 11:40:00			2.6	29.5	13.1	#	0	0	0.0				
BH411	30/04/15 11:41:00			2.4	27.2	13.6	#	0	0	0.0				
BH411	30/04/15 11:42:00			2.3	26.3	13.8	#	0	0	0.0				
BH411	30/04/15 11:43:00			2.3	25.5	14.1	#	0	0	0.0				
BH411	30/04/15 11:44:00			2.2	24.6	14.3	#	0	0	0.0			7.22	
BH411	14/05/15 10:39:00	1024	0								0.0	17		
BH411	14/05/15 10:40:00										0.0			
BH411	14/05/15 10:41:00										0.0			
BH411	14/05/15 10:42:00										0.0			
BH411	14/05/15 10:43:00										0.0			
BH411	14/05/15 10:44:00			0.0	0.0	20.2	0.0	0	0	1.1				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH411	14/05/15 10:45:00			0.0	0.0	20.2	0.0	0	0	1.1				
BH411	14/05/15 10:46:00			0.0	0.0	20.2	0.0	0	0	1.1				
BH411	14/05/15 10:47:00			0.0	0.0	20.5	0.0	0	0	1.1				
BH411	14/05/15 10:48:00			0.0	0.0	20.4	0.0	0	0	0.0				
BH411	14/05/15 10:49:00			0.0	0.0	20.8	0.0	0	0	0.0				
BH411	14/05/15 10:50:00			0.0	0.0	20.8	0.0	0	0	0.0				
BH411	14/05/15 10:51:00			0.0	0.0	20.8	0.0	0	0	0.0				
BH411	14/05/15 10:52:00			0.0	0.0	20.8	0.0	0	0	0.0				
BH411	14/05/15 10:53:00			0.0	0.0	20.8	0.0	0	0	0.0				
BH411	14/05/15 10:54:00												4.62	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH411	23/04/15 11:14:00												5.33	52 litres purged, base depth 14.00m.
BH411	30/04/15 11:44:00												7.35	39 litres purged, base depth 14.00m.
BH411	14/05/15 10:55:00												9.70	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Deep install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH412	23/04/15 12:30:00	1023	-0.62								0.0	14		0 litres purged, base depth 3.00m. Water sample not obtained. Not enough water in installation.
BH412	23/04/15 12:31:00										0.0			
BH412	23/04/15 12:32:00										0.0			
BH412	23/04/15 12:33:00										0.0			
BH412	23/04/15 12:34:00										0.0			
BH412	23/04/15 12:35:00			0.8	1.0	7.0	19.0	0	0	4.5				
BH412	23/04/15 12:36:00			3.0	0.5	8.8	9.0	0	0	3.6				
BH412	23/04/15 12:37:00			3.1	0.4	9.2	8.0	0	0	3.4				
BH412	23/04/15 12:38:00			3.2	0.4	9.3	7.0	0	0	2.9				
BH412	23/04/15 12:39:00			3.2	0.4	9.5	7.0	0	0	2.6				
BH412	23/04/15 12:40:00			3.3	0.3	9.8	6.0	0	0	2.4				
BH412	23/04/15 12:41:00			3.0	0.4	9.0	8.0	0	0	2.1				
BH412	23/04/15 12:42:00			3.0	0.4	9.1	8.0	0	0	2.2				
BH412	23/04/15 12:43:00			3.0	0.4	8.9	8.0	0	0	2.0				
BH412	23/04/15 12:44:00			2.8	0.5	8.6	9.0	0	0	1.9			2.83	
BH412	30/04/15 13:00:00	1013	-0.53								0.0	13		0 litres purged, base depth 3.00m. Not enough water in install to obtain sample.

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH412	30/04/15 13:01:00										0.0			
BH412	30/04/15 13:02:00										0.0			
BH412	30/04/15 13:03:00										0.0			
BH412	30/04/15 13:04:00										0.0			
BH412	30/04/15 13:05:00			4.1	0.4	13.4	6.0	0	0	4.3				
BH412	30/04/15 13:06:00			4.4	0.1	13.6	1.0	0	0	4.0				
BH412	30/04/15 13:07:00			4.4	0.0	13.6	0.0	0	0	3.6				
BH412	30/04/15 13:08:00			4.4	0.0	13.6	0.0	0	0	3.4				
BH412	30/04/15 13:09:00			4.4	0.0	13.5	0.0	0	0	3.2				
BH412	30/04/15 13:10:00			4.4	0.0	13.4	0.0	0	0	2.8				
BH412	30/04/15 13:11:00			4.4	0.0	13.4	0.0	0	0	2.6				
BH412	30/04/15 13:12:00			4.4	0.0	13.4	0.0	0	0	2.3				
BH412	30/04/15 13:13:00			4.4	0.0	13.4	0.0	0	0	1.9				
BH412	30/04/15 13:14:00			4.4	0.0	13.3	0.0	0	0	1.9			2.84	Water sample not obtained. Not enough water in installation.
BH412	21/05/15 11:57:00	1019									0.0	21		
BH412	21/05/15 11:58:00										0.0			
BH412	21/05/15 11:59:00										0.0			
BH412	21/05/15 12:00:00										0.0			

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH412	21/05/15 12:01:00										0.0			
BH412	21/05/15 12:02:00			3.2	0.0	15.6	0.0	0	0	0.0				
BH412	21/05/15 12:03:00			3.8	0.0	14.7	0.0	0	0	0.0				
BH412	21/05/15 12:04:00			3.9	0.0	14.4	0.0	0	0	0.0				
BH412	21/05/15 12:05:00			3.1	0.0	15.6	0.0	0	0	0.0				
BH412	21/05/15 12:06:00			3.4	0.0	15.2	0.0	0	0	0.0				
BH412	21/05/15 12:07:00			3.9	0.0	14.9	0.0	0	0	0.0				
BH412	21/05/15 12:08:00			3.8	0.0	14.6	0.0	0	0	0.0				
BH412	21/05/15 12:09:00			3.9	0.0	14.4	0.0	0	0	0.0				
BH412	21/05/15 12:10:00			3.8	0.0	14.5	0.0	0	0	0.0				
BH412	21/05/15 12:11:00			3.8	0.0	14.5	0.0	0	0	0.0				
BH412	21/05/15 12:12:00												Dry	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH412	23/04/15 12:44:00												8.79	67 litres purged, base depth 20.00m.
BH412	30/04/15 13:14:00												9.85	60 litres purged, base depth 20.00m.
BH412	21/05/15 12:13:00												10.57	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Deep install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH413	20/04/15 13:30:00	1031	0.1								0.0	17		0 litres purged, base depth 4.50m. Not enough water in install to recover sample. Very muddy/silty.
BH413	20/04/15 13:31:00										0.0			
BH413	20/04/15 13:32:00										0.0			
BH413	20/04/15 13:33:00										0.0			
BH413	20/04/15 13:34:00										0.0			
BH413	20/04/15 13:35:00			4.3	32.7	3.1	#	0	4	0.0				
BH413	20/04/15 13:36:00			4.6	34.8	1.7	#	0	3	0.0				
BH413	20/04/15 13:37:00			4.7	36.0	1.2	#	0	3	0.0				
BH413	20/04/15 13:38:00			4.6	35.8	1.3	#	0	3	0.0				
BH413	20/04/15 13:39:00			4.6	35.7	1.3	#	0	3	0.0				
BH413	20/04/15 13:40:00			4.7	35.7	1.2	#	0	3	0.0				
BH413	20/04/15 13:41:00			4.7	35.7	1.2	#	0	4	0.0				
BH413	20/04/15 13:42:00			4.7	35.7	1.1	#	0	4	0.1				
BH413	20/04/15 13:43:00			4.7	35.8	1.1	#	0	4	0.0				
BH413	20/04/15 13:44:00			4.7	35.7	1.1	#	0	4	0.1			2.28	Water sample not obtained. Not enough water in installation.
BH413	27/04/15 11:00:00	1017	-0.91								0.0	9		0 litres purged, base depth 4.50m. Not enough water in install to obtain sample.

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH413	27/04/15 11:01:00										0.0			
BH413	27/04/15 11:02:00										0.0			
BH413	27/04/15 11:03:00										0.0			
BH413	27/04/15 11:04:00										0.0			
BH413	27/04/15 11:05:00			5.1	41.5	1.5	#	0	5	0.0				
BH413	27/04/15 11:06:00			5.3	43.4	0.6	#	0	7	0.0				
BH413	27/04/15 11:07:00			5.4	44.3	0.2	#	0	9	0.0				
BH413	27/04/15 11:08:00			5.4	44.6	0.2	#	0	10	0.0				
BH413	27/04/15 11:09:00			5.4	44.6	0.2	#	0	10	0.0				
BH413	27/04/15 11:10:00			5.4	44.6	0.2	#	0	11	0.0				
BH413	27/04/15 11:11:00			5.4	44.6	0.1	#	0	11	0.0				
BH413	27/04/15 11:12:00			5.4	44.6	0.1	#	0	12	0.0				
BH413	27/04/15 11:13:00			5.4	44.6	0.1	#	0	12	0.0				
BH413	27/04/15 11:14:00			5.4	44.8	0.1	#	0	12	0.0			2.36	Water sample not obtained. Not enough water in installation.
BH413	05/05/15 11:45:00	998	-0.73								0.0	12		0 litres purged, base depth 4.50m. Not enough water to obtain sample.
BH413	05/05/15 11:46:00										0.0			
BH413	05/05/15 11:47:00										0.0			

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH413	05/05/15 11:48:00										0.0			
BH413	05/05/15 11:49:00										0.0			
BH413	05/05/15 11:50:00			5.2	47.3	0.3	#	0	27	0.0				
BH413	05/05/15 11:51:00			5.2	47.4	0.2	#	0	26	0.0				
BH413	05/05/15 11:52:00			5.3	47.7	0.2	#	0	23	0.0				
BH413	05/05/15 11:53:00			5.3	47.8	0.2	#	0	23	0.0				
BH413	05/05/15 11:54:00			5.3	47.8	0.2	#	0	23	0.0				
BH413	05/05/15 11:55:00			5.3	47.9	0.2	#	0	21	0.0				
BH413	05/05/15 11:56:00			5.3	47.9	0.2	#	0	21	0.0				
BH413	05/05/15 11:57:00			5.3	47.9	0.2	#	0	20	0.0				
BH413	05/05/15 11:58:00			5.3	48.0	0.1	#	0	19	0.0				
BH413	05/05/15 11:59:00			5.3	48.1	0.2	#	0	16	0.0			2.24	Water sample not obtained. Not enough water in installation.
BH413	12/05/15 13:40:00	1017	5								0.0	21		
BH413	12/05/15 13:41:00										1.3			
BH413	12/05/15 13:42:00										0.0			
BH413	12/05/15 13:43:00										1.6			
BH413	12/05/15 13:44:00										1.0			
BH413	12/05/15 13:45:00			4.7	40.5	0.8	#	0	0	0.0				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH413	12/05/15 13:46:00			4.7	40.9	0.7	#	0	0	0.0				
BH413	12/05/15 13:47:00			4.7	41.0	0.7	#	0	10	0.0				
BH413	12/05/15 13:48:00			4.7	40.9	0.7	#	0	10	0.0				
BH413	12/05/15 13:49:00			4.7	40.8	0.7	#	0	10	0.0				
BH413	12/05/15 13:50:00			4.7	40.8	0.7	#	0	10	0.0				
BH413	12/05/15 13:51:00			4.7	40.8	0.7	#	0	10	0.0				
BH413	12/05/15 13:52:00			4.7	40.8	0.7	#	0	10	0.0				
BH413	12/05/15 13:53:00			4.7	40.6	0.6	#	0	10	0.0				
BH413	12/05/15 13:54:00			4.7	40.6	0.6	#	0	10	0.0				
BH413	12/05/15 13:55:00												3.38	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT **30238**

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GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH413	20/04/15 13:44:00												7.86	72 litres purged, base depth 18.00m.
BH413	27/04/15 11:14:00												8.09	71 litres purged, base depth 18.00m.
BH413	05/05/15 11:59:00												7.79	73 litres purged, base depth 18.00m.
BH413	12/05/15 13:56:00												9.28	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Deep install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH415	20/04/15 11:00:00	1034	-0.72								0.0	12		49 litres purged, base depth 17.00m.
BH415	20/04/15 11:01:00										0.0			
BH415	20/04/15 11:02:00										0.0			
BH415	20/04/15 11:03:00										0.0			
BH415	20/04/15 11:04:00										0.0			
BH415	20/04/15 11:05:00			0.1	0.4	20.5	7.0	0	1	2.5				
BH415	20/04/15 11:06:00			0.1	0.1	20.6	1.0	0	0	2.3				
BH415	20/04/15 11:07:00			0.1	0.0	20.7	0.0	0	0	2.0				
BH415	20/04/15 11:08:00			0.1	0.3	20.7	4.0	0	0	1.8				
BH415	20/04/15 11:09:00			0.0	0.2	20.8	3.0	0	0	1.7				
BH415	20/04/15 11:10:00			0.0	0.2	20.8	2.0	0	0	1.6				
BH415	20/04/15 11:11:00			0.0	0.1	20.9	1.0	0	0	1.5				
BH415	20/04/15 11:12:00			0.1	0.2	20.8	3.0	0	0	1.3				
BH415	20/04/15 11:13:00			0.1	0.2	20.8	3.0	0	0	1.2				
BH415	20/04/15 11:14:00			0.1	0.2	20.8	3.0	0	0	1.2			6.08	
BH415	27/04/15 09:30:00	1018	-1.35								0.0	8		46 litres purged, base depth 17.00m.
BH415	27/04/15 09:31:00										0.0			
BH415	27/04/15 09:32:00										0.0			

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH415	27/04/15 09:33:00										0.0			
BH415	27/04/15 09:34:00										0.0			
BH415	27/04/15 09:35:00			0.1	0.1	20.2	2.0	0	0	2.0				
BH415	27/04/15 09:36:00			0.1	0.1	20.3	1.0	0	0	1.6				
BH415	27/04/15 09:37:00			0.0	0.0	20.4	0.0	0	0	1.4				
BH415	27/04/15 09:38:00			0.0	0.0	20.4	0.0	0	0	1.2				
BH415	27/04/15 09:39:00			0.0	0.0	20.4	0.0	0	0	1.0				
BH415	27/04/15 09:40:00			0.0	0.0	20.4	0.0	0	0	0.9				
BH415	27/04/15 09:41:00			0.0	0.0	20.5	0.0	0	0	0.8				
BH415	27/04/15 09:42:00			0.0	0.0	20.5	0.0	0	0	0.8				
BH415	27/04/15 09:43:00			0.0	0.0	20.5	0.0	0	0	0.8				
BH415	27/04/15 09:44:00			0.0	0.0	20.5	0.0	0	0	0.8			6.66	
BH415	05/05/15 10:15:00	996	-0.19								0.0	10		47 litres purged, base depth 17.00m.
BH415	05/05/15 10:16:00										0.0			
BH415	05/05/15 10:17:00										0.0			
BH415	05/05/15 10:18:00										0.0			
BH415	05/05/15 10:19:00										0.0			
BH415	05/05/15 10:20:00			0.3	0.2	20.6	3.0	0	1	1.4				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH415	05/05/15 10:21:00			0.2	0.1	20.7	2.0	0	1	1.2				
BH415	05/05/15 10:22:00			0.2	0.1	20.7	2.0	0	1	1.1				
BH415	05/05/15 10:23:00			0.1	0.1	20.8	1.0	0	1	0.9				
BH415	05/05/15 10:24:00			0.1	0.1	20.8	1.0	0	1	0.7				
BH415	05/05/15 10:25:00			0.1	0.1	20.8	1.0	0	0	0.6				
BH415	05/05/15 10:26:00			0.1	0.1	20.9	1.0	0	0	0.5				
BH415	05/05/15 10:27:00			0.1	0.1	20.9	1.0	0	0	0.4				
BH415	05/05/15 10:28:00			0.1	0.1	20.9	1.0	0	0	0.4				
BH415	05/05/15 10:29:00			0.1	0.1	20.9	1.0	0	0	0.3			6.36	
BH415	12/05/15 12:41:00	1019	2								0.0	19		
BH415	12/05/15 12:42:00										0.0			
BH415	12/05/15 12:43:00										0.0			
BH415	12/05/15 12:44:00										0.0			
BH415	12/05/15 12:45:00										0.0			
BH415	12/05/15 12:46:00			0.2	0.0	19.3	0.0	0	0	0.1				
BH415	12/05/15 12:47:00			0.0	0.0	19.9	0.0	0	0	0.0				
BH415	12/05/15 12:48:00			0.0	0.0	20.0	0.0	0	0	0.0				
BH415	12/05/15 12:49:00			0.0	0.0	20.1	0.0	0	0	0.0				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH415	12/05/15 12:50:00			0.0	0.0	20.1	0.0	0	0	0.0				
BH415	12/05/15 12:51:00			0.0	0.0	20.2	0.0	0	0	0.0				
BH415	12/05/15 12:52:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH415	12/05/15 12:53:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH415	12/05/15 12:54:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH415	12/05/15 12:55:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH415	12/05/15 12:56:00												7.77	17

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH415	20/04/15 11:14:00												6.51	199 litres purged, base depth 40.00m.
BH415	27/04/15 09:44:00												6.77	199 litres purged, base depth 40.00m.
BH415	05/05/15 10:29:00												6.61	200 litres purged, base depth 40.00m.
BH415	12/05/15 12:57:00												8.06	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Deep install.

CONTRACT	CHECKED
30238	**EC**

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		01

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		30/01/2008	09:50	2.45	25/02/2008	14:34	2.48	07/03/2008	14:25	2.60
SBHD03 CP	SPIE	10.00		30/01/2008	11:01	0.47	25/02/2008	14:52	0.43	07/03/2008	14:05	0.56
SBHD05 RC	SPIE	12.00		31/01/2008	09:00	1.02	25/02/2008	15:35	1.05	07/03/2008	13:50	1.77
SBHD06 RC	SP	15.00		30/01/2008	13:00	1.13	21/02/2008	10:30	1.39	07/03/2008	13:30	1.39
SBHD08 RC	SPIE	29.50		30/01/2008	13:50	1.20	25/02/2008	15:58	2.02	07/03/2008	13:35	1.40
SBHE02RD	SPIE	25.00		31/01/2008	09:25	2.18	25/02/2008	16:20	2.09	07/03/2008	13:10	2.48
SBHE04 RC	SPIE	17.20		31/01/2008	09:15	2.31	25/02/2008	16:11	2.51	07/03/2008	13:20	2.59
SBHF01 RC	SPIE	19.00		31/01/2008	09:40	5.69	25/02/2008	16:32	5.72	07/03/2008	12:50	5.43
SBHF02A CP	SPIE	17.00		01/02/2008	14:40	7.61	25/02/2008	17:13	7.57	07/03/2008	12:30	9.00
SBHF03 RC	SPIE	18.00		31/01/2008	10:35	6.97	26/02/2008	08:55	6.77	07/03/2008	12:15	7.22
SBHH01 RC	SPIE	25.00		31/01/2008	11:15	3.45	26/02/2008	09:39	3.42	07/03/2008	11:28	3.65
SBHH02 RC	SPIE	14.90		31/01/2008	11:10	3.42	26/02/2008	09:20	3.88	07/03/2008	11:35	3.64
SBHH05 RC	SPIE	21.50		31/01/2008	11:30	2.22	26/02/2008	10:01	2.13	07/03/2008	11:05	3.10
SBHH06 CP	SP	12.30		30/01/2008	15:30	3.75	21/02/2008	08:00	3.76	07/03/2008	11:10	3.87
SBHH07A RC	SPIE	24.85		30/01/2008	14:50	1.70	26/02/2008	10:40	1.34	07/03/2008	11:00	1.07
SBHJ01 CP	SP	7.50		01/02/2008	12:20	1.34	21/02/2008	11:45	5.98	06/03/2008	12:28	1.82
SBHJ03 CP	SP	5.20		01/02/2008	08:00	0.54	27/02/2008	16:15	0.70	07/03/2008	10:45	0.68
SBHJ04	SP	13.10		01/02/2008	11:55	6.61	22/02/2008	13::55	6.67	06/03/2008	11:46	6.75
SBHJ05	SP	11.50		01/02/2008	11:10	8.91	22/02/2008	09:00	9.07	06/03/2008	11:23	9.16
SBHJ06 CP	SP	4.10		01/02/2008	11:45	1.31	21/02/2008	15:30	1.32	06/03/2008	10:50	1.33
SBHJ07 CP	SP	10.40		01/02/2008	11:43	1.35	21/02/2008	14:40	1.40	06/03/2008	12:05	1.56
SBHJ08A CP	SP	7.40		01/02/2008	11:35	3.49	21/02/2008	13:05	2.31	06/03/2008	10:57	2.67
SBHJ09 CP	SP	2.20		01/02/2008	11:30	0.65	21/02/2008	12:25	0.85	06/03/2008	11:00	0.90
SBHJ10 CP	SP	10.00		01/02/2008	10:40	2.30	21/02/2008	13:45	2.24	06/03/2008	10:40	2.16
SBHK01 CP	SP	6.80		01/02/2008	10:55	0.70	25/02/2008	10:30	1.00	06/03/2008	14:24	1.06
SBHK02 CP	SP	11.20		01/02/2008	10:50	1.34	25/02/2008	11:20	1.33	06/03/2008	14:18	1.47
SBHK03 CP	SP	5.90		01/02/2008	10:45	0.87	25/02/2008	12:00	0.89	06/03/2008	14:15	1.00
SBHK04 CP	SP	12.20		01/02/2008	10:25	1.45	25/02/2008	12:30	1.60	06/03/2008	12:30	1.60
SBHL02 RC	SPIE	15.20		01/02/2008	10:35	2.27	25/02/2008	12:49	2.31	06/03/2008	14:00	2.42
SBHL03 RC	SPIE	15.00		31/01/2008	16:20	0.61	26/02/2008	11:15	0.51	07/03/2008	10:25	0.66
SBHM01 RC	SPIE	21.00		01/01/1900	08:20	-0.26	26/02/2008	11:30	-0.26	07/03/2008	10:17	0.05
SBHM02 RC	SPIE	20.00		01/02/2008	08:25	0.19	26/02/2008	11:41	0.49	07/03/2008	10:14	0.68
SBHN01A RC	SPIE	14.90		01/02/2008	15:20	8.49	27/02/2008	17:15	12.23	07/03/2008	14:45	13.18
SBHN02 RC	SPIE	20.40		31/01/2008	15:55	3.67	26/02/2008	11:57	4.19	07/03/2008	10:05	4.84
SBHN03 RC	SPIE	15.00		31/01/2008	15:45	1.07	26/02/2008	12:03	1.73	07/03/2008	09:55	2.34
SBHN04 RC	SPIE	10.00		31/01/2008	15:30	9.99	26/02/2008	14:42	DRY	07/03/2008	09:45	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		02

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		31/01/2008	14:50	DRY	26/02/2008	14:12	DRY	07/03/2008	09:35	DRY
SBHP02 RC	SPIE	9.80		31/01/2008	13:55	7.20	26/02/2008	13:59	8.09	07/03/2008	09:10	8.25
SBHP03 RC	SPIE	5.00		31/01/2008	13:40	4.09	26/02/2008	13:48	4.76	07/03/2008	09:05	4.78
SBHQ01 RC	SPIE	11.80		31/01/2008	14:20	5.76	26/02/2008	12:46	6.74	07/03/2008	09:30	7.20
SBHQ02 RC	SPIE	6.00		31/01/2008	14:15	4.98	26/02/2008	12:59	5.16	07/03/2008	09:25	5.98
SBHQ03 RC	SPIE	11.00		31/01/2008	13:20	6.04	26/02/2008	13:29	7.22	07/03/2008	08:38	7.59
SBHQ04 RC	SPIE	8.00		31/01/2008	13:05	4.35	26/02/2008	13:36	6.18	07/03/2008	08:55	6.94
SBHQ06 RC	SPIE	7.35		31/01/2008	13:00	3.89	26/02/2008	13:16	4.40	07/03/2008	08:25	4.63
SWSJ08	SP	3.30		01/02/2008	12:30	0.42	21/02/2008	11:45	0.37	06/03/2008	12:35	0.41
SWSJ13	SP	2.50		01/02/2008	12:00	DRY	22/02/2008	13:45	DRY	06/03/2008	11:50	DRY
SWSJ21	SP	6.00		01/02/2008	11:20	3.87	22/02/2008	09:30	5.72	06/03/2008	11:27	6.59
SWSJ23	SP	7.80		01/02/2008	11:22	5.92	22/02/2008	09:55	6.62	06/03/2008	11:30	6.97
SWSJ34	SP	6.00		01/02/2008	11:05	2.52	22/02/2008	10:55	3.33	06/03/2008	11:10	3.08
SWSJ37	SP	5.60		01/02/2008	11:25	0.46	22/02/2008	11:30	0.55	06/03/2008	11:15	0.61
LGBH02	SP	8.88					22/02/2008	14:35	7.50	06/03/2008	11:40	7.52
LGBH03	SP	8.90					22/02/2008	14:21	7.20	06/03/2008	11:44	7.28
LGBH04	SP	10.50					22/02/2008	10:30	8.87	06/03/2008	11:20	9.00
LGBH09	SP	7.00					22/02/2008	12:40	1.13	06/03/2008	10:48	1.56
LGBH10	SP	14.60					27/02/2008	14:30	8.15	06/03/2008	11:12	8.21
LGBH11	SP	11.20					27/02/2008	10:00	7.05	06/03/2008	11:03	7.07
LGBH12	SP	7.05					22/02/2008	13:10	1.40	06/03/2008	10:45	1.40
RBBH07	SP	6.25					27/02/2008	12.15	0.69	06/03/2008	12:20	0.71
RBBH09	SP	7.05					27/02/2008	13:40	1.25	06/03/2008	12:25	1.21
RBBH10	SP	6.85					27/02/2008	13:00	0.68	06/03/2008	12:30	0.82

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		03

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		20/03/2008	16:30	2.57	04/04/2008	08:00	2.59	18/04/2008	07:40	2.66
SBHD03 CP	SPIE	10.00		20/03/2008	16:45	0.58	04/04/2008	08:13	0.53	18/04/2008	08:00	0.60
SBHD05 RC	SPIE	12.00		20/03/2008	16:00	1.08	04/04/2008	09:15	1.22	18/04/2008	08:30	1.32
SBHD06 RC	SP	15.00		20/03/2008	17:55	1.20	04/04/2008	09:30	1.33	18/04/2008	08:40	1.44
SBHD08 RC	SPIE	29.50		19/03/2008	18:30	1.28	04/04/2008	10:00	1.39	18/04/2008	08:52	1.52
SBHE02RD	SPIE	25.00		20/03/2008	16:20	2.23	04/04/2008	08:50	2.46	18/04/2008	09:00	2.54
SBHE04 RC	SPIE	17.20		20/03/2008	15:45	2.20	04/04/2008	09:00	1.80	18/04/2008	08:15	1.80
SBHF01 RC	SPIE	19.00		20/03/2008	15:30	5.50	04/04/2008	08:40	5.55	18/04/2008	13:58	5.58
SBHF02A CP	SPIE	17.00		20/03/2008	15:10	5.60	04/04/2008	10:28	5.70	18/04/2008	13:45	5.77
SBHF03 RC	SPIE	18.00		20/03/2008	14:55	7.20	04/04/2008	10:36	7.38	18/04/2008	13:40	7.42
SBHH01 RC	SPIE	25.00		20/03/2008	14:25	3.60	04/04/2008	15:00	3.60	18/04/2008	13:10	3.62
SBHH02 RC	SPIE	14.90		20/03/2008	14:30	4.27	04/04/2008	15:05	3.64	18/04/2008	13:13	3.70
SBHH05 RC	SPIE	21.50		20/03/2008	17:30	2.17	04/04/2008	15:15	2.78	18/04/2008	11:34	2.90
SBHH06 CP	SP	12.30		17/03/2008	15:20	3.88	04/04/2008	15:20	3.89	17/04/2008	14:15	3.90
SBHH07A RC	SPIE	24.85		20/03/2008	13:55	1.33	04/04/2008	15:28	1.92	18/04/2008	11:43	0.88
SBHJ01 CP	SP	7.50		19/03/2008	14:15	1.81	03/04/2008	16:05	1.90	17/04/2008	12:40	1.80
SBHJ03 CP	SP	5.20		19/03/2008	16:40	0.78	03/04/2008	18:25	0.82	17/04/2008	15:55	0.80
SBHJ04	SP	13.10		17/03/2008	13:35	6.64	03/04/2008	18:10	6.74	17/04/2008	13:08	6.80
SBHJ05	SP	11.50		18/03/2008	13:50	9.02	03/04/2008	17:39	9.10	17/04/2008	13:31	9.11
SBHJ06 CP	SP	4.10		17/03/2008	12:55	1.29	03/04/2008	17:43	1.33	17/04/2008	15:05	1.20
SBHJ07 CP	SP	10.40		17/03/2008	10:25	1.59	03/04/2008	17:47	1.50	17/04/2008	13:58	1.47
SBHJ08A CP	SP	7.40		18/03/2008	10:00	2.50	03/04/2008	17:55	2.50	17/04/2008	15:33	2.50
SBHJ09 CP	SP	2.20		18/03/2008	10:25	0.69	03/04/2008	17:58	0.82	17/04/2008	15:22	0.90
SBHJ10 CP	SP	10.00		17/03/2008	09:15	2.10	03/04/2008	17:50	2.00	17/04/2008	13:55	2.00
SBHK01 CP	SP	6.80		19/03/2008	10:45	0.88	03/04/2008	16:40	1.00	17/04/2008	11:40	0.94
SBHK02 CP	SP	11.20		19/03/2008	11:15	1.46	03/04/2008	16:45	1.48	17/04/2008	11:43	1.46
SBHK03 CP	SP	5.90		19/03/2008	11:45	1.04	03/04/2008	16:48	1.07	17/04/2008	11::46	0.98
SBHK04 CP	SP	12.20		19/03/2008	12:15	1.64	03/04/2008	16:52	1.67	17/04/2008	12:05	1.60
SBHL02 RC	SPIE	15.20		19/03/2008	12:50	2.44	03/04/2008	17:00	2.45	17/04/2008	12:00	2.45
SBHL03 RC	SPIE	15.00		20/03/2008	13:25	0.76	08/04/2008	15:40	0.64	18/04/2008	09:50	0.62
SBHM01 RC	SPIE	21.00		20/03/2008	13:05	-0.21	08/04/2008	15:48	-0.45	18/04/2008	11:55	0.01
SBHM02 RC	SPIE	20.00		20/03/2008	13:10	0.61	08/04/2008	15:52	0.61	18/04/2008	11:50	0.61
SBHN01A RC	SPIE	14.90		20/03/2008	12:55	12.14	08/04/2008	16:05	12.58	18/04/2008	12:48	13.27
SBHN02 RC	SPIE	20.40		20/03/2008	12:45	4.26	08/04/2008	16:12	2.64	18/04/2008	12:45	4.85
SBHN03 RC	SPIE	15.00		20/03/2008	12:30	1.60	08/04/2008	16:17	2.07	18/04/2008	12:35	2.37
SBHN04 RC	SPIE	10.00		20/03/2008	12:10	DRY	08/04/2008	16:28	DRY	18/04/2008	10:55	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 17/03/08-17/04/08	Date: 21/04/2008	Date: 21/04/2008
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NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		04

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		20/03/2008	12:00	DRY	08/04/2008	16:40	DRY	18/04/2008	10:45	DRY
SBHP02 RC	SPIE	9.80		20/03/2008	11:45	5.59	08/04/2008	16:55	7.98	18/04/2008	10:30	8.20
SBHP03 RC	SPIE	5.00		20/03/2008	11:40	2.80	08/04/2008	16:50	DRY	18/04/2008	10:25	4.93
SBHQ01 RC	SPIE	11.80		20/03/2008	10:40	6.72	08/04/2008	17:13	7.24	18/04/2008	10:10	7.48
SBHQ02 RC	SPIE	6.00		20/03/2008	10:45	4.91	08/04/2008	17:10	DRY	18/04/2008	10:05	DRY
SBHQ03 RC	SPIE	11.00		20/03/2008	10:50	6.76	08/04/2008	17:05	7.69	18/04/2008	10:15	8.00
SBHQ04 RC	SPIE	8.00		20/03/2008	11:30	6.97	08/04/2008	17:02	DRY	18/04/2008	10:40	DRY
SBHQ06 RC	SPIE	7.35		20/03/2008	11:20	4.47	08/04/2008	17:20	6.63	18/04/2008	12:20	4.79
SWSJ08	SP	3.30		19/03/2008	15:10	0.44	03/04/2008	16:00	0.46	17/04/2008	12:35	0.42
SWSJ13	SP	2.50		17/03/2008	13:25	DRY	03/04/2008	18:12	DRY	17/04/2008	13:12	DRY
SWSJ21	SP	6.00		18/03/2008	14:30	4.42	03/04/2008	17:33	5.89	17/04/2008	13:32	6.50
SWSJ23	SP	7.80		18/03/2008	15:05	7.58	03/04/2008	17:35	7.20	17/04/2008	13:35	7.20
SWSJ34	SP	6.00		19/03/2008	08:55	2.36	03/04/2008	17:23	3.26	17/04/2008	13:46	DRY
SWSJ37	SP	5.60		18/03/2008	11:15	0.55	03/04/2008	17:25	0.67	17/04/2008	13:42	0.63
LGBH02	SP	8.88		17/03/2008	12:55	7.48	03/04/2008	18:05	7.46	17/04/2008	13:00	7.48
LGBH03	SP	8.90		17/03/2008	13:15	7.24	03/04/2008	18:08	7.32	17/04/2008	13:03	7.30
LGBH04	SP	10.50		18/03/2008	13:20	8.87	03/04/2008	17:40	8.90	17/04/2008	13:29	8.94
LGBH09	SP	7.00		17/03/2008	11:00	1.08	03/04/2008	17:45	1.15	17/04/2008	15:08	1.05
LGBH10	SP	14.60		18/03/2008	15:20	8.31	03/04/2008	17:27	8.20	17/04/2008	13:40	8.70
LGBH11	SP	11.20		18/03/2008	11:40	6.88	03/04/2008	17:18	7.00	17/04/2008	15:38	7.08
LGBH12	SP	7.05		17/03/2008	10:00	1.30	03/04/2008	17:49	1.47	17/04/2008	15:15	1.36
RBBH07	SP	6.25		19/03/2008	13:25	0.66	03/04/2008	15:50	0.68	17/04/2008	12:30	1.10
RBBH09	SP	7.05		19/03/2008	14:40	1.18	03/04/2008	16:07	1.21	17/04/2008	12:42	1.25
RBBH10	SP	6.85		19/03/2008	13:45	0.70	03/04/2008	16:03	0.75	17/04/2008	12:39	0.78

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
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NORWEST HOLST SOIL ENGINEERING

A3 Appendix 3

Tabulated Soil Laboratory Data

M4CAN
Soil Analysis Results & Screening Assessment
CL-13
09/07/2015

Geological Formation Legend

MG	Made Ground

Screening Values and Assessment

	Exceeds S4ULs criteria
X	Laboratory detection level higher than screening criterion

Notes

NFD No Fibres Detected
Chromium VI criteria used
Elemental Mercury criteria used
Screening criterion for lead is C4SL in the absence of a S4UL
Conservative 1% SOM has been used

Sample Reference	Units	BHF2	CH9	CH9	No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	Selected S4ULs Criteria	No. Data Exceeding S4ULs Criteria
Specimen Depth (m)		0.2	0	1.5							
OD Level (m)		8.6	9.8	9.8							
Sample Type		B	D	D							
Geology Code		MG	MG	MG							
Cluster Code		1997	2000	2000							
Location											
Metals											
Arsenic	mg/kg	11.9	8.7	13	3	3	13	8.7	CH9 @ 1.5mbGL	170	0
Boron	mg/kg	6.1	1.1	1.3	3	3	6.1	1.1	BHF2 @ 0.2mbGL	46000	0
Cadmium	mg/kg	1	0.38	0.13	3	3	1	0.13	BHF2 @ 0.2mbGL	190	0
Chromium	mg/kg	34.4	40	41	3	3	41	34.4	CH9 @ 1.5mbGL	33	3
Copper	mg/kg	29.1	20	19	3	3	29.1	19	BHF2 @ 0.2mbGL	44000	0
Mercury	mg/kg	0.5	0.14	0.02	3	3	0.5	0.02	BHF2 @ 0.2mbGL	30	0
Nickel	mg/kg	17	19	34	3	3	34	17	CH9 @ 1.5mbGL	980	0
Lead	mg/kg	117.5	245	52	3	3	245	52	CH9 @ 0mbGL	1300	0
Selenium	mg/kg	0.9	0.98	0.61	3	3	0.98	0.61	CH9 @ 0mbGL	1800	0
Zinc	mg/kg	437.5	149	100	3	3	437.5	100	BHF2 @ 0.2mbGL	170000	0
PAH											
Total PAH	mg/kg	8.1			1	1	8.1	8.1	BHF2 @ 0.2mbGL	1.1	1
PAH Screening	mg/kg		372	12	2	2	372	12	CH9 @ 0mbGL	1.1	2
TPH											
Oil FTIR	mg/kg		2230	184	2	2	2230	184	CH9 @ 0mbGL		
TPH FTIR	mg/kg		783	<20	2	1	783	783	CH9 @ 0mbGL	3200	0
Mineral Oil	mg/kg	1715			1	1	1715	1715	BHF2 @ 0.2mbGL		
Phenols											
Phenols Monohydric	mg/kg	<1			1	0	None > LOD	None > LOD		440	0
Other											
pH	no units	9.6	9.5	8	3	3	9.6	8	BHF2 @ 0.2mbGL	6-9	2
Cyanide (total)	mg/kg				0	0	None > LOD	None > LOD			
Cyanide (free)	mg/kg	<0.1	<1	<1	3	0	None > LOD	None > LOD			
Sulphate (total)	mg/kg	26797	6190	1070	3	3	26797	1070	BHF2 @ 0.2mbGL		

A4 Appendix 4

Tabulated Soil Leachate Laboratory Data

M4CAN
Leachate Analysis Results & Screening Assessment
CL-13
09/07/2015

Geological Formation Legend

MG	Made Ground

Screening Values & Assessment

EQS	Environmental Quality Standards
DWS	Drinking Water Standard
	Exceeds EQS
X	Exceeds DWS
X	Laboratory detection level higher than screening criterion

Notes

EQS calcium carbonate 100 - 150mg/l for heavy metals: chromium, copper, lead, nickel and zinc	
	Location logs unavailable, details unknown

Sample Reference	Units	Screening Criteria		BH13	TP19	TP20	TP20	TP45	CH9
Specimen Depth (m)		EQS	DWS	3.2	2	1	3	2	0
OD Level (m)									
Sample Type				L	L	L	L	L	L
Geology code									MG
Cluster Code				2002	2002	2002	2002	2002	2000
Location				Exploration Associates (North)					Exploration Associates (South)
2:1 Leachate									
Arsenic Dissolved	ug/l	50	10	<1	10	<1	3	2	0.002
Boron Dissolved	ug/l	2000	1000	70	2600	50	220	130	
Barium Dissolved	ug/l								
Cadmium Dissolved	ug/l	0.15	5	<0.1	<0.1	<0.1	<0.1	<0.1	
Chromium Dissolved	ug/l		50	<20	<20	<20	<20	<20	
Copper Dissolved	ug/l	10	2000	10	<10	<10	10	<10	0.002
Mercury Dissolved	ug/l	0.07	1	<0.1	<0.1	<0.1	<0.1	<0.1	
Molybdenum Dissolved	ug/l								
Nickel Dissolved	ug/l	4	20	<20	30	<20	<20	<20	
Lead Dissolved	ug/l	1.2	10	<30	<30	<30	<30	<30	
Antimony Dissolved	ug/l		5						
Selenium Dissolved	ug/l		10	<1	<1	<1	<1	<1	
Zinc Dissolved	ug/l	75		40	120	40	90	100	0.034
Total Cyanide	mg/l	0.001	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
pH Units	pH units	6-9	6.5-10	7.4	7	7.8	7.5	7.8	
PAH	ug/l			<0.18	<0.18	<0.18	<0.18	<0.18	
TPH FTIR	ug/l								400
TPH GC	ug/l			<100	400	<100	600	<100	<100

No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
6	4	10	0.002	TP19 @ 2mbGL	0	0
5	5	2600	50	TP19 @ 2mbGL	1	1
5	0	None > LOD	None > LOD			
5	0	None > LOD	None > LOD		0	0
5	0	None > LOD	None > LOD			0
6	3	10	0.002	BH13 @ 3.2 / TP20 @ 3mbGL	0	0
5	0	None > LOD	None > LOD		0	0
5	0	None > LOD	None > LOD			
5	1	30	30	TP19 @ 2mbGL	1	1
5	0	None > LOD	None > LOD		0	0
5	0	None > LOD	None > LOD			0
5	0	None > LOD	None > LOD			0
6	6	120	0.034	TP19 @ 2mbGL	3	
5	0	None > LOD	None > LOD		0	0
5	5	7.8	7	TP20 @ 1 / TP45 @ 2mbGL	0	0
5	0	None > LOD	None > LOD			
1	1	400	400	CH9 @ 0mbGL		
6	2	600	400	TP20 @ 3mbGL		

A5 Appendix 5

Tabulated Groundwater Laboratory Data

M4CAN
Groundwater Analysis Results & Screening Assessment
CL-13
14/07/2015

Geological Formation Legend

TFD	Tidal Flat Deposits
GFD	Glaciofluvial Deposit
MMG	Mercia Mudstone Group

Screening Values & Assessment

EQS	Environmental Quality Standards
DWS	Drinking Water Standard
	Exceeds EQS
X	Exceeds DWS
X	Laboratory detection level higher than screening criterion

Notes

EQS calcium carbonate 100 - 150mg/l for heavy metals: chromium, copper, lead, nickel and zinc

Monitoring Round	Units	Screening Criteria		1	2	3	1	2	1		2		3	
Location				BH412	BH412	BH412	BH413	BH413	BH415	BH415	BH415	BH415	BH415	BH415
Location Type				BH			BH		BH					
Response Zone Details (RZ)				GFD	GFD	GFD	GFD	GFD	GFD	MMG	GFD	MMG	GFD	MMG
Depth (m)				16.7	6.17	9.47	15.62	15.5	6.72	6.53	6.74	6.89	6.42	6.75
Installation Details		EQS	DWS	Deep	Deep	Deep	Deep	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep
Date Sampled				20/04/2015	23/04/2015	08/05/2015	27/04/2015	05/05/2015	20/04/2015		27/04/2015		05/05/2015	
Metals														
Arsenic Dissolved	ug/l	50	10	7.1	9.3	6	26	11	6.2	13	24	41	9.9	12
Boron Dissolved	ug/l	2000	1000	2300	410	490	3800	2600	530	220	1600	1000	1600	1100
Cadmium Dissolved	ug/l	0.15	5	<0.08	<0.08	0.11	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Chromium Dissolved	ug/l		50	14	22	<1	82	20	14	28	74	100	17	23
Copper Dissolved	ug/l	10	2000	31	8.5	23	8.8	15	6.9	24	8	9.3	13	14
Lead Dissolved	ug/l	1.2	10	<1	<1	3.3	<1	<1	<1	<1	<1	<1	<1	<1
Mercury Dissolved	ug/l	0.07	1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75	0.56	0.63	<0.5	<0.5
Nickel Dissolved	ug/l	4	20	7.8	1.9	1.8	6.8	2	3.6	1.6	5.3	3.5	5.2	2.6
Selenium Dissolved	ug/l		10	14	22	9.4	47	25	9.4	24	48	64	20	18
Zinc Dissolved	ug/l	75		3.7	14	13	14	9	3.7	12	12	18	11	14
Non-Metal Inorganics														
Total Alkalinity as CaCO3	mg/l			1700	180	150	1200	1100	540	170	470	210	630	230
Total Diss Sulphur	mg/l													
Chloride	mg/l	250	250	2000	2900	2600	2800	4200	1500	4100	2900	3700	3400	4000
Ammoniacal Nitrogen as N	mg/l	0.6		5.1	4	3.2	6.5	10	4.4	0.93	9.3	1.3	10	1.5
Total Cyanide	mg/l	0.001	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Free Cyanide	mg/l			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
pH Value	pH units	6-9	6.5-10	7.1	7.3	7.6	8	7.4	7.5	7.2	7.9	8.1	7.7	7.5
Phenols														
Phenol	ug/l	7.7				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dimethylphenols	ug/l													
Trimethylphenols	ug/l													
Cresols	ug/l													
Phenols	mg/l	0.0077		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
BTEX														
MTBE	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1
Benzene	ug/l	10	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	ug/l	50		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ethyl benzene	ug/l	20		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
m & p Xylene	ug/l	30		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
o Xylene	ug/l	30		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TPH														
TPH FTIR	ug/l													
TPH GC	ug/l													
Aliphatics C5-C6	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C6-C8	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C8-C10	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C10-C12	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C12-C16 Aqueous	ug/l			240	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C16-C21 Aqueous	ug/l			380	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C21-C35 Aqueous	ug/l			1100	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C35-44	ug/l			1.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C5-C7	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C7-C8	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >EC8-EC10	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >EC10-EC12	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >EC12-EC16 Aqueous	ug/l			280	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >EC16-EC21 Aqueous	ug/l			440	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >EC21-EC35 Aqueous	ug/l			910	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C35-44	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Aliphatic TPH	ug/l			1700	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total Aromatic TPH	ug/l			1600	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total petroleum hydrocarbons	ug/l			3300	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
PAHs														
Acenaphthene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	ug/l	0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene	ug/l	0.00017	0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b)fluoranthene	ug/l	0.017	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
11	11	41	6	BH415 @ Deep	0	6
11	11	3800	220	BH413 @ Deep	3	6
11	1	0.11	0.11	BH412 @ Deep	0	0
11	10	100	14	BH415 @ Deep		3
11	11	31	6.9	BH412 @ Deep	6	0
11	1	3.3	3.3	BH412 @ Deep	1	0
11	3	0.75	0.56	BH415 @ Deep	3	0
11	11	7.8	1.6	BH412 @ Deep	4	0
11	11	64	9.4	BH415 @ Deep		9
11	11	18	3.7	BH415 @ Deep	0	
11	11	1700	150	BH412 @ Deep		
0	0	None > LOD	None > LOD			
11	11	4200	1500	BH413 @ Deep	11	11
11	11	10	0.93	BH413 @ Deep	11	
11	0	None > LOD	None > LOD		0	0
11	0	None > LOD	None > LOD			
11	11	8.1	7.1	BH415 @ Deep	0	0
9	0	None > LOD	None > LOD		0	
0	0	None > LOD	None > LOD			
0	0	None > LOD	None > LOD			
0	0	None > LOD	None > LOD			
11	0	None > LOD	None > LOD		0	
9	0	None > LOD	None > LOD			
11	0	None > LOD	None > LOD		0	0
11	0	None > LOD	None > LOD		0	
11	0	None > LOD	None > LOD		0	
11	0	None > LOD	None > LOD		0	
11	0	None > LOD	None > LOD		0	
0	0	None > LOD	None > LOD			
0	0	None > LOD	None > LOD			
11	0	None > LOD	None > LOD			
11	0	None > LOD	None > LOD			
11	0	None > LOD	None > LOD			
11	0	None > LOD	None > LOD			
11	1	240	240	BH412 @ Deep		
11	1	380	380	BH412 @ Deep		
11	1	1100	1100	BH412 @ Deep		
11	1	1.4	1.4	BH412 @ Deep		
11	0	None > LOD	None > LOD			
11	0	None > LOD	None > LOD			
11	0	None > LOD	None > LOD			
11	0	None > LOD	None > LOD			
11	1	280	280	BH412 @ Deep		
11	1	440	440	BH412 @ Deep		
11	1	910	910	BH412 @ Deep		
11	0	None > LOD	None > LOD			
11	1	1700	1700	BH412 @ Deep		
11	1	1600	1600	BH412 @ Deep		
11	1	3300	3300	BH412 @ Deep		
11	0	None > LOD	None > LOD			
11	0	None > LOD	None > LOD			
11	0	None > LOD	None > LOD		0	
11	0	None > LOD	None > LOD			
11	0	None > LOD	None > LOD		0	0
11	0	None > LOD	None > LOD		0	0

Benzo(k)fluoranthene	ug/l	0.017	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	11	0	None > LOD	None > LOD		0	0
Chrysene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	11	0	None > LOD	None > LOD			
Dibenzo(a,h)anthracene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	11	0	None > LOD	None > LOD			
Fluoranthene	ug/l	0.0063		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	11	0	None > LOD	None > LOD		0	
Fluorene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	11	0	None > LOD	None > LOD			
Benzo(ghi)perylene	ug/l	0.0082	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	11	0	None > LOD	None > LOD		0	0
Indeno(1,2,3-cd)pyrene	ug/l		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	11	0	None > LOD	None > LOD			0
Naphthalene	ug/l	2		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	11	0	None > LOD	None > LOD		0	
Phenanthrene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	11	0	None > LOD	None > LOD			
Pyrene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	11	0	None > LOD	None > LOD			
Total PAHs (USEPA 16)	ug/l			<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	11	0	None > LOD	None > LOD			
VOCs																					
1,1,1,2-Tetrachloroethane	ug/l					<2	<2	<2	<2	<2	<2	<2	<2	<2	9	0	None > LOD	None > LOD			
1,1,1-Trichloroethane	ug/l	100				<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD		0	
1,1,2-Trichloroethane	ug/l	400				<10	<10	<10	<10	<10	<10	<10	<10	<10	9	0	None > LOD	None > LOD		0	
1,1-Dichloroethane	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			
1,1-Dichloroethene	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			
1,1-Dichloropropene	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			
1,2,3-Trichlorobenzene	ug/l	0.4				<2	<2	<2	<2	<2	<2	<2	<2	<2	9	0	None > LOD	None > LOD		0	
1,2,3-Trichloropropane	ug/l					<50	<50	<50	<50	<50	<50	<50	<50	<50	9	0	None > LOD	None > LOD			
1,2,4-Trichlorobenzene	ug/l	0.4				<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD		0	
1,2,4-Trimethylbenzene	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			
1,2-Dibromo-3-Chloropropane	ug/l					<50	<50	<50	<50	<50	<50	<50	<50	<50	9	0	None > LOD	None > LOD			
1,2-Dibromoethane	ug/l					<5	<5	<5	<5	<5	<5	<5	<5	<5	9	0	None > LOD	None > LOD			
1,2-Dichlorobenzene	ug/l	20				<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD		0	
1,2-Dichloroethane	ug/l	10	3			<2	<2	<2	<2	<2	<2	<2	<2	<2	9	0	None > LOD	None > LOD		0	0
1,2-Dichloropropane	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			
1,3,5-Trimethylbenzene	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			
1,3-Dichloropropane	ug/l					<2	<2	<2	<2	<2	<2	<2	<2	<2	9	0	None > LOD	None > LOD			
1,4-Dichlorobenzene	ug/l	20				<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD		0	
2-Chlorotoluene	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			
4-Chlorotoluene	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			
4-Isopropyltoluene	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			
Benzene	ug/l	10	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	11	0	None > LOD	None > LOD		0	0
Bromobenzene	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			
Bromochloromethane	ug/l		100			<5	<5	<5	<5	<5	<5	<5	<5	<5	9	0	None > LOD	None > LOD			0
Bromodichloromethane	ug/l					<5	<5	<5	<5	<5	<5	<5	<5	<5	9	0	None > LOD	None > LOD			
Bromomethane	ug/l					<5	<5	<5	<5	<5	<5	<5	<5	<5	9	0	None > LOD	None > LOD			
Chlorobenzene	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			
Chloroethane	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			
Chloroethene	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			
Chloroform	ug/l	2.5	100			<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD		0	0
Chloromethane	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			
cis-1,2-Dichloroethene	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			
cis-1,3-Dichloropropene	ug/l					<10	<10	<10	<10	<10	<10	<10	<10	<10	9	0	None > LOD	None > LOD			
Dibromochloromethane	ug/l		100			<10	<10	<10	<10	<10	<10	<10	<10	<10	9	0	None > LOD	None > LOD			0
Dibromomethane	ug/l					<10	<10	<10	<10	<10	<10	<10	<10	<10	9	0	None > LOD	None > LOD			
Dichlorodifluoromethane	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			
Ethylbenzene	ug/l	20		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	11	0	None > LOD	None > LOD		0	
Hexachlorobutadiene (HCBD)	ug/l	0.6				<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD		0	
Isopropylbenzene	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			
m,p xylenes	ug/l	30		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	11	0	None > LOD	None > LOD		0	
Methyl tert-butyl ether (MTBE)	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			
n-Butylbenzene	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			
n-propylbenzene	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			
O-Xylene	ug/l	30		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	11	0	None > LOD	None > LOD		0	
Sec-Butylbenzene	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			
Styrene	ug/l	50				<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD		0	
Tert-Butylbenzene	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			
Tetrachloroethene	ug/l	10	10			<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD		0	0
Tetrachloromethane (Carbon Tetra Chloride)	ug/l	12	3			<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD		0	0
Toluene	ug/l	50		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	11	0	None > LOD	None > LOD		0	
trans-1,2-Dichloroethene	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			
trans-1,3-Dichloropropene	ug/l					<10	<10	<10	<10	<10	<10	<10	<10	<10	9	0	None > LOD	None > LOD			
Tribromomethane	ug/l		100			<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			0
Trichloroethene	ug/l	10	10			<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD		0	0
Trichlorofluoromethane	ug/l					<1	<1	<1	<1	<1	<1	<1	<1	<1	9	0	None > LOD	None > LOD			
SVOCs																					
1,3-Dichlorobenzene	ug/l	20				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD		0	
2,4,5-Trichlorophenol	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
2,4,6-Trichlorophenol	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
2,4-Dichlorophenol	ug/l	20				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD		0	
2,4-Dimethylphenol	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
2,4-Dinitrotoluene	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
2,6-Dinitrotoluene	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
2-Chloronaphthalene	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
2-Chlorophenol	ug/l	50				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD		0	
2-Methyl-4,6-Dinitrophenol	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			

2-Methylnaphthalene	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
2-Methylphenol	ug/l	100				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD		0	
2-Nitroaniline	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
2-Nitrophenol	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
3-Nitroaniline	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
4-Bromophenyl Phenyl Ether	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
4-Chloro-3-Methylphenol	ug/l	40				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD		0	
4-Chloroaniline	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
4-Chlorophenyl Phenyl Ether	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
4-Methylphenol	ug/l	100				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD		0	
4-Nitroaniline	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
Azobenzene	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
Bis(2-chloroethoxy)methane	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
Bis(2-chloroethyl)ether	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
Bis(2-chloroisopropyl)ether	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
Bis(2-ethylhexyl)phthalate	ug/l	1.3				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD		0	
Butylbenzylphthalate	ug/l	20				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD		0	
Carbazole	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
Dibenzofuran	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
Diethylphthalate	ug/l	200				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD		0	
Dimethylphthalate	ug/l	800				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD		0	
Di-N-Butyl Phthalate	ug/l	8				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD		0	
Di-N-Octyl Phthalate	ug/l	20				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD		0	
Hexachlorobenzene (HCB)	ug/l	0.05				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD		0	
Hexachlorocyclopentadiene	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
Hexachloroethane	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
Isophorone	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
Nitrobenzene	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
n-nitrosodimethylamine	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
N-Nitroso-Di-N-Propylamine	ug/l					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD			
Pentachlorophenol (PCP)	ug/l	0.4				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD		0	
Phenol	ug/l	7.7				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9	0	None > LOD	None > LOD		0	
PCBs																					
Pcb-101 2,2',4,5,5' - Pentachlorobiphenyl	ug/l			<0.01	<0.01	<0.01	<0.01	<0.01							5	0	None > LOD	None > LOD			
Pcb-118 2,3',4,4',5 - Pentachlorobiphenyl	ug/l			<0.01	<0.01	<0.01	<0.01	<0.01							5	0	None > LOD	None > LOD			
Pcb-138 2,2',3,4,4',5' - Hexachlorobiphenyl	ug/l			<0.01	<0.01	<0.01	<0.01	<0.01							5	0	None > LOD	None > LOD			
Pcb-153 2,2',4,4',5,5' - Hexachlorobiphenyl	ug/l			<0.01	<0.01	<0.01	<0.01	<0.01							5	0	None > LOD	None > LOD			
Pcb-180 2,2',3,4,4',5,5' - Heptachlorobiphenyl	ug/l			<0.01	<0.01	<0.01	<0.01	<0.01							5	0	None > LOD	None > LOD			
Pcb-28 2,4,4' - Trichlororbiphenyl	ug/l			<0.01	<0.01	<0.01	<0.01	<0.01							5	0	None > LOD	None > LOD			
Pcb-52 2,2',5,5' - Tetrachlorobiphenyl	ug/l			<0.01	<0.01	<0.01	<0.01	<0.01							5	0	None > LOD	None > LOD			

A6 Appendix 6

Tabulated Surface Water Data

M4CAN
Surface Water Sample Analysis & Screening Assessment
CL13
21/09/2015

Monitoring Round / Location	Units	Screening Criteria			41076 - 20 ACRE REEN BELOW BSC WHITEHEAD : DOCKSWAY CULVERT (ST3105 8632)						
Date Sampled					19/08/2010	03/09/2010	19/10/2010	03/11/2010	16/11/2010	17/01/2011	01/02/2011
		EQS	DWS	CCW							
Metals & Non-Metal Inorganics											
Hardness Total	mg/l				358	386	374	326	415	395	410
Calcium (NRW)	mg/l			300	108	119	113	101	126	120	123
Iron Dissolved	ug/l	1000	200		115	133	409	157	206	189	283
Magnesium Dissolved	mg/l				21.5	21.5	22.3	18	24.3	23.1	25.1
Zinc Total	ug/l	75		1000	132	341	395	157	***1950***	146	725
Carbon, Organic, Dissolved as C :- {DOC}	mg/l										
Solids, Suspended at 105 C	mg/l										
pH Value	pH units	6-9	6.5-10	6.8-8.5							

03/03/2011	31/03/2011	11/05/2011	07/06/2011	08/07/2011	12/08/2011	09/09/2011	25/10/2011	04/11/2011	21/11/2011	10/01/2012	24/01/2012	12/03/2012
418	259	363	373	233	257	296	302	346	396	425	368	403
126	80.1	110	112	73.2	75.7	91.9	92.9	108	120	128	112	122
277	310	756	341	187	207	231	190	98.4		450	196	3700
25.2	14.3	21.5	22.7	12.1	16.4	16.1	16.9	18.6	23.5	25.5	21.4	23.8
167	73.2	91.8	34.8	104	6.82	62.8	49	142	86.7	194	285	328

17/04/2012	31/05/2012	25/06/2012	14/08/2012	31/08/2012	27/09/2012	26/10/2012	19/11/2012	10/01/2013	04/02/2013	01/03/2013	25/04/2013	02/05/2013
205	411	364	381	372	404	417	368	384	367	398	343	333
63.8	124	112	116	114	126	132	113	118	114	121	106	102
195	1410	199	129			118	53.3	105	150		53.5	40.6
11.1	24.7	20.4	22.1	21.1	21.6	21.3	20.9	21.6	20.1	23.4	19	19
304	79.8	183	43.1	225	292	135	118	95.3	148	118	61.1	55.6
		3.47			5.02			3.49			3.06	
		8.08			357			12.2			7.72	
		7.4			7.57			7.69			7.92	

31/05/2013	19/07/2013	19/08/2013	20/09/2013	07/10/2013	01/11/2013	16/12/2013	06/01/2014	07/02/2014	05/03/2014	11/06/2014	21/08/2014	15/09/2014
327	310	295	349	342	189	241	258	128	304	291	330	341
102	91.7	91.3	108	107	24.1	77.6	83.1	38.9	95.3	92.5	104	102
1110		59.2	44.4	79.9				235	34.4			42.3
17.5	19.6	16.2	19.3	18.2	31.4	11.5	12.3	7.41	16	14.5	17.2	21
195	50.3	78.1	619	148	20.5	129	113	25.3	77.6	57.7	73.4	38.2
	3.25			4			3.12					
	10.2			73.9			46.5					
	8.11			7.68			7.74					

												45397 - CEFN ADD
17/10/2014	12/11/2014	26/11/2014	01/12/2014	22/01/2015	23/01/2015	05/02/2015	09/02/2015	23/02/2015	16/03/2015	07/04/2015	19/05/2015	03/09/2010
327	308	316	2140	289	319	345	350	239	323	325	313	356
105	97.7	101	***825***	92.5	101	107	108	76.8	101	99.6	99.4	107
54.2	39.3				45.8	50.1	39.5	38.4	55.9			299
15.7	15.6	15.5	19.3	14.2	16.2	18.8	19.6	11.5	17.3	18.6	15.7	21.6
72.5	120	70.3	60.7	91.9	102	60.6	39.5	116	88.1	33.3	52.3	215
		3.21		3.15						2.88		
		11		17.5						6		
		7.5		7.58						7.95		

A REEN BRIDGE D/S MENDALGEIF HOLDER STATION

05/11/2010	03/03/2011	07/06/2011	09/09/2011	12/03/2012	31/05/2012	31/08/2012	19/11/2012	01/03/2013	19/06/2013	01/10/2013	09/12/2013	07/03/2014
168	330	312	246	8.94	366	273	338	362	364	341	345	202
52.7	101	89.4	74.8	2.13	111	84.9	103	110	110	102	106	62.4
87	169	565	249	104	259	107	94.6	178	253	162	184	93.2
8.83	18.9	21.5	14.3	0.881	21.7	14.9	19.6	21.2	21.7	20.9	19.6	11.2
73.8	21.1	251	39.4		17.6	19.7	170	20.2	34.8	73.6	26.5	37.3

05/06/2014	09/09/2014	30/10/2014	26/11/2014	22/01/2015	07/04/2015	04/07/2015
99.4	419	381	293	289	361	361
34.5	122	116	91.8	90.2	109	109
835	124	191	113	122	751	751
3.22	27.8	22.3	15.5	15.4	21.6	21.6
20.5	22.7	77.6	39.4	34.3	20.8	20.8

Notes

EQS calcium carbonate 100-150mg/l for heavy metals: chromium, copper, lead, nickel an
NDP - No determination possible

Screening Values and Assessment

EQS	Environmental Quality Standards
MRV	Minimum Reporting values
	Exceeds EQS
100	Exceeds DWS
<10	Laboratory detection level higher than screening criterion
BOL/ITA	Exceeds CCW

No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Date of Maximum Concentration
79	79	2140	8.94	01/12/2014
79	79	825	2.13	01/12/2014
64	64	3700	34.4	12/03/2012
79	79	31.4	0.881	01/11/2013
78	78	1950	6.82	16/11/2010
10	10	5.02	2.88	27/09/2012
10	10	357	6	27/09/2012
10	10	8.11	7.4	19/07/2013

d zinc

No. Data Exceeding EQS	No. Data Exceeding DWS	No. Data Exceeding CCW
		1
3	22	
41	0	1
0	0	0

A7 Appendix 7

Additional Gas Monitoring Data from Newport City Council

	Borehole	Methane CH4 (% Volume)					LEL (%)			CO2 (% Volume)					O2 (% Volume)					Initial Flow (m3/hr)			
		No. readings	MAX	MIN	No. exc	% exc	No. readings	MAX	MIN	No. readings	MAX	MIN	No. exc	% exc	No. readings	MIN	MAX	No. exc	% exc	No. readings	MAX	MIN	
	GP03_02	22	33.5	<0.1	20	90.9	12	>>>	0	22	17	0.3	20	90.9	22	0	20.3	19	86	22	0.2	0	in waste
	GP03_03a	22	20.1	<0.1	6	27.3	12	2	0	22	17.9	0	15	68.2	22	0.4	19.5	17	77	22	0.6	0	in waste
	GP03_13	22	69.8	<0.1	19	86.4	12	>>>	0	22	24	0.1	20	90.9	22	0.2	20.9	16	73	22	0.2	-0.4	in waste
A2	**GP07_05a**	22	17.2	<0.1	6	27.3	12	>>>	0	22	7.4	0	10	45.5	22	8.6	21.5	9	41	22	0.1	-12.5	no log
	GP12_26	22	74	0	12	54.5	12	>>>	0	22	25.3	0	12	54.5	22	0	21.2	12	55	22	0.3	-0.2	no log
	NCC2	22	5.6	0	4	18.2	12	38	0	22	12	5.6	22	100	22	0	14	22	100	21	0.2	-0.15	waste
	NCC3	22	0.5	0	0	0	12	1.1	0	22	5.4	1.4	21	95.5	22	13.6	19.9	19	86	22	0.2	-0.1	waste
	NCC5	22	0.5	0	0	0	12	0.9	0	22	5.8	0	12	54.5	22	7.3	20.8	12	55	20	0.2	0	waste
	NCC6	22	76	15.5	22	100	12	>>>	0	22	23.8	1.7	22	100	22	0	6.9	22	100	22	0.3	-1	no log

***LEL not reported from jan 2014 onwards**

A8 Appendix 8

Relevant Extract of Additional Environmental Data

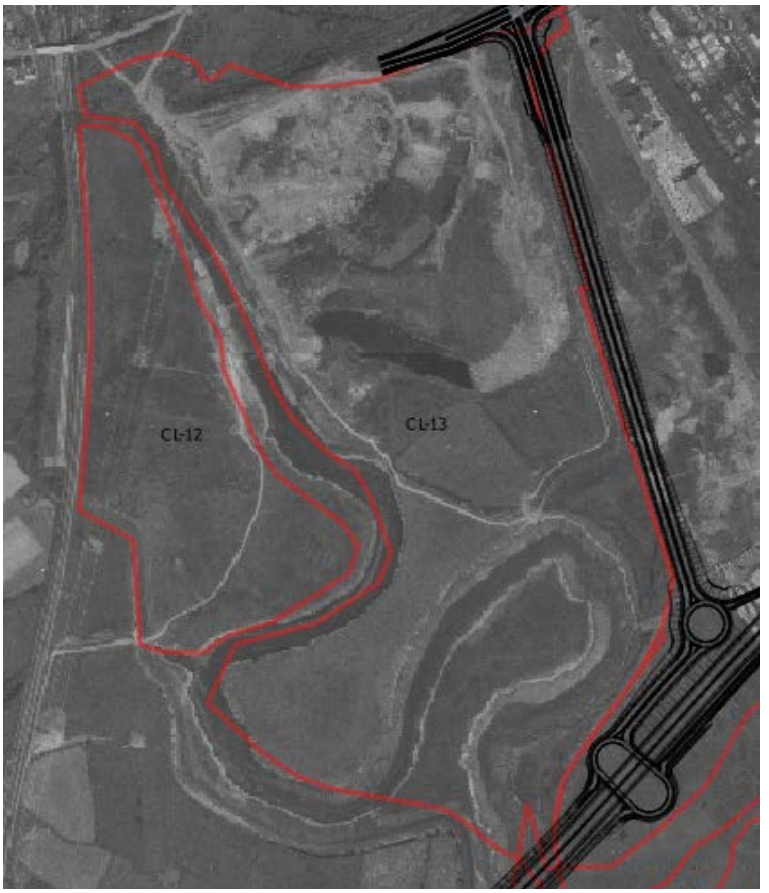

Plate 01: Extract of 1971 Aerial Photograph.

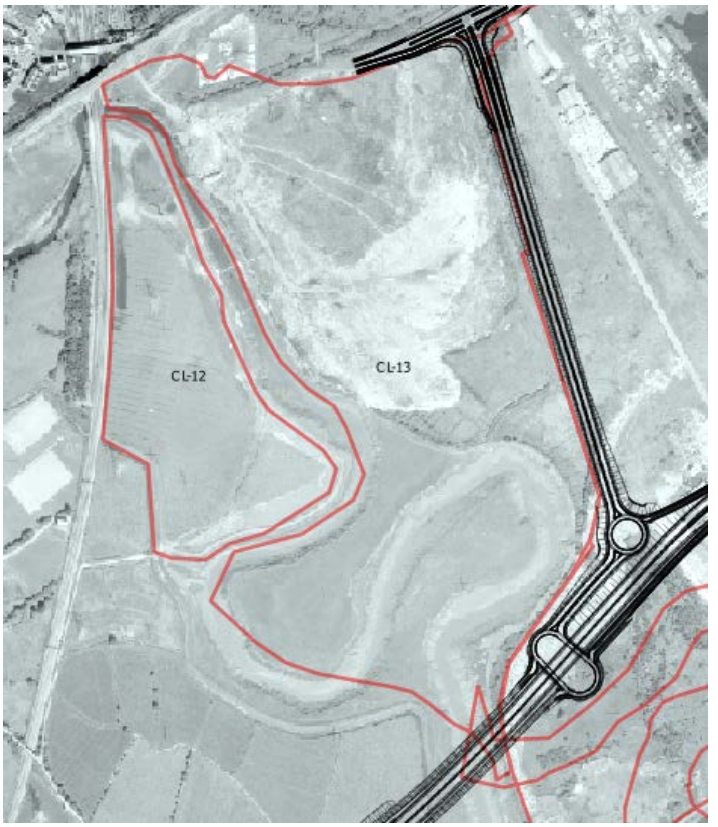

Plate 02: Extract of 1979 Aerial Photograph.

Client:	Welsh Government
Project:	M4CaN
Job Ref:	JER6591
Checked By:	
Date:	Oct 2015

Plate 03: Extract of 1991 Aerial Photograph.

Plate 04: Extract of 1998 Aerial Photograph.

Client:	Welsh Government
Project:	M4CaN
Job Ref:	JER6591
Checked By:	
Date:	Oct 2015

Plate 05: Extract of 2006 Aerial Photograph.

Plate 05: Extract of 2009/10 Aerial Photograph.

Client:	Welsh Government
Project:	M4CaN
Job Ref: JER6591	Checked By: Date: Oct 2015

Plate 07: Extract of 2006 Aerial Photograph.

Plate 08: Extract of 2014 High Resolution Aerial Photograph.

Client:	Welsh Government
Project:	M4CaN
Job Ref: JER6591 Checked By:	Date: Oct 2015

Welsh Government

M4 Corridor around Newport

Land Contamination Assessment Report Annex D
CL-14 Newport Docks

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1 Introduction

1.1 Background

1.1.1 This report relates to an area of land potentially affected by contamination (CL-14) known as the 'Newport Docks' herein referred to as the 'Site'.

1.1.2 The Site is located between chainage 8,600 and 10,000 (see Figure 1).

1.2 Reporting Context

1.2.1 The Site has been assessed as part of ground investigations and monitoring associated with the wider works for the M4 Corridor around Newport (M4CaN), hereafter referred to as the 'Scheme'. This report informs the baseline for the environmental impact assessment (EIA) for the Scheme. The EIA is reported in the M4CaN Environmental Statement (ES) of which this document is an appendix to the chapter on Geology and Soils.

1.2.2 In 2014, a Preliminary Sources Study Report (2014 PSSR) was prepared as an initial land contamination appraisal (Ove Arup & Partners, 2014) as part of Design Manual for Roads and Bridges (DMRB) Stage 2 Assessments for this Scheme. This identified a number of individual areas that may have been affected by contamination as a result of historical activities at the Site. In addition, this report draws upon the 2015 Supplementary Ground Investigation Works undertaken on behalf of the Welsh Government (Geotechnical Engineering, 2015). This report relates to the area defined on the Site Plan shown in Figure 1.

1.2.3 The overarching rationale and approach for the assessment of areas of land along the new section of motorway with potential contamination is detailed in the Land Contamination Assessment Report (Appendix 11.1 of the ES).

1.3 Objectives

1.3.1 The key objectives of this report are as below.

- Undertake a risk assessment of the Site and determine whether potential risks to human health or controlled waters could exist based upon the Scheme.
- Identify the need for further assessment or investigation in order to refine potential land contamination risks and inform the need for remediation/mitigation.
- To provide information to support the Ground Investigation Report (GIR) and Geotechnical Design Report (GDR) required under DMRB HD22/08 (Highways Agency, 2008).

1.4 Report Structure

1.4.1 The subsequent report structure is as follows.

- Section 2: Site Location and Description.
- Section 3: The Scheme – This section details the new section of motorway alignment and associated features at the Site.

- Section 4: Site History – This section summarises the history of the Site based on historical maps and historical land photographs.
- Section 5: Environmental Setting – This section summarises the Site description, published geology, hydrology and hydrogeology and any relevant environmental information presented in the 2014 PSSR.
- Section 6: Scope of Investigations – This section describes the previous and supplementary investigations undertaken at the Site.
- Section 7: Ground Conditions - This section describes the main findings of the intrusive site investigation including the ground conditions encountered and any significant visual or olfactory evidence of contamination identified.
- Section 8: Contamination Assessment – This section describes the findings of the Tier 1 and Tier 2 contamination risk assessment based upon potential contamination sources, potential receptors and potential contaminant linkages and presents the human health and controlled waters assessments.
- Section 9: Refined Conceptual Site Model – This section presents the Conceptual Site Model (CSM) for the Site and identifies potential contaminant linkages, based upon the findings of the data presented within Sections 2 to 7.
- Section 10: Conclusions and Recommendations – This section provides conclusions concerning the likelihood of land contamination associated with the Site affecting the Scheme and requirements for remediation/mitigation.
- Section 11: References – This section summarises the key documents referred to in this report.
- Section 12: Glossary – This section provides a summary of the terms used in this report.

2 Site Location and Description

2.1.1 The Newport Docks area is located to the west of the River Usk. It is located south of the A48 on the western bank of the River Usk and is centred at National Grid Reference ST315 852. It covers an area of approximately 1.2 km^2.

2.1.2 The Newport Docks developed around the North and South Docks is linked via the North Dock Cut (also known as Junction Cut or Junction Lock). The Newport Docks area, on either side of the docks, contains a variety of industrial and commercial premises. These include large areas of hardstanding, some of which are , and have been, used for storage of pallets, aggregates, building materials and scrap.

2.1.3 Between these areas of hardstanding are open areas of rough un-surfaced ground and vegetation.

2.1.4 The Newport Docks area also includes a historical River Ebbw channel in the south that has been infilled to enable development. It is bound to the north by the A48, the south by Alexandra South Dock, the west by Docks Way Landfill (CL-13) and to the east by the River Usk.

2.1.5 The Docks Way Landfill site is also an area of potential land contamination. It has been assessed separately in Land Contamination Assessment Report CL-13 (Annex D of Appendix 11.1 of the ES).

3 The Scheme

3.1.1 The Site is located at approximate chainage 8,600 to 10,000.

3.1.2 The Site is located on a section of the new motorway that is proposed to be carried on a viaduct approximately 10 to 40 m in height. The carriageway would be supported by piers to be founded on piles. The new section of motorway would also include a section of a piled embankment (2 to 5m high) to support the Southern Distributor Link Road (SDR). The SDR bounds the western edge of the Site, beyond which the Docks Way Landfill (CL-13) is situated.

3.1.3 The new section of motorway would impact the backfilled river channel in the area of the River Ebbw crossing.

4 Site History

4.1.1 The 2014 PSSR historical searches have been based on Ordnance Survey (OS) plans, literature reviews, information provided by Natural Resources Wales (NRW) (formerly Environment Agency Wales), Newport City Council and interpretation of aerial photography.

4.1.2 This is supplemented by a review of historical maps obtained in 2015 from Welsh Government. Relevant extracts are presented in Appendix 6.

4.1.3 A summary of the Site's history is presented in Table 1 below.

Table 1: Site History

Date	Land Use & Surrounding Land Use (200 m)	Source of Information
1843 - 1893	The majority of the Site comprises Alexandra Dock and **associated railway** and coal hoists. An engine house, boiler and tanks are also present in the south east associated with the Graving Dock. A timber float is also present in the west and a number of **tanks** are associated with the **Timber Yard and Saw Mill** in the north. The south west of the Site comprises the meandering River Ebbw channel and floodplain and the southern part of the Site consists of agricultural fields, Mendalgyf Farm and drainage ditches. The River Usk bounds the Site to the east and the River Ebbw and its floodplain meanders to the west. Agricultural fields traversed with drainage ditches are present to the south. 50 m to the northeast lies residential housing, brick fields, limekilns, Isca foundry and Alexandra pottery. The railway enters the Site from the north.	1:10,560 Historical Mapping
1891 - 1912	South Dock has been developed to the south of the Site and the **railway** has extended north-south through the Site with several buildings. **Mendalgyf Port Sanitary Hospital** has been developed in the west of Site and Mendalgyf New Reen runs south-north through the west of the Site. **Pumping stations** are now present in the north west and south east on Alexandra Dock. A further **Timber Yard** is located in the north west corner.	1:10,560 Historical Mapping
1904 - 1939	The South Dock has been enlarged to completely bound the Site to the south and has been renamed Alexandra Docks. The dock in the north of Site is now known as North Dock. A hydraulic Power Station is identified to the north of North Dock, in the position of the former Pumping Station. The **River Ebbw channel in the south west has been infilled** and rerouted around the Site to the west and the **railway** has been extended to cover this area and reach the South Dock. Transit Sheds are located in this area. The **hospital has been demolished**. The docks infrastructure has expanded to take up the whole extent of the Site, including fuel and engineering works in the north east. A second Timber Float is located adjacent to the east of the existing one and a further **Timber Yard** is located in the central western area, south east of the Timber Floats.	1:10,560 Historical Mapping
1947	No significant change.	Aerial Photograph

Date	Land Use & Surrounding Land Use (200 m)	Source of Information
1964 - 1965	Fuel works are no longer noted. South Lock has been renamed East Lock. A depot is located in the central southern area. (2014 PSSR states this depot to be present from 1955).	1:10,560 Historical Mapping
1969	The larger of the Timber Floats appears infilled and the railway has been dismantled in the west of the Site. The Hydraulic Power Station is no longer identified. The majority of railway sidings have been removed in the south western area. A large timber shed is present within a Timber Terminal in the south west area. Outside of the Timber Terminal, the south west area comprises rough marshy vegetation. The area to the south of the South Dock, approximately 300 m away, is in use as a shipbuilding yard.	Aerial Photograph
1969 - 1971	The depot in the central southern area of the Site is defined as a Ship Repair and Oil Tanker Cleansing Depot, with associated tanks. The second **Timber Float has been infilled** and a Spoil Heap is identified in the location of the previous Timber Float to the west. A pond is identified in the north western area.	1:1,250 Historical Mapping
1970 - 1973	No significant change.	1:10,000 Historical Mapping
1979	No significant change. The North Dock appears partially infilled and vegetated in the northern section.	Aerial Photography
1985 - 1996	Railway sidings in the south eastern area of the Site have been replaced by a **Coal Dump** and have been reduced in the eastern area, adjacent to the North Dock. The southern most of the two Graving Docks has been partially infilled.	1:10,000 Historical Mapping
1991	A Transit Shed has been removed in the south eastern area and a further building has been constructed, in the place of the former Coal Dump. A building of unknown use with six above ground tanks has been constructed in the south eastern area. Marshy land in the south west of the Site has been redeveloped with hardstanding which appears to be in use for the storage of vehicles. The **Timber Terminal** has expanded to the north. Stockpiles of what appears to be coal are identified adjacent to the Transit Shed to the east of North Dock.	Aerial Photography
1998	Further buildings are present within the Timber Yard in the north west of the Site and the Timber Terminal. (No image available for the east of the Site).	Aerial Photography
2006	The hardstanding in the south western area now appears to be in use for the storage of materials and shipping containers. The Ship Repair and Oil Tanker Cleansing Depot has been replaced by further commercial / industrial buildings, and stockpiles of material are present in this area. **Stockpiles** are also located in the south western area of the Site, within the previous Timber Terminal area. Further buildings and hardstanding identified in the central western area, are thought to be associated with Timber works. An area of bare ground located to the west of the A48 is now present running east-west to the north of the Site. Works in the northern area have expanded along the boundary of the A48.	Aerial Photography
2009 -	A further building is located in the south western area. Stockpiles	Aerial

Date	Land Use & Surrounding Land Use (200 m)	Source of Information
2010	of what appears to be aggregate are stored in the yard in this area. Further stockpiles are observed in the south western area. Bare ground in the central western area has revegetated. The coal stockpiles to the south of the Site have depleted.	Photography
2014	No significant change.	Aerial Photography

Note: Potential sources of contamination are underlined. Those within the temporary and permanent land take are shown in **bold**.

4.1.4 The sources of information presented above supplement those used in the 2014 PSSR. In particular, the 1991 aerial photographs have identified stockpiles of what appears to be coal in the central eastern area. The 2006 and 2009/2010 images identify stockpiles in the southern area of the Site. Relevant extracts of the photographs are presented in Appendix 6.

4.1.5 The 2014 PSSR identifies areas of potential earthworks/infilled ground in discrete areas in the central west, south west and south east of the Site. Three electrical substations are identified within the PSSR from study of OS maps, two of which are understood to still be present on the Site.

4.1.6 Historically the Site is known to have been bombed during World War II which is described in detail within the 2014 PSSR (Ove Arup and Partners, 2014) and the Explosive Ordnance Threat Assessment Report (Bactec, 2014). Thus, there is a risk from unexploded ordnance at the Site which is categorised as a medium-high risk Site.

5 Environmental Setting

5.1 Geology

5.1.1 British Geological Survey (BGS) geological maps show that the Site is underlain by Tidal Flat Deposits and Glaciofluvial Deposits. The underlying bedrock is of the Mercia Mudstone Group.

5.1.2 Due to the Site's Docklands history it is expected that the Site is overlain by significant fill materials.

5.2 Hydrology

5.2.1 The River Ebbw lies to the west of the Site and the River Usk bounds the Site to the east with the Alexandra North Docks within the Site. Alexandra South Docks is to the south and Maes-glas Pill is approximately 10 m to the north west.

5.3 Hydrogeology

5.3.1 NRW records indicate the Tidal Flat Deposits are classified as non- productive strata (negligibly permeable) over the majority of the Site and in localised areas in the west and north west they are indicated to be a minor aquifer of high productivity. However, groundwater is anticipated to be present in the Glaciofluvial Deposits beneath the Tidal Flat Deposits.

5.3.2 The bedrock is indicated to be a Secondary B aquifer.

5.3.3 Perched water may be present at the interface of the fill and Tidal Flat Deposits.

5.4 Environmental Information

5.4.1 The 2014 PSSR identifies the below NRW information within the study area.

- Three minor impact pollutant incidents and four no impact pollutant incidents have been recorded within the Site boundary.
- One significant impact air pollutant incident was recorded within the Alexandra South Docks in relation to burning of waste. Six minor impact pollutant incidents and two no impact pollutant incidents have also been recorded within 300 m of the Site boundary.
- There are no abstraction licences recorded within the Site boundary.
- There are five discharge consents recorded within the Site boundary.
- Within 300 m of the Site, thirteen discharge consents have been recorded along the southern Site boundary adjacent to the South Alexandra Docks, ten along the eastern Site boundary adjacent to the River Usk, two to the north of the Site and five along the western Site boundary.
- Two historic landfill sites have been recorded within the Site boundary as detailed in Table 2.

Table 2: Historic Landfills Within Site Boundary

Landfill Name	Location	Material Type	Date Waste First and Last Received
Old Coal Sidings	SW corner of the Site	Inert and industrial waste	Dec 1970 – Dec 1983
South Dock	SW corner of the Site	Inert and industrial waste	Jan 1976 – Dec 1990

- Two historic and one authorised landfills are recorded within 300 m of the Site to the west as detailed in Tables 3 and 4.

Table 3: Historic Landfills Within 300 m of Site

Landfill Name	Location	Material Type	Date Waste First and Last Received
Docks Way	Adjacent to the western Site boundary	Inert, industrial, commercial, household	Dec 1980 – unknown
Maesglas Tip	Adjacent to the western Site boundary	Commercial, liquids/ sludge	Apr 1967 – unknown

Table 4: Authorised Landfills Within 300 m of Site

Landfill Name	Location	Material Type	Date Waste First and Last Received
Docks Way Landfill	Adjacent to the western Site boundary	Household, commercial and industrial waste	Unknown – ongoing

5.4.2 It is postulated that Area 1 of Docks Way Landfill, located adjacent to the western boundary of the Site, was subject to uncontrolled tipping and is likely to have extended beyond the boundaries of the landfill and will therefore, encroach upon the route of the SDR and the proposed link road. This is discussed in detail within the report relating to CL-13.

5.4.3 A permitted waste management site (A1 skip hire) is located in the north western corner of the Site.

5.4.4 The environmental information confirms that the various uses of the Site could represent potential contamination sources that require due consideration in relation to the Scheme.

6 Scope of Investigations

6.1 General

6.1.1 A number of intrusive ground investigations have been undertaken that have acquired geological and hydrogeological data within the Site boundary.

6.1.2 For the purpose of meeting the requirements of Volume 4, Section 1, Part 2 of the DMRB HD22/08 – Managing Geotechnical Risks – 2008 (Highways Agency 2008), the historical data used to support the 2014 PSSR has been differentiated from the additional 2015 Supplementary Ground Investigation data (Geotechnical Engineering, 2015).

6.2 Scope of Works

6.2.1 The various intrusive ground investigations undertaken within the Site area are summarised in Table 5.

Table 5: Site Investigation Summary

Date	Contractor	Site Location	Boreholes	Trial Pits	Sampling
1997	Norwest Holst	South	BHF3, BHF4, BHF5, BHF6	-	Soil
2000	Exploration Associates	South	CH10, CH11, CH12, CH13, CH14, CH15, CH15A, CH16, CH17, CH18, CH19, CH19A, CH20, CH21, CH22, CH23	-	Soil, leachate and water
Sept 2001	Terra Firma (logs unavailable)	Central west	BH1, BH2, BH4, BH5	TP3 x2, TP4, TP5, TP7, TP8, TP9, TP12, TP14	None available
Nov 2001	Terra Firma (logs unavailable)	Central west	BH1, BH2	TP1, TP2, TP3, TP4, TP5, TP6	Soil (trial pits only)
May 2002	Terra Firma (logs unavailable)	Central west	BH1, BH2 x 2	TP1, TP2, TP3, TP4, TP5	Soil (trial pits only)
June 2005	Terra Firma (logs unavailable)	North East (specific locations not known)	-	TP1,TP2,TP3,TP4,TP5, TP6	Soil
Aug 2005	Terra Firma (logs unavailable)	Central west	BH1/1A, BH2/2A, BH3/3A, BH4/4A	TP1,TP2,TP3,TP4,TP5, TP6	Soil, leachate and water (trial pits only)

Date	Contractor	Site Location	Boreholes	Trial Pits	Sampling
Oct 2005	Corus	Unknown	-	TP1, TP2, TP3, TP4	None available
2008	Norwest Holst	South	SBHF02CP, SBHF02A CP SBHF02RC, SBHF03CP, SBHF03RC	STPF01, STPF02, STPF03, STPF04, STPF05, STPF06, STPF07, STPF08, STPF09, STPF10	Soil and leachate
2015	Geotechnical Engineering Limited	South and north west	BH412, BH413, BH414, BH415, BH416, BH417, BH418, BH419, BH420, BH421, BH421A, BH422, BH422A	TP405, TP406, TP407, TP409	Soil, leachate and water

6.2.2 The construction details of all boreholes installed with monitoring wells on the Site are summarised in Table 6.

Table 6: Summary of Borehole Construction Details

Borehole ID	Diameter (mm)	Total Drilled Depth (m)	Top of Slotted Well Casing / Gravel Pack (m bGL)	Base of Slotted Well Casing / Gravel Pack (m bGL)	Targeted Geology
BHF4	50 (not specified on log)	40.2	Unspecified	32	Mercia Mudstone
BHF5	50 (not specified on log)	45.75	Unspecified	17.5	Glaciofluvial Deposits
BHF6	50 (not specified on log)	55.65	Unspecified	30	Mercia Mudstone
SBHF02A CP	19	17.75	16.7	17.3	Glaciofluvial Deposits
SBHF03RC	19	40	17.6	18.2	Glaciofluvial Deposits
BH412	35	35	1	3	Made Ground
	50		15	20	Glaciofluvial Deposits
BH413	35	40	1	4.5	Made Ground
	50		15	18	Glaciofluvial Deposits / Mercia Mudstone

Borehole ID	Diameter (mm)	Total Drilled Depth (m)	Top of Slotted Well Casing / Gravel Pack (m bGL)	Base of Slotted Well Casing / Gravel Pack (m bGL)	Targeted Geology
BH415	35	40	13	17	Tidal Flat Deposits /Glaciofluvial Deposits
	50		20	40	Mercia Mudstone
BH417	35	25.7	0.9	2.5	Made Ground
	50		11.9	15	Glaciofluvial Deposits
BH420	35	64	1	7	Made Ground / Tidal Flat Deposits
	50		17	21	Glaciofluvial Deposits
BH422A	35	20	1	4	Tidal Flat Deposits
	50		14	20	Glaciofluvial Deposits

6.3 Surface water quality Monitoring

6.3.1 Surface water quality monitoring was not undertaken during the previous ground investigations of the Site.

6.4 Field Testing

6.4.1 During the 2008 investigation a Photo Ionisation Detector (PID) was used to check soil samples for the presence of volatile organic material. PID monitoring was undertaken on samples taken at borehole SBHF03CP and trail pits STPF01 to 10. The monitoring reported results of zero with the exception of one detected level of 18.1 ppm recorded at STPF04 at 3.3 m bGL. No significant contamination was identified within the soils at this location.

6.5 Groundwater Monitoring

6.5.1 A summary of the groundwater sampling, groundwater monitoring and ground gas monitoring is shown in Table 7.

Table 7: Summary of Monitoring Rounds

Location Ref.	Number and Date of Rounds	Monitoring Details	Notes
SBHF02A CP	6 no. 1st February 2008, 25th February 2008, 7th March 2008, 20th March 2008, 4th April 2008, 18th April 2008	Groundwater levels	-
SBHF03RC	6 no. 31st January 2008, 26th February 2008, 7th March 2008, 20th March 2008, 4th April 2008, 18th April 2008	Groundwater levels	-

Location Ref.	Number and Date of Rounds	Monitoring Details	Notes
BH412	3 no. 23rd April 2015, 30th April 2015, 21st May 2015	Groundwater levels and sampling Ground gas	Dual installations. Gas monitoring in 35 mm shallow installation only
BH413, BH415, BH417	4 no. 20th April 2015, 27th April 2015, 5th May 2015, 12th May 2015	Groundwater levels and sampling Ground gas	
BH420	4 no. 20th April 2015, 27th April 2015, 5th May 2015, 14th May 2015	Groundwater levels and sampling Ground gas	
BH422A	4 no. 23rd April 2015, 30th April 2015, 8th May 2015, 21st May 2015	Groundwater levels and sampling Ground gas	

6.6 Laboratory Chemical Testing

6.6.1 A summary of all laboratory analysis undertaken on soil, groundwater and leachate is summarised in Table 8 below:

Table 8: Summary of Previous Investigation Sampling – Intrusive Exploratory Locations

Site Investigation Date	No. of Soil Samples	No. of Leachate Samples	No. of Water Samples	Suites of Testing
1997	4	0	0	Metals, pH, sulphate, cyanide, PAH screening, phenols, mineral oil
2000	32	3	2	Metals, pH, sulphate, cyanide, PAH, TPH, oil, phenol, VOCs
Nov 2001	6	0	0	Metals, cyanide, pH, PAH screening, phenols
May 2002	5	0	0	Metals, cyanide, pH, PAH screening, phenols
June 2005	6	0	0	Metals, cyanide, pH, PAH screening, phenols
Aug 2005	10	10	1	Metals, TPH, PAH
2008	25	11	0	Metals, pH, sulphate, asbestos, cyanide, phenol, MTBE, BTEX, TPH, PAH, PCBs, pesticides, SVOCs, VOCs
2015	42	13	29	Metals, PAH, TPH, asbestos, pH, cyanide, organic matter, VOCs, SVOCs, nitrate, BTEX, phenols, PCBs

Soil Analysis

6.6.2 The following sections summarise the laboratory analytical results for soil samples collected during the various intrusive investigation phases. The available data set has been tabulated and is presented in Appendix 3 with the supporting laboratory certificates available in the relevant original ground investigation reports.

6.6.3 To inform the conceptual site model, the analytical data from the Made Ground has been assessed separately from those of the natural soils (Tidal Flat Deposits and fluvial alluvium specifically).

6.6.4 For the purpose of meeting the requirements of Volume 4, Section 1, Part 2 of the DMRB HD22/08 – Managing Geotechnical Risk – 2008 (Highway Agency, 2008), the historical data used to support the 2014 PSSR and the additional 2015 information (Geotechnical Engineering, 2015) have been differentiated in the following sections.

6.6.5 The available information has been summarised in Table 9.

Table 9: Summary of Analytical Soil Data

Formation Unit	Number of Soil Analysis per Analytical Suite - 2015 data/ All GI data								
	Metals & Inorganics	Asbestos	PAH	TPH	Phenol	BTEX	VOCs	SVOCs	PCBs
Made Ground	37 / 108	33 / 51	37 / 103	35 / 88	33 / 95	15 / 32	14 / 33	1 / 18	3 / 21
Natural Soils	5 / 18	0 / 4	5 / 18	5 / 12	2 / 14	0 / 4	0 / 4	0 / 4	0 / 4

Soil Leaching Analysis

6.6.6 All soil leachate analysis was undertaken on soils relating to Made Ground. The available information is presented in Appendix 5 and summarised in Table 10.

Table 10: Summary of Soil Leaching Analytical Data

Formation Unit	Number of Soil Leachate Analysis per Analytical Suite - 2015 data / All GI data						
	Metals & Inorganics	PAH	TPH	Phenol	BTEX	VOCs	SVOCs
Made Ground	13 / 37	13 / 23	13 / 27	13 / 13	13 / 13	13 / 13	1 / 1

Groundwater Analysis

6.6.7 The following section summarises the laboratory analytical results for groundwater samples collected during the various intrusive investigation phases. The available data set has been tabulated and is summarised in Table 11 and tabulated in Appendix 4 with supporting laboratory certificates available in the relevant original ground investigation reports.

6.6.8 The available data relates to groundwater samples taken from wells installed within the perched water of the Made Ground, groundwater of the Tidal Flat Deposits and deep groundwater of the Glaciofluvial Deposits and or Mercia Mudstone and is summarised in Table 11. It is unclear which strata one groundwater sample from TP6 during the August 2005 investigation is from and as such has been referred to as 'undifferentiated' for this report.

Table 11: Summary of Analytical Groundwater Data

Groundwater Unit	Number of Groundwater Analysis per Analytical Suite (number of well locations) – 2015 data / All GI data								
	Metals & Inorganics	PAH	TPH	PCBs	BTEX	VOCs	SVOCs	Non Metal Inorganics	Phenols
Perched (Made Ground)	6 (2) / 7 (3)	6 (2) / 7 (3)	6 (2) / 7 (3)	3 (1) / 3 (1)	6 (2) / 6 (2)	6 (2) / 6 (2)	6 (2) / 6 (2)	6 (2) / 7 (3)	6 (2) / 7 (3)
Perched (Tidal Flat Deposits)	3 (1) / 4 (2)	3 (1) / 4 (2)	3 (1) / 4 (2)	0 (0) / 0 (0)	3 (1) / 3 (1)	3 (1) / 3 (1)	1 (1) / 1 (1)	3 (1) / 4 (2)	1 (1) / 1 (1)
Groundwater (Glaciofluvial Deposits / Mercia Mudstone)	20 (6) / 20 (6)	20 (6) / 20 (6)	20 (6) / 20 (6)	8 (3) / 8 (3)	20 (6) / 20 (6)	20 (6) / 20 (6)	16 (6) / 16 (6)	20 (6) / 20 (6)	18 (6) / 18 (6)
Undifferentiated (TP6)	0 (0) / 1 (1)	0 (0) / 1 (1)	0 (0) / 1 (1)	0 (0) / 0 (0)	0 (0) / 0 (0)	0 (0) / 0 (0)	0 (0) / 0 (0)	0 (0) / 0 (0)	0 (0) / 0 (0)

6.7 Gap Analysis of Available Data

6.7.1 The investigation data for the Site is considered limited both in relation to Site coverage and available laboratory analysis. Specific gaps include the below.

- Investigations concentrated on the new section of motorway alignment with little investigation undertaken along the proposed SDR and areas of temporary land take to the south west and east of the new section of motorway.
- No investigation is located within the buried river channel.
- The majority of TPH / PAH testing undertaken is not speciated.
- Only limited asbestos screening has been undertaken.

7 Ground Conditions

7.1 General

7.1.1 The geological logs for all available exploratory holes excavated on or in close proximity to the Site are provided in Appendix 1. The observed geological sequence is consistent with that discussed in the 2014 PSSR report and is summarised in the following sections. Information from the Supplementary Ground Investigation (Geotechnical Engineering, 2015) has also been used.

7.1.2 The ground conditions were found to be relatively consistent across the Site with limited variability in the geological sequence.

Made Ground

7.1.3 Made Ground was encountered in all exploratory locations with thicknesses generally between 2.5 and 5.0 m in the area west of Alexandra South Docks and about 1 m to the east as summarised in Table 12.

7.1.4 Made Ground was identified as a coarse material comprising limestone, brick, slag, ash, concrete, coal and sandstone. Further man-made inclusions were also noted including glass, ceramics, plastics, slate and timber.

7.1.5 Gravelly sandy clays were encountered to a lesser extent across the Site. Gravels comprised sandstone, concrete, brick, slag and ash.

7.1.6 Evidence of domestic waste material that could be attributed to landfilling associated with Docks Way Landfill has not been identified in the investigation data available.

Superficial Deposits

7.1.7 Unconsolidated superficial deposits were encountered beneath the Made Ground at all locations. These comprised Tidal Flat Deposits, generally very soft and soft grey silty clays commonly described as organic. Occasional peat inclusions were encountered at depth in the east of the Site. The formation was found to be generally 10 m in thickness in the east, increasing eastwards to about 13 m in proximity to the River Usk.

7.1.8 Sandy gravels considered to represent Glaciofluvial Deposits (referred to as River Terrace Deposits in the 2015 logs and Fluvial Alluvium in those of 1997) were found to underlie the predominantly fine and cohesive Tidal Flat Deposits at depth of between generally 17 to 21 m bGL (-7 to -13 m AOD). These coarse deposits were generally 5 to 8 m in thickness and typically comprised dense fine to coarse sandy sandstone gravels with some cobbles.

Solid Geology

7.1.9 Below the Tidal Flat Deposits and Glaciofluvial Deposits, the Mercia Mudstone Group was encountered. The Mercia Mudstone was typically described as very stiff reddish brown gravelly clay becoming a very weak to moderately strong thinly bedded mudstone. It was encountered at a depth of between 17 and 23.2 m bGL.

7.1.10 A sandstone horizon and interbedded siltstone and sandstone were encountered within BH421 (0.15 m thickness) and BH422 (1.7 m thickness) respectively.

Geological Sequence Summary

7.1.11 The generalised geological sequence identified during the previous ground investigations is summarised in Table 12.

Table 12 Summary of Geological Sequence

Unit	Description	Thickness Range (m)	Basal Depth (m bGL)
Made Ground	Predominantly granular brick, ash fill or gravelly sandy clays.	0.46-5.0	0.46-5.0
Superficial Deposits (Tidal Flat Deposits)	Very soft and soft silty clay, organic in places. Occasional peat inclusions at depth in the east of the Site.	6.9-14.0	11.4-16.8
Superficial Deposits (Glaciofluvial Deposits)	Dense fine to coarse sandstone gravels with some cobbles.	4.4-7.7	17-23.2
Mercia Mudstone (Mudstone)	Very stiff red brown gravelly fissured clay becoming very weak to moderately strong bedded mudstone.	>40.8	>64.0

7.2 Visual and Olfactory Evidence of Contamination

7.2.1 A strong hydrocarbon odour was recorded at STPF04 within the base of the Made Ground from 3.2 to 3.7 m bGL. Strong hydrocarbon odours were also detected at STPF01 at 1.8 m bGL and a strong fuel odour was recorded at CH11 at 1.65 to 3 m bGL.

7.2.2 A moderate becoming mild hydrocarbon odour was recorded at BHF4 from 3.3 to 8.25 m bGL and a slight hydrocarbon sheen was observed on the groundwater strike at 1.4 m bGL at STPF7.

7.2.3 Full details and observations noted during the drilling and trial pitting are presented on the exploratory hole logs provided in Appendix 1.

7.3 Gas Monitoring

7.3.1 The gas monitoring data set collected during each of three monitoring rounds is summarised on the field data sheets provided in Appendix 2. The maximum gas concentrations (minimum for oxygen) are presented in Table 13 below.

Table 13 Summary of Gas Monitoring Data

Location ID and Targeted Geological Formation	Flow (l/hr)	VOCs (ppm)	CH_4 (%/vol)	Peak LEL (%)	CO_2 (%/vol)	O_2 (%/vol)	CO (ppm)	H_2S (ppm)
	Max.	Max.	Max.	Max.	Max.	Min.	Max.	Max.
BH412 (Made Ground)	0	4.5	1.0	19.0	4.4	7.0	0	0
BH413 (Made Ground)	1.6	0.1	48.1	>100	5.4	0.1	27	0
BH415 (Tidal Flat Deposits / Glaciofluvial Deposits	0	2.5	0.4	7.0	0.3	19.3	1	0
BH417 (Made Ground)	4.5	3.2	0.1	1.0	0.1	20.1	0	0
BH420 (Made Ground / Tidal Flat Deposits)	0	5.9	0.9	16	0.9	18.3	10	0
BH422A (Tidal Flat Deposits)	0.4	5.4	0.2	3	4.6	3.0	4	0

7.4 Groundwater Monitoring

Groundwater Encountered During Investigation

7.4.1 All water strikes encountered during the advancement of the boreholes are detailed on the geological logs provided in Appendix 1. They are also summarised in Table 14 below.

Table 14 Summary of Groundwater Level Data During Investigation

Location	Strike Depth (m bGL)	Geological Formation	Level after 20 minutes (m bGL)
BHF3	12.0	Tidal Flat Deposits	9.7
BHF4	12.3	Tidal Flat Deposits	9.8
	23.5	Mercia Mudstone	-
	31.5	Mercia Mudstone	-
	37.0	Mercia Mudstone	-
BHF5	1.1	Made Ground	0.5
BHF6	2.2	Made Ground	-
CH12	1.35	Made Ground	-
SBHF02 RC	13.5	Tidal Flat Deposits	-
	14.5	Glaciofluvial Deposits	-
SBHF02A CP	13.05	Tidal Flat Deposits	8.3
SBHF03 CP	12.8	Tidal Flat Deposits	9.5
BH412	3.0	Made Ground	2.8
	13.6	Tidal Flat Deposits	10.4

Location	Strike Depth (m bGL)	Geological Formation	Level after 20 minutes (m bGL)
BH413	2.24	Made Ground	-
BH415	1.0	Made Ground	0.8
	2.95	Made Ground	1.1
BH416	0.8	Made Ground	-
	11.8	Glaciofluvial Deposits	9.0
	17	Glaciofluvial Deposits	9.8
BH417	11.6	Tidal Flat Deposits	10.3
BH418	0.4	Made Ground	0.4
	3.8	Made Ground	3.8
	14.8	Tidal Flat Deposits	12.0
BH419	3.0	Tidal Flat Deposits	2.8
	6.0	Tidal Flat Deposits	4.6
	11.9	Tidal Flat Deposits	9.6
	14.0	Glaciofluvial Deposits	2.5
	18.0	Glaciofluvial Deposits	2.5
BH420	4.5	Tidal Flat Deposits	3.65
	16.0	Tidal Flat Deposits	11.8
BH421	13.5	Tidal Flat Deposits	8.0
BH422	0.8	Made Ground	0.65
	8.6	Tidal Flat Deposits	8.1

7.4.2 Groundwater seepages were also encountered within TP406 and TP407 within the Made Ground and/or Tidal Flat Deposits. A rapid ingress was recorded at 1.0 m bGL within the Made Ground encountered within TP409.

Groundwater Level During Monitoring Rounds

7.4.3 The entire groundwater level data set gathered on Site is provided in Appendix 2 and summarised in Table 15.

Table 15 Summary of Groundwater Level Data During Monitoring

Location	Installation[#] 1	Depth of Response Zone (m bGL) and Geological Formation	No. Measurements	Min. Depth (m bGL)	Max. Depth (m bGL)	Comments
BHF4	50 (not specified on log)	23-32 Mercia Mudstone	4	6.32	6.97	-
BHF5	50 (not specified on log)	15.5-17.5 Glaciofluvial Deposits	4	6.72	7.32	-
BHF6	50 (not specified on log)	25-30 Mercia Mudstone	4	5.93	8.6	-

Location	Installation[#1]	Depth of Response Zone (m bGL) and Geological Formation	No. Measurements	Min. Depth (m bGL)	Max. Depth (m bGL)	Comments
SBHF02A CP	19	16.7-17.3 Glaciofluvial Deposits	6	5.6	9.0	-
SBHF03 RC	19	17.6-18.2 Glaciofluvial Deposits	6	6.77	7.42	-
BH412	35	1-3 Made Ground	3	2.83	>3	-
	50	15-20 Glaciofluvial Deposits	3	8.79	10.57	-
BH413	35	1-4.5 Made Ground	4	2.24	3.38	-
	50	15-18 Glaciofluvial Deposits / Mercia Mudstone	4	7.79	9.28	-
BH415	35	13-17 Tidal Flat Deposits / Glaciofluvial Deposits	4	6.08	7.77	-
	50	20-40 Mercia Mudstone	4	6.51	8.06	-
BH417	35	0.9-2.5 Made Ground	4	0.6	2.12	Slow recharge
	50	11.9-15 Glaciofluvial Deposits	3	6.43	6.66	-
BH420	35	1-7 Made Ground / Tidal Flat Deposits	4	1.98	3.42	-
	50	17-21 Glaciofluvial Deposits	4	7.73	9.18	-
BH422A	35	1-4 Tidal Flat Deposits	4	1.58	2.24	-
	50	14-20 Glaciofluvial Deposits	4	6.21	7.73	-

Groundwater Summary

7.4.4 The main groundwater body is within the granular Glaciofluvial Deposits and/or the Mercia Mudstone, confined by the overlying Tidal Flat Deposits. The latter represents an aquitard to groundwater flow.

7.4.5 A discontinuous perched groundwater is also evident within the upper formation of the Tidal Flat Deposits. These are considered to represent discrete bodies with limited vertical or lateral flow.

7.4.6 Perched groundwater was also identified during the intrusive works and subsequent monitoring within the Made Ground.

8 Contamination Assessment

8.1 Introduction

8.1.1 The following sections provide details of the assessment of land contamination at the Site.

8.1.2 The Conceptual Site Model (CSM) presented within the 2014 PSSR has been reviewed and updated based on data from the Supplementary Ground Investigation (Geotechnical Engineering, 2015) and the current Scheme design. The main alterations to the 2014 PSSR model are summarised below.

- New contamination source identified (perched water body within the Made Ground).
- New ground gas source identified (Made Ground and superficial deposits).
- Update of the source-pathway-receptor linkages taking account of the above and more detailed assessments.

8.1.3 The Docks Way Landfill presents a potential off site source that could impact the Scheme. This is assessed separately under the Land Contamination Assessment Report CL-13 (Annex D of Appendix 11.1 of the ES).

8.2 Preliminary Risk Assessments

Potential Sources

8.2.1 The Made Ground was identified within the 2014 PSSR as a potential source based on the Site's historical usage. Historical usage includes:

- infilled timber floats and docks;
- infilled of part of River Ebbw channel
- old coal sidings / spoil heaps;
- electrical substations;
- railway sidings;
- industrial land use (to include depots, timber yards; shipyard, etc.); and
- sanitary hospital.

8.2.2 Waste materials may be encountered along the SDR associated with Docks Way Landfill although the available data has not identified their presence.

8.2.3 The perched water body within the Made Ground/Tidal Flat Deposits is considered to represent a potential source rather than a receptor where present.

8.2.4 In addition to the above sources, the quality of surface water, perched groundwater and the deeper aquifer within the Glaciofluvial Deposits and Mercia Mudstone bodies, may influence or impact the quality of the others (for instance the groundwater within the Glaciofluvial Deposits and Mercia Mudstone is saline whilst the surface water is not). Surface water, perched groundwater and the deeper aquifer are therefore regarded as both a source of possible contaminants as well as being receptors.

8.2.5 The Docks Way Landfill presents a potential source for gas and contaminated leachate/groundwater. Full details are discussed under The Land Contamination Assessment Report CL-13 (Annex D of Appendix 11.1 of the ES).

8.2.6 The Made Ground/Tidal Flat Deposits also represent a potential source of ground gas.

Potential Receptors

8.2.7 Receptors during the construction and the operational stages of the Scheme have been considered.

Construction

- Construction workers during site development works.
- General public/workers adjacent to construction works.
- Groundwater within the Glaciofluvial Deposits and Mercia Mudstone.
- Surface waters – the River Usk, River Ebbw and impounded water within the docks.

Operational

- General public end users.
- Maintenance workers, mainly from exposure to made ground materials outside the Scheme area and ground gas migration along the piled foundation.
- General public/workers adjacent to the permanent land take.
- Groundwater within the Glaciofluvial Deposits and Mercia Mudstone.
- Surface waters – the River Usk, River Ebbw and impounded water within the docks.

Potential Pathways

8.2.8 Pathways during the construction and the operational stages of the new section of motorway have been considered.

- Dermal contact, ingestion, inhalation pathways of potentially contaminated soils possible during development and maintenance works.
- Dermal contact, ingestion, inhalation pathways possible for general public end users and adjacent general public/workers. The later to be from soil dust only.
- Accumulation of ground gas within confined spaces during the earthworks.
- Upward migration of ground gases along piles.
- Vertical migration of impacted perched waters within the Made Ground and/or leachate from the Made Ground into the main groundwater bodies and subsequent lateral migration to surface water bodies.
- Vertical migration of groundwater from within the Glaciofluvial Deposits and Mercia Mudstone possibly recharging perched groundwater and/or saturating the Made Ground due to pile installation.
- Vertical or lateral migration of ground gas associated with the Made Ground and potential peat sources.

- Creation of new pathways with installation of piled piers and piled embankments through Made Ground, Tidal Flat Deposits and Glaciofluvial Deposits into the Mercia Mudstone.

8.3 Risk Evaluation

8.3.1 Source-pathway-receptor linkages were considered in the 2014 PSSR using the historical data available up to 2008. With review of the additional data described herein, the risk evaluation has been reconsidered and included the following.

- The new section of motorway is to be constructed on a viaduct or high embankment some 4 m or more above ground level. Motorway users will be within an open environment with no proposed structures or other confined spaces. Pathway linkages to motorway users are therefore limited to air born dust.
- The Site has been subject to a range of potential contaminating uses.
- The proposed embankment will encapsulate Made Ground reducing exposure pathways to motorway end users. However, remaining areas (outside embankment / pier locations) are to remain uncapped although these are likely to receive vegetation cover or some form of hardstanding.
- Superficial deposits are classified as non-productive and overlie a Secondary B aquifer associated with the mudstone.
- The cohesive TFD (typically over 10 m thickness) separates the Made Ground and main aquifer.
- Perched groundwater within the Tidal Flat Deposits is not considered a water resource due to its anticipated low vertical hydraulic continuity with the aquifer beneath, its low permeability and low storage capacity.
- Piled foundations may create pathways to the lower aquifer. Those pathways may enable an increase in the influx of water within the Made Ground, given the recorded sub-artesian pressures.
- High concentrations of ground gases have been reported at one location. Ground gas may migrate laterally and vertically including upward migration along the piles.
- Excavation for the construction of the piers will constitute confined spaces in which ground gases may accumulate.

8.4 Human Health Risk Assessment

8.4.1 The rationale and approach for the human health (Tier 2) screening assessment is detailed in the Land Contamination Preliminary Assessment Report (Appendix 11.1 of the ES). Soil chemical results and the findings of the generic tier 2 human health risk assessment are presented in Appendix 3. All exceedances to the relevant generic risk assessment criteria are summarised in Table 16.

Table 16: Summary of Human Health Soil Screening Exceedances (Made Ground)

Determinant	Units	Range	Screening Criteria	No. Samples Exceeding Screening Criteria (Total Number of Results)	Location of Exceedances
pH	pH units	6.8 - 11.1	6-9	16 (99)	BHF3, CH10, CH11, CH16, CH17, CH21, STPF07, TP2, BH412, BH413, BH416, BH420, TP405
Arsenic	mg/kg	<1 - 470	170	1 (107)	BH412
Chromium	mg/kg	0.03 - 310	33	37 (107)	BHF3, BHF4, BHF5, CH11, CH17, CH21, CH23, SBHF03CP, STPF04, STPF06, STPF07, TP2, TP3, TP6, TP02, TP06, BH412, BH413, BH414, BH416, BH417, BH418, BH420, TP406, TP407, TP409
Nickel	mg/kg	5.3 - 5500	980	1 (107)	BH412
Benzo(a)pyrene	mg/kg	<0.1 - 49	11	5 (64)	STPF01, TP05, BH419, BH422, TP405
Benzo(b)fluoranthene	mg/kg	<0.1 - 46	13	4 (64)	STPF01, BH419, BH422, TP405
Dibenzo (ah)anthracene	mg/kg	<0.008 – 9.8	1.1	7 (64)	STPF01, STPF10, TP05, BH416, BH419, BH422, TP405
PAH (screen)	mg/kg	<25 - 1620	1.1	29 (38)	BHF3, BHF4, BHF5, CH10, CH11, CH12, CH13, CH14, CH15, CH15A,

Determinant	Units	Range	Screening Criteria	No. Samples Exceeding Screening Criteria (Total Number of Results)	Location of Exceedances
					CH16, CH17, CH18, CH19, CH19A, CH22, CH23, TP1
TPH FTIR (AR)	mg/kg	<20 - 46,300	3,200	1 (26)	CH11
PCBs (vs Aroclor 1254)	mg/kg	<0.02 - 0.81	0.24	1 (18)	SBHF03

8.4.2 Alkaline soil conditions have been identified within Made Ground across the Site typically including ash and limestone gravel.

8.4.3 Single elevated arsenic and nickel concentrations were identified within a sample of granular Made Ground obtained from BH412 located within an area historically comprising an old coal sidings/spoil heap.

8.4.4 A single elevated PCB (vs aroclor 1254) was identified above the screening criterion at a location historically comprising old coal sidings/spoil heap. This test result does not necessarily comprise entirely of dioxin-like PCBs.

8.4.5 Although exceedances of chromium are identified throughout the Made Ground, the criterion relates to the hexavalent form. The majority of the results are considered to be within the normal background data range (<95 mg/kg) and therefore are not considered to represent a contaminant of concern. Several locations, with no discernible distribution within the Site exceed this background range. Further speciation may confirm this chromium relates to a lesser toxic form.

8.4.6 For the total PAH analysis, the most stringent criterion applicable for any PAH compound has been used for screening purposes (i.e. dibenzo(ah)anthracene). Elevated concentrations are identified within the majority of Made Ground samples typically associated with the presence of ash and tarmac materials.

8.4.7 Elevated concentrations for individual PAH compounds were also identified within Made Ground samples typically containing tarmac and ash materials.

8.4.8 A single elevated concentration of TPH was identified within the same sample in which the maximum PAH concentration was detected (CH11 at 1.65 m bGL). A strong fuel odour was noted at this location between 1.65 and 3 m bGL. This location is within an area which historically comprised old coal sidings/spoil heap.

8.4.9 Hydrocarbon testing was not undertaken on samples from STPF01 where strong hydrocarbon odours were noted.

8.4.10 All exceedances of the relevant criteria with respect to natural ground are summarised in in Table 17 (natural ground).

Table 17: Summary of Human Health Soil Screening Exceedances (Natural Ground)

Determinant	Units	Range	Screening Criteria	No. Samples Exceeding Screening Criteria (Total Number of Results)	Location of Exceedances
Chromium	mg/kg	12 - 50	33	9 (18)	SBHF03CP, STPF01, STPF05, CH21, CH22, BH419, BH422, TP406, TP407
PAH (screen)	mg/kg	<25 - 301	1.1	6 (8)	CH18, CH19, CH20, CH21 CH22, CH23

8.4.11 Although exceedances of chromium are identified within the natural deposits, the criterion relates to the hexavalent form and this is considered to be a conservative approach. Further speciation may confirm chromium relates to a lesser toxic form.

8.4.12 For the PAH screen analysed without speciation, the most stringent criterion applicable for any PAH compound is used for screening purposes (i.e. dibenzo(ah)anthracene). Elevated concentrations are predominantly identified within the Tidal Flat Deposits and to a lesser extent within the Glaciofluvial Deposits.

8.5 Controlled Waters Screening Assessment

8.5.1 The rationale and approach for the controlled waters (tier 1) screening assessment is detailed in the Land Contamination Assessment Report (Appendix 11.1 of the ES) and the groundwater chemical results are presented in Appendix 4. All exceedances to the relevant generic criteria are summarised in Tables 19 and 20 for soil leachate and groundwater, respectively.

8.5.2 Where an Environmental Quality Standard (EQS) is dependent on water hardness, i.e. some heavy metals, the hardness of the surface water receptor would normally be used. The Baseline Water Environment Report (Appendix 16.2 of the ES) indicates surface water to be generally moderately hard with hardness in a range of 100 to 150 mg/l as calcium carbonate. Therefore EQSs within this water hardness range have been used for screening purposes.

Soil Leachate Results

8.5.3 Thirty seven soil samples were subjected to leachate analysis, all from within the Made Ground. The majority of the soil leachate results were all below the applied screening criteria, with the exception of the contaminants presented in Table 18.

Table 18: Controlled Waters Screening Exceedances – Soil Leachate

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS Screening Criteria (Total Number of Results)	Location (Formation)	No. Exceeded DWS Screening Criteria (Total Number of Results)	Location (Formation)
Arsenic	µg/l	<1 - 19	50	10	0 (37)	-	3 (37)	STPF04, STPF05, TP409 (Made Ground)
Cadmium	µg/l	<0.08 – 0.25	0.15	5	3 (33)	BH414, BH417, BH418 (Made Ground)	0 (33)	-
Copper	µg/l	<1 - 20	10	2000	2 (37)	CH11, STPF05 (Made Ground)	0 (37)	-
Mercury	µg/l	<0.01 - 1.1	0.07	1	2 (26)	BH416, TP409 (Made Ground)	1 (26)	BH416 (Made Ground)
Nickel	µg/l	<1 - 5	4	20	1 (33)	STPF04 (Made Ground)	0 (33)	-
Lead	µg/l	<0.5 - 20	1.2	10	8 (33)	SBHF03CP, STP04, STPF07, BH417, BH418, BH419, TP405, TP409 (Made Ground)	1 (33)	BH418 (Made Ground)
Antimony	µg/l	<1 - 15	-	5	-	-	3 (24)	SBHF03CP, STPF04, STPF05 (Made Ground)
pH	pH units	7.3 - 11	6 - 9	6 - 9	1 (17)	BH412 (Made Ground)	1 (17)	BH412 (Made Ground)

8.5.4 The identified exceedances indicate leachable concentrations of heavy metals are not widespread. Exceedances identified are less than 3 times the criteria with the exception of mercury and lead.

8.5.5 The exceedances were identified in areas within the following historical land uses:

- timber yard;

- old coal sidings/spoil heap;
- timber yard depot; or
- timber floats.

8.5.6 The identified exceedances are considered to be minor and unlikely to pose a risk to controlled waters.

8.5.7 Certain laboratory detection levels in samples used in previous ground investigation for lead, mercury, cyanide, some PAHs, VOCs and SVOCs are higher than the screening criterion.

Groundwater Results

8.5.8 Thirty two groundwater samples were subjected to analysis. The majority of groundwater results were below the applied screening criteria with the exception of those tabulated in Table 19 below.

Table 19: Controlled Waters Screening Exceedances – Groundwater

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS Screening Criteria (Total Number of Results)	Location of Exceedance	No. Exceeded DWS Screening Criteria (Total Number of Results)	Location of Exceedance
Perched Groundwater (Made Ground)								
Arsenic	µg/l	2 - 36	50	10	0 (7)	-	3 (7)	BH420 (x3)
Boron	µg/l	250 - 1200	2000	1000	0 (6)	-	4 (6)	BH417 (x 2), BH420 (x 2)
Cadmium	µg/l	<0.08 - 0.73	0.15	5	1 (7)	BH420	0 (7)	-
Copper	µg/l	<1 - 13	10	2000	1 (7)	CH12	0 (7)	-
Mercury	µg/l	<0.5 - 0.69	0.07	1	2 (7)	BH417, BH420	0 (7)	-
Nickel	µg/l	<1 - 7	4	20	2 (7)	CH12, BH417	0 (7)	-
Chloride	mg/l	15 - 270	250	250	1 (6)	BH420	1 (6)	BH420
Ammoniacal Nitrogen as N	mg/l	0.061 - 2.8	0.6	-	3 (6)	BH420 (x 3)	0 (6)	-
Phenols	mg/l	<0.03 - 0.11	0.0077[1]	-	1 (25)	BH420	-	-
Perched Groundwater (Tidal Flat Deposits)								
Arsenic	µg/l	3 - 11	50	10	0 (4)	-	1 (4)	BH422A
Cadmium	µg/l	<0.08 - 0.33	0.15	5	2 (4)	BH422A (x 2)	0 (4)	-
Copper	µg/l	2 - 11	10	2000	1 (4)	BH422A	0 (4)	-
Lead	µg/l	<1 - 2.5	1.2	10	1 (4)	BH422A	0 (4)	-

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS Screening Criteria (Total Number of Results)	Location of Exceedance	No. Exceeded DWS Screening Criteria (Total Number of Results)	Location of Exceedance
Nickel	µg/l	2.6 - 9	4	20	2 (4)	CH17, BH422A	0 (4)	-
Chloride	mg/l	450	250	250	1 (1)	BH422A	1 (1)	BH422A
Ammoniacal Nitrogen as N	mg/l	0.75	0.6	-	1 (1)	BH422A	0 (1)	-
Aquifer (Glaciofluvial Deposits / Mercia Mudstone)								
Arsenic	µg/l	6 - 41	50	10	0 (20)	-	14 (20)	BH413 (x2), BH415 (x4), BH417 (x3), BH420 (x2, BH422A (x3)
Boron	µg/l	220 - 3800	2000	1000	6(20)	BH412, BH413 (x2), BH417, BH420 (x2)	13 (20)	BH412, BH413 (x2), BH415 (x3), BH417 (x3), BH420 (x3), BH422A
Chromium	µg/l	<1 - 100	-	50	0 (20)	-	6 (20)	BH413 , BH415 (x2), BH420, BH422A (x2)
Copper	µg/l	3.1 - 69	10	2000	12 (20)	BH412 (x2), BH413, BH415 (x3), BH420 (x3), BH422A (x3)	0 (20)	-
Lead	µg/l	<1 - 3.3	1.2	10	2 (20)	BH412, BH422A	0 (20)	-
Mercury	µg/l	<0.5 - 0.75	0.07	1	6 (20)	BH415 (x3), BH417, BH420 (x2)	0 (20)	-

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS Screening Criteria (Total Number of Results)	Location of Exceedance	No. Exceeded DWS Screening Criteria (Total Number of Results)	Location of Exceedance
Nickel	µg/l	1 - 7.8	4	20	5 (20)	BH412, BH413, BH415 (x2), BH422A	0 (20)	-
Selenium	µg/l	<1 - 64	-	10	0 (20)	-	13 (20)	BH412 (x2), BH413 (x2), BH415 (x5), BH417, BH420 (x3), BH422A
Chloride	mg/l	490 - 7100	250	250	18 (18)	BH412 (x3), BH413 (x2), BH415 (x6), BH417 (x3), BH420 (x3), BH422A	18 (18)	BH412 (x3), BH413 (x2), BH415 (x6), BH417 (x3), BH420 (x3), BH422A
Ammoniacal Nitrogen as N	mg/l	0.93 - 10	0.6	-	18 (18)	BH412 (x3), BH413 (x2), BH415 (x6), BH417 (x3), BH420 (x3), BH422A	0 (18)	-
Undifferentiated (TP6)								
Cadmium	µg/l	2	0.15	5	1 (1)	TP6	0 (1)	-

Note: [1] based on phenol criteria

8.5.9 The groundwater assessment includes data from three rounds of monitoring in BH412, BH415, BH417, BH420 and BH422A (two rounds for BH413) undertaken in 2015.

8.5.10 Samples were taken from perched water within the Made Ground with the below comments when considering EQS criteria.

- Typically exceedances of copper, cadmium, mercury, nickel and ammoniacal nitrogen were identified.
- Total phenols were found to be present within perched groundwater in borehole BH420. This has been compared against the criterion for phenol which is considered a conservative approach.
- Certain laboratory detection levels for mercury, lead, some PAHs, VOCs and SVOCs are higher than the applied screening criterion.

8.5.11 Within the perched groundwater of the Tidal Flat Deposits and the aquifer bodies within the Glaciofluvial Deposits and Mercia Mudstone, the below comments are made against EQS criteria.

- Typically exceedances of boron, copper, cadmium, lead, mercury, nickel and ammoniacal nitrogen are identified.
- The elevated chloride concentrations indicate saline intrusion within both the perched groundwater and the aquifer.
- Certain laboratory detection levels for mercury, lead, some PAHs, VOCs and SVOCs are higher than applied screening criterion.

8.5.12 The samples taken from perched water within the Made Ground gave exceedances of arsenic and boron when considering Drinking Water Standards (DWS) criteria.

8.5.13 Within the perched groundwater of the Tidal Flat Deposits and the aquifer bodies within the Glaciofluvial Deposits and Mercia Mudstone, arsenic, chromium, selenium and chloride were identified exceeding DWS criteria.

8.5.14 From the 7 no. water samples from the Made Ground, those of CH12 and BH417 (round 1 only) gave TPH concentrations of 220 µg/l and 1900 µg/l, respectively. All other samples (from BH417 round 2 and 3 and BH420) gave concentrations below laboratory limit of detection.

8.5.15 From the groundwater samples, all TPH results were found below laboratory limit of detection with the exception of CH17 (140 µg/l), BH412 (3300 µg/l – round 1 only).

8.5.16 A possible linkage between soil and perched water quality within the Made Ground is identified when considering the leachate data.

8.5.17 The water quality in the perched groundwater and aquifer is considered to be similar and distinctly more deteriorated than the water quality seen in the Made Ground, indicating potential off-site sources.

8.5.18 The data for the perched water within the Made Ground is however considered to be limited with identified hotspots within soils not being targeted for analysis.

8.6 Ground Gas Risk Assessment

8.6.1 The ground gas data available relates to boreholes BH412, BH413, BH415, BH417, BH20 and BH422A with response zones within the Made Ground (BH412 1 to 3 m bGL, BH413 1 to 4.5 m bGL, BH417 0.9 to 2.5 m bGL and BH420 1 to 7 m bGL), Tidal Flat Deposits (BH422A 1 to 4 m bGL) and the transition zone between the Tidal Flat Deposits and Glaciofluvial Deposits (BH415 13 to 17 m bGL). Of the data available the below comments can be made.

- The monitoring (undertaken on the 5th May 2015) was undertaken during low barometric pressure (less than 1000 mb), with the lowest conditions being 994 mb.
- Gas flow was generally recorded absent, with the exception of a peak of 1.6 l/hr during round one in BH413, a peak of 4.5 l/hr during round one in BH417 and a peak of 0.4 l/hr during round one in BH422A.
- Methane has been recorded within all of the boreholes generally with low levels (maximum concentration of 1 % in round one BH412). The noticeable exception to this is BH413 which has elevated and stable levels of methane in the range of 32.7 to 48.1 %.
- Carbon dioxide is identified in all boreholes at a maximum concentration of 5.4 % in BH413 during the second monitoring round. Generally concentrations were below the screening criteria of 5 %.
- Traces of VOCs of up to 5.4 ppm has been recorded.
- Hydrogen sulphide was recorded as zero throughout.
- With the exception of BH413, carbon monoxide was identified with concentrations of between 0 and 2 ppm. These concentrations are below the screening criteria of 30 ppm. At BH413, higher concentrations of generally 10 to 27 ppm were recorded.
- Oxygen has been recorded to be at relatively normal levels (ambient) with concentrations in BH415, BH417 and BH420 of between 18.3 and 20.7 %. Low levels of oxygen were encountered in the remaining three boreholes with concentrations of between 15.5 and 15.6 %. At BH413, a near depleted condition with concentrations of 0.1 to 1.5 % has been identified.

8.6.2 The available data identifies overall low methane concentrations and raised carbon dioxide with ambient or depleted oxygen. Conditions are considered representative of typical brownfield sites with low gas generation potential. However, the elevated ground gas concentrations at BH413 may be associated with offsite gas migration from Docks Way Landfill Area 2 (located 65m north) or other sources (such as the backfilled River Ebbw channel located 100 m south east) although this cannot be confirmed at this stage. Area 2 of Docks Way Landfill is understood to have engineered containment measures.

8.6.3 A gas assessment has been undertaken and is set out in the Land Contamination Assessment Report (Appendix 11.1 of the ES).

8.7 Summary

8.7.1 Made Ground has been identified to have elevated chromium concentrations above that considered as background and could cause a potential risk to human health. However a conservative screening assessment value has been used.

8.7.2 Elevated PAHs that could cause a potential risk to human health have been identified within the Made Ground and within natural soils although the lack of compound speciation within the analytical data required the use of a conservative screening criteria.

8.7.3 Heavy metals (arsenic and nickel) exceedances against generic criteria were identified within the Made Ground associated with BH412 which may cause a risk to human health.

8.7.4 Visual and olfactory evidence of hydrocarbon contamination was identified in discrete areas (STPF01 and CH11) and laboratory data indicated elevated concentrations which may pose a risk to human health.

8.7.5 A PCB exceedance was identified in the Made Ground of SBHF03CP.

8.7.6 Widespread high pH in the Made Ground is recorded probably associated with the presence of slag material.

8.7.7 Leachable heavy metals have been identified from the Made Ground though are not indicated to be widespread.

8.7.8 Exceedances of EQSs and DWSs are prevalent within the perched groundwaters and underlying aquifers.

8.7.9 The water quality in the perched groundwater and aquifer is considered to be similar and distinctly more deteriorated than the perched water quality seen in the Made Ground, indicating off site sources.

8.7.10 The data for the perched water within the Made Ground is considered to be limited with identified hotspots within soils not being targeted with installations (e.g. STPF01 and CH11 where gross hydrocarbon contamination is identified).

8.7.11 The available gas data identifies a gas regime consistent with that for a brownfield site. The data from BH413 indicates potential effluence from the adjacent Docks Way Landfill.

9 Refined Conceptual Site Model

9.1.1 The incorporation of data from the 2015 Supplementary Ground Investigation has enabled the original CSM presented in the 2014 PSSR to be updated. The assessment is based on the Scheme during its construction and operational phases.

9.1.2 A CSM representing general ground conditions, overall Scheme layout and relevant source-pathway-receptors (each of which has a specific alpha-numerical symbol attached) are presented in Figure 2 and is described in Table 20.

9.1.3 For the purpose of this report the potential source of the Docks Way Landfill (CL-13) is not fully described as this is covered in more detail through the Land Contamination Assessment Report CL-13 (Annex D of Appendix 11.1 of the ES).

Table 20: Site Conceptual Model

Contamination Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
On site Made Ground/fill material, electrical sub-stations, timber yards and saw mills, docks, coal sidings/dump including spoil heap, transit and storage sheds, pumping station works, sanitary hospital and railway land. Possible landfill waste.	Construction					
	Construction workers (B)	Direct dermal (1)	Likely	Moderate	Moderate	Elevated concentration of some heavy metals and organics are identified within the Made Ground in addition to visual/olfactory evidence of hydrocarbon contamination; however these are seen as discrete features with no widespread coverage. Exposure duration will be short term only. Prior to construction, a specific risk assessment will be required in line with CDM and health and safety legislation. This will enable safe methods of work and appropriate levels of PPE to be put in place. As such, all risks will be duly considered and suitably mitigated to protect construction workers. Excavations during construction would constitute confined spaces which would require specific risk assessment, control measures and appropriate PPE. A construction mat will be placed over the length and width of the proposed embankment to enable piling installation as
		Ingestion (3)	Likely	Moderate	Moderate	
		Inhalation of soil dust (2)	Likely	Moderate	Moderate	

Contamination Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
		Inhalation of ground gas or vapours (2)	Likely	Moderate	Moderate	well as general construction. This will break dermal, ingestion and inhalation pathways once placed. Construction workers may be exposed to ground gas during the excavation works. Overall the gas data does not exceed the screening threshold with the exception of one which indicates gas migration from Docks Way Landfill. A gap in the data has been identified and further investigations are required to delineate potential contamination, the extent of historical landfilled waste associated with Docks Way Landfill and confirm the level of risk posed.
	Groundwater - Aquifer (Da) from the Glaciofluvial Deposits and/or Mercia Mudstone	Vertical migration (4)	Low	Moderate	Moderate to low	Displacement of potentially impacted Made Ground possible during piling, however this is subject to choice of piling technique. A thick mantle of predominantly soft low permeability Tidal Flat Deposits overlying the aquifer reduces the risk of downward migration. Presence of discrete soil contamination within the Made Ground. Groundwater quality is identified to have elevated concentrations of contaminants of concern. A foundation works risk assessment is required to confirm the absence of risk to controlled waters. A gap in the data has been identified and further investigations are required to delineate potential contamination, the extent of historical landfilled waste associated with Docks Way Landfill and verify the risks posed.

Contamination Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
	Surface waters (E)	Saturated flow within perched water and groundwaters (4)	Likely	Low	Low	Water within the Made Ground and groundwater within the perched groundwater within the Tidal Flat Deposits are likely to be in hydraulic continuity with the river therefore contamination migration via saturated flow from the area of piling is possible. Waters and groundwater are indicated to have elevated concentrations of various organic and inorganic contaminants. During excavations of localised hydrocarbon contaminated perched water, control measures will be required. Further localised ground investigations are required to delineate potential contamination.
		Contaminated surface water run-off (5)	Likely	Low	Low	Surface water run-off may deteriorate the quality of surface water. Construction will adopt surface water control and management. Leachable metals have been identified within the soils. Application of appropriate surface water run-off control measures during the works is considered sufficient to manage this pollution linkage.
	Off site users during construction works (C)	Dermal contact with soil dust (1)	Unlikely	Low	Very low	During construction there is the possibility of dermal contact and inhalation of soil dust, short term exposure only. Dust suppression measures are recommended during construction works. Adjacent off site receptors are present associated with the dock's industrial activities (low sensitivity). A construction mat will be placed over the length and width of the proposed embankment to
		Ingestion of dust (3)	Unlikely	Low	Very low	

Contamination Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
		Inhalation of soil dust (2)	Unlikely	Low	Very low	enable piling installation as well as general construction. This will break dermal, ingestion and inhalation pathways once placed. Overall gas data indicates the screening threshold is not exceeded with the exception of one area which may indicate gas migration from Docks Way Landfill. A gap in the data has been identified and further investigations are required to delineate any potential contamination and confirm the risks.
		Inhalation of ground gas or vapours (2)	Unlikely	Low	Very low	
Groundwater – Aquifer from the Glaciofluvial Deposits and/or Mercia Mudstone	Surface water (land drainage) (E)	Piles (4)	Low	Low	Very low	Aquifer quality is shown to have elevated concentrations of metal, inorganic and organic contaminants. Hydrostatic pressure of the aquifer is potentially near the base of Made Ground. Groundwaters are indicated as saline. The construction of piles could create potential vertical pathways connecting the aquifer with Made Ground A foundation works risk assessment is required to determine whether further controls to piling to minimise risk to surface waters are needed.
Ground gas from TFD including peat	Construction Workers (B)	Inhalation of ground gas / explosion (2)	Unlikely	High	Moderate to low	No peat was identified within the available exploratory boreholes, although Tidal Flat Deposits are known to comprise thick organic deposits elsewhere along the Scheme. High methane concentrations associated with peat/organic clays but with low or absent flux. Peat overlain by low permeability cohesive soils. New pathways to be created with piling.
	Off site users during construction works (C)	Inhalation of ground gas / explosion (2)	Unlikely	High	Moderate to low	

Contamination Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
						Construction to be largely within open space. Any earthworks within confined space would require specific risk assessment, control measures and PPE. Piling could result in explosive risks during operations and risk assessment and gas mitigation controls will be needed.
Operation						
Made Ground/fill material, electrical sub-stations, timber yards and saw mills, docks, coal sidings/dump including spoil heap, transit and storage sheds, pumping station works, sanitary hospital and railway land. Possible landfill waste.	Maintenance workers (B)	Direct dermal (1)	Unlikely	Low	Very low	Maintenance workers may come into contact with Made Ground materials remaining *in situ* outside the pier footprints. Areas outside the motorway hardstanding are likely to receive topsoil cover and vegetation establishment or some form of hardstanding, reducing potential of exposure. The exposure duration will be short term only. Site specific risk assessment will be required in line with health and safety guidance. This will enable a safe methodology and appropriate levels of PPE to be put in place. As such, all risks will be duly considered and suitably mitigated. The current contamination status is not foreseen to represent abnormal constraints to maintenance workers health and safety over and above those typical of a brownfield site. A gap in the data has been identified and further investigations are required to delineate potential contamination , the extent of historical landfilled waste associated with Docks Way Landfill and confirm the risks.
		Ingestion (3)	Unlikely	Low	Very low	
		Inhalation of soil dust (2)	Unlikely	Low	Very low	

Contamination Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
		Inhalation of ground gas or vapours (2)	Unlikely	Low	Very low	Overall the gas data does not exceed the screening thresholds with the exception of one which may indicate gas migration from the Docks Way Landfill. Maintenance works are to be within open space. Any earthworks within a confined space would require specified risk assessments, control measures and PPE. A gap in the data has been identified and further investigations are required to delineate potential contamination, the extent of historical landfilled waste associated with Docks Way Landfill and confirm the risks.
	Future Motorway users (A) & Off site users (C)	Dermal contact (1)	Unlikely	Low	Very low	Areas outside the motorway hardstanding are likely to receive topsoil cover and vegetation establishment or some form of hardstanding, reducing potential for exposure. Adjacent off site receptors are present associated with the dock's industrial activities (low sensitivity). Exposure duration will be short term for M4 users which are to be elevated from ground level (embankment or viaduct). A gap in the data has been identified and further investigations are required to delineate potential contamination and confirm the risks
		Ingestion (3)	Unlikely	Low	Very low	
		Inhalation of soil dust (2)	Unlikely	Low	Very low	
		Inhalation of ground gas or vapours (2)	Unlikely	Low	Very low	

Contamination Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
Made Ground/fill material, electrical sub-stations, timber yards and saw mills, docks, coal sidings/dump including spoil heap, transit and storage sheds, pumping station works, sanitary hospital and railway land. Possible landfill waste	Groundwater aquifer (Da)	Leaching / migration of contaminants to natural groundwater, migration to aquifer and through piles.	Low	Moderate	Moderate to Low	A thick mantle of predominantly soft ,low permeability Tidal Flat Deposits overlying the aquifer reduces the risk of downward migration. Presence of discrete soil contamination within the Made Ground. Groundwater quality is identified to have elevated concentrations of contaminants of concerns. A foundation works risk assessment is required to confirm the absence of risk to controlled waters.
	Surface waters; River Usk and River Ebbw (E)	Leaching / migration of contaminants through perched waters / groundwaters.	Low	Low	Very low	Water within the Made Ground and the perched groundwater within the Tidal Flat Deposits are likely to be in hydraulic continuity with the river, therefore contamination migration via saturated flow from the area of piling is possible. Waters and groundwater are indicated to have elevated concentrations of various organic and inorganic contaminants.
Groundwater – Aquifer from the Glaciofluvial Deposits and/or Mercia Mudstone	Surface water (land drainage) (E)	Piles (4)	Low	Low	Very low	Aquifer quality is shown to have elevated concentrations of metal, inorganic and organic contaminants. Hydrostatic pressure of the aquifer is potentially near the base of Made Ground. Groundwaters are indicated as saline. Piles could create potential vertical pathways connecting the aquifer with Made Ground. A foundation works risk assessment is required to determine whether further controls to piling to minimise risk to surface waters are needed.

Contamination Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
Ground Gas from peat horizons in Tidal Flat Deposits	Maintenance workers (B)	Inhalation of ground gas / explosion (2)	Unlikely	High	Moderate to low	Although elevated methane concentrations are known within the natural soils of the Tidal Flat Deposits, the low permeability soils will result in limited gas migration post construction. Risk to maintenance workers is low but entry into any confined spaces will need to adhere to health and safety legislation requirements. Pathways along band drains could still allow localised gas migration. A gap in the data has been identified and further investigations are required to refine any potential gas and confirm the risks.
	Motorway users (A)	Inhalation of ground gas / explosion (2)	Unlikely	High	Moderate to low	Although elevated methane concentrations are known within the natural soils of the Tidal Flat Deposits, the low permeability soils will result in limited gas migration post construction. Motorway to be built on raised embankment providing a further barrier to migration of gases. Gap in the data has been identified and further investigations are required to refine any potential gas and confirm the risks.
	Off site users (C)	Inhalation of ground gas / explosion (2)	Unlikely	High	Moderate to low	Limited data on ground gas regime from natural

10 Conclusions and Recommendations

10.1 Conclusions

10.1.1 Ground investigations have been undertaken at the Site to assess risks from land contamination associated with the construction and operation of the Scheme including human health and controlled waters risks.

10.1.2 Widespread gross contamination associated with the Site's historical use has not been identified. However visual/olfactory evidence of hydrocarbon contamination was encountered which has not been sufficiently characterised. The risk assessment has identified that some residual risks to human health and controlled waters could exist and control measures are required to facilitate the construction and ongoing operation of the Scheme. Presence of ground gas has been identified and further monitoring and gas risk assessment should be considered

10.1.3 The majority of the excavated materials are likely to be suitable for reuse within the Scheme subject to development of a remediation strategy including reuse criteria and adoption of a Material Management Plan. Some form of remediation or offsite disposal is anticipated in the area grossly impacted by hydrocarbon contamination such as those encountered in CH11 and STPF01

10.1.4 Elevated concentrations of some heavy metals and PAHs as well as TPH will require the adoption of health and safety control measures in line with the CDM regulations to protect construction workers. It is not expected that the level of mitigation will be over and above those typical of brownfield sites.

10.1.5 During the construction phase, specific mitigation measures will be required to prevent inhalation pathways of dust to off site and workforce receptors, although such measures would be no more than typically expected on a construction site. Specific risk assessment will be required in relation to the potential for land gas accumulation within confined spaces. A suitable water management strategy will also be required to prevent potential impact to surface waters from contaminant run-off.

10.1.6 During the operational phase, the embankment/piers will cover the majority of the Site which will effectively remove many exposure pathways. In addition hard cover will significantly limit the infiltration of rainwater through the soils and potentially leaching any soil contaminants into the groundwater. Perched groundwater within the Made Ground materials will remain beneath the embankment.

10.1.7 Installation of piled foundations may provide new pathways which may lead to perched groundwater within the Made Ground and Tidal Flat Deposits to enter the currently confined aquifer within the Glaciofluvial Deposits and Mercia Mudstone.

10.1.8 The shallow and deep aquifers are identified to be impacted with metals, organic and inorganic contaminants which may reduce surface water quality if the piling pathways allow direct or indirect linkage although this is risk is considered to be low. Further consideration and a piling risk assessment will be undertaken to mitigate the potential impact of the piles and to allow specific mitigation measures to be implemented.

10.1.9 Post construction, the embankment itself and topsoil and/or subsoil cover along the motorway corridor will break potential human health pathways to end users and

maintenance workers. However, topsoil materials placed at the surface will need to be checked for contamination.

10.1.10 The potential source of the Docks Way Landfill (CL-13) is covered in more detail within the Land Contamination Assessment Report CL-13 (Annex D of Appendix 11.1 of the ES). Anecdotal information indicates that historical tipping of wastes may have occurred along the boundary between the Site and CL13 and further investigation is required to determine the presence of waste materials beneath the proposed link road.

10.2 Recommendations

10.2.1 Given the identified gaps in the data, in particular associated with the delineation of contaminated soils and extent of historical landfill waste along proposed link road (to support human health and material reuse) and ground gas regime (to support human health and the pier design), an additional scope of ground investigation works is required. Upon completion this report shall be reviewed and updated accordingly once the findings of the additional investigation are made available. The additional investigation will include the following.

- Trial pits and boreholes to collect soil samples.
- Installation of groundwater monitoring wells to collect groundwater samples and gas monitoring.

10.2.2 Upon review and assessment of the additional ground investigation information, any contamination identified that could cause an unacceptable risk to the identified receptors will require appropriate remedial mitigation measures to be implemented. These measures would be identified within a remediation strategy for the Scheme. The remediation strategy is anticipated to include but is not limited to the following.

- Addressing uncertain human health risk and controlled waters identified by the proposed additional ground investigation.
- Strategy for dealing with contaminated soils and appropriate reuse within the Scheme.
- Risk assessment of piles and associated construction works creating pathways enabling contaminants migration.
- Dealing with unexpected contamination.
- Verification of imported topsoils for suitability of use.
- Control measures to prevent risks to construction workers and the general public during construction.

10.2.3 The remediation strategy should include a remediation options appraisal, remediation implementation plan and remediation verification plan. The remediation strategy should be supported by a Scheme wide Material Management Plan prepared in accordance with CL:AIRE Code of Practice (CL:AIRE, 2011).

11 References

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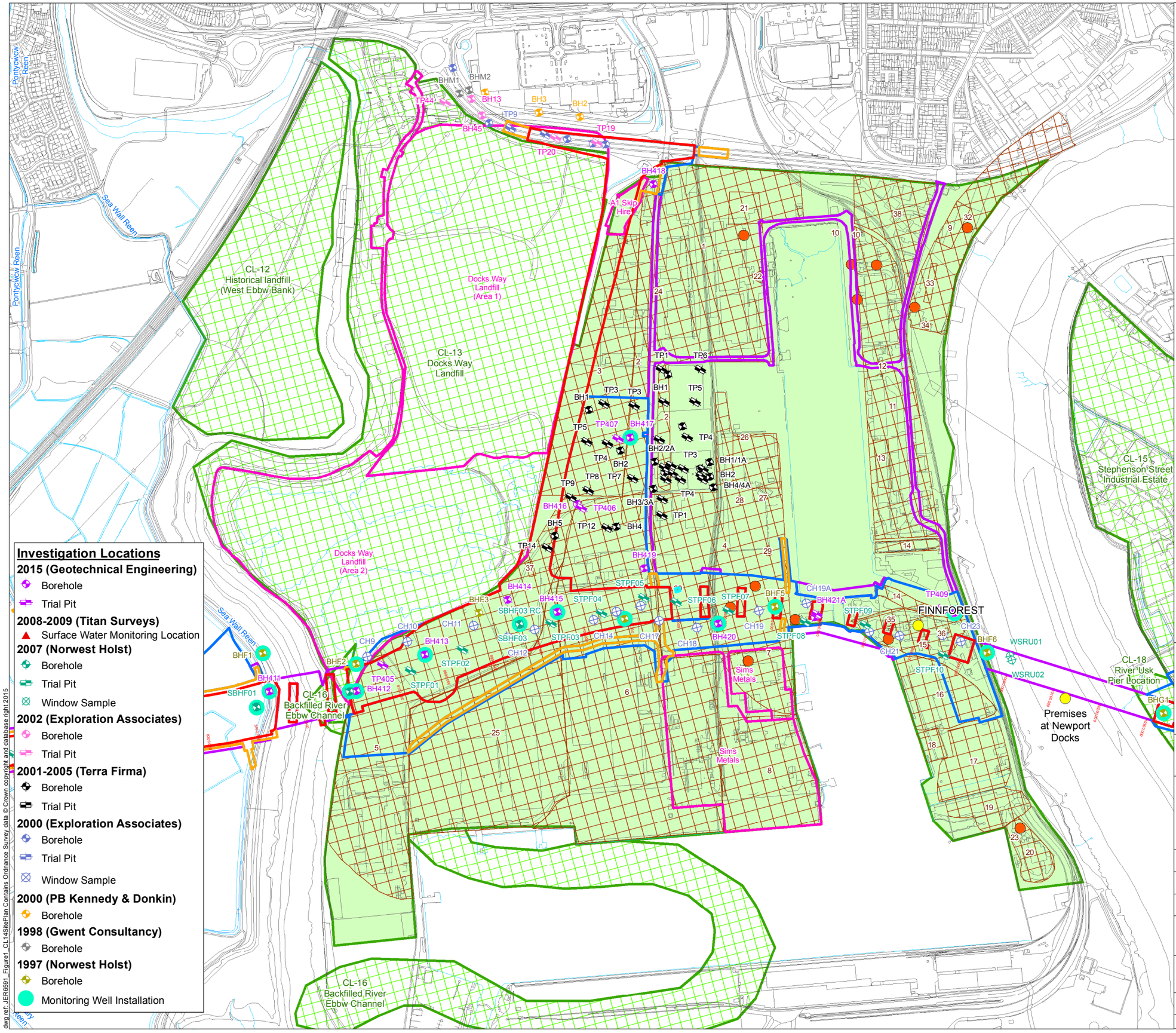
12 Glossary

BF	Blast Furnace
BGS	British Geological Survey
BOD	Biochemical Oxygen Demand
BOS	Basic Oxygen Slag
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CAT	Cable Avoidance Tool
CDM	Construction Design Management
CH_4	Methane
CLEA	Contaminated Land Exposure Assessment
CO_2	Carbon Dioxide
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CSM	Conceptual Site Model
DMRB	Design Manual for Roads and Bridges
DO	Dissolved Oxygen
DQRA	Detailed Quantitative Risk Assessment
DWS	Drinking Water Standard
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
ES	Environmental Statement
ESG	Environmental Scientifics Group
EQS	Environmental Quality Standard
FTIR	Fourier Transform Infrared (spectroscopy)
GAC	Generic Assessment Criteria
GDR	Geotechnical Design Report
GIR	Ground Investigation Report
GRO	Gasoline Range Organics
LEL	Lower Explosive Limit
LOD	Limit of Detection
M AOD	Metres Above Ordnance Datum

mb	Millibars
m bGL	Metres below Ground Level
MTBE	Methyl Tert-butyl Ether
NRW	Natural Resources Wales
ORP	Oxidation Reduction Potential
O_2	Oxygen
OS	Ordnance Survey
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCSM	Preliminary Conceptual Site Model
PID	Photo Ionisation Detector
PPE	Personnel Protection Equipment
SGVs	Soil Guideline Values
SSAC	Site Specific Assessment Criteria
SSSI	Site of Special Scientific Interest
SVOCs	Semi-Volatile Organic Compounds
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbon
TPH CWG	Total Petroleum Hydrocarbon Criteria Working Group
UKAS	United Kingdom Accreditation Service
VOCs	Volatile Organic Compounds
WFD	Water Framework Directive
UXO	Unexploded Ordnance Survey

Figures



Legend

- Permanent Highway Land within Fenceline (including Water Treatment Areas)
- Other Permanent Land Take
- Temporary Construction Land
- Easement Only
- Potential Area of Land Contamination based on 2014 PSSR
- Other Potential Area of Land Contamination
- Site Features from 2014 PSSR
- Tank Location from 2014 PSSR
- Permit Boundary
- Permit Location

Site	Historical/Existing Potential Contaminant Source
1	**Timber Yard**
2	**Timber Floats**
3	**Infilled Ground**
4	**Timber Yard Depot**
5	**Old Coal Sidings / Spoil Heap**
6	**Timber Yard**
7	Ship Repair & Oil Tanker Cleansing Depot
8	Old Coal Sidings / Container Terminal
9	Fuel Works
10	**Transit Shed**
11	**Coal Sidings / Industrial Site**
12	**Electrical Sub-Station**
13	Transit Shed
14	**Graving Docks**
15	**Central Pumping Station Works**
16	**Coal Dump**
17	Custom House / Transit Shed
18	Transit Shed
19	Infilled Ground / Earthworks
20	Transit Bay
21	**Hydraulic Power Station**
22	Saw Mill
23	Electrical Sub-Station
24	**Saw Mill**
25	**Timber Yard / Terminal**
26	Depot / Timber Yard
27	Engine Works
28	Storage Sheds / Railway Sidings
29	Storage Sheds / Railway Sidings
30	**Storage Sheds / Railway Sidings**
32	Works
33	Wagon Works
34	Sheep Pens
35	**Engine House**
36	**Pumping Station / Works**
37	**Sanitary Hospital**
38	**Timber Yard**

NOTE: Contaminant source areas in permanent or temporary land take shown in **Bold**

Investigation Locations

2015 (Geotechnical Engineering)
- Borehole
- Trial Pit

2008-2009 (Titan Surveys)
- Surface Water Monitoring Location

2007 (Norwest Holst)
- Borehole
- Trial Pit
- Window Sample

2002 (Exploration Associates)
- Borehole
- Trial Pit

2001-2005 (Terra Firma)
- Borehole
- Trial Pit

2000 (Exploration Associates)
- Borehole
- Trial Pit
- Window Sample

2000 (PB Kennedy & Donkin)
- Borehole

1998 (Gwent Consultancy)
- Borehole

1997 (Norwest Holst)
- Borehole
- Monitoring Well Installation

Llywodraeth Cymru
Welsh Government

Appendix 11.1 Annex D CL-14

Site Plan for CL-14

Figure: 1	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Scale: A3 @ 1:7,500
0 125 250 m

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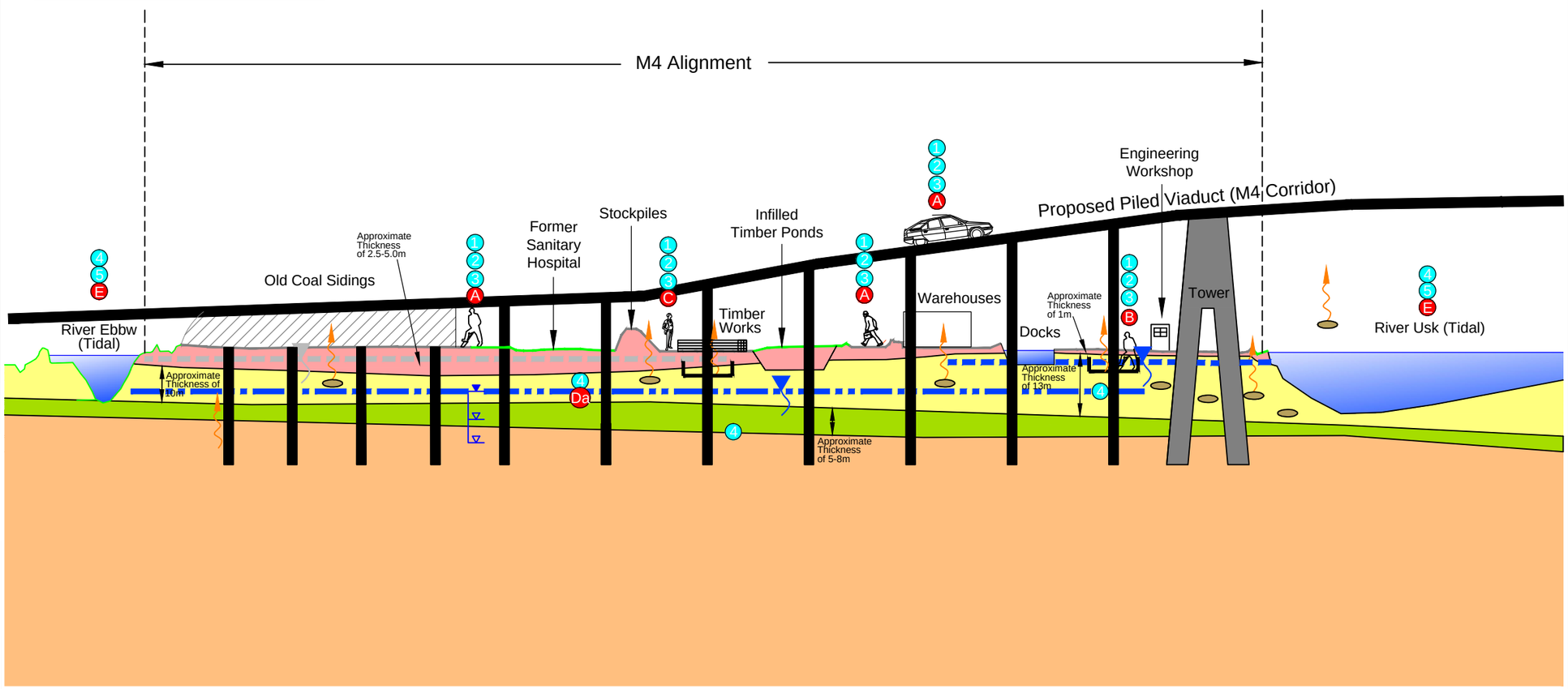
dwg ref: JER6591_Figure1_CL14SitePlan

dwg ref: JER6591_Figure1_CL14SitePlan Contains Ordnance Survey data © Crown copyright and database right 2015

CL-14 Newport Docks



NOTE: Please refer to CL-13 (Report No.M4CaN-DJV-EGT-ZG_GEN-RP-EN-0012) for the model interacting with the Docks Way Landfill

Ground conditions based on available information

Legend

- Made Ground - MG
- Tidal Flat Deposits - TFD
- Peat
- Glaciofluvial Deposits - GFD
- Mercia Mudstone - MM
- Proposed Embankment
- Proposed Piled Pier
- Proposed Pier Excavation
- Hardstanding
- Rough Grassland
- Perched Water (MG)
- Perched Groundwater (Top of TFD)
- Groundwater (GFD and MM)
- Water Strike
- Rest Water Level
- Gas Migration Pathway

Potential Receptors

- A Humans On-Site (M4 User)
- B Humans On-Site (Construction/Maintenance)
- C Humans Off-Site (Site Neighbours)
- Da Groundwater (Aquifer)
- E Surface Water

Potential Pathways

- 1 Dermal Contact
- 2 Inhalation
- 3 Ingestion
- 4 Leaching / Migration
- 5 Surface Run Off

Potential Sources of Contamination

Possible contamination present on site associated with :

On-Site

- Potential for contamination to be present on site associated with previous industrial uses including; timber yards, coal sidings, fuel works, railway land

NOTE
Drawing refined from PSSR Drawing Reference M4-OA-17-00DR-Z-XX-0118 (April 2014)

Llywodraeth Cymru
Welsh Government

Appendix 11.1 Annex D CL-14

Conceptual Site Model for CL-14

Figure: 2	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Not to Scale

dwg ref:JER6591_Figure2_CL14ConceptualSiteModel

dwg ref: JER6591_Figure2_CL14ConceptualSiteModel

Appendices

A1 Appendix 1

Exploratory Records

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF3
Header

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331173.4 E 184948.9 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Dando	Ground Level	10.20m AOD
Client	Welsh Office	Drillers	C.A/H.J	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	01/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	11/11/1997
		Core bit	Geocube		

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
01/11/1997	1800	8.50	8.50	Dry	
02/11/1997	0800	8.50	8.90	Dry	
02/11/1997	1600	15.80	15.50	9.70	
03/11/1997	0800	15.80	15.50	8.90	
03/11/1997	1800	20.30	19.80	8.90	
04/11/1997	0800	20.30	19.80	8.50	
04/11/1997	1100	21.00	20.80	8.50	
07/11/1997	0800	21.00	21.00	7.60	
07/11/1997	1800	23.40	21.00	NR	
10/11/1997	0800	23.40	21.00	7.80	
10/11/1997	1800	29.70	21.00	NR	

CABLE PERCUSSION DETAILS

Hard strata from depth	Hard strata to depth	Hours	Remarks
0.00	0.40	2.75	
12.70	13.00	0.75	
13.20	13.30	1.00	
15.40	15.80	1.25	
16.10	16.40	1.00	
16.40	16.70	0.75	
17.30	17.50	1.25	
17.80	18.00	1.50	
18.90	19.30	1.00	
19.95	20.25	1.00	
20.30	21.00	2.50	

CASING

Hole diameter	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
150	21.00	150	20.80

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
02/11/1997	0000	12.00	9.70	20	fast	11.90	0.00

ROTARY DRILLING DETAILS

From depth	To depth	Flush type	Flush return	Core diameter
21.00	35.20	air	100%	92

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
0.50	C	N=19 (3,3,4,7,5,3)
2.50	S	N=4 (2,2,1,1,1,1)
4.50	S	N=11 (2,1,2,3,3,3)
6.50	S	N=2 (1,0,1,0,1,0)
9.00	S	N=1 (0,0,1,0,0,0)
12.00	C	N=40 (3,2,6,10,12,12)
13.50	C	N=40 (8,10,10,12,8,10)
15.00	C	80/180mm (4,8,12,18,50)
16.50	C	N=114 (2,3,10,25,32,47)
18.00	C	50/75mm (4,22,50)
19.00	C	79/150mm (2,12,37,42)
19.80	S	N=114 (5,12,15,24,34,41)
20.80	S	85/115mm*
24.50	S	65/150mm*
26.80	S	50/22mm (13,34,50)

* Seating blows only.

GENERAL NOTES

Methane gas encountered with water strike at 12.00m. Strong flow greater than 5% (CH4) continued after one hour. Gas cased off with casing to 12.50m.

NB All depths in metres, all diameters in millimetres, water strike rise time in minutes, hard strata time in hours

Form	COMBINED HEADER
Version	2.00
Revised	26/06/1997

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF3
Sheet 1 of 4

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331173.4 E 184948.9 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Dando	Ground Level	10.20 m AOD
Client	Welsh Office	Drillers	C.A/H.J	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	01/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	11/11/1997
		Core Bit	Geocube		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring			Blow count to drive U100	SPT N & depth		Install-ation
MADE GROUND: Tarmac (drillers description).		0.10	10.10	B	0.20	- 0.50				
				D	0.20					
MADE GROUND: Dark greyish green sandy clayey brick cement fill.		0.50	9.70	B	0.50	- 0.95		Cl9	0.50	
				D	0.50				0.95	
MADE GROUND: Greyish brown clayey sandy gravelly brick and cement fill.				D	1.25					
				U	1.50	- 1.95	(20)			
		1.80	8.40							
Firm to stiff grey mottled black sandy organic CLAY with occasional fine to medium gravel. (Estuarine Alluvium)				D	2.00					
				D	2.25					
				B	2.50	- 2.95		S4	2.50	
--at 2.50m becoming soft greyish brown slightly sandy slightly organic				D	2.50				2.95	
				D	3.25					
				U	3.50	- 3.95	(10)			
				D	4.00					
				D	4.25					
		4.50	5.70	B	4.50	- 4.95		S11	4.50	
Soft brown mottled grey sandy CLAY. (Estuarine Alluvium)				D	4.50				4.95	
				D	5.25					
				U	5.50	- 5.95	(18)			
		5.60	4.60							
Soft grey mottled brown slightly sandy CLAY. (Estuarine Alluvium)				D	6.00					
				D	6.25					
				B	6.50	- 6.95		S2	6.50	
				D	6.50				6.95	
				D	7.25					
				U	7.50	- 7.95	(6)			
				D	8.00					
		8.50	1.70	D	8.50					
Soft grey blue CLAY. (Estuarine Alluvium)				B	9.00	- 9.45		S1	9.00	
									9.45	
				D	9.45					
				W	9.70					
				D	10.00					

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF3
Sheet 2 of 4

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331173.4 E 184948.9 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Dando	Ground Level	10.20 m AOD
Client	Welsh Office	Drillers	C.A/H.J	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	01/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	11/11/1997
		Core Bit	Geocube		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100 (4)	SPT N & depth	Install-ation
Soft grey blue CLAY. (Estuarine Alluvium)				D 10.00 - 10.95 U 10.05			
				D 11.00			
---at 11.50m becoming mottled black slightly organic				D 11.50			
		12.00	-1.80	B 12.00 - 12.45		C40 12.00 - 12.45	
Dense dark grey very sandy sub-rounded siliceous GRAVEL. (Fluvial Alluvium)				D 12.00 W 12.00 W 12.00			
				D 13.00			
				B 13.50 - 13.95		C40 13.50 - 13.95	
---at 14.00m becoming clayey				D 14.00			
---at 15.00m becoming very dense				B 15.00 - 15.45		C80/180mm 15.00 - 15.33	
				D 16.00			
				B 16.50 - 16.95		C114 16.50 - 16.95	
				D 17.50			
				B 18.00 - 18.45		C50/75mm 18.00 - 18.23	
				D 18.90 B 19.00 - 19.45		C79/150mm 19.00 - 19.30	
		19.70	-9.50	D 19.70 B 19.80 - 20.25		S114 19.80 - 20.25	

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF3
Sheet 3 of 4

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331173.4 E 184948.9 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Dando	Ground Level	10.20 m AOD
Client	Welsh Office	Drillers	C.A/H.J	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	01/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	11/11/1997
		Core Bit	Geocube		

Description of Strata	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown mottled greyish green occasionally thinly laminated highly to moderately weathered MUDSTONE, very weak to weak. (Mercia Mudstone Group)	21.00	-10.80	B 20.80 - 21.00					S85/115mm*20.80 20.92	
Reddish brown medium bedded moderately weathered slightly sandy MUDSTONE, moderately weak completely fractured. (Mercia Mudstone Group) ---from 21.20 to 21.40m highly weathered	21.55	-11.35	21.00 - 22.35	74	19	7	NI 5		
Reddish brown medium bedded moderately weathered very sandy MUDSTONE, moderately weak to moderately strong with very closely to closely spaced sub-horizontal to inclined discontinuities planar rough tight. (Mercia Mudstone Group) ---from 22.55 to 23.10m highly weathered completely fractured ---from 23.50m mottled greyish green moderately to highly weathered	23.90	-13.70	22.35 - 23.40	90	53	13	3 NI 5		
			23.40 - 23.90	90	80	0	NI		
Purplish brown medium sub-horizontal to inclined bedded slightly to moderately weathered silty MUDSTONE, moderately weak to moderately strong with very closely to closely spaced inclined discontinuities planar rough tight. (Mercia Mudstone Group) ---from 23.90 to 24.40m highly weathered very weak completely fractured ---from 24.40 to 24.65m moderately to highly weathered weak completely fractured ---from 25.40m with closely to medium spaced very thin beds of greyish green mudstone ---from 25.40 to 25.60m moderately weathered weak completely fractured ---from 26.00m moderately to highly weathered very weak completely fractured	26.40	-16.20	23.90 - 25.40	93	33	18		S65/150mm*24.50 24.65	
	26.80	-16.60	25.40 - 26.80	75	41	7	9	S50/22mm 26.80 26.97	
	27.10	-16.90	26.80 - 28.30	100	67	0	5 NI 7 12		
Reddish brown thinly bedded moderately weathered silty MUDSTONE, moderately weak completely fractured. (Mercia Mudstone Group)			28.30 - 29.70	96	44	0	8		
Greyish green medium sub-horizontally bedded moderately weathered very silty MUDSTONE, moderately weak with very closely spaced horizontal to sub-horizontal discontinuities planar rough tight. (Mercia Mudstone Group)	29.70	-19.50							

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF3
Sheet 4 of 4

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331173.4 E 184948.9 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Dando	Ground Level	10.20 m AOD
Client	Welsh Office	Driller	C.A/H.J	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	01/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	11/11/1997
		Core bit	Geocube		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown medium to thickly sub-horizontally bedded moderately weathered silty MUDSTONE, moderately weak to moderately strong with very closely spaced sub-horizontal discontinuities planar rough tight. (Mercia Mudstone Group)				29.70 - 30.90	98	53	0	NI		
(29.70-35.20) Reddish brown occasionally mottled greyish green medium to thickly bedded moderately to highly weathered silty MUDSTONE, moderately weak to moderately strong with medium to widely spaced horizontal to sub-horizontal discontinuities planar rough tight. (Mercia Mudstone Group) Detail:---from 30.90 to 31.20m slightly weathered Detail:completely fractured Detail:---from 32.00 to 32.25m slightly weathered Detail:completely fractured Detail:---from 32.95 to 33.25m with gravel size Detail:pockets of calcite ---from 30.90 to 31.20m slightly weathered completely fractured ---from 32.00 to 32.25m slightly weathered completely fractured ---from 32.95 to 33.25m with gravel size pockets of calcite				30.90 - 32.30	100	37	0	NI 8 NI		
				32.30 - 33.80	98	87	0	NI		
				33.80 - 35.20	100	93	0	NI		
		35.20	-25.00							
Borehole complete at 35.20 m.										

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	1.00
Revised	20/09/96

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF4
Header

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331437.7 E 185087.5 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Edeco	Ground Level	9.30m AOD
Client	Welsh Office	Drillers	C.A/J.M	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	19/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	27/11/1997
		Core bit	Chunk		

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
19/11/1997	1800	13.50	13.50	NR	
20/11/1997	0800	13.50	13.50	8.80	
20/11/1997	1800	19.00	19.00	NR	
21/11/1997	0800	19.00	19.00	6.80	
21/11/1997	1800	20.60	20.10	7.50	
24/11/1997	0800	20.60	20.60	6.30	
24/11/1997	1800	23.00	22.50	NR	
25/11/1997	0800	23.00	22.50	5.10	
25/11/1997	1800	32.55	24.00	4.80	
26/11/1997	0800	32.50	24.00	6.50	
26/11/1997	1800	40.20	24.50	7.40	

CABLE PERCUSSION DETAILS

Hard strata from depth	Hard strata to depth	Hours	Remarks
13.00	13.50	2.00	
14.40	14.70	1.50	
15.20	15.30	0.75	
15.70	16.10	1.25	
17.00	17.30	0.75	
18.70	19.00	1.50	
20.10	20.60	2.50	

CASING

Hole diameter	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
200	20.60	200	20.10
120	40.20	140	24.50

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
19/11/1997	0000	12.30	9.80	20	fast	12.30	0.00
25/11/1997	0000	23.50	0.00	0	moderate	22.50	0.00
25/11/1997	0000	31.50	0.00	0	heavy	24.00	0.00
26/11/1997	0000	37.00	0.00	0	heavy	24.50	0.00

ROTARY DRILLING DETAILS

From depth	To depth	Flush type	Flush return	Core diameter
20.60	31.00	foam	good	92
31.00	40.20	mist	good	92

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	C	N=20 (1,3,5,4,6,5)
2.00	C	N=11 (1,2,3,3,3,2)
3.00	C	N=4 (1,2,1,1,1,1)
5.00	S	N=1 (0,0,1,0,0,0)
7.50	S	N=1 (0,0,1,0,0,0)
10.00	S	N=1 (0,0,1,0,0,0)
12.50	C	N=66 (6,8,10,14,17,25)
15.00	C	50/30mm (18,25,50/30)
15.50	C	96/225mm (10,16,25,30,41)
17.00	C	88/225mm (8,10,20,26,42)
18.50	C	50/50mm (11,23,50/50)
20.00	S	80/125mm (14,11/15,30,50)
20.60	S	50/60mm (,25/30,50/60)
24.00	C	50/105mm (10,13,26,24)
25.00	C	36/110mm
32.50	S	50/30mm (10,14,50)
33.50	S	50/40mm*

* Seating blows only.

GENERAL NOTES

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, hard strata time in hours

Form	COMBINED HEADER
Version	2.00
Revised	26/06/1997

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF4
Sheet 1 of 5

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331437.7 E 185087.5 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Edeco	Ground Level	9.30 m AOD
Client	Welsh Office	Drillers	C.A/J.M	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	19/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	27/11/1997
		Core Bit	Chunk		

Description of Strata	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth
CONCRETE	0.20	9.10	D 0.30		
MADE GROUND: Blackish grey slightly silty sandy sub-angular gravel of brick ash and stone rubble.			B 0.50 - 1.00		
			B 1.00 - 1.45		C20 1.00 - 1.45
			D 1.75		
			B 2.00 - 2.45		C11 2.00 - 2.45
			D 2.85		
			B 3.00 - 3.45		C4 3.00 - 3.45
	3.30	6.00			
Very soft to soft greyish brown very silty CLAY with a moderate hydrocarbon odour. (Estuarine Alluvium)			D 3.75		
---at 3.75m mottled blackish brown			U 4.00 - 4.45	(18)	
			D 4.50		
	4.70	4.60	D 4.75		
Very soft grey very silty CLAY. (Estuarine Alluvium)			B 5.00 - 5.45		S1 5.00 - 5.45
---from 4.70 to 8.25m mild hydrocarbon odour			D 5.75		
			B 6.00 - 6.45	(5)	
			U 6.00 - 6.45		
			U 6.50 - 6.95	(4)	
			D 7.00		
			D 7.25		
			B 7.50 - 7.95		S1 7.50 - 7.95
			D 7.50		
			D 8.25		
			U 8.50 - 8.95	(5)	
			D 9.00		
			D 9.50		
			B 10.00 - 10.45		S1 10.00

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF4

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331437.7 E 185087.5 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Edeco	Ground Level	9.30 m AOD
Client	Welsh Office	Drillers	C.A/J.M	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	19/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	27/11/1997
		Core Bit	Chunk		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
Very soft grey very silty CLAY. (Estuarine Alluvium)				B 10.00 - 10.45 D 10.00		S1 10.00 10.45	
				D 11.00			
---from 11.50 to 11.95m slightly organic				U 11.50 - 11.95	(8)		
---from 11.50m dark grey				D 12.10 D 12.20 D 12.30			
		12.30	-3.00				
Very dense grey slightly sandy sub-rounded siliceous GRAVEL with some cobbles. (Fluvial Alluvium)				B 12.50 - 12.95		C66 12.50 12.95	
				D 13.50			
				B 14.00 - 14.50			
				D 15.00		C50/30mm 15.00 15.18	
				B 15.50 - 15.95		C96/225mm 15.50 15.88	
				D 16.50			
				B 17.00 - 17.45		C88/225mm 17.00 17.38	
				D 18.00			
				B 18.50 - 18.95		C50/50mm 18.50 18.70	
				D 19.50			
---from 19.50m very sandy							
		19.90	-10.60	D 19.90 - 20.50		S80/125mm 20.00	

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF4
Sheet 3 of 5

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331437.7 E 185087.5 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Edeco	Ground Level	9.30 m AOD
Client	Welsh Office	Drillers	C.A/J.M	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	19/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	27/11/1997
		Core Bit	Chunk		

Description of Strata	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown occasionally thinly laminated highly weathered MUDSTONE, weak. (Mercia Mudstone Group)			B 20.00 - 20.50 D 20.00					S80/125mm 20.00 20.22	
	20.60	-11.30	D 20.60					S50/60mm 20.60 20.69	
Reddish brown mottled green thinly to medium sub-horizontally bedded moderately to highly weathered silty MUDSTONE, weak with very closely to closely spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group) ---at 20.60m weak			20.80 - 22.10	92	28	0	NI 6		
	22.10	-12.80							
---from 21.25 to 21.60m weak to very weak completely fractured ---from 21.60 to 22.10m moderately weathered weak to moderately weak			22.10 - 23.00	83	0	0	NI		
Reddish brown mottled green medium bedded highly weathered silty MUDSTONE, very weak completely fractured. (Mercia Mudstone Group) ---from 22.82m reddish brown			23.00 - 24.00	0	0	0	NA	C50/105mm 24.00 24.26	
			24.00 - 25.00	0	0	0	NA	C36/110mm 25.00 25.11	
			25.00 - 26.00	100	0	0	NI		
			26.00 - 27.00	100	28	10	NI 2		
	26.75	-17.45							
Reddish brown thinly sub-horizontally bedded moderately to highly weathered silty MUDSTONE, weak to moderately weak. (Mercia Mudstone Group) ---from 26.95m occasionally mottled green ---from 27.00 to 27.55m highly weathered completely fractured ---from 27.90 to 28.00m highly weathered very weak completely fractured ---from 28.10 to 28.20m highly weathered very weak completely fractured ---from 28.55m thinly sub-horizontally to inclined bedding			27.00 - 28.40	100	36	14	NI 2 0 0 NI 2		
			28.40 - 29.90	97	63	31	4 NI 3 NI 2		

NB All depths in metres, all diameters in millimetres.
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BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF4

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331437.7 E 185087.5 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Edeco	Ground Level	9.30 m AOD
Client	Welsh Office	Driller	C.A/J.M	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	19/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	27/11/1997
		Core bit	Chunk		

Description of Strata	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown thinly sub-horizontally bedded moderately to highly weathered silty MUDSTONE, weak to moderately weak. (Mercia Mudstone Group) ---from 30.35 to 30.55m highly weathered very weak completely fractured ---from 30.55 to 30.67m moderately to highly weathered very weak completely fractured	31.55 31.76	-22.25 -22.46	29.90 - 31.35	97	14	0	NI 8		
			31.35 - 31.55	100	0	0	NI		
Purplish to reddish brown thinly bedded highly weathered very sandy silty MUDSTONE, very weak completely fractured. (Mercia Mudstone Group)	32.23	-22.93	31.55 - 32.50	79	0	0	NI	S50/30mm 32.50 32.68	
Green thinly bedded moderately to highly weathered silty sandy MUDSTONE, weak to very weak completely fractured. (Mercia Mudstone Group)			32.50 - 33.00	100	0	0	NI		
			33.00 - 33.50	0	0	0	NI	S50/40mm* 33.50 33.54	
Reddish brown thinly sub-horizontally bedded moderately weathered silty MUDSTONE, very weak to moderately weak with very closely spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group) ---from 32.50 to 33.15m slightly sandy highly weathered very weak completely fractured ---from 33.50 to 33.65m highly weathered very weak completely fractured ---from 33.65m very weak	34.50	-25.20	33.50 - 34.50	100	70	28	8		
			34.50 - 36.00	93	7	0	NI 2 NI		
Reddish brown occasionally mottled green thinly to medium bedded highly weathered silty MUDSTONE, very weak completely fractured. (Mercia Mudstone Group) ---from 35.60 to 35.75m moderately weathered moderately weak with closely spaced inclined fractures planar rough tight			36.00 - 37.50	100	0	0	NI		
	38.23	-28.93	37.50 - 38.70	100	33	25	NI 3		
Reddish brown occasionally mottled green very thinly to thinly sub-horizontally bedded to moderately weathered silty MUDSTONE, moderately weak with closely to medium spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group) ---from 38.70 to 39.00m highly weathered very weak completely fractured			38.70 - 40.20	100	79	50	NI 4		

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF4
Sheet 5 of 5

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331437.7 E 185087.5 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Edeco	Ground Level	9.30 m AOD
Client	Welsh Office	Driller	C.A/J.M	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	19/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	27/11/1997
		Core bit	Chunk		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown occasionally mottled green very thinly to thinly sub-horizontally bedded to moderately weathered silty MUDSTONE, moderately weak with closely to medium spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group)		40.20	-30.90							
Borehole complete at 40.20 m.										

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF5
Header

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331692.1 E 185263.3 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/T30	Ground Level	9.80m AOD
Client	Welsh Office	Drillers	C.A/J.H	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	16/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	21/11/1997
		Core bit	Geocube		

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
16/11/1997	1800	15.50	15.50	NR	
17/11/1997	0800	15.50	15.50	7.90	
17/11/1997	1800	18.50	18.50	8.20	
18/11/1997	0800	18.50	18.50	9.00	
18/11/1997	1800	21.10	20.90	NR	
19/11/1997	0800	21.10	21.10	4.40	
19/11/1997	1800	35.70	21.10	7.50	
20/11/1997	0800	35.70	21.10	7.45	
20/11/1997	1800	45.75	21.10	NR	

CABLE PERCUSSION DETAILS

Hard strata from depth	Hard strata to depth	Hours	Remarks
16.60	16.90	3.50	
17.20	18.30	4.00	
19.80	20.00	1.25	
20.80	21.00	1.50	

CASING

Hole diameter	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
150	21.10	150	20.90

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
16/11/1997	0000	1.10	0.50	20	fast	0.00	0.00

ROTARY DRILLING DETAILS

From depth	To depth	Flush type	Flush return	Core diameter
21.10	45.75	foam	100%	92

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	C	N=3 (1,0,1,1,0)
2.50	S	N=1 (1,0,0,1,0,0)
4.50	S	N=9 (1,1,2,2,2,3)
6.50	S	N=1 (1,0,0,1,0,0)
9.00	S	1/450mm
12.00	S	N=1 (1,0,0,1,0,0)
15.00	C	N=54 (7,8,10,12,15,17)
16.50	C	56/65mm (10,21,56)
18.00	C	80/150mm (8,17,38,42)
19.50	C	86/220mm (2,8,12,18,56)
21.00	S	50/30mm (14,25,50)

* Seating blows only.

GENERAL NOTES

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, hard strata time in hours

Form	COMBINED HEADER
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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF5
Sheet 1 of 5

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331692.1 E 185263.3 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/T30	Ground Level	9.80 m AOD
Client	Welsh Office	Drillers	C.A/J.H	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	16/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	21/11/1997
		Core Bit	Geocube		

Description of Strata	Depth Below G.L.	O.D. Level	Sampling & coring			Blow count to drive U100	SPT N & depth	
MADE GROUND: Black sandy sub-angular gravel fill of stone brick and rubble.			D	0.20				
			B	0.50	- 1.00			
			B	1.00	- 1.45		C3	1.00 - 1.45
	1.10	8.70	W	1.10				
Very soft bluish grey mottled brown occasionally organic CLAY. (Estuarine Alluvium)			D	1.25				
			B	2.00	- 2.45	(70)		
			U	2.00	- 2.45			
	2.40	7.40						
Very soft blackish brown mottled grey slightly silty sandy organic CLAY with occasional sub-angular fine to medium siliceous gravel and occasional gravel size pockets of very soft grey silty clay. (Estuarine Alluvium)			B	2.50	- 2.95		S1	2.50 - 2.95
			D	2.50				
	3.25	6.55	D	3.25				
Soft to firm grey mottled brown occasionally thinly laminated CLAY. (Estuarine Alluvium)			U	3.50	- 3.95	(19)		
			D	4.00				
			D	4.25				
			B	4.50	- 4.95		S9	4.50 - 4.95
			D	4.50				
			D	5.25				
			U	5.50	- 5.95	(17)		
			D	6.00				
	6.20	3.60	D	6.25				
Very soft grey CLAY. (Estuarine Alluvium)			B	6.50	- 6.95		S1	6.50 - 6.95
			D	6.50				
			D	7.25				
			U	7.50	- 7.95	(3)		
---at 7.75m slightly sandy			D	8.00				
			D	8.50				
			B	9.00	- 9.50		S1/450mm	9.00 - 9.45
			D	9.00				
			D	10.00				

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF5
Sheet 2 of 5

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331692.1 E 185263.3 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/T30	Ground Level	9.80 m AOD
Client	Welsh Office	Drillers	C.A/J.H	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	16/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	21/11/1997
		Core Bit	Geocube		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring		Blow count to drive U100	SPT N & depth	Install-ation
Very soft grey CLAY. (Estuarine Alluvium)				D	10.00			
				U	10.50 - 10.95	(5)		
---from 11.00m sandy				D	11.00			
				D	11.50			
				B D	12.00 - 12.45 12.00		S1 12.00 12.45	
				D	13.00			
				U	13.50 - 13.95	(15)		
				D	14.00			
		14.80	-5.00	D	14.80			
Very dense grey slightly sandy sub-rounded siliceous GRAVEL with many cobbles. (Fluvial Alluvium)				B	15.00 - 15.45		C54 15.00 15.45	
				D	16.00			
				B	16.50 - 16.95		C56/65mm 16.50 16.72	
				D	17.50			
				B	18.00 - 18.45		C80/150mm 18.00 18.30	
				D	19.00			
				B	19.50 - 19.95		C86/220mm 19.50 19.87	

NB All depths in metres, all diameters in millimetres.
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BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF5
Sheet 3 of 5

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331692.1 E 185263.3 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/T30	Ground Level	9.80 m AOD
Client	Welsh Office	Drillers	C.A/J.H	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	16/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	21/11/1997
		Core Bit	Geocube		

Description of Strata	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	Blow count to drive U100	SPT N & depth
Very dense grey slightly sandy sub-rounded siliceous GRAVEL with many cobbles. (Fluvial Alluvium)			D 20.50					
---from 20.50m very sandy	20.80	-11.00	D 20.80					
			B 21.00					S50/30mm 21.00
	21.10	-11.30	D 21.00					21.18
Reddish brown mottled greyish green highly to completely weathered MUDSTONE, very weak to weak. (Mercia Mudstone Group)								
	21.70	-11.90	21.10 - 22.40	98	65	38	FI NI 3	
Reddish brown medium bedded highly weathered silty MUDSTONE, very weak to weak completely fractured. (Mercia Mudstone Group)								
Reddish brown occasionally mottled green medium sub-horizontally bedded slightly to moderately weathered silty MUDSTONE, moderately weak to moderately strong with closely to medium spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group)			22.40 - 23.90	98	53	25	NI 6	
---from 22.40 to 22.90m moderately to highly weathered weak completely fractured							NI	
---from 23.07 to 23.90m moderately weathered moderately weak			23.90 - 25.40	100	93	60	5	
---from 23.90 to 24.05m moderately to highly weathered weak completely fractured								
---at 24.30m very weak								
---from 25.25 to 25.75m moderately weathered moderately weak							4	
---from 25.75 to 26.35m moderately to highly weathered weak completely fractured			25.40 - 26.90	100	41	14	NI	
	26.71	-16.91					5	
Green very thinly to thinly sub-horizontally bedded moderately weathered silty slightly sandy MUDSTONE, moderately weak to moderately strong with very closely to closely spaced sub-horizontal fractures planar rough tight. (Mercia Mudstone Group)	27.24	-17.44	26.90 - 28.00	75	29	0	7 NI NA	
---from 27.23 to 27.45m sub-vertical (70-75°) planar rough tight								
	28.32	-18.52	28.00 - 28.90	98	44	0	NI 0 4 NI 5	
Purplish brown thinly sub-horizontally bedded moderately to highly weathered silty MUDSTONE, moderately weak with very closely spaced sub-horizontal fractures planar rough tight. (Mercia Mudstone Group)								
	29.43	-19.63	28.90 - 29.90	95	52	0	4 5 NI NI	
---from 27.40 to 27.72m highly weathered very weak completely fractured								

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Version	2.00
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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF5

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331692.1 E 185263.3 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/T30	Ground Level	9.80 m AOD
Client	Welsh Office	Driller	C.A/J.H	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	16/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	21/11/1997
		Core bit	Geocube		

Description of Strata	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Green thinly sub-horizontally bedded slightly to moderately weathered silty slightly sandy MUDSTONE, moderately weak to moderately strong with widely spaced thin beds of purplish brown moderately to highly weathered mudstone and very closely to closely spaced sub-horizontal fractures planar rough tight. (Mercia Mudstone Group)			29.90 - 31.40	95	85	21	9 6		
(29.43-32.65) Reddish brown occasionally mottled green thinly to medium bedded moderately weathered silty MUDSTONE, moderately weak with widely spaced thin beds of green slightly sandy mudstone moderately strong and very closely spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group) Detail:---from 29.70 to 30.05m moderately to Detail:highly weathered weak completely fractured Detail:---from 31.40 to 31.60m moderately to Detail:highly weathered weak completely fractured Detail:---from 32.50 to 32.65m moderately to Detail:highly weathered weak completely fractured			31.40 - 32.65	100	74	18	NI NI NI		
---from 31.40 to 31.60m moderately to highly weathered weak completely fractured ---from 32.50 to 32.65m moderately to highly weathered weak completely fractured	32.65	-22.85	32.65 - 34.20	100	90	66	3 NI		
Reddish brown occasionally mottled green medium to thinly sub-horizontally bedded slightly to moderately weathered silty MUDSTONE, moderately weak with medium spaced inclined fractures planar rough tight. (Mercia Mudstone Group)	34.20	-24.40	34.20 - 35.70	100	46	33	NI 7		
Reddish brown occasionally mottled green medium sub-horizontally bedded moderately weathered silty MUDSTONE, moderately weak to moderately strong with closely spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group) ---from 34.10 to 34.44m highly weathered weak completely fractured ---from 34.84 to 35.60m slightly to moderately weathered ---from 35.70 to 35.90m completely fractured ---from 35.90m medium to thickly sub-horizontally bedded	37.20	-27.40	35.70 - 37.20	97	85	41	NI 9		
			37.20 - 38.70	98	85	72	7 5		
Reddish brown occasionally mottled green thickly sub-horizontally bedded slightly to moderately weathered silty MUDSTONE, very weak to moderately weak with medium spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group)			38.70 - 40.20	100	97	60	9		

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF5

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	331692.1 E 185263.3 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/T30	Ground Level	9.80 m AOD
Client	Welsh Office	Driller	C.A/J.H	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	16/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	21/11/1997
		Core bit	Geocube		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown occasionally mottled green thickly sub-horizontally bedded slightly to moderately weathered silty MUDSTONE, very weak to moderately weak with medium spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group)				40.20 - 41.70	100	97	61	12		
				41.70 - 43.20	99	93	59	5 7		
				43.20 - 44.35	100	100	94	3		
---from 44.05 to 44.35m with very closely spaced gravel size pockets of silt sized fragments of calcite										
---from 44.95 to 45.25m moderately to highly weathered weak to moderately weak				44.35 - 45.75	98	46	29	6		
---from 45.25 to 45.51m moderately to highly weathered very weak completely fractured		45.75	-35.95					NI 3		
Borehole complete at 45.75 m.										

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	1.00
Revised	20/09/96

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF6
Header

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	332114.9 E 185399.0 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/T30	Ground Level	8.80m AOD
Client	Welsh Office	Drillers	T.R/J.H	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	18/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	27/11/1997
		Core bit	Geocube		

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
18/11/1997	1800	14.00	14.00	6.65	
19/11/1997	0800	14.00	14.00	6.21	
19/11/1997	1800	21.70	21.50	8.40	
21/11/1997	0800	21.70	21.70	4.00	
21/11/1997	1800	28.80	21.70	7.70	
24/11/1997	0800	28.80	21.70	8.50	
24/11/1997	1800	34.70	21.70	7.10	
25/11/1997	0800	34.70	21.70	8.40	
25/11/1997	1800	45.20	21.70	3.15	
26/11/1997	0800	45.20	21.70	7.90	
26/11/1997	1800	54.15	21.70	5.70	

CABLE PERCUSSION DETAILS

Hard strata from depth	Hard strata to depth	Hours	Remarks
18.80	19.10	1.25	
19.70	19.90	0.75	
20.80	21.00	0.50	
21.40	21.70	1.00	

CASING

Hole diameter	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
150	21.70	150	21.50
120	21.70	140	55.65

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
18/11/1997	0000	2.00	0.00	0	seepage□□	1.50	3.00

ROTARY DRILLING DETAILS

From depth	To depth	Flush type	Flush return	Core diameter
21.70	55.65	foam	good	92

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.50	S	N=3 (1,0,1,1,0,1)
2.50	S	N=4 (1,0,1,1,1,1
5.00	S	N=3 (1,1,1,1,0,1)
7.00	S	N=2 (1,0,0,1,0,1)
9.50	S	N=1 (1,0,0,1,0,0)
13.20	S	N=2 (1,0,0,1,0,1)
16.00	S	N=12 (1,2,3,3,3,3)
17.00	C	N=37 (2,4,7,11,10,9)
18.50	C	79/125mm (7,14,29,50)
20.20	C	N=98 (3,6,10,28,29,31)
21.40	C	50/60mm*
21.70	C	50/50mm*
28.80	S	60/75mm (,25,60)
45.20	S	54/190mm
48.75	S	70/156mm

* Seating blows only.

GENERAL NOTES

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, hard strata time in hours

Form	COMBINED HEADER
Version	2.00
Revised	26/06/1997

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF6
Sheet 1 of 6

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	332114.9 E 185399.0 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/T30	Ground Level	8.80 m AOD
Client	Welsh Office	Drillers	T.R/J.H	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	18/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	27/11/1997
		Core Bit	Geocube		

Description of Strata	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth
MADE GROUND: Dark grey slightly clayey silty sandy sub-angular gravel of ash, brick, shale, and rubble fill.			D 0.50		
			B 1.50 - 1.95		S3 1.50 1.95
---at 2.10m slight hydrocarbon odour			D 2.10		
			B 2.50 - 2.95		S4 2.50 2.95
	2.80	6.00			
Soft greyish brown slightly organic CLAY. (Estuarine Alluvium)			D 3.00		
			U 3.20 - 3.65	(4)	
			U 4.00 - 4.45	(8)	
	4.20	4.60			
Very soft to soft grey occasionally mottled orangish brown CLAY. (Estuarine Alluvium)			D 4.50		
			D 4.80		
---from 4.80 to 5.70m occasionally thinly laminated organic			B 5.00 - 5.45		S3 5.00 5.45
---from 5.00m very soft			D 5.70		
			U 6.00 - 6.45	(9)	
			D 6.50		
	6.80	2.00	D 6.80		
Very soft brownish grey very silty CLAY. (Estuarine Alluvium)			B 7.00 - 7.45		S2 7.00 7.45
---at 6.80m bluish grey organic			D 7.80		
			U 8.00 - 8.45	(6)	
			D 8.50		
			D 9.00		
---at 9.00m slightly organic			B 9.50 - 9.95		S1 9.50 9.95

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF6
Sheet 2 of 6

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	332114.9 E 185399.0 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/T30	Ground Level	8.80 m AOD
Client	Welsh Office	Drillers	T.R/J.H	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	18/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	27/11/1997
		Core Bit	Geocube		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring		Blow count to drive U100	SPT N & depth	Install-ation
Very soft brownish grey very silty CLAY. (Estuarine Alluvium)				D	10.50			
				B	11.00 - 11.45			
				U	11.80 - 12.25	(4)		
				D	12.30			
				D	12.70			
---at 12.70m slightly organic								
				B	13.20 - 13.65		S2 13.20 13.65	
---from 13.20 to 15.10m with occasional gravel size pockets of brownish black firm fibrous woody peat								
				D	14.00			
---from 14.00m soft								
				U	14.60 - 15.00	(15)		
				D	15.10			
				D	15.50			
---at 15.50m with very occasional sub-rounded siliceous fine to medium gravel								
				B	16.00 - 16.45		S12 16.00 16.45	
---from 16.00m firm with occasional gravel size pockets of brownish black firm fibrous and woody peat								
		16.80	-8.00					
Dense grey slightly silty sandy sub-rounded siliceous GRAVEL with many cobbles. (Fluvial Alluvium)				B	17.00 - 17.45		C37 17.00 17.45	
				D	18.00			
				B	18.50 - 18.80		C79/125mm 18.50 18.78	
---from 18.50m very dense								
				D	19.50			

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No. **BHF6**

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	332114.9 E 185399.0 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/T30	Ground Level	8.80 m AOD
Client	Welsh Office	Drillers	T.R/J.H	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	18/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	27/11/1997
		Core Bit	Geocube		

Description of Strata	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth
Dense grey slightly silty sandy sub-rounded siliceous GRAVEL with many cobbles. (Fluvial Alluvium)			B 20.20 - 20.65		C98 20.20 20.65
	21.20	-12.40	B 21.20 - 21.40		
Greyish green highly to completely weathered MUDSTONE, very weak to weak. (Mercia Mudston Group)			D 21.20 D 21.40		C50/60mm* 21.40 21.46
	21.70	-12.90	D 21.70		C50/50mm* 21.70 21.75
---from 21.40m highly weathered weak to moderately weak	21.95	-13.15	21.70 - 21.95	TCR 40 SCR 0 RQD 0 NI	
			21.95 - 22.50	96 0 0 NI	
Green thinly bedded moderately to highly weathered silty MUDSTONE, weak with very closely spaced sub-horizontal fractures planar rough tight. (Mercia Mudstone Group) ---at 21.70m slightly to moderately weathered moderately strong to strong ---from 21.70 to 21.75m completely fractured ---from 21.80 to 21.95m completely fractured ---from 21.90 to 21.95m mottled purple	22.50	-13.70	22.50 - 24.00	97 53 15 NI 0 NI 10	
			24.00 - 25.50	100 40 20 12 NI	
Reddish brown thinly bedded highly weathered silty MUDSTONE, weak to very weak completely fractured. (Mercia Mudstone Group) ---from 22.42 to 23.05m highly weathered very weak completely fractured	25.25	-16.45			
Reddish brown thinly to medium sub-horizontally bedded moderately weathered silty MUDSTONE, moderately weak to weak with very closely to closely spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group) ---from 22.50 to 22.62m highly weathered very weak completely fractured ---from 23.05 to 25.25m with closely to medium spaced inclined thin to thick laminations of calcite ---from 24.00 to 24.30m light green moderately to highly weathered			25.50 - 27.00	93 7 0 NI	
			27.00 - 27.60	97 25 0 NI 3 NI	
	27.60	-18.80	27.60 - 28.10	70 56 0 5	
			28.10 - 28.80	71 7 0 NI 1 NA	S60/75mm 28.80 28.93
Reddish brown thinly to medium bedded highly weathered silty MUDSTONE, weak to very weak completely fractured. (Mercia Mudstone Group)			28.80 - 29.55	89 27 0 10 NI	

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF6
Sheet 4 of 6

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	332114.9 E 185399.0 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/T30	Ground Level	8.80 m AOD
Client	Welsh Office	Driller	T.R/J.H	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	18/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	27/11/1997
		Core bit	Geocube		

Description of Strata	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown thinly sub-horizontally bedded moderately to highly weathered silty MUDSTONE, very weak to weak with very closely to closely spaced sub-horizontal fractures planar rough tight. (Mercia Mudstone Group) ---at 28.00m very weak ---from 30.20 to 30.45m highly weathered weak completely fractured	30.55	-21.75	29.55 - 30.55	90	18	0	4 NI 2 2 NI		
			30.55 - 31.85	100	46	12	6 NI 9 NI		
Reddish brown thinly to medium sub-horizontally bedded moderately weathered silty MUDSTONE, weak with very closely to closely spaced sub-horizontal fractures planar rough tight. (Mercia Mudstone Group) ---from 30.65 to 30.95m highly weathered very weak completely fractured ---from 31.35 to 31.43m highly weathered very weak completely fractured ---from 31.70 to 31.85m highly weathered very weak completely fractured ---from 32.15 to 32.25m highly weathered very weak completely fractured	33.05	-24.25	31.85 - 33.85	74	48	15	9 NI		
	34.10	-25.30	33.85 - 34.70	94	71	12	NI 6 NI		
Reddish brown occasionally mottled green very thinly to thinly bedded highly weathered silty MUDSTONE, very weak completely fractured. (Mercia Mudstone Group)			34.70 - 36.20	100	80	15	NI 10		
Reddish brown occasionally mottled greyish green thinly to medium sub-horizontally bedded highly to moderately weathered silty MUDSTONE, weak to moderately weak with closely spaced sub-horizontal fractures planar rough tight. (Mercia Mudstone Group) ---from 34.45 to 34.70m highly weathered completely fractured ---from 34.70 to 36.40m highly weathered completely fractured ---from 35.60 to 35.70m inclined fracture (60°) planar rough tight (calcite infill) ---at 35.85m slightly calcareous ---from 36.20 to 36.40m completely fractured	36.40	-27.60	36.20 - 37.70	100	93	23	NI 13		
	37.70	-28.90	37.70 - 39.20	100	60	7	NI 10		
MUDSTONE As Sheet 5	38.60	-29.80	39.20 - 40.70	100	87	23	NI		

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	1.00
Revised	20/09/96

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF6

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	332114.9 E 185399.0 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/T30	Ground Level	8.80 m AOD
Client	Welsh Office	Driller	T.R/J.H	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	18/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	27/11/1997
		Core bit	Geocube		

Description of Strata	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown occasionally mottled greyish green thinly sub-horizontally bedded moderately weathered silty MUDSTONE, very weak with closely spaced sub-horizontal fractures planar rough tight. (Mercia Mudstone Group)	40.60	-31.80					7 NI		
(37.70-38.60) Reddish brown occasionally mottled greyish green very thinly to thinly sub-horizontally bedded highly weathered silty MUDSTONE, very weak to weak completely fractured. (Mercia Mudstone Group)			40.70 - 42.20	100	83	12	NI 1 NI		
(38.60-40.60) Reddish brown occasionally mottled greyish green thinly sub-horizontally bedded moderately to highly weathered silty MUDSTONE, weak to moderately weak with closely to medium spaced sub-horizontal fractures planar rough tight. (Mercia Mudstone Group) Detail:---from 38.60 to 39.20m reddish brown Detail:mottled greyish green calcitic Detail:---from 39.20 to 40.00m highly weathered Detail:very weak completely fractured	42.20 43.70	-33.40 -34.90	42.20 - 43.70	100	87	7	34 2		
Reddish brown mottled greyish green very thinly to thinly sub-horizontally bedded highly to moderately weathered silty MUDSTONE, very weak to moderately weak with closely to medium spaced sub-horizontal fractures planar rough tight. (Mercia Mudstone Group) ---from 40.60 to 41.90m completely fractured ---at 41.80m very weak ---from 41.90 to 42.00m inclined fracture (50°) planar rough tight (stained green calcite infill) ---from 42.00 to 42.20m completely fractured			43.70 - 45.20	61	0	0	NI	S54/190mm 45.20 45.39	
			45.20 - 46.20	76	0	0	NI		
			46.20 - 46.70	70	0	0	NA NI		
Reddish brown thinly sub-horizontally bedded moderately weathered silty MUDSTONE, moderately weak to moderately strong with very closely to closely spaced sub-horizontal fractures planar rough tight. (Mercia Mudstone Group)	46.92	-38.12	46.70 - 47.60	100	62	42	NI 3 NI		
Reddish brown thinly bedded highly weathered silty MUDSTONE very weak completely fractured. (Mercia Mudstone Group) ---from 46.22 to 47.50m medium spaced sub-horizontal fractures planar rough tight ---from 46.72 to 48.00m closely spaced thin to thick laminations of white calcite			47.60 - 48.75	46	4	0	NI	S70/156mm 48.75 48.91	
			48.75 - 49.75	93	45	10	NI 2 NI 3		
MUDSTONE As Sheet 6									

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	1.00
Revised	20/09/96

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHF6
Sheet 6 of 6

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	332114.9 E 185399.0 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/T30	Ground Level	8.80 m AOD
Client	Welsh Office	Driller	T.R/J.H	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	18/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	27/11/1997
		Core bit	Geocube		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown occasionally mottled green thinly sub-horizontally bedded moderately weathered silty MUDSTONE, very weak to weak with very closely to closely spaced sub-horizontal fractures planar rough tight. ---from 50.15 to 51.85m closely spaced thin sub-horizontal laminations of white calcite				49.75 - 51.25	91	59	29	8 6 NA 2		
		51.35	-42.55							
Reddish brown occasionally mottled green thinly to medium sub-horizontally bedded slightly to moderately weathered silty MUDSTONE, moderately weak to moderately strong with closely to medium spaced sub-horizontal fractures planar rough tight. (Mercia Mudstone Group) ---from 52.55 to 52.65m thin beds of white calcite ---from 52.65 to 54.70m with very closely to closely spaced inclined undulating thin to thick laminations of calcite				51.25 - 52.65	100	93	65	9		
		52.90	-44.10					0 NI 0 NI		
				52.65 - 54.15	100	62	43	4 NI 1		
		53.90	-45.10							
Reddish brown mottled green thinly sub-horizontally bedded moderately weathered silty MUDSTONE, moderately weak with closely to medium spaced sub-horizontal fractures planar rough tight. (Mercia Mudstone Group) ---from 52.90 to 53.05m highly weathered very weak completely fractured ---from 53.15 to 53.22m highly weathered very weak completely fractured ---from 53.65 to 53.90m highly weathered very weak completely fractured				54.15 - 55.65	99	90	60	6 4		
		55.65	-46.85							
Reddish brown mottled green thinly to medium sub-horizontally bedded slightly to moderately weathered silty MUDSTONE, moderately weak to moderately strong with closely to medium spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group) ---from 54.70 to 55.33m sub-vertical to vertical very thin (20mm-60mm) 1 vein of white calcite										
Borehole complete at 55.65 m.										

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	1.00
Revised	20/09/96

Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
			07/02 2020 DRY	
0.40-1.00	TO			
1.00-1.40	TO			
1.40-2.00	TO			
		NIL	DRY	
2.00				

Strata

Description	Depth (Thickness)	Level
	G.L.	10.29
MADE GROUND: Weak grey concrete	(0.40)	
	0.40	9.89
MADE GROUND: Moderately compact dark grey and red brown sandy very silty clayey sub-angular to sub-rounded fine to coarse gravel of slag, ash,brick,concrete and limestone with ocassional sub-rounded cobbles of sandstone.	(1.60)	
	2.00	8.29
End of Borehole.		

Legend

Equipment: Hand Held Window Sampler

Borehole Dia (mm) Casing Dia (mm)
202 to 0.40m
80 to 1.40m
60 to 2.00m

Groundwater
No. Struck Behaviour Sealed

No groundwater encountered

Ground Level 10.29 m OD
Coordinates 331076.30 mE
184823.93 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks Concrete core 202mm ϕ to a depth of 0.40m (1hr)
Refusal at 2.00m (possible cobbles?)

See key sheet and appendices for explanations.

Form 1/0

Borehole Record

Exploration Associates

Project
M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

Contract 150006

Borehole CH10(1 of 1)

Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
			07/02 0000 DRY	
0.35-0.85	TO			
0.85-1.15	B			
1.15-1.65	B			
1.65-2.15	TO			
3.00		NIL	DRY	

Strata

Description	Depth (Thickness)	Level
	G.L.	10.10
MADE GROUND: Black tarmac	0.15	9.95
MADE GROUND: Moderately compact grey slightly sandy angular to sub-angular fine to coarse gravel of siltstone and limestone(sub-base)	0.35	9.75
MADE GROUND: Firm red brown slightly sandy very silty clay with much angular to sub-angular fine to coarse gravel of slag,ash, coal,sandstone and brick	(1.30)	
MADE GROUND: Soft grey very silty clayey fine to coarse sand with occasional angular to sub-angular fine to coarse gravel of slag and ash (Strong fuel odour) no recovery 2.15m - 3.00m	(1.35)	
End of Borehole.	3.00	7.10

Legend

Equipment: Hand Held Window Sampler

Borehole Dia (mm) Casing Dia (mm)
202 to 0.15m
80 to 1.15m
60 to 3.00m

Groundwater
No. Struck Behaviour Sealed

No groundwater encountered

Ground Level 10.10 m OD
Coordinates 331177.34 mE
184920.35 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks Concrete Core 202mm ϕ to a depth of 0.15m (1hr)

See key sheet and appendices for explanations.

Form 1/0

Borehole Record

Exploration Associates

Project
M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

Contract 150006

Borehole CH11(1 of 1)

Sampling

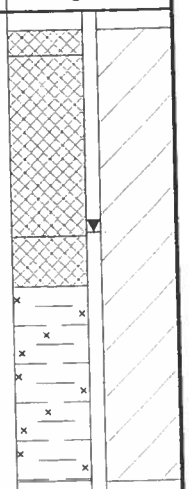
Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
			07/02 2000 DRY	
0.17-0.67	TO			
0.67-1.37	TO			
1.37-1.70	TO			
1.70-2.00	T			
1.35	W			
		NIL	1.35	
3.00				

Strata

Description	Depth (Thickness)	Level
	G.L.	9.66
MADE GROUND: Black tarmac	0.17	9.49
MADE GROUND: Moderately compact dark grey black very silty slightly clayey very sandy angular to sub-angular fine to coarse gravel of slag,ash,sandstone,brick and limestone with occasional cobbles of sandstone	(1.20)	
	1.37	8.29
MADE GROUND: Soft to firm grey very silty clay with occasional to some sub-rounded to sub-angular fine to coarse gravel of slag and sandstone	1.70	7.96
Soft to firm grey very silty organic CLAY no recovery 2.00m - 3.00m	(1.30)	
	3.00	6.66

End of Borehole.

Legend



Equipment: Hand Held Window Sampler

Borehole Dia (mm) / Casing Dia (mm)
202 to 0.17m
80 to 1.17m
60 to 3.00m

Groundwater

No.	Struck	Behaviour	Sealed
1	1.35	Rose to 1.35m in 20 mins 1.35/1.35/1.35 in 5/10/15 mins	

Ground Level 9.66 m OD
Coordinates 331249.31 mE 184935.22 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks Concrete core 202mm ϕ to a depth of 0.17 (1hr)
Only Sufficient amount of water for 1no litre sample (mineral)

See key sheet and appendices for explanations.

Form 1/0

Borehole Record

Exploration Associates

Project
M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

Contract 150006

Borehole CH12(1 of 1)

Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
0.00-0.40	TO		28/01 2000 DRY	
0.40-0.77	TO			
0.77-1.07	TO	NIL	DRY	
1.07				

Strata

Description	Depth (Thickness)	Level
	G.L.	9.74
MADE GROUND: Moderately compact brown slightly silty sandy sub-angular to sub-rounded fine to coarse gravel of chert, mudstone,brick and sandstone with occasional refuse of plastic	(0.40)	
	0.40	9.34
MADE GROUND: Concrete.	0.47	9.27
	0.77	8.97
MADE GROUND: Soft to firm red brown slightly sandy very silty clay with occasional to some sub-angular fine to coarse gravel of chert, sandstone,coal,slag,ash and brick with some cobbles of sub-rounded cobbles of sandstone	1.07	8.67
MADE GROUND: Soft to firm dark grey black very silty clay with occasional to some sub-rounded to sub-angular fine to coarse gravel of chert,coal,ash,brick and sandstone		
End of Borehole.		

Legend

Equipment: Hand Held Window Sampler

Borehole Dia (mm) 80 to 1.00m

Casing Dia (mm)

Groundwater

No. Struck Behaviour Sealed

No groundwater encountered

Ground Level 9.74 m OD
Coordinates 331289.61 mE
184976.66 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks Hole refusal at 1.07m (possible cobbles?)

See key sheet and appendices for explanations.

Form 1/0

Borehole Record

Exploration Associates

Project
M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

Contract 150006

Borehole CH13(1 of 1)

Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
			04/02 2000	
0.16-0.50	TO		DRY	
0.50-1.30	B			
		NIL	DRY	
1.30				

Strata

Description	Depth (Thickness)	Level
	G.L.	9.10
MADE GROUND: Strong grey intact re-inforced concrete.	0.16	8.94
MADE GROUND: Compact dark grey black very silty sandy angular to sub-angular fine to coarse gravel and cobbles of slag,ash,coal, sandstone and limestone	(1.14)	
.....	1.30	7.80
End of Borehole.		

Legend

Equipment: Hand held window sampler

Borehole Dia (mm) 202 to 0.16m
80 to 1.30m

Casing Dia (mm)

Groundwater

No. Struck Behaviour Sealed

No groundwater encountered

Ground Level 9.10 m OD
Coordinates 331384.08 mE
185053.24 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks Concrete core 202mm ϕ to a depth of 0.16 (1hr)
Refusal at 1.30 (Possible cobbles?)

See key sheet and appendices for explanations.

Form 1/0

Borehole Record

Exploration Associates

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M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

Contract 150006

Borehole CH14(1 of 1)

Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
			27/01 2000 DRY	
0.30-0.80	TO			
		NIL	DRY	
0.80				

Strata

Description	Depth (Thickness)	Level
	G.L.	9.21
MADE GROUND: Black tarmac	0.10	9.11
	0.20	9.01
MADE GROUND: Light grey reinforced concrete.	0.30	8.91
	(0.50)	
MADE GROUND: Compact red brown very sandy angular to sub-angular fine to coarse gravel of limestone (sub-base)	0.80	8.41
MADE GROUND: Compact dark grey very silty sandy very clayey angular to sub-angular fine to coarse gravel of sandstone,slag and ash		
End of Borehole.		

Legend

Equipment: Hand Held Window Sampler

Borehole Dia (mm) Casing Dia (mm)
202 to 0.20m
80 to 0.80m

Groundwater

No. Struck	Behaviour	Sealed
	No groundwater encountered	

Ground Level 9.21 m OD
Coordinates 331417.03 mE
185090.44 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks Hand Dug pit to 0.20m (½hr)
Refusal at 0.80m (possible cobbles?)

See key sheet and appendices for explanations.

Form 1/0

Borehole Record

Exploration Associates

Project
M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

Contract 150006

Borehole CH15(1 of 1)

Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
			28/01 2000	
0.17-0.67	TO		DRY	
0.67-0.87	B	NIL	DRY	
0.87				

Strata

Description	Depth (Thickness)	Level
	G.L.	9.24
MADE GROUND: Strong light grey intact re-inforced concrete.	0.17	9.07
MADE GROUND: Compact dark grey sandy very silty very clayey angular to sub-angular fine to coarse gravel of sandstone,slag,ash,brick and limestone	(0.70)	
End of Borehole.	0.87	8.37

Legend

Equipment: Hand Held Window Sampler

Borehole Dia (mm) 202 to 0.17m
80 to 0.87m

Casing Dia (mm)

Groundwater

No. Struck Behaviour Sealed

No groundwater encountered

Ground Level 9.24 m OD
Coordinates 331415.85 mE
185091.46 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks Concrete core 202mm ϕ to a depth of 0.17 (1½hrs)
Refusal at 0.87 (possible cobbles?)

See key sheet and appendices for explanations.

Form 1/0

Borehole Record

Exploration Associates

Project
M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

Contract 150006

Borehole CH15A(1 of 1)

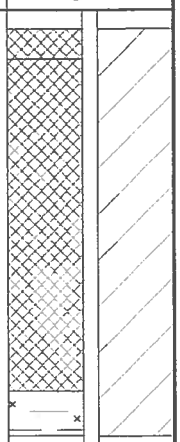
Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
			28/01 2000	
0.20-0.70	TO		DRY	
0.70-1.30	B			
1.30-1.90	B			
1.90-2.40	TO			
2.40-2.70	T	NIL	DRY	
2.70				

Strata

Description	Depth (Thickness)	Level
	G.L.	8.69
MADE GROUND: Light grey strong intact re-inforced concrete	0.20	8.49
MADE GROUND: Moderately compact dark grey very silty clayey slightly sandy angular to sub-angular fine to coarse gravel of slag, slate,mudstone,ash,coal,sandstone and limestone	(2.20)	
Soft grey very silty CLAY	2.40	6.29
End of Borehole.	2.70	5.99

Legend



Equipment: Hand Held Window Sampler

Borehole Dia (mm) Casing Dia (mm)
202 to 0.20m
80 to 1.20m
60 to 2.70m

Groundwater

No. Struck	Behaviour	Sealed

No groundwater encountered

Ground Level 8.69 m OD
Coordinates 331453.57 mE
185126.62 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks Concrete core 202mm ϕ to a depth of 0.20 (1½hrs)

See key sheet and appendices for explanations.

Form 1/0

Borehole Record

Exploration Associates

Project
M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

Contract 150006

Borehole CH16(1 of 1)

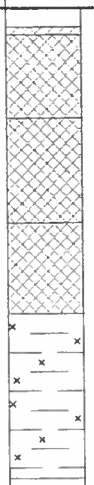
Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
0.05-0.60	TO		27/01 2000 DRY	
0.60-1.00	TO			
1.30-1.90	TO			
1.90-2.40	TO			
1.00-1.30	B			
		NIL	DRY	
3.00				

Strata

Description	Depth (Thickness)	Level
	G.L.	8.79
Brown slightly silty very sandy TOPSOIL	0.05	8.74
	(0.55)	
MADE GROUND: Dark brown and red brown sandy very silty very clayey angular to sub-angular fine to coarse gravel of slag,brick,coal,ash, chert and sandstone	0.60	8.19
	(0.70)	
MADE GROUND: Red brown sandy very silty clay with much angular to sub-angular fine to coarse gravel of brick,coal,slag,ash and sandstone	1.30	7.49
	(0.60)	
MADE GROUND: Loose dark grey very silty sandy angular to sub-angular fine to coarse gravel of slag,ash,coal and sandstone	1.90	6.89
	(1.10)	
Soft to firm grey very silty CLAY		
.....	3.00	5.79
End of Borehole.		

Legend



Equipment: Hand Held Window Sampler

Borehole Dia (mm) Casing Dia (mm)
80 to 1.00m
60 to 3.00m

Groundwater
No. Struck Behaviour Sealed

No groundwater encountered

Ground Level 8.79 m OD
Coordinates 331500.85 mE
185119.04 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks

See key sheet
and appendices
for explanations.

Form 1/0

Borehole Record

Exploration Associates

Project
M4 Relief Road - Stage 2. Preliminary
Chemical Investigation
Ove Arup & Partners

Contract 150006

Borehole CH17(1 of 1)

Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
			27/01 2000	
0.20-0.50	TO		DRY	
0.50-1.00	TO			
1.00-1.60	B			
1.60-2.20	TO			
3.20-4.00	T			
4.00-4.50	T			
4.50-5.00	T			
5.00		NIL	DRY	

Strata

Description	Depth (Thickness)	Level
	G.L.	10.02
MADE GROUND: Moderately compact red brown very sandy silty angular to sub-angular fine to coarse gravel of limestone and slag	0.20	9.82
MADE GROUND: Firm brown locally mottled orange brown sandy very silty clay with occasional to some sub-rounded fine to coarse gravel of sandstone	0.50	9.52
	(1.10)	
MADE GROUND: Moderately compact dark grey black very sandy very silty angular to sub-angular fine to coarse fine to coarse gravel of slag,ash,coal,chert and sandstone	1.60	8.42
MADE GROUND: Loose brown silty fine to coarse sand with occasional angular to sub-angular fine to coarse gravel of slag,ash,coal and sandstone no recovery 2.20m - 3.20m		
	(2.40)	
	4.00	6.02
Soft to firm grey very silty CLAY with occasional sub-rounded fine to coarse gravel of sandstone	(0.50)	
	4.50	5.52
	(0.50)	
Firm red brown very silty CLAY with occasional to some sub-angular fine to medium gravel of mudstone	5.00	5.02
End of Borehole.		

Legend

Equipment: Hand Held Window Sampler

Borehole Dia (mm) Casing Dia (mm)
80 to 1.00m
60 to 3.00m
40 to 5.00m

Groundwater
No. Struck Behaviour Sealed

No groundwater encountered

Ground Level 10.02 m OD
Coordinates 331575.33 mE
185145.01 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks

See key sheet
and appendices
for explanations.

Form 1/0

Borehole Record

Exploration Associates

Project
M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

Contract 150006

Borehole CH18(1 of 1)

Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
			27/01 2000	
0.20-0.75	TO		DRY	
0.75-2.00	B			
2.00-2.50	TO			
2.50-3.00	TO			
3.00		NIL	DRY	

Strata

Description	Depth (Thickness)	Level
	G.L.	10.32
MADE GROUND: Black tarmac	0.20	10.12
MADE GROUND: Loose dark grey black very silty sandy angular to sub-angular fine to coarse gravel of slag,ash,brick,sandstone and limestone	(1.80)	
Soft to firm grey slightly sandy very clayey SILT	2.00	8.32
	(1.00)	
End of Borehole.	3.00	7.32

Legend

Equipment: Hand Held Window Sampler

Borehole Dia (mm) Casing Dia (mm)
80 to 1.00m
60 to 3.00m

Groundwater
No. Struck Behaviour Sealed

No groundwater encountered

Ground Level 10.32 m OD
Coordinates 331668.12 mE
185238.85 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks Hand dug pit 0.00m - 0.20m (½hr)

See key sheet and appendices for explanations.

Form 1/0

Borehole Record

Exploration Associates

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M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

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Borehole CH19(1 of 1)

Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
0.00-0.30	TO		27/01 2000 DRY	
0.30-0.80	TO			
1.00-1.50	TO			
1.50-2.00	B			
2.00-2.50	TO			
2.50		NIL	DRY	

Strata

Description	Depth (Thickness)	Level
	G.L.	10.32
MADE GROUND: Loose yellow brown slightly silty fine to coarse sand	0.30	10.02
MADE GROUND: Loose dark brown sandy very silty angular to sub-angular fine to coarse gravel of brick,slag,ash and sandstone	(0.50) 0.80	9.52
MADE GROUND: Soft brown very sandy clayey silt	(1.20)	
	2.00	8.32
MADE GROUND: Soft grey very sandy clayey silt.	(0.50)	
	2.50	7.82

End of Borehole.

Legend

Equipment: Hand held Window Sampler

Borehole Dia (mm) Casing Dia (mm)
80 to 1.00m
60 to 2.50m

Groundwater

No. Struck	Behaviour	Sealed

No groundwater encountered

Ground Level 10.32 m OD
Coordinates 331745 mE
185300 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks Refusal at 2.50m (Gravels)

See key sheet and appendices for explanations.

Form 1/0

Borehole Record

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M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

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Borehole CH19A(1 of 1)

Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
0.00-0.50	TO		26/01 2000 DRY	
0.50-1.00	B			
1.00-1.50	TO			
1.50-2.20	TO			
3.00		NIL	DRY	

Strata

Description	Depth (Thickness)	Level
	G.L.	8.85
MADE GROUND: Compact dark brown very sandy silty angular to sub-angular fine to coarse gravel of slag,ash,sandstone and limestone	(1.00)	
	1.00	7.85
Soft to firm grey very silty slightly organic CLAY with occasional fine to medium sub-rounded gravel of sandstone	(2.00)	
no recovery 2.20m - 3.00m		
	3.00	5.85
End of Borehole.		

Legend

Equipment: Hand Held Window Sampler

Borehole Dia (mm) Casing Dia (mm)
80 to 1.00m
60 to 3.00m

Groundwater
No. Struck Behaviour Sealed

No groundwater encountered

Ground Level 8.85 m OD
Coordinates 331885.47 mE
185314.89 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks

See key sheet
and appendices
for explanations.

Form 1/0

Borehole Record

Exploration Associates

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M4 Relief Road - Stage 2. Preliminary Chemical Investigation
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Borehole CH20(1 of 1)

Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
0.00-0.50	TO		26/01 2000 DRY	
0.50-0.75	B			
0.75-1.50	TO			
1.50-2.00	B			
2.00-2.50	B			
2.50-3.00	TO			
3.00		NIL	DRY	

Strata

Description	Depth (Thickness)	Level
	G.L.	8.47
MADE GROUND: Compact dark brown and grey very sandy silty angular to sub-angular fine to coarse gravel of slag and ash	(0.75)	
	0.75	7.72
Soft to firm grey and brown very silty CLAY	(2.25)	
	3.00	5.47
End of Borehole.		

Legend

Equipment: Hand Held Window Sampler

Borehole Dia (mm) Casing Dia (mm)
80 to 1.00m
60 to 3.00m

Groundwater

No. Struck Behaviour Sealed

No groundwater encountered

Ground Level 8.47 m OD
Coordinates 331943.00 mE
185338.48 mN

Drilled by DC
Logged by DC
Checked by

Remarks

See key sheet and appendices for explanations.

Form 1/0

Borehole Record

Exploration Associates

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M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

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Borehole CH21 (1 of 1)

Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
			26/01 2000 DRY	
0.30-0.60	TO			
0.60-0.75	T			
0.75-0.95	T			
1.00-1.50	TO			
1.50-2.00	B			
2.00-2.50	B			
2.50-3.00	TO			
3.00		NIL	DRY	

Strata

Description	Depth (Thickness)	Level
	G.L.	8.37
MADE GROUND: Black tarmac	0.15	8.22
MADE GROUND: Loose brown very sandy angular fine to coarse gravel of limestone (sub-base)	0.30	8.07
MADE GROUND: Loose dark brown sandy very silty angular to sub-angular fine to coarse gravel of slag,ash,sandstone and limestone	0.60	7.77
MADE GROUND: Brown and grey very silty fine to medium sand	0.75	7.62
MADE GROUND: Loose dark grey sandy very silty angular to sub-angular fine to coarse gravel of slag and ash	0.95	7.42
Soft to firm grey locally mottled brown very silty CLAY	(2.00)	
End of Borehole.	2.95	5.42

Legend

Equipment: Hand Held Window Sampler

Borehole Dia (mm) Casing Dia (mm)
80 to 1.00m
60 to 3.00m

Groundwater

No. Struck Behaviour Sealed

No groundwater encountered

Ground Level 8.37 m OD
Coordinates 332018.57 mE
185383.50 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks Breakout (½hr)

See key sheet and appendices for explanations.

Form 1/0

Borehole Record

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M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

Contract 150006

Borehole CH22(1 of 1)

Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
			26/01 2000 DRY	
0.16-0.36	T			
0.36-0.46	T			
0.46-1.00	TO			
1.00-1.50	B			
1.50-2.00	B			
2.00-2.50	B			
2.50-3.07	TO			
3.07		NIL	DRY	

Strata

Description	Depth (Thickness)	Level
	G.L.	8.47
MADE GROUND: Light grey intact re-inforced concrete	0.16	8.31
MADE GROUND: Loose dark brown very sandy slightly silty angular to sub-angular fine to coarse gravel of slag,ash and limestone	0.36	8.11
MADE GROUND: Loose light brown very sandy sub-angular to sub-rounded fine to coarse gravel of slag,ash,slate,brick and sandstone	0.46	8.01
Soft to firm grey locally mottled brown very silty CLAY	(2.61)	
.....	3.07	5.40

End of Borehole.

Legend

Equipment: Hand Held Window Sampler

Borehole Dia (mm) Casing Dia (mm)
202 to 0.16m
80 to 1.16m
60 to 3.07m

Groundwater
No. Struck Behaviour Sealed

No groundwater encountered

Ground Level 8.47 m OD
Coordinates 332057.74 mE
185390.67 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks Concrete core 202mmφ to a depth of 0.16m (1½hrs)

See key sheet and appendices for explanations.

Form 1/0

Borehole Record

Exploration Associates

Project
M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

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Borehole CH23(1 of 1)

TRIAL PIT No: TP 1

Project	: SSQ Landfill Llanwern	**Ground Level :** 4.995m AOD		**Co-ordinates :** E338216.902 N185639.035	
Client	: Corus UK Ltd.	**Logged By :** AWJ		**Depth (m):** 3.60m	
Purpose	: Soil Characterisation	**Date :** 27.10.05		**Sheet No :** 1 of 1	

Depth (m)	Elevation	Geotechnical Description	Stratum Symbol	Sample Type	Sample Depth	Sample Strength kPA	Remarks
0.00	5.00	Ground Surface					
	4.70	**Made Ground** Loose dark grey silty sandy fine to coarse angular gravel and occasional cobble and rare boulder, comprising of slag					
0.50		**Estuarine Alluvium** Firm light brownish grey mottled orange in places CLAY with some organics		Bulk	S1	54	
1.00	4.00	**Estuarine Alluvium** Soft grey and bluish grey CLAY		Core	S2a	38 30	
1.50							
2.00						26	
2.50						20	
3.00				Core/B	S2b/3	20	
3.50	1.40						
4.00							
4.50							
5.00							

Notes :	**Plant Type :** Wheeled Excavator
Plan Dimensions : 0.75 x 3.0m	**Stability :** Stable to 3.20m
Long Axis Direction :	**Groundwater :** None
Log Template File : GEOTP3	**Seepages :** None

TRIAL PIT No: TP 2

Project : SSQ Landfill Llanwern	**Ground Level** : 4.626m AOD	**Co-ordinates** : E338232.128 N185934.655
Client : Corus UK Ltd.	**Logged By** : AWJ	**Depth (m)**: 3.60m
Purpose : Soil Characterisation	**Date** : 27.10.05	**Sheet No** : 1 of 1

Depth (m)	Elevation	Geotechnical Description	Stratum Symbol	Sample Type	Sample Depth	Sample Strength kPA	Remarks
0.00	4.63	Ground Surface					
		Made Ground Medium dense dark grey silty sandy fine to coarse angular gravel and occasional cobble and rare boulder, comprising of slag					
0.50	4.03						
	3.93	**Relict Topsoil** Soft black and dark grey SILT with much organics					Minor seepage at 0.70m
1.00	3.63	**Estuarine Alluvium** Firm to stiff in places light brownish grey mottled orange in places CLAY with some orangics		Bulk	S1	100	
		Estuarine Alluvium Firm becoming soft grey and bluish grey CLAY					
1.50						38	
2.00						26	
2.50				Bulk	S2	27	
3.00						27	
3.50	1.03						
4.00							
4.50							
5.00							

Notes :	**Plant Type :** Wheeled Excavator
Plan Dimensions : 0.75 x 3.0m	**Stability :** Stable to 3.20m
Long Axis Direction :	**Groundwater :** None
Log Template File : GEOTP3	**Seepages :** Minor at 0.70m

TRIAL PIT No: TP 3

Project : SSQ Landfill Llanwern	**Ground Level :** 5.925m AOD	**Co-ordinates :** E337304.006 N185757.14
Client : Corus UK Ltd.	**Logged By :** AWJ	**Depth (m):** 3.20m
Purpose : Soil Characterisation	**Date :** 27.10.05	**Sheet No :** 1 of 1

Depth (m)	Elevation	Geotechnical Description	Stratum Symbol	Sample Type	Sample Depth	Sample Strength kPA	Remarks
0.00	5.92	Ground Surface					
		Made Ground Medium dense dark grey silty sandy fine to coarse angular gravel and occasional cobble and rare boulder, comprising of slag brick and concrete					No seepages encountered
0.50							
1.00							
1.50							
2.00	3.72						
		Estuarine Alluvium Firm becoming soft brownish and bluish grey CLAY		Bulk	S1	65 80 43 27	
2.50				Bulk	S2		
3.00	2.72			Core/B	S34	24	
3.50							
4.00							
4.50							
5.00							

Notes :

Plan Dimensions : 0.75 x 3.0m

Long Axis Direction :

Log Template File : GEOTP3

Plant Type : Wheeled Excavator

Stability : Stable to 3.20m

Groundwater : None

Seepages : None

TRIAL PIT No: TP 4

Project : SSQ Landfill Llanwern	**Ground Level :** 5.144m AOD	**Co-ordinates :** E337749.515 N185574.449
Client : Corus UK Ltd.	**Logged By :** AWJ	**Depth (m):** 3.30m
Purpose : Soil Characterisation	**Date :** 27.10.05	**Sheet No :** 1 of 1

Depth (m)	Elevation	Geotechnical Description	Stratum Symbol	Sample Type	Sample Depth	Sample Strength kPA	Remarks
0.00	5.14	Ground Surface					
0.50	4.24	**Made Ground** Medium dense dark grey silty sandy fine to coarse angular gravel and occasional cobble and rare boulder, comprising of slag					No seepages encountered
1.00	3.74	**Estuarine Alluvium** Firm to stiff in places light brownish grey mottled orange in places CLAY with some orangics				90 62	
1.50	1.84	**Estuarine Alluvium** Firm becoming soft grey and bluish grey CLAY		Bulk	S1		
2.00						40	
2.50						28	
				Core	S2		
3.00				Bulk	S3		
						26	
4.00							
4.50							
5.00							

Notes :

Plan Dimensions : 0.75 x 3.0m

Long Axis Direction :

Log Template File : GEOTP3

Plant Type : Wheeled Excavator

Stability : Stable to 3.20m

Groundwater : None

Seepages : Minor at 0.70m

Norwest Holst Soil Engineering Ltd.

TRIAL PIT LOG

Hole ID.
STPF01
Sheet 1 of 1

Contract No.	F15056	Method	Machine Excavated	Coordinates	331111.86 E
Project	New M4 - Second Preliminary Ground Investigation				184775.54 N
		Equipment	JCB 3CX	Ground Level	9.89m AOD
Client	Transport Wales, Welsh Assembly Government			Date Started	07/12/2007
		Logged by	WA	Date Completed	07/12/2007
Consultant	Ove Arup & Partners Ltd				

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		Remarks
MADE GROUND: Tarmacadam.		0.10	9.79			
MADE GROUND: Hardcore.		0.30	9.59	ES1	0.30	
				D2	0.30	
MADE GROUND: Dark brown and black ashy gravelly silt. Gravel sized fragments are angular to subrounded fine to coarse of brick, plastic, polystyrene, ceramic, clinker and wood.				B3	0.30	
				ES4	1.00	
				D5	1.30	
---at 1.80m strong hydrocarbon odour				B6	1.80	
Soft locally firm grey organic CLAY. (Estuarine Alluvium)		2.30	7.59	ES7	2.40	
				D8	2.40	
				B9	2.40	
Trial pit complete at 2.90 m.		2.90	6.99			

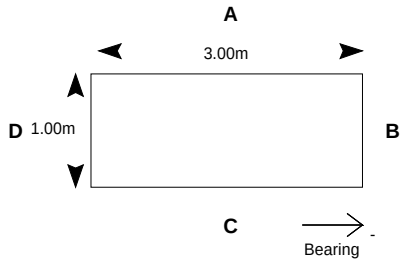
Stability: All faces stable

Shoring: None used

Groundwater: Water strike at 1.50m in face A - moderate

Remarks: 1.Trial pit complete at 2.90m.

Sketch Plan of Trial Pit



NOTES: All depths in metres, all soil strengths in kPa.
See legend sheet for key to symbols and abbreviations.
All bearings given relate to magnetic North

Form	ARIAL TP LOG
Version	3.06
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

HAND VANE AND HAND PENETROMETER TESTS

Hole ID.
STPF01
Data Sheet

Contract No.	F15056	Method	Machine Excavated	Coordinates	331111.86E
Project	New M4 - Second Preliminary Ground Investigation				184775.54 N
		Equipment	JCB 3CX	Ground Level	9.89m AOD
Client	Transport Wales, Welsh Assembly Government			Orientation	Vertical
		Logged by	WA	Date Started	07/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	07/12/2007

Hand Vane				Hand Penetrometer		
Depth	Test No	Peak	Remoulded	Depth	Test No	Result
2.50	01	90.0	90.0			
2.50	02	40.0	0.0			
2.50	03	50.0	20.0			

NOTES: All depths in metres, all diameters in millimetres, test results in kPa.

Form	ARIAL HAND VANE/PEN
Version	3.03
Revised	18/01/2007

Norwest Holst Soil Engineering Ltd.

TRIAL PIT LOG

Hole ID.
STPF02
Sheet 1 of 1

Contract No.	F15056	Method	Machine Excavated	Coordinates	331181.74 E
Project	New M4 - Second Preliminary Ground Investigation				184867.13 N
		Equipment	JCB 3CX	Ground Level	9.70m AOD
Client	Transport Wales, Welsh Assembly Government			Date Started	07/12/2007
		Logged by	WA	Date Completed	07/12/2007
Consultant	Ove Arup & Partners Ltd				

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		Remarks
MADE GROUND: Tarmacadam.		0.10	9.60			
MADE GROUND: Hardcore.		0.30	9.40	ES1 D2 B3	0.30 0.30 0.30	
MADE GROUND: Black slightly clayey gravelly ash. Gravel sized fragments are angular to subrounded fine to coarse of brick, glass and ceramics.		1.00	8.70	ES4 D5 B6	1.00 1.00 1.00	
MADE GROUND: Grey brown slightly sandy slightly gravelly clay. Gravel sized fragments are angular to rounded fine to coarse of brick and limestone.				ES7 D8	2.00 2.00	
Soft locally firm grey organic CLAY. (Estuarine Alluvium)		2.30	7.40	ES9 D10 B11	2.40 2.40 2.40	
Trial pit complete at 3.00 m.		3.00	6.70			

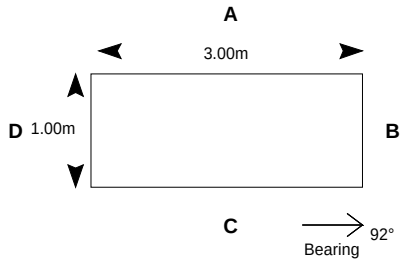
Stability: All faces stable

Shoring: None

Groundwater: Seepage at 1.00m - on face A

Remarks: 1.Trial pit complete at 3.00m.

Sketch Plan of Trial Pit



NOTES: All depths in metres, all soil strengths in kPa.
See legend sheet for key to symbols and abbreviations.
All bearings given relate to magnetic North

Form	ARIAL TP LOG
Version	3.06
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

HAND VANE AND HAND PENETROMETER TESTS

Hole ID.
STPF02
Data Sheet

Contract No.	F15056	Method	Machine Excavated	Coordinates	331181.74E
Project	New M4 - Second Preliminary Ground Investigation				184867.13 N
		Equipment	JCB 3CX	Ground Level	9.70m AOD
Client	Transport Wales, Welsh Assembly Government			Orientation	Vertical
		Logged by	WA	Date Started	07/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	07/12/2007

Hand Vane				Hand Penetrometer		
Depth	Test No	Peak	Remoulded	Depth	Test No	Result
1.00	01	130.0	130.0			
1.00	02	130.0	130.0			
1.00	03	130.0	130.0			
2.00	04	130.0	130.0			
2.00	05	130.0	130.0			
2.00	06	130.0	130.0			
3.00	07	50.0	50.0			
3.00	08	60.0	0.0			
3.00	09	70.0	70.0			

NOTES: All depths in metres, all diameters in millimetres, test results in kPa.

Form	ARIAL HAND VANE/PEN
Version	3.03
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Norwest Holst Soil Engineering Ltd.

TRIAL PIT LOG

Hole ID.
STPF03
Sheet 1 of 1

Contract No.	F15056	Method	Machine Excavated	Coordinates	331312.23 E
Project	New M4 - Second Preliminary Ground Investigation				185004.53 N
		Equipment	JCB 3CX	Ground Level	9.28m AOD
Client	Transport Wales, Welsh Assembly Government			Date Started	20/11/2007
		Logged by	WA	Date Completed	20/11/2007
Consultant	Ove Arup & Partners Ltd				

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		Remarks
MADE GROUND: Dark grey slightly clayey gravelly ash. Gravel sized fragments are angular to subangular fine to coarse of brick, glass, concrete and plastic.				ES1	0.30	
				D2	0.30	
				B3	0.30	
		0.80	8.48			
MADE GROUND: Black gravelly ash. Gravel sized fragments are angular to subangular fine to coarse of concrete, ceramic and glass. With low boulder content, boulder sized fragments are subangular of siltstone.				ES4	0.90	
				D5	0.90	
				B6	0.90	
				ES7	1.90	
				D8	1.90	
				B9	2.40	
		2.50	6.78			
Firm locally soft grey slightly sandy CLAY. (Esturaine Alluvium)				D10	2.60	
				B11	3.60	
				ES12	3.60	
				D13	3.60	
				B14	4.10	
		4.50	4.78			
Trial pit complete at 4.50 m.						

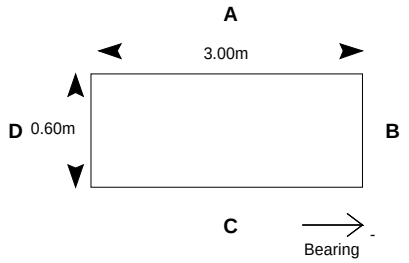
Stability: All faces stable

Shoring: None used

Groundwater: Water strike on faces A and C - moderate to fast

Remarks: 1.Trial pit complete at 4.50m

Sketch Plan of Trial Pit



NOTES: All depths in metres, all soil strengths in kPa.
See legend sheet for key to symbols and abbreviations.
All bearings given relate to magnetic North

Form	ARIAL TP LOG
Version	3.06
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

HAND VANE AND HAND PENETROMETER TESTS

Hole ID.
STPF03
Data Sheet

Contract No.	F15056	Method	Machine Excavated	Coordinates	331312.23E
Project	New M4 - Second Preliminary Ground Investigation				185004.53 N
		Equipment	JCB 3CX	Ground Level	9.28m AOD
Client	Transport Wales, Welsh Assembly Government			Orientation	Vertical
		Logged by	WA	Date Started	20/11/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	20/11/2007

Hand Vane				Hand Penetrometer		
Depth	Test No	Peak	Remoulded	Depth	Test No	Result
3.00	01	80.0	40.0			
3.00	02	70.0	60.0			
3.00	03	90.0	75.0			
4.00	04	40.0	20.0			
4.00	05	20.0	0.0			
4.00	06	20.0	0.0			

NOTES: All depths in metres, all diameters in millimetres, test results in kPa.

Form	ARIAL HAND VANE/PEN
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Norwest Holst Soil Engineering Ltd.

TRIAL PIT LOG

Hole ID.
STPF04
Sheet 1 of 1

Contract No.	F15056	Method	Machine Excavated	Coordinates	331391.63 E
Project	New M4 - Second Preliminary Ground Investigation				185073.40 N
		Equipment	JCB 3CX	Ground Level	9.23m AOD
Client	Transport Wales, Welsh Assembly Government			Date Started	05/12/2007
		Logged by	WA	Date Completed	05/12/2007
Consultant	Ove Arup & Partners Ltd				

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		Remarks
MADE GROUND: Reinforced concrete.		0.15	9.08			
MADE GROUND: Black compacted gravelly ash. Gravel sized fragments are angular to subangular fine to coarse of glass, concrete, limestone and mixed lithologies.				ES1 D2 B3	0.20 0.20 0.20	
				ES4	1.00	
				D5	1.30	
				B6	1.80	
				ES7	2.00	
				D8	2.30	
				ES9	3.00	
---from 3.20m strong hydrocarbon odour				D10 B11	3.30 3.30	
Stiff grey brown slightly sandy CLAY. (Estuarine Alluvium)		3.70	5.53	D12 B13	3.70 3.70	
Trial pit complete at 4.20 m.		4.20	5.03			

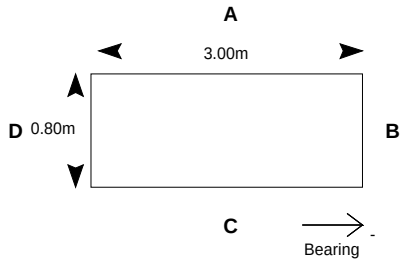
Stability: All faces stable

Shoring: None used

Groundwater: Water strike at 2.00m on face A - slow

Remarks: 1.Trial pit complete at 4.20m.

Sketch Plan of Trial Pit



NOTES: All depths in metres, all soil strengths in kPa.
See legend sheet for key to symbols and abbreviations.
All bearings given relate to magnetic North

Form	ARIAL TP LOG
Version	3.06
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

HAND VANE AND HAND PENETROMETER TESTS

Hole ID.
STPF04
Data Sheet

Contract No.	F15056	Method	Machine Excavated	Coordinates	331391.63E
Project	New M4 - Second Preliminary Ground Investigation				185073.40 N
		Equipment	JCB 3CX	Ground Level	9.23m AOD
Client	Transport Wales, Welsh Assembly Government			Orientation	Vertical
		Logged by	WA	Date Started	05/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	05/12/2007

Hand Vane				Hand Penetrometer		
Depth	Test No	Peak	Remoulded	Depth	Test No	Result
4.00	01	130.0	130.0			
4.00	02	130.0	130.0			
4.00	03	130.0	130.0			

NOTES: All depths in metres, all diameters in millimetres, test results in kPa.

Form	ARIAL HAND VANE/PEN
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Norwest Holst Soil Engineering Ltd.

TRIAL PIT LOG

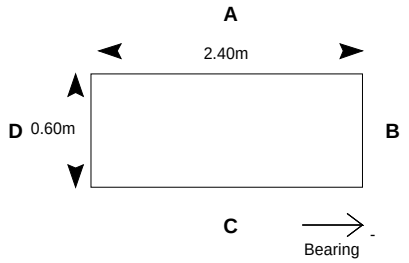
Hole ID.
STPF05
Sheet 1 of 1

Contract No.	F15056	Method	Machine Excavated	Coordinates	331450.12 E
Project	New M4 - Second Preliminary Ground Investigation				185144.53 N
		Equipment	JCB 3CX	Ground Level	8.67m AOD
Client	Transport Wales, Welsh Assembly Government			Date Started	05/12/2007
		Logged by	WA	Date Completed	05/12/2007
Consultant	Ove Arup & Partners Ltd				

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		Remarks
MADE GROUND: Paving slabs.		0.10	8.57			
MADE GROUND: Hardcore.		0.30	8.37	D1 B2 ES3	0.30 0.30 0.30	From 0.40m to 1.80m slight hydrocarbon smell
MADE GROUND: Black very gravelly ash. Gravel sized fragments are angular to subrounded fine to coarse of clinker, brick and coal. ---at 0.60m concrete in southeast wall				ES4 D5	1.00 1.30	
Stiff grey brown slightly sandy CLAY with occasional organic matter. (Estuarine Alluvium)		1.80	6.87	D6 B7 ES9	1.80 1.80 1.80	
Trial pit complete at 2.30 m.		2.30	6.37			

Stability	All faces stable
Shoring	None used
Groundwater	Water strike at 0.70m on face B - fast
Remarks	1.Trial pit terminated at 2.30m.

Sketch Plan of Trial Pit



NOTES: All depths in metres, all soil strengths in kPa.
See legend sheet for key to symbols and abbreviations.
All bearings given relate to magnetic North

Form	ARIAL TP LOG
Version	3.06
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

HAND VANE AND HAND PENETROMETER TESTS

Hole ID.
STPF05
Data Sheet

Contract No.	F15056	Method	Machine Excavated	Coordinates	331450.12E
Project	New M4 - Second Preliminary Ground Investigation				185144.53 N
		Equipment	JCB 3CX	Ground Level	8.67m AOD
Client	Transport Wales, Welsh Assembly Government			Orientation	Vertical
		Logged by	WA	Date Started	05/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	05/12/2007

Hand Vane				Hand Penetrometer		
Depth	Test No	Peak	Remoulded	Depth	Test No	Result
2.00	01	130.0	130.0			
2.00	02	130.0	130.0			
2.00	03	130.0	130.0			

NOTES: All depths in metres, all diameters in millimetres, test results in kPa.

Form	ARIAL HAND VANE/PEN
Version	3.03
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Norwest Holst Soil Engineering Ltd.

TRIAL PIT LOG

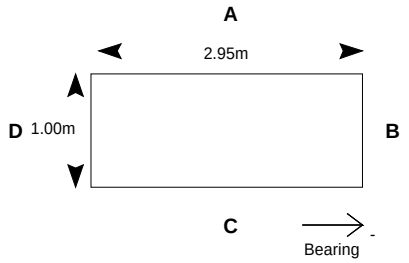
Hole ID.
STPF06
Sheet 1 of 1

Contract No.	F15056	Method	Machine Excavated	Coordinates	331512.15 E
Project	New M4 - Second Preliminary Ground Investigation				185169.65 N
		Equipment	JCB 3CX	Ground Level	9.27m AOD
Client	Transport Wales, Welsh Assembly Government			Date Started	11/12/2007
		Logged by	GS	Date Completed	11/12/2007
Consultant	Ove Arup & Partners Ltd				

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		Remarks
MADE GROUND:Tarmacadam.		0.15	9.12			
MADE GROUND: Concrete.		0.38	8.89	ES1	0.30	
				ES2	0.38	
MADE GROUND: Dark reddish brown silty slightly sandy slightly gravelly clay. With low cobble content. Gravel sized fragments are angular fine to coarse of brick, concrete and clay pipe. Cobble sized fragments are angular to subangular of brick and concrete.				D3	0.38	
				B4	0.38	
				B5	1.10 - 1.24	
				D6	1.24	
				ES7	1.24	
		1.62	7.65	B8	1.60 - 1.64	
MADE GROUND Light grey clay with frequent coarse gravel sized lenses and cobble sized pockets of organic material ---at 1.68m south face concrete slab		1.69	7.58	ES9	1.64	
				D10	1.64	
Very soft light grey CLAY. With frequent coarse gravel sized lenses and cobble sizes pockets of dark brown and black organic material. (Estuarine Alluvium)				B11	2.50 - 2.64	
		2.64	6.63	D12	2.64	
				B13	2.64 - 2.86	
Soft light brown to reddish brown mottled grey gravelly CLAY. Gravel is angular fine to coarse of mudstone. (Estuarine Alluvium)		2.86	6.41	D14	2.86	
Trial pit complete at 2.86 m.						

Stability	All faces stable
Shoring	None used
Groundwater	Slight seepage at 2.64m
Remarks	1.Trial pit complete at 2.86m.

Sketch Plan of Trial Pit



NOTES: All depths in metres, all soil strengths in kPa.
See legend sheet for key to symbols and abbreviations.
All bearings given relate to magnetic North

Form	ARIAL TP LOG
Version	3.06
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

TRIAL PIT LOG

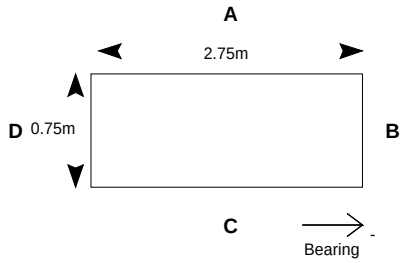
Hole ID.
STPF07
Sheet 1 of 1

Contract No.	F15056	Method	Machine Excavated	Coordinates	331613.65 E
Project	New M4 - Second Preliminary Ground Investigation				185207.82 N
		Equipment	JCB 3CX	Ground Level	10.73m AOD
Client	Transport Wales, Welsh Assembly Government			Date Started	10/12/2007
		Logged by	GS	Date Completed	10/12/2007
Consultant	Ove Arup & Partners Ltd				

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		Remarks
MADE GROUND: Tarmacadam.		0.01	10.72			
MADE GROUND: Concrete.		0.30	10.43	ES1 D2 B3	0.30 0.30 0.30	
MADE GROUND: Dark brown slightly clayey angular to subangular medium to coarse gravel sized fragments of sandstone and mudstone. With low cobble content cobbles sized fragments are subangular of concrete.		0.77	9.96	B4 D5 B6	0.80 - 0.89 0.89 1.00 - 1.45	
MADE GROUND: Light grey slightly sandy angular fine to coarse gravel sized fragments of slag, clinker and concrete. With low cobble content, cobble sized fragments are subangular of slag and concrete. With frequent strips of metal and coarse gravel sized pockets of light brown fine to medium sand. ---at 0.77m plastic mesh				D7 ES8 D9 B10 ES11 D12 B13	1.40 1.45 2.00 2.00 2.00 2.60 2.60 - 2.67	
Trial pit complete at 3.11 m.		3.11	7.62	D14	3.11	

Stability	Slight collapse on all faces
Shoring	None used
Groundwater	Water strike at 1.40m on all faces - moderate (slight hydrocarbon sheen)
Remarks	1.Trial pit terminated at 3.11m due to collapse.

Sketch Plan of Trial Pit



NOTES: All depths in metres, all soil strengths in kPa.
See legend sheet for key to symbols and abbreviations.
All bearings given relate to magnetic North

Form	ARIAL TP LOG
Version	3.06
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

TRIAL PIT LOG

Hole ID.
STPF08
Sheet 1 of 1

Contract No.	F15056	Method	Machine Excavated	Coordinates	331761.05 E
Project	New M4 - Second Preliminary Ground Investigation				185266.94 N
		Equipment	JCB 3CX	Ground Level	9.10m AOD
Client	Transport Wales, Welsh Assembly Government			Date Started	20/11/2007
		Logged by	WA	Date Completed	20/11/2007
Consultant	Ove Arup & Partners Ltd				

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		Remarks
MADE GROUND: Tarmacadam.		0.15	8.95	ES1	0.20	
MADE GROUND: Brown and black silty fine to coarse sand and subangular to subrounded fine to medium gravel sized fragments of ceramic, siltstone, mudstone and tarmacadam.		0.60	8.50	D2 B3	0.20 0.20	
		0.80	8.30	D4 B5	0.80 0.80	
MADE GROUND: Grey slightly sandy clay. ---at 0.70m ceramic drain and blue plastic pipe						
Stiff grey slightly sandy CLAY. (Estuarine Alluvium) ---from 1.20m soft with occasional cobble sized pockets of sandy clay				ES6 D7	1.60 1.80	
---from 2.00m firm bluish grey				B8	2.30	
				D9	2.80	
---at 3.80m frequent organic material				B10 D11	3.80 3.80	
Trial pit complete at 4.50 m.		4.50	4.60			

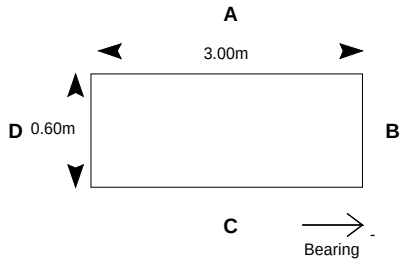
Stability: All faces stable

Shoring: None used

Groundwater: None encountered during excavation

Remarks:
1. 80mm black ducted electrical cable noted at corner of faces D and A at 0.70m.
2. Trial pit complete at 4.50m.

Sketch Plan of Trial Pit



NOTES: All depths in metres, all soil strengths in kPa.
See legend sheet for key to symbols and abbreviations.
All bearings given relate to magnetic North

Form	ARIAL TP LOG
Version	3.06
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

HAND VANE AND HAND PENETROMETER TESTS

Hole ID.
STPF08
Data Sheet

Contract No.	F15056	Method	Machine Excavated	Coordinates	331761.05E
Project	New M4 - Second Preliminary Ground Investigation				185266.94 N
		Equipment	JCB 3CX	Ground Level	9.10m AOD
Client	Transport Wales, Welsh Assembly Government			Orientation	Vertical
		Logged by	WA	Date Started	20/11/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	20/11/2007

Hand Vane				Hand Penetrometer		
Depth	Test No	Peak	Remoulded	Depth	Test No	Result
2.00	01	130.0	100.0			
2.00	02	130.0	130.0			
2.00	03	130.0	110.0			
3.00	04	130.0	130.0			
3.00	05	130.0	100.0			
3.00	06	130.0	130.0			
4.00	07	40.0	0.0			
4.00	08	30.0	0.0			
4.00	09	30.0	0.0			

NOTES: All depths in metres, all diameters in millimetres, test results in kPa.

Form	ARIAL HAND VANE/PEN
Version	3.03
Revised	18/01/2007

Norwest Holst Soil Engineering Ltd.

TRIAL PIT LOG

Hole ID.
STPF09
Sheet 1 of 1

Contract No.	F15056	Method	Machine Excavated	Coordinates	331870.83 E
Project	New M4 - Second Preliminary Ground Investigation				185323.27 N
		Equipment	JCB 3CX	Ground Level	8.86m AOD
Client	Transport Wales, Welsh Assembly Government			Date Started	20/11/2007
		Logged by	WA	Date Completed	20/11/2007
Consultant	Ove Arup & Partners Ltd				

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		Remarks
MADE GROUND: Tarmacadam.		0.08	8.78			
MADE GROUND: Hardcore.		0.15	8.71			
				ES1	0.30	
				D2	0.30	
MADE GROUND: Black silty fine to coarse sand and angular to subangular fine to coarse gravel sizeed fragments of glass, limestone, ash and brick.				B3	0.30	
		0.90	7.96	ES4	0.90	
---at 0.60m disused rubber encased copper cable		1.00	7.86			
				D5	1.10	
				B6	1.10	
Possible MADE GROUND: Light brown fine to coarse sand and subangular to rounded fine to coarse gravel sized fragments of sandstone and mudstone.						
Firm locally soft bluish grey slightly sandy CLAY. (Estuarine Alluvium)						
				ES7	2.10	
				D8	2.10	
				B9	2.60	
				D10	3.10	
				B11	4.10	
Trial pit complete at 4.50 m.		4.50	4.36			

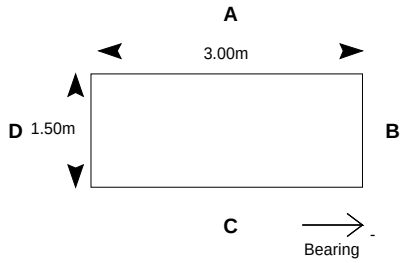
Stability: All faces stable

Shoring: None used

Groundwater: None encountered during excavation

Remarks: 1.Trial pit complete at 4.50m.

Sketch Plan of Trial Pit



NOTES: All depths in metres, all soil strengths in kPa.
See legend sheet for key to symbols and abbreviations.
All bearings given relate to magnetic North

Form	ARIAL TP LOG
Version	3.06
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

HAND VANE AND HAND PENETROMETER TESTS

Hole ID.
STPF09
Data Sheet

Contract No.	F15056	Method	Machine Excavated	Coordinates	331870.83E
Project	New M4 - Second Preliminary Ground Investigation				185323.27 N
		Equipment	JCB 3CX	Ground Level	8.86m AOD
Client	Transport Wales, Welsh Assembly Government			Orientation	Vertical
		Logged by	WA	Date Started	20/11/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	20/11/2007

Hand Vane				Hand Penetrometer		
Depth	Test No	Peak	Remoulded	Depth	Test No	Result
2.00	01	100.0	70.0			
2.00	02	100.0	90.0			
2.00	03	110.0	110.0			
3.00	04	80.0	10.0			
3.00	05	90.0	50.0			
3.00	06	60.0	10.0			
4.00	07	40.0	0.0			
4.00	08	30.0	0.0			
4.00	09	20.0	10.0			

NOTES: All depths in metres, all diameters in millimetres, test results in kPa.

Form	ARIAL HAND VANE/PEN
Version	3.03
Revised	18/01/2007

Norwest Holst Soil Engineering Ltd.

TRIAL PIT LOG

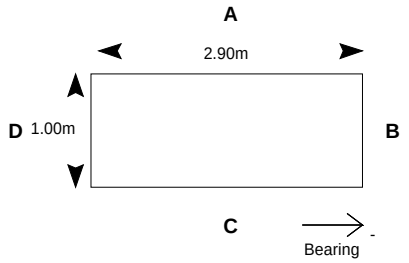
Hole ID.
STPF10
Sheet 1 of 1

Contract No.	F15056	Method	Machine Excavated	Coordinates	332041.63 E
Project	New M4 - Second Preliminary Ground Investigation				185348.73 N
		Equipment	JCB 3CX	Ground Level	8.69m AOD
Client	Transport Wales, Welsh Assembly Government			Date Started	06/12/2007
		Logged by	WA	Date Completed	06/12/2007
Consultant	Ove Arup & Partners Ltd				

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		Remarks
MADE GROUND: Tarmacadam.		0.10	8.59			
MADE GROUND: Dark grey angular to subangular fine to coarse gravel sized fragments of limestone. (Hardcore)		0.30	8.39	ES1 D2 B3	0.30 0.30 0.30	
MADE GROUND: Black sandy gravel sized fragments are angular to subrounded fine to coarse of siltstone, limestone, ash and glass.		1.00	7.69	ES4 D5 B6	1.00 1.00 1.00	
Light brown fine to medium SAND. (River Terrace Deposits)						
Trial pit complete at 2.00 m.		2.00	6.69	D7	2.00	

Stability	Collapse below 1.00m on all faces
Shoring	None used
Groundwater	Water strike at 1.20m from all sides - fast
Remarks	1.Trial pit complete at 2.00m.

Sketch Plan of Trial Pit



NOTES: All depths in metres, all soil strengths in kPa.
See legend sheet for key to symbols and abbreviations.
All bearings given relate to magnetic North

Form	ARIAL TP LOG
Version	3.06
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHF03 CP
Header

Contract No.	F15056	Method	Cable Percussion	Coordinates	331258.54 E
Project	New M4 - Second Preliminary Ground Investigation				184969.02 N
		Drilling Rig	Dando	Ground Level	9.88m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	PW	Orientation	Vertical
		Logged by	JB	Date Started	20/11/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	24/11/2007

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
20/11/2007	1730	8.00	8.00	DRY	End of Shift
21/11/2007	0730	8.00	8.00	DRY	Start of Shift
21/11/2007	1730	14.80	14.80	9.50	End of Shift
22/11/2007	0730	14.80	14.80	8.40	Start of Shift
22/11/2007	1730	18.00	18.00	9.50	End of Shift
23/11/2007	0730	18.00	18.00	8.50	Start of Shift
23/11/2007	1730	21.00	21.00	9.50	End of Shift
24/11/2007	0730	22.00	21.00	8.40	Start of Shift
24/11/2007	1730	23.30	23.10	9.80	End of hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks
14.00	14.80	2.25	Chiselling
17.20	17.30	0.75	Chiselling
17.80	17.90	0.83	Chiselling
18.00	18.65	5.00	Chiselling
21.30	22.20	2.50	Chiselling
23.10	23.30	1.00	Chiselling

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
200	3.50	200	3.50
150	23.30	150	23.10

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
21/11/2007		12.80	9.50	20	Rapid	12.80	NR

GENERAL NOTES

1. Service inspection pit hand excavated from GL to 1.20m.
2. Cable Percussive boring complete at 23.30m.
3. Insitu permeability testing carried out from 13.80m to 14.80m.
4. Borehole grouted upon completion.

SPT DETAILS

Depth	Type	Incremental blow count/penetration	Casing	Water Depth
1.20	S	N=47 (3,7,16,17,6,8)	1.20	DRY
2.20	S	N=42 (6,7,9,9,12,12)	2.20	DRY
4.00	S	N=7 (1,2,2,1,2,2)	3.50	DRY
6.00	S	N=6 (1,1,1,2,2,1)	5.50	DRY
8.00	S	N=8 (1,1,2,2,2,2)	8.00	DRY
10.00	S	N=10 (1,2,2,2,3,3)	9.50	DRY
12.00	S	N=11 (1,2,3,3,2,3)	11.50	DRY
13.00	C	N=35 (6,6,7,9,9,10)	13.00	9.50
15.00	C	N=53 (9,11,11,14,12,16)	15.00	8.50
17.00	C	65/155mm (8,8,15,50)	17.00	8.50
18.40	C	50/0mm (25,0,50)	18.40	8.50
19.00	C	N=48 (9,10,10,15,11,12)	19.00	8.90
20.50	S	50/235mm (9,11,11,12,18,9)	20.50	8.50
22.50	S	50/95mm (9,15,21,29)	22.50	8.70
23.30	S	50/15mm (25,50)	23.00	8.90

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes, chiselling time in hours.

Form	ARIAL CP HEADER
Version	3.05
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHF03 CP
Sheet 1 of 3

Contract No.	F15056	Method	Cable Percussion	Coordinates	331258.54 E
Project	New M4 - Second Preliminary Ground Investigation				184969.02 N
		Drilling Rig	Dando	Ground Level	9.88m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	PW	Orientation	Vertical
		Logged by	JB	Date Started	20/11/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	24/11/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Dark brown slightly sandy slightly gravelly silt. Gravel sized fragments are subangular to subrounded fine to coarse of slag, concrete, brick, metal and sandstone.				ES1	0.30				
				ES2	1.00				
				D3	1.00				
				D4	1.20	S47	S	1.20	1.65
---at 2.00m locally brown with rebar				D5	2.00				
				ES6	2.00				
				B7	2.00	S42	S	2.20	2.65
				D8	2.20				
Soft to firm medium strength greyish brown slightly sandy silty CLAY with abundant organic material. (Estuarine Alluvium)		3.00	6.88	D9	3.00				
				ES10	3.00				
				U11	3.50				
Soft to firm brown locally mottled grey slightly sandy CLAY. (Estuarine Alluvium)		4.00	5.88	D12	4.00	S7	S	4.00	4.45
				ES13	4.00				
---from 4.00m locally speckled black				D14	4.00				
				D15	5.00				
				U16	5.50				
Soft to firm grey very silty slightly sandy CLAY with rare organic material (rootlets) and frequent coarse gravel sized lenses of fine to coarse sand. (Estuarine Alluvium)		6.00	3.88	D17	6.00	S6	S	6.00	6.45
				D18	6.00				
				D19	6.00				
				D20	7.00				
				U21	7.50				
---from 7.66m to 7.76m compact grey silt ---at 7.73m 4no extremely closely spaced fine gravel sized shells.		7.76	2.12						
				D22	8.00	S8	S	8.00	8.45
				D23	8.00				
Very soft to soft greyish brown locally black silty CLAY with organic odour. (Estuarine Alluvium)									
				D24	9.00				
---from 9.00m becomes soft dark grey black ---from 9.00m to 10.00m with occasional of organic material				U25	9.50				

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHF03 CP
Sheet 2 of 3

Contract No.	F15056	Method	Cable Percussion	Coordinates	331258.54 E
Project	New M4 - Second Preliminary Ground Investigation				184969.02 N
		Drilling Rig	Dando	Ground Level	9.88m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	PW	Orientation	Vertical
		Logged by	JB	Date Started	20/11/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	24/11/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
Very soft to soft greyish brown locally black silty CLAY with organic odour. (Estuarine Alluvium)				D26	10.00	S10	S	10.00 10.45	
				D27	10.00				
				U28	11.50				
				D29	12.00	S11	S	12.00 12.45	
				D30	12.00				
		12.80	-2.92						
Dense brown slightly sandy clayey subangular to subrounded fine to coarse GRAVEL with low cobble content. Gravel is of siltstone and sandstone. Cobbles are subangular of siltstone. (Fluvial Alluvium)				D31	13.00	C35	C	13.00 13.45	
		13.80	-3.92						
Dense grey very gravelly fine to coarse SAND with low cobble content. Gravel is angular to rounded fine to coarse of silstone and sandstone. Cobbles are subangular of siltstone and sandstone. (Fluvial Alluvium)				D32	14.00				
---from 15.00m very dense				D33	15.00	C53	C	15.00 15.45	
				D34	16.00				
				B35	16.00				
				D36	17.00	C65/155mm	C	17.00 17.31	
		17.80	-7.92						
Dense grey and brown gravelly fine to coarse SAND. Gravel is subangular to rounded fine to coarse of sandstone and siltstone. (Fluvial Alluvium)				D37	18.00				
						C50/0mm	C	18.40 18.63	
		19.00	-9.12	D38	19.00	C48	C	19.00 19.45	
Dense reddish brown medium to coarse SAND and angular to rounded fine to coarse GRAVEL of sandstone and siltstone. With low cobble content, cobbles are subangular of sandstone and siltstone. (Fluvial Alluvium)									
		19.90	-10.02						

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHF03 CP
Sheet 3 of 3

Contract No.	F15056	Method	Cable Percussion	Coordinates	331258.54 E
Project	New M4 - Second Preliminary Ground Investigation				184969.02 N
		Drilling Rig	Dando	Ground Level	9.88m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	PW	Orientation	Vertical
		Logged by	JB	Date Started	20/11/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	24/11/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
Very stiff reddish brown mottled grey CLAY (Weathered Mudstone). (Mercia Mudstone Group)									
---from 19.90m to 20.00m sandy				D40	20.50	S50/235mm	S	20.50 20.89	
---from 21.00m to 21.30m stiff				D41	21.00				
---from 21.30m to 22.20m slightly gravelly. Gravel is subangular fine to medium of mudstone and siltstone				D42	22.00				
				D43	22.50	S50/95mm	S	22.50 22.75	
		23.00	-13.12	D44	23.00				
Weak reddish brown mottled greenish grey locally speckled white MUDSTONE. Recovered as angular medium to coarse gravel sized fragments with frequent gypsum crystals. (Mercia Mudstone Group)		23.30	-13.42	D45	23.30	S50/15mm	S	23.30 23.33	
Cable Percussion boring complete at 23.30 m.									

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - ROTARY

Hole ID.
SBHF03 RC
Header

Contract No.	F15056	Method	Rotary Coring	Coordinates	331257.03 E
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	T30		184970.61 N
		Driller	CB	Ground Level	10.03m AOD
Client	Transport Wales, Welsh Assembly Government	Logged by	DH	Orientation	Vertical
		Core barrel	T6116	Date Started	29/11/2007
Consultant	Ove Arup & Partners Ltd	Core bit	TC	Date Completed	04/12/2007

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
29/11/2007	1730	6.00	6.00	DRY	End of Shift
30/11/2007	0730	6.00	6.00	DRY	Start of Shift
30/11/2007	1730	23.00	22.00	15.45	End of Shift
03/12/2007	0730	23.00	22.00	7.10	Start of Shift
03/12/2007	1730	28.00	22.00	7.60	End of Shift
04/12/2007	0730	28.00	22.00	6.80	Start of Shift
04/12/2007	1730	40.00	22.00	7.50	End of Hole

DRILLING DETAILS

From depth	To depth	Flush type	Flush return	Core diameter
0.00	22.00	Air/Mist	Good	0.00*
22.00	40.00	Air/Mist	Good	92.0

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
121	40.00	121	22.00

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
30/11/2007	1030	14.50	NR	NR	Heavy	14.50	19.80

GENERAL NOTES

1. Rotary Openhole drilling from GL to 22.00m.
2. Rotary Coring complete at 40.00m.
3. 19mm diameter piezometer installed, tip at 18.00m, with response zone from 17.60m to 18.20m.
4. 0.00* indicates openhole drilling.

SPT DETAILS

Depth	Type	Incremental blow count/penetration	Casing	Water Depth
23.00	S	100/195mm (9,16,25,35,40)	22.00	7.60
25.00	S	100/170mm (11,14,28,36,36)	22.00	7.60

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes.

Form	ARIAL ROTARY HEADER
Version	3.06
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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - ROTARY

Hole ID.
SBHF03 RC
Sheet 1 of 4

Contract No.	F15056	Method	Rotary Coring	Coordinates	331257.03 E
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	T30		184970.61 N
		Driller	CB	Ground Level	10.03m AOD
Client	Transport Wales, Welsh Assembly Government	Logged by	DH	Orientation	Vertical
		Core barrel	T6116	Date Started	29/11/2007
Consultant	Ove Arup & Partners Ltd	Core bit	TC	Date Completed	04/12/2007

Description of Strata	Legend	Drilled Length	Datum Level	Coring and Sampling	TCR	SCR	RQD	IF	SPT N & depth	Install-ation
MADE GROUND: Fill. (Driller's description)										
		3.00	7.03							
Grey CLAY. (Driller's description)										

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - ROTARY

Hole ID.
SBHF03 RC
Sheet 2 of 4

Contract No.	F15056	Method	Rotary Coring	Coordinates	331257.03 E
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	T30		184970.61 N
		Driller	CB	Ground Level	10.03m AOD
Client	Transport Wales, Welsh Assembly Government	Logged by	DH	Orientation	Vertical
		Core barrel	T6116	Date Started	29/11/2007
Consultant	Ove Arup & Partners Ltd	Core bit	TC	Date Completed	04/12/2007

Description of Strata	Legend	Drilled Length	Datum Level	Coring and Sampling	TCR	SCR	RQD	IF	SPT N & depth	Install-ation
Grey CLAY. (Driller's description)		12.00	-1.97							
Claybound GRAVEL. (Driller's description)		15.70	-5.67							
Claybound SAND, GRAVELS. (Driller's description)		17.50	-7.47							
SAND, GRAVELS. (Driller's description)		19.80	-9.77							

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - ROTARY

Hole ID.
SBHF03 RC
Sheet 3 of 4

Contract No.	F15056	Method	Rotary Coring	Coordinates	331257.03 E
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	T30		184970.61 N
		Driller	CB	Ground Level	10.03m AOD
Client	Transport Wales, Welsh Assembly Government	Logged by	DH	Orientation	Vertical
		Core barrel	T6116	Date Started	29/11/2007
Consultant	Ove Arup & Partners Ltd	Core bit	TC	Date Completed	04/12/2007

Description of Strata	Legend	Drilled Length	Datum Level	Coring and Sampling		TCR	SCR	RQD	IF	SPT N & depth	Install-ation
Soft MARL. (Driller's description) (Mercia Mudstone Group)											
		22.00	-11.97								
Zone of Core Loss. MARL. (Driller's description)				22.00	23.00	0	0	0	NA		
		23.00	-12.97							23.00 23.32 S100/195mm	
Extremely weak to very weak reddish brown mottled greenish grey MUDSTONE. Recovered as non intact core (gravelly clay. Gravel sized fragments are angular fine to coarse). (Mercia Mudstone Group) ---from 23.30m to 23.50m assumed zone of core loss ---from 23.55m to 24.00m assumed zone of core loss				23.00	23.50	60	0	0			
				23.50	24.00	100	0	0	NI NI NI		
---from 24.15m to 24.50m assumed zone of core loss				24.00	24.50	30	0	0			
		24.50	-14.47								
Zone of Core Loss. MARL. (Driller's description)				24.50	25.00	0	0	0	NA		
		25.00	-14.97							25.00 25.28 S100/170mm	
Extremely weak to very weak reddish brown MUDSTONE. Discontinuities: 1) 0 -15 deg extremely closely to closely locally medium spaced undulating and planar rough locally infilled with clay. (Mercia Mudstone Group) ---from 25.00m to 27.05m recovered as non intact core (gravelly clay. Gravel sized fragments are angular fine to coarse) ---from 25.48m to 26.00m assumed zone of core loss ---from 26.61m to 27.00m assumed zone of core loss.				25.00	26.00	48	0	0			
				26.00	27.00	61	2	0	NI NI 20		
---from 27.24m to 27.29m recovered as non intact core (gravelly clay. Gravel sized fragments are angular fine to coarse) ---from 27.29m to 27.50m assumed zone of core loss ---from 27.50m to 28.66m recovered as non intact core (clayey slightly sandy fine to coarse gravel sized fragments) ---from 27.86m to 28.00m assumed zone of core loss. ---from 28.76m to 29.00m assumed zone of core loss ---from 29.00m to 29.87m recovered as non intact core (angular fine to coarse gravel sized fragments)				27.00	27.50	58	38	38			
				27.50	28.00	72	18	0			
				28.00	29.00	76	10	0	NI NI 90		
				29.00	30.00	100	13	0			

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Version	3.09
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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - ROTARY

Hole ID.
SBHF03 RC
Sheet 4 of 4

Contract No.	F15056	Method	Rotary Coring	Coordinates	331257.03 E
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	T30		184970.61 N
		Driller	CB	Ground Level	10.03m AOD
Client	Transport Wales, Welsh Assembly Government	Logged by	DH	Orientation	Vertical
		Core barrel	T6116	Date Started	29/11/2007
Consultant	Ove Arup & Partners Ltd	Core bit	TC	Date Completed	04/12/2007

Description of Strata	Legend	Drilled Length	Datum Level	Coring and Sampling		TCR	SCR	RQD	IF	SPT N & depth	Install-ation
Extremely weak to very weak reddish brown MUDSTONE. Discontinuities: 1) 0 -15 deg extremely closely to closely locally medium spaced undulating and planar rough locally infilled with clay. (Mercia Mudstone Group)				30.00	31.50	77	47	25			
---from 30.00m to 30.26m recovered as non intact core (angular coarse gravel sized fragments)											
---from 30.26m discontinuity: 1) 10-20 deg very closely to closely spaced locally medium spaced undulating smooth locally clay and gypsum infilled											
---from 30.45m to 30.65m recovered as non intact core (gravelly clay. Gravel sized fragments are angular fine to coarse)											
---from 30.75m to 30.85m recovered as non intact core (angular coarse gravel sized fragments)				31.50	33.00	97	75	29			
---from 31.15m to 31.20m recovered as non intact core (angular coarse gravel sized fragments)											
---from 31.50m to 31.60m recovered as non intact core (subangular fine to coarse gravel sized fragments)											
---from 32.88m to 32.95m recovered as non intact core (clayey angular fine to coarse gravel sized fragments)									NI 100 310		
---from 33.00m to 33.20m recovered as non intact core				33.00	34.60	100	63	44			
---from 34.18m to 34.20m recovered as non intact core (subangular medium to coarse gravel sized fragments)											
---from 34.20m to 34.36m 1 No discontinuity 50-60 deg undulating rough											
---from 34.27m to 34.39m recovered as non intact core (subangular fine to medium gravel sized fragments)											
---from 35.00m to 35.05m recovered as non intact core (angular to subangular fine to coarse gravel sized fragments)				34.60	36.10	100	64	43			
---from 35.17m to 35.19m recovered as non intact core (angular medium gravel sized fragments)											
---from 35.65m to 35.71m 1 No discontinuity 70-80 deg undulating smooth clean											
---from 35.82m to 36.00m 1 No discontinuity 60-70 deg undulating smooth locally clay infilled				36.10	37.60	100	33	24			
---from 37.00m to 37.17m recovered as non intact core (clayey fine to medium gravel sized fragments)									NI NI NI		
---from 37.33m to 38.06m recovered as non intact core (angular fine to coarse gravel sized fragments)											
---from 38.30m greenish grey locally reddish brown				37.60	39.00	99	43	8			
---from 38.54m to 38.59m recovered as non intact core (angular coarse gravel sized fragments)											
---from 38.72m to 38.77m recovered as non intact core (angular fine to coarse gravel sized fragments)									NI 40 110		
---from 39.12m to 39.20m recovered as non intact core (slightly clayey subangular coarse gravel sized fragments)				39.00	40.00	100	46	10			
---from 39.45m to 39.65m recovered as non intact core											

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - ROTARY

Hole ID.
SBHF03 RC
Sheet 4+ of 4

Contract No.	F15056	Method	Rotary Coring	Coordinates	331257.03 E
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	T30		184970.61 N
		Driller	CB	Ground Level	10.03m AOD
Client	Transport Wales, Welsh Assembly Government	Logged by	DH	Orientation	Vertical
		Core barrel	T6116	Date Started	29/11/2007
Consultant	Ove Arup & Partners Ltd	Core bit	TC	Date Completed	04/12/2007

Description of Strata	Legend	Drilled Length	Datum Level	Coring and Sampling	TCR	SCR	RQD	IF	SPT N & depth	Install-ation
Remaining Detail : 39.45m - 39.65m : (angular fine to coarse gravel sized fragments)		40.00	-29.97							
Rotary drilling complete at 40.00 m.										

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL ROTARY LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHF02 CP
Header

Contract No.	F15056	Method	Cable Percussion	Coordinates	331024.29 E
Project	New M4 - Second Preliminary Ground Investigation				184676.28 N
		Drilling Rig	Dando 2000	Ground Level	9.16m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	SJ	Orientation	Vertical
		Logged by	DH	Date Started	12/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	12/12/2007

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
12/12/2007	1730	1.35	NR	DRY	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks
1.35	1.35	1.00	Chiselling

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
200	40.00	200	19.30

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Service inspection pit hand excavated from GL to 1.20m.
2. Cable Percussive boring terminated at 1.35m due to obstruction.
3. Refer to SBHF02ACP for redrill.

SPT DETAILS

Depth	Type	Incremental blow count/penetration	Casing	Water Depth
1.10	S	50/75mm (25,50)	0.00	DRY

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes, chiselling time in hours.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHF02 CP
Sheet 1 of 1

Contract No.	F15056	Method	Cable Percussion	Coordinates	331024.29 E
Project	New M4 - Second Preliminary Ground Investigation				184676.28 N
		Drilling Rig	Dando 2000	Ground Level	9.16m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	SJ	Orientation	Vertical
		Logged by	DH	Date Started	12/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	12/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Brown slightly sandy slightly gravelly clay. Sand sized fragments are fine to coarse. Gravel sized fragments are angular to subangular fine to medium of mudstone, brick, timber and ash.				B3	0.00 - 1.20				
				D1	0.30				
				D2	1.00				
				D4	1.20 - 1.35	S50/75mm	S	1.10 1.25	
Cable Percussion boring complete at 1.35 m.		1.35	7.81						

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - ROTARY

Hole ID.
SBHF02 RC
Header

Contract No.	F15056	Method	Rotary Coring	Coordinates	331023.86 E
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	T30		184673.66 N
		Driller	CB	Ground Level	9.18m AOD
Client	Transport Wales, Welsh Assembly Government	Logged by	DH	Orientation	Vertical
		Core barrel	T6116	Date Started	06/12/2007
Consultant	Ove Arup & Partners Ltd	Core bit	TC	Date Completed	09/12/2007

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
06/12/2007	1730	15.00	15.00	NR	End of Shift
07/12/2007	0730	15.00	15.00	NR	Start of Shift
07/12/2007	1730	23.80	19.30	7.15	End of Shift
08/12/2007	0730	23.80	19.30	7.40	Start of Shift
08/12/2007	1730	35.80	19.30	8.10	End of Shift
09/12/2007	0730	35.80	19.30	7.00	Start of Shift
09/12/2007	1730	40.00	19.30	3.30	End of Hole

DRILLING DETAILS

From depth	To depth	Flush type	Flush return	Core diameter
0.00	17.80	Air/Mist	100%	0.00*
17.80	40.00	Air/Mist	100%	92.0

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
121	40.00	121	19.30

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
06/12/2007	1515	13.50	NR	NR	Moderate	13.50	NS
06/12/2007	1550	14.50	NR	NR	Heavy	14.50	NS

GENERAL NOTES

1. Rotary Openhole drilling from GL to 17.80m.
2. Rotary Coring complete at 40.00m.
3. Borehole grouted upon completion.
4. 0.00* indicates openhole drilling.

SPT DETAILS

Depth	Type	Incremental blow count/penetration	Casing	Water Depth
18.80	S	100/40mm (3,22,100)	18.80	NR
20.80	S	100/50mm (25,100)	19.30	NR

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - ROTARY

Hole ID.
SBHF02 RC
Sheet 1 of 4

Contract No.	F15056	Method	Rotary Coring	Coordinates	331023.86 E
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	T30		184673.66 N
		Driller	CB	Ground Level	9.18m AOD
Client	Transport Wales, Welsh Assembly Government	Logged by	DH	Orientation	Vertical
		Core barrel	T6116	Date Started	06/12/2007
Consultant	Ove Arup & Partners Ltd	Core bit	TC	Date Completed	09/12/2007

Description of Strata	Legend	Drilled Length	Datum Level	Coring and Sampling	TCR	SCR	RQD	IF	SPT N & depth	Install-ation
FILL. (Driller's description)		2.50	6.68							
Grey/brown CLAY. (Driller's description)		5.50	3.68							
Dark grey CLAY. (Driller's description)										

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - ROTARY

Hole ID.
SBHF02 RC
Sheet 2 of 4

Contract No.	F15056	Method	Rotary Coring	Coordinates	331023.86 E
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	T30		184673.66 N
		Driller	CB	Ground Level	9.18m AOD
Client	Transport Wales, Welsh Assembly Government	Logged by	DH	Orientation	Vertical
		Core barrel	T6116	Date Started	06/12/2007
Consultant	Ove Arup & Partners Ltd	Core bit	TC	Date Completed	09/12/2007

Description of Strata	Legend	Drilled Length	Datum Level	Coring and Sampling		TCR	SCR	RQD	IF	SPT N & depth	Install-ation
Dark grey CLAY. (Driller's description)											
		13.50	-4.32								
Claybound GRAVELS. (Driller's description)											
		15.00	-5.82								
SAND and GRAVELS/Cobbles. (Driller's description)											
		17.30	-8.12								
Soft MARL/GRAVELS. (Driller's description)											
		17.80	-8.62								
Zone of core loss. MARL. (Driller's description)				17.80	18.80	0	NA	NA	NA		
		18.80	-9.62							18.80 18.99 S100/40mm	
Extremely weak to very weak reddish brown mottled grey locally grey and greenish grey MUDSTONE. Discontinuities: 1) 0-10 deg very closely to closely spaced undulating rough locally clay infilled. 2) 40 - 60 deg medium to widely spaced undulating rough locally gypsum infilled. (Mercia Mudstone Group)				18.80	19.80	50	0	0			

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - ROTARY

Hole ID.
SBHF02 RC
Sheet 3 of 4

Contract No.	F15056	Method	Rotary Coring	Coordinates	331023.86 E
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	T30		184673.66 N
		Driller	CB	Ground Level	9.18m AOD
Client	Transport Wales, Welsh Assembly Government	Logged by	DH	Orientation	Vertical
		Core barrel	T6116	Date Started	06/12/2007
Consultant	Ove Arup & Partners Ltd	Core bit	TC	Date Completed	09/12/2007

Description of Strata	Legend	Drilled Length	Datum Level	Coring and Sampling	TCR	SCR	RQD	IF	SPT N & depth	Install-ation
Remaining Detail : 18.81m - 19.30m : ---from 18.80m to 19.30m recovered as non intact core (angular fine to coarse gravel sized fragments of grey mudstone)				19.80 20.80	85	6	0			
Detail 19.30m - 19.80m : ---from 19.30m to 19.80m assumed zone of core loss ---from 19.80m to 19.92m recovered as non intact core (angular fine to coarse gravel sized fragments of greenish grey mudstone) ---from 19.97m to 20.09m recovered as non intact core (angular fine to coarse gravel sized fragments of greenish grey mudstone) ---from 20.09m to 20.65m recovered as non intact core (angular fine to coarse sand sized fragments) ---from 20.65m to 20.80m assumed zone of core loss ---from 20.80m to 23.02m recovered as non intact core (gravelly clay. Gravel sized fragments are angular fine to coarse)				20.80 22.30	100	0	0	NI NI 60	20.80 20.88 S100/50mm	
				22.30 23.80	100	26	15			
---from 23.08m to 23.30m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 23.45m to 23.47m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 23.63m to 23.80m recovered as non intact core (angular to subangular fine to coarse gravel sized fragments) ---from 23.95m to 24.19m recovered as non intact core (clayey angular fine to coarse gravel sized fragments) ---from 24.46m to 24.53m recovered as non intact core (angular to subangular fine to coarse gravel sized fragments) ---from 24.72m to 24.78m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 24.90m to 25.30m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 25.38m to 25.51m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 25.58m to 25.73m recovered as non intact core (angular to subrounded fine to coarse gravel sized fragments) ---from 25.80m to 25.87m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 25.90m to 26.05m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 26.25m to 26.40m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 26.45m to 26.48m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 26.55m to 26.65m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 26.70m to 26.80m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 26.80m to 28.30m recovered as non intact core (gravelly clay. Gravel sized fragments are angular fine to coarse) ---from 28.51m to 28.90m recovered as non intact core (angular to subangular fine to coarse gravel sized fragments)				23.80 25.30	100	25	0	NI 40 150		
				25.30 26.80	100	35	0	NI NI 80		
				26.80 28.30	100	0	0	NI NI NI		
				28.30 29.80	87	51	39	NI 120 220		
---from 29.22m to 29.30m recovered as non intact core (gravelly clay. Gravel sized fragments are angular fine) ---from 29.55m to 29.60m recovered as non intact core										

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - ROTARY

Hole ID.
SBHF02 RC
Sheet 4 of 4

Contract No.	F15056	Method	Rotary Coring	Coordinates	331023.86 E
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	T30		184673.66 N
		Driller	CB	Ground Level	9.18m AOD
Client	Transport Wales, Welsh Assembly Government	Logged by	DH	Orientation	Vertical
		Core barrel	T6116	Date Started	06/12/2007
Consultant	Ove Arup & Partners Ltd	Core bit	TC	Date Completed	09/12/2007

Description of Strata	Legend	Drilled Length	Datum Level	Coring and Sampling		TCR	SCR	RQD	IF	SPT N & depth	Install-ation
Remaining Detail : 29.55m - 29.60m : (gravelly clay. Gravel sized fragments are angular fine to coarse) Detail 29.60m - 29.80m : ---from 29.60m to 29.80m assumed zone of core loss Detail 29.80m - 29.99m : ---from 29.80m to 29.99m recovered as non intact core (clayey angular fine to coarse gravel sized fragments) ---from 30.03m to 30.27m recovered as non intact core (clayey angular fine to coarse gravel sized fragments) ---from 30.31m to 30.92m recovered as non intact core (gravelly clay. Gravel sized fragments are angular fine to medium) ---from 31.10m to 31.30m recovered as non intact core (gravelly clay. Gravel sized fragments are fine to coarse with occasional angular fine to coarse gravel pieces of white gypsum) ---from 31.30m to 31.34m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 31.40m to 31.49m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 31.60m to 31.76m recovered as non intact core (angular fine to coarse gravel sized fragments) ---from 31.92m to 32.15m recovered as non intact core (gravelly clay. Gravel sized fragments are angular fine to medium) ---from 32.30m to 32.71m recovered as non intact core (gravelly clay. Gravel sized fragments are angular fine to coarse) ---from 32.80m to 36.73m recovered as non intact core (gravelly clay. Gravel sized fragments are angular to subangular fine to coarse)				29.80	31.30	100	17	0			
				31.30	32.80	94	37	0			
									NI NI 100		
				32.80	34.30	100	0	0			
				34.30	35.80	81	0	0			
				35.80	37.10	85	13	8			
---from 36.90m to 37.10m assumed zone of core loss ---from 37.10m to 37.20m recovered as non intact core (angular coarse gravel sized fragments) ---from 37.25m to 37.45m recovered as non intact core (angular coarse gravel sized fragments) ---from 37.45m to 37.83m recovered as non intact core (angular coarse gravel sized fragments) ---from 37.90m to 37.96m recovered as non intact core (angular coarse gravel sized fragments) ---from 38.21m to 38.42m recovered as non intact core (angular coarse gravel sized fragments) ---from 38.50m to 39.15m recovered as non intact core (angular to subangular fine to coarse gravel sized fragments) ---from 39.30m to 39.68m recovered as non intact core (angular fine to coarse gravel sized fragments)				37.10	38.50	94	33	0			
									NI 50 100		
				38.50	40.00	100	17	7			

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - ROTARY

Hole ID.
SBHF02 RC
Sheet 4+ of 4

Contract No.	F15056	Method	Rotary Coring	Coordinates	331023.86 E
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	T30		184673.66 N
		Driller	CB	Ground Level	9.18m AOD
Client	Transport Wales, Welsh Assembly Government	Logged by	DH	Orientation	Vertical
		Core barrel	T6116	Date Started	06/12/2007
Consultant	Ove Arup & Partners Ltd	Core bit	TC	Date Completed	09/12/2007

Description of Strata	Legend	Drilled Length	Datum Level	Coring and Sampling	TCR	SCR	RQD	IF	SPT N & depth	Install-ation
Remaining Detail : 39.80m - 39.85m : ---from 39.80m to 39.85m recovered as non intact core (angular coarse gravel sized fragments)		40.00	-30.82							
Rotary drilling complete at 40.00 m.										

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL ROTARY LOG
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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHF02A CP
Header

Contract No.	F15056	Method	Cable Percussion	Coordinates	331024.11 E
Project	New M4 - Second Preliminary Ground Investigation				184677.11 N
		Drilling Rig	Dando 2000	Ground Level	9.17m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	SJ	Orientation	Vertical
		Logged by	DH	Date Started	12/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	18/12/2007

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
12/12/2007	1730	7.05	6.00	DRY	End of Shift
13/12/2007	0730	7.05	6.00	DRY	Start of Shift
13/12/2007	1730	14.45	14.00	9.30	End of Shift
14/12/2007	0730	14.45	14.00	7.50	Start of Shift
14/12/2007	1730	16.45	16.45	7.50	End of Shift
17/12/2007	0730	16.45	17.30	8.30	Start of Shift
17/12/2007	1730	17.30	17.30	7.00	End of Shift
18/12/2007	0730	17.30	17.30	8.50	Start of Shift
18/12/2007	1000	17.30	17.30	8.00	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks
14.70	14.70	1.00	Chiselling
16.00	16.30	1.00	Chiselling
16.50	16.90	1.00	Chiselling
16.90	17.30	1.00	Chiselling
17.30	17.30	0.75	Chiselling

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
200	17.30	200	17.30

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
13/12/2007		13.05	8.30	20	Fast	12.00	NR

GENERAL NOTES

1. Service inspection pit hand excavated from GL to 1.20m.
2. Insitu permeability testing carried out from 15.00m to 16.00m.
3. Cable Percussive boring complete at 17.75m.
4. 1 No 19mm piezometer, tip at 17.00m, response zone 16.70m to 17.30m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration	Casing	Water Depth
1.20	S	N=7 (5,2,1,2,2,2)	2.00	DRY
2.60	S	N=4 (1,1,1,1,1,1)	2.00	DRY
4.60	S	N=2 (1,0,1,0,1,0)	4.00	DRY
6.60	S	N=4 (1,1,1,1,1,1)	8.00	DRY
8.60	S	N=2 (1,0,1,0,1,0)	8.00	DRY
10.60	S	N=4 (1,1,1,1,1,1)	12.00	8.30
12.60	S	N=14 (1,1,1,1,4,8)	14.00	8.30
14.00	S	N=42 (1,2,6,8,8,20)	14.00	8.30
16.00	S	N=47 (9,9,12,10,15,10)	16.00	7.50
17.30	S	N=49 (9,15,8,9,12,20)	17.30	8.50

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes, chiselling time in hours.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHF02A CP
Sheet 1 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	331024.11 E
Project	New M4 - Second Preliminary Ground Investigation				184677.11 N
		Drilling Rig	Dando 2000	Ground Level	9.17m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	SJ	Orientation	Vertical
		Logged by	DH	Date Started	12/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	18/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Brown slightly sandy slightly gravelly clay. Sand sized fragments are fine to coarse. Gravel sized fragments are angular to subangular fine to medium of mudstone, brick, timber and ash.				D1	1.20 - 1.65	S7	S	1.20 1.65	
Very soft to soft low strength grey mottled orangish brownslightly gravelly silty CLAY. Gravel is angular to subangular fine to medium of sandstone. (Estuarine Alluvium)		2.00	7.17	B2 D3 U4 D5 D6	2.00 2.00 2.00 - 2.45 2.45 - 2.60 2.60 - 3.05	(20) S4	S	2.60 3.05	
				D7 D8	3.05 - 4.00 3.05 - 4.00				
				U9	4.00 - 4.45	(40)			
---from 4.45m becomes stained brown				D10 D11	4.60 - 5.05 4.60 - 5.05	S2	S	4.60 5.13	
				B12	5.05 - 6.00				
				D13 U14	5.91 - 6.00 6.00 - 6.45	(30)			
				D15 D16	6.45 - 6.60 6.60 - 7.05	S4	S	6.60 7.05	
				B17	7.05 - 8.00				
				D18	8.00				
				W32	8.30				
				D19 D20	8.60 8.60 - 9.05	S2	S	8.60 9.13	
				D21 D22 D23	9.05 - 10.00 9.05 - 10.00 9.05 - 10.00				

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHF02A CP
Sheet 2 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	331024.11 E
Project	New M4 - Second Preliminary Ground Investigation				184677.11 N
		Drilling Rig	Dando 2000	Ground Level	9.17m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	SJ	Orientation	Vertical
		Logged by	DH	Date Started	12/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	18/12/2007

Description of Strata	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
Very soft to soft low strength grey mottled orangish brownslightly gravelly silty CLAY. Gravel is angular to subangular fine to medium of sandstone. (Estuarine Alluvium)			U24	10.00 - 10.45	(40)			
	10.45	-1.28	D25	10.45 - 10.60				
---10.21m with extremely closely to closely spaced thin laminations of brown fine to medium sand.			D26	10.60 - 11.05	S4	S	10.60 11.05	
Firm to stiff high strength greyish brown slightly sandy silty CLAY. Sand is fine to medium. (Estuarine Alluvium)			B27	11.05 - 12.00				
			D28	11.05 - 12.00				
			U29	12.00 - 12.45	(60)			
			D30	12.15 - 12.60				
Firm dark grey slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is rounded to subangular fine to coarse of mudstone, siltstone and sandstone. (Estuarine Alluvium)	12.60	-3.43	D31	12.60 - 13.05	S14	S	12.60 13.05	
			B33	13.05 - 14.00				
			D34	13.05 - 14.00				
			D35	14.00 - 14.45	S42	S	14.00 14.45	
Dense sandy grey subrounded to rounded fine to coarse GRAVEL of mudstone, siltstone and sandstone. (Fluvial Alluvium)	14.50	-5.33	D36	14.50 - 15.00				
			B37	14.50 - 15.00				
---from 16.00m with high cobble content, cobbles are subrounded of sandstone			D38	16.00 - 16.45	S47	S	16.00 16.45	
Very stiff reddish brown slightly gravelly CLAY. Gravel sized fragments are angular fine to medium (Weathered Mudstone). (Mercia Mudstone Group)	17.30	-8.13	D39	17.30 - 17.75	S49	S	17.30 17.75	
Cable Percussion boring complete at 17.75 m.	17.75	-8.58						

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
Version	3.09
Revised	17/12/2007

Geotechnical Engineering Limited

BOREHOLE LOG

BH412

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	1 of 4
Start Date	17 February 2015	Easting	331036.1	Scale	1 : 50
End Date	25 February 2015	Northing	184685.1 Ground level 10.50mOD	Depth	35.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
17/02/15 0800hrs	1B	0.00 - 0.50						MADE GROUND comprising black TARMACADAM. (MG)	0.10	10.40	
	2D*	0.00 - 0.50		Vo 0.5				Light grey sandy angular and subangular fine to coarse crystalline GRAVEL. (MG)	0.50	10.00	
	3B	0.50 - 1.20						Soft dark brownish grey slightly sandy gravelly CLAY. Gravel is subangular and subrounded fine to coarse slag and brick. (MG)			
	4D*	0.50 - 1.00		Vo 0.6							
		1.20 - 1.65	1.20	C 8				1.20 - 1.65m: Loose very clayey very sandy subangular and subrounded fine to coarse slag and brick gravel.			
	5B	1.20 - 1.65									
	6D*	1.20 - 1.70		Vo 0.7							
	7D	1.65 - 2.10	1.50	S 3							
	8B	1.65 - 2.10									
	9D*	1.70 - 2.20		Vo 1.2							
	10D	2.10 - 2.55	2.10	S 9							
	11B	2.10 - 2.55									
	12D*	2.20 - 2.70		Vo 3.5							
	13D	2.55 - 3.00	2.50	S 9							
17/02/15 1700hrs 2.80m	14B	2.55 - 3.00							2.80	7.70	
	15B	2.90 - 3.00						Soft dark grey mottled brown sandy gravelly CLAY with medium sandstone cobble content. Gravel is subangular and subrounded fine to coarse sandstone. (MG)			
	16D*	2.90 - 3.20		Vo 2.2							
18/02/15 1345hrs 2.90m	17D	3.00 - 3.45	2.90	S 3					3.40	7.10	
	18B	3.40 - 3.50						Soft to firm light grey mottled dark grey slightly sandy slightly gravelly silty CLAY. Gravel is subangular and subrounded fine mudstone and sandstone. (TFD)			
	19D	3.50 - 3.95	3.40	S 11							
	20B	3.90 - 4.00									
	21UT	4.00 - 4.45							4.20	6.30	
	22B	4.40 - 4.50						Firm brown mottled grey slightly sandy slightly gravelly silty CLAY. Gravel is subangular fine to coarse mudstone. (TFD)			
	23D*	4.40 - 4.60									
	24D	4.50 - 4.95	4.40	S 5							
	25B	4.90 - 5.00							4.90	5.60	
	26D*	4.90 - 5.10						Soft brownish grey slightly sandy CLAY. (TFD)			
	27UT	5.00 - 5.45									
									6.10	4.40	
	28B	6.40 - 6.50						Very soft and soft brownish grey slightly sandy CLAY. (TFD)			
	29D*	6.40 - 6.70									
	30D	6.50 - 6.95	6.40	S 3							
18/02/15 1700hrs NR	31B	7.90 - 8.00									

Continued Next Page {8.00}

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Cable percussion (200mm) 1.20-6.00m and (150mm) 6.00-20.50m. Waterflush rotary core drilled (116mm) 20.50-35.00m. CASING: 200mm diam to 6.00m 150mm diam to 20.50m. BACKFILL: On completion, borehole backfilled with bentonite seal 35.00-20.00m. A slotted standpipe (50mm) with geo-sock was installed to 20.00m, granular response zone 20.00-15.00m and bentonite seal 15.00-3.00m. A second slotted standpipe (35mm) with geo-sock was installed to 3.00m, granular response zone 3.00-1.00m, bentonite seal 1.00-0.20m, concrete and stopcock cover 0.20-0.00m. REMARKS: Hole advanced by chiselling 15.50-16.00m (1.5hr), 16.80-17.30m (1hr), 17.50 yielding no penetration (1hr), 17.50-18.00m (1hr), 18.50-19.00m (1hr), 20.40-20.50m (1hr). Downhole magnetometry for UXO risk mitigation undertaken 0.00-14.80m. No anomalies encountered. Falling head permeability test undertaken at 11.00m- 12.00m. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
3.00	2.50	2.80	20	Seepage.

AGS

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30238	EC

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BOREHOLE LOG

BH412

CLIENT	WELSH GOVERNMENT					Sheet	2 of 4
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	17 February 2015	Easting	331036.1			Depth	35.00 m
End Date	25 February 2015	Northing	184685.1	Ground level	10.50mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
19/02/15 0800hrs Dry	32UT	8.00 - 8.45	8.00								
	33D	8.45 - 8.60									
	34B	8.00 - 9.50									
	35D	9.50 - 9.95	9.50	S 1							
	36B	9.50 - 11.00									
	37UT	11.00 - 11.40	11.00								
	38D	11.40 - 11.60									
	39B	11.00 - 12.50									
	40D	12.50 - 12.95	12.50	S 1							
	41B	12.50 - 13.20									
	42UT	13.20 - 13.60	13.00								
	43D	13.60 - 13.80									
	44B	13.20 - 13.80	13.60	S 28							
	45D	13.80 - 14.25									
	46B	13.80 - 14.80									
								Stiff grey mottled brown gravelly CLAY. Gravel is subangular and subrounded fine sandstone. (RTD)	13.80	-3.30	
19/02/15 1545hrs 10.80m		14.80 - 15.23	14.80	C*54					14.80	-4.30	
	47B	14.80 - 16.30						Dense to very dense grey slightly sandy subangular and subrounded fine to coarse sandstone GRAVEL with a low subangular sandstone cobble content. (RTD)			
20/02/15 0830hrs 9.40m											
		16.30 - 16.75	16.30	C 47							
	48B	16.30 - 17.50						16.30 - 17.50m: Very sandy.			
20/02/15 1230hrs NR		17.50 - 17.68	17.50	C*313					17.50	-7.00	
23/02/15 0800hrs 6.75m	49B	17.50 - 19.00						Very dense brown locally slightly clayey gravelly fine to coarse SAND with low subangular sandstone cobble content. Gravel is subrounded fine to coarse sandstone.			
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks
13.60	13.00	10.40	20	Fast inflow.

AGS

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BOREHOLE LOG

BH412

CLIENT	WELSH GOVERNMENT					Sheet	3 of 4
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	17 February 2015	Easting	331036.1			Depth	35.00 m
End Date	25 February 2015	Northing	184685.1	Ground level	10.50mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
								(RTD)			
	50B	19.00 - 19.45 19.00 - 19.40	19.00	C 29				19.00m: Dense.			
	51B	19.40 - 19.85 19.40 - 20.00	19.40	C 29		NI		Extremely weak and very weak purplish brown and reddish brown locally mottled light greenish grey MUDSTONE recovered as slightly sandy very clayey angular and subangular fine to coarse mudstone gravel. (MMG) (Grade II)	19.40	-8.90	
23/02/15 1600hrs 11.95m	52D 53B 54D	20.00 - 20.32 20.00 - 20.40 20.40 - 20.52 20.40 - 20.50	20.00 20.00	S*88 C*366					20.50	-10.00	
24/02/15 1130hrs 9.22m	55C	20.50 - 22.00	20.50		100 6 0	NI		Extremely weak thinly laminated to very thinly bedded reddish brown MUDSTONE. Fractures are subhorizontal to 20° extremely closely spaced planar smooth. (MMG) (Grade II) 20.85 - 21.40m: Locally light greenish grey.	21.40	-10.90	
						NA		Stiff fissured reddish brown gravelly CLAY with frequent light greenish grey reduction spots (up to 20mm). Gravel is subangular fine to coarse mudstone lithorelicts. (MMG) (Grade III)	22.00	-11.50	
	56C	22.00 - 23.50	20.50		96 4 0	NI		21.90 - 22.00m: Light greenish grey.			
						NA		Extremely weak thinly laminated to very thinly bedded reddish brown MUDSTONE. Fractures are subhorizontal to 20° extremely closely spaced planar smooth. (MMG) (Grade II) 22.00 - 22.20m: Recovered non intact. 22.70 - 22.90m: 70° to subvertical fracture planar smooth.	22.90	-12.40	
	57C	23.50 - 25.00	20.50		86			Stiff fissured reddish brown gravelly CLAY with frequent light greenish grey reduction spots (up to 20mm). Gravel is subangular fine to coarse mudstone lithorelicts. (MMG) (Grade III) 23.70 - 23.90m: Tending to extremely weak mudstone. 24.75 - 25.10m: Tending to extremely weak mudstone.			
	58C	25.00 - 26.50	20.50		97 0 0				25.50	-15.00	
24/02/15 1530hrs 4.20m						NI		Extremely weak thinly laminated reddish brown MUDSTONE with frequent light greenish grey reduction spots (up to 20mm). Fractures are subhorizontal to 20° and subvertical extremely closely and very closely spaced planar smooth. (MMG) (Grade I/II)			
25/02/15 0830hrs 5.10m	59C	26.50 - 28.00	20.50		93 27 0	NI 20 40			27.40	-16.90	
						NA		Stiff fissured reddish brown gravelly CLAY with frequent light greenish grey reduction spots (up to 20mm). Gravel is subangular fine to coarse mudstone lithorelicts. (MMG)			
								Continued Next Page	{28.00}		

water strike (m) casing (m) rose to (m) time to rise (m) remarks

AGS

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BOREHOLE LOG

BH412

CLIENT	WELSH GOVERNMENT					Sheet	4 of 4
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	17 February 2015	Easting	331036.1			Depth	35.00 m
End Date	25 February 2015	Northing	184685.1	Ground level	10.50mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	60C	28.00 - 29.50	20.50		96 5 0			(Grade III)	29.20	-18.70	
	61C	29.50 - 30.50	20.50		60 3 0	NI NI 70		Extremely weak thinly laminated reddish brown MUDSTONE with frequent light greenish grey reduction spots (up to 20mm). Fractures are subhorizontal to 20° and subvertical extremely closely spaced planar smooth. (MMG) (Grade I/II)	30.50	-20.00	
	62C	30.50 - 32.00	20.50		100 0 0	NA		Very stiff fissured reddish brown gravelly CLAY with frequent light greenish grey reduction spots (up to 20mm). Gravel is subangular fine to coarse mudstone lithorelicts. (MMG) (Grade III)	31.70	-21.20	
	63C	32.00 - 33.50	20.50		95 0 0	NI		Extremely weak thinly laminated reddish brown MUDSTONE with rare light greenish grey reduction spots (up to 20mm) locally tending to claybound angular and subangular fine to coarse gravel sized mudstone lithorelicts. Fractures are subhorizontal to 20° and subvertical extremely closely spaced planar smooth. (MMG) (Grade I/II)	33.50	-23.00	
25/02/15 1530hrs 4.82m	64C	33.50 - 35.00	20.50		100	NA		Very stiff fissured reddish brown gravelly CLAY with frequent light greenish grey reduction spots (up to 20mm). Gravel is subangular fine to coarse mudstone lithorelicts. (MMG) (III)	35.00	-24.50	
								Borehole completed at 35.00m.	{38.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
					30238	EC

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BOREHOLE LOG

BH413

CLIENT	WELSH GOVERNMENT					Sheet	1 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	21 January 2015	Easting	331120.3				
End Date	5 February 2015	Northing	184819.6	Ground level	9.90mOD	Depth	40.00 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
21/01/15 1300hrs	1B	0.20	0.40						Dark and light grey sandy subangular fine and medium limestone GRAVEL. (MG)	0.40	9.50	
	2D*	0.20	0.30		Vo 0.2				Dark and light grey sandy subangular fine to coarse crystalline rock and brick GRAVEL with rare plant fragments (up to 20mm). (MG)	0.80	9.10	
	3B	0.40	0.80						Loose and medium dense dark and light grey sandy subangular fine to coarse crystalline rock, limestone and brick GRAVEL with low subangular limestone cobble content. (MG) 1.20 - 1.65m: Locally very dense			
	4D*	0.40	0.50		Vo 0.7							
	5B	0.80	1.20									
21/01/15 1430hrs Dry	6D*	0.80	1.20		Vo 0.4							
	7D	1.20	1.65	1.20	S 52							
26/01/15 0900hrs Dry	8B	1.20	1.70									
	9D	1.70	2.15	1.20	S 9							
	10B	1.70	2.15									
	11D*	1.70										
	12D	2.15	2.60	2.15	S 13							
	13B	2.15	2.60									
	14D*	2.15										
	15D	2.60	3.05	2.60	S 8							
	16B	2.60	3.00									
	17D*	2.60										
	18D	3.00	3.45	3.00	S 4							
26/01/15 1550hrs 3.25m	19B	3.00	3.50									
	20D*	3.05										
	21D	3.50	3.95	3.50	S 11							
27/01/15 0815hrs 2.60m	22B	3.50	4.00									
	23D*	3.50										
	24D	4.00	4.45	4.00	S 8							
	25B	4.00	4.50									
	26D*	4.00										
	27D	4.50	4.95	4.50	S 9							
	28B	4.50	5.00									
	29D*	4.50										
	30UT	5.00	5.45	5.00					Soft light grey mottled black and light brown organic silty CLAY. (TFD)	5.00	4.90	
	31D	5.45	5.50									
	32B	5.50	6.50									
	33D*	5.50										
	34D	6.50	6.95	6.50	S<1				6.50 - 12.00m: Very soft. Very soft light grey mottled black and light brown organic silty CLAY. (TFD)	6.50	3.40	
	35B	7.00	7.50									
	36D*	7.00										
									Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Cable percussion (200mm) 1.20 - 5.00m and (150mm) 5.00-19.00m and Pioneer 19.00 - 40.00m. Waterflush rotary core drilled (116mm) 19.00-40.00m.

CASING: (200mm) 0.00-5.00m and (150mm) 5.00-18.50m. BACKFILL: On completion, borehole backfilled with bentonite 40.00-18.00m. A slotted standpipe (50mm) was installed to 18.00m, granular response zone 18.00-15.00m, bentonite seal 15.00-4.50m. A second slotted standpipe (35mm) was installed to 4.50m, granular response zone 4.50-1.00m, bentonite seal 4.50-1.00m, bentonite seal 1.00-0.20m, concrete and stopcock cover 0.20-0.00m. REMARKS: Downhole magnetometry for UXO risk mitigation undertaken 0.00-1.20m. No anomalies encountered. Bentonite seal for aquifer protection installed during drilling at 5.00m, prior to reduction in casing diameter. Permeability test undertaken at 7.00m- 8.00m. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
2.24		2.24	20	

AGS

CONTRACT	CHECKED
30238	EC

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BOREHOLE LOG

BH413

CLIENT	WELSH GOVERNMENT					Sheet	2 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	21 January 2015	Easting	331120.3			Depth	40.00 m
End Date	5 February 2015	Northing	184819.6	Ground level	9.90mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	37UT	8.00 - 8.45	8.00								
	38B	8.45 - 8.50									
	39D*	8.45									
	40B	8.50 - 9.00									
	41D	9.50 - 9.95	9.50	S<1							
	42B	10.50 - 11.00									
	43UT	11.00 - 11.45	11.00								
	44D	11.45 - 11.50									
	45B	12.00 - 12.50						Firm dark grey mottled black slightly sandy slightly gravelly organic silty CLAY. Gravel is subangular and subrounded fine and medium sandstone. (RTD)	12.00	-2.10	
	46D	12.50 - 12.95	12.50	S 12							
	47B	13.50 - 14.00									
		14.00 - 14.45	14.00	C 15				Medium dense becoming dense dark grey sandy subangular and subrounded fine to coarse sandstone GRAVEL. (RTD)	14.00	-4.10	
	48B	15.00 - 15.50									
		15.50 - 15.95	15.50	C 47				15.50 - 17.00m: Dense.			
	49B	16.50 - 17.00									
		17.00 - 17.45	17.00	C 31				Stiff fissured reddish brown sandy gravelly CLAY. Gravel is subangular and subrounded fine and medium lithorelicts of extremely weak mudstone. (MMG) (Grade III)	17.00	-7.10	
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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Geotechnical Engineering Limited

BOREHOLE LOG

BH413

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	3 of 5
Start Date	21 January 2015	Easting	331120.3	Scale	1 : 50
End Date	5 February 2015	Northing	184819.6 Ground level 9.90mOD	Depth	40.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
27/01/15 1615hrs 7.35m	50B	18.00 - 18.50									
	51D	18.50 - 18.60	18.50	S*158							
28/01/15 0830hrs 7.25m	52B	18.55 - 19.00						18.55 - 19.30m: Reddish brown mudstone recovered as slightly sandy gravelly clay. Gravel is angular and subangular fine to coarse mudstone. 19.00 - 19.30m: Limited recovery			
28/01/15 1205hrs 7.35m		19.00 - 19.09	18.50	C*170							
	53C	19.00 - 20.50			66	NA			19.30	-9.40	
04/02/15 0800hrs 7.10m						NI		Weak reddish brown MUDSTONE recovered non intact as subangular fine to coarse gravel. (MMG) (Grade II)			
						NA		Very stiff fissured reddish brown gravelly CLAY with rare greenish grey reduction spots (up to 10mm). Gravel is subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced planar rough infilled with sand sized gypsum crystals and stained black. (MMG) (Grade III)	20.05	-10.15	
		20.50 - 20.68	18.50	C*150							
	54C	20.50 - 22.00			100 50 42				20.95	-11.05	
						NI 165 580		Extremely weak thinly laminated to very thinly bedded reddish brown MUDSTONE with rare greenish grey reduction spots (up to 5mm). Fractures are subhorizontal to 20° very closely spaced locally closely spaced planar rough infilled with sand sized gypsum and stained black. (MMG) (Grade II)	22.00	-12.10	
	55C	22.00 - 23.50			100	NA		Very stiff fissured reddish brown gravelly CLAY with rare greenish grey reduction spots (up to 10mm). Gravel is subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced planar rough infilled with sand sized gypsum crystals and stained black. (MMG) (Grade III) 22.10 - 26.90m: 20° fissures locally infilled with greenish grey clay and sand sized gypsum crystals (up to 3mm).			
	56C	23.50 - 25.00			100						
	57C	25.00 - 26.50			100						
	58C	26.50 - 28.00			100						
								27.60m: White angular fine and medium gravel sized gypsum crystals			
								Continued Next Page	{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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BOREHOLE LOG

BH413

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	4 of 5
Start Date	21 January 2015	Easting	331120.3	Scale	1 : 50
End Date	5 February 2015	Northing	184819.6 Ground level 9.90mOD	Depth	40.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	59C	28.00 - 29.50			100 53 33				28.60	-18.70	
04/02/15 1700hrs 7.01m						NI 100 350		Extremely weak thinly laminated to very thinly bedded reddish brown MUDSTONE with rare greenish grey reduction spots (up to 30mm). Fractures are subhorizontal to 20° closely spaced locally medium spaced planar rough infilled with sand sized gypsum and stained black. (MMG) (Grade II)			
05/02/15 0800hrs 7.23m	60C	29.50 - 31.00			100 40 33				31.00	-21.10	
	61C	31.00 - 32.50			100	NA		Very stiff fissured reddish brown gravelly CLAY with rare greenish grey reduction spots (up to 30mm). Gravel is subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced planar rough infilled with sand sized gypsum crystals and stained black. (MMG) (Grade III)			
	62C	32.50 - 34.00			100				34.00	-24.10	
	63C	34.00 - 35.50			100 20 0	NI 50 250		Extremely weak thinly laminated to very thinly bedded reddish brown MUDSTONE with rare greenish grey reduction spots (up to 5mm). Fractures are subhorizontal to 20° very closely spaced locally medium spaced planar rough infilled with sand sized gypsum and stained black. (MMG) (Grade II)	34.80	-24.90	
						NA		Very stiff fissured reddish brown gravelly CLAY with rare greenish grey reduction spots (up to 30mm). Gravel is subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced planar rough infilled with sand sized gypsum crystals and stained black. (MMG) (Grade III)	35.30	-25.40	
	64C	35.50 - 37.00			100 17 0	50 100 300			35.65	-25.75	
						NA		Extremely weak thinly laminated to very thinly bedded reddish brown MUDSTONE with rare greenish grey reduction spots (up to 5mm). Fractures are subhorizontal to 20° very closely to medium spaced locally medium spaced planar rough infilled with sand sized gypsum and stained black. (MMG) (Grade II)			
	65C	37.00 - 38.50			100			Very stiff fissured reddish brown gravelly CLAY with rare greenish grey reduction spots (up to 30mm). Gravel is subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical closely spaced planar rough infilled with sand sized gypsum crystals and stained black. (MMG) (Grade			

Continued Next Page

{38.00}

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks

AGS

CONTRACT	CHECKED
30238	EC

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Geotechnical Engineering Limited

BOREHOLE LOG

BH413

CLIENT	WELSH GOVERNMENT					Sheet	5 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	21 January 2015	Easting	331120.3			Depth	40.00 m
End Date	5 February 2015	Northing	184819.6	Ground level	9.90mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
						NI 100 350		III) 36.35m: 20° fissure infilled with greenish grey clay and sand sized gypsum crystals up to 3mm	38.15	-28.25	
	66C	38.50 - 40.00			100 46 46			Extremely weak thinly laminated to very thinly bedded reddish brown locally mottled greenish grey MUDSTONE with rare greenish grey reduction spots (up to 5mm). Fractures are subhorizontal to 20° very closely and closely spaced locally medium spaced planar rough infilled with sand sized gypsum and stained black. (MMG) (Grade II)			
05/02/15 1600hrs 7.89m									40.00	-30.10	
								Borehole completed at 40.00m.			
									{48.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
					30238	EC

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BOREHOLE LOG

BH414

CLIENT	WELSH GOVERNMENT					Sheet	1 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	22 January 2015	Easting	331211.3			Depth	40.70 m
End Date	3 February 2015	Northing	185001.0	Ground level	10.20mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
22/01/15 0800hrs	1B	0.20 - 0.40						MADE GROUND comprising TARMACADAM. (MG)	0.10	10.10	
	2D*	0.20 - 0.40						Ballast. (Driller's description). (MG)	0.20	10.00	
	3B	0.40 - 0.80						Black ashy gravelly fine and medium SAND with low subangular limestone cobble content. Gravel is subangular fine to coarse brick and limestone. (MG)	0.40	9.80	
	4D*	0.40 - 0.80									
	5B	0.80 - 1.20									
22/01/15 0830hrs Dry	6D*	0.80 - 1.20									
		1.20 - 1.65	Nil	S 13				Soft dark brownish grey slightly sandy slightly gravelly silty CLAY with low subangular limestone cobble content. Gravel is subangular and subrounded fine to coarse brick and limestone. (MG)	1.20	9.00	
28/01/15 1345hrs 0.50m	7X	1.20 - 2.20									
	8D*	1.30 - 1.50									
								Medium dense dark grey clayey angular and subangular fine to coarse limestone, sandstone and brick GRAVEL with frequent plant fragments (up to 30mm). (MG)	1.90	8.30	
	9D*	2.00 - 2.20									
		2.20 - 2.65	Nil	S 5							
	10X	2.20 - 3.20						Firm dark grey and reddish brown locally mottled greenish yellow slighty gravelly sandy silty CLAY. Gravel is subangular and subrounded fine to coarse limestone and sandstone. (MADE GROUND?)	2.40	7.80	
								Soft dark grey silty CLAY. (TFD)			
	11D*	3.00 - 3.20									
28/01/15 1635hrs 1.20m	12UT	3.20 - 3.65	2.80								
	15X	3.20 - 4.20									
	13D	3.45 - 3.70	2.80								
29/01/15 0820hrs 1.70m	13D	3.65 - 3.70	2.80								
	14D	3.70 - 4.15	2.80	S 3				3.70 - 4.70m: Very soft.			
	16D*	4.00 - 4.20									
	17UT	4.20 - 4.65	4.20								
	20X	4.20 - 5.20									
	18D	4.65 - 4.70							4.70	5.50	
	19D	4.70 - 5.15	4.20	S 11				4.70 - 5.20m: Mottled orangish brown. Firm dark bluish grey silty CLAY. (TFD)			
									5.20	5.00	
	21UT	5.20 - 5.65	4.20					Very soft dark bluish grey silty CLAY. (TFD)			
	23X	5.20 - 6.70									
	22D	5.70 - 6.15	4.20	S 2				5.70 - 5.80m: Subangular sandstone cobble.			
	24UT	6.70 - 7.15	6.70								
	27X	6.70 - 8.20									
	25D	7.15 - 7.20									
	26D	7.20 - 7.65	6.70	S<1							
								Continued Next Page	{8.00}		

EQUIPMENT: Geotechnical Pioneer rig.

METHOD: Surface hard standing broken out with hydraulic breaker 0.00-0.10m. Hand dug inspection pit 0.10-1.20m. Dynamic sampled (128mm) 1.20-20.30m. Rotary core drilled (123mm PQ3 wireline) 20.30-40.70m using a water flush.

CASING: 200mm diam to 4.20m, 168mm diam to 20.30m and 114mm diam to 40.70m. BACKFILL: On completion, hole backfilled with bentonite pellets 40.70-0.20m and concrete 0.20-0.00m. REMARKS: 70% flush returns from 29.90-40.70m. Downhole magnetometry for UXO risk mitigation undertaken 0.00-15.70m. No anomalies encountered. Bentonite seal for aquifer protection installed during drilling 4.20-3.20m, prior to reduction in casing diameter. Permeability test undertaken at 9.70m- 11.20m. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
				Groundwater not encountered prior to use of water flush.	30238	EC

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BOREHOLE LOG

BH414

CLIENT	WELSH GOVERNMENT					Sheet	2 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	22 January 2015	Easting	331211.3				
End Date	3 February 2015	Northing	185001.0	Ground level	10.20mOD	Depth	40.70 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	UT 28X	8.20 - 8.65 8.20 - 8.70	8.20								
	29D 30X	8.70 - 9.15 8.70 - 9.70	8.20	S<1							
	31UT 33X	9.70 - 10.15 9.70 - 11.20	9.70								
	32D	10.20 - 10.65	9.70	S 1							
	34UT 36X	11.20 - 11.65 11.20 - 12.70	11.20								
	35D	11.70 - 12.15	11.20	S 1				11.90 - 12.20m: Locally sandy.			
	37D 38X	12.70 - 13.15 12.70 - 14.20	12.70	S 3				12.70 - 12.90m: Locally slightly gravelly. Gravel is subangular and subrounded fine and medium sandstone. 12.70 - 13.50m: Locally slightly sandy.			
									13.50	-3.30	
								Brownish grey slightly sandy silty subangular and subrounded fine and medium sandstone GRAVEL. (RTD)	13.85	-3.65	
	39D 40X	14.20 - 14.65 14.20 - 15.70	14.20	S 6				Soft dark bluish grey slightly gravelly sandy silty CLAY. Gravel is subangular and subrounded fine and medium sandstone. (RTD) 14.60 - 15.70m: Locally very sandy.			
29/01/15 1630hrs 0.90m		15.70 - 16.06	15.70	C*71					15.70	-5.50	
30/01/15 0815hrs 2.41m	41X	15.70 - 17.20						Limited recovery. Recovered as very dense light grey and brownish red angular and subangular fine and medium limestone and sandstone GRAVEL with high subrounded cobble content. Possible loss of fines. (RTD)			
	42X	17.20 - 17.36 17.20 - 18.70	17.20	C*176							
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
				Groundwater not encountered prior to use of water flush.	30238	EC

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BOREHOLE LOG

BH414

CLIENT	WELSH GOVERNMENT					Sheet	3 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	22 January 2015	Easting	331211.3				
End Date	3 February 2015	Northing	185001.0	Ground level	10.20mOD	Depth	40.70 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	43X	18.70 - 18.85 18.70 - 20.00	18.70	C*176							
	44X	20.00 - 20.25 20.00 - 20.30	20.00	C*130					20.00	-9.80	
	45C	20.30 - 21.20	20.30		55	NA NA		Very dense dark reddish brown slightly sandy clayey subangular and subrounded fine and medium sandstone GRAVEL. (RTD)	20.50	-10.30	
30/01/15 1645hrs 1.60m	46C	21.20 - 21.70	21.20		51			Limited recovery. Stiff fissured reddish brown slightly sandy slightly gravelly CLAY. Gravel is randomly orientated subangular and subrounded fine lithorelicts of very stiff clay to extremely weak mudstone. (MMG) (Grade IVa)	21.70	-11.50	
02/02/15 0850hrs 3.50m	47C	21.70 - 22.50	21.70		100	NA		Very stiff fissured reddish brown gravelly silty CLAY with rare light greenish grey reduction spots (up to 30mm). Gravel is angular fine to coarse very stiff clay and extremely weak mudstone lithorelicts. (MMG) (Grade III) 22.30 - 22.50m: Intersecting 30-40° fissures planar rough.			
	48C	22.50 - 23.70	22.50		100			22.60 - 23.00m: Tending to extremely weak extremely closely fractured reddish brown and light greenish grey mudstone.			
	49C	23.70 - 24.70	23.70		94			23.40 - 24.55m: Tending to extremely weak thinly and thickly laminated mudstone. 23.70 - 23.75m: 30-40° fissure planar rough locally polished.			
	50C	24.70 - 25.70	24.70		93			24.95 - 25.15m: 60-70° fissure.			
	51C	25.70 - 27.20	25.70		100	NA		25.50 - 25.85m: Mottled light greenish grey.	25.85	-15.65	
	52C	27.20 - 28.70	27.20		100			Very stiff fissured reddish brown gravelly CLAY with frequent light greenish grey reduction spots (up to 50mm) locally tending to extremely weak mudstone. Gravel is angular and subangular fine to coarse lithorelicts of very stiff clay and extremely weak mudstone. Fissures are 10-20° and randomly orientated extremely closely and very closely spaced planar and undulating. (MMG) (Grade III) 26.05 - 26.15m: 50-60° fissure planar rough infilled (up to 2mm) with gypsum crystals. 26.35 - 26.45m: 50-60° fissure planar rough infilled (up to 2mm) with gypsum crystals. 26.95 - 27.05m: 50-60° fissure planar rough infilled (up to 2mm) with gypsum crystals.			
								Continued Next Page	{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
				Groundwater not encountered prior to use of water flush.	30238	EC

Geotechnical Engineering Limited

BOREHOLE LOG

BH414

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	4 of 5
Start Date	22 January 2015	Easting	331211.3	Scale	1 : 50
End Date	3 February 2015	Northing	185001.0 Ground level 10.20mOD	Depth	40.70 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
								28.10 - 28.65m: Inclined fissure infilled with fine and medium sand sized gypsum crystals.	28.65	-18.45	
	53C	28.70 - 29.90	28.70		92	NA		Very stiff fissured reddish brown gravelly silty CLAY with rare light greenish grey reduction spots (up to 50mm). Gravel is subangular fine to coarse extremely weak mudstone lithorelicts. (MMG) (Grade III) 28.85 - 28.90m: Fissure inclined 50-60° planar rough infilled (up to 2mm) with gypsum crystals. 29.50m: Locally gravelly. 29.70 - 29.80m: Fissure inclined 50-60° planar rough infilled (up to 2mm) with gypsum crystals.			
	54C	29.90 - 31.40	29.90		100			30.20 - 30.25m: Light greenish grey staining.			
02/02/15 1645hrs 3.20m											
03/02/15 0845hrs 3.00m	55C	31.40 - 32.90	31.40		99 0 0				31.90	-21.70	
						NI		Extremely weak thinly laminated reddish brown MUDSTONE. Fractures are subhorizontal to 10-20° extremely closely spaced planar smooth. (MMG) (Grade II)			
	56C	32.90 - 34.40	32.90		94 0 0			32.80 - 33.00m: Tending to extremely weak light greenish grey siltstone.			
						NI 10 200					
	57C	34.00 - 35.50	34.00		93 0 0	NI		34.10 - 34.20m: 60° undulating smooth fracture. 34.55 - 34.80m: Locally tending to very stiff reddish brown gravelly clay. Gravel is subangular fine and medium mudstone lithorelicts.			
	58C	35.50 - 36.20	35.50		100 0 0						
	59C	36.20 - 37.70	36.20		99 67 8	NI 60 120		36.20 - 37.70m: Fractures are closely spaced locally non intact.			
									37.70	-27.50	
	60C	37.70 - 39.20	37.70		99 60	50 180					
								Continued Next Page	{38.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
				Groundwater not encountered prior to use of water flush.	30238	EC

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BOREHOLE LOG

BH414

CLIENT	WELSH GOVERNMENT					Sheet	5 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	22 January 2015	Easting	331211.3				
End Date	3 February 2015	Northing	185001.0	Ground level	10.20mOD	Depth	40.70 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
						40	250		Weak and medium strong thickly laminated and very thinly bedded reddish brown MUDSTONE with frequent light greenish grey reduction spots (up to 20mm). Fractures are 5° to 10° very closely and closely rarely medium spaced planar smooth and rough. (MMG) (Grade I)			
	61C	39.20	40.70	39.20		99 92 43						
03/02/15 1530hrs 3.00m									40.10 - 40.40m: 70- 90° undulating smooth fracture.	40.70	-30.50	
									Borehole completed at 40.70m.	{48.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
				Groundwater not encountered prior to use of water flush.	30238	EC

Geotechnical Engineering Limited

BOREHOLE LOG

BH415

CLIENT	WELSH GOVERNMENT					Sheet	1 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	28 January 2015	Easting	331311.4				
End Date	9 February 2015	Northing	185030.5	Ground level	9.15mOD	Depth	40.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
28/01/15 1500hrs	1B	0.20 - 0.50						MADE GROUND comprising reinforced CONCRETE. (MG)	0.20	8.95	
	2D*	0.20 - 0.50		Vo 5.1				Black mottled red and grey clayey sandy angular fine to coarse slag, brick and limestone GRAVEL with low subangular cobble content. (MG)			
28/01/15 1700hrs Dry	3B	0.50 - 0.80									
	4D*	0.50 - 0.80		Vo 7.1							
	5B	0.80 - 1.00									
29/01/15 0840hrs Dry	6D*	0.80 - 1.00		Vo 5.3							
	7D	1.00 - 1.45	Nil	S 4				1.00 - 1.95m: Loose.			
	8B	1.00 - 1.50						1.00 - 2.50m: Loose to very loose.			
	9D*	1.00 - 1.60		Vo 14.2							
	10D	1.50 - 1.95	1.50	S 4							
	11B	1.50 - 2.00									
	12D*	1.50 - 1.60									
	13B	1.60 - 2.00							2.00	7.15	
	14D*	1.60 - 2.00		Vo 9.2				Soft dark grey mottled black sandy gravelly CLAY with a low subangular slag, brick and sandstone cobble content. Gravel is angular fine and medium slag, brick and sandstone. (MG)			
	15D	2.00 - 2.45	2.00	S 4							
	16B	2.00 - 2.50									
	17D*	2.00 - 2.50		Vo 24.1							
	18D	2.50 - 2.95	2.50	S 4							
	19B	2.50 - 3.00									
	20D*	2.50 - 3.00		Vo 7.6					3.00	6.15	
	21D	3.00 - 3.45	2.80	S 15				Firm dark grey mottled brown locally black organic silty CLAY. (TFD)			
	22B	3.00 - 3.50									
	23D*	3.00 - 3.50		Vo 4.6							
	24UT	3.50 - 3.95	3.50								
	26D*	3.50 - 4.00									
	25D	3.95 - 4.00									
	27D	4.00 - 4.45	4.00	S 8							
	28B	4.00 - 4.50									
	29D*	4.00 - 4.50							4.50	4.65	
29/01/15 1245hrs 1.15m	30UT	4.50 - 4.95	4.00					Very soft dark grey locally mottled black organic silty CLAY. (TFD)			
	32D*	4.50 - 5.00									
	31D	4.95 - 5.00									
02/02/15 0800hrs NR	33D	5.00 - 5.45	4.00	S 4							
	34D*	5.00 - 5.50		Vo 0.7							
02/02/15 1555hrs 1.25m											
03/02/15 0805hrs 3.25m	35B	6.00 - 6.50									
	36D*	6.00 - 6.50		Vo 9.8							
	37UT	6.50 - 6.95	6.00								
	38D	6.95 - 7.10									
	39D*	7.00 - 7.50		Vo 2.5							
	40B	7.50 - 8.00									
	41D	8.00 - 8.45	8.00	S 2							

Continued Next Page {8.00}

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.

METHOD: Surface hard standing broken out with hydraulic breaker 0.00-0.20m. Hand dug inspection pit 0.20-0.80m. Cable percussion (200mm) 0.80-5.00m and (150mm) 5.00-19.00m. Rotary core drilled (123mm PQ3 wireline) 19.00-40.00m using a water flush. CASING: 200mm diam to 4.00m, 150mm diam to 18.50m and 114mm diam to 40.00m.

BACKFILL: On completion, a slotted standpipe (50mm) with geosock was installed to 40.00m, granular response zone 40.00-20.00m, and bentonite seal 20.00-17.00m. A second slotted standpipe (35mm) with geosock was installed to 17.00m, granular response zone 17.00-13.00m, bentonite seal 13.00-0.30m, concrete and stopcock cover 0.30-0.00m. REMARKS: Hole advanced by chiselling 16.50-17.00m (1hr), 18.70-19.00m (45mins). Downhole magnetometry for UXO risk mitigation undertaken 0.00-15.50m. No anomalies encountered.

Bentonite seal for aquifer protection installed during drilling 4.00-5.00m, prior to reduction in casing diameter. Permeability test undertaken at 7.00-8.00m. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOG SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
1.00	0.00	0.80	20	Slow.
2.95	2.80	1.10	20	Medium.

AGS

CONTRACT	CHECKED
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BOREHOLE LOG

BH415

CLIENT	WELSH GOVERNMENT					Sheet	2 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	28 January 2015	Easting	331311.4				
End Date	9 February 2015	Northing	185030.5	Ground level	9.15mOD	Depth	40.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	42D*	8.00 - 8.50									
	43B	8.50 - 9.00									
	44UT	9.50 - 9.95	9.50								
	45D	9.95 - 10.10									
	46B	10.50 - 11.00									
	47D	11.00 - 11.45	11.00	S 3							
	48B	11.50 - 12.00									
	49UT	12.50 - 12.95	12.50								
	50D	12.95 - 13.10						Soft grey gravelly silty CLAY with a low subangular sandstone cobble content. Gravel is subangular fine and medium sandstone. (RTD)	13.00	-3.85	
	51B	13.25 - 13.50									
	52B	13.50 - 14.00									
	53D	14.00 - 14.45	14.00	S 4							
	54B	14.80 - 15.00						Very medium dense dark grey sandy subrounded and subangular fine to coarse sandstone GRAVEL with a medium subrounded sandstone cobble content. (RTD)	14.80	-5.65	
		15.50 - 15.74	15.50	C*63				Very dense dark grey sandy subrounded and subangular fine to coarse sandstone GRAVEL with a medium subrounded sandstone cobble content. (RTD)			
03/02/15 1615hrs 1.75m											
04/02/15 0800hrs 1.75m	55B	16.50 - 17.00	16.50								
		17.00 - 17.35	17.00	C*64							
								Very stiff fissured reddish brown mottled greenish grey sandy gravelly CLAY. Gravel is subangular fine and medium lithorelicts of extremely weak mudstone. (MMG)	17.50	-8.35	
								Continued Next Page	{18.00}		

water strike (m) casing (m) rose to (m) time to rise (m) remarks

AGS

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BOREHOLE LOG

BH415

CLIENT	WELSH GOVERNMENT					Sheet	3 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	28 January 2015	Easting	331311.4				
End Date	9 February 2015	Northing	185030.5	Ground level	9.15mOD	Depth	40.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	56B	18.20 - 18.33 18.20 - 18.70	18.00	C*115				(Grade IVa)	18.20	-9.05	
04/02/15 1235hrs 3.75m	57B	18.70 - 18.80 18.70 - 19.00 19.00 - 19.05	18.50 18.50	C*156 C*333				Very stiff fissured reddish brown mottled greenish grey sandy gravelly CLAY. Gravel is subangular fine and medium lithorelicts of extremely weak mudstone. (MMG) (Grade III)	19.00	-9.85	
05/02/15 1245hrs 5.00m	58C	19.00 - 19.90	19.00		100 22 0	NA NI		Hard fissured reddish brown mottled greenish grey sandy gravelly CLAY. Gravel is subangular fine and medium lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced planar rough. (MMG) (Grade III)	19.70	-10.55	
	59C	19.90 - 21.40	19.90		100 80 0			Extremely weak and very weak thinly laminated to very thinly bedded reddish brown locally mottled greenish grey MUDSTONE. Fractures are subhorizontal to 20° and subvertical very closely spaced planar rough and infilled with greenish grey clay up to 2mm. (MMG) (Grade II)	21.40	-12.25	
	60C	21.40 - 22.90	21.40		100	NA		Very stiff fissured reddish brown mottled greenish grey sandy gravelly CLAY with rare greenish grey reduction spots (up to 10mm). Gravel is subangular fine and medium lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced planar rough. (MMG) (Grade III)			
	61C	22.90 - 24.40	22.90		100						
	62C	24.40 - 25.90	24.40		33			24.40 - 25.90m: Limited recovery.			
05/02/15 1655hrs 5.20m											
06/02/15 0815hrs 5.00m	63C	25.90 - 27.20	25.90		100						
	64C	27.20 - 28.70	27.20		100			27.20 - 28.70m: Fissures locally infilled up to 3mm with fine and medium sand sized gypsum.			
								Continued Next Page	{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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BOREHOLE LOG

BH415

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	4 of 5
Start Date	28 January 2015	Easting	331311.4	Scale	1 : 50
End Date	9 February 2015	Northing	185030.5 Ground level 9.15mOD	Depth	40.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	65C	28.70 - 30.20	28.70		100			28.70 - 30.20m: Rare fine and medium sand sized gypsum crystals 28.70 - 31.70m: Rare fine and medium sand sized gypsum crystals.			
	66C	30.20 - 31.70	30.20		100			30.20 - 31.70m: Rare fine and medium sand sized gypsum crystals			
	67C	31.70 - 33.20	31.70		100						
	68C	33.20 - 34.70	33.20		100			32.90 - 33.20m: Locally tending to extremely weak mudstone. 33.20 - 34.70m: Locally tending to extremely weak mudstone with reddish brown clay laminae.			
	69C	34.70 - 36.00	34.70		30			34.70 - 36.00m: Limited recovery.	34.90	-25.75	
06/02/15 1620hrs 5.10m								Very stiff fissured reddish brown sandy gravelly CLAY with rare greenish grey reduction spots up to 5mm. Gravel is subangular fine and medium lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced planar rough. (MMG) (Grade III)	36.00	-26.85	
09/02/15 1005hrs 5.12m	70C	36.00 - 37.60	36.00		100 42 18	NI 100 200		Extremely weak and very weak locally tending to weak thinly laminated to very thinly bedded reddish brown MUDSTONE with rare greenish grey reduction spots (up to 10mm). Fractures are subhorizontal to 20° and subvertical extremely closely to medium closely spaced planar rough and locally infilled (up to 2mm) with greenish grey clay. (MMG) (Grade II) 36.50 - 36.70m: Vertical fractures infilled with greenish grey clay (up to 3mm).			
	71C	37.60 - 38.70	37.60		100 12 12			37.80 - 37.90m: Locally mottled greenish grey.			
								Continued Next Page	{38.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks

AGS

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BOREHOLE LOG

BH415

CLIENT	WELSH GOVERNMENT					Sheet	5 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	28 January 2015	Easting	331311.4				
End Date	9 February 2015	Northing	185030.5	Ground level	9.15mOD	Depth	40.00 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	72C	38.70	40.00	38.70		76 23 10	NI 30 110		39.10m: 20° fracture infilled with 3mm greenish grey clay.	39.20	-30.05	
09/02/15 1310hrs 4.85m									Weak and medium strong thinly laminated to very thinly bedded reddish brown mottled white MUDSTONE with rare greenish grey reduction spots(up to 5mm). Fractures are subhorizontal to 20° and subvertical extremely closely to closely spaced planar rough. (MMG) (Grade I)	40.00	-30.85	
									Borehole completed at 40.00m.			
										{48.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
					30238	EC

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BOREHOLE LOG

BH416

CLIENT	WELSH GOVERNMENT					Sheet	1 of 4
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	26 January 2015	Easting	331236.5			Depth	34.20 m
End Date	29 January 2015	Northing	185242.5	Ground level	10.05mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
26/01/15 0800hrs	1B	0.20 - 0.40						MADE GROUND comprising TARMACADAM. (MG)	0.10	9.95	
	2D*	0.20 - 0.40						Ballast. (Driller's description). (MG)	0.20	9.85	
	3B	0.40 - 0.80						Light brown angular to subangular fine and medium chert and limestone GRAVEL. (MG)			
	4D*	0.40 - 0.60									
	5B	0.80 - 1.00									
26/01/15 1700hrs Dry	6D*	0.80 - 1.00									
		1.20 - 1.65	1.20	C 14					1.20	8.85	
27/01/15 0800hrs Dry	7B	1.20 - 1.70		Vo 2.90				Firm dark greyish brown gravelly silty CLAY with rare glass fragments (up to 20mm). Gravel is angular to subangular fine to coarse limestone brick and rare tarmacadam. (MG)			
	8D*	1.50 - 1.60									
		1.65 - 2.10	1.60	C 23							
	9B	1.70 - 2.10		Vo 8.90							
	10D*	2.00 - 2.10									
		2.10 - 2.55	2.10	C 9							
	11B	2.10 - 2.60		Vo 2.40							
	12D*	2.50 - 2.60									
		2.55 - 3.00	2.50	C 11							
	13B	2.60 - 3.00		Vo 2.50							
		3.00 - 3.45	3.00	C 6							
	14B	3.00 - 3.50		Vo 3.10							
	15D	3.00 - 3.10									
	16D*	3.20 - 3.30									
	17D	3.50 - 3.95	3.50	S 3							
	18B	3.50 - 4.00	3.50	Vo 1.90					3.70	6.35	
	19D*	3.50 - 3.60						Firm dark grey slightly gravelly silty CLAY. Gravel is subrounded fine to coarse sandstone. (TFD)	4.00	6.05	
	20UT	4.00 - 4.45	4.00					Firm dark grey slightly gravelly silty CLAY. Gravel is subrounded fine to coarse sandstone. (TFD)			
	21D*	4.00 - 4.10									
	22D	4.45 - 4.50	4.00								
	23D	4.50 - 4.95	4.40	S 20							
	24B	4.50 - 5.00		Vo 0.90							
	25D*	4.50 - 4.60									
	26UT	5.00 - 5.45	4.50								
	27D	5.45 - 5.50	4.50								
	28D*	5.50 - 5.60									
	29D	6.00 - 6.50									
	30D	6.50 - 6.95	6.40	S 1					6.50	3.55	
	31B	6.50 - 7.00						Very soft dark grey slightly gravelly silty CLAY. Gravel is subrounded fine to coarse sandstone. (TFD)			
27/01/15 1700hrs Dry	32D*	6.50 - 6.60									
28/01/15 0800hrs 6.70m	33D	7.50									
	34B	7.50 - 7.60		Vo 2.50							
	35D*	7.50 - 7.60						7.50 - 7.60m: Slightly gravelly clayey silt.			
								Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig and Comacchio P450 Drilling rig.

METHOD: Surface hard standing broken out with hydraulic breaker 0.00-0.10m. Hand dug inspection pit 0.10-1.20m. Cable percussion (200mm) 1.20-4.50m and (150mm) 4.50-21.00m. Waterflush rotary core drilled (116mm) 21.00-34.20m.

CASING: 200mm diam to 4.50m and 150mm diam to 22.50m.

BACKFILL: On completion, hole backfilled with bentonite pellets.

REMARKS: Downhole magnetometry for UXO risk mitigation undertaken 0.00-13.00m. No anomalies encountered.

Bentonite seal for aquifer protection installed during drilling at 4.50m, prior to reduction in casing diameter.

MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
0.80	Nil	0.80	20	

AGS

CONTRACT	CHECKED
30238	EC

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BOREHOLE LOG

BH416

CLIENT	WELSH GOVERNMENT					Sheet	2 of 4
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	26 January 2015	Easting	331236.5				
End Date	29 January 2015	Northing	185242.5	Ground level	10.05mOD	Depth	34.20 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	36UT	8.00 - 8.45	15.50								
	37D	8.45 - 8.50									
	38D	9.00									
	39D	9.50 - 9.95	9.50	S 1							
	40B	9.50 - 10.00									
	41D	10.50									
	42UT	11.00 - 11.45	9.50								
	43D	11.45 - 11.50									
		11.50 - 11.95	11.50	C 9					11.40	-1.35	
	44B	11.50 - 12.00						Brownish grey sandy silty GRAVEL with medium cobble content. Gravel is subrounded to rounded fine and medium sandstone. Cobbles are subrounded and rounded sandstone. (RTD) 11.40 - 11.50m: Locally clayey. 11.50 - 11.95m: Loose.			
		13.00 - 13.19	11.50	C*375							
		13.50 - 13.95	13.50	C 31				13.50 - 15.45m: Dense.			
	45B	13.60 - 14.00									
	46B	14.50 - 15.00									
		15.00 - 15.45	15.00	C 43							
	47B	15.00 - 15.50									
	48B	16.00									
		16.50 - 16.95	16.50	C 19							
28/01/15 1700hrs 9.80m	49B	16.50 - 17.00						16.50 - 16.95m: Medium dense.			
29/01/15 0800hrs 5.20m											
	50B	17.50 - 18.00									
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks
11.80		9.00	5	
17.00		9.80		

AGS

CONTRACT	CHECKED
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BOREHOLE LOG

BH416

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	3 of 4
Start Date	26 January 2015	Easting	331236.5	Scale	1 : 50
End Date	29 January 2015	Northing	185242.5 Ground level 10.05mOD	Depth	34.20 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
		18.00 - 18.26	18.00	C 125				18.00 - 18.26m: Very dense.			
	51B	19.00 - 19.50									
	52B	19.50 - 19.95 19.50 - 20.00	19.50	C 31				19.50 - 19.90m: Dense.			
	53D 54D 55B	19.90 - 20.20 20.00 - 20.20 20.00 - 21.00		S*118				Stiff fissured reddish brown slightly sandy slightly gravelly CLAY. Gravel is randomly orientated subangular to rounded fine lithorelicts of very stiff clay to extremely weak mudstone. (MMG) (Grade IVa)	19.90	-9.85	
29/01/15 1700hrs 6.00m	56D	21.00 - 21.15	20.20	S*312							
03/02/15 0800hrs 6.60m	57C	21.00 - 22.50			83 0 0	NA					
						NI		Extremely weak and very weak thinly laminated reddish brown MUDSTONE. Fractures are subhorizontal to 20° and subvertical extremely closely spaced planar smooth. (MMG) (Grade II)	21.60	-11.55	
	58C	22.50 - 23.70	20.20		84 0 0						
03/02/15 1700hrs 9.20m											
04/02/15 0800hrs 7.05m	59C	23.70 - 25.20	20.20		97 0 0			24.00 - 24.20m: Locally tending to extremely weak light greenish grey siltstone. 24.10 - 24.20m: Intersecting fractures 50-70° planar rough.	24.70	-14.65	
						NA		Very stiff fissured reddish brown slightly gravelly CLAY with frequent light greenish grey reduction spots (up to 5mm). Gravel is angular and subangular fine to coarse very stiff clay to weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced. (MMG) (Grade III)			
	60C	25.20 - 26.70	20.20		100			26.40 - 26.60m: Very gravelly.			
	61C	26.70 - 28.20	20.20		86						
								Continued Next Page	{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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BOREHOLE LOG

BH416

CLIENT	WELSH GOVERNMENT					Sheet	4 of 4
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	26 January 2015	Easting	331236.5				
End Date	29 January 2015	Northing	185242.5	Ground level	10.05mOD	Depth	34.20 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	62C	28.20 - 29.70	20.20		100			28.20 - 28.60m: Locally tending to very weak mudstone.			
	63C	29.70 - 31.20	20.20		96			30.10 - 30.20m: Locally light greenish grey. 30.30 - 30.40m: Intersecting fissures 50-70° planar rough. 30.40 - 30.70m: Locally light greenish grey. 30.80 - 31.10m: Locally tending to extremely weak mudstone.			
	64C	31.20 - 32.70	20.20		100			31.20 - 31.70m: Locally firm.	31.70	-21.65	
								Very stiff fissured reddish brown slightly gravelly CLAY with frequent light greenish grey reduction spots (up to 5mm). Gravel is subangular lithorelicts of very stiff clay. (MMG) (Grade III)			
	65C	32.70 - 34.20	20.20		96 0 0	NI		Extremely weak and very weak thinly laminated reddish brown MUDSTONE. Fractures are subhorizontal to 20° and subvertical extremely closely spaced planar smooth. (MMG) (Grade II)	32.80	-22.75	
04/02/15 1730hrs 8.20m									34.20	-24.15	
								Borehole completed at 34.20m.	{38.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
					30238	EC

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BOREHOLE LOG

BH417

CLIENT	WELSH GOVERNMENT					Sheet	1 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	3 February 2015	Easting	331261.9				
End Date	10 February 2015	Northing	185414.6	Ground level	9.10mOD	Depth	25.70 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
03/02/15 0800hrs								Black slightly gravelly ashy silty fine and medium SAND with rare plant fragments (up to 40mm). Gravel is subangular fine to coarse limestone and sandstone. (MG)			
	1B	0.40 - 0.80									
	2D*	0.50 - 0.60		Vo 0.1							
	3B	0.90 - 1.20							0.80	8.30	
	4D*	1.00 - 1.10		Vo 0.2				Soft dark grey mottled brown slightly gravelly sandy silty CLAY. Gravel is subangular fine to coarse slag, limestone and sandstone. (MG)			
		1.20 - 1.65	1.20	C 28							
	5B	1.20 - 1.60									
	6D*	1.50 - 1.60		Vo 0.0							
		1.70 - 1.74	1.70	C*366				1.74m: Driller notes SPT hammer 'bouncing'.			
		2.20 - 2.65	2.20	C 6							
	7B	2.20 - 2.70									
	8D*	2.50 - 2.60		Vo 0.0							
		2.70 - 3.15	2.70	C 5							
	9B	2.70 - 3.20									
	10D*	3.00 - 3.10		Vo 0.2							
		3.20 - 3.65	3.20	C 5							
	11B	3.20 - 3.70									
03/02/14 1700hrs Dry	13D*	3.50 - 3.60									
		3.70 - 4.15	3.70	C 8							
04/02/15 0800hrs Dry	12B	3.70 - 4.20									
	14D*	4.00 - 4.10									
		4.20 - 4.65	4.20	C 8							
	15B	4.20 - 4.70									
	16D*	4.50 - 4.60									
	17D	4.80							4.80	4.30	
	18UT	5.00 - 5.45	5.00					Soft dark bluish grey silty CLAY with rare plant fragments (up to 30mm). (TFD)			
	19D*	5.00 - 5.10									
	20D	5.45 - 5.50									
	21D	6.00									
	22D*	6.00 - 6.10									
	23D	6.50 - 6.95	6.00	S 7							
	24B	6.50 - 7.00						6.50 - 7.00m: Rare black silt pockets (up to 30mm).			
	25D*	7.00 - 7.10									
	26D	7.50									
								Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig. METHOD: Hand dug inspection pit 0.00-1.20m. Cable percussion (200mm) 1.20-5.00m and (150mm) 5.00-21.00m. Waterflush rotary core drilled (116mm) 21.00-25.70m. CASING: 200mm diam to 5.00m and 150mm diam to 20.50m. BACKFILL: On completion, borehole backfilled 13/02/2015 with bentonite pellets 25.70-15.00m. A slotted standpipe (50mm) with geosock was installed to 15.00m, granular response zone 15.00-11.90m and bentonite seal 11.90-2.50m. A second slotted standpipe (35mm) was installed to 2.50m, granular response zone 2.50-0.90m, bentonite seal 0.90-0.40m, concrete and stopcock cover 0.40-0.00m. REMARKS: Hole advanced by chiselling 1.70-2.10m (1hr), 13.20-13.60m (1hr), 13.80-14.10m (1hr), 15.90-16.50m (1.5hr), 16.60-17.30m (1.5hr),18.50-18.90m (1.5hr). 19.00-19.40m (1.5hr) and 20.50-21.00m (1hr). Downhole magnetometry for UXO risk mitigation undertaken 0.00-13.50m. No anomalies encountered. Bentonite seal for aquifer protection installed during drilling 5.00m, prior to reduction in casing diameter. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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BOREHOLE LOG

BH417

CLIENT	WELSH GOVERNMENT					Sheet	2 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	3 February 2015	Easting	331261.9				
End Date	10 February 2015	Northing	185414.6	Ground level	9.10mOD	Depth	25.70 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	27UT	8.00 - 8.45	8.00								
	29D	8.45 - 8.50									
	28D*	8.00 - 8.10									
	30D	9.00									
	31D	9.50 - 9.95	9.00	S 3							
	32B	9.50 - 10.00									
									10.50	-1.40	
	33D	10.50						Firm brownish grey fine sandy CLAY. (TFD)			
	34UT	11.00 - 11.45	11.00								
	35D	11.50							11.70	-2.60	
04/02/15 1700hrs 0.44	36D	11.80						Dense and very dense brownish grey slightly silty sandy subangular and subrounded fine and medium sandstone GRAVEL. (RTD)			
		12.00 - 12.45	12.00	C 30							
05/02/15 0800hrs 8.70m	37B	12.00 - 12.50									
		13.50 - 13.95	13.50	C 41							
	38B	13.60 - 13.80						13.60 - 18.90m: Low subangular fine and medium sandstone cobble content.			
		15.00 - 15.45	15.00	C 19							
	39B	15.00 - 15.50						15.00m: SPT suggests medium dense, possibly affected by groundwater.			
		16.50 - 16.75	16.50	C*100							
		18.00 - 18.45	18.00	C 47							

Continued Next Page {18.00}

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks
11.60	9.00	10.30	5	Fast inflow.

AGS

CONTRACT	CHECKED
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BOREHOLE LOG

BH417

CLIENT	WELSH GOVERNMENT					Sheet	3 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	3 February 2015	Easting	331261.9			Depth	25.70 m
End Date	10 February 2015	Northing	185414.6	Ground level	9.10mOD		

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
05/02/15 1700hrs 9.10m	40B	18.00	18.50									
06/02/15 0800hrs 8.50m												
	41B	18.90	19.40									
	42D	19.40	19.50							19.40	-10.30	
	43D	19.50	19.95	19.50	S*55				Very stiff fissured reddish brown slightly gravelly CLAY. Gravel is angular and subangular fine to coarse lithorelicts of very stiff clay. (MMG) (Grade III)			
	44B	19.50	20.00									
	45B	20.50	21.00									
06/02/15 1700hrs 11.00m	47D	21.00	21.27	20.30	S*130							
	46C	20.70	22.20	20.30		80	NA					
09/02/15 1650hrs 5.85m												
										21.80	-12.70	
09/02/15 1720hrs 4.20m									Stiff fissured reddish brown very gravelly CLAY with rare light greenish grey reduction spots. Gravel is angular and subangular fine to coarse lithorelicts of extremely weak mudstone. (MMG) (Grade III)			
10/02/15 0810hrs 3.81m	48C	22.20	23.70	20.50		100						
										22.60	-13.50	
									Stiff fissured reddish brown slightly gravelly CLAY. Gravel is angular and subangular fine to coarse lithorelicts of very stiff clay. (MMG) (Grade III) 23.15 - 23.25m: Light greenish grey reduction spots (up to 90mm). 23.25 - 23.30m: Very gravelly.			
	49C	23.70	25.20	20.50		100						
	50C	25.20	25.70	20.50		80			25.30 - 25.45m: Very gravelly.			
10/02/15 1030hrs 3.95m										25.70	-16.60	
									Borehole completed at 25.70m.			
										{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks

AGS

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BOREHOLE LOG

BH418

CLIENT	WELSH GOVERNMENT					Sheet	1 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	30 January 2015	Easting	331043.9				
End Date	3 February 2015	Northing	185887.6	Ground level	11.40mOD	Depth	25.80 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
30/01/15 0800hrs	1B	0.00 - 0.40						Dark grey clayey sandy subangular fine and medium limestone and tarmacadam GRAVEL with rare plant fragments (up to 2mm). (MG)	0.40	11.00	
	2D*	0.50 - 1.00		Vo 0.3				Black mottled dark grey sandy subangular fine and medium tarmacadam GRAVEL with rare plant fragments (up to 2mm). (MG)			
	3B	0.60 - 1.00									
	4D*	1.00 - 1.50		Vo 3.8							
		1.20 - 1.43	1.20	C*216				1.20m: Very dense. 1.20 - 1.43m: Very dense.			
		1.70 - 1.75	1.20	C*326				1.70m: Very dense.			
	5D*	2.00 - 2.50		Vo 3.2							
		2.20 - 2.65	2.20	C 10							
	6B	2.20 - 2.70						2.20m: Loose to medium dense.			
	7D*	2.50 - 3.00		Vo 2.7							
		2.65 - 3.10	2.60	C 4							
	8B	2.70 - 3.10									
	9D*	3.00 - 3.50		Vo 6.1					3.00	8.40	
		3.10 - 3.55	3.00	C 7				Soft black mottled dark grey locally sandy gravelly silty CLAY with rare plant fragments (up to 2mm). Gravel is subangular fine and medium limestone and tarmacadam. (MG)			
	10B	3.10 - 3.60									
	11D	3.40									
		3.60 - 4.05	3.60	C 7							
	12B	3.60 - 4.10									
	13D*	4.00 - 4.50		Vo 3.3							
		4.10 - 4.55	4.10	C 5							
	14B	4.10 - 4.60									
	15D*	4.50 - 5.00		Vo 4							
		4.65 - 5.10	4.50	C 6							
	16B	4.65 - 5.00									
	17D	4.80							5.00	6.40	
	18UT	5.00 - 5.45	5.00					Soft dark grey mottled black organic silty CLAY with frequent plant fragments (up to 3mm). (TFD)			
	19D	5.50									
	20D*	5.00 - 5.50		Vo 2.4							
	21D	6.00							6.00	5.40	
	22D*	6.00 - 6.50		Vo 3.2				Firm dark grey mottled light brown silty CLAY with frequent plant fragments (up to 3mm). (TFD)			
	23D	6.50 - 6.95	6.00	S 12							
	24B	6.50 - 7.00									
									7.00	4.40	
	25D*	7.00 - 7.50		Vo 0				Soft dark grey mottled black and light brown organic silty CLAY with frequent plant and wood fragments (up to 5mm). (TFD)			
	26D	7.50									
								Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Cable percussion (200mm) 1.20-5.00m and (150mm) 5.00-20.80m. Waterflush rotary core drilled (116mm) 20.80-25.80m.

CASING: 200mm diam to 5.00m and 150mm to 20.50m.

BACKFILL: On completion, hole backfilled with bentonite pellets 25.80-0.50m and concrete 0.50-0.00m.

REMARKS: Hole advanced by chiselling 1.30-2.10m (2hr), 15.00-15.60m (1.5hr), 17.40-17.70m (1hr), 17.90-18.20m (1hr) and 20.30-20.80m (1hr). Downhole magnetometry for UXO risk mitigation undertaken 0.00-1.20m. No anomalies encountered. Bentonite seal for aquifer protection installed during drilling 5.50-4.50m, prior to reduction in casing diameter. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
0.40	Nil	0.40	20	Seepage.
3.80		3.80	20	Seepage.

AGS

CONTRACT	CHECKED
30238	EC

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BOREHOLE LOG

BH418

CLIENT	WELSH GOVERNMENT					Sheet	2 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	30 January 2015	Easting	331043.9				
End Date	3 February 2015	Northing	185887.6	Ground level	11.40mOD	Depth	25.80 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	27UT	8.00 - 8.45	7.90								
	28D	8.50									
	29D*	8.00 - 8.50		Vo 0							
	30D	9.00									
	31D	9.50 - 9.95	9.00	S 5							
	32B	9.50 - 10.00									
30/01/15 1630hrs Dry											
02/02/15 0800hrs 9.80m											
	33D	10.50									
	34UT	11.00 - 11.45	10.80								
	35D	11.50									
	36D	12.00									
	37D	12.50 - 12.95	12.50	S 1							
	38B	12.50 - 13.00									
									13.00	-1.60	
								Soft dark grey mottled black organic silty CLAY with frequent plant fragments (up to 3mm). (TFD)			
	39D	13.50									
	40UT	14.00 - 14.45	14.00								
		15.00 - 15.23	15.00	C*115					15.00	-3.60	
	41D	15.00						Very dense dark grey mottled brown sandy subangular and subrounded fine to coarse limestone GRAVEL with high subangular and subrounded limestone cobble content. (RTD)			
	42B	16.00									
		16.50 - 16.95	16.50	C 17							
	43B	16.50 - 17.00						16.50 - 16.95m: Medium dense.			
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks
14.80		12.00	5	Fast.

AGS

CONTRACT	CHECKED
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BOREHOLE LOG

BH418

CLIENT	WELSH GOVERNMENT					Sheet	3 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	30 January 2015	Easting	331043.9				
End Date	3 February 2015	Northing	185887.6	Ground level	11.40mOD	Depth	25.80 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
		18.00 - 18.20	18.00	C*211							
02/02/15 1630hrs 12.10m											
03/02/15 0800hrs 9.60m											
		19.50 - 19.95	19.50	C 30					19.50	-8.10	
	44B	19.50 - 20.00						Dense reddish brown clayey sandy subangular and subrounded fine to coarse mudstone GRAVEL with high subangular and subrounded mudstone cobble content. (RTD)			
	45D	19.80									
	46D	20.00 - 20.26	19.80	S*134							
	47B	20.00 - 20.80									
03/02/15 1000hrs 11.00m											
	48D	20.80 - 21.04	20.20	S*130					20.80	-9.40	
04/02/15 1315hrs 5.80m	49C	20.80 - 22.30	20.20		100 25 10	NI 100 300		Extremely weak and very weak thinly laminated to very thinly bedded reddish brown locally mottled greenish grey MUDSTONE. Fractures are subhorizontal to 20° and subvertical extremely closely to medium spaced planar rough and stained black. (MMG) (Grade II) 21.50 - 22.15m: Mottled greenish grey.			
									22.15	-10.75	
	50C	22.30 - 23.80	20.20		100 60 52	NI 100 300		Weak and medium strong thinly laminated to very thinly bedded reddish brown mottled greenish grey MUDSTONE. Fractures are subhorizontal to 20° and subvertical closely and medium spaced planar rough and stained black. (MMG) (Grade I)			
	51C	23.80 - 25.30	20.20		86 23 19						
04/02/15 1550hrs 0.75m	52C	25.30 - 25.80	20.20		100 0 0				25.80	-14.40	
								Borehole completed at 25.80m.			
									{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
					30238	EC

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BOREHOLE LOG

BH419

CLIENT	WELSH GOVERNMENT					Sheet	1 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	19 January 2015	Easting	331420.5			Depth	41.25 m
End Date	30 January 2015	Northing	185197.2	Ground level	8.80mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
19/01/15 1300hrs								MADE GROUND comprising strong black and grey CONCRETE. (MG)	0.30	8.50	
	1B	0.50 - 0.80						MADE GROUND comprising TARMACADAM recovered as black and grey sandy subangular fine and medium gravel. (MG)			
	2D*	0.30 - 0.80									
	3B	0.80 - 1.20									
19/01/15 1630hrs Dry	4D*	0.80 - 1.20							1.00	7.80	
	5B	1.20 - 1.65						Very soft dark grey locally mottled reddish brown organic silty CLAY. (TFD)			
20/01/15 0830hrs Dry	6D	1.20 - 1.65	1.20	S 2							
	7D*	1.20 - 1.65							1.65	7.15	
	8UT	1.65 - 2.10	1.65					Very soft dark grey organic silty CLAY with rare plant fragments (up to 2mm). (TFD)			
	9D	2.05 - 2.25									
	10B	1.65 - 2.25									
	11D*	1.65 - 2.25									
	12D	2.25 - 2.70	2.25	S 4				2.25 - 3.30m: Soft.			
	13B	2.25 - 2.70									
	14UT	2.70 - 3.15	2.70								
	15D	3.10 - 3.30									
	16B	2.70 - 3.30									
	17D*	2.70 - 3.30									
	18D	3.30 - 3.75	3.30	S 10				3.30 - 4.20m: Firm.			
	19B	3.30 - 3.75									
	20UT	3.75 - 4.20	3.75								
	21B	3.75 - 4.20									
	22D*	3.75 - 4.20									
	23D	4.20 - 4.65	4.20	S 4				4.20 - 4.60m: Soft.			
	24B	4.20 - 4.65							4.60	4.20	
	25UT	4.65 - 5.10	4.50					Very soft dark grey organic silty CLAY. (TFD)			
	26D	5.05 - 5.25									
	27D	4.65 - 5.25									
20/01/15 1630hrs Dry	28D	5.25 - 5.70	5.00	S 4							
	29B	5.25 - 5.70									
21/01/15 0900hrs 4.60m	30UT	5.70 - 6.15	5.70								
	31D	6.10 - 6.30									
	32B	5.70 - 6.70									
	33D	6.70 - 7.15	6.70	S<1							
	34B	6.70 - 7.70									
	35UT	7.70 - 8.15	7.70								
	36D	8.10 - 8.30									
								Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig and P450 Drilling rig.

METHOD: Surface hard standing broken out with hydraulic breaker 0.00-0.30m. Hand dug inspection pit 0.30-1.20m. Cable percussion (200mm) 1.20-6.00m and (150mm) 6.00-20.50m. Waterflush rotary core drilled (92mm) 20.50-41.25m. CASING: 200mm diam to 6.00m, 150mm diam to 20.50m and 140mm diam to 30.00m.

BACKFILL: On completion, hole backfilled with bentonite pellets.

REMARKS: Hole advanced by chiselling 15.20-15.40m (1hr), 15.40-15.70m (1hr) and 18.00-18.40m (1hr). Water added to assist boring 1.20-5.25m (20 gallons). Downhole magnetometry for UXO risk mitigation undertaken 0.00-15.00m. No anomalies encountered. Bentonite seal for aquifer protection installed during drilling 6.00-4.50m, prior to reduction in casing diameter. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
3.00		2.80	20	Seepage.
6.00		4.60	20	

AGS

CONTRACT	CHECKED
30238	EC

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BOREHOLE LOG

BH419

CLIENT	WELSH GOVERNMENT					Sheet	2 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	19 January 2015	Easting	331420.5			Depth	41.25 m
End Date	30 January 2015	Northing	185197.2	Ground level	8.80mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	36B	7.70 - 8.70									
	38D	8.70 - 9.70	8.70	S 3							
	39B	8.70 - 9.70									
	40UT	9.70 - 10.15	9.70								
	41D	10.10 - 10.30									
	42B	9.70 - 10.70									
	43D	10.70 - 11.15	10.70	S 4							
	44B	10.70 - 11.70									
	45UT	11.70 - 12.10	11.70								
	47B	11.70 - 12.00									
	46D	12.00 - 12.20									
		12.00 - 12.45	12.00	C 23							
	48B	12.00 - 13.00									
21/01/15 1630hrs 4.50m								Stiff dark grey sandy gravelly organic CLAY. Gravel is subangular and subrounded fine to coarse crystalline. (RTD)	11.90	-3.10	
		13.00 - 13.45	13.00	C 29					13.00	-4.20	
22/01/15 0830hrs 6.20m	49B	13.00 - 14.00						Medium dense brownish grey clayey sandy subrounded fine to coarse sandstone GRAVEL with low subrounded sandstone cobble content. (RTD)			
		14.00 - 14.45	14.00	C 13							
	50B	14.00 - 15.00									
		15.00 - 15.29	15.00	C*107							
	51B	15.00 - 15.50						15.00 - 15.66m: Very dense.			
		15.50 - 15.66	15.50	C*188							
	52B	15.50 - 16.00									
		16.00 - 16.45	16.00	C 39							
	53B	16.00 - 17.00						16.00 - 16.45m: Dense.			
22/01/15 1600hrs 9.50m											
23/01/15 0830hrs 8.60m											
		17.60 - 17.92	17.60	C*90							
	54B	17.60 - 18.60						17.60 - 17.91m: Very dense.			
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks
11.90		9.60	20	Fast.
14.00		2.50	20	Fast.
18.00		2.50	20	Fast.

AGS

CONTRACT	CHECKED
30238	EC

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BOREHOLE LOG

BH419

CLIENT	WELSH GOVERNMENT					Sheet	3 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	19 January 2015	Easting	331420.5				
End Date	30 January 2015	Northing	185197.2	Ground level	8.80mOD	Depth	41.25 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	55B	18.60 - 19.05 18.60 - 19.60	18.60	C 31				18.60 - 19.60m: Dense.			
23/01/15 1600hrs 2.50m		19.60 - 20.50	19.60	C 40				Dense reddish brown sandy subrounded fine to coarse sandstone GRAVEL with high subrounded and subangular sandstone cobble content. (RTD)	19.60	-10.80	
28/01/15 0800hrs 6.60m	56C	20.50 - 21.50			80 0 0	NA		20.50m: Clayey.	20.60	-11.80	
						NA NI		Stiff fissured reddish brown sandy gravelly CLAY. Gravel is randomly orientated subangular fine and medium lithorelicts of stiff clay and extremely weak mudstone. (MMG) (Grade III)	20.85	-12.05	
	57C	21.50 - 23.00			86 25 0			Extremely weak and very weak thinly laminated to very thinly bedded reddish brown MUDSTONE with rare greenish grey reduction spots (up to 40mm). Fractures are subhorizontal to 20° extremely closely spaced planar rough. (MMG) (Grade II) 20.85 - 21.00m: Recovered non intact.	22.40	-13.60	
	58C	23.00 - 24.50			93 50 0	NI		Weak thinly laminated to very thinly bedded reddish brown MUDSTONE with rare greenish grey reduction spots (up to 30mm). Fractures are subhorizontal to 20° and subvertical extremely closely spaced planar rough. (MMG) (Grade I)			
	59C	24.50 - 26.00			73 45 0			24.50 - 24.80m: No recovery. 24.80 - 25.00m: Reddish brown subangular fine to coarse mudstone gravel.			
	60C	26.00 - 26.10 26.00 - 26.75	20.50	S*375	100 0 0						
28/01/15 1730hrs 6.95m						NA		Limited recovery. Stiff fissured reddish brown gravelly CLAY with greenish grey reduction spots (up to 30mm). Gravel is subangular fine and medium lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced planar rough. (MMG) (Grade III) 26.75 - 28.25m: No recovery.	26.45	-17.65	
29/01/15 0800hrs 6.60m	C	26.75 - 28.25			0 0 0						
								Continued Next Page	{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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BOREHOLE LOG

BH419

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	4 of 5
Start Date	19 January 2015	Easting	331420.5	Scale	1 : 50
End Date	30 January 2015	Northing	185197.2 Ground level 8.80mOD	Depth	41.25 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	61C	28.25 - 28.62 28.25 - 29.25	20.50	C*70	95			Stiff fissured reddish brown gravelly CLAY with rare greenish grey reduction spots (up to 30mm). Gravel is subangular fine and medium lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced planar rough. (MMG) (Grade III)	28.50	-19.70	
	62C	29.25 - 30.05			100			Very stiff fissured reddish brown gravelly CLAY with rare greenish grey reduction spots (up to 10mm). Gravel is subangular fine and medium lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced planar rough. (MMG) (Grade III)	30.05	-21.25	
	63C	30.05 - 30.75			92			Very stiff fissured reddish brown locally mottled greenish grey gravelly CLAY with rare local greenish grey reduction spots (up to 20mm). Gravel is subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical extremely closely spaced planar rough. (MMG) (Grade III)			
29/01/15 1730hrs 7.20m											
30/01/15 0800hrs 6.40m	64C	30.75 - 32.25			100						
	65C	32.25 - 33.75			100				33.75	-24.95	
	66C	33.75 - 35.25			43 38 7	NI 50 120		Limited recovery of extremely weak and very weak thinly laminated to very thinly bedded reddish brown MUDSTONE with local greenish grey reduction spots (up to 20mm). Fractures are subhorizontal to 20° and subvertical extremely closely to closely spaced planar rough. (MMG) (Grade I/II)			
	67C	35.25 - 35.49 35.25 - 36.25	30.00	C*83	70 28 10			35.70 - 36.45m: Greenish grey staining	36.25	-27.45	
	68C	36.25 - 36.75			100 0 0	NA NI 100 230		Very stiff fissured reddish brown locally mottled greenish grey gravelly CLAY with local greenish grey reduction spots (up to 20mm). Gravel is subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical extremely closely spaced planar rough. (MMG) (Grade III)	36.45	-27.65	
	69C	36.75 - 38.25			60 38 13			Extremely weak and very weak thinly laminated to very thinly bedded reddish brown MUDSTONE with frequent local greenish grey reduction spots to 20mm. Fractures are subhorizontal to 20° and subvertical extremely closely to medium spaced planar rough. (MMG) (Grade II)			
								Continued Next Page	{38.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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BOREHOLE LOG

BH419

CLIENT	WELSH GOVERNMENT					Sheet	5 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	19 January 2015	Easting	331420.5			Depth	41.25 m
End Date	30 January 2015	Northing	185197.2	Ground level	8.80mOD		

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	70C	38.25	38.41	30.00	C*150							
		38.25	39.75			100 26 13			38.95 - 39.20m: Non intact.			
										39.75	-30.95	
	71C	39.75	41.25			67 30 13	NI 70 110		Weak and medium strong thinly laminated to very thinly bedded reddish brown MUDSTONE with rare greenish grey reduction spots (up to 10mm). Fractures are subhorizontal to 20° and subvertical extremely closely to closely spaced planar rough. (MMG) (Grade I)			
30/01/15 1730hrs 7.75m										41.25	-32.45	
									Borehole completed at 41.25m.			
										{48.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
					30238	EC

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BOREHOLE LOG

BH420

CLIENT	WELSH GOVERNMENT					Sheet	1 of 7
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	24 February 2015	Easting	331608.4			Depth	64.00 m
End Date	12 March 2015	Northing	185175.3	Ground level	10.55mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
24/02/15 1500hrs	1B	0.00 - 0.50						MADE GROUND comprising TARMACADAM. (Driller's description). (MG)	0.20	10.35	
	2D*	0.00 - 0.50		Vo 0.0							
	3B	0.50 - 1.20	Nil					Dark grey sandy subangular fine to coarse slag, brick, tarmacadam, concrete and limestone GRAVEL. (MG)	0.60	9.95	
	4D*	0.50 - 1.20		Vo 0.0							
24/02/15 1700hrs Dry								Medium dense brownish grey sandy clayey subangular fine to coarse brick, slag, limestone and siltstone GRAVEL with a medium subangular limestone cobble content. (MG)			
		1.20 - 1.65	1.20	C 11							
25/02/15 0800hrs Dry	5B	1.20 - 1.65									
	6D*	1.20 - 1.70		Vo 0.0							
		1.65 - 2.10	1.50	C 27							
	7B	1.65 - 2.10									
	8D*	1.70 - 2.20		Vo 0.0							
		2.10 - 2.55	2.00	C 29							
	9B	2.10 - 2.55									
	10D*	2.20 - 2.70		Vo 0.0					2.50	8.05	
	11D	2.55 - 3.00	2.50	S 1				Very loose becoming medium dense dark brown slightly gravelly fine SAND with low subrounded siltstone cobble content. Gravel is subangular fine to coarse siltstone. (TFD)			
	12B	2.55 - 3.00									
	13D	3.00 - 3.45	3.00	S 5				3.00 - 3.50m: Very gravelly.			
	14B	3.00 - 3.50									
	15D*	2.70 - 3.20		Vo 0.0							
	16D	3.50 - 3.95	3.00	S 3							
	17B	3.50 - 4.00									
	18D*	3.20 - 3.70		Vo 0.0							
	19D	4.00 - 4.45	4.00	S 24							
	20B	4.00 - 4.50									
	21D*	3.70 - 4.20		Vo 0.0							
	22D	4.50 - 4.95	4.50	S 7					4.50	6.05	
	23B	4.50 - 5.00						Soft brown silty CLAY. Driller notes ironstone cobbles. (TFD)			
	24D*	4.20 - 4.70		Vo 0.0							
	25D*	4.70 - 5.20		Vo 0.0							
		5.00 - 5.45	5.00	C 17				5.00 - 6.00m: Slightly sandy slightly gravelly clay.			
	26B	5.00 - 6.00									
									6.00	4.55	
	27UT	6.00 - 6.45	6.00					Very soft grey slightly sandy silty CLAY. (TFD)			
	30B	6.00 - 7.50						6.00 - 7.40m: Driller notes fragments of steel.			
	28D	6.45 - 6.65									
	29D	6.65 - 7.10	6.00	S 2							
25/02/15 1700hrs 2.10m											
26/02/15 0800hrs NR	31UT	7.50 - 7.90	7.50								
	33B	7.50 - 9.70									
								Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical pioneer rig. METHOD: Surface hard standing broken out with hydraulic breaker 0.00-0.20m. Hand dug inspection pit 0.20-1.20m. Cable percussion (200mm) 1.20-7.50m and (150mm) 7.50-23.70m. Waterflush rotary core drilled (116mm) 24.00-64.00m. CASING: 200mm diam to 7.50m, 150mm diam to 23.70m and 140mm diam to 35.70m. BACKFILL: On completion, borehole backfilled with bentonite pellets 64.00-21.00m. A slotted standpipe (50mm) was installed to 21.00m, granular response zone 21.00-17.00m and bentonite seal 17.00-7.00m. A second slotted standpipe (35mm) was installed to 7.00m, granular response zone 7.00-1.00m, bentonite seal 1.00-0.20m, concrete and stopcock cover 0.20-0.00m.

REMARKS: Hole advanced by chiselling 17.60-18.00m (1hr), 18.50-19.00m (1hr), 19.50-19.90m (1hr), 21.30m no penetration (1hr), 21.70-22.10m (1hr) and 23.70-24.00m (1hr). Driller notes reduced flush returns 27.00-47.50m (70-80% returned) and loss of flush 47.50-64.00m. Permeability test undertaken at 4.50m and 6.00m- 7.00m. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
4.50	4.50	3.65	20	Medium flow.

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BOREHOLE LOG

BH420

CLIENT	WELSH GOVERNMENT					Sheet	2 of 7
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	24 February 2015	Easting	331608.4				
End Date	12 March 2015	Northing	185175.3	Ground level	10.55mOD	Depth	64.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	32D	7.90 - 8.10									
	34D	9.70 - 10.15	9.70	S 2							
	35B	9.70 - 11.20									
	36UT	11.20 - 11.65	11.20								
	38B	11.20 - 12.70									
	37D	11.65 - 11.85									
	39D	12.70 - 13.15	12.70	S 4							
	40B	12.70 - 14.20						12.70 - 16.10m: Soft grey silty clay.			
	41UT	14.20 - 14.60	14.20								
	43B	14.20 - 15.70									
	42D	14.60 - 14.80									
	44D	15.70 - 16.15	15.70	S 9							
	45B	15.70 - 16.10						15.70m: Becoming firm.			
		16.10 - 16.55	16.10	C 24					16.10	-5.55	
	46B	16.10 - 17.60						Medium dense greyish brown very sandy subangular and subrounded fine to coarse sandstone GRAVEL with low subangular and subrounded sandstone cobble content. (RTD)			
26/02/15 1645hrs 12.20m											
27/02/15 0830hrs 7.80m		17.60 - 18.05	17.50	C 49					17.60	-7.05	
	47B	17.60 - 19.10									
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks
16.00	16.00	11.80	20	Fast flow.

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BOREHOLE LOG

BH420

CLIENT	WELSH GOVERNMENT					Sheet	3 of 7
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	24 February 2015	Easting	331608.4				
End Date	12 March 2015	Northing	185175.3	Ground level	10.55mOD	Depth	64.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	48B	19.10 - 19.55 19.10 - 20.60	19.00	C 42				Dense greyish brown very sandy subangular and subrounded fine to coarse sandstone GRAVEL with low subangular and subrounded sandstone cobble content. (RTD)			
27/02/15 1330hrs 9.95m											
02/03/15 0800hrs 3.20m	49B	20.60 - 21.05 20.60 - 22.10	20.60	C 46							
	50B	22.10 - 22.55 22.10 - 23.20	22.10	C 39							
	52D 51B	23.20 - 23.50 23.20 - 23.70	23.20	S*99					23.20	-12.65	
02/03/15 1700hrs 7.20m								Very stiff reddish brown slightly gravelly CLAY. Gravel is subangular fine to coarse mudstone lithorelicts. (MMG) (Grade III)			
09/03/15 0900hrs 7.20m	53C	23.70 - 23.85 24.00 - 24.15 24.00 - 25.50	23.70	C*200 C*200	100	NA			24.00	-13.45	
	54C	25.50 - 27.00	23.70		100			Very stiff fissured reddish brown locally mottled light greenish grey sandy gravelly CLAY. Gravel is subangular and subrounded fine and medium lithorelicts of very stiff clay to extremely weak mudstone. Localised relict fissures are randomly orientated extremely closely spaced. (MMG) (Grade III)			
	55C	27.00 - 28.50	23.70		100				27.60	-17.05	
								Very stiff fissured reddish brown sandy gravelly CLAY with light greenish grey reduction spots. Gravel is subangular			
								Continued Next Page	{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks

AGS

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BOREHOLE LOG

BH420

CLIENT	WELSH GOVERNMENT					Sheet	4 of 7
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	24 February 2015	Easting	331608.4				
End Date	12 March 2015	Northing	185175.3	Ground level	10.55mOD	Depth	64.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
								and subrounded fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced. (MMG) (Grade III)			
	56C	28.50 - 30.00	23.70		100						
	57C	30.00 - 31.50	23.70		100						
	58C	31.50 - 33.00	23.70		100						
	59C	33.00 - 34.50	23.70		100 66 43	NI 90 200		Extremely weak and very weak thinly laminated to very thinly bedded reddish brown MUDSTONE with light greenish grey reduction spots locally tending to claybound tabular fine to coarse gravel sized mudstone lithorelicts. Fractures are subhorizontal to 20° closely to medium spaced locally non intact planar smooth infilled (up to 2mm) with clay. (MMG) (Grade II)	33.00	-22.45	
	60C	34.50 - 36.00	23.70		100 0 0						
09/03/15 1700hrs 5.61m						NA		Very stiff fissured reddish brown sandy gravelly CLAY with light greenish grey reduction spots. Gravel is subangular and subrounded fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced. (MMG) (Grade III)	35.00	-24.45	
10/03/15 0900hrs 7.81m	61C	36.00 - 37.50	23.70		100						
	62C	37.50 - 39.00	23.70		100 87 79	NI 220 475		Very weak and weak thinly laminated to very thinly bedded reddish brown MUDSTONE with light greenish grey reduction spots. Fractures are subhorizontal 5° to 25° and	37.50	-26.95	
								Continued Next Page	{38.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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BOREHOLE LOG

BH420

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	5 of 7
Start Date	24 February 2015	Easting	331608.4	Scale	1 : 50
End Date	12 March 2015	Northing	185175.3 Ground level 10.55mOD	Depth	64.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
								subvertical medium spaced locally non intact planar smooth rarely stained black and locally with a veneer of clay. (MMG) (Grade II)			
	63C	39.00 - 40.00	23.70		100 96 96						
	64C	40.00 - 41.50	23.70		100 77 67						
	65C	41.50 - 43.00	23.70		100 75 75			41.40 - 41.65m: Recovered non intact.			
								42.30 - 42.50m: Tending to claybound subangular fine to coarse gravel sized mudstone lithorelicts.	43.00	-32.45	
	66C	43.00 - 44.50	23.70		100	NA		Stiff fissured reddish brown sandy gravelly CLAY with local light greenish grey reduction spots. Gravel is subangular and subrounded fine and medium lithorelicts of very stiff clay to extremely weak mudstone. Localised relict fissures are randomly orientated extremely closely spaced. (MMG) (Grade III)	44.50	-33.95	
	67C	44.50 - 46.00	23.70		100 60 27	NI 95 255		Very weak and weak thinly laminated to very thinly bedded reddish brown MUDSTONE with local light greenish grey reduction spots. Fractures are subhorizontal to 25° and subvertical closely to medium spaced locally non intact planar smooth rarely stained black and locally with a veneer of clay. (MMG) (Grade II)			
								44.50 - 44.95m: Disintegrated to stiff reddish brown slightly gravelly clay. Gravel is weak subangular fine to coarse gravel sized mudstone lithorelicts.			
	68C	46.00 - 47.50	23.70		100 88 56			46.00 - 46.45m: Frequent thin laminae of sandstone.			
10/03/15 1600hrs 6.11m						NI		47.30 - 47.55m: Disintegrated to stiff reddish brown slightly gravelly clay. Gravel is weak subangular fine to coarse gravel sized mudstone lithorelicts.			
11/03/15 0800hrs 7.91m	69C	47.50 - 49.00	23.70		100 0 0			47.50 - 47.86m: Recovered non intact.	47.90	-37.35	
								Continued Next Page	{48.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks

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BOREHOLE LOG

BH420

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	6 of 7
Start Date	24 February 2015	Easting	331608.4	Scale	1 : 50
End Date	12 March 2015	Northing	185175.3 Ground level 10.55mOD	Depth	64.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
						NA		47.55 - 47.90m: Recovered non intact.			
								Very stiff fissured reddish brown sandy gravelly CLAY with local light greenish grey reduction spots. Gravel is subangular and subrounded fine to coarse lithorelicts of extremely weak and very weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced infilled (up to 2mm) with clay. (MMG) (Grade III)			
	70C	49.00 - 50.50	23.70		100						
	71C	50.50 - 52.00	23.70		100						
									52.00	-41.45	
	72C	52.00 - 53.00	23.70		93 67 50	NI 110 160		Extremely weak and very weak thinly laminated to very thinly bedded reddish brown MUDSTONE with local light greenish grey reduction spots locally tending to claybound tabular fine to coarse gravel sized mudstone lithorelicts. Fractures are subhorizontal to 20° closely spaced locally non intact planar smooth infilled (up to 2mm) with clay. (MMG) (Grade II/III)			
11/03/15 1700hrs 9.33m											
12/03/15 0900hrs 9.02m	73C	53.00 - 53.50	23.70		50 0 0	NI 90 90					
	74C	53.50 - 55.00	23.70		90 60 24						
									53.90	-43.35	
						NA		Very stiff fissured reddish brown sandy gravelly CLAY with local light greenish grey reduction spots. Gravel is subangular and subrounded fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced. (MMG) (Grade III)			
									55.00	-44.45	
	75C	55.00 - 56.50	35.70		96 60 24	NI 90 165		Extremely weak and very weak thinly laminated to very thinly bedded reddish brown MUDSTONE with local light greenish grey reduction spots locally tending to claybound tabular fine to coarse gravel sized mudstone lithorelicts. Fractures are subhorizontal to 20° closely spaced locally non intact planar smooth infilled (up to 2mm) with clay. (MMG) (Grade III)			
12/03/15 1700hrs 8.02m											
13/03/15 0830hrs NR	76C	56.50 - 58.00	35.70		67 61 29			56.50 - 58.00m: Limited recovery.			
									58.00	-47.45	
								Continued Next Page	{58.00}		

water strike (m) casing (m) rose to (m) time to rise (m) remarks

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BOREHOLE LOG

BH420

CLIENT	WELSH GOVERNMENT					Sheet	7 of 7
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	24 February 2015	Easting	331608.4				
End Date	12 March 2015	Northing	185175.3	Ground level	10.55mOD	Depth	64.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	77C	58.00 - 59.50	35.70		87	NA		Stiff fissured reddish brown sandy gravelly CLAY with local light greenish grey reduction spots. Gravel is subangular and subrounded fine and medium lithorelicts of very stiff clay to extremely weak mudstone. Localised relict fissures are randomly orientated extremely closely spaced. (MMG) (Grade III)			
13/03/15 1600hrs NR											
16/03/15 0830hrs 8.30m	78C	59.50 - 61.00	35.70		60			59.50 - 61.00m: Limited recovery.			
	79C	61.00 - 62.50	35.70		100						
	80C	62.50 - 64.00	35.70		53			62.50 - 64.00m: Limited recovery.			
16/03/15 1700hrs 8.30m									64.00	-53.45	
								Borehole completed at 64.00m.			
									{68.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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Geotechnical Engineering Limited

BOREHOLE LOG

BH421

CLIENT	WELSH GOVERNMENT					Sheet	1 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	24 February 2015	Easting	331773.6			Depth	40.80 m
End Date	12 March 2015	Northing	185284.2	Ground level	9.30mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
24/02/15 1000hrs	1B	0.00 - 0.50						Granite blocks (Driller's description). (MG)	0.20	9.10	
	2D*	0.00 - 0.50		Vo 0.0				Black silty very gravelly SAND. Gravel is angular and subangular fine to coarse limestone and slag. (MG) 0.40 - 0.50m: Driller notes sand. 0.50 - 1.20m: Clayey very sandy angular and subangular fine to coarse limestone and slag gravel.			
	3B	0.50 - 1.20									
	4D*	0.50 - 1.20		Vo 0.0							
	5D	1.20 - 1.65	Nil	S 2					1.30	8.00	
	6B	1.20 - 1.65									
24/02/15 1400hrs Dry	7D*	1.20 - 1.70		Vo 0.0				Soft light greenish grey and black slightly sandy slightly gravelly silty CLAY. Gravel is angular and subangular fine to coarse limestone and slag. (MG)	1.65	7.65	
03/03/15 0800hrs 1.30m	8UT	1.65 - 2.10	1.60	Vo 0.0				Soft greenish grey slightly sandy CLAY. (TFD)			
	11D*	1.70 - 2.80									
	10B	1.65 - 2.80									
	9D	2.10 - 2.30									
		2.80	2.50	V 42							
	12D	2.80 - 3.25	2.80	S 2				2.80m: Medium strength.			
	13B	2.80 - 3.25									
	14D*	2.80 - 3.25		Vo 0.4							
	15UT	3.25 - 3.65	2.80								
	17B	3.25 - 3.85									
	18D*	3.25 - 3.85		Vo 0.0							
	20B	3.85 - 4.20									
	19D	3.85 - 4.20	2.80	S 4							
	21D*	3.85 - 4.25		Vo 0.0							
	UT	4.20 - 4.60	4.20								
	22B	4.20 - 4.65							4.50	4.80	
	23D*	4.25 - 4.65		Vo 0.0				Soft dark greenish grey mottled brown slightly sandy silty CLAY. (TFD)			
	22D	4.65 - 5.10	4.50	S 7							
	24B	4.65 - 5.10									
	25D*	4.65 - 5.10		Vo 0.0							
	26UT	5.10 - 5.65	4.50					5.10 - 5.65m: Firm.			
	28B	5.10 - 6.00									
	27D	5.65 - 5.85									
	29D	6.00 - 6.45	6.00	S 8					6.00	3.30	
	30B	6.00 - 7.00						Firm greyish brown slightly sandy silty CLAY. (TFD)			
03/03/15 1700hrs Dry											
04/03/15 0800hrs Dry	31UT	7.00 - 7.45	7.00								
	33B	7.00 - 8.50									
	32D	7.45 - 7.65									
								Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Cable percussion (200mm) 1.20-6.00m and (150mm) 6.00-20.80m. Rotary core drilled (116mm) using a water flush 20.80-32.80m and a polymer flush 32.80-40.80m.

CASING: 200mm diam to 6.00m and 150mm diam to 20.20m. BACKFILL: On completion, borehole backfilled on 12/03/15 with bentonite pellets 40.80-0.30m, and gravel 0.30-0.00m. REMARKS: Hole advanced by chiselling 14.80-15.20m (1hr), 16.50-17.00m (1hr), 17.50-18.00m (1hr), 18.00-18.50m (1hr), 18.70-19.00m (30 mins), and 20.50-20.80m (1hr). Driller notes reduced flush returns 28.00-29.80m (50-60% returned), 29.80-32.80m (0-20% returned) and 32.80-40.80m (50% returned). Downhole magnetometry for UXO risk mitigation undertaken 0.00-14.70m. No anomalies encountered. Bentonite seal for aquifer protection installed during drilling 6.00m, prior to reduction in casing diameter. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks

AGS

CONTRACT	CHECKED
30238	EC

Geotechnical Engineering Limited

BOREHOLE LOG

BH421

CLIENT	WELSH GOVERNMENT					Sheet	2 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	24 February 2015	Easting	331773.6			Depth	40.80 m
End Date	12 March 2015	Northing	185284.2	Ground level	9.30mOD		

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	34P 35B	8.50 - 9.50 8.50 - 10.00		8.50		P/S			8.50 - 13.70m: Locally grey.			
	36P 37B	10.00 10.00 - 11.00 10.00 - 12.00		8.50 10.00	V 38	P/S			10.00m: Low strength.			
		11.50		10.00	V 43				11.50m: Medium strength.			
	P 38B	12.00 - 13.00 12.00 - 13.00		12.00		P/S						
	39UT 40D 41B	13.00 - 13.45 13.45 - 13.65 13.00 - 13.70		12.00								
	42B	13.70 - 14.15 13.70 - 14.70		13.70	C 19				Medium dense becoming very dense light grey slightly sandy silty subangular and rounded fine and medium sandstone GRAVEL. (RTD)	13.70	-4.40	
04/03/15 1630hrs 9.30m 05/03/15 0800hrs 7.65m	43B	14.70 - 15.06 14.70 - 16.20		14.70	C*72				14.70 - 19.50m: Very dense.			
	44B	16.20 - 16.46 16.20 - 17.70		16.20	C*100							
	45B	17.70 - 18.15 17.70 - 19.20		17.70	C 50							

Continued Next Page {18.00}

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks
13.50	13.50	8.00	20	

AGS

CONTRACT	CHECKED
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BOREHOLE LOG

BH421

CLIENT	WELSH GOVERNMENT					Sheet	3 of 5
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	24 February 2015	Easting	331773.6				
End Date	12 March 2015	Northing	185284.2	Ground level	9.30mOD	Depth	40.80 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
05/03/15 1700hrs 10.40m												
		19.20	19.65	19.20	C 34				19.10m: Dense.			
06/03/15 0800hrs 6.20m	46B	19.20	20.20									
	47D	20.20	20.51	20.20	S*94					20.20	-10.90	
	48B	20.20	20.60						Hard dark reddish brown slightly sandy slightly gravelly CLAY. Gravel is subangular and subrounded fine to coarse mudstone lithorelicts. (MMG) (Grade III)			
06/03/15 1700hrs 7.70m		20.60	20.75	20.50	C*200					20.80	-11.50	
10/03/15 0940hrs 6.36m	49C	20.80	22.30	20.20		100	NA		Hard thickly laminated reddish brown gravelly silty CLAY locally tending to extremely weak mudstone with rare bluish grey reduction spots. Gravel is angular and subangular fine to coarse mudstone lithorelicts. (MMG) (Grade III)			
	50C	22.30	23.80	20.20		100						
	51C	23.80	25.30	20.20		100 22 8				24.20	-14.90	
							NI 80 120		Extremely weak thickly laminated reddish brown MUDSTONE locally disintegrated to gravelly clay with rare bluish grey reduction spots (up to 5mm). Gravel is subangular fine to coarse mudstone lithorelicts. Fractures are subhorizontal closely spaced locally non intact planar smooth. (MMG) (Grade II/III)			
	52C	25.30	26.80	20.20		100 0 0	NI		25.40 - 27.20m: Recovered non intact.			
	53C	26.80	28.30	20.20		100 0 0				27.20	-17.90	
							NI		Extremely weak thickly laminated purplish brown and greenish grey interbedded MUDSTONE and SILTSTONE. Fractures are subhorizontal extremely closely spaced locally non intact undulating rough. (MMG) (Grade II)			
									Continued Next Page	{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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BOREHOLE LOG

BH421

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	4 of 5
Start Date	24 February 2015	Easting	331773.6	Scale	1 : 50
End Date	12 March 2015	Northing	185284.2 Ground level 9.30mOD	Depth	40.80 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	54C	28.30 - 29.80	20.20		100 34 7	45 NA		Weak thinly bedded greenish grey interbedded SILTSTONE and fine SANDSTONE. Fractures are subhorizontal very closely spaced undulating rough. (MMG)	28.40 28.55	-19.10 -19.25	
						NI 70 110		Hard thickly laminated purplish brown gravelly silty CLAY with frequent greenish grey reduction spots (up to 20mm). Gravel is angular fine and medium mudstone lithorelicts. (MMG) (Grade III)	29.00	-19.70	
	55C	29.80 - 31.30	20.20		97 0 0	NI		Weak locally extremely weak thinly bedded locally crossed bedded greenish grey and purplish brown MUDSTONE and SILTSTONE. Fractures are subvertical and subhorizontal extremely closely to closely spaced undulating rough. (MMG) (Grade II)	30.20	-20.90	
								Extremely weak reddish brown and purplish brown MUDSTONE. Recovered non intact. (MMG) (Grade II)			
	56C	31.30 - 32.80	20.20		97 3 0			31.60m: 30mm band of medium strong greenish grey siltstone.	32.30	-23.00	
10/03/15 1700hrs 7.10m						NI 10 40		Extremely weak locally weak reddish brown MUDSTONE with rare greenish grey reduction spots (up to 10mm). Fractures are extremely closely and very closely spaced randomly orientated undulating rough. (MMG) (Grade II)			
11/03/15 0845hrs 7.10m	57C	32.80 - 34.30	20.20		100 4 0			33.40 - 33.45m: Weak.	33.60	-24.30	
						NA		Hard reddish brown clayey SILT with frequent angular fine and medium gravel sized mudstone lithorelicts and rare greenish grey reduction spots (up to 5mm). (MMG) (Grade III)			
	58C	34.30 - 35.80	20.20		100 0 0	NI 40 140		Extremely weak locally weak thinly laminated reddish brown MUDSTONE with frequent greenish grey reduction spots (up to 20mm). Fractures are subhorizontal, 50° and subvertical very closely and closely spaced locally non intact planar and undulating rough. (MMG) (Grade II)	34.50	-25.20	
	59C	35.80 - 37.30	20.20		87 9 0						
	60C	37.30 - 38.80	20.20		100 17 17						

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water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks

AGS

CONTRACT	CHECKED
30238	EC

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Geotechnical Engineering Limited

BOREHOLE LOG

BH421

CLIENT	WELSH GOVERNMENT						
SITE	M4 CORRIDOR AROUND NEWPORT					Sheet	5 of 5
Start Date	24 February 2015	Easting	331773.6			Scale	1 : 50
End Date	12 March 2015	Northing	185284.2	Ground level	9.30mOD	Depth	40.80 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
						NI		Extremely weak thinly laminated reddish brown MUDSTONE locally disintegrated to clayey angular fine and medium gravel sized mudstone lithorelicts with rare greenish grey reduction spots (up to 10mm). Recovered non intact. (MMG) (Grade II)	38.10	-28.80	
	61C	38.80 - 40.30	20.20		100 0 0						
11/03/15 1530hrs 6.68m	62C	40.30 - 40.80	20.20		100 0 0				40.80	-31.50	
12/03/15 0800hrs								Borehole completed at 40.80m.			
									{48.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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BOREHOLE LOG

BH421A

CLIENT	WELSH GOVERNMENT						
SITE	M4 CORRIDOR AROUND NEWPORT					Sheet	1 of 1
Start Date	24 February 2015	Easting	331774.2			Scale	1 : 50
End Date	24 February 2015	Northing	185292.0	Ground level	9.10mOD	Depth	0.50 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range		instru -ment	description	depth (m)	reduced level (m)	legend
24/02/15 0800hrs									Slag GRAVEL (Driller's description). (MG)	0.20	8.90	
									SAND (Driller's description). (MG)	0.30	8.80	
									Black ash and brick FILL (Driller's description). (MG)	0.50	8.60	
24/02/15 0900hrs Dry									Borehole completed at 0.50m.			
										{8.00}		

EQUIPMENT: Hand Tools only.

METHOD: Hand dug inspection pit 0.00-0.50m. Samples not retained.

CASING: Not used.

BACKFILL: On completion, hole backfilled with material arisings.

REMARKS: Service detected at 0.50m using CAT, hole abandoned on the instruction of the Engineer. Hole reattempted as BH421.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
				Groundwater not encountered.

AGS

CONTRACT	CHECKED
30238	EC

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Geotechnical Engineering Limited

BOREHOLE LOG

BH422

CLIENT	WELSH GOVERNMENT						
SITE	M4 CORRIDOR AROUND NEWPORT					Sheet	1 of 7
Start Date	16 January 2015	Easting	332017.2			Scale	1 : 50
End Date	29 January 2015	Northing	185435.4	Ground level	7.95mOD	Depth	60.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
16/01/15 0830hrs	1B	0.00 - 0.50						Black clayey subangular fine and medium GRAVEL of tarmacadam, brick and ash. (MG)			
	2D*	0.00 - 0.50		Vo 0.0							
	3B	0.50 - 1.00									
	4D*	0.50 - 1.00		Vo 0.2							
									1.00	6.95	
	5UT	1.00 - 1.45	Nil					Soft and very soft light and dark grey mottled light brown and black organic silty CLAY with rare plant fragments up to 2mm. (TFD)			
16/01/15 1600hrs Dry	6D	1.45 - 1.60									
	7D*	1.45 - 1.65		Vo 0.2							
		1.60 - 2.05	1.60	S 4							
19/01/15 0830hrs 0.50m	8B	1.60 - 2.00									
	9D*	1.60 - 2.00		Vo 0.3							
	10UT	2.00 - 2.45	2.00								
	11D	2.45 - 2.50									
	12D	2.50 - 2.95	2.50	S 8							
	13B	2.50 - 3.00									
	14UT	3.00 - 3.45	3.00								
	15D	3.45 - 3.50									
	16D	3.50 - 3.95	3.50	S 8							
	17B	3.50 - 4.00									
	18D	4.00 - 4.45	4.00	S 4					4.00	3.95	
	19B	4.00 - 4.50						Soft light and dark grey mottled light brown and black gravelly organic CLAY with low subangular sandstone cobble content and rare plant fragments (up to 2mm). Gravel is subangular fine and medium locally coarse sandstone. (TFD) 4.50 - 5.00m: Recovered as cobbles with some slightly sandy gravelly clay.			
		4.50 - 4.90	4.50	S 4							
	20B	4.50 - 5.00									
	21D	5.00 - 5.45	5.00	S 5							
	22B	5.50 - 6.00									
19/01/15 1610hrs 3.40m									6.00	1.95	
20/01/15 0830hrs 3.25m	23D	6.00 - 6.45	6.00	S 6				Soft and very soft light and dark grey organic CLAY. (TFD)			
	24B	6.50 - 7.00									
	25UT	7.00 - 7.45	7.00								
	26D	7.45 - 7.50									
	27B	7.50 - 8.00									
								Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.
METHOD: Hand dug inspection pit 0.00-1.00m. Cable percussion (200mm) 1.00-6.00m and (150mm) 6.00-21.70m. Waterflush rotary core drilled (116mm) 21.70-60.00m. CASING: 200mm diam to 5.00m, 150mm diam to 21.70m and 140mm diam to 24.50m. BACKFILL: On completion, hole backfilled with bentonite pellets. REMARKS: Hole advanced by chiselling 19.60-20.00m (1hr) and 20.50-21.00 (1hr). Water added to assist boring throughout borehole (30 gallons). Downhole magnetometry for UXO risk mitigation undertaken 0.00-10.00m. No anomalies encountered.
Bentonite seal for aquifer protection installed during drilling 5.00-6.00m, prior to reduction in casing diameter. Casing detached during installation, unable to retrieve; 4.00m of casing left down the borehole 15.00-19.00m. Borehole moved 2m away and re-drilled to install monitoring wells. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
0.80		0.65	20	Fast

AGS

CONTRACT	CHECKED
30238	EC

Geotechnical Engineering Limited

BOREHOLE LOG

BH422

CLIENT	WELSH GOVERNMENT					Sheet	2 of 7
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	16 January 2015	Easting	332017.2			Depth	60.00 m
End Date	29 January 2015	Northing	185435.4	Ground level	7.95mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	28D	8.00 - 8.45	8.00	S 8					8.60	-0.65	
	29B	8.60 - 9.00						Very loose dark grey silty fine and medium SAND. (TFD)			
	30D	9.00 - 9.45	9.00	S 4							
	31B	9.50 - 10.00									
	32D	10.00 - 10.45	10.00	S 2							
	33B	10.50 - 11.00									
	34D	11.00 - 11.45	11.00	S 38				11.00m: Becoming dense.			
	35B	11.50 - 12.00									
	36D	12.00 - 12.45	12.00	S 10							
								12.30m: Loose to medium dense.	12.50	-4.55	
	37B	12.50 - 13.00						Soft dark grey organic clayey SILT. (TFD)			
	38UT	13.00 - 13.45	13.00								
	39D	13.45 - 13.50									
20/01/15 1630hrs 8.30m	40B	13.50 - 14.00							13.90	-5.95	
21/01/15 0800hrs 6.20m	41D	14.00 - 14.45	14.00	S 43				Dense becoming very dense dark grey sandy subrounded fine to coarse sandstone GRAVEL with medium subrounded sandstone cobble content. (RTD)			
	42B	14.50 - 15.00									
		15.00 - 15.29	15.00	C*61							
	43B	15.50 - 16.00									
		16.00 - 16.45	16.00	C 42					16.00	-8.05	
								Dense locally medium dense dark grey sandy subrounded fine and medium locally coarse sandstone GRAVEL with medium subrounded sandstone cobble content. (RTD)			
21/01/15 1400hrs 8.10m	44B	16.50 - 17.00									
22/01/15 0815hrs 8.10m		17.00 - 17.45	17.00	C 12				17.00 - 17.45m: Medium dense.			
	45B	17.50 - 18.00									
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks
8.60		8.10	20	Fast

AGS

CONTRACT	CHECKED
30238	EC

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BOREHOLE LOG

BH422

CLIENT	WELSH GOVERNMENT					Sheet	3 of 7
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	16 January 2015	Easting	332017.2				
End Date	29 January 2015	Northing	185435.4	Ground level	7.95mOD	Depth	60.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
		18.00 - 18.45	18.00	C 34							
	46B	18.60 - 19.00									
		19.00 - 19.45	19.00	C 37							
	47B	19.00 - 20.00									
		20.00 - 20.45	20.00	C 48							
	48B	20.50 - 21.00									
		21.00 - 21.45	21.00	C 36				Firm reddish brown sandy gravelly CLAY. Gravel is subangular fine and medium lithorelicts of weak mudstone. (MMG) (Grade III)	21.00	-13.05	
22/01/15 1545hrs 10.60m		21.70 - 21.78	21.70	C*188					21.70	-13.75	
23/01/15 1130hrs 7.20m	49C	21.70 - 23.20	21.70		70 38 12	NI		Very weak reddish brown mottled green MUDSTONE decomposed to tabular clayey sandy gravel. (MMG) (Grade II)	22.20	-14.25	
						30 80 180		Weak thinly bedded greenish grey SANDSTONE. Fractures are subhorizontal very close and closely spaced planar rough. (MMG)			
	50C	23.20 - 24.50	21.70		69 0 0	NI		23.20 - 23.90m: Recovered non intact.			
						NA		Very stiff fissured reddish brown sandy gravelly CLAY. Gravel is subangular and subrounded fine and medium locally coarse lithorelicts of weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced planar rough. (MMG) (Grade III)	23.90	-15.95	
23/01/15 1530hrs 4.50m									24.50	-16.55	
26/01/15 0800hrs 7.15m	51C	24.50 - 25.00	24.50		70 0 0	NI		Extremely weak and very weak greenish grey mottled reddish brown MUDSTONE recovered as sandy subangular fine to coarse mudstone gravel. (MMG) (Grade II)			
	52C	25.00 - 26.50	24.50		33 0 0	NI					
	53C	26.50 - 28.00	24.50		80 0 0						
						NI		Extremely weak thinly laminated to very thinly bedded reddish brown MUDSTONE. Fractures are subhorizontal to 20° very closely spaced planar rough. (MMG) (Grade II)	27.20	-19.25	
								Continued Next Page	{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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BOREHOLE LOG

BH422

CLIENT	WELSH GOVERNMENT					Sheet	4 of 7
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	16 January 2015	Easting	332017.2				
End Date	29 January 2015	Northing	185435.4	Ground level	7.95mOD	Depth	60.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	54C	28.00 - 29.50	24.50		100 0 0	NA		Stiff fissured reddish brown sandy gravelly CLAY. Gravel is subangular fine and medium locally coarse lithorelicts of weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced planar rough. (MMG) (Grade III)	28.20	-20.25	
	55C	29.50 - 31.00	24.50		83						
	56C	31.00 - 32.00	24.50		100				32.00	-24.05	
	57C	32.00 - 33.50	24.50		100	NA		Very stiff fissured reddish brown sandy gravelly CLAY with frequent greenish grey reduction spots (up to 20mm). Gravel is subangular fine and medium locally coarse lithorelicts of weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced planar rough. (MMG) (Grade III)			
26/01/15 1700hrs 9.10m											
27/01/15 1100hrs 5.56m	58C	33.50 - 35.00	24.50		100						
	59C	35.00 - 36.50	24.50		100						
	60C	36.50 - 38.00	24.50		100 8 0				37.50	-29.55	
						NI 50 60		Weak thinly laminated to very thinly bedded reddish brown MUDSTONE with rare greenish grey reduction spots (up to 5mm). Fractures are subhorizontal to 20° and	37.90	-29.95	
								Continued Next Page	{38.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
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BOREHOLE LOG

BH422

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	5 of 7
Start Date	16 January 2015	Easting	332017.2	Scale	1 : 50
End Date	29 January 2015	Northing	185435.4 Ground level 7.95mOD	Depth	60.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	61C	38.00 - 39.50	24.50		100	NA		subvertical very closely spaced planar rough. (MMG) (Grade I)			
								Stiff fissured reddish brown sandy gravelly CLAY with rare greenish grey reduction spots (up to 20mm). Gravel is randomly orientated subangular fine to coarse lithorelicts of extremely weak mudstone. Local relict fissures are randomly orientated extremely closely spaced. (MMG) (Grade III)	38.75	-30.80	
	62C	39.50 - 41.00	24.50		100	NA		Very stiff fissured reddish brown sandy gravelly CLAY with frequent greenish grey reduction spots (up to 35mm). Gravel is subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced. (MMG) (Grade III)	39.50	-31.55	
27/01/15 1645hrs 6.55m								Stiff fissured reddish brown sandy gravelly CLAY with frequent greenish grey reduction spots (up to 30mm). Gravel is subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced with local greenish grey staining and sand sized gypsum crystals. (MMG) (Grade III)			
28/01/15 0800hrs 5.45m	63C	41.00 - 42.50	24.50		100				42.50	-34.55	
	64C	42.50 - 44.00	24.50		100			Firm fissured reddish brown locally mottled light grey sandy gravelly CLAY. Gravel is subangular fine and medium lithorelicts of very stiff clay and extremely weak mudstone. Localised relict fissures are randomly spaced locally stained light grey with frequent sand sized gypsum crystals. (MMG) (Grade III)	43.35	-35.40	
	65C	44.00 - 45.50	24.50		100			Stiff fissured reddish brown sandy gravelly CLAY with frequent greenish grey reduction spots (up to 30mm). Gravel is subangular fine and medium locally coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced planar rough with local greenish grey staining and sand sized gypsum crystals. (MMG) (Grade III) 43.35 - 44.00m: Subvertical fissure with sand sized gypsum crystals.	45.10	-37.15	
	66C	45.50 - 47.00	24.50		73 0 0	NI		Very stiff fissured reddish brown sandy gravelly CLAY with frequent greenish grey reduction spots (up to 30mm). Gravel is subangular fine and medium locally coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced planar rough with local greenish grey staining and sand sized gypsum crystals. (MMG) (Grade III)	45.85	-37.90	
						NI		Extremely weak and very weak thinly laminated to very thinly bedded reddish brown MUDSTONE with frequent local greenish grey reduction spots (up to 30mm). Fractures are subhorizontal very closely spaced planar rough. (MMG) (Grade II)	46.60	-38.65	
	67C	47.00 - 48.50	24.50		100 0 0			45.85 - 46.10m: Recovered non intact.			
						NA		Extremely weak and very weak thinly laminated to very thinly bedded reddish brown MUDSTONE with local greenish grey reduction spots (up to 30mm). Fractures are subhorizontal to 20° and subvertical very closely spaced	47.65	-39.70	
								Continued Next Page	{48.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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BOREHOLE LOG

BH422

CLIENT	WELSH GOVERNMENT					Sheet	6 of 7
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	16 January 2015	Easting	332017.2			Depth	60.00 m
End Date	29 January 2015	Northing	185435.4	Ground level	7.95mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
								planar rough stained light grey with fine to coarse sand sized gypsum crystals. (MMG) (Grade II)			
	68C	48.50 - 50.00	24.50		100 0 0			Very stiff fissured reddish brown sandy gravelly CLAY with frequent greenish grey reduction spots (up to 30mm). Gravel is subangular fine and medium locally coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced planar rough with localised greenish grey staining and frequent sand sized gypsum crystals. (MMG) (Grade III)	49.65	-41.70	
						NI		Extremely weak thinly laminated to very thinly bedded reddish brown MUDSTONE with local greenish grey reduction spots (up to 30mm). Fractures are subhorizontal up to 20° and subvertical very closely spaced planar rough. (MMG) (Grade II)	50.00	-42.05	
	69C	50.00 - 51.50	24.50		100	NA		Stiff fissured reddish brown sandy gravelly CLAY with rare greenish grey reduction spots (up to 10mm). Gravel is subangular fine and medium locally coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced. (MMG) (Grade III)			
	70C	51.50 - 53.00	24.50		100 18 6				52.50	-44.55	
28/01/15 1630hrs 6.72m						30 150 480		Weak and medium strong thinly laminated to very thinly bedded reddish brown mottled white MUDSTONE with rare greenish grey reduction spots (up to 10mm). Fractures are subhorizontal to 20° and subvertical closely and medium spaced planar rough infilled (up to 5mm) with fine to coarse sand sized gypsum crystals. (MMG) (Grade II)			
29/01/15 0900hrs 5.62m	71C	53.00 - 54.50	24.50		100 42 16						
	72C	54.50 - 56.00	24.50		100 45 30			54.50 - 54.60m: Recovered non intact. 54.90 - 54.95m: Fractures infilled (up to 5mm) with reddish brown clay.			
	73C	56.00 - 57.50	24.50		100 63 70			56.20 - 56.30m: Recovered non intact.			
	74C	57.50 - 59.00	24.50		100 26 6	NA			57.70	-49.75	
								Continued Next Page	{58.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
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BOREHOLE LOG

BH422

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	7 of 7
Start Date	16 January 2015	Easting	332017.2	Scale	1 : 50
End Date	29 January 2015	Northing	185435.4 Ground level 7.95mOD	Depth	60.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
						NI 40 60		Stiff fissured reddish brown sandy gravelly CLAY with rare greenish grey reduction spots (up to 10mm). Gravel is subangular fine and medium locally coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced with local sand sized gypsum infill to 5mm. (MMG) (Grade III)	58.10	-50.15	
						NA			58.45	-50.50	
						15 90			58.80	-50.85	
	75C	59.00 - 60.00	24.50		100 40 31	110 30 200 300		Extremely weak and very weak thinly laminated to very thinly bedded reddish brown MUDSTONE with rare local greenish grey reduction spots (up to 10mm). Fractures are subhorizontal to 20° and subvertical very closely spaced planar rough infilled (up to 5mm) with fine to coarse sand sized gypsum crystals. (MMG) (Grade II)			
29/01/15 1500hrs 7.23m									60.00	-52.05	
								Stiff fissured reddish brown sandy gravelly CLAY with rare greenish grey reduction spots (up to 10mm). Gravel is subangular fine and medium locally coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced infilled (up to 10mm) with fine to coarse sand sized gypsum crystals. (MMG) (Grade III)			
								Weak and medium strong thinly laminated to very thinly bedded reddish brown mottled white MUDSTONE with rare greenish grey reduction spots (up to 15mm). Fractures are subhorizontal to 20° and subvertical very closely spaced planar rough in filled (up to 5mm) with fine to coarse sand sized gypsum crystals. (MMG) (Grade I) 58.80 - 59.10m: Fractures infilled (up to 5mm) with fine to coarse sand sized gypsum crystals.			
								Borehole completed at 60.00m.			
									{68.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
					30238	EC

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BOREHOLE LOG

BH422A

CLIENT	WELSH GOVERNMENT					Sheet	1 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	2 February 2015	Easting	332017.2				
End Date	3 February 2015	Northing	185435.5	Ground level	7.95mOD	Depth	20.00 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range		instru -ment	description	depth (m)	reduced level (m)	legend
02/02/15 1400hrs									MADE GROUND comprising black TARMACADAM, brick and ash, recovered as clayey subangular fine and medium gravel. (MG)	1.00	6.95	
	CASE	1.20	12.00	1.20					Soft light and dark grey mottled light brown and black organic silty CLAY with rare plant fragments up to 2mm. (TFD)	4.00	3.95	
									Soft light and dark grey mottled light brown and black organic gravelly CLAY with low subangular sandstone cobble content and rare plant fragments (up to 2mm). Gravel is subangular fine and medium locally coarse sandstone. (TFD)	6.00	1.95	
									Soft light and dark grey organic CLAY. (TFD)			
									Continued Next Page	{8.00}		

EQUIPMENT: Geotechnical Pioneer rig.
METHOD: Hand dug inspection pit 0.00-1.20m. Borehole advanced by reaming casing (140mm) 1.20-20.00m using a water flush.
CASING: 140mm diam to 20.00m.
BACKFILL: On completion, a slotted standpipe (50mm) was installed to 20.00m, granular response zone 20.00-14.00m, bentonite seal 14.00-4.00m. A second slotted standpipe (35mm) was installed to 4.00m, granular response zone 4.00-1.00m, bentonite seal 1.00-0.10m, concrete and stopcock cover 0.10-0.00m.
REMARKS: Borehole advanced by open hole techniques. Stratum descriptions taken from BH422.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
				Groundwater not encountered prior to use of water flush.	30238	EC

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BOREHOLE LOG

BH422A

CLIENT	WELSH GOVERNMENT					Sheet	2 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	2 February 2015	Easting	332017.2				
End Date	3 February 2015	Northing	185435.5	Ground level	7.95mOD	Depth	20.00 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range		instru -ment	description	depth (m)	reduced level (m)	legend
										8.60	-0.65	
									Very loose dark grey fine and medium SAND. (TFD)			
									11.00m: Becoming dense.			
02/02/15 1600hrs 0.10m												
03/02/15 0800hrs 5.25m	CASE	12.00	20.00	12.00						12.50	-4.55	
									Soft dark grey organic clayey SILT. (TFD)			
										13.90	-5.95	
									Dense and very dense dark grey sandy subrounded fine to coarse sandstone GRAVEL with medium subrounded sandstone cobble content. (RTD)			
										16.00	-8.05	
									Medium dense and dense dark grey sandy subrounded fine and medium locally coarse sandstone GRAVEL with low and medium subrounded sandstone cobble content. (RTD)			
									Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks
				Groundwater not encountered prior to use of water flush.

AGS

CONTRACT	CHECKED
30238	EC

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BOREHOLE LOG

BH422A

CLIENT	WELSH GOVERNMENT					Sheet	3 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	2 February 2015	Easting	332017.2			Depth	20.00 m
End Date	3 February 2015	Northing	185435.5	Ground level	7.95mOD		

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range		instru -ment	description	depth (m)	reduced level (m)	legend
03/02/15 1230hrs 7.35m										20.00	-12.05	
		20.00		20.00					Borehole completed at 20.00m.			
										{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
				Groundwater not encountered prior to use of water flush.	30238	EC

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TRIAL PIT LOG

TP405

CLIENT	WELSH GOVERNMENT						
SITE	M4 CORRIDOR AROUND NEWPORT					Sheet	1 of 1
Start Date	9 March 2015	Easting	331055.8			Scale	1 : 25
End Date	9 March 2015	Northing	184758.1	Ground level	10.20mOD	Depth	2.60 m

water record	sample/test no/type	result	depth (m)	description	depth (m)	level (m)	legend
				MADE GROUND comprising dark grey TARMACADAM. (MG)	0.15	10.05	
	1B	Vo 0.3	0.20- 0.30	Light bluish green angular and subangular fine to coarse vesicular slag GRAVEL. Low angular and subangular red brick and slag cobble content. (MG)			
	2D		0.20				
					0.60	9.60	
	3B	Vo 0.3	0.70- 0.80	Stiff fissured reddish brown slightly sandy slightly gravelly silty CLAY with frequent fine and medium gravel sized reduction spots. Gravel is angular to subangular slag and red brick fragments. (MG)			
	4D		0.70				
	5B	Vo 4.0	1.40- 1.50				
	6D		1.40				
	7B	Vo 5.9	2.20- 2.30				
	8D		2.40				
					2.60	7.60	
Dry				Trial pit completed at 2.60m.			

Notes

Trial pit excavated by JCB 3CX mechanical excavator.
Groundwater not encountered.
Trial pit sides remained stable and vertical.
Trial pit dimensions 3.00x0.90x2.60m.
On completion, the trial pit was backfilled with materials arising.

Sketch of Foundation - Not to scale. All dimensions in metres.

CONTRACT	CHECKED
30238	EC

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

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TRIAL PIT LOG

TP406

CLIENT	WELSH GOVERNMENT						
SITE	M4 CORRIDOR AROUND NEWPORT					Sheet	1 of 1
Start Date	12 February 2015	Easting	331248.0			Scale	1 : 25
End Date	12 February 2015	Northing	185240.0	Ground level	10.10mOD	Depth	4.00 m

water record	sample/test no/type	result	depth (m)	description	depth (m)	level (m)	legend
	1D*		0.00- 0.20	Black clayey very sandy angular and subangular fine to coarse brick and timber GRAVEL with a low angular brick cobble content. (MG)			
	2B		0.50				
	3D*	Vo 0.8	0.60- 0.80		0.80	9.30	
				Light brownish grey sandy angular and subangular fine to coarse brick, timber and slag GRAVEL. (MG)			
	4B		1.00				
	5D*	Vo 0.9	1.00- 1.20				
				1.40 - 1.50m: Locally tending to stiff dark grey mottled black slightly sandy clay.	1.50	8.60	
				Stiff dark reddish brown mottled light grey slightly sandy slightly gravelly CLAY. Gravel is angular and subangular fine to coarse brick and plastic. (MG)			
	6D*		1.60- 1.80				
	7B		2.00				
	8D*	Vo 0.4	2.20- 2.40				
	9D*		2.80- 3.00				
	10B		3.00		3.20	6.90	
3.20m: Seepage				Soft locally firm light bluish grey slightly sandy CLAY with frequent organic fragments (up to 3mm). (TFD)			
	11D*	Vo 1.4	3.40- 3.60				
	12D*	Vo 1.1	3.90- 4.00				
3.90m	13B	H 25	4.00		4.00	6.10	

Trial pit completed at 4.00m.

Notes

Trial pit excavated by JCB 3CX mechanical excavator.
Groundwater seepages noted between 3.20m and 3.90m.
Trial pit sides remained stable and vertical.
Trial pit dimensions 0.75x2.30x4.00m.
On completion, the trial pit was backfilled with materials arising.
Trial pit was terminated at 4.00m due to no effective penetration, upon instruction of the engineer.

Sketch of Foundation - Not to scale. All dimensions in metres.

CONTRACT	CHECKED
30238	EC

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

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TRIAL PIT LOG

TP407

CLIENT	WELSH GOVERNMENT						
SITE	M4 CORRIDOR AROUND NEWPORT					Sheet	1 of 2
Start Date	12 February 2015	Easting	331242.2			Scale	1 : 25
End Date	12 February 2015	Northing	185400.0	Ground level	9.45mOD	Depth	4.50 m

water record	sample/test no/type	result	depth (m)	description	depth (m)	level (m)	legend
	1D*		0.00- 0.20	Dark brown slightly clayey gravelly fine to coarse SAND. Gravel is angular and subangular fine to coarse brick. (MG)	0.20	9.25	
	2D*	Vo 0.7	0.20- 0.50	Black slightly silty sandy angular and subangular fine to coarse ash and charcoal GRAVEL with a high cobble content. (MG)	0.55	8.90	
	3B		0.30- 0.50				
	4B		0.60- 0.80	Dark yellowish brown silty very sandy angular and subangular fine to coarse slag, mortar, charcoal and ash GRAVEL. (MG)	2.00	7.45	
	5D*	Vo 0.2	0.60- 0.80				
	6B		1.20- 1.40				
	7D*	Vo 0.3	1.20- 1.40				
	8B		1.80- 2.00				
	9D*	Vo 0.3	1.80- 2.00	Firm locally soft light greyish brown slightly sandy CLAY. (TFD)	2.90	6.55	
	10B		2.40- 2.60				
	11D*	Vo 0.5	2.40- 2.60				
		H 56	2.50				
	12B		3.00- 3.20	Soft locally firm dark bluish grey sandy CLAY with frequent organic fragments (up to 3mm). (TFD)	4.00	5.45	
	13D*	Vo 0.9	3.00- 3.20				
		H 26	3.00				
3.60m: Seepage	14B		3.60- 3.80	3.60 - 3.70m: Abundant organic fragments (up to 10mm).			
	15D*		3.60- 3.80				

Notes

Trial pit excavated by JCB 3CX mechanical excavator.
Groundwater seepages noted between 3.60m and 4.50m.
Trial pit sides remained stable and vertical.
Trial pit dimensions 0.70x2.60x4.50m.
On completion, the trial pit was backfilled with materials arising.

Sketch of Foundation - Not to scale. All dimensions in metres.

CONTRACT	CHECKED
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EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

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TRIAL PIT LOG

TP407

CLIENT	WELSH GOVERNMENT						
SITE	M4 CORRIDOR AROUND NEWPORT					Sheet	2 of 2
Start Date	12 February 2015	Easting	331242.2			Scale	1 : 25
End Date	12 February 2015	Northing	185400.0	Ground level	9.45mOD	Depth	4.50 m

water record	sample/test no/type	result	depth (m)	description	depth (m)	level (m)	legend
		H 48	4.00	Firm locally stiff light grey mottled light orange brown slightly sandy CLAY. (TFD)			
	16B		4.20- 4.40				
	17D*	Vo 2.1	4.20- 4.40				
4.45m				Trial pit completed at 4.50m.	4.50	4.95	

Notes

Trial pit excavated by JCB 3CX mechanical excavator.
Groundwater seepages noted between 3.60m and 4.50m.
Trial pit sides remained stable and vertical.
Trial pit dimensions 0.70x2.60x4.50m.
On completion, the trial pit was backfilled with materials arising.

Sketch of Foundation - Not to scale. All dimensions in metres.

CONTRACT	CHECKED
30238	EC

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

Geotechnical Engineering Ltd, Tel. 01452 527743 30238 YODA.GPJ TRIALJH.GPJ GEOTECH.GLB 16/07/2015 15:49:17 RDL SF

Geotechnical Engineering Limited

TRIAL PIT LOG

TP409

CLIENT	WELSH GOVERNMENT						
SITE	M4 CORRIDOR AROUND NEWPORT					Sheet	1 of 1
Start Date	12 February 2015	Easting	331991.5			Scale	1 : 25
End Date	12 February 2015	Northing	185430.9	Ground level	8.05mOD	Depth	1.60 m

water record	sample/test no/type	result	depth (m)	description	depth (m)	level (m)	legend
	1B		0.00	Grass over dark brown slightly gravelly sandy CLAY with frequent rootlets (<1mm diam.). Gravel is angular and subangular fine and medium brick. (MG)			
	2D*	Vo 0.5	0.00		0.30	7.75	
	3D*	Vo 0.4	0.50	Dark brownish grey slightly clayey sandy angular and subangular fine to coarse brick, slate and timber GRAVEL with rare cobbles and boulders. Cobbles and boulders are angular concrete slabs. (MG)			
1.00m: Rapid ingress	4B		1.00				
	5D*	Vo 0.4	1.00				
					1.60	6.45	
1.60m				Trial pit completed at 1.60m.			

Notes

Trial pit excavated by JCB 3CX mechanical excavator.
Groundwater was encountered at 1.00m.
Trial pit sides collapsed at 0.50m to 1.60m.
Trial pit dimensions 0.90x2.40x1.60m.
On completion, the trial pit was backfilled with materials arising.
Trial pit terminated at 1.60m due to instability, upon instruction of the engineer.

Sketch of Foundation - Not to scale. All dimensions in metres.

CONTRACT	CHECKED
30238	EC

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

Geotechnical Engineering Ltd, Tel. 01452 527743 30238 YODA.GPJ TRIALJH.GPJ GEOTECH.GLB 16/07/2015 15:49:18 RDL SF

A2 Appendix 2

Tabulated Gas and Groundwater Monitoring Data

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH412	23/04/15 12:30:00	1023	-0.62								0.0	14		0 litres purged, base depth 3.00m. Water sample not obtained. Not enough water in installation.
BH412	23/04/15 12:31:00										0.0			
BH412	23/04/15 12:32:00										0.0			
BH412	23/04/15 12:33:00										0.0			
BH412	23/04/15 12:34:00										0.0			
BH412	23/04/15 12:35:00			0.8	1.0	7.0	19.0	0	0	4.5				
BH412	23/04/15 12:36:00			3.0	0.5	8.8	9.0	0	0	3.6				
BH412	23/04/15 12:37:00			3.1	0.4	9.2	8.0	0	0	3.4				
BH412	23/04/15 12:38:00			3.2	0.4	9.3	7.0	0	0	2.9				
BH412	23/04/15 12:39:00			3.2	0.4	9.5	7.0	0	0	2.6				
BH412	23/04/15 12:40:00			3.3	0.3	9.8	6.0	0	0	2.4				
BH412	23/04/15 12:41:00			3.0	0.4	9.0	8.0	0	0	2.1				
BH412	23/04/15 12:42:00			3.0	0.4	9.1	8.0	0	0	2.2				
BH412	23/04/15 12:43:00			3.0	0.4	8.9	8.0	0	0	2.0				
BH412	23/04/15 12:44:00			2.8	0.5	8.6	9.0	0	0	1.9			2.83	
BH412	30/04/15 13:00:00	1013	-0.53								0.0	13		0 litres purged, base depth 3.00m. Not enough water in install to obtain sample.

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH412	30/04/15 13:01:00										0.0			
BH412	30/04/15 13:02:00										0.0			
BH412	30/04/15 13:03:00										0.0			
BH412	30/04/15 13:04:00										0.0			
BH412	30/04/15 13:05:00			4.1	0.4	13.4	6.0	0	0	4.3				
BH412	30/04/15 13:06:00			4.4	0.1	13.6	1.0	0	0	4.0				
BH412	30/04/15 13:07:00			4.4	0.0	13.6	0.0	0	0	3.6				
BH412	30/04/15 13:08:00			4.4	0.0	13.6	0.0	0	0	3.4				
BH412	30/04/15 13:09:00			4.4	0.0	13.5	0.0	0	0	3.2				
BH412	30/04/15 13:10:00			4.4	0.0	13.4	0.0	0	0	2.8				
BH412	30/04/15 13:11:00			4.4	0.0	13.4	0.0	0	0	2.6				
BH412	30/04/15 13:12:00			4.4	0.0	13.4	0.0	0	0	2.3				
BH412	30/04/15 13:13:00			4.4	0.0	13.4	0.0	0	0	1.9				
BH412	30/04/15 13:14:00			4.4	0.0	13.3	0.0	0	0	1.9			2.84	Water sample not obtained. Not enough water in installation.
BH412	21/05/15 11:57:00	1019									0.0	21		
BH412	21/05/15 11:58:00										0.0			
BH412	21/05/15 11:59:00										0.0			
BH412	21/05/15 12:00:00										0.0			

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH412	21/05/15 12:01:00										0.0			
BH412	21/05/15 12:02:00			3.2	0.0	15.6	0.0	0	0	0.0				
BH412	21/05/15 12:03:00			3.8	0.0	14.7	0.0	0	0	0.0				
BH412	21/05/15 12:04:00			3.9	0.0	14.4	0.0	0	0	0.0				
BH412	21/05/15 12:05:00			3.1	0.0	15.6	0.0	0	0	0.0				
BH412	21/05/15 12:06:00			3.4	0.0	15.2	0.0	0	0	0.0				
BH412	21/05/15 12:07:00			3.9	0.0	14.9	0.0	0	0	0.0				
BH412	21/05/15 12:08:00			3.8	0.0	14.6	0.0	0	0	0.0				
BH412	21/05/15 12:09:00			3.9	0.0	14.4	0.0	0	0	0.0				
BH412	21/05/15 12:10:00			3.8	0.0	14.5	0.0	0	0	0.0				
BH412	21/05/15 12:11:00			3.8	0.0	14.5	0.0	0	0	0.0				
BH412	21/05/15 12:12:00												Dry	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH412	23/04/15 12:44:00												8.79	67 litres purged, base depth 20.00m.
BH412	30/04/15 13:14:00												9.85	60 litres purged, base depth 20.00m.
BH412	21/05/15 12:13:00												10.57	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Deep install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH413	20/04/15 13:30:00	1031	0.1								0.0	17		0 litres purged, base depth 4.50m. Not enough water in install to recover sample. Very muddy/silty.
BH413	20/04/15 13:31:00										0.0			
BH413	20/04/15 13:32:00										0.0			
BH413	20/04/15 13:33:00										0.0			
BH413	20/04/15 13:34:00										0.0			
BH413	20/04/15 13:35:00			4.3	32.7	3.1	#	0	4	0.0				
BH413	20/04/15 13:36:00			4.6	34.8	1.7	#	0	3	0.0				
BH413	20/04/15 13:37:00			4.7	36.0	1.2	#	0	3	0.0				
BH413	20/04/15 13:38:00			4.6	35.8	1.3	#	0	3	0.0				
BH413	20/04/15 13:39:00			4.6	35.7	1.3	#	0	3	0.0				
BH413	20/04/15 13:40:00			4.7	35.7	1.2	#	0	3	0.0				
BH413	20/04/15 13:41:00			4.7	35.7	1.2	#	0	4	0.0				
BH413	20/04/15 13:42:00			4.7	35.7	1.1	#	0	4	0.1				
BH413	20/04/15 13:43:00			4.7	35.8	1.1	#	0	4	0.0				
BH413	20/04/15 13:44:00			4.7	35.7	1.1	#	0	4	0.1			2.28	Water sample not obtained. Not enough water in installation.
BH413	27/04/15 11:00:00	1017	-0.91								0.0	9		0 litres purged, base depth 4.50m. Not enough water in install to obtain sample.

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH413	27/04/15 11:01:00										0.0			
BH413	27/04/15 11:02:00										0.0			
BH413	27/04/15 11:03:00										0.0			
BH413	27/04/15 11:04:00										0.0			
BH413	27/04/15 11:05:00			5.1	41.5	1.5	#	0	5	0.0				
BH413	27/04/15 11:06:00			5.3	43.4	0.6	#	0	7	0.0				
BH413	27/04/15 11:07:00			5.4	44.3	0.2	#	0	9	0.0				
BH413	27/04/15 11:08:00			5.4	44.6	0.2	#	0	10	0.0				
BH413	27/04/15 11:09:00			5.4	44.6	0.2	#	0	10	0.0				
BH413	27/04/15 11:10:00			5.4	44.6	0.2	#	0	11	0.0				
BH413	27/04/15 11:11:00			5.4	44.6	0.1	#	0	11	0.0				
BH413	27/04/15 11:12:00			5.4	44.6	0.1	#	0	12	0.0				
BH413	27/04/15 11:13:00			5.4	44.6	0.1	#	0	12	0.0				
BH413	27/04/15 11:14:00			5.4	44.8	0.1	#	0	12	0.0			2.36	Water sample not obtained. Not enough water in installation.
BH413	05/05/15 11:45:00	998	-0.73								0.0	12		0 litres purged, base depth 4.50m. Not enough water to obtain sample.
BH413	05/05/15 11:46:00										0.0			
BH413	05/05/15 11:47:00										0.0			

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
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Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH413	05/05/15 11:48:00										0.0			
BH413	05/05/15 11:49:00										0.0			
BH413	05/05/15 11:50:00			5.2	47.3	0.3	#	0	27	0.0				
BH413	05/05/15 11:51:00			5.2	47.4	0.2	#	0	26	0.0				
BH413	05/05/15 11:52:00			5.3	47.7	0.2	#	0	23	0.0				
BH413	05/05/15 11:53:00			5.3	47.8	0.2	#	0	23	0.0				
BH413	05/05/15 11:54:00			5.3	47.8	0.2	#	0	23	0.0				
BH413	05/05/15 11:55:00			5.3	47.9	0.2	#	0	21	0.0				
BH413	05/05/15 11:56:00			5.3	47.9	0.2	#	0	21	0.0				
BH413	05/05/15 11:57:00			5.3	47.9	0.2	#	0	20	0.0				
BH413	05/05/15 11:58:00			5.3	48.0	0.1	#	0	19	0.0				
BH413	05/05/15 11:59:00			5.3	48.1	0.2	#	0	16	0.0			2.24	Water sample not obtained. Not enough water in installation.
BH413	12/05/15 13:40:00	1017	5								0.0	21		
BH413	12/05/15 13:41:00										1.3			
BH413	12/05/15 13:42:00										0.0			
BH413	12/05/15 13:43:00										1.6			
BH413	12/05/15 13:44:00										1.0			
BH413	12/05/15 13:45:00			4.7	40.5	0.8	#	0	0	0.0				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH413	12/05/15 13:46:00			4.7	40.9	0.7	#	0	0	0.0				
BH413	12/05/15 13:47:00			4.7	41.0	0.7	#	0	10	0.0				
BH413	12/05/15 13:48:00			4.7	40.9	0.7	#	0	10	0.0				
BH413	12/05/15 13:49:00			4.7	40.8	0.7	#	0	10	0.0				
BH413	12/05/15 13:50:00			4.7	40.8	0.7	#	0	10	0.0				
BH413	12/05/15 13:51:00			4.7	40.8	0.7	#	0	10	0.0				
BH413	12/05/15 13:52:00			4.7	40.8	0.7	#	0	10	0.0				
BH413	12/05/15 13:53:00			4.7	40.6	0.6	#	0	10	0.0				
BH413	12/05/15 13:54:00			4.7	40.6	0.6	#	0	10	0.0				
BH413	12/05/15 13:55:00												3.38	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT **30238**

CHECKED **EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH413	20/04/15 13:44:00												7.86	72 litres purged, base depth 18.00m.
BH413	27/04/15 11:14:00												8.09	71 litres purged, base depth 18.00m.
BH413	05/05/15 11:59:00												7.79	73 litres purged, base depth 18.00m.
BH413	12/05/15 13:56:00												9.28	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Deep install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH415	20/04/15 11:00:00	1034	-0.72								0.0	12		49 litres purged, base depth 17.00m.
BH415	20/04/15 11:01:00										0.0			
BH415	20/04/15 11:02:00										0.0			
BH415	20/04/15 11:03:00										0.0			
BH415	20/04/15 11:04:00										0.0			
BH415	20/04/15 11:05:00			0.1	0.4	20.5	7.0	0	1	2.5				
BH415	20/04/15 11:06:00			0.1	0.1	20.6	1.0	0	0	2.3				
BH415	20/04/15 11:07:00			0.1	0.0	20.7	0.0	0	0	2.0				
BH415	20/04/15 11:08:00			0.1	0.3	20.7	4.0	0	0	1.8				
BH415	20/04/15 11:09:00			0.0	0.2	20.8	3.0	0	0	1.7				
BH415	20/04/15 11:10:00			0.0	0.2	20.8	2.0	0	0	1.6				
BH415	20/04/15 11:11:00			0.0	0.1	20.9	1.0	0	0	1.5				
BH415	20/04/15 11:12:00			0.1	0.2	20.8	3.0	0	0	1.3				
BH415	20/04/15 11:13:00			0.1	0.2	20.8	3.0	0	0	1.2				
BH415	20/04/15 11:14:00			0.1	0.2	20.8	3.0	0	0	1.2			6.08	
BH415	27/04/15 09:30:00	1018	-1.35								0.0	8		46 litres purged, base depth 17.00m.
BH415	27/04/15 09:31:00										0.0			
BH415	27/04/15 09:32:00										0.0			

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH415	27/04/15 09:33:00										0.0			
BH415	27/04/15 09:34:00										0.0			
BH415	27/04/15 09:35:00			0.1	0.1	20.2	2.0	0	0	2.0				
BH415	27/04/15 09:36:00			0.1	0.1	20.3	1.0	0	0	1.6				
BH415	27/04/15 09:37:00			0.0	0.0	20.4	0.0	0	0	1.4				
BH415	27/04/15 09:38:00			0.0	0.0	20.4	0.0	0	0	1.2				
BH415	27/04/15 09:39:00			0.0	0.0	20.4	0.0	0	0	1.0				
BH415	27/04/15 09:40:00			0.0	0.0	20.4	0.0	0	0	0.9				
BH415	27/04/15 09:41:00			0.0	0.0	20.5	0.0	0	0	0.8				
BH415	27/04/15 09:42:00			0.0	0.0	20.5	0.0	0	0	0.8				
BH415	27/04/15 09:43:00			0.0	0.0	20.5	0.0	0	0	0.8				
BH415	27/04/15 09:44:00			0.0	0.0	20.5	0.0	0	0	0.8			6.66	
BH415	05/05/15 10:15:00	996	-0.19								0.0	10		47 litres purged, base depth 17.00m.
BH415	05/05/15 10:16:00										0.0			
BH415	05/05/15 10:17:00										0.0			
BH415	05/05/15 10:18:00										0.0			
BH415	05/05/15 10:19:00										0.0			
BH415	05/05/15 10:20:00			0.3	0.2	20.6	3.0	0	1	1.4				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH415	05/05/15 10:21:00			0.2	0.1	20.7	2.0	0	1	1.2				
BH415	05/05/15 10:22:00			0.2	0.1	20.7	2.0	0	1	1.1				
BH415	05/05/15 10:23:00			0.1	0.1	20.8	1.0	0	1	0.9				
BH415	05/05/15 10:24:00			0.1	0.1	20.8	1.0	0	1	0.7				
BH415	05/05/15 10:25:00			0.1	0.1	20.8	1.0	0	0	0.6				
BH415	05/05/15 10:26:00			0.1	0.1	20.9	1.0	0	0	0.5				
BH415	05/05/15 10:27:00			0.1	0.1	20.9	1.0	0	0	0.4				
BH415	05/05/15 10:28:00			0.1	0.1	20.9	1.0	0	0	0.4				
BH415	05/05/15 10:29:00			0.1	0.1	20.9	1.0	0	0	0.3			6.36	
BH415	12/05/15 12:41:00	1019	2								0.0	19		
BH415	12/05/15 12:42:00										0.0			
BH415	12/05/15 12:43:00										0.0			
BH415	12/05/15 12:44:00										0.0			
BH415	12/05/15 12:45:00										0.0			
BH415	12/05/15 12:46:00			0.2	0.0	19.3	0.0	0	0	0.1				
BH415	12/05/15 12:47:00			0.0	0.0	19.9	0.0	0	0	0.0				
BH415	12/05/15 12:48:00			0.0	0.0	20.0	0.0	0	0	0.0				
BH415	12/05/15 12:49:00			0.0	0.0	20.1	0.0	0	0	0.0				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH415	12/05/15 12:50:00			0.0	0.0	20.1	0.0	0	0	0.0				
BH415	12/05/15 12:51:00			0.0	0.0	20.2	0.0	0	0	0.0				
BH415	12/05/15 12:52:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH415	12/05/15 12:53:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH415	12/05/15 12:54:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH415	12/05/15 12:55:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH415	12/05/15 12:56:00												7.77	17

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH415	20/04/15 11:14:00												6.51	199 litres purged, base depth 40.00m.
BH415	27/04/15 09:44:00												6.77	199 litres purged, base depth 40.00m.
BH415	05/05/15 10:29:00												6.61	200 litres purged, base depth 40.00m.
BH415	12/05/15 12:57:00												8.06	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Deep install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH417	20/04/15 10:00:00	1035	-1.21								0.0	12		1 litre purged, base depth 2.50m.
BH417	20/04/15 10:01:00										0.0			
BH417	20/04/15 10:02:00										0.0			
BH417	20/04/15 10:03:00										0.0			
BH417	20/04/15 10:04:00										0.0			
BH417	20/04/15 10:05:00			0.0	0.1	20.4	1.0	0	0	3.2				
BH417	20/04/15 10:06:00			0.0	0.1	20.4	1.0	0	0	2.8				
BH417	20/04/15 10:07:00			0.0	0.1	20.4	1.0	0	0	2.3				
BH417	20/04/15 10:08:00			0.0	0.1	20.4	1.0	0	0	2.2				
BH417	20/04/15 10:09:00			0.0	0.1	20.4	1.0	0	0	1.9				
BH417	20/04/15 10:10:00			0.0	0.1	20.5	1.0	0	0	1.7				
BH417	20/04/15 10:11:00			0.0	0.1	20.5	1.0	0	0	1.6				
BH417	20/04/15 10:12:00			0.0	0.1	20.5	1.0	0	0	1.6				
BH417	20/04/15 10:13:00			0.0	0.1	20.5	1.0	0	0	1.5				
BH417	20/04/15 10:14:00			0.0	0.1	20.5	1.0	0	0	1.5			1.25	
BH417	27/04/15 08:30:00	1019	-1.55								0.0	8		Only 1 litre purged as running dry & slow recharge. Base depth 2.50m.
BH417	27/04/15 08:31:00										0.0			

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH417	27/04/15 08:32:00										0.0			
BH417	27/04/15 08:33:00										0.0			
BH417	27/04/15 08:34:00										0.0			
BH417	27/04/15 08:35:00			0.1	0.1	20.1	0.0	0	0	1.8				
BH417	27/04/15 08:36:00			0.1	0.0	20.2	0.0	0	0	1.4				
BH417	27/04/15 08:37:00			0.1	0.0	20.2	0.0	0	0	1.2				
BH417	27/04/15 08:38:00			0.1	0.0	20.3	0.0	0	0	1.1				
BH417	27/04/15 08:39:00			0.1	0.0	20.3	0.0	0	0	1.0				
BH417	27/04/15 08:40:00			0.1	0.0	20.3	0.0	0	0	0.9				
BH417	27/04/15 08:41:00			0.1	0.0	20.4	0.0	0	0	0.8				
BH417	27/04/15 08:42:00			0.1	0.0	20.4	0.0	0	0	0.8				
BH417	27/04/15 08:43:00			0.1	0.0	20.4	0.0	0	0	0.7				
BH417	27/04/15 08:44:00			0.0	0.0	20.4	0.0	0	0	0.7			1.23	
BH417	05/05/15 09:00:00	994	-0.95								0.0	10		Only 2 litres purged as installation was running dry with a slow recharge. Base depth 2.50m.
BH417	05/05/15 09:01:00										0.0			
BH417	05/05/15 09:02:00										0.0			
BH417	05/05/15 09:03:00										0.0			

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH417	05/05/15 09:04:00										0.0			
BH417	05/05/15 09:05:00			0.0	0.0	20.9	0.0	0	0	1.6				
BH417	05/05/15 09:06:00			0.0	0.0	20.9	0.0	0	0	1.6				
BH417	05/05/15 09:07:00			0.0	0.0	20.9	0.0	0	0	1.5				
BH417	05/05/15 09:08:00			0.0	0.0	21.0	0.0	0	0	1.5				
BH417	05/05/15 09:09:00			0.0	0.0	21.0	0.0	0	0	1.4				
BH417	05/05/15 09:10:00			0.0	0.0	21.0	0.0	0	0	1.2				
BH417	05/05/15 09:11:00			0.0	0.0	21.0	1.0	0	0	1.2				
BH417	05/05/15 09:12:00			0.0	0.0	21.0	0.0	0	0	1.2				
BH417	05/05/15 09:13:00			0.0	0.0	21.0	0.0	0	0	1.1				
BH417	05/05/15 09:14:00			0.0	0.0	21.0	0.0	0	0	1.1			0.60	
BH417	12/05/15 11:50:00	1019	2								4.5	19		
BH417	12/05/15 11:51:00										4.5			
BH417	12/05/15 11:52:00										4.5			
BH417	12/05/15 11:53:00										4.5			
BH417	12/05/15 11:54:00										4.5			
BH417	12/05/15 11:55:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH417	12/05/15 11:56:00			0.0	0.0	20.4	0.0	0	0	0.0				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH417	12/05/15 11:57:00			0.0	0.0	20.4	0.0	0	0	0.0				
BH417	12/05/15 11:58:00			0.0	0.0	20.4	0.0	0	0	0.0				
BH417	12/05/15 11:59:00			0.0	0.0	20.4	0.0	0	0	0.0				
BH417	12/05/15 12:00:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH417	12/05/15 12:01:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH417	12/05/15 12:02:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH417	12/05/15 12:03:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH417	12/05/15 12:04:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH417	12/05/15 12:05:00												2.12	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

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GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH417	20/04/15 10:14:00												6.66	50 litres purged, base depth 15.00m.
BH417	27/04/15 08:44:00												6.51	50 litres purged, base depth 15.00m.
BH417	05/05/15 09:14:00												6.43	51 litres purged, base depth 15.00m.

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Deep install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH420	20/04/15 15:00:00	1031	-0.15								0.0	19		22 litres purged, base depth 7.00m.
BH420	20/04/15 15:01:00										0.0			
BH420	20/04/15 15:02:00										0.0			
BH420	20/04/15 15:03:00										0.0			
BH420	20/04/15 15:04:00										0.0			
BH420	20/04/15 15:05:00			0.0	0.1	20.7	2.0	0	1	5.9				
BH420	20/04/15 15:06:00			0.0	0.1	20.7	2.0	0	2	3.4				
BH420	20/04/15 15:07:00			0.0	0.1	20.6	2.0	0	2	2.9				
BH420	20/04/15 15:08:00			0.0	0.1	20.6	2.0	0	1	2.9				
BH420	20/04/15 15:09:00			0.0	0.1	20.5	3.0	0	2	2.8				
BH420	20/04/15 15:10:00			0.5	0.5	19.2	12.0	0	1	1.6				
BH420	20/04/15 15:11:00			0.5	0.8	19.3	12.0	0	1	1.5				
BH420	20/04/15 15:12:00			0.8	0.9	18.6	15.0	0	2	1.0				
BH420	20/04/15 15:13:00			0.5	0.6	19.3	11.0	0	2	1.5				
BH420	20/04/15 15:14:00			0.7	0.6	18.9	13.0	0	2	1.3			2.09	
BH420	27/04/15 12:30:00	1015	-0.44								0.0	12		22 litres purged, base depth 7.00m.
BH420	27/04/15 12:31:00										0.0			
BH420	27/04/15 12:32:00										0.0			

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH420	27/04/15 12:33:00										0.0			
BH420	27/04/15 12:34:00										0.0			
BH420	27/04/15 12:35:00			0.8	0.7	18.3	14.0	0	1	2.7				
BH420	27/04/15 12:36:00			0.8	0.8	18.3	15.0	0	1	2.2				
BH420	27/04/15 12:37:00			0.9	0.8	18.3	16.0	0	1	1.9				
BH420	27/04/15 12:38:00			0.9	0.8	18.3	16.0	0	1	1.7				
BH420	27/04/15 12:39:00			0.8	0.8	18.3	15.0	0	1	1.6				
BH420	27/04/15 12:40:00			0.8	0.7	18.4	14.0	0	1	1.4				
BH420	27/04/15 12:41:00			0.8	0.7	18.4	14.0	0	1	1.3				
BH420	27/04/15 12:42:00			0.8	0.7	18.6	13.0	0	1	1.2				
BH420	27/04/15 12:43:00			0.8	0.7	18.5	13.0	0	1	1.2				
BH420	27/04/15 12:44:00			0.8	0.7	18.5	13.0	0	1	1.2			2.09	
BH420	05/05/15 12:30:00	997	-0.62								0.0	13		22 litres purged, base depth 7.00m.
BH420	05/05/15 12:31:00										0.0			
BH420	05/05/15 12:32:00										0.0			
BH420	05/05/15 12:33:00										0.0			
BH420	05/05/15 12:34:00										0.0			
BH420	05/05/15 12:35:00			0.7	0.4	19.5	7.0	0	0	3.7				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT **30238**

CHECKED **EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH420	05/05/15 12:36:00			0.9	0.4	19.0	8.0	0	0	1.7				
BH420	05/05/15 12:37:00			0.9	0.5	19.1	9.0	0	0	1.5				
BH420	05/05/15 12:38:00			0.8	0.4	19.2	7.0	0	0	1.6				
BH420	05/05/15 12:39:00			0.8	0.4	19.3	7.0	0	0	1.4				
BH420	05/05/15 12:40:00			0.8	0.4	19.4	7.0	0	0	1.5				
BH420	05/05/15 12:41:00			0.8	0.4	19.3	7.0	0	0	2.2				
BH420	05/05/15 12:42:00			0.7	0.4	19.4	6.0	0	0	2.1				
BH420	05/05/15 12:43:00			0.8	0.3	19.4	6.0	0	0	2.1				
BH420	05/05/15 12:44:00			0.8	0.3	19.2	7.0	0	0	2.1			1.98	
BH420	14/05/15 09:31:00	1022	0								0.0	17		
BH420	14/05/15 09:32:00										0.0			
BH420	14/05/15 09:33:00										0.0			
BH420	14/05/15 09:34:00										0.0			
BH420	14/05/15 09:35:00										0.0			
BH420	14/05/15 09:36:00			0.5	0.0	19.3	0.6	0	0	0.0				
BH420	14/05/15 09:37:00			0.5	0.0	19.2	2.3	0	0	0.0				
BH420	14/05/15 09:38:00			0.5	0.0	19.1	2.1	0	10	0.0				
BH420	14/05/15 09:39:00			0.5	0.0	19.1	1.5	0	10	0.0				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT **30238**

CHECKED **EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH420	14/05/15 09:40:00			0.5	0.0	19.2	0.0	0	10	0.0				
BH420	14/05/15 09:41:00			0.5	0.0	19.2	0.0	0	10	0.0				
BH420	14/05/15 09:42:00			0.5	0.0	19.2	0.0	0	10	0.0				
BH420	14/05/15 09:43:00			0.5	0.0	19.2	0.0	0	10	0.0				
BH420	14/05/15 09:44:00			0.4	0.0	19.2	0.0	0	10	0.0				
BH420	14/05/15 09:45:00			0.4	0.0	19.3	0.0	0	10	0.0				
BH420	14/05/15 09:46:00												3.42	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT **30238**

CHECKED **EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH420	20/04/15 15:14:00												7.79	79 litres purged, base depth 21.00m.
BH420	27/04/15 12:44:00												7.83	79 litres purged, base depth 21.00m.
BH420	05/05/15 12:44:00												7.73	79 litres purged, base depth 21.00m.
BH420	14/05/15 09:47:00												9.18	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Deep install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH422A	23/04/15 14:00:00	1020	-0.04								0.1	18		8 litres purged, base depth 4.00m.
BH422A	23/04/15 14:01:00										0.1			
BH422A	23/04/15 14:02:00										0.1			
BH422A	23/04/15 14:03:00										0.1			
BH422A	23/04/15 14:04:00										0.1			
BH422A	23/04/15 14:05:00			1.3	0.1	14.2	2.0	0	4	5.4				
BH422A	23/04/15 14:06:00			3.6	0.2	3.2	3.0	0	1	4.7				
BH422A	23/04/15 14:07:00			3.9	0.2	3.0	3.0	0	1	3.8				
BH422A	23/04/15 14:08:00			3.9	0.1	3.4	2.0	0	1	3.3				
BH422A	23/04/15 14:09:00			3.9	0.1	3.6	2.0	0	1	2.9				
BH422A	23/04/15 14:10:00			4.0	0.1	3.7	2.0	0	1	2.8				
BH422A	23/04/15 14:11:00			4.0	0.1	3.8	2.0	0	1	2.6				
BH422A	23/04/15 14:12:00			4.0	0.1	4.0	2.0	0	1	2.5				
BH422A	23/04/15 14:13:00			4.1	0.1	4.2	2.0	0	1	2.3				
BH422A	23/04/15 14:14:00			4.1	0.1	4.3	2.0	0	1	2.3			2.20	
BH422A	30/04/15 14:30:00	1012	-0.25								0.0	13		7 litres purged, base depth 4.00m.
BH422A	30/04/15 14:31:00										0.0			
BH422A	30/04/15 14:32:00										0.0			

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT **30238**

CHECKED **EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH422A	30/04/15 14:33:00										0.0			
BH422A	30/04/15 14:34:00										0.0			
BH422A	30/04/15 14:35:00			4.3	0.1	6.1	1.0	0	1	3.2				
BH422A	30/04/15 14:36:00			4.4	0.1	6.1	1.0	0	0	2.6				
BH422A	30/04/15 14:37:00			4.4	0.1	6.0	1.0	0	0	2.5				
BH422A	30/04/15 14:38:00			4.4	0.1	6.0	1.0	0	0	2.3				
BH422A	30/04/15 14:39:00			4.5	0.1	6.0	1.0	0	0	2.4				
BH422A	30/04/15 14:40:00			4.5	0.1	6.1	1.0	0	0	2.3				
BH422A	30/04/15 14:41:00			4.5	0.1	6.2	1.0	0	0	2.2				
BH422A	30/04/15 14:42:00			4.6	0.1	6.3	1.0	0	0	2.2				
BH422A	30/04/15 14:43:00			4.6	0.1	6.3	1.0	0	0	2.0				
BH422A	30/04/15 14:44:00			4.6	0.1	6.4	1.0	0	0	2.0			2.24	
BH422A	08/05/15 13:00:00	1010	0								0.0	12		9 litres purged, base depth 4.00m.
BH422A	08/05/15 13:01:00										0.0			
BH422A	08/05/15 13:02:00										0.0			
BH422A	08/05/15 13:03:00										0.0			
BH422A	08/05/15 13:04:00										0.0			
BH422A	08/05/15 13:05:00			0.5	0.0	16.9	0.0	0	0	2.0				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH422A	08/05/15 13:06:00			0.4	0.0	18.0	0.0	0	0	1.6				
BH422A	08/05/15 13:07:00			0.3	0.0	18.9	0.0	0	0	1.0				
BH422A	08/05/15 13:08:00			0.1	0.0	19.6	0.0	0	0	0.7				
BH422A	08/05/15 13:09:00			0.1	0.0	19.8	0.0	0	0	0.6				
BH422A	08/05/15 13:10:00			0.1	0.0	19.8	0.0	0	0	0.5				
BH422A	08/05/15 13:11:00			0.1	0.0	19.9	0.0	0	0	0.4				
BH422A	08/05/15 13:12:00			0.1	0.0	19.9	0.0	0	0	0.4				
BH422A	08/05/15 13:13:00			0.1	0.0	19.8	0.0	0	0	0.3				
BH422A	08/05/15 13:14:00			0.0	0.0	20.0	0.0	0	0	0.3			1.80	
BH422A	21/05/15 13:10:00	1025	0								0.4	21		
BH422A	21/05/15 13:11:00										0.0			
BH422A	21/05/15 13:12:00										0.0			
BH422A	21/05/15 13:13:00										0.0			
BH422A	21/05/15 13:14:00										-0.4			
BH422A	21/05/15 13:15:00			3.4	0.0	6.2	0.0	0	0	0.0				
BH422A	21/05/15 13:16:00			3.5	0.0	5.9	0.0	0	0	0.0				
BH422A	21/05/15 13:17:00			3.6	0.0	5.5	0.0	0	0	0.0				
BH422A	21/05/15 13:18:00			3.7	0.0	5.5	0.0	0	0	0.0				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT **30238**

CHECKED **EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH422A	21/05/15 13:19:00			3.7	0.0	5.5	0.0	0	0	0.0				
BH422A	21/05/15 13:20:00			3.7	0.0	5.5	0.0	0	0	0.0				
BH422A	21/05/15 13:21:00			3.7	0.0	5.5	0.0	0	0	0.0				
BH422A	21/05/15 13:22:00			3.7	0.0	5.6	0.0	0	0	0.0				
BH422A	21/05/15 13:23:00			3.7	0.0	5.6	0.0	0	0	0.0				
BH422A	21/05/15 13:24:00			3.7	0.0	5.6	0.0	0	0	0.0				
BH422A	21/05/15 13:25:00												1.58	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT **30238**

CHECKED **EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH422A	23/04/15 14:14:00												6.79	79 litres purged, base depth 20.00m.
BH422A	30/04/15 14:44:00												7.42	75 litres purged, base depth 20.00m.
BH422A	08/05/15 13:14:00												6.21	82 litres purged, base depth 20.00m.
BH422A	21/05/15 13:26:00												7.73	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Deep install.

CONTRACT **30238**

CHECKED **EC**

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		01

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		30/01/2008	09:50	2.45	25/02/2008	14:34	2.48	07/03/2008	14:25	2.60
SBHD03 CP	SPIE	10.00		30/01/2008	11:01	0.47	25/02/2008	14:52	0.43	07/03/2008	14:05	0.56
SBHD05 RC	SPIE	12.00		31/01/2008	09:00	1.02	25/02/2008	15:35	1.05	07/03/2008	13:50	1.77
SBHD06 RC	SP	15.00		30/01/2008	13:00	1.13	21/02/2008	10:30	1.39	07/03/2008	13:30	1.39
SBHD08 RC	SPIE	29.50		30/01/2008	13:50	1.20	25/02/2008	15:58	2.02	07/03/2008	13:35	1.40
SBHE02RD	SPIE	25.00		31/01/2008	09:25	2.18	25/02/2008	16:20	2.09	07/03/2008	13:10	2.48
SBHE04 RC	SPIE	17.20		31/01/2008	09:15	2.31	25/02/2008	16:11	2.51	07/03/2008	13:20	2.59
SBHF01 RC	SPIE	19.00		31/01/2008	09:40	5.69	25/02/2008	16:32	5.72	07/03/2008	12:50	5.43
SBHF02A CP	SPIE	17.00		01/02/2008	14:40	7.61	25/02/2008	17:13	7.57	07/03/2008	12:30	9.00
SBHF03 RC	SPIE	18.00		31/01/2008	10:35	6.97	26/02/2008	08:55	6.77	07/03/2008	12:15	7.22
SBHH01 RC	SPIE	25.00		31/01/2008	11:15	3.45	26/02/2008	09:39	3.42	07/03/2008	11:28	3.65
SBHH02 RC	SPIE	14.90		31/01/2008	11:10	3.42	26/02/2008	09:20	3.88	07/03/2008	11:35	3.64
SBHH05 RC	SPIE	21.50		31/01/2008	11:30	2.22	26/02/2008	10:01	2.13	07/03/2008	11:05	3.10
SBHH06 CP	SP	12.30		30/01/2008	15:30	3.75	21/02/2008	08:00	3.76	07/03/2008	11:10	3.87
SBHH07A RC	SPIE	24.85		30/01/2008	14:50	1.70	26/02/2008	10:40	1.34	07/03/2008	11:00	1.07
SBHJ01 CP	SP	7.50		01/02/2008	12:20	1.34	21/02/2008	11:45	5.98	06/03/2008	12:28	1.82
SBHJ03 CP	SP	5.20		01/02/2008	08:00	0.54	27/02/2008	16:15	0.70	07/03/2008	10:45	0.68
SBHJ04	SP	13.10		01/02/2008	11:55	6.61	22/02/2008	13::55	6.67	06/03/2008	11:46	6.75
SBHJ05	SP	11.50		01/02/2008	11:10	8.91	22/02/2008	09:00	9.07	06/03/2008	11:23	9.16
SBHJ06 CP	SP	4.10		01/02/2008	11:45	1.31	21/02/2008	15:30	1.32	06/03/2008	10:50	1.33
SBHJ07 CP	SP	10.40		01/02/2008	11:43	1.35	21/02/2008	14:40	1.40	06/03/2008	12:05	1.56
SBHJ08A CP	SP	7.40		01/02/2008	11:35	3.49	21/02/2008	13:05	2.31	06/03/2008	10:57	2.67
SBHJ09 CP	SP	2.20		01/02/2008	11:30	0.65	21/02/2008	12:25	0.85	06/03/2008	11:00	0.90
SBHJ10 CP	SP	10.00		01/02/2008	10:40	2.30	21/02/2008	13:45	2.24	06/03/2008	10:40	2.16
SBHK01 CP	SP	6.80		01/02/2008	10:55	0.70	25/02/2008	10:30	1.00	06/03/2008	14:24	1.06
SBHK02 CP	SP	11.20		01/02/2008	10:50	1.34	25/02/2008	11:20	1.33	06/03/2008	14:18	1.47
SBHK03 CP	SP	5.90		01/02/2008	10:45	0.87	25/02/2008	12:00	0.89	06/03/2008	14:15	1.00
SBHK04 CP	SP	12.20		01/02/2008	10:25	1.45	25/02/2008	12:30	1.60	06/03/2008	12:30	1.60
SBHL02 RC	SPIE	15.20		01/02/2008	10:35	2.27	25/02/2008	12:49	2.31	06/03/2008	14:00	2.42
SBHL03 RC	SPIE	15.00		31/01/2008	16:20	0.61	26/02/2008	11:15	0.51	07/03/2008	10:25	0.66
SBHM01 RC	SPIE	21.00		01/01/1900	08:20	-0.26	26/02/2008	11:30	-0.26	07/03/2008	10:17	0.05
SBHM02 RC	SPIE	20.00		01/02/2008	08:25	0.19	26/02/2008	11:41	0.49	07/03/2008	10:14	0.68
SBHN01A RC	SPIE	14.90		01/02/2008	15:20	8.49	27/02/2008	17:15	12.23	07/03/2008	14:45	13.18
SBHN02 RC	SPIE	20.40		31/01/2008	15:55	3.67	26/02/2008	11:57	4.19	07/03/2008	10:05	4.84
SBHN03 RC	SPIE	15.00		31/01/2008	15:45	1.07	26/02/2008	12:03	1.73	07/03/2008	09:55	2.34
SBHN04 RC	SPIE	10.00		31/01/2008	15:30	9.99	26/02/2008	14:42	DRY	07/03/2008	09:45	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		02

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		31/01/2008	14:50	DRY	26/02/2008	14:12	DRY	07/03/2008	09:35	DRY
SBHP02 RC	SPIE	9.80		31/01/2008	13:55	7.20	26/02/2008	13:59	8.09	07/03/2008	09:10	8.25
SBHP03 RC	SPIE	5.00		31/01/2008	13:40	4.09	26/02/2008	13:48	4.76	07/03/2008	09:05	4.78
SBHQ01 RC	SPIE	11.80		31/01/2008	14:20	5.76	26/02/2008	12:46	6.74	07/03/2008	09:30	7.20
SBHQ02 RC	SPIE	6.00		31/01/2008	14:15	4.98	26/02/2008	12:59	5.16	07/03/2008	09:25	5.98
SBHQ03 RC	SPIE	11.00		31/01/2008	13:20	6.04	26/02/2008	13:29	7.22	07/03/2008	08:38	7.59
SBHQ04 RC	SPIE	8.00		31/01/2008	13:05	4.35	26/02/2008	13:36	6.18	07/03/2008	08:55	6.94
SBHQ06 RC	SPIE	7.35		31/01/2008	13:00	3.89	26/02/2008	13:16	4.40	07/03/2008	08:25	4.63
SWSJ08	SP	3.30		01/02/2008	12:30	0.42	21/02/2008	11:45	0.37	06/03/2008	12:35	0.41
SWSJ13	SP	2.50		01/02/2008	12:00	DRY	22/02/2008	13:45	DRY	06/03/2008	11:50	DRY
SWSJ21	SP	6.00		01/02/2008	11:20	3.87	22/02/2008	09:30	5.72	06/03/2008	11:27	6.59
SWSJ23	SP	7.80		01/02/2008	11:22	5.92	22/02/2008	09:55	6.62	06/03/2008	11:30	6.97
SWSJ34	SP	6.00		01/02/2008	11:05	2.52	22/02/2008	10:55	3.33	06/03/2008	11:10	3.08
SWSJ37	SP	5.60		01/02/2008	11:25	0.46	22/02/2008	11:30	0.55	06/03/2008	11:15	0.61
LGBH02	SP	8.88					22/02/2008	14:35	7.50	06/03/2008	11:40	7.52
LGBH03	SP	8.90					22/02/2008	14:21	7.20	06/03/2008	11:44	7.28
LGBH04	SP	10.50					22/02/2008	10:30	8.87	06/03/2008	11:20	9.00
LGBH09	SP	7.00					22/02/2008	12:40	1.13	06/03/2008	10:48	1.56
LGBH10	SP	14.60					27/02/2008	14:30	8.15	06/03/2008	11:12	8.21
LGBH11	SP	11.20					27/02/2008	10:00	7.05	06/03/2008	11:03	7.07
LGBH12	SP	7.05					22/02/2008	13:10	1.40	06/03/2008	10:45	1.40
RBBH07	SP	6.25					27/02/2008	12.15	0.69	06/03/2008	12:20	0.71
RBBH09	SP	7.05					27/02/2008	13:40	1.25	06/03/2008	12:25	1.21
RBBH10	SP	6.85					27/02/2008	13:00	0.68	06/03/2008	12:30	0.82

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		03

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		20/03/2008	16:30	2.57	04/04/2008	08:00	2.59	18/04/2008	07:40	2.66
SBHD03 CP	SPIE	10.00		20/03/2008	16:45	0.58	04/04/2008	08:13	0.53	18/04/2008	08:00	0.60
SBHD05 RC	SPIE	12.00		20/03/2008	16:00	1.08	04/04/2008	09:15	1.22	18/04/2008	08:30	1.32
SBHD06 RC	SP	15.00		20/03/2008	17:55	1.20	04/04/2008	09:30	1.33	18/04/2008	08:40	1.44
SBHD08 RC	SPIE	29.50		19/03/2008	18:30	1.28	04/04/2008	10:00	1.39	18/04/2008	08:52	1.52
SBHE02RD	SPIE	25.00		20/03/2008	16:20	2.23	04/04/2008	08:50	2.46	18/04/2008	09:00	2.54
SBHE04 RC	SPIE	17.20		20/03/2008	15:45	2.20	04/04/2008	09:00	1.80	18/04/2008	08:15	1.80
SBHF01 RC	SPIE	19.00		20/03/2008	15:30	5.50	04/04/2008	08:40	5.55	18/04/2008	13:58	5.58
SBHF02A CP	SPIE	17.00		20/03/2008	15:10	5.60	04/04/2008	10:28	5.70	18/04/2008	13:45	5.77
SBHF03 RC	SPIE	18.00		20/03/2008	14:55	7.20	04/04/2008	10:36	7.38	18/04/2008	13:40	7.42
SBHH01 RC	SPIE	25.00		20/03/2008	14:25	3.60	04/04/2008	15:00	3.60	18/04/2008	13:10	3.62
SBHH02 RC	SPIE	14.90		20/03/2008	14:30	4.27	04/04/2008	15:05	3.64	18/04/2008	13:13	3.70
SBHH05 RC	SPIE	21.50		20/03/2008	17:30	2.17	04/04/2008	15:15	2.78	18/04/2008	11:34	2.90
SBHH06 CP	SP	12.30		17/03/2008	15:20	3.88	04/04/2008	15:20	3.89	17/04/2008	14:15	3.90
SBHH07A RC	SPIE	24.85		20/03/2008	13:55	1.33	04/04/2008	15:28	1.92	18/04/2008	11:43	0.88
SBHJ01 CP	SP	7.50		19/03/2008	14:15	1.81	03/04/2008	16:05	1.90	17/04/2008	12:40	1.80
SBHJ03 CP	SP	5.20		19/03/2008	16:40	0.78	03/04/2008	18:25	0.82	17/04/2008	15:55	0.80
SBHJ04	SP	13.10		17/03/2008	13:35	6.64	03/04/2008	18:10	6.74	17/04/2008	13:08	6.80
SBHJ05	SP	11.50		18/03/2008	13:50	9.02	03/04/2008	17:39	9.10	17/04/2008	13:31	9.11
SBHJ06 CP	SP	4.10		17/03/2008	12:55	1.29	03/04/2008	17:43	1.33	17/04/2008	15:05	1.20
SBHJ07 CP	SP	10.40		17/03/2008	10:25	1.59	03/04/2008	17:47	1.50	17/04/2008	13:58	1.47
SBHJ08A CP	SP	7.40		18/03/2008	10:00	2.50	03/04/2008	17:55	2.50	17/04/2008	15:33	2.50
SBHJ09 CP	SP	2.20		18/03/2008	10:25	0.69	03/04/2008	17:58	0.82	17/04/2008	15:22	0.90
SBHJ10 CP	SP	10.00		17/03/2008	09:15	2.10	03/04/2008	17:50	2.00	17/04/2008	13:55	2.00
SBHK01 CP	SP	6.80		19/03/2008	10:45	0.88	03/04/2008	16:40	1.00	17/04/2008	11:40	0.94
SBHK02 CP	SP	11.20		19/03/2008	11:15	1.46	03/04/2008	16:45	1.48	17/04/2008	11:43	1.46
SBHK03 CP	SP	5.90		19/03/2008	11:45	1.04	03/04/2008	16:48	1.07	17/04/2008	11::46	0.98
SBHK04 CP	SP	12.20		19/03/2008	12:15	1.64	03/04/2008	16:52	1.67	17/04/2008	12:05	1.60
SBHL02 RC	SPIE	15.20		19/03/2008	12:50	2.44	03/04/2008	17:00	2.45	17/04/2008	12:00	2.45
SBHL03 RC	SPIE	15.00		20/03/2008	13:25	0.76	08/04/2008	15:40	0.64	18/04/2008	09:50	0.62
SBHM01 RC	SPIE	21.00		20/03/2008	13:05	-0.21	08/04/2008	15:48	-0.45	18/04/2008	11:55	0.01
SBHM02 RC	SPIE	20.00		20/03/2008	13:10	0.61	08/04/2008	15:52	0.61	18/04/2008	11:50	0.61
SBHN01A RC	SPIE	14.90		20/03/2008	12:55	12.14	08/04/2008	16:05	12.58	18/04/2008	12:48	13.27
SBHN02 RC	SPIE	20.40		20/03/2008	12:45	4.26	08/04/2008	16:12	2.64	18/04/2008	12:45	4.85
SBHN03 RC	SPIE	15.00		20/03/2008	12:30	1.60	08/04/2008	16:17	2.07	18/04/2008	12:35	2.37
SBHN04 RC	SPIE	10.00		20/03/2008	12:10	DRY	08/04/2008	16:28	DRY	18/04/2008	10:55	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 17/03/08-17/04/08	Date: 21/04/2008	Date: 21/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		04

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		20/03/2008	12:00	DRY	08/04/2008	16:40	DRY	18/04/2008	10:45	DRY
SBHP02 RC	SPIE	9.80		20/03/2008	11:45	5.59	08/04/2008	16:55	7.98	18/04/2008	10:30	8.20
SBHP03 RC	SPIE	5.00		20/03/2008	11:40	2.80	08/04/2008	16:50	DRY	18/04/2008	10:25	4.93
SBHQ01 RC	SPIE	11.80		20/03/2008	10:40	6.72	08/04/2008	17:13	7.24	18/04/2008	10:10	7.48
SBHQ02 RC	SPIE	6.00		20/03/2008	10:45	4.91	08/04/2008	17:10	DRY	18/04/2008	10:05	DRY
SBHQ03 RC	SPIE	11.00		20/03/2008	10:50	6.76	08/04/2008	17:05	7.69	18/04/2008	10:15	8.00
SBHQ04 RC	SPIE	8.00		20/03/2008	11:30	6.97	08/04/2008	17:02	DRY	18/04/2008	10:40	DRY
SBHQ06 RC	SPIE	7.35		20/03/2008	11:20	4.47	08/04/2008	17:20	6.63	18/04/2008	12:20	4.79
SWSJ08	SP	3.30		19/03/2008	15:10	0.44	03/04/2008	16:00	0.46	17/04/2008	12:35	0.42
SWSJ13	SP	2.50		17/03/2008	13:25	DRY	03/04/2008	18:12	DRY	17/04/2008	13:12	DRY
SWSJ21	SP	6.00		18/03/2008	14:30	4.42	03/04/2008	17:33	5.89	17/04/2008	13:32	6.50
SWSJ23	SP	7.80		18/03/2008	15:05	7.58	03/04/2008	17:35	7.20	17/04/2008	13:35	7.20
SWSJ34	SP	6.00		19/03/2008	08:55	2.36	03/04/2008	17:23	3.26	17/04/2008	13:46	DRY
SWSJ37	SP	5.60		18/03/2008	11:15	0.55	03/04/2008	17:25	0.67	17/04/2008	13:42	0.63
LGBH02	SP	8.88		17/03/2008	12:55	7.48	03/04/2008	18:05	7.46	17/04/2008	13:00	7.48
LGBH03	SP	8.90		17/03/2008	13:15	7.24	03/04/2008	18:08	7.32	17/04/2008	13:03	7.30
LGBH04	SP	10.50		18/03/2008	13:20	8.87	03/04/2008	17:40	8.90	17/04/2008	13:29	8.94
LGBH09	SP	7.00		17/03/2008	11:00	1.08	03/04/2008	17:45	1.15	17/04/2008	15:08	1.05
LGBH10	SP	14.60		18/03/2008	15:20	8.31	03/04/2008	17:27	8.20	17/04/2008	13:40	8.70
LGBH11	SP	11.20		18/03/2008	11:40	6.88	03/04/2008	17:18	7.00	17/04/2008	15:38	7.08
LGBH12	SP	7.05		17/03/2008	10:00	1.30	03/04/2008	17:49	1.47	17/04/2008	15:15	1.36
RBBH07	SP	6.25		19/03/2008	13:25	0.66	03/04/2008	15:50	0.68	17/04/2008	12:30	1.10
RBBH09	SP	7.05		19/03/2008	14:40	1.18	03/04/2008	16:07	1.21	17/04/2008	12:42	1.25
RBBH10	SP	6.85		19/03/2008	13:45	0.70	03/04/2008	16:03	0.75	17/04/2008	12:39	0.78

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 17/03/08-17/04/08	Date: 21/04/2008	Date: 21/04/2008
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NORWEST HOLST SOIL ENGINEERING

A3 Appendix 3

Tabulated Soil Laboratory Data

M4CAN
Soil (MG) Analysis Results & Screening Assessment
CL-14
14/07/2015

Sample Reference	Units	BHF3	BHF4	BHF5	BHF6 (5 m east)	CH10	CH10	CH11	CH11	CH12	CH12	CH13	CH13	CH14	CH15	CH15A	CH16	CH16	CH17	CH17	CH17	CH18	CH18	CH19	CH19A	CH19A	CH20	CH21
Specimen Depth		0.5	1.75	0.2	0.5	0.4	1.4	0.35	1.65	0.17	0.67	0	0.77	0.16	0.3	0.17	0.2	1.9	0.6	1.3	1.9	0.2	1.6	0.2	0.3	1	0	0
Level		9.7	7.55	9.6	8.3	9.89	8.89	9.75	8.45	9.49	8.99	9.74	8.97	8.94	8.91	9.07	8.49	6.79	8.19	7.49	6.89	9.82	8.42	10.12	10.02	9.32	8.85	8.47
Sample Type		D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
Cluster Code		1997 GI	1997 GI	1997 GI	1997 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI
Metals																												
Antimony	mg/kg																											
Arsenic	mg/kg	20.1	25.3	36.9	124.2	21	10	11	86	40	27	36	12	21	18	19	12	22	9.2	11	15	11	22	13	34	8.1	17	17
Barium	mg/kg																											
Boron	mg/kg	9.4	3.1	2.2	0.2	3.2	1.7	1.3	<0.5	1.8	0.8	<0.5	1.1	1.6	2.5	2.1	1.7	1.8	<0.5	1	2.9	1.1	<0.5	1.1	2.3	2.1	<0.5	<0.9
Boron Water Soluble	mg/kg																											
Cadmium	mg/kg	0.8	0.3	0.5	0.3	11.2	0.82	0.28	0.31	0.3	0.53	9.74	0.25	0.41	0.3	0.29	0.17	0.48	0.17	0.28	0.09	0.18	0.27	0.12	1.72	0.21	0.27	0.17
Chromium	mg/kg	39.4	49.1	51.4	59.8	27	25	42	160	0.03	31	13	20	25	29	33	15	22	26	21	38	31	16	14	17	19	33	42
Copper	mg/kg	49.6	87.8	181.7	181.1	181	34	64	402	0.169	100	42	18	141	80	128	78	61	27	104	22	16	69	38	56	14	315	164
Lead	mg/kg	126.6	119.8	165	171.4	421	90	120	390	304	118	154	69	173	126	98	98	60	86	92	61	63	298	59	232	47	82	102
Mercury	mg/kg	0.2	1.5	1.1	0.8	3.77	0.42	0.16	0.16	0.41	0.19	0.27	0.07	1.27	0.68	0.54	0.42	0.3	0.2	0.35	0.12	<0.01	0.1	0.11	0.08	0.03	<0.24	<1.76
Molybdenum	mg/kg																											
Nickel	mg/kg	26.6	43.3	35.3	43.1	31	24	47	183	34	34	14	20	43	35	43	41	23	28	37	35	30	21	37	35	18	32	24
Selenium	mg/kg	1	1.2	1.2	0.8	1.07	0.64	0.61	0.76	1.07	1.02	1.09	0.58	0.96	0.88	0.87	1.25	1.01	0.51	0.6	<0.5	0.61	0.91	0.61	0.82	0.72	1.55	<1.6
Zinc	mg/kg	174	188.5	195.6	222.8	1040	144	398	3230	170	131	912	94	258	138	116	105	91	119	142	112	96	163	61	830	77	272	116
Iron	mg/kg																											
Hexavalent Chromium	mg/kg																											
Non-Metal Inorganics																												
Cyanide (total)	mg/kg	<0.1	<0.1	0.1	0.1	1	<1	4	2	<0.001	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	2	<1	<1	<1	<1	<1
Cyanide (free)	mg/kg	<0.1	<0.1	<0.1	<0.1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		
Ferro/ferricyanide	mg/kg	<10	<10	<10	<10																							
Acid Soluble Sulphate	mg/kg					2830	1310	2640	7650	1900	1150	1410	2200	906	1120	974	680	1760	779	1740	796	1380	1960	498	1550	1450	712	1080
Sulphate (soluble)	g/l																											
Sulphate (total)	mg/kg	5410	1074																									
Sulphide	mg/kg			50.2	24.6	502	50	<1	58	114	27	21	30	54	73	158	5	16	<1	14	7	1	<1	2	<1	4		
Other																												
Asbestos Presence Screen	None																											
Loss on Ignition	%																											
Total Organic Carbon	%																											
Organic Matter	%																											
pH Value	pH units	10.2	8.3	8.4	8.2	9.9	8.4	10.1	9.7	8.8	7.9	8.5	8.7	8.8	9	8.9	8.3	9.9	8.3	10.3	7.7	8.1	8.1	8.2	8.5	8.4	8.1	9.2
Material >2mm	%																											
Calorific Value	MJ/kg																											
Organics																												
PAH (Screening)	mg/kg	49.3	13.3	23.8	52.7	87	108	233	1620	170	177	143	332	111	81	43	49	215	515	564	45	17	20	19	12	22	<43	<44
Mineral Oil	mg/kg	73	29	273	22																							
TPH FTIR (AR)	mg/kg					136	63	75	46300	405	303	220	113	169	106	140	335	711	35	144	95	38	<20	91	<20	99	112	79
OIL FTIR	mg/kg					547	1410	23800	116000	932	809	247	1160	2260	242	229	157	1460	126	251	128	95	42	131	64	159	112	172
PCBs																												
PCBs (vs Aroclor 1254)	mg/kg																											
PCB 105	mg/kg																											
PCB 114	mg/kg																											
PCB 123	mg/kg																											
PCB 126	mg/kg																											
PCB 157	mg/kg																											
PCB 167	mg/kg																											
PCB 169	mg/kg																											
PCB 189	mg/kg																											
PCB 77	mg/kg																											
PCB 81	mg/kg																											
Pcb-118 2,3',4,4',5 - Pentachlorobiphenyl	mg/kg																											
Pcb-156 2,3,3,4,4,5 - Hexachlorobiphenyl	mg/kg																											
Phenols																												
Phenol Index	mg/kg					<0.5	<0.5	<0.5	1.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Phenols Monohydric	mg/kg	<1	<1	<1	<1																							
Phenols (total)	mg/kg	<1	<1	<1	<1																							
Organotin Compounds																												
Dibutyl Tin	ug/kg																											
Tributyl Tin	ug/kg																											
Triphenyl Tin	ug/kg																											
BTEX																												
GRO (C4-C12)	mg/kg																											
MTBE	mg/kg																											
Benzene	mg/kg																											
Toluene	mg/kg																											
Ethyl benzene	mg/kg																											
m & p Xylene	mg/kg																											
o Xylene	mg/kg																											
TPH																												

M4CAN
Soil (MG) Analysis Results & Screening Assessment
CL-14
14/07/2015

Sample Reference	Units	CH22	CH22	CH23	SBHF03CP	STPF01	STPF02	STPF02	STPF03	STPF03	STPF04	STPF04	STPF05	STPF06	STPF06	STPF07	STPF07	STPF08	STPF09	STPF09	STPF10	STPF10	TP1	TP2
Specimen Depth		0.3	0.75	0.16	1	1	1	2	0.3	1.9	1	3	1	0.38	1.24	0.3	2	0.2	0.3	0.9	0.3	1	0.5	0.5
Level		8.07	7.62	8.31	8.88	8.89	8.7	7.7	8.98	7.38	8.23	6.23	7.67	8.89	8.03	10.43	8.73	8.9	8.56	7.96	8.39	7.69		
Sample Type		D	D	D	ES	ES	D	D	ES	ES	ES	ES	ES	B	D	D	D	B	ES	ES	B	ES	D	D
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
Cluster Code		2000 GI	2000 GI	2000 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	June 2005 GI	June 2005 GI
Metals																								
Antimony	mg/kg				11	3.8	2	3.1	5.8	8.8	7.7	5.5	2.6	3.1	3.5	15	<1.5	4.6	6.7	<1.5	15	3.2		
Arsenic	mg/kg	31	10	83	31	7	10	<3	11	29	11		6	<3	6	<3	12	19	19	4	38	20	29	20
Barium	mg/kg				740	870	140	490	340	340	350	490	380	240	260	430	350	780	490	27	780	37		
Boron	mg/kg	<0.5	<0.5	<0.5																				
Boron Water Soluble	mg/kg				<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5		
Cadmium	mg/kg	1.27	0.11	6.08	0.8	0.4	0.5	<0.3	0.7	0.6	<0.3		<0.3	<0.3	<0.3	<0.3	0.5	5	3.6	<0.3	1	<0.3	1.1	<0.5
Chromium	mg/kg	27	15	44	35	22	20	27	20	21	69		16	34	26	310	9.9	18	18	7.1	26	6.5	31	42
Copper	mg/kg	490	26	743	200	75	13	19	81	220	77		33	7	21	10	<6	130	760	19	280	83	76	18
Lead	mg/kg	426	36	969	200	110	31	45	130	260	100		37	11	86	43	10	150	110	22	800	38	160	45
Mercury	mg/kg	0.46	0.04	1.32	<0.6	<0.6	<0.6	<0.6	<0.6	0.8	<0.6		<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	0.29	<0.2
Molybdenum	mg/kg				5.7	0.9	<0.6	<0.6	1.2	2.5	2.5	2.3	<0.6	<0.6	1	1.1	<0.6	2.7	2.6	<0.6	4.1	<0.6		
Nickel	mg/kg	44	12	91	49	24	20	34	31	67	37		22	31	29	5.3	8.3	31	33	7.6	50	6.4	34	41
Selenium	mg/kg	<1.7	<0.5	1.21	<3	<3	<3	<3	<3	<3	<3		<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	0.64	0.34
Zinc	mg/kg	434	47	718	1200	180	130	95	200	360	160		73	57	90	110	44	370	730	37	750	83	240	130
Iron	mg/kg													28000	26000	58000	3600							
Hexavalent Chromium	mg/kg										<0.3													
Non-Metal Inorganics																								
Cyanide (total)	mg/kg	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	<1	<1	<0.5	<0.5
Cyanide (free)	mg/kg																							
Ferro/ferricyanide	mg/kg																							
Acid Soluble Sulphate	mg/kg	1320	444	1660																				
Sulphate (soluble)	g/l				0.094	0.27	0.018	0.25	0.06	0.062	0.086	0.042	0.051	0.16	0.13	<0.003	0.084	0.056	0.01	0.043	0.041	0.009		
Sulphate (total)	mg/kg																							
Sulphide	mg/kg																							
Other																								
Asbestos Presence Screen	None				NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD		
Loss on Ignition	%					5.5	4.1					21	15	1.5			1.5				29			
Total Organic Carbon	%					6.2	1.2					16	9.5	0.5			<0.2				25			
Organic Matter	%																							
pH Value	pH units	8.2	8.2	7.8	7.96	8.02	8.18	8.5	8.15	8.01	8.2	7.61	8.97	7.62	7.82	10.33	10.52	8.26	8.13	8.19	7.69	7.96	8.1	7.9
Material >2mm	%																							
Calorific Value	MJ/kg																							
Organics																								
PAH (Screening)	mg/kg	288	84	832																				
Mineral Oil	mg/kg																							
TPH FTIR (AR)	mg/kg	1220	65	67																				
OIL FTIR	mg/kg	1120	87	732																				
PCBs																								
PCBs (vs Aroclor 1254)	mg/kg				0.81	<0.2	0.022	<0.2	<0.2	<0.02	<0.2	<0.02	<0.2	<0.02	<0.04	<0.2	<0.02	<0.2	0.13	<0.02	<0.2	<0.02		
PCB 105	mg/kg																							
PCB 114	mg/kg																							
PCB 123	mg/kg																							
PCB 126	mg/kg																							
PCB 157	mg/kg																							
PCB 167	mg/kg																							
PCB 169	mg/kg																							
PCB 189	mg/kg																							
PCB 77	mg/kg																							
PCB 81	mg/kg																							
Pcb-118 2,3',4,4',5 - Pentachlorobiphenyl	mg/kg																							
Pcb-156 2,3,3,4,4,5 - Hexachlorobiphenyl	mg/kg																							
Phenols																								
Phenol Index	mg/kg	<0.5	<0.5	0.5																				
Phenols Monohydric	mg/kg																						<0.5	<0.5
Phenols (total)	mg/kg				<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15		
Organotin Compounds																								
Dibutyl Tin	ug/kg					<100				<100									<100					
Tributyl Tin	ug/kg					<100				<100									<100					
Triphenyl Tin	ug/kg					<100				<100									<100					
BTEX																								
GRO (C4-C12)	mg/kg				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.024	0.65	0.047	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
MTBE	mg/kg				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
Benzene	mg/kg				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.018	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
Toluene	mg/kg				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
Ethyl benzene	mg/kg				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
m & p Xylene	mg/kg				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.011	0.026	0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
o Xylene	mg/kg				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.014	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
TPH																								

M4CAN
Soil (MG) Analysis Results & Screening Assessment
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Sample Reference	Units	TP3	TP4	TP5	TP6	TP01	TP02	TP02	TP03	TP04	TP04	TP05	TP05	TP06	TP1	TP2	TP3	TP4	TP6	TP1	TP2	TP3
Specimen Depth		0.3	0.9	0.5	0.6	0.5	0.5	0.8	0.1	0.5	0.9	0.5	1	0.6	0.8	1.4	1	0.7	0.6	1.5	1	0.7
Level																						
Sample Type		D	D	D	D										D	D	D	D	D	D	D	D
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
Cluster Code		June 2005 GI	June 2005 GI	June 2005 GI	June 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Oct 2001 GI	Oct 2001 GI	Oct 2001 GI	Oct 2001 GI	Oct 2001 GI	April 2002 GI	April 2002 GI	April 2002 GI
Metals																						
Antimony	mg/kg																					
Arsenic	mg/kg	65	150	36	15	27	10	32	91	8.8	5.5	27	2.6	11	13.5	5.51	10.4	40.4	15.1	28.03	54.38	35.84
Barium	mg/kg																					
Boron	mg/kg														2.2	0.8	0.6	0.4	0.4	0.8	0.7	0.4
Boron Water Soluble	mg/kg																					
Cadmium	mg/kg	2.1	6.4	1.3	<0.5	0.56	<0.5	0.58	1.3	<0.5	<0.5	0.52	<0.5	0.58	3.7	<1.7	<1.7	<1.7	<1.7	1.1	1.9	2.2
Chromium	mg/kg	64	23	25	38	25	35	23	27	16	27	32	33	130	12	8	14	10	20	26	24	17
Copper	mg/kg	170	1800	160	12	120	28	94	320	32	21	69	11	43	50	17	61	103	79	180	117	172
Lead	mg/kg	340	230	170	40	78	59	63	820	65	98	220	10	290	195	45	114	375	54	190	277	45
Mercury	mg/kg	1.6	1.8	<0.2	<0.2	<0.2	<0.2	<0.2	2.5	0.24	<0.2	0.78	<0.2	2.2	<0.05	0.24	0.1	1.5	0.16	0.3	0.9	0.1
Molybdenum	mg/kg																					
Nickel	mg/kg	44	24	46	37	40	43	37	56	17	30	40	43	42	16	10	18	27	37	39	41	29
Selenium	mg/kg	1.3	1.6	0.94	<0.3										0.27	0.16	0.26	1.27	4.79	3.03	1.23	1.04
Zinc	mg/kg	480	2700	1400	120	210	98	140	820	120	71	310	56	230	488	85	127	57	49	369	366	141
Iron	mg/kg																					
Hexavalent Chromium	mg/kg																					
Non-Metal Inorganics																						
Cyanide (total)	mg/kg	<0.5	<0.5	<0.5	<0.5										4	<2	<2	<2	<2	<2	<2	<2
Cyanide (free)	mg/kg																					
Ferro/ferricyanide	mg/kg																					
Acid Soluble Sulphate	mg/kg																					
Sulphate (soluble)	g/l																					
Sulphate (total)	mg/kg																					
Sulphide	mg/kg																					
Other																						
Asbestos Presence Screen	None																					
Loss on Ignition	%																					
Total Organic Carbon	%																					
Organic Matter	%																					
pH Value	pH units	7.8	7.8	8.4	7.6										6.8	9.1	8	8.1	7.8	7.8	7.8	8.2
Material >2mm	%																					
Calorific Value	MJ/kg																					
Organics																						
PAH (Screening)	mg/kg														27	<25	<25	<25	<25	<25	<25	<25
Mineral Oil	mg/kg																					
TPH FTIR (AR)	mg/kg																					
OIL FTIR	mg/kg																					
PCBs																						
PCBs (vs Aroclor 1254)	mg/kg																					
PCB 105	mg/kg																					
PCB 114	mg/kg																					
PCB 123	mg/kg																					
PCB 126	mg/kg																					
PCB 157	mg/kg																					
PCB 167	mg/kg																					
PCB 169	mg/kg																					
PCB 189	mg/kg																					
PCB 77	mg/kg																					
PCB 81	mg/kg																					
Pcb-118 2,3',4,4',5 - Pentachlorobiphenyl	mg/kg																					
Pcb-156 2,3,3,4,4,5 - Hexachlorobiphenyl	mg/kg																					
Phenols																						
Phenol Index	mg/kg																					
Phenols Monohydric	mg/kg	<0.5	<0.5	<0.5	1.3										<2	<2	<2	<2	<2	<2	<2	<2
Phenols (total)	mg/kg																					
Organotin Compounds																						
Dibutyl Tin	ug/kg																					
Tributyl Tin	ug/kg																					
Triphenyl Tin	ug/kg																					
BTEX																						
GRO (C4-C12)	mg/kg																					
MTBE	mg/kg																					
Benzene	mg/kg																					
Toluene	mg/kg																					
Ethyl benzene	mg/kg																					
m & p Xylene	mg/kg																					
o Xylene	mg/kg																					
TPH																						

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Soil (MG) Analysis Results & Screening Assessment
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Sample Reference	Units	TP5	BH412	BH412	BH412	BH412	BH413	BH413	BH413	BH414	BH414	BH414	BH416	BH416	BH417	BH417	BH418	BH418	BH418	BH419	BH420	BH420	BH421	BH421	BH421	BH422	TP405	TP405	TP405	TP406	TP406	TP406
Specimen Depth		0.4	0 - 0.5	1.2 - 1.7	2.2 - 2.7	2.9 - 3.2	0.2 - 0.4	0.8 - 1.2	3.5 - 4	0.2 - 0.4	0.4 - 0.8	1.3 - 1.5	0.4 -0.6	1.5 - 1.6	0.5 - 0.6	1.5 - 1.6	0.5 - 1	1 - 1.5	3 - 3.5	0.3 - 0.8	0.5 - 1.2	1.7 - 2.2	0 - 0.5	0.5 - 1.2	1.2 - 1.7	0 - 0.5	0 - 0.2	1.4 - 1.5	2.4 - 2.5	0 - 0.2	1 - 1.2	1.6 - 1.8
Level			10.5	9.3	8.3	7.6	9.7	9.1	6.4	10	9.8	8.9	9.65	8.55	8.6	7.6	10.9	10.4	8.4	8.5	10.05	8.85	9.3	8.8	8.1	7.95	10.2	8.8	7.8	10.1	9.1	8.5
Sample Type		D	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
Cluster Code		April 2002 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI
Metals																																
Antimony	mg/kg																															
Arsenic	mg/kg	21.05	470	18	27	20	28	23	17	49	35	15	26	19	12	13	15	20	50	17	27	17	30	27	20	29	34	12	14	25	36	23
Barium	mg/kg																															
Boron	mg/kg	0.5	5.8	1.8	2.9	1.3	4.2	4.6	3.8	1.7	1.7	2	0.66	0.81	<0.4	0.81	3.2	2.9	1.7	2.8	0.56	0.68	0.59	0.69	1.7	<0.4	2.4	1.1	1.1	4.1	1.5	0.6
Boron Water Soluble	mg/kg																															
Cadmium	mg/kg	<1.7	0.9	3.1	0.33	0.16	0.2	0.62	0.11	1.1	1.3	0.79	13	1.6	0.15	0.51	1.8	2.2	0.36	0.51	2.7	0.61	0.36	0.47	0.45	0.61	5.5	1.2	1.4	0.81	0.82	0.28
Chromium	mg/kg	18	130	30	48	37	8.2	30	43	210	110	67	19	80	53	77	28	40	34	20	62	28	10	8.1	15	23	13	19	19	31	48	120
Copper	mg/kg	37	280	30	32	43	3.4	71	69	260	250	99	47	120	29	110	58	55	32	78	49	21	130	210	33	180	6.1	25	34	20	25	20
Lead	mg/kg	36	51	58	76	50	4	93	71	590	370	170	620	140	18	180	70	78	50	150	52	26	220	100	16	350	130	120	480	140	160	87
Mercury	mg/kg	0.06	0.36	0.22	0.24	0.16	<0.1	0.25	0.14	2	0.97	0.31	0.43	6.5	<0.1	0.14	0.26	0.21	0.11	1.1	0.49	0.21	0.88	0.41	0.13	6.8	0.26	0.41	0.52	0.21	0.3	0.13
Molybdenum	mg/kg																															
Nickel	mg/kg	25	5500	31	37	36	27	48	39	95	87	54	20	37	72	43	26	33	31	33	44	48	27	27	31	38	14	26	26	18	23	82
Selenium	mg/kg	1.08	<0.2	0.74	0.35					0.86	0.53	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.38	0.48	<0.2	0.8	<0.2	0.45	0.4	0.59	<0.2	<0.2	0.46	0.47	<0.2	<0.2	<0.2
Zinc	mg/kg	70	450	130	96	100	34	120	130	1500	910	590	1400	520	84	290	200	180	130	160	220	120	160	160	110	250	160	120	140	160	200	110
Iron	mg/kg																															
Hexavalent Chromium	mg/kg																															
Non-Metal Inorganics																																
Cyanide (total)	mg/kg	<2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cyanide (free)	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ferro/ferricyanide	mg/kg																															
Acid Soluble Sulphate	mg/kg																															
Sulphate (soluble)	g/l																															
Sulphate (total)	mg/kg																															
Sulphide	mg/kg																															
Other																																
Asbestos Presence Screen	None		NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD			NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD		NAD	NAD	NAD
Loss on Ignition	%																															
Total Organic Carbon	%		1.5		4.9				1.1			8.6			0		6.1				2					24				0.25		
Organic Matter	%																															
pH Value	pH units	7.4	10.6	9.8	8.7	8.3	11.1	9	8.7	8.1	8.1	8	8.7	9.6	7.2	8.1	8.9	9	8.4	8.6	9.1	8.7	8.6	8.5	7.6	7.7	9.9	8.5	8.3	8.5	8.6	8.6
Material >2mm	%																															
Calorific Value	MJ/kg																						4.4									
Organics																																
PAH (Screening)	mg/kg	<25																														
Mineral Oil	mg/kg																															
TPH FTIR (AR)	mg/kg																															
OIL FTIR	mg/kg																															
PCBs																																
PCBs (vs Aroclor 1254)	mg/kg																															
PCB 105	mg/kg			<0.01																												
PCB 114	mg/kg			<0.01																												
PCB 123	mg/kg			<0.01																												
PCB 126	mg/kg			<0.01																												
PCB 157	mg/kg			<0.01																												
PCB 167	mg/kg			<0.01																												
PCB 169	mg/kg			<0.01																												
PCB 189	mg/kg			<0.01																												
PCB 77	mg/kg			<0.01																												
PCB 81	mg/kg			<0.01																												
Pcb-118 2,3',4,4',5 - Pentachlorobiphenyl	mg/kg			<0.01																												
Pcb-156 2,3,3,4,4,5 - Hexachlorobiphenyl	mg/kg			<0.01																												
Phenols																																
Phenol Index	mg/kg																															
Phenols Monohydric	mg/kg	<2																														
Phenols (total)	mg/kg		<0.3		<0.3		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Organotin Compounds																																
Dibutyl Tin	ug/kg																															
Tributyl Tin	ug/kg																															
Triphenyl Tin	ug/kg																															
BTEX																																
GRO (C4-C12)	mg/kg																															
MTBE	mg/kg																															
Benzene	mg/kg		<0.001	0.0017		<0.001				<0.001													<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Toluene	mg/kg		<0.001	0.002		<0.001				<0.001													<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Ethyl benzene	mg/kg		<0.001	<0.001		<0.001				<0.001													<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
m & p Xylene	mg/kg		<0.001	0.0018		<0.001				<0.001													<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
o Xylene	mg/kg		<0.001	<0.001		<0.001				<0.001													<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TPH																																

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Geological Formation Legend

MG	Made Ground

Screening Values and Assessment

	Exceeds S4ULs criteria
X	Laboratory detection level higher than screening criterion

Notes

NFD No Fibres Detected (Asbestos screening)
Screening values are based on CLEA SGV soil guidance values and Land Quality Management Generic Assessment Criteria
* Arup CLEA GAC values where no published values are available
Where various values for SOM are presented the more conservative 1% SOM has been used

Sample Reference	Units	TP406	TP407	TP407	TP407	TP409	TP409	TP409
Specimen Depth		2.8 - 3	0.2 - 0.5	0.6 - 0.8	1.2 - 1.4	0 - 0.3	0.5 - 0.6	1 - 1.1
Level		7.3	9.25	8.85	8.25	8.05	7.55	7.05
Sample Type		ES	ES	ES	ES	ES	ES	ES
Geology Code		MG	MG	MG	MG	MG	MG	MG
Cluster Code		2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI
Metals								
Antimony	mg/kg							
Arsenic	mg/kg	8.6	<1	<1	2.9	8.2	79	<1
Barium	mg/kg							
Boron	mg/kg	0.58	<0.4	<0.4	0.43	1	0.63	0.45
Boron Water Soluble	mg/kg							
Cadmium	mg/kg	<0.1	0.22	0.17	<0.1	1.6	0.6	0.21
Chromium	mg/kg	90	8.1	29	43	48	41	14
Copper	mg/kg	15	62	13	15	60	89	20
Lead	mg/kg	65	33	17	26	150	510	11
Mercury	mg/kg	<0.1	0.22	<0.1	<0.1	0.46	1.3	<0.1
Molybdenum	mg/kg							
Nickel	mg/kg	66	23	38	32	31	30	12
Selenium	mg/kg	<0.2	1.3	0.23	<0.2	0.22	0.24	<0.2
Zinc	mg/kg	85	69	94	88	290	330	110
Iron	mg/kg							
Hexavalent Chromium	mg/kg							
Non-Metal Inorganics								
Cyanide (total)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cyanide (free)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ferro/ferricyanide	mg/kg							
Acid Soluble Sulphate	mg/kg							
Sulphate (soluble)	g/l							
Sulphate (total)	mg/kg							
Sulphide	mg/kg							
Other								
Asbestos Presence Screen	None	NAD	NAD	NAD	NAD	NAD	NAD	
Loss on Ignition	%							
Total Organic Carbon	%			2		11		
Organic Matter	%							
pH Value	pH units	8.1	8.5	8.1	7.7	8.1	8.4	8.5
Material >2mm	%							
Calorific Value	MJ/kg							
Organics								
PAH (Screening)	mg/kg							
Mineral Oil	mg/kg							
TPH FTIR (AR)	mg/kg							
OIL FTIR	mg/kg							
PCBs								
PCBs (vs Aroclor 1254)	mg/kg							
PCB 105	mg/kg				<0.01		<0.01	
PCB 114	mg/kg				<0.01		<0.01	
PCB 123	mg/kg				<0.01		<0.01	
PCB 126	mg/kg				<0.01		<0.01	
PCB 157	mg/kg				<0.01		<0.01	
PCB 167	mg/kg				<0.01		<0.01	
PCB 169	mg/kg				<0.01		<0.01	
PCB 189	mg/kg				<0.01		<0.01	
PCB 77	mg/kg				<0.01		<0.01	
PCB 81	mg/kg				<0.01		<0.01	
Pcb-118 2,3',4,4',5 - Pentachlorobiphenyl	mg/kg				<0.01		<0.01	
Pcb-156 2,3,3,4,4,5 - Hexachlorobiphenyl	mg/kg				<0.01		<0.01	
Phenols								
Phenol Index	mg/kg							
Phenols Monohydric	mg/kg							
Phenols (total)	mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	
Organotin Compounds								
Dibutyl Tin	ug/kg							
Tributyl Tin	ug/kg							
Triphenyl Tin	ug/kg							
BTEX								
GRO (C4-C12)	mg/kg							
MTBE	mg/kg							
Benzene	mg/kg	<0.001						
Toluene	mg/kg	<0.001						
Ethyl benzene	mg/kg	<0.001						
m & p Xylene	mg/kg	<0.001						
o Xylene	mg/kg	<0.001						
TPH								

Cluster Code	No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	UCL to be Derived?	95 UCL Value	No. of Outliers	Selected S4ULs Criteria	Comment	No. Data Exceeding S4ULs Criteria
Metals											
Antimony	18	16	15	2	STPF07 @ 0.3mbGL	Yes					
Arsenic	108	102	470	2.6	BH412 @ 0 - 0.5mbGL	Yes			170		1
Barium	18	18	870	27	STPF01 @ 1mbGL	Yes					
Boron	76	63	9.4	0.2	BHF3 @ 0.5mbGL	Yes			46000		0
Boron Water Soluble	18	0	None > LOD	None > LOD		Yes					
Cadmium	108	87	13	0.09	BH416 @ 0.4 -0.6mbGL	Yes			190		0
Chromium	108	108	310	0.03	STPF07 @ 0.3mbGL	Yes			33		37
Copper	108	107	1800	0.169	TP4 @ 0.9mbGL	Yes			44000		0
Lead	108	108	969	4	CH23 @ 0.16mbGL	Yes			1300		0
Mercury	108	74	6.8	0.03	BH422 @ 0 - 0.5mbGL	Yes			30		0
Molybdenum	18	11	5.7	0.9	SBHF03CP @ 1mbGL	Yes					
Nickel	108	108	5500	5.3	BH412 @ 0 - 0.5mbGL	Yes			980		1
Selenium	95	56	4.79	0.16	TP6 @ 0.6mbGL	Yes			1800		0
Zinc	108	108	3230	34	CH11 @ 1.65mbGL	Yes			170000		0
Iron	4	4	58000	3600	STPF07 @ 0.3mbGL	IS					
Hexavalent Chromium	1	0	None > LOD	None > LOD		IS					
Non-Metal Inorganics											
Cyanide (total)	100	9	4	0.1	CH11 @ 0.35mbGL	Yes					
Cyanide (free)	62	0	None > LOD	None > LOD		Yes					
Ferro/ferricyanide	4	0	None > LOD	None > LOD		IS					
Acid Soluble Sulphate	26	26	7650	444	CH11 @ 1.65mbGL	Yes					
Sulphate (soluble)	18	17	0.27	0.009	STPF01 @ 1mbGL	Yes					
Sulphate (total)	2	2	5410	1074	BHF3 @ 0.5mbGL	IS					
Sulphide	23	19	502	1	CH10 @ 0.4mbGL	Yes					
Other											
Asbestos Presence Screen	51	0	None > LOD	None > LOD		Yes					
Loss on Ignition	7	7	29	1.5	STPF10 @ 0.3mbGL	Yes					
Total Organic Carbon	18	17	25	0	STPF10 @ 0.3mbGL	Yes					
Organic Matter	0	0	None > LOD	None > LOD		IS					
pH Value	100	100	11.1	6.8	BH413 @ 0.2 - 0.4mbGL	Yes			6-9		16
Material >2mm	0	0	None > LOD	None > LOD		IS					
Calorific Value	1	1	4.4	4.4	BH421 @ 0 - 0.5mbGL	IS					
Organics											
PAH (Screening)	39	29	1620	12	CH11 @ 1.65mbGL	Yes			1.1		29
Mineral Oil	30	4	273	22	BHF5 @ 0.2mbGL	Yes					
TPH FTIR (AR)	26	24	46300	35	CH11 @ 1.65mbGL	Yes			3200		1
OIL FTIR	30	26	116000	42	CH11 @ 1.65mbGL	Yes					
PCBs											
PCBs (vs Aroclor 1254)	18	3	0.81	0.022	SBHF03CP @ 1mbGL	Yes			0.24		1
PCB 105	3	0	None > LOD	None > LOD		IS			0.24		0
PCB 114	3	0	None > LOD	None > LOD		IS			0.24		0
PCB 123	3	0	None > LOD	None > LOD		IS			0.24		0
PCB 126	3	0	None > LOD	None > LOD		IS			0.24		0
PCB 157	3	0	None > LOD	None > LOD		IS			0.24		0
PCB 167	3	0	None > LOD	None > LOD		IS			0.24		0
PCB 169	3	0	None > LOD	None > LOD		IS			0.24		0
PCB 189	3	0	None > LOD	None > LOD		IS			0.24		0
PCB 77	3	0	None > LOD	None > LOD		IS			0.24		0
PCB 81	3	0	None > LOD	None > LOD		IS			0.24		0
Pcb-118 2,3',4,4',5 - Pentachlorobiphenyl	3	0	None > LOD	None > LOD		IS			0.24		0
Pcb-156 2,3,3,4,4,5 - Hexachlorobiphenyl	3	0	None > LOD	None > LOD		IS			0.24		0
Phenols											
Phenol Index	26	5	1.3	0.5	CH11 @ 1.65mbGL	Yes			440		0
Phenols Monohydric	19	1	1.3	1.3	TP6 @ 0.6mbGL	Yes			440		0
Phenols (total)	55	0	None > LOD	None > LOD		Yes			440		0
Organotin Compounds											
Dibutyl Tin	3	0	None > LOD	None > LOD		IS					
Tributyl Tin	3	0	None > LOD	None > LOD		IS					
Triphenyl Tin	3	0	None > LOD	None > LOD		IS					
BTEX											
GRO (C4-C12)	18	3	0.65	0.024	STPF04 @ 3mbGL	Yes					
MTBE	18	0	None > LOD	None > LOD		Yes					
Benzene	32	2	0.018	0.0017	STPF05 @ 1mbGL	Yes			27		0
Toluene	32	1	0.002	0.002	BH412 @ 1.2 - 1.7mbGL	Yes			56000		0
Ethyl benzene	32	0	None > LOD	None > LOD		Yes			5700		0
m & p Xylene	32	4	0.026	0.0018	STPF04 @ 3mbGL	Yes			5900		0
o Xylene	32	1	0.014	0.014	STPF04 @ 3mbGL	Yes			6600		0
TPH											

Sample Reference	Units	BHF3	BHF4	BHF5	BHF6	CH10	CH10	CH11	CH11	CH12	CH12	CH13	CH13	CH14	CH15	CH15A	CH16	CH16	CH17	CH17	CH17	CH18	CH18	CH19	CH19A	CH19A	CH20	CH21
Specimen Depth		0.5	1.75	0.2	0.5	0.4	1.4	0.35	1.65	0.17	0.67	0	0.77	0.16	0.3	0.17	0.2	1.9	0.6	1.3	1.9	0.2	1.6	0.2	0.3	1	0	0
Level		9.7	7.55	9.6	8.3	9.89	8.89	9.75	8.45	9.49	8.99	9.74	8.97	8.94	8.91	9.07	8.49	6.79	8.19	7.49	6.89	9.82	8.42	10.12	10.02	9.32	8.85	8.47
Sample Type		D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
Cluster Code		1997 GI	1997 GI	1997 GI	1997 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI
TPH >C6-C8.	mg/kg																											
TPH >C8-C10.	mg/kg																											
TPH >C10-C12.	mg/kg																											
TPH >C12-C16.	mg/kg																											
TPH >C16-C21.	mg/kg																											
TPH >C21-C35.	mg/kg																											
Aliphatics C5-C6	mg/kg																											
Aliphatics >C6-C8	mg/kg																											
Aliphatics >C8-C10	mg/kg																											
Aliphatics >C10-C12	mg/kg																											
Aliphatics >C12-C16	mg/kg																											
Aliphatics >C16-C21	mg/kg																											
Aliphatics >C21-C35	mg/kg																											
Total Aliphatics C5-C35	mg/kg																											
Aliphatics >C35-44	mg/kg																											
Aromatics >C5-7	mg/kg																											
Aromatics C6-C7	mg/kg																											
Aromatics >C7-C8	mg/kg																											
Aromatics >EC8-EC10	mg/kg																											
Aromatics >EC10-EC12	mg/kg																											
Aromatics >EC12-EC16	mg/kg																											
Aromatics >EC16-EC21	mg/kg																											
Aromatics >EC21-EC35	mg/kg																											
Total Aromatics C6-C35	mg/kg																											
Aromatics >C35-44	mg/kg																											
Total Aliphatic hydrocarbons	mg/kg																											
Total Aromatic hydrocarbons	mg/kg																											
TPH (Aliphatics and Aromatics C5-C35)	mg/kg																											
Total petroleum hydrocarbons	mg/kg																											
PAH																												
Acenaphthene	mg/kg																											
Acenaphthylene	mg/kg																											
Anthracene	mg/kg																											
Benz(a)anthracene	mg/kg																											
Benzo(a)pyrene	mg/kg																											
Benzo(b)fluoranthene	mg/kg																											
Benzo(ghi)perylene	mg/kg																											
Benzo(k)fluoranthene	mg/kg																											
Chrysene	mg/kg																											
Dibenzo(ah)anthracene	mg/kg																											
Fluoranthene	mg/kg																											
Fluorene	mg/kg																											
Indeno(123cd)pyrene	mg/kg																											
Naphthalene	mg/kg																											
Phenanthrene	mg/kg																											
Pyrene	mg/kg																											
PAH 16 Total	mg/kg																											
Pesticides																												
Aldrin	ug/kg																											
Alpha-BHC (Lindane)	ug/kg																											
Beta-BHC (Lindane)	ug/kg																											
Chlorothalonil	ug/kg																											
cis-Chlordane	ug/kg																											
Dieldrin	ug/kg																											
Endosulphan I	ug/kg																											
Endosulphan II	ug/kg																											
Endosulphan sulphate	ug/kg																											
Endrin	ug/kg																											
Gamma-BHC (Lindane)	ug/kg																											
Heptachlor	ug/kg																											
Heptachlor Epoxide	ug/kg																											
Hexachlorobenzene	ug/kg																											
Isodrin	ug/kg																											
o,p'-DDE	ug/kg																											
o,p'-DDT	ug/kg																											
o,p'-Methoxychlor	ug/kg																											
o,p'-TDE(DDD)	ug/kg																											
p,p'-DDE	ug/kg																											
p,p'-DDT	ug/kg																											
p,p'-Methoxychlor	ug/kg																											
p,p'-TDE(DDD)	ug/kg																											
Pendimethalin	ug/kg																											
Permethrin I	ug/kg																											
Permethrin II	ug/kg																											
Quintozene (PCNB)	ug/kg																											

Sample Reference	Units	CH22	CH22	CH23	SBHF03CP	STPF01	STPF02	STPF02	STPF03	STPF03	STPF04	STPF04	STPF05	STPF06	STPF06	STPF07	STPF07	STPF08	STPF09	STPF09	STPF10	STPF10	TP1	TP2
Specimen Depth		0.3	0.75	0.16	1	1	1	2	0.3	1.9	1	3	1	0.38	1.24	0.3	2	0.2	0.3	0.9	0.3	1	0.5	0.5
Level		8.07	7.62	8.31	8.88	8.89	8.7	7.7	8.98	7.38	8.23	6.23	7.67	8.89	8.03	10.43	8.73	8.9	8.56	7.96	8.39	7.69		
Sample Type		D	D	D	ES	ES	D	D	ES	ES	ES	ES	ES	B	D	D	D	B	ES	ES	B	ES	D	D
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
Cluster Code		2000 GI	2000 GI	2000 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	June 2005 GI	June 2005 GI
TPH >C6-C8.	mg/kg																							
TPH >C8-C10.	mg/kg																							
TPH >C10-C12.	mg/kg																							
TPH >C12-C16.	mg/kg																							
TPH >C16-C21.	mg/kg																							
TPH >C21-C35.	mg/kg																							
Aliphatics C5-C6	mg/kg				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
Aliphatics >C6-C8	mg/kg				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.013	0.012	0.014	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
Aliphatics >C8-C10	mg/kg				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.048	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
Aliphatics >C10-C12	mg/kg				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.19	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
Aliphatics >C12-C16	mg/kg				6.4	8.1	1.7	6.2	2.8	12	2	13	5.3	<0.1	4.3	2.5	2.6	15	8.2	<0.1	9.1	<0.1		
Aliphatics >C16-C21	mg/kg				26	19	14	40	11	24	6.3	22	5.5	<0.1	3.5	3.2	5.8	37	16	<0.1	26	<0.1		
Aliphatics >C21-C35	mg/kg				130	91	38	69	62	75	51	31	12	<0.1	16	110	50	500	78	0.58	91	1.3		
Total Aliphatics C5-C35	mg/kg				160	120	54	120	75	110	60	66	23	<0.1	23	120	59	550	100	0.58	130	1.3		
Aliphatics >C35-44	mg/kg																							
Aromatics >C5-7	mg/kg																							
Aromatics C6-C7	mg/kg				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.018	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
Aromatics >C7-C8	mg/kg				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
Aromatics >EC8-EC10	mg/kg				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.011	0.11	0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
Aromatics >EC10-EC12	mg/kg				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.29	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
Aromatics >EC12-EC16	mg/kg				6	9.8	0.19	4.3	2.2	6.6	5.4	31	2.4	<0.1	0.46	2	<0.1	4.7	2.8	<0.1	21	<0.1		
Aromatics >EC16-EC21	mg/kg				17	35	0.72	17	8.8	19	5.9	57	8.3	<0.1	2.2	3	<0.1	16	12	0.23	39	<0.1		
Aromatics >EC21-EC35	mg/kg				230	370	16	72	110	120	45	95	31	<0.1	21	130	5.4	310	120	3.3	210	<0.1		
Total Aromatics C6-C35	mg/kg				250	410	17	93	120	150	56	180	42	<0.1	24	130	5.4	330	130	3.5	270	<0.1		
Aromatics >C35-44	mg/kg																							
Total Aliphatic hydrocarbons	mg/kg																							
Total Aromatic hydrocarbons	mg/kg																							
TPH (Aliphatics and Aromatics C5-C35)	mg/kg				410	530	71	210	200	260	120	250	64	<0.1	47	250	64	890	230	4.1	390	1.3		
Total petroleum hydrocarbons	mg/kg																							
PAH																								
Acenaphthene	mg/kg				0.073	2.5	0.061	1.2	0.33	0.25	0.096	3.1	0.065	<0.014	0.015	0.027	<0.014	0.12	0.068	0.02	0.34	<0.014		
Acenaphthylene	mg/kg				0.11	1	0.15	0.083	0.12	0.16	0.054	0.25	0.016	0.007	0.024	0.015	<0.005	0.081	0.15	0.009	0.38	0.007		
Anthracene	mg/kg				0.35	3.1	0.3	0.35	0.75	0.85	0.29	2	0.11	0.012	0.057	0.052	<0.009	0.32	0.32	0.072	0.99	0.034		
Benz(a)anthracene	mg/kg				1.2	12	0.85	0.89	2	3.6	0.83	1.4	0.34	0.062	0.24	0.16	0.025	2.2	1.5	0.16	5.2	0.092		
Benzo(a)pyrene	mg/kg				1.1	14	1.2	1.1	2.3	3.3	0.69	0.81	0.3	0.051	0.21	0.12	0.013	2.7	1.7	0.13	6.3	0.16		
Benzo(b)fluoranthene	mg/kg				1.4	21	2.1	1.6	3.7	4.4	1.5	1.5	0.48	0.077	0.36	0.18	0.023	4.5	2.9	0.24	13	0.18		
Benzo(ghi)perylene	mg/kg				0.9	9.6	0.78	0.66	1.7	2	0.49	0.5	0.25	0.047	0.19	0.11	0.013	2	1	0.096	4.5	0.21		
Benzo(k)fluoranthene	mg/kg				0.87	7.3	0.74	0.37	1.1	1.9	0.4	0.56	0.22	0.049	0.15	0.14	<0.025	2.2	1.5	0.093	3.9	0.072		
Chrysene	mg/kg				1.9	13	1.2	1.2	2.5	4.1	1.3	1.8	0.63	0.069	0.32	0.22	0.022	3.2	2.2	0.2	9.8	0.11		
Dibenzo(ah)anthracene	mg/kg				0.34	3.2	0.32	0.28	0.46	0.58	0.18	0.14	0.089	0.008	0.048	0.029	<0.008	0.74	0.39	0.043	1.2	0.03		
Fluoranthene	mg/kg				2.3	20	1.6	1.9	3.5	6.6	1.7	5.6	0.62	0.079	0.38	0.3	<0.025	4.1	2.6	0.29	16	0.13		
Fluorene	mg/kg				0.22	2.3	0.08	0.94	0.37	0.35	0.29	3.3	0.17	<0.012	0.025	0.04	<0.012	0.17	0.074	0.024	0.47	<0.012		
Indeno(123cd)pyrene	mg/kg				0.71	8.8	0.72	0.6	1.5	1.5	0.38	0.41	0.15	0.042	0.13	0.082	<0.011	1.6	1.1	0.094	4.2	0.17		
Naphthalene	mg/kg				0.52	0.34	0.094	0.32	0.24	0.63	0.74	9.8	0.51	0.051	0.082	0.05	0.017	0.49	0.25	0.12	1.2	0.038		
Phenanthrene	mg/kg				2.1	11	0.58	2.1	2.2	3.9	1.9	11	1	0.053	0.23	0.25	0.042	2.1	1.2	0.15	11	0.085		
Pyrene	mg/kg				2	17	1.4	1.5	2.4	5.3	1.3	3.6	0.53	0.064	0.31	0.25	<0.022	3.1	2.1	0.26	13	0.1		
PAH 16 Total	mg/kg				16	150	12	15	25	40	12	45	5.5	0.67	2.8	2	0.16	30	19	2	91	1.4	120	4
Pesticides																								
Aldrin	ug/kg													<1	<10	<20								
Alpha-BHC (Lindane)	ug/kg													<1	<10	<20								
Beta-BHC (Lindane)	ug/kg													<1	<10	<20								
Chlorothalonil	ug/kg													<1	<10	<20								
cis-Chlordane	ug/kg													<1	<10	<20								
Dieldrin	ug/kg													<1	<10	<20								
Endosulphan I	ug/kg													<1	<10	<20								
Endosulphan II	ug/kg													<1	<10	<20								
Endosulphan sulphate	ug/kg													<1	<10	<20								
Endrin	ug/kg													<1	<10	<20								
Gamma-BHC (Lindane)	ug/kg													<1	<10	<20								
Heptachlor	ug/kg													<1	<10	<20								
Heptachlor Epoxide	ug/kg													<1	<10	<20								
Hexachlorobenzene	ug/kg													<1	<10	<20								
Isodrin	ug/kg													<1	<10	<20								
o,p'-DDE	ug/kg													<1	<10	<20								
o,p'-DDT	ug/kg													<1	<10	<20								
o,p'-Methoxychlor	ug/kg													<1	<10	<20								
o,p'-TDE(DDD)	ug/kg													<1	<10	<20								
p,p'-DDE	ug/kg													<1	<10	<20								
p,p'-DDT	ug/kg													<1	<10	<20								
p,p'-Methoxychlor	ug/kg													<1	<10	<20								
p,p'-TDE(DDD)	ug/kg													<1	<10	<20								
Pendimethalin	ug/kg													<1	<10	<20								
Permethrin I	ug/kg													<1	<10	<20								
Permethrin II	ug/kg													<1	<10	<20								
Quintozene (PCNB)	ug/kg													<1	<10	<20								

Sample Reference	Units	TP3	TP4	TP5	TP6	TP01	TP02	TP02	TP03	TP04	TP04	TP05	TP05	TP06	TP1	TP2	TP3	TP4	TP6	TP1	TP2	TP3
Specimen Depth		0.3	0.9	0.5	0.6	0.5	0.5	0.8	0.1	0.5	0.9	0.5	1	0.6	0.8	1.4	1	0.7	0.6	1.5	1	0.7
Level																						
Sample Type		D	D	D	D										D	D	D	D	D	D	D	D
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
Cluster Code		June 2005 GI	June 2005 GI	June 2005 GI	June 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Oct 2001 GI	Oct 2001 GI	Oct 2001 GI	Oct 2001 GI	Oct 2001 GI	April 2002 GI	April 2002 GI	April 2002 GI
TPH >C6-C8.	mg/kg																					
TPH >C8-C10.	mg/kg																					
TPH >C10-C12.	mg/kg																					
TPH >C12-C16.	mg/kg																					
TPH >C16-C21.	mg/kg																					
TPH >C21-C35.	mg/kg																					
Aliphatics C5-C6	mg/kg																					
Aliphatics >C6-C8	mg/kg																					
Aliphatics >C8-C10	mg/kg																					
Aliphatics >C10-C12	mg/kg																					
Aliphatics >C12-C16	mg/kg																					
Aliphatics >C16-C21	mg/kg																					
Aliphatics >C21-C35	mg/kg																					
Total Aliphatics C5-C35	mg/kg																					
Aliphatics >C35-44	mg/kg																					
Aromatics >C5-7	mg/kg																					
Aromatics C6-C7	mg/kg																					
Aromatics >C7-C8	mg/kg																					
Aromatics >EC8-EC10	mg/kg																					
Aromatics >EC10-EC12	mg/kg																					
Aromatics >EC12-EC16	mg/kg																					
Aromatics >EC16-EC21	mg/kg																					
Aromatics >EC21-EC35	mg/kg																					
Total Aromatics C6-C35	mg/kg																					
Aromatics >C35-44	mg/kg																					
Total Aliphatic hydrocarbons	mg/kg																					
Total Aromatic hydrocarbons	mg/kg																					
TPH (Aliphatics and Aromatics C5-C35)	mg/kg					270	<50	630	180	430	<50	130	<50	270								
Total petroleum hydrocarbons	mg/kg																					
PAH																						
Acenaphthene	mg/kg					<0.5	<0.5	<0.5	<0.5	5.3	<0.5	8.5	<0.5	1.1								
Acenaphthylene	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5								
Anthracene	mg/kg					<0.5	<0.5	<0.5	<0.5	4.4	<0.5	14	0.69	1.1								
Benz(a)anthracene	mg/kg					1.3	<0.5	0.85	1.4	9.5	<0.5	19	<0.5	4.3								
Benzo(a)pyrene	mg/kg					0.76	<0.5	0.69	2.5	7.5	<0.5	13	<0.5	3.9								
Benzo(b)fluoranthene	mg/kg					1	<0.5	0.98	2.6	8.8	<0.5	12	<0.5	3.4								
Benzo(ghi)perylene	mg/kg					0.66	<0.5	0.51	2	5.2	<0.5	9.5	<0.5	2.8								
Benzo(k)fluoranthene	mg/kg					<0.5	<0.5	<0.5	1	3.4	<0.5	7.3	<0.5	2								
Chrysene	mg/kg					1.4	<0.5	0.81	2.3	12	<0.5	22	<0.5	5.5								
Dibenzo(ah)anthracene	mg/kg					<0.5	<0.5	<0.5	<0.5	0.74	<0.5	1.5	<0.5	<0.5								
Fluoranthene	mg/kg					2.1	<0.5	2	3.8	17	<0.5	49	<0.5	8								
Fluorene	mg/kg					<0.5	<0.5	<0.5	<0.5	2.9	<0.5	4.3	<0.5	<0.5								
Indeno(123cd)pyrene	mg/kg					0.51	<0.5	<0.5	1.3	4.6	<0.5	9.3	<0.5	2.8								
Naphthalene	mg/kg					0.7	<0.5	1.1	0.88	2.9	<0.5	6.9	<0.5	0.72								
Phenanthrene	mg/kg					1	<0.5	1.4	2.7	14	<0.5	44	<0.5	2.4								
Pyrene	mg/kg					1.8	<0.5	1.2	3.4	12	<0.5	34	<0.5	5.4								
PAH 16 Total	mg/kg	20	9	6	3	12	<2	11	25	110	3	250	3	44								
Pesticides																						
Aldrin	ug/kg																					
Alpha-BHC (Lindane)	ug/kg																					
Beta-BHC (Lindane)	ug/kg																					
Chlorothalonil	ug/kg																					
cis-Chlordane	ug/kg																					
Dieldrin	ug/kg																					
Endosulphan I	ug/kg																					
Endosulphan II	ug/kg																					
Endosulphan sulphate	ug/kg																					
Endrin	ug/kg																					
Gamma-BHC (Lindane)	ug/kg																					
Heptachlor	ug/kg																					
Heptachlor Epoxide	ug/kg																					
Hexachlorobenzene	ug/kg																					
Isodrin	ug/kg																					
o,p'-DDE	ug/kg																					
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p,p'-DDE	ug/kg																					
p,p'-DDT	ug/kg																					
p,p'-Methoxychlor	ug/kg																					
p,p'-TDE(DDD)	ug/kg																					
Pendimethalin	ug/kg																					
Permethrin I	ug/kg																					
Permethrin II	ug/kg																					
Quintozene (PCNB)	ug/kg																					

Sample Reference	Units	TP5	BH412	BH412	BH412	BH412	BH413	BH413	BH413	BH414	BH414	BH414	BH416	BH416	BH417	BH417	BH418	BH418	BH418	BH419	BH420	BH420	BH421	BH421	BH421	BH422	TP405	TP405	TP405	TP406	TP406	TP406
Specimen Depth		0.4	0 - 0.5	1.2 - 1.7	2.2 - 2.7	2.9 - 3.2	0.2 - 0.4	0.8 - 1.2	3.5 - 4	0.2 - 0.4	0.4 - 0.8	1.3 - 1.5	0.4 -0.6	1.5 - 1.6	0.5 - 0.6	1.5 - 1.6	0.5 - 1	1 - 1.5	3 - 3.5	0.3 - 0.8	0.5 - 1.2	1.7 - 2.2	0 - 0.5	0.5 - 1.2	1.2 - 1.7	0 - 0.5	0 - 0.2	1.4 - 1.5	2.4 - 2.5	0 - 0.2	1 - 1.2	1.6 - 1.8
Level			10.5	9.3	8.3	7.6	9.7	9.1	6.4	10	9.8	8.9	9.65	8.55	8.6	7.6	10.9	10.4	8.4	8.5	10.05	8.85	9.3	8.8	8.1	7.95	10.2	8.8	7.8	10.1	9.1	8.5
Sample Type		D	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
Cluster Code		April 2002 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI
TPH >C6-C8.	mg/kg				<1		<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1			<1							
TPH >C8-C10.	mg/kg				<1		<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1			<1							
TPH >C10-C12.	mg/kg				<1		<1	<1	<1		9.3	<1	1.7	<1	<1	<1	<1	<1	<1	1.9	<1	<1			<1							
TPH >C12-C16.	mg/kg				<1		<1	5.5	<1		21	13	9	<1	<1	<1	<1	<1	<1	15	<1	<1			<1							
TPH >C16-C21.	mg/kg				3.2		<1	21	<1		83	14	28	5.8	<1	<1	2.1	4.5	<1	120	<1	<1			<1							
TPH >C21-C35.	mg/kg				6.9		<1	55	<1		210	21	65	12	<1	<1	<1	1.8	<1	320	<1	<1			<1							
Aliphatics C5-C6	mg/kg		<0.1	<0.1		<0.1				<0.1													<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C6-C8	mg/kg		<0.1	<0.1		<0.1				<0.1													<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C8-C10	mg/kg		<0.1	<0.1		<0.1				<0.1													<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C10-C12	mg/kg		<1	<1		<1				<1													<1	<1		<1	<1	<1	<1	<1	<1	<1
Aliphatics >C12-C16	mg/kg		<1	<1		<1				<1													<1	<1		<1	<1	<1	<1	<1	<1	<1
Aliphatics >C16-C21	mg/kg		<1	<1		<1				<1													<1	<1		46	<1	<1	<1	<1	<1	<1
Aliphatics >C21-C35	mg/kg		80	<1		<1				<1													<1	<1		150	<1	<1	<1	<1	<1	<1
Total Aliphatics C5-C35	mg/kg																															
Aliphatics >C35-44	mg/kg		12	<1		<1				<1													<1	<1		2.9	<1	<1	<1	<1	<1	<1
Aromatics >C5-7	mg/kg		<0.1	<0.1		<0.1				<0.1													<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics C6-C7	mg/kg																															
Aromatics >C7-C8	mg/kg		<0.1	<0.1		<0.1				<0.1													<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >EC8-EC10	mg/kg		<0.1	<0.1		<0.1				<0.1													<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >EC10-EC12	mg/kg		<1	<1		<1				<1													<1	<1		4.2	<1	2.3	<1	<1	<1	<1
Aromatics >EC12-EC16	mg/kg		<1	<1		<1				<1													<1	<1		11	<1	16	12	3.9	3.1	<1
Aromatics >EC16-EC21	mg/kg		<1	<1		1.6				11													16	3.3		58	<1	33	19	8.1	4.3	2.1
Aromatics >EC21-EC35	mg/kg		18	<1		<1				30													40	4.5		120	<1	65	27	13	7.5	<1
Total Aromatics C6-C35	mg/kg																															
Aromatics >C35-44	mg/kg		3.4	<1		<1				<1													<1	<1		6	<1	1.7	<1	<1	<1	<1
Total Aliphatic hydrocarbons	mg/kg		92	<5		<5				<5													<5	<5		200	<5	<5	<5	<5	<5	<5
Total Aromatic hydrocarbons	mg/kg		21	<5		<5				41													56	8.2		200	<5	120	58	25	15	<5
TPH (Aliphatics and Aromatics C5-C35)	mg/kg																															
Total petroleum hydrocarbons	mg/kg		110	<10		<10				41													56	<10		400	<10	120	58	25	15	<10
PAH																																
Acenaphthene	mg/kg		<0.1	<0.1	<0.1	0.13	<0.1	0.68	<0.1	0.31	0.31	0.2	3.9	2.2	<0.1	<0.1	0.14	0.12	<0.1	2	<0.1	0.31	0.29	<0.1	<0.1	2.2	<0.1	14	1.8	0.6	0.11	<0.1
Acenaphthylene	mg/kg		<0.1	<0.1	<0.1	0.16	<0.1	0.24	<0.1	0.42	0.26	0.68	0.31	0.17	<0.1	0.11	0.12	0.1	<0.1	0.37	<0.1	<0.1	0.28	<0.1	<0.1	3.3	<0.1	1.6	0.24	0.44	0.22	<0.1
Anthracene	mg/kg		<0.1	0.19	0.1	0.22	<0.1	0.67	<0.1	1.1	0.77	1.2	2.9	3.8	<0.1	0.19	0.26	0.24	<0.1	4	0.11	<0.1	0.19	<0.1	<0.1	11	<0.1	24	3.2	1.6	0.78	<0.1
Benz(a)anthracene	mg/kg		<0.1	0.76	0.56	0.57	<0.1	3.6	<0.1	2.6	2	2.5	8.7	5.1	<0.1	0.55	0.59	0.58	0.22	15	<0.1	<0.1	2.1	<0.1	<0.1	49	<0.1	33	5.1	7.4	2.3	<0.1
Benzo(a)pyrene	mg/kg		<0.1	0.79	0.28	0.66	<0.1	3.5	<0.1	2	1.9	2	8.9	4.2	<0.1	0.61	0.65	0.58	0.38	14	<0.1	<0.1	2	<0.1	<0.1	46	<0.1	23	4.2	5.9	1.9	<0.1
Benzo(b)fluoranthene	mg/kg		<0.1	1.7	1.4	0.86	<0.1	5.4	<0.1	3.7	2.5	2.6	14	5.9	<0.1	0.99	0.76	0.67	0.3	19	<0.1	<0.1	3.3	<0.1	<0.1	66	<0.1	34	6.2	8.5	2.9	<0.1
Benzo(ghi)perylene	mg/kg		<0.1	<0.1	0.16	0.75	<0.1	2.1	<0.1	0.51	0.62	<0.1	5	1.9	<0.1	0.63	0.91	0.83	0.33	8.5	<0.1	<0.1	1.2	<0.1	<0.1	28	<0.1	9.6	1.8	3.7	1.4	<0.1
Benzo(k)fluoranthene	mg/kg		<0.1	0.54	0.31	0.2	<0.1	1.9	<0.1	1.4	0.74	0.8	4.6	2.2	<0.1	0.33	0.13	<0.1	<0.1	7.4	<0.1	<0.1	1.3	<0.1	<0.1	25	<0.1	13	2.1	3.5	1.1	<0.1
Chrysene	mg/kg		<0.1	0.32	0.36	0.9	<0.1	3.9	<0.1	3.6	3.3	3.1	12	5.9	<0.1	0.92	0.86	0.89	0.37	16	<0.1	<0.1	3.2	<0.1	<0.1	60	<0.1	40	6	9.2	2.8	<0.1
Dibenzo(ah)anthracene	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1	0.52	<0.1	0.13	<0.1	<0.1	2.7	0.67	<0.1	<0.1	<0.1	0.1	<0.1	2	<0.1	<0.1	0.47	<0.1	<0.1	9.8	<0.1	4.7	0.61	0.76	0.19	<0.1
Fluoranthene	mg/kg		<0.1	2.5	2.5	1.6	<0.1	6.6	0.1	4.6	3.5	3.7	17	14	<0.1	1.3	1	0.93	0.48	28	0.3	0.18	3.9	0.65	0.46	85	<0.1	81	13	11	4.4	0.15
Fluorene	mg/kg		<0.1	<0.1	<0.1	0.26	<0.1	0.64	<0.1	0.74	0.45	0.65	3.1	2.3	<0.1	0.16	0.13	0.13	<0.1	2	0.13	<0.1	0.35	<0.1	<0.1	2.4	<0.1	29	3	1.3	0.26	<0.1
Indeno(123cd)pyrene	mg/kg		<0.1	<0.1	0.57	0.52	<0.1	1.9	<0.1	1.4	1.4	<0.1	6	2	<0.1	0.34	0.34	0.25	0.29	9.8	<0.1	<0.1	1.4	<0.1	<0.1	30	<0.1	13	1.6	3.6	1.2	<0.1
Naphthalene	mg/kg		<0.1	<0.1	<0.1	0.55	<0.1	1.9	<0.1	1.3	0.87	1.7	1.2	0.58	<0.1	0.27	<0.1	0.18	<0.1	4.4	0.47	0.42	2.4	<0.1	<0.1	2.2	<0.1	10	1.7	2.2	0.27	<0.1
Phenanthrene	mg/kg		<0.1	1.7	1.2	1.3	<0.1	4	0.11	4.7	2.4	2.7	13	11	<0.1	0.62	0.9	0.72	<0.1	17	0.41	0.46	2.5	1.2	1.1	34	<0.1	110	14	5.9	2	<0.1
Pyrene	mg/kg		<0.1	2.4	2.6	1.3	<0.1	5.9	0.17	4.5	3.8	4.9	14	11	<0.1	1.3	0.97	0.89	0.48	26	0.19	0.2	3.7	0.58	0.49	78	<0.1	59	9.4	10	4.2	0.15
PAH 16 Total	mg/kg		<2	11	10	10	<2	44	<2	33	25	27	120	73	<2	8.3	7.8	7.2	2.9	180	<2	<2	29	2.4	2.1	530	<2	500	74	76	26	<2
Pesticides																																
Aldrin	ug/kg																															
Alpha-BHC (Lindane)	ug/kg																															
Beta-BHC (Lindane)	ug/kg																															
Chlorothalonil	ug/kg																															
cis-Chlordane	ug/kg																															
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Pendimethalin	ug/kg																															
Permethrin I	ug/kg																															
Permethrin II	ug/kg																															
Quintozene (PCNB)	ug/kg																															

NFD No Fibres Detected (Asbestos screening)
Screening values are based on CLEA SGV soil guidance values and Land Quality Management Generic Assessment Criteria
* Arup CLEA GAC values where no published values are available
Where various values for SOM are presented the more conservative 1% SOM has been used

Sample Reference	Units	TP406	TP407	TP407	TP407	TP409	TP409	TP409	No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	UCL to be Derived?	95 UCL Value	No. of Outliers	Selected S4ULs Criteria	Comment	No. Data Exceeding S4ULs Criteria
Specimen Depth		2.8 - 3	0.2 - 0.5	0.6 - 0.8	1.2 - 1.4	0 - 0.3	0.5 - 0.6	1 - 1.1											
Level		7.3	9.25	8.85	8.25	8.05	7.55	7.05											
Sample Type		ES	ES	ES	ES	ES	ES	ES											
Geology Code		MG	MG	MG	MG	MG	MG	MG											
Cluster Code		2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI											
TPH >C6-C8.	mg/kg			<1		<1	<1	<1	21	0	None > LOD	None > LOD		Yes			7800		0
TPH >C8-C10.	mg/kg			<1		<1	<1	<1	21	0	None > LOD	None > LOD		Yes			2000		0
TPH >C10-C12.	mg/kg			<1		<1	<1	<1	21	3	9.3	1.7	BH414 @ 0.4 - 0.8mbGL	Yes			9200		0
TPH >C12-C16.	mg/kg			<1		<1	3.3	2.5	21	7	21	2.5	BH414 @ 0.4 - 0.8mbGL	Yes			10000		0
TPH >C16-C21.	mg/kg			<1		3.5	14	8.5	21	12	120	2.1	BH419 @ 0.3 - 0.8mbGL	Yes			7600		0
TPH >C21-C35.	mg/kg			<1		11	52	25	21	11	320	1.8	BH419 @ 0.3 - 0.8mbGL	Yes			7800		0
Aliphatics C5-C6	mg/kg	<0.1							32	0	None > LOD	None > LOD		Yes			3200		0
Aliphatics >C6-C8	mg/kg	<0.1							32	3	0.014	0.012	STPF05 @ 1mbGL	Yes			7800		0
Aliphatics >C8-C10	mg/kg	<0.1							32	1	0.048	0.048	STPF04 @ 3mbGL	Yes			2000		0
Aliphatics >C10-C12	mg/kg	<1							32	1	0.19	0.19	STPF04 @ 3mbGL	Yes			9700		0
Aliphatics >C12-C16	mg/kg	<1							32	15	15	1.7	STPF08 @ 0.2mbGL	Yes			25000		0
Aliphatics >C16-C21	mg/kg	<1							32	16	46	3.2	BH422 @ 0 - 0.5mbGL	Yes			450000		0
Aliphatics >C21-C35	mg/kg	<1							32	19	500	0.58	STPF08 @ 0.2mbGL	Yes			450000		0
Total Aliphatics C5-C35	mg/kg								18	17	550	0.58	STPF08 @ 0.2mbGL	Yes			2000		0
Aliphatics >C35-44	mg/kg	<1							14	2	12	2.9	BH412 @ 0 - 0.5mbGL	Yes			450000		0
Aromatics >C5-7	mg/kg	<0.1							14	0	None > LOD	None > LOD		Yes			26000		0
Aromatics C6-C7	mg/kg								18	1	0.018	0.018	STPF05 @ 1mbGL	Yes			7800		0
Aromatics >C7-C8	mg/kg	<0.1							32	0	None > LOD	None > LOD		Yes			56000		0
Aromatics >EC8-EC10	mg/kg	<0.1							32	3	0.11	0.011	STPF04 @ 3mbGL	Yes			3500		0
Aromatics >EC10-EC12	mg/kg	<1							32	3	4.2	0.29	BH422 @ 0 - 0.5mbGL	Yes			9200		0
Aromatics >EC12-EC16	mg/kg	<1							32	19	31	0.19	STPF04 @ 3mbGL	Yes			10000		0
Aromatics >EC16-EC21	mg/kg	<1							32	25	58	0.23	BH422 @ 0 - 0.5mbGL	Yes			7600		0
Aromatics >EC21-EC35	mg/kg	<1							32	25	370	3.3	STPF01 @ 1mbGL	Yes			7800		0
Total Aromatics C6-C35	mg/kg								33	16	410	3.5	STPF01 @ 1mbGL	Yes			3500		0
Aromatics >C35-44	mg/kg	<1							14	3	6	1.7	BH422 @ 0 - 0.5mbGL	Yes			7800		0
Total Aliphatic hydrocarbons	mg/kg	<5							14	2	200	92	BH422 @ 0 - 0.5mbGL	Yes					
Total Aromatic hydrocarbons	mg/kg	<5							14	9	200	8.2	BH422 @ 0 - 0.5mbGL	Yes			3500		0
TPH (Aliphatics and Aromatics C5-C35)	mg/kg								33	23	890	1.3	STPF08 @ 0.2mbGL	Yes			2000		0
Total petroleum hydrocarbons	mg/kg	<10							14	8	400	15	BH422 @ 0 - 0.5mbGL	Yes			2000		0
PAH																			
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	0.12	<0.1	0.11	<0.1	64	37	14	0.015	TP405 @ 1.4 - 1.5mbGL	Yes			29000		0
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	0.12	0.18	<0.1	<0.1	64	36	3.3	0.007	BH422 @ 0 - 0.5mbGL	Yes			29000		0
Anthracene	mg/kg	<0.1	0.39	0.42	<0.1	0.15	0.2	0.31	64	46	24	0.012	TP405 @ 1.4 - 1.5mbGL	Yes			150000		0
Benz(a)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	0.7	0.8	0.46	64	47	49	0.025	BH422 @ 0 - 0.5mbGL	Yes			49		0
Benzo(a)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	1.4	0.93	0.51	64	47	46	0.013	BH422 @ 0 - 0.5mbGL	Yes			11		5
Benzo(b)fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1	1.9	1.4	1.1	64	47	66	0.023	BH422 @ 0 - 0.5mbGL	Yes			13		5
Benzo(ghi)perylene	mg/kg	<0.1	<0.1	<0.1	<0.1	0.91	0.72	0.58	64	45	28	0.013	BH422 @ 0 - 0.5mbGL	Yes			1400		0
Benzo(k)fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1	0.42	0.33	0.33	64	42	25	0.049	BH422 @ 0 - 0.5mbGL	Yes			370		0
Chrysene	mg/kg	<0.1	<0.1	<0.1	<0.1	0.65	0.65	0.54	64	47	60	0.022	BH422 @ 0 - 0.5mbGL	Yes			93		0
Dibenzo(ah)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	0.19	<0.1	64	32	9.8	0.008	BH422 @ 0 - 0.5mbGL	Yes			1.1		7
Fluoranthene	mg/kg	<0.1	0.27	0.44	0.14	1.4	1.6	1.2	64	55	85	0.079	BH422 @ 0 - 0.5mbGL	Yes			6300		0
Fluorene	mg/kg	<0.1	<0.1	<0.1	0.18	0.21	0.18	<0.1	64	38	29	0.024	TP405 @ 1.4 - 1.5mbGL	Yes			20000		0
Indeno(123cd)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	1	0.65	0.45	64	43	30	0.042	BH422 @ 0 - 0.5mbGL	Yes			150		0
Naphthalene	mg/kg	<0.1	<0.1	<0.1	0.66	0.55	0.64	<0.1	64	45	10	0.017	TP405 @ 1.4 - 1.5mbGL	Yes			190		0
Phenanthrene	mg/kg	<0.1	1.9	1	0.64	0.64	1.1	0.79	64	54	110	0.042	TP405 @ 1.4 - 1.5mbGL	Yes			6200		0
Pyrene	mg/kg	<0.1	0.28	0.4	0.24	1.5	1.7	1.2	64	55	78	0.064	BH422 @ 0 - 0.5mbGL	Yes			15000		0
PAH 16 Total	mg/kg	<2	2.8	2.3	2.1	12	11	7.5	70	60	530	0.16	BH422 @ 0 - 0.5mbGL	Yes					
Pesticides																			
Aldrin	ug/kg								3	0	None > LOD	None > LOD		IS			30000		0
Alpha-BHC (Lindane)	ug/kg								3	0	None > LOD	None > LOD		IS					
Beta-BHC (Lindane)	ug/kg								3	0	None > LOD	None > LOD		IS					
Chlorothalonil	ug/kg								3	0	None > LOD	None > LOD		IS					
cis-Chlordane	ug/kg								3	0	None > LOD	None > LOD		IS					
Dieldrin	ug/kg								3	0	None > LOD	None > LOD		IS			30000		0
Endosulphan I	ug/kg								3	0	None > LOD	None > LOD		IS					
Endosulphan II	ug/kg								3	0	None > LOD	None > LOD		IS					
Endosulphan sulphate	ug/kg								3	0	None > LOD	None > LOD		IS					
Endrin	ug/kg								3	0	None > LOD	None > LOD		IS					
Gamma-BHC (Lindane)	ug/kg								3	0	None > LOD	None > LOD		IS					
Heptachlor	ug/kg								3	0	None > LOD	None > LOD		IS					
Heptachlor Epoxide	ug/kg								3	0	None > LOD	None > LOD		IS					
Hexachlorobenzene	ug/kg								3	0	None > LOD	None > LOD		IS			30000		0
Isodrin	ug/kg								3	0	None > LOD	None > LOD		IS					
o,p'-DDE	ug/kg								3	0	None > LOD	None > LOD		IS					
o,p'-DDT	ug/kg								3	0	None > LOD	None > LOD		IS					
o,p'-Methoxychlor	ug/kg								3	0	None > LOD	None > LOD		IS					
o,p'-TDE(DDD)	ug/kg								3	0	None > LOD	None > LOD		IS					
p,p'-DDE	ug/kg								3	0	None > LOD	None > LOD		IS					
p,p'-DDT	ug/kg								3	0	None > LOD	None > LOD		IS					
p,p'-Methoxychlor	ug/kg								3	0	None > LOD	None > LOD		IS					
p,p'-TDE(DDD)	ug/kg								3	0	None > LOD	None > LOD		IS					
Pendimethalin	ug/kg								3	0	None > LOD	None > LOD		IS					
Permethrin I	ug/kg								3	0	None > LOD	None > LOD		IS					
Permethrin II	ug/kg								3	0	None > LOD	None > LOD		IS					
Quintozene (PCNB)	ug/kg								3	0	None > LOD	None > LOD		IS					

Sample Reference	Units	BHF3	BHF4	BHF5	BHF6	CH10	CH10	CH11	CH11	CH12	CH12	CH13	CH13	CH14	CH15	CH15A	CH16	CH16	CH17	CH17	CH17	CH18	CH18	CH19	CH19A	CH19A	CH20	CH21
Specimen Depth		0.5	1.75	0.2	0.5	0.4	1.4	0.35	1.65	0.17	0.67	0	0.77	0.16	0.3	0.17	0.2	1.9	0.6	1.3	1.9	0.2	1.6	0.2	0.3	1	0	0
Level		9.7	7.55	9.6	8.3	9.89	8.89	9.75	8.45	9.49	8.99	9.74	8.97	8.94	8.91	9.07	8.49	6.79	8.19	7.49	6.89	9.82	8.42	10.12	10.02	9.32	8.85	8.47
Sample Type		D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
Cluster Code		1997 GI	1997 GI	1997 GI	1997 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI
Tecnazene	ug/kg																											
Telodrin	ug/kg																											
trans-Chlordane	ug/kg																											
Triadimefon	ug/kg																											
Triallate	ug/kg																											
Trifluralin	ug/kg																											
SVOCs																												
Phenols																												
2-Chlorophenol	mg/kg																											
2-Methylphenol	mg/kg																											
2-Nitrophenol	mg/kg																											
2-Methyl-4,6 Dinitrophenol	mg/kg																											
2,4-Dichlorophenol	mg/kg																											
2,4-Dimethylphenol	mg/kg																											
2,4,5-Trichlorophenol	mg/kg																											
2,4,6-Trichlorophenol	mg/kg																											
4-Chloro-3-methylphenol	mg/kg																											
4-Methylphenol	mg/kg																											
4-Nitrophenol	mg/kg																											
Pentachlorophenol	mg/kg																											
Phenol	mg/kg																											
PAHs																												
2-Chloronaphthalene	mg/kg																											
2-Methylnaphthalene	mg/kg																											
Acenaphthene	mg/kg																											
Acenaphthylene	mg/kg																											
Anthracene	mg/kg																											
Benzo(a)anthracene	mg/kg																											
Benzo(a)pyrene	mg/kg																											
Benzo(b)fluoranthene	mg/kg																											
Benzo(ghi)perylene	mg/kg																											
Benzo(k)fluoranthene	mg/kg																											
Chrysene	mg/kg																											
Dibenzo(a,h)anthracene	mg/kg																											
Fluoranthene	mg/kg																											
Fluorene	mg/kg																											
Indeno(1,2,3-cd)pyrene	mg/kg																											
Naphthalene	mg/kg																											
Phenanthrene	mg/kg																											
Pyrene	mg/kg																											
Pthalates																												
Bis(2-ethylhexyl)phthalate	mg/kg																											
Butylbenzyl phthalate	mg/kg																											
Di-n-butyl phthalate	mg/kg																											
Di-n-Octyl phthalate	mg/kg																											
Diethyl phthalate	mg/kg																											
Dimethyl phthalate	mg/kg																											
Other Semi-Volatiles																												
1,2-Dichlorobenzene	mg/kg																											
1,2,4-Trichlorobenzene	mg/kg																											
1,3-Dichlorobenzene	mg/kg																											
1,4-Dichlorobenzene	mg/kg																											
2-Nitroaniline	mg/kg																											
2,4-Dinitrotoluene	mg/kg																											
2,6-Dinitrotoluene	mg/kg																											
3-Nitroaniline	mg/kg																											
4-Bromophenylphenylether	mg/kg																											
4-Chloroaniline	mg/kg																											
4-Chlorophenylphenylether	mg/kg																											
4-Nitroaniline	mg/kg																											
Azobenzene	mg/kg																											
Bis(2-chloroethoxy)methane	mg/kg																											
Bis(2-chloroethyl)ether	mg/kg																											
Bis(2-chloroisopropyl)ether	mg/kg																											
Carbazole	mg/kg																											
Dibenzofuran	mg/kg																											
Hexachlorobenzene	mg/kg																											
Hexachlorobutadiene	mg/kg																											
Hexachlorocyclopentadiene	mg/kg																											
Hexachloroethane	mg/kg																											
Isophorone	mg/kg																											
N-nitrosodimethylamine	mg/kg																											
N-nitrosodi-n-propylamine	mg/kg																											
Nitrobenzene	mg/kg																											
VOCs																												

Sample Reference	Units	CH22	CH22	CH23	SBHF03CP	STPF01	STPF02	STPF02	STPF03	STPF03	STPF04	STPF04	STPF05	STPF06	STPF06	STPF07	STPF07	STPF08	STPF09	STPF09	STPF10	STPF10	TP1	TP2
Specimen Depth		0.3	0.75	0.16	1	1	1	2	0.3	1.9	1	3	1	0.38	1.24	0.3	2	0.2	0.3	0.9	0.3	1	0.5	0.5
Level		8.07	7.62	8.31	8.88	8.89	8.7	7.7	8.98	7.38	8.23	6.23	7.67	8.89	8.03	10.43	8.73	8.9	8.56	7.96	8.39	7.69		
Sample Type		D	D	D	ES	ES	D	D	ES	ES	ES	ES	ES	B	D	D	D	B	ES	ES	B	ES	D	D
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
Cluster Code		2000 GI	2000 GI	2000 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	June 2005 GI	June 2005 GI
Tecnazene	ug/kg													<1	<10	<20								
Telodrin	ug/kg													<1	<10	<20								
trans-Chlordane	ug/kg													<1	<10	<20								
Triadimefon	ug/kg													<1	<10	<20								
Triallate	ug/kg													<1	<10	<20								
Trifluralin	ug/kg													<1	<10	<20								
SVOCs																								
Phenols																								
2-Chlorophenol	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
2-Methylphenol	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
2-Nitrophenol	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
2-Methyl-4,6 Dinitrophenol	mg/kg																							
2,4-Dichlorophenol	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
2,4-Dimethylphenol	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
2,4,5-Trichlorophenol	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
2,4,6-Trichlorophenol	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
4-Chloro-3-methylphenol	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
4-Methylphenol	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
4-Nitrophenol	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
Pentachlorophenol	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
Phenol	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
PAHs																								
2-Chloronaphthalene	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
2-Methylnaphthalene	mg/kg				0.21	<0.1	<0.1	0.44	<0.1	<0.1	0.91	4.9	0.29	<0.1	<0.1	<0.1	<0.1	0.2	0.26	<0.1	0.52	<0.1		
Acenaphthene	mg/kg					<0.1	<0.1	1			<0.1	5.6	<0.1	<0.1	<0.1	<0.1	<0.1				0.23	<0.1		
Acenaphthylene	mg/kg					0.19	<0.1	<0.1			<0.1	0.42	<0.1	<0.1	<0.1	<0.1	<0.1				0.24	<0.1		
Anthracene	mg/kg					0.5	0.23	0.37			0.3	2	<0.1	<0.1	<0.1	<0.1	<0.1				0.59	<0.1		
Benzo(a)anthracene	mg/kg					3.7	0.86	0.69			1.1	1.4	0.25	<0.1	0.35	<0.1	<0.1				4.1	<0.1		
Benzo(a)pyrene	mg/kg					3.8	0.94	0.63			1.1	0.87	0.22	<0.1	0.28	<0.1	<0.1				5.7	<0.1		
Benzo(b)fluoranthene	mg/kg					3.5	0.83	0.51			0.99	0.75	0.19	<0.1	0.34	<0.1	<0.1				5.6	<0.1		
Benzo(ghi)perylene	mg/kg					1.8	0.86	0.29			0.87	0.59	0.18	<0.1	0.21	<0.1	<0.1				4.8	<0.1		
Benzo(k)fluoranthene	mg/kg					2.9	0.61	0.49			0.82	0.66	0.16	<0.1	0.24	<0.1	<0.1				4.5	<0.1		
Chrysene	mg/kg					3.4	1	0.7			1.3	1.5	0.3	<0.1	0.39	<0.1	<0.1				7.1	<0.1		
Dibenzo(a,h)anthracene	mg/kg					0.57	0.22	<0.1			0.23	0.16	<0.1	<0.1	<0.1	<0.1	<0.1				1.2	<0.1		
Fluoranthene	mg/kg					4.8	1.4	1.5			2	5.8	0.43	<0.1	0.51	<0.1	<0.1				14	<0.1		
Fluorene	mg/kg					0.14	<0.1	0.67			0.21	3.8	<0.1	<0.1	<0.1	<0.1	<0.1				0.22	<0.1		
Indeno(1,2,3-cd)pyrene	mg/kg					1.8	1.2	0.3			1.3	0.82	0.25	<0.1	0.22	<0.1	<0.1				6.7	<0.1		
Naphthalene	mg/kg					0.23	0.13	0.62			0.59	15	0.23	<0.1	<0.1	<0.1	<0.1				0.57	<0.1		
Phenanthrene	mg/kg					1.6	0.67	2.1			1.7	11	0.38	<0.1	0.31	<0.1	<0.1				7.5	<0.1		
Pyrene	mg/kg					4.4	1.1	1.3			1.5	3.7	0.35	<0.1	0.45	<0.1	<0.1				10	<0.1		
Pthalates																								
Bis(2-ethylhexyl)phthalate	mg/kg				0.46	1.5	1.2	0.79	0.26	<0.1	0.55	<0.2	<0.2	<0.1	<0.1	<0.1	<0.1	1	<0.1	0.16	<0.2	<0.2		
Butylbenzyl phthalate	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
Di-n-butyl phthalate	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
Di-n-Octyl phthalate	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
Diethyl phthalate	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
Dimethyl phthalate	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
Other Semi-Volatiles																								
1,2-Dichlorobenzene	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
1,2,4-Trichlorobenzene	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
1,3-Dichlorobenzene	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
1,4-Dichlorobenzene	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
2-Nitroaniline	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
2,4-Dinitrotoluene	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
2,6-Dinitrotoluene	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
3-Nitroaniline	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
4-Bromophenylphenylether	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
4-Chloroaniline	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
4-Chlorophenylphenylether	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
4-Nitroaniline	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
Azobenzene	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
Bis(2-chloroethoxy)methane	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
Bis(2-chloroethyl)ether	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
Bis(2-chloroisopropyl)ether	mg/kg																							
Carbazole	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.39	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.15	<0.1	0.68	<0.1		
Dibenzofuran	mg/kg				<0.1	0.12	<0.1	0.57	<0.1	<0.1	0.26	2.9	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.35	<0.1		
Hexachlorobenzene	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
Hexachlorobutadiene	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
Hexachlorocyclopentadiene	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
Hexachloroethane	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
Isophorone	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
N-nitrosodimethylamine	mg/kg																							
N-nitrosodi-n-propylamine	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
Nitrobenzene	mg/kg				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
VOCs																								

Sample Reference	Units	TP3	TP4	TP5	TP6	TP01	TP02	TP02	TP03	TP04	TP04	TP05	TP05	TP06	TP1	TP2	TP3	TP4	TP6	TP1	TP2	TP3
Specimen Depth		0.3	0.9	0.5	0.6	0.5	0.5	0.8	0.1	0.5	0.9	0.5	1	0.6	0.8	1.4	1	0.7	0.6	1.5	1	0.7
Level																						
Sample Type		D	D	D	D										D	D	D	D	D	D	D	D
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
Cluster Code		June 2005 GI	June 2005 GI	June 2005 GI	June 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Oct 2001 GI	Oct 2001 GI	Oct 2001 GI	Oct 2001 GI	Oct 2001 GI	April 2002 GI	April 2002 GI	April 2002 GI
Tecnazene	ug/kg																					
Telodrin	ug/kg																					
trans-Chlordane	ug/kg																					
Triadimefon	ug/kg																					
Triallate	ug/kg																					
Trifluralin	ug/kg																					
SVOCs																						
Phenols																						
2-Chlorophenol	mg/kg																					
2-Methylphenol	mg/kg																					
2-Nitrophenol	mg/kg																					
2-Methyl-4,6 Dinitrophenol	mg/kg																					
2,4-Dichlorophenol	mg/kg																					
2,4-Dimethylphenol	mg/kg																					
2,4,5-Trichlorophenol	mg/kg																					
2,4,6-Trichlorophenol	mg/kg																					
4-Chloro-3-methylphenol	mg/kg																					
4-Methylphenol	mg/kg																					
4-Nitrophenol	mg/kg																					
Pentachlorophenol	mg/kg																					
Phenol	mg/kg																					
PAHs																						
2-Chloronaphthalene	mg/kg																					
2-Methylnaphthalene	mg/kg																					
Acenaphthene	mg/kg																					
Acenaphthylene	mg/kg																					
Anthracene	mg/kg																					
Benzo(a)anthracene	mg/kg																					
Benzo(a)pyrene	mg/kg																					
Benzo(b)fluoranthene	mg/kg																					
Benzo(ghi)perylene	mg/kg																					
Benzo(k)fluoranthene	mg/kg																					
Chrysene	mg/kg																					
Dibenzo(a,h)anthracene	mg/kg																					
Fluoranthene	mg/kg																					
Fluorene	mg/kg																					
Indeno(1,2,3-cd)pyrene	mg/kg																					
Naphthalene	mg/kg																					
Phenanthrene	mg/kg																					
Pyrene	mg/kg																					
Pthalates																						
Bis(2-ethylhexyl)phthalate	mg/kg																					
Butylbenzyl phthalate	mg/kg																					
Di-n-butyl phthalate	mg/kg																					
Di-n-Octyl phthalate	mg/kg																					
Diethyl phthalate	mg/kg																					
Dimethyl phthalate	mg/kg																					
Other Semi-Volatiles																						
1,2-Dichlorobenzene	mg/kg																					
1,2,4-Trichlorobenzene	mg/kg																					
1,3-Dichlorobenzene	mg/kg																					
1,4-Dichlorobenzene	mg/kg																					
2-Nitroaniline	mg/kg																					
2,4-Dinitrotoluene	mg/kg																					
2,6-Dinitrotoluene	mg/kg																					
3-Nitroaniline	mg/kg																					
4-Bromophenylphenylether	mg/kg																					
4-Chloroaniline	mg/kg																					
4-Chlorophenylphenylether	mg/kg																					
4-Nitroaniline	mg/kg																					
Azobenzene	mg/kg																					
Bis(2-chloroethoxy)methane	mg/kg																					
Bis(2-chloroethyl)ether	mg/kg																					
Bis(2-chloroisopropyl)ether	mg/kg																					
Carbazole	mg/kg																					
Dibenzofuran	mg/kg																					
Hexachlorobenzene	mg/kg																					
Hexachlorobutadiene	mg/kg																					
Hexachlorocyclopentadiene	mg/kg																					
Hexachloroethane	mg/kg																					
Isophorone	mg/kg																					
N-nitrosodimethylamine	mg/kg																					
N-nitrosodi-n-propylamine	mg/kg																					
Nitrobenzene	mg/kg																					
VOCs																						

Sample Reference	Units	TP5	BH412	BH412	BH412	BH412	BH413	BH413	BH413	BH414	BH414	BH414	BH416	BH416	BH417	BH417	BH418	BH418	BH418	BH419	BH420	BH420	BH421	BH421	BH421	BH422	TP405	TP405	TP405	TP406	TP406	TP406
Specimen Depth		0.4	0 - 0.5	1.2 - 1.7	2.2 - 2.7	2.9 - 3.2	0.2 - 0.4	0.8 - 1.2	3.5 - 4	0.2 - 0.4	0.4 - 0.8	1.3 - 1.5	0.4 -0.6	1.5 - 1.6	0.5 - 0.6	1.5 - 1.6	0.5 - 1	1 - 1.5	3 - 3.5	0.3 - 0.8	0.5 - 1.2	1.7 - 2.2	0 - 0.5	0.5 - 1.2	1.2 - 1.7	0 - 0.5	0 - 0.2	1.4 - 1.5	2.4 - 2.5	0 - 0.2	1 - 1.2	1.6 - 1.8
Level			10.5	9.3	8.3	7.6	9.7	9.1	6.4	10	9.8	8.9	9.65	8.55	8.6	7.6	10.9	10.4	8.4	8.5	10.05	8.85	9.3	8.8	8.1	7.95	10.2	8.8	7.8	10.1	9.1	8.5
Sample Type		D	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
Cluster Code		April 2002 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI
Tecnazene	ug/kg																															
Telodrin	ug/kg																															
trans-Chlordane	ug/kg																															
Triadimefon	ug/kg																															
Triallate	ug/kg																															
Trifluralin	ug/kg																															
SVOCs																																
Phenols																																
2-Chlorophenol	mg/kg																												<0.5			
2-Methylphenol	mg/kg																												<0.5			
2-Nitrophenol	mg/kg																												<0.5			
2-Methyl-4,6 Dinitrophenol	mg/kg																												<0.5			
2,4-Dichlorophenol	mg/kg																												<0.5			
2,4-Dimethylphenol	mg/kg																												<0.5			
2,4,5-Trichlorophenol	mg/kg																												<0.5			
2,4,6-Trichlorophenol	mg/kg																												<0.5			
4-Chloro-3-methylphenol	mg/kg																												<0.5			
4-Methylphenol	mg/kg																												<0.5			
4-Nitrophenol	mg/kg																												<0.5			
Pentachlorophenol	mg/kg																												<0.5			
Phenol	mg/kg																												<0.5			
PAHs																																
2-Chloronaphthalene	mg/kg																												<0.5			
2-Methylnaphthalene	mg/kg																												<0.5			
Acenaphthene	mg/kg																															
Acenaphthylene	mg/kg																															
Anthracene	mg/kg																															
Benzo(a)anthracene	mg/kg																															
Benzo(a)pyrene	mg/kg																															
Benzo(b)fluoranthene	mg/kg																															
Benzo(ghi)perylene	mg/kg																															
Benzo(k)fluoranthene	mg/kg																															
Chrysene	mg/kg																															
Dibenzo(a,h)anthracene	mg/kg																															
Fluoranthene	mg/kg																															
Fluorene	mg/kg																															
Indeno(1,2,3-cd)pyrene	mg/kg																															
Naphthalene	mg/kg																															
Phenanthrene	mg/kg																															
Pyrene	mg/kg																															
Pthalates																																
Bis(2-ethylhexyl)phthalate	mg/kg																												<0.5			
Butylbenzyl phthalate	mg/kg																												<0.5			
Di-n-butyl phthalate	mg/kg																												<0.5			
Di-n-Octyl phthalate	mg/kg																												<0.5			
Diethyl phthalate	mg/kg																												<0.5			
Dimethyl phthalate	mg/kg																												<0.5			
Other Semi-Volatiles																																
1,2-Dichlorobenzene	mg/kg																															
1,2,4-Trichlorobenzene	mg/kg																															
1,3-Dichlorobenzene	mg/kg																															
1,4-Dichlorobenzene	mg/kg																															
2-Nitroaniline	mg/kg																												<0.5			
2,4-Dinitrotoluene	mg/kg																												<0.5			
2,6-Dinitrotoluene	mg/kg																												<0.5			
3-Nitroaniline	mg/kg																												<0.5			
4-Bromophenylphenylether	mg/kg																												<0.5			
4-Chloroaniline	mg/kg																												<0.5			
4-Chlorophenylphenylether	mg/kg																												<0.5			
4-Nitroaniline	mg/kg																												<0.5			
Azobenzene	mg/kg																												<0.5			
Bis(2-chloroethoxy)methane	mg/kg																												<0.5			
Bis(2-chloroethyl)ether	mg/kg																												<0.5			
Bis(2-chloroisopropyl)ether	mg/kg																												<0.5			
Carbazole	mg/kg																												<0.5			
Dibenzofuran	mg/kg																												<0.5			
Hexachlorobenzene	mg/kg																												<0.5			
Hexachlorobutadiene	mg/kg																												<0.001			
Hexachlorocyclopentadiene	mg/kg																												<0.5			
Hexachloroethane	mg/kg																												<0.5			
Isophorone	mg/kg																												<0.5			
N-nitrosodimethylamine	mg/kg																												<0.5			
N-nitrosodi-n-propylamine	mg/kg																												<0.5			
Nitrobenzene	mg/kg																												<0.5			
VOCs																																

NFD No Fibres Detected (Asbestos screening)
Screening values are based on CLEA SGV soil guidance values and Land Quality Management Generic Assessment Criteria
* Arup CLEA GAC values where no published values are available
Where various values for SOM are presented the more conservative 1% SOM has been used

Sample Reference	Units	TP406	TP407	TP407	TP407	TP409	TP409	TP409	No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	UCL to be Derived?	95 UCL Value	No. of Outliers	Selected S4ULs Criteria	Comment	No. Data Exceeding S4ULs Criteria
Specimen Depth		2.8 - 3	0.2 - 0.5	0.6 - 0.8	1.2 - 1.4	0 - 0.3	0.5 - 0.6	1 - 1.1											
Level		7.3	9.25	8.85	8.25	8.05	7.55	7.05											
Sample Type		ES	ES	ES	ES	ES	ES	ES											
Geology Code		MG	MG	MG	MG	MG	MG	MG											
Cluster Code		2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI											
Tecnazene	ug/kg								3	0	None > LOD	None > LOD		IS					
Telodrin	ug/kg								3	0	None > LOD	None > LOD		IS					
trans-Chlordane	ug/kg								3	0	None > LOD	None > LOD		IS					
Triadimefon	ug/kg								3	0	None > LOD	None > LOD		IS					
Triallate	ug/kg								3	0	None > LOD	None > LOD		IS					
Trifluralin	ug/kg								3	0	None > LOD	None > LOD		IS					
SVOCs																			
Phenols																			
2-Chlorophenol	mg/kg								19	0	None > LOD	None > LOD		Yes					
2-Methylphenol	mg/kg								19	0	None > LOD	None > LOD		Yes					
2-Nitrophenol	mg/kg								19	0	None > LOD	None > LOD		Yes					
2-Methyl-4,6 Dinitrophenol	mg/kg								19	0	None > LOD	None > LOD		Yes					
2,4-Dichlorophenol	mg/kg								19	0	None > LOD	None > LOD		Yes					
2,4-Dimethylphenol	mg/kg								19	0	None > LOD	None > LOD		Yes					
2,4,5-Trichlorophenol	mg/kg								19	0	None > LOD	None > LOD		Yes					
2,4,6-Trichlorophenol	mg/kg								19	0	None > LOD	None > LOD		Yes					
4-Chloro-3-methylphenol	mg/kg								19	0	None > LOD	None > LOD		Yes					
4-Methylphenol	mg/kg								19	0	None > LOD	None > LOD		Yes					
4-Nitrophenol	mg/kg								19	0	None > LOD	None > LOD		Yes					
Pentachlorophenol	mg/kg								19	0	None > LOD	None > LOD		Yes					
Phenol	mg/kg								19	0	None > LOD	None > LOD		Yes			440		0
PAHs																			
2-Chloronaphthalene	mg/kg								19	0	None > LOD	None > LOD		Yes					
2-Methylnaphthalene	mg/kg								19	8	4.9	0.2	STPF04 @ 3mbGL	Yes					
Acenaphthene	mg/kg								12	3	5.6	0.23	STPF04 @ 3mbGL	Yes			29000		0
Acenaphthylene	mg/kg								12	3	0.42	0.19	STPF04 @ 3mbGL	Yes			29000		0
Anthracene	mg/kg								12	6	2	0.23	STPF04 @ 3mbGL	Yes			150000		0
Benzo(a)anthracene	mg/kg								12	8	4.1	0.25	STPF10 @ 0.3mbGL	Yes					
Benzo(a)pyrene	mg/kg								12	8	5.7	0.22	STPF10 @ 0.3mbGL	Yes			11		0
Benzo(b)fluoranthene	mg/kg								12	8	5.6	0.19	STPF10 @ 0.3mbGL	Yes			13		0
Benzo(ghi)perylene	mg/kg								12	8	4.8	0.18	STPF10 @ 0.3mbGL	Yes			1400		0
Benzo(k)fluoranthene	mg/kg								12	8	4.5	0.16	STPF10 @ 0.3mbGL	Yes			370		0
Chrysene	mg/kg								12	8	7.1	0.3	STPF10 @ 0.3mbGL	Yes			93		0
Dibenzo(a,h)anthracene	mg/kg								12	5	1.2	0.16	STPF10 @ 0.3mbGL	Yes					
Fluoranthene	mg/kg								12	8	14	0.43	STPF10 @ 0.3mbGL	Yes			6300		0
Fluorene	mg/kg								12	5	3.8	0.14	STPF04 @ 3mbGL	Yes			20000		0
Indeno(1,2,3-cd)pyrene	mg/kg								12	8	6.7	0.22	STPF10 @ 0.3mbGL	Yes					
Naphthalene	mg/kg								12	7	15	0.13	STPF04 @ 3mbGL	Yes			190		0
Phenanthrene	mg/kg								12	8	11	0.31	STPF04 @ 3mbGL	Yes			6200		0
Pyrene	mg/kg								12	8	10	0.35	STPF10 @ 0.3mbGL	Yes			15000		0
Pthalates																			
Bis(2-ethylhexyl)phthalate	mg/kg								19	8	1.5	0.16	STPF01 @ 1mbGL	Yes					
Butylbenzyl phthalate	mg/kg								19	0	None > LOD	None > LOD		Yes					
Di-n-butyl phthalate	mg/kg								19	0	None > LOD	None > LOD		Yes					
Di-n-Octyl phthalate	mg/kg								19	0	None > LOD	None > LOD		Yes					
Diethyl phthalate	mg/kg								19	0	None > LOD	None > LOD		Yes					
Dimethyl phthalate	mg/kg								19	0	None > LOD	None > LOD		Yes					
Other Semi-Volatiles																			
1,2-Dichlorobenzene	mg/kg								18	0	None > LOD	None > LOD		Yes					
1,2,4-Trichlorobenzene	mg/kg								18	0	None > LOD	None > LOD		Yes			220		0
1,3-Dichlorobenzene	mg/kg								18	0	None > LOD	None > LOD		Yes					
1,4-Dichlorobenzene	mg/kg								18	0	None > LOD	None > LOD		Yes					
2-Nitroaniline	mg/kg								19	0	None > LOD	None > LOD		Yes					
2,4-Dinitrotoluene	mg/kg								19	0	None > LOD	None > LOD		Yes					
2,6-Dinitrotoluene	mg/kg								19	0	None > LOD	None > LOD		Yes					
3-Nitroaniline	mg/kg								19	0	None > LOD	None > LOD		Yes					
4-Bromophenylphenylether	mg/kg								19	0	None > LOD	None > LOD		Yes					
4-Chloroaniline	mg/kg								19	0	None > LOD	None > LOD		Yes					
4-Chlorophenylphenylether	mg/kg								19	0	None > LOD	None > LOD		Yes					
4-Nitroaniline	mg/kg								19	0	None > LOD	None > LOD		Yes					
Azobenzene	mg/kg								19	0	None > LOD	None > LOD		Yes					
Bis(2-chloroethoxy)methane	mg/kg								19	0	None > LOD	None > LOD		Yes					
Bis(2-chloroethyl)ether	mg/kg								19	0	None > LOD	None > LOD		Yes					
Bis(2-chloroisopropyl)ether	mg/kg								19	0	None > LOD	None > LOD		Yes					
Carbazole	mg/kg								19	4	0.68	0.15	STPF10 @ 0.3mbGL	Yes					
Dibenzofuran	mg/kg								19	5	2.9	0.12	STPF04 @ 3mbGL	Yes					
Hexachlorobenzene	mg/kg								19	0	None > LOD	None > LOD		Yes			30		0
Hexachlorobutadiene	mg/kg								19	0	None > LOD	None > LOD		Yes			31		0
Hexachlorocyclopentadiene	mg/kg								19	0	None > LOD	None > LOD		Yes					
Hexachloroethane	mg/kg								19	0	None > LOD	None > LOD		Yes					
Isophorone	mg/kg								19	0	None > LOD	None > LOD		Yes					
N-nitrosodimethylamine	mg/kg								19	0	None > LOD	None > LOD		Yes					
N-nitrosodi-n-propylamine	mg/kg								19	0	None > LOD	None > LOD		Yes					
Nitrobenzene	mg/kg								19	0	None > LOD	None > LOD		Yes					
VOCs																			

Sample Reference	Units	BHF3	BHF4	BHF5	BHF6	CH10	CH10	CH11	CH11	CH12	CH12	CH13	CH13	CH14	CH15	CH15A	CH16	CH16	CH17	CH17	CH17	CH18	CH18	CH19	CH19A	CH19A	CH20	CH21
Specimen Depth		0.5	1.75	0.2	0.5	0.4	1.4	0.35	1.65	0.17	0.67	0	0.77	0.16	0.3	0.17	0.2	1.9	0.6	1.3	1.9	0.2	1.6	0.2	0.3	1	0	0
Level		9.7	7.55	9.6	8.3	9.89	8.89	9.75	8.45	9.49	8.99	9.74	8.97	8.94	8.91	9.07	8.49	6.79	8.19	7.49	6.89	9.82	8.42	10.12	10.02	9.32	8.85	8.47
Sample Type		D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
Cluster Code		1997 GI	1997 GI	1997 GI	1997 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI
Methyl Tertiary Butyl Ether	ug/kg																											
Benzene	ug/kg								<5																			
Toluene	ug/kg								120																			
Ethylbenzene	ug/kg								9																			
p/m-Xylene	ug/kg								37																			
o-Xylene	ug/kg								15																			
Naphthalene	ug/kg								51																			
Hexachlorobutadiene	ug/kg								<25																			
1.2.4-Trichlorobenzene	ug/kg								<25																			
1.2-Dichlorobenzene	ug/kg								23																			
1.3-Dichlorobenzene	ug/kg								<5																			
1.4-Dichlorobenzene	ug/kg								<5																			
1.1.1.2-Tetrachloroethane	ug/kg								<5																			
1.1.1-Trichloroethane	ug/kg								<5																			
1.1.2.2-Tetrachloroethane	ug/kg								<5																			
1.1.2-Trichloroethane	ug/kg								<5																			
1.1-Dichloropropene	ug/kg								<5																			
1.1-Dichloroethane	ug/kg								<5																			
1.1-Dichloroethene	ug/kg								<5																			
1.2.3-Trichlorobenzene	ug/kg								<25																			
1.2.3-Trichloropropane	ug/kg																											
1.2.4-Trimethylbenzene	ug/kg								81																			
1.2-Dibromo-3-chloropropane	ug/kg								<25																			
1.2-Dichloroethane	ug/kg								<5																			
cis-1-2-Dichloroethene	ug/kg								<5																			
1.2-Dibromoethane	ug/kg								<5																			
1.2-Dichloropropane	ug/kg								<5																			
1.3.5-Trimethylbenzene	ug/kg								26																			
cis-1-3-Dichloropropene	ug/kg								<5																			
1.3-Dichloropropane	ug/kg								<5																			
2.2-Dichloropropane	ug/kg								<5																			
2-Chlorotoluene	ug/kg								<5																			
4-Chlorotoluene	ug/kg								<5																			
4-Isopropyltoluene	ug/kg																											
Bromobenzene	ug/kg								<5																			
Bromochloromethane	ug/kg								<5																			
Bromoform	ug/kg								<5																			
Bromomethane	ug/kg								<5																			
Bromodichloromethane	ug/kg								<5																			
Chlorobenzene	ug/kg								<5																			
Carbon Disulphide	ug/kg																											
Chloroethane	ug/kg								<5																			
Chloroform	ug/kg								<5																			
Chloromethane	ug/kg								<5000																			
Carbontetrachloride	ug/kg								<5																			
Carbontetrachloride	ug/kg								<5																			
Dibromomethane	ug/kg																											
Dichlorodifluoromethane	ug/kg								<5000																			
Dibromochloromethane	ug/kg								<5																			
Dibromomethane	ug/kg								<5																			
Dichloromethane	ug/kg																											
Isopropylbenzene	ug/kg								<5																			
n-Butylbenzene	ug/kg								12																			
Propylbenzene	ug/kg								<5																			
p-Isopropyltoluene	ug/kg								12																			
sec-Butylbenzene	ug/kg								7																			
Styrene	ug/kg								<5																			
trans-1-2-Dichloroethene	ug/kg								<5																			
trans-1-3-Dichloropropene	ug/kg								<5																			
Trichlorofluoromethane	ug/kg								<5																			
tert-Butylbenzene	ug/kg								<5																			
Tetrachloroethene	ug/kg								<5																			
Tribromomethane	ug/kg																											
Trichloroethene	ug/kg								<7																			
Vinyl Chloride	ug/kg								<5000																			

Sample Reference	Units	CH22	CH22	CH23	SBHF03CP	STPF01	STPF02	STPF02	STPF03	STPF03	STPF04	STPF04	STPF05	STPF06	STPF06	STPF07	STPF07	STPF08	STPF09	STPF09	STPF10	STPF10	TP1	TP2
Specimen Depth		0.3	0.75	0.16	1	1	1	2	0.3	1.9	1	3	1	0.38	1.24	0.3	2	0.2	0.3	0.9	0.3	1	0.5	0.5
Level		8.07	7.62	8.31	8.88	8.89	8.7	7.7	8.98	7.38	8.23	6.23	7.67	8.89	8.03	10.43	8.73	8.9	8.56	7.96	8.39	7.69		
Sample Type		D	D	D	ES	ES	D	D	ES	ES	ES	ES	ES	B	D	D	D	B	ES	ES	B	ES	D	D
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
Cluster Code		2000 GI	2000 GI	2000 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	June 2005 GI	June 2005 GI
Methyl Tertiary Butyl Ether	ug/kg				<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11		
Benzene	ug/kg				<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9		
Toluene	ug/kg				<5	<5	<5	<5	6	9	20	19	9	<5	<5	<5	<5	9	<5	<5	<5	<5		
Ethylbenzene	ug/kg				<4	<4	<4	<4	<4	<4	<4	30	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4		
p/m-Xylene	ug/kg				<14	<14	<14	<14	<14	<14	<14	110	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14		
o-Xylene	ug/kg				<10	<10	<10	<10	<10	<10	<10	80	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10		
Naphthalene	ug/kg				<13	<13	<13	<13	<13	<13	<13	37000	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13		
Hexachlorobutadiene	ug/kg				<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12		
1.2.4-Trichlorobenzene	ug/kg				<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6		
1.2-Dichlorobenzene	ug/kg				<12	<12	<12	<12	<12	130	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12		
1.3-Dichlorobenzene	ug/kg				<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6		
1.4-Dichlorobenzene	ug/kg				<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5		
1.1.1.2-Tetrachloroethane	ug/kg				<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10		
1.1.1-Trichloroethane	ug/kg				<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7		
1.1.2.2-Tetrachloroethane	ug/kg				<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10		
1.1.2-Trichloroethane	ug/kg				<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10		
1.1-Dichloropropene	ug/kg				<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11		
1.1-Dichloroethane	ug/kg				<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8		
1.1-Dichloroethene	ug/kg				<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10		
1.2.3-Trichlorobenzene	ug/kg				<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11		
1.2.3-Trichloropropane	ug/kg				<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17		
1.2.4-Trimethylbenzene	ug/kg				<9	<9	<9	<9	<9	<9	<9	150	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9		
1.2-Dibromo-3-chloropropane	ug/kg				<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14		
1.2-Dichloroethane	ug/kg				<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5		
cis-1-2-Dichloroethene	ug/kg				<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5		
1.2-Dibromoethane	ug/kg				<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12		
1.2-Dichloropropane	ug/kg				<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12		
1.3.5-Trimethylbenzene	ug/kg				<8	<8	<8	<8	<8	<8	<8	80	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8		
cis-1-3-Dichloropropene	ug/kg				<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14		
1.3-Dichloropropane	ug/kg				<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7		
2.2-Dichloropropane	ug/kg				<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12		
2-Chlorotoluene	ug/kg				<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9		
4-Chlorotoluene	ug/kg				<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12		
4-Isopropyltoluene	ug/kg				<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11		
Bromobenzene	ug/kg				<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10		
Bromochloromethane	ug/kg				<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14		
Bromoform	ug/kg				<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10		
Bromomethane	ug/kg				<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13		
Bromodichloromethane	ug/kg				<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7		
Chlorobenzene	ug/kg				<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5		
Carbon Disulphide	ug/kg				<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7		
Chloroethane	ug/kg				<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14		
Chloroform	ug/kg				<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8		
Chloromethane	ug/kg				<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7		
Carbontetrachloride	ug/kg				<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14		
Carbontetrachloride	ug/kg				<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14		
Dibromomethane	ug/kg				<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9		
Dichlorodifluoromethane	ug/kg				<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4		
Dibromochloromethane	ug/kg				<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13		
Dibromomethane	ug/kg																							
Dichloromethane	ug/kg				<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10		
Isopropylbenzene	ug/kg				<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5		
n-Butylbenzene	ug/kg				<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10		
Propylbenzene	ug/kg				<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11		
p-Isopropyltoluene	ug/kg																							
sec-Butylbenzene	ug/kg				<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10		
Styrene	ug/kg				<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10		
trans-1-2-Dichloroethene	ug/kg				<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11		
trans-1-3-Dichloropropene	ug/kg				<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14		
Trichlorofluoromethane	ug/kg				<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6		
tert-Butylbenzene	ug/kg				<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12		
Tetrachloroethene	ug/kg				<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5		
Tribromomethane	ug/kg																							
Trichloroethene	ug/kg				<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9		
Vinyl Chloride	ug/kg				<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10		

Sample Reference	Units	TP3	TP4	TP5	TP6	TP01	TP02	TP02	TP03	TP04	TP04	TP05	TP05	TP06	TP1	TP2	TP3	TP4	TP6	TP1	TP2	TP3
Specimen Depth		0.3	0.9	0.5	0.6	0.5	0.5	0.8	0.1	0.5	0.9	0.5	1	0.6	0.8	1.4	1	0.7	0.6	1.5	1	0.7
Level																						
Sample Type		D	D	D	D										D	D	D	D	D	D	D	D
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
Cluster Code		June 2005 GI	June 2005 GI	June 2005 GI	June 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Oct 2001 GI	Oct 2001 GI	Oct 2001 GI	Oct 2001 GI	Oct 2001 GI	April 2002 GI	April 2002 GI	April 2002 GI
Methyl Tertiary Butyl Ether	ug/kg																					
Benzene	ug/kg																					
Toluene	ug/kg																					
Ethylbenzene	ug/kg																					
p/m-Xylene	ug/kg																					
o-Xylene	ug/kg																					
Naphthalene	ug/kg																					
Hexachlorobutadiene	ug/kg																					
1.2.4-Trichlorobenzene	ug/kg																					
1.2-Dichlorobenzene	ug/kg																					
1.3-Dichlorobenzene	ug/kg																					
1.4-Dichlorobenzene	ug/kg																					
1.1.1.2-Tetrachloroethane	ug/kg																					
1.1.1-Trichloroethane	ug/kg																					
1.1.2.2-Tetrachloroethane	ug/kg																					
1.1.2-Trichloroethane	ug/kg																					
1.1-Dichloropropene	ug/kg																					
1.1-Dichloroethane	ug/kg																					
1.1-Dichloroethene	ug/kg																					
1.2.3-Trichlorobenzene	ug/kg																					
1.2.3-Trichloropropane	ug/kg																					
1.2.4-Trimethylbenzene	ug/kg																					
1.2-Dibromo-3-chloropropane	ug/kg																					
1.2-Dichloroethane	ug/kg																					
cis-1-2-Dichloroethene	ug/kg																					
1.2-Dibromoethane	ug/kg																					
1.2-Dichloropropane	ug/kg																					
1.3.5-Trimethylbenzene	ug/kg																					
cis-1-3-Dichloropropene	ug/kg																					
1.3-Dichloropropane	ug/kg																					
2.2-Dichloropropane	ug/kg																					
2-Chlorotoluene	ug/kg																					
4-Chlorotoluene	ug/kg																					
4-Isopropyltoluene	ug/kg																					
Bromobenzene	ug/kg																					
Bromochloromethane	ug/kg																					
Bromoform	ug/kg																					
Bromomethane	ug/kg																					
Bromodichloromethane	ug/kg																					
Chlorobenzene	ug/kg																					
Carbon Disulphide	ug/kg																					
Chloroethane	ug/kg																					
Chloroform	ug/kg																					
Chloromethane	ug/kg																					
Carbontetrachloride	ug/kg																					
Carbontetrachloride	ug/kg																					
Dibromomethane	ug/kg																					
Dichlorodifluoromethane	ug/kg																					
Dibromochloromethane	ug/kg																					
Dibromomethane	ug/kg																					
Dichloromethane	ug/kg																					
Isopropylbenzene	ug/kg																					
n-Butylbenzene	ug/kg																					
Propylbenzene	ug/kg																					
p-Isopropyltoluene	ug/kg																					
sec-Butylbenzene	ug/kg																					
Styrene	ug/kg																					
trans-1-2-Dichloroethene	ug/kg																					
trans-1-3-Dichloropropene	ug/kg																					
Trichlorofluoromethane	ug/kg																					
tert-Butylbenzene	ug/kg																					
Tetrachloroethene	ug/kg																					
Tribromomethane	ug/kg																					
Trichloroethene	ug/kg																					
Vinyl Chloride	ug/kg																					

Sample Reference	Units	TP5	BH412	BH412	BH412	BH412	BH413	BH413	BH413	BH414	BH414	BH414	BH416	BH416	BH417	BH417	BH418	BH418	BH418	BH419	BH420	BH420	BH421	BH421	BH421	BH422	TP405	TP405	TP405	TP406	TP406	TP406
Specimen Depth		0.4	0 - 0.5	1.2 - 1.7	2.2 - 2.7	2.9 - 3.2	0.2 - 0.4	0.8 - 1.2	3.5 - 4	0.2 - 0.4	0.4 - 0.8	1.3 - 1.5	0.4 -0.6	1.5 - 1.6	0.5 - 0.6	1.5 - 1.6	0.5 - 1	1 - 1.5	3 - 3.5	0.3 - 0.8	0.5 - 1.2	1.7 - 2.2	0 - 0.5	0.5 - 1.2	1.2 - 1.7	0 - 0.5	0 - 0.2	1.4 - 1.5	2.4 - 2.5	0 - 0.2	1 - 1.2	1.6 - 1.8
Level			10.5	9.3	8.3	7.6	9.7	9.1	6.4	10	9.8	8.9	9.65	8.55	8.6	7.6	10.9	10.4	8.4	8.5	10.05	8.85	9.3	8.8	8.1	7.95	10.2	8.8	7.8	10.1	9.1	8.5
Sample Type		D	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
Cluster Code		April 2002 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI
Methyl Tertiary Butyl Ether	ug/kg																												<1			
Benzene	ug/kg		<1	1.7		<1				<1													<1	<1		<1	<1	<1	<1	<1	<1	<1
Toluene	ug/kg		<1	2		<1				<1													<1	<1		<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	ug/kg		<1	<1		<1				<1													<1	<1		<1	<1	<1	<1	<1	<1	<1
p/m-Xylene	ug/kg		<1	1.8		<1				<1													<1	<1		<1	<1	<1	<1	<1	<1	<1
o-Xylene	ug/kg		<1	<1		<1				<1													<1	<1		<1	<1	<1	<1	<1	<1	<1
Naphthalene	ug/kg																															
Hexachlorobutadiene	ug/kg																												<1			
1.2.4-Trichlorobenzene	ug/kg																												<1			
1.2-Dichlorobenzene	ug/kg																												<1			
1.3-Dichlorobenzene	ug/kg																												<1			
1.4-Dichlorobenzene	ug/kg																												<1			
1.1.1.2-Tetrachloroethane	ug/kg																												<2			
1.1.1-Trichloroethane	ug/kg																												<1			
1.1.2.2-Tetrachloroethane	ug/kg																															
1.1.2-Trichloroethane	ug/kg																												<10			
1.1-Dichloropropene	ug/kg																												<1			
1.1-Dichloroethane	ug/kg																												<1			
1.1-Dichloroethene	ug/kg																												<1			
1.2.3-Trichlorobenzene	ug/kg																												<2			
1.2.3-Trichloropropane	ug/kg																												<50			
1.2.4-Trimethylbenzene	ug/kg																												<1			
1.2-Dibromo-3-chloropropane	ug/kg																												<50			
1.2-Dichloroethane	ug/kg																												<2			
cis-1-2-Dichloroethene	ug/kg																												<1			
1.2-Dibromoethane	ug/kg																												<5			
1.2-Dichloropropane	ug/kg																												<1			
1.3.5-Trimethylbenzene	ug/kg																												<1			
cis-1-3-Dichloropropene	ug/kg																												<10			
1.3-Dichloropropane	ug/kg																												<1			
2.2-Dichloropropane	ug/kg																															
2-Chlorotoluene	ug/kg																												<1			
4-Chlorotoluene	ug/kg																												<1			
4-Isopropyltoluene	ug/kg																												<1			
Bromobenzene	ug/kg																												<1			
Bromochloromethane	ug/kg																												<5			
Bromoform	ug/kg																															
Bromomethane	ug/kg																												<20			
Bromodichloromethane	ug/kg																												<5			
Chlorobenzene	ug/kg																												<1			
Carbon Disulphide	ug/kg																															
Chloroethane	ug/kg																												<2			
Chloroform	ug/kg																												<1			
Chloromethane	ug/kg																												<1			
Carbontetrachloride	ug/kg																												<1			
Carbontetrachloride	ug/kg																												<1			
Dibromomethane	ug/kg																												<1			
Dichlorodifluoromethane	ug/kg																												<1			
Dibromochloromethane	ug/kg																												<10			
Dibromomethane	ug/kg																															
Dichloromethane	ug/kg																															
Isopropylbenzene	ug/kg																												<1			
n-Butylbenzene	ug/kg																												<1			
Propylbenzene	ug/kg																												<1			
p-Isopropyltoluene	ug/kg																															
sec-Butylbenzene	ug/kg																												<1			
Styrene	ug/kg																												<1			
trans-1-2-Dichloroethene	ug/kg																												<1			
trans-1-3-Dichloropropene	ug/kg																												<10			
Trichlorofluoromethane	ug/kg																												<1			
tert-Butylbenzene	ug/kg																												<1			
Tetrachloroethene	ug/kg																												<1			
Tribromomethane	ug/kg																												<1			
Trichloroethene	ug/kg																												<1			
Vinyl Chloride	ug/kg																															

NFD No Fibres Detected (Asbestos screening)
Screening values are based on CLEA SGV soil guidance values and Land Quality Management Generic Assessment Criteria
* Arup CLEA GAC values where no published values are available
Where various values for SOM are presented the more conservative 1% SOM has been used

Sample Reference	Units	TP406	TP407	TP407	TP407	TP409	TP409	TP409	No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	UCL to be Derived?	95 UCL Value	No. of Outliers	Selected S4ULs Criteria	Comment	No. Data Exceeding S4ULs Criteria
Specimen Depth		2.8 - 3	0.2 - 0.5	0.6 - 0.8	1.2 - 1.4	0 - 0.3	0.5 - 0.6	1 - 1.1											
Level		7.3	9.25	8.85	8.25	8.05	7.55	7.05											
Sample Type		ES	ES	ES	ES	ES	ES	ES											
Geology Code		MG	MG	MG	MG	MG	MG	MG											
Cluster Code		2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI											
Methyl Tertiary Butyl Ether	ug/kg								19	0	None > LOD	None > LOD		Yes					
Benzene	ug/kg	<1							33	1	1.7	1.7	BH412 @ 1.2 - 1.7mbGL	Yes			27000		0
Toluene	ug/kg	<1							33	8	120	2	CH11 @ 1.65mbGL	Yes			56000000		0
Ethylbenzene	ug/kg	<1							33	2	30	9	STPF04 @ 3mbGL	Yes			5700000		0
p/m-Xylene	ug/kg	<1							33	3	110	1.8	STPF04 @ 3mbGL	Yes					
o-Xylene	ug/kg	<1							33	2	80	15	STPF04 @ 3mbGL	Yes			6600000		0
Naphthalene	ug/kg								19	2	37000	51	STPF04 @ 3mbGL	Yes			190000		0
Hexachlorobutadiene	ug/kg								20	0	None > LOD	None > LOD		Yes			31000		0
1.2.4-Trichlorobenzene	ug/kg								20	0	None > LOD	None > LOD		Yes			220000		0
1.2-Dichlorobenzene	ug/kg								20	2	130	23	STPF03 @ 1.9mbGL	Yes					
1.3-Dichlorobenzene	ug/kg								20	0	None > LOD	None > LOD		Yes					
1.4-Dichlorobenzene	ug/kg								20	0	None > LOD	None > LOD		Yes					
1.1.1.2-Tetrachloroethane	ug/kg								20	0	None > LOD	None > LOD		Yes					
1.1.1-Trichloroethane	ug/kg								20	0	None > LOD	None > LOD		Yes					
1.1.2.2-Tetrachloroethane	ug/kg								19	0	None > LOD	None > LOD		Yes					
1.1.2-Trichloroethane	ug/kg								20	0	None > LOD	None > LOD		Yes					
1.1-Dichloropropene	ug/kg								20	0	None > LOD	None > LOD		Yes					
1.1-Dichloroethane	ug/kg								20	0	None > LOD	None > LOD		Yes					
1.1-Dichloroethene	ug/kg								20	0	None > LOD	None > LOD		Yes					
1.2.3-Trichlorobenzene	ug/kg								20	0	None > LOD	None > LOD		Yes			102000		0
1.2.3-Trichloropropane	ug/kg								19	0	None > LOD	None > LOD		Yes					
1.2.4-Trimethylbenzene	ug/kg								20	2	150	81	STPF04 @ 3mbGL	Yes					
1.2-Dibromo-3-chloropropane	ug/kg								20	0	None > LOD	None > LOD		Yes					
1.2-Dichloroethane	ug/kg								20	0	None > LOD	None > LOD		Yes					
cis-1-2-Dichloroethene	ug/kg								20	0	None > LOD	None > LOD		Yes					
1.2-Dibromoethane	ug/kg								20	0	None > LOD	None > LOD		Yes					
1.2-Dichloropropane	ug/kg								20	0	None > LOD	None > LOD		Yes					
1.3.5-Trimethylbenzene	ug/kg								20	2	80	26	STPF04 @ 3mbGL	Yes					
cis-1-3-Dichloropropene	ug/kg								20	0	None > LOD	None > LOD		Yes					
1.3-Dichloropropane	ug/kg								20	0	None > LOD	None > LOD		Yes					
2.2-Dichloropropane	ug/kg								19	0	None > LOD	None > LOD		Yes					
2-Chlorotoluene	ug/kg								20	0	None > LOD	None > LOD		Yes					
4-Chlorotoluene	ug/kg								20	0	None > LOD	None > LOD		Yes					
4-Isopropyltoluene	ug/kg								19	0	None > LOD	None > LOD		Yes					
Bromobenzene	ug/kg								20	0	None > LOD	None > LOD		Yes					
Bromochloromethane	ug/kg								20	0	None > LOD	None > LOD		Yes					
Bromoform	ug/kg								19	0	None > LOD	None > LOD		Yes					
Bromomethane	ug/kg								20	0	None > LOD	None > LOD		Yes					
Bromodichloromethane	ug/kg								20	0	None > LOD	None > LOD		Yes					
Chlorobenzene	ug/kg								20	0	None > LOD	None > LOD		Yes			56000		0
Carbon Disulphide	ug/kg								18	0	None > LOD	None > LOD		Yes			11000		0
Chloroethane	ug/kg								20	0	None > LOD	None > LOD		Yes					
Chloroform	ug/kg								20	0	None > LOD	None > LOD		Yes			99000		0
Chloromethane	ug/kg								20	0	None > LOD	None > LOD		Yes					
Carbontetrachloride	ug/kg								20	0	None > LOD	None > LOD		Yes					
Carbontetrachloride	ug/kg								20	0	None > LOD	None > LOD		Yes					
Dibromomethane	ug/kg								19	0	None > LOD	None > LOD		Yes					
Dichlorodifluoromethane	ug/kg								20	0	None > LOD	None > LOD		Yes					
Dibromochloromethane	ug/kg								20	0	None > LOD	None > LOD		Yes					
Dibromomethane	ug/kg								1	0	None > LOD	None > LOD		IS					
Dichloromethane	ug/kg								18	0	None > LOD	None > LOD		Yes					
Isopropylbenzene	ug/kg								20	0	None > LOD	None > LOD		Yes					
n-Butylbenzene	ug/kg								20	1	12	12	CH11 @ 1.65mbGL	Yes					
Propylbenzene	ug/kg								20	0	None > LOD	None > LOD		Yes					
p-Isopropyltoluene	ug/kg								1	1	12	12	CH11 @ 1.65mbGL	IS					
sec-Butylbenzene	ug/kg								20	1	7	7	CH11 @ 1.65mbGL	Yes					
Styrene	ug/kg								20	0	None > LOD	None > LOD		Yes					
trans-1-2-Dichloroethene	ug/kg								20	0	None > LOD	None > LOD		Yes					
trans-1-3-Dichloropropene	ug/kg								20	0	None > LOD	None > LOD		Yes					
Trichlorofluoromethane	ug/kg								20	0	None > LOD	None > LOD		Yes					
tert-Butylbenzene	ug/kg								20	0	None > LOD	None > LOD		Yes					
Tetrachloroethene	ug/kg								20	0	None > LOD	None > LOD		Yes			19000		0
Tribromomethane	ug/kg								1	0	None > LOD	None > LOD		IS					
Trichloroethene	ug/kg								20	0	None > LOD	None > LOD		Yes			1200		0
Vinyl Chloride	ug/kg								19	0	None > LOD	None > LOD		Yes			59		0

M4CAN
Soil (Nat) Analysis Results & Screening Assessment
CL-14
14/07/2015

Geological Formation Legend

TFD	Tidal Flat Deposits
FLUV	Fluvial Alluvium

Screening Values and Assessment

	Exceeds S4ULs criteria
X	Laboratory detection level higher than screening criterion

Notes

NFD No Fibres Detected (Asbestos screening)
Screening values are based on CLEA SGV soil guidance values and Land Quality Management Generic Assessment Criteria
* Arup CLEA GAC values where no published values are available
Where various values for SOM are presetned the more conservative 1% SOM has been used

Sample Reference	Units	SBHF03CP	SBHF03CP	SBHF03CP	SBHF03CP	STPF01	STPF05	STPF08	CH18	CH19	CH20	CH21	CH22	CH23	TP1	TP5	TP4	BH419	BH421	BH422	TP406	TP407	No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	UCL to be Derived?	95 UCL Value	No. of Outliers	Selected S4ULs Criteria	Comment	No. Data Exceeding S4ULs Criteria
Specimen Depth		3	6	7	17	2.4	1.8	1.6	4	2	1	2.5	1	0.46	1.2	1.5	0.5	1.2 - 1.65	1.7 - 2.8	1.45 - 1.65	3.4 - 3.6	2.4 - 2.6											
Level		6.88	3.88	2.88	-7.12	7.49	6.87	7.5	6.02	8.32	7.85	5.97	7.37	8.01				7.6	7.6	6.5	6.7	7.05											
Sample Type		ES	D	D	D	B	D	ES	D	D	D	D	D	D		D	D	ES	ES	ES	ES	ES											
Geology Code		TFD	TFD	TFD	FLUV	TFD	TFD	TFD	FLUV	TFD	TFD	TFD	TFD	TFD				TFD	TFD	TFD	TFD	TFD											
Cluster Code		2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	Aug 2005 GI	Oct 2001 GI	April 2002 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI											
Metals																																	
Antimony	mg/kg	2.8				2.9	2.8	1.8															4	4	2.9	1.8	STPF01 @ 2.4mbGL	IS					
Arsenic	mg/kg	21				6	10	6	15	6.2	11	10	12	13	6.5	12.4	22.04	16	13	13	20	5.9	18	18	22.04	5.9	TP4 @ 0.5mbGL	Yes			170		0
Barium	mg/kg	56				92	80	27															4	4	92	27	STPF01 @ 2.4mbGL	IS					
Boron	mg/kg								1.1	1.3	1	2.5	1.5	<0.5		2.4	0.7	3.7	2.3	1.2	1.9	2.7	13	12	3.7	0.7	BH419 @ 1.2 - 1.65mbGL	Yes			46000		0
Boron Water Soluble	mg/kg	<3.5				<3.5	<3.5	<3.5															4	0	None > LOD	None > LOD		IS					
Cadmium	mg/kg	<0.3				<0.3	<0.3	<0.3	0.22	0.08	0.11	0.15	0.13	0.17	<0.5	<1.7	<1.7	0.26	0.13	<0.1	<0.1	<0.1	18	8	0.26	0.08	BH419 @ 1.2 - 1.65mbGL	Yes			190		0
Chromium	mg/kg	36				35	38	19	20	21	27	39	34	16	12	15	24	50	30	44	46	48	18	18	50	12	BH419 @ 1.2 - 1.65mbGL	Yes			33		9
Copper	mg/kg	16				20	15	20	35	8	26	22	18	46	5.9	9	54	25	15	15	11	17	18	18	54	5.9	TP4 @ 0.5mbGL	Yes			44000		0
Lead	mg/kg	30				38	20	17	80	26	34	43	38	78	13	19	95	50	19	34	48	29	18	18	95	13	TP4 @ 0.5mbGL	Yes			1300		0
Mercury	mg/kg	<0.6				<0.6	<0.6	<0.6	0.35	<0.01	<0.01	<0.01	<0.01	0.08	<0.2	0.15	0.15	0.13	<0.1	0.21	<0.1	<0.1	18	6	0.35	0.08	CH18 @ 4mbGL	Yes			30		0
Molybdenum	mg/kg	0.7				<0.6	<0.6	<0.6															4	1	0.7	0.7	SBHF03CP @ 3mbGL	IS					
Nickel	mg/kg	33				32	36	20	24	21	24	31	28	14	14	16	26	47	35	40	25	36	18	18	47	14	BH419 @ 1.2 - 1.65mbGL	Yes			980		0
Selenium	mg/kg	<3				<3	<3	<3	0.89	0.58	0.9	<0.5	<0.5	0.53		2.47	0.95	<0.2	<0.2	<0.2	<0.2	<0.2	17	6	2.47	0.53	TP5 @ 1.5mbGL	Yes			1800		0
Zinc	mg/kg	140				160	130	88	149	51	103	120	87	67	37	59	170	150	95	110	68	100	18	18	170	37	TP4 @ 0.5mbGL	Yes			170000		0
Iron	mg/kg																						0	0	None > LOD	None > LOD		IS					
Hexavalent Chromium	mg/kg																						0	0	None > LOD	None > LOD		IS					
Non Metal Inorganics																																	
Cyanide (total)	mg/kg	<1				<1	<1	<1	<1	<1	<1	<1	1	<1		<2	<2	<0.5	<0.5	<0.5	<0.5	<0.5	17	1	1	1	CH22 @ 1mbGL	Yes					
Cyanide (free)	mg/kg								<1	<1								<0.5	<0.5	<0.5	<0.5	<0.5	7	0	None > LOD	None > LOD		Yes					
Ferro/ferricyanide	mg/kg																						0	0	None > LOD	None > LOD		IS					
Acid Soluble Sulphate	mg/kg								891	1490	632	1090	513	325									6	6	1490	325	CH19 @ 2mbGL	Yes					
Sulphate (soluble)	g/l	0.073	1.135		<0.1	0.031	0.045	0.027															6	5	1.135	0.027	SBHF03CP @ 6mbGL	Yes					
Sulphate (total)	mg/kg																						0	0	None > LOD	None > LOD		IS					
Sulphide	mg/kg								21	8													2	2	21	8	CH18 @ 4mbGL	IS					
Other																																	
Asbestos Presence Screen	None	NFD				NFD	NFD	NFD															4	0	None > LOD	None > LOD		IS					
Loss on Ignition	%																						0	0	None > LOD	None > LOD		IS					
Total Organic Carbon	%																						0	0	None > LOD	None > LOD		IS					
Organic Matter	%			2																			1	1	2	2	SBHF03CP @ 7mbGL	IS					
pH Value	pH Unit	8.07	8.1		8.5	8.14	7.96	8.4	8.3	8.1	8.1	8.1	8	8.4		8.1	7.8	8	7.9	8	8.3	8	19	19	8.5	7.8	SBHF03CP @ 17mbGL	Yes			6-9		0
Material >2mm	%		90.8	68.8	71.3																		3	3	90.8	68.8	SBHF03CP @ 6mbGL	IS					
Calorific Value	MJ/kg																						0	0	None > LOD	None > LOD		IS					
Organics																																	
PAH (Screening)	mg/kg								34	11	14	301	13	35		<25	<25						8	6	301	11	CH21 @ 2.5mbGL	Yes			1.1		6
Mineral Oil	mg/kg																						0	0	None > LOD	None > LOD		IS					
TPH FTIR (AR)	mg/kg								30	<20													2	1	30	30	CH18 @ 4mbGL	IS			3200		0
OIL FTIR	mg/kg								103	85													2	2	103	85	CH18 @ 4mbGL	IS					
PCBs																																	
PCBs (vs Aroclor 1254)	mg/kg	<0.02				<0.02	<0.02	<0.02															4	0	None > LOD	None > LOD		IS			0.24		0
PCB 105	mg/kg																						0	0	None > LOD	None > LOD		IS			0.24		0
PCB 114	mg/kg																						0	0	None > LOD	None > LOD		IS			0.24		0
PCB 123	mg/kg																						0	0	None > LOD	None > LOD		IS			0.24		0
PCB 126	mg/kg																						0	0	None > LOD	None > LOD		IS			0.24		0
PCB 157	mg/kg																						0	0	None > LOD	None > LOD		IS			0.24		0
PCB 167	mg/kg																						0	0	None > LOD	None > LOD		IS			0.24		0
PCB 169	mg/kg																						0	0	None > LOD	None > LOD		IS			0.24		0
PCB 189	mg/kg																						0	0	None > LOD	None > LOD		IS			0.24		0
PCB 77	mg/kg																						0	0	None > LOD	None > LOD		IS			0.24		0
PCB 81	mg/kg																						0	0	None > LOD	None > LOD		IS			0.24		0
Pcb-118 2,3',4,4',5 - Pentachlorobiph	mg/kg																						0	0	None > LOD	None > LOD		IS			0.24		0
Pcb-156 2,3,3,4,4,5 - Hexachlorobiph	mg/kg																						0	0	None > LOD	None > LOD		IS			0.24		0
Phenols																																	
Phenol Index	mg/kg								<0.5	<0.5	<0.5	<1.5	<0.5	<0.5									6	0	None > LOD	None > LOD		Yes			440		0
Phenols Monohydric	mg/kg																						0	0	None > LOD	None > LOD		IS			440		0
Phenols (total)	mg/kg	<0.15				<0.15	<0.15	<0.15								<2	<2				<0.3	<0.3	8	0	None > LOD	None > LOD		Yes			440		0
Organotin Compounds																																	
Dibutyl Tin	ug/kg																						0	0	None > LOD	None > LOD		IS					
Tributyl Tin	ug/kg																						0	0	None > LOD	None > LOD		IS					
Triphenyl Tin	ug/kg																						0	0	None > LOD	None > LOD		IS					
BTEX																																	
GRO (C4-C12)	mg/kg	<0.01				<0.01	<0.01	<0.01															4	0	None > LOD	None > LOD		IS					
MTBE	mg/kg	<0.01				<0.01	<0.01	<0.01															4	0	None > LOD	None > LOD		IS					
Benzene	mg/kg	<0.01				<0.01	<0.01	<0.01															4	0	None > LOD	None > LOD		IS			27		0
Toluene	mg/kg	<0.01				<0.01	<0.01	<0.01															4	0	None > LOD	None > LOD		IS			56000		0
Ethyl benzene	mg/kg	<0.01				<0.01	<0.01	<0.01															4	0	None > LOD	None > LOD		IS			5700		0
m & p Xylene	mg/kg	<0.01				<0.01	<0.01	<0.01															4	0	None > LOD	None > LOD		IS			5900		0
o Xylene	mg/kg	<0.01				<0.01	<0.01	<0.01															4	0	None > LOD	None > LOD		IS			6600		0
TPH																																	
TPH >C6-C8.	mg/kg																	<1	<1	<1	<1	<1	5	0	None > LOD	None > LOD		IS			7800		0
TPH >C8-C10.	mg/kg																	<1	<1	<1	<1	<1	5	0	None > LOD	None > LOD		IS			2000		0
TPH >C10-C12.	mg/kg																	<1	<1	<1	<1	<1	5	0	None > LOD	None > LOD		IS			9200		0
TPH >C12-C16.	mg/kg																	<1	<1	<1	<1	<1	5	0	None > LOD	None > LOD		IS			10000		0
TPH >C16-C21.	mg/kg																	<1	<1	<1	<1	<1	5	0	None > LOD	None > LOD		IS			7600		0
TPH >C21-C35.	mg/kg																	<1	<1	<1	<1	<1	5	0	None > LOD	None > LOD		IS			7800		0
Aliphatics C5-C6	mg/kg	<0.01				<0.01	<0.01	<0.01															4	0	None > LOD	None > LOD		IS			3200		0
Aliphatics >C6-C8	mg/kg	<0.01				<0.01	<0.01	<0.01															4	0	None > LOD	None > LOD		IS			7800		0
Aliphatics >C8-C10	mg/kg	<0.01				<0.01	<0.01	<0.01															4	0	None > LOD	None > LOD		IS			2000		0
Aliphatics >C10-C12	mg/kg	<0.01				<0.01	<0.01	<0.01															4	0	None > LOD	None > LOD		IS			9700		0
Aliphatics >C12-C16	mg/kg	<0.1				0.6	<0.1	<0.1															4	1	0.6	0.6	STPF01 @ 2.4mbGL	IS			25000		0
Aliphatics >C16-C21	mg/kg	<0.1				1.6	<0.1	<0.1															4	1	1.6	1.6	STPF01 @ 2.4mbGL	IS			450000		0
Aliphatics >C21-C35	mg/kg	6.9				4.3	3.5	1.5															4	4	6.9	1.5	SBHF03CP @ 3mbGL	IS			450000		0
Total Aliphatics C5-C35	mg/kg	6.9				6.4	3.5	1.5															4	4	6.9	1.5	SBHF03CP @ 3mbGL	IS			2000		0
Aliphatics >C35-44	mg/kg																						0	0	None > LOD	None > LOD		IS			450000		0
Aromatics >C5-7	mg/kg																						0	0	None > LOD	None > LOD		IS			26000		0
Aromatics C6-C7	mg/kg	<0.01				<0.01	<0.01	<0.01															4	0	None > LOD	None > LOD		IS			7800		0
Aromatics >C7-C8	mg/kg	<0.01				<0.01	<0.01	<0.01															4	0	None > LOD	None > LOD		IS			56000		0
Aromatics >EC8-EC10	mg/kg	<0.01				<0.01	<0.01	<0.01															4	0	None > LOD	None > LOD		IS			3500		0
Aromatics >EC10-EC12	mg/kg	<0.01				<0.01	<0.01	<0.01															4	0	None > LOD	None > LOD		IS			9200		0
Aromatics >EC12-EC16	mg/kg	0.68				<0.1	<0.1	<0.1															4	1	0.68	0.68	SBHF03CP @ 3mbGL	IS			10000		0
Aromatics >EC16-EC21	mg/kg	1.6				<0.1	<0.1	0.52															4	2	1.6	0.52	SBHF03CP @ 3mbGL	IS			7600		0

Aromatics >EC21-EC35	mg/kg	57				3.9	5.6	5.4															4	4	57	3.9	SBHF03CP @ 3mbGL	IS			7800		0
Total Aromatics C6-C35	mg/kg	60				3.9	5.6	6															4	4	60	3.9	SBHF03CP @ 3mbGL	IS			3500		0
Aromatics >C35-44	mg/kg																						0	0	None > LOD	None > LOD		IS			7800		0
Total Aliphatic hydrocarbons	mg/kg																						0	0	None > LOD	None > LOD		IS					
Total Aromatic hydrocarbons	mg/kg																						0	0	None > LOD	None > LOD		IS			3500		0
TPH (Aliphatics and Aromatics C5-C3	mg/kg	66				10	9.1	7.4							<50								8	4	66	7.4	SBHF03CP @ 3mbGL	Yes			2000		0
Total petroleum hydrocarbons	mg/kg																						0	0	None > LOD	None > LOD		IS			2000		0
PAH																																	
Acenaphthene	mg/kg	0.024				0.035	0.053	0.022							<0.5			0.78	<0.1	<0.1	<0.1	<0.1	10	5	0.78	0.022	BH419 @ 1.2 - 1.65mbGL	Yes			29000		0
Acenaphthylene	mg/kg	0.008				0.019	0.008	0.011							<0.5			<0.1	<0.1	<0.1	<0.1	<0.1	10	4	0.019	0.008	STPF01 @ 2.4mbGL	Yes			29000		0
Anthracene	mg/kg	0.052				0.072	0.042	0.054							<0.5			<0.1	<0.1	0.18	<0.1	<0.1	10	5	0.18	0.042	BH422 @ 1.45 - 1.65mbGL	Yes			150000		0
Benz(a)anthracene	mg/kg	0.08				0.17	0.05	0.16							<0.5			<0.1	<0.1	0.82	<0.1	<0.1	10	5	0.82	0.05	BH422 @ 1.45 - 1.65mbGL	Yes			49		0
Benzo(a)pyrene	mg/kg	0.051				0.17	0.03	0.16							<0.5			<0.1	<0.1	0.84	<0.1	<0.1	10	5	0.84	0.03	BH422 @ 1.45 - 1.65mbGL	Yes			11		0
Benzo(b)fluoranthene	mg/kg	0.1				0.34	0.056	0.21							<0.5			<0.1	<0.1	1.4	<0.1	<0.1	10	5	1.4	0.056	BH422 @ 1.45 - 1.65mbGL	Yes			13		0
Benzo(ghi)perylene	mg/kg	0.058				0.12	0.022	0.12							<0.5			<0.1	<0.1	0.89	<0.1	<0.1	10	5	0.89	0.022	BH422 @ 1.45 - 1.65mbGL	Yes			1400		0
Benzo(k)fluoranthene	mg/kg	0.04				0.14	0.027	0.1							<0.5			<0.1	<0.1	6.5	<0.1	<0.1	10	5	6.5	0.027	BH422 @ 1.45 - 1.65mbGL	Yes			370		0
Chrysene	mg/kg	0.1				0.26	0.074	0.2							<0.5			<0.1	<0.1	7	<0.1	<0.1	10	5	7	0.074	BH422 @ 1.45 - 1.65mbGL	Yes			93		0
Dibenzo(ah)anthracene	mg/kg	0.021				0.036	<0.008	0.042							<0.5			<0.1	<0.1	0.17	<0.1	<0.1	10	4	0.17	0.021	BH422 @ 1.45 - 1.65mbGL	Yes			1.1		0
Fluoranthene	mg/kg	0.21				0.41	0.14	0.32							<0.5			0.65	<0.1	1.5	<0.1	<0.1	10	6	1.5	0.14	BH422 @ 1.45 - 1.65mbGL	Yes			6300		0
Fluorene	mg/kg	0.06				0.059	0.073	0.029							<0.5			0.26	<0.1	<0.1	<0.1	<0.1	10	5	0.26	0.029	BH419 @ 1.2 - 1.65mbGL	Yes			20000		0
Indeno(123cd)pyrene	mg/kg	0.031				0.088	0.017	0.098							<0.5			<0.1	<0.1	0.69	<0.1	<0.1	10	5	0.69	0.017	BH422 @ 1.45 - 1.65mbGL	Yes			150		0
Naphthalene	mg/kg	0.062				0.1	0.23	0.063							<0.5			7	<0.1	<0.1	<0.1	<0.1	10	5	7	0.062	BH419 @ 1.2 - 1.65mbGL	Yes			190		0
Phenanthrene	mg/kg	0.18				0.37	0.26	0.28							<0.5			0.52	<0.1	0.74	<0.1	<0.1	10	6	0.74	0.18	BH422 @ 1.45 - 1.65mbGL	Yes			6200		0
Pyrene	mg/kg	0.19				0.31	0.11	0.26							<0.5			0.61	<0.1	1.4	<0.1	<0.1	10	6	1.4	0.11	BH422 @ 1.45 - 1.65mbGL	Yes			15000		0
PAH 16 Total	mg/kg	1.3				2.7	1.2	2.1							<2			9.8	<2	22	<2	<2	10	6	22	1.2	BH422 @ 1.45 - 1.65mbGL	Yes					
Pesticides																																	
Aldrin	ug/kg																						0	0	None > LOD	None > LOD		IS			30000		0
Alpha-BHC (Lindane)	ug/kg																						0	0	None > LOD	None > LOD		IS					
Beta-BHC (Lindane)	ug/kg																						0	0	None > LOD	None > LOD		IS					
Chlorothalonil	ug/kg																						0	0	None > LOD	None > LOD		IS					
cis-Chlordane	ug/kg																						0	0	None > LOD	None > LOD		IS					
Dieldrin	ug/kg																						0	0	None > LOD	None > LOD		IS			30000		0
Endosulphan I	ug/kg																						0	0	None > LOD	None > LOD		IS					
Endosulphan II	ug/kg																						0	0	None > LOD	None > LOD		IS					
Endosulphan sulphate	ug/kg																						0	0	None > LOD	None > LOD		IS					
Endrin	ug/kg																						0	0	None > LOD	None > LOD		IS					
Gamma-BHC (Lindane)	ug/kg																						0	0	None > LOD	None > LOD		IS					
Heptachlor	ug/kg																						0	0	None > LOD	None > LOD		IS					
Heptachlor Epoxide	ug/kg																						0	0	None > LOD	None > LOD		IS					
Hexachlorobenzene	ug/kg																						0	0	None > LOD	None > LOD		IS			30000		0
Isodrin	ug/kg																						0	0	None > LOD	None > LOD		IS					
o,p'-DDE	ug/kg																						0	0	None > LOD	None > LOD		IS					
o,p'-DDT	ug/kg																						0	0	None > LOD	None > LOD		IS					
o,p'-Methoxychlor	ug/kg																						0	0	None > LOD	None > LOD		IS					
o,p'-TDE(DDD)	ug/kg																						0	0	None > LOD	None > LOD		IS					
p,p'-DDE	ug/kg																						0	0	None > LOD	None > LOD		IS					
p,p'-DDT	ug/kg																						0	0	None > LOD	None > LOD		IS					
p,p'-Methoxychlor	ug/kg																						0	0	None > LOD	None > LOD		IS					
p,p'-TDE(DDD)	ug/kg																						0	0	None > LOD	None > LOD		IS					
Pendimethalin	ug/kg																						0	0	None > LOD	None > LOD		IS					
Permethrin I	ug/kg																						0	0	None > LOD	None > LOD		IS					
Permethrin II	ug/kg																						0	0	None > LOD	None > LOD		IS					
Quintozene (PCNB)	ug/kg																						0	0	None > LOD	None > LOD		IS					
Tecnazene	ug/kg																						0	0	None > LOD	None > LOD		IS					
Telodrin	ug/kg																						0	0	None > LOD	None > LOD		IS					
trans-Chlordane	ug/kg																						0	0	None > LOD	None > LOD		IS					
Triadimefon	ug/kg																						0	0	None > LOD	None > LOD		IS					
Triallate	ug/kg																						0	0	None > LOD	None > LOD		IS					
Trifluralin	ug/kg																						0	0	None > LOD	None > LOD		IS					
SVOCs																																	
Phenols																																	
2-Chlorophenol	mg/kg	<0.1				<0.1	<0.1	<0.1															7	0	None > LOD	None > LOD		Yes					
2-Methylphenol	mg/kg	<0.1				<0.1	<0.1	<0.1															7	0	None > LOD	None > LOD		Yes					
2-Nitrophenol	mg/kg	<0.1				<0.1	<0.1	<0.1															7	0	None > LOD	None > LOD		Yes					
2-Methyl-4,6 Dinitrophenol	mg/kg																						7	0	None > LOD	None > LOD		Yes					
2,4-Dichlorophenol	mg/kg	<0.1				<0.1	<0.1	<0.1															7	0	None > LOD	None > LOD		Yes					
2,4-Dimethylphenol	mg/kg	<0.1				<0.1	<0.1	<0.1															7	0	None > LOD	None > LOD		Yes					
2,4,5-Trichlorophenol	mg/kg	<0.1				<0.1	<0.1	<0.1															7	0	None > LOD	None > LOD		Yes					
2,4,6-Trichlorophenol	mg/kg	<0.1				<0.1	<0.1	<0.1															7	0	None > LOD	None > LOD		Yes					
4-Chloro-3-methylphenol	mg/kg	<0.1				<0.1	<0.1	<0.1															7	0	None > LOD	None > LOD		Yes					
4-Methylphenol	mg/kg	<0.1				<0.1	<0.1	<0.1															7	0	None > LOD	None > LOD		Yes					
4-Nitrophenol	mg/kg	<0.1				<0.1	<0.1	<0.1															7	0	None > LOD	None > LOD		Yes					
Pentachlorophenol	mg/kg	<0.1				<0.1	<0.1	<0.1															7	0	None > LOD	None > LOD		Yes					
Phenol	mg/kg	<0.1				<0.1	<0.1	<0.1															4	0	None > LOD	None > LOD		IS			440		0
PAHs																																	
2-Chloronaphthalene	mg/kg	<0.1				<0.1	<0.1	<0.1															7	0	None > LOD	None > LOD		Yes					
2-Methylnaphthalene	mg/kg	<0.1				<0.1	<0.1	<0.1															7	0	None > LOD	None > LOD		Yes					
Acenaphthene	mg/kg					<0.1	<0.1																2	0	None > LOD	None > LOD		IS			29000		0
Acenaphthylene	mg/kg					<0.1	<0.1																2	0	None > LOD	None > LOD		IS			29000		0
Anthracene	mg/kg					<0.1	<0.1																2	0	None > LOD	None > LOD		IS			150000		0
Benzo(a)anthracene	mg/kg					<0.1	<0.1																2	0	None > LOD	None > LOD		IS					
Benzo(a)pyrene	mg/kg					<0.1	<0.1																2	0	None > LOD	None > LOD		IS			11		0
Benzo(b)fluoranthene	mg/kg					<0.1	<0.1																2	0	None > LOD	None > LOD		IS			13		0
Benzo(ghi)perylene	mg/kg					<0.1	<0.1																2	0	None > LOD	None > LOD		IS			1400		0
Benzo(k)fluoranthene	mg/kg					<0.1	<0.1																2	0	None > LOD	None > LOD		IS			370		0
Chrysene	mg/kg					<0.1	<0.1																2	0	None > LOD	None > LOD		IS			93		0
Dibenzo(a,h)anthracene	mg/kg					<0.1	<0.1																2	0	None > LOD	None > LOD		IS					
Fluoranthene	mg/kg					<0.1	<0.1																2	0	None > LOD	None > LOD		IS			6300		0
Fluorene	mg/kg					<0.1	<0.1																2	0	None > LOD	None > LOD		IS			20000		0
Indeno(1,2,3-cd)pyrene	mg/kg					<0.1	<0.1																2	0	None > LOD	None > LOD		IS					
Naphthalene	mg/kg					<0.1	<0.1																2	0	None > LOD	None > LOD		IS			190		0
Phenanthrene	mg/kg					<0.1	<0.1																2	0	None > LOD	None > LOD		IS			6200		0
Pyrene	mg/kg					<0.1	<0.1																2	0	None > LOD	None > LOD		IS			15000		0
Pthalates																																	
Bis(2-ethylhexyl) phthalate	mg/kg	<0.1				<0.2	<0.2	0.28															7	1	0.28	0.28	STPF08 @ 1.6mbGL	Yes					
Butylbenzyl phthalate	mg/kg	<0.1				<0.1	<0.1	<0.1															7	0	None > LOD	None > LOD		Yes					
Di-n-butyl phthalate	mg/kg	<0.1				<0.1	<0.1	<0.1															7	0	None > LOD	None > LOD		Yes					
Di-n-Octyl phthalate	mg/kg	0.36				<0.1	<0.1	<0.1															7	1	0.36	0.36	SBHF03CP @ 3mbGL	Yes					
Diethyl phthalate	mg/kg	<0.1				<0.1	<0.1	<0.1															7	0	None > LOD	None > LOD		Yes					
Dimethyl phthalate	mg/kg	<0.1				<0.1	<0.1	<0.1															7	0	None > LOD	None > LOD		Yes					
Other Semi-Volatiles																																	
1,2-Dichlorobenzene	mg/kg	<0.1				<0.1	<0.1	<0.1															7	0	None > LOD	None > LOD		Yes					
1,2,4-Trichlorobenzene	mg/kg	<0.1				<0.1	<0.1	<0.1															4	0	None > LOD	None > LOD		IS			220		0
1,3-Dichlorobenzene	mg/kg	<0.1				<0.1	<0.1	<0.1															4	0	None > LOD	None > LOD		IS					

1,4-Dichlorobenzene	mg/kg	<0.1				<0.1	<0.1	<0.1															4	0	None > LOD	None > LOD		IS					
2-Nitroaniline	mg/kg	<0.1				<0.1	<0.1	<0.1															4	0	None > LOD	None > LOD		IS					
2,4-Dinitrotoluene	mg/kg	<0.1				<0.1	<0.1	<0.1															4	0	None > LOD	None > LOD		IS					
2,6-Dinitrotoluene	mg/kg	<0.1				<0.1	<0.1	<0.1															4	0	None > LOD	None > LOD		IS					
3-Nitroaniline	mg/kg	<0.1				<0.1	<0.1	<0.1															4	0	None > LOD	None > LOD		IS					
4-Bromophenylphenylether	mg/kg	<0.1				<0.1	<0.1	<0.1															4	0	None > LOD	None > LOD		IS					
4-Chloroaniline	mg/kg	<0.1				<0.1	<0.1	<0.1															4	0	None > LOD	None > LOD		IS					
4-Chlorophenylphenylether	mg/kg	<0.1				<0.1	<0.1	<0.1															4	0	None > LOD	None > LOD		IS					
4-Nitroaniline	mg/kg	<0.1				<0.1	<0.1	<0.1															4	0	None > LOD	None > LOD		IS					
Azobenzene	mg/kg	<0.1				<0.1	<0.1	<0.1															4	0	None > LOD	None > LOD		IS					
Bis(2-chloroethoxy)methane	mg/kg	<0.1				<0.1	<0.1	<0.1															4	0	None > LOD	None > LOD		IS					
Bis(2-chloroethyl)ether	mg/kg	<0.1				<0.1	<0.1	<0.1															4	0	None > LOD	None > LOD		IS					
Bis(2-chloroisopropyl)ether	mg/kg																						4	0	None > LOD	None > LOD		IS					
Carbazole	mg/kg	<0.1				<0.1	<0.1	<0.1															4	0	None > LOD	None > LOD		IS					
Dibenzofuran	mg/kg	<0.1				<0.1	<0.1	<0.1															4	0	None > LOD	None > LOD		IS					
Hexachlorobenzene	mg/kg	<0.1				<0.1	<0.1	<0.1															4	0	None > LOD	None > LOD		IS			30		0
Hexachlorobutadiene	mg/kg	<0.1				<0.1	<0.1	<0.1															4	0	None > LOD	None > LOD		IS			31		0
Hexachlorocyclopentadiene	mg/kg	<0.1				<0.1	<0.1	<0.1															4	0	None > LOD	None > LOD		IS					
Hexachloroethane	mg/kg	<0.1				<0.1	<0.1	<0.1															7	0	None > LOD	None > LOD		Yes					
Isophorone	mg/kg	<0.1				<0.1	<0.1	<0.1															7	0	None > LOD	None > LOD		Yes					
Bis(2-chloroisopropyl)ether	mg/kg																						7	0	None > LOD	None > LOD		Yes					
N-nitrosodi-n-propylamine	mg/kg	<0.1				<0.1	<0.1	<0.1															7	0	None > LOD	None > LOD		Yes					
Nitrobenzene	mg/kg	<0.1				<0.1	<0.1	<0.1															7	0	None > LOD	None > LOD		Yes					
VOCs																																	
Methyl Tertiary Butyl Ether	ug/kg	<11				<11	<11	<11															4	0	None > LOD	None > LOD		IS					
Benzene	ug/kg	<9				<9	<9	<9															4	0	None > LOD	None > LOD		IS			27000		0
Toluene	ug/kg	<5				<5	<5	<5															4	0	None > LOD	None > LOD		IS			56000000		0
Ethylbenzene	ug/kg	<4				<4	<4	<4															4	0	None > LOD	None > LOD		IS			5700000		0
p/m-Xylene	ug/kg	<14				<14	<14	<14															4	0	None > LOD	None > LOD		IS					
o-Xylene	ug/kg	<10				<10	<10	<10															4	0	None > LOD	None > LOD		IS			6600000		0
Naphthalene	ug/kg	<13				<13	<13	<13															4	0	None > LOD	None > LOD		IS			190000		0
Hexachlorobutadiene	ug/kg	<12				<12	<12	<12															4	0	None > LOD	None > LOD		IS			31000		0
1.2.4-Trichlorobenzene	ug/kg	<6				<6	<6	<6															4	0	None > LOD	None > LOD		IS			220000		0
1.2-Dichlorobenzene	ug/kg	<12				<12	<12	<12															4	0	None > LOD	None > LOD		IS					
1.3-Dichlorobenzene	ug/kg	<6				<6	<6	<6															4	0	None > LOD	None > LOD		IS					
1.4-Dichlorobenzene	ug/kg	<5				<5	<5	<5															4	0	None > LOD	None > LOD		IS					
1.1.1.2-Tetrachloroethane	ug/kg	<10				<10	<10	<10															4	0	None > LOD	None > LOD		IS					
1.1.1-Trichloroethane	ug/kg	<7				<7	<7	<7															4	0	None > LOD	None > LOD		IS					
1.1.2.2-Tetrachloroethane	ug/kg	<10				<10	<10	<10															4	0	None > LOD	None > LOD		IS					
1.1.2-Trichloroethane	ug/kg	<10				<10	<10	<10															4	0	None > LOD	None > LOD		IS					
1.1-Dichloropropene	ug/kg	<11				<11	<11	<11															4	0	None > LOD	None > LOD		IS					
1.1-Dichloroethane	ug/kg	<8				<8	<8	<8															4	0	None > LOD	None > LOD		IS					
1.1-Dichloroethene	ug/kg	<10				<10	<10	<10															4	0	None > LOD	None > LOD		IS					
1.2.3-Trichlorobenzene	ug/kg	<11				<11	<11	<11															4	0	None > LOD	None > LOD		IS			102000		0
1.2.3-Trichloropropane	ug/kg	<17				<17	<17	<17															4	0	None > LOD	None > LOD		IS					
1.2.4-Trimethylbenzene	ug/kg	<9				<9	<9	<9															4	0	None > LOD	None > LOD		IS					
1.2-Dibromo-3-chloropropane	ug/kg	<14				<14	<14	<14															4	0	None > LOD	None > LOD		IS					
1.2-Dichloroethane	ug/kg	<5				<5	<5	<5															4	0	None > LOD	None > LOD		IS					
cis-1-2-Dichloroethene	ug/kg	<5				<5	<5	<5															4	0	None > LOD	None > LOD		IS					
1.2-Dibromoethane	ug/kg	<12				<12	<12	<12															4	0	None > LOD	None > LOD		IS					
1.2-Dichloropropane	ug/kg	<12				<12	<12	<12															4	0	None > LOD	None > LOD		IS					
1.3.5-Trimethylbenzene	ug/kg	<8				<8	<8	<8															4	0	None > LOD	None > LOD		IS					
cis-1-3-Dichloropropene	ug/kg	<14				<14	<14	<14															4	0	None > LOD	None > LOD		IS					
1.3-Dichloropropane	ug/kg	<7				<7	<7	<7															4	0	None > LOD	None > LOD		IS					
2.2-Dichloropropane	ug/kg	<12				<12	<12	<12															4	0	None > LOD	None > LOD		IS					
2-Chlorotoluene	ug/kg	<9				<9	<9	<9															4	0	None > LOD	None > LOD		IS					
4-Chlorotoluene	ug/kg	<12				<12	<12	<12															4	0	None > LOD	None > LOD		IS					
4-Isopropyltoluene	ug/kg	<11				<11	<11	<11															4	0	None > LOD	None > LOD		IS					
Bromobenzene	ug/kg	<10				<10	<10	<10															4	0	None > LOD	None > LOD		IS					
Bromochloromethane	ug/kg	<14				<14	<14	<14															4	0	None > LOD	None > LOD		IS					
Bromoform	ug/kg	<10				<10	<10	<10															4	0	None > LOD	None > LOD		IS					
Bromomethane	ug/kg	<13				<13	<13	<13															4	0	None > LOD	None > LOD		IS					
Bromodichloromethane	ug/kg	<7				<7	<7	<7															4	0	None > LOD	None > LOD		IS					
Chlorobenzene	ug/kg	<5				<5	<5	<5															4	0	None > LOD	None > LOD		IS			56000		0
Carbon Disulphide	ug/kg	<7				<7	<7	<7															4	0	None > LOD	None > LOD		IS			11000		0
Chloroethane	ug/kg	<14				<14	<14	<14															4	0	None > LOD	None > LOD		IS					
Chloroethene	ug/kg																						0	0	None > LOD	None > LOD		IS			59		0
Chloroform	ug/kg	<8				<8	<8	<8															4	0	None > LOD	None > LOD		IS			99000		0
Chloromethane	ug/kg	<7				<7	<7	<7															4	0	None > LOD	None > LOD		IS					
Carbontetrachloride	ug/kg	<14				<14	<14	<14															4	0	None > LOD	None > LOD		IS					
Dibromomethane	ug/kg	<9				<9	<9	<9															4	0	None > LOD	None > LOD		IS					
Dichlorodifluoromethane	ug/kg	<4				<4	<4	<4															4	0	None > LOD	None > LOD		IS					
Dibromochloromethane	ug/kg	<13				<13	<13	<13															4	0	None > LOD	None > LOD		IS					
Dichloromethane	ug/kg																						0	0	None > LOD	None > LOD		IS					
Dichloromethane	ug/kg	<10				<10	<10	<10															4	0	None > LOD	None > LOD		IS					
Isopropylbenzene	ug/kg	<5				<5	<5	<5															4	0	None > LOD	None > LOD		IS					
n-Butylbenzene	ug/kg	<10				<10	<10	<10															4	0	None > LOD	None > LOD		IS					
Propylbenzene	ug/kg	<11				<11	<11	<11															4	0	None > LOD	None > LOD		IS					
sec-Butylbenzene	ug/kg																						0	0	None > LOD	None > LOD		IS					
sec-Butylbenzene	ug/kg	<10				<10	<10	<10															4	0	None > LOD	None > LOD		IS					
Styrene	ug/kg	<10				<10	<10	<10															4	0	None > LOD	None > LOD		IS					
trans-1-2-Dichloroethene	ug/kg	<11				<11	<11	<11															4	0	None > LOD	None > LOD		IS					
trans-1-3-Dichloropropene	ug/kg	<14				<14	<14	<14															4	0	None > LOD	None > LOD		IS					
Trichlorofluoromethane	ug/kg	<6				<6	<6	<6															4	0	None > LOD	None > LOD		IS					
tert-Butylbenzene	ug/kg	<12				<12	<12	<12															4	0	None > LOD	None > LOD		IS					
Tetrachloroethene	ug/kg																						0	0	None > LOD	None > LOD		IS			19000		0
Tetrachloroethene	ug/kg	<5				<5	<5	<5															4	0	None > LOD	None > LOD		IS			19000		0
Trichloroethene	ug/kg	<9				<9	<9	<9															4	0	None > LOD	None > LOD		IS			1200		0
Vinyl Chloride	ug/kg	<10				<10	<10	<10															4	0	None > LOD	None > LOD		IS			59		0

A4 Appendix 4

Tabulated Groundwater Data

M4CAN
Groundwater Analysis Results & Screening Assessment
CL-14
14/07/2015

Monitoring Round	Units	Screening Criteria					1	2	3	1	2	1		2		3		1		2		3		1		2		3
Location		EQS	DWS	CH12	CH 17	TP6	BH412	BH412	BH412	BH413	BH413	BH415	BH415	BH415	BH415	BH415	BH415	BH417	BH417	BH417	BH417	BH417	BH417	BH420	BH420	BH420	BH420	BH420
Location Type							BH			BH		BH						BH						BH				
Response Zone Details (RZ)				MG	TFD		GFD	GFD	GFD	GFD	GFD	MM	GFD	GFD	MM	GFD	MM	MG	GFD	MG	GFD	MG	GFD	MG	GFD	MG	GFD	MG
Depth (m)				1.35	2.7	-	16.7	6.17	9.47	15.62	15.5	6.53	6.72	6.74	6.89	6.42	6.75	2.3	6.69	2.39	6.67	0.81	6.52	2.15	7.8	2.15	8.02	2.02
Installation Details							Deep	Deep	Deep	Deep	Deep	Deep	Shallow	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow
Date Sampled				07/02/2000	2000	Aug-05	20/04/2015	23/04/2015	08/05/2015	27/04/2015	05/05/2015	20/04/2015		27/04/2015		05/05/2015		20/04/2015		27/04/2015		05/05/2015		20/04/2015		27/04/2015		05/05
Metals																												
Arsenic Dissolved	ug/l	50	10	2	3	<10	7.1	9.3	6	26	11	13	6.2	24	41	9.9	12	4.2	14	4.1	17	2.2	22	36	12	19	30	17
Boron Dissolved	ug/l	2000	1000				2300	410	490	3800	2600	220	530	1600	1000	1600	1100	1100	1400	610	1700	1100	2100	250	1300	1100	2400	1200
Cadmium Dissolved	ug/l	0.15	5	<0.1	<0.1	2	<0.08	<0.08	0.11	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.73	<0.08	<0.08	<0.08	<0.08
Chromium Dissolved	ug/l		50	<1	<1	<10	14	22	<1	82	20	28	14	74	100	17	23	8.7	14	24	37	<1	<1	<1	23	41	97	12
Copper Dissolved	ug/l	10	2000	13	2	<10	31	8.5	23	8.8	15	24	6.9	8	9.3	13	14	<1	5.3	<1	3.1	<1	3.1	1.7	34	2	12	3.6
Lead Dissolved	ug/l	1.2	10	<1	<1	<50	<1	<1	3.3	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	1.1	<1	<1
Mercury Dissolved	ug/l	0.07	1	<0.1	<0.1		<0.5	<0.5	<0.5	<0.5	<0.5	0.75	<0.5	0.56	0.63	<0.5	<0.5	<0.5	<0.5	0.6	0.55	<0.5	<0.5	0.69	0.72	<0.5	0.54	<0.5
Nickel Dissolved	ug/l	4	20	7	9	<20	7.8	1.9	1.8	6.8	2	1.6	3.6	5.3	3.5	5.2	2.6	4	1	3.4	2.2	6.7	1.3	1.8	1.8	2.8	3.1	1.8
Selenium Dissolved	ug/l		10	<1	<1		14	22	9.4	47	25	24	9.4	48	64	20	18	<1	5.1	<1	11	<1	4.4	3.8	21	6.4	55	3.2
Zinc Dissolved	ug/l	75		7	7	<10	3.7	14	13	14	9	12	3.7	12	18	11	14	5.9	2.2	6	7	2.4	2.2	<1	4.4	6.9	12	5.2
Non-Metal Inorganics																												
Total Alkalinity as CaCO3	mg/l						1700	180	150	1200	1100	170	540	470	210	630	230	400	1300	62	890	440	1200	550	730	340	600	490
Total Diss Sulphur	mg/l			79.8	253																							
Chloride	mg/l	250	250				2000	2900	2600	2800	4200	4100	1500	2900	3700	3400	4000	19	510	21	490	15	520	190	2500	240	2700	270
Ammoniacal Nitrogen as N	mg/l	0.6					5.1	4	3.2	6.5	10	0.93	4.4	9.3	1.3	10	1.5	0.18	7.8	0.061	7.2	0.19	7.4	2.8	12	2.3	15	2.2
Total Cyanide	mg/l	0.001	0.05		<0.025		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Free Cyanide	mg/l						<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
pH Value	pH units	6-9	6.5-10	7.4	7.7		7.1	7.3	7.6	8	7.4	7.2	7.5	7.9	8.1	7.7	7.5	7.7	7.6	7.6	8.1	7.5	7.8	7.7	7.4	8.4	8.4	7.8
Phenols																												
Phenol	ug/l	7.7		<0.0005					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dimethylphenols	ug/l			<0.5																								
Trimethylphenols	ug/l			<0.5																								
Cresols	ug/l			<0.5																								
Phenols	mg/l	0.0077					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.11
BTEX																												
MTBE	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Benzene	ug/l	10	1				<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	ug/l	50					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ethyl benzene	ug/l	20					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
m & p Xylene	ug/l	30					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
o Xylene	ug/l	30					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TPH																												
TPH FTIR	ug/l				80																							
TPH GC	ug/l			220	140	<100																						
Aliphatics C5-C6	ug/l						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C6-C8	ug/l						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C8-C10	ug/l						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C10-C12	ug/l						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C12-C16 Aqueous	ug/l						240	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	73	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C16-C21 Aqueous	ug/l						380	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	130	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C21-C35 Aqueous	ug/l						1100	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1500	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C35-44	ug/l						1.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C5-C7	ug/l						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C7-C8	ug/l						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >EC8-EC10	ug/l						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >EC10-EC12	ug/l						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >EC12-EC16 Aqueous	ug/l						280	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	25	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >EC16-EC21 Aqueous	ug/l						440	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	51	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >EC21-EC35 Aqueous	ug/l						910	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	89	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C35-44	ug/l						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Aliphatic TPH	ug/l						1700	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	1700	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total Aromatic TPH	ug/l						1600	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	170	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total petroleum hydrocarbons	ug/l						3300	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	1900	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
PAHs																												
Acenaphthene	ug/l			<0.05	<0.05		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	ug/l			<1.00	<1.00		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	ug/l	0.1		<0.05	<0.05		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	ug/l			<0.05	<0.05		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene	ug/l	0.00017	0.01	<0.05	<0.05		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b)fluoranthene	ug/l	0.017	0.1	<0.05	<0.05		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	ug/l	0.017	0.1	<0.05	<0.05		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

M4CAN
Groundwater Analysis Results & Screening Assessment
CL-14
14/07/2015

Geological Formation Legend

MG	Made Ground
MM	Mercia Mudstone Group
GFD	Glaciofluvial Deposits
TFD	Tidal Flat deposit

Screening Values & Assessment

EQS	Environmental Quality Standards
DWS	Drinking Water Standard
	Exceeds EQS
X	Exceeds DWS
X	Laboratory detection level higher than screening criterion

Notes

EQS calcium carbonate 100 - 150mg/l for heavy metals: chromium, copper, lead, nickel and zinc

Monitoring Round	Units	Screening Criteria		3	1		2		3	
Location		EQS	DWS	BH420	BH422A	BH422A	BH422A	BH422A	BH422A	BH422A
Location Type					BH					
Response Zone Details (RZ)				GFD	TFD	GFD	TFD	GFD	TFD	GFD
Depth (m)				7.87	2.22	8.17	2.92	7.85	2.75	8.27
Installation Details				Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep
Date Sampled				/2015	23/04/2015		30/04/2015		08/05/2015	
Metals										
Arsenic Dissolved	ug/l	50	10	10	11	24	10	25	4.8	18
Boron Dissolved	ug/l	2000	1000	2100	620	1700	230	1000	240	1000
Cadmium Dissolved	ug/l	0.15	5	<0.08	0.33	0.13	<0.08	<0.08	0.17	0.15
Chromium Dissolved	ug/l		50	17	7.1	65	13	68	<1	<1
Copper Dissolved	ug/l	10	2000	12	11	69	3.1	37	2.7	22
Lead Dissolved	ug/l	1.2	10	<1	<1	<1	<1	<1	2.5	2.2
Mercury Dissolved	ug/l	0.07	1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nickel Dissolved	ug/l	4	20	2.5	6.9	5	2.6	2.4	3.8	2.2
Selenium Dissolved	ug/l		10	16	2.9	2.9	3.1	<1	<1	<1
Zinc Dissolved	ug/l	75		5.7	12	16	2	17	<1	12
Non-Metal Inorganics										
Total Alkalinity as CaCO3	mg/l			740					420	480
Total Diss Sulphur	mg/l									
Chloride	mg/l	250	250	3100					450	7100
Ammoniacal Nitrogen as N	mg/l	0.6		16					0.75	5.7
Total Cyanide	mg/l	0.001	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Free Cyanide	mg/l			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
pH Value	pH units	6-9	6.5-10	7.7	7.9	7.7	7.6	7.2	7.7	7.5
Phenols										
Phenol	ug/l	7.7		<0.5					<0.5	<0.5
Dimethylphenols	ug/l									
Trimethylphenols	ug/l									
Cresols	ug/l									
Phenols	mg/l	0.0077		<0.03					<0.03	<0.03
BTEX										
MTBE	ug/l			<1					<1	<1
Benzene	ug/l	10	1	<1	<1	<1	<1	<1	<1	<1
Toluene	ug/l	50		<1	<1	<1	<1	<1	<1	<1
Ethyl benzene	ug/l	20		<1	<1	<1	<1	<1	<1	<1
m & p Xylene	ug/l	30		<1	<1	<1	<1	<1	<1	<1
o Xylene	ug/l	30		<1	<1	<1	<1	<1	<1	<1
TPH										
TPH FTIR	ug/l									
TPH GC	ug/l									
Aliphatics C5-C6	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C6-C8	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C8-C10	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C10-C12	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C12-C16 Aqueous	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C16-C21 Aqueous	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C21-C35 Aqueous	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C35-44	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C5-C7	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C7-C8	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >EC8-EC10	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >EC10-EC12	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >EC12-EC16 Aqueous	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >EC16-EC21 Aqueous	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >EC21-EC35 Aqueous	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C35-44	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Aliphatic TPH	ug/l			<5	<5	<5	<5	<5	<5	<5
Total Aromatic TPH	ug/l			<5	<5	<5	<5	<5	<5	<5
Total petroleum hydrocarbons	ug/l			<10	<10	<10	<10	<10	<10	<10
PAHs										
Acenaphthene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	ug/l	0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene	ug/l	0.00017	0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b)fluoranthene	ug/l	0.017	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	ug/l	0.017	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
32	31	41	2	BH415 @ 6.89mbGL	0	18
29	29	3800	220	BH413 @ 15.62mbGL	6	17
32	7	2	0.11	TP6 @ -mbGL	4	0
32	23	100	7.1	BH415 @ 6.89mbGL		6
32	28	69	1.7	BH422A @ 8.17mbGL	14	0
32	5	3.3	1	BH412 @ 9.47mbGL	3	0
31	8	0.75	0.54	BH415 @ 6.53mbGL	8	0
32	31	9	1	CH 17 @ 2.7mbGL	9	0
31	23	64	2.9	BH415 @ 6.89mbGL		13
32	29	18	2	BH415 @ 6.89mbGL	0	
25	25	1700	62	BH412 @ 16.7mbGL		
2	2	253	79.8	CH 17 @ 2.7mbGL		
25	25	7100	15	BH422A @ 8.27mbGL	20	20
25	25	16	0.061	BH420 @ 7.87mbGL	22	
30	0	None > LOD	None > LOD		0	0
29	0	None > LOD	None > LOD			
31	31	8.4	7.1	BH420 @ 2.15mbGL	0	0
24	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
25	1	0.11	0.11	BH420 @ 2.02mbGL	1	
23	0	None > LOD	None > LOD			
29	0	None > LOD	None > LOD		0	0
29	0	None > LOD	None > LOD		0	
29	0	None > LOD	None > LOD		0	
29	0	None > LOD	None > LOD		0	
29	0	None > LOD	None > LOD		0	
1	1	80	80	CH 17 @ 2.7mbGL		
3	2	220	140	CH12 @ 1.35mbGL		
29	0	None > LOD	None > LOD			
29	0	None > LOD	None > LOD			
29	0	None > LOD	None > LOD			
29	0	None > LOD	None > LOD			
29	2	240	73	BH412 @ 16.7mbGL		
29	2	380	130	BH412 @ 16.7mbGL		
29	2	1500	1100	BH417 @ 2.3mbGL		
29	1	1.4	1.4	BH412 @ 16.7mbGL		
29	0	None > LOD	None > LOD			
29	0	None > LOD	None > LOD			
29	0	None > LOD	None > LOD			
29	0	None > LOD	None > LOD			
29	2	280	25	BH412 @ 16.7mbGL		
29	2	440	51	BH412 @ 16.7mbGL		
29	2	910	89	BH412 @ 16.7mbGL		
29	0	None > LOD	None > LOD			
29	2	1700	1700	BH412 @ 16.7mbGL		
29	2	1600	170	BH412 @ 16.7mbGL		
29	2	3300	1900	BH412 @ 16.7mbGL		
31	0	None > LOD	None > LOD			
31	0	None > LOD	None > LOD			
31	0	None > LOD	None > LOD		0	
31	0	None > LOD	None > LOD			
31	0	None > LOD	None > LOD		0	0
31	0	None > LOD	None > LOD		0	0
31	0	None > LOD	None > LOD		0	0

Monitoring Round	Units	Screening Criteria					1	2	3	1	2	1		2		3		1		2		3		1		2		3
Location		EQS	DWS	CH12	CH 17	TP6	BH412	BH412	BH412	BH413	BH413	BH415	BH415	BH415	BH415	BH415	BH415	BH417	BH417	BH417	BH417	BH417	BH417	BH420	BH420	BH420	BH420	BH420
Location Type							BH			BH		BH						BH						BH				
Response Zone Details (RZ)				MG	TFD		GFD	GFD	GFD	GFD	GFD	MM	GFD	GFD	MM	GFD	MM	MG	GFD	MG	GFD	MG	GFD	MG	GFD	MG	GFD	MG
Depth (m)				1.35	2.7	-	16.7	6.17	9.47	15.62	15.5	6.53	6.72	6.74	6.89	6.42	6.75	2.3	6.69	2.39	6.67	0.81	6.52	2.15	7.8	2.15	8.02	2.02
Installation Details							Deep	Deep	Deep	Deep	Deep	Deep	Shallow	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow
Date Sampled				07/02/2000	2000	Aug-05	20/04/2015	23/04/2015	08/05/2015	27/04/2015	05/05/2015	20/04/2015		27/04/2015		05/05/2015		20/04/2015		27/04/2015		05/05/2015		20/04/2015		27/04/2015		05/05
Chrysene	ug/l			<0.05	<0.05		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	ug/l			<0.05	<0.05		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	ug/l	0.0063		<0.05	<0.05		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	ug/l			<0.05	<0.05		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	ug/l	0.0082	0.1	<0.05	<0.05		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-cd)pyrene	ug/l		0.1	<0.05	<0.05		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Naphthalene	ug/l	2		<0.50	<0.50		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	ug/l			<0.05	<0.05		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	ug/l			<0.05	<0.05		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total PAHs (USEPA 16)	ug/l			<2.20	<2.20	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
VOCs																												
1,1,1,2-Tetrachloroethane	ug/l								<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,1,1-Trichloroethane	ug/l	100							<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2-Trichloroethane	ug/l	400							<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
1,1-Dichloroethane	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1-Dichloroethene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1-Dichloropropene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-Trichlorobenzene	ug/l	0.4							<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,2,3-Trichloropropane	ug/l								<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
1,2,4-Trichlorobenzene	ug/l	0.4							<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-Trimethylbenzene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-Dibromo-3-Chloropropane	ug/l								<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
1,2-Dibromoethane	ug/l								<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
1,2-Dichlorobenzene	ug/l	20							<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-Dichloroethane	ug/l	10	3						<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,2-Dichloropropane	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,3,5-Trimethylbenzene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,3-Dichloropropane	ug/l								<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,4-Dichlorobenzene	ug/l	20							<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
2-Chlorotoluene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
4-Chlorotoluene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
4-Isopropyltoluene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Benzene	ug/l	10	1				<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromobenzene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromochloromethane	ug/l		100						<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Bromodichloromethane	ug/l								<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Bromomethane	ug/l								<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Chlorobenzene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloroethane	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloroethene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloroform	ug/l	2.5	100						<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloromethane	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
cis-1,2-Dichloroethene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
cis-1,3-Dichloropropene	ug/l								<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Dibromochloromethane	ug/l		100						<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Dibromomethane	ug/l								<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Dichlorodifluoromethane	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	ug/l	20					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Hexachlorobutadiene (HCBD)	ug/l	0.6							<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Isopropylbenzene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
m,p xylenes	ug/l	30					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Methyl tert-butyl ether (MTBE)	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
n-Butylbenzene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
n-propylbenzene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
O-Xylene	ug/l	30					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Sec-Butylbenzene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Styrene	ug/l	50							<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Tert-Butylbenzene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Tetrachloroethene	ug/l	10	10						<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Tetrachloromethane (Carbon Tetra Chloride)	ug/l	12	3						<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	ug/l	50					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
trans-1,2-Dichloroethene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
trans-1,3-Dichloropropene	ug/l								<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Tribromomethane	ug/l		100						<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Trichloroethene	ug/l	10	10						<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Trichlorofluoromethane	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
SVOCs																												
1,3-Dichlorobenzene	ug/l	20							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Monitoring Round	Units	Screening Criteria		3	1		2		3	
Location		EQS	DWS	BH420	BH422A	BH422A	BH422A	BH422A	BH422A	BH422A
Location Type					BH					
Response Zone Details (RZ)				GFD	TFD	GFD	TFD	GFD	TFD	GFD
Depth (m)				7.87	2.22	8.17	2.92	7.85	2.75	8.27
Installation Details				Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep
Date Sampled				/2015	23/04/2015		30/04/2015		08/05/2015	
Chrysene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	ug/l	0.0063		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	ug/l	0.0082	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-cd)pyrene	ug/l		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Naphthalene	ug/l	2		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total PAHs (USEPA 16)	ug/l			<2	<2	<2	<2	<2	<2	<2
VOCs										
1,1,1,2-Tetrachloroethane	ug/l			<2					<2	<2
1,1,1-Trichloroethane	ug/l	100		<1					<1	<1
1,1,2-Trichloroethane	ug/l	400		<10					<10	<10
1,1-Dichloroethane	ug/l			<1					<1	<1
1,1-Dichloroethene	ug/l			<1					<1	<1
1,1-Dichloropropene	ug/l			<1					<1	<1
1,2,3-Trichlorobenzene	ug/l	0.4		<2					<2	<2
1,2,3-Trichloropropane	ug/l			<50					<50	<50
1,2,4-Trichlorobenzene	ug/l	0.4		<1					<1	<1
1,2,4-Trimethylbenzene	ug/l			<1					<1	<1
1,2-Dibromo-3-Chloropropane	ug/l			<50					<50	<50
1,2-Dibromoethane	ug/l			<5					<5	<5
1,2-Dichlorobenzene	ug/l	20		<1					<1	<1
1,2-Dichloroethane	ug/l	10	3	<2					<2	<2
1,2-Dichloropropane	ug/l			<1					<1	<1
1,3,5-Trimethylbenzene	ug/l			<1					<1	<1
1,3-Dichloropropane	ug/l			<2					<2	<2
1,4-Dichlorobenzene	ug/l	20		<1					<1	<1
2-Chlorotoluene	ug/l			<1					<1	<1
4-Chlorotoluene	ug/l			<1					<1	<1
4-Isopropyltoluene	ug/l			<1					<1	<1
Benzene	ug/l	10	1	<1	<1	<1	<1	<1	<1	<1
Bromobenzene	ug/l			<1					<1	<1
Bromochloromethane	ug/l		100	<5					<5	<5
Bromodichloromethane	ug/l			<5					<5	<5
Bromomethane	ug/l			<5					<5	<5
Chlorobenzene	ug/l			<1					<1	<1
Chloroethane	ug/l			<1					<1	<1
Chloroethene	ug/l			<1					<1	<1
Chloroform	ug/l	2.5	100	<1					<1	<1
Chloromethane	ug/l			<1					<1	<1
cis-1,2-Dichloroethene	ug/l			<1					<1	<1
cis-1,3-Dichloropropene	ug/l			<10					<10	<10
Dibromochloromethane	ug/l		100	<10					<10	<10
Dibromomethane	ug/l			<10					<10	<10
Dichlorodifluoromethane	ug/l			<1					<1	<1
Ethylbenzene	ug/l	20		<1	<1	<1	<1	<1	<1	<1
Hexachlorobutadiene (HCBD)	ug/l	0.6		<1					<1	<1
Isopropylbenzene	ug/l			<1					<1	<1
m,p xylenes	ug/l	30		<1	<1	<1	<1	<1	<1	<1
Methyl tert-butyl ether (MTBE)	ug/l			<1					<1	<1
n-Butylbenzene	ug/l			<1					<1	<1
n-propylbenzene	ug/l			<1					<1	<1
O-Xylene	ug/l	30		<1	<1	<1	<1	<1	<1	<1
Sec-Butylbenzene	ug/l			<1					<1	<1
Styrene	ug/l	50		<1					<1	<1
Tert-Butylbenzene	ug/l			<1					<1	<1
Tetrachloroethene	ug/l	10	10	<1					<1	<1
Tetrachloromethane (Carbon Tetra Chloride)	ug/l	12	3	<1					<1	<1
Toluene	ug/l	50		<1	<1	<1	<1	<1	<1	<1
trans-1,2-Dichloroethene	ug/l			<1					<1	<1
trans-1,3-Dichloropropene	ug/l			<10					<10	<10
Tribromomethane	ug/l		100	<1					<1	<1
Trichloroethene	ug/l	10	10	<1					<1	<1
Trichlorofluoromethane	ug/l			<1					<1	<1
SVOCs										
1,3-Dichlorobenzene	ug/l	20		<0.5					<0.5	<0.5

Notes

EQS calcium carbonate 100 - 150mg/l for heavy metals: chromium, copper, lead, nickel and zinc

No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
31	0	None > LOD	None > LOD			
31	0	None > LOD	None > LOD			
31	0	None > LOD	None > LOD		0	
31	0	None > LOD	None > LOD			
31	0	None > LOD	None > LOD		0	0
31	0	None > LOD	None > LOD			0
31	0	None > LOD	None > LOD		0	
31	0	None > LOD	None > LOD			
31	0	None > LOD	None > LOD			
32	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD		0	
23	0	None > LOD	None > LOD		0	
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD		0	
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD		0	
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD		0	
23	0	None > LOD	None > LOD		0	0
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD		0	
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
29	0	None > LOD	None > LOD		0	0
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			0
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD		0	
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
29	0	None > LOD	None > LOD		0	
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD		0	
23	0	None > LOD	None > LOD			
29	0	None > LOD	None > LOD		0	
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			0
23	0	None > LOD	None > LOD		0	0
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD		0	

Monitoring Round	Units	Screening Criteria					1	2	3	1	2	1		2		3		1		2		3		1		2		3
Location		EQS	DWS	CH12	CH 17	TP6	BH412	BH412	BH412	BH413	BH413	BH415	BH415	BH415	BH415	BH415	BH415	BH417	BH417	BH417	BH417	BH417	BH417	BH420	BH420	BH420	BH420	BH420
Location Type							BH			BH		BH						BH						BH				
Response Zone Details (RZ)				MG	TFD		GFD	GFD	GFD	GFD	GFD	MM	GFD	GFD	MM	GFD	MM	MG	GFD	MG	GFD	MG	GFD	MG	GFD	MG	GFD	MG
Depth (m)				1.35	2.7	-	16.7	6.17	9.47	15.62	15.5	6.53	6.72	6.74	6.89	6.42	6.75	2.3	6.69	2.39	6.67	0.81	6.52	2.15	7.8	2.15	8.02	2.02
Installation Details							Deep	Deep	Deep	Deep	Deep	Deep	Shallow	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow
Date Sampled				07/02/2000	2000	Aug-05	20/04/2015	23/04/2015	08/05/2015	27/04/2015	05/05/2015	20/04/2015		27/04/2015		05/05/2015		20/04/2015		27/04/2015		05/05/2015		20/04/2015		27/04/2015		05/05
2,4,5-Trichlorophenol	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4,6-Trichlorophenol	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-Dichlorophenol	ug/l	20							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-Dimethylphenol	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-Dinitrotoluene	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,6-Dinitrotoluene	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Chloronaphthalene	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Chlorophenol	ug/l	50							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Methyl-4,6-Dinitrophenol	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Methylnaphthalene	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Methylphenol	ug/l	100							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Nitroaniline	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Nitrophenol	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
3-Nitroaniline	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Bromophenyl Phenyl Ether	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Chloro-3-Methylphenol	ug/l	40							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Chloroaniline	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Chlorophenyl Phenyl Ether	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Methylphenol	ug/l	100							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Nitroaniline	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Azobenzene	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bis(2-chloroethoxy)methane	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bis(2-chloroethyl)ether	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bis(2-chloroisopropyl)ether	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bis(2-ethylhexyl)phthalate	ug/l	1.3							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Butylbenzylphthalate	ug/l	20							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbazole	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibenzofuran	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Diethylphthalate	ug/l	200							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dimethylphthalate	ug/l	800							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Di-N-Butyl Phthalate	ug/l	8							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Di-N-Octyl Phthalate	ug/l	20							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobenzene (HCB)	ug/l	0.05							**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**
Hexachlorocyclopentadiene	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachloroethane	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Isophorone	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nitrobenzene	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
n-nitrosodimethylamine	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
N-Nitroso-Di-N-Propylamine	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Pentachlorophenol (PCP)	ug/l	0.4							**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**
Phenol	ug/l	7.7							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
PCBs																												
Pcb-101 2,2',4,5,5' - Pentachlorobiphenyl	ug/l						<0.01	<0.01	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					
Pcb-118 2,3',4,4',5 - Pentachlorobiphenyl	ug/l						<0.01	<0.01	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					
Pcb-138 2,2',3,4,4',5' - Hexachlorobiphenyl	ug/l						<0.01	<0.01	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					
Pcb-153 2,2',4,4',5,5' - Hexachlorobiphenyl	ug/l						<0.01	<0.01	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					
Pcb-180 2,2',3,4,4',5,5' - Heptachlorobiphenyl	ug/l						<0.01	<0.01	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					
Pcb-28 2,4,4' - Trichlororbiphenyl	ug/l						<0.01	<0.01	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					
Pcb-52 2,2',5,5' - Tetrachlorobiphenyl	ug/l						<0.01	<0.01	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					

Monitoring Round	Units	Screening Criteria		3	1		2		3	
Location		EQS	DWS	BH420	BH422A	BH422A	BH422A	BH422A	BH422A	BH422A
Location Type					BH					
Response Zone Details (RZ)				GFD	TFD	GFD	TFD	GFD	TFD	GFD
Depth (m)				7.87	2.22	8.17	2.92	7.85	2.75	8.27
Installation Details				Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep
Date Sampled				/2015	23/04/2015		30/04/2015		08/05/2015	
2,4,5-Trichlorophenol	ug/l			<0.5					<0.5	<0.5
2,4,6-Trichlorophenol	ug/l			<0.5					<0.5	<0.5
2,4-Dichlorophenol	ug/l	20		<0.5					<0.5	<0.5
2,4-Dimethylphenol	ug/l			<0.5					<0.5	<0.5
2,4-Dinitrotoluene	ug/l			<0.5					<0.5	<0.5
2,6-Dinitrotoluene	ug/l			<0.5					<0.5	<0.5
2-Chloronaphthalene	ug/l			<0.5					<0.5	<0.5
2-Chlorophenol	ug/l	50		<0.5					<0.5	<0.5
2-Methyl-4,6-Dinitrophenol	ug/l			<0.5					<0.5	<0.5
2-Methylnaphthalene	ug/l			<0.5					<0.5	<0.5
2-Methylphenol	ug/l	100		<0.5					<0.5	<0.5
2-Nitroaniline	ug/l			<0.5					<0.5	<0.5
2-Nitrophenol	ug/l			<0.5					<0.5	<0.5
3-Nitroaniline	ug/l			<0.5					<0.5	<0.5
4-Bromophenyl Phenyl Ether	ug/l			<0.5					<0.5	<0.5
4-Chloro-3-Methylphenol	ug/l	40		<0.5					<0.5	<0.5
4-Chloroaniline	ug/l			<0.5					<0.5	<0.5
4-Chlorophenyl Phenyl Ether	ug/l			<0.5					<0.5	<0.5
4-Methylphenol	ug/l	100		<0.5					<0.5	<0.5
4-Nitroaniline	ug/l			<0.5					<0.5	<0.5
Azobenzene	ug/l			<0.5					<0.5	<0.5
Bis(2-chloroethoxy)methane	ug/l			<0.5					<0.5	<0.5
Bis(2-chloroethyl)ether	ug/l			<0.5					<0.5	<0.5
Bis(2-chloroisopropyl)ether	ug/l			<0.5					<0.5	<0.5
Bis(2-ethylhexyl)phthalate	ug/l	1.3		<0.5					<0.5	<0.5
Butylbenzylphthalate	ug/l	20		<0.5					<0.5	<0.5
Carbazole	ug/l			<0.5					<0.5	<0.5
Dibenzofuran	ug/l			<0.5					<0.5	<0.5
Diethylphthalate	ug/l	200		<0.5					<0.5	<0.5
Dimethylphthalate	ug/l	800		<0.5					<0.5	<0.5
Di-N-Butyl Phthalate	ug/l	8		<0.5					<0.5	<0.5
Di-N-Octyl Phthalate	ug/l	20		<0.5					<0.5	<0.5
Hexachlorobenzene (HCB)	ug/l	0.05		**<0.5**					**<0.5**	**<0.5**
Hexachlorocyclopentadiene	ug/l			<0.5					<0.5	<0.5
Hexachloroethane	ug/l			<0.5					<0.5	<0.5
Isophorone	ug/l			<0.5					<0.5	<0.5
Nitrobenzene	ug/l			<0.5					<0.5	<0.5
n-nitrosodimethylamine	ug/l			<0.5					<0.5	<0.5
N-Nitroso-Di-N-Propylamine	ug/l			<0.5					<0.5	<0.5
Pentachlorophenol (PCP)	ug/l	0.4		**<0.5**					**<0.5**	**<0.5**
Phenol	ug/l	7.7		<0.5					<0.5	<0.5
PCBs										
Pcb-101 2,2',4,5,5' - Pentachlorobiphenyl	ug/l									
Pcb-118 2,3',4,4',5 - Pentachlorobiphenyl	ug/l									
Pcb-138 2,2',3,4,4',5' - Hexachlorobiphenyl	ug/l									
Pcb-153 2,2',4,4',5,5' - Hexachlorobiphenyl	ug/l									
Pcb-180 2,2',3,4,4',5,5' - Heptachlorobiphenyl	ug/l									
Pcb-28 2,4,4' - Trichlororbiphenyl	ug/l									
Pcb-52 2,2',5,5' - Tetrachlorobiphenyl	ug/l									

Notes

EQS calcium carbonate 100 - 150mg/l for heavy metals: chromium, copper, lead, nickel and zinc

No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD		0	
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD		0	
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD		0	
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD		0	
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD		0	
23	0	None > LOD	None > LOD		0	
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD		0	
23	0	None > LOD	None > LOD		0	
23	0	None > LOD	None > LOD		0	
23	0	None > LOD	None > LOD		0	
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD			
23	0	None > LOD	None > LOD		0	
23	0	None > LOD	None > LOD		0	
11	0	None > LOD	None > LOD			
11	0	None > LOD	None > LOD			
11	0	None > LOD	None > LOD			
11	0	None > LOD	None > LOD			
11	0	None > LOD	None > LOD			
11	0	None > LOD	None > LOD			
11	0	None > LOD	None > LOD			

A5 Appendix 5

Tabulated Soil Leachate Data

M4CAN
Leachate Analysis Results & Screening Assessment
CL-14
14/07/2015

Sample Reference	Units	Screening Criteria		CH10	CH11	CH11	SBHF03	STPF01	STPF02	STPF04	STPF05	STPF06	STPF07	STPF08	CH23	STPF09	STPF10	TP1	TP1	TP2	TP2	TP3	TP4	TP4	TP5	TP5
Specimen Depth				0.4	0.35	1.65	1	1	1	3	1	0.38	2	0.2	0.16	0.3	0.3	0.5	1.2	0.5	0.8	0.1	0.5	0.9	0.5	1
Level				9.89	9.75	8.45	8.88	8.89	8.7	6.23	7.67	8.89	8.73	8.9	8.31	8.56	8.39									
Sample Type				D	D	D	ES	ES	D	ES	ES	ES	D	B	D	B	ES									
Geology Code		**EQS**	**DWS**	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG		MG	MG	MG	MG	MG	MG	MG
Cluster Code				2000 GI	2000 GI	2000 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2000 GI	2007 GI	2007 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI
Location				OCS						OSH	TW		TW-NDE		EDW											
2:1 Leachate																										
Arsenic Dissolved	ug/l	50	10	5	2	9	2	NDP	7	13	19	<1	<1	1	4	2	1	<10	<10	<10	<10	<10	<10	<10	<10	<10
Boron Dissolved	ug/l	2000	1000				20	NDP	190	84	180	<10	<10	50		<20	<10									
Barium Dissolved	ug/l						120	NDP	48	120	22	45	1200	57		70	110									
Cadmium Dissolved	ug/l	0.15	5				<0.5	NDP	<0.4	<0.4	<0.4	<0.4	<0.4	<0.5		<0.5	<0.4	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium Dissolved	ug/l		50				9	NDP	2	2	<1	<1	<1	3		2	3	<10	<10	<10	<10	<10	<10	<10	<10	<10
Copper Dissolved	ug/l	10	2000	6	2	11	8	NDP	9	1	20	<1	3	7.5	7	5.4	2	<10	<10	<10	<10	<10	<10	<10	<10	<10
Mercury Dissolved	ug/l	0.07	1				<0.01							<0.01		<0.01		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Molybdenum Dissolved	ug/l						18	NDP	89	94	12	9	15	11		4	3									
Nickel Dissolved	ug/l	4	20				<1.5	NDP	3	5	3	<1	4	2.7		<1.5	2	<20	<20	<20	<20	<20	<20	<20	<20	<20
Lead Dissolved	ug/l	1.2	10				5.7	NDP	<1	2	1	<1	3	<0.5		<0.5	1	<50	<50	<50	<50	<50	<50	<50	<50	<50
Antimony Dissolved	ug/l		5				8	NDP	<5	9	15	<5	<5	<1		3	<5									
Selenium Dissolved	ug/l		10				2	NDP	<1	2	6	1	2	<1		2	<1									
Zinc Dissolved	ug/l	75		11	20	25	18	NDP	<3	<3	<3	5	<3	<5	21	<5	<3	<10	<10	<10	<10	<10	<10	<10	<10	<10
Total Cyanide	mg/l	0.001	0.05				<0.05	NDP	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		<0.05	<0.05									
Cyanide Free	mg/l																									
pH Units	pH units	6-9	6.5-10	8	7.9	7.7									7.4											
Organics																										
PAH	ug/l																	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.74
TPH FTIR	ug/l			600	3700	1000									5900											
TPH GC	ug/l			<100	<100	3700									IS			<100	<100	<100	<100	<100	<100	<100	<100	<100
Phenols	mg/l	0.0077																								
BTEX																										
Benzene	ug/l	10	1																							
Toluene	ug/l	50																								
Ethylbenzene	ug/l	20																								
m,p xylenes	ug/l	30																								
O-Xylene	ug/l	30																								
TPH																										
Aliphatics >C5-C6	ug/l																									
Aliphatics >C6-C8	ug/l																									
Aliphatics >C8-C10	ug/l																									
Aliphatics >C10-C12	ug/l																									
Aliphatics >C12-C16	ug/l																									
Aliphatics >C16-C21	ug/l																									
Aliphatics >C21-C35	ug/l																									
Aliphatics >C35-44	ug/l																									
Aromatics >C5-C7	ug/l																									
Aromatics >C7-C8	ug/l																									
Aromatics >C8-C10	ug/l																									
Aromatics >C10-C12	ug/l																									
Aromatics >C12-C16	ug/l																									
Aromatics >C16-C21	ug/l																									
Aromatics >C21-C35	ug/l																									
Aromatics >C35-44	ug/l																									
Total Aliphatic TPH	ug/l																									
Total Aromatic TPH	ug/l																									
Total petroleum hydrocarbons	ug/l																									
PAH																										
Acenaphthene	ug/l																									
Acenaphthylene	ug/l																									
Anthracene	ug/l	0.1																								
Benz(a)anthracene	ug/l																									
Benzo(a)pyrene	ug/l	0.00017	0.01																							
Benzo(b)fluoranthene	ug/l	0.017	0.1																							
Benzo(ghi)perylene	ug/l	0.0082	0.1																							
Benzo(k)fluoranthene	ug/l	0.017	0.1																							
Chrysene	ug/l																									
Dibenzo(ah)anthracene	ug/l																									
Fluoranthene	ug/l	0.0063																								
Fluorene	ug/l																									
Indeno(123cd)pyrene	ug/l	N/A	0.1																							
Naphthalene	ug/l	2																								
Phenanthrene	ug/l																									
Pyrene	ug/l																									
PAH 16 Total	ug/l																									
VOCs																										

M4CAN
Leachate Analysis Results & Screening Assessment
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Location

OCS	Old Coal Sidings
OSH	Old Sanitary Hospital
TW	Timber Works
TW-NDE	Between timber works and north docks entrance
EDW	Engineering Docks Workshop

Geological Formation Legend

MG	Made Ground

Screening Values & Assessment

EQS	Environmental Quality Standards
DWS	Drinking Water Standard
	Exceeds EQS
X	Exceeds DWS
X	Laboratory detection level higher than screening criterion

Notes

EQS calcium carbonate 100 - 150mg/l for heavy metals: chromium, copper, lead, nickel and zinc
IS = Insufficient Sample
NFD = No Fibres Detected

Sample Reference	Units	Screening Criteria		TP6	BH412	BH413	BH414	BH416	BH417	BH418	BH419	BH420	BH421	TP405	TP406	TP407	TP409
Specimen Depth				0.5	1.2 - 1.7	0.8 - 1.2	1.3 - 1.5	1.5 - 1.6	1.5 - 1.6	1 - 1.5	0.3 - 0.8	1.7 - 2.2	1.2 - 1.7	2.4 - 2.5	1.6 - 1.8	1.2 - 1.4	0.5 - 0.6
Level					9.3	9.1	8.9	8.55	7.6	10.4	8.5	8.85	8.1	7.8	8.5	8.25	7.55
Sample Type					ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES
Geology Code		EQS	DWS	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
Cluster Code				Aug 2005 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI
Location																	
2:1 Leachate																	
Arsenic Dissolved	ug/l	50	10	<10	<1	6.6	1.4	3.8	<1	<1	6.7	1.6	4.7	5.3	2.4	1.2	11
Boron Dissolved	ug/l	2000	1000		<20	280	160	94	<20	21	190	59	83	170	56	61	<20
Barium Dissolved	ug/l																
Cadmium Dissolved	ug/l	0.15	5	<0.5	<0.08	<0.08	0.22	0.098	0.16	0.25	<0.08	<0.08	<0.08	0.091	<0.08	<0.08	<0.08
Chromium Dissolved	ug/l		50	<10	<1	<1	5.8	<1	<1	<1	<1	<1	16	<1	49	42	39
Copper Dissolved	ug/l	10	2000	<10	2.1	5.3	1.3	1.4	<1	1.6	7.7	<1	3.4	3.5	<1	<1	<1
Mercury Dissolved	ug/l	0.07	1	<0.2	<0.5	<0.5	<0.5	1.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.66
Molybdenum Dissolved	ug/l																
Nickel Dissolved	ug/l	4	20	<20	<1	1.6	<1	<1	<1	<1	<1	2	<1	1.9	<1	<1	<1
Lead Dissolved	ug/l	1.2	10	<50	<1	<1	<1	<1	9.1	20	4.4	<1	<1	1.5	<1	<1	2.8
Antimony Dissolved	ug/l		5														
Selenium Dissolved	ug/l		10		6.1	2.2	<1	<1	<1	1.7	3	2.2	7.4	3.6	1	1.1	1.4
Zinc Dissolved	ug/l	75		<10	14	18	6.7	2	3.4	8.8	2.7	3.4	4.2	2.9	<1	1.8	<1
Total Cyanide	mg/l	0.001	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cyanide Free	mg/l				<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
pH Units	pH units	6-9	6.5-10		11	7.3	8.1	8.4	8.6	8.4	7.7	8.1	7.7	8.4	8.4	8.3	8.5
Organics																	
PAH	ug/l			<0.2													
TPH FTIR	ug/l																
TPH GC	ug/l			<100													
Phenols	mg/l	0.0077			<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
BTEX																	
Benzene	ug/l	10	1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	ug/l	50			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	ug/l	20			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
m,p xylenes	ug/l	30			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
O-Xylene	ug/l	30			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TPH																	
Aliphatics >C5-C6	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C6-C8	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C8-C10	ug/l				<0.1	<0.1	<0.1	<0.1	1.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C10-C12	ug/l				<0.1	<0.1	<0.1	<0.1	77	5.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C12-C16	ug/l				<0.1	<0.1	<0.1	<0.1	260	53	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C16-C21	ug/l				<0.1	<0.1	<0.1	<0.1	210	50	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C21-C35	ug/l				<0.1	<0.1	<0.1	<0.1	30	28	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C35-44	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C5-C7	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C7-C8	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C8-C10	ug/l				<0.1	<0.1	<0.1	<0.1	0.71	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C10-C12	ug/l				<0.1	<0.1	<0.1	<0.1	15	1.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C12-C16	ug/l				<0.1	<0.1	<0.1	<0.1	34	14	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C16-C21	ug/l				<0.1	<0.1	<0.1	<0.1	17	11	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C21-C35	ug/l				<0.1	<0.1	<0.1	<0.1	20	13	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C35-44	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Aliphatic TPH	ug/l				<5	<5	<5	<5	580	140	<5	<5	<5	<5	<5	<5	<5
Total Aromatic TPH	ug/l				<5	<5	<5	<5	86	39	<5	<5	<5	<5	<5	<5	<5
Total petroleum hydrocarbons	ug/l				<10	<10	<10	<10	660	180	<10	<10	<10	<10	<10	<10	<10
PAH																	
Acenaphthene	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	ug/l	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benz(a)anthracene	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene	ug/l	0.00017	0.01		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b)fluoranthene	ug/l	0.017	0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	ug/l	0.0082	0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	ug/l	0.017	0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(ah)anthracene	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	ug/l	0.0063			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(123cd)pyrene	ug/l	N/A	0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Naphthalene	ug/l	2			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PAH 16 Total	ug/l				<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
VOCs																	

Sample Reference	No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
2:1 Leachate							
Arsenic Dissolved	37	21	19	1	STPF05 @ 1mbGL	0	3
Boron Dissolved	23	15	280	20	BH413 @ 0.8 - 1.2mbGL	0	0
Barium Dissolved	20	9	1200	22	STPF07 @ 2mbGL		
Cadmium Dissolved	33	5	0.25	0.091	BH418 @ 1 - 1.5mbGL	3	0
Chromium Dissolved	36	11	49	2	TP406 @ 1.6 - 1.8mbGL		0
Copper Dissolved	37	20	20	1	STPF05 @ 1mbGL	2	0
Mercury Dissolved	26	2	1.1	0.66	BH416 @ 1.5 - 1.6mbGL	2	1
Molybdenum Dissolved	20	9	94	3	STPF04 @ 3mbGL		
Nickel Dissolved	33	9	5	1.6	STPF04 @ 3mbGL	1	0
Lead Dissolved	33	10	20	1	BH418 @ 1 - 1.5mbGL	8	1
Antimony Dissolved	24	4	15	3	STPF05 @ 1mbGL		3
Selenium Dissolved	37	16	7.4	1	BH421 @ 1.2 - 1.7mbGL		0
Zinc Dissolved	37	17	25	1.8	CH11 @ 1.65mbGL	0	
Total Cyanide	23	0	None > LOD	None > LOD		0	0
Cyanide Free	21	0	None > LOD	None > LOD			
pH Units	25	17	11	7.3	BH412 @ 1.2 - 1.7mbGL	1	1
Organics							
PAH	24	1	0.74	0.74	TP5 @ 1mbGL		
TPH FTIR	16	4	5900	600	CH23 @ 0.16mbGL		
TPH GC	24	1	3700	3700	CH11 @ 1.65mbGL		
Phenols	13	0	None > LOD	None > LOD		0	
BTEX							
Benzene	13	0	None > LOD	None > LOD		0	0
Toluene	13	0	None > LOD	None > LOD		0	
Ethylbenzene	13	0	None > LOD	None > LOD		0	
m,p xylenes	13	0	None > LOD	None > LOD		0	
O-Xylene	13	0	None > LOD	None > LOD		0	
TPH							
Aliphatics >C5-C6	13	0	None > LOD	None > LOD			
Aliphatics >C6-C8	13	0	None > LOD	None > LOD			
Aliphatics >C8-C10	13	1	1.1	1.1	BH417 @ 1.5 - 1.6mbGL		
Aliphatics >C10-C12	13	2	77	5.4	BH417 @ 1.5 - 1.6mbGL		
Aliphatics >C12-C16	13	2	260	53	BH417 @ 1.5 - 1.6mbGL		
Aliphatics >C16-C21	13	2	210	50	BH417 @ 1.5 - 1.6mbGL		
Aliphatics >C21-C35	13	2	30	28	BH417 @ 1.5 - 1.6mbGL		
Aliphatics >C35-44	13	0	None > LOD	None > LOD			
Aromatics >C5-C7	13	0	None > LOD	None > LOD			
Aromatics >C7-C8	13	0	None > LOD	None > LOD			
Aromatics >C8-C10	13	1	0.71	0.71	BH417 @ 1.5 - 1.6mbGL		
Aromatics >C10-C12	13	2	15	1.2	BH417 @ 1.5 - 1.6mbGL		
Aromatics >C12-C16	13	2	34	14	BH417 @ 1.5 - 1.6mbGL		
Aromatics >C16-C21	13	2	17	11	BH417 @ 1.5 - 1.6mbGL		
Aromatics >C21-C35	13	2	20	13	BH417 @ 1.5 - 1.6mbGL		
Aromatics >C35-44	13	0	None > LOD	None > LOD			
Total Aliphatic TPH	13	2	580	140	BH417 @ 1.5 - 1.6mbGL		
Total Aromatic TPH	13	2	86	39	BH417 @ 1.5 - 1.6mbGL		
Total petroleum hydrocarbons	13	2	660	180	BH417 @ 1.5 - 1.6mbGL		
PAH							
Acenaphthene	13	0	None > LOD	None > LOD			
Acenaphthylene	13	0	None > LOD	None > LOD			
Anthracene	13	0	None > LOD	None > LOD		0	
Benz(a)anthracene	13	0	None > LOD	None > LOD			
Benzo(a)pyrene	13	0	None > LOD	None > LOD		0	0
Benzo(b)fluoranthene	13	0	None > LOD	None > LOD		0	0
Benzo(ghi)perylene	13	0	None > LOD	None > LOD		0	0
Benzo(k)fluoranthene	13	0	None > LOD	None > LOD		0	0
Chrysene	13	0	None > LOD	None > LOD			
Dibenzo(ah)anthracene	13	0	None > LOD	None > LOD			
Fluoranthene	13	0	None > LOD	None > LOD		0	
Fluorene	13	0	None > LOD	None > LOD			
Indeno(123cd)pyrene	13	0	None > LOD	None > LOD		0	0
Naphthalene	13	0	None > LOD	None > LOD		0	
Phenanthrene	13	0	None > LOD	None > LOD			
Pyrene	13	0	None > LOD	None > LOD			
PAH 16 Total	13	0	None > LOD	None > LOD			
VOCs							

Sample Reference	Units	Screening Criteria		CH10	CH11	CH11	SBHF03	STPF01	STPF02	STPF04	STPF05	STPF06	STPF07	STPF08	CH23	STPF09	STPF10	TP1	TP1	TP2	TP2	TP3	TP4	TP4	TP5	TP5
Specimen Depth		EQS	DWS	0.4	0.35	1.65	1	1	1	3	1	0.38	2	0.2	0.16	0.3	0.3	0.5	1.2	0.5	0.8	0.1	0.5	0.9	0.5	1
Level				9.89	9.75	8.45	8.88	8.89	8.7	6.23	7.67	8.89	8.73	8.9	8.31	8.56	8.39									
Sample Type				D	D	D	ES	ES	D	ES	ES	ES	D	B	D	B	ES									
Geology Code				MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG		MG	MG	MG	MG	MG	MG	MG
Cluster Code				2000 GI	2000 GI	2000 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2000 GI	2007 GI	2007 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI
Location				OCS						OSH	TW		TW-NDE		EDW											
1,1,1,2-Tetrachloroethane	ug/l																									
1,1,1-Trichloroethane	ug/l	100																								
1,1,2-Trichloroethane	ug/l	400																								
1,1-Dichloroethane	ug/l																									
1,1-Dichloroethene	ug/l																									
1,1-Dichloropropene	ug/l																									
1,2,3-Trichlorobenzene	ug/l	0.4																								
1,2,3-Trichloropropane	ug/l																									
1,2,4-Trimethylbenzene	ug/l																									
1,2-Dibromo-3-Chloropropane	ug/l																									
1,2-Dichlorobenzene	ug/l	20																								
1,2-Dichloroethane	ug/l	10	3																							
1,2-Dichloropropane	ug/l																									
1,3,5-Trimethylbenzene	ug/l																									
1,3-Dichlorobenzene	ug/l	20																								
1,3-Dichloropropane	ug/l																									
1,4-Dichlorobenzene	ug/l	20																								
2-Chlorotoluene	ug/l																									
4-Chlorotoluene	ug/l																									
4-Isopropyltoluene	ug/l																									
Benzene	ug/l	10	1																							
Bromobenzene	ug/l																									
Bromochloromethane	ug/l		100																							
Bromodichloromethane	ug/l																									
Bromomethane	ug/l																									
Chlorobenzene	ug/l																									
Chloroethane	ug/l																									
Chloroethene	ug/l																									
Chloroform	ug/l	2.5	100																							
Chloromethane	ug/l																									
cis-1,2-Dichloroethene	ug/l																									
cis-1,3-Dichloropropene	ug/l																									
Dibromochloromethane	ug/l		100																							
Dibromomethane	ug/l																									
Dichlorodifluoromethane	ug/l																									
Ethylbenzene	ug/l	20																								
Isopropylbenzene	ug/l																									
m,p xylenes	ug/l	30																								
Methyl tert-butyl ether (MTBE)	ug/l																									
n-Butylbenzene	ug/l																									
n-propylbenzene	ug/l																									
O-Xylene	ug/l	30																								
Sec-Butylbenzene	ug/l																									
Styrene	ug/l	50																								
Tert-Butylbenzene	ug/l																									
Tetrachloroethene	ug/l	10	10																							
Tetrachloromethane (Carbon Tetra Chloride)	ug/l	12	3																							
Toluene	ug/l	50																								
trans-1,2-Dichloroethene	ug/l																									
trans-1,3-Dichloropropene	ug/l																									
Tribromomethane	ug/l		100																							
Trichloroethene	ug/l	10	10																							
Trichlorofluoromethane	ug/l																									
SVOCs																										
1,2,4-Trichlorobenzene	ug/l	0.4																								
2,4,5-Trichlorophenol	ug/l																									
2,4,6-Trichlorophenol	ug/l																									
2,4-Dichlorophenol	ug/l	20																								
2,4-Dimethylphenol	ug/l																									
2,4-Dinitrotoluene	ug/l																									
2,6-Dinitrotoluene	ug/l																									
2-Chloronaphthalene	ug/l																									
2-Chlorophenol	ug/l	50																								
2-Methyl-4,6-Dinitrophenol	ug/l																									
2-Methylnaphthalene	ug/l																									
2-Methylphenol	ug/l	100																								
2-Nitroaniline	ug/l																									
2-Nitrophenol	ug/l																									
3-Nitroaniline	ug/l																									
4-Bromophenyl Phenyl Ether	ug/l																									
4-Chloro-3-Methylphenol	ug/l	40																								
4-Chloroaniline	ug/l																									
4-Chlorophenyl Phenyl Ether	ug/l																									
4-Methylphenol	ug/l	100																								
4-Nitroaniline	ug/l																									

Sample Reference	Units	Screening Criteria		TP6	BH412	BH413	BH414	BH416	BH417	BH418	BH419	BH420	BH421	TP405	TP406	TP407	TP409
Specimen Depth		EQS	DWS	0.5	1.2 - 1.7	0.8 - 1.2	1.3 - 1.5	1.5 - 1.6	1.5 - 1.6	1 - 1.5	0.3 - 0.8	1.7 - 2.2	1.2 - 1.7	2.4 - 2.5	1.6 - 1.8	1.2 - 1.4	0.5 - 0.6
Level					9.3	9.1	8.9	8.55	7.6	10.4	8.5	8.85	8.1	7.8	8.5	8.25	7.55
Sample Type					ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES
Geology Code				MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
Cluster Code				Aug 2005 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI
Location																	
1,1,1,2-Tetrachloroethane	ug/l													<2			
1,1,1-Trichloroethane	ug/l	100												<1			
1,1,2-Trichloroethane	ug/l	400												<10			
1,1-Dichloroethane	ug/l													<1			
1,1-Dichloroethene	ug/l													<1			
1,1-Dichloropropene	ug/l													<1			
1,2,3-Trichlorobenzene	ug/l	0.4												<2			
1,2,3-Trichloropropane	ug/l													<50			
1,2,4-Trimethylbenzene	ug/l													<1			
1,2-Dibromo-3-Chloropropane	ug/l													<50			
1,2-Dichlorobenzene	ug/l	20												<1			
1,2-Dichloroethane	ug/l	10	3											<2			
1,2-Dichloropropane	ug/l													<1			
1,3,5-Trimethylbenzene	ug/l													<1			
1,3-Dichlorobenzene	ug/l	20												<1			
1,3-Dichloropropane	ug/l													<2			
1,4-Dichlorobenzene	ug/l	20												<1			
2-Chlorotoluene	ug/l													<1			
4-Chlorotoluene	ug/l													<1			
4-Isopropyltoluene	ug/l													<1			
Benzene	ug/l	10	1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromobenzene	ug/l													<1			
Bromochloromethane	ug/l		100											<5			
Bromodichloromethane	ug/l													<5			
Bromomethane	ug/l													<5			
Chlorobenzene	ug/l													<1			
Chloroethane	ug/l													<2			
Chloroethene	ug/l													<1			
Chloroform	ug/l	2.5	100											<1			
Chloromethane	ug/l													<1			
cis-1,2-Dichloroethene	ug/l													<1			
cis-1,3-Dichloropropene	ug/l													<10			
Dibromochloromethane	ug/l		100											<10			
Dibromomethane	ug/l													<10			
Dichlorodifluoromethane	ug/l													<1			
Ethylbenzene	ug/l	20			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Isopropylbenzene	ug/l													<1			
m,p xylenes	ug/l	30			1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Methyl tert-butyl ether (MTBE)	ug/l													<1			
n-Butylbenzene	ug/l													<1			
n-propylbenzene	ug/l													<1			
O-Xylene	ug/l	30			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Sec-Butylbenzene	ug/l													<1			
Styrene	ug/l	50												<1			
Tert-Butylbenzene	ug/l													<1			
Tetrachloroethene	ug/l	10	10											<1			
Tetrachloromethane (Carbon Tetra Chloride)	ug/l	12	3											<1			
Toluene	ug/l	50			<1	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	<1
trans-1,2-Dichloroethene	ug/l													<1			
trans-1,3-Dichloropropene	ug/l													<10			
Tribromomethane	ug/l		100											<1			
Trichloroethene	ug/l	10	10											<1			
Trichlorofluoromethane	ug/l													<1			
SVOCs																	
1,2,4-Trichlorobenzene	ug/l	0.4												<0.5			
2,4,5-Trichlorophenol	ug/l													<0.5			
2,4,6-Trichlorophenol	ug/l													<0.5			
2,4-Dichlorophenol	ug/l	20												<0.5			
2,4-Dimethylphenol	ug/l													<0.5			
2,4-Dinitrotoluene	ug/l													<0.5			
2,6-Dinitrotoluene	ug/l													<0.5			
2-Chloronaphthalene	ug/l													<0.5			
2-Chlorophenol	ug/l	50												<0.5			
2-Methyl-4,6-Dinitrophenol	ug/l													<0.5			
2-Methylnaphthalene	ug/l													<0.5			
2-Methylphenol	ug/l	100												<0.5			
2-Nitroaniline	ug/l													<0.5			
2-Nitrophenol	ug/l													<0.5			
3-Nitroaniline	ug/l													<0.5			
4-Bromophenyl Phenyl Ether	ug/l													<0.5			
4-Chloro-3-Methylphenol	ug/l	40												<0.5			
4-Chloroaniline	ug/l													<0.5			
4-Chlorophenyl Phenyl Ether	ug/l													<0.5			
4-Methylphenol	ug/l	100												<0.5			
4-Nitroaniline	ug/l													<0.5			

Notes

EQS calcium carbonate 100 - 150mg/l for heavy metals: chromium, copper, lead, nickel and zinc
IS = Insufficient Sample
NFD = No Fibres Detected

No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD		0	0
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
13	0	None > LOD	None > LOD		0	0
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			0
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD		0	0
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			0
1	0	None > LOD	None > LOD			
13	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD			
13	1	1	1	BH412 @ 1.2 - 1.7mbGL	0	
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
13	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			0
1	0	None > LOD	None > LOD		0	0
1	0	None > LOD	None > LOD			
13	1	1	1	BH419 @ 0.3 - 0.8mbGL	0	
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			0
1	0	None > LOD	None > LOD		0	0
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD			

Sample Reference	Units	Screening Criteria		CH10	CH11	CH11	SBHF03	STPF01	STPF02	STPF04	STPF05	STPF06	STPF07	STPF08	CH23	STPF09	STPF10	TP1	TP1	TP2	TP2	TP3	TP4	TP4	TP5	TP5
Specimen Depth				0.4	0.35	1.65	1	1	1	3	1	0.38	2	0.2	0.16	0.3	0.3	0.5	1.2	0.5	0.8	0.1	0.5	0.9	0.5	1
Level				9.89	9.75	8.45	8.88	8.89	8.7	6.23	7.67	8.89	8.73	8.9	8.31	8.56	8.39									
Sample Type				D	D	D	ES	ES	D	ES	ES	ES	D	B	D	B	ES									
Geology Code				MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG		MG	MG	MG	MG	MG	MG	MG
Cluster Code				2000 GI	2000 GI	2000 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2000 GI	2007 GI	2007 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI	Aug 2005 GI
Location				OCS						OSH	TW		TW-NDE		EDW											
Azobenzene	ug/l																									
Bis(2-chloroethoxy)methane	ug/l																									
Bis(2-chloroethyl)ether	ug/l																									
Bis(2-chloroisopropyl)ether	ug/l																									
Bis(2-ethylhexyl)phthalate	ug/l	1.3																								
Butylbenzylphthalate	ug/l	20																								
Carbazole	ug/l																									
Dibenzofuran	ug/l																									
Diethylphthalate	ug/l	200																								
Dimethylphthalate	ug/l	800																								
Di-N-Butyl Phthalate	ug/l	8																								
Di-N-Octyl Phthalate	ug/l	20																								
Hexachlorobenzene (HCB)	ug/l	0.05																								
Hexachlorobutadiene (HCBD)	ug/l	0.6																								
Hexachlorocyclopentadiene	ug/l																									
Hexachloroethane	ug/l																									
Isophorone	ug/l																									
Nitrobenzene	ug/l																									
n-nitrosodimethylamine	ug/l																									
N-Nitroso-Di-N-Propylamine	ug/l																									
Pentachlorophenol (PCP)	ug/l	0.4																								
Phenol	ug/l	7.7																								

Sample Reference	Units	Screening Criteria		TP6	BH412	BH413	BH414	BH416	BH417	BH418	BH419	BH420	BH421	TP405	TP406	TP407	TP409
Specimen Depth		EQS	DWS	0.5	1.2 - 1.7	0.8 - 1.2	1.3 - 1.5	1.5 - 1.6	1.5 - 1.6	1 - 1.5	0.3 - 0.8	1.7 - 2.2	1.2 - 1.7	2.4 - 2.5	1.6 - 1.8	1.2 - 1.4	0.5 - 0.6
Level					9.3	9.1	8.9	8.55	7.6	10.4	8.5	8.85	8.1	7.8	8.5	8.25	7.55
Sample Type					ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES
Geology Code				MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
Cluster Code				Aug 2005 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI
Location																	
Azobenzene	ug/l													<0.5			
Bis(2-chloroethoxy)methane	ug/l													<0.5			
Bis(2-chloroethyl)ether	ug/l													<0.5			
Bis(2-chloroisopropyl)ether	ug/l													<0.5			
Bis(2-ethylhexyl)phthalate	ug/l	1.3												<0.5			
Butylbenzylphthalate	ug/l	20												<0.5			
Carbazole	ug/l													<0.5			
Dibenzofuran	ug/l													<0.5			
Diethylphthalate	ug/l	200												<0.5			
Dimethylphthalate	ug/l	800												<0.5			
Di-N-Butyl Phthalate	ug/l	8												<0.5			
Di-N-Octyl Phthalate	ug/l	20												<0.5			
Hexachlorobenzene (HCB)	ug/l	0.05												<0.5			
Hexachlorobutadiene (HCBD)	ug/l	0.6												<0.5			
Hexachlorocyclopentadiene	ug/l													<0.5			
Hexachloroethane	ug/l													<0.5			
Isophorone	ug/l													<0.5			
Nitrobenzene	ug/l													<0.5			
n-nitrosodimethylamine	ug/l													<0.5			
N-Nitroso-Di-N-Propylamine	ug/l													<0.5			
Pentachlorophenol (PCP)	ug/l	0.4												<0.5			
Phenol	ug/l	7.7												<0.5			

Notes

EQS calcium carbonate 100 - 150mg/l for heavy metals: chromium, copper, lead, nickel and zinc
IS = Insufficient Sample
NFD = No Fibres Detected

No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD		0	

A6 Appendix 6

Relevant Extract of Additional Environmental Data

Plate 01: Extract of 1991 Aerial Photograph

Client:	Welsh Government
Project:	M4CaN
Job Ref:	JER6591 Checked By: Date: Oct 2015

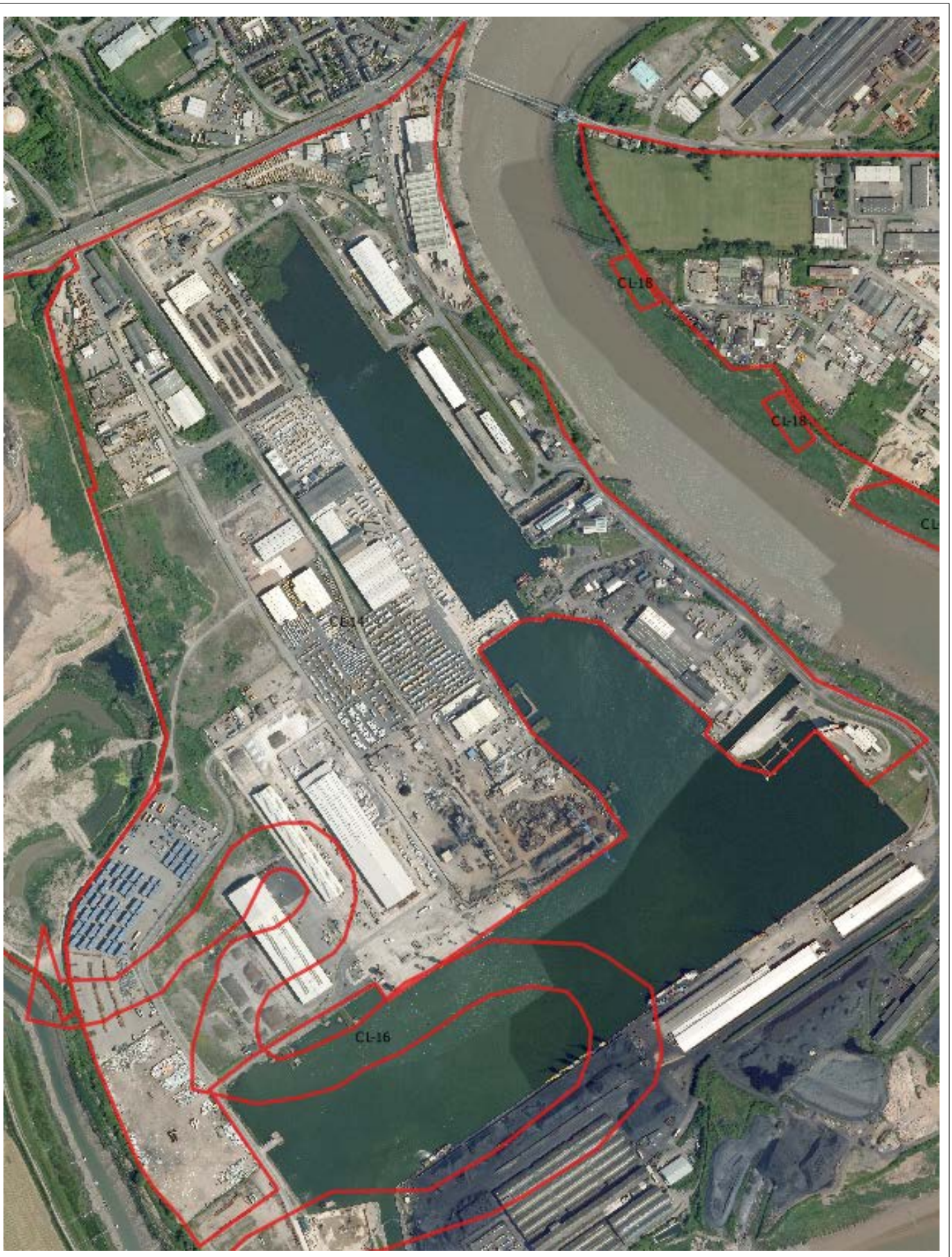

Plate 02: Extract of 2006 Aerial Photograph

Client:	Welsh Government
Project:	M4CaN
Job Ref:	JER6591 Checked By: Date: Oct 2015

Plate 03: Extract of 2009/10 Aerial Photograph

Client:	Welsh Government
Project:	M4CaN
Job Ref:	JER6591 Checked By: Date: Oct 2015

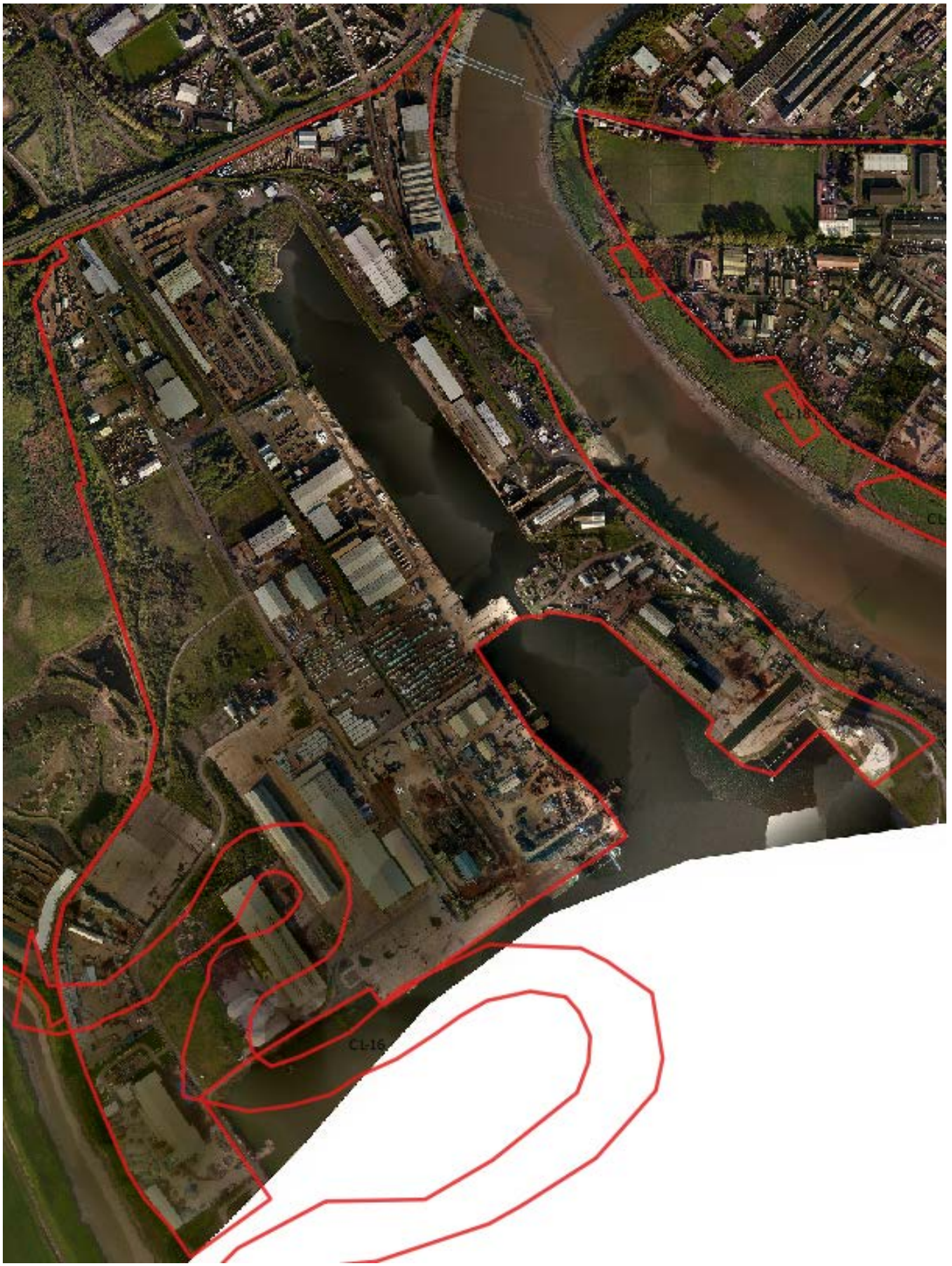

Plate 04: Extract of 2009/10 Aerial Photograph

Client:	Welsh Government
Project:	M4CaN
Job Ref: JER6591 Checked By:	Date: Oct 2015

Welsh Government

M4 Corridor around Newport

Land Contamination Assessment Report Annex D
CL-15, Stephenson Street Industrial Estate Area

M4CaN-DJV-EGT-ZG_GEN-RP-EN-0014

At Issue | March 2016

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Appendix 2 Tabulated Gas and Groundwater Monitoring Data
Appendix 3 Tabulated Soil Laboratory Data
Appendix 4 Tabulated Groundwater Laboratory Data
Appendix 5 Tabulated Soil Leachate Data
Appendix 6 Relevant Extract of Additional Environmental Data

1 Introduction

1.1 Background

1.1.1 This report relates to an area of land potentially affected by contamination (CL15) known as the 'Stephenson Street Industrial Estate' hereinafter referred to as the Site. It also includes the 'Mir Steelworks and Associated Waste Disposal Site' formerly referred to in the 2014 Preliminary Sources Study Report (PSSR) (Ove Arup & Partners, 2014) as CL20.

1.1.2 The Site is located between chainage 10,450 and 11,900 (Figure 1).

1.2 Reporting Context

1.2.1 The Site has been considered within several phases of investigation and monitoring associated with the wider works for the M4 Corridor around Newport M4CaN (the 'Scheme'). The Environmental Impact Assessment (EIA) is reported in the M4CaN Environmental Statement (ES) of which this document is an appendix to the chapter on Geology and Soils.

1.2.2 In 2014, a PSSR was undertaken as an initial land contamination appraisal (Ove Arup & Partners, 2014) as part of Design Manual for Roads and Bridges (DMRB) Stage 2 Assessments for a number of potential route options. This identified a number of individual areas that may have been affected by contamination as a result of historical activities at the Site. In addition, this report draws upon the 2015 Supplementary Ground Investigation report on behalf of the Welsh Government (Geotechnical Engineering, 2015). This report relates to the area defined in the Site Location Plan Figure 1.

1.2.3 The overarching rationale and approach for the assessment of areas of land along the proposed new section of motorway with potential contamination is detailed in the Land Contamination Assessment Report (Appendix 11.1 of the ES).

1.3 Objectives

1.3.1 The key objectives of this report are as follows:

- Undertake a preliminary risk assessment of the Site and determine whether potential risks to human health or controlled waters could exist based upon the Scheme.
- Identify the need for further assessment or investigation in order to refine potential land contamination risks and inform the need for remediation/mitigation.
- To provide information to support the Ground Investigation Report (GIR) and Geotechnical Design Report (GDR) required under DMRB HD22/08 (Highways Agency, 2008).

1.4 Report Structure

1.4.1 The remainder of this report is structured as follows:

- Section 2: Site Location and Description – This section summarises the Site description.
- Section 3: The Scheme – This section details the new section of motorway alignment and associated features at the Site.
- Section 4: Site History – This section summarises the history of the Site based on historical maps and historical land photographs.
- Section 5: Environmental Setting – This section summarises the Site description, published geology, hydrology and hydrogeology and any relevant environmental information presented in the 2014 PSSR document.
- Section 6: Summary of Ground Investigation Works – This section describes the previous and supplementary investigations undertaken at the Site.
- Section 7: Ground Conditions– This section describes the main findings of the intrusive site investigation including the ground conditions encountered and any significant visual or olfactory evidence of contamination identified.
- Section 8: Contamination Assessment – This section describes the findings of the Tier 1 and Tier 2 contamination risk assessment based upon potential contamination sources, potential receptors and potential contaminant linkages and presents the human health and controlled waters screening assessments.
- Section 9: Refine Conceptual Site Model – This section presents the Conceptual Site Model (CSM) for the Site and identifies potential contaminant linkages, based upon the findings of the data presented within Sections 2 to 7.
- Section 10: Conclusions and Recommendations - This section provides conclusions concerning the likelihood of land contaminant associated with the Site affecting the Scheme and requirements for remediation / mitigation.
- Section 11: References – This section details the key reference documents referred to within the text.
- Section 12: Glossary – This section details the key terms and acronyms used throughout the report.

2 Site Location and Description

2.1.1 The Site is located north east of the tidal estuary of the River Usk and approximately 250 m south of the A48. It is centred at National Grid Reference ST326 855. The location and layout of the Site are presented on Figure 1.

2.1.2 The Site comprises a number of industrial buildings, the Felnex and Stephenson Street industrial estates, docks and associated hardstanding, together with areas of rough vegetation. The Site also incorporates the northern part of the Mir Steelworks including industrial units, storage areas, sewage treatment works and waste disposal lagoons. In the west, the new section of motorway will pass over the River Usk.In the east of the Site the new section of motorway will pass over a north south trending railway line and parallel to this Corporation Road. Two sets of overhead powerlines traverse across the northern end of the Site, passing east west.

2.1.3 A walkover survey was undertaken in January 2014. The Site was accessed to the south of the Site via Corporation Road and a public footpath. A filled dock was noted to the south of the footpath and a number of ponds, marked as deep water were noted within the wooded area to the north of the pathway.

2.1.4 The steelworks part of the Site is located over 20 m south of the proposed new section of motorway at approximate chainage 11,000 and the associated waste disposal lagoon approximately 50 m to the south at approximate chainage 11,000 to 11,900.

2.1.5 Beyond the railway lines to the eastern end of the Site lies Solutia Chemical Works. Details related to this area can be found in the Land Contamination Assessment Report CL17 (Appendix 11.1 of the ES).

3 The Scheme

3.1.1 The Site is situated at approximate chainage 10,450 to 11,900.

3.1.2 The new section of motorway would be carried on a viaduct across the industrial estate area which will be supported by piers founded on piles. Wider areas of temporary land take are proposed north and south of the viaduct to support the construction phase. The pier locations for the viaduct are shown in Figure 1.

3.1.3 The westernmost pier of the River Usk Crossing is located within the Newport Docks area but outside the Stephenson Street Industrial Estate. There will be no construction in the wetted channels of the River Usk, Details related to the River Usk Pier area can be found in the Land Contamination Assessment Report CL18 (Appendix 11.1 of the ES).

3.1.4 The main alignment of the new section of motorway in the vicinity of the steelworks would be positioned on a piled viaduct leading to an earth embankment. No construction activities would take place within the steelworks area although a small wooded area north of the existing steelwork yard is to be included within the land take for landscaping purposes.

3.1.5 The permanent and temporary land areas take are shown in Figure 1.

4 Site History

4.1 Site History

4.1.1 The 2014 PSSR historical searches have been based on Ordnance Survey plans, literature reviews, information provided by British Steel, Natural Resources Wales (NRW), Newport City Council and aerial photographic interpretation.

4.1.2 This is supplemented by a review of historical maps obtained in 2015 from Welsh Government. Relevant extracts are presented in Appendix 6.

4.1.3 A summary of the Site history is presented in Table 1 below.

Table 1: Site History

Date	Use	Source of information
1843 - 1893	The Site comprises agricultural fields traversed by a number of drainage ditches / reens. Coldharbour Farm buildings are present in the centre and Picklane Farm in the east. The Site is bound to the west by the River Usk and to the south by Julian's Pill. Alexandra Docks and associated infrastructure are located on the western bank of the River Usk approximately 250 m from Site.	1:10,560 Historical Mapping
1891 - 1912	Two docks ('Union Dry Docks') have been developed in centre of the Site, including a pumping house, electric light station and piers. Union Dry Dock cottages have been developed to the north of the docks, with a pond adjacent. The Great Western Railway (East Usk Branch) now bounds the Site to the east and runs into the southern section of Site, terminating in the centre of the southern section.	1:10,560 Historical Mapping
1904 - 1939	A recreational ground ('Coronation Park') is located in the northwest corner of the Site. Further jetties have been developed around the docks in the centre. A footpath runs along the Site's western boundary and between the cottages and the docks. The railway construction has continued and now runs north - south through the whole of the southern section of the Site. A road running east-west (Stephenson Street) now bounds the Site to the north. An iron works in the north has expanded and is located 50 m from the Site.	1:10.560 Historical Mapping
1947 - 1949	Large industrial buildings and a reservoir appear under development to the west of the railway line in the southern section of Site. Neither farm is evident and are assumed demolished. Further development around the docks area in the centre of Site is indicated by earthworks.	Aerial photography

Date	Use	Source of information
1964 – 1965	Coronation Park has expanded across the north of the Site. The areas to the north and south of the docks are marked as marshy ground. The buildings and infrastructure around the docks have been developed to include a Petrol Depot with associated tanks and pipelines. Allotment Gardens are identified adjacent to the cottages and six further ponds of varying size are located in the eastern area of the Site. Overhead electricity wires cross the northern part of the Site east-west with two onsite supporting masts. Union Dry Dock Cottages referred to as Slipway Cottages. In the south of the Site an Aluminium works has been constructed to the west of the railway line including a sluice reservoir with a sluice conduit feeding from the south of the building, sports ground, allotment gardens, a number of tanks including filter tanks, electrical substation, sewage treatment works, and large industrial buildings. To the east of the railway line are associated sludge beds and a spoil heap. A number of works and non-specific industrial buildings have been developed to the east of the Site, approximately 50 m away on the other side of the railway.	1:10,560 Historical Mapping & 2014 PSSR
1969 - 1971	Further infrastructure has been developed in the Docks area of the Site including cranes, tanks, hoppers, electrical transformer, a conveyor, slag heap and refuse tip. The 2014 PSSR identifies a scrap yard adjacent to the slag heap. Further recreation infrastructure is located in the northern part of the site, within Coronation Park.	1:1,250 Historical Mapping
1970 - 1973	No significant change	1: 10,000 Historical Mapping
1979	A number of industrial buildings, tracks and spoil heaps are now shown present in the north of the Site. Works with associated broken ground / spoil heaps have been developed in the place of the Slipway Cottages in the central area of the Site. An area of broken ground which appears to be a depression is located on the western boundary, south of Coronation Park. The 2014 PSSR identifies this as Tidal Ponds.	Aerial Photography
1981	Evidence of <u>infilling</u> can be seen in the west of the Site where part of the River Ebbw was located. It looks as though car containers are being stored in this area. Industrial processes are shown to the west of the north dock and north of the south dock. Industrial / commercial works have expanded in the northern area of the Site.	2014 PSSR Aerial photography
1985 - 1996	The Felnex Industrial Estate, which includes a Depot associated road network and jetty, is located on the western boundary. Marshy ground is no longer marked and four ponds in the central area of the Site appear to have been infilled. A Container Terminal is identified in the Docks area. Reevesland Industrial Estate has been developed to the east of the Site. A works has been built on the area of the refuse tip around the docks.	1 : 10,000 Historical Mapping

Date	Use	Source of information
1991	Further buildings have been developed in the Felnex Industrial Estate. Tanks and storage containers are identified in the eastern area of the Industrial Estate. A heap of what appears to be aggregate is identified within the compound adjacent to the Jetty on the western boundary. An area of hardstanding associated with the Works in the western area of the Site has been removed. The ground in this area appears roughly vegetated. In the southern part of the Site, two sludge beds associated with the steelworks appear to have been infilled and vegetated.	
2006	Areas of rough vegetation in the central area of the Site with evidence of potential tipping activity. A strip of hardstanding approximately 250 m x 25 m is located in the east of the Site, covering an area where two ponds were formerly located. Heaps of waste materials are identified in this area. A heap of black material, potentially coal, and other waste heaps are identified adjacent to the southern Dock, in the former container terminal area. A rectangular pond has been excavated in the western area of the Site. Infrastructure associated with the Industrial Estate has expanded in the central eastern area. The southern part of the Site is still in use as active steel works and appears to have been expanded (2014 PSSR dates expansion as 1993 and 2002). Two sludge beds adjacent to the railway line in the south east of Site have been infilled and are vegetated. A large tank has been constructed on the eastern side of the railway line. The sports ground in the centre of the site has been developed during an extension of the steelworks main industrial unit and is now shown as hardstanding.	Aerial Photography
2009 - 2010	The majority of the Site is now under industrial use, with the exception of an area of rough vegetation along the eastern boundary and Coronation Park in the northwest corner. An area of ground adjacent to the docks appears to have been infilled and heaps (possibly aggregate) are identified in this area.	Aerial Photography
2014	No significant change	Aerial Photography

Note: Potential sources of contamination have been underlined. Those within the temporary and permanent land take are shown in bold.

4.1.4 The sources of information presented above supplement those used in the 2014 PSSR. In particular, the 2006 aerial image identified further stockpiling of materials and extensions to existing industrial units and hardstanding in the central area of the Site. Relevant extracts of the photographs are presented in Appendix 6.

4.1.5 In addition to Table 1, the 2014 PSSR (Ove Arup and Partners 2014) identifies from study of Ordnance Survey (OS) maps a spoil heap in the central western corner of the Site and two electrical substations in the northern area of the Site. The dates of these maps were not provided within the PSSR report.

4.1.6 All identified potential sources of contamination are shown in Figure 1.

4.1.7 Historically there is the potential for the Site to have been bombed during World War II which is described in detail within the 2014 PSSR (Ove Arup and Partners 2014) and also the Explosive Ordnance Threat Assessment Report (Bactec, 2014) which categorises the site as a high risk with respect to unexploded ordnance.

5 Environmental Setting

5.1 Geology

5.1.1 British Geological Survey (BGS) data indicates that the Site is underlain by Tidal Flat Deposits overlying bedrock of the Mercia Mudstone Group.

5.1.2 It is expected that the Site is overlain by fill materials associated with the docks construction.

5.2 Hydrology

5.2.1 The River Usk bounds the Site to the west, Julian's Reen and Julian's Gout bound the Site to the south and a number of small ponds and drainage channels are present across the Site. A reservoir and sludge beds are also present associated with the steelworks in the south of the Site.

5.3 Hydrogeology

5.3.1 Natural Resources Wales (NRW) classifies the Mercia Mudstone Group as a Secondary B Aquifer. Tidal Flat Deposits in the Newport area have been classified as a Secondary (undifferentiated) Aquifer.

5.3.2 The Site does not lie within a Groundwater Source Protection Zone (SPZ). However, the parts of the western boundary of the Site lie within a groundwater vulnerability zone, classified as a minor aquifer with high leaching potential.

5.4 Environmental Information

5.4.1 The 2014 PSSR identifies the following information within the study area as reported by NRW:

- Two significant pollution incidents with water and land impacts and one significant impact pollutant incident with air impact have been recorded within the Site boundary which are set out in Table 2. Twelve minor impact pollutant incidents and two no impact pollutant incidents have been recorded within the Site boundary.
- In addition, eight pollution incidents, with either a minor impact on air or minor and significant impact on water in relation to the Usk River due to release of oils and fuels/chemicals are identified in the southern part of the Site.
- One major air impact, two significant air and water impacts, three minor impacts and three no impact pollutant incidents were recorded within 300 m of the Site boundary.
- There is one discharge consent recorded within the Site boundary, (central western area of the Site) in relation to Newport Felnex Industrial Estate.
- Within 300 m of the Site, two discharge consents have been recorded along the western Site boundary adjacent to the River Usk.

- One abstraction licence pertains to the Site. It relates to the abstraction of surface water for evaporative cooling of Mir Steelworks. The abstraction takes place from the lagoon within the site boundary.
- A landfill is located 100 m south of the Site, known as 'Sloblands'. It is an active authorised landfill facility accepting industrial waste originating from the Mir Steel works.

Table 2: Natural Resources Wales - Significant Pollution Incidents within the Site

Date	Impact to air	Impact to land	Impact to water	Pollutant	Location
8/7/2005	Significant	No impact	No impact	Organic chemical products	NE of the Site, adjacent to the Felnex Industrial
6/9/2010	Minor	Significant	Significant	Oils and fuels	N, adjacent to the River Usk and Felnex Industrial Estate
4/5/2011	No impact	Significant	Significant	Pollutant not identified	N, adjacent to the River Usk and Felnex Industrial Estate

5.4.2 Information obtained from NRW in 2015 indicates that a surface water abstraction licence previously reported as active in the PSSR has since been revoked. No further information is considered relevant since the 2014 PSSR.

5.4.3 Residual level of potential contamination may be present associated with these historical pollution incidents.

6 Scope of Investigations

6.1 General

6.1.1 Four intrusive ground investigations were undertaken within the Site.

6.1.2 For the purpose of meeting the requirements of Volume 4, Section 1, Part 2 of the DMRB (HD22/08 – Managing Geotechnical Risk – 2008 (Highway Agency, 2008), the historical data used to support the 2014 PSSR has been differentiated from additional 2015 Supplementary Ground Investigation data (Geotechnical Engineering, 2015).

6.2 Scope of Works

6.2.1 The various intrusive ground investigations undertaken within the Site area are summarised in Table 3.

Table 3: Site Investigation Summary

Date	Contractor	Site Location	Boreholes	Trial Pits	Sampling
1997	Norwest Holst	South	BHG2, BHG3, BHG4	-	Soil
2000	Exploration Associates	South	CH24, CH25, CH26, CH27, CH28, CH29, CH30, CH31, CH32	-	Soil, leachate and groundwater
2008	Norwest Holst	South	-	STPG01, STPG02	Soil and leachate
2015	Geotechnical Engineering Limited	South	BH423, BH424, BH425, BH426	TP410, TP411	Soil

6.2.2 The well construction details of all boreholes installed on the Site are summarised in Table 4.

Table 4: Summary of Borehole Construction Details

Borehole ID	Diameter (mm)	Total Drilled Depth (m)	Top of Slotted Well Casing / Gravel Pack (m bGL)	Base of Slotted Well Casing / Gravel Pack (m bGL)	Targeted Geology
BHG2	Assumed 50	45	Unspecified	13.5	Tidal Flat Deposits / Glaciofluvial Deposits
BHG3	Assumed 50	40.5	Unspecified	19.7	Mercia Mudstone
BH423	35	60	15	18	Glaciofluvial Deposits
	50		25	40	Mercia Mudstone

Borehole ID	Diameter (mm)	Total Drilled Depth (m)	Top of Slotted Well Casing / Gravel Pack (m bGL)	Base of Slotted Well Casing / Gravel Pack (m bGL)	Targeted Geology
BH425	35	54.4	11.8	12.3	Glaciofluvial Deposits
	50		20	30	Mercia Mudstone
BH426	35	54.5	1	2	Made Ground
	50		4	13	Tidal Flat Deposits

6.3 Surface Water Quality Monitoring

6.3.1 Surface water quality monitoring was not undertaken during the previous ground investigations of the Site.

6.4 Field Testing

6.4.1 During the 2007 investigation a photo-ionisation detector (PID) was used on selected soil samples to identify the presence of volatile organics. The monitoring results did not identify any elevated results above background.

6.5 Groundwater and Ground Gas Monitoring

6.5.1 A summary of the groundwater sampling, groundwater monitoring and ground gas monitoring is shown in Table 5.

Table 5: Summary of Monitoring Rounds

Location Ref.	Number and date of rounds	Monitoring details	Notes
BHG2	4no. 27th November 1997, 3rd December 1997, 11th December 1997, 17th December 1997	Groundwater level	
BHG3	5no. 15th November 1997, 25th November 1997, 3rd December 1997, 11th December 1997, 17th December 1997	Groundwater level	
BH423 (35 mm)	4 no. 28th April 2015, 6th May 2015, 11th May 2015, 19th May 2015	Groundwater level and sampling Ground Gas	Gas monitoring in the shallow 35 mm installation only.
BH423 (50 mm)			
BH425 (35 mm)	4 no. 28th April 2015, 6th May 2015, 12th May 2015, 19th May 2015	Groundwater level and sampling Ground Gas	Gas monitoring in the shallow 35 mm installation only.
BH425 (50 mm)			
BH426 (35 mm)	3 no. 28th April 2015, 6th May 2015, 12th May 2015	Groundwater level & sampling Ground Gas	Gas monitoring only undertaken during the 12th May round.
BH426 (50 mm)			

6.6 Laboratory Chemical Testing

6.6.1 Laboratory chemical analytical results are presented in Appendices 3 - 5.

6.7 Gap Analysis of Available Data

6.7.1 The ground investigation sampling locations at the Site are concentrated along and immediately south of the new section of motorway alignment. Since the 2015 supplementary Ground Investigation was undertaken, the new section of motorway alignment has developed and includes wider areas of temporary and permanent land take in which no sample data is available.

6.7.2 Some specific potential contamination sources (e.g. former refuse tip) have not been targeted by the investigations. Additional assessment of these areas is thus needed particularly at the proposed viaduct pier locations. Key gaps that need to be addressed are as follows:

- There is no data on contamination and ground conditions in the proposed location of a Water Treatment Area which is located on an area of infilled ground.
- There is limited ground gas and water data relating to shallow Made Ground at the Site.
- Only limited polychlorinated biphenyls (PCB) data is available from the perched groundwater and lower aquifer and thus it is not possible to fully assess potential risks of offsite migration of PCBs in groundwater from the Solutia Chemical Works where known PCB contamination is present within soils and groundwater.
- Limited data on contamination and ground conditions is available to the north of the alignment within the temporary land take areas.
- The containment details of the sludge pits within Mir Steelworks site and their potential impact to water receptors are not known and this is considered in more details within the Land Contamination Assessment Report Annex D, CL17 Solutia Chemical Works (Appendix 11.1 of the ES).

7 Ground Conditions

7.1 Geology

7.1.1 The geological logs for all available exploratory holes on the Site are provided in Appendix 1. The observed geological sequence is consistent with that discussed in the 2014 PSSR report and is summarised in the following sections. Information from the Supplementary Ground Investigation (Geotechnical Engineering, 2015) has also been used.

Made Ground

7.1.2 Made Ground was encountered in the majority of exploratory holes with thicknesses generally around 1.4 m across the area investigated but ranging between 0.3-3.1 m as summarised in Table 6.

7.1.3 Made Ground is commonly present as a coarse material comprising slag, brick, concrete, limestone and ash. Further man-made inclusions including clinker, plastics and timber were also noted.

7.1.4 Made Ground consisting of clay with varying proportions of sands and gravels were noted to a lesser extent across the Site.

Superficial Deposits

7.1.5 Unconsolidated superficial deposits were encountered beneath the Made Ground. These comprised Tidal Flat Deposits, generally consisting of soft or very soft grey silty clays.

7.1.6 Thick laminae of fine sand were noted within the clays encountered within BH423 between 13.2 and 15 m bGL. A sand horizon with rare fragments of fibrous organic material or frequent shells was encountered beneath this, between 15 and 16.45 m bGL. This borehole is located on the banks of the River Usk.

7.1.7 Sand and gravel material considered to represent Glaciofluvial Deposits (referred to as River Terrace Deposits or Fluvial Alluvium in the exploratory holes) was found to underlie the predominantly fine and cohesive Tidal Flat Deposits. The Glaciofluvial Deposits are considered to be continuous and up to 2 m in thickness at the western end of the Site (BH423), thinning out eastwards. East of BH424, the formation is considered to be discrete and relatively thin. The formation was found to be absent at BH424, BH425, BHG3, BHG4 and 0.8 m in thickness in BHG2 and 0.7 m at BH425.

Solid Geology

7.1.8 Below the Tidal Flat or Glaciofluvial deposits the Mercia Mudstone Group typically was encountered and described as stiff or very stiff, reddish brown, fissured clay becoming very weak to moderately strong.

7.1.9 The formation is found at 12.2-14 m bGL (-4.35 to -7.6 m AOD) beneath much of the Site, deepening to 18.3 m bGL (-11.3 m AOD) associated with the river bed of the River Usk (BH423) at the western end.

Geological Sequence Summary

7.1.10 The general geological sequence identified during the previous ground investigations is summarised in Table 6.

Table 6: Summary of Geological Sequence

Unit	Description	Thickness Range (m)	Basal depth (m bGL)
Made Ground	Predominantly coarse includes ash, slag, brick, limestone	0.3-3.1	0.7-3.1
Superficial Deposits (Tidal Flat Deposits)	Silty clay, organic in places with sand horizon within BH423.	10.3-16.45	12.4-16.45
Superficial Deposits (Glaciofluvial Deposits)	Sand & Gravel	Absent-1.85	12.4-18.3
Mercia Mudstone (Mudstone)	Stiff and very stiff red brown clay becoming very weak to moderately strong mudstone	>42	>54.5

7.2 Visual and Olfactory Evidence of Contamination

7.2.1 Visual and olfactory evidence of contamination was not encountered during the previous ground investigations with the exception of man-made inclusions within the Made Ground noted above.

7.2.2 Full details and observations noted during the drilling and trial pitting are presented on the exploratory logs attached in Appendix 1.

7.3 Groundwater Monitoring

Groundwater Encountered During Investigation

7.3.1 All groundwater strikes encountered are detailed on the geological logs provided in Appendix 1. These are summarised below.

Table 7: Summary of Groundwater Level Data During Investigation

Location	Strike Depth (m bGL)	Geological Formation	Level after 20 minutes (m bGL)	Comment
BHG2	13.2	Glaciofluvial Deposits	8.9	Fast flow
CH26	0.65	Made Ground	0.65	-
CH32	0.1	Made Ground	0.1	-
STPG01	0.4	Made Ground	-	Fast flow
BH423	1.2	Tidal Flat Deposits	0.54	-
BH424	1.1	Made Ground	1.1	-
BH425	1.8	Made Ground	1.7	-

Location	Strike Depth (m bGL)	Geological Formation	Level after 20 minutes (m bGL)	Comment
BH426	0.2	Made Ground	0.2	-

7.3.2 Groundwater was not encountered in any other boreholes and trial pits.

Groundwater Level during Monitoring Rounds

7.3.3 The entire groundwater level dataset gathered on Site is provided in Appendix 2 and summarised in Table 8.

Table 8: Summary of Groundwater Level Data During Monitoring

Location	Installation	Depth of response zone (m bGL) and Geological Formation	No. Measurements	Min Depth (mbGL)	Max Depth (mbGL)	Comments
BHG2	50 mm (not specified on log)	12.5-14 Tidal Flat Deposits / Glaciofluvial Deposits	4	3.98	5.72	-
BHG3	50 mm (not specified on log)	16-20 Mercia Mudstone	5	3.12	5.21	-
BH423	35 mm	15-18 Glaciofluvial Deposits	4	5.18	6.377.4	-
	50 mm	25-40 Mercia Mudstone	4	5.27	6.90	-
BH425	35 mm	11.8-12.3 Glaciofluvial Deposits	4	2.10	7.24	-
	50 mm	20-30 Mercia Mudstone	4	5.30	6.73	-
BH426	35 mm	1-2 Made Ground	3	0.1	0.5	-
	50 mm	4-13 Tidal Flat Deposits	3	0.7	1.77	Slow recharge

Groundwater Summary

7.3.4 The main groundwater body is within the granular Glaciofluvial Deposits and the Mercia Mudstone which are confined by the overlying Tidal Flat Deposits. This demonstrates the latter to represent an aquitard to the vertical groundwater flow.

7.3.5 A discontinuous perched groundwater is also seen within the upper formation of the Tidal Flat Deposits. These are considered to represent discrete bodies with little vertical or lateral flow.

7.3.6 Perched shallow water was also identified within the Made Ground as well as subsequent monitoring.

7.3.7 The groundwater conditions at the Site are as expected based on the hydrogeological model details in the Baseline Water Environment Report (Appendix 16.2 of the ES).

7.4 Gas Monitoring

7.4.1 The gas monitoring dataset collected during each of the four monitoring rounds is summarised on the summary field data sheets provided in Appendix 2. The maximum gas concentrations (minimum for oxygen) are presented in Table 9.

Table 9: Summary of Gas Monitoring Data

Location ID and Geological Formation	Flow (l/hr)	VOCs (ppm)	CH4 (%/vol)	Peak LEL (%)	CO2 (%/vol)	O2 (%/vol)	CO (ppm)	H2S (ppm)
	Max.	Max.	Max.	Max.	Max.	Min.	Max.	Max.
BH423 (Glaciofluvial Deposits)	0	3.3	1	24.2	0.3	19.8	0	0
BH425 (Glaciofluvial Deposits)	0	2.3	67.5	>>>	3.3	5.3	22	0
BH426 (Made Ground)	0	0	74.1	>>>	0.3	0.2	0	0

8 Contamination Assessment

8.1 Introduction

8.1.1 The following sections provide details of the assessment of land contamination at the Site.

8.1.2 The conceptual site model presented within the 2014 PSSR has been reviewed and updated based on data from the Supplementary Ground Investigation (Geotechnical Engineering, 2015) and the design of the new section of motorway. The main alterations to the 2014 PSSR model are summarised as follows.

- New contamination source (identified as perched water body within the Made Ground.
- New ground gas source identified (Made Ground and superficial deposits).
- Revision of the geological Site model.
- Update of the source/pathway/receptor linkages taking account of the above and more detailed assessments.

8.2 Preliminary Risk Assessments

Potential Sources

8.2.1 The Made Ground was identified within the 2014 PSSR as a potential source of contamination based on the Site's historical and current uses including industrial processes such as of various infill processes, timber yards, fuel depot, scrap yard, electrical substations, steelworks, aluminium works, sludge lagoons, sewage treatment plant, railway line and industrial estates. The potential contamination sources are shown in Figure 1.

8.2.2 A former refuse tip and backfilled ponds also represent discrete areas of possible contamination.

8.2.3 Where present, the perched water body within the Made Ground is considered to represent a potential source rather than a receptor.

8.2.4 The Made Ground and superficial deposits represent potential gas sources.

8.2.5 Confined groundwater from within the Glaciofluvial Deposits and Mercia Mudstone is potentially saline and may contain anthropogenic contaminants of concern.

8.2.6 Landfill gas generation in the Slobsland landfill area is most likely to occur outside the study area, and is unlikely to impact on the new section of motorway.

8.2.7 A known off site source of contamination (PCBs) is present at Solutia Chemical Works.

Potential Receptors

8.2.8 Receptors during the construction and operational stages of the new section of motorway have been considered:

Construction

- Construction workers during site development works.
- General public/workers adjacent to construction works.
- Groundwater within the Glaciofluvial Deposits and Mercia Mudstone.
- Surface waters – The River Usk and impounded water within the docks.

Operational

- Maintenance workers.
- General public end users.
- General public/workers adjacent to the permanent land take.
- Groundwater within the Glaciofluvial Deposits and Mercia Mudstone.
- Surface waters – The River Usk and impounded water within the docks.

Potential Pathways

8.2.9 Pathways during the construction and the operational stages of the new section of motorway have been considered:

- Dermal contact, ingestion, inhalation pathways of potentially contaminated soils possible during development and maintenance works.
- Dermal contact, ingestion, inhalation pathways possible for general public end users and adjacent general public/workers. The latter pathway will be rom soil dust only.
- Accumulation of ground gas within confined spaces during the earthworks.
- Vertical migration of impacted perched water within the Made Ground and/or leachate from the Made Ground into main groundwater bodies and subsequent lateral migration to surface water bodies.
- Vertical or lateral migration of ground gas associated with Made Ground / superficial deposits potential sources.
- Upward migration of ground gases along piles.
- Creation of new pathways for shallow contamination to migrate along piles and foundations through Made Ground, Tidal Flat Deposits and Glaciofluvial Deposits into the Mercia Mudstone.
- Vertical migration of groundwater within the Glaciofluvial Deposits and Mercia Mudstone possibly recharging perched groundwater and/or saturating the Made Ground due to the pile installations.

8.3 Risk Evaluation

8.3.1 Source pathway receptor linkages were considered in the 2014 PSSR using the historical data available up to 2008. With review of the other data described herein, the following risk evaluation has been re-considered and included the following:

- The new section of motorway is to be carried via a viaduct and high embankment some 4 m or more above ground level. Motorway users will be within an open environment with no proposed structures or other confined spaces. Pathways linkages to M4 users during its operation are therefore limited to air born dust.
- The Site has been subject to a range of potential contaminating uses. Off site sources associated with Solutia Chemical Works are also identified.
- Proposed piers will encapsulate Made Ground reducing exposure pathways to motorway end users / maintenance workers. However, remaining areas (outside pier locations) are to comprise both soft and hardstanding.
- Superficial Deposits are classified as non-productive and overlie a Secondary B Aquifer associated with the mudstone.
- There are no nearby abstractions for potable water in or within the vicinity of the Site.
- The cohesive Tidal Flat Deposits which are over 10 m thick, separates the Made Ground and aquifer. Thus, the main groundwater body identified being confined by the Tidal Flat Deposits which provide a layer of protection to the aquifer.
- Perched groundwater within the Tidal Flat Deposits is not considered a water resource due to its anticipated low vertical hydraulic continuity with the aquifer beneath, low permeability and low storage capacity.
- Piled foundations may create pathways to the lower aquifer. Pathways may allow an increase in the influx of water within the Made Ground, given the recorded sub-artesian pressure.
- Some contaminants in the soil matrix of the Made Ground appear to be leachable.
- High recorded concentrations of ground gases which may migrate laterally and vertically including upward migration along the proposed piles.
- Earthworks for the construction of the pier foundations may constitute confined spaces in which ground gases may accumulate.
- The proposed water treatment area (WTA) is to receive surface water from the viaduct and will be lined to prevent downward infiltration. Discharge of waters is to be controlled under a discharge consent and the WTA is neither considered as a source or receptor in this report.

8.4 Human Health Risk Assessment

8.4.1 The rationale and approach for the human health (tier 2) screening assessment is detailed in the Land Contamination Assessment Report (Appendix 11.1 of the ES). Soil chemical analysis results and the findings of the generic tier 2 human

health risk assessment are presented in Appendix 3. All exceedances within Made Ground are summarised in Table 10.

Table 10: Summary of Human Health Soil Screening Exceedances (Made Ground)

Determinant	Units	Range	Screening Criteria	No. samples exceeding Screening Criteria (Total number of results)	Locations of exceedances
pH	pH units	7.9 - 12	6-9	17 (25)	BHG3, CH24, CH25, CH28, CH29, CH30, CH31, CH32, STPG01, BH424, BH425, BH426
Chromium	mg/kg	13-2,170	33	12 (25)	BHG2, BHG3, CH24, CH27, CH30, CH31, CH32, STPG01, BH424, BH426
Polycyclic Aromatic Hydrocarbons (PAH) [screen]	mg/kg	9.3 - 191	1.1	12 (13)	BHG3, CH24, CH25, CH26, CH27, CH28, CH29, CH30, CH31, CH32
PCB – Aroclors	mg/kg	0.2 – 0.5	0.24	1 (3)	CH32
PCB (vs Aroclor 1254)	mg/kg	0.062 – 0.61	0.24	1 (2)	STPG01

8.4.2 Alkaline soil conditions have been identified within Made Ground across the Site typically associated with ash, slag, concrete and limestone gravel.

8.4.3 Although exceedances of chromium are identified throughout the Made Ground, the criterion relates to the hexavalent form. The majority of the results are considered to be within normal background data range (<95 mg/kg) and therefore, are not considered to represent a contaminant of concern. However seven isolated samples, with no apparent pattern exceed this background range with maximum of up to 2,500 mg/kg. Limited chromium speciation analysis confirms chromium relates to a lesser toxic form within these samples. The highest speciation test relates to Made Ground in STPG01 with a total chromium concentration of 1,900 mg/kg and an associated hexavalent chromium of 0.4 mg/kg. The latter is well below the criteria of 33 mg/kg. It is therefore, considered that chromium represents a low risk to human health.

8.4.4 For the total PAH analysis, the most stringent criterion applicable for any PAH compound has been used for screening purposes (i.e. dibenzo(ah)anthracene at 1.1 mg/kg). Twelve samples with concentrations above 1.1 mg/kg have been identified within the majority of Made Ground samples commonly noted to contain ash, slag and coal. The lack of speciated PAH test results prevents a more detailed assessment.

8.4.5 Elevated concentrations of PCBs were detected within CH32 and STPG01. PCBs are analysed as a total with respect to aroclors type. The screening criterion (0.25 mg/kg) used is for comparison with the sum of dioxins, furans and dioxin-like PCBs and therefore is considered to be very conservative. Further speciation for PCBs may have identified the presence of less toxic congeners. It is of note that these two exploratory holes are located adjacent to the Solutia Chemical Works (CL17) known to contain elevated PCBs. Further sampling in this area should be undertaken.

8.4.6 Low to moderate hydrocarbon levels with maximum Total Petroleum Hydrocarbons (TPH) concentrations of 1,190 mg/kg were recorded. These values are below screening criteria and are therefore considered to pose a low risk to human health.

8.4.7 All exceedances within natural ground to the relevant criteria are summarised in in Table 11 (natural ground).

8.4.8 In summary, with the possible exception of PCBs, the previous ground investigations have identified levels of contamination within Made Ground that are at tolerable levels of risk for the construction of the new section of motorway.

Table 11: Summary of Human Health Soil Screening Exceedances (Natural Ground)

Determinant	Units	Range	Screening Criteria	No. samples exceeding Screening Criteria (Total number of results)	Locations of exceedances
pH	pH units	7.3 – 11.1	6 - 9	2 (10)	CH28, BH426
Chromium	mg/kg	14 - 84	33	8 (10)	BHG4, CH24, CH25, CH27, STPG01, STPG02, BH423, BH426
PAH (screen)	mg/kg	<10 - 71	1.1	2 (4)	CH25, CH28

8.4.9 Eight samples of natural soils had total chromium concentrations above the screening criteria of 33 mg/kg. However, as discussed previously the screening criteria is for hexavalent chromium rather than total chromium. The maximum chromium concentration (STPG02 – 84 mg/kg) has been speciated with a concentration of hexavalent chromium below laboratory limit of detection. It is therefore considered that chromium levels represent a low risk to human health.

8.4.10 Only total PAH was analysed in soils and was compared against the conservative screening criteria (1.1 mg/kg) Elevated concentrations are identified for two samples at the interface with the Made Ground. Greater concentrations were detected within samples from the overlying Made Ground at the same locations, indicating a vertical migration of PAH contaminants.

8.4.11 PCBs were identified at trace level in STPG01 (1.2 m depth) with a concentration of 0.025 mg/kg which is below screening criterion. The concentration also indicates limited vertical migration of the contaminant as the concentration in the Made Ground at the same location was higher.

8.5 Controlled Waters Screening Assessment

8.5.1 The rationale and approach for the controlled waters (Tier 1) screening assessment is detailed in the Land Contamination Assessment Report (Appendix 11.1 of the ES) and the groundwater and soil leachate chemical results are presented in Appendices 4 and 5, respectively. All exceedances to the relevant generic criteria are summarised in Tables 12 and 13 for soil leachate and groundwater respectively.

8.5.2 Where an Environmental Quality Standard (EQS) is dependent on water hardness (i.e. some heavy metals), the hardness of the surface water receptor would normally be used. The Baseline Water Environment Report (Appendix 16.2 of the ES) indicates surface water to be generally moderately hard with hardness in a range of 100 to 150 mg/l as calcium carbonate. Therefore, EQSs within this water hardness range have been used for screening purposes.

Soil Leachate Results

8.5.3 Nine soil samples were subjected to leachate analysis. The majority of the soil leachate results were all below the applied screening criteria, with the exception of the contaminants listed in Table 12.

Table 12: Controlled Waters Screening Exceedances - Soil Leachate

Determinant	Units	Range	EQS	DWS[1]	No. exceeded EQS Screening Criteria (Total number of results)	Location (formation)	No. exceeded DWS Screening Criteria (Total number of results)	Location (formation)
Arsenic	µg/l	<1 - 21	50	10	0 (7)	-	1 (7)	BH425 (Made Ground)
Cadmium	µg/l	<0.08 – 2.5	0.15	5	1 (7)	TP410 (Made Ground)	0 (7)	-
Chromium	µg/l	<1 - 160	-	50	0 (9)	-	1 (9)	STPG01 (Made Ground)
Copper	µg/l	2.5 – 39	10	2,000	3 (9)	CH31, STPG01, TP410 (Made Ground)	0 (9)	-
Antimony	µg/l	<1 - 19	-	5	-	-	2 (4)	STPG02 (Made Ground), STPG01 (Tidal Flat Deposits)
Selenium	µg/l	<1 - 13	-	10	0 (7)	-	2 (7)	BH426, TP410 (Made Ground)

Determinant	Units	Range	EQS	DWS[1]	No. exceeded EQS Screening Criteria (Total number of results)	Location (formation)	No. exceeded DWS Screening Criteria (Total number of results)	Location (formation)
pH	pH units	8.3 – 10.8	6 - 9	6 - 9	2 (5)	CH31, CH32 (Made Ground)	1 (5)	CH31 (Made Ground)

Note [1]: DWS refers to Drinking Water Standards

8.5.4 The identified exceedances indicate leachable concentrations of heavy metals are not widespread. It's considered that the elevated concentrations of arsenic, chromium and selenium are not considered to result in unacceptable risks as there are no potable water abstractions at or near the Site and the aquifer is identified to be saline. The concentrations of these contaminants are below EQS.

8.5.5 Copper and pH are exceeding EQS criteria and may pose a risk given the presence of nearby controlled surface waters (River Usk, Julian's Reen and Julian's Gout).

8.5.6 Trial Pit TP410 is located outside the land take required for the new section of motorway and thus represents an offsite source.

8.5.7 Certain laboratory detection levels in samples used in previous ground investigations for cadmium, mercury, cyanide and some PAHs are higher than the screening criteria.

Groundwater Results

8.5.8 Sixteen groundwater samples from previous ground investigations were obtained for chemical analysis. Many of the groundwater results were below the screening criteria, with the exception of the contaminants in Table 13.

Table 13: Controlled Waters Screening Exceedances - Groundwater

Determinant	Units	Range	EQS	DWS	No. exceeded EQS Screening Criteria (Total number of results)	Location (formation)	No. exceeded DWS Screening Criteria (Total number of results)	Location (formation)
Perched Water: Made Ground								
Copper	µg/l	19	10	2,000	1 (1)	CH32 (Made Ground)	0 (1)	-
Lead	µg/l	10	1.2	10	1 (11)	CH32 (Made Ground)	0 (1)	-
Nickel	µg/l	9	4	20	1 (1)	CH32 (Made Ground)	0 (1)	-
Mercury	µg/l	0.3	0.07	1	1 (11)	CH32 (Made Ground)	0 (1)	-
Fluoranthene	µg/l	0.17	0.0063	-	1 (1)	CH32 (Made Ground)	0 (1)	-
pH	pH units	10.8	6-9	6.5-10	1 (1)	CH32 (Made Ground)	1 (1)	CH32 (Made Ground)
Phenol Index	mg/l	0.06	(0.0077)[1]	-	1 (1)	CH32 (Made Ground)	0 (1)	-
Discontinuous Perched Groundwater: Tidal Flat Deposits								
Arsenic	µg/l	7.2 - 19	50	10	0 (3)	-	2 (3)	BH426 (TFD)
Nickel	µg/l	5.7 - 20	4	20	3 (3)	BH426 (TFD)	0 (3)	-
Boron	µg/l	1800 - 3000	2000	1000	1 (3)	BH426 (TFD)	3 (3)	BH426 (TFD)
Copper	µg/l	2.2 - 13	10	2,000	1 (3)	BH426 (TFD)	0 (3)	-
Selenium	µg/l	7.3 - 17	-	10	0 (3)	-	2 (3)	BH426 (TFD)
Chloride	mg/l	1100 - 2300	250	250	3 (3)	BH426 (TFD)	3 (3)	BH426 (TFD)
Ammoniacal Nitrogen as N	mg/l	3.9 - 10	0.6	-	3 (3)	BH426 (TFD)	0 (3)	-
Total Cyanide	mg/l	<0.05 – 0.05	0.001	0.05	1 (3)	BH426 (TFD)	0 (3)	-
Aquifer: Glaciofluvial Deposits / Mercia Mudstone								
Arsenic	µg/l	4.8 - 31	50	10	0 (12)	-	9 (12)	BH423 (GFD & MMG), BH425 (GFD & MMG)
Boron	µg/l	480 - 4200	2000	1000	7 (12)	BH423 (GFD & MMG), BH425 (GFD & MMG)	10 (12)	BH423 (GFD & MMG), BH425 (GFD & MMG)
Chromium	µg/l	<1 - 53	-	50	0 (12)	-	1 (12)	BH425 (MMG)
Copper	µg/l	4.8 - 29	10	2,000	7 (12)	BH423 (GFD & MMG), BH425 (GFD & MMG)	0 (12)	-

Determinant	Units	Range	EQS	DWS	No. exceeded EQS Screening Criteria (Total number of results)	Location (formation)	No. exceeded DWS Screening Criteria (Total number of results)	Location (formation)
Nickel	µg/l	<1 - 9.9	4	20	8 (12)	BH423 (GFD & MMG), BH425 (GFD & MMG)	0 (12)	-
Selenium	µg/l	6.1 - 34	-	10	0 (12)	-	10 (12)	BH423 (GFD & MMG), BH425 (GFD & MMG)
Cadmium	µg/l	<0.08 – 0.33	0.15	5	1 (12)	BH425 (GFD)	0 (12)	-
Chloride	mg/l	280 - 6800	250	250	10 (10)	BH423 (GFD & MMG), BH425 (GFD & MMG) (Glaciofluvial Deposits and Mercia Mudstone), BH426 (Tidal Flat Deposits)	10 (10)	BH423 (GFD & MMG), BH425 (GFD & MMG)
Ammoniacal Nitrogen as N	mg/l	0.65 - 45	0.6	-	10 (10)	BH423 (GFD & MMG), BH425 (GFD & MMG) (Glaciofluvial Deposits and Mercia Mudstone), BH426 (Tidal Flat Deposits)	0 (10)	-

Note: [1] based on phenol criteria

8.5.9 The groundwater screening assessment includes data from three rounds of monitoring in BH423, BH425 and BH426 undertaken in 2015. The groundwater samples were taken from perched water within the Made Ground, perched groundwater within the Tidal Flat Deposits as well as the aquifer within the Glaciofluvial deposits and Mercia Mudstone.

8.5.10 A single sample was taken from perched water within the Made Ground.

8.5.11 Exceedances above EQS of copper, lead, nickel, mercury, fluoranthene and pH are identified. Laboratory detection levels for some PAHs are higher than screening criterion within the data set. The elevated levels in perched water are considered a potential source of contamination rather than pollution of a receptor.

8.5.12 Samples taken from perched water within the Made Ground exceeded DWS criteria for pH.

8.5.13 Within the perched groundwater of the Tidal Flat Deposits and the aquifer bodies within the Glaciofluvial Deposits and Mercia Mudstone, the following comments may be made when considering EQS criteria:

- Exceedances of boron, copper, nickel, chloride and ammoniacal nitrogen are identified.

- A discrete exceedance of cadmium (BH425 in round 2) are identified, however concentration below laboratory limit of detection were present in rounds 1 and 3.
- The elevated chloride concentrations indicate the water that both the perched groundwater and the aquifer are affected by saline intrusion.
- Certain laboratory detection levels for mercury, lead, some PAHs, Volatile Organic Compounds (VOCs) and Semi-Volatile Organic Compounds (SVOCs) are higher than their respective applied screening criteria within the data set.

8.5.14 Within the perched groundwater of the Tidal Flat Deposits and the aquifer bodies within the Glaciofluvial Deposits and Mercia Mudstone, arsenic, selenium, boron and chloride were typically identified exceeding DWS criteria. Chromium was also found exceeding on one occasion (BH425 in round 1). However, as the groundwater is saline and not used for potable water supply, the exceedances are considered tolerable.

8.5.15 When considering metals and inorganics, the water quality in the perched groundwater and aquifer is comparable to the water perched in the Made Ground.

8.5.16 Elevated hydrocarbon concentrations (TPH of 14,000 µg/l) and trace concentration of PCBs have also been recorded associated with the single sample of perched water within the Made Ground (CH32).

8.5.17 Round 2 for BH426 gave TPH of 400 µg/l within the TFD perched groundwater, which indicated a transient and localised impact. Organics within the perched groundwater and aquifer were otherwise below laboratory limit of detection.

8.6 Ground Gas Risk Assessment

8.6.1 The ground gas data available relates to three boreholes drilled and monitored during the 2015 investigation (BH423, BH425 and BH426). The former two have response zones within the Glaciofluvial Deposits (15 - 18 m bGL and 11.8 - 12.3 m bGL respectively) and the latter within the Made Ground (1 - 2 m bGL). Of the four monitoring rounds available (only one round is available for BH426 due to high water level). Based on the available data, the following observations have been made.

- No monitoring was undertaken during low barometric pressure (less than 1000 mb), with the lowest conditions being 1004 mb. As such worst case atmospheric conditions for potential ground gas generation may have not been monitored.
- Gas flow was generally recorded absent or negative which indicates the ground is not generating large volumes of ground gas.
- Methane has been recorded as nil or up to 1 % in BH423 during all 4 no. rounds, which is below or at the screening criteria of 1 %.
- In BH425, methane was recorded at 0.1 % on the first round. However, on the two following rounds, the initial concentrations were recorded as 50 - 67.5 % with a clear decrease at each 1 minute interval reading with concentrations

at 9.9-12.2 % after 10 minutes. These concentrations are above the screening criteria of 1 %.

- In BH426, methane was identified to a maximum of 74.1 % during the single monitoring round. This is above the screening criteria of 1 %. The Lower Explosion Limit correlated with the methane concentration per volume.
- Carbon dioxide is identified between 0-3.3 % in all borehole wells monitored which is below the screening criteria of 5 %.
- Traces of Volatile Organic Compounds of up to 3.3 ppm have been recorded.
- Hydrogen sulphide was not detected throughout the monitoring.
- Carbon monoxide was recorded absent on all monitoring rounds for BH423 and BH426. The first monitoring round for BH425 identified a maximum of up to 22 ppm, falling to 7 ppm on the second monitoring round, 1 ppm on the third and nil on the fourth. The maximum recorded concentration is below the Workplace Exposure Limit of 30 ppm.
- Oxygen has been recorded to be at relatively normal levels (ambient) in BH423 with concentrations between 19.8 - 20.7 %. However it is recorded at low levels in BH425 and BH426 with a minimum of 5.3 % and 0.2 % respectively.

8.6.2 All gas results are presented in Appendix 2.

8.6.3 Within the Made Ground, the available data identifies elevated methane concentrations, negligible gas flows and trace level of carbon dioxide with ambient or depleted oxygen conditions. These are considered representative of typical brownfield sites with low gas generation potential. The set of data is insufficient to determine if the methane concentrations are stable or representative of a peak event as only one monitoring data is available.

8.6.4 The presence of methane within the Glaciofluvial Deposits and in particular at BH425 is considered to be associated with the presence of natural organic material (peat) within the formation. The absence of gas flow and the recorded decrease in the concentration with time indicate a low gas flux with limited ground gas being generated.

8.6.5 The presence of organic matter within the Glaciofluvial Deposits has not been widely identified elsewhere along the route of the new section of motorway (Geotechnical Engineering, 2015).

8.6.6 A gas risk assessment for the Scheme has been undertaken and is set out in the Land Contamination Assessment Report (Appendix 11.1 of the ES).

8.7 Summary

8.7.1 Made Ground and natural soils have been shown to have elevated chromium concentrations. However the speciation indicates these are not of the more toxic hexavalent chromium form thus, are considered to be at tolerable levels to human health.

8.7.2 Elevated total PAHs that could cause a potential risk to human health have been identified within Made Ground and underlying natural soils although the lack of

compound speciation within the analytical data requires the use of conservative screening criteria.

8.7.3 Localised elevated PCBs near the boundary with Solutia Chemical Works have been identified within the Made Ground and perched water. Further sampling in this area will be needed to establish if remediation is needed to protect human health and future site users.

8.7.4 Widespread high pH in the Made Ground is recorded and is likely associated with the presence of slag material in the Made Ground.

8.7.5 Leachable heavy metals have been identified from the Made Ground.

8.7.6 Exceedances of EQSs and DWSs are prevalent within the perched water, perched groundwater and underlying aquifers. When considering metals and inorganics, the water quality in the perched groundwater and aquifer is considered to be comparable to the perched water quality observed in the Made Ground. The groundwater and aquifer water quality is considered to be at background levels of this area of Newport associated with heavy industrial legacy. As such the Site may not be the sole cause for water quality deterioration although its contribution may not be ruled out.

8.7.7 Hydrocarbons in groundwater were identified in the single monitoring point targeting the perched water within the Made Ground (CH32).

8.7.8 Elevated methane levels and depleted oxygen levels with low gas flows have been identified. The results indicated that limited ground gas is being generated in Made Ground and natural soils, however further monitoring is recommended.

9 Refined Conceptual Site Model

9.1.1 The incorporation of data from the 2015 Supplementary Ground Investigation has enabled the original CSM presented in the 2014 PSSR to be updated. Relevant contaminant (Source-Pathway-Receptor) linkages are considered within the refined CSM. The assessment is based on the new section of motorway during construction and operational phases.

9.1.2 The CSM representing general ground conditions, overall layout of the new section of motorway and relevant source/pathway/receptors (each of which having a specific alpha-numerical symbol attached) are presented in Figure 2 and is described in Table 14.

Table 14: Site Conceptual Model

Contamination Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
On site: Elevated metals, TPH, PCBs, PAH originating from a number of industrial processes including Made Ground, fuel depot, scrap yard, slag heap, backfilled ponds, steelworks, refuse tip and railway sidings. Off site: Solutia Chemical Works (CL-17)	**Construction**					
	Construction Workers (B)	Direct dermal (1)	Likely	Moderate	Moderate	Elevated concentrations of some heavy metals, PAHs and PCBs are identified within the Made Ground; however exposure duration will be short term only. Prior to construction, a specific risk assessment will be required in line with Construction (design and management) (CDM) and Health & Safety guidance. This will enable safe methodology and appropriate level of Personal Protective Equipment (PPE) to be put in place. As such, all risks will be duly considered and suitably mitigated to protect construction workers. The concentrations within the Made Ground soils are not foreseen to represent abnormal constraints to construction workers health and safety over and above those typical of a brown field site. Construction works associated with piling which will require piling mat to be in place. This will reduce potential for exposure to contaminated soils and dust. Construction workers may be exposed to ground gas potentially during the excavation works in any confined spaces. Gas data shown to exceed the screening threshold. New pathways for gas migration may be created through placement of piles. Any construction works within confined space would require specified risk assessment, control measures and appropriate PPE.
		Ingestion (3)	Likely	Moderate	Moderate	
		Inhalation of soil dust (2)	Likely	Moderate	Moderate	
		Inhalation of ground gas or vapours (2)	Likely	Moderate	Moderate	

Contamination Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
	Aquifer (Da) within the Glaciofluvial Deposits and/or Mercia Mudstone	Vertical migration (4)	Likely	Moderate	Moderate	Displacement of contaminants in soils and perched water in Made Ground possible during piling. This is subject to selected piling technique and a piling risk assessment will be required. Thick mantle of predominantly soft low permeability Tidal Flat Deposits overlying Aquifer, reducing risk of downward migration. During excavations of localised hydrocarbon contaminated perched water control measures will be required. The aquifer has elevated metal and inorganic contaminants but the levels appear similar to levels in the perched waters in the TFD and Made Ground and are considered at background levels Further investigations are required to delineate any potential contamination and confirm risks associated with PCBs identified in soils and perched water in Made Ground near Solutia Chemical works Boundary.
	Surface Waters (E)	Saturated flow within perched water and groundwaters (4)	Low	Moderate	Moderate to low	Water within the Made Ground and perched groundwater within the Tidal Flat Deposits are likely to be in hydraulic continuity with the river therefore contamination migration via saturated flow from the area of piling is possible and a piling risk assessment is required. During excavations of localised hydrocarbon contaminated perched water control measures will be required. Further localised ground investigations are required to delineate potential contamination and confirm the risks including the area of elevated hydrocarbons and PCBs near Solutia Chemical Works.

Contamination Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
		Contaminated surface water run-off (5)	Unlikely	Moderate	Low	Surface water run-off may deteriorate the quality of surface water and thus construction process may need to adopt surface water control and management. Leachable metals identified within the soils. Application of appropriate surface water run-off control measures during the works is considered sufficient to break this potential pollutant linkage.
	Offsite users during construction works (C)	Dermal contact with dust (1)	Likely	Low	Low	During construction there is the possibility of dermal contact and inhalation of soil dust, short term exposure only. Dust suppression measures will be needed during construction works. Adjacent off-site receptors present associated with industrial activities (low sensitivity). Some gas data shown to exceed the screening threshold both within Made Ground and in natural soils. Works are not anticipated to alter gas regime of the ground beneath. Receptors located within open space or within buildings offsite to the construction activity. Construction works associated with piling which will require piling mat to be in place. This will reduce potential for exposure. Further localised ground investigations are required to delineate potential contamination and confirm the risks including the area of elevated hydrocarbons and PCBs near Solutia Chemical Works.
		Ingestion of soil dust (3)	Likely	Low	Low	
		Inhalation of soil dust (2)	Likely	Low	Low	
		Inhalation of ground gas or vapours (2)	Unlikely	Low	Very low	

Contamination Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
Groundwater – Aquifer from the Glaciofluvial Deposits and/or Mercia Mudstone	Surface water (land drainage) (E)	Piles (4)	Low likelihood	Low	Very low	Aquifer quality shown to be impacted by metal, inorganic and organic contaminants. Perched waters are of similar quality than the groundwater, respective to metals and inorganics contaminants. Groundwaters impacted by saline intrusion. A piling risk assessment is required.
Peat / organic rich soils within Tidal Flat Deposits and/or Glaciofluvial Deposits	Construction workers (B)	Inhalation of ground gas/ explosion (2)	Low likelihood	High	Moderate	No peat deposits identified but organic rich Glaciofluvial Deposits encountered. Methane concentrations are elevated but have low gas flow. New pathways could be created with piles and appropriate pile design is required to mitigate risk. Construction to be largely within open space. Any construction works within confined space would require specific risk assessment, control measures and appropriate PPE. Piling installation could result in explosive risks during operation and risk assessment and gas mitigation controls will be needed.
	Offsite users during construction works (C)	Inhalation of ground gas/ explosion (2)	Unlikely	High	Moderate to low	No peat deposits identified but organic rich Glaciofluvial Deposits encountered. Methane concentrations are elevated but have low gas flow. New pathways could be created with piles and appropriate pile design is required to mitigate risk. Adjacent off-site receptors present associated with industrial activities. Limited potential for lateral gas migration given the presence of low permeability Tidal Flat Deposits to shallow depth.

Contamination Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
	Operation					
On site: Elevated metals, TPH, PCBs, PAH originating from a number of industrial processes including Made Ground , fuel depot, scrap yard, slag heap, backfilled ponds, steelworks, refuse tip and railway sidings. Off site: Solutia Chemical Works (CL-17)	Maintenance Workers (B)	Direct dermal (1)	Likely	Low	Low	Further localised ground investigations are required to delineate potential contamination and confirm the risks including the area of elevated hydrocarbons and PCB near Solutia Chemical Works. Maintenance workers may come into contact with Made Ground materials remaining in situ outside the pier footprints. Areas outside the piers are likely to receive topsoil cover and vegetation establishment or some form of hardstanding, reducing potential of exposure. Exposure duration will be short term only. Site specific risk assessment and method statement will be required in line with health and safety legislation. This will enable safe methodology and appropriate level of appropriate PPE to be put in place. As such all risks will be duly considered and suitably mitigated for instance during future excavation required during maintenance. Current contamination status is not foreseen to represent abnormal constraints to maintenance workers health & safety over and above those typical of a brown field site.
		Ingestion (3)	Likely	Low	Low	
		Inhalation of soil dust (2)	Likely	Low	Low	
		Inhalation of ground gas or vapours (2)	Unlikely	Low	Very low	Gas data shown to exceed the screening thresholds. Maintenance works to be within open space. Any works within confined space would require specified risk assessment, control measures and appropriate PPE to meet legislative requirements. Further investigations are required to delineate any potential contamination and verify the risks.

Contamination Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
	Future motorway users (A) and off-site users (C)	Direct dermal (1)	Unlikely	Low	Very low	Further localised ground investigations are required to delineate potential contamination and confirm the risks including the area of elevated hydrocarbons and PCB near Solutia Chemical Works. Areas outside the piers are likely to receive topsoil cover and vegetation establishment or some form of hardstanding, reducing potential of exposure. Adjacent off-site receptors present associated with industrial activities. Exposure duration will be short term only for M4 users which are to be elevated from ground level (viaduct). Low gas flow identified. Additional monitoring required to verify risks.
		Ingestion (3)	Unlikely	Low	Very low	
		Inhalation of soil dust (2)	Unlikely	Low	Very low	
		Inhalation of ground gas or vapours (2)	Unlikely	Low	Very low	
On site: Elevated metals, TPH, PCBs, PAH originating from a number of industrial processes including Made Ground , fuel depot, scrap yard, slag heap, backfilled ponds, steelworks,	Aquifer (Da) within the Glaciofluvial Deposits and/or Mercia Mudstone	Vertical migration (4)	Likely	Moderate	Moderate	Thick mantle of predominantly soft, low permeability Tidal Flat Deposits overlying Aquifer, reducing risk of downward migration. The aquifer has elevated metal and inorganic contaminants but the levels appear similar to levels in the perched waters in the TFD and Made Ground and are considered to represent background levels Further investigations are required to delineate any potential contamination and verify risks associated with PCBs identified in soils and perched water in Made Ground near Solutia Chemical works Boundary.

Contamination Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
refuse tip and railway sidings. Off site: Solutia Chemical Works (CL-17)	Surface waters; River Usk (E)	Leaching / migration of contaminants to surface waters (4)	Low likelihood	Moderate	Moderate to low	Water within the Made Ground and perched groundwater within the Tidal Flat Deposits are likely to be in hydraulic continuity with the river, therefore contamination migration via saturated flow from the area of piling is possible and a piling risk assessment is required. Further localised ground investigations are required to delineate potential contamination and verify the risks including the area of elevated hydrocarbons and PCBs near Solutia Chemical Works.
Groundwater – Aquifer from the Glaciofluvial Deposits and/or Mercia Mudstone	Surface water (land drainage) (E)	Piles (4)	Low	Low	Very low	Aquifer quality shown to be impacted by metal, inorganic and organic contaminants. Perched waters are of similar quality to the groundwater, in terms of metals and inorganics contaminants. Groundwaters impacted by saline intrusion. A piling risk assessment is required.
Peat / organic rich oils within Tidal Flat Deposits and/or Glaciofluvial Deposits	Maintenance Workers (B)	Inhalation of ground gas/ explosion (2)	Unlikely	High	Moderate to low	No peat deposits identified but organic rich Glaciofluvial Deposits encountered. Methane concentrations are elevated but have low gas flow. New pathways could be created with piles and appropriate pile design is required to mitigate risk. Maintenance work to be largely within open space. Piling installation could result in explosive risks during operation and risk assessment and gas mitigation controls will be needed.

Contamination Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
	Future motorway users (A) and off-site users (C)	Inhalation of ground gas/ explosion (2)	Unlikely	High	Moderate to low	Exposure duration will be short term only for M4 users which are to be elevated from ground level (viaduct). Additional monitoring required to more fully quantify risks.

10 Conclusions and Recommendations

10.1 Conclusions

10.1.1 Ground investigations have been undertaken at the Site to assess risks from land contamination associated with the construction and operation of the new section of motorway including human health and controlled waters risks.

10.1.2 Widespread gross contamination associated with the Site historical use has not been identified. The risk assessment has identified that some residual risks to human health and controlled waters could exist and control measures are required to facilitate the construction and ongoing operation of the new section of motorway. The presence of ground gas has been identified and further monitoring and gas risk assessment should be considered as only limited data is currently available.

10.1.3 The majority of excavated materials are likely to be suitable for reuse within the construction phase subject to development of a remediation strategy including reuse criteria and adoption of a Material Management Plan. Remediation is anticipated to be needed in the area of hydrocarbon contamination such as those encountered in CH11 and STPF01.

10.1.4 Elevated concentrations of some heavy metals, PAHs and PCBs will require the adoption of health and safety control measures in line with the CDM regulations to protect construction workers. However, it is not expected that the level of mitigation will be over and above those typical of brownfield sites.

10.1.5 During the construction phase, specific mitigation measures will be required to prevent inhalation pathways of dust to the general public off site receptors. The placement of construction and piling mats will further reduce inhalation, dermal and ingestion pathways. A suitable water management strategy will also be required to prevent impact to surface waters from run-offs during construction.

10.1.6 During the operational phase, the piers, landscaping and hardstandings will cover the majority of the Site which will effectively remove dermal and ingestion exposure pathways to future site users and off site general public receptors. In addition hard cover will significantly limit the infiltration of rainwater through the soils and potentially leaching any soil contaminants into the groundwater.

10.1.7 Adoption of piled foundations could provide new pathways which may lead to contaminants in soils and perched groundwater within the Made Ground and Tidal Flat Deposits to enter the currently confined aquifer within the Glaciofluvial and Mercia Mudstone.

10.1.8 The shallow and deep aquifers are identified to be impacted with metals, organic and inorganic contaminants which may reduce surface water quality if the piling pathways allow direct or indirect linkage. Further consideration and risk assessment should be given to the potential impact of the piles and whether specific precautions or mitigations measures should be implemented prior to construction.

10.1.9 During operation, maintenance workers involved with excavations into potentially contaminated materials within the footprint of the new section of motorway will

require adoption of safety controls including risk assessments and method statements to manage potential exposure to contaminated soils and waters.

10.2 Recommendations

10.2.1 Given the identified gap in the available ground investigation data, in particular associated with the delineation of hydrocarbon and PCB contaminated soils (to support human health and material reuse), controlled waters (limited site coverage) and ground gas regime (to support human health and the foundation design), additional ground investigation works is to be undertaken. Upon completion of the ground investigation, the report shall be reviewed and updated accordingly once the findings of the additional investigation are made available.

10.2.2 Additional ground investigation should be undertaken at the Site to refine the risk assessments and enable the remediation strategy to be developed and implemented. The ground investigation should include the flowing:

- Delineation of the hydrocarbons in perched waters identified around CH32.
- Delineation of PCB contamination around CH32 and STPG01.
- Installation of groundwater monitoring wells for gas and groundwater monitoring.
- Soils sampling and groundwater sampling in the area of the proposed WTA, associated discharge route and also in the area of temporary land take.

10.2.3 Upon review and assessment of the proposed additional ground investigation information, any contamination identified that could cause an unacceptable risk to the identified receptors will require appropriate remedial mitigation measures. These measures would be identified within a remedial strategy for the new section of motorway. At this stage, the strategy is anticipated to include but is not limited to the following:

- Addressing potential human health risk and controlled waters risk identified by the proposed additional ground investigation.
- Risk assessment of piles and associated construction works creating pathways enabling contaminants and gas migration.
- Dealing with unexpected contamination.
- Verification sampling to confirm suitability for soils for re-use or verify imported topsoils.
- Control measures to prevent risks to construction workers and the general public during construction.

10.2.4 The remediation strategy should include a remediation options appraisal, remediation implementation plan and remediation verification plan.

10.2.5 The remediation strategy should be supported by a Scheme wide Material Management Plan prepared in accordance with CL:AIRE Code of Practice (CL:AIRE, 2011).

11 References

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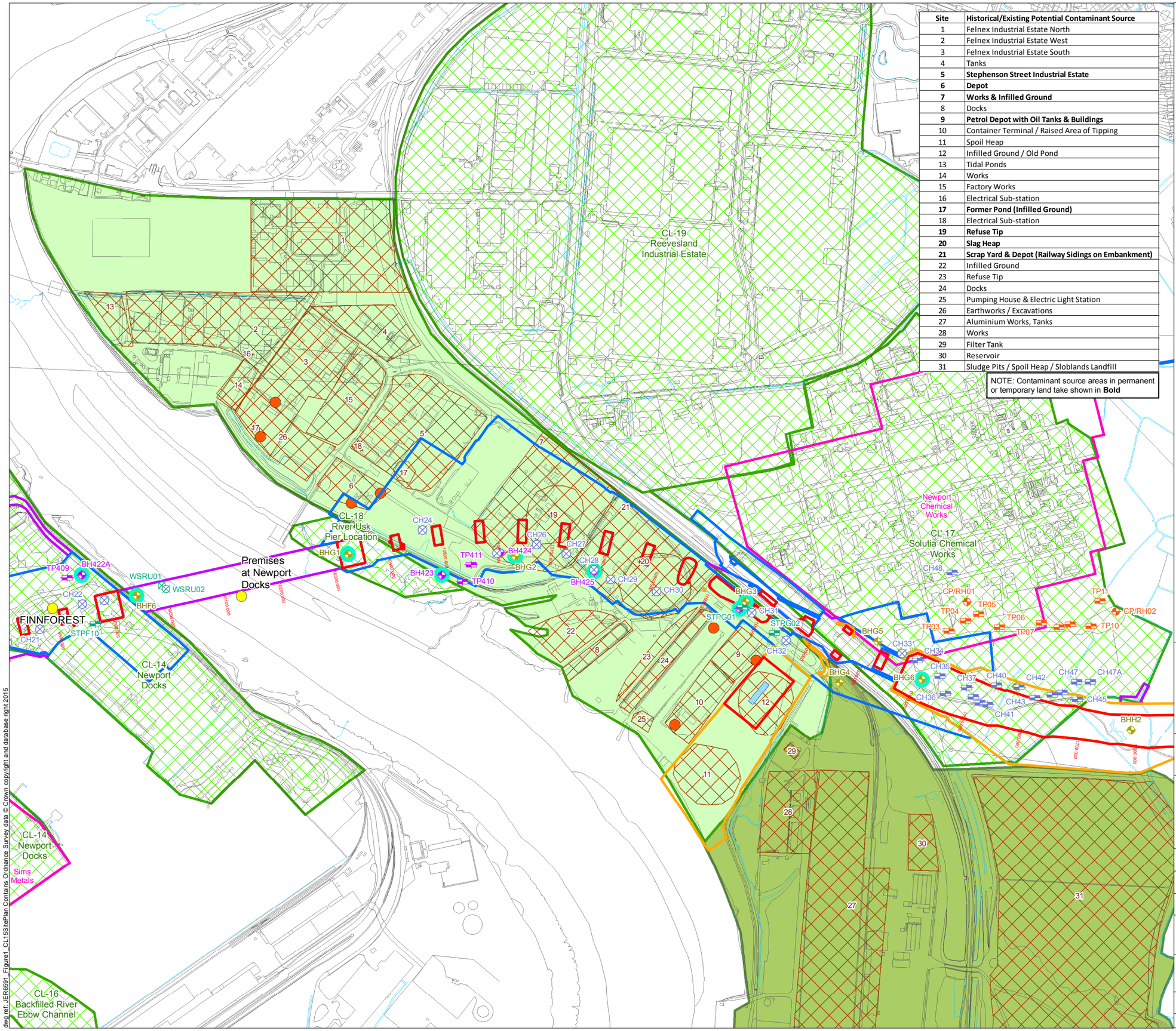
12 Glossary

BF	Blast Furnace
BGS	British Geological Survey
BOD	Biochemical Oxygen Demand
BOS	Basic Oxygen Slag
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CAT	Cable Avoidance Tool
CDM	Construction Design Management
CH_4	Methane
CLEA	Contaminated Land Exposure Assessment
CO_2	Carbon Dioxide
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CSM	Conceptual Site Model
DMRB	Design Manual for Roads and Bridges
DO	Dissolved Oxygen
DQRA	Detailed Quantitative Risk Assessment
DWS	Drinking Water Standard
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
ES	Environmental Statement
ESG	Environmental Scientifics Group
EQS	Environmental Quality Standard
FTIR	Fourier Transform Infrared (spectroscopy)
GAC	Generic Assessment Criteria
GDR	Geotechnical Design Report
GIR	Ground Investigation Report
GRO	Gasoline Range Organics
LEL	Lower Explosive Limit
LOD	Limit of Detection
mAOD	Metres Above Ordnance Datum

mb	Millibars
mbGL	Metres below Ground Level
MTBE	Methyl Tert-butyl Ether
NRW	Natural Resources Wales
ORP	Oxidation Reduction Potential
O_2	Oxygen
OS	Ordnance Survey
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCSM	Preliminary Conceptual Site Model
PID	Photo Ionisation Detector
PPE	Personnel Protection Equipment
SGVs	Soil Guideline Values
SSAC	Site Specific Assessment Criteria
SSSI	Site of Special Scientific Interest
SVOCs	Semi-Volatile Organic Compounds
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbon
TPH CWG	Total Petroleum Hydrocarbon Criteria Working Group
UKAS	United Kingdom Accreditation Service
VOCs	Volatile Organic Compounds
WFD	Water Framework Directive
UXO	Unexploded Ordnance Survey

Figures



Site	Historical/Existing Potential Contaminant Source
1	Felnex Industrial Estate North
2	Felnex Industrial Estate West
3	Felnex Industrial Estate South
4	Tanks
5	**Stephenson Street Industrial Estate**
6	**Depot**
7	**Works & Infilled Ground**
8	Docks
9	**Petrol Depot with Oil Tanks & Buildings**
10	Container Terminal / Raised Area of Tipping
11	Spoil Heap
12	Infilled Ground / Old Pond
13	Tidal Ponds
14	Works
15	Factory Works
16	Electrical Sub-station
17	**Former Pond (Infilled Ground)**
18	Electrical Sub-station
19	**Refuse Tip**
20	**Slag Heap**
21	**Scrap Yard & Depot (Railway Sidings on Embankment)**
22	Infilled Ground
23	Refuse Tip
24	Docks
25	Pumping House & Electric Light Station
26	Earthworks / Excavations
27	Aluminium Works, Tanks
28	Works
29	Filter Tank
30	Reservoir
31	Sludge Pits / Spoil Heap / Sloblands Landfill

NOTE: Contaminant source areas in permanent or temporary land take shown in **Bold**

Legend

- Permanent Highway Land within Fenceline (including Water Treatment Areas)
- Other Permanent Land Take
- Temporary Construction Land
- Easement Only
- Proposed Water Treatment Area (WTA)
- Potential Area of Land Contamination based on 2014 PSSR
- CL-20: Mir Steel Works
- Other Potential Area of Land Contamination
- Site Features from 2014 PSSR
- Tank Location from 2014 PSSR
- Permit Boundary
- Permit Location

Investigation Locations

2015 (Geotechnical Engineering)
- Borehole
- Trial Pit

2008 (WSP)
- Borehole
- Trial Pit

2007 (Norwest Holst)
- Trial Pit
- Window Sample

2000 (Exploration Associates)
- Trial Pit
- Window Sample

1997 (Norwest Holst)
- Borehole
- Monitoring Well Installation

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Appendix 11.1 Annex D CL-15

Site Plan for CL-15

Figure: 1	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Scale: A3 @ 1:6,500
0 105 210 m

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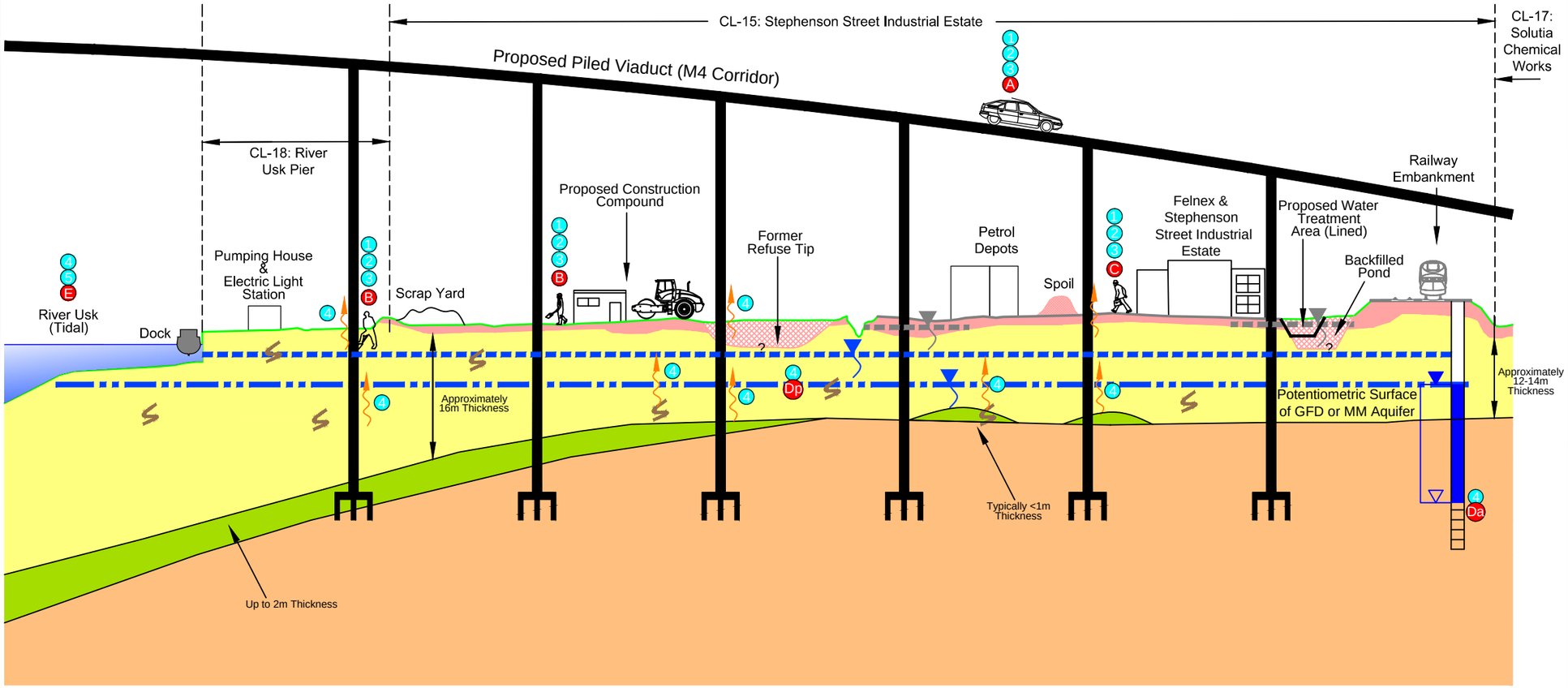
dwg ref: JER6591_Figure1_CL15SitePlan

dwg ref: JER6591_Figure1_CL15SitePlan Contains Ordnance Survey data © Crown copyright and database right 2015

CL-15 Stephenson Street Industrial Estate



Ground conditions based on available information

Legend

- Stockpile / Fill Material
- Made Ground - MG
- Tidal Flat Deposits - TFD
- Glaciofluvial Deposits - GFD
- Organic Matter within TFD & GFD
- Mercia Mudstone - MM
- Proposed Piled Pier
- Hardstanding
- Rough Grassland
- ? No Information Available
- Perched Water (MG)
- Perched Groundwater (Top of TFD)
- Groundwater (GFD and MM)
- Gas Migration Pathway

Potential Receptors

- A Humans On-Site (M4 User)
- B Humans On-Site (Construction/Maintenance)
- C Humans Off-Site (Site Neighbours)
- Dp/Da Groundwater (Aquifer)
- E Surface Water

Potential Pathways

- 1 Dermal Contact
- 2 Inhalation
- 3 Ingestion
- 4 Leaching / Migration
- 5 Surface Run Off

Potential Sources of Contamination

Possible contamination present on site associated with :

On-Site

- Potential contamination associated with previous industrial uses including; timber yards, coal sidings, fuel works and railway land
- Steelworks

Off-Site

- Potential for off-site sources of contamination to be present associated with industrial estate and Solutia Chemical Works (Cl-17)

NOTE
Drawing refined from PSSR Drawing Reference M4-OA-17-00DR-Z-XX-0119 (April 2014)

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Welsh Government

Appendix 11.1 Annex D CL-15

Conceptual Site Model for CL-15

Figure: 2	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Not to Scale

dwg ref:JER6591_Figure2_CL15ConceptualSiteModel

dwg ref: JER6591_Figure2_CL15ConceptualSiteModel

Appendices

A1 Appendix 1

Exploratory Borehole Records

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG2
Header

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	332787.0 E 185468.2 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Knebel 77	Ground Level	8.00m AOD
Client	Welsh Office	Drillers	T.W/E.D	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	18/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	20/11/1997
		Core bit	Saw Tooth		

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
18/11/1997	1800	14.80	14.50	Dry	
19/11/1997	0800	14.80	14.50	8.40	
19/11/1997	1800	16.60	15.00	Dry	
19/11/1997	1800	31.50	16.25	10.68	
20/11/1997	0800	31.50	16.25	6.31	
20/11/1997	1530	45.00	16.25	10.32	

CABLE PERCUSSION DETAILS

Hard strata from depth	Hard strata to depth	Hours	Remarks
13.30	13.40	0.75	

CASING

Hole diameter	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
150	16.60	150	15.50

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
18/11/1997	0000	13.20	8.90	20	fast	0.00	0.00

ROTARY DRILLING DETAILS

From depth	To depth	Flush type	Flush return	Core diameter
16.50	45.00	mist	100%	92

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	C	N=16 (6,7,4,3,4,5)
7.00	S	N=2 (1,0,1,0,1,0)
13.50	C	N=37 (7,8,11,10,7,9)
14.80	S	N=55 (5,6,10,16,14,15)
16.30	S	56/225mm (7,8,16,16,24)
25.60	S	50/75mm (5,20,50)
39.00	S	99/225mm (6,6,21,28,50)

* Seating blows only.

GENERAL NOTES

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, hard strata time in hours

Form	COMBINED HEADER
Version	2.00
Revised	26/06/1997

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG2
Sheet 1 of 5

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	332787.0 E 185468.2 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Knebel 77	Ground Level	8.00 m AOD
Client	Welsh Office	Drillers	T.W/E.D	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	18/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	20/11/1997
		Core Bit	Saw Tooth		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring			Blow count to drive U100	SPT N & depth		Install-ation
MADE GROUND: Blackish brown slightly clayey silty sandy sub-angular gravel of brick, clinker, slag and rubble with occasional cobbles.				B	1.00	- 1.50		C16	1.00 1.45	
		1.30	6.70							
Stiff brown mottled grey occasionally thinly laminated CLAY. (Estuarine Alluvium)				D	1.80					
				U	2.00	- 2.50	(30)			
				D	2.50					
		2.70	5.30							
Soft becoming very soft grey CLAY. (Estuarine Alluvium)				U	3.00	- 3.50	(11)			
				D	3.50					
---at 3.50m organic				U	4.00	- 4.50	(9)			
				D	4.50					
				U	5.00	- 5.50	(8)			
				D	5.50					
---from 5.50m dark grey				U	6.00	- 6.50	(9)			
				D	6.50					
---at 7.00m very soft								S2	7.00 7.45	
				D	7.50					
---from 7.50 to 10.00m very silty				U	8.00	- 8.50	(9)			
				D	8.50					
				D U	9.50 9.50	- 10.00	(13)			
				D	10.00					

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG2
Sheet 2 of 5

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	332787.0 E 185468.2 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Knebel 77	Ground Level	8.00 m AOD
Client	Welsh Office	Drillers	T.W/E.D	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	18/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	20/11/1997
		Core Bit	Saw Tooth		

Description of Strata	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
Soft becoming very soft grey CLAY. (Estuarine Alluvium)			D 10.00			
			D 10.70			
			U 11.00 - 11.50	(14)		
			D 11.50			
			D 12.20			
			U 12.50 - 13.00			
			D 13.00			
---from 13.00m dark grey mottled black organic very silty	13.20	-5.20				
			B 13.50 - 14.00		C37 13.50 13.95	
Dense grey slightly silty sandy sub-rounded siliceous GRAVEL with many cobbles. (Fluvial Alluvium)	14.00	-6.00				
Greyish green mottled reddish brown highly to completely weathered MUDSTONE, very weak to weak. (Mercia Mudstone Group)			B 14.50 - 15.00 U 14.50 - 14.75	(100)		
					S55 14.80 15.25	
			B 15.50 - 16.00			
					S56/225mm 16.30 16.68	
---from 16.30m reddish brown mottled greyish green slightly to moderately weathered moderately strong to strong	16.60	-8.60				
---from 16.50 to 16.65m moderately to highly weathered weak			16.50 - 18.00	TCR 93, SCR 57, RQD 8, FI		
Reddish brown thinly sub-horizontally bedded moderately weathered silty MUDSTONE, moderately weak with very closely to closely spaced sub-horizontal fractures planar rough tight. (Mercia Mudstone Group)						
---from 16.90 to 17.15m with very closely spaced thick laminations to very thin beds of calcite			18.00 - 19.50	TCR 98, SCR 69, RQD 42, FI		
---from 17.35 to 17.50m moderately to highly weathered moderately weak						
---from 17.60 to 18.00m green highly						

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG2

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	332787.0 E 185468.2 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Knebel 77	Ground Level	8.00 m AOD
Client	Welsh Office	Driller	T.W/E.D	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	18/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	20/11/1997
		Core bit	Saw Tooth		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown thinly sub-horizontally bedded moderately weathered silty MUDSTONE, moderately weak with very closely to closely spaced sub-horizontal fractures planar rough tight. (Mercia Mudstone Group) ---from 21.00m moderately to highly weathered weak completely fractured		21.33	-13.33	19.50 - 21.00	100	73	35			
Reddish to purplish brown occasionally mottled green medium bedded moderately to highly weathered silty slightly sandy MUDSTONE, weak to moderately weak with extremely to very closely spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group) ---from 21.33 to 21.50m completely fractured ---from 21.70 to 21.90m completely fractured ---from 22.20 to 22.30m completely fractured ---from 22.60 to 22.80m completely fractured ---from 23.05 to 23.78m slightly to moderately weathered moderately weak with medium spaced sub-horizontal to inclined fractures planar rough tight ---from 23.78 to 24.30m weak completely fractured		24.60	-16.60	21.00 - 22.60	90	13	0			
				22.60 - 24.00	96	54	30			
				24.00 - 25.60	94	51	30	5 7	S50/75mm 25.60 25.83	
Reddish brown occasionally mottled green medium to thickly sub-horizontally bedded moderately weathered silty MUDSTONE, moderately weak with medium spaced sub-horizontal fractures planar rough tight. (Mercia Mudstone Group) ---from 27.10 to 27.40m moderately to highly weathered weak to moderately weak		27.40	-19.40	25.60 - 27.10	100	73	45	7		
Reddish brown occasionally mottled green medium to thickly sub-horizontally bedded slightly to moderately weathered silty MUDSTONE, very weak to weak locally moderately strong with medium spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group) ---from 28.40 to 28.62m moderately to highly weathered very weak completely fractured				27.10 - 28.40	100	96	58	5 5		
				28.40 - 30.00	95	83	65	NI 5		

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG2
Sheet 4 of 5

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	332787.0 E 185468.2 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Knebel 77	Ground Level	8.00 m AOD
Client	Welsh Office	Driller	T.W/E.D	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	18/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	20/11/1997
		Core bit	Saw Tooth		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown occasionally mottled green medium to thickly sub-horizontally bedded slightly to moderately weathered silty MUDSTONE, very weak to weak locally moderately strong with medium spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group) ---from 31.00 to 33.10m with closely to medium spaced thin to thick laminations and gravel size pockets of calcite ---from 31.50 to 31.75m moderately to highly weathered weak completely fractured ---from 32.80 to 33.10m highly weathered very weak completely fractured		33.10	-25.10	30.00 - 31.50	100	83	49	NI 6		
				31.50 - 33.10	94	55	43	NI 4 NI		
Reddish brown mottled greyish green very thinly to thinly sub-horizontally bedded moderately weathered MUDSTONE, moderately weak to moderately strong with very closely to closely spaced sub-horizontal fractures planar rough tight. (Mercia Mudstone Group) ---from 35.50 to 35.70m moderately to highly weathered completely fractured ---from 36.00 to 36.30m completely fractured weak ---at 36.30m sub-horizontal fracture with calcite infill ---from 36.50 to 37.10m completely fractured weak ---from 37.30m sub-horizontal fracture with calcite infill ---from 37.60 to 37.80m completely fractured weak ---from 39.00 to 39.30m moderately to highly weathered completely fractured ---from 39.30 to 39.90m no recovery				33.10 - 34.60	100	97	90	9		
				34.60 - 36.00	100	96	57	4 NI 4		
				36.00 - 37.60	100	88	25	NI 1 NI 2 NI		
				37.60 - 39.00	93	79	54	NI 3	S99/225mm 39.00	
				39.00 - 39.90	33	0	0	NI NA NI	39.38	

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG2
Sheet 5 of 5

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	332787.0 E 185468.2 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Knebel 77	Ground Level	8.00 m AOD
Client	Welsh Office	Driller	T.W/E.D	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	18/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	20/11/1997
		Core bit	Saw Tooth		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown mottled greyish green very thinly to thinly sub-horizontally bedded moderately weathered MUDSTONE, moderately weak to moderately strong with very closely to closely spaced sub-horizontal fractures planar rough tight. (Mercia Mudstone Group)				39.90 - 40.50	100	83	50	NI 2		
---from 40.50 to 41.60m moderately to highly weathered weak				40.50 - 42.00	80	67	20	10 NI		
---from 41.60 to 41.70m moderately to highly weathered weak completely fractured								NA		
---from 42.00 to 42.40m completely fractured				42.00 - 43.50	100	73	47	NI 6		
---from 43.20 to 43.50m completely fractured								NI		
---at 43.40m calcitic				43.50 - 45.00	90	73	0	NI		
---from 43.50 to 44.20m completely fractured								6		
---from 44.40 to 44.65m inclined fracture (50°) planar rough tight (calcite infill)								NA		
---from 44.85 to 45.00m no recovery		45.00	-37.00							
Borehole complete at 45.00 m.										

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG3
Header

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	333196.2 E 185387.5 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Hands England	Ground Level	8.00m AOD
Client	Welsh Office	Driller	C.A/D.D	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	30/10/1997
Consultant	Ove Arup and Partners			Date Completed	11/11/1997

CASING

Hole diameter	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
150	15.80	150	15.50
120	40.05	140	30.00

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
2.00	S	N=4 (1,2,1,1,1,1)
4.00	S	N=1 (0,0,1,0,0,0)
6.50	S	N=1 (1,0,1,0,0,0)
9.00	S	N=2 (1,0,1,0,1,0)
12.00	S	N=1 (0,0,1,0,0,0)
15.00	S	N=2 (1,0,0,0,1,1)
15.76	S	95/95mm*
16.95	C	50/70mm (16,9,50)
18.35	C	127/200mm (7,13,35,42,50)
19.35	C	116/200mm (13,12,28,38,50)
20.35	C	50/65mm (9,16,50)
22.90	C	75/115mm*
25.50	C	50/60mm (20,5,50)
26.50	C	97/220mm (4,4,8,39,50)
27.50	C	20/223mm*
27.72	C	50/60mm (17,8,50)
30.80	C	75/150mm (9,16,25,50)
33.30	C	78/145mm (6,14,28,50)
34.30	C	50/75mm (19,6,50)
35.55	C	78/145mm (8,15,28,50)
36.55	C	N=89 (,9,17,27,36)
39.05	C	50/50mm (19,6,50)
40.05	C	50/60mm (7,9,50)

* Seating blows only.

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

Form	COMBINED HEADER
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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG3
Header

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	333196.2 E 185387.5 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Hands England	Ground Level	8.00m AOD
Client	Welsh Office	Driller	C.A/D.D	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	30/10/1997
Consultant	Ove Arup and Partners			Date Completed	11/11/1997

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
30/10/1997	1800	8.00	7.50	Dry	
31/10/1997	0800	8.00	7.50	7.80	
31/10/1997	1800	15.80	15.50	10.10	
04/11/1997	1300	18.35	18.55	4.45	
04/11/1997	1800	18.35	15.50	Dry	
05/11/1997	0800	18.35	17.55	4.50	
05/11/1997	1800	21.90	19.35	6.20	
06/11/1997	0800	21.90	19.35	5.00	
06/11/1997	1800	30.00	19.35	8.10	
10/11/1997	0800	30.00	19.35	5.10	
10/11/1997	1800	35.55	30.00	6.80	
11/11/1997	0800	35.55	30.00	5.15	
11/11/1997	1800	40.05	30.00	5.80	

DRILLING DETAILS

From depth	To depth	Flush type	Flush return	Core diameter
15.80	40.05	foam	100%	92.0

CABLE PERCUSSION DETAILS

Hard Strata from depth	Hard Strata to depth	Hours	Remarks
0.00	0.40	1.00	
0.40	0.60	0.75	
15.60	15.80	1.00	

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

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BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG3
Sheet 1 of 5

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	333196.2 E 185387.5 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Hands England	Ground Level	8.00 m AOD
Client	Welsh Office	Drillers	C.A/D.D	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	30/10/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	11/11/1997
		Core Bit	P.C.D		

Description of Strata	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth
MADE GROUND: Black sandy clayey slag and brick fill.			D 0.20 B 0.30 - 0.70		
	0.70	7.30			
Soft becoming very soft grey mottled brown sandy very silty CLAY with occasional thin laminations of greyish blue silt. (Estuarine Alluvium)			D 0.80 U 1.00 - 1.45	(10)	
			D 1.50 D 1.75 B 2.00 - 2.45 D 2.00		S4 2.00 - 2.45
---from 2.75 to 3.75m becoming slightly organic			D 2.75 U 3.00 - 3.45	(7)	
			D 3.50 D 3.75 B 4.00 - 4.45 D 4.00		S1 4.00 - 4.45
---at 4.00m becoming very soft and slightly sandy					
---at 4.75m becoming slightly organic			D 4.75 B 5.00 - 5.40 U 5.00 - 5.40	(5)	
			U 5.50 - 5.95	(4)	
---at 6.00m becoming grey mottled black			D 6.00 D 6.25 B 6.50 - 6.95 D 6.50		S1 6.50 - 6.95
			D 7.25 U 7.50 - 7.95	(5)	
	8.00	0.00	D 8.00		
Very soft grey mottled black organic CLAY. (Estuarine Alluvium)			D 8.50		
---at 9.00m becoming slightly sandy			B 9.00 - 9.45 D 9.00		S2 9.00 - 9.45
			D 10.00		

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG3

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	333196.2 E 185387.5 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Hands England	Ground Level	8.00 m AOD
Client	Welsh Office	Drillers	C.A/D.D	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	30/10/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	11/11/1997
		Core Bit	P.C.D		

Description of Strata	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Installation
Very soft grey mottled black organic CLAY. (Estuarine Alluvium)			D 10.00			
			U 10.50 - 10.95	(4)		
			D 11.00			
			D 11.50			
			B 12.00 - 12.45		S1 12.00 - 12.45	
	13.00	-5.00	D 13.00			
Soft dark grey slightly sandy very silty CLAY. (Estuarine Alluvium)			U 13.50 - 13.95	(5)		
			D 14.00			
---at 14.50m becoming mottled black			D 14.50			
			B 15.00 - 15.45		S2 15.00 - 15.45	
	15.60	-7.60				
Brown mottled greyish green highly to moderately weathered sandy MUDSTONE, very weak to weak. (Mercia Mudstone Group)	15.80	-7.80	B 15.76		S95/95mm* 15.76 - 15.86	
Greyish green mottled reddish brown thinly to medium sub-horizontally bedded highly weathered MUDSTONE, moderately weak to moderately strong with extremely closely to very closely spaced horizontal to vertical fractures irregular rough tight to open. (Mercia Mudstone Group)			15.80 - 16.95	TCR 32, SCR 10, RQD 0, Fl NI 9, NA	C50/70mm 16.95 - 17.17	
---from 15.80 to 16.03m completely fractured			16.95 - 17.95	0, 0, 0, NA		
---from 16.17 to 16.95m no recovery	17.95	-9.95	17.95 - 18.35	100, 88, 0, NI 7	C127/200mm 18.35 - 18.70	
---from 16.95 to 17.95m no recovery	18.35	-10.35				
Greyish green mottled reddish brown sub-horizontally bedded completely weathered MUDSTONE, weak to moderately weak with extremely closely spaced sub-horizontal to vertical fractures irregular rough tight to open. (Mercia Mudstone Group)			18.35 - 19.35	15, 5, 0, NI, NA	C116/200mm 19.35 - 19.70	
			19.35 - 20.35	0, 0, 0, NA		

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG3
Sheet 3 of 5

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	333196.2 E 185387.5 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Hands England	Ground Level	8.00 m AOD
Client	Welsh Office	Driller	C.A/D.D	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	30/10/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	11/11/1997
		Core bit	P.C.D		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown mottled greyish green thinly to medium sub-horizontally bedded moderately to highly weathered MUDSTONE, very to moderately weak with closely to medium spaced sub-horizontal to inclined discontinuities planar rough tight. (Mercia Mudstone Group)									C50/65mm 20.35 20.57	
---from 20.35 to 20.60m completely fractured				20.35 - 21.35	25	5	0	NI NA		
---from 20.60 to 21.35m no recovery				21.35 - 21.90	0	0	0	NA		
---from 21.35 to 21.90m no recovery ---from 21.90 to 22.90m no recovery				21.90 - 22.90	0	0	0	NA	C75/115mm 22.90 23.02	
---from 22.90 to 23.10m highly weathered				22.90 - 23.90	100	87	79	5		
				23.90 - 24.60	100	79	31	0		
---from 24.60 to 24.80m completely fractured				24.60 - 25.50	22	0	0	NI NA		
---from 24.80 to 25.50m no recovery ---from 25.50 to 26.50m no recovery				25.50 - 26.50	0	0	0	NA	C50/60mm 25.50 25.71	
---from 26.50 to 26.77m completely fractured				26.50 - 27.50	27	0	0	NI 0	C97/220mm 26.50 26.87	
---from 26.77 to 27.50m no recovery									C20/223mm 27.50	
---from 27.50 to 27.70m highly weathered completely fractured		27.90	-19.90	27.50 - 28.50	63	25	0	NI 4 NI	C50/60mm 27.72 27.72 27.93	
Reddish brown thinly to medium bedded highly weathered silty MUDSTONE, very weak completely fractured. (Mercia Mudstone Group)				28.50 - 30.00	22	0	0	NI		
		30.00	-22.00							

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG3
Sheet 4 of 5

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	333196.2 E 185387.5 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Hands England	Ground Level	8.00 m AOD
Client	Welsh Office	Driller	C.A/D.D	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	30/10/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	11/11/1997
		Core bit	P.C.D		

Description of Strata	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown thinly to medium bedded highly weathered silty MUDSTONE, very weak completely fractured. (Mercia Mudstone Group)	30.00	-22.00	30.00 - 30.80	0	0	0	NA	C75/150mm 30.80 31.10	
Reddish brown medium bedded completely weathered silty MUDSTONE, very weak completely fractured. (Mercia Mudstone Group) ---from 31.25m moderately to highly weathered ---from 31.65m occasionally mottled greyish green slightly to moderately weathered ---from 31.75m very closely spaced sub-horizontal discontinuities planar rough tight			30.80 - 31.80	90	15	0	NI		
			31.80 - 33.30	40	20	0	7 0	C78/145mm 33.30 33.60	
			33.30 - 34.30	0	0	0	NA	C50/75mm 34.30 34.53	
			34.30 - 34.55	100	60	0	NI		
			34.55 - 35.55	0	0	0	NA	C78/145mm 35.55 35.85	
			35.55 - 36.55	0	0	0	NI	C89 36.55 37.00	
Reddish brown occasionally mottled greyish green medium bedded moderately weathered silty MUDSTONE, moderately weak with closely spaced horizontal to sub-horizontal discontinuities planar rough tight. (Mercia Mudstone Group) ---from 37.15 to 37.55m moderately to highly weathered weak completely fractured ---from 37.25 to 37.45m slightly calcitic	36.55	-28.55	36.55 - 37.55	97	56	17	4 NI		
	37.55	-29.55	37.55 - 39.05	65	39	11	1 NI 8	C50/50mm 39.05 39.25	
Reddish brown thinly sub-horizontally bedded slightly weathered silty MUDSTONE, moderately strong with very closely to closely spaced horizontal to sub-horizontal discontinuities planar rough tight. (Mercia Mudstone Group) ---from 37.67 to 37.79m completely fractured			39.05 - 40.05	0	0	0	NI		

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	1.00
Revised	20/09/96

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG3
Sheet 5 of 5

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	333196.2 E 185387.5 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Hands England	Ground Level	8.00 m AOD
Client	Welsh Office	Driller	C.A/D.D	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	30/10/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	11/11/1997
		Core bit	P.C.D		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown thinly sub-horizontally bedded slightly weathered silty MUDSTONE, moderately strong with very closely to closely spaced horizontal to sub-horizontal discontinuities planar rough tight. (Mercia Mudstone Group)		40.05	-32.05						C50/60mm 40.05 40.26	
Borehole complete at 40.05 m.										

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	1.00
Revised	20/09/96

Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
0.00-0.50	TO		08/02 2000 DRY	
0.50-0.75	B			
0.75-1.00	TO			
1.00-1.50	TO			
1.50-2.00	B			
2.00-2.50	TO			
3.00		NIL	DRY	

Strata

Description	Depth (Thickness)	Level
	G.L.	7.41
MADE GROUND: Compact brown slightly clayey silty fine to coarse sand with occasional to some sub-angular fine to coarse gravel of brick,chert,coal,slag and ash with occasional sub-angular cobbles of sandstone	(0.75)	
	0.75	6.66
Firm grey brown slightly organic slightly sandy very silty CLAY	(1.25)	
	2.00	5.41
Soft to firm grey mottled brown very silty CLAY no recovery 2.50m - 3.00m	(1.00)	
	3.00	4.41
End of Borehole.		

Legend

Equipment: Hand Held Window Sampler

Borehole Dia (mm) 80 to 1.00m, 60 to 3.00m

Casing Dia (mm)

Groundwater

No. Struck Behaviour Sealed

No groundwater encountered

Ground Level 7.41 m OD
Coordinates 332622.32 mE, 185515.17 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks

See key sheet and appendices for explanations.

Form 1/0

Borehole Record

Exploration Associates

Project

M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

Contract 150006

Borehole CH24(1 of 1)

Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
0.00-0.50	TO		05/02 2000 DRY	
0.50-0.80	B			
0.80-1.10	TO			
1.10-1.80	B			
1.80-2.30	TO			
3.00		NIL	DRY	

Strata

Description	Depth (Thickness)	Level
	G.L.	7.61
MADE GROUND: Compact brown and grey sandy very silty very clayey sub-rounded to sub-angular fine to coarse gravel of brick,slag, sandstone and limestone	(0.80)	
	0.80	6.81
Firm to stiff grey mottled brown very silty CLAY		
....becoming soft to firm below 1.80m.	(2.20)	
	3.00	4.61
End of Borehole.		

Legend

Equipment: Hand Held Window Sampler

Borehole Dia (mm) Casing Dia (mm)
80 to 1.00m
60 to 3.00m

Groundwater

No. Struck	Behaviour	Sealed

No groundwater encountered

Ground Level 7.61 m OD
Coordinates 332754.50 mE
185473.49 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks

See key sheet and appendices for explanations.

Form 1/0

Borehole Record

Exploration Associates

Project
M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

Contract 150006

Borehole CH25(1 of 1)

Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
			08/02 0000 DRY	
0.30-0.65	TO			
0.65-1.00	T	NIL	0.65	
1.00				

Strata

Description	Depth (Thickness)	Level
	G.L.	7.19
MADE GROUND: Strong grey intact re-inforced concrete.	0.30	6.89
MADE GROUND: Moderately compact grey slightly sandy silty slightly clayey sub-angular to angular fine to coarse gravel of sandstone, brick and quartz with some cobbles of sndstone	(0.70)	
End of Borehole.	1.00	6.19

Legend

Equipment: Hand HeldWindow Sampler

Borehole Dia (mm) 80 to 1.00m

Casing Dia (mm)

Groundwater

No.	Struck	Behaviour	Sealed
1	0.65	Rose to 0.65m in 20 mins .65/.65/.65 in 5/10/15 mins	

Ground Level 7.19 m OD
Coordinates 332824.91 mE 185489.35 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks Concrete core 202mmφ to a depth of 0.30 (1hr)
Refusal at 1.00m (Possible cobbles??) Insufficient amount of water for same

See key sheet and appendices for explanations.

Form 1/0

Borehole Record

Exploration Associates

Project
M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

Contract 150006

Borehole CH26(1 of 1)

Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
			08/02 0000 DRY	
0.55-0.90	TO			
1.10-1.50	TO			
2.00-2.50	TO			
3.00		NIL	DRY	

Strata

Description	Depth (Thickness)	Level
MADE GROUND: Strong grey re-inforced concrete.	G.L.	6.78
	0.25	6.53
MADE GROUND: Moderately compact brown sandy angular to sub-angular fine to coarse gravel of limestone and brick	0.55	6.23
MADE GROUND: Moderately compact dark grey black very silty slightly clayey fine sand with occasionl to some sub-angular fine to coarse gravel of sandstone and slag	0.90	5.88
	1.10	5.68
MADE GROUND: Firm grey very silty clay with occasional sub-angular fine to medium gravel of coal and ash	(1.90)	
Firm grey very silty CLAY from 2.00 Becoming soft to firm		
.....	3.00	3.78

End of Borehole.

Legend

Equipment: Hand Held Window Sampler

Borehole Dia (mm) 80 to 1.00m, 60 to 3.00m

Casing Dia (mm)

Groundwater

No. Struck Behaviour Sealed

No groundwater encountered

Ground Level 6.78 m OD
Coordinates 332877.57 mE, 185472.83 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks Concrete core 202mmø to a depth of 0.25 (1.5 hrs)

See key sheet and appendices for explanations.

Form 1/0

Borehole Record

Exploration Associates

Project
M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

Contract 150006

Borehole CH27(1 of 1)

Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
			08/02 2000 DRY	
0.27-0.72	TO			
1.40-1.90	B			
1.90-2.50	TO			
2.50-3.00	TO			
3.00		NIL	DRY	

Strata

Description	Depth (Thickness)	Level
	G.L.	7.89
MADE GROUND: Strong grey intact re-inforced concrete	0.27	7.62
MADE GROUND: Compact brown slightly clayey very silty fine to medium sand with some sub-angular to sub-rounded fine to coarse gravel of quartz,sandstone,mudstone,coal,slag and ash with occasional cobbles of slag	(1.13)	
	1.40	6.49
MADE GROUND: Moderately compact slightly clayey slightly silty fine to medium sand with some to much angular to sub-angular fine to coarse gravel of sandstone	(0.50)	
	1.90	5.99
Soft to firm grey mottled brown slightly sandy very silty CLAY From 2.30 becoming firm to stiff	(1.10)	
	3.00	4.89
End of Borehole.		

Legend

Equipment: Hand Held Window Sampler

Borehole Dia (mm) Casing Dia (mm)
202 to 0.27m
80 to 1.27m
60 to 3.00m

Groundwater
No. Struck Behaviour Sealed

No groundwater encountered

Ground Level 7.89 m OD
Coordinates 332926.36 mE
185443.98 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks Concrete core 202mmφ to a depth of 0.27m (1hr)

See key sheet and appendices for explanations.

Form 1/0

Borehole Record

Exploration Associates

Project
M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

Contract 150006

Borehole CH28(1 of 1)

Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
0.20-0.30	TO		08/02 0000 DRY	
0.40-0.50	TO			
0.50		NIL	DRY	

Strata

Description	Depth (Thickness)	Level
	G.L.	8.04
MADE GROUND: Strong grey intact re-inforced concrete.	0.20	7.84
MADE GROUND: Moderately compact grey sandy sub-angular fine to coarse gravel of limestone (sub-base)	0.30	7.74
MADE GROUND: Strong to weak grey concrete.	0.40	7.64
MADE GROUND: Compact dark grey slightly silty slightly clayey sandy angular to sub-angular fine to medium gravel of sandstone,slag and limestone	0.50	7.54
End of Borehole.		

Legend

Equipment: Hand Held Window Sampler

Borehole Dia (mm) Casing Dia (mm)
202 to 0.20m
80 to 0.30m
100 to 0.40m

Groundwater

No. Struck Behaviour Sealed

No groundwater encountered

Ground Level 8.04 m OD
Coordinates 332956.17 mE
185427.60 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks Refusal at 0.50m (possible cobbles?)

See key sheet and appendices for explanations.

Form 1/0

Borehole Record

Exploration Associates

Project
M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

Contract 150006

Borehole CH29(1 of 1)

Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
0.00-0.50	TO		08/02 0000 DRY	
0.50-1.00	B			
1.00-1.50	TO			
1.50		NIL	DRY	

Strata

Description	Depth (Thickness)	Level
	G.L.	8.23
MADE GROUND: Compact brown slightly clayey slightly silty fine sand with much angular to sub-angular fine to coarse gravel of chert, brick,sandstone and slag with occasional cobbles of sandstone from 0.75m becoming moderately compact	(1.50)	
	1.50	6.73

End of Borehole.

Legend

Equipment: Hand Held Window Sampler

Borehole Dia (mm) Casing Dia (mm)
80 to 1.00m
60 to 1.50m

Groundwater

No. Struck Behaviour Sealed

No groundwater encountered

Ground Level 8.23 m OD
Coordinates 333037.64 mE
185405.50 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks Hole refusal at 1.50m (possible wooden sleepers?)

See key sheet and appendices for explanations.

Form 1/0

Borehole Record

Exploration Associates

Project
M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

Contract 150006

Borehole CH30(1 of 1)

Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
0.00-0.40	T		08/02 0000 DRY	
		NIL	DRY	
0.40				

Strata

Description	Depth (Thickness)	Level	Legend
	G.L.	7.96	
MADE GROUND: Very compact grey black slightly silty sandy slightly clayey sub-angular fine to coarse gravel of slag,ash,sandstone and coal with occasionl cobbles of sandstone	(0.40)		
	0.40	7.56	
End of Borehole.			

Equipment: Hand Held Window Sampler

Borehole Dia (mm) 80 to 0.40m

Casing Dia (mm)

Groundwater

No. Struck Behaviour Sealed

No groundwater encountered

Ground Level 7.96 m OD
Coordinates 333206.82 mE
185368.33 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks Hole refusal at 0.40m (could not penertrate gravels)

See key sheet and appendices for explanations.

Form 1/0

Borehole Record

Exploration Associates

Project
M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

Contract 150006

Borehole CH31(1 of 1)

Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
0.00-0.35	T		08/02 0000 DRY	
0.35-1.00 0.10	TO W			
1.00		NIL	0.10	

Strata

Description	Depth (Thickness)	Level
	G.L.	8.13
MADE GROUND: Moderately compact red brown slightly sandy slightly silty slightly clayey angular to sub-angular fine to coarse gravel of sandstone, limestone and brick with occasional to some cobbles of sandstone	0.35	7.78
	(0.65)	
MADE GROUND: Firm to stiff brown slightly sandy very silty clay with occasional sub-angular fine to coarse gravel of coal and ash	1.00	7.13
End of Borehole.		

Legend

Equipment: Hand Held Window Sampler

Borehole Dia (mm) 80 to 1.00m

Casing Dia (mm)

Groundwater

No.	Struck	Behaviour	Sealed
1	0.10	Rose to 0.10m in 20 mins .10/.10/.10 in 5/10/15 mins	

Ground Level 8.13 m OD
Coordinates 333267.59 mE
185318.45 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks Refusal at 1.00m (possible wooden sleepers?)

See key sheet and appendices for explanations.

Form 1/0

Borehole Record

Exploration Associates

Project
M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

Contract 150006

Borehole CH32(1 of 1)

Norwest Holst Soil Engineering Ltd.

TRIAL PIT LOG

Hole ID.
STPG01
Sheet 1 of 1

Contract No.	F15056	Method	Machine Excavated	Coordinates	333190.21 E
Project	New M4 - Second Preliminary Ground Investigation				185378.09 N
		Equipment	JCB 3CX	Ground Level	7.84m AOD
Client	Transport Wales, Welsh Assembly Government			Date Started	21/11/2007
		Logged by	WA	Date Completed	21/11/2007
Consultant	Ove Arup & Partners Ltd				

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		Remarks
MADE GROUND: Dark grey very clayey sandy angular to subangular fine to coarse gravel sized fragments of clinker, slag, plastic, ash , limestone and housebricks with medium cobble content. Cobble sized fragments are subangular of limestone and brick.				ES1	0.30	
				D2	0.30	
				B3	0.30	
		1.00	6.84	ES4	1.00	
MADE GROUND: Brown slightly gravelly slightly sandy clay. Gravel sized fragments are subangular to rounded fine to coarse of mixed lithologies including siltstone.				D5	1.00	
		1.20	6.64	ES6	1.20	
				D7	1.20	
				B8	1.20	
				ES9	1.30	
				D10	1.30	
Firm locally soft grey slightly sandy CLAY. (Estuarine Alluvium)						
				B11	2.20	
		2.30	5.54	D12	2.20	
Firm locally soft bluish grey slightly sandy CLAY. (Estuarine Alluvium)				ES13	2.30	
				D14	2.30	
				B15	2.30	
				D16	3.30	
				B17	3.80	
				D18	4.30	
		4.50	3.34			
Trial pit complete at 4.50 m.						

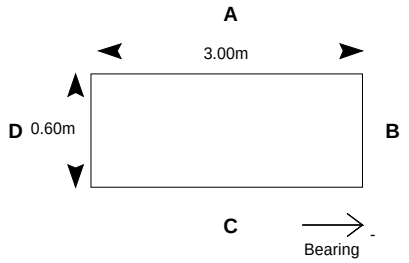
Stability: All faces stable

Shoring: None used

Groundwater: Water strike at 0.40m on face D - fast

Remarks: 1.Trial pit complete at 4.50m.

Sketch Plan of Trial Pit



NOTES: All depths in metres, all soil strengths in kPa.
See legend sheet for key to symbols and abbreviations.
All bearings given relate to magnetic North

Form	ARIAL TP LOG
Version	3.06
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

HAND VANE AND HAND PENETROMETER TESTS

Hole ID.
STPG01
Data Sheet

Contract No.	F15056	Method	Machine Excavated	Coordinates	333190.21E
Project	New M4 - Second Preliminary Ground Investigation				185378.09 N
		Equipment	JCB 3CX	Ground Level	7.84m AOD
Client	Transport Wales, Welsh Assembly Government			Orientation	Vertical
		Logged by	WA	Date Started	21/11/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	21/11/2007

Hand Vane				Hand Penetrometer		
Depth	Test No	Peak	Remoulded	Depth	Test No	Result
1.00	01	100.0	0.0			
1.00	02	80.0	0.0			
1.00	03	40.0	0.0			
2.00	04	110.0	90.0			
2.00	05	100.0	70.0			
2.00	06	120.0	100.0			
3.00	07	80.0	60.0			
3.00	08	80.0	80.0			
3.00	09	60.0	30.0			
4.00	10	40.0	10.0			
4.00	11	20.0	0.0			
4.00	12	30.0	0.0			

NOTES: All depths in metres, all diameters in millimetres, test results in kPa.

Form	ARIAL HAND VANE/PEN
Version	3.03
Revised	18/01/2007

Norwest Holst Soil Engineering Ltd.

TRIAL PIT LOG

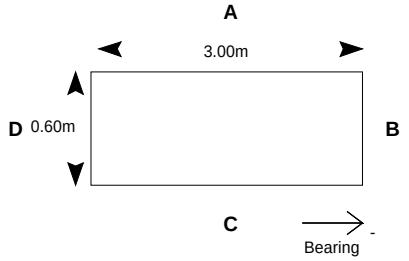
Hole ID.
STPG02
Sheet 1 of 1

Contract No.	F15056	Method	Machine Excavated	Coordinates	333246.74 E
Project	New M4 - Second Preliminary Ground Investigation				185332.34 N
		Equipment	JCB 3CX	Ground Level	7.87m AOD
Client	Transport Wales, Welsh Assembly Government			Date Started	26/11/2007
		Logged by	WA	Date Completed	26/11/2007
Consultant	Ove Arup & Partners Ltd				

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		Remarks
MADE GROUND: Reddish brown clayey very sandy angular to subangular fine to coarse gravel sized fragments of siltstone, concrete and brick.				ES1	0.30	
				D2	0.30	
				B3	0.30	
		0.60	7.27	ES4	0.60	
MADE GROUND: Grey brown slightly sandy clay.		0.80	7.07	D5	0.60	
Stiff locally soft grey brown silty slightly sandy CLAY. (Estuarine Alluvium)				B6	0.60	
---from 1.00m grey				ES7	1.00	
				D8	1.00	
				B9	1.00	
---from 2.00m occasional organic material				D10	2.00	
				B11	2.50	
				D12	3.00	
				B13	4.00	
				D14	4.00	
Trial pit complete at 4.20 m.		4.20	3.67			

Stability	All faces stable
Shoring	None used
Groundwater	None encountered during excavation
Remarks	1.Trial pit terminated at 4.20m.

Sketch Plan of Trial Pit



NOTES: All depths in metres, all soil strengths in kPa.
See legend sheet for key to symbols and abbreviations.
All bearings given relate to magnetic North

Form	ARIAL TP LOG
Version	3.06
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

HAND VANE AND HAND PENETROMETER TESTS

Hole ID.
STPG02
Data Sheet

Contract No.	F15056	Method	Machine Excavated	Coordinates	333246.74E
Project	New M4 - Second Preliminary Ground Investigation				185332.34 N
		Equipment	JCB 3CX	Ground Level	7.87m AOD
Client	Transport Wales, Welsh Assembly Government			Orientation	Vertical
		Logged by	WA	Date Started	26/11/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	26/11/2007

Hand Vane				Hand Penetrometer		
Depth	Test No	Peak	Remoulded	Depth	Test No	Result
1.00	01	130.0	130.0			
1.00	02	130.0	120.0			
1.00	03	130.0	130.0			
2.00	04	130.0	100.0			
2.00	05	100.0	100.0			
2.00	06	120.0	110.0			
3.00	07	90.0	70.0			
3.00	08	100.0	70.0			
3.00	09	110.0	70.0			
4.00	10	70.0	50.0			
4.00	11	70.0	30.0			
4.00	12	60.0	30.0			

NOTES: All depths in metres, all diameters in millimetres, test results in kPa.

Form	ARIAL HAND VANE/PEN
Version	3.03
Revised	18/01/2007

Geotechnical Engineering Limited

BOREHOLE LOG

BH423

CLIENT	WELSH GOVERNMENT					Sheet	1 of 7
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	10 March 2015	Easting	332656.3			Depth	60.00 m
End Date	27 March 2015	Northing	185435.3	Ground level	7.00mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
10/03/15 1150hrs	1B	0.20 - 0.50						Soft dark brownish grey slightly sandy CLAY with frequent roots (up to 20mm diam) and rootlets. (TFD)			
	2D*	0.20 - 0.50		Vo 0.0							
	3B	0.50 - 1.00									
	4D*	0.50 - 1.00		Vo 0.0							
	5B	1.00 - 1.20									
	6D*	1.00 - 1.20		Vo 0.0					1.00	6.00	
	UT	1.20 - 1.65	Nil					Very soft dark grey organic CLAY with rare fragments of fibrous organic material (up to 2mm diam). (TFD)			
	8X	1.20 - 1.70									
	9D*	1.20 - 1.40									
	10X	1.70 - 2.20									
	UT	2.20 - 2.65	Nil								
	12X	2.20 - 2.70									
	13D*	2.20 - 2.40									
10/03/15 1655hrs 0.00m	14X	2.70 - 3.20	Nil								
	15D*	3.00 - 3.20									
11/03/15 0930hrs 0.00m	16P	3.20 - 4.00	3.20		P/S						
	17X	4.00 - 4.60	3.20								
		4.50	3.20	V 29				4.50m: Low strength.			
	18P	4.60 - 5.40	4.60		P/S						
	19X	5.40 - 5.80									
		5.70	4.60	V 1				5.70m: Extremely low strength.			
	20P	5.80 - 6.60			P/S						
	21X	6.60 - 7.00									
		6.90	4.60	V 9				6.90m: Extremely low strength.			
	22P	7.00 - 7.80	7.00		P/S						
	23X	7.80 - 8.20									
								Continued Next Page	{8.00}		

EQUIPMENT: Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Dynamic sampled (128mm) 1.20-3.20m, (113mm) 4.00-15.20m. Waterflush rotary core drilled (116mm) 15.20-60.00m.

CASING: 140mm diam to 18.20m.

BACKFILL: On completion, borehole backfilled with bentonite 60.00-40.00m. A slotted standpipe (50mm) was installed to 40.00m, granular response zone 40.00-25.00m and bentonite seal 25.00-18.00m. A second slotted standpipe (35mm) was installed to 18.00m, granular response zone 18.00-15.00m, bentonite seal 15.00-0.30m and concrete and raised cover 0.30-0.00m.

REMARKS: Downhole magnetometry for UXO risk mitigation undertaken 0.00-15.20m. No anomalies encountered. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
1.20	Nil	0.54	20	

AGS

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BOREHOLE LOG

BH423

CLIENT	WELSH GOVERNMENT					Sheet	2 of 7
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	10 March 2015	Easting	332656.3			Depth	60.00 m
End Date	27 March 2015	Northing	185435.3	Ground level	7.00mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
		8.10	7.00	V 35				8.10m: Low strength.			
	24P	8.20 - 9.00	8.20		P/S			8.20m: Soft.			
	25X	9.00 - 10.00							9.20	-2.20	
								Soft dark grey organic silty CLAY. (TFD)			
11/03/15 1700hrs 0.00m		9.50	8.20	V 24				9.50m: Low strength.			
12/03/15 0850hrs 0.00m	26P	10.00 - 10.80	10.00		P/S						
	27X	10.80 - 11.80									
	28P	11.80 - 12.60	10.00		P/S						
	29X	12.60 - 13.60									
									13.20	-6.20	
								Dark grey thickly interlaminated fine SAND and CLAY with frequent fragments of organic material (up to 2mm). (TFD)	13.30	-6.30	
	30P	13.60 - 14.05	12.60		P/S			Soft dark grey organic silty CLAY with frequent thick laminae of fine sand. (TFD)			
	31D	14.05 - 14.50	14.05	S 4							
	32X	14.05 - 15.20									
									15.00	-8.00	
	33D	15.20 - 15.59	15.20	S*64				Very dense grey thickly laminated silty fine and medium SAND with rare fragments of fibrous organic material (up to 2mm). (TFD)			
	34C	15.20 - 16.60			100	NA					
									15.60	-8.60	
								Grey thickly bedded silty fine and medium SAND with rare fragments of fibrous organic material (up to 2mm). (TFD)	16.00	-9.00	
								Grey and reddish brown gravelly fine to coarse SAND with frequent bivalve shells (up to 10mm). Gravel is subangular to rounded fine and medium sandstone and quartz. (TFD)	16.20	-9.20	
12/03/15 1700hrs 0.00m	35D	16.60 - 16.91	15.20	S*94					16.45	-9.45	
									16.60	-9.60	
13/03/15 0915hrs 0.00m	36C	16.60 - 16.90	16.60		67			Grey fine to coarse SAND with frequent shells (up to 10mm). (TFD)	16.90	-9.90	
	37C	16.90 - 18.20	16.60		15			Grey and reddish brown sandy subangular to rounded fine to coarse sandstone and quartzite GRAVEL with a low subrounded sandstone and quartz cobble content. (RTD)			
								Limited recovery. Grey slightly sandy gravelly subangular to rounded sandstone COBBLES. Gravel is subangular to			
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks

AGS

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BOREHOLE LOG

BH423

CLIENT	WELSH GOVERNMENT					Sheet	3 of 7
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	10 March 2015	Easting	332656.3			Depth	60.00 m
End Date	27 March 2015	Northing	185435.3	Ground level	7.00mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
		18.20 - 18.48	18.20	S*100				rounded coarse sandstone. Loss of fines. (RTD)	18.20	-11.20	
	38C	18.20 - 18.30			100				18.30	-11.30	
	39C	18.30 - 19.30	18.20		100	NA		Limited recovery. Soft reddish brown slightly sandy silty CLAY. (RTD)			
								Grey subrounded to well rounded sandstone and conglomerate COBBLES. (RTD)			
13/03/15 1600hrs 4.20m	40C	19.30 - 19.60	18.20		100			Hard fissured friable reddish brown gravelly silty CLAY locally tending to extremely weak mudstone frequent greenish grey reduction spots (up to 10mm). Gravel is angular fine and medium mudstone lithorelicts. Fissures are randomly orientated extremely closely spaced undulating rough. (MMG) (Grade III) 19.40m: Cobble sized lithorelict of weak mudstone.			
		19.60 - 19.85	18.20	C*125							
16/03/15 0955hrs 5.70m	41C	19.60 - 21.10			97						
	42C	21.10 - 22.60	18.20		97						
						NA		Hard fissured reddish brown silty CLAY with frequent fine sand sized gypsum crystals along fissure surfaces. Fissures are randomly orientated extremely closely spaced undulating rough. (MMG) (Grade III)	22.30	-15.30	
	43C	22.60 - 24.10	18.20		100						
						NA		Hard fissured friable reddish brown gravelly silty CLAY frequent greenish grey reduction spots (up to 10mm). Gravel is angular fine and medium mudstone lithorelicts. Locally tending to extremely weak mudstone. Fissures are randomly orientated extremely closely spaced undulating rough. (MMG) (Grade III)	24.00	-17.00	
	44C	24.10 - 25.60	18.20		100						
	45C	25.60 - 27.10	18.20		100			25.55m: 50° relict fissure infilled with fine sand sized gypsum crystals.			
	46C	27.10 - 28.60	18.20		100 7 7						
								Continued Next Page	{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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BOREHOLE LOG

BH423

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	4 of 7
Start Date	10 March 2015	Easting	332656.3	Scale	1 : 50
End Date	27 March 2015	Northing	185435.3 Ground level 7.00mOD	Depth	60.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
								27.95 - 28.05m: Weak mudstone.			
16/03/15 1700hrs 5.10m									28.60	-21.60	
17/03/15 0930hrs 5.60m	47C	28.60 - 30.10	18.20		97 27 9	NI 80 150		Extremely weak reddish brown MUDSTONE locally disintegrated to gravelly clay with frequent greenish grey reduction spots (up to 40mm). Fractures are subhorizontal and 20° very closely and closely spaced undulating rough. (MMG) (Grade II)	29.50	-22.50	
						NA		Hard fissured reddish brown gravelly silty CLAY. Gravel is angular fine and medium mudstone lithorelicts. (MMG) (Grade III)			
	48C	30.10 - 31.60	18.20		93 45 32	NI 60 210		Extremely weak reddish brown MUDSTONE with rare greenish grey reduction spots (up to 20mm). Fractures are subhorizontal very closely to medium closely spaced undulating rough. (MMG) (Grade II)	30.30	-23.30	
	49C	31.60 - 33.10	18.20		97 19 0				32.50	-25.50	
						NA		Hard fissured reddish brown gravelly silty CLAY locally tending to extremely weak mudstone. Gravel is angular fine and medium extremely weak mudstone lithorelicts. Fissures are randomly orientated extremely closely spaced undulating rough. (MMG) (Grade III)			
	50C	33.10 - 34.60	18.20		100			34.20 - 34.75m: Frequent fine sand sized gypsum crystals along fissure surfaces.			
	51C	34.60 - 36.10	18.20		100 4 0	NI NI 60		Extremely weak reddish brown MUDSTONE. Fractures are subhorizontal, 20° and 70° extremely closely spaced undulating rough. (MMG) (Grade II)	34.75	-27.75	
						NA		Hard fissured reddish brown gravelly silty CLAY with rare greenish grey reduction spots (up to 30mm). Gravel is angular fine and medium extremely weak mudstone lithorelicts. Fissures are randomly orientated extremely closely spaced undulating rough. (MMG) (Grade III)	35.25	-28.25	
	52C	36.10 - 37.60	18.20		87						
17/03/15 1700hrs 6.20m											
18/03/15 0910hrs 5.60m	53C	37.60 - 39.10	18.20		90						
								Continued Next Page	{38.00}		

water strike (m) casing (m) rose to (m) time to rise (m) remarks

AGS

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BOREHOLE LOG

BH423

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	5 of 7
Start Date	10 March 2015	Easting	332656.3	Scale	1 : 50
End Date	27 March 2015	Northing	185435.3 Ground level 7.00mOD	Depth	60.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	54C	39.10 - 40.60	18.20		100	NI		Extremely weak reddish brown MUDSTONE locally disintegrated to gravelly clay. Recovered non intact. (MMG) (Grade II/III)	39.10	-32.10	
								Hard fissured reddish brown gravelly silty CLAY. Gravel is angular fine and medium extremely weak mudstone lithorelicts. (MMG) (Grade III)	39.70	-32.70	
								Extremely weak reddish brown MUDSTONE locally disintegrated to gravelly clay. Non-intact. (MMG) (Grade II/III)	39.90	-32.90	
	55C	40.60 - 42.10	18.20		100 5 0						
						NA		Hard fissured reddish brown gravelly silty CLAY. Gravel is angular fine and medium extremely weak mudstone lithorelicts. Fissures are randomly orientated extremely closely spaced undulating rough. (MMG) (Grade III) 41.20 - 41.30m: Frequent fine and medium sand sized gypsum crystals.	41.10	-34.10	
						NI			41.70	-34.70	
	56C	42.10 - 43.60	18.20		100 0 0			Extremely weak reddish brown MUDSTONE. Recovered non intact. (MMG) (Grade II)	42.40	-35.40	
						NA		Hard fissured reddish brown gravelly silty CLAY locally tending to extremely weak mudstone. Gravel is angular fine and medium extremely weak mudstone lithorelicts. Fissures are randomly orientated extremely closely spaced undulating rough. (MMG) (Grade III)			
	57C	43.60 - 45.10	18.20		87						
18/03/15 1600hrs 6.80m											
19/03/15 0940hrs 6.60m	58C	45.10 - 46.60	18.20		90 14 8						
						NI 80 190		Extremely weak locally weak reddish brown MUDSTONE with frequent gypsum veining along healed fractures (up to 3mm thick). Rare greenish grey reduction spots (up to 20mm). Fractures are subhorizontal, 20° and 60° extremely closely to closely spaced planar smooth. (MMG) (Grade II) 46.10m: Subvertical tending to 70° undulating gypsum vein (17mm thick). 47.05m: Subhorizontal and 70° intersecting planar gypsum veins (5mm thick). 47.50m: 60° planar gypsum vein (5mm thick). 47.80m: 20° undulating gypsum vein (15mm thick).	45.80	-38.80	
	59C	46.60 - 48.10	18.20		93 59 32						
								Continued Next Page	{48.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks

AGS

CONTRACT	CHECKED
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BOREHOLE LOG

BH423

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	6 of 7
Start Date	10 March 2015	Easting	332656.3	Scale	1 : 50
End Date	27 March 2015	Northing	185435.3 Ground level 7.00mOD	Depth	60.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	60C	48.10 - 49.10	18.20		85 39 19						
	61C	49.10 - 50.60	18.20		77 47 21						
19/03/15 1600hrs 7.00m								50.30m: 20° planar gypsum vein (up to 8mm thick).			
24/03/15 1220hrs 8.10m	62C	50.60 - 52.10	18.20		97 90 66				51.00	-44.00	
						160 180 250		Very weak and weak reddish brown MUDSTONE with frequent gypsum infill along healed fractures. Fractures are subhorizontal to 20° and 70° to subvertical, closely and medium spaced planar smooth. (MMG) (Grade I) 51.10 - 52.00m: Subvertical tending to 70° undulating gypsum vein (20mm thick).			
	63C	52.10 - 52.60	18.20		100 80 60						
	64C	52.60 - 54.10	18.20		100 76 61						
						50 100 160		53.25 - 54.60m: Fractures are subhorizontal, 20°, 50° and 70° very closely and closely spaced planar smooth. 53.55 - 53.80m: Frequent greenish grey reduction spots (up to 30mm thick).			
24/03/15 1745hrs 8.50m								53.90 - 54.05m: 70° undulating gypsum vein (15mm thick). 54.10 - 54.25m: 70° planar gypsum vein (12mm thick).			
25/03/15 0945hrs 8.60m	65C	54.10 - 55.60	18.20		97 90 53						
						40 150 300		54.60 - 58.60m: Fractures are subhorizontal, 20° and 30° closely and medium spaced planar smooth.			
	66C	55.60 - 57.10	18.20		93 78 57						
								55.90 - 56.10m: 70° undulating gypsum vein (12mm thick).			
	67C	57.10 - 58.60	18.20		97 79 63						
								57.10 - 57.20m: 70° undulating gypsum vein (30mm thick).			
								Continued Next Page	{58.00}		

water strike (m) casing (m) rose to (m) time to rise (m) remarks

AGS

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BOREHOLE LOG

BH423

CLIENT	WELSH GOVERNMENT					Sheet	7 of 7
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	10 March 2015	Easting	332656.3				
End Date	27 March 2015	Northing	185435.3	Ground level	7.00mOD	Depth	60.00 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
25/03/15 1530hrs 8.70m												
26/03/15 1020hrs 8.70m	68C	58.60	60.00	18.20		89 89 86	80 110 250		58.75 - 58.80m: 20° planar gypsum vein (4mm thick).			
26/03/15 1430hrs 8.50m									59.55 - 59.57m: 20° planar gypsum vein (7mm thick).	60.00	-53.00	
									Borehole completed at 60.00m.			
										{68.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
					30238	EC

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BOREHOLE LOG

BH424

CLIENT	WELSH GOVERNMENT					Sheet	1 of 4
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	9 February 2015	Easting	332760.1			Depth	34.70 m
End Date	17 February 2015	Northing	185474.9	Ground level	7.90mOD		

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
09/02/15 0800hrs									Black mottled dark grey very sandy subangular fine to coarse slag, brick, concrete and limestone GRAVEL. (MG)			
	1B	0.30	0.60									
	2D*	0.30	0.60		Vo 4.6							
	3B	0.70	1.00									
	4D*	0.70	1.00		Vo 7.6							
		1.10	1.14	Nil	C*417					1.10	6.80	
	5B	1.10							Black mottled dark grey sandy subangular fine to coarse slag, brick, concrete and limestone GRAVEL with high subangular limestone cobble content. (MG)			
	6D*	1.10			Vo 6.2							
	7D	1.50	1.95	1.50	S 17					1.50	6.40	
	8B	1.50	2.00						Firm dark grey slightly gravelly silty CLAY. Gravel is subangular fine and medium limestone. (MADE GROUND?)			
	9D*	1.50	1.60		Vo 9.6							
	10D	1.55										
	11UT	2.00	2.45	2.00								
	12D*	2.00	2.10									
	15D	2.45	2.55									
	13D	2.50	2.95	2.40	S 12				2.50 - 3.10m: Firm.			
	14B	2.50	3.00									
	16D*	2.50	2.60		Vo 1.5							
										3.10	4.80	
09/02/15 1700hrs Dry	17UT	3.00	3.45	3.00					Very soft brownish grey organic silty CLAY with rare subangular fine and medium sandstone gravel and rare wood fragments (up to 40mm). (TFD)			
	18D*	3.00	3.10									
	19D	3.45	3.50									
11/02/15 0800hrs Dry	20D	3.50	3.95	3.50	S<1							
	21B	3.50	4.00									
	22D*	3.50	3.60									
	23UT	4.00	4.45	3.50								
	26D	4.45	4.50									
	24D	4.50	4.95	4.40	S 2							
	25B	4.50	5.00									
	27UT	5.00	5.45	4.90								
	28D	5.50										
	29D*	5.50	5.60									
	30D	6.00										
	31D	6.50	6.95	6.40	S<1							
	32B	6.50	7.20									
	33D	7.50										
									Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.10m. Cable percussion (200mm) 1.10-2.50m and (150mm) 2.50-14.00m. Rotary core drilled (123mm PQ3 Wireline) 14.00-25.80m using a water flush. Waterflush rotary core drilled (116mm) 25.80-34.70m.

CASING: 200mm diam to 2.00m, 150mm diam to 13.40m and 114mm diam to 25.80m (withdrawn to allow conventional coring).

BACKFILL: On completion, hole backfilled with bentonite pellets.

REMARKS: Hole advanced by chiselling 1.10-1.50m (1hr) and 13.70-13.90m (1hr).

Downhole magnetometry for UXO risk mitigation undertaken 0.00-13.50m. No anomalies encountered.

Bentonite seal for aquifer protection installed during drilling 2.50-1.50m, prior to reduction in casing diameter.

MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
1.10	Nil	1.10	20	

AGS

CONTRACT	CHECKED
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BOREHOLE LOG

BH424

CLIENT	WELSH GOVERNMENT					Sheet	2 of 4
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	9 February 2015	Easting	332760.1			Depth	34.70 m
End Date	17 February 2015	Northing	185474.9	Ground level	7.90mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	34UT	8.00 - 8.45	7.90								
	35D	8.50									
	36D	9.00									
	37D	9.50 - 9.95	9.20	S 3							
	38B	9.50 - 10.00									
	39D	10.50									
	40UT	11.00 - 11.45	10.90								
	41D	11.50									
	42D	12.00									
	44B	12.50 - 13.20									
	43D	12.70 - 13.10	12.40	S 2							
	45D	13.40							13.40	-5.50	
	46D	13.50 - 13.83	13.40	S*83				(Recovered as soft) Greenish grey mottled reddish brown slightly gravelly silty CLAY. Gravel is subangular fine and medium limestone. (TFD)			
11/02/15 1700hrs Dry	47B	13.50 - 13.90									
	48D	13.90 - 14.00	13.40	S*395					14.00	-6.10	
13/02/15 1500hrs 4.10m 13/02/15 1615hrs 4.10m	49C	14.00 - 14.90	14.90		72 0 0	NI		Very weak and weak thinly laminated greenish grey SILTSTONE. Fractures are subhorizontal to 20° very closely spaced and non intact planar rough. (MMG) (Grade II)			
16/02/15 0845hrs 4.15m	50C	14.90 - 15.30	15.30		100 0 0				15.20	-7.30	
	51C	15.30 - 16.80	16.80		100	NA		Stiff fissured greenish grey gravelly CLAY. Gravel is subangular fine to coarse lithorelicts of extremely weak siltstone. Fissures are subhorizontal to 20° planar rough locally infilled (up to 2mm) with greenish grey clay. (MMG) (Grade III)	15.45	-7.55	
	52C	16.80 - 18.30	18.30		100			Stiff fissured reddish brown mottled greenish grey gravelly CLAY. Gravel is subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical extremely closely spaced planar rough locally stained light grey locally infilled (up to 2mm) with reddish brown clay. (MMG) (Grade III) 17.50 - 17.70m: Tending to greenish grey siltstone.			
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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BOREHOLE LOG

BH424

CLIENT	WELSH GOVERNMENT					Sheet	3 of 4
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	9 February 2015	Easting	332760.1				
End Date	17 February 2015	Northing	185474.9	Ground level	7.90mOD	Depth	34.70 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
									18.30	-10.40	
	53C	18.30 - 19.80	19.80		100 0 0	NI		Extremely weak and very weak thinly laminated and very thinly bedded greenish grey MUDSTONE with rare greenish grey reduction spots (up to 25mm). Fractures are subhorizontal to 20° very closely spaced planar rough. (MMG) (Grade II)	19.80	-11.90	
	54C	19.80 - 21.10	21.10		100 0 0	NA		19.75 - 19.80m: Greenish grey.			
						NI		Stiff fissured reddish brown mottled greenish grey gravelly CLAY with rare greenish grey reduction spots (up to 10mm). Gravel is subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical planar rough locally infilled (up to 2mm) with gypsum crystals (up to 3mm). (MMG) (Grade III)	20.55	-12.65	
	55C	21.10 - 22.60	22.60		73 0 0			Extremely weak and very weak thinly laminated and very thinly bedded reddish brown MUDSTONE with frequent greenish grey reduction spots (up to 10mm). Fractures are subhorizontal to 20° very closely spaced planar rough. (MMG) (Grade II)	22.00	-14.10	
						NA		Stiff fissured reddish brown mottled greenish grey gravelly CLAY with frequent greenish grey reduction spots (up to 10mm). Gravel is subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical extremely closely spaced planar rough locally infilled (up to 2mm) with gypsum crystals (up to 3mm). (MMG) (Grade III)	22.65	-14.75	
	56C	22.60 - 23.60	23.60		100 20 14	NI 100 170					
								Extremely weak and very weak thinly laminated and very thinly bedded reddish brown mottled greenish grey MUDSTONE with rare greenish grey reduction spots (up to 10mm). Fractures are subhorizontal to 20° closely spaced planar rough. (MMG) (Grade II)			
	57C	23.60 - 24.30	24.30		100 0 0				24.30	-16.40	
	58C	24.30 - 25.80	25.80		100 60 43	NI 200 650		Extremely weak and very weak thinly laminated and very thinly bedded reddish brown mottled greenish grey MUDSTONE with rare greenish grey reduction spots (up to 5mm). Fractures are subhorizontal to 20° medium and widely spaced infilled (up to 2mm) with gypsum planar rough. (MMG) (Grade II)			
16/02/15 1725hrs 2.10m									25.80	-17.90	
17/02/15 0840hrs 4.10m	59C	25.80 - 27.30	27.30		100 20 0	NA		Stiff fissured reddish brown mottled greenish grey gravelly CLAY with frequent greenish grey reduction spots (up to 20mm). Gravel is subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical to 10° extremely closely spaced planar rough locally infilled (up to 2mm) with gypsum crystals (up to 3mm). (MMG) (Grade III)	26.75	-18.85	
						NI 50 95		Extremely weak and very weak thinly laminated reddish brown mottled greenish grey MUDSTONE with frequent greenish grey reduction spots (up to 5mm). Fractures are subhorizontal to 20° very closely and closely spaced planar rough stained black infilled (up to 2mm) with gypsum crystals (up to 3mm). (MMG) (Grade II)	27.20	-19.30	
	60C	27.30 - 28.80	28.80		100 0 0	NA					
								Continued Next Page	{28.00}		

water strike (m) casing (m) rose to (m) time to rise (m) remarks

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BOREHOLE LOG

BH424

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	4 of 4
Start Date	9 February 2015	Easting	332760.1	Scale	1 : 50
End Date	17 February 2015	Northing	185474.9 Ground level 7.90mOD	Depth	34.70 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
								Stiff fissured reddish brown gravelly CLAY with frequent greenish grey reduction spots (up to 30mm). Gravel is subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical to 80° extremely closely spaced planar rough locally stained black locally infilled (up to 2mm) with gypsum crystals (up to 3mm). (MMG) (Grade III)	28.40	-20.50	
	61C	28.80 - 30.30	30.30		100 0 0	NI NA		Extremely weak and very weak thinly laminated reddish brown mottled greenish grey MUDSTONE with frequent greenish grey reduction spots (up to 5mm). Fractures are subhorizontal to 20° very closely spaced planar rough stained black infilled (up to 2mm) with gypsum crystals (up to 3mm). (MMG) (Grade II)	28.80	-20.90	
	62C	30.30 - 31.80	31.80		100 20 20	NI NI 40 300		Stiff fissured reddish brown gravelly CLAY with rare greenish grey reduction spots (up to 10mm) and local sand sized gypsum crystals. Gravel is subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical planar rough locally stained black locally infilled (up to 2mm) with gypsum crystals. (MMG) (Grade III)	30.50	-22.60	
	63C	31.80 - 33.30	33.30		100	300 NI NA		Extremely weak and very weak thinly laminated reddish brown mottled greenish grey MUDSTONE with rare greenish grey reduction spots (up to 10mm) and local sand sized gypsum crystals. Fractures are subhorizontal to 20° closely spaced locally medium spaced planar rough stained black infilled (up to 2mm) with gypsum crystals. (MMG) (Grade II) 30.85 - 31.25m: Subvertical to 20° fracture stained black.	31.80	-23.90	
	64C	33.30 - 34.70	34.70		100			Stiff fissured reddish brown gravelly CLAY with rare greenish grey reduction spots (up to 10mm) and localised gypsum crystals (up to 2mm). Gravel is subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical planar rough locally stained black infilled (up to 2mm) with gypsum crystals (up to 3mm). (MMG) (Grade III)	34.70	-26.80	
17/02/15 1400hrs 1.54m								Borehole completed at 34.70m.	{38.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
					30238	EC

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BOREHOLE LOG

BH425

CLIENT	WELSH GOVERNMENT					Sheet	1 of 6
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	12 February 2015	Easting	332927.2				
End Date	24 February 2015	Northing	185442.1	Ground level	7.85mOD	Depth	54.40 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
12/02/15 0800hrs									MADE GROUND comprising CONCRETE. (MG)	0.30	7.55	
	1B	0.40	0.70						Dark grey clayey subangular fine to coarse limestone, slag and brick GRAVEL with medium limestone cobble content. (MG)	0.80	7.05	
	2D*	0.50	0.60		Vo 0.5							
	3B	0.80	1.20									
	4D*	1.00	1.10		Vo 0.4				Medium dense becoming loose with depth grey very clayey very sandy subangular fine to coarse limestone and sandstone GRAVEL with medium cobble content. (MG)			
		1.20	1.65		C 15							
	5B	1.20	1.70	1.20								
	6D*	1.50	1.60		Vo 0.4							
		1.65	2.10	1.60	C 9							
	7B	1.70	2.10									
	8D*	2.00	2.10		Vo 0.9					2.10	5.75	
		2.10	2.55	2.10	C 4				Soft grey mottled brown gravelly silty CLAY. Gravel is subangular fine to coarse limestone and sandstone. (TFD)	2.50	5.35	
	9D	2.30	2.60									
	10D*	2.50	2.60		Vo 0.7				Very soft grey mottled brown silty CLAY. (TFD)			
	11UT	2.60	3.05	2.50								
	14D*	3.00	3.10		Vo 0.7							
		3.10	3.55	2.80	C 11							
	12D	3.10							3.10 - 3.60m: Rare fragments of black organic material.			
	13B	3.10	3.60									
	15D*	3.50	3.60									
	16UT	3.60	4.05	3.50								
	18D*	4.00	4.10									
	17D	4.10	4.55	4.00	S<1				4.10 - 5.10m: Very soft.			
	19D*	4.50	4.60									
	20UT	4.60	5.05	4.50								
	23D*	5.00	5.10							5.10	2.75	
12/02/15 1700hrs Dry	21D	5.10							Very soft grey mottled brown silty CLAY with rare subangular fine to coarse sandstone and slag gravel. (TFD)	5.50	2.35	
	22B	5.10	5.60									
16/02/15 0800hrs 2.30m	24D	5.10	5.55	5.00	S 1				Soft grey mottled brown silty CLAY. (TFD)			
	25D	6.00	6.20						Very soft becoming soft grey mottled brown silty CLAY. (TFD)			
	26UT	6.50	6.95	6.00								
	27D	7.00	7.10									
	28D	7.50	7.60									
	29D	8.00	8.45	8.00	S<1							

Continued Next Page {8.00}

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Cable percussion (200mm) 1.20-2.50m and (150mm) 2.50-15.30m. Rotary core drilled (123mm PQ3 Wireline) 15.30-21.90m using a water flush. Waterflush rotary core drilled (116mm) 21.90-54.40m. CASING: 200mm diam to 2.50m, 150mm diam to 14.40m, 140mm diam to 15.30m and 114mm to 21.90m (withdrawn to allow conventional coring). BACKFILL: On completion, hole backfilled with bentonite pellets 54.00-30.00m. A slotted standpipe (50mm) was installed to 30.00m, granular response zone 30.00-20.00m, bentonite seal 20.00-12.30m. A second slotted standpipe (35mm) was installed to 12.30m, granular response zone 12.30-11.80m, bentonite seal 11.80-0.20m, concrete and stopcock cover 0.20-0.00m.

REMARKS: Driller notes reduced flush returns 15.30-34.90m (90% returned). Downhole magnetometry for UXO risk mitigation undertaken 0.00-13.50m. No anomalies encountered. Bentonite seal for aquifer protection installed during drilling 1.50-3.00m, prior to reduction in casing diameter. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
1.80	1.60	1.70	20	Slow.

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BOREHOLE LOG

BH425

CLIENT	WELSH GOVERNMENT					Sheet	2 of 6
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	12 February 2015	Easting	332927.2				
End Date	24 February 2015	Northing	185442.1	Ground level	7.85mOD	Depth	54.40 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	30B	8.00 - 8.50									
	31D	9.00 - 9.10									
	32UT	9.50 - 9.95	9.40								
	33D	10.00 - 10.10									
	34D	10.50 - 10.20									
	35D	11.00 - 11.45	10.50	S<1							
	36B	11.00 - 11.60									
									11.70	-3.85	
	37B	11.90 - 12.30						Driller notes 'coarse gravel with wood' and 'chisel jamming'. (RTD)			
	38D	12.40 - 12.50						11.70m: Driller notes 'coarse gravel with wood' and 'chisel jamming'.	12.40	-4.55	
	39D	12.50 - 12.95	12.50	S 23							
	40B	12.50 - 13.00						Stiff reddish brown slightly gravelly silty CLAY. Gravel is subangular fine mudstone. (MMG)			
									13.00	-5.15	
						NI		Very weak reddish brown MUDSTONE recovered non intact as slightly sandy clayey angular and subangular fine to coarse gravel. (MMG)			
16/02/15 1700hrs 5.60m	41B	13.50 - 14.00	13.90								
17/02/15 0800hrs 5.00m	42D	14.00 - 14.45	13.90	S 35					14.00	-6.15	
	43B	14.00 - 14.50						Very stiff dark reddish brown mottled light grey slightly sandy slightly gravelly silty CLAY. Gravel is angular and subangular fine to coarse mudstone lithorelicts. (MMG. Weathering grade III). (MMG) (Grade III)			
	44D	14.90							14.90	-7.05	
17/02/15 1200hrs 5.00m	45D	15.00 - 15.19	14.40	S*268		NI		Very weak light greenish grey SILTSTONE recovered non intact as subangular fine to coarse gravel. (MMG)			
	46B	15.00 - 15.30									
	47D	15.30 - 15.45	14.40	S*333					15.30	-7.45	
18/02/15 1330hrs 5.00m	48C	15.30 - 16.50	15.30		100 45 38	NI 60 60		15.30 - 15.50m: Tending to greenish grey silty clay.			
						NI 170 400		Medium strong thinly laminated to very thinly bedded greenish grey SILTSTONE. Fractures are subhorizontal to 20° extremely closely and very closely spaced planar rough. (MMG) (Grade I)	15.80	-7.95	
	49C	16.50 - 18.00	16.50		100 38 30			Weak and medium strong thinly laminated purplish brown mottled greenish grey MUDSTONE. Fractures are subhorizontal to 20° and 70° to subvertical closely and medium spaced locally non intact planar rough locally infilled (up to 5mm) with greenish grey clay. (MMG) (Grade II)	17.10	-9.25	
						NI 100 300		Extremely weak and very weak thinly laminated purplish brown MUDSTONE with rare greenish grey reduction spots (up to 20mm). Fractures are subhorizontal to 20° closely and medium spaced planar rough infilled (up to 2mm) with gypsum crystals (up to 3mm). (MMG) (Grade II)			
18/02/15 1645hrs 4.50m											
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks

AGS

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BOREHOLE LOG

BH425

CLIENT	WELSH GOVERNMENT					Sheet	3 of 6
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	12 February 2015	Easting	332927.2				
End Date	24 February 2015	Northing	185442.1	Ground level	7.85mOD	Depth	54.40 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
19/02/15 0840hrs 4.15m	50C	18.00 - 19.50	18.00		100 71 62			17.75 - 18.00m: Recovered non intact. 18.80 - 19.05m: Light greenish grey.			
	51C	19.50 - 21.00	19.50		100 56 33				21.00	-13.15	
	52C	21.00 - 21.90	21.00		100 22 22	NA NI 50 160		Very stiff fissured reddish brown sandy CLAY. Fissures are subhorizontal to 20° very closely spaced planar smooth. (MMG) (Grade III)	21.30	-13.45	
	53C	21.90 - 23.20	15.30		92	NA		Extremely weak and very weak thinly laminated purplish brown MUDSTONE with frequent greenish grey reduction spots (up to 20mm). Fractures are subhorizontal to 20° very closely and closely spaced planar rough infilled (up to 2mm) with gypsum crystals (up to 3mm). (MMG) (Grade II)	21.90	-14.05	
	54C	23.20 - 24.70	15.30		100	NA		Stiff fissured reddish brown sandy gravelly CLAY. Gravel is randomly orientated subangular fine to coarse lithorelicts of very stiff clay and extremely weak mudstone. Local relict fissures are randomly orientated extremely closely spaced planar smooth. (MMG) (Grade III) Very stiff fissured reddish brown sandy gravelly CLAY with greenish grey reduction spots (up to 10mm). Gravel is subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical closely spaced planar rough locally infilled (up to 2mm) with gypsum crystals (up to 3mm). (MMG) (Grade III)	23.20	-15.35	
	55C	24.70 - 26.20	15.30		100				26.20	-18.35	
19/02/15 1645hrs 1.59m	56C	26.20 - 27.40	15.30		100			Stiff fissured reddish brown sandy gravelly CLAY with greenish grey reduction spots (up to 20mm). Gravel is subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and 70° to subvertical closely and medium planar smooth locally rough locally infilled (up to 2mm) with gypsum crystals (up to 2mm). (MMG) (Grade III)			
20/02/15 0830hrs 4.00m	57C	27.40 - 28.90	15.30		100						
								Continued Next Page	{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
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BOREHOLE LOG

BH425

CLIENT	WELSH GOVERNMENT					Sheet	4 of 6
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	12 February 2015	Easting	332927.2				
End Date	24 February 2015	Northing	185442.1	Ground level	7.85mOD	Depth	54.40 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	58C	28.90 - 30.40	15.30		100						
	59C	30.40 - 31.90	15.30		100						
	60C	31.90 - 33.40	15.30		100						
	61C	33.40 - 34.90	15.30		100			33.40 - 34.90m: Fissures infilled (up to 3mm) with gypsum and greenish grey clay.			
	62C	34.90 - 36.40	15.30		100						
20/02/15 1550hrs 2.00m											
23/02/15 0840hrs 5.00m	63C	36.40 - 37.90	15.30		100						
								Continued Next Page	{38.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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BOREHOLE LOG

BH425

CLIENT	WELSH GOVERNMENT					Sheet	5 of 6
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	12 February 2015	Easting	332927.2				
End Date	24 February 2015	Northing	185442.1	Ground level	7.85mOD	Depth	54.40 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	64C	37.90 - 39.40	15.30		100			37.90 - 39.90m: Tending to extremely weak and weak reddish brown mudstone. 38.00 - 38.40m: Tending to extremely weak and weak reddish brown mudstone. 38.70 - 38.85m: Tending to extremely weak and weak reddish brown mudstone.			
	65C	39.40 - 40.90	15.30		100						
						NA		Stiff and very stiff fissured thinly laminated reddish brown locally mottled greenish grey CLAY with frequent greenish grey reduction spots (up to 40mm). Fissures are subhorizontal to 20° and 70° to subvertical very closely and closely spaced planar smooth locally infilled (up to 3mm) with gypsum crystals (up to 2mm). (MMG) (Grade III)	39.90	-32.05	
	66C	40.90 - 42.40	15.30		100						
	67C	42.40 - 43.90	15.30		100						
	68C	43.90 - 45.40	15.30		100	NA		Very stiff fissured reddish brown gravelly CLAY with rare greenish grey reduction spots (up to 30mm). Fissures are subhorizontal to 20° and 70° to subvertical very closely and closely spaced planar smooth locally infilled (up to 5mm) with gypsum crystals (up to 2mm). (MMG) (Grade III) 44.30 - 44.60m: Subvertical fissure infilled (up to 15mm) greenish grey mottled black clay and gypsum crystals (up to 2mm). 45.30 - 45.60m: Subvertical fissure infilled with gypsum (up to 2mm).	43.90	-36.05	
23/02/15 1645hrs 5.00m											
24/02/15 0825hrs 9.20m	69C	45.40 - 46.90	15.30		100						
	70C	46.90 - 48.40	15.30		100						
								Continued Next Page	{48.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
					30238	EC

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BOREHOLE LOG

BH425

CLIENT	WELSH GOVERNMENT					Sheet	6 of 6
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	12 February 2015	Easting	332927.2				
End Date	24 February 2015	Northing	185442.1	Ground level	7.85mOD	Depth	54.40 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	71C	48.40 - 49.90	15.30		100			48.10 - 48.30m: Subhorizontal and subvertical fissures infilled (up to 5mm) with gypsum crystals (up to 2mm). 48.90 - 49.20m: Tending to extremely weak mudstone. 49.60 - 49.85m: Subvertical fissure infilled (up to 20mm) with gypsum crystals (up to 2mm).			
	72C	49.90 - 51.40	15.30		100			49.90 - 50.20m: Tending to extremely weak mudstone. 50.65m: gypsum crystals (up to 20mm). 51.00 - 51.10m: Subhorizontal fissure infilled (up to 5mm) with gypsum.	51.40	-43.55	
	73C	51.40 - 52.90	15.30		100 51 33	NI 70 200		Very weak and weak thinly laminated reddish brown MUDSTONE with rare greenish grey reduction spots (up to 20mm). Fractures are subhorizontal to 20° and 70° to subvertical closely spaced locally non intact planar rough locally infilled (up to 10mm) with greenish grey clay and gypsum crystals (up to 2mm). (MMG) (Grade II)			
	74C	52.90 - 54.40	15.30		93 31 9						
24/02/15 1615hrs 1.90m									54.40	-46.55	
								Borehole completed at 54.40m.	{58.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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BOREHOLE LOG

BH426

CLIENT	WELSH GOVERNMENT					Sheet	1 of 6
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	17 February 2015	Easting	333185.1			Depth	54.50 m
End Date	4 March 2015	Northing	185375.4	Ground level	7.75mOD		

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
17/02/15 0800hrs									MADE GROUND comprising crushed slag (Driller's description). (MG)	0.40	7.35	
	1B	0.50	0.80						Firm dark brownish grey slightly sandy slightly gravelly CLAY with frequent pockets (up to 150mm) of very soft bluish grey and greyish brown clay. Gravel is angular and subangular fine to coarse slag. Single cobble of black slag. 300mm plastic fragment. (MG)	0.90	6.85	
	2D*	0.50	0.60		Vo 0.1							
	3B	0.90	1.20							1.10	6.65	
	4D*	1.00	1.10		Vo 0.0							
	5D	1.20	1.65	1.20	S 4				Soft grey and brownish grey slightly sandy slightly gravelly CLAY. Gravel is angular and subangular fine to coarse slag and brick. Rare brick cobbles and metal nails (50mm). (MG)			
	6B	1.20	1.70									
	7D*	1.50	1.60		Vo 0.0							
	8D	1.65	2.10	1.50	S 6							
	9B	1.70	2.10									
	10D*	2.00	2.10		Vo 0.0				Soft grey mottled brownish grey and light brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine to coarse sandstone. Frequent fragments of black organic material (up to 10mm). (MG)	2.30	5.45	
	11D	2.10	2.55	2.00	S 7							
	12B	2.10	2.50									
	13D*	2.50	2.60		Vo 0.0							
17/02/15 1700hrs Dry	15B	2.50	3.00						Soft light bluish grey and grey CLAY with rare thin laminae of light grey fine sand and frequent fragments of plant material (up to 80mm x 2mm diam). Slight organic odour. (TFD)			
	14D	2.55	3.00	2.30	S 9							
	16D*	3.00	3.10									
18/02/15 0800hrs 2.80m	17UT	3.00	3.45	3.00								
	18D	3.50										
	19D	3.50	3.95	3.40	S 3							
	20B	3.50	4.00							3.80	3.95	
	21D*	3.50	4.50		Vo 0.0				Very soft bluish grey slightly sandy silty CLAY with frequent fragments of black organic material (up to 10mm). (TFD)			
	22UT	4.00	4.45	3.90								
	23D	4.50										
	24D	4.50	4.95	4.00	S 3							
	25B	4.50	5.00									
	26D*	4.50	5.00									
	27UT	5.00	5.45	4.80								
	28D	5.50							5.50m: Frequent rootlets (up to 1mm diam).			
	29D	6.00							6.00 - 7.00m: Grey and brownish grey.			
	30D	6.50	6.95	6.30	S 2							
	31B	6.50	7.00									
	32D	7.50										
									Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Cable percussion (200mm) 1.20-3.00m and (150mm) 3.00-14.50m. Waterflush rotary core drilled (116mm) 14.50-54.50m. CASING: 200mm diam to 2.30m and 150mm diam to 14.50m.

BACKFILL: On completion, borehole backfilled on 06/03/2015 with bentonite pellets 54.50-13.00m. A slotted standpipe (50mm) was installed to 13.00m, granular response zone 13.00-4.00m and bentonite seal 4.00-2.00m. A second slotted standpipe (35mm) was installed to 2.00m, granular response zone 2.00-1.00m, bentonite seal 1.00-0.30m, concrete and stopcock cover 0.30-0.00m.

REMARKS: Hole advanced by chiselling 14.50-15.00m (1hr). Downhole magnetometry for UXO risk mitigation undertaken 0.00-14.50m. No anomalies encountered. Bentonite seal for aquifer protection installed during drilling 3.00-2.00m, prior to reduction in casing diameter. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
0.20	Nil	0.20	20	Slow flow.

AGS

CONTRACT	CHECKED
30238	EC

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Geotechnical Engineering Limited

BOREHOLE LOG

BH426

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	2 of 6
Start Date	17 February 2015	Easting	333185.1	Scale	1 : 50
End Date	4 March 2015	Northing	185375.4 Ground level 7.75mOD	Depth	54.50 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	33UT	8.00 - 8.45	7.90								
	34D	8.50						8.50 - 12.00m: Dark bluish grey.			
	35D	9.00									
	36D	9.50 - 9.95	9.30	S<1							
	37B	9.50 - 10.00									
	38D	10.50									
	39UT	11.00 - 11.45	10.90								
	40D	11.50									
	41D	12.00						Very soft bluish grey slightly sandy clayey SILT with frequent fragments of black organic material (up to 10mm). (TFD)	12.00	-4.25	
18/02/15 1700hrs 7.20m	42D	12.50 - 12.95	12.50	S<1							
19/02/15 0800hrs 7.10m	43B	12.50 - 13.20									
	44D	13.50									
19/02/15 1200hrs 9.00m	45UT	14.00 - 14.45	13.90								
	47D	14.30							14.30	-6.55	
	46D	14.50						Stiff reddish brown and light greenish grey slightly sandy silty CLAY. (MMG) (Grade III)	14.50	-6.75	
27/02/15 1030hrs 9.22m	48D	14.50 - 14.75	14.40	S*152				Extremely weak reddish brown MUDSTONE with frequent light greenish grey reduction spots (up to 15mm). (MMG) (Grade II)	15.00	-7.25	
	49D	15.00 - 15.16	14.40	S*500	67 12 7	NI NI 50		Extremely weak thinly laminated to very thinly bedded greenish grey SILTSTONE interbedded (up to 70mm) with extremely weak reddish brown mudstone. Fractures are subhorizontal to 20° and 90° extremely and very closely spaced planar smooth. (MMG) (Grade II)			
	50C	15.00 - 16.00									
	51C	16.00 - 17.50	14.50		100 3 0	NI NI 50		15.00 - 16.00m: Limited recovery. 15.10 - 15.15m: Weak grey fine and medium sandstone. 15.80 - 15.90m: Weak grey fine and medium sandstone.			
						NI NI 100		17.10 - 17.15m: Weak grey fine and medium sandstone.	17.20	-9.45	
	52C	17.50 - 19.00	14.50		90 7 7			Extremely weak thinly laminated reddish brown MUDSTONE with rare greenish grey reduction spots (up to 10mm). Fractures are subhorizontal to 20° and 90° extremely closely and very closely spaced planar smooth			
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks

AGS

CONTRACT	CHECKED
30238	EC

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BOREHOLE LOG

BH426

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	3 of 6
Start Date	17 February 2015	Easting	333185.1	Scale	1 : 50
End Date	4 March 2015	Northing	185375.4 Ground level 7.75mOD	Depth	54.50 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
								infilled (up to 1mm) with clay. (MMG) (Grade II) 18.00 - 18.10m: Weak greenish grey siltstone.			
	53C	19.00 - 20.50	14.50		100 0 0						
	54C	20.50 - 22.00	14.50		87 5 0						
						NA		20.95 - 21.00m: Very weak reddish brown mudstone.	21.00	-13.25	
								Very stiff indistinctly fissured reddish brown and greenish grey slightly sandy gravelly CLAY. Gravel is subangular fine to coarse extremely weak mudstone lithorelicts. Fissures are randomly orientated extremely closely and very closely spaced planar smooth. (MMG) (Grade III)			
	55C	22.00 - 23.50	14.50		83 11 0				22.20	-14.45	
						NI NI 60		Extremely weak and very weak thinly laminated to very thinly bedded reddish brown MUDSTONE with rare greenish grey reduction spots (up to 10mm). Fractures are randomly orientated very closely and closely spaced planar smooth infilled (up to 2mm) with clay. (MMG) (Grade II)			
	56C	23.50 - 25.00	14.50		100 0 0						
	57C	25.00 - 26.50	14.50		85 4 0						
27/02/15 1530hrs 5.05m											
02/03/15 0800hrs 4.39m	58C	26.50 - 28.00	14.50		100 3 0						
						NA			27.80	-20.05	
								Continued Next Page	{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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BOREHOLE LOG

BH426

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	4 of 6
Start Date	17 February 2015	Easting	333185.1	Scale	1 : 50
End Date	4 March 2015	Northing	185375.4 Ground level 7.75mOD	Depth	54.50 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	59C	28.00 - 29.50	14.50		100			Very stiff indistinctly fissured reddish brown and greenish grey slightly sandy gravelly CLAY. Gravel is subangular fine to coarse extremely weak mudstone lithorelicts and rare gypsum (up to 10mm). Fissures are randomly orientated extremely closely and very closely spaced planar smooth. (MMG) (Grade III)			
	60C	29.50 - 31.00	14.50		100						
	61C	31.00 - 32.50	14.50		100 35 13	NI NI 190			31.25	-23.50	
								Very weak thinly laminated to very thinly bedded reddish brown MUDSTONE with rare greenish grey reduction spots (up to 10mm). Fractures are subhorizontal to 20° and 45-65° very closely and closely spaced planar smooth. (MMG) (Grade II)			
	62C	32.50 - 34.00	14.50		100 3 0						
	63C	34.00 - 35.50	14.50		100 0 0						
02/03/15 1700hrs 6.03m											
03/03/15 0900hrs 6.45m	64C	35.50 - 37.00	14.50		100 0 0				35.90	-28.15	
						NA		Very stiff indistinctly fissured reddish brown slightly sandy gravelly CLAY. Gravel is subangular fine to coarse extremely weak mudstone lithorelicts with greenish grey reduction spots (up to 30mm). Fissures are randomly orientated extremely closely and very closely spaced planar smooth locally infilled (up to 5mm) with gypsum. (MMG) (Grade III)			
	65C	37.00 - 38.50	14.50		100						
								Continued Next Page	{38.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
					30238	EC

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BOREHOLE LOG

BH426

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	5 of 6
Start Date	17 February 2015	Easting	333185.1	Scale	1 : 50
End Date	4 March 2015	Northing	185375.4 Ground level 7.75mOD	Depth	54.50 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	66C	38.50 - 40.00	14.50		100 4 0						
						NI NI 60		Extremely weak and very weak thinly laminated to very thinly bedded reddish brown MUDSTONE with rare greenish grey reduction spots (up to 10mm). Fractures are subhorizontal to 20° and 90° very closely spaced planar smooth infilled (up to 2mm) with clay. (MMG) (Grade II)	39.10	-31.35	
						NA			39.60	-31.85	
	67C	40.00 - 41.50	14.50		100 7 0	NI NI 110		Very stiff indistinctly fissured reddish brown slightly sandy gravelly CLAY. Gravel is subangular fine to coarse extremely weak mudstone lithorelicts with greenish grey reduction spots (up to 30mm). Fissures are randomly orientated extremely closely and very closely spaced planar smooth locally infilled (up to 5mm) with gypsum. (MMG) (Grade III)	40.00	-32.25	
	68C	41.50 - 43.00	14.50		100 3 0			Extremely weak and very weak thinly laminated to very thinly bedded reddish brown MUDSTONE with rare greenish grey reduction spots (up to 10mm). Fractures are subhorizontal to 20° and 90° very closely and closely spaced planar smooth infilled (up to 2mm) with clay. (MMG) (Grade II)	42.10	-34.35	
						NA		Very stiff indistinctly fissured reddish brown slightly sandy gravelly CLAY. Gravel is subangular fine to coarse extremely weak mudstone lithorelicts with greenish grey reduction spots (up to 30mm). Fissures are randomly orientated extremely closely and very closely spaced planar smooth. (MMG) (Grade III)			
	69C	43.00 - 44.50	14.50		100						
	70C	44.50 - 46.00	14.50		100						
03/03/15 1700hrs 5.03m									46.00	-38.25	
04/03/15 0800hrs 5.55m	71C	46.00 - 47.50	14.50		56 5 0	NI NI 80		Extremely weak thinly laminated to very thinly bedded reddish brown MUDSTONE with rare greenish grey reduction spots (up to 10mm). Fractures are subhorizontal to 20° and 90° very closely and closely spaced planar smooth infilled (up to 2mm) with clay. (MMG) (Grade II) 46.00 - 47.50m: Limited recovery.			
	72C	47.50 - 49.00	14.50		100 0 0						
								Continued Next Page	{48.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
					30238	EC

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BOREHOLE LOG

BH426

CLIENT	WELSH GOVERNMENT					Sheet	6 of 6
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	17 February 2015	Easting	333185.1				
End Date	4 March 2015	Northing	185375.4	Ground level	7.75mOD	Depth	54.50 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	73C	49.00 - 50.50	14.50		81 19 0	NI 80 190		Very weak thinly laminated to very thinly bedded reddish brown MUDSTONE with rare greenish grey reduction spots (up to 10mm). Fractures are subhorizontal to 20° and 90° very closely and closely spaced planar smooth infilled (up to 2mm) with clay. (MMG) (Grade II)	49.30	-41.55	
	74C	50.50 - 52.00	14.50		100 47 16						
	75C	52.00 - 53.50	14.50		100 32 32						
	76C	53.50 - 54.50	14.50		100 82 11						
04/03/15 1630hrs 5.89m									54.50	-46.75	
								Borehole completed at 54.50m.			
									{58.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
					30238	EC

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TRIAL PIT LOG

CLIENT	WELSH GOVERNMENT						**TP410**
SITE	M4 CORRIDOR AROUND NEWPORT					Sheet	1 of 1
Start Date	9 March 2015	Easting	332693.1			Scale	1 : 25
End Date	9 March 2015	Northing	185424.0	Ground level	7.20mOD	Depth	4.00 m

water record	sample/test no/type	result	depth (m)	description	depth (m)	level (m)	legend
	1B	Vo 0.0	0.00- 0.20	Grass over soft dark brown peaty silty CLAY with frequent roots (up to 5mm diam) and rootlets (up to 1mm diam). Frequent plastic bottles, steel cans and cobble sized fragments of wood, timber and plastic. (MG)	0.20	7.00	
	2D		0.10				
				Soft dark brownish grey slightly sandy slightly gravelly silty CLAY. Gravel is angular and subangular medium and coarse red brick, crystalline and sandstone. Low angular and subangular red brick, crystalline and sandstone cobble content. (MG)			
0.90m: Fast inflow.	3B	Vo 1.2	0.90- 1.00				
	4D		1.00				
	5B	Vo 1.1	1.40- 1.50				
	6D		1.50				
					1.80	5.40	
				Soft greenish brown silty CLAY with frequent partings of soft black organic CLAY. (TFD)			
		H 24	2.00				
	7B	Vo 2.6	2.50- 2.60				
	8D	H 22	2.50				
	9B	Vo 0.6	3.70- 3.80				
	10D		3.80				
3.85m					4.00	3.20	

Trial pit completed at 4.00m.

Notes

Trial pit excavated by JCB 3CX mechanical excavator.
Groundwater encountered below 0.90m.
Trial pit sides remained stable and vertical.
Trial pit dimensions 3.50x0.80x4.00m.
On completion, the trial pit was backfilled with materials arising.

Sketch of Foundation - Not to scale. All dimensions in metres.

CONTRACT	CHECKED
30238	EC

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

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Geotechnical Engineering Limited

TRIAL PIT LOG

TP411

CLIENT	WELSH GOVERNMENT						
SITE	M4 CORRIDOR AROUND NEWPORT					Sheet	1 of 1
Start Date	20 February 2015	Easting	332708.5			Scale	1 : 25
End Date	20 February 2015	Northing	185453.8	Ground level	7.60mOD	Depth	3.80 m

water record	sample/test no/type	result	depth (m)	description	depth (m)	level (m)	legend
	1B	Vo 0.4	0.00- 0.30	Dark brown sandy angular and subangular fine to coarse red brick and breeze block gravel with low angular breeze block cobble content. (MADE GROUND) (MG)			
	2D*		0.00- 0.30				
Rapid ingress at 0.70m	3B	Vo 1.3	0.70- 0.90				
	4D*		0.70- 0.90		1.00	6.60	
				Firm locally stiff light brown mottled dark grey slightly sandy CLAY. (TFD)			
	5B	Vo 1.7	1.20- 1.40				
	6D*		1.20- 1.40				
		H 73	1.50				
	7B	Vo 0.8	1.80- 2.00				
	8D*		1.80- 2.00				
	9B	Vo 0.2	2.40- 2.60				
	10D*	H 38	2.40- 2.60		2.60	5.00	
			2.50	Firm dark bluish grey slightly sandy CLAY. (TFD)			
	11B	Vo 0	2.80- 3.00				
	12D*		2.80- 3.00				
	13B	H 25	3.50				
	14D*	Vo 3.9	3.50- 3.70		3.80	3.80	
0.80m.				Trial pit completed at 3.80m.			

Notes

Trial pit excavated by JCB 3CX mechanical excavator.
Groundwater was encountered rapidly ingressing at 0.70m.
Trial pit sides remained stable and vertical.
Trial pit dimensions 1.00x2.60x3.80m.
On completion, the trial pit was backfilled with materials arising.

Sketch of Foundation - Not to scale. All dimensions in metres.

CONTRACT	CHECKED
30238	EC

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

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A2 Appendix 2

Tabulated Gas & Groundwater Monitoring Data

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH423	28/04/15 11:00:00	1016	0								0.0	10		53 litres purged, base depth 18.00m.
BH423	28/04/15 11:01:00										0.0			
BH423	28/04/15 11:02:00										0.0			
BH423	28/04/15 11:03:00										0.0			
BH423	28/04/15 11:04:00										0.0			
BH423	28/04/15 11:05:00			0.2	0.4	19.8	11.1	0	0	0.6				
BH423	28/04/15 11:06:00			0.3	0.4	19.9	9.3	0	0	0.6				
BH423	28/04/15 11:07:00			0.3	0.6	19.9	16.7	0	0	0.5				
BH423	28/04/15 11:08:00			0.2	0.9	19.8	23.0	0	0	0.5				
BH423	28/04/15 11:09:00			0.2	1.0	19.8	23.4	0	0	0.4				
BH423	28/04/15 11:10:00			0.2	1.0	19.8	23.4	0	0	0.4				
BH423	28/04/15 11:11:00			0.1	1.0	19.9	24.0	0	0	0.3				
BH423	28/04/15 11:12:00			0.1	1.0	19.9	24.2	0	0	0.3				
BH423	28/04/15 11:13:00			0.1	1.0	19.9	23.6	0	0	0.1				
BH423	28/04/15 11:14:00			0.1	1.0	19.9	23.6	0	0	0.1			6.21	
BH423	06/05/15 11:00:00	1004	-1.16								0.0	13		57 litres purged, base depth 18.00m.
BH423	06/05/15 11:01:00										0.0			
BH423	06/05/15 11:02:00										0.0			

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

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GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH423	06/05/15 11:03:00										0.0			
BH423	06/05/15 11:04:00										0.0			
BH423	06/05/15 11:05:00			0.0	0.1	20.4	1.0	0	0	3.3				
BH423	06/05/15 11:06:00			0.0	0.1	20.5	1.0	0	0	3.0				
BH423	06/05/15 11:07:00			0.0	0.1	20.5	1.0	0	0	2.8				
BH423	06/05/15 11:08:00			0.0	0.1	20.6	1.0	0	0	2.7				
BH423	06/05/15 11:09:00			0.0	0.0	20.6	0.0	0	0	2.6				
BH423	06/05/15 11:10:00			0.0	0.0	20.6	0.0	0	0	2.6				
BH423	06/05/15 11:11:00			0.0	0.0	20.7	0.0	0	0	2.5				
BH423	06/05/15 11:12:00			0.0	0.0	20.7	0.0	0	0	2.4				
BH423	06/05/15 11:13:00			0.0	0.0	20.7	0.0	0	0	2.3				
BH423	06/05/15 11:14:00			0.0	0.0	20.7	0.0	0	0	2.3			5.18	
BH423	11/05/15 09:00:00	1015	0								0.0	15		52 litres purged, base depth 18.00m.
BH423	11/05/15 09:31:00										0.0			
BH423	11/05/15 10:02:00										0.0			
BH423	11/05/15 10:33:00										0.0			
BH423	11/05/15 11:04:00										0.0			
BH423	11/05/15 11:35:00			0.0	0.0	20.5	0.0	0	0	1.4				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH423	11/05/15 12:06:00			0.0	0.0	20.4	0.0	0	0	1.1				
BH423	11/05/15 12:37:00			0.0	0.0	20.4	0.0	0	0	1.0				
BH423	11/05/15 13:08:00			0.0	0.0	20.4	0.0	0	0	1.0				
BH423	11/05/15 13:39:00			0.0	0.0	20.4	0.0	0	0	0.9				
BH423	11/05/15 14:10:00			0.1	0.0	20.4	0.0	0	0	0.9				
BH423	11/05/15 14:41:00			0.0	0.0	20.3	0.0	0	0	0.8				
BH423	11/05/15 15:12:00			0.0	0.0	20.3	0.0	0	0	0.8				
BH423	11/05/15 15:43:00			0.0	0.0	20.3	0.0	0	0	0.8				
BH423	11/05/15 16:14:00			0.0	0.0	20.3	0.0	0	0	0.8			6.37	
BH423	19/05/15 09:38:00	1004	0								-3.4	12		
BH423	19/05/15 09:39:00										0.0			
BH423	19/05/15 09:40:00										-0.4			
BH423	19/05/15 09:41:00										0.0			
BH423	19/05/15 09:42:00										-1.6			
BH423	19/05/15 09:43:00			0.0	0.0	20.3	0.0	0	0	0.1				
BH423	19/05/15 09:44:00			0.0	0.0	20.3	0.0	0	0	0.1				
BH423	19/05/15 09:45:00			0.0	0.0	20.3	0.0	0	0	0.1				
BH423	19/05/15 09:46:00			0.0	0.0	20.3	0.0	0	0	0.1				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH423	19/05/15 09:47:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH423	19/05/15 09:48:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH423	19/05/15 09:49:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH423	19/05/15 09:50:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH423	19/05/15 09:51:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH423	19/05/15 09:52:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH423	19/05/15 09:53:00												7.40	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

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GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH423	28/04/15 11:14:00												6.02	203 litres purged, base depth 40.00m.
BH423	06/05/15 11:14:00												5.27	208 litres purged, base depth 40.00m.
BH423	11/05/15 16:14:00												6.20	202 litres purged, base depth 40.00m.
BH423	19/05/15 09:54:00												6.90	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Deep install.

CONTRACT **30238**

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GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH425	28/04/15 12:30:00	1022	-0.8								0.0	12		Only 15 litres purged. Thick sediment in water making purging difficult. Base depth 12.30m.
BH425	28/04/15 12:31:00										0.0			
BH425	28/04/15 12:32:00										0.0			
BH425	28/04/15 12:33:00										0.0			
BH425	28/04/15 12:34:00										0.0			
BH425	28/04/15 12:35:00			0.1	0.1	20.5	2.0	0	22	2.3				
BH425	28/04/15 12:36:00			0.0	0.1	20.6	1.0	0	3	1.4				
BH425	28/04/15 12:37:00			0.0	0.1	20.6	1.0	0	1	1.2				
BH425	28/04/15 12:38:00			0.0	0.1	20.6	1.0	0	0	0.9				
BH425	28/04/15 12:39:00			0.0	0.1	20.6	1.0	0	0	0.9				
BH425	28/04/15 12:40:00			0.0	0.1	20.6	1.0	0	0	0.8				
BH425	28/04/15 12:41:00			0.0	0.1	20.5	1.0	0	0	0.8				
BH425	28/04/15 12:42:00			0.0	0.1	20.5	1.0	0	0	0.7				
BH425	28/04/15 12:43:00			0.0	0.1	20.5	0.0	0	0	0.8				
BH425	28/04/15 12:44:00			0.0	0.1	20.5	1.0	0	0	0.7			2.10	
BH425	06/05/15 12:30:00	1004	-0.43								0.0	14		15 litres purged, base depth 12.30m.
BH425	06/05/15 12:31:00										0.0			

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
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GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH425	06/05/15 12:32:00										0.0			
BH425	06/05/15 12:33:00										0.0			
BH425	06/05/15 12:34:00										0.0			
BH425	06/05/15 12:35:00			3.3	67.5	5.3	#	0	7	0.0				
BH425	06/05/15 12:36:00			3.3	65.3	5.7	#	0	5	0.0				
BH425	06/05/15 12:37:00			3.1	60.2	6.7	#	0	3	0.0				
BH425	06/05/15 12:38:00			3.0	55.9	7.3	#	0	0	1.4				
BH425	06/05/15 12:39:00			0.5	29.1	8.4	#	0	0	0.9				
BH425	06/05/15 12:40:00			1.0	14.5	17.2	#	0	0	0.0				
BH425	06/05/15 12:41:00			1.2	19.9	16.3	#	0	0	0.0				
BH425	06/05/15 12:42:00			1.3	22.3	15.6	#	0	0	0.0				
BH425	06/05/15 12:43:00			1.5	25.1	14.7	#	0	0	0.0				
BH425	06/05/15 12:44:00			1.6	26.9	14.3	#	0	0	0.0			4.45	
BH425	12/05/15 10:30:00	1017	0								0.0	14		10 litres purged, base depth 12.30m.
BH425	12/05/15 10:31:00										0.0			
BH425	12/05/15 10:32:00										0.0			
BH425	12/05/15 10:33:00										0.0			
BH425	12/05/15 10:34:00										0.0			

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
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GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH425	12/05/15 10:35:00			2.0	45.1	10.8	#	0	1	0.0				
BH425	12/05/15 10:36:00			1.4	31.2	13.4	#	0	0	0.0				
BH425	12/05/15 10:37:00			1.0	24.1	15.0	#	0	0	0.0				
BH425	12/05/15 10:38:00			0.9	19.4	16.1	#	0	0	0.0				
BH425	12/05/15 10:39:00			0.8	17.8	16.4	#	0	0	0.0				
BH425	12/05/15 10:40:00			0.8	17.9	16.3	#	0	0	0.0				
BH425	12/05/15 10:41:00			0.7	16.5	16.8	#	0	0	0.0				
BH425	12/05/15 10:42:00			0.8	16.5	16.7	#	0	0	0.0				
BH425	12/05/15 10:43:00			0.7	13.8	17.4	#	0	0	0.0				
BH425	12/05/15 10:44:00			0.6	12.2	17.5	#	0	0	0.0			5.27	
BH425	19/05/15 10:40:00	1003	0								0.0	12		
BH425	19/05/15 10:41:00										0.0			
BH425	19/05/15 10:42:00										0.0			
BH425	19/05/15 10:43:00										0.0			
BH425	19/05/15 10:44:00										0.0			
BH425	19/05/15 10:45:00			2.3	50.5	9.5	#	0	0	0.0				
BH425	19/05/15 10:46:00			1.8	38.2	12.2	#	0	0	0.0				
BH425	19/05/15 10:47:00			1.3	28.1	14.2	#	0	0	0.0				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
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GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH425	19/05/15 10:48:00			1.0	21.3	15.6	#	0	0	0.0				
BH425	19/05/15 10:49:00			0.8	17.9	16.4	#	0	0	0.0				
BH425	19/05/15 10:50:00			0.6	14.4	17.3	#	0	0	0.0				
BH425	19/05/15 10:51:00			0.5	11.6	17.9	#	0	0	0.0				
BH425	19/05/15 10:52:00			0.5	12.5	17.8	#	0	0	0.0				
BH425	19/05/15 10:53:00			0.4	10.7	18.1	#	0	0	0.0				
BH425	19/05/15 10:54:00			0.4	9.9	18.3	#	0	0	0.0				
BH425	19/05/15 10:55:00												7.24	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

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GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH425	28/04/15 12:44:00												5.46	Only 40 litres purged. Thick sediment in water making purging difficult. Base depth 30.00m.
BH425	06/05/15 12:44:00												5.30	40 litres purged, base depth 30.00m.
BH425	12/05/15 10:44:00												5.41	40 litres purged, base depth 30.00m.
BH425	19/05/15 10:56:00												6.73	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Deep install.

CONTRACT **30238**

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GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH426	28/04/15 14:00:00											14	0.10	Unable to obtain gas readings due to water level. Base depth 2.00m.
BH426	06/05/15 13:30:00											14	0.50	Unable to obtain gas readings due to water level. Base depth 2.00m.
BH426	12/05/15 09:00:00	1017	0								0.0	12		Upsurge at 2m 10s. Not enough water in shallow install to obtain sample. Base depth 2.00m.
BH426	12/05/15 09:01:00										0.0			
BH426	12/05/15 09:02:00										0.0			Only 25ltrs purged from deep install - running dry with slow recharge.
BH426	12/05/15 09:03:00										0.0			
BH426	12/05/15 09:04:00										0.0			
BH426	12/05/15 09:05:00			0.2	39.9	7.6	#	0	0	0.0				
BH426	12/05/15 09:06:00			0.3	74.1	0.2	#	0	0	0.0				
BH426	12/05/15 09:07:00													
BH426	12/05/15 09:08:00													
BH426	12/05/15 09:09:00													
BH426	12/05/15 09:10:00													
BH426	12/05/15 09:11:00													
BH426	12/05/15 09:12:00													
BH426	12/05/15 09:13:00													

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
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GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH426	12/05/15 09:14:00												0.43	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

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GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH426	28/04/15 14:14:00												1.69	Only 20 litres purged due to thick sediment making purging difficult. Base depth 13.00m.
BH426	06/05/15 13:44:00												0.70	Only 20 litres purged due to thick sediment. Base depth 13.00m.
BH426	12/05/15 09:14:00												1.77	Only 25 litres purged from deep install - running dry with slow recharge. Base depth 13.00m.

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Deep install.

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A3 Appendix 3

Tabulated Soil Laboratory Data

M4CAN
Soil Sample Analysis & Screening Assessment
CL-15
19/10/2015

Geological Formation Legend

MG	Made Ground
TFD	Tidal Flat Deposit

Screening Values and Assessment

	Exceeds S4ULs criteria
X	Laboratory detection level higher than screening criterion

Notes

NFD = No Fibres Detected
NAD = No Asbestos Detected
Chromium VI criteria used
Elemental Mercury criteria used
Screening criterion for lead is C4SL in the absence of a S4UL

Sample Reference	Units	BHG2	BHG3	CH24	CH25	CH26	CH27	CH28	CH29	CH30	CH30	CH31	CH32	CH32	STPG01	STPG02	BH424	BH424	BH424	BH425	BH425	BH425	BH426	BH426	TP410	TP410	BHG4	CH24	CH25	CH27	CH28	STPG01	STPG02	STPG02	BH423	BH423	BH426
Specimen Depth (m)		1	0.2	0	0	0.3	0.55	0.22	0.4	0	1	0	0	0.5	0.3	0.3	0.3 - 0.6	0.7 - 1	1 - 1.1	0.5 - 0.6	1.5 - 1.6	2 - 2.1	0.5 - 0.6	1.5 - 1.6	0 - 0.1	0.9 - 1	0.4	0.75	0.8	1.1	1.9	1.2	1	3	0.2 - 0.5	0.5 - 1	2.5 - 2.6
OD Level (m)		7	7.8	7.41	7.61	6.89	6.23	7.67	7.64	8.23	7.23	7.96	8.13	7.63	7.54	7.57	7.6	7.2	6.9	7.35	6.35	5.85	7.25	6.25	7.2	6.3	6.52	6.66	6.81	5.68	5.99	6.64	6.87	4.87	6.8	6.5	5.25
Sample Type		B	D	D	D	D	D	D	D	D	D	D	D	D	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	D	D	D	D	ES	B	D	ES	ES	ES
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD
Cluster Code		1997 GI	1997 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2007 GI	2007 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	1997 GI	2000 GI	2000 GI	2000 GI	2000 GI	2007 GI	2007 GI	2007 GI	2015 GI	2015 GI	2015 GI
Metals																																					
Antimony	mg/kg														92	2																4	3.3				
Arsenic	mg/kg	20.9	13.3	9.3	4.6	6.43	14.4	16.7	8.18	8.85	12	21.3	12.8	29.5	4	5	23	27	27	16	22	21	170	16	8.9	31	15.2	17	15	11.3	5.52	8	13		26	17	12
Barium	mg/kg														460	67																70	82				
Boron	mg/kg	2.9	35.3	<0.5	0.5	1	1.8	0.6	0.7	1.5	3.2	23	2.1	1.3	Boron		0.75	0.81	0.8	1.4	0.91	1.1	4.7	2.4	4.4	3.3		<5	1.6	2.6	0.6				7.6	6.8	1.8
Boron Water Soluble	mg/kg														23	<3.5											1.6										
Cadmium	mg/kg	<0.2	10.6	0.87	0.51	0.1	0.35	0.22	0.18	0.36	0.68	1.09	0.57	0.29	4.1	0.5	0.34	1.2	0.51	<0.1	0.37	<0.1	0.66	0.66	0.41	0.14	0.6	0.2	0.21	0.12	0.17	1.2	0.4		1.2	0.2	0.19
Chromium	mg/kg	67.5	1137.9	99	16	13	120	16	33	32	45	2170	1790	41	1900	26	21	26	41	32	13	16	190	51	16	20	60.3	44	35	42	14	84	38		36	19	43
Copper	mg/kg	26	228.4	141	16	19	147	43	52	60	77	536	221	172	350	20	66	60	19	21	42	22	160	36	17	18	15.5	25	23	15	10	20	49		42	25	19
Lead	mg/kg	59.5	449.9	154	56	45	157	62	60	125	111	182	166	417	340	47	36	160	48	52	73	200	71	96	120	53	41.6	69	68	49	26	34	41		99	46	61
Mercury	mg/kg	<0.1	0.5	<0.14	<0.14	0.09	0.14	2.91	0.8	0.38	1.21	0.38	3.21	16.9	<0.6	<0.6	0.22	0.39	0.2	0.19	0.88	0.54	0.73	0.81	1.3	0.21	<0.1	<0.14	0.14	0.04	0.13	<0.6	<0.6		0.84	0.38	0.28
Molybdenum	mg/kg														36	0.8																2.5	2				
Nickel	mg/kg	39.3	81.5	51	9	10	53	13	29	23	29	141	49	32	140	10	34	32	27	29	13	12	620	35	16	22	38.6	39	32	33	10	32	39		33	19	34
Selenium	mg/kg	0.3	1.2	0.6	0.64	0.94	0.6	0.99	0.67	0.83	0.97	2.52	1.79	0.97	<3	<3	0.59	0.26	0	0	0	0	0.58	0.38	0.68	0	0.1	0.42		<0.5	1.01	<3	<3		0.39	0	0
Tin	mg/kg																						8.5	<5													
Vanadium	mg/kg																						81	44													
Zinc	mg/kg	136.7	1368.1	280	69	53	188	89	63	139	168	475	390	389	980	87	70	140	72	140	290	210	330	160	150	86	95.3	122	129	92	44	130	160		260	130	100
Iron	mg/kg																						13000	17000													
Hexavalent Chromium	mg/kg														0.4	<0.3							<0.5	<0.5								<0.3	<0.3				
Non-Metal Inorganics																																					
Cyanide (total)	mg/kg	<0.1	0.3	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.5	<0.5	<0.5	<0.5	0.7	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	<1	<1		<0.5	<0.5	<0.5
Cyanide (free)	mg/kg	<0.1	<0.1	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	<1			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.1	<1		<1	<1				<0.5	<0.5	<0.5
Thiocyanate	mg/kg	<1																																			
Ferro/ferricyanide	mg/kg	<10	<10																								<10										
Acid Soluble Sulphate	mg/kg			<836	2440	1110	626	2240	674	760	1190	2440	1150	1420														760	843	533	1370						
Sulphate (soluble)	g/l														0.058	0.025																0.041	0.096				
Sulphate (total)	mg/kg	777	3456																				1400	1400			575										
Sulphide	mg/kg	10.8		40	12	16	<11	<1	19	19	20	14	38	<1									16	15				6		4	1						
Sulphur	%																						0.22	0.13													
Other																																					
Ammoniacal Nitrogen as N	mg/kg																						19	56													
Nitrate as N	mg/kg																						<1	<1													
Nitrate as NO2	mg/kg																						0.14	<0.1													
Asbestos Presence Screen	None														NFD	NFD	NAD	NAD	NAD	NAD	NAD		NAD	NAD	NAD	NAD						NFD	NFD				
Total Organic Carbon	%														0.5	0.5				0.85			0.78									0.7	1				
Organic Matter	%																						1.3	4.5										1.1			
Calorific Value	MJ/kg																						<0.1														
pH Units	pH Units	8.3	11.5	9.5	10.6	10.3	8.5	11.2	10	9.2	10.4	11.7	11.2	8.8	10.83	8.85	11.3	10.8	12	8.7	10.1	9.1	9.2	8.5	7.9	8.4	7.8	7.3	7.6	8.6	11.1	8.33	8		8.3	8.7	9.1
Organics																																					
PAH (Screening)	mg/kg	<0.1	9.3	17	191	40	56	58	21	10	66	10	26	44														<19	71	<10	20						
Mineral Oil	mg/kg	<1	53																																		
TPH FTIR (AR)	mg/kg				302	<20	<346	66	88	<20	132	105	1190	94														<20		<20	53						
OIL FTIR	mg/kg			200	1130	137	485	175	443	152	477	160	514	131														149		105	137						
PCBs																																					
PCB - ARO	mg/kg											0.2	0.2	0.5																							
PCBs (vs Aroclor 1254)	mg/kg														0.61	0.062																0.025	<0.1				
PCB 105	mg/kg																			<0.01	<0.01	<0.01	<0.01	<0.01		<0.01											<0.01
PCB 114	mg/kg																			<0.01	<0.01	<0.01	<0.01	<0.01		<0.01											<0.01
PCB 123	mg/kg																			<0.01	<0.01	<0.01	<0.01	<0.01		<0.01											<0.01
PCB 126	mg/kg																			<0.01	<0.01	<0.01	<0.01	<0.01		<0.01											<0.01
PCB 157	mg/kg																			<0.01	<0.01	<0.01	<0.01	<0.01		<0.01											<0.01
PCB 167	mg/kg																			<0.01	<0.01	<0.01	<0.01	<0.01		<0.01											<0.01
PCB 169	mg/kg																			<0.01	<0.01	<0.01	<0.01	<0.01		<0.01											<0.01
PCB 189	mg/kg																			<0.01	<0.01	<0.01	<0.01	<0.01		<0.01											<0.01
PCB 77	mg/kg																			<0.01	<0.01	<0.01	<0.01	<0.01		<0.01											<0.01
PCB 81	mg/kg																			<0.01	<0.01	<0.01	<0.01	<0.01		<0.01											<0.01
Pcb-118 2,3',4,4',5 - Pentachlorobiphenyl	mg/kg																			<0.01	<0.01	<0.01	<0.01	<0.01		<0.01											<0.01
Pcb-156 2,3,3',4,4',5 - Hexachlorobiphenyl	mg/kg																			<0.01	<0.01	<0.01	<0.01	<0.01		<0.01											<0.01
Phenols																																					
Phenol Index	mg/kg			<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5														<0.5	<0.5	<0.5	<0.5						
Phenols Monohydric	mg/kg	<1	<1																								<1										
Phenols (total)	mg/kg	<1	<1												<0.15	<0.15				<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<1					<0.15	<0.15				
BTEX																																					
GRO (C4-C12)	mg/kg														<0.01	<0.01																<0.01	<0.01				
MTBE	mg/kg														<0.01	<0.01				<0.001												<0.01	<0.01				
Benzene	mg/kg														<0.01	<0.01				<0.001	<0.001	<0.001	<0.001	<0.001								<0.01	<0.01				
Toluene	mg/kg														<0.01	<0.01				<0.001	<0.001	<0.001	<0.001	<0.001								<0.01	<0.01				
Ethyl benzene	mg/kg														<0.01	<0.01				<0.001	<0.001	<0.001	<0.001	<0.001								<0.01	<0.01				
m & p Xylene	mg/kg														<0.01	<0.01				<0.001	<0.001	<0.001	<0.001	<0.001								<0.01	<0.01				
o Xylene	mg/kg														<0.01	<0.01				<0.001	<0.001	<0.001	<0.001	<0.001								<0.01	<0.01				

No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	Selected S4ULs Criteria	No. Data Exceeding S4ULs Criteria
4	4	92	2	STPG01 @ 0.3mbGL		
35	35	170	4	BH426 @ 0.5 - 0.6mbGL	170	0
4	4	460	67	STPG01 @ 0.3mbGL		
30	28	35.3	0.5	BHG3 @ 0.2mbGL	46000	0
3	2	23	1.6	STPG01 @ 0.3mbGL		
35	32	10.6	0.1	BHG3 @ 0.2mbGL	190	0
35	35	2170	13	CH31 @ 0mbGL	33	20
35	35	536	10	CH31 @ 0mbGL	44000	0
35	35	449.9	26	BHG3 @ 0.2mbGL	1300	0
35	26	16.9	0.04	CH32 @ 0.5mbGL	30	0
4	4	36	0.8	STPG01 @ 0.3mbGL		
35	35	620	9	BH426 @ 0.5 - 0.6mbGL	980	0
34	29	2.52	0	CH31 @ 0mbGL	1800	0
2	1	8.5	8.5	BH426 @ 0.5 - 0.6mbGL		
2	2	81	44	BH426 @ 0.5 - 0.6mbGL	5000	0
35	35	1368.1	44	BHG3 @ 0.2mbGL	170000	0
2	2	17000	13000	BH426 @ 1.5 - 1.6mbGL		
6	1	0.4	0.4	STPG01 @ 0.3mbGL		
35	2	0.7	0.3	BH425 @ 1.5 - 1.6mbGL		
30	1	1	1	CH29 @ 0.4mbGL		
1	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
15	14	2440	533	CH25 0 / CH28 @ 0.22mbGL		
4	4	0.096	0.025	STPG02 @ 1mbGL		
5	5	3456	575	BHG3 @ 0.2mbGL		
17	14	40	1	CH24 @ 0mbGL		
2	2	0.22	0.13	BH426 @ 0.5 - 0.6mbGL		
2	2	56	19	BH426 @ 1.5 - 1.6mbGL		
2	0	None > LOD	None > LOD			
2	1	0.14	0.14	BH426 @ 0.5 - 0.6mbGL		
13	0	None > LOD	None > LOD			
6	6	1	0.5	STPG02 @ 1mbGL		
3	3	4.5	1.1	BH426 @ 1.5 - 1.6mbGL		
1	0	None > LOD	None > LOD			
35	35	12	7.3	BH424 @ 1 - 1.1mbGL	6-9	19
17	14	191	9.3	CH25 @ 0mbGL	1.1	14
13	1	53	53	BHG3 @ 0.2mbGL		
13	8	1190	53	CH32 @ 0mbGL	3200	0
16	14	1130	105	CH25 @ 0mbGL		
3	3	0.5	0.2	CH32 @ 0.5mbGL	0.24	1
4	3	0.61	0.025	STPG01 @ 0.3mbGL	0.24	1
7	0	None > LOD	None > LOD		0.24	0
7	0	None > LOD	None > LOD		0.24	0
7	0	None > LOD	None > LOD		0.24	0
7	0	None > LOD	None > LOD		0.24	0
7	0	None > LOD	None > LOD		0.24	0
7	0	None > LOD	None > LOD		0.24	0
7	0	None > LOD	None > LOD		0.24	0
7	0	None > LOD	None > LOD		0.24	0
7	0	None > LOD	None > LOD		0.24	0
7	0	None > LOD	None > LOD		0.24	0
7	0	None > LOD	None > LOD		0.24	0
7	0	None > LOD	None > LOD		0.24	0
15	1	0.5	0.5	CH29 @ 0.4mbGL	440	0
3	0	None > LOD	None > LOD		440	0
14	0	None > LOD	None > LOD		440	0
4	0	None > LOD	None > LOD			
5	0	None > LOD	None > LOD			
9	0	None > LOD	None > LOD		27	0
9	0	None > LOD	None > LOD		56000	0
9	0	None > LOD	None > LOD		5700	0
9	0	None > LOD	None > LOD		5900	0
9	0	None > LOD	None > LOD		6600	0

M4CAN
Soil Sample Analysis & Screening Assessment
CL-15
19/10/2015

Geological Formation Legend

MG	Made Ground
TFD	Tidal Flat Deposit

Screening Values and Assessment

	Exceeds S4ULs criteria
X	Laboratory detection level higher than screening criterion

Notes

NFD = No Fibres Detected
NAD = No Asbestos Detected
Chromium VI criteria used
Elemental Mercury criteria used
Screening criterion for lead is C4SL in the absence of a S4UL

Sample Reference	Units	BHG2	BHG3	CH24	CH25	CH26	CH27	CH28	CH29	CH30	CH30	CH31	CH32	CH32	STPG01	STPG02	BH424	BH424	BH424	BH425	BH425	BH425	BH426	BH426	TP410	TP410	BHG4	CH24	CH25	CH27	CH28	STPG01	STPG02	STPG02	BH423	BH423	BH426
Specimen Depth (m)		1	0.2	0	0	0.3	0.55	0.22	0.4	0	1	0	0	0.5	0.3	0.3	0.3 - 0.6	0.7 - 1	1 - 1.1	0.5 - 0.6	1.5 - 1.6	2 - 2.1	0.5 - 0.6	1.5 - 1.6	0 - 0.1	0.9 - 1	0.4	0.75	0.8	1.1	1.9	1.2	1	3	0.2 - 0.5	0.5 - 1	2.5 - 2.6
OD Level (m)		7	7.8	7.41	7.61	6.89	6.23	7.67	7.64	8.23	7.23	7.96	8.13	7.63	7.54	7.57	7.6	7.2	6.9	7.35	6.35	5.85	7.25	6.25	7.2	6.3	6.52	6.66	6.81	5.68	5.99	6.64	6.87	4.87	6.8	6.5	5.25
Sample Type		B	D	D	D	D	D	D	D	D	D	D	D	D	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	D	D	D	D	ES	B	D	ES	ES	ES
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD
Cluster Code		1997 GI	1997 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2007 GI	2007 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	1997 GI	2000 GI	2000 GI	2000 GI	2000 GI	2007 GI	2007 GI	2007 GI	2015 GI	2015 GI	2015 GI
TPH																																					
TPH >C6-C8	mg/kg																								<1	<1									<1	<1	<1
TPH >C8-C10	mg/kg																								<1	<1									<1	<1	<1
TPH >C10-C12	mg/kg																								<1	<1									<1	<1	<1
TPH >C12-C16	mg/kg																								<1	<1									<1	<1	<1
TPH >C16-C21	mg/kg																								<1	<1									<1	<1	<1
TPH >C21-C35	mg/kg																								<1	<1									<1	<1	<1
Aliphatics C5-C6	mg/kg														<0.01	<0.01				<0.1	<0.1	<0.1	<0.1	<0.1								<0.01	<0.01				
Aliphatics >C6-C8	mg/kg														<0.01	<0.01				<0.1	<0.1	<0.1	<0.1	<0.1								<0.01	<0.01				
Aliphatics >C8-C10	mg/kg														<0.01	<0.01				<0.1	<0.1	<0.1	<0.1	<0.1								<0.01	<0.01				
Aliphatics >C10-C12	mg/kg														<0.01	<0.01				<1	<1	<1	<1	<1								<0.01	<0.01				
Aliphatics >C12-C16	mg/kg														3.9	2.8				<1	<1	<1	<1	<1								0.62	30				
Aliphatics >C16-C21	mg/kg														25	13				<1	<1	<1	<1	<1								2.2	64				
Aliphatics >C21-C35	mg/kg														130	93				<1	<1	<1	<1	<1								7.4	200				
Total Aliphatics C5-C35	mg/kg														160	110																10	290				
Aliphatics >C35-C44	mg/kg																			<0.1	<0.1	<0.1	<0.1	<0.1													
Aromatics >C5-C7	mg/kg																			<1	<1	<1	<1	<1													
Aromatics C6-C7	mg/kg														<0.01	<0.01																<0.01	<0.01				
Aromatics >C7-C8	mg/kg														<0.01	<0.01				<0.1	<0.1	<0.1	<0.1	<0.1								<0.01	<0.01				
Aromatics >EC8-EC10	mg/kg														<0.01	<0.01				<0.1	<0.1	<0.1	<0.1	<0.1								<0.01	<0.01				
Aromatics >EC10-EC12	mg/kg														<0.01	<0.01				<0.1	<0.1	<0.1	<0.1	<0.1								<0.01	<0.01				
Aromatics >EC12-EC16	mg/kg														<0.1	<0.1				<1	<1	<1	3.2	<1								<0.1	1.7				
Aromatics >EC16-EC21	mg/kg														0.99	0.22				<1	3.5	<1	3.3	<1								0.33	5.3				
Aromatics >EC21-EC35	mg/kg														2.9	23				<1	6.5	<1	7.4	<1								0.31	48				
Total Aromatics C6-C35	mg/kg														3.9	24																0.64	55				
Aromatics >C35-C44	mg/kg																			<1	<1	<1	<1	<1													
Total Aliphatic hydrocarbons	mg/kg																			<5	<5	<5	<5	<5													
Total Aromatic hydrocarbons	mg/kg																			<5	10	<5	14	<5													
TPH (Aliphatics and Aromatics C5-C35)	mg/kg														160	130																11	350				
Total petroleum hydrocarbons	mg/kg																			<10	10	<10	14	<10													
PAH																																					
Acenaphthene	mg/kg														<0.014	0.015	<0.1	0.3	<0.1	<0.1	<0.1	<0.1	1	0.27	1.1	0.23						<0.014	0.056		0.36	0.11	<0.1
Acenaphthylene	mg/kg														0.013	0.008	<0.1	0.45	<0.1	<0.1	<0.1	<0.1	0.11	<0.1	0.5	<0.1						<0.005	0.044		0.34	0.22	<0.1
Anthracene	mg/kg														0.032	0.019	<0.1	0.22	<0.1	<0.1	<0.1	<0.1	1.6	0.12	0.64	0.11						<0.009	0.077		0.16	0.12	<0.1
Benz(a)anthracene	mg/kg														0.14	0.098	<0.1	0.84	0.42	<0.1	<0.1	0.13	4.9	0.6	1.1	<0.1						0.025	0.18		0.57	0.36	<0.1
Benzo(a)pyrene	mg/kg														0.13	0.11	<0.1	1.1	<0.1	<0.1	<0.1	<0.1	5.7	0.7	1.3	<0.1						<0.012	0.12		0.58	0.1	<0.1
Benzo(b)fluoranthene	mg/kg														0.27	0.23	<0.1	1.9	<0.1	<0.1	<0.1	<0.1	7.5	1.2	2.1	<0.1						0.017	0.13		0.6	0.69	<0.1
Benzo(ghi)perylene	mg/kg														0.099	0.09	<0.1	2	<0.1	<0.1	<0.1	<0.1	3.7	0.67	0.5	<0.1						0.01	0.089		0.33	<0.1	<0.1
Benzo(k)fluoranthene	mg/kg														0.11	0.08	<0.1	0.33	<0.1	<0.1	<0.1	<0.1	2.4	0.34	0.5	<0.1						<0.025	0.052		0.14	0.14	<0.1
Chrysene	mg/kg														0.22	0.17	<0.1	1.4	0.3	<0.1	<0.1	0.16	3.7	0.61	0.57	<0.1						0.017	0.17		0.85	0.24	<0.1
Dibenzo(ah)anthracene	mg/kg														0.022	0.018	<0.1	0.39	<0.1	<0.1	<0.1	<0.1	0.24	0.11	0.61	<0.1						<0.008	0.015		<0.1	<0.1	<0.1
Fluoranthene	mg/kg														0.28	0.21	0.34	0.34	1.2	0.28	0.52	0.37	9.7	1.4	3.1	0.67						<0.025	0.29		1.3	0.93	0.47
Fluorene	mg/kg														0.015	0.019	<0.1	0.4	<0.1	<0.1	<0.1	<0.1	0.68	<0.1	0.52	0.27						<0.012	0.096		0.36	0.19	<0.1
Indeno(123cd)pyrene	mg/kg														0.081	0.074	<0.1	1.2	<0.1	<0.1	<0.1	<0.1	4	0.76	0.67	<0.1						<0.011	0.069		0.24	<0.1	<0.1
Naphthalene	mg/kg														0.027	0.041	<0.1	0.66	<0.1	<0.1	<0.1	<0.1	0.23	0.24	0.58	0.3						<0.01	0.069		0.61	0.3	<0.1
Phenanthrene	mg/kg														0.17	0.17	<0.1	1.9	0.84	0.22	0.35	0.3	7.4	0.74	2.7	0.94						<0.021	0.25		1.2	0.77	0.18
Pyrene	mg/kg														0.25	0.17	0.27	0.27	0.91	0.24	0.48	0.36	7.7	1	2.6	0.48						<0.022	0.28		0.97	0.82	0.28
Coronene	mg/kg																						<0.1	<0.1													
PAH 16 Total	mg/kg														1.8	1.5	<2	14	3.7	<2	<2	<2	64	7.5	19	3						0.069	2		8.6	5	<2
SVOCs																																					
Phenols																																					
2,3,4,5-tetrachlorophenol.	mg/kg																			<0.2	<0.2																
2,3,4,6-Tetrachlorophenol	mg/kg																			<0.2	<0.2																
2,3,4-trichlorophenol.	mg/kg																			<0.2	<0.2																
2,3,5,6-Tetrachlorophenol	mg/kg																			<0.2	<0.2																
2,3,5-Trichlorophenol	mg/kg																			<0.2	<0.2																
2,3,6-Trichlorophenol	mg/kg																			<0.2	<0.2																
2,6-Dichlorophenol	mg/kg																			<0.2	<0.2																
2-sec-Butyl-4,6-dinitrophenol	mg/kg																			<0.2	<0.2																
3,4,5-Trichlorophenol	mg/kg																			<0.2	<0.2																
3-methylphenol	mg/kg																			<0.2	<0.2																
2-Chlorophenol	mg/kg														<0.1	<0.1				<0.2	<0.2											<0.1	<0.1				
2-Methylphenol	mg/kg														<0.1	<0.1				<0.2	<0.2											<0.1	<0.1				
2-Nitrophenol	mg/kg														<0.1	<0.1				<0.2	<0.2											<0.1	<0.1				
2-Methyl-4,6 Dinitrophenol	mg/kg																			<0.2	<0.2																
2,4-Dichlorophenol	mg/kg														<0.1	<0.1				<0.2	<0.2											<0.1	<0.1				
2,4-Dimethylphenol	mg/kg														<0.1	<0.1				<0.2	<0.2											<0.1	<0.1				
2,4,5-Trichlorophenol	mg/kg														<0.1	<0.1				<0.2	<0.2											<0.1	<0.1				
2,4,6-Trichlorophenol	mg/kg														<0.1	<0.1				<0.2	<0.2											<0.1	<0.1				
4-Chloro-3-methylphenol	mg/kg														<0.1	<0.1				<0.2	<0.2											<0.1	<0.1				
4-Methylphenol	mg/kg														<0.1	<0.1				<0.2	<0.2											<0.1	<0.1				
4-Nitrophenol	mg/kg														<0.1	<0.1				<0.2	<0.2											<0.1	<0.1				
Pentachlorophenol	mg/kg														<0.1	<0.1				<0.2	<0.2											<0.1	<0.1				
1-naphthol	mg/kg																						<0.05	<0.05													
Methylphenols	mg/kg																			<0.05	<0.05																
Resorcinol	mg/kg																						<0.05	<0.05													
Trimethylphenol	mg/kg																			<0.05	<0.05																
Xylenols	mg/kg																						<0.05	<0.05													
Phenol	mg/kg														<0.1	<0.1				<0.05	<0.05											<0.1	<0.1				
Phenols	mg/kg																			<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3											
PAHs																																					
2-Chloronaphthalene	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
2-Methylnaphthalene	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
Acenaphthene	mg/kg															<0.1																	<0.1				
Acenaphthylene	mg/kg															<0.1																	<0.1				
Anthracene	mg/kg															<0.1																	<0.1				
Benzo(a)anthracene	mg/kg															0.14																	<0.1				
Benzo(a)pyrene	mg/kg															0.11																	<0.1				
Benzo(b)fluoranthene	mg/kg															0.12																	<0.1				
Benzo(ghi)perylene	mg/kg															0.11																	<0.1				
Benzo(k)fluoranthene	mg/kg															<0.1																	<0.1				
Chrysene	mg/kg															0.16																	<0.1				
Dibenzo(a,h)anthracene	mg/kg															<0.1																	<0.1				
Fluoranthene	mg/kg															0.29																	<0.1				
Fluorene	mg/kg															<0.1																	<0.1				
Indeno(1,2,3-cd)pyrene	mg/kg															0.15																	<0.1				
Naphthalene	mg/kg															<0.1																	<0.1				
Phenanthrene	mg/kg															0.25																	<0.1				
Pyrene	mg/kg															0.23																	<0.1				

No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	Selected S4ULs Criteria	No. Data Exceeding S4ULs Criteria
TPH						
5	0	None > LOD	None > LOD		7800	0
5	0	None > LOD	None > LOD		2000	0
5	0	None > LOD	None > LOD		9200	0
5	0	None > LOD	None > LOD		10000	0
5	0	None > LOD	None > LOD		7600	0
5	0	None > LOD	None > LOD		7800	0
9	0	None > LOD	None > LOD		3200	0
9	0	None > LOD	None > LOD		7800	0
9	0	None > LOD	None > LOD		2000	0
9	0	None > LOD	None > LOD		9700	0
9	4	30	0.62	STPG02 @ 1mbGL	25000	0
9	4	64	2.2	STPG02 @ 1mbGL	450000	0
9	4	200	7.4	STPG02 @ 1mbGL	450000	0
4	4	290	10	STPG02 @ 1mbGL		
5	0	None > LOD	None > LOD		450000	0
5	0	None > LOD	None > LOD		26000	0
4	0	None > LOD	None > LOD		7800	0
9	0	None > LOD	None > LOD		56000	0
9	0	None > LOD	None > LOD		3500	0
9	0	None > LOD	None > LOD		9200	0
9	2	3.2	1.7	BH426 @ 0.5 - 0.6mbGL	10000	0
9	6	5.3	0.22	STPG02 @ 1mbGL	7600	0
9	6	48	0.31	STPG02 @ 1mbGL	7800	0
4	4	55	0.64	STPG02 @ 1mbGL		
5	0	None > LOD	None > LOD		7800	0
5	0	None > LOD	None > LOD			
5	2	14	10	BH426 @ 0.5 - 0.6mbGL		
4	4	350	11	STPG02 @ 1mbGL		
5	2	14	10	BH426 @ 0.5 - 0.6mbGL		
PAH						
17	9	1.1	0.015	TP410 @ 0 - 0.1mbGL	29000	0
17	8	0.5	0.008	TP410 @ 0 - 0.1mbGL	29000	0
17	10	1.6	0.019	BH426 @ 0.5 - 0.6mbGL	150000	0
17	12	4.9	0.025	BH426 @ 0.5 - 0.6mbGL	49	0
17	9	5.7	0.1	BH426 @ 0.5 - 0.6mbGL	11	0
17	10	7.5	0.017	BH426 @ 0.5 - 0.6mbGL	13	0
17	9	3.7	0.01	BH426 @ 0.5 - 0.6mbGL	1400	0
17	9	2.4	0.052	BH426 @ 0.5 - 0.6mbGL	370	0
17	12	3.7	0.017	BH426 @ 0.5 - 0.6mbGL	93	0
17	7	0.61	0.015	TP410 @ 0 - 0.1mbGL	1.1	0
17	16	9.7	0.21	BH426 @ 0.5 - 0.6mbGL	6300	0
17	9	0.68	0.015	BH426 @ 0.5 - 0.6mbGL	20000	0
17	8	4	0.069	BH426 @ 0.5 - 0.6mbGL	150	0
17	10	0.66	0.027	BH424 @ 0.7 - 1mbGL	190	0
17	15	7.4	0.17	BH426 @ 0.5 - 0.6mbGL	6200	0
17	16	7.7	0.17	BH426 @ 0.5 - 0.6mbGL	15000	0
2	0	None > LOD	None > LOD			
17	12	64	0.069	BH426 @ 0.5 - 0.6mbGL		
SVOCs						
Phenols						
2	0	None > LOD	None > LOD			
2	0	None > LOD	None > LOD			
2	0	None > LOD	None > LOD			
2	0	None > LOD	None > LOD			
2	0	None > LOD	None > LOD			
2	0	None > LOD	None > LOD			
2	0	None > LOD	None > LOD			
2	0	None > LOD	None > LOD			
2	0	None > LOD	None > LOD			
2	0	None > LOD	None > LOD			
2	0	None > LOD	None > LOD			
2	0	None > LOD	None > LOD			
2	0	None > LOD	None > LOD			
6	0	None > LOD	None > LOD			
6	0	None > LOD	None > LOD			
6	0	None > LOD	None > LOD			
2	0	None > LOD	None > LOD			
6	0	None > LOD	None > LOD			
6	0	None > LOD	None > LOD			
6	0	None > LOD	None > LOD			
6	0	None > LOD	None > LOD			
6	0	None > LOD	None > LOD			
6	0	None > LOD	None > LOD			
6	0	None > LOD	None > LOD			
2	0	None > LOD	None > LOD			
2	0	None > LOD	None > LOD			
2	0	None > LOD	None > LOD			
2	0	None > LOD	None > LOD			
6	0	None > LOD	None > LOD		440	0
7	0	None > LOD	None > LOD		440	0
PAHs						
5	0	None > LOD	None > LOD			
5	0	None > LOD	None > LOD			
2	0	None > LOD	None > LOD		29000	0
2	0	None > LOD	None > LOD		29000	0
2	0	None > LOD	None > LOD		150000	0
2	1	0.14	0.14	STPG02 @ 0.3mbGL		
2	1	0.11	0.11	STPG02 @ 0.3mbGL	11	0
2	1	0.12	0.12	STPG02 @ 0.3mbGL	13	0
2	1	0.11	0.11	STPG02 @ 0.3mbGL	1400	0
2	0	None > LOD	None > LOD		370	0
2	1	0.16	0.16	STPG02 @ 0.3mbGL	93	0
2	0	None > LOD	None > LOD			
2	1	0.29	0.29	STPG02 @ 0.3mbGL	6300	0
2	0	None > LOD	None > LOD		20000	0
2	1	0.15	0.15	STPG02 @ 0.3mbGL		
2	0	None > LOD	None > LOD		190	0
2	1	0.25	0.25	STPG02 @ 0.3mbGL	6200	0
2	1	0.23	0.23	STPG02 @ 0.3mbGL	15000	0

M4CAN
Soil Sample Analysis & Screening Assessment
CL-15
19/10/2015

Geological Formation Legend

MG	Made Ground
TFD	Tidal Flat Deposit

Screening Values and Assessment

	Exceeds S4ULs criteria
X	Laboratory detection level higher than screening criterion

Notes

NFD = No Fibres Detected
NAD = No Asbestos Detected
Chromium VI criteria used
Elemental Mercury criteria used
Screening criterion for lead is C4SL in the absence of a S4UL

Sample Reference	Units	BHG2	BHG3	CH24	CH25	CH26	CH27	CH28	CH29	CH30	CH30	CH31	CH32	CH32	STPG01	STPG02	BH424	BH424	BH424	BH425	BH425	BH425	BH426	BH426	TP410	TP410	BHG4	CH24	CH25	CH27	CH28	STPG01	STPG02	STPG02	BH423	BH423	BH426
Specimen Depth (m)		1	0.2	0	0	0.3	0.55	0.22	0.4	0	1	0	0	0.5	0.3	0.3	0.3 - 0.6	0.7 - 1	1 - 1.1	0.5 - 0.6	1.5 - 1.6	2 - 2.1	0.5 - 0.6	1.5 - 1.6	0 - 0.1	0.9 - 1	0.4	0.75	0.8	1.1	1.9	1.2	1	3	0.2 - 0.5	0.5 - 1	2.5 - 2.6
OD Level (m)		7	7.8	7.41	7.61	6.89	6.23	7.67	7.64	8.23	7.23	7.96	8.13	7.63	7.54	7.57	7.6	7.2	6.9	7.35	6.35	5.85	7.25	6.66	7.2	6.3	6.52	6.66	6.81	5.68	5.99	6.64	6.87	4.87	6.8	6.5	5.25
Sample Type		B	D	D	D	D	D	D	D	D	D	D	D	D	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	D	D	D	D	ES	B	D	ES	ES	ES
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD
Cluster Code		1997 GI	1997 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2007 GI	2007 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	1997 GI	2000 GI	2000 GI	2000 GI	2000 GI	2007 GI	2007 GI	2007 GI	2015 GI	2015 GI	2015 GI
Phthalates																																					
Bis(2-ethylhexyl) phthalate	mg/kg														2.9	8.6				<0.5												<0.1	<0.1				
Butylbenzyl phthalate	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
Di-n-butyl phthalate	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
Di-n-Octyl phthalate	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
Diethyl phthalate	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
Dimethyl phthalate	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
Other Semi-Volatiles																																					
1,2-Dichlorobenzene	mg/kg														<0.1	<0.1																<0.1	<0.1				
1,2,4-Trichlorobenzene	mg/kg														<0.1	<0.1																<0.1	<0.1				
1,3-Dichlorobenzene	mg/kg														<0.1	<0.1																<0.1	<0.1				
1,4-Dichlorobenzene	mg/kg														<0.1	<0.1																<0.1	<0.1				
2-Nitroaniline	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
2,4-Dinitrotoluene	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
2,6-Dinitrotoluene	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
3-Nitroaniline	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
4-Bromophenylphenylether	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
4-Chloroaniline	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
4-Chlorophenylphenylether	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
4-Nitroaniline	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
Azobenzene	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
Bis(2-chloroethoxy)methane	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
Bis(2-chloroethyl)ether	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
Bis(2-chloroisopropyl)ether	mg/kg																			<0.5																	
Carbazole	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
Dibenzofuran	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
Hexachlorobenzene	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
Hexachlorobutadiene	mg/kg														<0.1	<0.1				<0.001												<0.1	<0.1				
Hexachlorocyclopentadiene	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
Hexachloroethane	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
Isophorone	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
N-nitrosodimethylamine	mg/kg																			<0.5																	
N-nitrosodi-n-propylamine	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
Nitrobenzene	mg/kg														<0.1	<0.1				<0.5												<0.1	<0.1				
VOCs																																					
Methyl Tertiary Butyl Ether	ug/kg														<11	<11				<1												<11	<11				
Benzene	ug/kg														<9	<9				<1												<9	<9				
Toluene	ug/kg														<5	<5				<1												<5	<5				
Ethylbenzene	ug/kg														<4	<4				<1												<4	<4				
p/m-Xylene	ug/kg														<14	<14				<1												<14	<14				
o-Xylene	ug/kg														<10	<10				<1												<10	<10				
Naphthalene	ug/kg														<13	<13																<13	<13				
Hexachlorobutadiene	ug/kg														<12	<12				<1												<12	<12				
1,2,4-Trichlorobenzene	ug/kg														<6	<6				<1												<6	<6				
1,2-Dichlorobenzene	ug/kg														<12	<12				<1												<12	<12				
1,3-Dichlorobenzene	ug/kg														<6	<6				<1												<6	<6				
1,4-Dichlorobenzene	ug/kg														<5	<5				<1												<5	<5				
1,1,1,2-Tetrachloroethane	ug/kg														<10	<10				<2												<10	<10				
1,1,1,-Trichloroethane	ug/kg														<7	<7				<1												<7	<7				
1,1,2,2-Tetrachloroethane	ug/kg														<10	<10																<10	<10				
1,1,2-Trichloroethane	ug/kg														<10	<10				<10												<10	<10				
1,1-Dichloropropene	ug/kg														<11	<11				<1												<11	<11				
1,1-Dichloroethane	ug/kg														<8	<8				<1												<8	<8				
1,1-Dichloroethene	ug/kg														<10	<10				<1												<10	<10				
1,2,3-Trichlorobenzene	ug/kg														<11	<11				<2												<11	<11				
1,2,3-Trichloropropane	ug/kg														<17	<17				<50												<17	<17				
1,2,4-Trimethylbenzene	ug/kg														<9	<9				<1												<9	<9				
1,2-Dibromo-3-chloropropane	ug/kg														<14	<14				<50												<14	<14				
1,2-Dichloroethane	ug/kg														<5	<5				<2												<5	<5				
cis-1,2-Dichloroethene	ug/kg														<5	<5				<1												<5	<5				
1,2-Dibromoethane	ug/kg														<12	<12				<5												<12	<12				
1,2-Dichloropropane	ug/kg														<12	<12				<1												<12	<12				
1,3,5-Trimethylbenzene	ug/kg														<8	<8				<1												<8	<8				
cis-1,3-Dichloropropene	ug/kg														<14	<14				<10												<14	<14				
1,3-Dichloropropane	ug/kg														<7	<7				<1												<7	<7				
2,2-Dichloropropane	ug/kg														<12	<12																<12	<12				
2-Chlorotoluene	ug/kg														<9	<9				<1												<9	<9				
4-Chlorotoluene	ug/kg														<12	<12				<1												<12	<12				
4-Isopropyltoluene	ug/kg														<11	<11				<1												<11	<11				
Bromobenzene	ug/kg														<10	<10				<1												<10	<10				
Bromochloromethane	ug/kg														<14	<14				<5												<14	<14				
Bromoform	ug/kg														<10	<10																<10	<10				
Bromomethane	ug/kg														<13	<13				<20												<13	<13				
Bromodichloromethane	ug/kg														<7	<7				<5												<7	<7				
Chlorobenzene	ug/kg														<5	<5				<1												<5	<5				
Carbon Disulphide	ug/kg														<7	<7																<7	<7				
Chloroethane	ug/kg														<14	<14				<2												<14	<14				
Chloroethene	ug/kg																			<1																	
Chloroform	ug/kg														<8	<8				<1												<8	<8				
Chloromethane	ug/kg														<7	<7				<1												<7	<7				
Carbontetrachloride	ug/kg														<14	<14				<1												<14	<14				
Dibromomethane	ug/kg														<9	<9				<1												<9	<9				
Dichlorodifluoromethane	ug/kg														<4	<4				<1												<4	<4				
Dibromochloromethane	ug/kg														<13	<13				<10												<13	<13				
Dichloromethane	ug/kg														<10	<10																<10	<10				
Isopropylbenzene	ug/kg														<5	<5				<1												<5	<5				
n-Butylbenzene	ug/kg														<10	<10				<1												<10	<10				
Propylbenzene	ug/kg														<11	<11				<1												<11	<11				
sec-Butylbenzene	ug/kg														<10	<10				<1												<10	<10				
Styrene	ug/kg														<10	<10				<1												<10	<10				
trans-1-2-Dichloroethene	ug/kg														<11	<11				<1												<11	<11				
trans-1-3-Dichloropropene	ug/kg														<14	<14				<10												<14	<14				
Trichlorofluoromethane	ug/kg														<6	<6				<1												<6	<6				
tert-Butylbenzene	ug/kg														<12	<12				<1												<12	<12				
Tetrachloroethene	ug/kg														<5	<5				<1												<5	<5				
Tribromomethane	ug/kg																			<1																	
Trichloroethene	ug/kg														<9	<9				<1												<9	<9				
Vinyl Chloride	ug/kg														<10	<10																<10	<10				

Cluster Code	No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	Selected S4ULs Criteria	No. Data Exceeding S4ULs Criteria
Phthalates							
Bis(2-ethylhexyl) phthalate	5	2	8.6	2.9	STPG02 @ 0.3mbGL		
Butylbenzyl phthalate	5	0	None > LOD	None > LOD			
Di-n-butyl phthalate	5	0	None > LOD	None > LOD			
Di-n-Octyl phthalate	5	0	None > LOD	None > LOD			
Diethyl phthalate	5	0	None > LOD	None > LOD			
Dimethyl phthalate	5	0	None > LOD	None > LOD			
Other Semi-Volatiles							
1,2-Dichlorobenzene	4	0	None > LOD	None > LOD			
1,2,4-Trichlorobenzene	4	0	None > LOD	None > LOD		220	0
1,3-Dichlorobenzene	4	0	None > LOD	None > LOD			
1,4-Dichlorobenzene	4	0	None > LOD	None > LOD			
2-Nitroaniline	5	0	None > LOD	None > LOD			
2,4-Dinitrotoluene	5	0	None > LOD	None > LOD			
2,6-Dinitrotoluene	5	0	None > LOD	None > LOD			
3-Nitroaniline	5	0	None > LOD	None > LOD			
4-Bromophenylphenylether	5	0	None > LOD	None > LOD			
4-Chloroaniline	5	0	None > LOD	None > LOD			
4-Chlorophenylphenylether	5	0	None > LOD	None > LOD			
4-Nitroaniline	5	0	None > LOD	None > LOD			
Azobenzene	5	0	None > LOD	None > LOD			
Bis(2-chloroethoxy)methane	5	0	None > LOD	None > LOD			
Bis(2-chloroethyl)ether	5	0	None > LOD	None > LOD			
Bis(2-chloroisopropyl)ether	1	0	None > LOD	None > LOD			
Carbazole	5	0	None > LOD	None > LOD			
Dibenzofuran	5	0	None > LOD	None > LOD			
Hexachlorobenzene	5	0	None > LOD	None > LOD		30	0
Hexachlorobutadiene	5	0	None > LOD	None > LOD		31	0
Hexachlorocyclopentadiene	5	0	None > LOD	None > LOD			
Hexachloroethane	5	0	None > LOD	None > LOD			
Isophorone	5	0	None > LOD	None > LOD			
N-nitrosodimethylamine	1	0	None > LOD	None > LOD			
N-nitrosodi-n-propylamine	5	0	None > LOD	None > LOD			
Nitrobenzene	5	0	None > LOD	None > LOD			
VOCs							
Methyl Tertiary Butyl Ether	5	0	None > LOD	None > LOD			
Benzene	5	0	None > LOD	None > LOD		27	0
Toluene	5	0	None > LOD	None > LOD		56000	0
Ethylbenzene	5	0	None > LOD	None > LOD		5700	0
p/m-Xylene	5	0	None > LOD	None > LOD			
o-Xylene	5	0	None > LOD	None > LOD		6600	0
Naphthalene	4	0	None > LOD	None > LOD		190	0
Hexachlorobutadiene	5	0	None > LOD	None > LOD		31	0
1,2,4-Trichlorobenzene	5	0	None > LOD	None > LOD		220	0
1,2-Dichlorobenzene	5	0	None > LOD	None > LOD			
1,3-Dichlorobenzene	5	0	None > LOD	None > LOD			
1,4-Dichlorobenzene	5	0	None > LOD	None > LOD			
1,1,1,2-Tetrachloroethane	5	0	None > LOD	None > LOD			
1,1,1,-Trichloroethane	5	0	None > LOD	None > LOD			
1,1,2,2-Tetrachloroethane	4	0	None > LOD	None > LOD			
1,1,2-Trichloroethane	5	0	None > LOD	None > LOD			
1,1-Dichloropropene	5	0	None > LOD	None > LOD			
1,1-Dichloroethane	5	0	None > LOD	None > LOD			
1,1-Dichloroethene	5	0	None > LOD	None > LOD			
1,2,3-Trichlorobenzene	5	0	None > LOD	None > LOD		102	0
1,2,3-Trichloropropane	5	0	None > LOD	None > LOD			
1,2,4-Trimethylbenzene	5	0	None > LOD	None > LOD			
1,2-Dibromo-3-chloropropane	5	0	None > LOD	None > LOD			
1,2-Dichloroethane	5	0	None > LOD	None > LOD			
cis-1,2-Dichloroethene	5	0	None > LOD	None > LOD			
1,2-Dibromoethane	5	0	None > LOD	None > LOD			
1,2-Dichloropropane	5	0	None > LOD	None > LOD			
1,3,5-Trimethylbenzene	5	0	None > LOD	None > LOD			
cis-1,3-Dichloropropene	5	0	None > LOD	None > LOD			
1,3-Dichloropropane	5	0	None > LOD	None > LOD			
2,2-Dichloropropane	4	0	None > LOD	None > LOD			
2-Chlorotoluene	5	0	None > LOD	None > LOD			
4-Chlorotoluene	5	0	None > LOD	None > LOD			
4-Isopropyltoluene	5	0	None > LOD	None > LOD			
Bromobenzene	5	0	None > LOD	None > LOD			
Bromochloromethane	5	0	None > LOD	None > LOD			
Bromoform	4	0	None > LOD	None > LOD			
Bromomethane	5	0	None > LOD	None > LOD			
Bromodichloromethane	5	0	None > LOD	None > LOD			
Chlorobenzene	5	0	None > LOD	None > LOD		56	0
Carbon Disulphide	4	0	None > LOD	None > LOD		11	0
Chloroethane	5	0	None > LOD	None > LOD			
Chloroethene	1	0	None > LOD	None > LOD		0.059	0
Chloroform	5	0	None > LOD	None > LOD		99	0
Chloromethane	5	0	None > LOD	None > LOD			
Carbontetrachloride	5	0	None > LOD	None > LOD			
Dibromomethane	5	0	None > LOD	None > LOD			
Dichlorodifluoromethane	5	0	None > LOD	None > LOD			
Dibromochloromethane	5	0	None > LOD	None > LOD			
Dichloromethane	4	0	None > LOD	None > LOD			
Isopropylbenzene	5	0	None > LOD	None > LOD			
n-Butylbenzene	5	0	None > LOD	None > LOD			
Propylbenzene	5	0	None > LOD	None > LOD			
sec-Butylbenzene	5	0	None > LOD	None > LOD			
Styrene	5	0	None > LOD	None > LOD			
trans-1-2-Dichloroethene	5	0	None > LOD	None > LOD			
trans-1-3-Dichloropropene	5	0	None > LOD	None > LOD			
Trichlorofluoromethane	5	0	None > LOD	None > LOD			
tert-Butylbenzene	5	0	None > LOD	None > LOD			
Tetrachloroethene	5	0	None > LOD	None > LOD		19	0
Tribromomethane	1	0	None > LOD	None > LOD			
Trichloroethene	5	0	None > LOD	None > LOD		1.2	0
Vinyl Chloride	4	0	None > LOD	None > LOD		0.059	0

A4 Appendix 4

Tabulated Groundwater Laboratory Data

M4CAN
Groundwater Sample Analysis & Screening Assessment
CL-15
14/07/2015

Geological Formation Legend

TFD	Tidal Flat Deposits
GFD	Glaciofluvial Deposits
MM	Mercia Mudstone

Screening Values & Assessment

	Exceeds EQS
X	Exceeds DWS
X	Laboratory detection level higher than screening criterion
N/A	Not Available

Notes

EQS calcium carbonate 100 - 150mg/l for heavy metals: chromium, copper, lead, nickel and zinc
X Inferred from fieldwork records (standpipe depths)

Monitoring Round	Units	Screening Criteria		1		2		3		1	2	3
Location				CH 32	BH425	BH425	BH425	BH425	BH425	BH426	BH426	BH426
Location Type				WS	BH							
Depth (m)				0.1	10.14	15.66	11.42	16.53	11.83	16.34	5.7	8.54	7.79
Installation Details		EQS	DWS		Shallow	Deep	Shallow	Deep	Shallow	Deep	Deep	Deep	Deep
Response Zone				MG	GFD	MM	GFD	MM	GFD	MM	TDF	TDF	TDF
Date Sampled				2000	28/04/2015		06/05/2015		12/05/2015		28/04/2015	06/05/2015	12/05/2015
Metals													
Arsenic Dissolved	ug/l	50	10	7	4.8	12	8.9	12	13	24	7.2	11	19
Boron	ug/l	2000	1000	760	3300	1800	3300	3900	4200	3300	1800	3000	1800
Chromium Dissolved	ug/l		50	1	39	53	15	15	<1	7.2	38	16	<1
Copper Dissolved	ug/l	10	2000	19	5.2	11	13	17	4.7	21	7	13	2.2
Lead Dissolved	ug/l	1.2	10	10	<1	<1	<1	<1	<1	<1	<1	<1	<1
Nickel Dissolved	ug/l	4	20	9	3.1	4.8	6.3	8.2	5.5	9.9	7.6	20	5.7
Selenium Dissolved	ug/l		10	4	6.1	23	13	18	7.1	15	16	17	7.3
Cadmium Dissolved	ug/l	0.15	5	<0.1	<0.08	<0.08	0.33	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Zinc Dissolved	ug/l	75		3	75	64	33	32	46	36	22	8.2	7.1
Mercury Dissolved	ug/l	0.07	1	0.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Non-Metal Inorganics													
Total Alkalinity as CaCO3	mg/l				620	750	1300	1100	1700	1600	1900	1100	1200
Total Diss Sulphur	mg/l			65.5									
Chloride	mg/l	250	250		280	1600	3000	2900	1300	3400	1800	2300	1100
Ammoniacal Nitrogen as N	mg/l	0.6			0.65	1.2	5	4.3	7.1	5.9	3.9	10	5.3
Total Cyanide	mg/l	0.001	0.05	<0.025	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05
Free Cyanide	mg/l				<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
pH Value	pH units	6-9	6.5-10	10.8	8.5	8.2	7.6	7.5	7.1	7.3	8.2	7.4	7.6
Phenols													
Phenol	ug/l	7.7					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Phenol Index	mg/l			0.06									
Phenols	mg/l	0.0077			<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
BTEX													
MTBE	ug/l						<1	<1	<1	<1	<1	<1	<1
Benzene	ug/l	10	1		<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	ug/l	50			<1	<1	<1	<1	<1	<1	<1	<1	<1
Ethyl benzene	ug/l	20			<1	<1	<1	<1	<1	<1	<1	<1	<1
m & p Xylene	ug/l	30			<1	<1	<1	<1	<1	<1	<1	<1	<1
o Xylene	ug/l	30			<1	<1	<1	<1	<1	<1	<1	<1	<1
TPH													
TPH FTIR	ug/l			4150									
TPH GC	ug/l			14000									
Aliphatics C5-C6	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C6-C8	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C8-C10	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C10-C12	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C12-C16 Aqueous	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	49	<0.1
Aliphatics >C16-C21 Aqueous	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	23	<0.1
Aliphatics >C21-C35 Aqueous	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	260	<0.1
Aliphatics >C35-44	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1	<0.1
Aromatics >C5-C7	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C7-C8	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >EC8-EC10	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >EC10-EC12	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >EC12-EC16 Aqueous	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	17	<0.1
Aromatics >EC16-EC21 Aqueous	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	11	<0.1
Aromatics >EC21-EC35 Aqueous	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	36	<0.1
Aromatics >C35-44	ug/l				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.97	<0.1
Total Aliphatic TPH	ug/l				<5	<5	<5	<5	<5	<5	<5	330	<5
Total Aromatic TPH	ug/l				<5	<5	<5	<5	<5	<5	<5	65	<5
Total petroleum hydrocarbons	ug/l				<10	<10	<10	<10	<10	<10	<10	400	<10
Speciated PAHs													
Acenaphthene	ug/l			<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	ug/l			<1.00	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	ug/l	0.1		0.06	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	ug/l			0.12	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene	ug/l	0.00017	0.01	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b)fluoranthene	ug/l	0.017	0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	ug/l	0.017	0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	ug/l	0.0082	0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-cd)pyrene	ug/l		0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	ug/l			<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	ug/l			<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	ug/l	0.0063		0.17	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	ug/l			0.63	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Naphthalene	ug/l	2		<1.00	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	ug/l			0.38	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	ug/l			0.21	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total PAHs (USEPA 16)	ug/l			<3.97	<2	<2	<2	<2	<2	<2	<2	<2	<2
VOCs													
1,1,1,2-Tetrachloroethane	ug/l						<2	<2	<2	<2	<2	<2	<2
1,1,1-Trichloroethane	ug/l	100					<1	<1	<1	<1	<1	<1	<1
1,1,2-Trichloroethane	ug/l	400					<10	<10	<10	<10	<10	<10	<10
1,1-Dichloroethane	ug/l						<1	<1	<1	<1	<1	<1	<1
1,1-Dichloroethene	ug/l						<1	<1	<1	<1	<1	<1	<1
1,1-Dichloropropene	ug/l						<1	<1	<1	<1	<1	<1	<1
1,2,3-Trichlorobenzene	ug/l	0.4					<2	<2	<2	<2	<2	<2	<2
1,2,3-Trichloropropane	ug/l						<50	<50	<50	<50	<50	<50	<50
1,2,4-Trichlorobenzene	ug/l	0.4					<1	<1	<1	<1	<1	<1	<1
1,2,4-Trimethylbenzene	ug/l						<1	<1	<1	<1	<1	<1	<1
1,2-Dibromo-3-Chloropropane	ug/l						<50	<50	<50	<50	<50	<50	<50
1,2-Dibromoethane	ug/l						<5	<5	<5	<5	<5	<5	<5
1,2-Dichlorobenzene	ug/l	20					<1	<1	<1	<1	<1	<1	<1
1,2-Dichloroethane	ug/l	10	3				<2	<2	<2	<2	<2	<2	<2
1,2-Dichloropropane	ug/l						<1	<1	<1	<1	<1	<1	<1

No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
10	10	24	4.8	BH425 @ 16.34mbGL	0	6
10	10	4200	760	BH425 @ 11.83mbGL	7	9
10	8	53	1	BH425 @ 15.66mbGL		1
10	10	21	2.2	BH425 @ 16.34mbGL	6	0
10	1	10	10	CH 32 @ 0.1mbGL	1	0
10	10	20	3.1	BH426 @ 8.54mbGL	9	0
10	10	23	4	BH425 @ 15.66mbGL		6
10	1	0.33	0.33	BH425 @ 11.42mbGL	1	0
10	10	75	3	BH425 @ 10.14mbGL	0	
10	1	0.3	0.3	CH 32 @ 0.1mbGL	1	0
9	9	1900	620	BH426 @ 5.7mbGL		
1	1	65.5	65.5	CH 32 @ 0.1mbGL		
9	9	3400	280	BH425 @ 16.34mbGL	9	9
9	9	10	0.65	BH426 @ 8.54mbGL	9	
10	1	0.05	0.05	BH426 @ 8.54mbGL	1	0
9	0	None > LOD	None > LOD			
10	10	10.8	7.1	CH 32 @ 0.1mbGL	1	1
7	0	None > LOD	None > LOD		0	
1	1	0.06	0.06	CH 32 @ 0.1mbGL		
9	0	None > LOD	None > LOD		0	
7	0	None > LOD	None > LOD			
9	0	None > LOD	None > LOD		0	0
9	0	None > LOD	None > LOD		0	
9	0	None > LOD	None > LOD		0	
9	0	None > LOD	None > LOD		0	
9	0	None > LOD	None > LOD		0	
1	1	4150	4150	CH 32 @ 0.1mbGL		
1	1	14000	14000	CH 32 @ 0.1mbGL		
9	0	None > LOD	None > LOD			
9	0	None > LOD	None > LOD			
9	0	None > LOD	None > LOD			
9	0	None > LOD	None > LOD			
9	0	None > LOD	None > LOD			
9	1	49	49	BH426 @ 8.54mbGL		
9	1	23	23	BH426 @ 8.54mbGL		
9	1	260	260	BH426 @ 8.54mbGL		
9	1	1	1	BH426 @ 8.54mbGL		
9	0	None > LOD	None > LOD			
9	0	None > LOD	None > LOD			
9	0	None > LOD	None > LOD			
9	0	None > LOD	None > LOD			
9	1	17	17	BH426 @ 8.54mbGL		
9	1	11	11	BH426 @ 8.54mbGL		
9	1	36	36	BH426 @ 8.54mbGL		
9	1	0.97	0.97	BH426 @ 8.54mbGL		
9	1	330	330	BH426 @ 8.54mbGL		
9	1	65	65	BH426 @ 8.54mbGL		
9	1	400	400	BH426 @ 8.54mbGL		
10	0	None > LOD	None > LOD			
10	0	None > LOD	None > LOD			
10	1	0.06	0.06	CH 32 @ 0.1mbGL	0	
10	1	0.12	0.12	CH 32 @ 0.1mbGL		
10	0	None > LOD	None > LOD		0	0
10	0	None > LOD	None > LOD		0	0
10	0	None > LOD	None > LOD		0	0
10	0	None > LOD	None > LOD			0
10	0	None > LOD	None > LOD			
10	0	None > LOD	None > LOD			
10	1	0.17	0.17	CH 32 @ 0.1mbGL	1	
10	1	0.63	0.63	CH 32 @ 0.1mbGL		
10	0	None > LOD	None > LOD		0	
10	1	0.38	0.38	CH 32 @ 0.1mbGL		
10	1	0.21	0.21	CH 32 @ 0.1mbGL		
10	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD		0	
7	0	None > LOD	None > LOD		0	
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD		0	
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD		0	
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD		0	
7	0	None > LOD	None > LOD		0	0
7	0	None > LOD	None > LOD			

M4CAN
Groundwater Sample Analysis & Screening Assessment
CL-15
14/07/2015

Geological Formation Legend

TFD	Tidal Flat Deposits
GFD	Glaciofluvial Deposits
MM	Mercia Mudstone

Screening Values & Assessment

	Exceeds EQS
X	Exceeds DWS
X	Laboratory detection level higher than screening criterion
N/A	Not Available

Notes

EQS calcium carbonate 100 - 150mg/l for heavy metals: chromium, copper, lead, nickel and zinc
X Inferred from fieldwork records (standpipe depths)

Monitoring Round	Units	Screening Criteria		1		2		3		1	2	3
Location				CH 32	BH425	BH425	BH425	BH425	BH425	BH426	BH426	BH426
Location Type				WS	BH							
Depth (m)				0.1	10.14	15.66	11.42	16.53	11.83	16.34	5.7	8.54	7.79
Installation Details		EQS	DWS		Shallow	Deep	Shallow	Deep	Shallow	Deep	Deep	Deep	Deep
Response Zone				MG	GFD	MM	GFD	MM	GFD	MM	TDF	TDF	TDF
Date Sampled				2000	28/04/2015		06/05/2015		12/05/2015		28/04/2015	06/05/2015	12/05/2015
1,3,5-Trimethylbenzene	ug/l						<1	<1	<1	<1	<1	<1	<1
1,3-Dichloropropane	ug/l						<2	<2	<2	<2	<2	<2	<2
1,4-Dichlorobenzene	ug/l	20					<1	<1	<1	<1	<1	<1	<1
2-Chlorotoluene	ug/l						<1	<1	<1	<1	<1	<1	<1
4-Chlorotoluene	ug/l						<1	<1	<1	<1	<1	<1	<1
4-Isopropyltoluene	ug/l						<1	<1	<1	<1	<1	<1	<1
Benzene	ug/l	10	1		<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromobenzene	ug/l						<1	<1	<1	<1	<1	<1	<1
Bromochloromethane	ug/l		100				<5	<5	<5	<5	<5	<5	<5
Bromodichloromethane	ug/l						<5	<5	<5	<5	<5	<5	<5
Bromomethane	ug/l						<5	<5	<5	<5	<5	<5	<5
Chlorobenzene	ug/l						<1	<1	<1	<1	<1	<1	<1
Chloroethane	ug/l						<1	<1	<1	<1	<1	<1	<1
Chloroethene	ug/l						<1	<1	<1	<1	<1	<1	<1
Chloroform	ug/l	2.5	100				<1	<1	<1	<1	<1	<1	<1
Chloromethane	ug/l						<1	<1	<1	<1	<1	<1	<1
cis-1,2-Dichloroethene	ug/l						<1	<1	<1	<1	<1	<1	<1
cis-1,3-Dichloropropene	ug/l						<10	<10	<10	<10	<10	<10	<10
Dibromochloromethane	ug/l		100				<10	<10	<10	<10	<10	<10	<10
Dibromomethane	ug/l						<10	<10	<10	<10	<10	<10	<10
Dichlorodifluoromethane	ug/l						<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	ug/l	20			<1	<1	<1	<1	<1	<1	<1	<1	<1
Hexachlorobutadiene (HCBD)	ug/l	0.6					<1	<1	<1	<1	<1	<1	<1
Isopropylbenzene	ug/l						<1	<1	<1	<1	<1	<1	<1
m,p xylenes	ug/l	30			<1	<1	<1	<1	<1	<1	<1	<1	<1
Methyl tert-butyl ether (MTBE)	ug/l						<1	<1	<1	<1	<1	<1	<1
n-Butylbenzene	ug/l						<1	<1	<1	<1	<1	<1	<1
n-propylbenzene	ug/l						<1	<1	<1	<1	<1	<1	<1
O-Xylene	ug/l	30			<1	<1	<1	<1	<1	<1	<1	<1	<1
Sec-Butylbenzene	ug/l						<1	<1	<1	<1	<1	<1	<1
Styrene	ug/l	50					<1	<1	<1	<1	<1	<1	<1
Tert-Butylbenzene	ug/l						<1	<1	<1	<1	<1	<1	<1
Tetrachloroethene	ug/l	10	10				<1	<1	<1	<1	<1	<1	<1
Tetrachloromethane (Carbon Tetra	ug/l	12	3				<1	<1	<1	<1	<1	<1	<1
Toluene	ug/l	50			<1	<1	<1	<1	<1	<1	<1	<1	<1
trans-1,2-Dichloroethene	ug/l						<1	<1	<1	<1	<1	<1	<1
trans-1,3-Dichloropropene	ug/l						<10	<10	<10	<10	<10	<10	<10
Tribromomethane	ug/l		100				<1	<1	<1	<1	<1	<1	<1
Trichloroethene	ug/l	10	10				<1	<1	<1	<1	<1	<1	<1
Trichlorofluoromethane	ug/l						<1	<1	<1	<1	<1	<1	<1
SVOCs													
1,3-Dichlorobenzene	ug/l	20					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4,5-Trichlorophenol	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4,6-Trichlorophenol	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-Dichlorophenol	ug/l	20					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-Dimethylphenol	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-Dinitrotoluene	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,6-Dinitrotoluene	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Chloronaphthalene	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Chlorophenol	ug/l	50					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Methyl-4,6-Dinitrophenol	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Methylnaphthalene	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Methylphenol	ug/l	100					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Nitroaniline	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Nitrophenol	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
3-Nitroaniline	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Bromophenyl Phenyl Ether	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Chloro-3-Methylphenol	ug/l	40					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Chloroaniline	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Chlorophenyl Phenyl Ether	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Methylphenol	ug/l	100					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Nitroaniline	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Azobenzene	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bis(2-chloroethoxy)methane	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bis(2-chloroethyl)ether	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bis(2-chloroisopropyl)ether	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bis(2-ethylhexyl)phthalate	ug/l	1.3					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Butylbenzylphthalate	ug/l	20					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbazole	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibenzofuran	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Diethylphthalate	ug/l	200					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dimethylphthalate	ug/l	800					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Di-N-Butyl Phthalate	ug/l	8					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Di-N-Octyl Phthalate	ug/l	20					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobenzene (HCB)	ug/l	0.05					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorocyclopentadiene	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachloroethane	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Isophorone	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nitrobenzene	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
n-nitrosodimethylamine	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
N-Nitroso-Di-N-Propylamine	ug/l						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Pentachlorophenol (PCP)	ug/l	0.4					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Phenol	ug/l	7.7					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
PCBs													
PCB- ARO	ug/l			0.8									
Pcb-101 2,2',4,5,5' - Pentachlorobip	ug/l										<0.01		
Pcb-118 2,3',4,4',5 - Pentachlorobip	ug/l										<0.01		
Pcb-138 2,2',3,4,4',5' - Hexachlorob	ug/l										<0.01		
Pcb-153 2,2',4,4',5,5' - Hexachlorob	ug/l										<0.01		
Pcb-180 2,2',3,4,4',5,5' - Heptachlor	ug/l										<0.01		
Pcb-28 2,4,4' - Trichlororbiphenyl	ug/l										<0.01		
Pcb-52 2,2',5,5' - Tetrachlorobipher	ug/l										<0.01		

No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD		0	
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
9	0	None > LOD	None > LOD		0	0
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			0
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD		0	0
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			0
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
9	0	None > LOD	None > LOD		0	
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
9	0	None > LOD	None > LOD		0	
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD		0	
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD		0	0
7	0	None > LOD	None > LOD		0	0
9	0	None > LOD	None > LOD		0	
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			0
7	0	None > LOD	None > LOD		0	0
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD		0	
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
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7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD			
7	0	None > LOD	None > LOD		0	
7	0	None > LOD	None > LOD		0	
1	1	0.8	0.8	CH 32 @ 0.1mbGL		
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			

A5 Appendix 5

Tabulated Soil Leachate Data

M4CAN
Leachate Sample Analysis & Screening Assessment
CL-15
14/07/2015

Geological Formation Legend

MG	Made Ground
TFD	Tidal Flat Deposit

Screening Values & Assessment

	Exceeds EQS
X	Exceeds DWS
X	Laboratory detection level higher than screening criterion
N/A	Not Available

Notes

EQS calcium carbonate 100 - 150mg/l for heavy metals: chromium, copper, lead, nickel and zinc

Sample Reference	Units	Screening Criteria		CH31	CH32	STPG01	STPG02	BH425	BH426	TP410	STPG01	STPG02
Specimen Depth (m)				0	0	0.3	0.3	1.5 - 1.6	1.5 - 1.6	0.9 - 1	1.2	1
OD Level (m)				7.96	8.13	7.54	7.57	6.35	6.25	6.3	6.64	6.87
Sample Type		EQS	DWS	D	D	D	B	ES	ES	ES	B	B
Geology Code				MG	MG	MG	MG	MG	MG	MG	TFD	TFD
Cluster Code				2000 GI	2000 GI	2007 GI	2007 GI	2015 GI	2015 GI	2015 GI	2007 GI	2007 GI
2:1 Leachate Results												
Arsenic Dissolved	ug/l	50	10			<1	8	21	2.3	8.4	2	2
Boron Dissolved	ug/l	2000	1000			350	60				250	340
Boron	ug/l	2000	1000	90	140			92		370		
Barium Dissolved	ug/l					41	62				19	25
Cadmium Dissolved	ug/l	0.15	5			<0.5	<0.5	<0.08	<0.08	2.5	<0.5	<0.5
Chromium Dissolved	ug/l		50	35	5	160	2	<1	<1	22	4	<1
Copper Dissolved	ug/l	10	2000	14	8	39	10	3.8	2.5	25	3.5	8.4
Mercury Dissolved	ug/l	0.07	1			<0.01		<0.5	<0.5	<0.5	<0.01	
Molybdenum Dissolved	ug/l					20	8				17	5
Nickel Dissolved	ug/l	4	20			2.3	<1.5	<1	<1	2.7	1.7	1.8
Lead Dissolved	ug/l	1.2	10			<0.5	0.6	<1	<1	<1	<0.5	<0.5
Antimony Dissolved	ug/l		5			<1	12				19	<1
Selenium Dissolved	ug/l		10			5	<1	1.1	11	13	7	3
Zinc Dissolved	ug/l	75				<5	<5	3.4	8.5	7.2	<5	<5
Total Cyanide	mg/l	0.001	0.05			<50	<50	<0.05	<0.05	<0.05	<50	<50
Cyanide Free	mg/l								<0.05	<0.05		
pH	pH units	6-9	6.5-10	10.8	9.4			9	8.9	8.3		
Organics												
TPH GC	ug/l			<100	<100							
Phenols	mg/l	0.0077							<0.03	<0.03		
BTEX												
Benzene	ug/l	10	1					<1	<1	<1		
Toluene	ug/l	50						<1	<1	<1		
Ethylbenzene	ug/l	20						<1	<1	<1		
m,p xylenes	ug/l	30						<1	1.4	<1		
O-Xylene	ug/l	30						<1	<1	<1		
PCBs												
Pcb-101 2,2',4,5,5' - Pentachlorobiphenyl	ug/l							<0.01	<0.01	<0.01		
Pcb-118 2,3',4,4',5 - Pentachlorobiphenyl	ug/l							<0.01	<0.01	<0.01		
Pcb-138 2,2',3,4,4',5,5' - Hexachlorobiphenyl	ug/l							<0.01	<0.01	<0.01		
Pcb-153 2,2',4,4',5,5' - Hexachlorobiphenyl	ug/l							<0.01	<0.01	<0.01		
Pcb-180 2,2',3,4,4',5,5' - Heptachlorobiphenyl	ug/l							<0.01	<0.01	<0.01		
Pcb-28 2,4,4' - Trichlororbiphenyl	ug/l							<0.01	<0.01	<0.01		
Pcb-52 2,2',5,5' - Tetrachlorobiphenyl	ug/l							<0.01	<0.01	<0.01		
TPH												
Aliphatics >C5-C6	ug/l							<0.1	<0.1	<0.1		
Aliphatics >C6-C8	ug/l							<0.1	<0.1	<0.1		
Aliphatics >C8-C10	ug/l							<0.1	<0.1	<0.1		
Aliphatics >C10-C12	ug/l							<0.1	<0.1	<0.1		
Aliphatics >C12-C16	ug/l							<0.1	<0.1	<0.1		
Aliphatics >C16-C21	ug/l							<0.1	<0.1	<0.1		
Aliphatics >C21-C35	ug/l							<0.1	<0.1	<0.1		
Aliphatics >C35-44	ug/l							<0.1	<0.1	<0.1		
Aromatics >C5-C7	ug/l							<0.1	<0.1	<0.1		
Aromatics >C7-C8	ug/l							<0.1	<0.1	<0.1		
Aromatics >C8-C10	ug/l							<0.1	<0.1	<0.1		
Aromatics >C10-C12	ug/l							<0.1	<0.1	<0.1		
Aromatics >C12-C16	ug/l							<0.1	<0.1	<0.1		
Aromatics >C16-C21	ug/l							27	<0.1	<0.1		
Aromatics >C21-C35	ug/l							<0.1	<0.1	<0.1		
Aromatics >C35-44	ug/l							<0.1	<0.1	<0.1		
Total Aliphatic TPH	ug/l							<5	<5	<5		
Total Aromatic TPH	ug/l							27	<5	<5		
Total petroleum hydrocarbons	ug/l							27	<10	<10		
PAH												
Acenaphthene	ug/l							<0.1	<0.1	<0.1		
Acenaphthylene	ug/l							<0.1	<0.1	<0.1		
Anthracene	ug/l	0.1						<0.1	<0.1	<0.1		
Benz(a)anthracene	ug/l							<0.1	<0.1	<0.1		
Benzo(a)pyrene	ug/l	0.00017	0.01					<0.1	<0.1	<0.1		
Benzo(b)fluoranthene	ug/l	0.017	0.1					<0.1	<0.1	<0.1		
Benzo(ghi)perylene	ug/l	0.0082	0.1					<0.1	<0.1	<0.1		
Benzo(k)fluoranthene	ug/l	0.017	0.1					<0.1	<0.1	<0.1		
Chrysene	ug/l							<0.1	<0.1	<0.1		
Dibenzo(ah)anthracene	ug/l							<0.1	<0.1	<0.1		
Fluoranthene	ug/l	0.0063						<0.1	<0.1	<0.1		
Fluorene	ug/l							<0.1	<0.1	<0.1		
Indeno(123cd)pyrene	ug/l	N/A	0.1					<0.1	<0.1	<0.1		
Naphthalene	ug/l	2						<0.1	<0.1	<0.1		
Phenanthrene	ug/l							<0.1	<0.1	<0.1		
Pyrene	ug/l							<0.1	<0.1	<0.1		
PAH 16 Total	ug/l							<2	<2	<2		

No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
2:1 Leachate Results						
7	6	21	2	BH425 @ 1.5 - 1.6mbGL	0	1
4	4	350	60	STPG01 @ 0.3mbGL	0	0
4	4	370	90	TP410 @ 0.9 - 1mbGL	0	0
6	4	62	19	STPG02 @ 0.3mbGL		
7	1	2.5	2.5	TP410 @ 0.9 - 1mbGL	1	0
9	6	160	2	STPG01 @ 0.3mbGL		1
9	9	39	2.5	STPG01 @ 0.3mbGL	3	0
5	0	None > LOD	None > LOD		0	0
6	4	20	5	STPG01 @ 0.3mbGL		
7	4	2.7	1.7	TP410 @ 0.9 - 1mbGL	0	0
7	1	0.6	0.6	STPG02 @ 0.3mbGL	0	0
4	2	19	12	STPG01 @ 1.2mbGL		2
7	6	13	1.1	TP410 @ 0.9 - 1mbGL		2
7	3	8.5	3.4	BH426 @ 1.5 - 1.6mbGL	0	
7	0	None > LOD	None > LOD		0	0
2	0	None > LOD	None > LOD			
5	5	10.8	8.3	CH31 @ 0mbGL	2	1
Organics						
2	0	None > LOD	None > LOD			
2	0	None > LOD	None > LOD		0	
BTEX						
3	0	None > LOD	None > LOD		0	0
3	0	None > LOD	None > LOD		0	
3	0	None > LOD	None > LOD		0	
3	1	1.4	1.4	BH426 @ 1.5 - 1.6mbGL	0	
3	0	None > LOD	None > LOD		0	
PCBs						
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
TPH						
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
3	1	27	27	BH425 @ 1.5 - 1.6mbGL		
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
3	1	27	27	BH425 @ 1.5 - 1.6mbGL		
3	1	27	27	BH425 @ 1.5 - 1.6mbGL		
PAH						
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD		0	
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD		0	0
3	0	None > LOD	None > LOD		0	0
3	0	None > LOD	None > LOD		0	0
3	0	None > LOD	None > LOD		0	0
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD		0	
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD		0	0
3	0	None > LOD	None > LOD		0	
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			
3	0	None > LOD	None > LOD			

Sample Reference	Units	STPG01	STPG01	STPG02	STPG02	No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration
Sample Depth (m)		0.3	1.2	0.3	1					
Sample Type		L	L	L	L					
Antimony Dissolved (CEN 10:1C) (ICP-MS)	mg/kg	0.06	0.02	0.21	0.01	4	4	0.21	0.01	
Arsenic Dissolved (CEN 10:1C) (ICP-MS)	mg/kg	<0.01	0.02	0.07	0.01	4	3	0.07	0.01	
Barium Dissolved (CEN 10:1C) (ICP-MS)	mg/kg	0.48	0.05	0.43	0.11	4	4	0.48	0.05	
Boron Dissolved (CEN 10:1C) (ICP-MS)	mg/kg	3.9	0.3	<0.2	1.1	4	3	3.9	0.3	
Cadmium Dissolved (CEN 10:1C) (ICP-MS)	mg/kg	<0.005	<0.005	<0.005	<0.005	4	0	None > LOD	None > LOD	
Chromium Dissolved (CEN 10:1C) (ICP-MS)	mg/kg	0.58	0.02	<0.01	<0.01	4	2	0.58	0.02	
Copper Dissolved (CEN 10:1C) (ICP-MS)	mg/kg	0.13	0.023	<0.016	0.056	4	3	0.13	0.023	
Lead Dissolved (CEN 10:1C) (ICP-MS)	mg/kg	0.015	0.066	<0.005	0.35	4	3	0.35	0.015	
Mercury Dissolved (CEN 10:1C) (CVAF)	mg/kg	<0.0001	<0.0001			2	0	None > LOD	None > LOD	
Molybdenum Dissolved (CEN 10:1C) (ICP-MS)	mg/kg	0.07	0.08	0.04	0.03	4	4	0.08	0.03	
Nickel Dissolved (CEN 10:1C) (ICP-MS)	mg/kg	<0.015	<0.015	<0.015	<0.015	4	0	None > LOD	None > LOD	
Selenium Dissolved (CEN 10:1C) (ICP-MS)	mg/kg	0.02	0.02	0.02	0.02	4	4	0.02	0.02	
Total Cyanide (CEN 10:1C)	mg/kg	<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD	
Zinc Dissolved (CEN 10:1C) (ICP-MS)	mg/kg	<0.05	<0.05	<0.05	<0.05	4	0	None > LOD	None > LOD	

A6 Appendix 6

Relevant Extract of Additional Environmental Data

Plate 01: Extract of 1991 Aerial Photograph

Client:	Welsh Government
Project:	M4CaN
Job Ref: JER6591	Checked By: Date: Oct 2015

Plate 02: Extract of 2006 Aerial Photograph

Client:	Welsh Government
Project:	M4CaN
Job Ref:	JER6591 Checked By: Date: Oct 2015

Plate 03: Extract of 2013/14 Aerial Photograph

Client:	Welsh Government
Project:	M4CaN
Job Ref:	JER6591 Checked By: Date: Oct 2015

Welsh Government

M4 Corridor around Newport

Land Contamination Assessment Report Annex D
CL-17 Solutia Chemical Works

M4CaN-DJV-EGT-ZG_GEN-RP-EN-0015

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1 Introduction

1.1 Background

1.1.1 This report relates to an area of land potentially affected by contamination (CL-17) known as the 'Solutia Chemical Works' herein referred to as the 'Site'.

1.1.2 The Site is located between chainage 11,100 and 11,800 (see Figure 1), at an operational chemical works.

1.2 Reporting Context

1.2.1 The Site has been assessed as part of ground investigations and monitoring associated with the wider works for the M4 Corridor around Newport (M4CaN (hereafter referred to as the 'Scheme'). This report informs the baseline for the environmental impact assessment (EIA) for the Scheme. The EIA is reported in the M4CaN Environmental Statement (ES) of which this document is an appendix to the chapter on Geology and Soils.

1.2.2 In 2014, a Preliminary Sources Study Report (2014 PSSR) was prepared as an initial land contamination appraisal (Ove Arup & Partners, 2014) as part of Design Manual for Roads and Bridges (DMRB) Stage 2 Assessments for a number of potential route options. This identified a number of individual areas that may have been affected by contamination as a result of historical activities at the Site. In addition, this report draws upon the 2015 Supplementary Ground Investigation Works undertaken on behalf of the Welsh Government (Geotechnical Engineering, 2015). This report relates to the area defined in the Site Plan shown in Figure 1.

1.2.3 The overarching rationale and approach for the assessment of areas of land along the Scheme with potential contamination is detailed in the Land Contamination Assessment Report (Appendix 11.1 of the ES).

1.3 Objectives

1.3.1 The key objectives of this report are as follows:

- Undertake a risk assessment of the Site and determine whether potential risks to human health or controlled waters could exist based upon the Scheme.
- Identify the need for further assessment or investigation in order to refine potential land contamination risks and inform on the need for remediation/mitigation.
- Provide information to support the Ground Investigation Report (GIR) and Geotechnical Design Report (GDR) required under DMRB HD22/08 (Highways Agency, 2008).

1.4 Report Structure

1.4.1 The remainder of this report is structured as follows:

- Section 2: Site Location and Description – This section summarises the Site description.
- Section 3: The Scheme – This section details the new section of motorway alignment and associated features at the Site.
- Section 4: Site History – This section summarises the history of the Site based on historical maps and historical land photographs.
- Section 5: Environmental Setting – This section summarises the Site description, published geology, hydrology and hydrogeology and any relevant environmental information presented in the 2014 PSSR.
- Section 6: Scope of Ground Investigations Work – This section describes the previous and supplementary ground investigation data available for the Site.
- Section 7: Ground Conditions – This section describes the main findings of the intrusive site investigation including the ground conditions encountered and visual or olfactory evidence of contamination identified.
- Section 8: Contamination Assessment – This section describes the findings of the Tier 1 and Tier 2 contamination risk assessment based upon potential contamination sources, potential receptors and potential contaminant linkages and presents the human health and controlled waters assessments.
- Section 9: Refined Conceptual Site Model – This section presents the Conceptual Site Model (CSM) for the Site and identifies potential contaminant linkages, based upon the findings of the data presented within Sections 2 to 7.
- Section 10: Conclusions and Recommendations – This section provides conclusions concerning the likelihood of land contamination associated with the Site affecting the Scheme and requirements for remediation/mitigation.

2 Site Location and Description

2.1.1 The Site comprises an active chemical plant which occupies some 126 ha of flat ground on the north-east side of Corporation Road, Newport, National Grid References ST 334 853 to ST 338 852 as shown on Figure 1.

2.1.2 The Site is situated at a general elevation of 7 mAOD. East of the Site the land is mostly open fields, whereas elsewhere the surroundings of the Site are used for various industrial/commercial purposes.

2.1.3 The Site area is generally covered by buildings, hardstanding and landscaping.

2.1.4 A Site walkover was completed in August 2015. The walkover included visits to both the operational area of the Site and the disused area to the south of the Site. The latter was predominantly scrubland with large concrete bases from previous Site operations. The remnants of a butane sphere could be seen in the south-east of the Site. A water treatment system was also located in the south-west of the Site that collected Site drainage and run-off. Selected photographs of the areas visited are included in Appendix 7.

2.1.5 Of particular importance is that the Site has an area of buried chemical waste, mainly polychlorinated biphenyls (PCB), that occupies land between the railway line and the fenced boundary of the chemical plant as shown on Figure 1 (also shown in Appendix 9). This burial area is also known as the 'PCB Cell' and is discussed further in Section 4.1. Within the PCB Cell is an electricity pylon, understood to have been piled in the 1960's. Anecdotal information indicated the piling crew complained of '*strong odours coming from the ground'.* The PCB Cell is located adjacent to a cycle path that bounds the south of the main works Site. A network of monitoring boreholes and leachate extraction infrastructure were seen to be in reasonable condition situated at intervals throughout the PCB Cell.

2.1.6 The Site is bounded to the west by a railway line, beyond which lies Stephenson Street Industrial Estate. Details of the land contamination for the estate are provided in Land Contamination Assessment Report CL-15 (Annex D of Appendix 11.1 of the ES).

2.1.7 To the south, the Site is bounded by Mir Steelworks and associated lagoons (CL-20). The information relating to the land contamination specific to the steelworks are very limited and these are provided within the Land Contamination Assessment Report CL-15 (Annex D of Appendix 11.1 of the ES).

2.1.8 A report undertaken by WSP in 2008, as reported within the 2014 PSSR, identified one area where disposal of hazardous substances has taken place, two areas of historic in-filled ground and five areas of on site disposal which are shown on the drawing contained within Appendix 9.

2.1.9 The Site layout is shown in Figure 1.

3 The Scheme

3.1.1 From west to east the new section of motorway crosses an active railway line before entering the Site. Within the western Site area the alignment crosses the PCB Cell and the Solutia Landfill (see Table 2) in the southern part of the Site.

3.1.2 The construction of the new section of motorway in the western part of the Site would comprise the motorway being supported on a viaduct which is designed to bridge the PCB Cell. As the motorway heads eastwards from the viaduct section, a piled embankment is to be constructed in the eastern part of the Site as well as band drains being proposed further east to aid surcharging.

3.1.3 It is currently proposed that no construction will be undertaken within the PCB Cell, so as not to affect its integrity.

4 Site History

4.1 Site History

4.1.1 The 2014 PSSR historical searches have been based on Ordnance Survey plans, literature reviews, information provided by Natural Resources Wales (NRW) (formerly Environment Agency Wales), Newport City Council and aerial photographic interpretation.

4.1.2 This is supplemented by a review of historical maps obtained in 2015 from Welsh Government. Relevant extracts are presented in Appendix 8.

4.1.3 A summary of the Site's history is presented in Table 1 below.

Table 1: Site History

Date	Use	Source of Information
1843 - 1893	The Site consists of agricultural fields traversed by drainage ditches. Great Traston Farm and a small copse are located in the north of Site. Traston Road runs northeast–southwest to the north of the Site.	1:10,560 Historical Mapping
1891 - 1912	The Great Western railway (East Usk Branch Line) runs along the Site's south-western boundary.	1:10,560 Historical Mapping
1904 - 1939	No significant change.	1:10.560 Historical Mapping
1964 - 1965	A works consisting of many small industrial buildings has been built in the centre of Site. Works have also been developed to the north and to the west of the Site.	1:10,560 Historical Mapping
1969 / 1971	The Site has been largely developed with the chemical works, bounded by the railway to the west and fields to the north, east and south with a large industrial site to the north-west.	2014 PSSR Aerial Photograph
1970 - 1973	An electrical sub-station has been built in the north-west corner of Site.	1:10,000 Historical Mapping
1979 / 1981	Infilling activity within an area in the south of the Site with a road leading off towards another earthworks site approximately 430 m to the east (Llanwern Research Laboratories). The PCB Cell located on the western boundary is slightly visible and looks to have been capped. A haul road is indicated to lead from the southern entrance of the Site towards CL-22 (Former Llanwern Research Laboratories).	2014 PSSR Aerial Photograph
1981 - 1989	No significant change.	1:10,000 Historical Mapping
1985 - 1996	The works has extended into the south of the Site.	1:10,000 Historical Mapping
1991	Works extension in the southern area of the Site appears to consist of additional hardstanding and a tank of unknown use with associated pipe infrastructure.	Aerial Photograph
2006	The south of Site has been landscaped and a track separates the works are to the north from a wooded area to the south. The works area has extended in the south-eastern corner onto what	Aerial Photography

Date	Use	Source of Information
	was previously agricultural land. This area comprises bare ground and vegetation. Tank and above ground pipework identified in 1991 no longer present.	
2009 - 2010	Two wind turbines are under construction in the south-east and south centre of Site.	Aerial Photography
2014	Hardstanding to the south of the main works complex appears in poor condition with surface vegetation.	Aerial Photography

Note: Potential contamination sources are underlined. Those within the temporary and permanent land take are shown in **bold**.

4.1.4 The sources of information presented in Table 1 supplement those used in the 2014 PSSR. In particular, the 1991 image shows the presence of a tank within the proposed the new section of motorway alignment. Relevant extracts of photographs are presented in Appendix 8.

4.1.5 The 2014 PSSR states the Solutia Chemical Works were constructed in the 1940's and identifies areas of tipping within the chemical works from 1949 to the present.

4.1.6 The summary below is taken from Solutia's 2007 Annual Review and Environmental Statement. (Solutia 2014 Environmental Statement has a similar though slightly less detailed summary.)

http://www.eastman.com/Company/Worldwide/our_sites/Documents/Newport_HSE_Review.pdf:

'In the past PCB (polychlorinated biphenyls), PCP (pentachlorophenol) and chlorine (made in a mercury cellhouse) were manufactured on Site. These activities left a legacy of soil contamination. Consultants completed a comprehensive risk assessment in 1992, to determine if these activities had resulted in any unacceptable risks. This assessment concluded that the Site was stable and did not pose a threat to human health or the environment. A risk management strategy was developed to ensure this stability was maintained and some voluntary remediation work was completed in 1996.'

4.1.7 The remediation works comprised the following:

- Encapsulation of a disused landfill at the western perimeter (the PCB Cell). Further details are provided below.
- Installation of an interceptor trench around the Therminols plant, where PCB used to be manufactured.
- Installation of sediment traps in reen systems. The effectiveness of these actions is checked during an annual monitoring programme. Any significant changes will trigger contingency actions to prevent migration.

4.1.8 The risk assessment completed in 1992 was not available at the time of writing this report and therefore has not been discussed further within this report.

4.1.9 The 1996 Arup risk assessment report (Ove Arup & partners, 1996) includes information from Solutia on eight identified on site disposal areas at the factory complex where chemical wastes have been buried; two are located within the west of the Site whilst the others are located in the south-west of the Site. The disposal area at the south-western boundary of the Solutia complex, adjacent to the active railway line is reported to be approximately rectangular measuring

approximately 70 m by 20 m and orientated north-west to south-east. This is the PCB Cell referred to in the previous sections.

4.1.10 The 1996 Arup report states that: *'The quantitative assessment has shown that the concentrations of PCB detected in the surface soils within the Study Area do not pose a significant risk to the site investigation staff, even without normal protective clothing. However, the number of sampling points on which this assessment is based is limited and previous investigations carried out adjacent to the Study Area suggest that if the concentrations of PCB detected there are found within the Study Area, then the risk to site investigation staff would be several times higher. In view of this and in accordance with good practice, it is recommended that precautions to limit the amount of contact with the soil be required for all ground investigations undertaken by the Welsh Office in this area.'*

4.1.11 As discussed above, the PCB Cell was constructed in the mid 1990's. It comprises using a cut-off wall of flexible membrane liner set in bentonite clay, with an impermeable cap consisting of a polypropylene membrane overlain with clay and topsoil. The design relies on the low permeability clay of the Tidal Flat Deposits to provide water tightness of the PCB Cell at the base. The objective of the PCB Cell is to prevent the escape of PCB and other chemical compounds. Details of the PCB Cell are set out in Appendix 6.

4.1.12 The PCB Cell has monitoring and leachate extraction infrastructure installed within it and this is shown on photos in Appendix 7 (Plates 15-18). Based on discussions with Solutia staff during the Site walkover, leachate is pumped out of the PCB Cell periodically and typically 1 m^3 of leachate is removed indicating little leachate is being generated.

4.1.13 The southern area of the Solutia complex was landfilled with debris of hardcore and rubble arising from demolition of former plant and buildings from within the factory area. This is also confirmed by information provided from Natural Resources Wales' (NRW, formerly the Environment Agency) website (see also Table 2). In addition, Newport City Council has informed that various boreholes have been installed to monitor groundwater and three boreholes were installed within the last few years in order for the Site to be compliant with its new waste management permit. The landfill is shown on Figure 1.

4.1.14 A drawing provided by Newport City Council identifies a redundant benzene pipeline to enter the Solutia Site from Llanwern Research Laboratories. This location is approximately 280 m north of the new section of motorway alignment. The pipeline is discussed further within the Land Contamination Assessment Report CL-22 report (Annex D of Appendix 11.1 of the ES).

4.1.15 Historically the Site is in close proximity to areas of bombing during World War II which is described within the 2014 PSSR and the Explosive Ordnance Threat Assessment Report (Bactec, 2014). The latter report categorises the Site as medium to high risk with respect to unexploded ordnance.

5 Environmental Setting

5.1 Geology

5.1.1 British Geological Survey (BGS) data indicates that the Site is underlain by Tidal Flat Deposits overlying bedrock of the Mercia Mudstone Group.

5.1.2 It is expected that the Site is overlain by fill materials associated with the various landfills and waste disposal areas.

5.2 Hydrology

5.2.1 A number of drainage ditches and reens traverse the south of the Site and are part of the wider network of ditches and reens that make up the Caldicot Levels as shown in Figure 1.

5.2.2 The River Usk is approximately 650 m to the west of the Site.

5.3 Hydrogeology

5.3.1 NRW records indicate the Tidal Flat Deposits to be non-productive strata (negligibly permeable).

5.3.2 The Mercia Mudstone Group bedrock is indicated to be a Secondary B aquifer.

5.3.3 The Site does not lie within a groundwater source protection zone.

5.4 Environmental Information

5.4.1 Solutia is a regulated facility which falls under the permit EPR/BR9715IB. The permit boundary comprises the main infrastructure footprint.

5.4.2 The 2014 PSSR reports that Solutia's 2007 Environmental Statement (published in 2008) reports four effluent exceedances at the works in March 2007 which comprised one mercury residue in soil and three PCB incidents.

5.4.3 NRW's website ('What's in your back yard?') reports the following information regarding the Site:

- Five pollution incidents within the Solutia Chemical Works, two of which have minor air impacts involving atmospheric pollutants with the remaining three recording no impact to land, water or air.
- A further three minor impact pollution incidents have been recorded within 300 m of the Site.
- No discharge consents or abstraction licences were recorded within the Site or within 300 m of the Site boundary.
- Two registered landfill sites have been recorded within the Site boundary and are summarised in Table 2.

Table 2: Historic Landfills Within Site Boundary

Landfill Name and Address	Location	Material Type	Date Waste First and Last Received
Solutia Landfill Solutia, Corporation Road, Newport	Within the south of the Site. Created in two phases.	Inert and industrial waste	Dec 1981 – Dec 1996
Corporation Road (Phase III Monsanto), Corporation Road, Newport	Within the south of the Site.	Inert waste	March 1997 – unknown date

- Newport City Council and NRW have provided information on Solutia Landfill Site at National Grid Reference ST 33892 85433. The landfill was created in two phases (Phase I and II). The information suggests that Phase I may have been covered by previous licence 30/82 issued 24/08/1981.
- One authorised landfill was recorded to the south of the Site, within 300 m of the Site boundary and is described in Table 3.

Table 3: Authorised Landfills Within 300 m of Site

Landfill Name	Location	Material Type	Date Waste First and Last Received	License Status
Sloblands: East Of Alphasteel Corporation Road, Newport	Adjacent to the southern Site boundary	Industrial waste landfill	Unknown	Expired

5.4.4 Residual levels of potential contamination associated with these historical pollution incidents are unlikely to be present. However, the landfills are considered to represent potential off site pollutant sources.

5.4.5 The new section of motorway alignment would require a pier construction within the south-eastern corner of the regulated chemical facility. The permit EPR/BR9715IB will require a variation to allow partial surrender in order to remove the permanent land take required for the new section of motorway from the regulated boundaries.

5.4.6 Following discussion with NRW, no permit variation is understood to be required for the land take associated with the two historical landfills within the Site.

5.4.7 Figure 3 provides an overview of the permit boundaries at the Site and surrounding.

6 Scope of Investigations

6.1 General

6.1.1 Five intrusive ground investigations at the Site include works that have been undertaken within the Scheme alignment corridor. The information provided covers the original route corridor and has been summarised below.

6.2 Scope of Works

6.2.1 The various intrusive ground investigations undertaken within the route alignment area are summarised in Table 4.

Table 4: Site Investigation Summary

Date	Contractor	Site Location	Boreholes	Window Sampler	Trial Pits	Sampling	Note
1997	Norwest Holst	South-west	BHG5, BHG6, BHH1	-	-	Soil	-
2000	Exploration Associates	South	CH33	-	CH34, CH35, CH36, CH37, CH38, CH39, CH40, CH41, CH42, CH43, CH44, CH45, CH46, CH47, CH47A, CH48	Soil, leachate and groundwater	-
2008 a	Unknown	Central south	CP/RH01, CP/RH02,	-	TP03, TP04, TP05, TP06, TP07, TP08, TP09, TP10, TP11	Soil, leachate	Borehole logs unavailable
2008 b	Unknown	Unknown	BH1, BH2	-	-	Groundwater	Borehole logs unavailable
2008	WSP	Unknown	-	-	T1/1, T1/2, T1/3, T1/4, T1/5, T1/6, T1/7, T1/8, T1/9, T1/10, T1/11, T1/12, T1/13, T1/14, T1/15, T2/1, T2/2, T2/3, T2/4, T2/5, T2/5, T2/7, T2/8, T2/9, T2/10, T2/11, T2/12, T2/13, T2/14, T2/15, T2/16, T2/17, T2/18	Soil	Logs unavailable and depth / strata of samples unknown

6.2.2 The well construction details of all boreholes installed on the Site are summarised in Table 5.

Table 5: Summary of On Site Borehole Construction Details

Borehole ID	Diameter (mm)	Total Drilled Depth (m)	Top of Slotted Well Casing / Gravel Pack (mbGL)	Base of Slotted Well Casing / Gravel Pack (mbGL)	Targeted Geology
BHG6	not confirmed	40	13.5	16.5	Glaciofluvial Deposits

6.3 Surface Water Quality Monitoring

6.3.1 Surface water monitoring has been undertaken at four locations in the general vicinity of the Site, one of which was part of the Titan monitoring round in 2007/2008 (Titan, 2008) and the remainder in 2015 by RPS (Appendix 16.2 of the ES).

6.3.2 The results for these samples are reported within the Baseline Water Environment Report (Appendix 16.2 of the ES). Tabulated data are included in Appendix 3.

Table 6: Surface Water Monitoring Locations

Surface Water Monitoring Point ID	Water Body	Position	Field Observations
12.1 / IDB78	Lakes Reen	Approximately 500 m east of the Site.	No flow recorded with flowmeter.
12.2 / IDB78	Lakes Reen	Approximately 570 m east of the Site.	No flow recorded with flowmeter.
13.1 / IDB78	Lakes Reen	Approximately 450 m east of the Site.	No flow recorded with flowmeter.
R8 / IDB78	Lakes Reen	Approximately 530 m east of the Site.	Slack and turbid, no obvious direction

6.3.3 It is not considered that these locations are close enough of the Site to be of relevance and indeed may be up hydraulic gradient.

6.3.4 The analytical data has not been considered further within this report.

6.4 Field Testing

6.4.1 Photo-ionisation detector (PID) monitoring for Volatile Organic Compounds (VOCs) was not undertaken in any exploratory locations during the previous ground investigations.

6.5 Groundwater Monitoring

6.5.1 A summary of groundwater sampling, groundwater monitoring and ground gas monitoring rounds are shown in Table 7.

Table 7: Summary of Monitoring Rounds

Location Ref.	Number rounds (date of sampling)	Monitoring details	Notes
BHG6	4no.	Groundwater level	-
BH1, BH2	Unknown	Groundwater sampling	-
CH35, CH40, CH41, CH45	During ground investigation. (Unspecified dates - 2000)	Groundwater sampling	-

6.6 Laboratory Chemical Testing

6.6.1 A summary of all laboratory analysis on soil, leachate, groundwater and surface water is summarised in Tables 8 to 11.

Table 8: Summary of Previous Investigation Sampling

Site Investigation Date	No. of Soil Samples	No. of Leachate Samples	No. of Water Samples	Suites of Testing
1997	11	0	0	Metals, pH, phenols, sulphate, cyanide, mineral oil, PCB, VOCs, pentachlorophenol and PAH
2000	31	5	4	Metals, pH, phenols, sulphate, cyanide, TPH, PAH, VOCs, SVOCs, chloride, ammonia, cresols and pentachlorophenol.
2008a	21	4	0	Metals, pH, phenol, sulphate, cyanide, asbestos, ammonia, TPH, PAH, PCB, BTEX, VOCs and SVOCs
2008b	0	0	2	Metals, pH, TPH, PCB, phenols, PAHs, VOCs
2008 WSP	33	0	0	PCB, asbestos

Soil Analysis

6.6.2 The following sections summarise the laboratory analytical results for the soil samples collected during the various intrusive investigation phases. The available data set has been tabulated and is presented in Appendix 3. The supporting laboratory certificates are available in the relevant original ground investigation report.

6.6.3 To inform the conceptual site model, the analytical data from the Made Ground has been assessed separately from those of the natural soils (namely the Tidal Flat Deposits, Glaciofluvial Deposits and Mercia Mudstone bedrock).

6.6.4 The available information used in this assessment is summarised below for both within the route corridor and outside the route corridor.

Table 9: Summary of Analytical Soil Data

Formation Unit	Number of Soil Analysis per Analytical Suite - Historical data							
	Metals & Inorganics	PCB	PAH	TPH	Phenol	Pthalates	VOC	SVOC
Made Ground	44	69	44	38	44	36	20	43
Superficial Deposits	19	16	19	13	19	9	7	13
Bedrock	2	2	2	0	2	0	0	2

Soil Leaching Analysis

6.6.5 Leachate analysis was undertaken on 4 soil samples within the route corridor and 2 soil samples from unknown locations BH1 and BH2. The available information is presented in Appendix 5 and summarised in Table 10.

Table 10: Summary of Soil Leaching Analytical Data

Formation Unit	Number of Soil Leachate Analysis per Analytical Suite - Historical Data			
	Metals	PCB	Total Petroleum Hydrocarbons	Phenol
Made Ground	9	5	5	5

Groundwater Results

6.6.6 The following sections summarise the laboratory analytical results for groundwater samples collected during the various intrusive investigation phases. The available data has been tabulated and is presented in Appendix 4 with the supporting laboratory certificates available in the relevant original reports.

6.6.7 The available on site data relates to grab samples taken during trial pitting at CH35, CH40, CH41 and CH45 during the 2000 investigation within the route corridor, and BH1 and BH2 during a 2008 investigation at an unknown location. These relate to perched water samples taken in the Made Ground.

6.6.8 The available information is summarised in Table 11 below.

Table 11: Summary of Analytical Groundwater Data

Groundwater Unit	Number of Groundwater Analysis Per Analytical Suite (Number of Grab Locations) – Historical Data					
	Metals & Inorganics	PAH	TPH	Phenol	VOCs	PCBs
Perched (Made Ground)	6 (6)	10 (10)	4 (4)	4 (4)	6 (6)	4 (4)

6.7 Gap Analysis of Available Data

6.7.1 The investigation data for the Site is considered limited both in relation to Site coverage and in laboratory analysis. Specific gaps are highlighted below.

- Previous ground investigation has not identified full lateral and vertical extent of PCB contamination.

- Very limited data with contamination status of groundwater is available and no data has been obtained from the aquifer underlying the site.
- No previous investigations have been undertaken along the historical haul road (1979/1981 aerial photograph) leading from the southern entrance of the Site.
- The majority of TPH/PAH testing undertaken is not speciated.
- PCB testing has not been speciated for those dioxin-like PCBs considered to pose risk to human health.
- Limited asbestos screening undertaken.
- No ground gas or groundwater (aquifer) data within the Site boundary.

7 Ground Conditions

7.1 Geology

7.1.1 The geological logs for all available exploratory holes excavated on or in close proximity to the Site are provided in Appendix 1. The observed geological sequence is consistent with that discussed in the 2014 PSSR report and is summarised in the following sections.

7.1.2 The ground conditions detailed below relate to the area south of the main factory buildings only, which includes the area directly affected by the proposed new section of motorway alignment. No intrusive investigation has been undertaken within the factory area (northern half of the Site) and as such the ground conditions remain unproven. However, this area is not going to be directly affected by the new section of motorway.

Made Ground

7.1.3 Made Ground was encountered in all exploratory locations (with the exception of BHG5) with thicknesses ranging between 0.45 and 2.6 m as summarised in Table 12.

7.1.4 Made Ground is commonly present as clayey sandy gravels of concrete, brick, sandstone, limestone, slag, ash, wood, metal and plastic. Silty clays with variable proportions of slag, ash, concrete, sandstone and brick were also noted across the Site.

Superficial Deposits

7.1.5 Unconsolidated superficial deposits were encountered beneath the Made Ground in all locations. These comprised Tidal Flat Deposits (referred to as Estuarine Alluvium in the logsheet), generally very soft or firm to stiff bluish grey organic clays.

7.1.6 A 1.65 m layer of fibrous peat with occasional lamination of soft organic clay was encountered within BHH1 at 6.7 mbGL. The two other deep boreholes have not identified presence of peat layers, indicating a discontinuous feature.

7.1.7 Sandy gravels considered to represent Glaciofluvial Deposits (referred to as Fluvial Alluvium in the logsheets) was found to underlie the predominantly fine and cohesive Tidal Flat Deposits at depth below 12.45 to 13.45 mbGL.

Solid Geology

7.1.8 Below the Tidal Flat Deposits and Glaciofluvial Deposits the Mercia Mudstone formation was encountered at depths of 16.9 to 17.05 mbGL. The Mercia Mudstone was typically described as a reddish brown thinly bedded moderately weathered sandy mudstone.

Geological Sequence Summary

7.1.9 The general geological sequence identified during the previous ground investigations is summarised in Table 12.

Table 12: Summary of Geological Sequence

Unit	Description	Thickness Range (m)	Basal Depth (mbGL)
Made Ground	Predominantly coarse including concrete, brick, sandstone, limestone, slag, ash, wood, metal and plastic.	0.4 - 2.6	0.4 - 2.6
Superficial Deposits (Tidal Flat Deposits)	Blue grey organic clay.	8.8 - 12.35	9 - 13.45
Superficial Deposits (Glaciofluvial Deposits)	Sandy gravels with some cobbles.	3.6 - 4.45	16.9 - 17.05
Mercia Mudstone (Mudstone)	Reddish brown very weak to moderately strong bedded mudstone.	>23.1	unproven

7.2 Visual and Olfactory Evidence of Contamination

7.2.1 Visual and olfactory evidence of contamination was recorded at seven separate locations within the Made Ground across the central area of the Site during the previous ground investigations. The observed contamination during the ground investigations is summarised in Table 13 below.

Table 13: Visual and Olfactory Evidence of Contamination Summary

Location ID	Depth (mbGL)	Strata	Evidence of Potential Contamination
BHH1	0 - 2.15	Made Ground	Strong hydrocarbon odour. A moderate petroleum odour at 0.9 m depth
CH35	0 - 0.2	Made Ground	Strong acid odour
CH41	1.6	Made Ground	Oil film on groundwater
CP1 (Source PSSR – unconfirmed)	0.25 - 0.6	Unknown (logs not available)	Possible slight stale solvent odour
TP03 (Source PSSR – unconfirmed)	0.7	Unknown (logs not available)	Slight solvent odour
TP03 (Source PSSR – unconfirmed)	1.1	Unknown (logs not available)	Slight hydrocarbon odour
TP11 (Source PSSR – unconfirmed)	0 - 0.6	Unknown (logs not available)	Presence of occasional tar

7.2.2 Full details and observations noted during the drilling and trial pitting are presented on the exploratory logs attached in Appendix 1.

7.3 Gas Monitoring

7.3.1 No monitoring wells were installed on site during the previous ground investigations and therefore no gas monitoring data is available.

7.3.2 There are no off site boreholes with monitoring installations within the vicinity of the Site.

7.4 Groundwater

Groundwater Encountered During Investigation

7.4.1 All water strikes encountered during the investigations are detailed on the geological logs provided in Appendix 1. These are summarised in Table 14.

Table 14: Summary of Groundwater Strike Data During Investigation

Location	Strike Depth (mbGL)	Geological Formation	Level After 20 Minutes (mbGL)	Comment
BHG5	12.8	Tidal Flat Deposits / Glaciofluvial Deposits	9.7	Fast flow
	-	-	-	Water level recorded at 6.3 mbGL when borehole complete within Mercia Mudstone Group (17.47 mbGL)
BHH1	1.4	Made Ground	1.0	Slow flow
	13.45	Tidal Flat Deposits	8.75	Fast flow
	-	-	-	Water level recorded at 7.9 mbGL when borehole complete within Mercia Mudstone Group (18.2 mbGL)
CH35	0.8	Interface Made Ground / Tidal Flat Deposits	-	Medium inflow
CH37	2.0	Tidal Flat Deposits	-	Slight seepage
CH39	1.4	Made Ground	-	Slight seepage
CH40	1.1	Interface Made Ground / Tidal Flat Deposits		Fast strike
CH41	1.1	Made Ground	-	Medium inflow
CH42	1.6	Made Ground	-	Medium inflow
CH44	1.7	Tidal Flat Deposits	-	Slight seepage
CH45	1.3	Interface Made Ground / Tidal Flat Deposits	-	Medium inflow
CH47A	1.2	Tidal Flat Deposits	-	Slight seepage

7.4.2 Groundwater was not recorded in any other boreholes and trial pits during the previous investigations.

Groundwater Level During Monitoring

7.4.3 The entire groundwater level data set gathered on Site is provided in Appendix 2 and summarised in Table 15.

Table 15: Summary of Groundwater Level Data During Monitoring

Location	Installation	Depth of response zone (mbGL) and Geological Formation	No. Measurements	Minimum Depth (mbGL)	Maximum Depth (mbGL)	Comments
BHG6	19	13.5 - 16.5 Glaciofluvial Deposits	4	4.03	4.72	-

Groundwater Summary

7.4.4 The intrusive investigation confirms the generic hydrogeological model details in the Baseline Water Environment Report (Appendix 16.2 of the ES).

7.4.5 The main groundwater body is within the granular Glaciofluvial Deposits confined by the overlying Tidal Flat Deposits. This demonstrates the latter to represent an aquitard to the groundwater flow. Hydrostatic pressures within the confined aquifer are approximately 4 to 5 mbGLs.

7.4.6 A discontinuous perched groundwater is also seen within the upper formation of the Tidal Flat Deposits. These are considered to represent discrete bodies with little vertical or lateral flow.

7.4.7 A perched water body was also identified within the Made Ground. It is anticipated that this water body is strongly influenced by rainfall events and water levels within the reen and ditch system.

8 Contamination Assessment

8.1.1 The following sections provide details of the assessment of land contamination at the Site.

8.1.2 The Conceptual Site Model (CSM) presented within the 2014 PSSR has been reviewed and updated based on data from the Supplementary Ground Investigation (Geotechnical Engineering, 2015) and the Scheme. The main alterations to the 2014 PSSR CSM are summarised as follows:

- Additional gas pollutant (methane and/or carbon dioxide) considered from peat.
- Sub-artesian pressures within the Glaciofluvial Deposits and Mercia Mudstone considered within the Scheme.
- Addition of piled foundations as a pathway.
- Proposed band drain considered as a new pathway.
- Update of the source-pathway-receptor linkages taking account of the above and more detailed assessments.

8.2 Preliminary Risk Assessment

Potential Sources

8.2.1 The potential sources of contamination and associated contaminants which may be present on Site are detailed in Table 16.

8.2.2 The Made Ground was identified within the 2014 PSSR as a potential contaminant source based on the Site's historical and current usage associated with the chemical works.

Table 16: Potential Sources of Contamination

Potential Sources	Potential Contaminants
Chemical works	The main products that have been manufactured are organochlorines and aromatic based organic compounds such as PCB, terphenyl, pentachlorophenol, dodecylbenzene and phtalic anhydride. Other chemicals include phenolic waste, heavy metals, phthalic waste. Expected soil and groundwater contamination includes mainly PCB and dioxins.
Historical haul road	Construction vehicles which used a former haul road indicated to lead from the southern entrance of the Site towards CL-22 (Llanwern Research Laboratory) may have had possible fuel leak/spillage incidents.
Solutia Landfill and Corporation Road Landfill	Located within the south of the Site. Inert and industrial wastes were deposited within the Solutia Landfill and inert waste was deposited in the Corporation Road Landfill as per the information provided by the NRW.
Hazardous waste cell (the 'PCB Cell')	This cell is thought to contain PCB waste but may also contain other waste generated from the chemical works.

Potential Sources	Potential Contaminants
Area of known historical infilling	Area to the north of the PCB Cell is thought to have been used to dispose of effluent retention tank sludge. Piling from the bridge may disturb this.
Ground gas generation from fill material and natural soils including peat	Methane, carbon dioxide, carbon monoxide, hydrogen sulphide

8.2.3 To the west and south lies Stephenson Street Industrial Estate (CL-15) and Mir Steelworks (CL-20) which have been identified as potential off site sources of contamination. Within CL-15, some discrete areas of impacted soils found to include PCB, organics and metals have been identified. High pH in the Made Ground soils is widespread. Perched water within the Made Ground was recorded to be grossly impacted with hydrocarbons although it is not considered to be a widespread status across the Site. Groundwater quality was identified to be impacted by various contaminants of concern although at a level considered to be in line with the overall baseline seen in this part of Newport associated with heavy industrial legacy. Further ground investigation is planned for this area.

Potential Receptors

8.2.4 Potential receptors during the construction and the operational stages of the Scheme have been considered:

Construction

- Construction workers during site development works.
- General public and workers adjacent to construction works.
- Groundwater within the Glaciofluvial Deposits/Mercia Mudstone.
- Nearby surface waters including the reens and ditches in the south of the Site and surrounding fields to the east. This land drainage likely connects with the Gwent Levels SSSI wider network of reens and ditches.

Operational

- Maintenance workers.
- General public end users.
- General public and workers adjacent to permanent land take.
- Groundwater within the Glaciofluvial Deposits and/or Mercia Mudstone.
- Land drainage including the reens and existing and/or proposed surface water ditches within the Site and bordering the surrounding fields to the east. This land drainage may be connected with the Gwent Levels SSSI wider network of reens and ditches.

Potential Pathways

8.2.5 Pathways during the construction and operational stages of the Scheme have been considered:

- Construction activity including piling impacting the integrity of PCB cell, leading to release of contaminants into controlled waters.

- Construction activity affecting the integrity of the PCB Cell leading to spread of contamination and exposure to construction workers.
- Dermal contact, ingestion, inhalation pathways of potentially contaminated soils possible during construction and maintenance works.
- Accumulation of ground gas within confined spaces during the earthworks.
- Leaching of contaminants from the Made Ground to shallow groundwater and migration to land drainage.
- Surface water run-off into existing/new drainage system.
- Lateral migration of impacted perched water within the Made Ground and/or leachate from the Made Ground into existing/new drainage system.
- Vertical migration of impacted perched water within the Made Ground and/or leachate from the Made Ground into perched or main groundwater bodies.
- Vertical or lateral migration of ground gas associated with Made Ground and natural soils.
- Vertical migration of contaminants from Made Ground via piled foundations or band drains.
- Vertical migration of groundwater from within the Glaciofluvial Deposits and Mercia Mudstone possibly recharging perched groundwater and/or saturating the Made Ground due to pile installation or band drains.
- Creation of new pathways with installation of band drain through Made Ground, Tidal Flat Deposits and Peat into the Glaciofluvial Deposits and/or Mercia Mudstone.

8.3 Risk Evaluation

8.3.1 Source-pathway-receptor linkages were considered in the 2014 PSSR using the historical data available up to 2008. With review of the other data described herein, the following risk evaluations have been reconsidered and include:

- The new section of motorway is to be carried via a viaduct or high embankment some 4 m or more above ground level. Motorway users will be within an open environment with no proposed structures or other confined spaces. Pathway linkages to new section of motorway users are therefore limited to air born dust.
- The design of the new section of motorway on a viaduct enables the PCB Cell to be bridged and no construction will be undertaken within the cell itself thus mitigating the risk of impacting the integrity of the liners. Piers are however to be located in close proximity and on either side of the PCB Cell. There is a risk for piles to provide a pathway for any potentially impacted groundwaters to migrate downwards into the aquifer. As such, only the aquifer has been considered as a receptor in the Conceptual Site Model in relation to the PCB Cell potential source.
- The Site has been subject to a range of potential contaminating uses including a chemical works and landfilling. Off site sources associated with the industrial estate and steelworks area are also identified.

- Proposed piled viaduct and embankment with overlying hardstanding cover which is to encompass most of the motorway corridor reducing pathways to motorway users. Remaining areas (outside embankment) are to be landscaped within the permanent land take.
- Superficial deposits are classified as non-productive and overlie a Secondary B Aquifer associated with the Mercia Mudstone.
- The cohesive Tidal Flat Deposits (TFD) (of over 10 m thickness) separates the Made Ground and Aquifer and thus the aquifer is confined by the TFD.
- Perched groundwater within the TFD is not considered a water resource due to its anticipated low vertical hydraulic continuity with the aquifer beneath, low permeability and storage capacity. Indeed, the TFD provides a layer of protection to the underling aquifer.
- Piled foundations and band drains may create pathways to the lower aquifer. Pathways may allow increase in the influx of water within the Made Ground given the recorded sub-artesian pressures.
- Foundation construction such as pile caps for the construction of the piers may constitute confined spaces in which ground gases may accumulate.
- No soils ground gas data is available for the Site. Gas migration requires consideration in relation to proposed piling for the embankment and viaduct foundations.
- Motorway users will be within open environment with no proposed structure or other confined spaces.

8.4 Human Health Risk Assessment

8.4.1 The rationale and approach for the human health (Tier 2) screening assessment is detailed in the Land Contamination Assessment Report (Appendix 11.1 of the ES). Soil chemical analysis results and the findings of the generic tier 2 human health risk assessment are presented in Appendix 3.

8.4.2 All exceedances to the relevant generic risk assessment criteria of Made Ground within the route corridor are summarised in Table 17.

Table 17: Summary of Human Health Soil Screening Exceedances (Made Ground)

Determinant	Units	Range	Screening Criteria	No. Samples Exceeding Screening Criteria (Total Number of Results)	Locations of Exceedances
pH	pH units	7.5 - 11.8	6 - 9	28 (44)	BHH1 (x2), CH35, CH36, CH37, CH38, CH39 (x2), CH40 (x2), CH41 (x2), CH42, CH43, CH44 (x2), CH45, CH46, CH47, CH47A, CH48, CP/RH01, CP/RH02, TP05, TP07, TP09, TP10, TP11

Determinant	Units	Range	Screening Criteria	No. Samples Exceeding Screening Criteria (Total Number of Results)	Locations of Exceedances
Chromium	mg/kg	0.025 - 349	33	29 (44)	BHG6, BHH1 (x3), CH33, CH34 (x2), CH35, CH38, CH39 (x2), CH40, CH41 (x2), CH43, CH44 (x2), CH45, CH46, CH47 (x2), CH47A, CH48, CP/RH02, TP03, TP04, TP05, TP07, TP11
Mercury	mg/kg	0.07 - 34	30	2 (44)	BHH1, CH44
PAH (screen)	mg/kg	<0.1 - 2370	1.1	25 (30)	BHH1 (x3), CH33, CH35 (x2), CH36, CH37, CH39 (x2), CH40 (x2), CH41 (x2), CH42 (x2), CH43, CH44 (x2), CH45, CH46, CH47 (x2), CH47A, CH48
Arsenic	mg/kg	3.41 - 460	170	4 (44)	TP03, TP04, TP05, TP11
PCB (ARO)	mg/kg	1.1 - 1691.2	0.24	29 (29)	BHG6, BHH1 (x3), CH33, CH34 (x2), CH35 (x3), CH36, CH37, CH38, CH39 (x2), CH40 (x2), CH41 (x2), CH42 (x2), CH43, CH44 (x2), CH45, CH46, CH47 (x2), CH47A
PCB (7 congeners)	mg/kg	<0.01 - 110	0.24	33 (40)	CP/RH01, TP03 , TP04 (x3), TP05 (x2), TP06, T1/1, T1/2, T1/3, T1/4, T1/5, T1/6, T1/7, T1/8, T1/10, T2/1, T2/2, T2/3, T2/4, T2/7, T2/8, T2/9, T2/10, T2/11, T2/12, T2/13, T2/14, T2/15, T2/16, T2/17, T2/18

8.4.3 Alkaline soil conditions have been identified within Made Ground across the Site typically including ash and limestone gravel.

8.4.4 Although exceedances of chromium are identified throughout the Made Ground, the criterion relates to the hexavalent form. The majority of the results are considered to be within normal background data range (<95 mg/kg) and therefore are not considered to represent a contaminant of concern (Appendix 11.1 of the ES). A total of seven locations (with no apparent distribution within the Site), exceed this background range with a maximum of up to 349 mg/kg. Further sampling and speciation may confirm chromium relates to a lesser toxic form.

8.4.5 Elevated arsenic concentrations were identified within exploratory holes advanced during the WSP 2008 investigation. The exploratory records were not available for review at the time of writing however the borehole locations are

indicated to be north of the route alignment and the risk to the Scheme from arsenic is therefore considered low.

8.4.6 Two marginally elevated concentrations of mercury were identified for locations in the north of the permanent and temporary land take.

8.4.7 For the total PAH analysis, the most stringent criterion applicable for any PAH compound has been used for screening purposes (i.e. dibenzo(ah)anthracene). The greatest concentrations were identified within a number of Made Ground samples typically including brick, concrete, slag, ash and wood, metal and plastic although no visual or olfactory evidence of hydrocarbon contamination was identified. Hydrocarbon contamination was noted within two locations of elevated PAHs; hydrocarbon odour within BHH1 and an oil film noted on the groundwater within CH41.

8.4.8 Within the VOC suite, concentrations of BTEX compounds are identified within several Made Ground samples above laboratory limit of detection but none are exceeding the screening criteria.

8.4.9 PCBs are generally elevated across the Site in Made Ground however the tests for aroclors may mean PCB concentrations detected will not necessarily comprise entirely of concentrations of dioxin-like PCBs. The screening criterion is for dioxins, furans and dioxin-like PCB and thus the assessment is considered conservative. The tests for PCB (7 congeners) excludes many dioxin-like PCBs. Notwithstanding this the concentrations identified are typically up to 3 to 4 orders of magnitude greater that the screening criterion which suggests risks to construction workers and future Site users.

8.4.10 A sample obtained during the WSP Ground Investigation (WSP, 2008) was tested positive for asbestos (amosite and crocidolite). This sample location is unknown though reportedly in the vicinity of the wind turbines north of the permanent and temporary land take. No other samples were tested for asbestos.

8.4.11 All exceedances to the relevant criteria within natural ground are summarised in in Table 18.

Table 18: Summary of Human Health Soil Screening Exceedances (Natural Ground)

Determinant	Units	Range	Screening Criteria	No. Samples Exceeding Screening Criteria (Total Number of Results)	Locations of Exceedances
Arsenic	mg/kg	17 - 370	170	7 (21)	CP/RH01, CP/RH02, TP03 (x2), TP04, TP05, TP06 (all TFD)
Chromium	mg/kg	28.7 - 93.7	33	19 (31)	BHG5 (x2 TFD, x1 MMG), BHG6 (x1 TFD, x1 GFD, x1 MMG), CH37, CH38, CH43 (all TFD) CH48, CP/RH01, CP/RH02, TP03

Determinant	Units	Range	Screening Criteria	No. Samples Exceeding Screening Criteria (Total Number of Results)	Locations of Exceedances
					(x2), TP04, TP05, TP06 (all TFD)
PAH (screen)	mg/kg	<0.1 - 953	1.1	8 (15)	BHG5 (x2), BHG6, CH33, CH37, CH43, (all TFD), CH46 (TFD)
pH	pH units	7.8 - 9.3	6 - 9	3 (21)	BHG5 (GFD), CP/RH02 (TFD), TP03 (TFD)
PCB (ARO)	mg/kg	<0.1 - 41	0.24	6 (13)	CH33, CH36, CH37, CH38, CH43 (all TFD), CH46 (TFD)

8.4.12 Although exceedances of chromium are identified within natural deposits, the criterion relates to the hexavalent form and this is considered to be a conservative approach. All results are considered to be within normal background data range (<95 mg/kg) and therefore chromium is not considered to represent a contaminant of concern (Appendix 11.1 of the ES).

8.4.13 For the PAH screen analysed without speciation, the most stringent criterion applicable for any PAH compound is used for screening purposes (i.e. dibenzo(ah)anthracene). Elevated concentrations are identified within the organic clays of the Tidal Flat Deposits. Whilst the concentrations are generally lower than those of the Made Ground, some degree of downwards migration into the upper part of the TFD is evident.

8.4.14 PCB are elevated in approximately half the samples with a maximum concentration of 44 mg/kg. As for the PAH, the concentrations are generally lower than those of the Made Ground although some degree of downward migration is also evident.

8.4.15 Elevated concentrations of benzene and naphthalene were identified within a sample (TP03) collected north of the permanent and temporary land take at a location where solvent and hydrocarbon odours were noted in the logs. However, concentrations are below the screening criteria.

8.5 Controlled Waters Screening Assessment

8.5.1 The rationale and approach for the controlled waters (Tier 1) screening assessment is detailed in the Land Contamination Assessment Report (Appendix 11.1 of the ES) and the groundwater chemical results are presented in Appendix 4.

8.5.2 Where an Environmental Quality Standard (EQS) is dependent on water hardness, i.e. some heavy metals, the hardness of the surface water receptor would normally be used. The Baseline Water Environment Report (Appendix 16.2 of the ES) indicates surface water to be generally moderately hard with hardness in a range of 100 to 150 mg/l as calcium carbonate. Therefore EQSs

within this water hardness range have been used for screening purposes for this Site.

Soil Leachate Results

8.5.3 Nine soil samples were subjected to leachate analysis. No exceedances of the Screening Criteria were identified.

8.5.4 Certain laboratory detection levels in samples used in previous ground investigation for cadmium, nickel, lead, copper and pentachlorophenol are higher than the screening criterion.

8.5.5 Organics contaminants (total petroleum hydrocarbons (TPH)) identified as leachable with maximum concentration of 4 mg/l at CH43 (330 mg/kg recorded in the soil matrix). There are no screening criteria for TPH contaminants.

Groundwater Results

8.5.6 Six groundwater samples from previous ground investigations were subjected to analysis. All relate to grab samples of perched water within the Made Ground taken during ground investigation. The quality of the samples are therefore considered poor and results should be regarded as indicative only.

8.5.7 Exceedances to the relevant criteria from the groundwater are summarised in Table 19.

Table 19: Controlled Waters Screening Exceedances (Made Ground)

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS Screening Criteria (Total Number of Results)	Location of Exceedances	No. Exceeded DWS Screening Criteria (Total Number of Results)	Location of Exceedances
Arsenic	µg/l	7 - 21	50	10	0 (6)	-	3 (6)	CH41, BH1, BH2
Cadmium	µg/l	<0.1 - 0.5	0.15	5	1 (6)	BH1	0 (6)	-
Nickel	µg/l	4 - 10	4	20	5 (6)	CH35, CH40, CH41, BH1, BH2	0 (6)	-
Ammoniacal Nitrogen as N	mg/l	<0.2 - 17	0.6	-	3 (6)	CH35, BH1, BH2	0 (6)	-
BOD	mg/l	2 - 17	5	-	1 (4)	CH35	0 (4)	-
Total Cyanide	mg/l	<0.025 - 0.05	0.001	0.05	2 (4)	CH35, CH40	0 (4)	-
TPH FTIR	µg/l	170 - 660	-	-	-	-	-	-
TPH GC	µg/l	800 - 10000	-	-	-	-	-	-
PCBs ARO	µg/l	2.3 - 66	-	-	-	-	-	-
Pentachlorophenol	µg/l	<0.05 - 4.275	0.4	-	1 (4)	CH35	0 (4)	-
Anthracene	µg/l	<0.05 - 0.64	0.1	-	1(4)	CH35	0 (4)	-
Benzo(a)pyrene	µg/l	<0.05 - 0.16	0.00017	0.01	1 (4)	CH41	1 (4)	CH41
Benzo(b)fluoranthene	µg/l	<0.05 - 0.16	0.017	0.1	1 (4)	CH41	1 (4)	CH41
Benzo(k)fluoranthene	µg/l	<0.05 - 0.06	0.017	0.1	1 (4)	CH41	0 (4)	-
Benzo(ghi)perylene	µg/l	<0.05 -	0.0082	0.1	1 (4)	CH41	0 (4)	-

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS Screening Criteria (Total Number of Results)	Location of Exceedances	No. Exceeded DWS Screening Criteria (Total Number of Results)	Location of Exceedances
		0.07						
Fluoranthene	µg/l	<0.05 - 0.21	0.0063	-	1 (4)	CH41	0 (4)	-
Benzene	µg/l	<1 - 130	10	1	1 (4)	CH35	1 (4)	CH35
Ethylbenzene	µg/l	<1 - 255	20	-	1 (4)	CH35	0 (4)	-
m/p Xylene	µg/l	<1 - 872	30	-	1 (4)	CH35	0 (4)	-
1,2,4 Trichlorobenzene	µg/l	<3 - 204	0.4	-	1 (4)	CH35	0 (4)	-

8.5.8 All groundwater samples were obtained from perched waters within the Made Ground.

8.5.9 Elevated levels of some heavy metals (arsenic, nickel), total cyanide and ammoniacal nitrogen were identified in approximately half the samples. More local exceedances of cadmium, BOD, pentachlorophenol, PAHs and VOCs were also recorded.

8.5.10 Elevated PCBs were identified in four locations (CH35, CH40, CH41 and CH45) with concentrations of up to 66 µg/l recorded in shallow perched water within the Made Ground. Elevated PCB concentrations in soils are recorded at these locations albeit based on a conservative assessment. Total TPH of up to 10,000 µg/l were also recorded in the same four samples analysed. This indicates the shallow perched groundwater is contaminated and represents a potential contaminant source.

8.5.11 With the exception of the elevated PCBs and very high TPHs, the water quality seen in the Made Ground is in line with that seen within this general area of Newport, in particular the docks (CL-13 and CL-14) and Stephenson Street Industrial Estate (CL-15). The presence of a number of PAH compounds may indicate a soil–water linkage. However, the elevated PAHs, BTEX and pentachlorophenol observed may indicate contamination is leaching from the Made Ground or previous historical activities have introduced contaminants into the perched water.

8.5.12 There is no groundwater data to assess the integrity of the PCB Cell and whether contaminant is escaping from it. Similarly there is no groundwater data within the wider Site to confirm impact resulting from the historical land use (chemical works, landfills, etc.).

8.6 Ground Gas Risk Assessment

8.6.1 No monitoring wells were installed on site during the investigations and therefore no gas monitoring data is available. However the following initial comments may be made:

- A mantle of Made Ground has been identified with maximum thickness of 2.6 m. Limited presence of putrescible material has been recorded within the formation. Elevated ground gas generation from the Made Ground is likely to be typical of brownfield site.
- Elevated PAH concentrations within the soils have been recorded and presence of some Volatile Organic Compounds may be expected.
- Methane and carbon dioxide gases were recorded in the Glaciofluvial Deposits in the adjacent industrial estate (CL-15) during previous ground investigations. The source was considered to be associated with the presence of organic material including wood within the formation. Whilst no putrescible organic matter has been recorded in the Glaciofluvial Deposits, peat band of up to 1.5 m thick was proven at one location within the TFD. As such ground gas from the natural soils cannot be ruled out at this Site.

8.6.2 A gas risk assessment has been undertaken and is set out within the Land Contamination Assessment Report (Appendix 11.1 of the ES). Further assessment of the gas regime at the Site will be required to confirm associated risks following completion of additional ground investigation.

8.7 Summary

8.7.1 Widespread elevated PCB concentrations above the screening criteria within the Made Ground have been identified which could cause a potential risk to human health. A degree of vertical (downward) migration of PCB contaminants impacting the natural soils beneath the Made Ground is noted. The lateral and vertical extent of the contamination has not been determined by the current investigations.

8.7.2 Whilst most of the reported total PAH are likely to be associated with the lack of speciation and use of conservative screening criteria, some elevated concentrations are recorded which may present a risk to human health. Further sampling and analysis is recommended.

8.7.3 Widespread high pH in the Made Ground is recorded probably associated with the presence of slag material.

8.7.4 The Made Ground has exhibited limited leachability and no exceedances of the relevant screening criteria have been identified. Presence of leachable TPH is noted.

8.7.5 Perched water within the Made Ground has high levels of metals, inorganics, organics, PAHs and VOCs. These water qualities are considered to be within the baseline of this area of Newport associated with heavy industry legacy. However, the organic contamination including PAHs may have resulted from historical activities undertaken at the Site. However, high levels of TPH and also elevated PCBs have also been encountered that are most likely associated with operations undertaken at the Site and this potential contaminant source needs to be carefully managed to ensure no new pathways to receptors are created during construction.

8.7.6 Whilst no gas data is available for the Site, some elevated methane levels have been recorded in the adjacent industrial estate site associated with Made Ground

and natural organic rich soils. These conditions exist within the Site and the presence of similar gas regime is expected.

9 Refined Conceptual Site Model

9.1.1 The incorporation of data from the 2015 Supplementary Ground Investigation has enabled the original CSM presented in the 2014 PSSR to be updated. Relevant contaminant (source-pathway-receptor) linkages are considered within the refined CSM. The assessment is based on the Scheme during construction and operational phases.

9.1.2 A CSM representing general ground conditions, overall Scheme layout and relevant source-pathway-receptors (each of which having a specific alpha-numerical symbol attached) are presented in Figure 2 and described in Table 19.

Table 20: Conceptual Site Model

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
On Site Organochlorines and aromatic based organic compounds such as TPH, PCB, terphenyl, pentachlorophenol, dodecylbenzene and phthalic anhydride. Other chemicals include phenolic waste, heavy metals, phthalic waste in soil and groundwater associated with historical spills, inert and industrial waste landfills. Off site Stephenson Street Industrial Estate (CL-15) Mir Steelworks lagoons (CL-20)	Construction					
	Construction Workers (B)	Direct dermal (1)	Likely	High	High	Elevated concentration of some heavy metals, PAHs and PCB are identified within the Made Ground; however exposure duration will be short term only. Prior to construction, a specific risk assessment will be required in line with health and safety legislation. This will enable safe methods of work and appropriate levels of PPE to be put in place. As such all risks will be duly considered and suitably mitigated to protect construction workers. Given the widespread presence of PCB within the shallow soils, the concentrations within the Made Ground soils represent abnormal constraints to construction workers health and safety over and above those typical of a brownfield site. A construction mat will be placed over the length and width of the proposed construction area to enable piling as well as general construction. This will break dermal, ingestion and inhalation pathways once placed. Construction workers may be exposed to ground gas potentially during excavation works, band drain installation and piling. No gas data available for the Site and further monitoring is recommended. Further ground investigation is recommended to establish the extent of shallow soil contamination and ground gas and vapour levels.
		Ingestion (3)	Likely	High	High	
		Inhalation of soil dust (2)	Likely	High	High	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
		Inhalation of ground gas or vapours (2)	Low	High	Moderate	
	General public/site neighbours during construction works (C)	Dermal contact of soil derived dust (1)	Likely	High	High	During construction period there is the possibility of inhalation/ingestion of soil dust. Dust suppression measures will be required during construction works. Adjacent off site receptors present associated with industrial activities. No ground gas data available for the Site. Adjacent industrial estate is associated with ground gas from Made Ground and natural soils. Gap in the data has been identified and further investigations are required to delineate any potential contamination and confirm the risks.
		Ingestion of soil derived dust (3)	Likely	High	High	
		Inhalation of soil derived dust (2)	Likely	High	High	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
		Inhalation of ground gas or vapours (2)	Unlikely	Low	Low	
	Groundwater aquifer (Da) from the Glaciofluvial Deposits and/or Mercia Mudstone	Leaching/vertical migration (4)	Likely	Moderate	Moderate	Displacement of contaminated Made Ground is possible during piling, and a piling risk assessment is required. Thick mantle of predominantly soft low permeability Tidal Flat Deposits overlying Aquifer, reducing risk of downward migration. Increased vertical pathways between possible contaminant and receptor with construction of band drains and piles. Groundwater quality anticipated to be impacted by metal, inorganic and organic contaminants of concerns and likely to have saline intrusion. Therefore aquifer unlikely to be used as a potable water supply. Perched water in Made Ground grossly contaminated with hydrocarbon and PCBs are also present. Contaminated perched water will require management during construction. Gap in the data has been identified and further investigations are required to delineate any potential contamination and confirm the risks to controlled waters.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
	Surface waters (D)	Leaching/saturated flow within perched water and groundwaters (4)	Likely	Moderate	Moderate	Potential for increase in leachate from Made Ground during surcharge loading via the embankment construction. Perched groundwater is likely to have low flow and may be absent seasonally. Leachable organics identified within the soils. Perched water within the Made Ground has elevated metals, PCBs and organics and could enter surface waters if uncontrolled during construction. Application of appropriate surface water run-off control measures during the works is considered sufficient to break this pollution linkage. Further ground investigation and groundwater sampling and monitoring are required.
		Contaminated surface water run-off (5)	Likely	Moderate	Moderate	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
PCB Cell	Groundwater Aquifer (Da) from the Glaciofluvial Deposits and/or Mercia Mudstone	Vertical migration (4)	Likely	Moderate	Moderate	Piling works to be undertaken outside the PCB Cell and its containment integrity should not be compromised. The performance of the retrospectively installed containment infrastructure is not proven and perched water in Made Ground or perched groundwater within the Tidal Flat Deposit may be contaminated with PCB and other contaminants. Contaminated perched water will require management during construction and a piling risk assessment is required. Thick mantle of predominantly soft low permeability Tidal Flat Deposits overlying Aquifer, reducing risk of downward migration. Groundwater quality anticipated to be impacted by metal, inorganic and organic contaminants of concerns and likely to have saline intrusion. Therefore aquifer unlikely to be used as a potable water supply. Gap in the data has been identified and further investigations are required to delineate any potential contamination and confirm the risks to controlled waters.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
Groundwater – aquifer of the Glaciofluvial Deposits and/or Mercia Mudstone	Surface water (land drainage) (E)	Piles / band drains (4)	Likely	Moderate	Moderate	Aquifer quality not known but anticipated to be impacted by metal, inorganic and organic contaminants as recorded in the adjacent industrial estate. Perched waters in Made Ground identified with exceedances for metals, inorganics and organic contaminants. Hydrostatic pressure of the aquifer below near base of Made Ground. Piles and band drains could create potential vertical pathways connecting the aquifer with perched groundwater. A foundation risk assessment is required to manage risk to controlled waters.
Ground gas from peat / organic rich soils within Tidal Flat Deposits and/or Glaciofluvial Deposits	Construction workers (B)	Inhalation of ground gas/ explosion (2)	Low	High	Moderate	No ground gas data available to characterise gas regime from TFD. Peat of up to 1.5 m proven and likely to be associated with high methane concentration but with low or absent flux (flow). Peat overlain by low permeability cohesive soils. New pathways to be created with piles and band drains and thus construction operation will need a gas mitigation controls to protect construction (piling/band drains) operatives. Construction to be largely within open space. Any earthworks within confined space would require specific risk assessment, control measures and PPE. Further gas monitoring and gas risk assessment required to determine need for gas control measures.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
	Offsite users during construction works (C)	Inhalation of ground gas/ explosion (2)	Unlikely	High	Moderate-Low	No ground gas data available for the Site. Adjacent industrial estate is associated with high methane gas from natural soils. Peat of up to 1.5 m proven and likely to be associated with high methane concentration but with low or absent flux (flow). Peat overlain by low permeability cohesive soils. Flux likely to increase during surcharge loading. New pathways to be created with piles and band drains. Adjacent offsite receptors present associated with industrial activities. Limited potential for lateral gas migration given the presence of low permeability Tidal Flat Deposits to shallow depth. Further gas monitoring and gas risk assessment required to determine need for gas control measures.
On Site Organochlorines and aromatic based organic compounds such as TPH, PCB, terphenyl, pentachlorophenol, dodecylbenzene and	Operational					
	Maintenance Workers (B)	Direct dermal (1)	Low	High	Moderat	Maintenance workers may come into contact with Made Ground materials remaining *in situ* outside the pier footprints or embankment footprint. Areas outside the pier or embankment are likely to receive topsoil cover and vegetation establishment or
		Ingestion of soil (3)	Low	High	Moderate	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
phthalic anhydride. Other chemicals include phenolic waste, heavy metals, phthalic waste, heavy metals, phthalic waste in soil and groundwater associated with historical spills, inert and industrial waste landfills. Off site Stephenson Street Industrial Estate (CL-15) Mir Steelworks lagoons (CL-20)		Inhalation of soil dust (2)	Low	High	Moderate	some form of hardstanding, reducing potential of exposure. Exposure duration will be short term only. Site specific risk assessment will be required in line with health and safety guidance. This will enable safe methodology and appropriate levels of PPE to be put in place. As such all risks will be duly considered and suitably mitigated. Previous ground investigation soil analysis data has numerous exceedances of the screening criteria. Gap in the data has been identified and further investigations are required to delineate any potential contamination and confirm the risks.
		Inhalation of ground gas or vapours (2)	Low	High	Moderate	Gas regime uncertain and further gas monitoring recommended. However risks will be limited to confined entry for which compliance with health and safety legislation will be required anyway.
	Future motorway users (A) and off site users (C)	Dermal contact with soil derived dust (1)	Unlikely	Moderate	Low	Future Site users are very unlikely to be exposed to soil contamination as the Scheme will cross the Site on a viaduct and a raised embankment and the PCB Cell is being bridged to retain its integrity. However gaps in the data have been identified and further investigations are required to delineate any potential contamination and confirm the risks.
		Ingestion of soil derived dust (3)	Unlikely	Moderate	Low	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
		Inhalation of soil derived dust (2)	Unlikely	Moderate	Low	
		Inhalation of ground gas or vapours (2)	Unlikely	Low	Very low	
	Groundwater Aquifer (Da) from the Glaciofluvial Deposits and/or Mercia Mudstone	Leaching/vertical migration (4)	Low	Moderate	Moderate to low	Leaching of contaminants from the Made Ground materials could migrate via piling or band drains. Thick mantle of predominantly soft low permeability Tidal Flat Deposits overlying Aquifer, reducing risk of downward migration. Groundwater quality anticipated to be impacted by metal, inorganic and organic contaminants of concerns and likely to have saline intrusion. Therefore aquifer unlikely to be used as a potable water supply. Perched water in Made Ground grossly contaminated with hydrocarbons and also PCBs are present.. Contaminated perched water will require management during construction. Gap in the data has been identified and further investigations are required to delineate any potential contamination and confirm the risks to controlled waters. Band drains should not be installed through contaminated soils and waters.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
	Surface water (land drainage) (D)	Leaching / migration of contaminants to surface waters (4)	Likely	Moderate	Moderate	Potential for increase in leachate from Made Ground during surcharge loading via the embankment construction would have ceased. Perched groundwater is likely to have low flow and may be absent seasonally. Leachable organics identified within the soils. Perched water within the Made Ground has elevated metals, PCBs and organics and could enter surface waters. Application of appropriate surface water run-off control measures will be required to break this pollution linkage. Further ground investigation and groundwater sampling and monitoring are required.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
PCB Cell	Groundwater aquifer (Da) from the Glaciofluvial Deposits and/or Mercia Mudstone	Vertical migration (4)	Likely	Moderate	Moderate	Piled piers to be located outside the PCB Cell and its containment integrity should not be compromised. The performance of the retrospectively installed containment infrastructure not proven and perched water in Made Ground or perched groundwater within the Tidal Flat Deposit may be contaminated with PCB and other contaminants. Contaminated perched water will require management during construction and a piling risk assessment is required. Thick mantle of predominantly soft low permeability Tidal Flat Deposits overlying Aquifer, reducing risk of downward migration. Groundwater quality anticipated to be impacted by metal, inorganic and organic contaminants of concerns and likely to have saline intrusion. Therefore aquifer unlikely to be used as a potable water supply. Gap in the data has been identified and further investigations are required to delineate any potential contamination and confirm the risks to controlled waters.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
Groundwater – aquifer from the Glaciofluvial Deposits and/or Mercia Mudstone	Surface water (land drainage) (E)	Piles/band drains (4)	Likely	Moderate	Moderate	Aquifer quality not known but anticipated to be impacted by metal, inorganic and organic contaminants as recorded in the adjacent industrial estate. Perched waters in Made Ground identified with exceedances for metals, inorganics and organic contaminants. Hydrostatic pressure of the aquifer below near base of Made Ground. Piles and band drains could create potential vertical pathways connecting the aquifer with perched groundwater. A foundation risk assessment is required to manage risk to controlled waters. Band drains should not be installed through contaminated soils and waters.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
Ground gas from peat / organic rich soils within Tidal Flat Deposits and/or Glaciofluvial Deposits	Maintenance workers (B)	Inhalation of ground gas/ explosion (2)	Unlikely	High	Moderate to low	No ground gas data available to characterise gas regime from TFD. Peat of up to 1.5 m proven and likely to be associated with high methane concentration but with low or absent flux (flow). Peat overlain by low permeability cohesive soils. New pathways to be created with piles and band drains. Low gas flux likely to achieve equilibrium after construction. Pathways along piles likely to 'heal' with increase in soil contact along shaft. Further gas monitoring and gas risk assessment required to determine need for gas control measures.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
	Future motorway users (A) and off site users (C)	Inhalation of ground gas/ explosion (2)	Unlikely	High	Moderate to low	No ground gas data available for the Site. Adjacent industrial estate is associated with high methane gas from Made Ground and natural soils. New pathways to be created with piles and band drains. Peat of up to 1.5 m proven and likely to be associated with high methane concentration but with low or absent flux. Peat overlain by low permeability cohesive soils. Low flux regime likely to achieve equilibrium after construction. Pathways along piles likely to 'heal' with increase in soil contact along shaft. Adjacent off site receptors present associated with industrial activities. Limited potential for lateral gas migration given the presence of low permeability Tidal Flat Deposits to shallow depth. Motorway to be built on raised embankment and viaduct providing a further barrier to migration gases. Pathways along piles likely to 'heal' with increase in soil contact along pile shaft preventing gas migration. However band drains could still allow localised gas migration. Further gas monitoring and gas risk assessment required to determine need for gas control measures.

10 Conclusions and Recommendations

10.1 Conclusions

10.1.1 Ground investigations have been undertaken at the Site to assess risks from land contamination associated with the construction and operation of the Scheme including human health and controlled waters risks.

10.1.2 Widespread PCB contamination associated with the Site's historical use has been identified. The risk assessment has identified that residual risks to human health and controlled waters could exist and control measures are required to facilitate the construction and ongoing operation of the Scheme. It is recommended that the construction area is capped to mitigate risks of exposure to construction workers and the spread of contamination.

10.1.3 Materials are unlikely to be suitable for direct reuse and some form of remediation or off site disposal is anticipated.

10.1.4 Elevated concentrations of some heavy metals, PAHs and PCB will require specific risk assessment and control measures to be designed and implemented to protect construction workers and general public in line with health and safety legislation and guidance.

10.1.5 The control measures will also need to manage risks from organic soil vapours and ground gases as well as dust.

10.1.6 A suitable water management strategy will also be required to prevent potential impact to surface waters from contaminant run-offs.

10.1.7 The presence of elevated concentrations of TPH and PCBs in shallow perched water in the Made Ground should preclude the use of band drains in order to mitigate the risk of the underlying aquifer and surface waters becoming contaminated.

10.1.8 The PCB Cell will be bridged by the new section of motorway viaduct and no construction work is to be undertaken on the PCB Cell. This will mitigate risks of affecting its integrity during construction. However an emergency plan will be required to deal with any accidental breaches of the PCB cell.

10.2 Recommendations

10.2.1 Given the identified gap in the data, in particular associated with the delineation of PCB and organic contaminated soils (to support human health and material reuse), ground gas regime (to support human health and the pier design) and controlled waters (perched water and aquifer); an additional ground investigation is to be undertaken to verify the risk levels identified in this report. The ground investigation findings shall be reviewed and this report updated. The additional investigation will include the following:

- Trial pits and boreholes to collect soil samples and analysis.
- Installation of groundwater monitoring wells in boreholes.
- Collection of groundwater samples.

- Gas monitoring.

10.2.2 The risk investigation should target the following:

- Delineation of waste.
- Disposal areas.
- Shallow contamination extent.
- Groundwater to determine if contaminated.
- Asbestos contaminated soils in Made Ground.
- Installation and monitoring wells next to the PCB Cell to establish adjacent groundwater condition.

10.2.3 Upon review and assessment of the additional ground investigation information, any contamination identified that could cause an unacceptable risk to the identified receptors will require appropriate remedial mitigation measures to be implemented. These measures would be identified within a remediation strategy for the Scheme. The remediation strategy is anticipated to include but is not limited to the below:

- Addressing potential human health risk and controlled waters risks identified by the proposed additional ground investigation.
- Risk assessment of band drains/piles and associated construction works creating pathways enabling contaminants migration.
- Dealing with unexpected contamination.
- Verification sampling to confirm suitability of soils for reuse or verify imported topsoils.
- Control measures to prevent risks to construction workers and the general public during construction.
- Emergency plan to deal with potential accidental breaches of the PCB cell.

10.2.4 The remediation strategy should include a remediation options appraisal, remediation implementation plan and remediation verification plan. The remediation strategy should be supported by a Scheme wide Materials Management Plan prepared in accordance with CL:AIRE Code of Practice (CL:AIRE, 2011).

11 References

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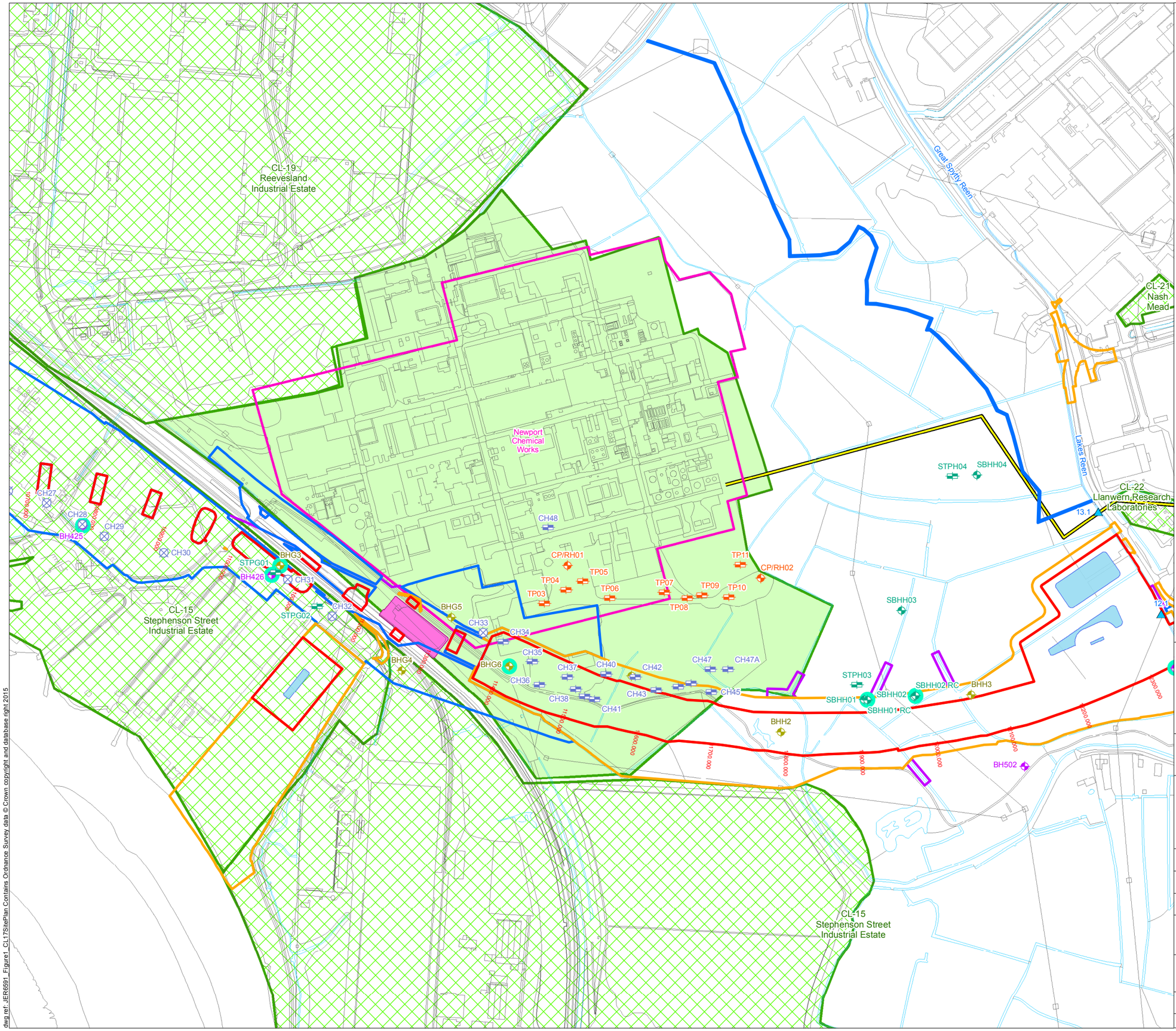
12 Glossary

BF	Blast Furnace
BGS	British Geological Survey
BOD	Biochemical Oxygen Demand
BOS	Basic Oxygen Slag
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CAT	Cable Avoidance Tool
CDM	Construction Design Management
CH_4	Methane
CLEA	Contaminated Land Exposure Assessment
CO_2	Carbon Dioxide
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CSM	Conceptual Site Model
DMRB	Design Manual for Roads and Bridges
DO	Dissolved Oxygen
DQRA	Detailed Quantitative Risk Assessment
DWS	Drinking Water Standard
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
ES	Environmental Statement
ESG	Environmental Scientifics Group
EQS	Environmental Quality Standard
FTIR	Fourier Transform Infrared (spectroscopy)
GAC	Generic Assessment Criteria
GDR	Geotechnical Design Report
GIR	Ground Investigation Report
GRO	Gasoline Range Organics
LEL	Lower Explosive Limit
LOD	Limit of Detection
mAOD	Metres Above Ordnance Datum

mb	Millibars
mbGL	Metres below Ground Level
MTBE	Methyl Tert-butyl Ether
NRW	Natural Resources Wales
ORP	Oxidation Reduction Potential
O_2	Oxygen
OS	Ordnance Survey
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCSM	Preliminary Conceptual Site Model
PID	Photo Ionisation Detector
PPE	Personnel Protection Equipment
SGVs	Soil Guideline Values
SSAC	Site Specific Assessment Criteria
SSSI	Site of Special Scientific Interest
SVOCs	Semi-Volatile Organic Compounds
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbon
TPH CWG	Total Petroleum Hydrocarbon Criteria Working Group
UKAS	United Kingdom Accreditation Service
VOCs	Volatile Organic Compounds
WFD	Water Framework Directive
UXO	Unexploded Ordnance Survey

Figures



Legend

- Permanent Highway Land within Fenceline (including Water Treatment Areas)
- Other Permanent Land Take
- Temporary Construction Land
- Easement Only
- Proposed Water Treatment Area (WTA)
- Potential Area of Land Contamination based on 2014 PSSR
- Other Potential Area of Land Contamination
- Solutia PCB Cell
- Redundant Benzene Pipeline
- Permit Boundary

Investigation Locations

2015 (RPS)
- Surface Water Monitoring Location - Q1

2015 (Geotechnical Engineering)
- Borehole

2008 (WSP)
- Borehole
- Trial Pit

2007 (Norwest Holst)
- Borehole
- Trial Pit

2000 (Exploration Associates)
- Trial Pit
- Window Sample

1997 (Norwest Holst)
- Borehole
- Monitoring Well Installation

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Welsh Government

Appendix 11.1 Annex D CL-17

Site Plan for CL-17

Figure: 1	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Scale: A3 @ 1:5,000

0 80 160 m

N

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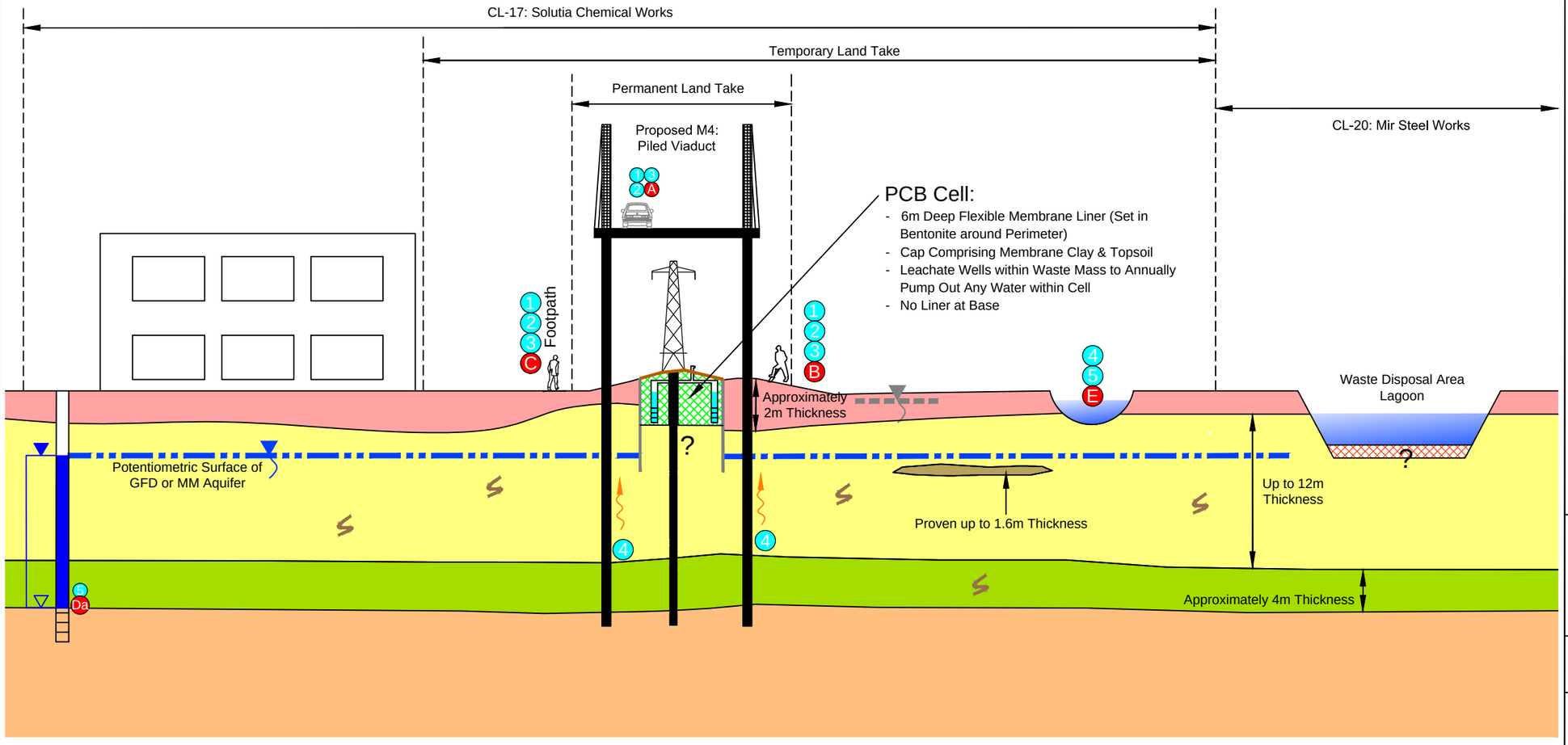
dwg ref: JER6591_Figure1_CL17SitePlan

dwg ref: JER6591_Figure1_CL17SitePlan Contains Ordnance Survey data © Crown copyright and database right 2015

CL-17 Solutia Chemical Works



Ground conditions based on available information

Legend

- Made Ground - MG (including PCB Contamination)
- PCB Cell
- Potentially Contaminated Sediments within Lagoon
- Tidal Flat Deposits - TFD
- Peat
- Glaciofluvial Deposits - GFD
- Organic Inclusions within TFD & GFD
- Mercia Mudstone - MM
- Proposed Piled Pier
- No Information Available
- Perched Water (MG)
- Groundwater (GFD and MM)
- Water Strike
- Rest Water Level
- Gas Migration Pathway

Potential Receptors

- A Humans On-Site (M4 User)
- B Humans On-Site (Construction/Maintenance)
- C Humans Off-Site (Site Neighbours)
- Da Groundwater (Aquifer)
- E Surface Water

Potential Pathways

- 1 Dermal Contact
- 2 Inhalation
- 3 Ingestion
- 4 Leaching / Migration
- 5 Surface Run Off

Potential Sources of Contamination

Possible contamination present on site associated with :

On-Site

- PCB Cell
- Previous industrial uses including; timber yards, coal sidings, fuel works, railway land
- Elevated concentrations of PCB's identified across the site
- Strong acid and hydrocarbon odours noted in the shallow made ground

Off-Site

- CL-15: Stephenson Industrial Estate
- CL-20: Mir Steelworks

NOTE
Drawing refined from PSSR Drawing Reference M4-OA-17-00DR-Z-XX-0120 (January 2014)

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Welsh Government

Appendix 11.1 Annex D CL-17

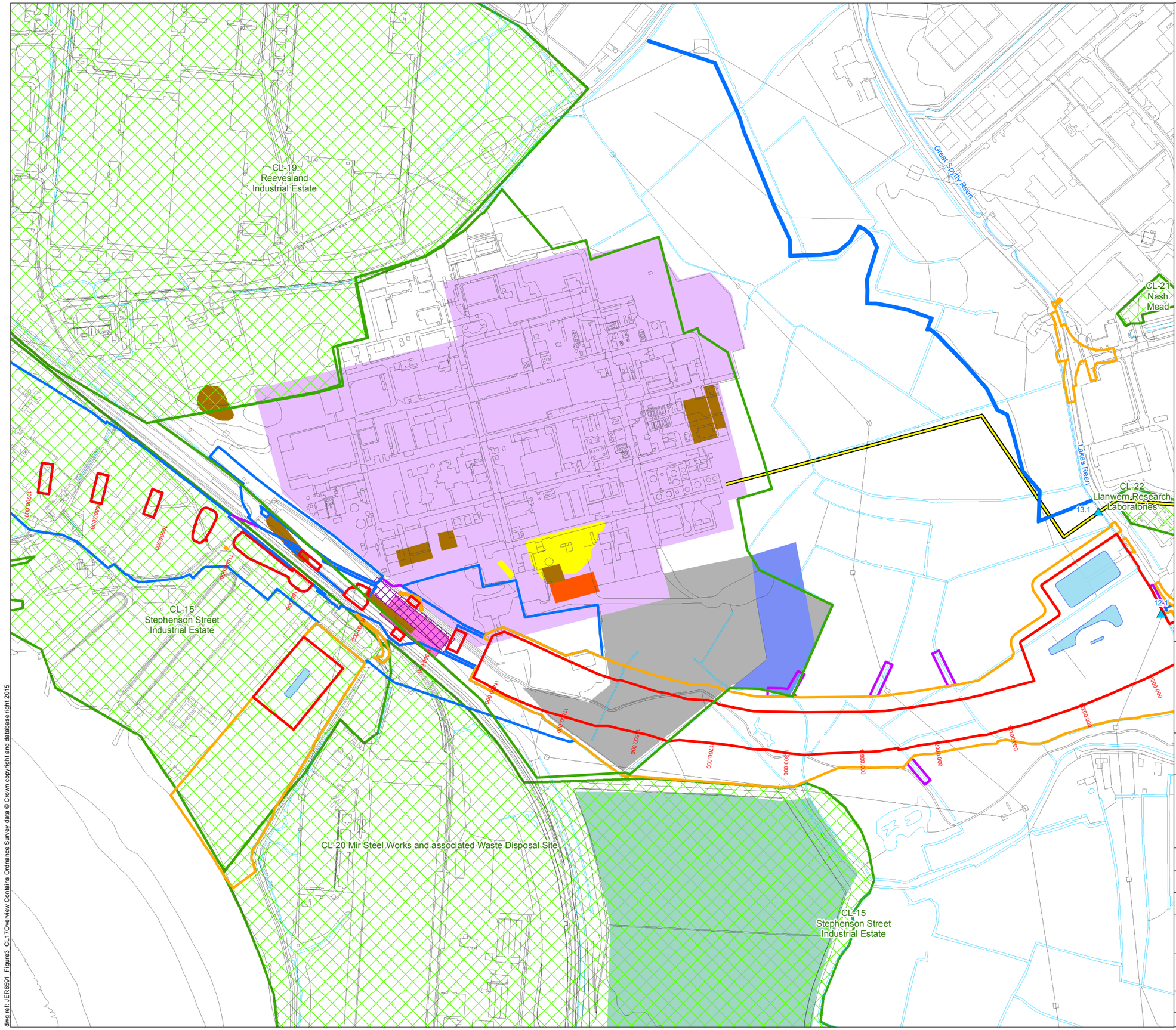
Conceptual Site Model for CL-17

Figure: 2	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Not to Scale

dwg ref:JER6591_Figure2_CL17ConceptualSiteModel

dwg ref: JER6591_Figure2_CL17ConceptualSiteModel



Legend

- Permanent Highway Land within Fenceline (including Water Treatment Areas)
- Other Permanent Land Take
- Temporary Construction Land
- Easement Only
- Proposed Water Treatment Area (WTA)
- Potential Area of Land Contamination based on 2014 PSSR
- Other Potential Area of Land Contamination
- Solutia PCB Cell
- Solutia PCB Cell (Original Defined Extent)
- Redundant Benzene Pipeline
- Chemical Works - Permit EPR/BR9715IB
- Historical Solutia Landfill (Inert and Industrial Waste
- Historical Landfill - Sloblands (Industrial Waste)
- Historical Landfill - Phase III Monsanto (Inert Waste)
- Disposal Area
- Historical Disposal Area
- Historical Filled Ground

Investigation Locations

- Surface Water Monitoring Location - Q1

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Welsh Government

Appendix 11.1 Annex D CL-17

Overview Site Plan for CL-17 with Permit Boundaries

Figure: 3	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Scale: A3 @ 1:5,000
0 80 160 m

N

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dwg ref: JER6591_Figure3_CL17Overview

dwg ref: JER6591_Figure3_CL17Overview Contains Ordnance Survey data © Crown copyright and database right 2015

Appendices

A1 Appendix 1

Exploratory Records

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Borehole No.
BHG5
Header

Contract No.	F10895	Method	Cable Percussion	Coordinates	333430.1 E
Project	M4 Relief Road Magor to Castleton Stage 2				185316.9 N
		Drilling Rig	Pilcon	Ground Level	7.40m AOD
Client	Welsh Office	Driller	I.M	Orientation	Vertical
		Logged by	C.D	Date Started	16/11/1997
Consultant	Ove Arup and Partners			Date Completed	17/11/1997

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
16/11/1997	1800	8.00	7.70	Dry	
17/11/1997	0800	8.00	7.70	Dry	
17/11/1997	1800	17.47	17.00	6.30	

DRILLING DETAILS

Hardbore from depth	Hardbore to depth	Chiselling hours	Remarks
14.00	14.20	0.75	
16.95	17.40	2.00	

CASING

Hole diameter	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
150	17.47	150	17.00

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
17/11/1997	0000	12.80	9.70	20.0	fast	12.70	0.00

GENERAL NOTES

1. Rotary follow on cancelled, borehole grouted to ground level on completion.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
2.00	S	N=6 (2,1,2,2,1,1)
4.00	S	N=3 (1,0,0,1,1,1)
6.00	S	1/450mm
8.00	S	N=1 (0,0,0,1,0,0)
11.00	S	N=6 (1,2,1,1,2,2)
12.70	C	N=19 (3,4,4,4,5,6)
14.20	C	N=35 (4,5,8,8,9,10)
15.50	C	N=32 (6,6,7,6,8,11)
17.20	C	50/30mm (25,50)
17.40	S	55/20mm (25,55)

* Seating blows only.

NB All depths in metres, all diameters in millimetres, water strike rise time in minutes, chiselling time in hours.

Form	CP HEADER
Version	2.00
Revised	25/06/1997

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Borehole No.
BHG5
Sheet 1 of 2

Contract No.	F10895	Method	Cable Percussion	Coordinates	333430.1 E
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon		185316.9 N
		Driller	I.M	Ground Level	7.40m AOD
Client	Welsh Office	Logged by	C.D	Orientation	Vertical
				Date Started	16/11/1997
Consultant	Ove Arup and Partners			Date Completed	17/11/1997

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling	SPT N & (U blows)	SPT type & depth	Install-ation
TOPSOIL		0.20	7.20				
Soft becoming brown mottled greyish brown occasional thinly laminated CLAY. (Estuarine Alluvium)				D 0.40 B 0.50 - 1.00 U 1.00 - 1.45	(8)		
---from 0.20 to 1.45m with occasional rootlets				D 1.45 D 1.70 D 2.00 B 2.45 - 2.70	S6	S 2.00 - 2.45	
		2.85	4.55	D 2.85			
Very soft to soft grey occasionally mottled dark grey CLAY. (Estuarine Alluvium)				U 3.00 - 3.45 D 3.45 D 3.80 D 4.00 B 4.45 - 5.00	(6) S3	S 4.00 - 4.45	
		5.00	2.40	D 5.10			
Very soft dark grey CLAY. (Estuarine Alluvium)				U 5.20 - 5.65 D 5.65 D 5.80 D 6.00 B 6.45 - 7.00 U 7.00 - 7.45	(1) S1/450mm (1)	S 6.00 - 6.45	
---from 7.45m very silty				D 7.45 D 7.70 D 8.00 B 8.45 - 9.00	S1	S 8.00 - 8.45	
		9.00	-1.60				
Very soft becoming soft firm dark grey occasionally organic very silty CLAY. (Estuarine Alluvium)				U 9.50 - 9.95 W 9.70 D 9.95	(4)		

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH CP LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Borehole No.
BHG5
Sheet 2 of 2

Contract No.	F10895	Method	Cable Percussion	Coordinates	333430.1 E
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon		185316.9 N
		Driller	I.M	Ground Level	7.40m AOD
Client	Welsh Office	Logged by	C.D	Orientation	Vertical
				Date Started	16/11/1997
Consultant	Ove Arup and Partners			Date Completed	17/11/1997

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
Very soft becoming soft firm dark grey occasionally organic very silty CLAY. (Estuarine Alluvium)				D	10.50				
				D	11.00	S6	S	11.00 11.45	
---from 11.00m with occasional to some gravel size pockets of blackish brown firm fibrous peat				B	11.45 - 12.00				
				D	12.10				
				U	12.30 - 12.55	NR			
		12.55	-5.15						
Medium dense greyish brown silty sandy sub-rounded and occasionally sub-angular siliceous GRAVEL with some cobbles. (Fluvial Alluvium)				D	12.70	C19	C	12.70 13.15	
				B	13.15 - 14.00				
---from 14.20m dense				D	14.20	C35	C	14.20 14.65	
				B	14.65 - 15.10				
				D	15.50	C32	C	15.50 15.95	
		16.95	-9.55						
Greyish green slightly to moderately weathered sandy MUDSTONE, moderately strong. (Mercia Mudstone Group)				D	17.10				
				D	17.20	C50/30mm	C	17.20	
		17.47	-10.07	D	17.40	S55/20mm	S	17.40 17.31 17.47	
Cable Percussion boring complete at 17.47 m.									

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH CP LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG6
Header

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	333509.1 E 185250.1 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Hands England	Ground Level	7.00m AOD
Client	Welsh Office	Drillers	I.M/D.D	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	14/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	19/11/1997
		Core bit	Saw Tooth		

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
14/11/1997	1800	8.00	7.70	Dry	
15/11/1997	0800	8.00	7.70	6.60	
15/11/1997	1800	18.00	17.55	5.40	
16/11/1997	0800	18.00	17.55	4.80	
16/11/1997	1800	18.00	17.85	4.25	
17/11/1997	1800	20.25	18.06	15.60	
18/11/1997	0800	20.25	18.06	Dry	
18/11/1997	1800	31.15	18.06	4.40	
19/11/1997	0800	30.15	18.06	4.00	
19/11/1997	1800	40.00	18.06	0.00	

CABLE PERCUSSION DETAILS

Hard strata from depth	Hard strata to depth	Hours	Remarks
16.10	16.35	1.00	
16.60	16.70	0.50	
17.55	17.85	1.00	
17.85	18.00	1.00	

CASING

Hole diameter	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
150	18.06	150	17.85

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

ROTARY DRILLING DETAILS

From depth	To depth	Flush type	Flush return	Core diameter
18.06	40.00	foam	100%	92

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
2.00	S	N=4 (1,0,0,1,1,2)
4.00	S	N=1 (1,0,0,1,0,0)
6.00	S	N=1 (1,0,1,0,0,0)
8.00	S	N=1 (1,0,1,0,0,0)
12.50	C	N=19 (2,4,3,4,5,7)
14.00	C	N=36 (2,3,3,8,9,16)
15.45	C	N=38 (5,7,8,10,10,10)
17.10	S	N=43 (4,6,7,7,14,15)
17.95	S	75/105mm*
20.25	C	50/70mm (25/60,50/70)
21.25	C	50/75mm (25/135,50/75)
22.25	C	50/50mm (25/120,50/50)
23.25	C	50/75mm (25/110,50/75)
24.25	C	50/60mm (25/90,50/60)
25.25	C	50/50mm (25/80,50/50)
27.75	C	50/50mm (25/75,50/50)

* Seating blows only.

GENERAL NOTES

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, hard strata time in hours

Form	COMBINED HEADER
Version	2.00
Revised	26/06/1997

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG6
Sheet 1 of 4

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	333509.1 E 185250.1 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Hands England	Ground Level	7.00 m AOD
Client	Welsh Office	Drillers	I.M/D.D	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	14/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	19/11/1997
		Core Bit	Saw Tooth		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring			Blow count to drive U100	SPT N & depth		Install-ation
MADE GROUND: Dark grey sandy gravelly brick and concrete fill.				D	0.30					
		0.60	6.40	D	0.60					
Firm becoming very soft to soft dark brown slightly sandy CLAY. (Estuarine Alluvium)				B	0.70	- 0.90				
				D	0.95	- 1.45	(17)			
				U	1.00					
---at 0.95m becoming mottled grey sandy with occasional thin laminations of bluish grey silt				D	1.45					
				D	1.70					
---at 1.70m becoming slightly sandy				D	2.00			S4	2.00 2.45	
				B	2.45	- 2.70				
				D	2.80					
---from 2.80 to 4.00m slightly sandy				U	3.00	- 3.45	(7)			
				D	3.45					
				D	3.80					
				D	4.00			S1	4.00 4.45	
				B	4.45	- 5.00				
				U	5.00	- 5.45				
				D	5.45					
				D	5.85					
				D	6.00			S1	6.00 6.45	
---at 6.00m becoming slightly organic				B	6.45	- 7.00				
				W	6.60					
				U	7.00	- 7.45	(2)			
				D	7.45					
				D	7.70					
				D	8.00			S1	8.00 8.45	
---at 8.00m becoming pale grey				B	8.60	- 8.90				
		9.60	-2.60	U	9.50	- 9.95	(3)			
CLAY - SD As Sheet 2				D	9.95					

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG6
Sheet 2 of 4

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	333509.1 E 185250.1 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Hands England	Ground Level	7.00 m AOD
Client	Welsh Office	Drillers	I.M/D.D	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	14/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	19/11/1997
		Core Bit	Saw Tooth		

Description of Strata	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
Very soft grey mottled black very sandy CLAY. (Estuarine Alluvium)	10.40	-3.40	D 10.20			
Very soft to soft dark grey mottled black slightly sandy CLAY with occasionally medium to coarse gravel sized pockets of black fibrous peat. (Estuarine Alluvium)			D 10.60			
			U 11.50 - 11.95			
			D 11.95			
Medium dense becoming dense brownish grey sandy sub-rounded to sub-angular GRAVEL with some cobbles. (Fluvial Alluvium)	12.45	-5.45	D 12.50		C19 12.50 12.95	
			B 13.00 - 13.50			
---at 14.00m becoming dense very sandy			D 14.00		C36 14.00 14.45	
			B 14.50 - 15.00			
			D 15.40		C38 15.45 15.90	
			B 16.35 - 16.60			
Reddish brown mottled greyish green highly to completely weathered sandy MUDSTONE, weak to weak. (Mercia Mudstone Group)	16.90	-9.90	D 17.00 D 17.10		S43 17.10 17.55	
---at 17.10m becoming highly weathered moderately weak	17.55	-10.55	D 17.85 D 18.00		S75/105mm*17.95 18.06	
Reddish brown mottled greyish green moderately weathered sandy MUDSTONE (marl), moderately weak to moderately strong. (Mercia Mudstone Group)	18.06	-11.06	18.06 - 19.10	TCR 96, SCR 56, RQD 0, FI NI 3 NI 3 NI		
MUDSTONE As Sheet 3			19.10 - 20.25	TCR 30, SCR 17, RQD 9, FI NI 0 NA		

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG6
Sheet 3 of 4

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	333509.1 E 185250.1 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Hands England	Ground Level	7.00 m AOD
Client	Welsh Office	Driller	I.M/D.D	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	14/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	19/11/1997
		Core bit	Saw Tooth		

Description of Strata	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Greyish green occasionally mottled reddish brown thinly to medium sub-horizontally bedded highly to completely weathered MUDSTONE, very weak to weak with very closely to closely spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group)	20.25	-13.25	20.25 - 21.25	25	0	0	NI NA	C50/70mm 20.25 20.38	
Reddish brown occasionally mottled greyish green very thinly to thinly sub-horizontally bedded moderately to highly weathered MUDSTONE, moderately strong completely fractured. (Mercia Mudstone Group) ---from 20.50 to 21.25m no recovery	21.50	-14.50	21.25 - 22.25	65	30	0	NI NI 3 NA	C50/75mm 21.25 21.46	
Purplish brown mottled greyish green thinly to medium sub-horizontally bedded highly weathered sandy MUDSTONE, moderately weak to moderately strong with very closely to closely spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group) ---from 21.50 to 21.75m completely fractured ---from 21.90 to 22.25m no recovery ---from 22.25 to 22.30m greyish green calcareous slightly weathered strong ---from 22.25 to 22.45m completely fractured ---from 22.45 to 23.25m no recovery	22.55	-15.55	22.25 - 23.25	20	0	0	NI NA	C50/50mm 22.25 22.42	
			23.25 - 24.24	35	20	0	NI 5 NA	C50/75mm 23.25 23.44	
			24.24 - 25.25	60	25	0	NI 6 NA	C50/60mm 24.25 24.40	
Reddish brown mottled greyish green medium to thinly sub-horizontally to inclined bedding moderately to highly weathered MUDSTONE, very weak to weak locally moderately strong with closely to medium spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group) ---from 23.25 to 23.40m completely fractured ---from 23.40m moderately weathered ---from 23.60 to 24.25m no recovery ---from 24.25 to 24.60m completely fractured ---from 24.85 to 25.25m no recovery ---from 25.25 to 25.45m completely fractured ---from 27.35 to 27.75m no recovery			25.25 - 26.25	100	75	40	NI 8	C50/50mm 25.25 25.38	
			26.25 - 27.75	73	67	28	14 NA	C50/50mm 27.75 27.88	
			27.75 - 28.75	95	70	0	18		
			28.75 - 30.15	93	50	34	NI 4		

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	1.00
Revised	20/09/96

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG6
Sheet 4 of 4

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	333509.1 E 185250.1 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Hands England	Ground Level	7.00 m AOD
Client	Welsh Office	Driller	I.M/D.D	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	14/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	19/11/1997
		Core bit	Saw Tooth		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown mottled greyish green medium to thinly sub-horizontally to inclined bedding moderately to highly weathered MUDSTONE, very weak to weak locally moderately strong with closely to medium spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group)		30.15	-23.15	30.15 - 30.75	97	92	53	5		
Reddish brown occasionally mottled green thinly to medium sub-horizontally bedded moderately weathered silty MUDSTONE, very weak to moderately weak to moderately strong with very closely to closely spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group) ---from 30.15 to 31.15m slightly to moderately weathered ---from 31.20 to 31.32m highly weathered very weak completely fractured ---from 32.95 to 33.10m highly weathered weak completely fractured ---from 34.00 to 34.20m highly weathered weak completely fractured from 34.20m medium bedded with medium to widely spaced sub-horizontal to inclined fractures planar rough tight				30.75 - 32.25	99	79	29	5 NI 9		
				32.25 - 33.80	100	66	16	5 NI 6		
				33.80 - 35.35	100	75	40	3 NI 8		
Reddish brown medium bedded highly weathered silty MUDSTONE, very weak completely fractured. (Mercia Mudstone Group)		35.35	-28.35	35.35 - 35.80	100	0	0	NI		
				35.80 - 36.90	100	42	15	NI		
Reddish brown thinly to medium sub-horizontally bedded moderately weathered silty MUDSTONE, moderately weak to moderately strong with closely to medium spaced sub-horizontal fractures planar rough tight. (Mercia Mudstone Group) ---from 37.35 to 37.90m moderately to highly weathered weak ---from 37.90 to 38.95m very weak completely fractured ---from 39.40 to 39.80m very weak completely fractured		36.55	-29.55					4		
				36.90 - 38.40	97	50	21	1 3 NI		
				38.40 - 39.50	91	55	18	NI 6 NI		
				39.50 - 40.00	96	52	22	NI 7		
Borehole complete at 40.00 m.		40.00	-33.00							

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	1.00
Revised	20/09/96

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Borehole No.
BHH1
Header

Contract No.	F10895	Method	Cable Percussion	Coordinates	333676.1 E
Project	M4 Relief Road Magor to Castleton Stage 2				185237.1 N
		Drilling Rig	Pilcon	Ground Level	7.70m AOD
Client	Welsh Office	Driller	I.M	Orientation	Vertical
		Logged by	C.D	Date Started	13/11/1997
Consultant	Ove Arup and Partners			Date Completed	14/11/1997

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
13/11/1997	1800	15.00	15.00	8.50	
14/11/1997	0800	15.00	15.00	6.30	
14/11/1997	1800	18.20	17.85	7.90	

DRILLING DETAILS

Hardbore from depth	Hardbore to depth	Chiselling hours	Remarks
0.55	0.90	1.00	
16.20	16.40	0.50	
17.85	18.10	1.00	

CASING

Hole diameter	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
150	18.20	150	17.82

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
13/11/1997	0000	1.40	1.00	20.0	slow	0.00	4.50
13/11/1997	0000	13.45	8.75	20.0	fast	13.30	0.00

GENERAL NOTES

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	S	N=30 (2,16,19,4,3,4)
2.00	S	N=14 (3,4,6,3,2,3)
4.00	S	N=2 (2,1,1,0,0,1)
6.00	S	N=1 (0,0,0,1,0,0)
8.50	S	N=1 (0,0,1,0,0,0)
11.50	S	N=1 (0,0,0,0,0,1)
13.70	C	N=37 (4,7,9,9,10,9)
15.00	C	N=38 (4,7,8,8,10,12)
16.50	C	N=40 (3,5,8,10,11,11)
17.20	S	N=30 (4,5,6,7,8,9)
18.10	S	25/50mm, 50/50mm

* Seating blows only.

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

Form	CP HEADER
Version	2.00
Revised	25/06/1997

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Borehole No.
BHH1
Sheet 1 of 2

Contract No.	F10895	Method	Cable Percussion	Coordinates	333676.1 E
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon		185237.1 N
		Driller	I.M	Ground Level	7.70m AOD
Client	Welsh Office	Logged by	C.D	Orientation	Vertical
				Date Started	13/11/1997
Consultant	Ove Arup and Partners			Date Completed	14/11/1997

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling	SPT N & (U blows)	SPT type & depth	Install-ation
MADE GROUND: Brownish grey sandy clay with some sub-angular gravel size fragments of brick, concrete and rubble, with occasional fragments of wood, strong hydrocarbon odour.				D 0.20 B 0.30 - 0.55			
---at 0.90m moderate petroleum odour				D 0.90 D 1.00 W 1.00	S30	S 1.00 1.45	
				B 1.45 - 1.70			
				D 1.85 D 2.00	S14	S 2.00 2.45	
		2.15	5.55				
Firm brown mottled grey thinly laminated CLAY. (Estuarine Alluvium)				B 2.45 - 3.00			
				U 3.00 - 3.45	(7)		
		3.30	4.40				
Very soft to soft grey organic CLAY. (Estuarine Alluvium)				D 3.45			
---from 3.45 to 4.00m with occasional vegetation				D 3.80 D 4.00	S1	S 4.00 4.45	
---from 4.00m becomes dark grey				B 4.45 - 5.00			
				B 5.00 - 6.00 U 5.00	NR		
				U 5.50	NR		
				D 6.00	S1	S 6.00 6.53	
		6.70	1.00	D 6.70			
Blackish brown firm fibrous PEAT with occasionally thin and thick laminations of very soft grey silty organic clay. (Peat)				U 6.90 - 7.35	(4)		
				D 7.35			
				D 8.00			
		8.35	-0.65	D 8.35			
Very soft grey very silty sandy CLAY. (Estuarine Alluvium)				D 8.50	S1	S 8.50 8.95	
---from 9.00m with occasional gravel size pockets of blackish brown firm fibrous peat				W 8.90 - 9.50 B 8.95			
				U 10.00 - 10.45	(2)		

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH CP LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Borehole No.
BHH1
Sheet 2 of 2

Contract No.	F10895	Method	Cable Percussion	Coordinates	333676.1 E
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon		185237.1 N
		Driller	I.M	Ground Level	7.70m AOD
Client	Welsh Office	Logged by	C.D	Orientation	Vertical
				Date Started	13/11/1997
Consultant	Ove Arup and Partners			Date Completed	14/11/1997

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
Very soft grey very silty sandy CLAY. (Estuarine Alluvium)				U	10.00 - 10.45	(2)			
				D	10.45				
				D	11.00				
				D	11.50	S1	S	11.50 11.95	
				B	12.00 - 12.50				
		12.85	-5.15	D	12.85				
Firm reddish brown occasionally mottled greyish brown sandy CLAY with occasional sub-angular and sub-rounded sandstone and mudstone gravel. (Estuarine Alluvium)				U	13.00 - 13.43	(20)			
		13.45	-5.75						
---from 13.00m stiff to very stiff				D	13.70 - 14.15	C37	C	13.70 14.15	
Dense reddish brown clayey sandy sub-rounded siliceous GRAVEL, with many cobbles. (Fluvial Alluvium)				B	14.15 - 14.75				
				D	15.00	C38	C	15.00 15.45	
				B	15.45 - 16.00				
				B	16.50 - 17.05	C40	C	16.50 16.95	
				D	16.50				
		17.05	-9.35	D	17.05				
Reddish brown mottled greyish green highly weathered sandy MUDSTONE , weak to moderately weak. (Mercia Mudstone Group)				D	17.20	S30	S	17.20 17.65	
		17.85	-10.15						
Reddish brown moderately weathered sandy MUDSTONE, moderately weak. (Mercia Mudstone Group)		18.00	-10.30	D	18.10	S25/50mm, 50/50mm	S	18.10 18.23	
Cable Percussion boring complete at 18.20 m.									

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH CP LOG
Version	2.00
Revised	19/12/1996

Sampling

Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)
			08/02 0000 DRY	
0.20-0.50	TO			
0.50-1.00	B			
1.50-2.00	TO			
2.00-2.50	B			
2.50-3.00	TO			
3.00		NIL	DRY	

Strata

Description	Depth (Thickness)	Level
	G.L.	8.28
MADE GROUND: Stiff brown mottled grey very silty organic clay with a little sub-rounded fine to coarse gravel of brick and slag and with much root material	(1.20)	
	1.20	7.08
Firm to stiff blue grey mottled brown very silty organic CLAY with some root material	(1.30)	
	2.50	5.78
Firm to stiff brown mottled grey very silty organic CLAY with much root material	(0.50)	
	3.00	5.28
End of Borehole.		

Legend

Equipment: Hand Held Window Sampler

Borehole Dia (mm) Casing Dia (mm)
80 to 1.00m
60 to 3.00m

Groundwater
No. Struck Behaviour Sealed

No groundwater encountered

Ground Level 8.28 m OD
Coordinates 333473.63 mE
185296.04 mN

Drilled by DC
Logged by DC
Checked by AF

Remarks CH33 Changed from trial pit to window sample due to unsuitable access for JCB.

See key sheet and appendices for explanations.

Form 1/0

Borehole Record

Exploration Associates

Project
M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

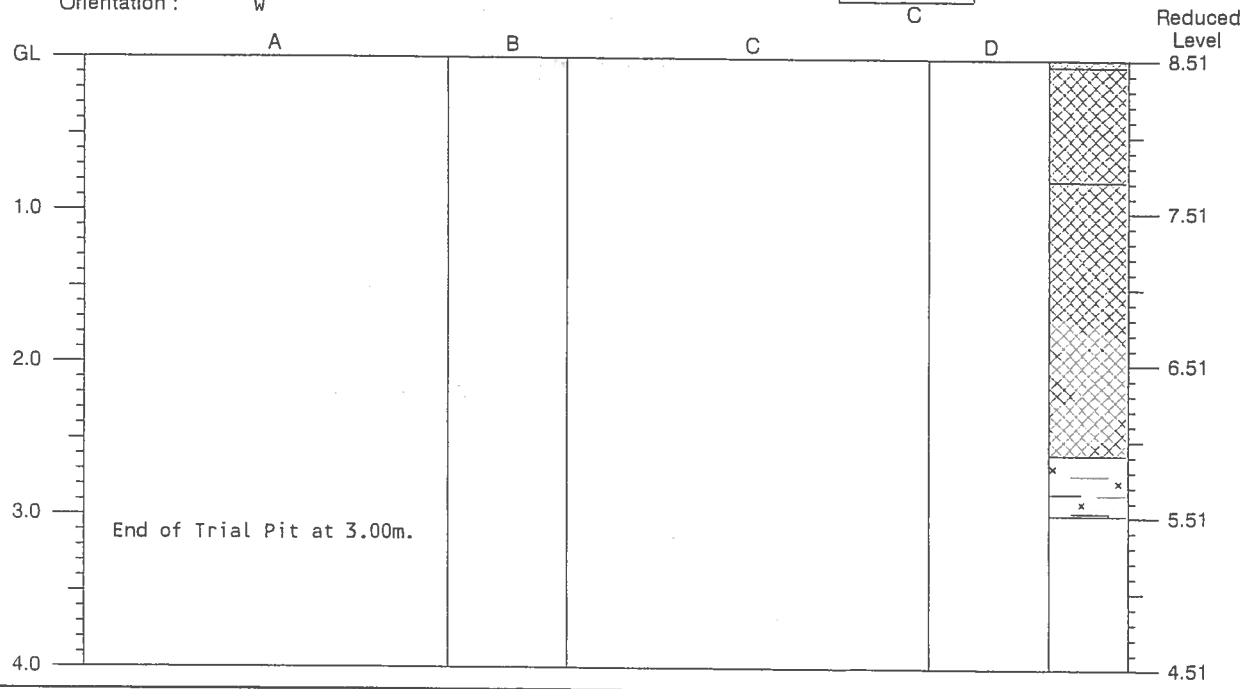
Contract 150006

Borehole CH33(1 of 1)

Dimensions : 2.60 x 1.40

Orientation : W

Orientation →



Strata

Depth (m)	No.	Description
0.00-0.05	1	MADE GROUND: Loose brown sandy angular to sub-angular fine to coarse gravel of limestone (hardcore).
0.05-0.80	2	MADE GROUND: Firm brown mottled grey very silty clay with occasional sub-angular to sub-rounded fine to coarse gravel of siltstone with much root material.
0.80-2.60	3	MADE GROUND: Firm to stiff grey mottled brown very silty clay with occasional to some root material. ....at 1.00m a little sub-angular fine to coarse gravel of slag ....at 2.00m some pockets of brown fibrous peat ....at 2.40m much root material
2.60-3.00	4	Firm to stiff brown mottled blue grey very silty CLAY with some root material

Samples and Tests

Depth (m)	Type	Results
0.15-0.50	BTO	
1.40-1.60	BTO	
2.60-2.70	BTO	

Date of Excavation 01/02/00
Equipment JCB 3CX
Stability Stable

Groundwater

No.	Struck	Behaviour
		Not encountered during excavation

Ground Level 8.51 m OD
Coordinates 333500.60 mE
185283.99 mN

Logged by DC
Checked by AF

Remarks

See key sheet
and appendices
for explanations.

Form 2/0

Trial Pit Record

Exploration Associates

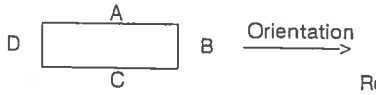
Project
M4 Relief Road - Stage 2. Preliminary
Chemical Investigation
Ove Arup & Partners

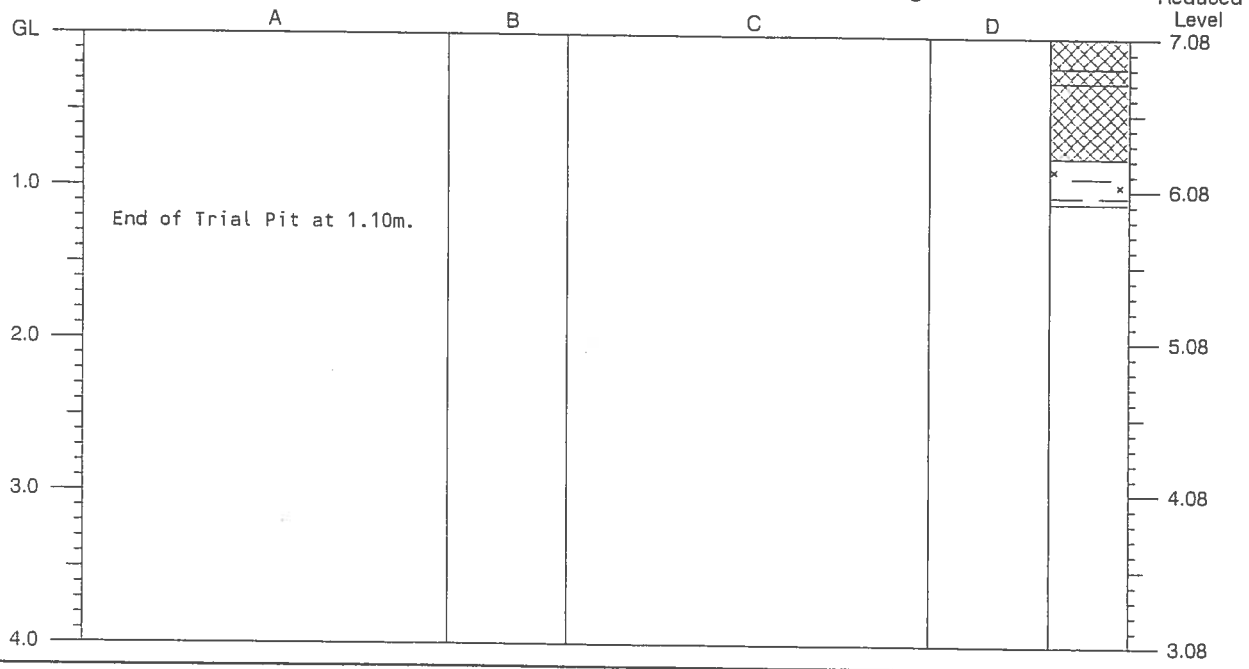
Contract 150006

Trial Pit CH34

Dimensions : 2.60 x 1.30

Orientation : W





Strata

Depth (m)	No.	Description
0.00-0.20	1	MADE GROUND: Moderately compact grey and brown slightly silty sand sub-angular to sub-rounded fine to coarse gravel and cobbles of slag, ash, concrete, brick, limestone (strong acidic odour).
0.20-0.30	2	MADE GROUND: Moderately compact brown sandy angular to sub-angular fine to coarse gravel of limestone (sub-base).
0.30-0.80	3	MADE GROUND: Moderately compact grey sandy very silty very clayey sub-angular fine to coarse gravel and cobbles of concrete, slag, ash, limestone and siltstone with some boulders (<440mm) of slag and concrete and some metal piping (5%).
0.80-1.10	4	Stiff blue grey mottled brown very silty organic CLAY with much root material.

Samples and Tests

Depth (m)	Type	Results
0.00-0.20	BTO	
0.20-0.30	BTO	
0.50-0.70	BTO	
0.80	W	
0.80-1.10	BTO	

Date of Excavation 01/02/00
Equipment JCB 3CX
Stability Stable

Groundwater

No.	Struck	Behaviour
1	0.80	medium inflow

Ground Level 7.08 m OD
Coordinates 333540.67 mE
185256.56 mN

Logged by DC
Checked by AF

Remarks

See key sheet and appendices for explanations.

Form 2/0

Trial Pit Record

Exploration Associates

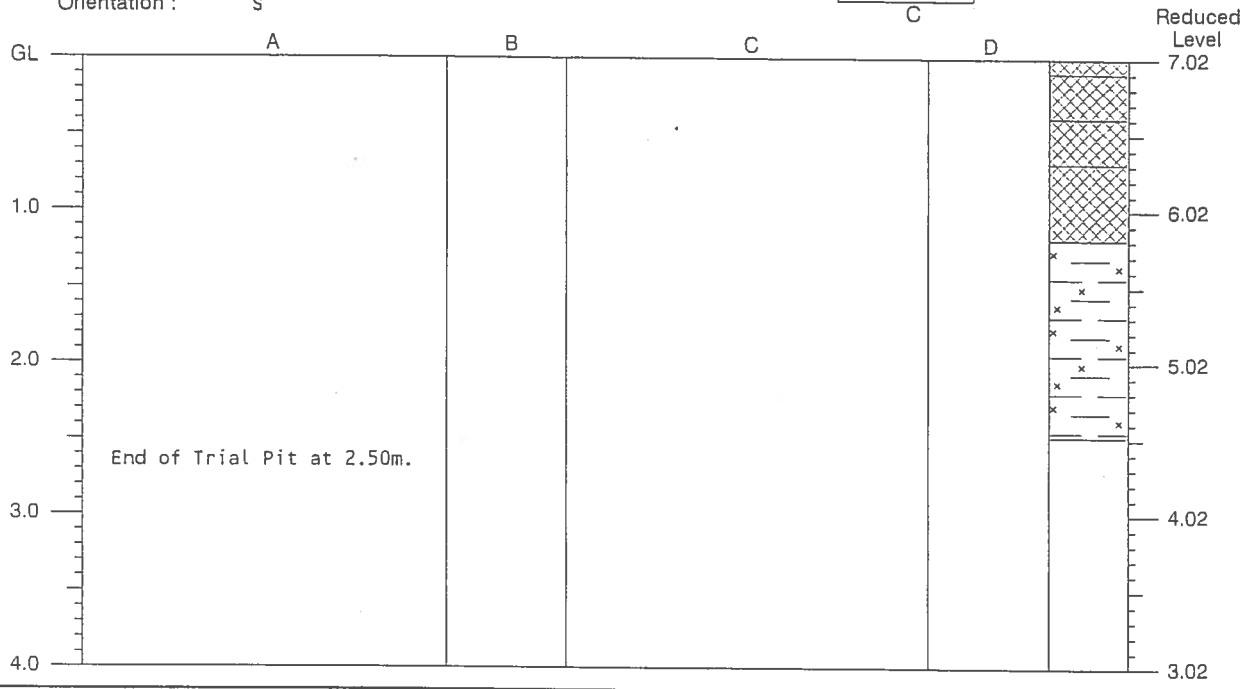
Project
M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

Contract 150006

Trial Pit CH35

Dimensions : 1.00 x 1.80

Orientation : S



Strata

Depth (m)	No.	Description
0.00-0.10	1	MADE GROUND: Loose dark grey sandy slightly silty angular to sub-angular fine to coarse gravel of limestone and sandstone.
0.10-0.40	2	MADE GROUND: Loose brown sandy angular to sub-angular fine to coarse gravel and cobbles of limestone (sub-base).
0.40-0.70	3	Firm grey very silty organic CLAY.
0.70-1.20	4	Firm to stiff grey and brown very silty organic CLAY with much root material.
1.20-2.50	5	Firm brown mottled grey very silty CLAY with some root material. ....from 1.90m becoming soft to firm

Samples and Tests

Depth (m)	Type	Results
0.00-0.10	BTO	
0.10-0.40	BTO	
0.70-1.00	BTO	
1.50-1.70	BTO	

Date of Excavation 01/02/00
Equipment JCB 3CX
Stability Stable

Groundwater
No. Struck Behaviour
Not encountered during excavation

Ground Level 7.02 m OD
Coordinates 333550.07 mE
185225.06 mN

Logged by DC
Checked by AF

Remarks

See key sheet and appendices for explanations.

Form 2/0

Trial Pit Record

Exploration Associates

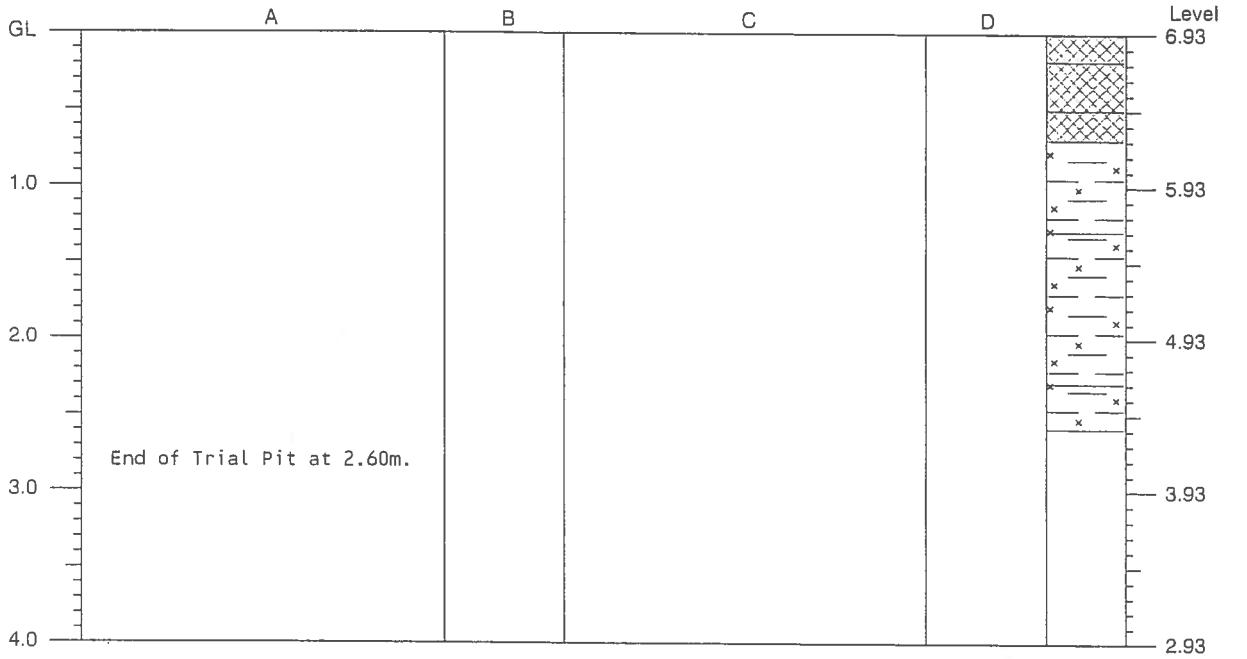
Project
M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

Contract 150006

Trial Pit CH36

Dimensions : 1.00 x 2.00

Orientation : E



Strata

Depth (m)	No.	Description
0.00-0.18	1	MADE GROUND: Loose dark grey sandy angular to sub-angular fine to coarse gravel of limestone (hardcore).
0.18-0.50	2	MADE GROUND: Brown and grey slightly silty slightly clayey angular to sub-angular cobbles and boulders (<880mm) of brick and concrete with some refuse of plastic (1%).
0.50-0.70	3	MADE GROUND: Firm blue grey very silty clay with many sub-angular fine to coarse gravel and cobbles of brick and much root material and refuse of plastic (1%).
0.70-1.30	4	Firm to stiff blue grey mottled brown very silty organic CLAY.
1.30-2.30	5	Firm stiff brown mottled blue grey very silty CLAY with much root material.
2.30-2.60	6	Soft to firm blue grey very silty CLAY with occasional root material.

Samples and Tests

Depth (m)	Type	Results
0.00-0.18	BTO	
1.20-1.30	BTO	
1.50-2.00	BTO	
2.30-2.60	BTO	

Date of Excavation 01/02/00
Equipment JCB 3CX
Stability Stable

Groundwater

No.	Struck	Behaviour
1	2.00	slight seepage

Ground Level 6.93 m OD
Coordinates 333588.39 mE
185235.73 mN

Logged by DC
Checked by Af

Remarks

See key sheet and appendices for explanations.

Form 2/0

Trial Pit Record

Exploration Associates

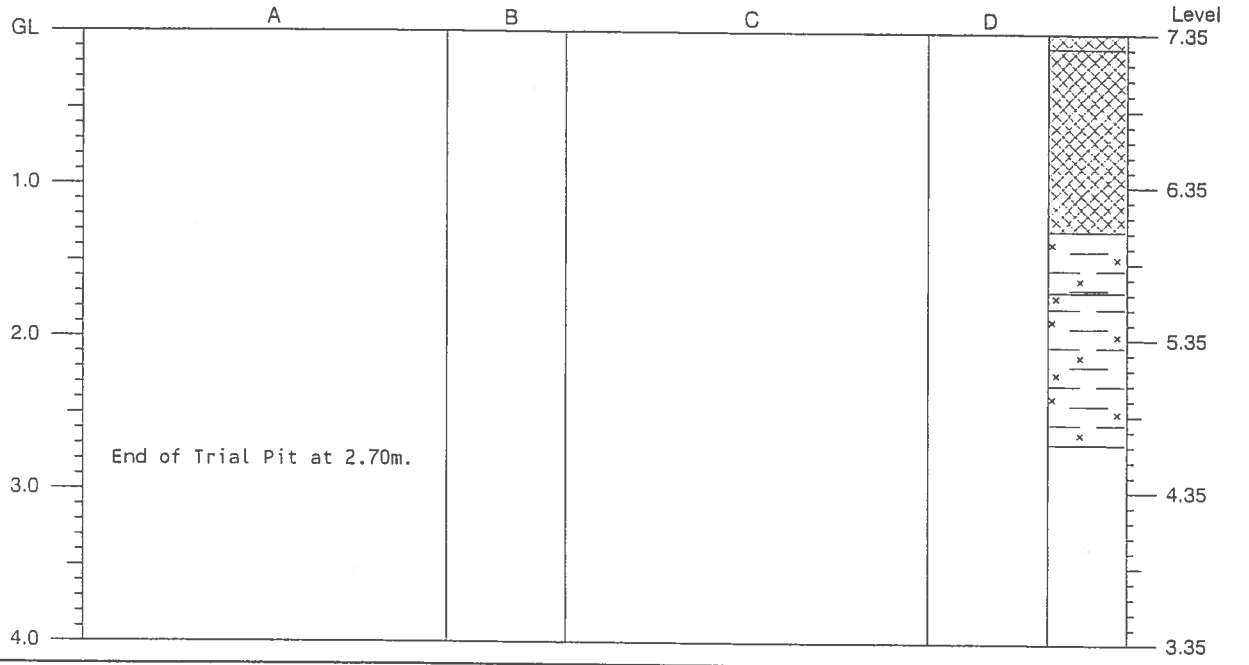
Project
M4 Relief Road - Stage 2. Preliminary Chemical Investigation
Ove Arup & Partners

Contract 150006

Trial Pit CH37

Dimensions : 1.10 x 1.90

Orientation : S



Strata

Depth (m)	No.	Description
0.00-0.10	1	MADE GROUND: Loose dark grey sandy angular to sub-angular fine to coarse gravel of limestone and siltstone (hardcore).
0.10-1.30	2	MADE GROUND: Brown sandy sub-angular cobbles and boulders (>900mm) of concrete and brick with much refuse of wood (5%), metal (5%) and plastic (1%).
1.30-1.70	3	Firm to stiff blue grey mottled brown very silty CLAY with much root material.
1.70-2.70	4	Soft to firm brown mottled blue grey very silty CLAY with much root material.

Samples and Tests

Depth (m)	Type	Results
0.10-0.80	BTO	
1.30-1.70	BTO	
2.50-2.70	BTO	

Date of Excavation 01/02/00
Equipment JCB 3CX
Stability Stable

Groundwater

No.	Struck	Behaviour
		Not encountered during excavation

Ground Level 7.35 m OD
Coordinates 333599.73 mE
185219.05 mN

Logged by DC
Checked by AF

Remarks

See key sheet
and appendices
for explanations.

Form 2/0

Trial Pit Record

Exploration Associates

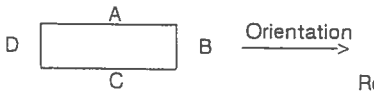
Project
M4 Relief Road - Stage 2. Preliminary
Chemical Investigation
Ove Arup & Partners

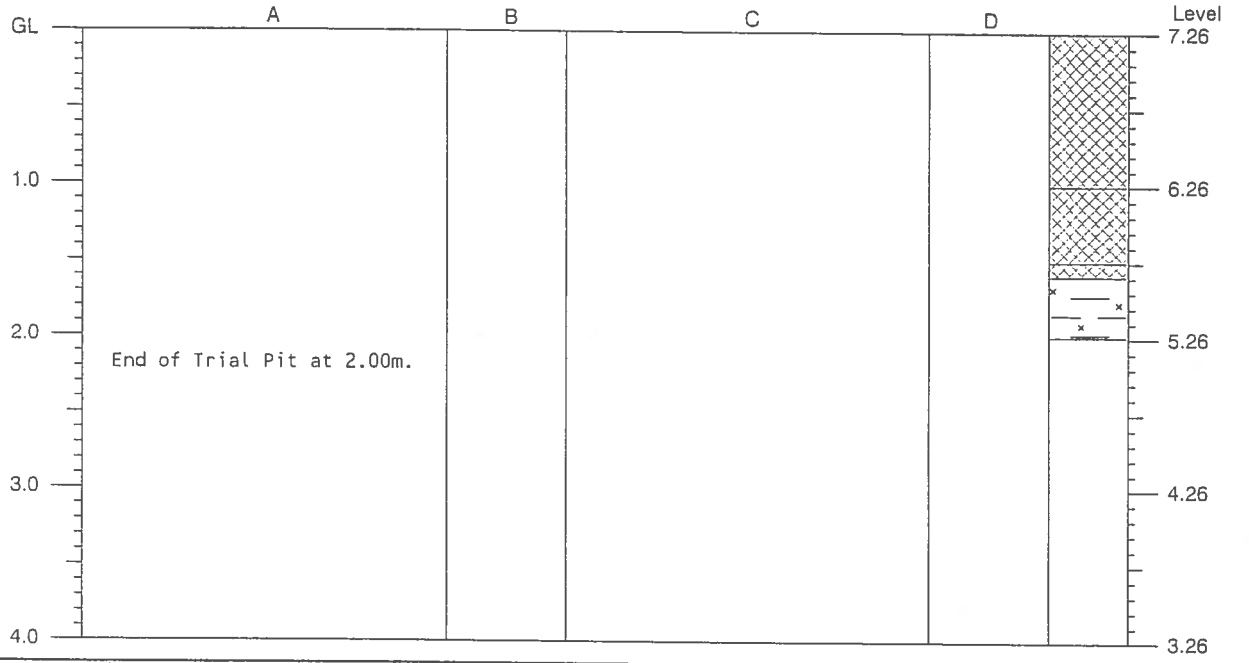
Contract 150006

Trial Pit CH38

Dimensions : 1.00 x 2.00

Orientation : S





Strata

Depth (m)	No.	Description
0.00-1.00	1	MADE GROUND: Soft to firm brown very silty sandy clay with much sub-rounded to sub-angular fine to coarse gravel and cobbles of concrete, brick, sandstone and boulders (<560mm) of concrete and occasional refuse of plastic (1%).
1.00-1.50	2	MADE GROUND: Moderately compact brown sandy very silty clayey sub-angular to sub-rounded fine to coarse gravel and cobbles of concrete, brick, slate, sandstone and slag with some boulders (<500mm) of concrete and refuse of wood (5%) and metal (5%).
1.50-1.60	3	MADE GROUND: Concrete.
1.60-2.00	4	Firm to stiff blue grey mottled brown very silty organic CLAY with much root material.

Samples and Tests

Depth (m)	Type	Results
0.00-0.60	BTO	
1.00-1.30	BTO	
1.60-2.00	BTO	

Date of Excavation 02/02/00
Equipment JCB 3CX
Stability Stable

Groundwater

No.	Struck	Behaviour
1	1.40	slight seepage

Ground Level 7.26 m OD
Coordinates 333612.01 mE
185209.37 mN

Logged by DC
Checked by AF

Remarks

See key sheet
and appendices
for explanations.

Form 2/0

Trial Pit Record

Exploration Associates

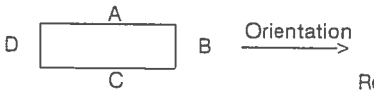
Project
M4 Relief Road - Stage 2. Preliminary
Chemical Investigation
Ove Arup & Partners

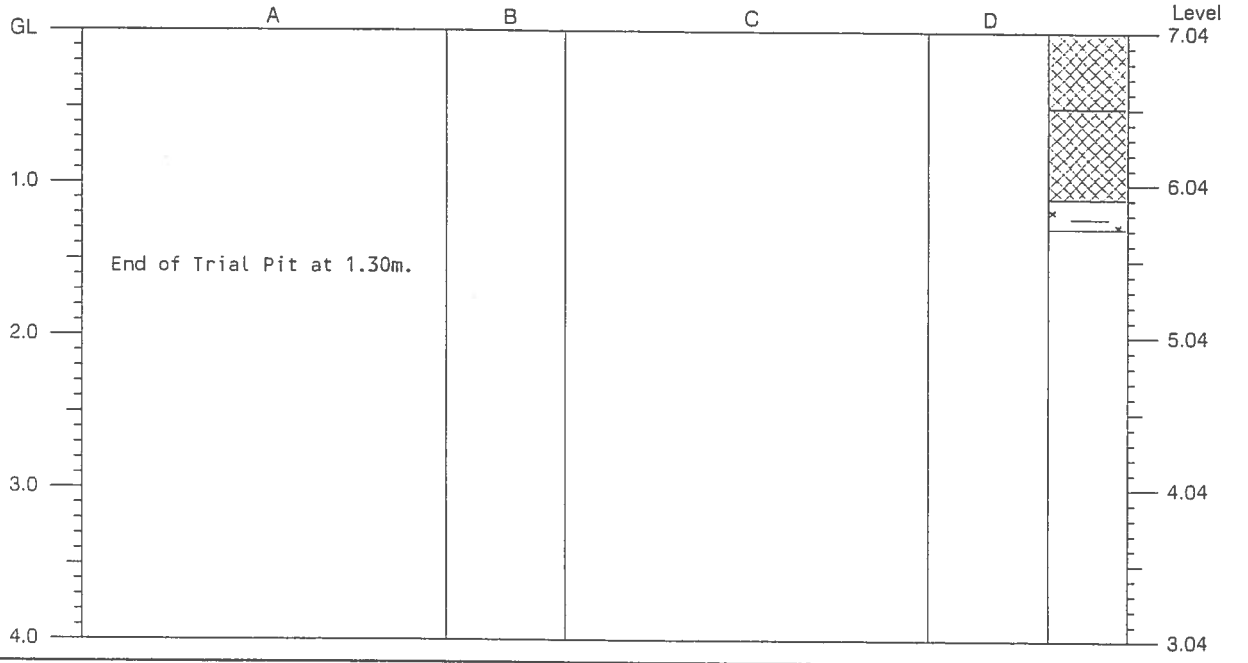
Contract 150006

Trial Pit CH39

Dimensions : 1.20 x 2.50

Orientation : S





Strata

Depth (m)	No.	Description
0.00-0.50	1	MADE GROUND: Loose brown sandy angular to sub-angular fine to coarse gravel of limestone (hardcore). ....at 0.50m a layer of "terram".
0.50-1.10	2	MADE GROUND: Moderately compact brown and grey sandy angular to sub-angular fine to coarse gravel and cobbles of concrete, brick, slag, sandstone and limestone with many boulders (<1400mm) of concrete and some refuse of plastic (5%) and metal (10%).
1.10-1.30	3	Firm to stiff blue grey mottled brown very silty organic CLAY.

Samples and Tests

Depth (m)	Type	Results
0.00-0.50	BTO	
0.50-0.80	BTO	
1.10-1.30	BTO	
1.10	W	

Date of Excavation 02/02/00
Equipment JCB 3CX
Stability Stable

Groundwater

No.	Struck	Behaviour
1	1.10	fast strike

Ground Level 7.04 m OD
Coordinates 333641.12 mE
185239.97 mN

Logged by DC
Checked by AF

Remarks

See key sheet
and appendices
for explanations.

Form 2/0

Trial Pit Record

Exploration Associates

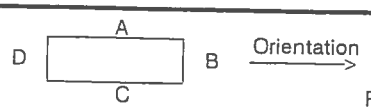
Project
M4 Relief Road - Stage 2. Preliminary
Chemical Investigation
Ove Arup & Partners

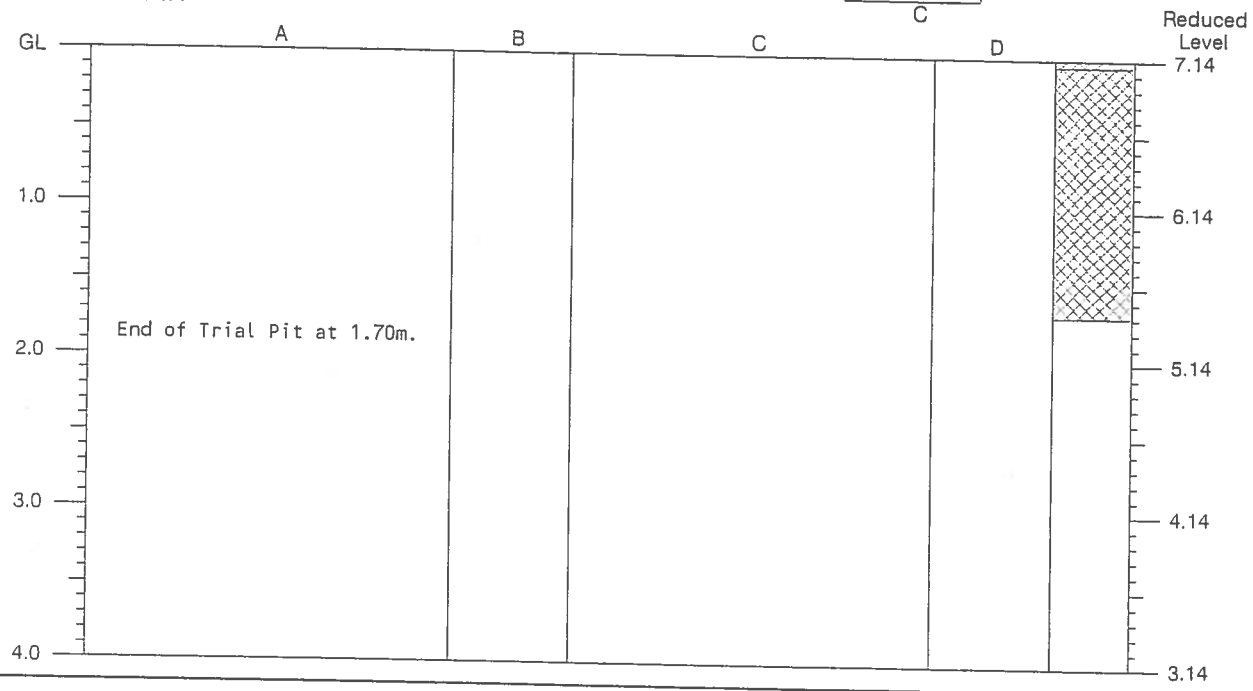
Contract 150006

Trial Pit CH40

Dimensions :

Orientation :





Strata

Depth (m)	No.	Description
0.00-0.05	1	Brown sandy TOPSOIL.
0.05-1.70	2	MADE GROUND: Brown and grey sandy very silty clayey sub-angular fine to coarse gravel and cobbles of concrete, brick and sandstone and many boulders (<900mm) of concrete "bollards". ....from 1.40m becoming dark grey ("oil film" noticed on water in pit and on spoil excavated).

Samples and Tests

Depth (m)	Type	Results
0.05-0.40	BTO	
1.10	W	
1.40	BTO	

Date of Excavation 01/02/00
Equipment JCB 3CX
Stability Stable

Groundwater

No.	Struck	Behaviour
1	1.10	medium inflow

Ground Level 7.14 m OD
Coordinates 333625.63 mE
185205.04 mN

Logged by DC
Checked by AF

Remarks

See key sheet
and appendices
for explanations.

Form 2/0

Trial Pit Record

Exploration Associates

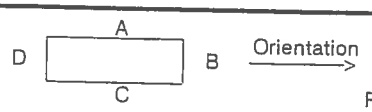
Project
M4 Relief Road - Stage 2. Preliminary
Chemical Investigation
Ove Arup & Partners

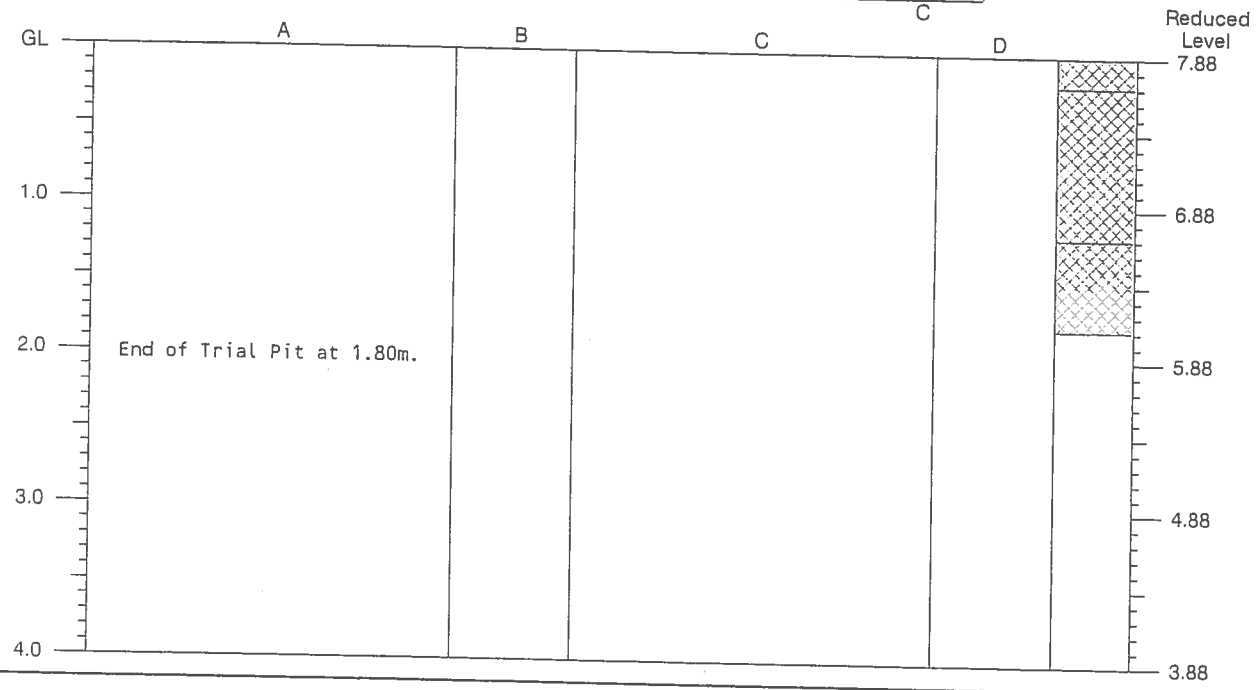
Contract 150006

Trial Pit CH41

Dimensions :

Orientation :





Strata

Depth (m)	No.	Description
0.00-0.20	1	Brown sandy very silty clayey TOPSOIL.
0.20-1.20	2	MADE GROUND: Loose brown sandy very silty very clayey sub-angular to sub-rounded fine to coarse gravel and cobbles of brick, concrete, slag and ash.
1.20-1.80	3	MADE GROUND: Moderately compact brown slightly sandy cobbles and boulders (<1000mm) of concrete, brick and slag with some refuse of plastic (1%) and metal (5%).

Samples and Tests

Depth (m)	Type	Results
0.20-0.70	BTO	
1.20-1.30	BTO	—

Date of Excavation 01/02/00
Equipment JCB 3CX
Stability Stable

Groundwater

No.	Struck	Behaviour
1	1.60	medium inflow

Ground Level 7.88 m OD
Coordinates 333681.23 mE
185236.03 mN

Logged by DC
Checked by Af

Remarks

See key sheet
and appendices
for explanations.

Form 2/0

Trial Pit Record

Exploration Associates

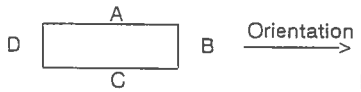
Project
M4 Relief Road - Stage 2. Preliminary
Chemical Investigation
Ove Arup & Partners

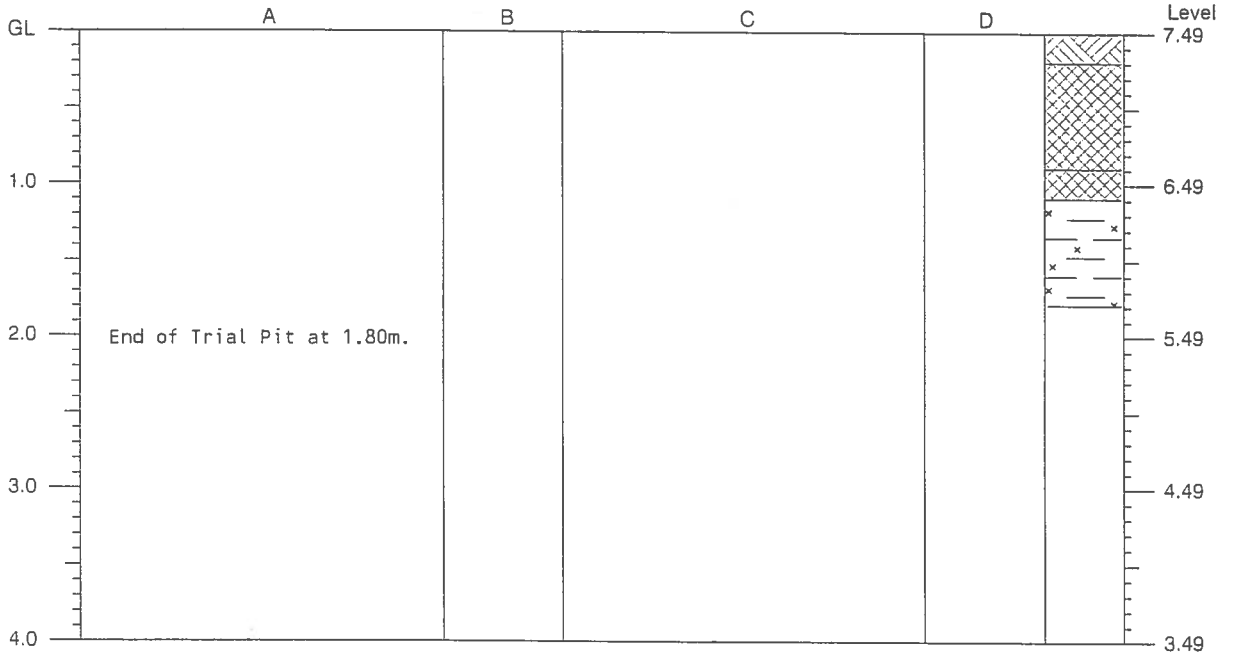
Contract 150006

Trial Pit CH42

Dimensions :

Orientation :





Strata

Depth (m)	No.	Description
0.00-0.20	1	Brown sandy very silty clayey TOPSOIL.
0.20-0.90	2	MADE GROUND: Firm stiff blue grey and brown very silty clay with much sub-rounded to sub-angular fine to coarse gravel and cobbles of concrete, brick, sandstone and slag and with some wooden sleepers.
0.90-1.10	3	MADE GROUND: Compact brown and grey slightly sandy cobbles and boulders (<1200) of concrete and brick.
1.10-1.80	4	Firm to stiff blue grey mottled brown very silty slightly organic CLAY with much root material.

Samples and Tests

Depth (m)	Type	Results
0.20-0.70	BTO	
1.30-1.80	BTO	

Date of Excavation 02/02/00
Equipment JCB 3CX
Stability Stable

Groundwater
No. Struck Behaviour
Not encountered during excavation

Ground Level 7.49 m OD
Coordinates 333709.24 mE
185218.15 mN

Logged by DC
Checked by AF

Remarks

See key sheet
and appendices
for explanations.

Form 2/0

Trial Pit Record

Exploration Associates

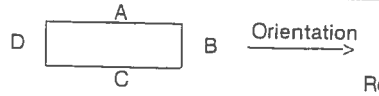
Project
M4 Relief Road - Stage 2. Preliminary
Chemical Investigation
Ove Arup & Partners

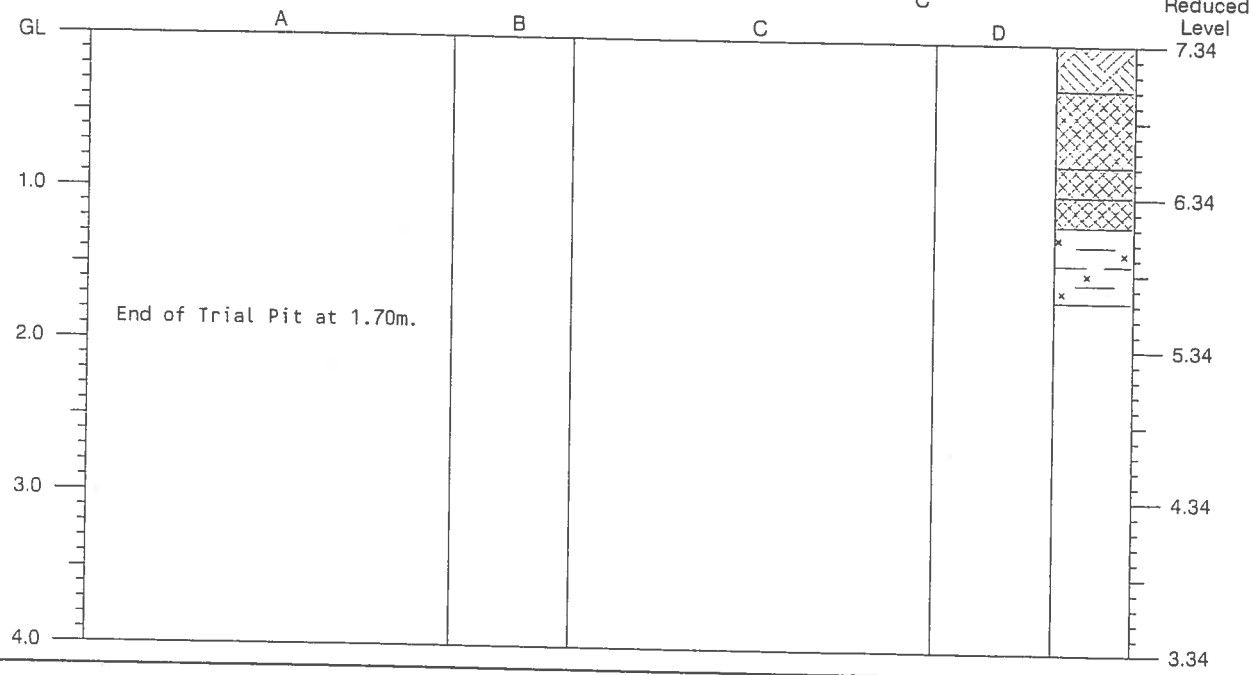
Contract 150006

Trial Pit CH43

Dimensions :

Orientation :





Strata

Depth (m)	No.	Description
0.00-0.30	1	Brown very silty clayey TOPSOIL.
0.30-0.80	2	MADE GROUND: Loose grey and brown sandy very silty clayey angular to sub-angular fine to coarse gravel and cobbles of brick, concrete, slag, ash and sandstone with some <400mm of concrete.
0.80-1.00	3	MADE GROUND:- Compact brown and grey cobbles and boulders (<450mm) of concrete and brick with some refuse of metal (5%).
1.00-1.20	4	MADE GROUND: Moderately compact brown and grey sandy sub-angular to sub-rounded fine to coarse gravel and cobbles of concrete, brick and sandstone.
1.20-1.70	5	Soft to firm blue grey mottled brown very silty organic CLAY with some root material.

Samples and Tests

Depth (m)	Type	Results
0.30-0.80	BTO	
1.00-1.20	BTO	
1.20-1.50	BTO	

Date of Excavation 02/02/00
Equipment JCB 3CX
Stability Stable

Groundwater

No.	Struck	Behaviour
1	1.70	slight seepage

Ground Level 7.34 m OD
Coordinates 333740.12 mE
185222.28 mN

Logged by DC
Checked by AF

Remarks

See key sheet
and appendices
for explanations.

Form 2/0

Trial Pit Record

Exploration Associates

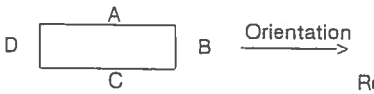
Project
M4 Relief Road - Stage 2. Preliminary
Chemical Investigation
Ove Arup & Partners

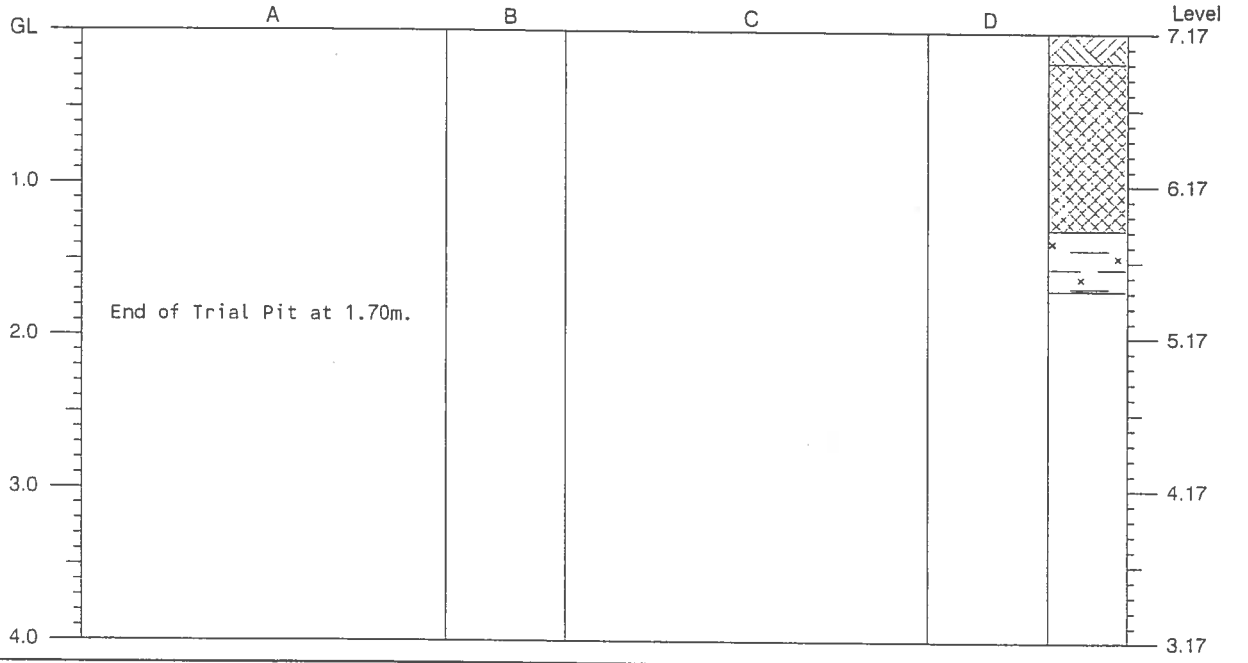
Contract 150006

Trial Pit CH44

Dimensions :

Orientation :





Strata

Depth (m)	No.	Description
0.00-0.20	1	Brown very silty slightly clayey TOPSOIL.
0.20-1.30	2	MADE GROUND: Moderately compact brown and grey sandy angular to sub-angular fine to coarse gravel and cobbles of concrete, brick and sandstone with some boulders (<560mm) of concrete and much refuse of metal (5%).
1.30-1.70	3	Firm to stiff brown mottled orange brown and blue grey very silty organic CLAY.

Samples and Tests

Depth (m)	Type	Results
0.20-0.50	BTO	
1.30-1.70	BTO	
1.30	W	

Date of Excavation 02/02/00
Equipment JCB 3CX
Stability Stable

Groundwater

No.	Struck	Behaviour
1	1.30	medium inflow

Ground Level 7.17 m OD
Coordinates 333784.67 mE
185215.33 mN

Logged by DC
Checked by AF

Remarks

See key sheet
and appendices
for explanations.

Form 2/0

Trial Pit Record

Exploration Associates

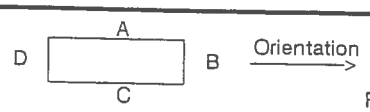
Project
M4 Relief Road - Stage 2. Preliminary
Chemical Investigation
Ove Arup & Partners

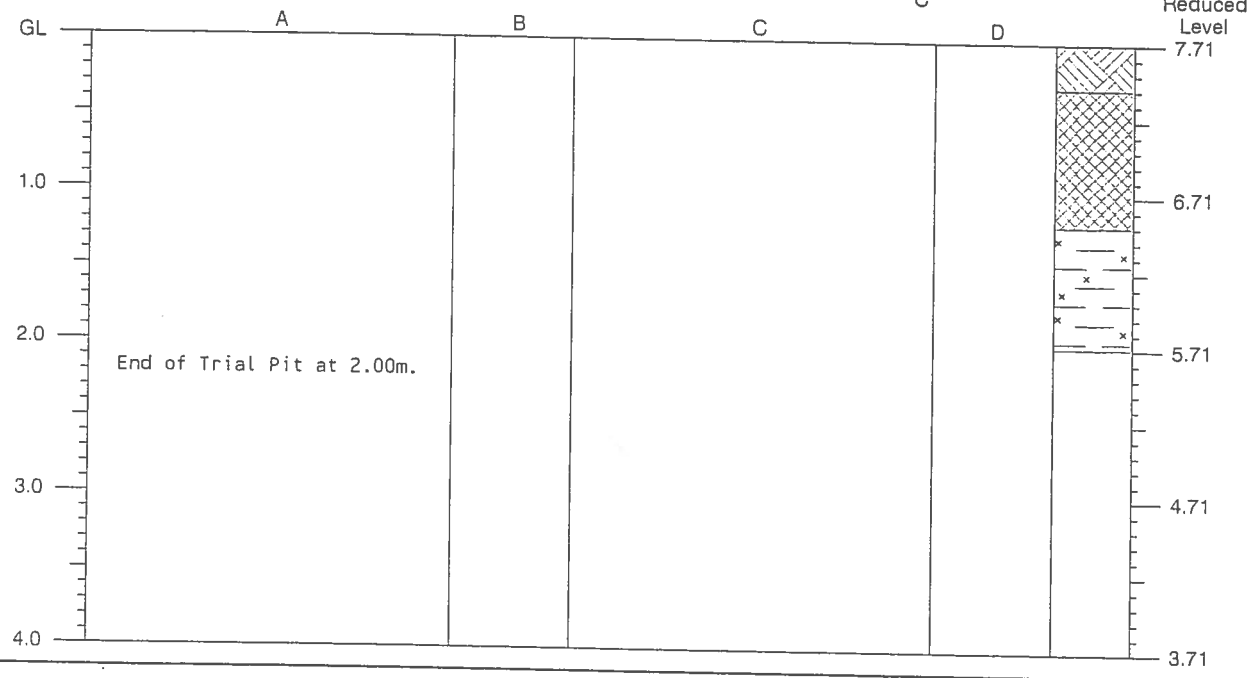
Contract 150006

Trial Pit CH45

Dimensions :

Orientation :





Strata

Depth (m)	No.	Description
0.00-0.30	1	Brown very silty clayey TOPSOIL with a little angular to sub-angular fine to coarse gravel of sandstone.
0.30-1.20	2	MADE GROUND: Loose brown sandy very silty very clayey sub-rounded to sub-angular fine to coarse gravel and cobbles of concrete, brick, slag, ash, slate, sandstone and limestone with occasional boulders (<650mm) of concrete and some refuse of plastic (1%) and metal (5%).
1.20-2.00	3	Firm to stiff blue grey very silty organic CLAY with much root material.

Samples and Tests

Depth (m)	Type	Results
0.50-0.90	BTO	
1.20-1.70	BTO	

Date of Excavation 02/02/00
Equipment JCB 3CX
Stability Stable

Groundwater
No. Struck Behaviour
Not encountered during excavation

Ground Level 7.71 m OD
Coordinates 333757.41 mE
185226.90 mN

Logged by DC
Checked by AF

Remarks

See key sheet
and appendices
for explanations.

Form 2/0

Trial Pit Record

Exploration Associates

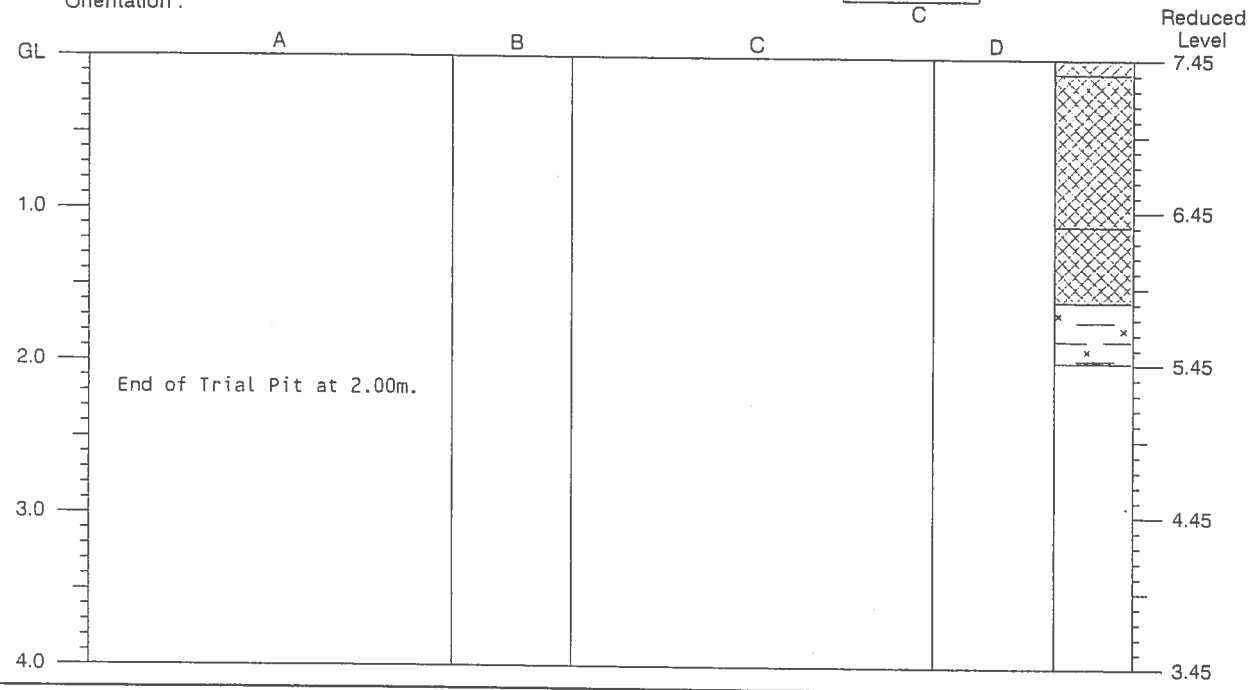
Project
M4 Relief Road - Stage 2. Preliminary
Chemical Investigation
Ove Arup & Partners

Contract 150006

Trial Pit CH46

Dimensions :

Orientation :



Strata

Depth (m)	No.	Description
0.00-0.10	1	Brown sandy very silty slightly clayey TOPSOIL.
0.10-1.10	2	MADE GROUND: Moderately compact brown sandy very silty very clayey angular to sub-angular fine to coarse gravel of concrete, brick, slag, ash and sandstone with some boulders (<1080mm) of concrete and some refuse of plastic (1%), metal (5%) and wood (1%).
1.10-1.60	3	MADE GROUND: Firm to stiff blue grey very silty slightly organic clay with a little angular to sub-angular fine to coarse gravel of concrete and brick.
1.60-2.00	4	Firm to stiff brown very silty organic CLAY.

Samples and Tests

Depth (m)	Type	Results
0.20-0.60	BTO	
1.10-1.60	BTO	
1.60-2.00	BTO	

Date of Excavation 02/02/00
Equipment JCB 3CX
Stability Stable

Groundwater
No. Struck Behaviour
Not encountered during excavation

Ground Level 7.45 m OD
Coordinates 333783.57 mE
185246.27 mN

Logged by DC
Checked by Af

Remarks

See key sheet
and appendices
for explanations.

Form 2/0

Trial Pit Record

Exploration Associates

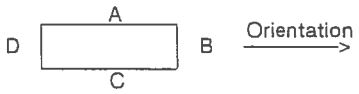
Project
M4 Relief Road - Stage 2. Preliminary
Chemical Investigation
Ove Arup & Partners

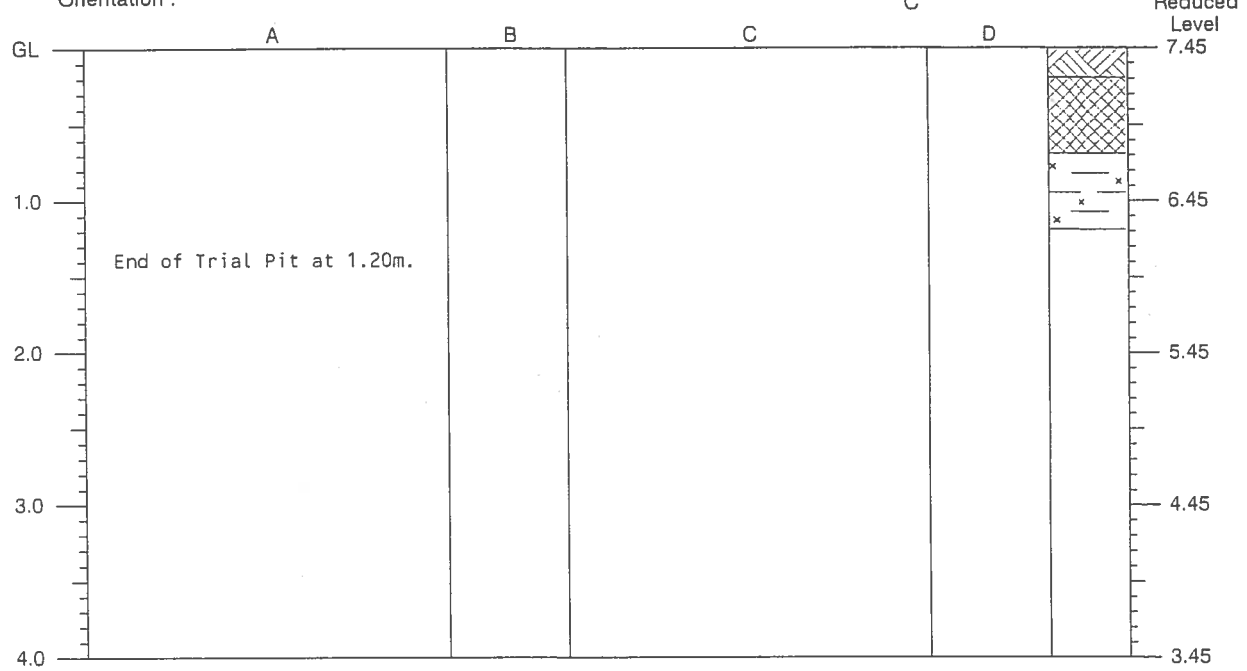
Contract 150006

Trial Pit CH47

Dimensions :

Orientation :





Strata

Depth (m)	No.	Description
0.00-0.20	1	Brown very silty clayey TOPSOIL.
0.20-0.70	2	MADE GROUND: Soft to firm brown very silty clay with occasional refuse of plastic (1%).
0.70-1.20	3	Firm to stiff blue grey very silty slightly organic CLAY.

Samples and Tests

Depth (m)	Type	Results
0.20-0.70	BTO	
0.70-1.20	BTO	

Date of Excavation 02/02/00
Equipment JCB 3CX
Stability Stable

Groundwater

No.	Struck	Behaviour
1	1.20	slight seepage

Ground Level 7.45 m OD
Coordinates 333807.57 mE
185246.27 mN

Logged by DC
Checked by AF

Remarks

See key sheet
and appendices
for explanations.

Form 2/0

Trial Pit Record

Exploration Associates

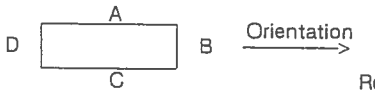
Project
M4 Relief Road - Stage 2. Preliminary
Chemical Investigation
Ove Arup & Partners

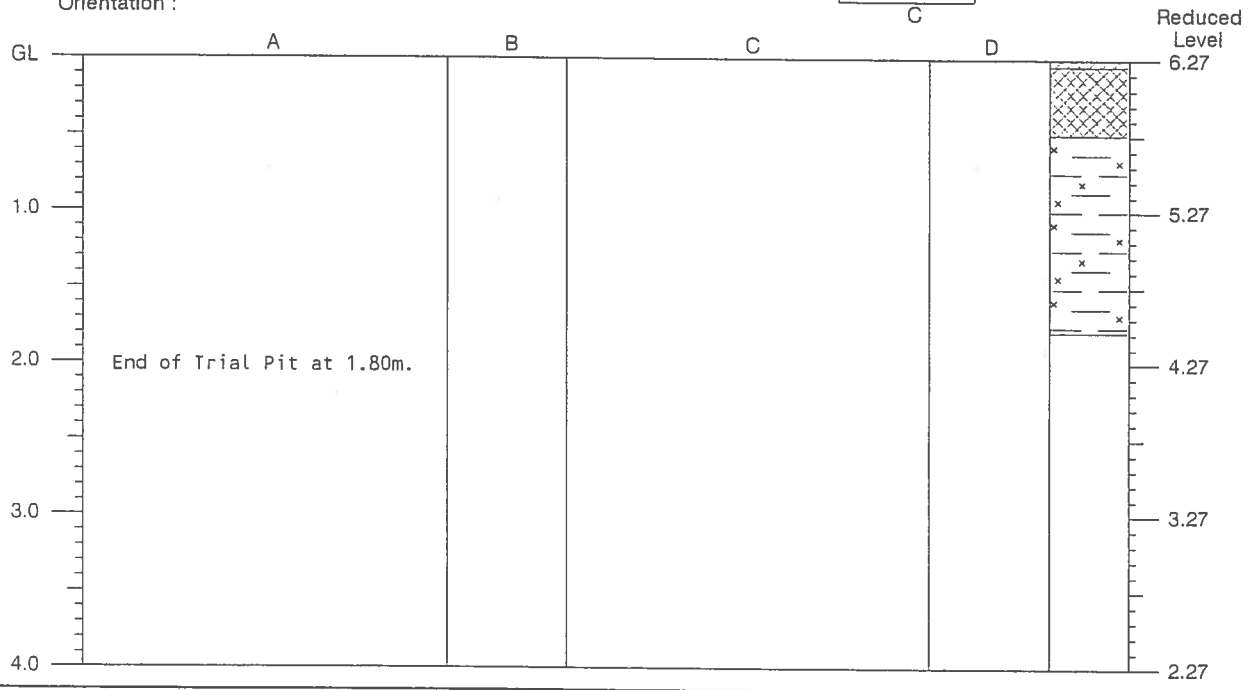
Contract 150006

Trial Pit CH47A

Dimensions :

Orientation :





Strata

Depth (m)	No.	Description
0.00-0.05	1	Brown very silty clayey TOPSOIL.
0.05-0.50	2	MADE GROUND: Very compact brown and grey sandy sub-angular to sub-rounded fine to coarse gravel and cobbles of slag, ash, limestone and sandstone with some boulders (<400mm) of slag.
0.50-1.80	3	Firm to stiff blue grey mottled brown very silty slightly organic CLAY with occasional some root matrial. ....from 1.50m becoming soft to firm.

Samples and Tests

Depth (m)	Type	Results
0.05-0.50	BTO	
1.00-1.20	BTO	
1.50-1.80	BTO	

Date of Excavation 04/02/00
Equipment JCB 3CX
Stability Stable

Groundwater
No. Struck Behaviour
Not encountered during excavation

Ground Level 6.27 m OD
Coordinates 333562.09 mE
185439.87 mN

Logged by DC
Checked by AF

Remarks

See key sheet
and appendices
for explanations.

Form 2/0

Trial Pit Record

Exploration Associates

Project
M4 Relief Road - Stage 2. Preliminary
Chemical Investigation
Ove Arup & Partners

Contract 150006

Trial Pit CH48

A2 Appendix 2

Tabulated Groundwater Monitoring Data

NORWEST HOLST SOIL ENGINEERING LTD.

M4 RELIEF ROAD MAGOR TO CASTLETON STAGE 2

PIEZOMETER RECORDS BHG6

DATE	TIME(24hr)	WATER LEVEL(m)	WATER LEVEL mOD
11/27/97	9:30	4.72	2.28
12/3/97	9:05	4.03	2.97
12/11/97	13:00	4.52	2.48
12/17/97	11:55	4.68	2.32

TIP DEPTH:16.00m

TYPE OF COVER:BARREL

HEIGHT OF COVER A.B.G.L:0.11m

HEIGHT OF PIPE A.B.G.L:0.09m

COMMENTS:

A3 Appendix 3

Tabulated Soil Laboratory Data

M4CAN
Soil Sample Analysis & Screening Assessment
CL-17
14/07/2015

Geological Formation Legend

MG	Made Ground
TFD	Tidal Flat Deposit
GFD	Glaciofluvial Deposits
MMG	Mercia Mudstone Group

Screening Values and Assessment

(orange)	Exceeds S4ULs criteria
x	Laboratory detection level higher than screening criterion

Notes
NFD No Fibres Detected
Chromium VI criteria used
Elemental Mercury criteria used
Screening criterion for lead is C4SL in the absence of a S4UL

Sample Reference	Units	BHG6	BHH1	BHH1	BHH1	CH33	CH34	CH34	CH35	CH35	CH35	CH36	CH37	CH38	CH39	CH39	CH40	CH40	CH41	CH41	CH42	CH42	CH43	CH44	CH44	CH45	CH46	CH47	CH47	CH47A	CH48	CP/RH01	CP/RH02	TP03	TP04	TP04	TP04	TP05	TP05	TP06	TP07	TP08	TP09	TP10	TP11
Specimen Depth (m)		0.3	0.2	0.9	1.85	0.2	0.15	1.4	0	0.5	0.8	0.1	0	0.1	0	1	0	0.5	0.05	1.4	0.2	1.2	0.2	0.3	1	0.2	0.5	0.1	1.1	0.2	0.05	0.2-0.25	0.2-0.5	0.1-0.2	0.3-0.4	0.7-0.8	0.8-0.9	0.2-0.5	0.6-0.7	0.1-0.3	0.2-0.5	0.1-0.3	0.2-0.5	0.1-0.2	0.2-0.3
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
Investigation Date		1997 GI	1997 GI	1997 GI	1997 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2008 GI	2008 GI	2008 GI	2008 GI	2008 GI	2008 GI	2008 GI	2008 GI	2008 GI	2008 GI	2008 GI	2008 GI	2008 GI	2008 GI
Metals																																													
Arsenic	mg/kg	11.2	9.6	13.4	11	13.3	16	13	6.9	15	13	6	3.8	9.8	12	12	8.3	8.3	9.8	8.1	7.4	7.7	10.2	7.91	8.15	8.74	7.34	9.03	13.6	7.52	3.41	100	120	230	170	270	50	24	260	67	100	160	100	91	460
Boron	mg/kg	1.1	0.9	0.5	1	1.1	2.9	1	0.8	<2.4	2.9	<0.5	<0.5	<0.5	<0.5	0.5	0.7	0.7	<0.5	<0.5	0.6	<0.5	0.7	0.7	1	0.6	0.6	1	1.3	1.2	1.8														
Cadmium	mg/kg	1.1	1.2	2	1	0.12	0.13	0.13	1.37	0.27	0.17	7.17	1.57	0.83	0.54	0.71	0.41	0.41	0.35	0.75	1.15	1.7	0.1	0.47	0.4	0.14	0.5	0.46	0.14	0.43	0.13	0.78	1	1.2	0.71	0.88	<0.25	<0.25	0.92	0.96	0.55	0.73	0.51	0.44	1.9
Chromium	mg/kg	35.8	39.2	55.1	41.1	40	45	38	56	0.031	0.03	0.025	18	221	142	184	10	74	120	272	0.037	0.043	41	49	50	76	87	54	51	67	349	14	39	57	28	43	8.1	8	42	13	38	26	20	16	45
Copper	mg/kg	17.5	33.8	44.1	37	16	17	14	343	0.022	0.012	0.022	35	52	40	34	20	20	31	64	0.025	0.026	15	41	16	19	31	22	18	20	30	29	16	29	11	9.4	2.7	<2.5	18	10	15	15	9.4	17	77
Lead	mg/kg	50.9	74.8	71.1	73.5	56	59	45	95	71	45	128	75	368	497	98	53	53	85	61	54	64	44	62	46	45	124	54	84	55	56	40	45	53	39	28	6.3	5.4	32	41	38	42	33	25	54
Mercury	mg/kg	0.5	30.9	24.8	4.8	0.64	0.18	0.43	<15.2	<0.67	0.2	1.09	2.34	5.96	4.22	7.67	9.82	9.82	6.83	12.5	8.88	14.9	0.07	34	7.66	0.19	2.5	1.02	0.14	2.27	0.15	0.4	<0.2	<0.2	2.9	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.3	0.4	0.5	0.5
Nickel	mg/kg	17.9	31.9	40.5	221.7	33	34	33	31	25	28	11	14	29	34	46	24	24	28	32	26	33	31	28	15	11	37	24	36	22	7	14	16	47	78	33	5.7	3.4	38	9.5	16	21	15	11	67
Selenium	mg/kg	0.6	0.3	0.2	0.3	0.47	<0.5	<0.5	1.51	<0.89	<0.5	1.55	1.39	0.94	1.49	1.38	0.89	0.89	1.37	0.91	1.08	1.03	0.36	1.03	1.02	0.87	1.14	0.98	<0.5	0.91	1.85	<0.3	0.4	0.4	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.3	<0.3	0.4	0.7	0.3
Zinc	mg/kg	191.5	188.9	225.6	178.4	103	113	100	239	112	90	303	206	499	243	151	134	134	386	488	128	133	91	123	70	37	145	125	118	115	41	240	190	440	93	100	39	11	130	98	200	110	100	160	110
Non-Metal Inorganics																																													
Cyanide (total)	mg/kg	<0.2	<0.1	<0.1	0.1	<1	<1	<1	<1	<0.001	<0.001	<0.001	<1	<1	<1	<1	<1	<1	<1	1	<0.001	<0.001	<1	<1	<1	<1	<1	<1	<1	<1		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Cyanide (free)	mg/kg	0.1	<0.1	<0.1	<0.1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1															
Thiocyanate	mg/kg	<1	<1	<1	<1			8	<2	13	4	<2	<2	2	2	5	<2	<2	2	<2	<2	<2																							
Ferro/ferricyanide	mg/kg	<10	<10	<10	<10																																								
Acid Soluble Sulphate	mg/kg					694	575	424	1630	944	485	2270	1450	1920	1600	2020	2440	2440	1360	1760	1050	987	1340	1690	2550	2950	1560	1210	1050	1100	4810														
Sulphate (total)	mg/kg	1709	2487	1218	2525																																								
Sulphide	mg/kg	4.2	22.1	18.4	30.4	<1	5	<1	<1	13	6	10	2	25	363	122	4	4	803	23	24	10	7	6	17	11	25	44	9	29	762														
Other																																													
pH Value	pH	8.1	11.2	8.4	11.2	8	7.7	8.1	9.4	7.8	7.8	9.5	9.7	9.8	10.3	10.4	11.2	11.2	10.6	10.3	9.4	8.9	9.3	9.8	9.6	11.8	9.7	10	8.1	9.8	10.6	9.3	10	9	8.6	7.5	8.9	9.5	8.4	9	9.2	8.4	9.8	9.7	9.9
Asbestos																																													
Organics																																													
PAH (Screening)	mg/kg	<0.1	155.3	62.5	142.6	16	<10	<10	50	33	<18	432	23	<10	126	610	86	86	62	146	1470	1970	2370	2310	1430	55	1940	47	26	97	72														
VOC (screen)	ug/kg	<100	<100	<100	<100																																								
Mineral Oil	mg/kg	29	1557	452	1630																																								
TPH FTIR (AR)	mg/kg					28	116	420	275	256	40	1530	258	843	245	609	524	524	141	2400	127	244	330	879	162	72	88	273	24	114	25														
OIL FTIR	mg/kg					141	178	104	280	365	238	1749	185	1120	285	2900	894	894	566	866	548	656	906	805	657	251	487	401	93	294	74														
TPH																																													
Aliphatics C5-C6	mg/kg																															<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
Aliphatics >C6-C8	mg/kg																															<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
Aliphatics >C8-C10	mg/kg																															<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
Aliphatics >C10-C12	mg/kg																															<35	<35	<35	<35	<35		<35	<35	<35	<35	<35	54	70	71
Aliphatics >C12-C16	mg/kg																															<50	<50	<50	170	<50		<50	<50	<50	71	<50	<50	<50	<50
Aliphatics >C16-C21	mg/kg																															<100	<100	<100	160	<100		<100	<100	<100	<100	<100	<100	<100	<100
Aliphatics >C21-C35	mg/kg																															<100	<100	<100	220	<100		<100	<100	360	240	<100	<100	<100	120
Aliphatics >C35-C40	mg/kg																															<100	<100	<100	<100	<100		<100	<100	160	<100	<100	<100	<100	<100
Aliphatics >C40-C44	mg/kg																															<100	<100	<100	<100	<100		<100	<100	<100	<100	<100	<100	<100	<100
Total Aliphatics C5-C35	mg/kg																																												
Aromatics >C6-C7	mg/kg																															<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aromatics >C7-C8	mg/kg																															<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aromatics >EC8-EC10	mg/kg																															<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aromatics >EC10-EC12	mg/kg																															<35	<35	<35	<35	<35		<35	<35	<35	<35	<35	54	37	48
Aromatics >EC12-EC16	mg/kg																															<50	<50	<50	<50	<50		<50	57	<50	<50	<50	<50	<50	<50
Aromatics >EC16-EC21	mg/kg																															<100	<100	<100	400	<100		<100	<100	<100	<100	<100	<100	<100	<100
Aromatics >EC21-EC35	mg/kg																															<100	<100	160	2100	<100		<100	<100	480	240	180	140	<100	240
Aromatics >EC35-EC40	mg/kg																															<100	<100	<100	150000	<100		<100	<100	210	<100	<100	<100	<100	<100
Aromatics >EC40-EC44	mg/kg																															<100	<100	<100	<100	<100		<100	<100	360	<100	<100	120	<100	<100
Total Aromatics C6-C35	mg/kg																																												
TPH (Aliphatics and Aromatics C5-C35)	mg/kg																																												
PCB																																													
PCB - ARO	mg/kg	4.6	538	1691.2	418.2	1.1	1.2	2.8	17	18	7.8	27	117	117	94	165	96	96	103	80	1010	1430	136	58	19.9	2	35	238	7	72															
PCB Congener 28	mg/kg																															0.11		0.72	1.1	0.0091	0.18	0.0063	6	0.051					
PCB Congener 52	mg/kg																															0.1		2.1	12	0.037	0.44	0.016	6.7	0.13					
PCB Congener 101	mg/kg																															0.14		2.7	20	0.062	0.66	0.041	7	0.32					
PCB Congener 118	mg/kg																															0.18		2.1	17	0.072	0.92	0.049	7.8	0.45					
PCB Congener 138	mg/kg																															0.19		3	19	0.063	0.93	0.065	7.4	0.47					
PCB Congener 153	mg/kg																															0.25		3.8	24	0.089	1.2	0.084	9.7	0.65					
PCB Congener 180	mg/kg																															0.18		2.5	12	0.044	0.9	0.062	8.6	0.41					
Total PCB Congeners	mg/kg																															1.2		17	110	0.38	5.2	0.32	53	2.5					
Phenols																																													
Phenol Index	mg/kg					<0.5	<0.5	<0.5	<0.5	<1.3	<0.5	<0.5	<0.5	0.8	1.3	1.6	0.8	0.8	<0.5	0.5	0.8	1.1	11.2	0.6	0.7	<0.5	1.5	1.1	<0.5	<0.5	<0.5														
Phenols Monohydric	mg/kg	<1	<1	<1	<1																											<2.5	0.4	1.3	1.6	<2.5	<2.5	<2.5	<2.5	4.2	<2.5	<2.5	<2.5	6.9	4.3
Phenols (total)	mg/kg	<1	<1	<1	<0.1																																								
SVOCs																																													
Phenols																																													
2-Chlorophenol	mg/kg					<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
2-Methylphenol	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
2-Nitrophenol	mg/kg					<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	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
2,4-Dichlorophenol	mg/kg					<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
2,4-Dimethylphenol	mg/kg					<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
2,4,5-Trichlorophenol	mg/kg					<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
2,4,6-Trichlorophenol	mg/kg					<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
4-Chloro-3-methylphenol	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
4-Nitrophenol	mg/kg					<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
Pentachlorophenol	mg/kg	<0.1	6.2	0.1	0.2	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5															
Phenol	mg/kg					<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
2,4-Dinitrophenol	mg/kg					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
3- & 4-Methylphenol	mg/kg					<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
4,6-Dinitro-2-methylphenol	mg/kg					<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
4-Chlorophenol *	mg/kg					<2	<2	<2	<2	6	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2															
PAHs																																													
2-Chloronaphthalene	mg/kg					<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	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
2-Methylnaphthalene	mg/kg					<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	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
Acenaphthene	mg/kg					<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	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.6	0.3	<0.3	<0.3	<0.3	<0.3	0.4
Acenaphthylene	mg/kg					<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	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Anthracene	mg/kg					<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.4	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	4.1	<0.2	<0.2	<0.2		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.5	<0.3	0.5	<0.3	<0.3	<0.3
Benzo(a)anthracene	mg/kg					<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.7	<0.2	<0.2	<0.2	<0.2	<0.2	0.3	<0.2	<0.2	<0.2	0.5	<0.2	<0.2	<0.2	<0.2	<0.2		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.5	2.7	<0.3	2.2	<0.3	<0.3	0.3
Benzo(a)pyrene	mg/kg					<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.8	0.6	<0.2	<0.2	<0.2	<0.2	0.6	0.2	<0.2	0.6	<0.2	<0.2	<0.2	<0.2	<0.2	0.2		<0.3	0.4	<0.3	0.4	<0.3	<0.3	<0.3	0.5	2.6	0.3	2.2	<0.3	<0.3	0.5
Benzo(b)fluoranthene	mg/kg					<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.8	0.5	<0.2	<0.2	<0.2	<0.2	0.6	0.2	<0.2	<0.2	0.6	<0.2	<0.2	<0.2	<0.2	0.2		<0.3	0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.4	2.5	0.4	2.1	<0.3	<0.3	0.4
Benzo(g,h,i)perylene	mg/kg					<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.4	<0.2	0.6	0.4	<0.2	<0.2	<0.2	<0.2	0.4	<0.2	<0.2	<0.2	0.6	<0.2	<0.2	<0.2	<0.2	<0.2		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.3	1.6	<0.3	1.3	<0.3	<0.3	<0.3
Benzo(k)fluoranthene	mg/kg					<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.6	0.4	<0.2	<0.2	<0.2	<0.2	0.5	<0.2	<0.2	0.7	1.2	<0.2	<0.2	<0.2	<0.2	<0.2		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.3	1.8	<0.3	1.5	<0.3	<0.3	<0.3
Chrysene	mg/kg					<0.2	<0.2	<0.2	0.7	<0.2	<0.2	<0.2	0.3	2	1.1	1.9	<0.2	<0.2	<0.2	<0.2	0.8	1.6	44	20.4	27.8	<0.2	158	0.3	<0.2	0.4		1	1.4	5.4	4.3	<0.3	<0.3	<0.3	0.6	2.4	0.5	2.2	<0.3	<0.3	0.5
Dibenzo(a,h)anthracene	mg/kg					<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	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.7	<0.3	0.6	<0.3	<0.3	<0.3
Fluoranthene	mg/kg					<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	1.3	2.2	0.8	<0.2	<0.2	<0.2	<0.2	0.8	<0.2	<0.2	0.6	1.2	<0.2	2.8	<0.2	<0.2	0.3		<0.3	0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.7	4.1	0.4	3.6	0.4	<0.3	0.6
Fluorene	mg/kg					<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	<0.2	2.2	0.8	1.3	<0.2	22.5	<0.2	<0.2	<0.2		<0.3	<0.3	0.4	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.4	<0.3	<0.3	<0.3
Indeno(1,2,3-cd)pyrene	mg/kg					<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.3	<0.2	0.3	0.5	<0.2	<0.2	<0.2	<0.2	0.5	<0.2	<0.2	0.4	0.7	<0.2	<0.2	<0.2	<0.2	0.2		<0.3	0.4	<0.3	<0.3	<0.3	<0.3	<0.3	0.5	2.2	0.3	1.8	<0.3	<0.3	0.4
Naphthalene	mg/kg					<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.3	<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	<0.2		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.9	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Phenanthrene	mg/kg					<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	1.7	0.4	<0.2	<0.2	<0.2	<0.2	0.3	<0.2	2.9	1.1	1.7	<0.2	37.3	<0.2	<0.2	<0.2		<0.3	<0.3	0.4	<0.3	<0.3	<0.3	<0.3	0.4	2.1	<0.3	2.4	<0.3	<0.3	0.5
Pyrene	mg/kg					<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	1.5	0.6	<0.2	<0.2	<0.2	<0.2	0.7	<0.2	<0.2	0.5	0.6	<0.2	<0.2	<0.2	<0.2	0.2		<0.3	0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.6	3.3	0.3	2.5	0.3	<0.3	0.5
1-Methyl naphthalene *	mg/kg					<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	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2															
Pthalates																																													
bis(2-Ethylhexyl)phthalate	mg/kg					<0.5	2.2	1.7	1.9	2.6	0.8	4.7	1.7	<0.5	4.1	6.9	<0.5	3.5	1.6	<0.5	1.8	0.9	6.9	4.4	7.7	<0.5	<0.5	3.8	8.1	0.7		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
Butylbenzyl phthalate	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
Di-n-butyl phthalate	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
Diethyl phthalate	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
Dimethyl phthalate	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
Other Semi-Volatiles																																													
1,2-Dichlorobenzene	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
1,2,4-Trichlorobenzene	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	7.2	<0.5	<0.5	<0.5	2.6	<0.5	14.9	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
1,3-Dichlorobenzene	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
1,4-Dichlorobenzene	mg/kg					<0.5	<0.5	<0.5	<0.5	3.9	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
2-Nitroaniline	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
2,4-Dinitrotoluene	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
2,6-Dinitrotoluene	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
3-Nitroaniline	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
4-Bromophenylphenylether	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
4-Chloroaniline	mg/kg					<0.5	<0.5	<0.5	<0.5	19.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
4-Chlorophenylphenylether	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
4-Nitroaniline	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.7	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
Bis(2-chloroethoxy)methane	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
bis(2-Chloroethyl)ether	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
Dibenzofuran	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
Hexachlorobenzene	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
Hexachlorobutadiene	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
Hexachlorocyclopentadiene	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
Hexachloroethane	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
Isophorone	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
N-Nitroso-di-npropylamine	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
Nitrobenzene	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
3,3'-Dichlorobenzidine	mg/kg					<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
bis(2-Chloroisopropyl)ether	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
Benzoic Acid	mg/kg					<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
Benzyl alcohol	mg/kg					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
Biphenyl *	mg/kg					<0.2	<0.2	<0.2	0.5	<0.2	<0.2	<0.2	0.5	3.4	0.3	0.6	<0.2	<0.2	<0.2	<0.2	0.2	0.6	9.6	4.8	7.8	<0.2	50.7	0.5	<0.2	0.4		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
Diphenyl ether *	mg/kg					<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	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		<1.3		<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3		<1.3	<1.3	<1.3	
VOCs																																													
Benzene	ug/kg								<5	168	96									<5	<5						<5					<10	<10	<10	<10	<10		<10	<10	<10	<10	<10	<10	<10	<10
Toluene	ug/kg								<5	23	10									<5	<5						<5					<10	<10	<10	<10	<10		<10	<10	<10	<10	<10	<10	<10	<10
Ethylbenzene	ug/kg								<5	571	244									9	<5						<5					<10	<10	<10	<10	<10		<10	400	<10	<10	<10	<10	<10	<10
m and p-Xylene	ug/kg								<5	2390	968									12	<5						<5					<10	<10	<10	<10	<10		<10	1200	<10	<10	<10	<10	<10	<10
o-Xylene	ug/kg								<5	496	213									<5	<5						<5					<10	<10	<10	<10	<10		<10	700	<10	<10	<10	<10	<10	<10
Naphthalene	ug/kg								<25	<25	<25									<25	<25						<25					<300	<300	<300	<300	<300	<300	<300	900	<300	<300	<300	<300	<300	<300
Hexachlorobutadiene	ug/kg								<25	<25	<25									<25	<25						<25					<1300		<1300	<1300	<1300	<1300	<1300	<1300	<1300	<1300	<1300	<1300	<1300	<1300
1,2,4-Trichlorobenzene	ug/kg								<25	64	25									72	<25						<25					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
1,2-Dichlorobenzene	ug/kg								<5	174	36									5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
1,3-Dichlorobenzene	ug/kg								<5	39	6									6	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
1,4-Dichlorobenzene	ug/kg								<5	594	165									46	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		30	<10	<10	
1.1.1.2-Tetrachloroethane	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
1.1.1-Trichloroethane	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
1.1.2.2-Tetrachloroethane	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
1.1.2-Trichloroethane	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
1.1-Dichloropropene	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
1.1-Dichloroethane	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
1.1-Dichloroethene	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
1.2.3-Trichlorobenzene	ug/kg								<25	<25	<25									<25	<25						<25					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
1.2.4-Trimethylbenzene	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
1.2-Dibromo-3-chloropropane	ug/kg								<25	<25	<25									<25	<25						<25					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
1.2-Dichloroethane	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
cis-1-2-Dichloroethene	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
1.2-Dibromoethane	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
1.2-Dichloropropane	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
1.3.5-Trimethylbenzene	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
cis-1-3-Dichloropropene	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
1.3-Dichloropropane	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
2.2-Dichloropropane	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
2-Chlorotoluene	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
4-Chlorotoluene	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
Bromobenzene	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
Bromochloromethane	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
Bromoform	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
Bromomethane	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
Bromodichloromethane	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
Chlorobenzene	ug/kg								<5	56	17									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
Chloroethane	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
Chloroform	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
Chloromethane	ug/kg								<5000	<5000	<5000									<5000	<5000						<5000					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
Carbontetrachloride	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
Dichlorodifluoromethane	ug/kg								<5000	<5000	<5000									<5000	<5000						<5000					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
Dibromochloromethane	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
Dibromomethane	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
Isopropylbenzene	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
n-Butylbenzene	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
Propylbenzene	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
p-Isopropyltoluene	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		20	<10	<10	
sec-Butylbenzene	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
Styrene	ug/kg								<5	<5	<5									20	<5						<5					<10		<10	<10	<10	<10	<10	400	300		<10	<10	<10	
trans-1-2-Dichloroethene	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
trans-1-3-Dichloropropene	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
Trichlorofluoromethane	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
tert-Butylbenzene	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
Tetrachloroethene	ug/kg								<5	<5	<5									<5	<5						<5					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	
Trichloroethene	ug/kg								<7	<7	<7									<7	<7						<7					<10		<10	<10	<10	<10	<10	<10	20		<10	<10	<10	
Vinyl Chloride	ug/kg								<5000	<5000	<5000									<5000	<5000						<5000					<10		<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	

2008 WSP Investigation. Locations unknown - though to be in the south of the site (wind turbine area). Depths unknown

Sample Reference	T1/1	T1/2	T1/3	T1/4	T1/5	T1/6	T1/7	T1/8	T1/9	T1/10	T1/11	T1/12	T1/13	T1/14	T1/15	T2/1	T2/2	T2/3	T2/4	T2/5	T2/6	T2/7	T2/8	T2/9	T2/10	T2/11	T2/12	T2/13	T2/14	T2/15	T2/16	T2/17	T2/18
Asbestos									Amosite/ Crocidolite																								
PCB Congener 28	0.02	0.03	<0.01	0.06	<0.01	0.02	0.04	0.03		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.8	0.38	0.1	<0.01	<0.01	<0.01	0.538	0.12	0.21	0.074	0.15	0.121	0.21	0.163	0.016	0.078	0.022	0.06
PCB Congener 52	0.09	0.09	0.03	0.14	0.03	0.05	0.07	0.1		0.034	0.026	0.013	0.023	<0.01	<0.01	1.64	0.84	0.25	0.05	0.03	<0.01	1.414	0.49	0.83	0.214	0.38	0.574	0.861	0.842	0.103	0.368	0.155	0.537
PCB Congener 101	0.16	0.14	0.04	0.22	0.06	0.08	0.1	0.14		0.062	0.026	0.021	0.03	<0.01	<0.01	1.24	0.77	0.24	0.05	0.04	0.01	1.638	0.62	1.11	0.283	0.52	1.054	0.941	1.239	0.201	0.531	0.319	0.938
PCB Congener 118	0.1	0.08	0.03	0.16	0.05	0.05	0.07	0.08		0.05	0.016	0.014	0.022	<0.01	<0.01	0.69	0.48	0.16	0.03	0.03	<0.01	1.164	0.36	0.75	0.164	0.35	0.699	0.565	0.895	0.122	0.311	0.137	0.509
PCB Congener 138	0.28	0.2	0.06	0.29	0.11	0.11	0.12	0.18		0.08	0.029	0.032	0.037	<0.01	<0.01	1.37	0.91	0.22	0.05	0.04	<0.01	2.34	0.66	1.25	0.363	0.607	1.349	1.071	1.808	0.288	0.581	0.272	0.779
PCB Congener 153	0.23	0.17	0.05	0.24	0.1	0.1	0.11	0.17		0.064	0.027	0.03	0.034	<0.01	<0.01	1.02	0.73	0.19	0.05	0.04	<0.01	1.653	0.59	0.98	0.321	0.482	1.114	0.851	1.341	0.218	0.502	0.301	0.746
PCB Congener 180	0.46	0.19	0.06	0.27	0.12	0.12	0.12	0.2		0.07	0.031	0.039	0.038	<0.01	<0.01	1.14	0.87	0.18	0.06	0.03	<0.01	2.004	0.59	1.04	0.454	0.474	1.143	1.044	1.683	0.25	0.464	0.23	0.543
Total PCB Congeners	1.34	0.89	0.26	1.36	0.47	0.52	0.63	0.89		0.36	0.155	0.149	0.184	0	0	7.89	4.97	1.33	0.28	0.21	0.01	10.75	3.42	6.17	1.873	2.963	6.054	5.543	7.971	1.198	2.835	1.436	4.112

Sample Reference	BHG5	BHG5	BHG5	BHG5	BHG6	BHG6	BHG6	CH33	CH36	CH37	CH38	CH43	CH46	CH48	CP/RH01	CP/RH02	TP03	TP03	TP04	TP05	TP06
Specimen Depth (m)	0.4	2.85	12.7	17.2	0.6	12.5	17.1	1.5	0.7	1.2	1.3	1.3	1.2	1	0.7-0.8	2.4-2.5	0.8-0.9	1-1.1	1.4-1.5	1.6-1.7	1.3-1.5
Geology Code	TFD	TFD	GFD	MMG	TFD	GFD	MMG	TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD
Investigation Date	1997 GI	1997 GI	1997 GI	1997 GI	1997 GI	1997 GI	1997 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2008 GI	2008 GI	2008 GI	2008 GI	2008 GI	2008 GI	2008 GI
Arsenic	21.9	8.1	4.2	3.9	18.5	5.4	7.8	7.68	8.9	11	13	12.3	8.18	17	240	240	370	270	240	300	280
Boron	3.3	1.4	2.1	1.4	1.5	1.5	3.9	2	1.5	2.4	2.5	2.2	<0.5	0							
Cadmium	0.3	<0.2	<0.2	<0.2	1.5	1.5	3.9	0.54	0.09	0.11	0.08	0.07	0.72	0.2	0.92	1	1.4	0.95	0.84	0.55	0.53
Chromium	93.7	54.1	28.7	34	65.2	35.7	43.6	30	33	37	37	36	0.101	42	41	83	250	52	39	61	46
Copper	27.3	13.4	7.7	29.2	15.7	26.9	42.2	19	10	12	11	11	0.03	11	13	7.2	33	6.4	4.4	7.6	9.5
Lead	60.6	41.3	15.7	19.5	47.2	21.4	31.1	52	37	42	44	41	131	44	33	21	52	28	21	27	31
Mercury	<0.1	0.4	0.2	<0.1	<0.1	<0.1	0.1	2.14	0.08	0.14	0.16	0.24	2.84	<0.01	0.2	<0.2	<0.2	0.9	<0.2	<0.2	0.2
Nickel	40.1	35.9	16	21.1	35.9	23.3	31.6	21	29	32	34	33	44	32	35	24	42	37	34	37	34
Selenium	0.3	0.3	0.2	0.3	0.3	0.1	<0.1	0.94	<0.5	<0.5	<0.5	<0.5	1.24	0.42	<0.3	0.4	0.8	<0.3	<0.3	<0.3	<0.3
Zinc	136.6	95.1	33.2	68.3	146.7	45.4	112.6	121	80	98	91	82	143	116	110	78	280	100	86	110	110
Cyanide (total)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<1	<1	<1	<1	<0.001		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Cyanide (free)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<1	<1	<1	<1	<1								
Thiocyanate	<1	<1	<1	<1	<1	<1	<1		<2	2	<2										
Ferro/ferricyanide	<10	<10	<10	<10	<10	<10	<10														
Acid Soluble Sulphate														668							
Sulphate (total)	603	731	317	557	490	706	649														
Sulphide	<2	3.4	12.9	2.1	3.4	15.7	<2	17	<1	<1	<1	<1	7								
pH Value	8.1	8.3	9.3	8.8	7.8	8.3	8.6	8	8.2	8.5	8.6	8	8.8	8.6	7.6	11	10	7.9	8.5	8	8.1
PAH (Screening)	1.7	17.6	<0.1	<0.1	9.5	<0.1	<0.1	38	<10	953	<10	60	2400	<10							
VOC (screen)	<100	<100	<100	<100	<100	<100	<100														
Mineral Oil	<1	<1	<1	<1	<1	<1	<1														
TPH FTIR (AR)								22	195	1870	31	60	58								
OIL FTIR								234	67	74	77	72	780								
Aliphatics C5-C6															<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Aliphatics >C6-C8															<0.2	<0.2	0.3	<0.2	<0.2	<0.2	<0.2
Aliphatics >C8-C10															<0.2	<0.2	3.2	<0.2	<0.2	<0.2	<0.2
Aliphatics >C10-C12															84	93	69	71	70	<35	<35
Aliphatics >C12-C16															<50	<50	66	<50	<50	<50	<50
Aliphatics >C16-C21															<100	<100	<100	<100	<100	<100	<100
Aliphatics >C21-C35															<100	<100	<100	<100	<100	<100	<100
Aliphatics >C35-C40															<100	<100	<100	<100	<100	<100	<100
Aliphatics >C40-C44															<100	<100	<100	<100	<100	<100	<100
Aromatics >C6-C7															<0.01	<0.01	0.46	<0.01	<0.01	<0.01	<0.01
Aromatics >C7-C8															<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
Aromatics >EC8-EC10															<0.01	<0.01	0.89	<0.01	<0.01	<0.01	<0.01
Aromatics >EC10-EC12															78	45	38	52	37	<35	<35
Aromatics >EC12-EC16															<50	<50	<50	<50	<50	<50	<50
Aromatics >EC16-EC21															<100	<100	<100	<100	<100	<100	<100
Aromatics >EC21-EC35															<100	<100	<100	<100	<100	<100	<100
Aromatics >EC35-EC40															<100	<100	<100	<100	<100	<100	<100
Aromatics >EC40-EC44															<100	<100	<100	<100	<100	<100	<100
PCB - ARO	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.9	1.5	41	2.1	1.8	44								
PCB Congener 28																	0.33	0.0033	<0.001		
PCB Congener 52																	0.27	0.0027	0.0025		
PCB Congener 101																	0.17	0.0021	0.0022		
PCB Congener 118																	0.2	0.0019	0.0027		
PCB Congener 138																	0.13	0.0018	0.0023		
PCB Congener 153																	0.15	0.0029	0.0031		
PCB Congener 180																	0.092	0.0015	0.0015		
Total PCB Congeners																	1.3	0.016	0.015		
Phenol Index								0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5							
Phenols Monohydric	<1	<1	<1	<1	<1	<1	<1								0.0027	<0.0025	0.021	<0.0025	<0.0025	0.0032	<0.0025
Phenols (total)	<1	<1	<1	<1	<1	<1	<1														
2-Chlorophenol								<2	<2	<2	<2	<2	<2				<1.3	<1.3	<1.3		
2-Methylphenol								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
2-Nitrophenol								<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				<1.3	<1.3	<1.3		
2,4-Dichlorophenol								<2	<2	<2	<2	<2	<2				<1.3	<1.3	<1.3		
2,4-Dimethylphenol								<2	<2	<2	<2	<2	<2				<1.3	<1.3	<1.3		
2,4,5-Trichlorophenol								<2	<2	<2	<2	<2	<2				<1.3	<1.3	<1.3		
2,4,6-Trichlorophenol								<2	<2	<2	<2	<2	<2				<1.3	<1.3	<1.3		
4-Chloro-3-methylphenol								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
4-Nitrophenol								<5	<5	<5	<5	<5	<5				<1.3	<1.3	<1.3		
Pentachlorophenol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<5	<5	<5	<5	<5								
Phenol								<2	<2	<2	<2	<2	<2				<1.3	<1.3	<1.3		
2,4-Dinitrophenol								<1	<1	<1	<1	<1	<1				<1.3	<1.3	<1.3		
3- & 4-Methylphenol								<2	<2	<2	<2	<2	<2				<1.3	<1.3	<1.3		
4,6-Dinitro-2-methylphenol								<5	<5	<5	<5	<5	<5				<1.3	<1.3	<1.3		
4-Chlorophenol *								<2	<2	<2	<2	<2	<2								
2-Chloronaphthalene								<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				<1.3	<1.3	<1.3		
2-Methylnaphthalene								<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				<1.3	<1.3	<1.3		
Acenaphthene								<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Acenaphthylene								<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Anthracene								<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Benzo(a)anthracene								<0.2	<0.2	<0.2	<0.2	<0.2	0.3		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Benzo(a)pyrene								<0.2	<0.2	<0.2	<0.2	<0.2	0.3		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Benzo(b)fluoranthene								<0.2	<0.2	<0.2	<0.2	<0.2	0.3		<0.3	<0.3	0.4	<0.3	<0.3	<0.3	<0.3
Benzo(g,h,i)perylene								<0.2	<0.2	<0.2	<0.2	<0.2	0.2		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Benzo(k)fluoranthene								<0.2	<0.2	<0.2	<0.2	<0.2	0.4		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Chrysene								<0.2	<0.2	<0.2	<0.2	<0.2	2.9		<0.3	<0.3	5.3	0.3	<0.3	<0.3	<0.3
Dibenzo(a,h)anthracene								<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Fluoranthene								<0.2	<0.2	<0.2	<0.2	<0.2	0.6		<0.3	<0.3	0.4	<0.3	<0.3	<0.3	<0.3
Fluorene								<0.2	<0.2	<0.2	<0.2	<0.2	0.3		<0.3	<0.3	0.7	<0.3	<0.3	<0.3	<0.3
Indeno(1,2,3-cd)pyrene								<0.2	<0.2	<0.2	<0.2	<0.2	0.2		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Naphthalene								<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		<0.3	<0.3	0.3	<0.3	<0.3	<0.3	<0.3
Phenanthrene								<0.2	<0.2	<0.2	<0.2	<0.2	0.5		<0.3	<0.3	0.5	<0.3	<0.3	<0.3	<0.3
Pyrene								<0.2	<0.2	<0.2	<0.2	<0.2	0.5		<0.3	<0.3	0.3	<0.3	<0.3	<0.3	<0.3
1-Methyl naphthalene *								<0.2	<0.2	<0.2	<0.2	<0.2	<0.2								
bis(2-Ethylhexyl)phthalate								<0.5	2.6	2.1	2.2	5.6	<0.5				<1.3	<1.3	<1.3		
Butylbenzyl phthalate								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
Di-n-butyl phthalate								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
Diethyl phthalate								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
Dimethyl phthalate								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
1,2-Dichlorobenzene								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
1,2,4-Trichlorobenzene								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
1,3-Dichlorobenzene								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
1,4-Dichlorobenzene								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
2-Nitroaniline								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
2,4-Dinitrotoluene								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
2,6-Dinitrotoluene								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
3-Nitroaniline								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
4-Bromophenylphenylether								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
4-Chloroaniline								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
4-Chlorophenylphenylether								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
4-Nitroaniline								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
Bis(2-chloroethoxy)methane								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
bis(2-Chloroethyl)ether								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
Dibenzofuran								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
Hexachlorobenzene								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
Hexachlorobutadiene								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
Hexachlorocyclopentadiene								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
Hexachloroethane								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
Isophorone								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
N-Nitroso-di-npropylamine								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
Nitrobenzene								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
3,3'-Dichlorobenzidine								<2	<2	<2	<2	<2	<2				<1.3	<1.3	<1.3		
bis(2-Chloroisopropyl)ether								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
Benzoic Acid								<10	<10	<10	<10	<10	<10				<1.3	<1.3	<1.3		
Benzyl alcohol								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<1.3	<1.3	<1.3		
Biphenyl *								<0.2	<0.2	<0.2	<0.2	<0.2	1.4				<1.3	<1.3	<1.3		
Diphenyl ether *								<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				<1.3	<1.3	<1.3		
Benzene															<10	<10	460	<10	<10	<10	<10
Toluene															<10	<10	10	<10	<10	<10	<10
Ethylbenzene															<10	<10	60	<10	<10	<10	<10
m and p-Xylene															<10	<10	590	<10	<10	<10	<10
o-Xylene															<10	<10	150	<10	<10	<10	<10
Naphthalene															<300	<300	300	<300	<300	<300	<300
Hexachlorobutadiene																	<10	<10	<10		
1,2,4-Trichlorobenzene																	<10	<10	<10		
1,2-Dichlorobenzene																	<10	<10	<10		
1,3-Dichlorobenzene																	<10	<10	<10		
1,4-Dichlorobenzene																	<10	<10	<10		
1.1.1.2-Tetrachloroethane																	<10	<10	<10		
1.1.1-Trichloroethane																	<10	<10	<10		
1.1.2.2-Tetrachloroethane																	<10	<10	<10		
1.1.2-Trichloroethane																	<10	<10	<10		
1.1-Dichloropropene																	<10	<10	<10		
1.1-Dichloroethane																	<10	<10	<10		
1.1-Dichloroethene																	<10	<10	<10		
1.2.3-Trichlorobenzene																	<10	<10	<10		
1.2.4-Trimethylbenzene																	<10	<10	<10		
1.2-Dibromo-3-chloropropane																	<10	<10	<10		
1.2-Dichloroethane																	<10	<10	<10		
cis-1-2-Dichloroethene																	<10	<10	<10		
1.2-Dibromoethane																	<10	<10	<10		
1.2-Dichloropropane																	<10	<10	<10		
1.3.5-Trimethylbenzene																	<10	<10	<10		
cis-1-3-Dichloropropene																	<10	<10	<10		
1.3-Dichloropropane																	<10	<10	<10		
2.2-Dichloropropane																	<10	<10	<10		
2-Chlorotoluene																	<10	<10	<10		
4-Chlorotoluene																	<10	<10	<10		
Bromobenzene																	<10	<10	<10		
Bromochloromethane																	<10	<10	<10		
Bromoform																	<10	<10	<10		
Bromomethane																	<10	<10	<10		
Bromodichloromethane																	<10	<10	<10		
Chlorobenzene																	<10	<10	<10		
Chloroethane																	<10	<10	<10		
Chloroform																	<10	<10	<10		
Chloromethane																	<10	<10	<10		
Carbontetrachloride																	<10	<10	<10		
Dichlorodifluoromethane																	<10	<10	<10		
Dibromochloromethane																	<10	<10	<10		
Dibromomethane																	<10	<10	<10		
Isopropylbenzene																	<10	<10	<10		
n-Butylbenzene																	30	<10	<10		
Propylbenzene																	<10	<10	<10		
p-Isopropyltoluene																	20	<10	<10		
sec-Butylbenzene																	<10	<10	<10		
Styrene																	<10	<10	<10		
trans-1-2-Dichloroethene																	<10	<10	<10		
trans-1-3-Dichloropropene																	<10	<10	<10		
Trichlorofluoromethane																	<10	<10	<10		
tert-Butylbenzene																	<10	<10	<10		
Tetrachloroethene																	<10	<10	<10		
Trichloroethene																	<10	<10	<10		
Vinyl Chloride																	<10	<10	<10		

Determinand	No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	Selected S4ULs Criteria	No. Data Exceeding S4ULs Criteria
Arsenic	65	65	460	3.41	TP11 @ 0.2-0.3mbGL	170	11
Boron	44	35	3.9	0	BHG6 @ 17.1mbGL	46000	0
Cadmium	65	60	7.17	0.07	CH36 @ 0.1mbGL	190	0
Chromium	65	65	349	0.025	CH48 @ 0.05mbGL	33	46
Copper	65	64	343	0.012	CH35 @ 0mbGL	44000	0
Lead	65	65	497	5.4	CH39 @ 0mbGL	1300	0
Mercury	65	46	34	0.07	CH44 @ 0.3mbGL	30	2
Nickel	65	65	221.7	3.4	BHH1 @ 1.85mbGL	980	0
Selenium	65	41	1.85	0.1	CH48 @ 0.05mbGL	1800	0
Zinc	65	65	499	11	CH38 @ 0.1mbGL	170000	0
Cyanide (total)	63	2	1	0.1	CH41 @ 1.4mbGL		
Cyanide (free)	42	1	0.1	0.1	BHG6 @ 0.3mbGL		
Thiocyanate	30	8	13	2	CH35 @ 0.5mbGL		
Ferro/ferricyanide	11	0	None > LOD	None > LOD			
Acid Soluble Sulphate	27	27	4810	424	CH48 @ 0.05mbGL		
Sulphate (total)	11	11	2525	317	BHH1 @ 1.85mbGL		
Sulphide	43	34	803	2	CH41 @ 0.05mbGL		
pH Value	65	65	11.8	7.5	CH45 @ 0.2mbGL	6-9	31
Asbestos	1	0	None > LOD	None > LOD			
PAH (Screening)	44	32	2400	1.7	CH46 @ 1.2mbGL	1.1	32
VOC (screen)	42	0	None > LOD	None > LOD			
Mineral Oil	42	4	1630	29	BHH1 @ 1.85mbGL		
TPH FTIR (AR)	32	32	2400	22	CH41 @ 1.4mbGL	3200	0
OIL FTIR	43	32	2900	67	CH39 @ 1mbGL		
Aliphatics C5-C6	20	0	None > LOD	None > LOD		3200	0
Aliphatics >C6-C8	20	1	0.3	0.3	TP03 @ 0.8-0.9mbGL	7800	0
Aliphatics >C8-C10	20	1	3.2	3.2	TP03 @ 0.8-0.9mbGL	2000	0
Aliphatics >C10-C12	20	8	93	54	CP/RH02 @ 2.4-2.5mbGL	9700	0
Aliphatics >C12-C16	20	3	170	66	TP04 @ 0.3-0.4mbGL	25000	0
Aliphatics >C16-C21	20	1	160	160	TP04 @ 0.3-0.4mbGL	450000	0
Aliphatics >C21-C35	20	4	360	120	TP06 @ 0.1-0.3mbGL	450000	0
Aliphatics >C35-C40	20	1	160	160	TP06 @ 0.1-0.3mbGL		
Aliphatics >C40-C44	20	0	None > LOD	None > LOD			
Total Aliphatics C5-C35	0	0	None > LOD	None > LOD		2000	0
Aromatics >C6-C7	20	1	0.46	0.46	TP03 @ 0.8-0.9mbGL	26000	0
Aromatics >C7-C8	20	1	0.01	0.01	TP03 @ 0.8-0.9mbGL	56000	0
Aromatics >EC8-EC10	20	1	0.89	0.89	TP03 @ 0.8-0.9mbGL	3500	0
Aromatics >EC10-EC12	20	8	78	37	CP/RH01 @ 0.7-0.8mbGL	9200	0
Aromatics >EC12-EC16	20	1	57	57	TP05 @ 0.6-0.7mbGL	10000	0
Aromatics >EC16-EC21	20	1	400	400	TP04 @ 0.3-0.4mbGL	7600	0
Aromatics >EC21-EC35	20	7	2100	140	TP04 @ 0.3-0.4mbGL	7800	0
Aromatics >EC35-EC40	20	2	150000	210	TP04 @ 0.3-0.4mbGL		
Aromatics >EC40-EC44	20	2	360	120	TP06 @ 0.1-0.3mbGL		
Total Aromatics C6-C35	0	0	None > LOD	None > LOD		3500	0
TPH (Aliphatics and Aromatics C5-C35)	0	0	None > LOD	None > LOD		2000	0
PCB - ARO	42	35	1691.2	1.1	BHH1 @ 0.9mbGL	0.24	35
PCB Congener 28	96	31	6	0.0033	TP05 @ 0.6-0.7mbGL	#N/A	#N/A
PCB Congener 52	96	40	12	0.0025	TP04 @ 0.3-0.4mbGL	#N/A	#N/A
PCB Congener 101	96	41	20	0.0021	TP04 @ 0.3-0.4mbGL	#N/A	#N/A
PCB Congener 118	96	40	17	0.0019	TP04 @ 0.3-0.4mbGL	#N/A	#N/A
PCB Congener 138	96	40	19	0.0018	TP04 @ 0.3-0.4mbGL	#N/A	#N/A
PCB Congener 153	96	40	24	0.0029	TP04 @ 0.3-0.4mbGL	#N/A	#N/A
PCB Congener 180	96	40	12	0.0015	TP04 @ 0.3-0.4mbGL	#N/A	#N/A
Total PCB Congeners	96	43	110	0	TP04 @ 0.3-0.4mbGL	0.24	35
Phenol Index	33	15	11.2	0.5	CH43 @ 0.2mbGL	440	0
Phenols Monohydric	32	9	6.9	0.0027	TP10 @ 0.1-0.2mbGL	440	0
Phenols (total)	11	0	None > LOD	None > LOD		440	0
2-Chlorophenol	62	0	None > LOD	None > LOD			
2-Methylphenol	62	0	None > LOD	None > LOD			
2-Nitrophenol	62	0	None > LOD	None > LOD			
2,4-Dichlorophenol	62	0	None > LOD	None > LOD			
2,4-Dimethylphenol	62	0	None > LOD	None > LOD			
2,4,5-Trichlorophenol	62	0	None > LOD	None > LOD			
2,4,6-Trichlorophenol	62	0	None > LOD	None > LOD			
4-Chloro-3-methylphenol	59	0	None > LOD	None > LOD			
4-Nitrophenol	59	0	None > LOD	None > LOD			
Pentachlorophenol	59	3	6.2	0.1	BHH1 @ 0.2mbGL		
Phenol	45	0	None > LOD	None > LOD		440	0
2,4-Dinitrophenol	52	0	None > LOD	None > LOD			
3- & 4-Methylphenol	62	0	None > LOD	None > LOD			
4,6-Dinitro-2-methylphenol	62	0	None > LOD	None > LOD			
4-Chlorophenol *	62	1	6	6	CH35 @ 0.5mbGL		
2-Chloronaphthalene	54	0	None > LOD	None > LOD			
2-Methylnaphthalene	53	0	None > LOD	None > LOD			
Acenaphthene	52	3	0.6	0.3	TP05 @ 0.6-0.7mbGL	29000	0
Acenaphthylene	52	1	0.3	0.3	TP06 @ 0.1-0.3mbGL	29000	0
Anthracene	52	4	4.1	0.4	CH46 @ 0.5mbGL	150000	0
Benzo(a)anthracene	52	8	2.7	0.3	TP06 @ 0.1-0.3mbGL		
Benzo(a)pyrene	52	14	2.6	0.2	TP06 @ 0.1-0.3mbGL	11	0
Benzo(b)fluoranthene	52	14	2.5	0.2	TP06 @ 0.1-0.3mbGL	13	0
Benzo(g,h,i)perylene	52	9	1.6	0.2	TP06 @ 0.1-0.3mbGL	1400	0
Benzo(k)fluoranthene	52	10	1.8	0.3	TP06 @ 0.1-0.3mbGL	370	0
Chrysene	52	25	158	0.3	CH46 @ 0.5mbGL	93	1
Dibenzo(a,h)anthracene	52	3	0.7	0.2	TP06 @ 0.1-0.3mbGL		
Fluoranthene	52	17	4.1	0.3	TP06 @ 0.1-0.3mbGL	6300	0
Fluorene	52	8	22.5	0.3	CH46 @ 0.5mbGL	20000	0
Indeno(1,2,3-cd)pyrene	52	14	2.2	0.2	TP06 @ 0.1-0.3mbGL		
Naphthalene	52	3	0.9	0.3	TP05 @ 0.6-0.7mbGL	190	0
Phenanthrene	52	14	37.3	0.3	CH46 @ 0.5mbGL	6200	0
Pyrene	52	15	3.3	0.2	TP06 @ 0.1-0.3mbGL	15000	0
1-Methyl naphthalene *	54	0	None > LOD	None > LOD			
bis(2-Ethylhexyl)phthalate	51	23	8.1	0.7	CH47 @ 1.1mbGL		
Butylbenzyl phthalate	51	0	None > LOD	None > LOD			
Di-n-butyl phthalate	51	0	None > LOD	None > LOD			
Diethyl phthalate	51	0	None > LOD	None > LOD			
Dimethyl phthalate	51	0	None > LOD	None > LOD			
1,2-Dichlorobenzene	51	0	None > LOD	None > LOD			
1,2,4-Trichlorobenzene	45	3	14.9	2.6	CH41 @ 1.4mbGL	220	0
1,3-Dichlorobenzene	48	0	None > LOD	None > LOD			
1,4-Dichlorobenzene	48	1	3.9	3.9	CH35 @ 0.5mbGL		
2-Nitroaniline	48	0	None > LOD	None > LOD			
2,4-Dinitrotoluene	48	0	None > LOD	None > LOD			
2,6-Dinitrotoluene	48	0	None > LOD	None > LOD			
3-Nitroaniline	48	0	None > LOD	None > LOD			
4-Bromophenylphenylether	48	0	None > LOD	None > LOD			
4-Chloroaniline	48	1	19.2	19.2	CH35 @ 0.5mbGL		
4-Chlorophenylphenylether	48	0	None > LOD	None > LOD			
4-Nitroaniline	48	1	0.7	0.7	CH37 @ 0mbGL		
Bis(2-chloroethoxy)methane	48	0	None > LOD	None > LOD			
bis(2-Chloroethyl)ether	48	0	None > LOD	None > LOD			
Dibenzofuran	48	0	None > LOD	None > LOD			
Hexachlorobenzene	47	0	None > LOD	None > LOD			
Hexachlorobutadiene	45	0	None > LOD	None > LOD		30	0
Hexachlorocyclopentadiene	45	0	None > LOD	None > LOD		31	0
Hexachloroethane	50	0	None > LOD	None > LOD			
Isophorone	51	0	None > LOD	None > LOD			
N-Nitroso-di-npropylamine	51	0	None > LOD	None > LOD			
Nitrobenzene	51	0	None > LOD	None > LOD			
3,3'-Dichlorobenzidine	51	0	None > LOD	None > LOD			
bis(2-Chloroisopropyl)ether	51	0	None > LOD	None > LOD			
Benzoic Acid	51	0	None > LOD	None > LOD			
Benzyl alcohol	51	0	None > LOD	None > LOD			
Biphenyl *	51	14	50.7	0.2	CH46 @ 0.5mbGL		
Diphenyl ether *	51	0	None > LOD	None > LOD			
Benzene	26	3	460	96	TP03 @ 0.8-0.9mbGL	27000	0
Toluene	26	3	23	10	CH35 @ 0.5mbGL	56000000	0
Ethylbenzene	26	5	571	9	CH35 @ 0.5mbGL	5700000	0
m and p-Xylene	26	5	2390	12	CH35 @ 0.5mbGL	5900000	0
o-Xylene	26	4	700	150	TP05 @ 0.6-0.7mbGL	6600000	0
Naphthalene	27	2	900	300	TP05 @ 0.6-0.7mbGL	190000	0
Hexachlorobutadiene	22	0	None > LOD	None > LOD		31000	0
1,2,4-Trichlorobenzene	20	3	72	25	CH41 @ 1.4mbGL	220000	0
1,2-Dichlorobenzene	20	3	174	5	CH35 @ 0.5mbGL	#VALUE!	#VALUE!
1,3-Dichlorobenzene	20	3	39	6	CH35 @ 0.5mbGL	#VALUE!	#VALUE!
1,4-Dichlorobenzene	20	4	594	30	CH35 @ 0.5mbGL	#VALUE!	#VALUE!
1.1.1.2-Tetrachloroethane	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
1.1.1-Trichloroethane	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
1.1.2.2-Tetrachloroethane	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
1.1.2-Trichloroethane	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
1.1-Dichloropropene	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
1.1-Dichloroethane	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
1.1-Dichloroethene	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
1.2.3-Trichlorobenzene	20	0	None > LOD	None > LOD		102000	0
1.2.4-Trimethylbenzene	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
1.2-Dibromo-3-chloropropane	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
1.2-Dichloroethane	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
cis-1-2-Dichloroethene	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
1.2-Dibromoethane	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
1.2-Dichloropropane	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
1.3.5-Trimethylbenzene	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
cis-1-3-Dichloropropene	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
1.3-Dichloropropane	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
2.2-Dichloropropane	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
2-Chlorotoluene	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
4-Chlorotoluene	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
Bromobenzene	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
Bromochloromethane	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
Bromoform	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
Bromomethane	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
Bromodichloromethane	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
Chlorobenzene	20	2	56	17	CH35 @ 0.5mbGL	56000	0
Chloroethane	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
Chloroform	20	0	None > LOD	None > LOD		99000	0
Chloromethane	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
Carbontetrachloride	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
Dichlorodifluoromethane	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
Dibromochloromethane	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
Dibromomethane	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
Isopropylbenzene	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
n-Butylbenzene	20	1	30	30	TP03 @ 0.8-0.9mbGL	#VALUE!	#VALUE!
Propylbenzene	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
p-Isopropyltoluene	20	2	20	20	TP08 @ 0.1-0.3mbGL	#VALUE!	#VALUE!
sec-Butylbenzene	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
Styrene	20	3	400	20	TP05 @ 0.6-0.7mbGL	#VALUE!	#VALUE!
trans-1-2-Dichloroethene	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
trans-1-3-Dichloropropene	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
Trichlorofluoromethane	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
tert-Butylbenzene	20	0	None > LOD	None > LOD		#VALUE!	#VALUE!
Tetrachloroethene	20	0	None > LOD	None > LOD		19000	0
Trichloroethene	20	1	20	20	TP06 @ 0.1-0.3mbGL	1200	0
Vinyl Chloride	20	0	None > LOD	None > LOD		59	0

A4 Appendix 4

Tabulated Groundwater Data

M4CAN
Groundwater Sample Analysis & Screening Assessment
CL-17
14/07/2015

Screening Values & Assessment

EQS	Environmental Quality Standards
DWS	Drinking Water Standard
	Exceeds EQS
X	Exceeds DWS
x	Laboratory detection level higher than screening criterion

Notes

EQS calcium carbonate 100 - 150mg/l for heavy metals: chromium, copper, lead, nickel and zinc

Location	Units	Screening Criteria		CH 35	CH 40	CH 41	CH 45	BH1	BH2	No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
Location Type				TP	TP	TP	TP									
Response Zone (RZ) Details		EQS	DWS	MG	MG	MG	MG	MG	MG							
Depth (m)				0.8	1.1	1.1	1.3									
Date sampled				2000	2000	2000	2000	2008 GI	2008 GI							
Metals																
Arsenic Dissolved	ug/l	50	10	9	7	12	9	13	21	6	6	21	7	BH2 @ mbGL	0	3
Chromium Dissolved	ug/l		50	2	3	4	18	<10	<10	6	4	18	2	CH 45 @ 1.3mbGL		0
Copper Dissolved	ug/l	10	2000	4	10	3	9	<25	<25	6	4	10	3	CH 40 @ 1.1mbGL	0	0
Lead Dissolved	ug/l	1.2	10	<1	<1	<1	<1	<10	<10	6	0	None > LOD	None > LOD		0	0
Nickel Dissolved	ug/l	4	20	7	6	10	4	9.8	5.1	6	6	10	4	CH 41 @ 1.1mbGL	5	0
Selenium Dissolved	ug/l		10	2	<1	<1	<1	<5.0	<5.0	6	1	2	2	CH 35 @ 0.8mbGL		0
Cadmium Dissolved	ug/l	0.15	5	<0.1	<0.1	<0.1	<0.1	0.5	<0.5	6	1	0.5	0.5	BH1 @ mbGL	1	0
Zinc Dissolved	ug/l	75		30	16	34	9	<10	<10	6	4	34	9	CH 41 @ 1.1mbGL	0	
Mercury Dissolved	ug/l	0.07	1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.2	6	0	None > LOD	None > LOD		0	0
Non-Metal Inorganics																
BOD	mg/l	5		17	4	2	3			4	4	17	2	CH 35 @ 0.8mbGL	1	
COD	mg/l						33			1	1	33	33	CH 45 @ 1.3mbGL		
Hardness	mg/l							500	260	2	2	500	260	BH1 @ mbGL		
Total Diss Sulphur	mg/l			91.4	41.1	23.3	4.07			4	4	91.4	4.07	CH 35 @ 0.8mbGL		
Chloride	mg/l	250	250	75	21	17				3	3	75	17	CH 35 @ 0.8mbGL	0	0
Ammoniacal Nitrogen as N	mg/l	0.6		17	<0.2	<0.2	<0.2	8.3	1	6	3	17	1	CH 35 @ 0.8mbGL	3	
Unionised Ammonia	mg/l			0.196964	0.025719	0.000929	0.013773			4	4	0.196964405	0.000928984	CH 35 @ 0.8mbGL		
Thiocyanate	mg/l			0.6	<0.2	9.2	<0.2			4	2	9.2	0.6	CH 41 @ 1.1mbGL		
Total Cyanide	mg/l	0.001	0.05	0.05	0.05	<0.025	<0.025			4	2	0.05	0.05	CH 35 @ 0.8mbGL	2	0
Free Cyanide	mg/l			<0.025	<0.025	<0.025	<0.025			4	0	None > LOD	None > LOD			
Complex Cyanide	mg/l			0.05	0.05	<0.025	<0.025			4	2	0.05	0.05	CH 35 @ 0.8mbGL		
pH Value	pH units	6-9	6.5-10	7.8	8.9	7.4	8.6	7.8	7.8	6	6	8.9	7.4	CH 40 @ 1.1mbGL	0	0
Organics																
TPH FTIR	ug/l			170	180	660	410			4	4	660	170	CH 41 @ 1.1mbGL		
TPH GC	ug/l			10000	800	8000	5700			4	4	10000	800	CH 35 @ 0.8mbGL		
PCB- ARO	ug/l			66	48	22	2.3			4	4	66	2.3	CH 35 @ 0.8mbGL		
Phenols																
Phenols Monohydric	mg/l			1.06	<0.05	<0.05	<0.05			4	1	1.06	1.06	CH 35 @ 0.8mbGL		
Cresols	ug/l			4140	<0.5	2.4	40.1			4	3	4140	2.4	CH 35 @ 0.8mbGL		
Dimethylphenols	ug/l			50	<0.5	<0.5	18.6			4	2	50	18.6	CH 35 @ 0.8mbGL		
Trimethylphenols	ug/l			978	<0.5	<0.5	<0.5			4	1	978	978	CH 35 @ 0.8mbGL		
Pentachlorophenol	ug/l	0.4		4.275	<0.05	0.063	<0.05			4	2	4.275	0.063	CH 35 @ 0.8mbGL	1	
Phenol	ug/l	7.7		1.083	<0.0005	0.0006	0.0204			4	3	1.083	0.0006	CH 35 @ 0.8mbGL	0	
PAHs																
Acenaphthene	ug/l			0.54	<0.05	<0.05	<0.05	<1	<1	6	1	0.54	0.54	CH 35 @ 0.8mbGL		
Acenaphthylene	ug/l			<1.00	<1.00	<1.00	<1.00	<1	<1	6	0	None > LOD	None > LOD			
Anthracene	ug/l	0.1		0.64	<0.05	<0.05	<0.05	<1	<1	6	1	0.64	0.64	CH 35 @ 0.8mbGL	1	
Benzo(a)anthracene	ug/l			<0.50	<0.05	0.5	<0.05	<1	<1	6	1	0.5	0.5	CH 41 @ 1.1mbGL		
Benzo(a)pyrene	ug/l	0.00017	0.01	<0.50	<0.05	0.16	<0.05	<1	<1	6	1	0.16	0.16	CH 41 @ 1.1mbGL	1	1
Benzo(b)fluoranthene	ug/l	0.017	0.1	<0.50	<0.05	0.16	<0.05	<1	<1	6	1	0.16	0.16	CH 41 @ 1.1mbGL	1	1
Benzo(k)fluoranthene	ug/l	0.017	0.1	<0.50	<0.05	0.06	<0.05	<1	<1	6	1	0.06	0.06	CH 41 @ 1.1mbGL	1	0
Benzo(ghi)perylene	ug/l	0.0082	0.1	<0.50	<0.05	0.07	<0.05	<1	<1	6	1	0.07	0.07	CH 41 @ 1.1mbGL	1	0
Indeno(1,2,3-cd)pyrene	ug/l		0.1	<0.50	<0.05	0.07	<0.05	<1	<1	6	1	0.07	0.07	CH 41 @ 1.1mbGL		0
Chrysene	ug/l			<0.50	<0.05	0.56	<0.05	<1	<1	6	1	0.56	0.56	CH 41 @ 1.1mbGL		
Dibenzo(a,h)anthracene	ug/l			<0.50	<0.05	<0.05	<0.05	<1	<1	6	0	None > LOD	None > LOD			
Fluoranthene	ug/l	0.0063		<0.50	<0.05	0.21	<0.05	<1	<1	6	1	0.21	0.21	CH 41 @ 1.1mbGL	1	
Fluorene	ug/l			1.07	<0.05	0.07	<0.05	<1	<1	6	2	1.07	0.07	CH 35 @ 0.8mbGL		
Naphthalene	ug/l	2		<5.00	<0.50	<0.50	<0.50	<1	<1	6	0	None > LOD	None > LOD		0	
Phenanthrene	ug/l			<0.50	<0.05	0.17	<0.05	<1	<1	6	1	0.17	0.17	CH 41 @ 1.1mbGL		
Pyrene	ug/l			<0.50	<0.05	0.19	<0.05	<1	<1	6	1	0.19	0.19	CH 41 @ 1.1mbGL		
Total PAHs (USEPA 16)	ug/l			<13.75	<2.20	<3.87	<2.20			4	0	None > LOD	None > LOD			
VOCs																
Dichlorodifluoromethane	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
Chloromethane	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
Vinyl Chloride	ug/l	0	0.5	<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD		0	0
Bromomethane	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
Chloroethane	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
Trichlorofluoromethane	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
trans-1-2-Dichloroethene	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
1.1-Dichloroethene	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
1.1-Dichloroethane	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
cis-1-2-Dichloroethene	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
Bromochloromethane	ug/l		100	<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			0
Chloroform	ug/l	2.5	100	<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD		0	0
2.2-Dichloropropane	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
1.2-Dichloroethane	ug/l	10	3	<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD		0	0
1.1.1-Trichloroethane	ug/l	100		<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD		0	
1.1-Dichloropropene	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
Benzene	ug/l	10	1	130	<1	<1	<1	<3.0	<3.0	6	1	130	130	CH 35 @ 0.8mbGL	1	1
Carbontetrachloride	ug/l	12	3	<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD		0	0
Dibromomethane	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
Bromodichloromethane	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
Trichloroethene	ug/l	10	10	<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD		0	0
cis-1-3-Dichloropropene	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
trans-1-3-Dichloropropene	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
1.1.2-Trichloroethane	ug/l	400		<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD		0	
Toluene	ug/l	50		18	<1	<1	<1	<3.0	<3.0	6	1	18	18	CH 35 @ 0.8mbGL	0	
1.3-Dichloropropane	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
Dibromochloromethane	ug/l		100	<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			0
1.2-Dibromoethane	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
Tetrachloroethene	ug/l	10	10	<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD		0	0
Chlorobenzene	ug/l			6	<1	<1	<1	<3.0	<3.0	6	1	6	6	CH 35 @ 0.8mbGL		
Ethylbenzene	ug/l	20		255	<1	<1	<1	<3.0	<3.0	6	1	255	255	CH 35 @ 0.8mbGL	1	
p/m-Xylene	ug/l	30		872	<1	<1	<1	<3.0	<3.0	6	1	872	872	CH 35 @ 0.8mbGL	1	
Bromoform	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
Styrene	ug/l	50		<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD		0	
1.1.2.2-Tetrachloroethane	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
o-Xylene	ug/l	30		<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD		0	
1.2.3-Trichloropropane	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
Isopropylbenzene	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
Bromobenzene	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
2-Chlorotoluene	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
Propylbenzene	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
4-Chlorotoluene	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
1.2.4-Trimethylbenzene	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
4-Isopropyltoluene	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
1.3.5-Trimethylbenzene	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
1.2-Dichlorobenzene	ug/l	20		<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD		0	
1.4-Dichlorobenzene	ug/l	20		<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD		0	
sec-Butylbenzene	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
tert-Butylbenzene	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
1.3-Dichlorobenzene	ug/l	20		<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD		0	
n-Butylbenzene	ug/l			<5	<1	<1	<1	<3.0	<3.0	6	0	None > LOD	None > LOD			
1.2-Dibromo-3-chloropropane	ug/l			<25	<5	<5	<5	<3.0	<3.0	6	0	None > LOD	None > LOD			
1.2.4-Trichlorobenzene	ug/l	0.4		204	<5	<5	<5	<3.0	<3.0	6	1	204	204	CH 35 @ 0.8mbGL	1	
Naphthalene	ug/l	2		<25	<5	<5	<5	<3.0	<3.0	6	0	None > LOD	None > LOD		0	
1.2.3-Trichlorobenzene	ug/l	0.4		<25	<5	<5	<5	<3.0	<3.0	6	0	None > LOD	None > LOD		0	
Hexachlorobutadiene	ug/l	0.6		<25	<5	<5	<5	<3.0	<3.0	6	0	None > LOD	None > LOD		0	

A5 Appendix 5

Tabulated Soil Leachate Data

M4CAN
Leachate Sample Analysis & Screening Assessment
CL-17
14/07/2015

Geological Formation Legend

MG	Made Ground

Screening Values & Assessment

EQS	Environmental Quality Standards
DWS	Drinking Water Standard
	Exceeds EQS
X	Exceeds DWS
x	Laboratory detection level higher than screening criterion

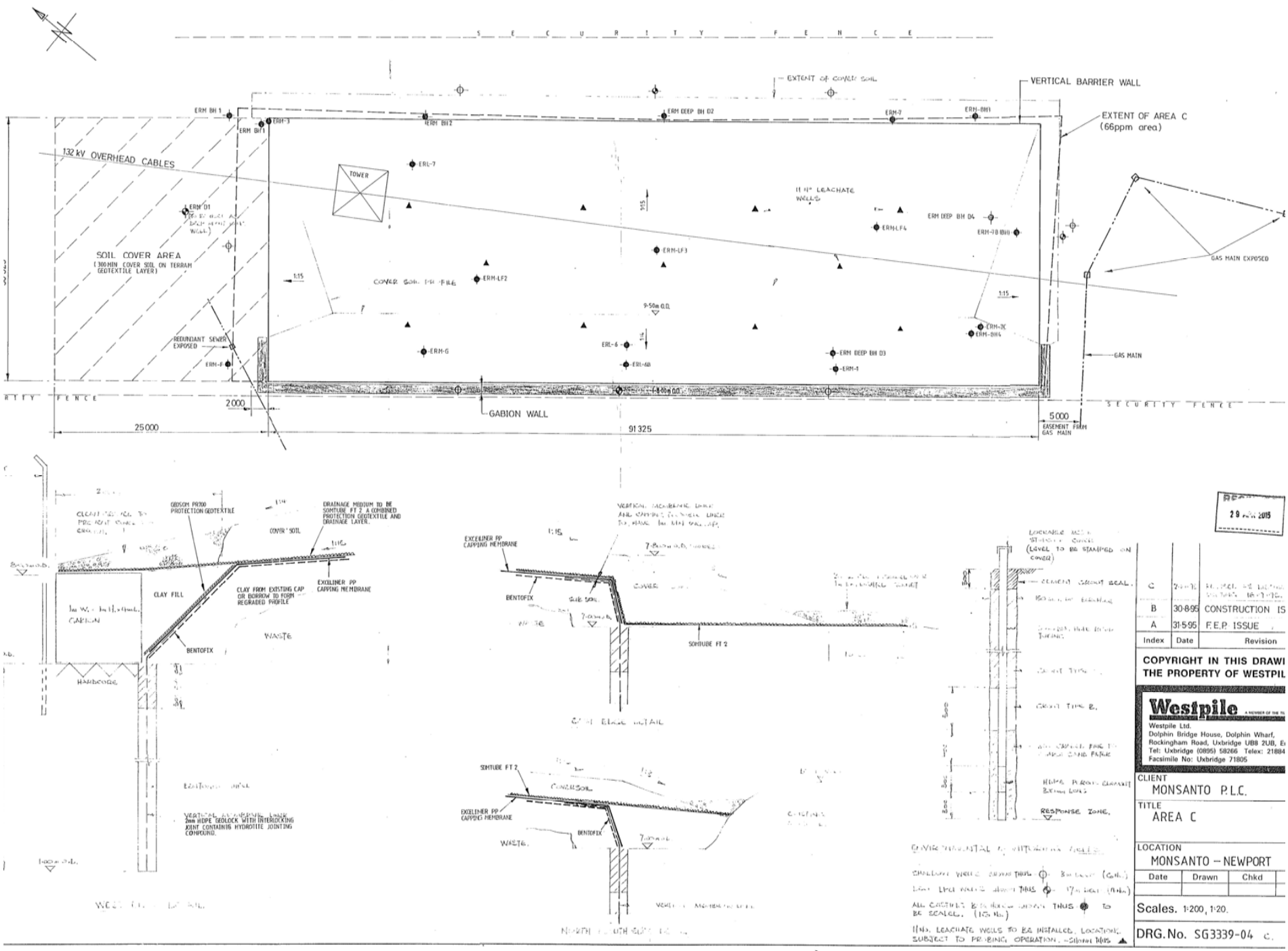
Notes

EQS calcium carbonate 100 - 150mg/l for heavy metals: chromium, copper, lead, nickel and zinc

Sample Reference	Units	Screening Criteria		CH36	CH38	CH39	CH43	CH47	TP03	TP04	TP05	TP06	No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
Specimen Depth (m)		EQS	DWS	0.1	0.1	0	0.2	0.1	0.1-0.2	0.3-0.4	0.6-0.7	0.1-0.3							
OD Level (m)				6.92	7.25	7.26	7.29	7.35											
Sample Type				D	D	D	D	D											
Geology Code				MG	MG	MG	MG	MG											
Cluster Code				2000 GI	2000 GI	2000 GI	2000 GI	2000 GI	2008 GI	2008 GI	2008 GI	2008 GI							
2:1 Results																			
Selenium Dissolved	ug/l		10						<5	<5	<5	<5	4	0	None > LOD	None > LOD			0
Arsenic Dissolved	ug/l	50	10						<10	<10	<10	<10	4	0	None > LOD	None > LOD		0	0
Cadmium Dissolved	ug/l	0.15	5						<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD		0	0
Chromium Dissolved	ug/l		50						<10	<10	<10	<10	4	0	None > LOD	None > LOD			0
Nickel Dissolved	ug/l	4	20						<5	<5	<5	<5	4	0	None > LOD	None > LOD		0	0
Lead Dissolved	ug/l	1.2	10						<10	<10	<10	<10	4	0	None > LOD	None > LOD		0	0
Copper Dissolved	ug/l	10	2000	3	3	7	4	3	<25	<25	<25	<25	9	5	7	3	CH39 @ 0mbGL	0	0
Zinc Dissolved	ug/l	75		8	16	23	6	10	<10	12	<10	<10	9	6	23	6	CH39 @ 0mbGL	0	
pH	pH units	6-9	6.5-10	7.9	7.8	7.9	8.8	8.6	7.8	7.5	7.8	7.9	9	9	8.8	7.5	CH43 @ 0.2mbGL	0	0
Pentachlorophenol	ug/l	0.4		<50	<50	<50	<83	<50					5	0	None > LOD	None > LOD		0	
PCB- ARO	ug/l			<0.8	<0.8	<1	<2	<0.9					5	0	None > LOD	None > LOD			
TPH FTIR	ug/l			500	<300	<300	4000	<200					5	2	4000	500	CH43 @ 0.2mbGL		
TPH GC	ug/l			IS	IS	IS	<200	<200					5	0	None > LOD	None > LOD			

A6 Appendix 6

Plan and Layout of PCB Cell



Index	Date	Revision
C	[illegible]	[illegible]
B	30-8-95	CONSTRUCTION IS
A	31-5-95	F.E.P. ISSUE

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Tel: Uxbridge (0895) 58266 Telex: 21884
Facsimile No: Uxbridge 71805

CLIENT
MONSANTO P.L.C.

TITLE
AREA C

LOCATION
MONSANTO – NEWPORT

Date	Drawn	Chkd

Scales. 1:200, 1:20.

DRG.No. SG3339-04 C.

A7 Appendix 7

Site Walkover Photographs

Plate 01: CL17 -

Plate 02: CL17

Client:	Welsh Government
Project:	M4CaN
Job Ref:	JER6591 Checked By: Date: May 2015

Plate 03: CL17

Client:	Welsh Government
Project:	M4CaN
Job Ref: JER6591	Checked By: Date: May 2015

Plate 03: CL17

Client:	Welsh Government
Project:	M4CaN
Job Ref: JER6591	Checked By: Date: May 2015

Plate 03: CL17

Client:	Welsh Government		
Project:	M4CaN		
Job Ref:	JER6591	Checked By:	Date: May 2015

Plate 03: CL17

Client:	Welsh Government
Project:	M4CaN
Job Ref:	JER6591 Checked By: Date: May 2015

Plate 03: CL17

Client:	Welsh Government		
Project:	M4CaN		
Job Ref:	JER6591	Checked By:	Date: May 2015

Plate 03: CL17

Client:	Welsh Government
Project:	M4CaN
Job Ref: JER6591	Checked By: Date: May 2015

Plate 03: CL17

Client:	Welsh Government		
Project:	M4CaN		
Job Ref:	JER6591	Checked By:	Date: May 2015

Plate 03: CL17

Client:	Welsh Government
Project:	M4CaN
Job Ref: JER6591	Checked By: Date: May 2015

A8 Appendix 8

Relevant Extracts of Additional Environmental Data

Plate 01: Extract of 1991 Aerial Photograph showing the position of a tank in the southern area of the Site.

Plate 02: Extract of 2006 Aerial Photograph showing extension of works area in the south east.

Client:	Welsh Government
Project:	M4CaN
Job Ref:	JER6591 Checked By: Date: Oct 2015

Plate 03: Extract of 2009/10 Aerial Photograph.

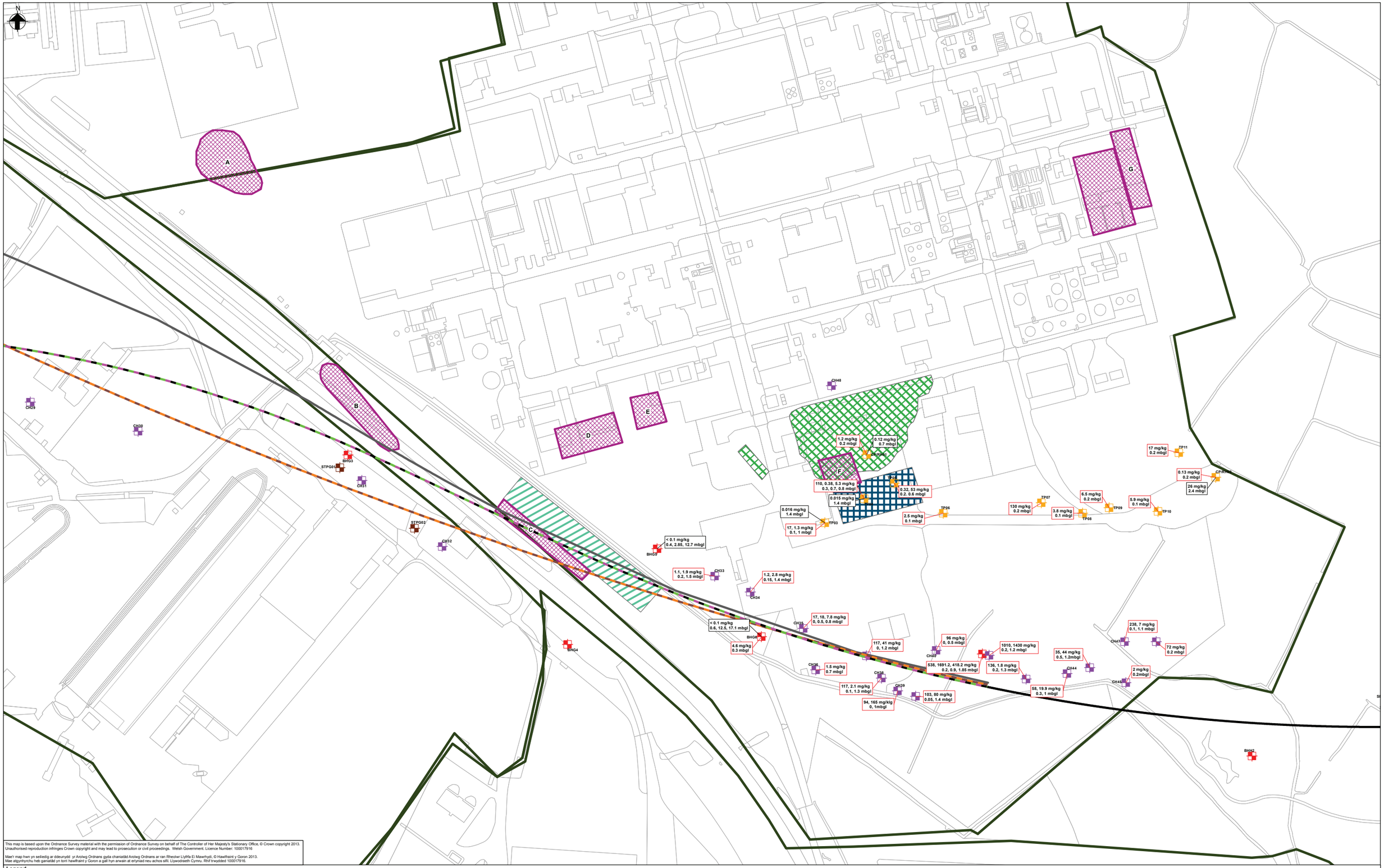
Plate 04: Extract of 2014 High Resolution Aerial Photograph.

Client:	Welsh Government
Project:	M4CaN
Job Ref:	JER6591 Checked By: Date: Oct 2015

A9 Appendix 9

PSSR Figure showing Historical Disposal Areas / Infilled Ground

A1



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Legend

- Site Boundary
- Option 1 - Black Route High (without Junction)
- Option 2 - Black Route High
- Option 3 - Black Route Low
- Option 4 - ABP Route High (without Junction)
- Option 5 - ABP Route Low
- Option 6 - Black Route North Shift Low
- On-site Disposal Areas - as per Arup 1996 report figure 2
- Option B1, B2, B3
- Options B4, B5
- Option B6
- Sections A and C

EA Pollution Incidents

- Category 2 (Significant)
- Category 3 (Minor)
- Category 4 (No Impact)

Ground Investigations

- 1997 Norwest Holst
- 2000 (May) Exploration Associates
- 2007 Norwest Holst
- 2008

- PCB results recorded above the 0.24mgkg screening level
- Approximate location of buried disposal cell
- Approximate location of disposal area for hazardous substances
- Approximate location of historic infilled ground WSP

Issue	Date	By	Chkd	Appd
F1	2014-03-21	EB	AL	SH

For Issue

Client

Llywodraeth Cymru
Welsh Government

Transport
Department for Economy, Science and Transport
Welsh Government
Cathays Park
Cardiff
CF10 3NQ

Trafnidiaeth
Adran Economi, Gwyddoniaeth a Thrafnidiaeth
Llywodraeth Cymru
Parc Cathays
Caerdydd
CF10 3NQ

Job Title

M4 Corridor Around Newport

Coridor yr M4 o amgylch Casnewydd

Metres: 0 15 30 60

Scale at A3: **1:1,300**

ARUP

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Cardiff, CF10 4QP
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www.arup.com

Drawing Title

Figure 3
Solutia PCB Levels

Job No	Drawing Status
117300-01	**For Issue**

Drawing No	Issue
M4-OA-01-00-DR-Z-XX-0078	**F1**

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