

COMPREHENSIVE GROUNDWATER MONITORING EVENT

Shell Hitchin



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EXECUTIVE SUMMARY

AECOM undertook a Comprehensive Groundwater Monitoring Event (GME) of Shell Hitchin, Bedford Road, Hitchin, Hertfordshire, SG5 2TY. This report has been collated to provide a status of groundwater quality beneath the site following redevelopment works in 2013. The site is currently an active petrol filling station located in a mixed residential and commercial area. There are two (2) active tanks with four (4) compartments in use at the site installed during redevelopment works between March and August 2013.

A total of ten GMEs have been undertaken at the site with three (3) monitoring rounds completed between October 2011 and January 2013 prior to construction works at the site, and a further seven (7) GMEs completed between September 2013 and February 2016 following completion of the redevelopment works.

This comprehensive GME report details the results of the four (4) GMEs undertaken at the site in December 2014, May and November 2015 and February 2016. The scope of work of each GME included groundwater sampling of five (5) monitoring wells and an assessment of potential risks to controlled waters and human health receptors.

The Controlled Waters receptors for the site are the underlying Zig Zag Chalk (Principal Aquifer) and the superficial deposits of the Lowestoft Formation (Unproductive Strata) and Glaciofluvial Deposits (Secondary A Aquifer). The site is close to the edge of a significant buried valley feature with drift deposits reaching up to 80 metres (m) in thickness within 1 kilometre (km) to the north west, north and north east of the site.

The site is not located within a Source Protection Zone. There are no reported licensed or private groundwater abstractions within 1km of the site. The closest surface water feature is the Bearton Pond located approximately 200m north of the site. The River Hiz is located approximately 850m east of the site, the River Oughton is located 1km north of the site and the River Purwell is located approximately 1.2km north east of the site.

The monitoring indicates

- Groundwater was encountered in all five (5) groundwater monitoring wells during each of four groundwater monitoring events at elevations ranging from 63.69 metres Above Ordnance Datum (m AOD) 64.89m AOD. The depth to groundwater ranged from 5.94 to 7.10m bgl. Groundwater is inferred to flow in an easterly direction towards the River Purwell.
- A hydrocarbon odour was observed in the groundwater sample collected from BH102 in the eastern part of the forecourt in the December 2014, May 2015 and November 2015 GMEs. No visual and olfactory evidence of chemicals of potential concern (COPC) was identified in groundwater sampled from other locations at the site.
- The post construction groundwater levels have been relatively stable at the site until the most recent round where all boreholes were higher than usual with BH102 (and BH103) significantly higher than has been previously monitored. Data from May 2015 showed water levels within the typical range.

Stage 2 Risk Assessment Results

A Stage 2 risk assessment was performed on the data collected during the four rounds of GME to assess potential risks to human health (on-site workers, off-site workers and off-site residents):

- Groundwater concentrations were not considered to present an unacceptable risk to human health receptors

Stage 3 Risk Assessment Results

A controlled waters detailed quantitative risk assessment (DQRA) was completed by URS in March 2013. Two models were created for the site to assess potential risks to groundwater in the Chalk and groundwater in the Drift Deposits:

Groundwater concentrations detected in each of the last four GMEs were compared against the Stage 3 screening criteria generated in the March 2013 DQRA and the following concluded:

- Unacceptable risks were not identified to groundwater quality within the Drift Deposits Secondary A Aquifer or the underlying Chalk Principal Aquifer. The site is considered suitable for continued oil use.

1. INTRODUCTION

AECOM was requested by Shell UK Oil Products (Shell) to undertake a Comprehensive Groundwater Monitoring Event (GME) at Shell Hitchin located Bedford Road, Hitchin, Hertfordshire, SG5 2TY.

Table A – Site Information

Site Name	Shell Hitchin
Site Operation	The site is currently an active petroleum filling station.
GSAP ID Number	10019011
Site Address	The site is located at Bedford Road, Hitchin, Hertfordshire, SG5 2TY. (Figure 1) .
Grid Reference (easting and northing)	517920 (E), 229840 (N)
Reported Site Area	Approximately 1,500 square metres (m ²)
Freehold/Leasehold	Freehold. AECOM understands that the site is owned by Shell.

1.1 Objectives

This report has been collated to provide a status of groundwater quality beneath the site following redevelopment works in 2013.

1.2 Scope of Work

The scope included:

- Completion of four groundwater monitoring events in December 2014, May 2015, November 2015 and February 2016 of five (5) groundwater monitoring wells.
- Assessment of the magnitude, type and extent of chemicals of potential concern (COPC) present through the performance of laboratory and/or on-site analysis of soil, groundwater and soil vapour for various chemical indicators associated with operation as a petrol filling station.
- Screening of analytical results against appropriate Generic Assessment Criteria (GAC) to determine the requirement for a Detailed Quantitative Risk Assessment (DQRA).
- Completion and submission of this Comprehensive GME Report.

1.3 Sustainability

In implementing the scope of works outlined above, AECOM made the following considerations of sustainability:

- Field work was staffed from local AECOM office to reduce travel impact.

2. BACKGROUND INFORMATION AND PRELIMINARY RISK ASSESSMENT

2.1 Background Information

A summary of the information about the site setting, site use and development is provided in Tables B, C and D below. Full details are provided in the Phase 1 (Ref 1).

Table B – Environmental Setting	
Surrounding Land Use	North: A tyre dealership is situated approximately 5m north of the site beyond an access road. A three-storey apartment block with surrounding garden lies approximately 30 metres (m) north of the site. South: A hotel lies approximately 5m south of the site beyond a small car parking area. Residential properties are situated approximately 30m south of the site. East: The site is bounded to the east by the A550 Bedford Road. Hitchin Town FC football ground is approximately 20m east of the site. West: The site is bounded to the west by a garage and car park. Residential properties with gardens lay approximately 20m west the site.
Elevation	The site is located at an approximate elevation of 70m Above Ordnance Datum (AOD).
Topography	The site was observed to have a gentle slope downwards towards the Bedford Road at the east of the site. The surrounding topography decreases towards the River Oughton in the north and River Purwell in the east.
Surface Water Features	The closest surface water feature is Bearton Pond, located approximately 200 m north of the site. The River Hiz is located approximately 700m east of the site, the River Oughton is located 1kilometre (km) north of the site and the River Purwell is located approximately 1.2km north east of the site.
Geology	The site is shown to be underlain by the Lowestoft Formation, which forms an extensive sheet of chalky till, together with outwash sands and gravels, silts and clays. The Lowestoft Formation is shown on the 1:50,000 geological map to be underlain and surrounded by Glaciofluvial Deposits (classified as a Secondary A Aquifer). It has been assumed that the on-site boreholes are installed in the more sensitive Secondary A Aquifer as the vertical and horizontal extent of the Lowestoft Till and Glaciofluvial Deposit units within the permeable drift are not known. The site is close to the edge of a significant buried valley feature with drift deposits reaching up to 80m in thickness within 1km to the north west, north and north east of the site. The Bedrock Geology of the site is reported to be the Zig Zag Chalk Formation. This consists of mostly firm, pale grey to off-white blocky chalk with a lower part characterised by rhythmic alternations of marls and marly chalks with firm white chalk. Thin gritty, silty chalk beds act as markers in the sequence. The thickness is typically 35–50 m. During intrusive works by URS in September 2011 and February 2012, Chalk was encountered at a depth of 5.4m below ground level (bgl) at boreholes BH105 and BH106 located in the western area of the site and at 14.2m bgl at BH102A located in the eastern area of site.
Hydrogeology	The Environment Agency (EA) classifies the Lowestoft Formation as Unproductive Strata. The underlying Glaciofluvial Deposits are classified as a Secondary A Aquifer. The Zig Zag Chalk Formation is classified as a Principal Aquifer.

Table B – Environmental Setting

Groundwater Abstractions and SPZs	There are four current groundwater abstractions between 1 and 2km from the site: - Pilkington Farms 1.4km west of the site is licensed to abstract groundwater from chalk sourced from a well and borehole. Abstraction is currently unspecified but previous permit was for Household Water Supply: Drinking, Cooking, Sanitary, Washing; (Small Garden). Status: Perpetuity. - Environment Agency 1.7km south of the site is licensed to abstract groundwater from a well for Environmental use: Remedial/Wetland Support: Transfer Between Sources. Status: Not Supplied. - DPH Parker 2km north west of the site is licensed to abstract groundwater from chalk for General Farming and Domestic use. Status: Perpetuity. - Veolia Water Central Limited 2km west of the site is licensed to abstract groundwater from chalk for Public Water Supply: Potable Water Supply – Direct. Status: Perpetuity. License was previously held by Three Valleys Water Plc. The site is not located within a Source Protection Zone and there are no reported licensed or private groundwater abstractions within 1km of the site. SPZ's are present 2km west, 2km south and 4km to the east of the site.
Potential Vapour Receptors	No risks to human health from potential vapours were identified during the URS Phase 2 site investigation (Refs 2 & 3) or 2013 validation works (Ref. 4), therefore these have not been reassessed.

Table C – Site use and Development

Current Use	The site is currently an active petrol filling station located in a mixed residential and commercial area. There are two (2) active tanks with four (4) compartments in use at the site installed during redevelopment works between March and August 2013.
Site History	Historical mapping indicates that from 1881 - 1932 the site is shown as open ground associated with a building located to the south of what is the current site boundary. In 1964 the site is shown as open ground with a garage adjacent to the northern boundary. The 1981-1992 historical maps shows two buildings on the site. The layout appears to be that of a petrol filling station with a shop/canopy and ancillary building. The building layout is different from the current site layout, by 1994 the site is shown in its current petrol filling station configuration
Dates of accidental release or known source of COPC	Records held by the local Petroleum Officer (PO) do not indicate any significant accidental releases at the site. No significant wet stock variance reported.
Dates of closure, tank removal, soil removal etc	Information from the PO report dated August 2011 indicates that the site underwent development works in 2000 which consisted of a re-pump. Between March and August 2013 the site underwent further redevelopment where five active tanks (comprising seven compartments) and one solid filled decommissioned tank were removed from the site and replaced with two new double walled 65KL split compartment tanks.
Previous site investigations	<u>GeoDelft, Petroleum Risk Tier 1 report ref: C1402.SG474.8008, dated May 1999 (Ref.5)</u>

Table C – Site use and Development

A GeoDelft Tier 1 report identified no historical known pollution incidents at the site. Concentrations of VOC <50ppm were recorded at the site. Minimal impact was identified at the site

URS Preliminary Phase I Investigation Report (Ref R46370079-001) Final Phase I; dated October 2011) (Ref.1)

A Phase 1 Investigation was undertaken by URS in September 2011 and included an initial desk based investigation and site walkover to provide information on the environmental site setting. The preliminary risk assessment identified a number of potential pollutant linkages, summarised as follows:

Human Health

- Migration of hydrocarbon vapours from potentially impacted shallow soils and/or groundwater to on-site workers within the shop area and off-site workers to the north and east of the site.
- Permeation of hydrocarbons from potentially impacted soil into plastic water supply pipes followed by ingestion by on-site shop staff.

Controlled Waters

- Vertical migration of COPC from potentially impacted shallow soils into perched water and/or the shallow groundwater within the shallow Drift Deposits that border the site (Secondary A Aquifer), and potentially deeper groundwater in the underlying Zig Zag Chalk Formation (Principal Aquifer).
- Migration of COPC from potentially impacted shallow soils into perched water and/or the shallow groundwater followed by lateral migration to Surface Waters (Bearton Pond located 200m north of the site, The River Hiz located approximately 700m east of the site, the River Oughton located 1km north of the site and the River Purwell located approximately 1.2km north east of the site).

URS Phase 2 Environmental Site Investigation Report (Ref R46370079-002) Final; dated April 2012 (Ref.2)

A comprehensive investigation was undertaken by URS in December 2011. Intrusive works included the drilling and installation of 5 monitoring wells into the superficial deposits and 3 vapour wells at the site. A DQRA was carried out on available soil, groundwater and vapour data. The principal conclusions were:

- No significant risks to human health (on-site workers or off-site residents) were identified
- Potentially unacceptable risks to groundwater in the underlying superficial deposits were identified from reported concentrations of benzene, TPH Aromatics <C5-C7 and naphthalene in groundwater at a 50m compliance point. The 50m compliance point was selected based on the hazardous classification of these substances, the presence of the Principal Aquifer beneath the superficial deposits and the uncertainty in groundwater flow direction and gradient.
- Potentially unacceptable risks to groundwater in the underlying Chalk Principal aquifer were identified from reported concentrations of benzene at a 50m compliance point however this assessment was based on a number of assumptions in the absence of site specific data.

Table C – Site use and Development**URS Phase 2 Comprehensive Environmental Site Assessment – Further Investigation (Ref R46370079-003) Final; dated February 2013) (Ref.3)**

To refine the DQRA, URS completed further intrusive works including the installation of two monitoring wells into the Zig Zag Chalk Formation, and one monitoring well into the superficial deposits.

URS conducted a Controlled Waters Detailed Quantitative Risk Assessment (DQRA) to assess the significance of identified potential pollutant linkages from soil and groundwater monitoring from both the December 2011 and February 2012 investigations and January 2013 GME. Two models were created for the site to assess potential risks to groundwater in the Chalk and groundwater in the Drift Deposits:

The principal conclusions of the Controlled Waters DQRA are summarised below:

Model 1: Groundwater in the Chalk

Of the COPC groups assessed, soil concentrations of naphthalene and fluoranthene were simulated to present a theoretical risk to the Principal Aquifer at a 50m compliance point considering a 3.6m mixing zone. At 95% confidence the simulated controlled water hazard index (CWHI) for naphthalene and fluoranthene were 15.2 and 3.54 respectively.

If additional dilution is considered within a 10m mixing zone, the hazard indices of the simulated concentrations decrease proportionally, indicating a marginal risk of naphthalene exceeding the GAC at 50m, and no risk of fluoranthene exceeding the withdrawn EEC MAC.

No significant risks were identified from concentrations of COPC in groundwater to the underlying Principal Chalk aquifer at a 50m compliance point.

Model 2: Groundwater in the Drift Deposits

No significant risks were identified from concentrations of chemicals of potential concern (COPC) in soil to the drift deposits Secondary-A Aquifer.

Of the COPC groups assessed, groundwater concentrations of benzene were simulated to present a theoretical risk at the 50m compliance point protective of the Secondary-A Aquifer at a 95% confidence level with a CWHI of 12.0. At the 50th percentile ('most likely'), the model did not simulate a risk from concentrations of benzene at the 50m compliance point with an HI of 0.371. No risks were simulated from benzene at the 100m compliance point.

Given the low exploitation potential of the aquifer, an extended compliance point of 100m is considered appropriate. As no risks were simulated at the 95th percentile (worst case) at the extended compliance point, or at the 50th percentile ('most likely'), at the 50m compliance point, from a conservative DQRA, the theoretical risks simulated by the model were considered unlikely to pose a significant risk to controlled waters in the drift.

URS Comprehensive Groundwater Monitoring Event Ref R46370079-006) Final; dated October 2014) (Ref.6)

URS undertook a post construction Comprehensive Groundwater Monitoring Event (GME) at Shell Hitchin located on Bedford Road, Hitchin, Hertfordshire, SG5 2TY to assess groundwater conditions following the 2013 construction works at the site.

Groundwater was encountered in all five (5) groundwater monitoring wells at elevations ranging from 63.9m Above Ordnance Datum (AOD) to 65.1m AOD. The average depth to groundwater was 6.3m below ground level (bgl) with an inferred flow to the east in the direction of the River Purwell located approximately 1.2km north east of the site.

Table C – Site use and Development

	Groundwater results were compared to Stage 2 human health GAC and Stage 3 controlled waters SSAC. The principal conclusions were as follows: Potentially significant risks to human health receptors (on-site workers, off-site workers and off-site residents) have not been identified at the site, Potentially significant risks to the underlying Secondary A Aquifer or Principal Aquifer have not been identified at the site. The site is considered suitable for on-going oil use.
Historical Remedial Activities	<u>URS Environmental Strategy Plan (Ref R46370079-004) Final; dated March 2013) (Ref.5)</u> URS prepared an Environmental Remedial Strategy Plan (ESP) to support the environmental aspects of the planning process for a proposed site redevelopment. The ESP was submitted to the local Planning Department of North Hertfordshire District Council; this was accepted in March 2012 as an appropriate remedial strategy to manage identified impact. The findings of the site investigations and risk assessment indicate that no potentially significant risks to human health or controlled waters have been identified.
	<u>URS Verification Report (Ref R46370079-005) Final; dated October 2013) (Ref.4)</u> URS provided environmental support during the construction programme where five active tanks (comprising seven compartments) and one solid filled decommissioned tank were removed from the site and replaced with two new double walled 65KL split compartment tanks. In conjunction with the fuel infrastructure removal, URS undertook validation sampling of excavations advanced for the removal of the underground storage tanks (USTs), the removal of the fuel infrastructure and the excavation for the new tank farm. A total of 59 soil samples were collected. In total approximately 1,705 m³ of material was excavated and disposed of as inert and non-hazardous waste. A total of about 11 m³ of asbestos impacted material was removed from site as hazardous waste. Resultant excavations were backfilled with approximately 1,070 m³ imported material (excluding poured concrete and tarmac). Following completion of the construction works post construction groundwater monitoring was undertaken at the site. No visual or olfactory signs of hydrocarbon impact were reported in any of the monitoring wells sampled. A risk assessment was undertaken on validation samples collected from soil left in-situ underlying the site and post construction groundwater monitoring data. No potentially significant risks to human health (protective of on-site workers and off-site residents) were identified. No potentially significant risks were identified to groundwater quality within the Drift Deposits Secondary-A Aquifer or the underlying Chalk Principal Aquifer. The site was considered suitable for on-going oil use.

Table D – Summary of On-site Fuel Tank / Compartments

Tank number or ID	Tank 1			Tank 2
Compartment number or ID	Compartment 1	Compartment 2	Compartment 3	Compartment 4
Tank type ⁽¹⁾	Double skinned steel	Double skinned steel	Double skinned steel	Double skinned steel
Tank size (litres) ⁽²⁾	45,000	20,000	40,000	25,000
Product stored ⁽²⁾	Unleaded	VP Unleaded	Diesel	VP Diesel
Status ⁽²⁾	Operational	Operational	Operational	Operational
Date of installation ⁽³⁾	2013	2013	2013	2013
Removal date or abandonment date	Fill point is offset	Fill point is offset	Fill point is offset	Fill point is offset
Relative level (RL) of tank base	4.5 m bgl	4.5 m bgl	4.5 m bgl	4.5 m bgl

NOTES:

Information obtained from Shell As-Built drawing 10019011-FIN-2013-D Finishes Drawing

2.2 Preliminary Conceptual Site Model

Following review of the available data regarding site history, environmental setting, and continued oil use, a preliminary conceptual site model (CSM) was developed, as presented in Table E below. For a risk from a given source to be considered plausible, a 'pathway' must be present by which COPC can reach a given receptor. Such complete Source ⇒ Pathway ⇒ Receptor (SPR) exposure mechanisms are commonly termed 'pollutant linkages'. The CSM illustrates the potentially viable source-pathway-receptor linkages which have been identified.

Table E – Preliminary Conceptual Site Model

Source	Pathway	Receptor
Human Health		
- Impacted soils - Soil vapour - Impacted groundwater	- Lateral and vertical vapour migration and subsequent inhalation. - Particulate - Ingestion, inhalation, dermal contact, with soil particulates. - Permeation - Migration of hydrocarbon substances through plastic potable water supply pipes.	- No risks to human health from potential vapours were identified during the URS Phase 2 site investigation (Refs 2 & 3) or 2013 validation works (Ref. 4), therefore these have not been reassessed. - Visiting contractors excavating ground.*
Controlled Waters		
- Impacted soils - Impacted groundwater	- Partitioning between soil and pore water. - Leaching of impacted soils. - Lateral migration of impacted groundwater.	- Groundwater within Superficial Deposits (Secondary A Aquifer) and Zig Zag Chalk Formation (Principal Aquifer) - Surface water (Bearton Pond located approximately 200m north and the River Hiz located approximately 850m east of the site e).

* Potential risks to visiting contractors undertaking intrusive works should be managed by appropriate PPE, risk assessment and method statements. Risks to visiting contractors excavating the ground have therefore not been further assessed.

3. FIELD WORK

3.1 Summary of Field Work

Table F – Summary of Field Work

Date of Field Work	The four GME's were completed on the following dates: 01 December 2014, 29 May 2015, 11 November 2015 and 26 February 2016.																										
Site Activities	Field works included the following key tasks: - Groundwater level gauging of five (5) groundwater monitoring wells (BH102, BH102A, BH103, BH105A and BH106A). - Purging and groundwater sample collection from five (5) groundwater monitoring wells, and collection of field measurements of groundwater quality (pH, conductivity, temperature, redox potential, dissolved oxygen).																										
Details of Existing Monitoring Well Network	Drilling locations were designed to evaluate the soil, soil vapour and / or groundwater conditions associated with the target locations described below. A borehole location plan is provided as Figure 2. A summary of the well installation details is presented in Table 1. <table> <tr> <th>Borehole ID</th><th>Location</th><th>Completion Depth (m bgl)</th><th>Monitoring Well Screening Strata</th></tr> <tr> <td>BH102</td><td>Eastern boundary of the site.</td><td>9.0</td><td>Drift</td></tr> <tr> <td>BH102A</td><td>Eastern boundary of the site.</td><td>14.4</td><td>Drift</td></tr> <tr> <td>BH103</td><td>Southern corner of the site.</td><td>9.0</td><td>Drift</td></tr> <tr> <td>BH105A</td><td>Northern corner of the site.</td><td>9.0</td><td>Chalk</td></tr> <tr> <td>BH106A</td><td>Western area of the site.</td><td>8.70</td><td>Chalk</td></tr> </table>			Borehole ID	Location	Completion Depth (m bgl)	Monitoring Well Screening Strata	BH102	Eastern boundary of the site.	9.0	Drift	BH102A	Eastern boundary of the site.	14.4	Drift	BH103	Southern corner of the site.	9.0	Drift	BH105A	Northern corner of the site.	9.0	Chalk	BH106A	Western area of the site.	8.70	Chalk
Borehole ID	Location	Completion Depth (m bgl)	Monitoring Well Screening Strata																								
BH102	Eastern boundary of the site.	9.0	Drift																								
BH102A	Eastern boundary of the site.	14.4	Drift																								
BH103	Southern corner of the site.	9.0	Drift																								
BH105A	Northern corner of the site.	9.0	Chalk																								
BH106A	Western area of the site.	8.70	Chalk																								
Surveying	The elevations of groundwater and vapour monitoring well standpipes installed by AECOM were surveyed to National Grid coordinates and m AOD by Glovers Ltd, under the supervision of URS in February 2012.																										

Table F – Summary of Field Work

Groundwater gauging and sampling	Groundwater level gauging and sampling was undertaken during each monitoring event. Prior to sampling, the depth to groundwater and Light Non-Aqueous Phase Liquid (LNAPL) (if present) was gauged using a portable oil / water interface probe. Groundwater gauging results are presented in Appendix A. Groundwater wells (BH102, BH102A, BH103, BH105A and BH106A) were purged and sampled using a low-flow sampling method incorporating a flow through cell and dedicated tubing. During well purging activities, water was periodically monitored for temperature, pH, conductivity, dissolved oxygen (DO), and oxidation/reduction potential (ORP or Redox) using a water quality meter to determine when representative formation waters were being encountered. Following sufficient recharge, groundwater samples were collected. All groundwater samples were collected into laboratory supplied containers, labelled and placed on ice Table 2 in Appendix A provides details of the purging, and indicates if any wells did not recharge sufficiently to allow low flow sampling, and a sample was taken once water recharged. All groundwater samples were collected into laboratory supplied containers, labelled and placed on ice.
Field quality control sampling	The following field quality control samples were collected as part of this CGME: • Groundwater: four (4) duplicate samples, four (4) trip blanks, and four (4) equipment blanks.

3.2 Field Screening Results / Observations

Table G – Field Screening	
Observations	Key visual and olfactory observations which are considered relevant to the CSM were observed during the GMEs are summarised below. • Slight hydrocarbon odour noted at BH102 during the December 2014, May 2015 and November 2015 GMEs. Full details of observations are presented in Table 2 in Appendix A.
Light Non-Aqueous Phase Liquid (LNAPL)	LNAPL was not encountered in any of the monitoring wells during any of the four monitoring events, and has not been reported historically at the site
Field Groundwater Quality Parameters	Groundwater parameter data, i.e. redox, Electrical conductivity, Groundwater temperature Dissolved oxygen, pH, and temperature were collected following purging and are presented in Table 2 in Appendix A.

3.3 Geological/Hydrogeological Information

Table H – Hydrogeological Information

Depth to Groundwater	Drift Deposits: BH102 and BH103 are installed within the drift deposits. Groundwater was encountered within both wells during each of the four monitoring rounds. Groundwater was reported in BH102 at depths ranging between 4.75m bgl in February 2016 and 6.89m bgl in May 2015. Groundwater within BH103 was reported at depths ranging between 4.78m bgl in February 2016 and 7.09m bgl in November 2015. Chalk: BH105A and BH106A are installed within the putty Chalk beneath the site. The overlying drift deposits were reported to be dry during the drilling of these locations. Groundwater was encountered at depths ranging between of 6.13m bgl in February 2016 and 6.36m bgl in November 2015 at BH105A. Groundwater was reported at depths ranging between 6.21m bgl in May 2015 and 6.61m bgl in December 2014 at BH106A. BH102A is located approximately 3m west of BH102 and screened at a deeper depth (11.5m bgl - 13.5m bgl) across the top of the Chalk and the overlying drift deposits. Groundwater was reported at depths ranging between 5.94m bgl in December 2014 and February 2016 to 6.10m bgl in November 2015. During the drilling of this well a 1.3m band of stiff Clay was encountered between 10m and 11.3m bgl which appears to separate the groundwater body encountered within the drift deposits in BH102 and BH103 screened between 7.5m bgl and 9m bgl. This band of Clay was not proven in any other borehole at the site due to the depth of drilling. Its lateral extent across the site is therefore unknown and it is assumed that groundwater within the drift deposits and Chalk may be in continuity. Post construction groundwater levels have been relatively stable at the site until the most recent February 2016 monitoring round where all boreholes were higher than usual with BH102 (and BH103) significantly higher than has been previously monitored. These high levels were maintained, before, during and after purging. Groundwater level data is presented in Table 1 in Appendix A.
Inferred Groundwater Flow	Groundwater was encountered in all boreholes and was found to flow to the east of the site towards the River Purwell (Figure 3a – Figure 3C) with a hydraulic gradient range in the drift of 0.032 in December 2014 to 0.048 in November 2015. Groundwater levels from the February 2016 GME are significantly higher than previous rounds and show a potential flow direction to the west. This is not consistent with any of the nine previous monitoring events at the site.
Hydraulic Conductivity	Rising and falling head tests using a slug were conducted in wells BH102A, BH105A and BH106A within the superficial deposits and Chalk during the February 2012 Comprehensive ESA (Ref.3). The data were interpreted using the Bouwer Rice method. Groundwater within the drift deposits at the site was calculated to have a hydraulic conductivity of 0.38m/day. Groundwater within the Chalk had a hydraulic conductivity of 1.54m/day.

3.4 Analytical Schedules & QA/QC

Table I – Analytical Information

Analytical Laboratory	Groundwater samples were analysed by Alcontrol Laboratories of Chester. The results are discussed in Section 4 and presented in Appendix B . Copies of the Chain of Custodies (COCs) and laboratory certificates are presented in Appendix C .	
Analytical Schedule	The following schedule of analysis was completed, excluding QAQC samples. The COPC in bold are those identified by Shell as potential risk drivers from retail petroleum sites. The results and analytical methodology are presented in Appendix C .	
	Analysis	Number of Groundwater Samples
	Total Petroleum Hydrocarbons (TPH) Health risk fractions including C8-C12	20
	Benzene, Toluene , Ethylbenzene, Xylenes (BTEX) compounds	20
	Fuel Oxygenates (methyl tertiary butyl ether (MTBE), tert-butyl ethyl ether (ETBE), di-isopropyl ether (DIPE), tert butanol (TBA), tert-amyl methyl ether (TAME), Ethanol)	20
	Polycyclic Aromatic Hydrocarbons (PAH) 16 Speciated including naphthalene	20
	Ferrous Iron, Nitrate (as NO ₃ -), Sulphate (soluble)	20
Field and laboratory quality control sampling	The analytical data have been reviewed for quality assurance and control purposes (QA/QC), the results of which are presented in Appendix E. • Laboratory holding times for groundwater samples not exceeded. • The surrogate data were reported within acceptable limits. • The relative percentage difference (RPD) between detected concentrations in the groundwater duplicate sample (DUP) and the parent samples, BH106A in December 2014 and February 2016, BH1-2A in May 2015 and BH102 in November 2015 were within acceptable limits. • The laboratory blanks were within acceptable limits. • Where concentrations were detected in the equipment blank in December 2014 and February 2016 above the method detection limit (MDL) the results are within the same order of magnitude as the MDL. In general, the data are considered appropriate for reporting.	

4. HUMAN HEALTH STAGE 2 GENERIC QUANTITATIVE RISK ASSESSMENT

4.1 Methodology

The risk based methodology adopted in this report is primarily based upon the UK Defra and EA "best practice" in regard to the assessment of contaminated land. The approach taken reflects that promoted in CLR11 (Ref. 8) and R&D Publication 66 (Ref.9) and the supporting guidance referenced within them. For the assessment of potential risks from vapour intrusion, additional assessment has been completed in line with more recent guidance from the USEPA (USEPA, 2015. Ref. 10)

An assessment of ground gas is contained in section 4.2. Gas risk assessment has been carried out following guidance in B8485 (Ref. 12) which sets out an empirical semi-quantitative approach for deriving Gas Screening Values based on gas monitoring measurements to select a Characteristic Situation which informs the scope of gas protection measures that could be required, if any.

A screening exercise has then been completed to assess the potential for vapour intrusion pathways to be present between identified impacts and receptors, for acute and chronic vapour risks. The screening process comprises four steps:

1. Identification of priority receptor buildings
2. Evaluate whether screening is applicable, or whether precluding factors mean that this approach is not suitable and assessment should be based on soil vapour measurements and GAC.
3. Screen buildings in or out of the likely zone of vapour migration using the USEPA screening criteria. These criteria are based on the distance between source and receptor, nature and magnitude of impact (LNAPL vs dissolved phase) and depth to groundwater.
4. Complete further assessment of any buildings not screened out in the above steps.

Where potential pathways have been identified, further assessment has been completed using generic assessment criteria.

In addition to the above, all data have been screened against generic assessment criteria protective of all potential human health receptors within 10m of the site in order to set potential risks into context within the UK regulatory framework.

4.2 Vapour Intrusion Potential

A vapour screening assessment was completed in February 2014 as part of the URS Phase 2 site investigation (Ref. 3). No unacceptable risks to the human health receptors were identified. Therefore ground gas monitoring and soil vapour monitoring to assess for acute and chronic vapour risks were not undertaken as part of this investigation. Concentrations of COPC in groundwater also presented no unacceptable risk to human health receptors; however groundwater samples from this CGME have been screened against human health GAC as part of this assessment for completeness.

4.3 Generic Assessment Criteria (GAC)

4.3.1 Generic Assessment Criteria (GAC) – Groundwater and Vapours

The Stage 2 Generic Assessment Criteria (GAC) for groundwater and vapours were derived using the LQM/CIEH S4UL methodology (Ref 13), protective of:

- On-site and off-site workers (including Shell shop staff, site users and off-site workers) using a continued petroleum use (CPU) end use scenario.
- Off-site residents to the north and west of the site and live-in hotel staff in Firs Hotel to the south of the site using a high density residential (HDR) end use scenario.

Table K – assumptions within the GAC and applicability to the site

	GAC	Assumption	Applicable at site	Likely to over or under simulate risks
Active Pathways	High Density Residential	Only vapour pathways are viable. No exposure to soils via direct contact pathways including dermal contact and dust inhalation/ingestion as the receptor is off-site	Neighbouring houses with gardens are off site so direct contact and ingestion pathway not active	GAC are applicable to offsite houses
	Low Density Residential	All standard CLEA pathways for Residential use are active.	Potential future redevelopment of site for houses with private gardens	GAC are applicable to future use scenario
	Commercial GAC	All standard CLEA pathways for Commercial use are active. Includes a potential pathway of exposure through direct contact with the soft landscaping at the site	The site surface is covered in 100% hardstanding	GAC not applicable
	CPU	Only vapour pathways are viable. No exposure to soils via direct contact pathways including dermal contact and dust inhalation/ingestion as the site is fully covered in hardstanding/building footprint and/or managed landscape	The site surface is covered in 100% hardstanding	GAC applicable to site shop and adjacent commercial premises
Model Parameters all CLEA defaults except those listed below	All land uses - Groundwater	Vertical distance between source and receptor for vapour pathways is approximately 1.0m and receptor building directly overlies source	Groundwater greater than 6m bgl	GAC may overestimate risks
	All landuses - Vapour	'Soil vapour to indoor air' factor for volatile compounds set to zero	Soil vapour data collected from wells with top of screen at 0.5m bgl	GAC are applicable
	All landuses - Groundwater and vapour	For volatile compounds it is assumed that vapour ingress is via a 2mm crack between concrete floor slab and walls.	Site shop and commercial buildings likely to have a ground bearing slab. Off-site hotel likely to have suspended wooden floor.	GAC applicable for site shop and commercial building, but may underestimate risks to adjacent off-site hotel.
	CPU - Groundwater and vapour	Building size set to 14m x 6.5m x 2.4m high representative of a small site shop	Site shop is larger. Offsite commercial building has greater volume	GAC may overestimate risks due to greater dilution of soil air in building than assumed by GAC

4.4 Analytical Results GAC Screening

Comparison of groundwater, analytical results to Stage 2 GAC is provided in **Appendix B** and GAC exceedances are summarised in the table below:

Receptor Type	Screening Criteria	Media	Benzene / TPH Aromatic C ₅ -C ₇	TEX / TPH Aromatic C ₇ -C ₁₀	Other Aromatic TPH	Aliphatic TPH	MTBE	Other Oxygenates	TPH Hazard Index	Naphthalene	Benzo(a)pyrene	Other PAHs (incl. 2-methyl naphthalene)
Human Health	CPU	Groundwater	x	x	x	x	x	x	x	x	x	x
	HDR	Groundwater	x	x	x	x	x	x	x	x	x	x

Notes: ✓ = Measured in excess of GAC
 x = Not measured in excess of GAC
 n/a = not applicable

4.5 Discussion of Key Exceedances of Human Health GAC

4.5.1 Human Health - HDR

The TPH Hazard Indices (HI) in the groundwater sample collected from BH102 in November 2015 (HI of 1.16) was observed to be greater than 1. This marginal exceedance is considered unlikely to pose an unacceptable risk given the limited exceedances and is to be a likely over estimation of risks by the HDR GAC (see Section 4.2.1) and has not been further assessed.

No other exceedances of the Stage 2 human health CPU GAC were reported in the groundwater samples collected from site.

4.5.2 Human Health – CPU

No exceedances of the Stage 2 human health HDR GAC were reported in the groundwater samples collected from site.

4.6 Summary

No unacceptable risks to human health receptors are considered to be present from the concentrations of COPCs detected in groundwater.

5. CONTROLLED WATERS STAGE 2 GENERIC QUANTITATIVE RISK ASSESSMENT

5.1 Generic Assessment Criteria

The risk based methodology adopted in this report is primarily based upon the UK Defra and EA "best practice" in regard to the assessment of contaminated land. The approach taken reflects that promoted in CLR11 (Ref 8) and R&D Publication 66 (Ref 9) and the supporting guidance referenced within them.

Analytical results for soil and groundwater samples recovered are tabulated in **Appendix B** and have been compared against Stage 2 Generic Assessment Criteria (GAC), protective of:

- Groundwater within the Zig Zag Chalk Formation (Principal Aquifer).
- Shallow groundwater within superficial glaciofluvial deposits (Secondary A Aquifer)

5.1.1 Drinking Water Standard (DWS)

For assessment of groundwater resource potential GAC have based upon the UK Drinking Water Standard (DWS), or where not available EU drinking water standards or World Health Organisation (WHO) drinking water standards. In addition for compounds where published DWS are not available, additional criteria have been considered, although it is recognised that these are not published standards, such as

- published taste or odour data have been used for a number of oxygenates (MTBE, ETBE, TAME, DIPE) which are known to have taste and odour thresholds which are significantly lower than toxicity based criteria,
- WHO (2008) proposals for drinking water guidelines which are based on the TPHCWG approach for TPH fractions
- Risk-based screening levels derived by GSI (2014) for Shell downstream sites, derived to be protective of groundwater ingestion using published toxicity data (for naphthalene, other PAHs, and n-hexane), and derived by AECOM (for TBA).

The groundwater within the Zig Zag Chalk Formation is considered to be the primary controlled waters receptor. The shallow groundwater on site within the superficial glaciofluvial deposits is considered to be a secondary controlled waters receptor.

5.2 Analytical Results Screening

Comparison of groundwater analytical results to Stage 2 GAC is provided in **Appendix B** and GAC exceedances are summarised in the table below:

Receptor Type	Screening Criteria	Media	Benzene / TPH Aromatic C ₅ -C ₇	TEX / TPH Aromatic C ₇ -C ₁₀	Other Aromatic TPH	Aliphatic TPH	MTBE	Other Oxygenates	Naphthalene	Benzo(a)pyrene	Other PAHs (incl. 2-methyl naphthalene)
Controlled Waters	DWS	Groundwater	✓	✓	✓	✓	✗	✓	✗	✓	✗

Notes: ✓ = Measured in excess of GAC
 ✗ = Not measured in excess of GAC
 n/a = not applicable

5.3 Discussion of Key Exceedances of DWS GAC

Table 1b provides details of each COPC which exceeds DWS GAC. The key exceedances of the DWS GAC are discussed below.

The following COPC exceeded the DWS controlled waters GAC:

- Benzene at BH102 in monitoring rounds December 2014, May 2015 and November 2015
- Ethylbenzene at BH102 in monitoring rounds December 2014 and November 2015. Total Xylene at BH102 in November 2015 only, with concentrations less than a factor of 2 above DWS.
- MTBE at BH102 in December 2014 and May 2015 monitoring rounds.
- ETBE in the groundwater sample collected from BH102 in December 2014 and November 2015; with concentrations less than a factor of 2 above DWS.
- TPH Aromatic bands >EC5 – EC7, >EC8-EC12 and Aliphatic bands > C8 – C10 in BH102 in December 2014 and November 2015 only,
- Benzo(a)pyrene in groundwater in BH102A in December 2014, May and November 2015 monitoring rounds with concentrations less than a factor of 4 above DWS.
- Sum of 4 PAHs in groundwater in BH102A in the November 2015 monitoring round with concentrations less than a factor of 1.4 above DWS.

The following GAC exceedances/scenarios have been further assessed:

- Benzene (and associated TPH Aromatic >EC5 – EC7) and MTBE.

Ethylbenzene, total xylenes, ETBE, other TPH fractions and benzo(a)pyrene are not considered to be key risk drivers given their limited exceedances of DWS GAC. However the monitoring data has been compared to previously derived SSAC for completeness.

5.4 Groundwater Trends

There are 5 accessible monitoring wells which contain groundwater on the site. Based on key COPC concentration trends over time, these are considered to be located in the following areas:

- Up gradient wells are represented by BH105A and BH106A.
- Cross gradient wells are represented by BH103
- Down hydraulic gradient wells are represented by BH102 and BH102A.

A total of ten GME have been undertaken at the site with three (3) monitoring rounds completed between October 2011 and January 2013 prior to construction works at the site, and a further seven (7) GME completed between September 2013 and February 2016 following completion of the redevelopment works.

Benzene

Since monitoring began at the site in 2011, groundwater concentrations in monitoring well BH102 have been identified as the key risk driver for the site. Benzene concentrations from October 2011 to February 2016 are illustrated in Graph 1 and Table N. The results indicate a decrease in benzene concentrations in BH102 since monitoring began in October 2011 from 1,460 µg/l to <1 µg/l. Concentrations decreased after the 2013 construction project in comparison to pre-construction concentrations. Concentrations since 2013 have been variable but all benzene concentrations have been below 300 µg/l and there is no evidence of rebound or an upward trend.

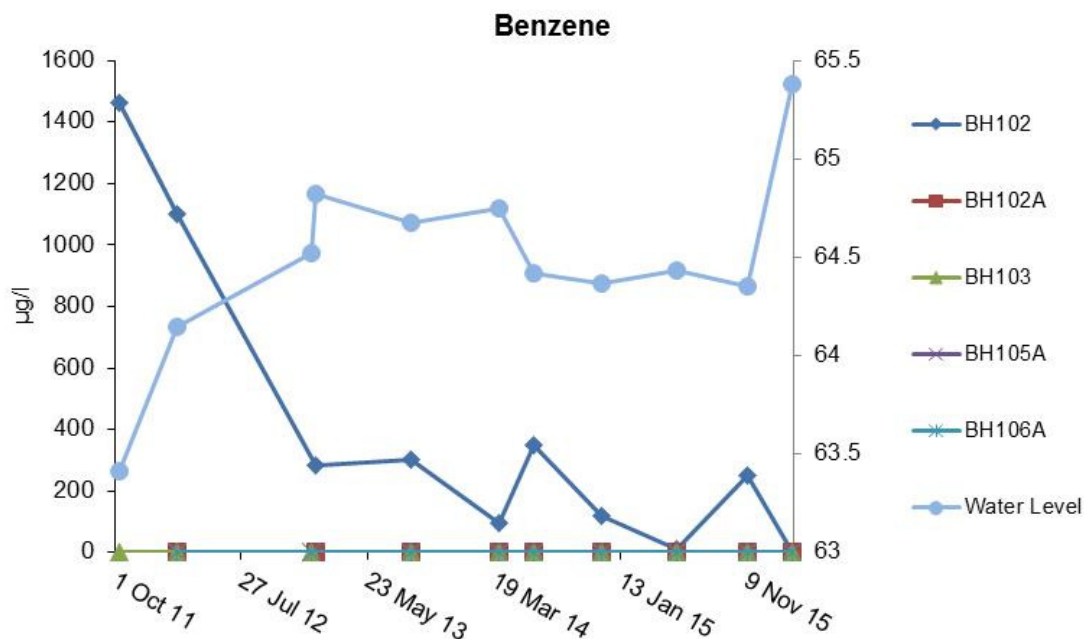


Table N - BTEX concentrations over time in BH102

Analyte	Concentration (µg/l)									
	12/10/2011	27/02/2012	22/01/2013	04/09/2013	31/03/2013	23/06/2014	01/12/2014	29/05/2015	11/11/2015	26/02/2016
Benzene	1460	1100	282	303	92.8	348	118	12.6	267	<MDL
Toluene	465	150	241	35	5.54	17.7	9.3	<MDL	15.8	<MDL
Ethylbenzene	2350	3600	3760	756	437	801	347	28.5	696	<MDL
M_P_Xylene	6480	9330	12400	1570	303	547	219	39.6	1080	<MDL
O_Xylene	2460	4380	4500	389	41.1	148	23.3	2.68	185	<MDL
Water level (mAOD)	63.51	63.769	63.911	63.735	64.407	64.054	63.985	64.045	63.964	66.25

COPC in groundwater sampled from BH102A (located approximately 3m west of BH102 closer to the tank farm and installed in the deeper drift geology) were all reported below the laboratory detection limit.

MTBE

MTBE has historically been reported below the laboratory MDL since monitoring began in 2011. In the January 2014 GME MTBE was reported at a concentration of 144µg/l and in May 2015 at a concentration of 24.5 µg/l exceeding the controlled waters GAC by a factor of 7.2 and 1.2 respectively, In the two most recent monitoring events in November 2015 and February 2016 MTBE has been reported below the laboratory detection limit. MTBE concentrations are presented in Table O below.

Table O - MTBE concentrations over time in BH102

Analyte	Concentration (µg/l)									
	12/10/2011	27/02/2012	22/01/2013	04/09/2013	31/03/2013	23/06/2014	01/12/2014	29/05/2015	11/11/2015	26/02/2016
MTBE	<1	<1	<1	<1	<1	<1	144	24.5	<1	<1
Water level (mAOD)	63.51	63.769	63.911	63.735	64.407	64.054	63.985	64.045	63.964	66.25

MTBE has been reported below the laboratory MDL in all other on-site wells since monitoring began in 2011 and is not considered to present a risk to controlled waters receptors.

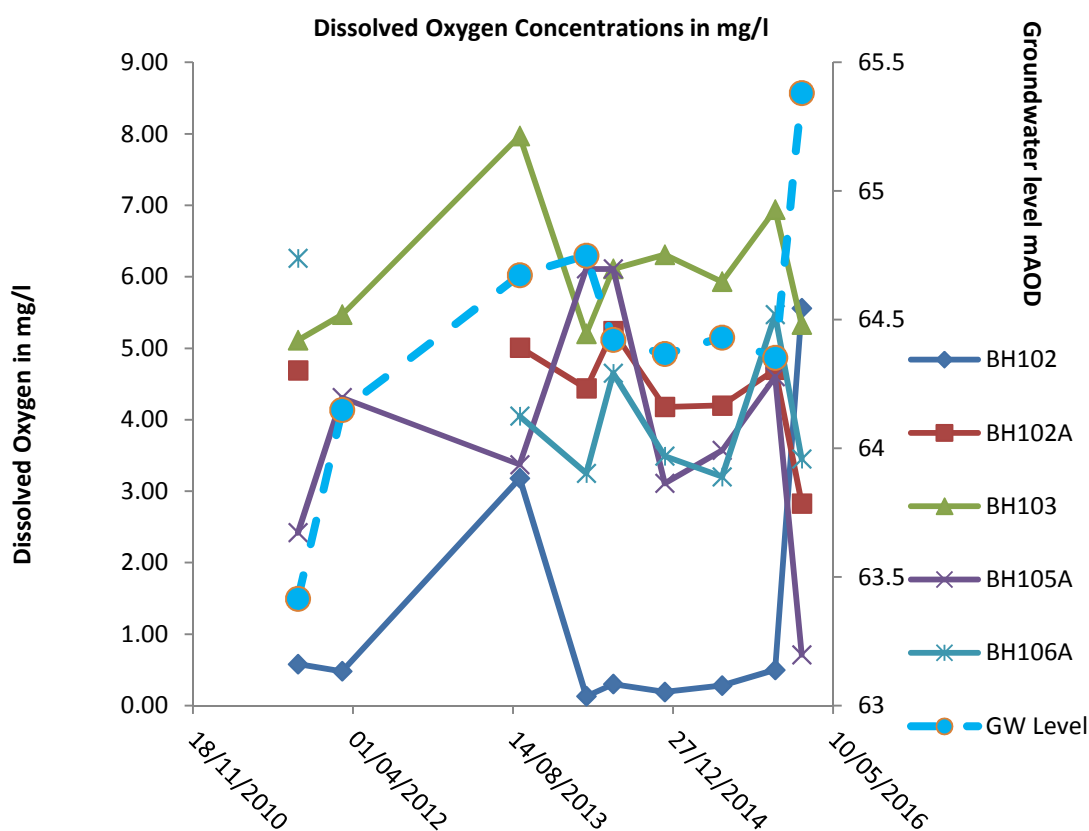
5.5

MNA Indicators

Primary indicators of attenuation are discussed in the section above, and show that concentrations since 2013 have been variable there is no evidence of rebound or an upward trend.

The secondary MNA indicator parameters analysed were dissolved oxygen (field readings), nitrate, ferrous iron and sulphate. Notable observations were:

- Dissolved oxygen (DO) concentrations have been measured at the site since monitoring began in 2011. Up gradient wells in the west of the site (BH105A and BH106A) and downgradient wells (BH102A and BH103) in the east show DO concentrations predominantly between 3 and 6 mg/l with no clear seasonal variations. DO readings in down gradient well BH102 were reported below 1 mg/l, lowest concentration where aerobic degradation is likely to be dominant, from March 2014 until the most recent February 2016 GME where a concentration of 5.56 mg/l was observed. The data suggest a mildly anaerobic groundwater at BH102 within an aerobic aquifer.



Nitrate, ferrous iron and sulphate concentrations have been recorded at the site since December 2013.

- Nitrate concentrations are above 10 mg/l in most wells indicating that background concentrations in the aquifer are relatively high and therefore there will be recharge of nitrate to depleted areas. Nitrate decreased in BH102 between December 2014 and November 2015. This correlates with increased BTEX and C6-C12 hydrocarbons in this well at this time. During the most recent February 2016 GME nitrate in BH102 has increased from 0.3 µg/l to 26.1 µg/l and concentrations of COPC have been reported below the MDL, indicating that groundwater is becoming more aerobic.

- Ferrous iron concentrations were elevated in BH102 at maximum concentrations of 9,340 µg/l reported in December 2014 indicating that iron reduction was occurring, but were reported below the MDL in the most recent February 2016 GME. Ferrous iron is reported below the MDL in all other monitoring wells in all other monitoring rounds.
- Sulphate concentrations are typically over 20 mg/l, do not show depletion on the down-hydraulic gradient boundary and do not show clear trends over time. Sulphate reduction is therefore unlikely to be a dominant mechanism for degradation of hydrocarbons at this site.

The DO, nitrate and ferrous iron data suggest mildly anaerobic groundwater at BH102 within an aerobic aquifer.

6. STAGE 3 DETAILED QUANTITATIVE RISK ASSESSMENT

6.1 Controlled Waters DQRA

Potential risks to groundwater underlying the site were assessed in the URS February 2013 CW DQRA (Ref.3) using two separate models:

Model 1: Groundwater in the Chalk - Primary Receptor

Model 2: Groundwater in the Drift Deposits – Secondary Receptor

The controlled waters model was submitted to the EA for review in February 2013 in order to discharge a planning condition relating to the redevelopment of the site. The model was accepted and the planning condition discharged in March 2013 (Ref. 13) The Controlled Waters receptors for the site are the underlying Zig Zag Chalk (Principal Aquifer) and the Superficial Deposits. Although the site is underlain by superficial deposits of the Lowestoft Formation which are described by the EA as Unproductive Strata, the formation is shown on the 1:50,000 geological map to be underlain and surrounded by Glaciofluvial Deposits (classified as a Secondary-A Aquifer). It was assumed for the 2013 models that the boreholes are installed in the more sensitive Secondary-A Aquifer as the vertical and horizontal extent of the Lowestoft Till and Glaciofluvial Deposit units within the permeable drift are not known. The site is close to the edge of a significant buried valley feature with drift deposits reaching up to 80m in thickness within 1km to the north west, north and north east of the site.

2013 Model 1 – Groundwater in the Chalk Principal aquifer

Local flow in the Chalk Principal Aquifer in the area has been inferred towards the east towards the River Hiz which feeds into the River Purwell. The 1:50,000 geological map indicates that the increasingly thick drift sequence may be directly underlain by the Gault Clay, with the Lower Chalk absent, within 300m of the west of the site, and within 1km to the north and north east.

Groundwater flowing laterally in the Chalk in the area of the site is therefore likely to discharge laterally to the drift sequence, as the top of the Chalk becomes increasingly deeper, for example the groundwater in the Chalk on site is assumed to flow eastwards with a gradient of approximately 0.005 at approximately 6.2m bgl however the depth to the Chalk increases from 5.4m bgl in the western area of the site to 14.2m bgl at BH102A located in the eastern area of site.

Groundwater in the underlying Zig Zag Chalk formation was selected as the primary compliance point for the assessment and was modelled assuming impacted pore water from soils and groundwater could migrate into the Principal Aquifer at a rate equal to infiltration, followed by horizontal migration within the aquifer. A Compliance Point of 50m was selected to model the potential risks from hazardous substances to groundwater.

2013 Model 2 – Groundwater in the Drift Secondary A Aquifer

Groundwater in the superficial deposits underlying the site has been selected as the secondary compliance point. For the purpose of this assessment it has been conservatively assumed that the wells installed in the drift are installed in a Secondary-A Aquifer, as the vertical and horizontal extent of the Lowestoft Formation and Glaciofluvial Deposits is not known.

Although the drift deposits are considered a controlled waters receptor, there are physical constraints on the ability to use the groundwater resource. The exploitation potential of the drift deposits beneath the site is considered likely to be low for the following reasons:

- Field tests indicate the drift deposits below the site are only slowly permeable
- There are no reported licensed groundwater abstractions within 1km of the site and no reported private groundwater abstractions within 2km of the site. The nearest surface water abstraction is located 835m south of the site; and
- The down-gradient area is a residential area with mains water supply.

An arbitrary Compliance Point of 50m in the drift deposits was selected to be protective of the Secondary A Aquifer, however due to the low exploitation of the aquifer an extended compliance point of 100m was also presented in the assessment to provide an indication of potential risks to the wider aquifer.

It was assumed that the aquifer is aerobic based on the geology, depth to groundwater, ferrous iron, nitrate and sulphate concentrations and field groundwater measurements.

6.2 Discussion of Key Exceedances

Groundwater in the Chalk

COPC were not reported above the Chalk SSAC in any of the groundwater samples collected at the site from any of the four monitoring events.

Groundwater in the Drift 50m Compliance Point

It should be noted that concentrations of benzene in BH102 have significantly decreased since the start of sampling in October 2011 from a concentration of 1,460 µg/l to concentrations below the laboratory detection limit in February 2016. The seven rounds of post construction monitoring show that concentrations in BH102 are variable but with no evidence of rebound or an upward trend.

Benzene was detected in concentrations greater than the controlled waters SSAC for a 50m compliance point at the 95 percentile protective of the drift deposits in groundwater sampled from BH102 during the December 2014 and November 2015 monitoring events. Controlled Waters Hazard Indices were reported at 1.85 and 3.90 respectively.

The concentration of benzene in groundwater sampled from BH102 in May 2015 of 12.6 µg/l was well below the 50m SSAC, and the concentration in groundwater sampled from February 2016 was below the laboratory detection limit. These monitoring rounds indicate that concentrations above the SSAC are not continually present through the year.

As the SSAC were derived using the RTM methodology which assumes a constant source, the SSAC of 63.7 µg/l for 50m is considered conservative and an exceedance for part of the year does not necessarily indicate a risk to controlled waters..

Groundwater in the Drift 100m Compliance Point

Although the drift deposits are recognised as a controlled waters receptor, there are physical constraints on the ability to use the groundwater resource. The exploitation potential of the drift deposits beneath the site is considered likely to be low as discussed in Section 6.1 above, and in the 2013 DQRA report. Given the low exploitation potential of the aquifer, an extended compliance point of 100m is considered appropriate. Concentrations pre redevelopment exceeded the benzene 100m SSAC, however none of the post construction monitoring data has exceeded the SSAC derived for a 100m compliance point. Simulated benzene SSAC at a 75m compliance point is 292 µg/l. At this distance, no risks are simulated from the four most recent GME presented in this report.

Table P- BTEX concentrations over time in BH102

Analyte	2013 SSAC at 95 %ile (µg/l)		Concentration (µg/l)									
	50m	100m	12/10/2011	27/02/2012	22/01/2013	04/09/2013	31/03/2013	23/06/2014	01/12/2014	29/05/2015	11/11/2015	26/02/2016
Benzene	63.7	1000	1460	1100	282	303	92.8	348	118	12.6	267	<MDL

Comparison of groundwater, analytical results to Stage 3 SSAC is provided in **Appendix D**.

Conclusions

As no risks are simulated for a 100m compliance point, and only data from part of the year exceeds the 50m SSAC with hazard indices which are marginal. The theoretical risks simulated by the model are considered unlikely to pose a significant risk to controlled waters in the drift. COPC in groundwater sampled from BH102a (located approximately 3m west of BH102 closer to the tank farm and installed in the deeper drift and top of chalk geology) were all reported below the laboratory detection limit. No risks have been simulated to groundwater quality within the Chalk Principal aquifer from post construction groundwater concentrations at the site.

7. CONCEPTUAL SITE MODEL

The Conceptual Site Model (CSM) presented here is based on the information provided in the historic reports prepared for the site, on observations made during the AECOM GME, and on the subsequent AECOM generic and detailed quantitative risk assessments.

The GME has indicated that the COPC listed in Section 4.6 and 5.6 are present in the areas of the site which were investigated.

The potential pathways and receptors identified for assessment at Stage 2 and/or Stage 3 are listed in **Tables Q and R** below.

7.1 Review of Potential Source-Pathway-Receptor Linkages

The following pollutant linkages were evaluated at Stage 2 and Stage 3 given continued oil use. These are also detailed on **Figure 4**.

Table Q – Human Health CSM

Source	Pathway	Receptor	Likelihood of Pollutant Linkage Presenting an Unacceptable Risk
- Potentially impacted groundwater. - Potentially impacted soils (soil data has not been assessed within this report; however, the potential presence of impacted soil is being evaluated through modelling of soil vapour.	Lateral and vertical vapour migration and subsequent inhalation.	On-site shop staff, visiting staff and general public.	Unlikely: Vapour monitoring at the site was reported below the Stage 2 GAC protective of on-site workers or off-site residents during the URS CESA Report (Ref.3).
		Off-site workers in adjacent commercial properties.	
		Off-site residents	
	Particulate - Ingestion, inhalation, dermal contact with soil particulates.	Visiting on-site contractors excavating ground.	Possible*
	Permeation – Migration of hydrocarbon substances through plastic potable water supply pipes.	On-site shop staff (ingestion of drinking water on-site).	Unlikely: COPC were reported at concentrations below the drinking water standards in potable water samples recovered from the shop during the URS CESA Report (Ref.3).

* Potential risks to visiting contractors undertaking intrusive works should be managed by appropriate PPE, risk assessment and method statements. Risks to visiting contractors excavating the ground were therefore not assessed within the scope of the DQRA.

Table R – Controlled Waters CSM

Source	Pathway	Receptor	Likelihood of Pollutant Linkage Presenting an Unacceptable Risk
- Potentially impacted groundwater. - Potentially impacted soils (soil data has not been assessed within this report; however, the potential presence of impacted soil is being evaluated through modelling of soil vapour.	- Partitioning between soil and pore water. - Leaching of impacted soils into groundwater. - Lateral migration of impacted groundwater.	Superficial Deposits (Secondary A Aquifer) Zig Zag Chalk Formation (Principal Aquifer)	Unlikely: Unacceptable risks were not identified from concentrations of COPC in post-construction groundwater to the underlying Drift Deposits Secondary A Aquifer or underlying Principal Chalk Aquifer.
		Surface water within the Bearton Pond located approximately 200m north and the River Hiz located approximately 850m east of the site.	

8. CONCLUSIONS

The following conclusions have been made based on the groundwater data collected, and on the Stage 2 and Stage 3 risk assessments completed as part of this Comprehensive GME.

Field Work

Groundwater was encountered in all five (5) groundwater monitoring wells during each of four groundwater monitoring events at elevations typically ranging from 63.69 metres Above Ordnance Datum (m AOD) 64.89m AOD. The depth to groundwater ranged from 5.94 to 7.10m bgl. Groundwater is inferred to flow in an easterly direction towards the River Purwell.

Mild hydrocarbon odours were observed during purging of well BH102 located adjacent to the eastern site boundary during the December 2014, May 201 and November 2015 monitoring events. No evidence of hydrocarbon impact was observed in any other monitoring wells, including BH102A (located approximately 3m west of BH102 and closer to the tank farm). LNAPL was not identified in any of the wells.

Risk Assessment Results

Stage 2 Risk Assessment Results

A Stage 2 risk assessment was performed on the data collected during the December 2014, May and November 2015 and February 2016 GME to assess potential risks to human health (on-site workers, off-site workers and off-site residents):

- Groundwater concentrations were not considered to present an unacceptable risk to human health receptors

Stage 3 Risk Assessment Results

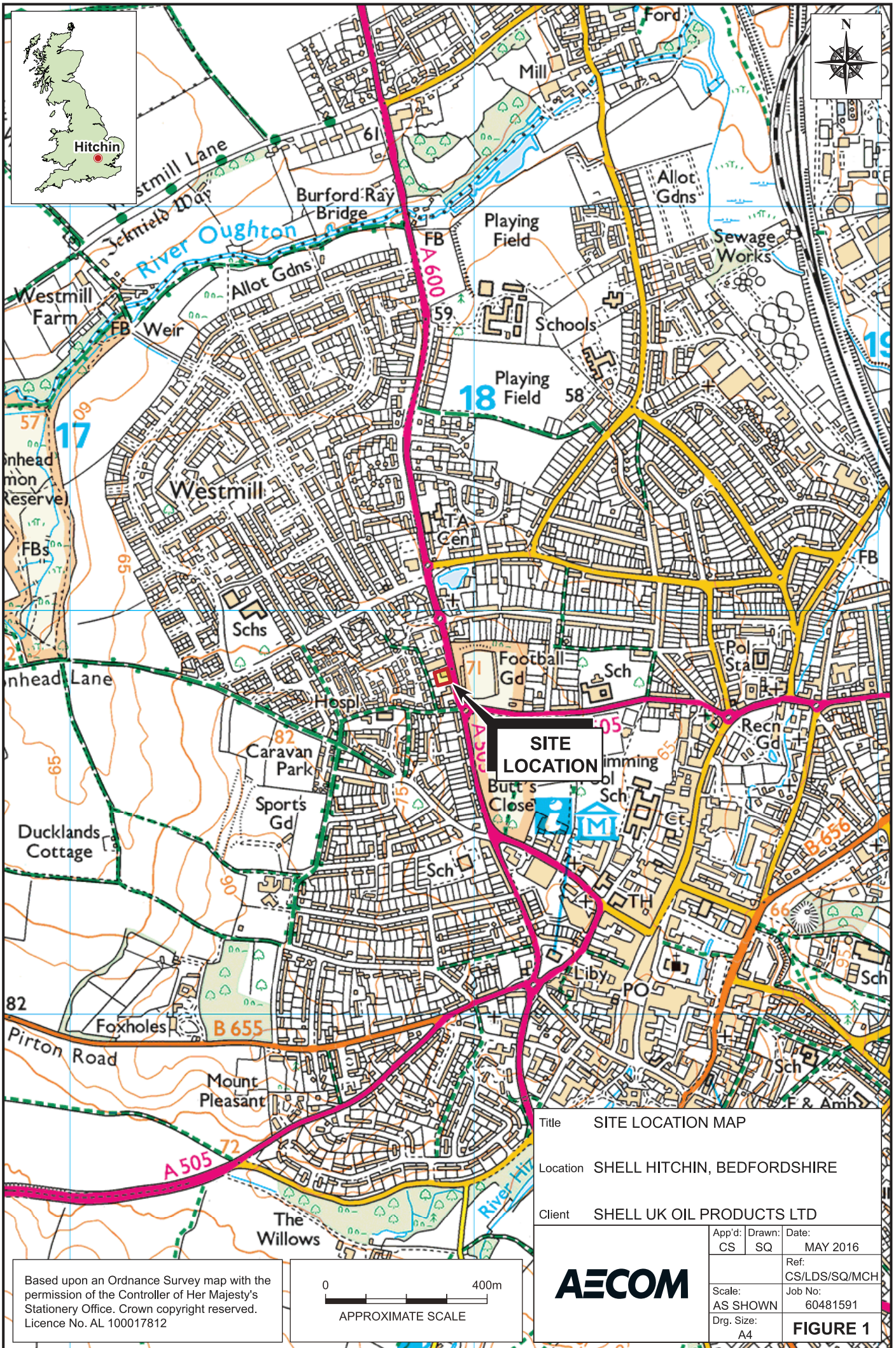
A controlled waters detailed quantitative risk assessment (DQRA) was completed by URS in March 2013. Two models were created for the site to assess potential risks to groundwater in the Chalk and groundwater in the Drift Deposits. Groundwater concentrations detected in each of the four GMEs were compared against the Stage 3 screening criteria generated in this DQRA and the following concluded:

- Unacceptable risks were not identified to groundwater quality within the Drift Deposits Secondary A Aquifer or the underlying Chalk Principal Aquifer. The site is considered suitable for on-going oil use.

9. REFERENCES

- Reference 1 - URS Preliminary Phase I Investigation Report (Ref R46370079-001) Final Phase I; dated October 2011)
- Reference 2 - URS Phase 2 Environmental Site Investigation Report (Ref R46370079-002) Final; dated April 2012
- Reference 3 – URS Phase 2 Comprehensive Environmental Site Assessment – Further Investigation (Ref R46370079-003) Final; dated February 2013)
- Reference 4 - URS Verification Report (Ref R46370079-005) Final; dated October 2013)
- Reference 5 - GeoDelft, Petroleum Risk Tier 1 report ref; C1402.SG474.8008, dated May 1999
- Reference 6 - URS Comprehensive Groundwater Monitoring Event (Ref R46370079-006) Final; dated October 2014)
- Reference 7 - URS Environmental Strategy Plan (Ref R46370079-004) Final; dated March 2013)
- Reference 8. - CLR11
- Reference 9. - Guidance for the Safe Development of Housing on Land Affected by Contamination, R&D Publication 66: 2008 (Volume 1), NHBC and the Environment Agency 2008.
- Reference 10 - USPEA. Technical Guide For Addressing Petroleum Vapour Intrusion At Leaking Underground Storage Tank Sites. EPA 510-R-15-001. June 2015
- Reference 11 - British Standard Institute. Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings. BS8485:2015. June 2015.
- Reference 12. - LQM/CIEH S4UL methodology
- Reference 13 – Environment Agency. Shell Petrol Station, Bedford Road, Hitchin, Discharge of condition 3 & 7. Ref: NE/2012/115913/03-L01 dated 12 March 2013

FIGURES



DO NOT SCALE



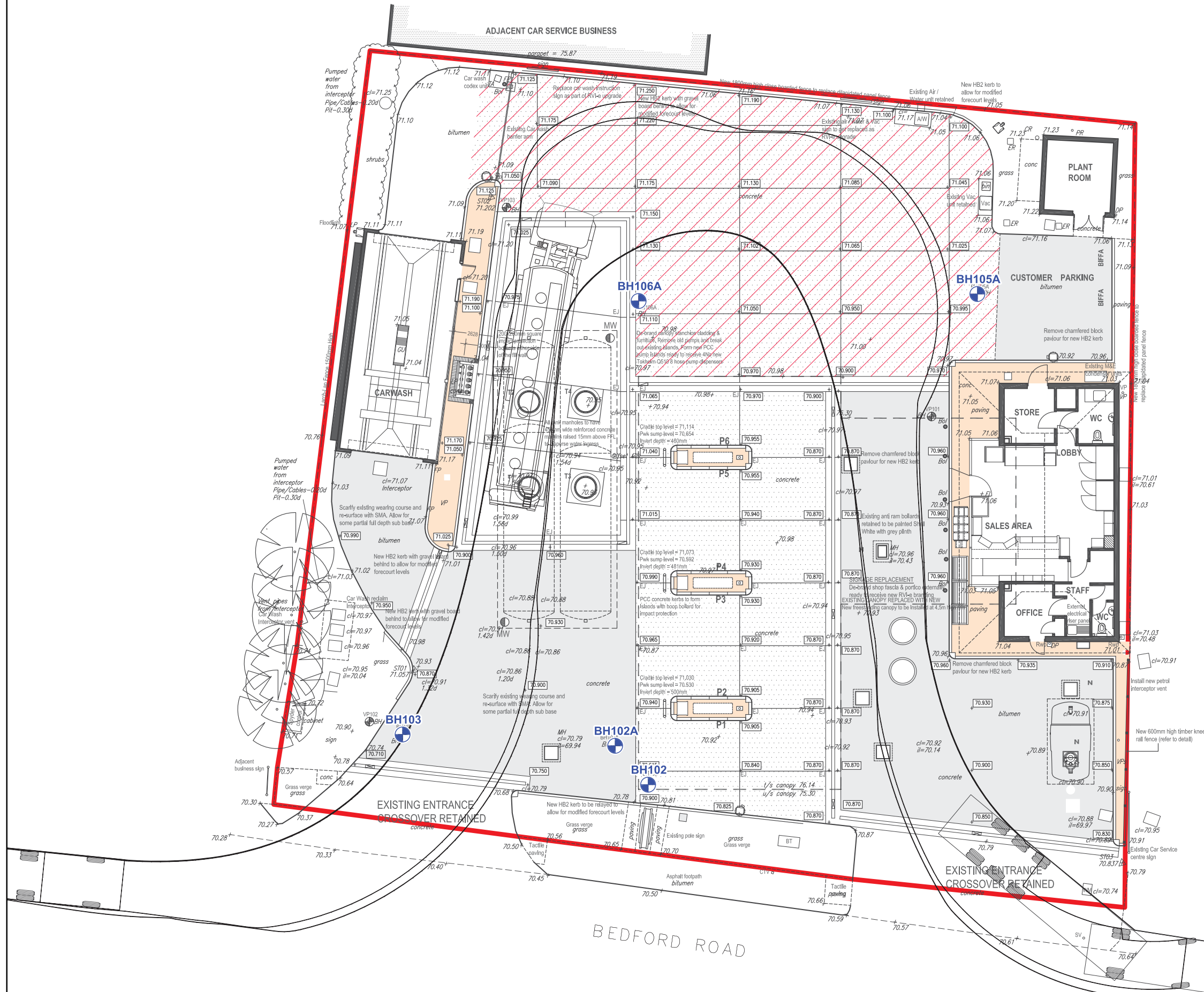
NOTES

KEY:

SITE BOUNDARY



MONITORING WELL LOCATION



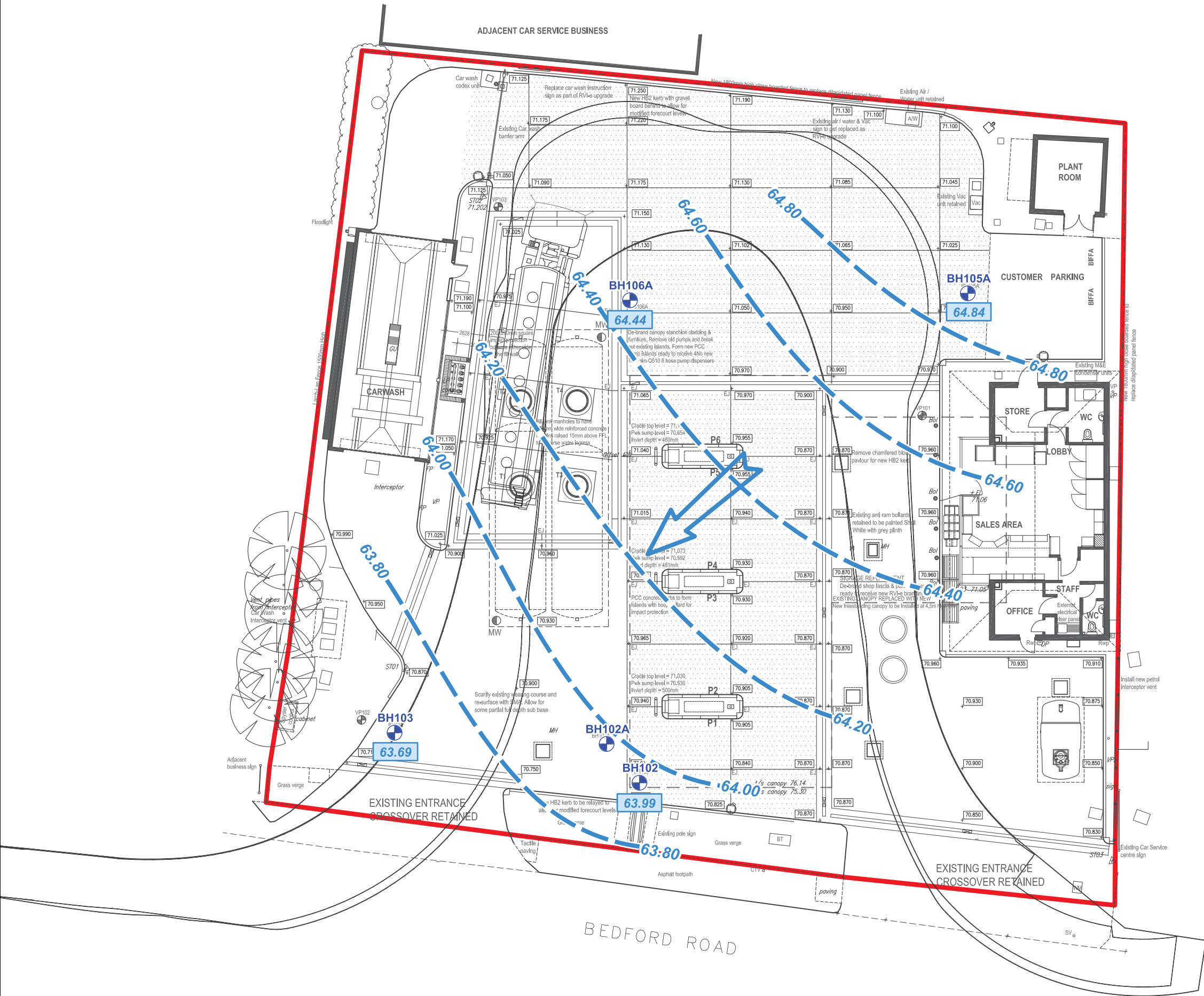
ADJACENT BUILDING

3	DESCRIPTION	DRAWN	APPROVED	DATE
	STATUS FOR INFORMATION CONSULTING ENGINEERS AECOM BRIDGEWATER HOUSE, WHITWORTH STREET, MANCHESTER, M1 6LT TEL 0161-907-3500 FAX 0161-907-3501			
CLIENT SHELL UK OIL PRODUCTS LTD				
PROJECT SHELL HITCHIN, BEDFORDSHIRE				
DRAWING TITLE Figure 2 Site Features Plan				
DRAWN SQ		CHECKED CS	APPROVED CS	DATE MAY 2016
SCALE AS SHOWN	DRG No.	60481591		REV.

ORIGINAL DRAWING A3

DRG No.	60481591
---------	----------

DO NOT SCALE



NOTES

- KEY:
- SITE BOUNDARY
 - ⊕ MONITORING WELL LOCATION
 - 64.44 GROUNDWATER ELEVATION (mAOD)
 - (mAOD) METRES ABOVE ORDANANCE DATUM
 - 126.70 INFERRED GROUNDWATER CONTOUR (mAOD)
 - INFERRED GROUNDWATER FLOW DIRECTION

DESCRIPTION	DATE	APPROVED	DATE
-------------	------	----------	------

STATUS

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PROJECT
SHELL HITCHIN, BEDFORDSHIRE

DRAWING TITLE
Figure 3A
Piezometric Surface Plot
(December 2014)

DRAWN	CHECKED	APPROVED	DATE
SQ	CS	CS	MAY 2016

SCALE	DRG No.	REV.
AS SHOWN	60481591	

ORIGINAL DRAWING A3



DO NOT SCALE



NOTES

- KEY:
- SITE BOUNDARY
 - MONITORING WELL LOCATION
 - 64.44 GROUNDWATER ELEVATION (mAOD)
 - (mAOD) METRES ABOVE ORDANANCE DATUM
 - 126.70 INFERRED GROUNDWATER CONTOUR (mAOD)
 - INFERRED GROUNDWATER FLOW DIRECTION

DESCRIPTION	DATE	APPROVED	DRAWN
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STATUS

FOR INFORMATION

CONSULTING ENGINEERS

AECOM

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CLIENT
SHELL UK OIL PRODUCTS LTD

PROJECT
SHELL HITCHIN, BEDFORDSHIRE

DRAWING TITLE
Figure 3B
Piezometric Surface Plot
(May 2015)

DRAWN	CHECKED	APPROVED	DATE
SQ	CS	CS	MAY 2016

SCALE	DRG No.	REV.
AS SHOWN	60481591	

ORIGINAL DRAWING A3



DO NOT SCALE



NOTES

- KEY:
- SITE BOUNDARY
 -  MONITORING WELL LOCATION
 - 64.44 GROUNDWATER ELEVATION (mAOD)
 - (mAOD) METRES ABOVE ORDANANCE DATUM
 - 126.70  INFERRED GROUNDWATER CONTOUR (mAOD)
 -  INFERRED GROUNDWATER FLOW DIRECTION

DESCRIPTION	DATE	APPROVED	DRAWN
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STATUS

FOR INFORMATION

CONSULTING ENGINEERS

AECOM

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CLIENT
SHELL UK OIL PRODUCTS LTD

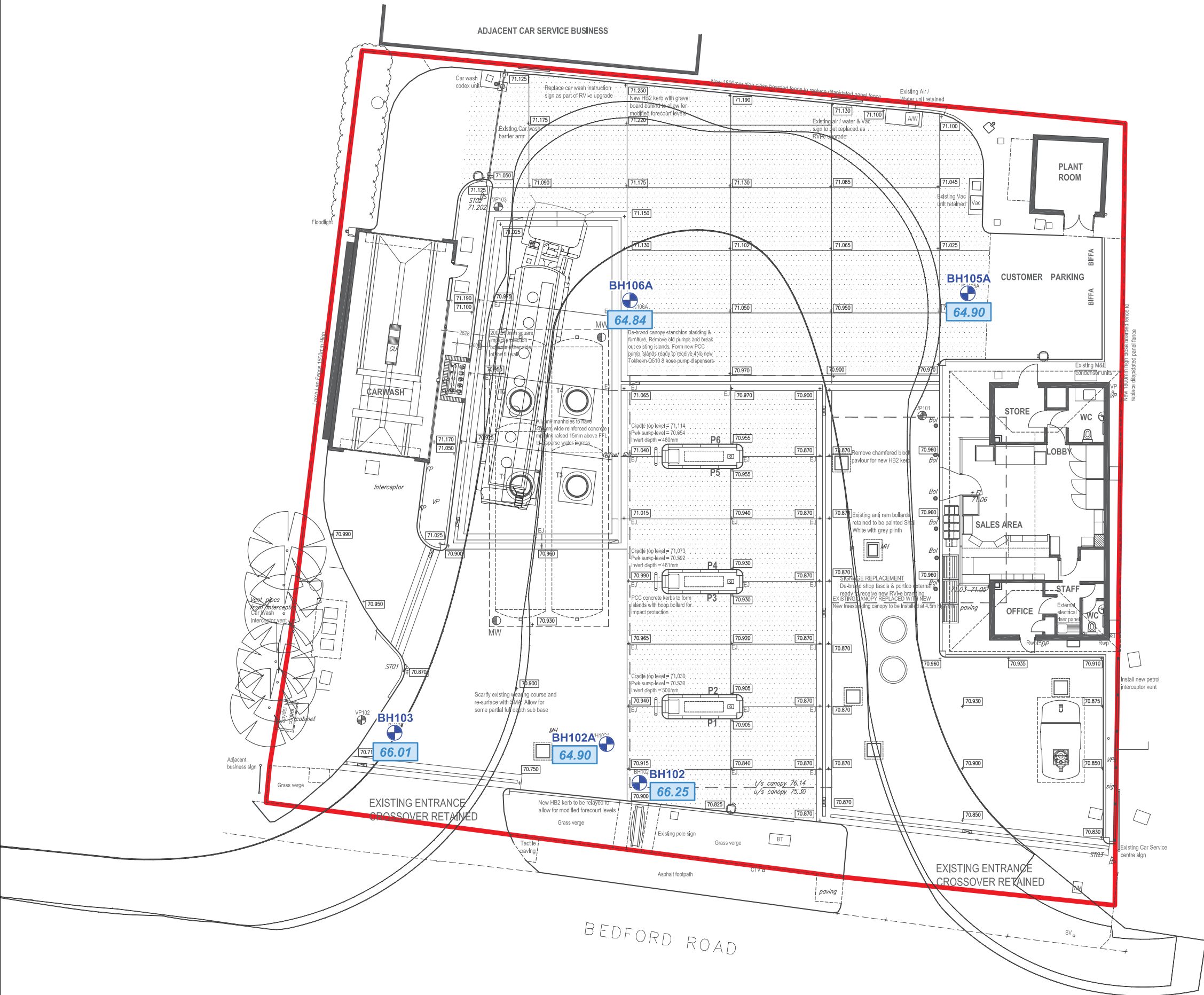
PROJECT
SHELL HITCHIN, BEDFORDSHIRE

DRAWING TITLE
Figure 3C
Piezometric Surface Plot
(Nov 2015)

DRAWN SQ	CHECKED CS	APPROVED CS	DATE MAY 2016
SCALE AS SHOWN	DRG No. 60481591	REV.	

ORIGINAL DRAWING A3

DO NOT SCALE

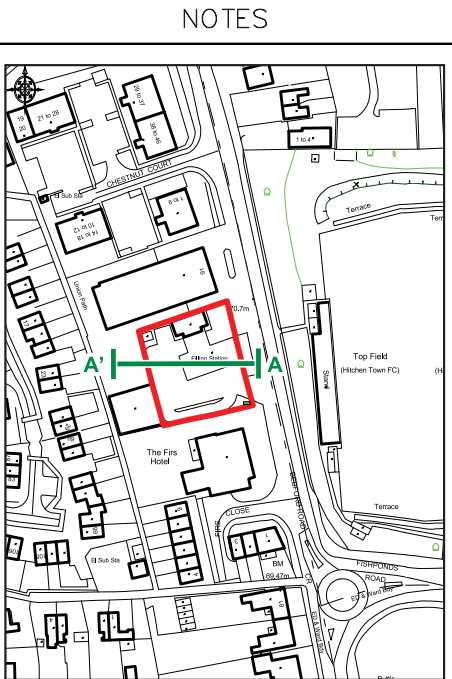
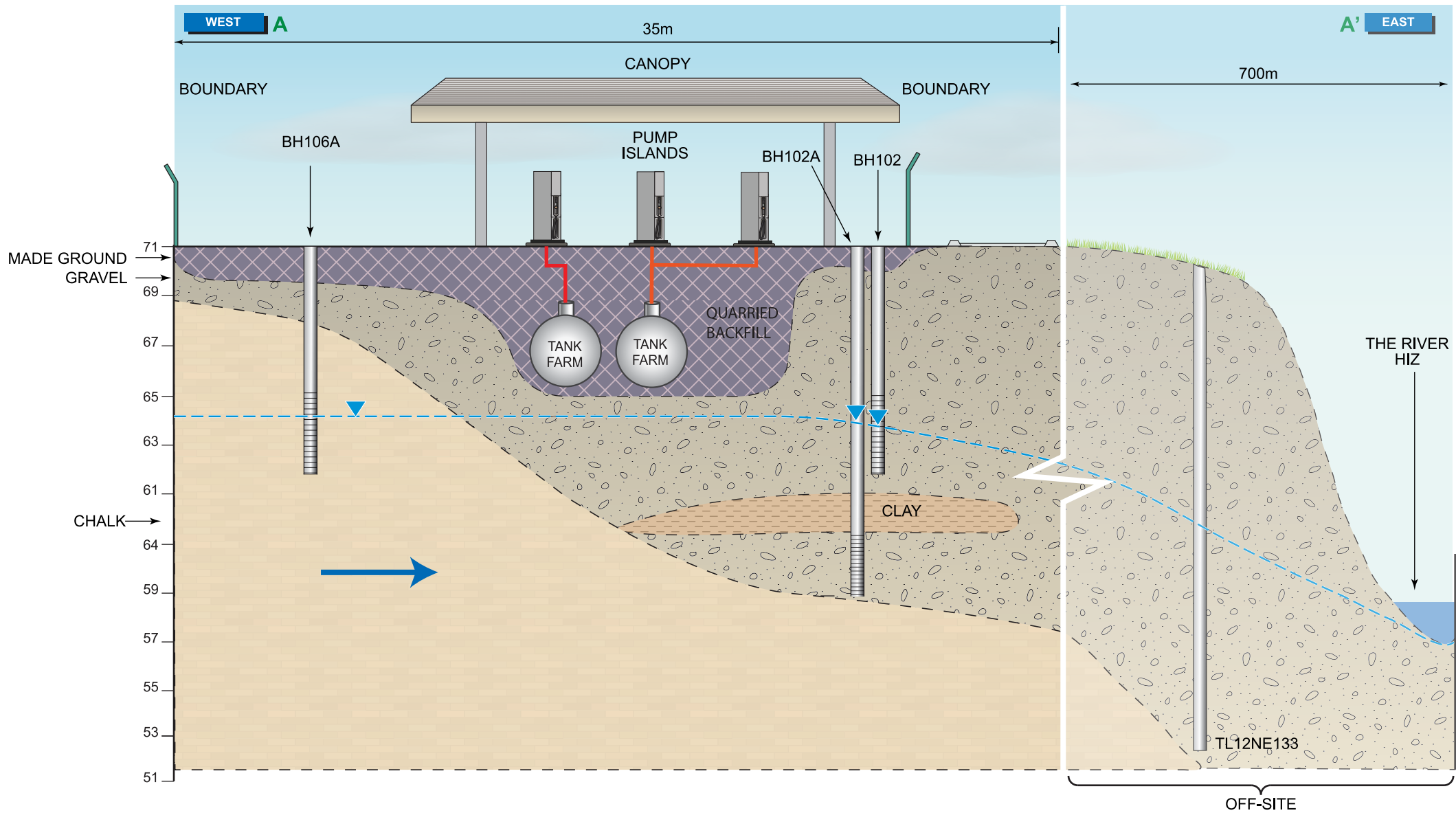


NOTES

- KEY:
- SITE BOUNDARY
 - MONITORING WELL LOCATION
 - 64.44 GROUNDWATER ELEVATION (mAOD)
 - (mAOD) METRES ABOVE ORDANANCE DATUM

DESCRIPTION	TRAIN	APPROVED	DATE
STATUS			
FOR INFORMATION			
CONSULTING ENGINEERS			
AECOM			
BRIDGEWATER HOUSE, WHITWORTH STREET, MANCHESTER, M1 6LT TEL 0161-907-3500 FAX 0161-907-3501			
CLIENT			
SHELL UK OIL PRODUCTS LTD			
PROJECT			
SHELL HITCHIN, BEDFORDSHIRE			
DRAWING TITLE			
Figure 3D Piezometric Surface Plot (Feb 2016)			
DRAWN SQ	CHECKED JW	APPROVED JW	DATE JUNE 2016
SCALE AS SHOWN	DRG No. 60481591		REV.

ORIGINAL DRAWING A3



NOTES

AREA OF POTENTIAL CONCERN

- On-site**
- Historical**
- Historical use of the site as a petrol filling station since 1970.
 - Leaking and joints were noted during an inspection of the pumps and pipework by the Petroleum Officer in October 1986.
 - A leak on pump 8/9 noted by the Petroleum Officer in January 1991.
- Current**
- Operational underground storage tanks (URSSW understands there are no historic / decommissioned storage tanks on-site).
 - Accidental releases to ground from off-set fill points, located to the south of the forecourt.
 - Accidental releases to ground from dispenser pumps: 3 car fuel islands under the canopy and cracks in concrete surface of the forecourt.
 - Accidental releases from fuel lines: Present between the tanks, offset fill points and fuel islands.
 - Site interceptors (main forecourt interceptor located at the north east of the site, and interceptor associated with the car wash at the south of the site) and associated drainage lines.
 - Drainage from the car wash.
- Off-site**
- Historical**
- An Aboveground Storage Tank (AST) associated with a warehouse is shown approximately 30m north of the site boundary.
 - Garage (later shown as depot) approximately 5m north of the site boundary.
- Current**
- Garage adjacent to the site boundary at the west of the site.
 - Tyre Centre/Garage approximately 5m north of the site boundary.

CHEMICALS OF POTENTIAL CONCERN

- Historical**
- Metals – arsenic, boron, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium and zinc.
 - VOCs
- Current**
- TPH - Petroleum hydrocarbons.
 - BTEX- Benzene, toluene, ethylbenzene and xylenes.
 - Petroleum Additives- Methyl tertiary butyl ether (MTBE) and tertiary amyl methyl ether (TAME).
 - PAHs- Polycyclic aromatic hydrocarbons.
 - Metals – arsenic, boron, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium and zinc.

POTENTIAL PATHWAYS

- Human Health**
- Vapours – Migration of vapours through made ground to above ground buildings.
 - Particulate – Ingestion, inhalation, dermal contact, with soil particulates.
 - Permeation – Migration of hydrocarbon substances through plastic potable water supply pipes.
- Controlled Waters**
- Leaching – Migration of hydrocarbon substances from soils into shallow (and potentially deep) aquifers.
 - Migration of impacted perched water into shallow (and potentially deep) aquifers

POTENTIAL RECEPTORS

- Human Health**
- Shop staff.
 - The general public and visiting staff (such as contractors, including those conducting excavation works).
 - Workers in the garage adjacent to the east of the site, tyre centre approximately 5m north of the site and workers and guests at the Fir Hotel approximately 5m south of the site.
 - Occupants of residential properties approximately 30m north and south of the site and 20m to the west of the site
- Controlled Waters**
- Groundwater within the Superficial Deposits on-site (Potentially a Secondary A Aquifer).
 - Groundwater within the Zig Zag Chalk Formation (Principal Aquifer).
- Human Health**
- Potentially impacted shallow soils / groundwater, followed by vapour migration to on-site workers within the shop area and off-site workers to the north and east of the site.
 - Potentially impacted shallow soils / groundwater, followed by permeation through plastic pipes into the site potable water supply.
- Controlled Waters**
- Potentially impacted shallow soils / groundwater, followed by vertical migration into the shallow groundwater within the shallow Drift Deposits that border the site, and potentially deeper groundwater in the underlying Zig Zag Chalk Formation Principal Aquifer
 - Potentially impacted shallow soils / groundwater: migration of chemicals of potential concern (COPC) from soils into shallow groundwater.

POTENTIALLY COMPLETE POLLUTANT LINKAGES:

- None identified.

DESCRIPTION	DATE	APPROVED	DATE
STATUS			
CONSULTING ENGINEERS			
AECOM			
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CLIENT SHELL UK OIL PRODUCTS LTD			
PROJECT SHELL HITCHIN, BEDFORDSHIRE			
DRAWING TITLE Figure 4 CONCEPTUAL SITE MODEL			
DRAWN SQ	DESIGNED	CHECKED CS	APPROVED CS
SCALE	DRG No.	DATE	REV.
NTS	60481591	MAY 2016	

APPENDIX A FIELD DATA TABLES

TABLE 1
GROUNDWATER ELEVATIONS MEASUREMENTS

Site	Shell Hitchin
Sample Round	01 December 2014

Borehole	Ground elevation (m AOD)	Elevation of top of pipe (m AOD)	Top and base of screen (mbgl)		Base of drilled borehole (mbgl)	Top and base of screen (mAOD)		Base of borehole (mAOD)	Dip date	Depth to LNAPL (m below top pipe)	Depth to water (m below top pipe)	Depth to base (m below top pipe)	Difference from installed depth / silt thickness (m)	NAPL Surface Elevation (mAOD)	Groundwater elevation (m AOD)	Comments
BH102	70.83	70.83	5.80	9.00	9.00	65.03	61.83	61.83	01/12/2014	-	6.85	8.96	0.04	-	63.99	
BH102A	70.83	70.83	11.30	13.50	14.40	59.53	57.33	56.43	01/12/2014	-	5.94	12.84	0.66	-	64.89	
BH103	70.79	70.78	5.80	9.00	9.00	64.98	61.78	61.78	01/12/2014	-	7.10	8.34	0.66	-	63.69	
BH105A	71.04	71.03	6.30	8.50	9.00	64.73	62.53	62.03	01/12/2014	-	6.19	8.39	0.12	-	64.84	
BH106A	71.05	71.05	4.80	8.50	8.70	66.25	62.55	62.35	01/12/2014	-	6.61	8.25	0.26	-	64.44	

Legend

m bgl - metres below ground level
m AOD - metres Above Ordnance Datum

Notes

Boreholes were levelled to ordnance datum on February 2012.

TABLE 2
GROUNDWATER QUALITY MEASUREMENTS

Site	Shell Hitchin
Sample Round	01 December 2014

Borehole	Purge Date	Purge Method	Purge Technique	Purge Volume (L)	pH	Temperature (°C)	Conductivity (mS/cm ²)	ORP (mV)	ORP (mV) Corrected	Dissolved Oxygen (mg/L)	Comments	Sample Date	Sample Method	Comments
BH102	01/12/2014	Dewater and resample	Peristaltic pump	5	7.14	12.72	1965	-107	105	0.47	Clear sheen, mild HC odour.	01/12/2014	Peristaltic pump	
				8	7.11	12.96	1960	-116	96	0.27				
				12	7.11	13.50	1971	-128	84	0.19				
BH102A	01/12/2014	Dewater and resample	Peristaltic pump	10	7.04	13.63	1953	75	287	4.32	Creamy white, slightly turbid. NVO	01/12/2014	Peristaltic pump	
				20	6.99	13.22	1911	29	241	4.40				
				31	6.98	13.22	1905	26	237	4.18				
BH103	01/12/2014	Dewater and resample	Peristaltic pump	3	7.06	13.47	1847	51	263	6.12	Creamy white, slightly turbid	01/12/2014	Peristaltic pump	
				6	7.07	13.69	1840	53	265	6.31				
				9	7.06	13.77	1839	50	261	6.31				
BH105A	01/12/2014	Dewater and resample	Peristaltic pump	5	6.88	13.05	2127	36	248	3.46	Creamy white, slightly turbid. NVO	01/12/2014	Peristaltic pump	
				9	6.85	13.17	2116	32	244	3.11				
				14	6.86	13.13	2100	32	244	3.11				
BH106A	01/12/2014	Dewater and resample	Peristaltic pump	4	7.15	12.98	1646	43	254	3.98	Creamy white, slightly turbid. NVO	01/12/2014	Peristaltic pump	
				9	7.08	12.96	1663	41	252	3.61				
				13	7.06	12.99	1662	38	250	3.49				

Legend

°C - degrees celsius
L - Litres
NVO - no visible or olfactory evidence of impact
pH - potential of Hydrogen (dimensionless)
mg/L - milligrams per litre
mS - milli siemens
mV - milli volts
ORP - Oxidation Reduction Potential

Notes

ORP is corrected against temperature of groundwater.

Equation: $E_h = E_m + E_{ref}$

Where: E_h = Corrected ORP value

E_m = ORP measured by probe

E_{ref} = Correction factor = $[(\text{temperature}^2) \times -0.0013] - (\text{temperature} \times 0.6656) + 222.02$ (for a 3.5mol KCl probe)

Temperature Approximate specific correction factor

10°C 215.2
15°C 211.7
20°C 208.2

TABLE 1
GROUNDWATER ELEVATIONS MEASUREMENTS

Site	Shell Hitchin
Sample Round	29 May 2015

Borehole	Ground elevation (m AOD)	Elevation of top of pipe (m AOD)	Top and base of screen (mbgl)		Base of drilled borehole (mbgl)	Top and base of screen (mAOD)		Base of borehole (mAOD)	Dip date	Depth to LNAPL (m below top pipe)	Depth to water (m below top pipe)	Depth to base (m below top pipe)	Difference from installed depth / silt thickness (m)	NAPL Surface Elevation (mAOD)	Groundwater elevation (m AOD)	Comments
BH102	70.83	70.83	5.80	9.00	9.00	65.03	61.83	61.83	29/05/2015	-	6.79	8.95	0.05	-	64.05	
BH102A	70.83	70.83	11.30	13.50	14.40	59.53	57.33	56.43	29/05/2015	-	6.05	12.90	0.60	-	64.79	
BH103	70.79	70.78	5.80	9.00	9.00	64.98	61.78	61.78	29/05/2015	-	6.96	8.33	0.67	-	63.82	
BH105A	71.04	71.03	6.30	8.50	9.00	64.73	62.53	62.03	29/05/2015	-	6.31	8.39	0.11	-	64.72	
BH106A	71.05	71.05	4.80	8.50	8.70	66.25	62.55	62.35	29/05/2015	-	6.28	8.23	0.27	-	64.77	

Legend

m bgl - metres below ground level
m AOD - metres Above Ordnance Datum

Notes

Boreholes were levelled to ordnance datum on February 2012.

TABLE 2
GROUNDWATER QUALITY MEASUREMENTS

Site	Shell Hitchin
Sample Round	29 May 2015

Borehole	Purge Date	Purge Method	Purge Technique	Purge Volume (L)	pH	Temperature (°C)	Conductivity (mS/cm ²)	ORP (mV)	ORP (mV) Corrected	Dissolved Oxygen (mg/L)	Comments	Sample Date	Sample Method	Comments
BH102	29/05/2015	Dewater and resample	Peristaltic pump	4	7.51	12.90	653	213	424	0.28	Recharge ok, clear slight HC odour	29/05/2015	Peristaltic pump	
				8	7.52	12.80	652	157	369	0.26				
				12	7.52	12.80	650	130	342	0.28				
BH102A	29/05/2015	Dewater and resample	Peristaltic pump	4	7.36	13.20	618	351	563	4.41	Clear, NVO	29/05/2015	Peristaltic pump	
				12	7.40	12.30	610	315	527	4.13				
				26	7.40	12.20	608	312	523	4.20				
BH103	29/05/2015	Dewater and resample	Peristaltic pump	3	7.61	12.60	620	319	531	5.89	Turbid, orange/brown becoming clearer but still turbid ~ 6l	29/05/2015	Peristaltic pump	
				6	7.60	12.60	624	319	531	5.93				
				9	7.50	12.70	625	321	533	5.93				
BH105A	29/05/2015	Dewater and resample	Peristaltic pump	4	7.32	13.30	745	335	547	3.12	Clear, NVO.	29/05/2015	Peristaltic pump	Sampled after 12l
				8	7.30	13.40	747	314	526	3.60				
				12	7.29	13.20	745	331	542	3.57				
BH106A	29/05/2015	Dewater and resample	Peristaltic pump	4	7.51	12.70	518	319	531	3.12	White/turbid, clearer after 5l. NVO	29/05/2015	Peristaltic pump	Sampled after 12l
				8	7.51	12.90	518	318	530	3.17				
				12	7.50	13.00	520	317	529	3.20				

Legend

°C - degrees celsius
L - Litres
NVO - no visible or olfactory evidence of impact
pH - potential of Hydrogen (dimensionless)
mg/L - milligrams per litre
mS - milli siemens
mV - milli volts
ORP - Oxidation Reduction Potential

Notes

ORP is corrected against temperature of groundwater.

Equation: $E_h = E_m + E_{ref}$

Where: E_h = Corrected ORP value

E_m = ORP measured by probe

E_{ref} = Correction factor = $[(\text{temperature}^2) \times -0.0013] - (\text{temperature} \times 0.6656) + 222.02$ (for a 3.5mol KCl probe)

Temperature Approximate specific correction factor

10°C 215.2
15°C 211.7
20°C 208.2

TABLE 1
GROUNDWATER ELEVATIONS MEASUREMENTS

Site	Shell Hitchin
Sample Round	11 November 2015

Borehole	Ground elevation (m AOD)	Elevation of top of pipe (m AOD)	Top and base of screen (mbgl)		Base of drilled borehole (mbgl)	Top and base of screen (mAOD)		Base of borehole (mAOD)	Dip date	Depth to LNAPL (m below top pipe)	Depth to water (m below top pipe)	Depth to base (m below top pipe)	Difference from installed depth / silt thickness (m)	NAPL Surface Elevation (mAOD)	Groundwater elevation (m AOD)	Comments
BH102	70.83	70.83	5.80	9.00	9.00	65.03	61.83	61.83	11/05/2015	-	6.87	8.946	0.05	-	63.96	-
BH102A	70.83	70.83	11.30	13.50	14.40	59.53	57.33	56.43	11/05/2015	-	6.10	12.86	0.64	-	64.73	-
BH103	70.79	70.78	5.80	9.00	9.00	64.98	61.78	61.78	11/05/2015	-	7.09	8.34	0.66	-	63.69	-
BH105A	71.04	71.03	6.30	8.50	9.00	64.73	62.53	62.03	11/05/2015	6.362	6.363	8.38	0.12	-	64.67	-
BH106A	71.05	71.05	4.80	8.50	8.70	66.25	62.55	62.35	11/05/2015	-	6.34	8.25	0.25	-	64.71	-

Legend

m bgl -
m AOD -

Notes

Boreholes were levelled to ordnance datum on February 2012.

TABLE 2
GROUNDWATER QUALITY MEASUREMENTS

Site	Shell Hitchin
Sample Round	11 November 2015

Borehole	Purge Date	Purge Method	Purge Technique	Purge Volume (L)	pH	Temperature (°C)	Conductivity (µS/cm°)	ORP (mV)	ORP (mV) Corrected	Dissolved Oxygen (mg/L)	Comments	Sample Date	Sample Method	Comments
BH102	11/11/2015	Volume purging	Peristaltic pump	1.5	7.03	13.00	847	-57	155	0.61	Clear Hydrocarbon odour.	11/11/2015	Peristaltic pump	Duplicate taken
				3	7.02	13.00	841	-80	132	0.58				
				5	6.99	12.90	837	-80	131	0.51				
				8	6.99	12.90	835	-78	134	0.51				
				12	7.00	12.90	833	-78	134	0.50				
BH102A	11/11/2015	Volume purging	Peristaltic pump	1	6.81	12.50	780	51	263	5.75	Turbid and cloudly, NVO.	11/11/2015	Peristaltic pump	
				6	6.87	12.50	799	46	258	5.80				
				14	6.85	12.50	802	70	282	5.55				
				20	6.88	12.50	800	60	272	5.26				
				27	6.88	12.50	802	60	272	5.03				
				35	9.89	12.50	802	61	273	4.92				
				40	6.89	12.50	802	61	273	4.70				
				2	6.92	13.20	829	59	271	6.25				
BH103	11/11/2015	Volume purging	Peristaltic pump	2.5	6.93	13.70	817	52	263	6.21	Turbid and cloudly, NVO.	11/11/2015	Peristaltic pump	
				3	6.96	13.30	823	53	265	6.07				
				4	6.96	13.30	824	55	266	7.43				
				6	6.96	13.30	823	52	264	6.46				
				7	6.97	13.30	821	51	263	6.46				
				8	6.97	13.20	825	50	261	6.94				
				2	6.80	12.20	912	6	218	5.32				
BH105A	11/11/2015	Volume purging	Peristaltic pump	6	6.80	13.30	913	7	219	5.41	Turbid and cloudly, NVO.	11/11/2015	Peristaltic pump	
				12	6.80	12.30	917	10	222	4.60				
				15	6.80	12.30	919	9	221	4.58				
				2	7.00	12.40	618.4	-6	206	5.17				
BH106A	11/11/2015	Volume purging	Peristaltic pump	4	7.01	12.30	622	-2	210	5.16	Turbid and cloudly, NVO.	11/11/2015	Peristaltic pump	
				8	7.01	12.30	621	2	213	5.34				
				12	6.99	12.30	623	5	217	5.47				

Legend

°C - degrees celsius
L - Litres
NVO - no visible or olfactory evidence of impact
pH - potential of Hydrogen (dimensionless)

mg/L - milligrams per litre
mS - milli siemens
mV - milli volts
ORP - Oxidation Reduction Potential

Notes

ORP is corrected against temperature of groundwater.

Equation: $E_h = E_m + E_{ref}$

Where: E_h = Corrected ORP value

E_m = ORP measured by probe

E_{ref} = Correction factor = $[(\text{temperature}^2) \times -0.0013] - (\text{temperature} \times 0.6656) + 222.02$ (for a 3.5mol KCl probe)

Temperature Approximate specific correction factor

10°C 215.2

15°C 211.7

20°C 208.2

TABLE 1
GROUNDWATER ELEVATIONS MEASUREMENTS

Site	Shell Hitchin
Sample Round	26 February 2016

Borehole	Ground elevation (m AOD)	Elevation of top of pipe (m AOD)	Top and base of screen (mbgl)		Base of drilled borehole (mbgl)	Top and base of screen (mAOD)		Base of borehole (mAOD)	Dip date	Depth to LNAPL (m below top pipe)	Depth to water (m below top pipe)	Depth to base (m below top pipe)	Difference from installed depth / silt thickness (m)	NAPL Surface Elevation (mAOD)	Groundwater elevation (m AOD)	Comments
BH102	70.83	70.83	5.80	9.00	9.00	65.03	61.83	61.83	26/02/2016	-	4.59	8.96	0.04	-	66.25	-
BH102A	70.83	70.83	11.30	13.50	14.40	59.53	57.33	56.43	26/02/2016	-	5.94	12.39	1.11	-	64.90	-
BH103	70.79	70.78	5.80	9.00	9.00	64.98	61.78	61.78	26/02/2016	-	4.78	8.35	0.65	-	66.01	-
BH105A	71.04	71.03	6.30	8.50	9.00	64.73	62.53	62.03	26/02/2016	-	6.13	8.24	0.26	-	64.90	-
BH106A	71.05	71.05	4.80	8.50	8.70	66.25	62.55	62.35	26/02/2016	-	6.21	8.33	0.17	-	64.84	-

Legend

m bgl -
m AOD -

Notes

Boreholes were levelled to ordnance datum on February 2012.

TABLE 2
GROUNDWATER QUALITY MEASUREMENTS

Site	Shell Hitchin
Sample Round	26 February 2016

Borehole	Purge Date	Purge Method	Purge Technique	Purge Volume (L)	pH	Temperature (°C)	Conductivity (µS/cm°)	ORP (mV)	ORP (mV) Corrected	Dissolved Oxygen (mg/L)	Comments	Sample Date	Sample Method	Comments
BH102	26/02/2016	Low flow purging	Peristaltic pump	15	7.04	9.40	579	225	437	5.94	Clear NVO.	26/02/2016	Peristaltic pump	
				35	7.18	9.53	623	262	474	5.56				
				50	7.21	9.50	635	263	475	5.56				
BH102A	26/02/2016	Low flow purging	Peristaltic pump	20	7.17	11.88	711	263	475	3.02	Clear NVO.	26/02/2016	Peristaltic pump	
				35	7.15	11.90	709	267	479	3.00				
				50	7.13	12.03	712	284	495	2.83				
BH103	26/02/2016	Low flow purging	Peristaltic pump	20	7.08	10.51	641	228	439	5.65	Clear NVO.	26/02/2016	Peristaltic pump	
				30	7.10	10.48	638	240	452	5.54				
				45	7.12	10.45	644	241	453	5.33				
BH105A	26/02/2016	Low flow purging	Peristaltic pump	15	6.79	12.79	783	-148	60	1.13	Clear NVO.	26/02/2016	Peristaltic pump	
				25	6.81	12.87	867	-150	62	0.79				
				35	6.82	12.89	861	-162	49	0.71				
BH106A	26/02/2016	Low flow purging	Peristaltic pump	15	7.05	12.63	665	244	455	3.80	Clear NVO.	27/02/2016	Peristaltic pump	Duplicate taken.
				25	7.08	12.73	664	266	477	3.56				
				35	7.08	12.72	662	273	485	3.45				

Legend

°C - degrees celsius
L - Litres
NVO - no visible or olfactory evidence of impact
pH - potential of Hydrogen (dimensionless)

mg/L - milligrams per litre
mS - milli siemens
mV - milli volts
ORP - Oxidation Reduction Potential

Notes

ORP is corrected against temperature of groundwater.

Equation: $E_h = E_m + E_{ref}$

Where: E_h = Corrected ORP value

E_m = ORP measured by probe

E_{ref} = Correction factor = $[(\text{temperature}^2) \times -0.0013] - (\text{temperature} \times 0.6656) + 222.02$ (for a 3.5mol KCl probe)

Temperature Approximate specific correction factor

10°C 215.2

15°C 211.7

20°C 208.2

APPENDIX B STAGE 2 TABLES

Table 1a
Groundwater Analytical Results
Compared Against Stage 2 Human Health (Continued Petroleum Use, CPU and
High Density Residential, HDR) Screening Criteria

	Units	Method Detection Unit	2015 GAC - Continued Petroleum Use	2015 GAC - High Density Residential	Location Well Lab Report Number	BH102				BH102A				BH103			
						Date				Date				Date			
						Sample Type				Sample Type				Sample Type			
						Normal				Normal				Normal			
						294880				320704				338729			
BTEX						118	12.6	248	<1	<1	<1	<1	<1	<1	<1	<1	<1
Benzene	µg/l	1	22,000 ^{#1}	1,600 ^{#1}		9.3	<1	15.4	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	µg/l	1	Sat ^{#1}	Sat ^{#1}		347	28.5	551	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	µg/l	1	Sat ^{#1}	85,000 ^{#1}		219	39.6	1,080	<1	<1	<1	<1	<1	<1	<1	<1	<1
Xylene (m & p)	µg/l	1	Sat ^{#1}			23.3	2.68	184	<1	<1	<1	<1	<1	<1	<1	<1	<1
Xylene (o)	µg/l	1	Sat ^{#1}	92,000 ^{#1}		242.3	42.28	1,264	0	0	0	0	0	0	0	0	0
Xylene Total	µg/l		Sat ^{#1}	77,000 ^{#1}													
Oxygenates						<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Diisopropyl Ether	µg/l	1	430,000 ^{#1}	31,000 ^{#1}		31.2	12.1	36.4	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ethyl Tert Butyl Ether	µg/l	1	3,000,000 ^{#1}	220,000 ^{#1}		144	24.5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Methyl Tert Butyl Ether	µg/l	1	6,800,000 ^{#1}	470,000 ^{#1}		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Tert Amyl Methyl Ether	µg/l	1	200,000 ^{#1}	14,000 ^{#1}		<10	21.3	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Tert Butyl Alcohol	µg/l	10	14,000,000 ^{#1}	770,000 ^{#1}		<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Ethanol	µg/l	50															
PAH						0.062	<0.075	0.113	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Acenaphthene	µg/l	0.015	Sat ^{#1}	Sat ^{#1}		0.0135	<0.055	<0.044	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011
Acenaphthylene	µg/l	0.011	Sat ^{#1}	Sat ^{#1}		<0.015	<0.075	<0.06	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Anthracene	µg/l	0.015	Sat ^{#1}	Sat ^{#1}		<0.017	<0.085	<0.068	<0.017	<0.017	0.0173	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017
Benzo(a)anthracene	µg/l	0.017	Sat ^{#1}	Sat ^{#1}		<0.009	<0.045	<0.036	<0.009	0.0222	0.01	0.0383	0.0212	<0.009	<0.009	<0.009	<0.009
Benzo(a)pyrene	µg/l	0.009	Sat ^{#1}	Sat ^{#1}		<0.023	<0.115	<0.092	<0.023	0.0281	<0.023	0.0546	0.0293	<0.023	<0.023	<0.023	<0.023
Benzo(b)fluoranthene	µg/l	0.023	Sat ^{#1}	Sat ^{#1}		<0.016	<0.08	<0.064	<0.016	0.0275	0.02	0.0555	0.0281	<0.016	<0.016	<0.016	<0.016
Benzo(g,h,i)perylene	µg/l	0.016	Sat ^{#1}	Sat ^{#1}		<0.027	<0.135	<0.108	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027
Benzo(k)fluoranthene	µg/l	0.027	Sat ^{#1}	Sat ^{#1}		<0.013	<0.065	<0.052	<0.013	0.0192	<0.013	0.0246	0.0134	<0.013	<0.013	<0.013	<0.013
Chrysene	µg/l	0.013	Sat ^{#1}	Sat ^{#1}		<0.016	<0.08	<0.064	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016
Dibenz(a,h)anthracene	µg/l	0.016	Sat ^{#1}	Sat ^{#1}		<0.017	<0.085	<0.068	<0.017	0.0185	<0.017	0.0341	0.0254	<0.017	<0.017	<0.017	<0.017
Fluoranthene	µg/l	0.017	Sat ^{#1}	Sat ^{#1}		0.109	0.0782	0.248	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014
Fluorene	µg/l	0.014	Sat ^{#1}	Sat ^{#1}		<0.014	<0.07	<0.056	<0.014	0.0261	0.02	0.0276	0.0244	<0.014	<0.014	<0.014	<0.014
Indeno(1,2,3-c,d)pyrene	µg/l	0.014	Sat ^{#1}	Sat ^{#1}		54	6.86	76.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Naphthalene	µg/l	0.1	16,000 ^{#1}	910 ^{#1}		0.0787	<0.11	0.133	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022
Phenanthrene	µg/l	0.022	Sat ^{#1}	Sat ^{#1}		<0.015	<0.075	<0.06	<0.015	0.0217	<0.015	0.0375	0.0271	<0.015	<0.015	<0.015	<0.015
Pyrene	µg/l	0.015	Sat ^{#1}	Sat ^{#1}		0	0	0	0	0.0817	0.04	0.1377	0.0818	0	0	0	0
PAHs (sum of 4)	µg/l					0	0	0	0	0.0281	0	0.0546	0.0293	0	0	0	0
Benzo(b,k)fluoranthene	µg/l					54.2	7.04	77.1	<0.344	<0.344	<0.344	<0.344	<0.344	<0.344	<0.344	<0.344	<0.344
PAH 16 Total	µg/l	0.344				0	0	0	0	0.0536	0.04	0.0831	0.0525	0	0	0	0
Benzo(g,h,i)perylene + Indeno(1,2,3-cd)pyrene	µg/l					0	0	0	0	0.0222	0.01	0.0383	0.0212	0	0	0	0
Coal tar (BaP as a surrogate)	µg/l		Sat ^{#1}	Sat ^{#1}													
TPH						78	<10	163	<10	<10	<10	<10	<10	<10	<10	<10	<10
>EC5-EC7 Aromatics	µg/l	10	Sat ^{#1}	1,600,000 ^{#1}		<10	<10	11	<10	<10	<10	<10	<10	<10	<10	<10	<10
>EC7-EC8 Aromatics	µg/l	10	Sat ^{#1}	Sat ^{#1}		524	18	1,800	<10	<10	<10	<10	<10	<10	<10	<10	<10
>EC8-EC10 Aromatics	µg/l	10	Sat ^{#1}	14,000 ^{#1}		152	29	330	<10	<10	<10	<10	<10	<10	<10	<10	<10
>EC10-EC12 Aromatics	µg/l	10	Sat ^{#1}	Sat ^{#1}		30	<10	46	<10	<10	<10	<10	<10	<10	<10	<10	<10
>EC12-EC16 Aromatics	µg/l	10	Sat ^{#1}	Sat ^{#1}		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
>EC16-EC21 Aromatics	µg/l	10	Sat ^{#1}	Sat ^{#1}		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
>EC21-EC35 Aromatics	µg/l	10	Sat ^{#1}	Sat ^{#1}		22	<10	161	<10	<10	<10	<10	<10	<10	<10	<10	<10
>C5-C6 Aliphatics	µg/l	10	Sat ^{#1}	15,000 ^{#1}		143	40	385	<10	<10	<10	<10	<10	<10	<10	<10	<10
>C6-C8 Aliphatics	µg/l	10	Sat ^{#1}	Sat ^{#1}		260	27	843	<10	<10	<10	<10	<10	<10	<10	<10	<10
>C8-C10 Aliphatics	µg/l	10	Sat ^{#1}	Sat ^{#1}		229	43	495	<10	<10	<10	<10	<10	<10	<10	<10	<10
>C10-C12 Aliphatics	µg/l	10	Sat ^{#1}	Sat ^{#1}		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
>C12-C16 Aliphatics	µg/l	10	Sat ^{#1}	Sat ^{#1}		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
>C16-C21 Aliphatics	µg/l	10				0	0	0	0	0	0	0	0	0	0	0	0
>C16-C35 Aliphatics	µg/l		Sat ^{#1}	Sat ^{#1}		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
>C21-C35 Aliphatics	µg/l	10				0.0530	0.0234	0.0823	0.0048	0.0048	0.0048	0.0056	0.0140	0.0048	0.0048	0.0048	0.0048
TPH Stage 2 HI - Human Health CPU	-					0.7500	0.3328	1.1656	0.0691	0.0691	0.0691	0.0691	0.0802	0.1990	0.0691	0.0691	0.0691
TPH Stage 2 HI - Human Health HDR	-																
Misc						4,540	9,340	8,920	<100	<100	<100	<100	<100	<100	<100	<100	<100
Ferrous Iron	µg/l	100				3.13	2.55	<0.3	26.1	38.6	38	39.7	37	22.8	19.8	23.4	27.9
Nitrate (as NO3-)	mg/l	0.3				50.6	49.9	19.1	39.3	74.2	70.2	72.3	70.2	47.2	46.2	53.8	43
Sulphate (soluble)	mg/l	2															

Comments
#1 Derived GAC for petrol filling stations
GAC: Generic Assessment Criteria
(blank): No assessment criteria available
Sat: Unacceptable risk not achieved due to calculated saturation of vapour pathway
HH GAC calculated using CLEA methodology with C4SL exposure scenarios, specifically for petrol filling stations
HH GAC based on soil properties for 'CLEA sand' and 1% SOM (0.58% TOC)
Sat: Hazard quotient at vapour saturation < 1

Key
XXX Exceedance of 2015 GAC - Continued Petroleum Use
XXX Exceedance of 2015 GAC - High Density Residential

Table 1a
Groundwater Analytical Results
Compared Against Stage 2 Human Health (Continued Petroleum Use, CPU and
High Density Residential, HDR) Screening Criteria

	Units	Method Detection Limit	2015 GAC - Continued Petroleum Use	2015 GAC - High Density Residential	Location Well	BH105A				BH106A				
						Date	01/12/2014	29/05/2015	11/11/2015	26/02/2016	01/12/2014	29/05/2015	11/11/2015	26/02/2016
						Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	
						Sample Type								
						Lab Report Number	294880	320704	338729	352050	294880	320704	338729	352050
BTEX														
Benzene	µg/l	1	22,000 ^{#1}	1,600 ^{#1}		<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	µg/l	1	Sat ^{#1}	Sat ^{#1}		<1	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	µg/l	1	Sat ^{#1}	85,000 ^{#1}		<1	<1	<1	<1	<1	<1	<1	<1	<1
Xylene (m & p)	µg/l	1				<1	<1	<1	<1	<1	<1	<1	<1	<1
Xylene (o)	µg/l	1	Sat ^{#1}	92,000 ^{#1}		<1	<1	<1	<1	<1	<1	<1	<1	<1
Xylene Total	µg/l	1	Sat ^{#1}	77,000 ^{#1}		0	0	0	0	0	0	0	0	0
Oxygenates														
Diisopropyl Ether	µg/l	1	430,000 ^{#1}	31,000 ^{#1}		<1	<1	<1	<1	<1	<1	<1	<1	<1
Ethyl Tert Butyl Ether	µg/l	1	3,000,000 ^{#1}	220,000 ^{#1}		<1	<1	<1	<1	<1	<1	<1	<1	<1
Methyl Tert Butyl Ether	µg/l	1	6,800,000 ^{#1}	470,000 ^{#1}		<1	<1	<1	<1	<1	<1	<1	<1	<1
Tert Amyl Methyl Ether	µg/l	1	200,000 ^{#1}	14,000 ^{#1}		<1	<1	<1	<1	<1	<1	<1	<1	<1
Tert Butyl Alcohol	µg/l	10	14,000,000 ^{#1}	770,000 ^{#1}		<10	<10	<10	<10	<10	<10	<10	<10	<10
Ethanol	µg/l	50				<50	<50	<50	<50	<50	<50	<50	<50	<50
PAH														
Acenaphthene	µg/l	0.015	Sat ^{#1}	Sat ^{#1}		<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Acenaphthylene	µg/l	0.011	Sat ^{#1}	Sat ^{#1}		<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011
Anthracene	µg/l	0.015	Sat ^{#1}	Sat ^{#1}		<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Benzo(a)anthracene	µg/l	0.017	Sat ^{#1}	Sat ^{#1}		<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017
Benzo(a)pyrene	µg/l	0.009	Sat ^{#1}	Sat ^{#1}		<0.009	<0.009	<0.009	<0.009	0.01	<0.009	<0.009	<0.009	<0.009
Benzo(b)fluoranthene	µg/l	0.023	Sat ^{#1}	Sat ^{#1}		<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023
Benzo(g,h,i)perylene	µg/l	0.016	Sat ^{#1}	Sat ^{#1}		<0.016	<0.016	<0.016	<0.016	0.02	<0.016	<0.016	<0.016	<0.016
Benzo(k)fluoranthene	µg/l	0.027	Sat ^{#1}	Sat ^{#1}		<0.027	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027
Chrysene	µg/l	0.013	Sat ^{#1}	Sat ^{#1}		<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013
Dibenz(a,h)anthracene	µg/l	0.016	Sat ^{#1}	Sat ^{#1}		<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016
Fluoranthene	µg/l	0.017	Sat ^{#1}	Sat ^{#1}		<0.017	<0.017	<0.017	<0.017	<0.017	0.02	<0.017	<0.017	<0.017
Fluorene	µg/l	0.014	Sat ^{#1}	Sat ^{#1}		<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014
Indeno(1,2,3-c,d)pyrene	µg/l	0.014	Sat ^{#1}	Sat ^{#1}		<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014
Naphthalene	µg/l	0.1	16,000 ^{#1}	910 ^{#1}		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	µg/l	0.022	Sat ^{#1}	Sat ^{#1}		<0.022	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022
Pyrene	µg/l	0.015	Sat ^{#1}	Sat ^{#1}		<0.015	<0.015	<0.015	<0.015	<0.015	0.02	<0.015	<0.015	<0.015
PAHs (sum of 4)	µg/l					0	0	0	0	0	0.02	0	0	0
Benzo(b,k)fluoranthene	µg/l					0	0	0	0	0	0	0	0	0
PAH 16 Total	µg/l	0.344				<0.344	<0.344	<0.344	<0.344	<0.344	<0.344	<0.344	<0.344	<0.344
Benzo(g,h,i)perylene + Indeno(1,2,3-cd)pyrene	µg/l					0	0	0	0	0	0.02	0	0	0
Coal tar (BaP as a surrogate)	µg/l		Sat ^{#1}	Sat ^{#1}		0	0	0	0	0	0.01	0	0	0
TPH														
>EC5-EC7 Aromatics	µg/l	10	Sat ^{#1}	1,600,000 ^{#1}		<10	<10	<10	<10	<10	<10	<10	<10	<10
>EC7-EC8 Aromatics	µg/l	10	Sat ^{#1}	Sat ^{#1}		<10	<10	<10	<10	<10	<10	<10	<10	<10
>EC8-EC10 Aromatics	µg/l	10	Sat ^{#1}	14,000 ^{#1}		<10	<10	<10	<10	<10	<10	<10	<10	<10
>EC10-EC12 Aromatics	µg/l	10	Sat ^{#1}	Sat ^{#1}		<10	<10	<10	<10	<10	<10	<10	<10	<10
>EC12-EC16 Aromatics	µg/l	10	Sat ^{#1}	Sat ^{#1}		<10	<10	<10	<10	<10	<10	<10	<10	<10
>EC16-EC21 Aromatics	µg/l	10	Sat ^{#1}	Sat ^{#1}		<10	<10	<10	<10	<10	<10	<10	<10	<10
>EC21-EC35 Aromatics	µg/l	10	Sat ^{#1}	Sat ^{#1}		<10	<10	<10	<10	<10	<10	<10	<10	<10
>C5-C6 Aliphatics	µg/l	10	Sat ^{#1}	15,000 ^{#1}		<10	<10	<10	<10	<10	<10	<10	<10	<10
>C6-C8 Aliphatics	µg/l	10	Sat ^{#1}	Sat ^{#1}		<10	<10	<10	<10	<10	<10	<10	<10	<10
>C8-C10 Aliphatics	µg/l	10	Sat ^{#1}	Sat ^{#1}		<10	<10	<10	<10	<10	<10	<10	<10	<10
>C10-C12 Aliphatics	µg/l	10	Sat ^{#1}	Sat ^{#1}		<10	<10	<10	<10	<10	<10	<10	<10	<10
>C12-C16 Aliphatics	µg/l	10	Sat ^{#1}	Sat ^{#1}		<10	<10	<10	<10	<10	<10	<10	<10	<10
>C16-C21 Aliphatics	µg/l	10				<10	<10	<10	<10	<10	<10	<10	<10	<10
>C21-C35 Aliphatics	µg/l	10	Sat ^{#1}	Sat ^{#1}		0	0	0	0	0	0	0	0	0
>C31-C35 Aliphatics	µg/l	10				<10	<10	<10	<10	<10	<10	<10	<10	<10
TPH Stage 2 HI - Human Health CPU	-					0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048
TPH Stage 2 HI - Human Health HDR	-					0.0691	0.0691	0.0691	0.0691	0.0691	0.0691	0.0691	0.0691	0.0691
Misc														
Ferrous Iron	µg/l	100				<100	<100	<100	<100	<100	<100	<100	<100	<100
Nitrate (as NO3-)	mg/l	0.3				38	38	41.9	33.1	7.18	7.29	8.5	10.2	10.2
Sulphate (soluble)	mg/l	2				87.8	84.4	86.6	101	39.2	41.9	53.1	47.2	47.2

Comments
#1 Derived GAC for petrol filling stations
GAC: Generic Assessment Criteria
(blank): No assessment criteria available
Sat: Unacceptable risk not achieved due to calculated saturation of vapour pathway
HH GAC calculated using CLEA methodology with C4SL exposure scenarios, specifically for petrol filling stations
HH GAC based on soil properties for 'CLEA sand' and 1% SOM (0.58% TOC)
Sat: Hazard quotient at vapour saturation < 1

Key	
XXX	Exceedance of 2015 GAC - Continued Petroleum Use
XXX	Exceedance of 2015 GAC - High Density Residential

Table 1b
Groundwater Analytical Results
Compared Against Stage 2 Controlled Waters
(Drinking Water Standards, DWS, aScreening Criteria

					BH102				BH102A				BH103			
				Location	-				-				-			
				Well	-				-				-			
				Date	01/12/2014	29/05/2015	11/11/2015	26/02/2016	01/12/2014	29/05/2015	11/11/2015	26/02/2016	01/12/2014	29/05/2015	11/11/2015	26/02/2016
				Sample Type	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
				Lab Report Number	294880	320704	338729	352050	294880	320704	338729	352050	294880	320704	338729	352050
BTEx																
Benzene	µg/l	1	1 ^{#2}		118	12.6	248	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	µg/l	1	700 ^{#5}		9.3	<1	15.4	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	µg/l	1	300 ^{#5}		347	28.5	551	<1	<1	<1	<1	<1	<1	<1	<1	<1
Xylene (m & p)	µg/l	1			219	39.6	1,080	<1	<1	<1	<1	<1	<1	<1	<1	<1
Xylene (o)	µg/l	1			23.3	2.68	184	<1	<1	<1	<1	<1	<1	<1	<1	<1
Xylene Total	µg/l		500 ^{#5}		242.3	42.28	1,264	0	0	0	0	0	0	0	0	0
Oxygenates																
Diisopropyl Ether	µg/l	1	0.8 ^{#12}		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ethyl Tert Butyl Ether	µg/l	1	13 ^{#11}		31.2	12.1	36.4	<1	<1	<1	<1	<1	<1	<1	<1	<1
Methyl Tert Butyl Ether	µg/l	1	20 ^{#7}		144	24.5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Tert Amyl Methyl Ether	µg/l	1	130 ^{#9}		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Tert Butyl Alcohol	µg/l	10	1,300 ^{#8}		<10	21.3	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Ethanol	µg/l	50			<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
PAH																
Acenaphthene	µg/l	0.015			0.062	<0.075	0.113	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Acenaphthylene	µg/l	0.011			0.0135	<0.055	<0.044	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011
Anthracene	µg/l	0.015			<0.015	<0.075	<0.06	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Benzo(a)anthracene	µg/l	0.017			<0.017	<0.085	<0.068	<0.017	<0.017	<0.017	0.0173	<0.017	<0.017	<0.017	<0.017	<0.017
Benzo(a)pyrene	µg/l	0.009	0.01 ^{#2}		<0.009	<0.045	<0.036	<0.009	0.0222	0.01	0.0383	0.0212	<0.009	<0.009	<0.009	<0.009
Benzo(b)fluoranthene	µg/l	0.023			<0.023	<0.115	<0.092	<0.023	0.0281	<0.023	0.0546	0.0293	<0.023	<0.023	<0.023	<0.023
Benzo(g,h,i)perylene	µg/l	0.016			<0.016	<0.08	<0.064	<0.016	0.0275	0.02	0.0555	0.0281	<0.016	<0.016	<0.016	<0.016
Benzo(k)fluoranthene	µg/l	0.027			<0.027	<0.135	<0.108	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027
Chrysene	µg/l	0.013			<0.013	<0.065	<0.052	<0.013	0.0192	<0.013	0.0246	0.0134	<0.013	<0.013	<0.013	<0.013
Dibenz(a,h)anthracene	µg/l	0.016			<0.016	<0.08	<0.064	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016
Fluoranthene	µg/l	0.017			<0.017	<0.085	<0.068	<0.017	0.0185	<0.017	0.0341	0.0254	<0.017	<0.017	<0.017	<0.017
Fluorene	µg/l	0.014			0.109	0.0782	0.248	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014
Indeno(1,2,3-c,d)pyrene	µg/l	0.014			<0.014	<0.07	<0.056	<0.014	0.0261	0.02	0.0276	0.0244	<0.014	<0.014	<0.014	<0.014
Naphthalene	µg/l	0.1	150 ^{#10}		54	6.86	76.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	µg/l	0.022			0.0787	<0.11	0.133	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022
Pyrene	µg/l	0.015			<0.015	<0.075	<0.06	<0.015	0.0217	<0.015	0.0375	0.0271	<0.015	<0.015	<0.015	<0.015
PAHs (sum of 4)	µg/l		0.1 ^{#2}		0	0	0	0	0.0817	0.04	0.1377	0.0818	0	0	0	0
Benzo(b,k)fluoranthene	µg/l				0	0	0	0	0.0281	0	0.0546	0.0293	0	0	0	0
PAH 16 Total	µg/l	0.344			54.2	7.04	77.1	<0.344	<0.344	<0.344	<0.344	<0.344	<0.344	<0.344	<0.344	<0.344
Benzo(g,h,i)perylene + Indeno(1,2,3-cd)pyrene	µg/l				0	0	0	0	0.0536	0.04	0.0831	0.0525	0	0	0	0
Coal tar (BaP as a surrogate)	µg/l				0	0	0	0	0.0222	0.01	0.0383	0.0212	0	0	0	0
TPH																
>EC5-EC7 Aromatics	µg/l	10	1 ^{#1}		78	<10	163	<10	<10	<10	<10	<10	<10	<10	<10	<10
>EC7-EC8 Aromatics	µg/l	10	700 ^{#4}		<10	<10	11	<10	<10	<10	<10	<10	20	<10	<10	<10
>EC8-EC10 Aromatics	µg/l	10	300 ^{#3}		524	18	1,800	<10	10	<10	<10	<10	148	<10	<10	<10
>EC10-EC12 Aromatics	µg/l	10	90 ^{#3}		152	29	330	<10	<10	<10	<10	<10	64	<10	<10	<10
>EC12-EC16 Aromatics	µg/l	10	90 ^{#3}		30	<10	46	<10	<10	<10	<10	<10	<10	<10	<10	<10
>EC16-EC21 Aromatics	µg/l	10	90 ^{#3}		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
>EC21-EC35 Aromatics	µg/l	10	90 ^{#3}		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
>C5-C6 Aliphatics	µg/l	10	15,000 ^{#3}		22	<10	161	<10	<10	<10	<10	<10	<10	<10	<10	<10
>C6-C8 Aliphatics	µg/l	10	15,000 ^{#3}		143	40	385	<10	<10	<10	<10	<10	31	<10	<10	<10
>C8-C10 Aliphatics	µg/l	10	300 ^{#3}		260	27	843	<10	<10	<10	<10	<10	28	<10	<10	<10
>C10-C12 Aliphatics	µg/l	10	300 ^{#3}		229	43	495	<10	<10	<10	<10	<10	96	<10	<10	<10
>C12-C16 Aliphatics	µg/l	10	300 ^{#3}		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
>C16-C21 Aliphatics	µg/l	10	300 ^{#3}		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
>C16-C35 Aliphatics	µg/l				0	0	0	0	0	0	0	0	0	0	0	0
>C21-C35 Aliphatics	µg/l	10			<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Misc																
Ferrous Iron	µg/l	100			4,540	9,340	8,920	<100	<100	<100	<100	<100	<100	<100	<100	<100
Nitrate (as NO3-)	mg/l	0.3			3.13	2.55	<0.3	26.1	38.6	38	39.7	37	22.8	19.6	23.4	27.9
Sulphate (soluble)	mg/l	2			50.6	49.9	19.1	39.3	74.2	70.2	72.3	70.2	47.2	46.2	53.8	43

Comments

#1 WS Regs 2010 (Eng/Wal) for benzene

#2 WS Regs 2010 (Eng/Wal)

#3 WHO Petroleum In DW 2008

#4 WHO DWG 2011 for toluene

#5 WHO DWG 2011

#6 USEPA RSL (tapwater)

#7 USEPA 1997

#8 URS derived using API (2005) RfD & WHO DWG

#9 Taste - API (1993)

#10 Shell RBSL (2014)

#11 Odour - Health Effects Institute (1996)

#12 Odour - Amoores and Hautala, 1983,

GAC: Generic Assessment Criteria

(blank): No assessment criteria available

CW: Controlled Waters

DWS: Drinking Water Standard

Soil CW/WE GAC calculated using EA RTM methodology

Soil CW/WE GAC based on soil properties for sand and either low TOC (0.2%) or high TOC (1%)

Key

XXX Exceedance of 2015 GAC - CW (EN/WA) DWS

Table 1b
Groundwater Analytical Results
Compared Against Stage 2 Controlled Waters
(Drinking Water Standards, DWS, aScreening Criteria

					BH105A				BH106A				
				Location	-				-				
				Well									
				Date	01/12/2014	29/05/2015	11/11/2015	26/02/2016	01/12/2014	29/05/2015	11/11/2015	26/02/2016	
				Sample Type	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	
				Lab Report Number	294880	320704	338729	352050	294880	320704	338729	352050	
BTEx													
Benzene	µg/l	1	1 ^{#2}		<1	<1	<1	<1	<1	<1	<1	<1	
Toluene	µg/l	1	700 ^{#5}		<1	<1	<1	<1	<1	<1	<1	<1	
Ethylbenzene	µg/l	1	300 ^{#5}		<1	<1	<1	<1	<1	<1	<1	<1	
Xylene (m & p)	µg/l	1			<1	<1	<1	<1	<1	<1	<1	<1	
Xylene (o)	µg/l	1			<1	<1	<1	<1	<1	<1	<1	<1	
Xylene Total	µg/l		500 ^{#5}		0	0	0	0	0	0	0	0	
Oxygenates													
Diisopropyl Ether	µg/l	1	0.8 ^{#12}		<1	<1	<1	<1	<1	<1	<1	<1	
Ethyl Tert Butyl Ether	µg/l	1	13 ^{#11}		<1	<1	<1	<1	<1	<1	<1	<1	
Methyl Tert Butyl Ether	µg/l	1	20 ^{#7}		<1	<1	<1	<1	<1	<1	<1	<1	
Tert Amyl Methyl Ether	µg/l	1	130 ^{#9}		<1	<1	<1	<1	<1	<1	<1	<1	
Tert Butyl Alcohol	µg/l	10	1,300 ^{#8}		<10	<10	<10	<10	<10	<10	<10	<10	
Ethanol	µg/l	50			<50	<50	<50	<50	<50	<50	<50	<50	
PAH													
Acenaphthene	µg/l	0.015	0.01 ^{#2}		<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	
Acenaphthylene	µg/l	0.011		<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011		
Anthracene	µg/l	0.015		<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015		
Benzo(a)anthracene	µg/l	0.017		<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017		
Benzo(a)pyrene	µg/l	0.009		<0.009	<0.009	<0.009	<0.009	0.01	<0.009	<0.009	<0.009		
Benzo(b)fluoranthene	µg/l	0.023		<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023		
Benzo(g,h,i)perylene	µg/l	0.016		<0.016	<0.016	<0.016	<0.016	0.02	<0.016	<0.016	<0.016		
Benzo(k)fluoranthene	µg/l	0.027		<0.027	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027		
Chrysene	µg/l	0.013		<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013		
Dibenz(a,h)anthracene	µg/l	0.016		<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016		
Fluoranthene	µg/l	0.017	<0.017	<0.017	<0.017	<0.017	0.02	<0.017	<0.017	<0.017			
Fluorene	µg/l	0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014			
Indeno(1,2,3-c,d)pyrene	µg/l	0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014			
Naphthalene	µg/l	0.1	150 ^{#10}		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
Phenanthrene	µg/l	0.022		<0.022	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022		
Pyrene	µg/l	0.015		<0.015	<0.015	<0.015	<0.015	0.02	<0.015	<0.015	<0.015		
PAHs (sum of 4)	µg/l			0	0	0	0	0	0.02	0	0		
Benzo(b,k)fluoranthene	µg/l			0	0	0	0	0	0	0	0		
PAH 16 Total	µg/l	0.344		<0.344	<0.344	<0.344	<0.344	<0.344	<0.344	<0.344	<0.344		
Benzo(g,h,i)perylene + Indeno(1,2,3-cd)pyrene	µg/l			0	0	0	0	0	0.02	0	0		
Coal tar (BaP as a surrogate)	µg/l			0	0	0	0	0	0.01	0	0		
TPH													
>EC5-EC7 Aromatics	µg/l	10		1 ^{#1}		<10	<10	<10	<10	<10	<10	<10	<10
>EC7-EC8 Aromatics	µg/l	10	700 ^{#4}		<10	<10	<10	<10	<10	<10	<10	<10	
>EC8-EC10 Aromatics	µg/l	10	300 ^{#3}		<10	<10	<10	<10	<10	<10	<10	<10	
>EC10-EC12 Aromatics	µg/l	10	90 ^{#3}		<10	<10	<10	<10	<10	<10	<10	<10	
>EC12-EC16 Aromatics	µg/l	10	90 ^{#3}		<10	<10	<10	<10	<10	<10	<10	<10	
>EC16-EC21 Aromatics	µg/l	10	90 ^{#3}		<10	<10	<10	<10	<10	<10	<10	<10	
>EC21-EC35 Aromatics	µg/l	10	90 ^{#3}		<10	<10	<10	<10	<10	<10	<10	<10	
>C5-C6 Aliphatics	µg/l	10	15,000 ^{#3}		<10	<10	<10	<10	<10	<10	<10	<10	
>C6-C8 Aliphatics	µg/l	10	15,000 ^{#3}		<10	<10	<10	<10	<10	<10	<10	<10	
>C8-C10 Aliphatics	µg/l	10	300 ^{#3}		<10	<10	<10	<10	<10	<10	<10	<10	
>C10-C12 Aliphatics	µg/l	10	300 ^{#3}		<10	<10	<10	<10	<10	<10	<10	<10	
>C12-C16 Aliphatics	µg/l	10	300 ^{#3}		<10	<10	<10	<10	<10	<10	<10	<10	
>C16-C21 Aliphatics	µg/l	10	300 ^{#3}		<10	<10	<10	<10	<10	<10	<10	<10	
>C16-C35 Aliphatics	µg/l				0	0	0	0	0	0	0	0	
>C21-C35 Aliphatics	µg/l	10			<10	<10	<10	<10	<10	<10	<10	<10	
Misc													
Ferrous Iron	µg/l	100			<100	<100	<100	<100	<100	<100	<100	<100	
Nitrate (as NO3-)	mg/l	0.3			38	38	41.9	33.1	7.18	7.29	8.5	10.2	
Sulphate (soluble)	mg/l	2			87.8	84.4	86.6	101	39.2	41.9	53.1	47.2	

Comments
#1 WS Regs 2010 (Eng/Wal) for benzene
#2 WS Regs 2010 (Eng/Wal)
#3 WHO Petroleum In DW 2008
#4 WHO DWG 2011 for toluene
#5 WHO DWG 2011
#6 USEPA RSL (tapwater)
#7 USEPA 1997
#8 URS derived using API (2005) RID & WHO DWG
#9 Taste - API (1993)
#10 Shell RBSL (2014)
#11 Odour - Health Effects Institute (1996)
#12 Odour - Amoores and Hautala, 1983,
GAC: Generic Assessment Criteria
(blank): No assessment criteria available
CW: Controlled Waters
DWS: Drinking Water Standard
Soil CW/WE GAC calculated using EA RTM methodology
Soil CW/WE GAC based on soil properties for sand and either low TOC (0.2%) or high TOC (1%)

Key
XXX Exceedance of 2015 GAC - CW (EN/WA) DWS

APPENDIX C LABORATORY ANALYTICAL RESULTS CERTIFICATES



AECOM
St. George's House
2nd Floor
5 St. George's Road
Wimbledon
Greater London
SW19 4DR
Attention: Bethan Short

CERTIFICATE OF ANALYSIS

Date: 09 June 2015
Customer: H_URS_WIM
Sample Delivery Group (SDG): 150530-79
Your Reference: 46370079
Location: Shell Hitchin
Report No: 316276

This report has been revised and directly supersedes 316268 in its entirety.

We received 8 samples on Saturday May 30, 2015 and 8 of these samples were scheduled for analysis which was completed on Tuesday June 09, 2015. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

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

All chemical testing (unless subcontracted) is performed at ALcontrol Hawarden Laboratories.

Approved By:

Sonia McWhan
Operations Manager





SDG:

Job:

Client Reference:

150530-79

H_URS_WIM-174

46370079

Location:

Customer:

Attention:

Shell Hitchin

AECOM

Bethan Short

Order Number:

Report Number:

Superseded Report:

46370079

316276

316268

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
11455007	BH102			29/05/2015
11455009	BH103			29/05/2015
11455008	BH102A			29/05/2015
11455010	BH105A			29/05/2015
11455011	BH106A			29/05/2015
11455013	DUP 01			29/05/2015
11455012	EQUIPMENT BLANK			29/05/2015
11455014	TRIP BLANK			29/05/2015

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



SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 46370079
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LIQUID Results Legend X Test N No Determination Possible	Lab Sample No(s)		Customer Sample Reference		AGS Reference		Depth (m)		Container	
	11455014		TRIP BLANK						Vial (AL E297)	
	11455012		EQUIPMENT BLANK						Vial (AL E297)	
	11455013		DUP 01						HCl Filtered (ALE250) 500ml Plastic (ALE208) 1000ml glass bottle Vial (AL E297)	
	11455011		BH106A						HCl Filtered (ALE250) 500ml Plastic (ALE208) 1000ml glass bottle Vial (AL E297)	
Anions by Kone (w)	All	NDPs: 0 Tests: 7								
EPH CWG (Aliphatic) Aqueous GC (W)	All	NDPs: 0 Tests: 7								
EPH CWG (Aromatic) Aqueous GC (W)	All	NDPs: 0 Tests: 7								
Ferrous Iron	All	NDPs: 0 Tests: 7								
GRO by GC-FID (W)	All	NDPs: 0 Tests: 7								
Oxygenates (W)	All	NDPs: 0 Tests: 7								
PAH Spec MS - Aqueous (W)	All	NDPs: 0 Tests: 7								
VOC MS (W)	All	NDPs: 0 Tests: 8								

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Client Reference: 46370079

Location: Shell Hitchin
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EPH CWG (Aliphatic) Aqueous GC (W)

[illegible]

SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

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EPH CWG (Aliphatic) Aqueous GC (W)

[illegible]

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SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

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EPH CWG (Aromatic) Aqueous GC (W)

[illegible]

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Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
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GRO by GC-FID (W)

[illegible]

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SDG: 150530-79
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Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
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PAH Spec MS - Aqueous (W)

[illegible]

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SDG: 150530-79
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VOC MS (W)

[illegible]



SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

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Table of Results - Appendix

Method No	Reference	Description	Wet/Dry Sample ¹	Surrogate Corrected
TM061	Method for the Determination of EPH,Massachusetts Dept.of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)		
TM125	DIN 38405 D17	Determination of Ferrous Iron		
TM174	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	Determination of Speciated Extractable Petroleum Hydrocarbons in Waters by GC-FID		
TM178	Modified: US EPA Method 8100	Determination of Polynuclear Aromatic Hydrocarbons (PAH) by GC-MS in Waters		
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers		
TM208	Modified: US EPA Method 8260b & 624	Determination of Volatile Organic Compounds by Headspace / GC-MS in Waters		
TM245	By GC-FID	Determination of GRO by Headspace in waters		
TM289		Determination of Oxygenates in Waters by Headspace/GC-MS		

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



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Test Completion Dates

Lab Sample No(s)	11455007	11455009	11455008	11455010	11455011	11455013	11455012	11455014
Customer Sample Ref.	BH102	BH103	BH102A	BH105A	BH106A	DUP 01	EQUIPMENT BLANK	TRIP BLANK
AGS Ref.								
Depth								
Type	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID
Anions by Kone (w)	03-Jun-2015	03-Jun-2015	03-Jun-2015	05-Jun-2015	03-Jun-2015	05-Jun-2015	05-Jun-2015	
EPH CWG (Aliphatic) Aqueous GC (W)	05-Jun-2015	05-Jun-2015	05-Jun-2015	05-Jun-2015	05-Jun-2015	05-Jun-2015	05-Jun-2015	
EPH CWG (Aromatic) Aqueous GC (W)	05-Jun-2015	05-Jun-2015	05-Jun-2015	05-Jun-2015	05-Jun-2015	05-Jun-2015	05-Jun-2015	
Ferrous Iron	03-Jun-2015	03-Jun-2015	03-Jun-2015	03-Jun-2015	03-Jun-2015	03-Jun-2015	03-Jun-2015	
GRO by GC-FID (W)	08-Jun-2015	08-Jun-2015	09-Jun-2015	09-Jun-2015	08-Jun-2015	09-Jun-2015	09-Jun-2015	
Nitrite by Kone (w)	02-Jun-2015	02-Jun-2015	02-Jun-2015	03-Jun-2015	02-Jun-2015	03-Jun-2015	03-Jun-2015	
Oxygenates (W)	04-Jun-2015	04-Jun-2015	04-Jun-2015	04-Jun-2015	04-Jun-2015	04-Jun-2015	04-Jun-2015	
PAH Spec MS - Aqueous (W)	05-Jun-2015	05-Jun-2015	05-Jun-2015	05-Jun-2015	05-Jun-2015	05-Jun-2015	05-Jun-2015	
TPH CWG (W)	08-Jun-2015	08-Jun-2015	09-Jun-2015	09-Jun-2015	08-Jun-2015	09-Jun-2015	09-Jun-2015	
VOC MS (W)	05-Jun-2015	05-Jun-2015	06-Jun-2015	05-Jun-2015	05-Jun-2015	05-Jun-2015	05-Jun-2015	05-Jun-2015



SDG: 150530-79
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ASSOCIATED AQC DATA

Anions by Kone (w)

Component	Method Code	QC 1113
Chloride	TM184	103.0 94.64 : 106.82
Phosphate (Ortho as PO ₄)	TM184	104.8 96.40 : 108.40
Sulphate (soluble)	TM184	99.2 96.47 : 104.74
TON as NO ₃	TM184	103.0 93.05 : 112.12

EPH CWG (Aliphatic) Aqueous GC (W)

Component	Method Code	QC 1181	QC 1198
Total Aliphatics >C12-C35	TM174	93.54 66.67 : 110.42	92.5 66.67 : 110.42

EPH CWG (Aromatic) Aqueous GC (W)

Component	Method Code	QC 1183	QC 1126
Total Aromatics >EC12-EC35	TM174	96.0 63.00 : 121.00	97.33 63.00 : 121.00

Ferrous Iron

Component	Method Code	QC 1134	QC 1158
Ferrous Iron	TM125	96.33 94.00 : 102.00	98.67 94.00 : 102.00

GRO by GC-FID (W)

Component	Method Code	QC 1106	QC 1156
Benzene by GC	TM245	90.5 76.72 : 118.62	106.5 76.72 : 118.62
Ethylbenzene by GC	TM245	86.5 74.74 : 116.76	106.5 74.74 : 116.76
m & p Xylene by GC	TM245	86.5 73.06 : 114.58	106.0 73.06 : 114.58
MTBE GC-FID	TM245	94.0 80.00 : 121.03	107.5 80.00 : 121.03
o Xylene by GC	TM245	87.5 70.00 : 130.00	107.0 70.00 : 130.00
QC	TM245	82.92 70.00 : 130.00	70.00 : 130.00



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GRO by GC-FID (W)

		QC 1106	QC 1156
Toluene by GC	TM245	89.5 79.35 : 119.27	106.5 79.35 : 119.27

Oxygenates (W)

Component	Method Code	QC 1107
Benzene	TM289	114.0 87.69 : 119.72
Diisopropyl ether	TM289	110.5 86.70 : 122.79
Ethanol	TM289	109.0 74.12 : 156.61
Ethylbenzene	TM289	106.5 84.52 : 113.38
o-Xylene	TM289	107.5 84.40 : 112.41
p/m-Xylene	TM289	108.0 83.20 : 115.01
tert Butanol	TM289	106.0 70.51 : 143.48
tert-amyl methyl ether	TM289	113.0 78.92 : 124.29
tert-butyl ethyl ether	TM289	111.0 78.17 : 124.34
tert-butyl methyl ether	TM289	114.0 87.75 : 127.35
Toluene	TM289	108.0 79.08 : 122.51

PAH Spec MS - Aqueous (W)

Component	Method Code	QC 1192	QC 1123	QC 1159
Acenaphthene by GCMS	TM178	94.5 88.78 : 115.50	100.5 88.78 : 115.50	96.5 91.90 : 109.30
Acenaphthylene by GCMS	TM178	87.0 85.27 : 110.71	94.5 85.27 : 110.71	93.5 87.74 : 109.69
Anthracene by GCMS	TM178	91.5 86.06 : 112.26	95.5 86.06 : 112.26	93.5 89.70 : 111.80
Benz(a)anthracene by GCMS	TM178	93.0 79.25 : 124.25	94.5 79.25 : 124.25	104.0 88.64 : 112.43
Benzo(a)pyrene by GCMS	TM178	109.5 83.10 : 128.10	109.5 83.10 : 128.10	120.5 85.00 : 130.00
Benzo(b)fluoranthene by GCMS	TM178	115.5 86.00 : 131.00	119.0 86.00 : 131.00	121.5 85.50 : 130.50
Benzo(ghi)perylene by GCMS	TM178	100.5 85.11 : 114.59	92.5 85.11 : 114.59	93.5 88.43 : 116.76
Benzo(k)fluoranthene by GCMS	TM178	118.5 87.50 : 132.50	117.5 87.50 : 132.50	125.0 87.50 : 132.50
Chrysene by GCMS	TM178	99.5 86.00 : 114.60	103.0 86.00 : 114.60	107.5 89.75 : 115.25
Dibenzo(ah)anthracene by GCMS	TM178	99.5 80.00 : 119.98	91.5 80.00 : 119.98	88.5 85.97 : 110.46
Fluoranthene by GCMS	TM178	94.0 81.15 : 116.55	97.5 81.15 : 116.55	96.0 86.85 : 115.35



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PAH Spec MS - Aqueous (W)

		QC 1192	QC 1123	QC 1159
Fluorene by GCMS	TM178	95.0 90.88 : 112.23	102.5 90.88 : 112.23	96.0 92.39 : 113.85
Indeno(123cd)pyrene by GCMS	TM178	101.5 82.25 : 114.75	98.0 82.25 : 114.75	113.0 84.94 : 119.98
Naphthalene by GCMS	TM178	92.0 92.00 : 113.00	96.0 92.00 : 113.00	97.0 88.20 : 115.80
Phenanthrene by GCMS	TM178	93.5 93.18 : 113.92	99.5 93.18 : 113.92	96.5 88.40 : 114.20
Pyrene by GCMS	TM178	93.0 82.25 : 116.15	98.5 82.25 : 116.15	94.0 87.50 : 116.00

VOC MS (W)

Component	Method Code	QC 1193	QC 1182
1,1,1,2-Tetrachloroethane	TM208	103.0 87.29 : 112.22	98.5 77.50 : 122.50
1,1,1-Trichloroethane	TM208	94.0 80.57 : 121.77	91.5 77.50 : 122.50
1,1-Dichloroethane	TM208	99.5 77.85 : 123.56	93.0 77.50 : 122.50
1,2-Dichloroethane	TM208	107.0 80.96 : 124.37	99.5 77.50 : 122.50
2-Chlorotoluene	TM208	102.0 84.42 : 112.35	95.5 77.50 : 122.50
4-Chlorotoluene	TM208	102.0 88.70 : 113.67	96.5 77.50 : 122.50
Benzene	TM208	97.5 85.85 : 118.22	92.0 77.50 : 122.50
Bromomethane	TM208	107.5 78.68 : 126.84	97.5 75.87 : 132.10
Carbontetrachloride	TM208	95.0 82.06 : 117.49	95.5 77.50 : 122.50
Chlorobenzene	TM208	101.5 77.50 : 122.50	95.0 77.50 : 122.50
Chloroform	TM208	102.5 77.50 : 122.50	97.5 77.50 : 122.50
Chloromethane	TM208	100.5 64.99 : 145.80	94.5 77.12 : 138.43
Cis-1,2-Dichloroethene	TM208	104.5 82.70 : 120.11	96.5 77.50 : 122.50
Dichloromethane	TM208	106.0 80.45 : 125.21	97.0 77.50 : 122.50
Ethylbenzene	TM208	93.5 81.00 : 111.00	88.5 81.27 : 109.50
Hexachlorobutadiene	TM208	87.5 79.39 : 111.07	88.0 72.12 : 118.38
o-Xylene	TM208	97.0 84.32 : 113.42	94.5 81.27 : 117.89
p/m-Xylene	TM208	93.5 82.25 : 112.25	93.0 74.83 : 118.29
Tert-butyl methyl ether	TM208	92.0 76.57 : 125.98	88.5 68.24 : 122.50
Tetrachloroethene	TM208	98.5 84.88 : 110.14	97.0 77.50 : 122.50



SDG:	150530-79	Location:	Shell Hitchin	Order Number:	46370079
Job:	H_URS_WIM-174	Customer:	AECOM	Report Number:	316276
Client Reference:	46370079	Attention:	Bethan Short	Superseded Report:	316268

VOC MS (W)

		QC 1193	QC 1182
Toluene	TM208	98.5 85.71 : 113.18	92.5 77.50 : 122.50
Trichloroethene	TM208	101.0 87.32 : 112.88	97.5 77.50 : 122.50
Vinyl Chloride	TM208	93.0 67.57 : 130.24	86.0 64.36 : 126.94

The above information details the reference name of the analytical quality control sample (AQC) that has been run with the samples contained in this report for the different methods of analysis.

The figure detailed is the percentage recovery result for the AQC.

The subscript numbers below are the percentage recovery lower control limit (LCL) and the upper control limit (UCL). The percentage recovery result for the AQC should be between these limits to be statistically in control.



SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

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Chromatogram

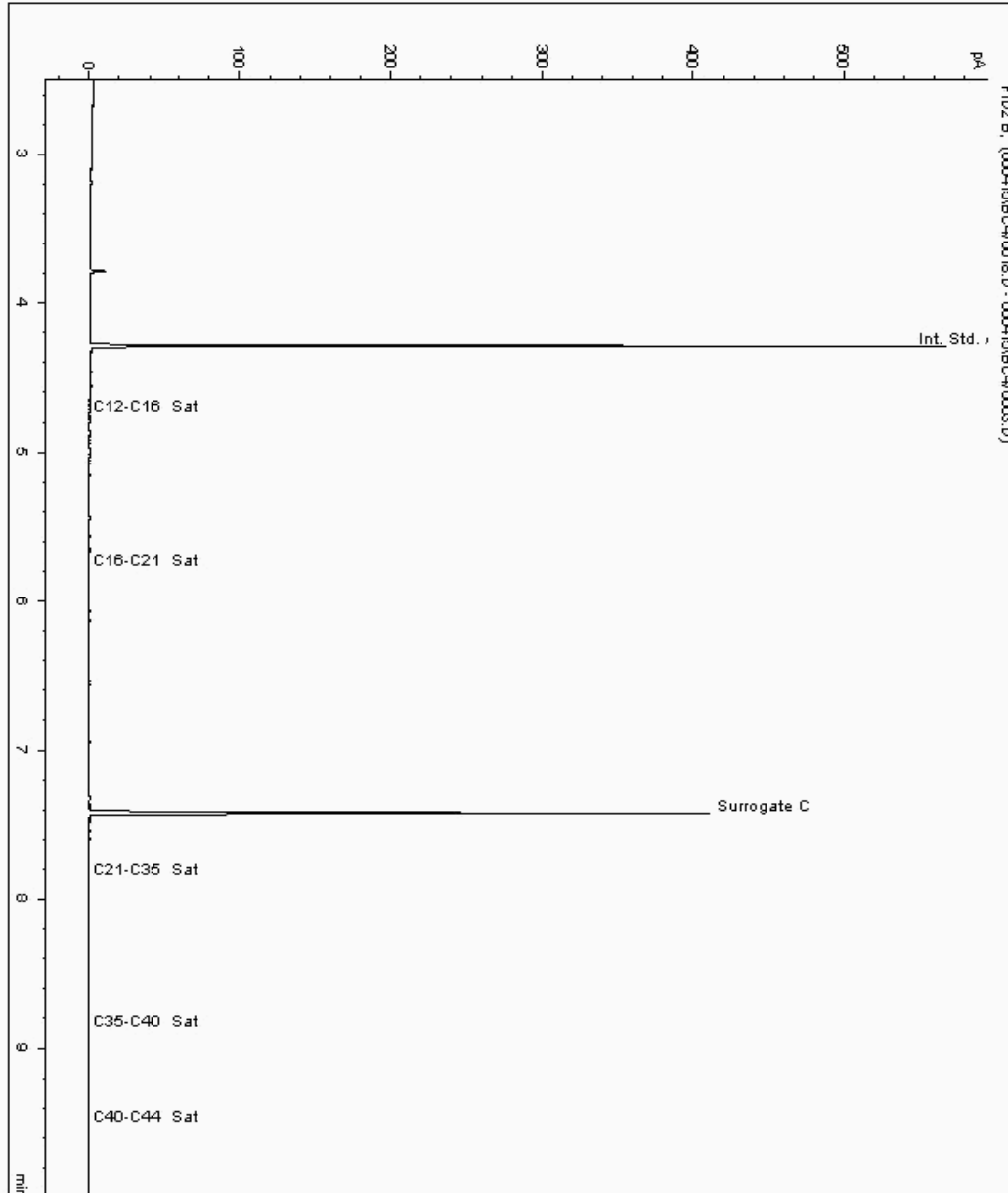
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 11459838
Sample ID : BH105A

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 10888006-
Date Acquired : 04/06/15 21:17:06 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
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Chromatogram

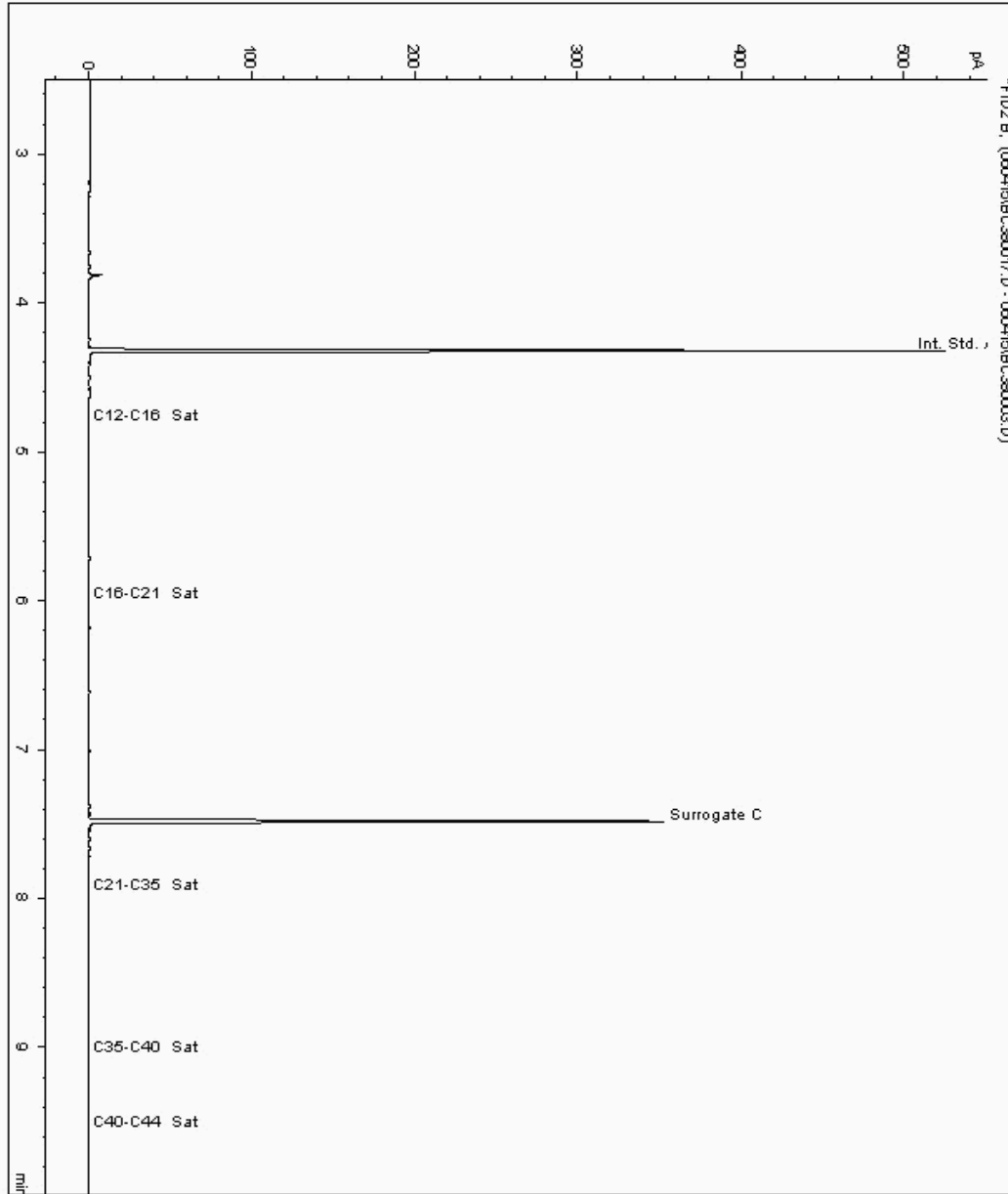
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 11459850
Sample ID : BH103

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 10887996-
Date Acquired : 04/06/15 20:53:00 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 46370079
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Chromatogram

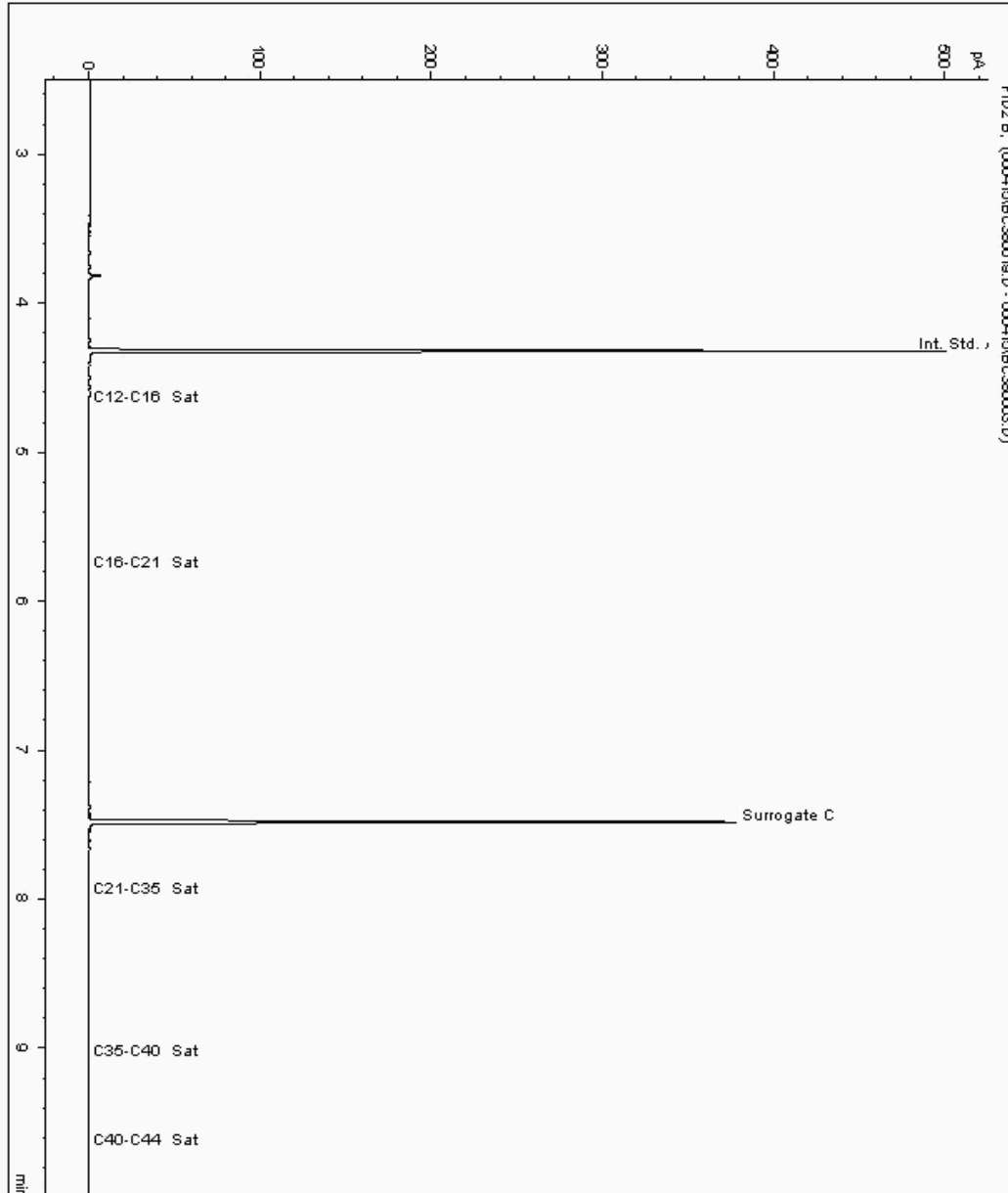
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 11459859
Sample ID : BH102A

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 10887986-
Date Acquired : 04/06/15 21:29:56 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 46370079
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Chromatogram

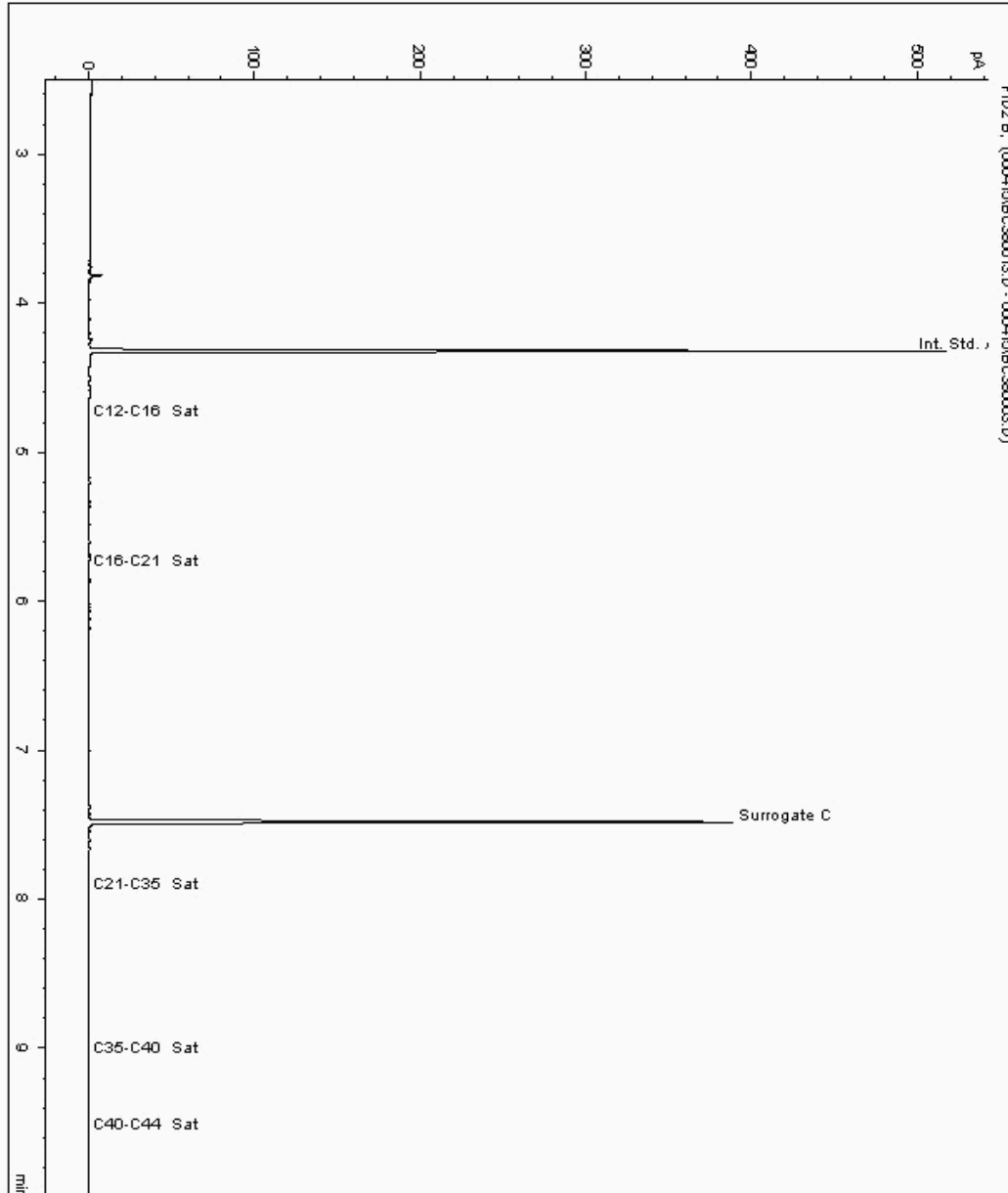
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 11459864
Sample ID : BH102

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 10887976-
Date Acquired : 04/06/15 19:38:42 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 46370079
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Chromatogram

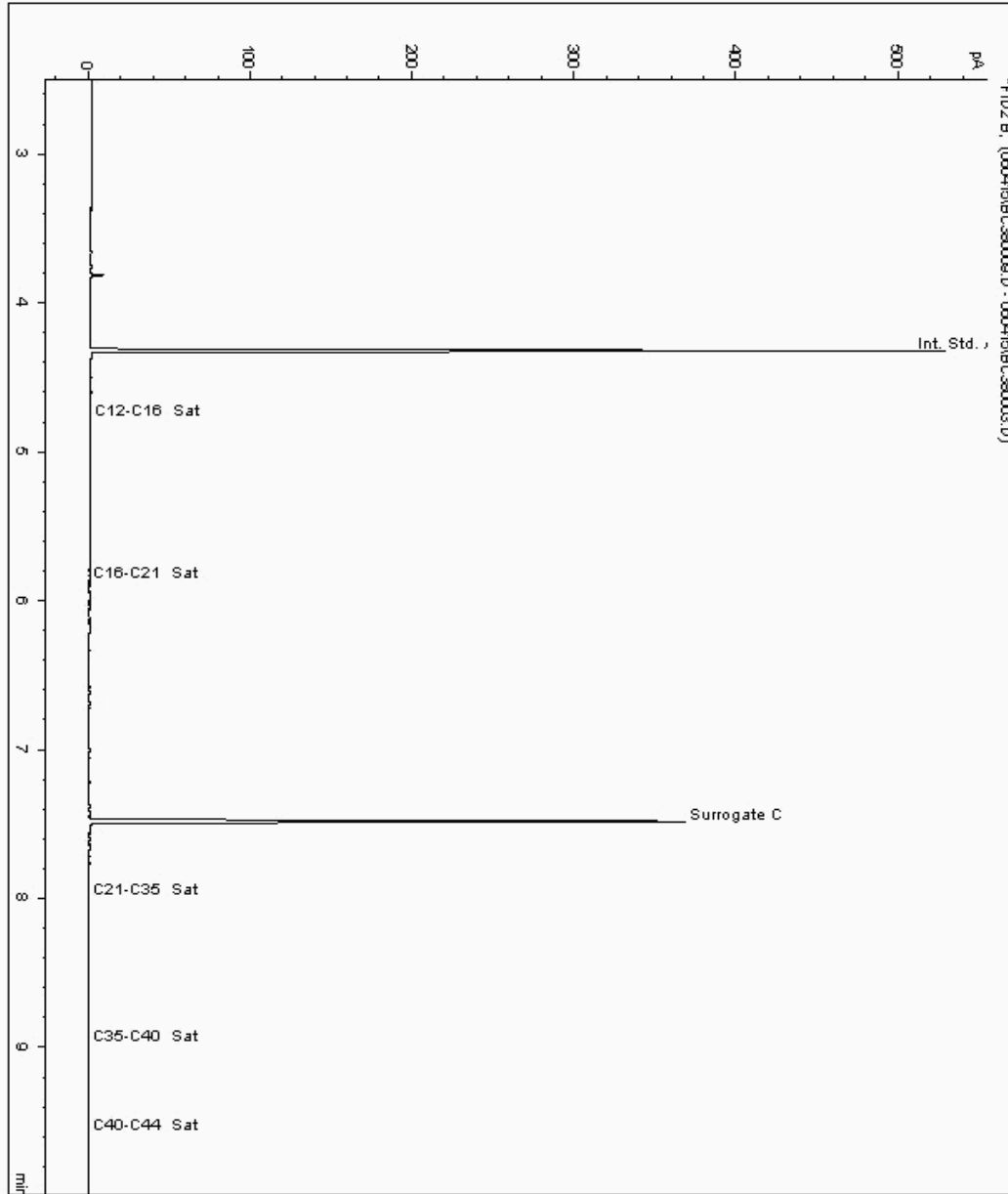
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 11459976
Sample ID : DUP 01

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 10888036-
Date Acquired : 04/06/15 18:24:17 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





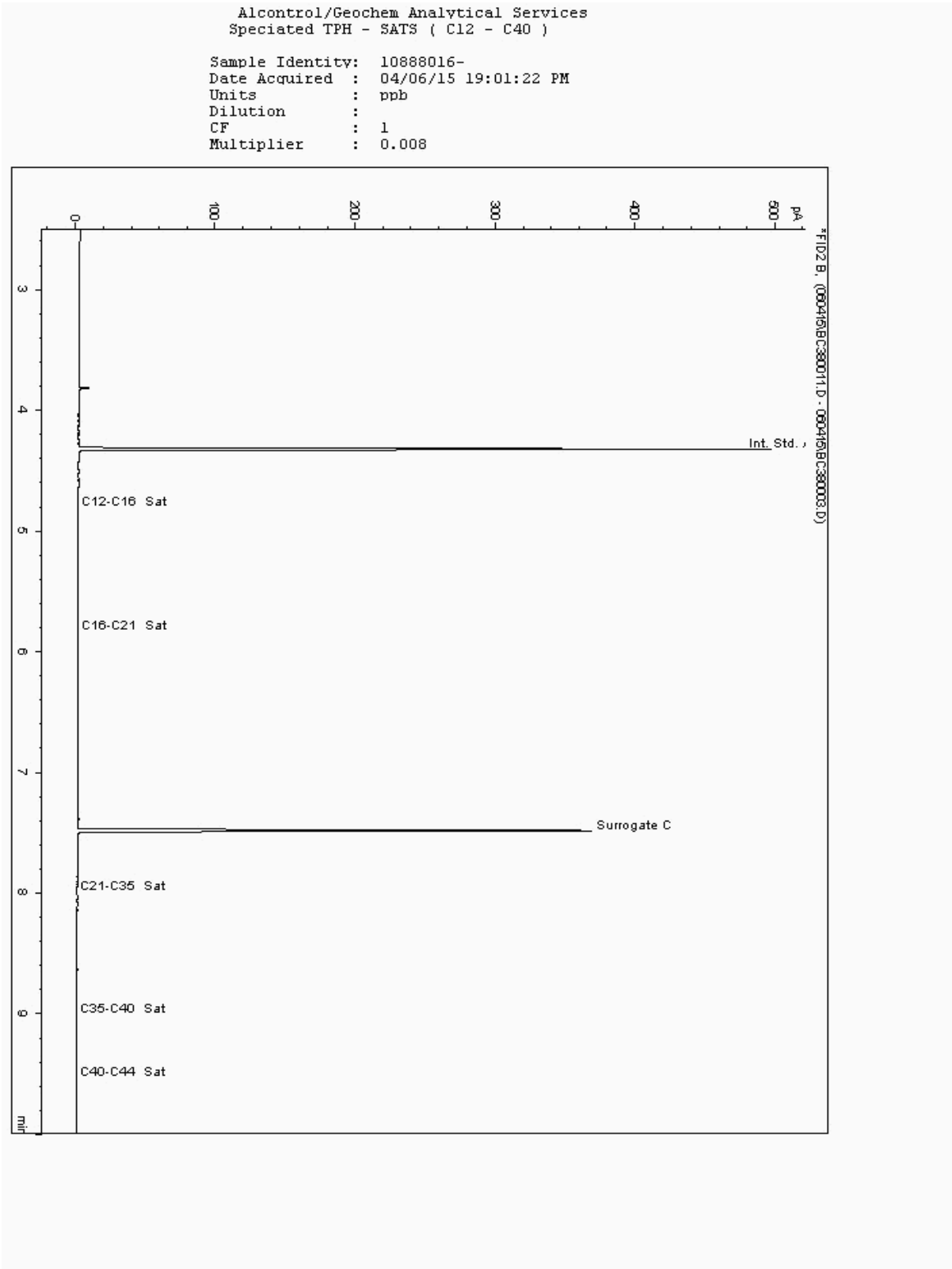
SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 46370079
Report Number: 316276
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Chromatogram

Analysis: EPH CWG (Aliphatic) Aqueous GC (W) Sample No : 11459984 Depth :
Sample ID : BH106A





SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 46370079
Report Number: 316276
Superseded Report: 316268

Chromatogram

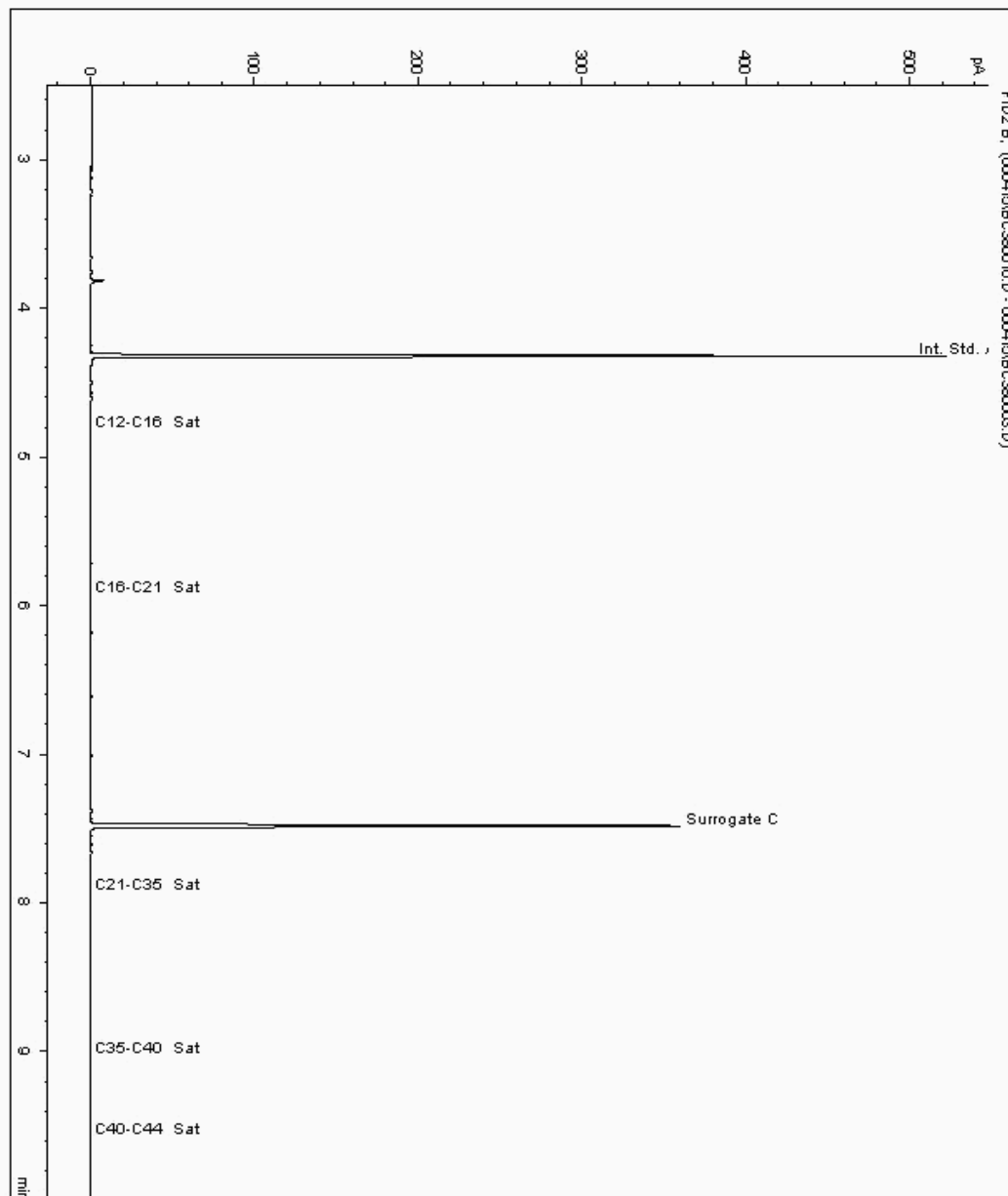
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 11459988
Sample ID : EQUIPMENT BLANK

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 10888026-
Date Acquired : 04/06/15 18:42:49 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 46370079
Report Number: 316276
Superseded Report: 316268

Chromatogram

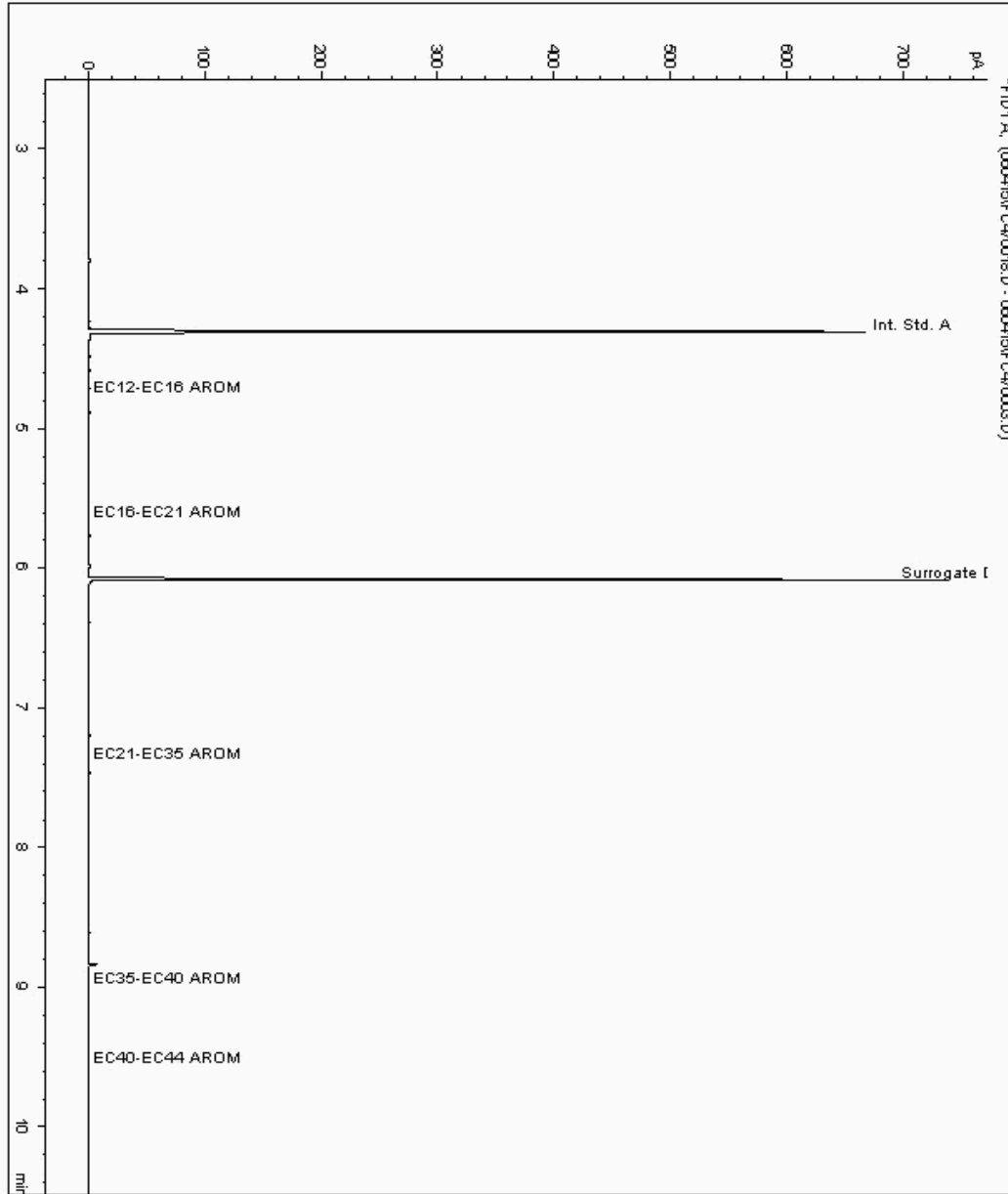
Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 11459838
Sample ID : BH105A

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 10888007-
Date Acquired : 04/06/15 21:17:06 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008

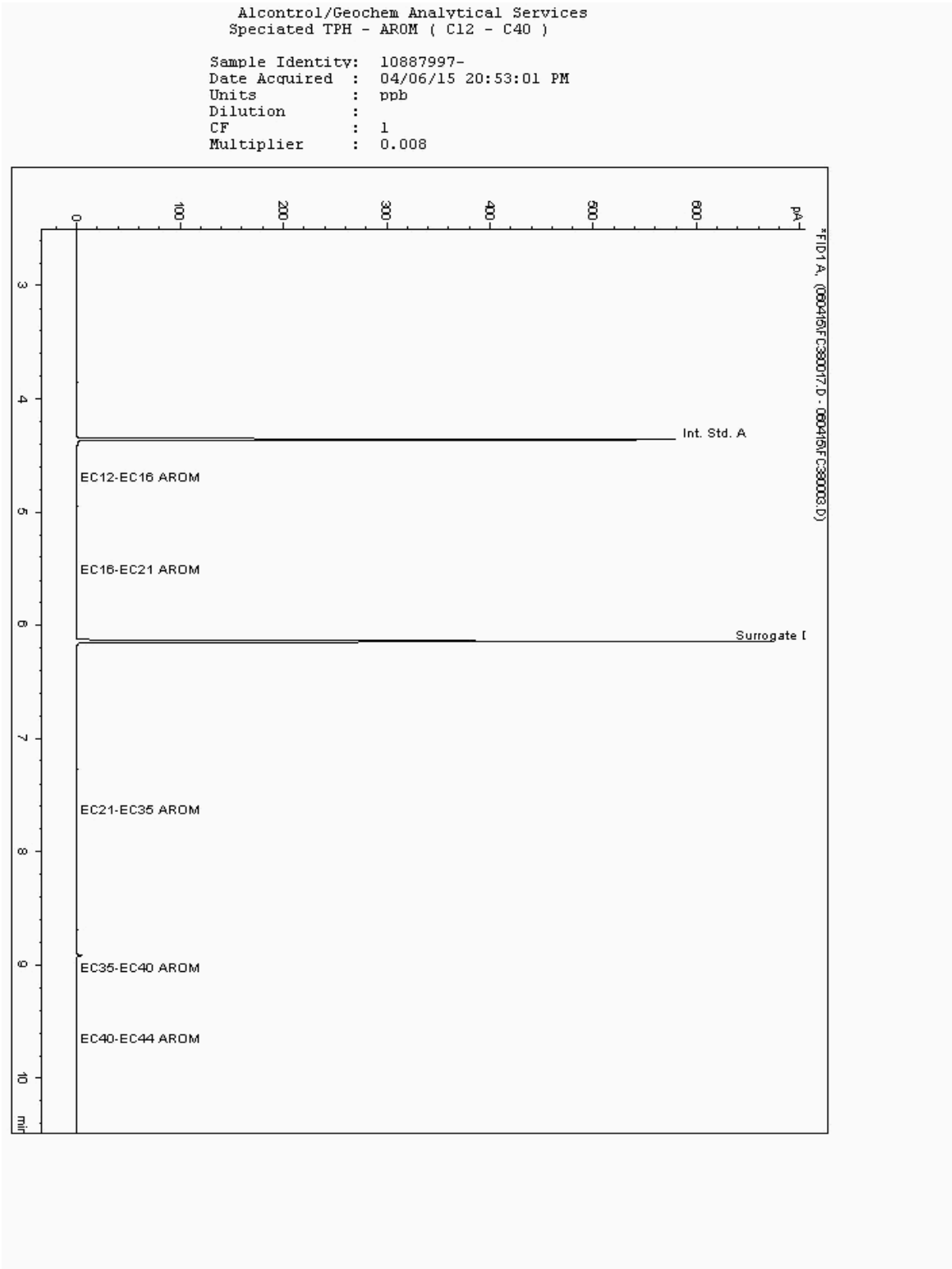




SDG:	150530-79	Location:	Shell Hitchin	Order Number:	46370079
Job:	H_URS_WIM-174	Customer:	AECOM	Report Number:	316276
Client Reference:	46370079	Attention:	Bethan Short	Superseded Report:	316268

Chromatogram

Analysis: EPH CWG (Aromatic) Aqueous GC (W) Sample No : 11459850 Depth :
Sample ID : BH103





SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 46370079
Report Number: 316276
Superseded Report: 316268

Chromatogram

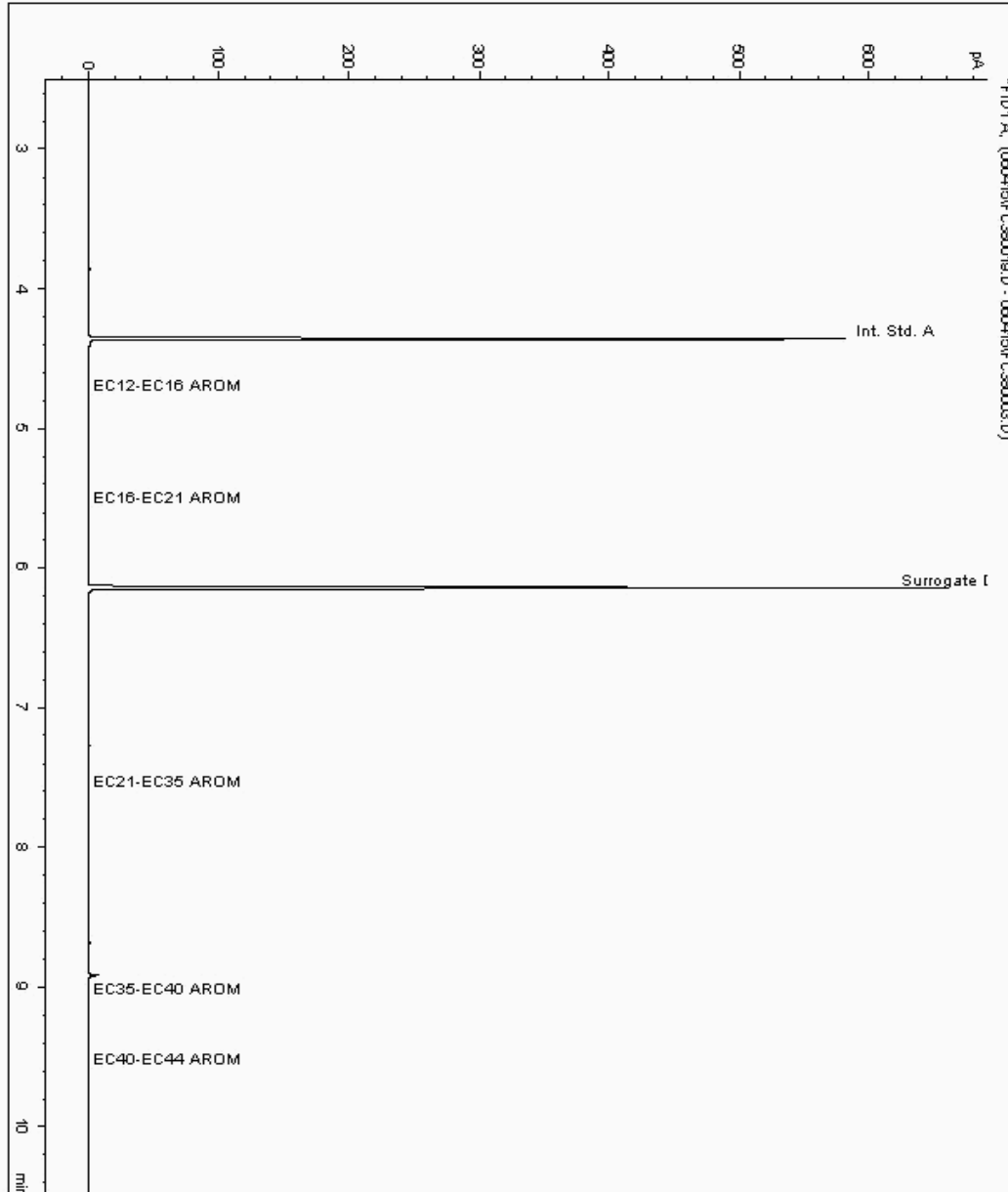
Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 11459859
Sample ID : BH102A

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 10887987-
Date Acquired : 04/06/15 21:29:57 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 46370079
Report Number: 316276
Superseded Report: 316268

Chromatogram

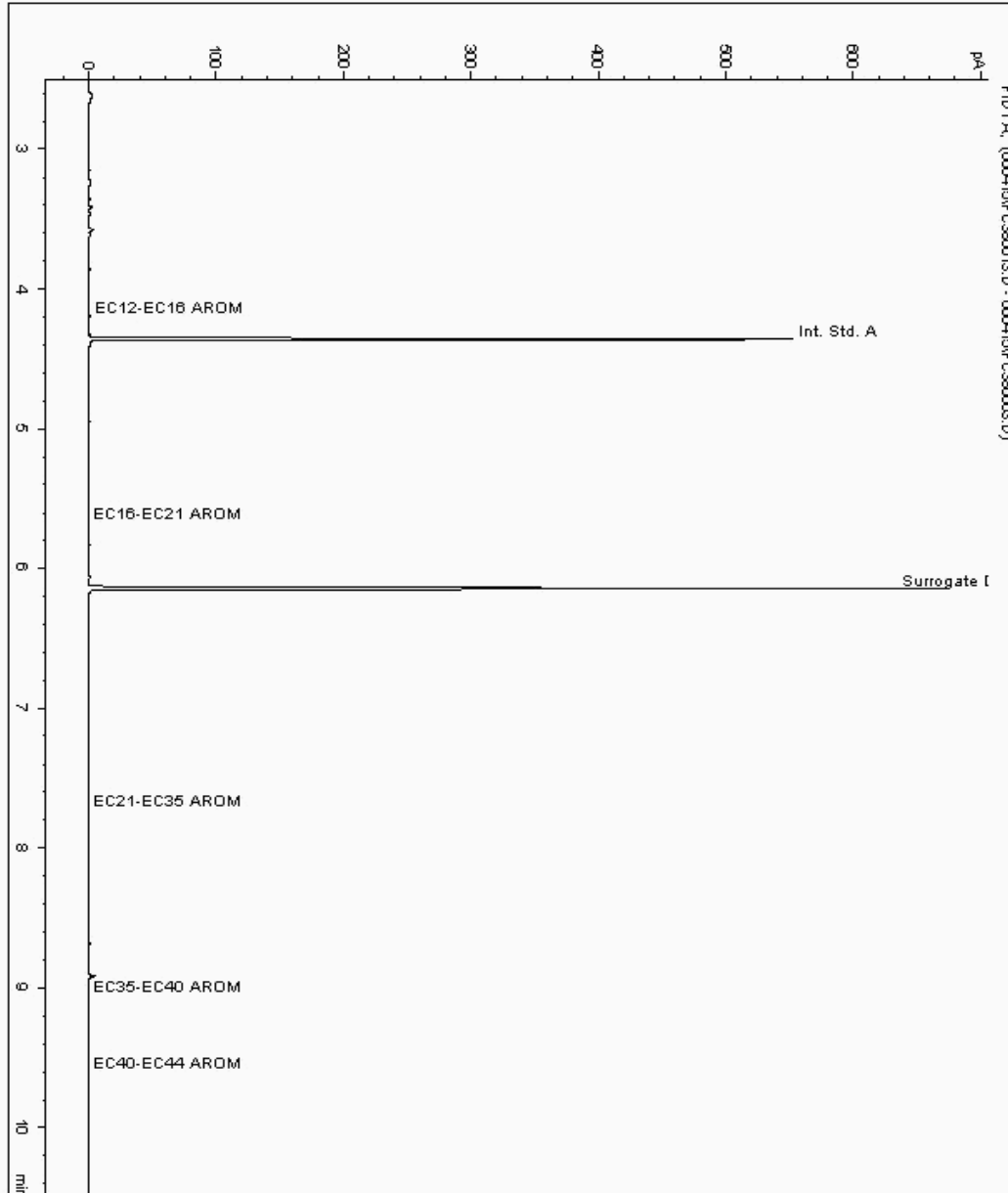
Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 11459864
Sample ID : BH102

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 10887977-
Date Acquired : 04/06/15 19:38:41 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 46370079
Report Number: 316276
Superseded Report: 316268

Chromatogram

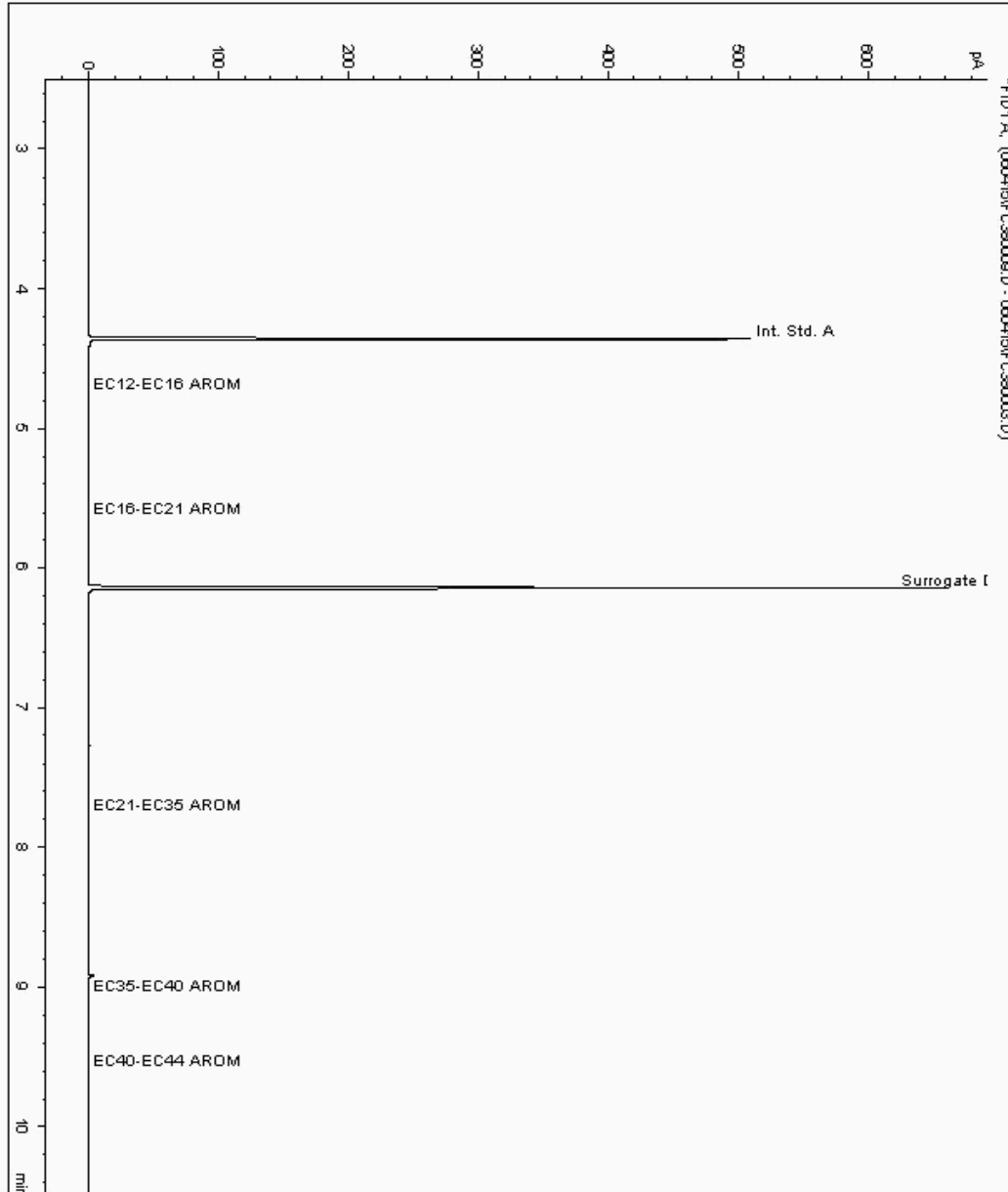
Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 11459976
Sample ID : DUP 01

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 10888037-
Date Acquired : 04/06/15 18:24:17 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 46370079
Report Number: 316276
Superseded Report: 316268

Chromatogram

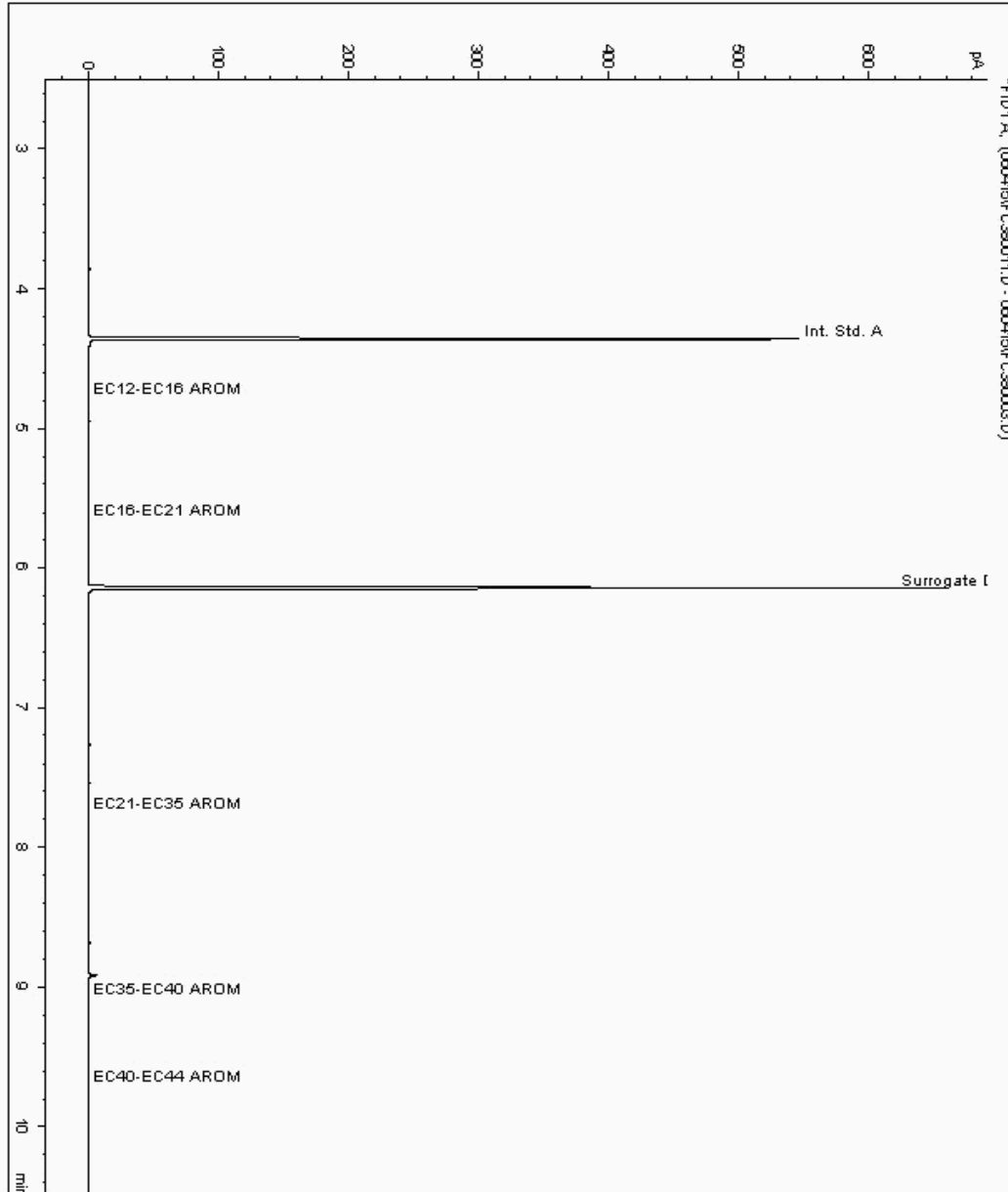
Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 11459984
Sample ID : BH106A

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 10888017-
Date Acquired : 04/06/15 19:01:22 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 46370079
Report Number: 316276
Superseded Report: 316268

Chromatogram

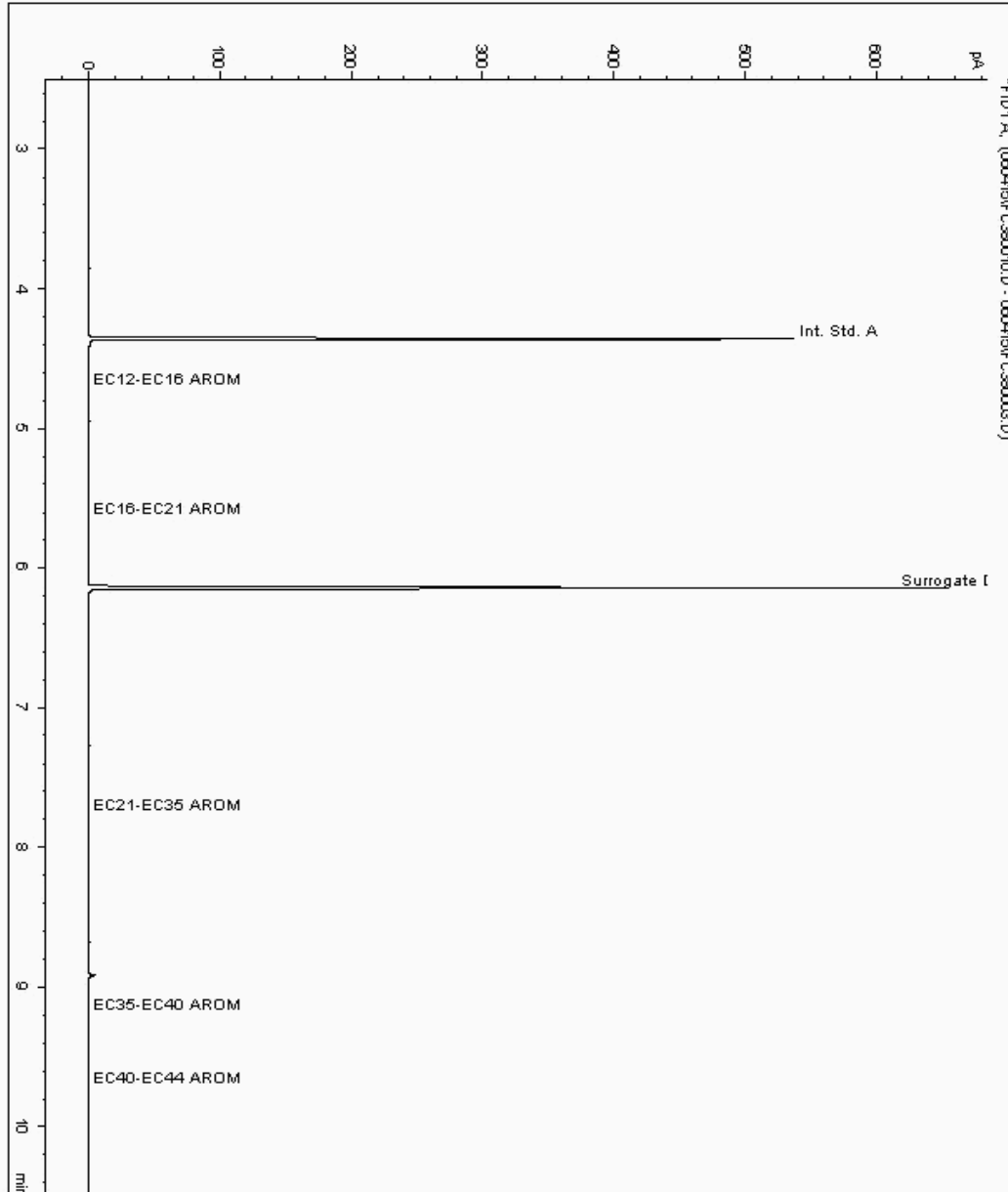
Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 11459988
Sample ID : EQUIPMENT BLANK

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 10888027-
Date Acquired : 04/06/15 18:42:48 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

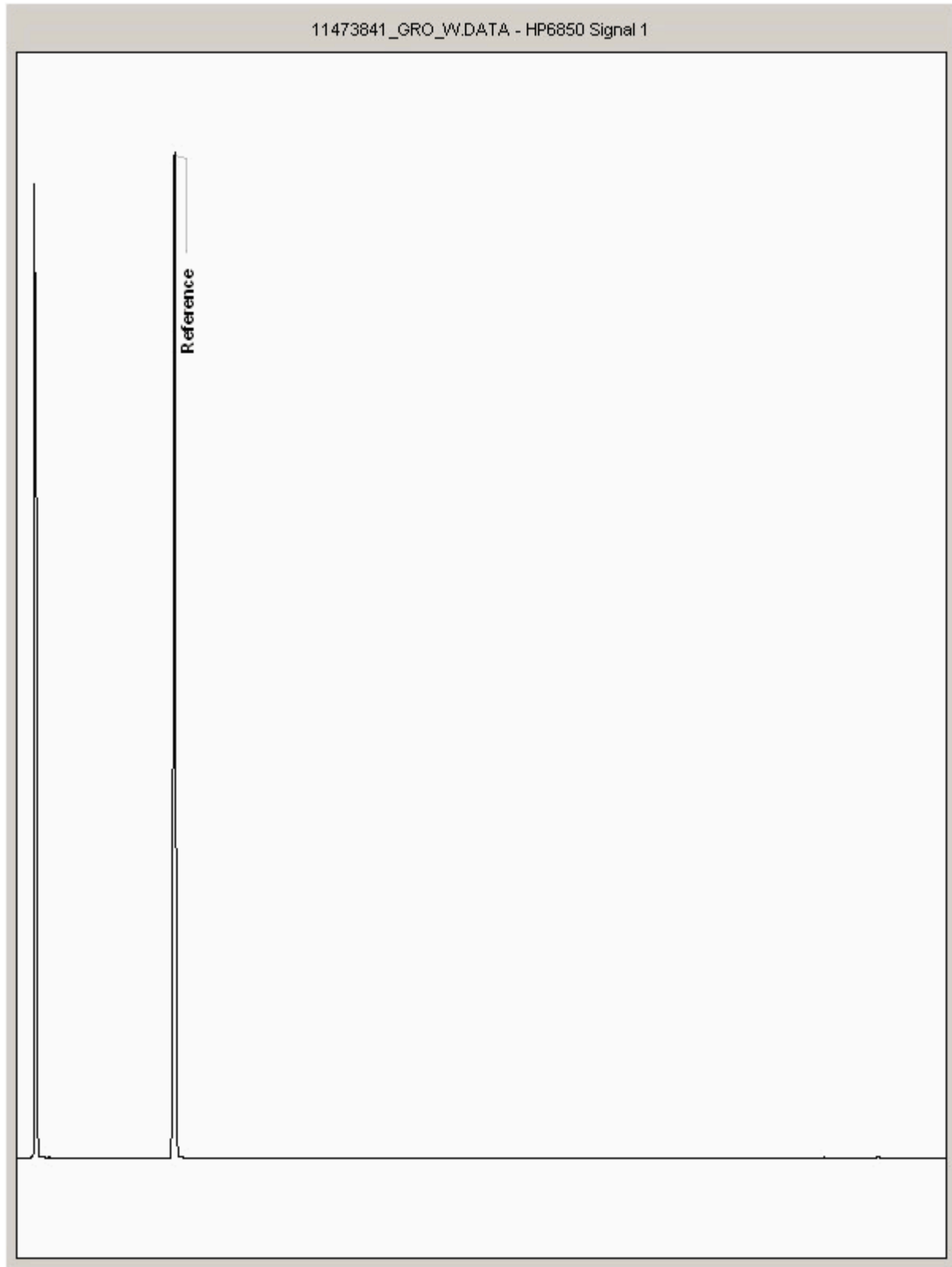
Order Number: 46370079
Report Number: 316276
Superseded Report: 316268

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 11473841
Sample ID : BH103

Depth :





SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

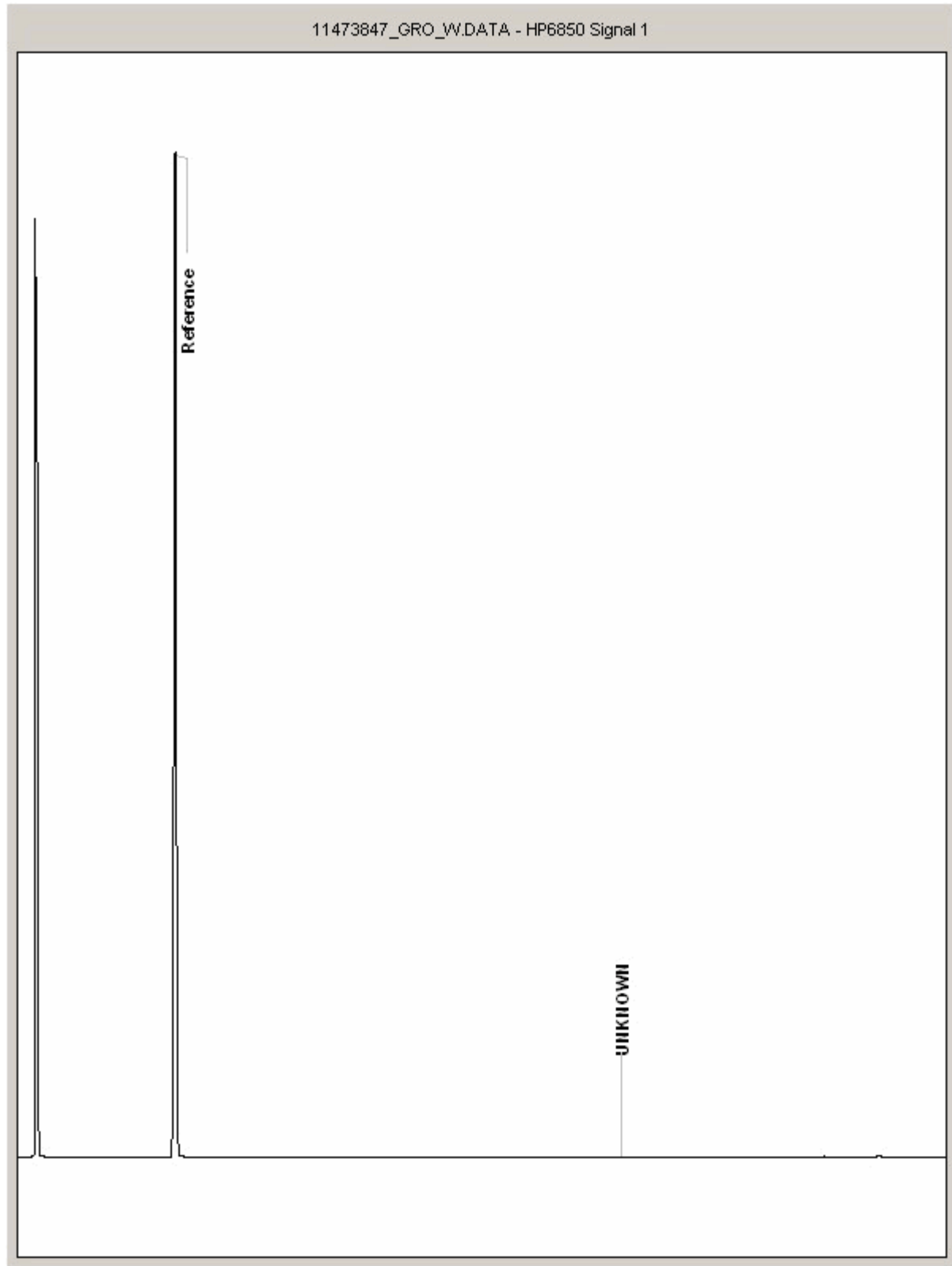
Order Number: 46370079
Report Number: 316276
Superseded Report: 316268

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 11473847
Sample ID : BH102

Depth :





SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

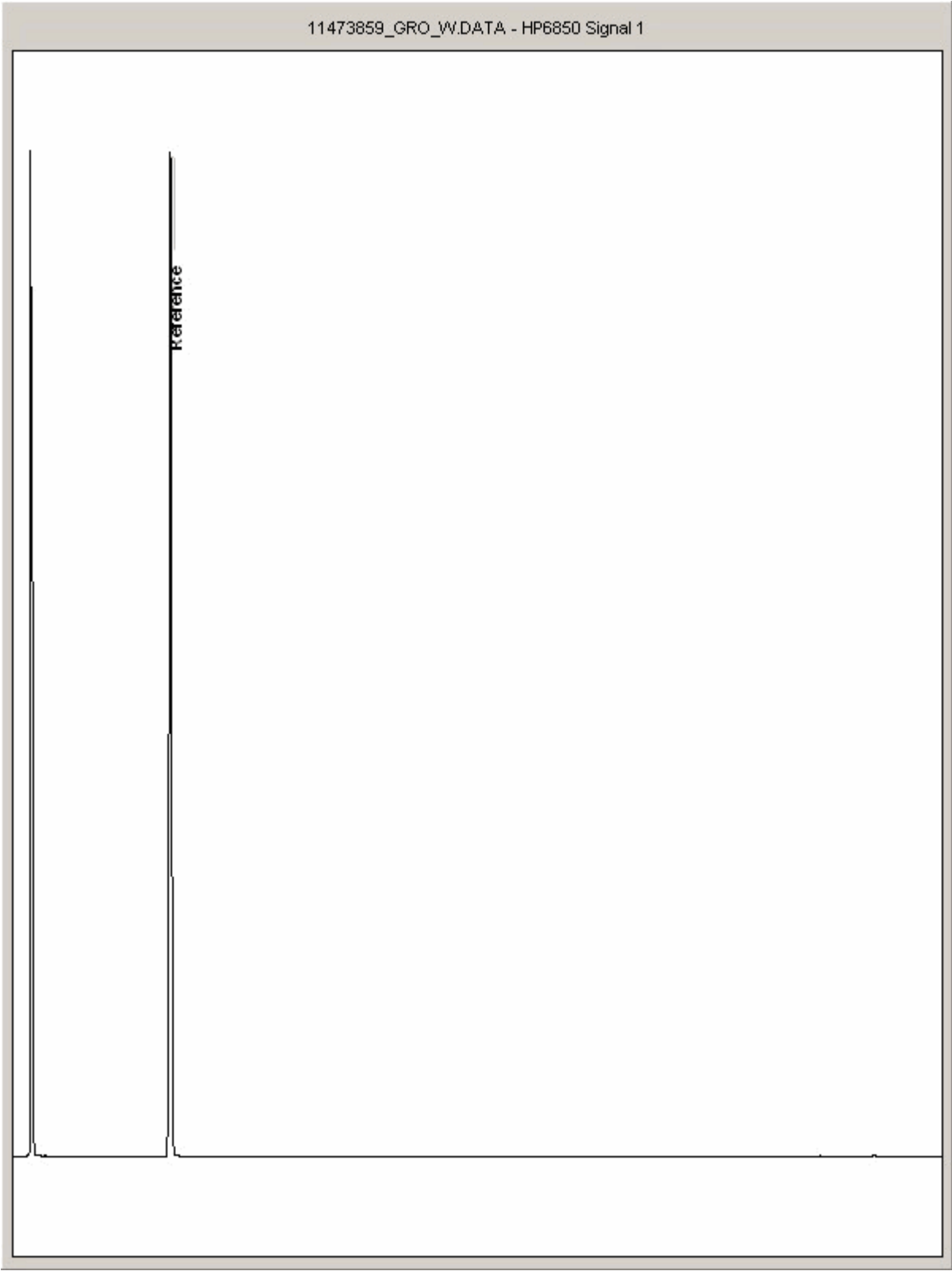
Order Number: 46370079
Report Number: 316276
Superseded Report: 316268

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 11473859
Sample ID : BH106A

Depth :

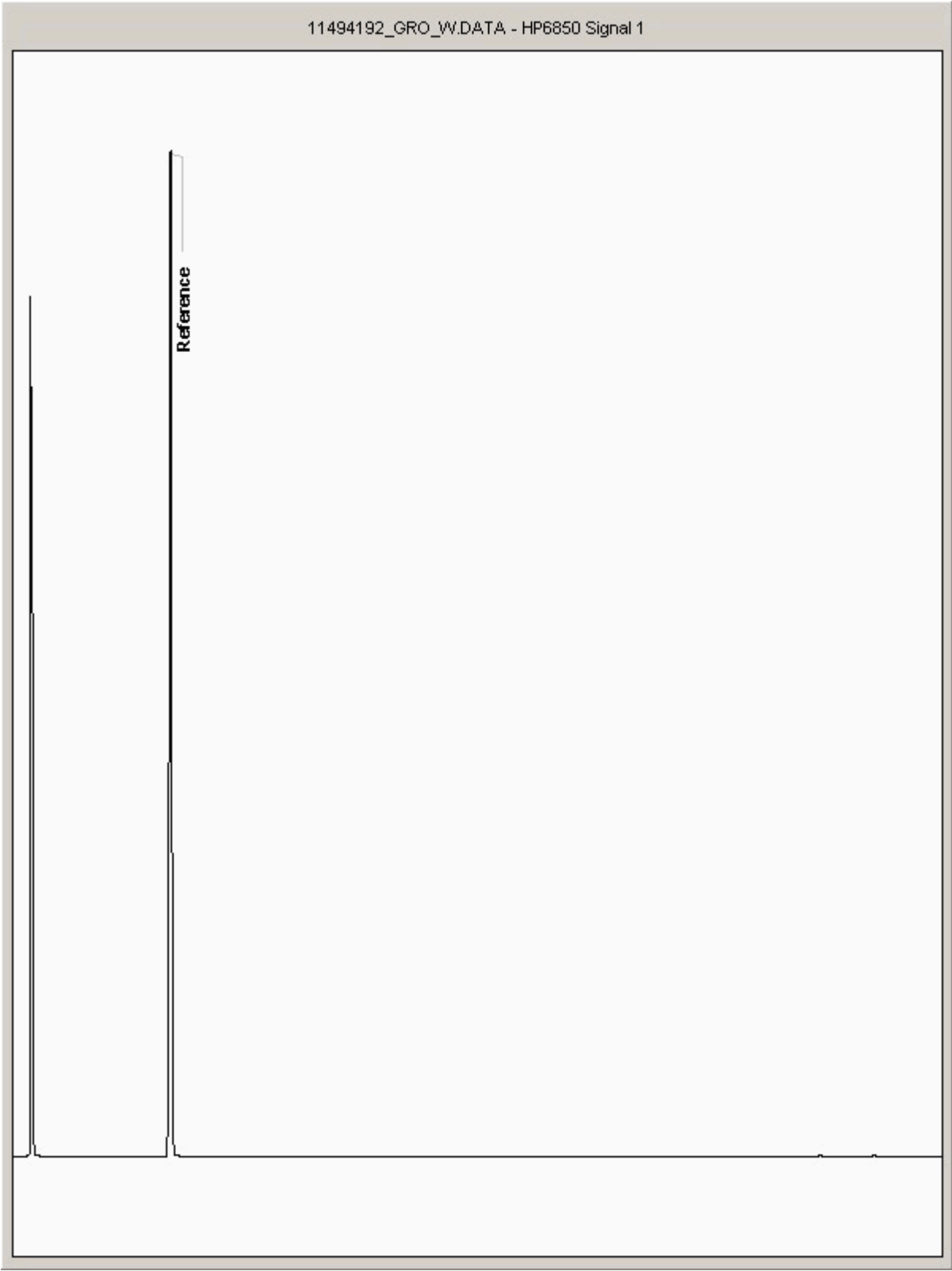




SDG:	150530-79	Location:	Shell Hitchin	Order Number:	46370079
Job:	H_URS_WIM-174	Customer:	AECOM	Report Number:	316276
Client Reference:	46370079	Attention:	Bethan Short	Superseded Report:	316268

Chromatogram

Analysis:	GRO by GC-FID (W)	Sample No :	11494192	Depth :	
		Sample ID :	DUP 01		





SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

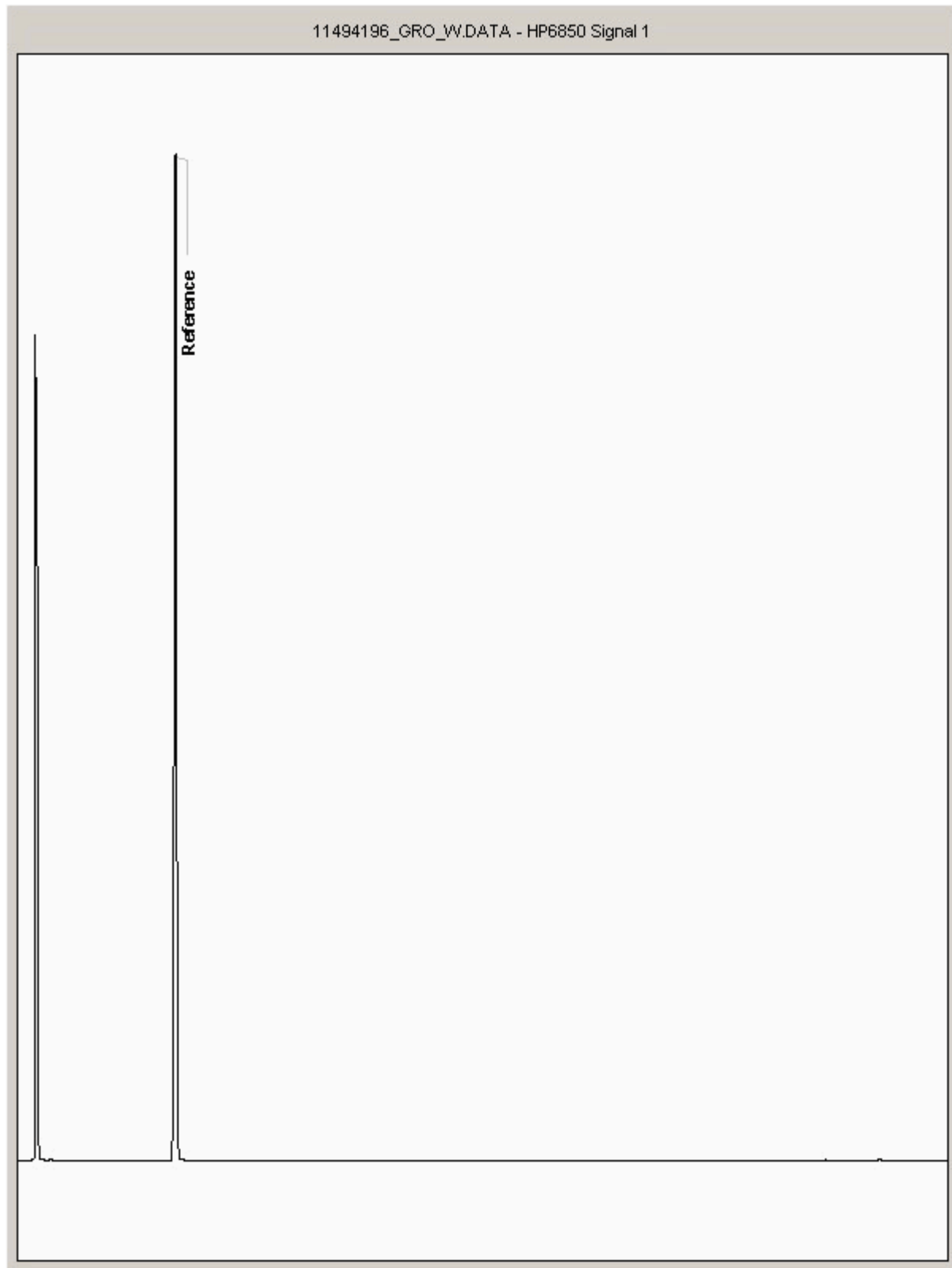
Order Number: 46370079
Report Number: 316276
Superseded Report: 316268

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 11494196
Sample ID : BH105A

Depth :





SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

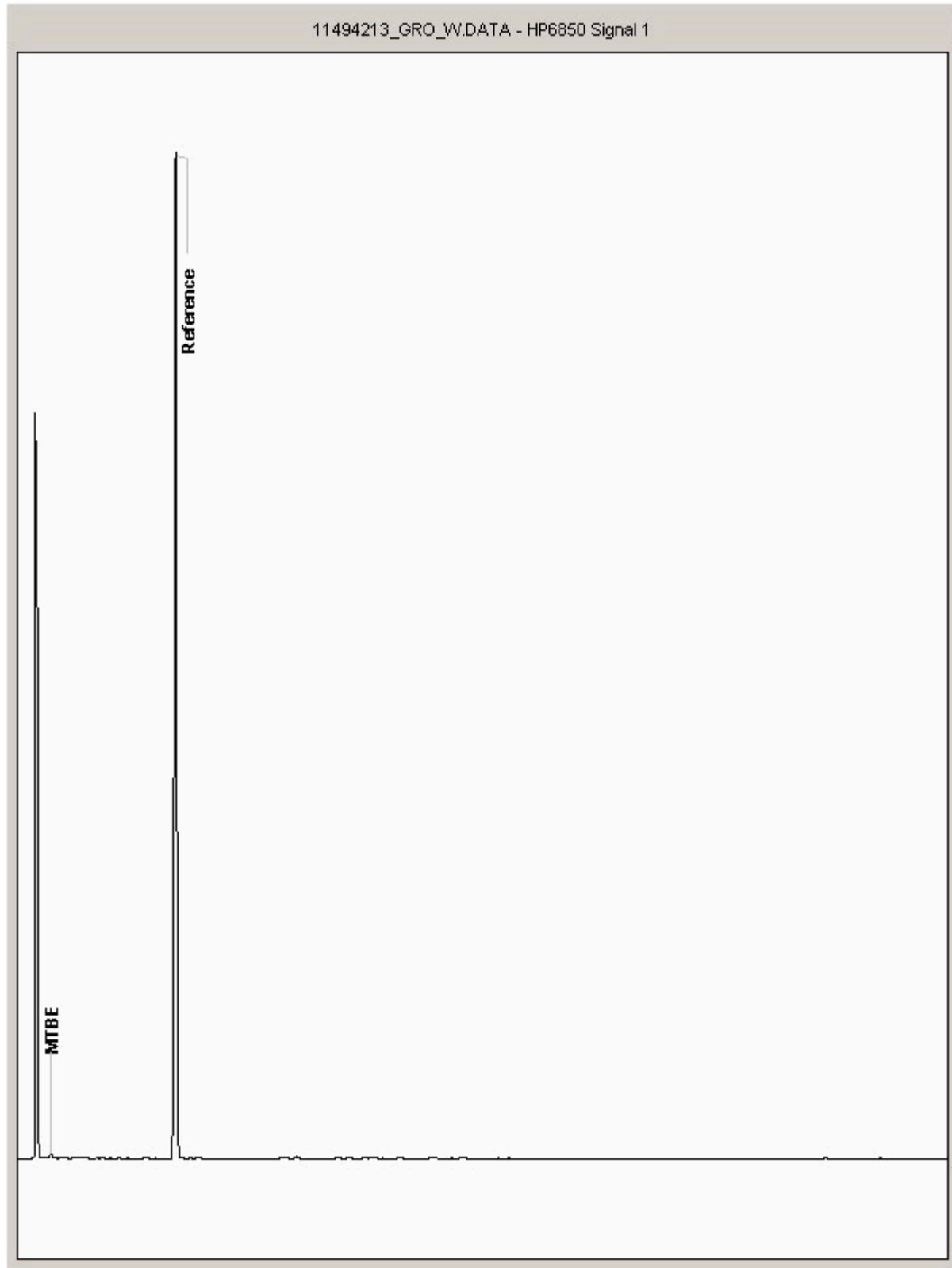
Order Number: 46370079
Report Number: 316276
Superseded Report: 316268

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 11494213
Sample ID : BH102A

Depth :





SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

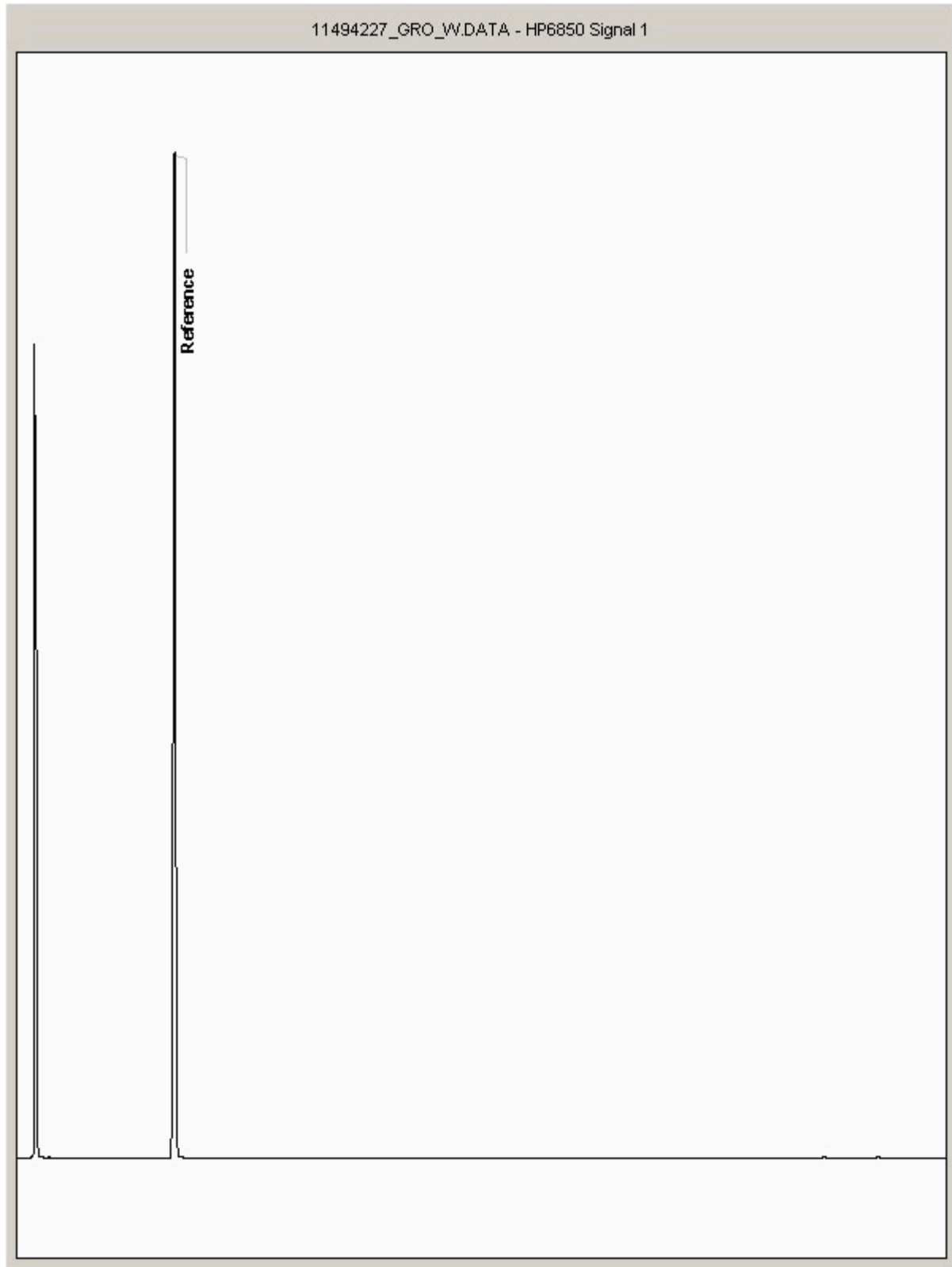
Order Number: 46370079
Report Number: 316276
Superseded Report: 316268

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 11494227
Sample ID : EQUIPMENT BLANK

Depth :





SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 46370079
Report Number: 316276
Superseded Report: 316268

Appendix

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA Leach tests, flash point, ammonium as NH₄ by the BRE method, VOC TICS, SVOC TICS, TOF-MS SCAN/SEARCH and TOF-MS TICS.

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

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for both soil jars, tubs and volatile jars. All waters and vials will be discarded 10 days after the analysis is completed (e-mailed). All material removed during an asbestos containing material screen and analysed for the presence of asbestos will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALcontrol Laboratories reserve the right to charge for samples received and stored but not analysed.

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

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

6. When requested, the individual sub sample scheduled will be screened in house for the presence of large asbestos containing material fragments/pieces. If no asbestos containing material is found this will be reported as 'no asbestos containing material detected'. If asbestos containing material is detected it will be removed and analysed by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If asbestos containing material is present no further analysis will be undertaken. At no point is the fibre content of the soil sample determined.

7. If no separate volatile sample is supplied by the client, the integrity of the data may be compromised if the laboratory is required to create a sub-sample from the bulk sample -similarly, if a headspace or sediment is present in the volatile sample. This will be flagged up as an invalid VOC on the test schedule or recorded on the log sheet.

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

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

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

11. A table containing the date of analysis for each parameter is not routinely included with the report, but is available upon request.

12. Results relate only to the items tested

13. **Surrogate recoveries** -Most of our organic methods include surrogates, the recovery of which is monitored and reported. For EPH, MO, PAH, GRO and VOCs on soils the result is not surrogate corrected, but a percentage recovery is quoted. Acceptable limits for most organic methods are 70 -130 %.

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

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

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 14).

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

18. Our MCERTS accreditation for PAHs by GCMS applies to all product types apart from Kerosene, where naphthalene only is not accredited.

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

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

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

22. For all leachate preparations (NRA, DIN, TCLP, BSEN 12457-1, 2, 3) volatile loss may occur, as we do not employ zero headspace extraction.

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

24. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C₄-C₁₀ range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

SOLID MATRICES EXTRACTION SUMMARY

ANALYSIS	D/C OR WET	EXTRACTION SOLVENT	EXTRACTION METHOD	ANALYSIS
SOLVENT EXTRACTABLE MATTER	D&C	DCM	SOX THERM	GRAVIMETRIC
CYCLOHEXANE EXT. MATTER	D&C	CYCLOHEXANE	SOX THERM	GRAVIMETRIC
THIN LAYER CHROMATOGRAPHY	D&C	DCM	SOX THERM	ATROSCAN
ELEMENTAL SULPHUR	D&C	DCM	SOX THERM	HPLC
PHENOL SUBSTITUENTS	WET	DCM	SOX THERM	GC-MS
HERBICIDES	D&C	HEXANE/ACETONE	SOX THERM	GC-MS
PESTICIDES	D&C	HEXANE/ACETONE	SOX THERM	GC-MS
EPH (DRO)	D&C	HEXANE/ACETONE	END OVEREND	GC-FD
EPH (MINO L)	D&C	HEXANE/ACETONE	END OVEREND	GC-FD
EPH (CLEANED UP)	D&C	HEXANE/ACETONE	END OVEREND	GC-FD
EPH CWG BY GC	D&C	HEXANE/ACETONE	END OVEREND	GC-FD
PCB TOT/PCB CON	D&C	HEXANE/ACETONE	END OVEREND	GC-MS
POLYAROMATIC HYDROCARBONS (MS)	WET	HEXANE/ACETONE	MICROWAVE TM218	GC-MS
C8-C40 (C6-C40) EZ FLASH	WET	HEXANE/ACETONE	SHAKER	GC-EZ
POLYAROMATIC HYDROCARBONS RAPID GC	WET	HEXANE/ACETONE	SHAKER	GC-EZ
SEM VOLATILE ORGANIC COMPOUNDS	WET	DCM/ACETONE	SONICATE	GC-MS

LIQUID MATRICES EXTRACTION SUMMARY

ANALYSIS	EXTRACTION SOLVENT	EXTRACTION METHOD	ANALYSIS
PAHMS	HEXANE	STIRRED EXTRACTION (STIR -BAR)	GCMS
EPH	HEXANE	STIRRED EXTRACTION (STIR -BAR)	GC FD
EPH CWG	HEXANE	STIRRED EXTRACTION (STIR -BAR)	GC FD
MINERAL OIL	HEXANE	STIRRED EXTRACTION (STIR -BAR)	GC FD
PCB CONGENERS	HEXANE	STIRRED EXTRACTION (STIR -BAR)	GCMS
PCB TOTAL	HEXANE	STIRRED EXTRACTION (STIR -BAR)	GCMS
SVOC	DCM	LIQUID/LIQUID SHAKE	GCMS
FREESULPHUR	DCM	SOLID PHASE EXTRACTION	HPLC
PESTOC/OPP	DCM	LIQUID/LIQUID SHAKE	GCMS
TRIAZINE HERBS	DCM	LIQUID/LIQUID SHAKE	GCMS
PHENOL SMS	DCM	SOLID PHASE EXTRACTION	GCMS
THH by INFRARED (R)	TCE	LIQUID/LIQUID SHAKE	HPLC
MINERAL OIL by R	TCE	LIQUID/LIQUID SHAKE	HPLC
GLYCOLS	NONE	DIRECT INJECTION	GCMS

Identification of Asbestos in Bulk Materials

The results for asbestos identification for soil samples are obtained from possible Asbestos Containing Material, removed during the 'Screening of soils for Asbestos Containing Materials', which have been examined to determine the presence of asbestos fibres using Alcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Visual Estimation Of Fibre Content

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

Further guidance on typical asbestos fibre content of manufactured products can be found in MDHS 100.

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

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



SDG: 150530-79
Job: H_URS_WIM-174
Client Reference: 46370079

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 46370079
Report Number: 316276
Superseded Report: 316268

Appendix General

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

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

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

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

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

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

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

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

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

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

11. Results relate only to the items tested.

12. LODs for wet tests reported on a dry weight basis are not corrected for moisture content.

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

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

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

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

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

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

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

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

21. For all leachate preparations (NRA, DIN, TCLP, BSEN 12457-1, 2, 3) volatile loss may occur, as we do not employ zero headspace extraction.

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

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

Sample Deviations

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

Asbestos

Identification of Asbestos in Bulk Materials & Soils

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

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

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

Visual Estimation Of Fibre Content

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

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

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



AECOM
St. George's House
2nd Floor
5 St. George's Road
Wimbledon
Greater London
SW19 4DR

Attention: Tim Rolfe

CERTIFICATE OF ANALYSIS

Date: 19 November 2015
Customer: H_URS_WIM
Sample Delivery Group (SDG): 151113-72
Your Reference:
Location: Shell Hitchin
Report No: 338729

We received 8 samples on Friday November 13, 2015 and 8 of these samples were scheduled for analysis which was completed on Thursday November 19, 2015. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

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

All chemical testing (unless subcontracted) is performed at ALcontrol Hawarden Laboratories.

Approved By:

Sonia McWhan

Operations Manager





SDG:	151113-72	Location:	Shell Hitchin	Order Number:	46370079
Job:	H_URS_WIM-174	Customer:	AECOM	Report Number:	338729
Client Reference:		Attention:	Tim Rolfe	Superseded Report:	

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
12433136	BH102			11/11/2015
12433134	BH103			11/11/2015
12433135	BH102A			11/11/2015
12433138	BH105A			11/11/2015
12433137	BH106A			11/11/2015
12433133	DUP			11/11/2015
12433140	EQB			11/11/2015
12433141	Trip Blank (BCBQ0253V)			11/11/2015

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



SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

Order Number: 46370079
Report Number: 338729
Superseded Report:

LIQUID Results Legend X Test N No Determination Possible	Lab Sample No(s)		Customer Sample Reference		AGS Reference		Depth (m)		Container	
	12433141		Trip Blank						Vial (ALE297)	
	12433140		ECB						Vial (ALE297)	
	12433133		DUP						HCl Filtered (ALE25) 1000ml glass bottle Vial (ALE297)	
	12433137		BH106A						HCl Filtered (ALE25) 1000ml glass bottle Vial (ALE297)	
Anions by Kone (w)	All	NDPs: 0 Tests: 7								
EPH CWG (Aliphatic) Aqueous GC (W)	All	NDPs: 0 Tests: 7								
EPH CWG (Aromatic) Aqueous GC (W)	All	NDPs: 0 Tests: 7								
Ferrous Iron	All	NDPs: 0 Tests: 7								
GRO by GC-FID (W)	All	NDPs: 0 Tests: 7								
Oxygenates (W)	All	NDPs: 0 Tests: 7								
PAH Spec MS - Aqueous (W)	All	NDPs: 0 Tests: 7								
VOC MS (W)	All	NDPs: 0 Tests: 8								

CERTIFICATE OF ANALYSIS

SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

Order Number: 46370079
Report Number: 338729
Superseded Report:

[illegible]

Order Number: 46370079
Report Number: 338729
Superseded Report:

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Order Number: 46370079
Report Number: 338729
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Order Number: 46370079
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Report Number: 338729
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Order Number: 46370079
Report Number: 338729
Superseded Report:

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SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

Order Number: 46370079
Report Number: 338729
Superseded Report:

VOC MS (W)

[illegible]



SDG:	151113-72	Location:	Shell Hitchin	Order Number:	46370079
Job:	H_URS_WIM-174	Customer:	AECOM	Report Number:	338729
Client Reference:		Attention:	Tim Rolfe	Superseded Report:	

Table of Results - Appendix

Method No	Reference	Description	Wet/Dry Sample ¹	Surrogate Corrected
TM061	Method for the Determination of EPH,Massachusetts Dept.of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)		
TM125	DIN 38405 D17	Determination of Ferrous Iron		
TM174	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	Determination of Speciated Extractable Petroleum Hydrocarbons in Waters by GC-FID		
TM178	Modified: US EPA Method 8100	Determination of Polynuclear Aromatic Hydrocarbons (PAH) by GC-MS in Waters		
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers		
TM208	Modified: US EPA Method 8260b & 624	Determination of Volatile Organic Compounds by Headspace / GC-MS in Waters		
TM245	By GC-FID	Determination of GRO by Headspace in waters		
TM289		Determination of Oxygenates in Waters by Headspace/GC-MS		

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



CERTIFICATE OF ANALYSIS

Validated

SDG:	151113-72	Location:	Shell Hitchin	Order Number:	46370079
Job:	H_URS_WIM-174	Customer:	AECOM	Report Number:	338729
Client Reference:		Attention:	Tim Rolfe	Superseded Report:	

Test Completion Dates

Lab Sample No(s)	12433136	12433134	12433135	12433138	12433137	12433133	12433140	12433141
Customer Sample Ref.	BH102	BH103	BH102A	BH105A	BH106A	DUP	EQB	Trip Blank (BCB Q0253V)
AGS Ref.								
Depth								
Type	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID

Anions by Kone (w)	17-Nov-2015	17-Nov-2015	17-Nov-2015	17-Nov-2015	17-Nov-2015	17-Nov-2015	17-Nov-2015	
EPH CWG (Aliphatic) Aqueous GC (W)	18-Nov-2015	18-Nov-2015	18-Nov-2015	18-Nov-2015	18-Nov-2015	18-Nov-2015	18-Nov-2015	
EPH CWG (Aromatic) Aqueous GC (W)	18-Nov-2015	18-Nov-2015	18-Nov-2015	18-Nov-2015	18-Nov-2015	18-Nov-2015	18-Nov-2015	
Ferrous Iron	18-Nov-2015	18-Nov-2015	18-Nov-2015	18-Nov-2015	18-Nov-2015	18-Nov-2015	18-Nov-2015	
GRO by GC-FID (W)	17-Nov-2015	19-Nov-2015	17-Nov-2015	17-Nov-2015	17-Nov-2015	19-Nov-2015	17-Nov-2015	
Nitrite by Kone (w)	17-Nov-2015	17-Nov-2015	17-Nov-2015	17-Nov-2015	17-Nov-2015	17-Nov-2015	17-Nov-2015	
Oxygenates (W)	17-Nov-2015	17-Nov-2015	17-Nov-2015	17-Nov-2015	17-Nov-2015	17-Nov-2015	17-Nov-2015	
PAH Spec MS - Aqueous (W)	19-Nov-2015	18-Nov-2015	18-Nov-2015	18-Nov-2015	18-Nov-2015	19-Nov-2015	18-Nov-2015	
TPH CWG (W)	18-Nov-2015	19-Nov-2015	18-Nov-2015	18-Nov-2015	18-Nov-2015	19-Nov-2015	18-Nov-2015	
VOC MS (W)	17-Nov-2015	16-Nov-2015	16-Nov-2015	16-Nov-2015	16-Nov-2015	17-Nov-2015	16-Nov-2015	16-Nov-2015



SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

Order Number: 46370079
Report Number: 338729
Superseded Report:

ASSOCIATED AQC DATA

Anions by Kone (w)

Component	Method Code	QC 1255
Chloride	TM184	106.0 85.00 : 115.00
Phosphate (Ortho as PO4)	TM184	96.40 : 108.40
Sulphate (soluble)	TM184	103.2 85.00 : 115.00
TON as NO3	TM184	104.5 85.00 : 115.00

EPH CWG (Aliphatic) Aqueous GC (W)

Component	Method Code	QC 1283
Total Aliphatics >C12-C35	TM174	90.42 66.67 : 110.42

EPH CWG (Aromatic) Aqueous GC (W)

Component	Method Code	QC 1284
Total Aromatics >EC12-EC35	TM174	97.33 63.00 : 121.00

Ferrous Iron

Component	Method Code	QC 1290	QC 1215	QC 1226
Ferrous Iron	TM125	99.33 94.00 : 102.00	97.67 94.00 : 102.00	101.0 94.00 : 102.00

GRO by GC-FID (W)

Component	Method Code	QC 1240	QC 1201
Benzene by GC	TM245	95.0 76.72 : 118.62	96.0 76.72 : 118.62
Ethylbenzene by GC	TM245	92.5 74.74 : 116.76	98.5 74.74 : 116.76
m & p Xylene by GC	TM245	91.75 73.06 : 114.58	98.5 73.06 : 114.58
MTBE GC-FID	TM245	97.0 80.00 : 121.03	98.0 80.00 : 121.03
o Xylene by GC	TM245	93.0 70.00 : 130.00	99.5 70.00 : 130.00
QC	TM245	86.92 70.00 : 130.00	100.53 70.00 : 130.00



SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

Order Number: 46370079
Report Number: 338729
Superseded Report:

GRO by GC-FID (W)

		QC 1240	QC 1201
Toluene by GC	TM245	94.0 79.35 : 119.27	97.0 79.35 : 119.27

Oxygenates (W)

Component	Method Code	QC 1227
Benzene	TM289	118.0 87.69 : 119.72
Diisopropyl ether	TM289	99.0 86.70 : 122.79
Ethanol	TM289	94.8 74.12 : 156.61
Ethylbenzene	TM289	107.0 84.52 : 113.38
o-Xylene	TM289	104.5 84.40 : 112.41
p/m-Xylene	TM289	108.0 83.20 : 115.01
tert Butanol	TM289	95.1 70.51 : 143.48
tert-amyl methyl ether	TM289	100.5 78.92 : 124.29
tert-butyl ethyl ether	TM289	98.5 78.17 : 124.34
tert-butyl methyl ether	TM289	101.0 87.75 : 127.35
Toluene	TM289	109.0 79.08 : 122.51

PAH Spec MS - Aqueous (W)

Component	Method Code	QC 1225
Acenaphthene by GCMS	TM178	98.5 91.90 : 109.30
Acenaphthylene by GCMS	TM178	97.0 87.74 : 109.69
Anthracene by GCMS	TM178	95.5 89.70 : 111.80
Benz(a)anthracene by GCMS	TM178	100.0 88.64 : 112.43
Benzo(a)pyrene by GCMS	TM178	109.5 85.00 : 130.00
Benzo(b)fluoranthene by GCMS	TM178	120.0 85.50 : 130.50
Benzo(ghi)perylene by GCMS	TM178	94.5 81.04 : 111.10
Benzo(k)fluoranthene by GCMS	TM178	112.5 87.50 : 132.50
Chrysene by GCMS	TM178	100.0 89.75 : 115.25
Dibenzo(ah)anthracene by GCMS	TM178	91.0 77.91 : 107.68
Fluoranthene by GCMS	TM178	100.5 86.85 : 115.35



SDG:	151113-72	Location:	Shell Hitchin	Order Number:	46370079
Job:	H_URS_WIM-174	Customer:	AECOM	Report Number:	338729
Client Reference:		Attention:	Tim Rolfe	Superseded Report:	

PAH Spec MS - Aqueous (W)

		QC 1225
Fluorene by GCMS	TM178	99.0 92.39 : 113.85
Indeno(123cd)pyrene by GCMS	TM178	106.5 84.94 : 119.98
Naphthalene by GCMS	TM178	100.0 88.20 : 115.80
Phenanthrene by GCMS	TM178	99.5 88.40 : 114.20
Pyrene by GCMS	TM178	97.0 87.50 : 116.00

VOC MS (W)

Component	Method Code	QC 1203	QC 1262	QC 1201
1,1,1,2-Tetrachloroethane	TM208	91.0 79.47 : 113.27	94.5 77.50 : 122.50	94.0 84.25 : 114.84
1,1,1-Trichloroethane	TM208	93.5 83.02 : 113.68	97.0 77.50 : 122.50	91.0 84.67 : 111.97
1,1-Dichloroethane	TM208	95.5 77.85 : 123.56	107.0 77.50 : 122.50	97.5 80.19 : 121.45
1,2-Dichloroethane	TM208	100.0 76.84 : 121.25	101.0 77.50 : 122.50	97.0 77.68 : 127.05
2-Chlorotoluene	TM208	90.0 82.27 : 113.28	93.5 77.50 : 122.50	101.0 85.81 : 116.77
4-Chlorotoluene	TM208	91.0 82.43 : 113.78	94.5 77.50 : 122.50	100.0 83.92 : 115.84
Benzene	TM208	94.0 85.85 : 118.22	103.0 77.50 : 122.50	96.0 82.30 : 120.49
Bromomethane	TM208	96.0 78.68 : 126.84	94.0 75.87 : 132.10	92.0 76.16 : 123.35
Carbontetrachloride	TM208	93.0 82.06 : 117.49	95.5 77.50 : 122.50	90.0 83.96 : 117.98
Chlorobenzene	TM208	90.5 77.50 : 122.50	96.0 77.50 : 122.50	97.5 85.75 : 114.88
Chloroform	TM208	97.5 77.50 : 122.50	98.0 77.50 : 122.50	98.0 84.84 : 119.97
Chloromethane	TM208	96.0 64.99 : 145.80	131.5 77.12 : 138.43	128.0 75.44 : 153.92
Cis-1,2-Dichloroethene	TM208	97.5 87.80 : 126.43	108.0 77.50 : 122.50	108.5 81.65 : 120.44
Dichloromethane	TM208	97.0 80.45 : 125.21	105.5 77.50 : 122.50	106.0 79.31 : 122.56
Ethylbenzene	TM208	87.5 79.93 : 107.44	95.5 78.88 : 104.73	92.0 80.74 : 110.74
Hexachlorobutadiene	TM208	100.5 77.87 : 124.14	88.5 72.12 : 118.38	94.5 66.89 : 118.01
o-Xylene	TM208	90.0 82.09 : 109.87	97.0 78.97 : 105.98	95.0 85.43 : 113.21
p/m-Xylene	TM208	89.0 79.94 : 107.81	95.0 74.83 : 118.29	93.5 80.94 : 113.51
Tert-butyl methyl ether	TM208	111.0 76.57 : 125.98	120.5 70.43 : 124.31	111.0 59.77 : 129.51
Tetrachloroethene	TM208	91.0 80.21 : 115.87	94.5 80.60 : 110.75	92.0 83.21 : 115.40



CERTIFICATE OF ANALYSIS

Validated

SDG:	151113-72	Location:	Shell Hitchin	Order Number:	46370079
Job:	H_URS_WIM-174	Customer:	AECOM	Report Number:	338729
Client Reference:		Attention:	Tim Rolfe	Superseded Report:	

VOC MS (W)

		QC 1203	QC 1262	QC 1201
Toluene	TM208	90.5 85.71 : 113.18	96.0 80.95 : 110.35	94.5 86.02 : 114.04
Trichloroethene	TM208	91.0 83.36 : 113.06	94.5 77.32 : 109.93	91.0 83.50 : 113.50
Vinyl Chloride	TM208	92.5 67.57 : 130.24	102.5 64.36 : 126.94	89.5 63.71 : 124.88

The above information details the reference name of the analytical quality control sample (AQC) that has been run with the samples contained in this report for the different methods of analysis .

The figure detailed is the percentage recovery result for the AQC .

The subscript numbers below are the percentage recovery lower control limit (LCL) and the upper control limit (UCL). The percentage recovery result for the AQC should be between these limits to be statistically in control .



SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

Order Number: 46370079
Report Number: 338729
Superseded Report:

Chromatogram

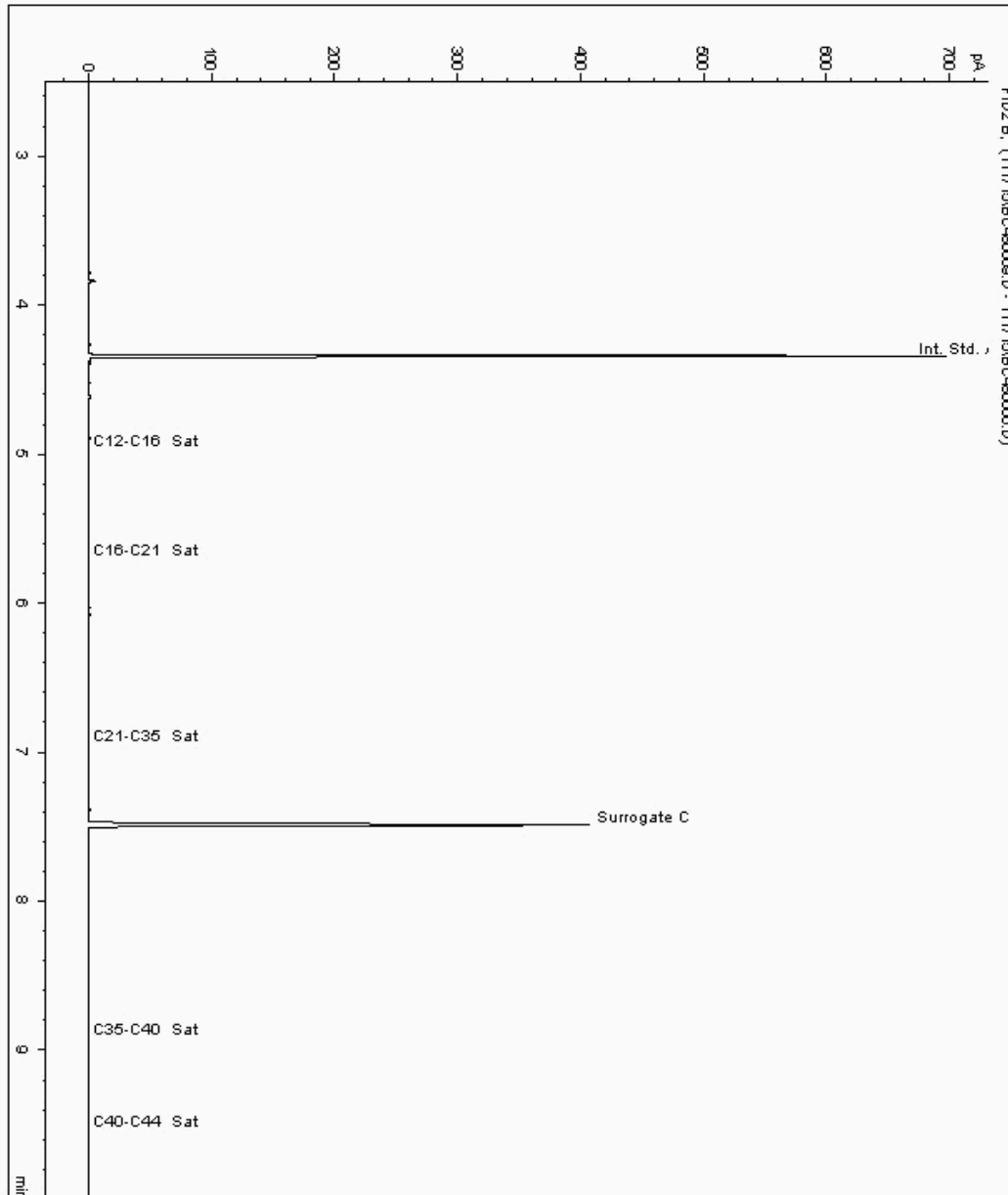
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 12445918
Sample ID : BH103

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 11767855-
Date Acquired : 17/11/2015 18:02:17 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

Order Number: 46370079
Report Number: 338729
Superseded Report:

Chromatogram

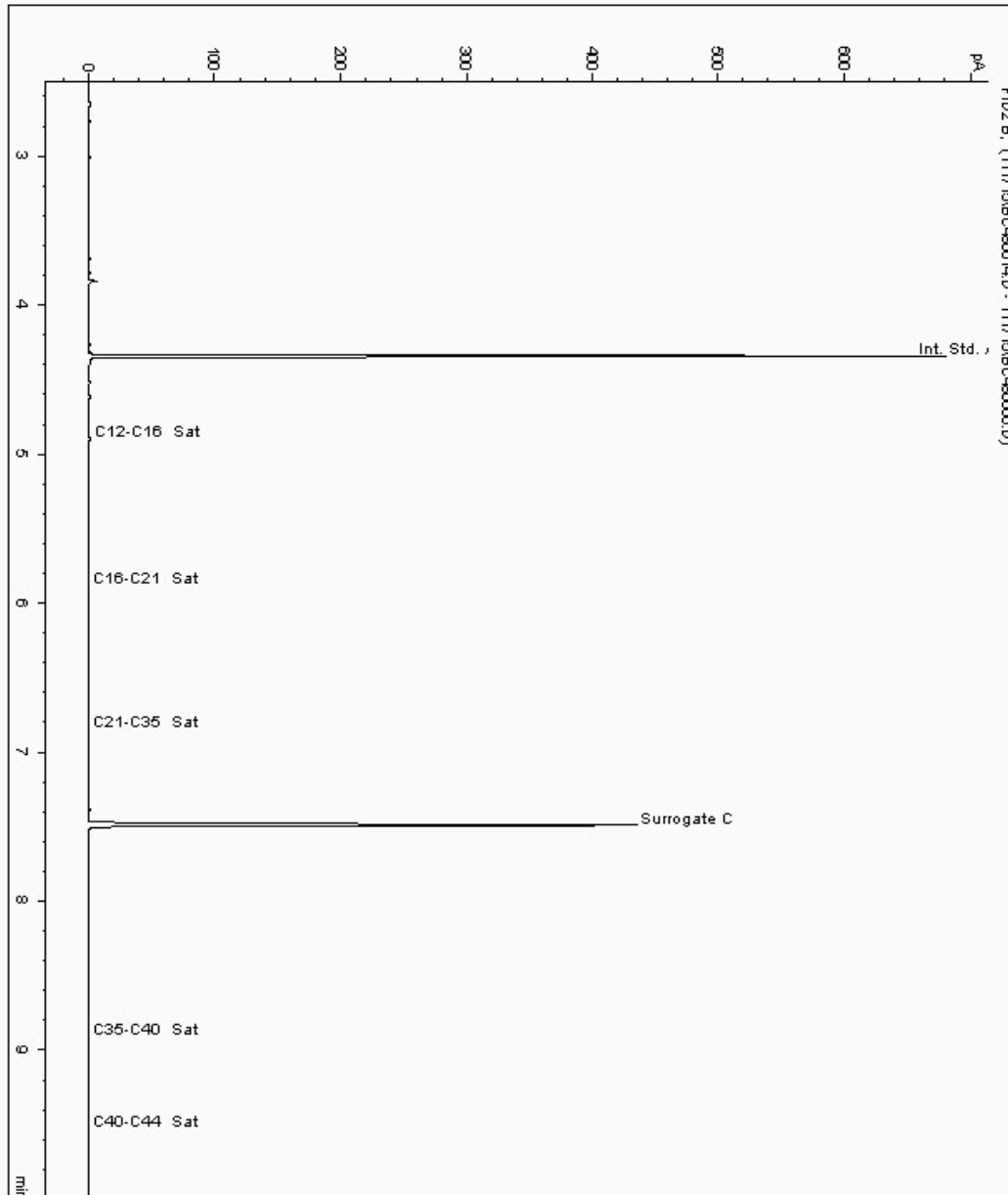
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 12445932
Sample ID : DUP

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 11767842-
Date Acquired : 17/11/2015 19:36:05 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

Order Number: 46370079
Report Number: 338729
Superseded Report:

Chromatogram

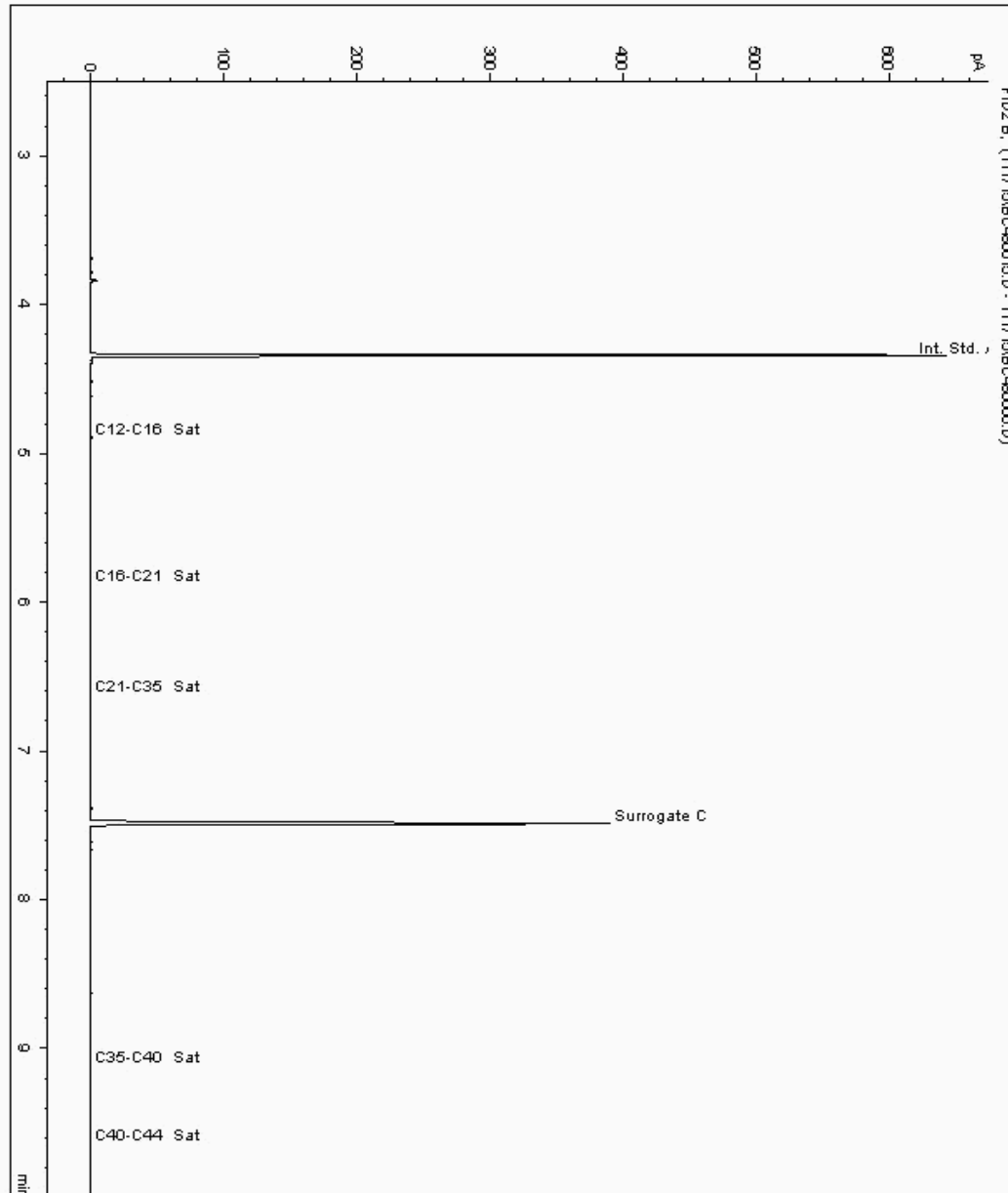
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 12445948
Sample ID : BH102A

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 11767865-
Date Acquired : 17/11/2015 19:54:58 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

Order Number: 46370079
Report Number: 338729
Superseded Report:

Chromatogram

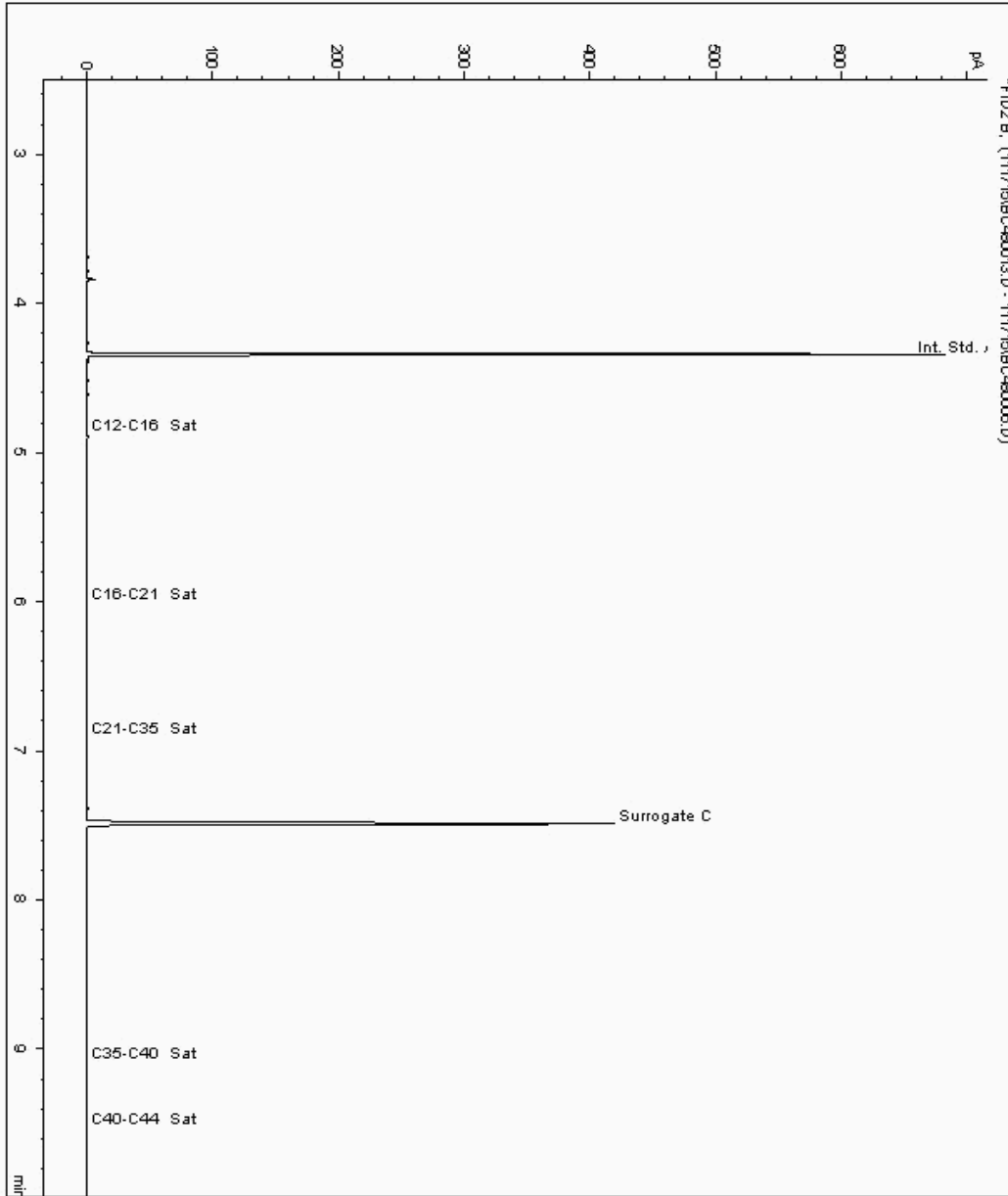
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 12445966
Sample ID : BH102

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 11767875-
Date Acquired : 17/11/2015 19:17:13 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

Order Number: 46370079
Report Number: 338729
Superseded Report:

Chromatogram

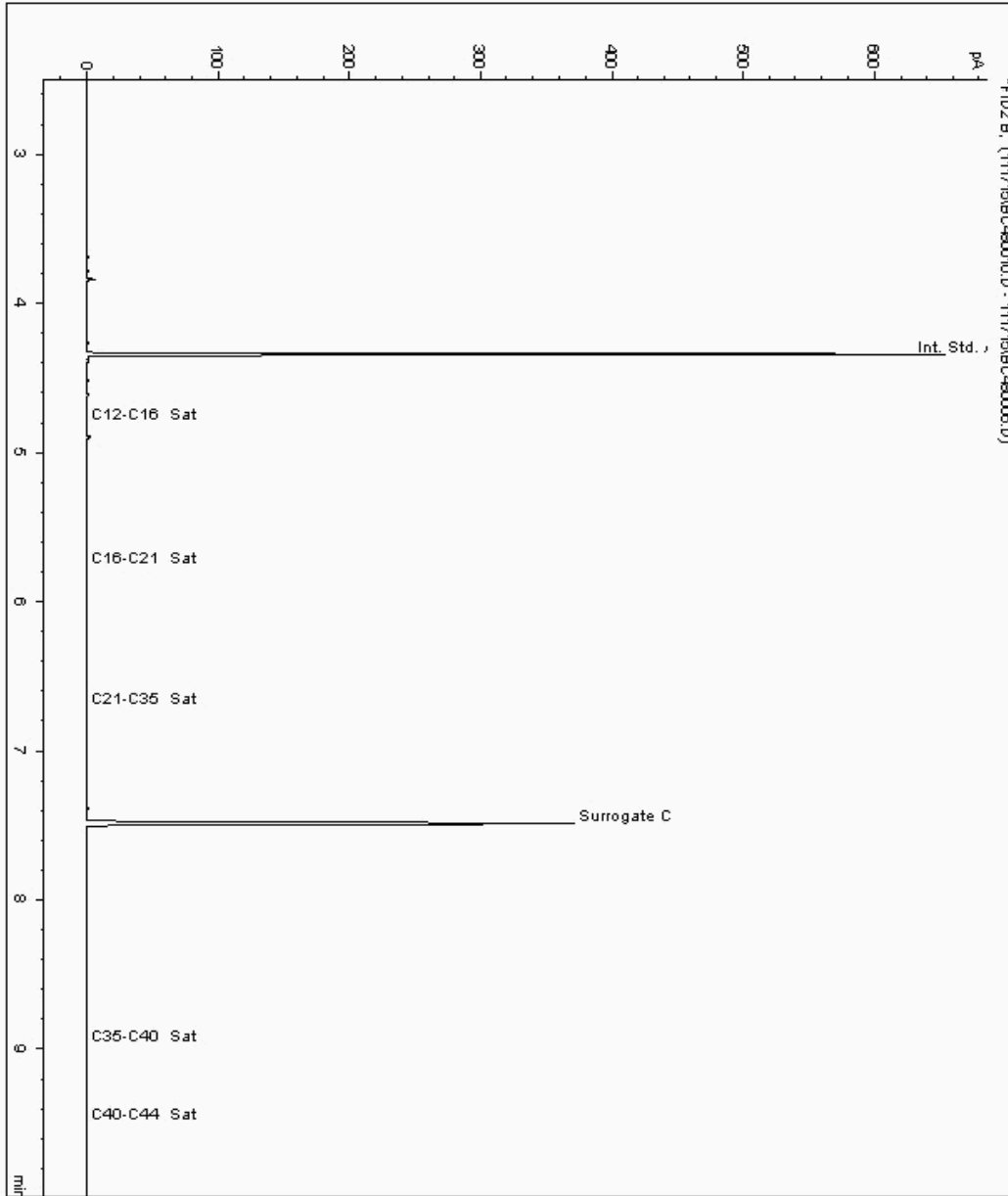
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 12446001
Sample ID : BH105A

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 11767895-
Date Acquired : 17/11/2015 18:20:59 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

Order Number: 46370079
Report Number: 338729
Superseded Report:

Chromatogram

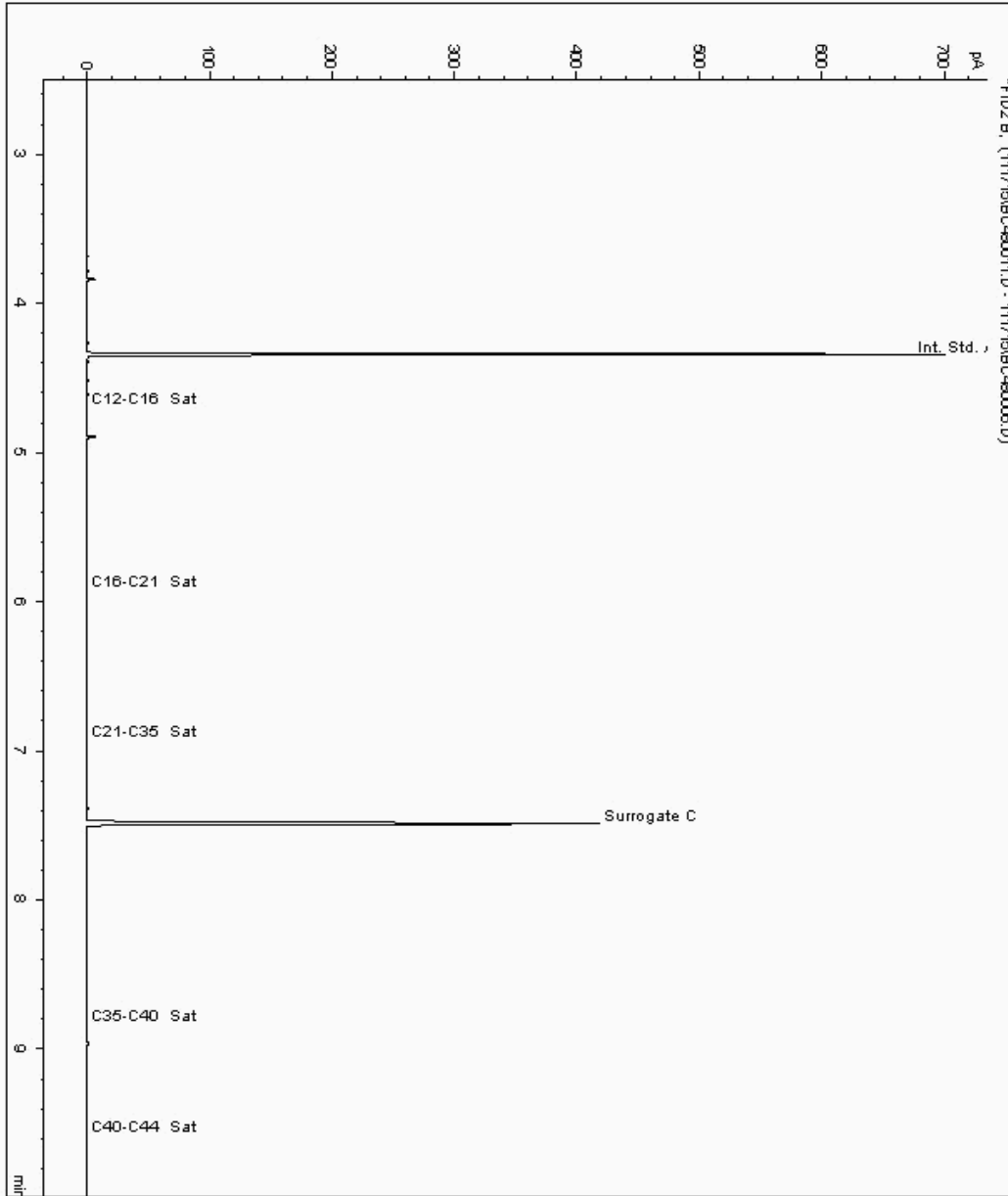
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 12446012
Sample ID : BH106A

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 11767885-
Date Acquired : 17/11/2015 18:39:39 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

Order Number: 46370079
Report Number: 338729
Superseded Report:

Chromatogram

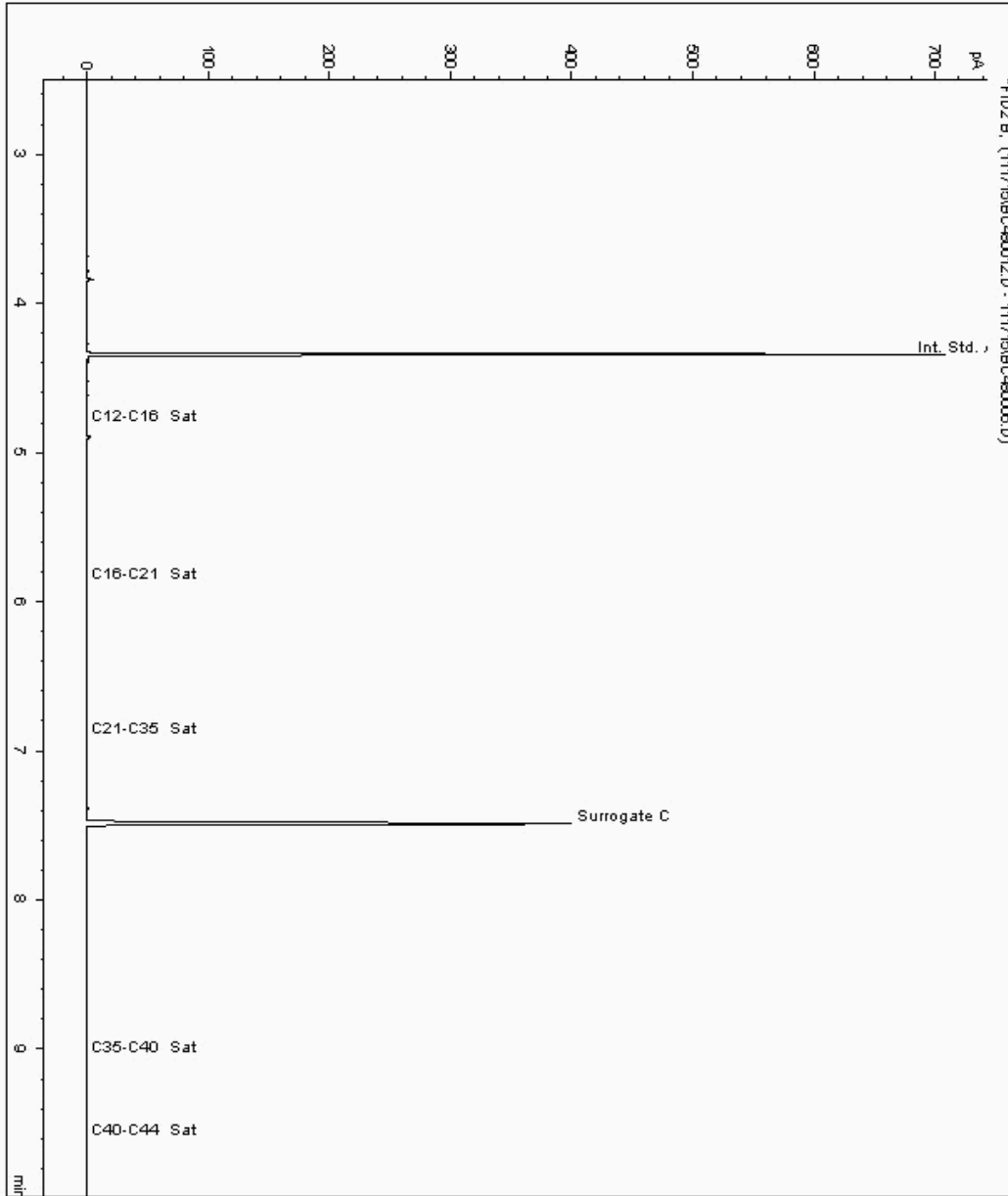
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 12446022
Sample ID : EQB

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 11767905-
Date Acquired : 17/11/2015 18:58:17 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

Order Number: 46370079
Report Number: 338729
Superseded Report:

Chromatogram

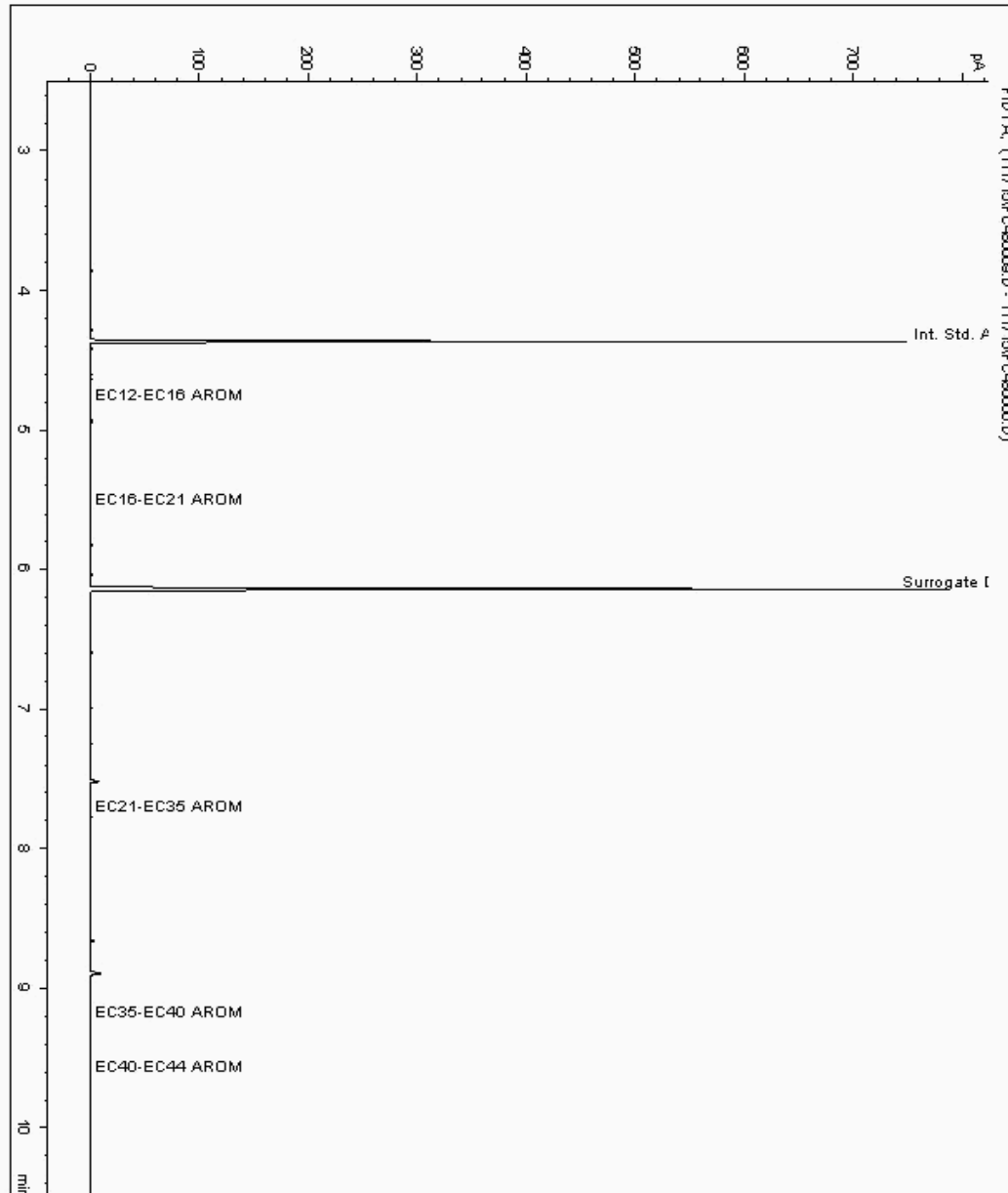
Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 12445918
Sample ID : BH103

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 11767856-
Date Acquired : 17/11/2015 18:02:17 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

Order Number: 46370079
Report Number: 338729
Superseded Report:

Chromatogram

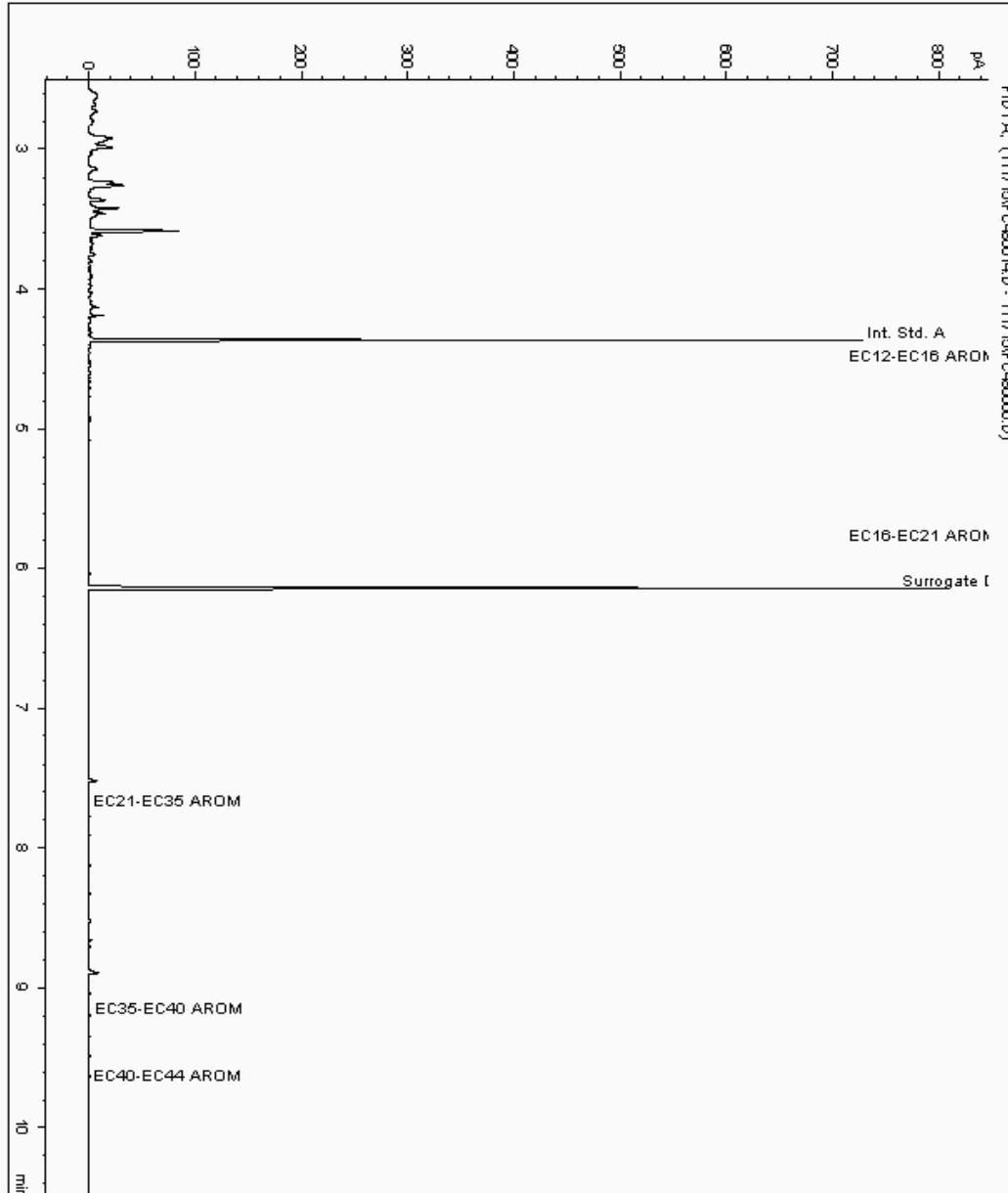
Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 12445932
Sample ID : DUP

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 11767843-
Date Acquired : 17/11/2015 19:36:05 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008

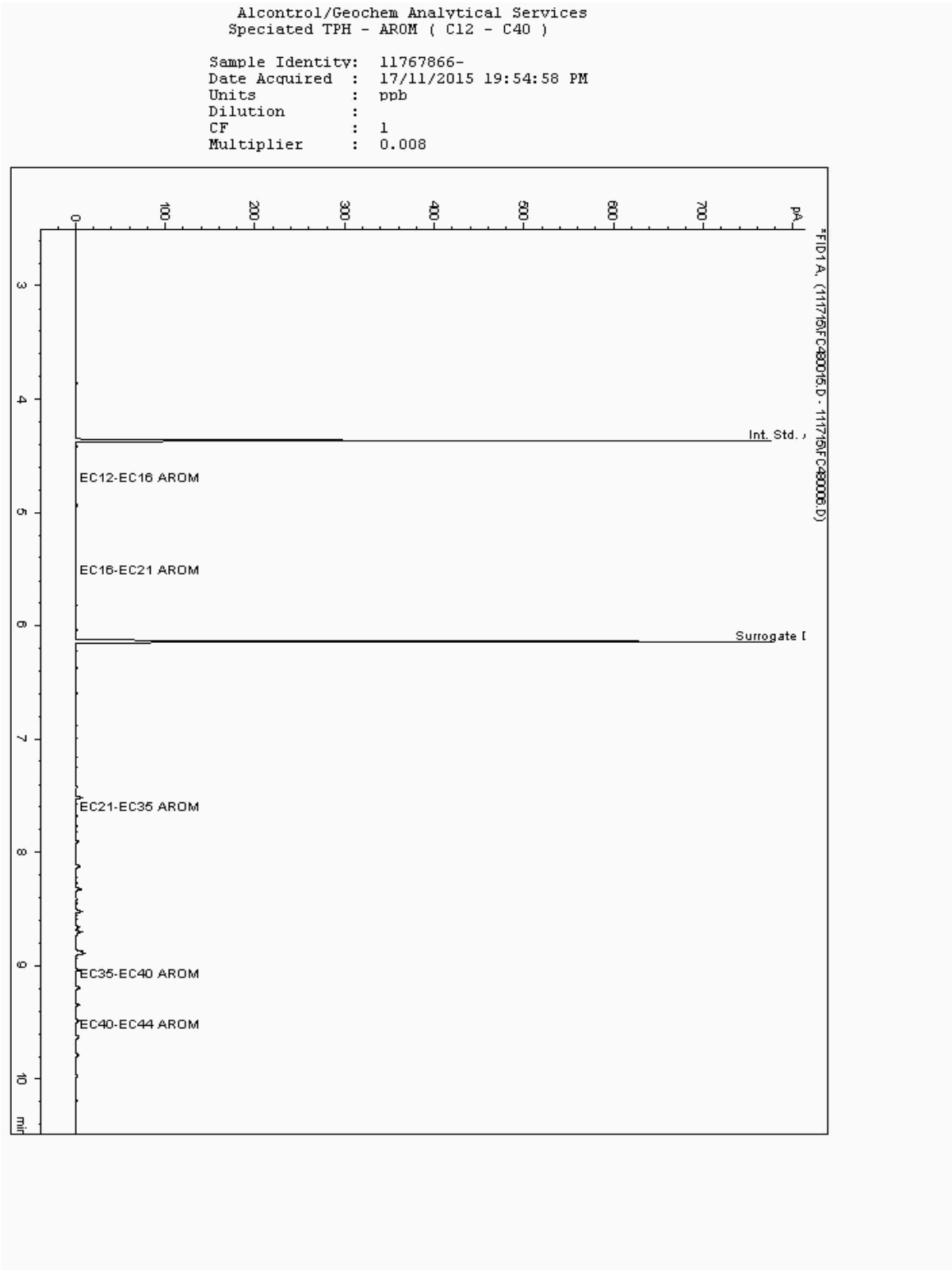




SDG:	151113-72	Location:	Shell Hitchin	Order Number:	46370079
Job:	H_URS_WIM-174	Customer:	AECOM	Report Number:	338729
Client Reference:		Attention:	Tim Rolfe	Superseded Report:	

Chromatogram

Analysis:	EPH CWG (Aromatic) Aqueous GC (W)	Sample No :	12445948	Depth :	
		Sample ID :	BH102A		





SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

Order Number: 46370079
Report Number: 338729
Superseded Report:

Chromatogram

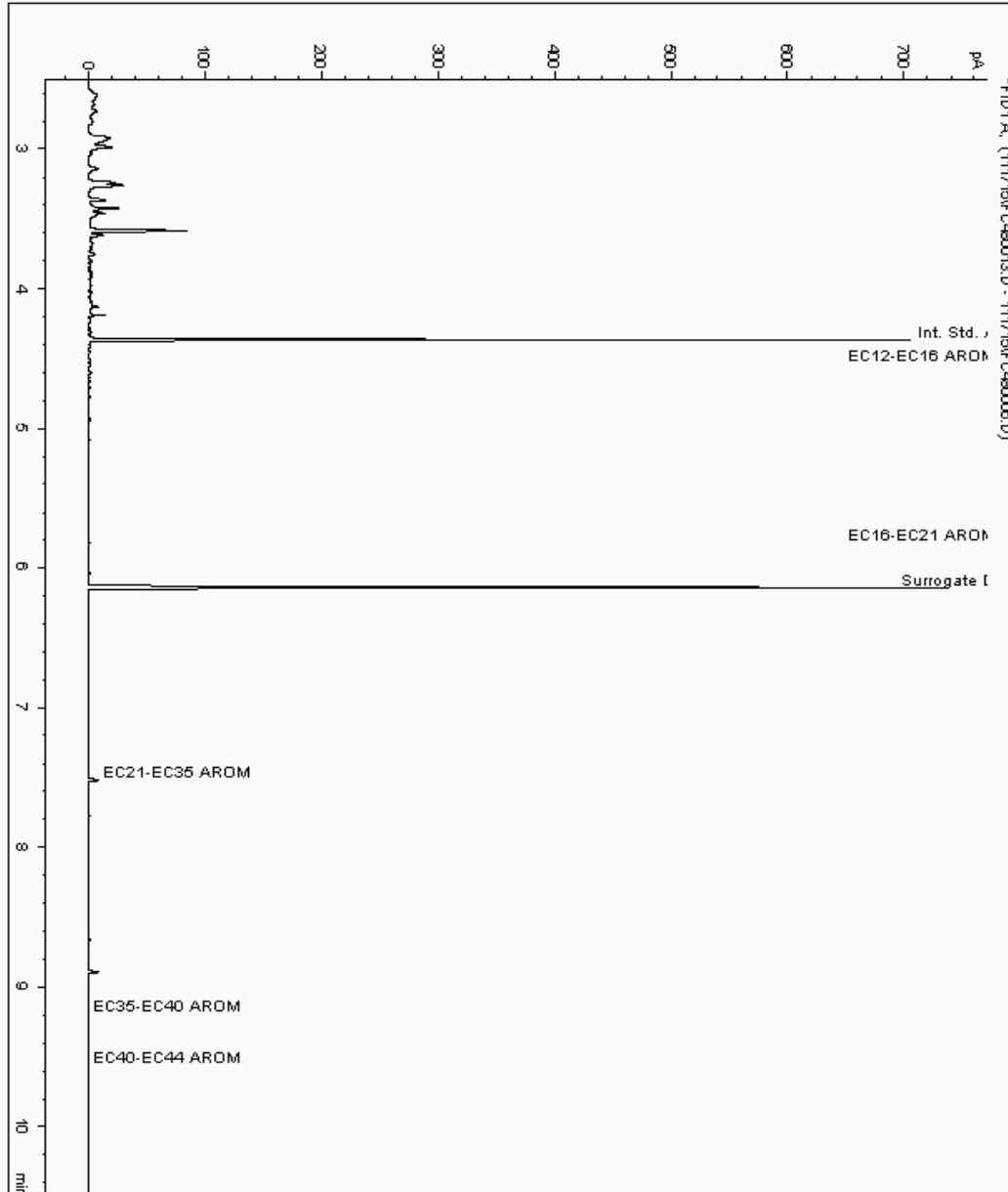
Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 12445966
Sample ID : BH102

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 11767876-
Date Acquired : 17/11/2015 19:17:13 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

Order Number: 46370079
Report Number: 338729
Superseded Report:

Chromatogram

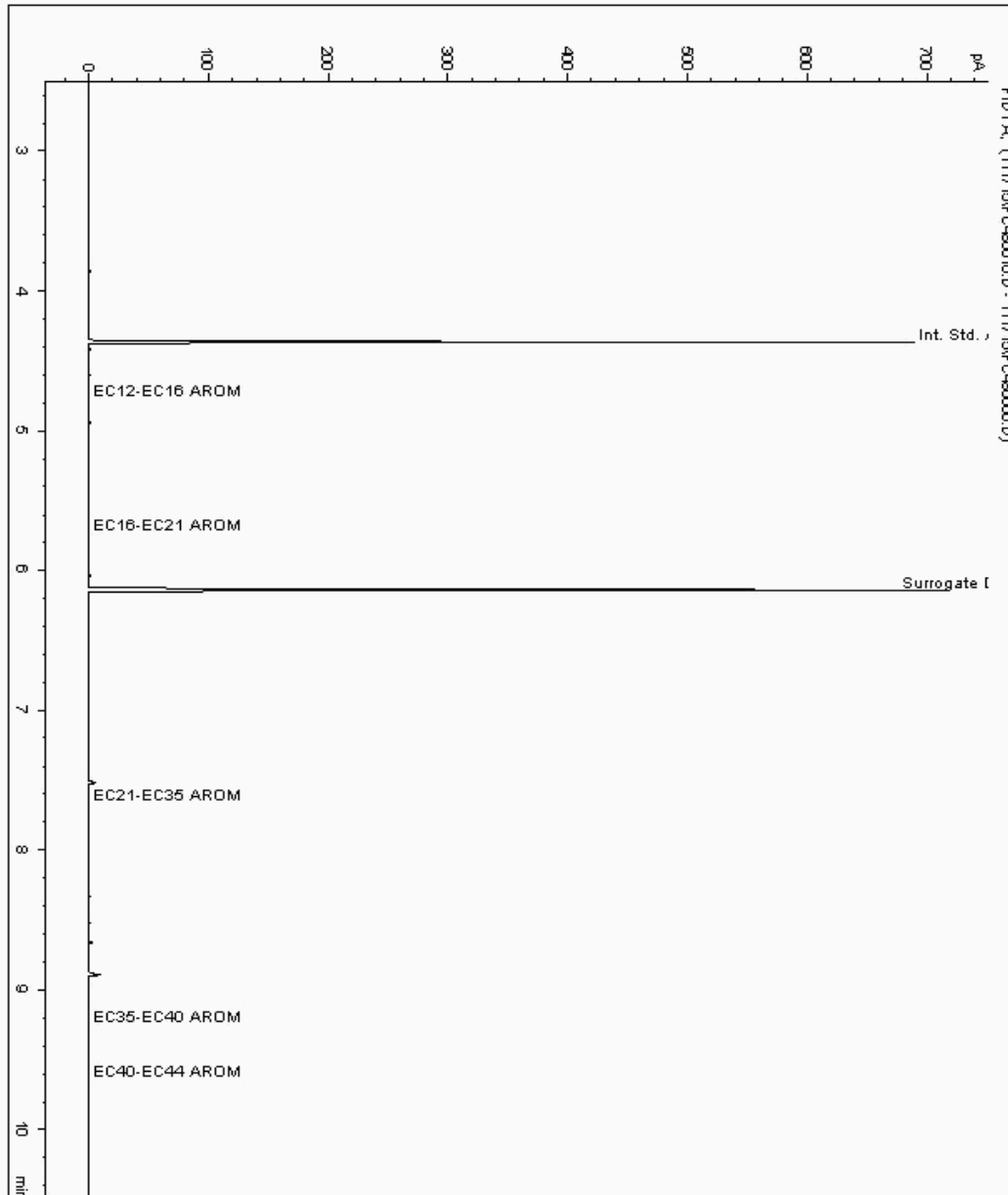
Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 12446001
Sample ID : BH105A

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 11767896-
Date Acquired : 17/11/2015 18:20:59 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

Order Number: 46370079
Report Number: 338729
Superseded Report:

Chromatogram

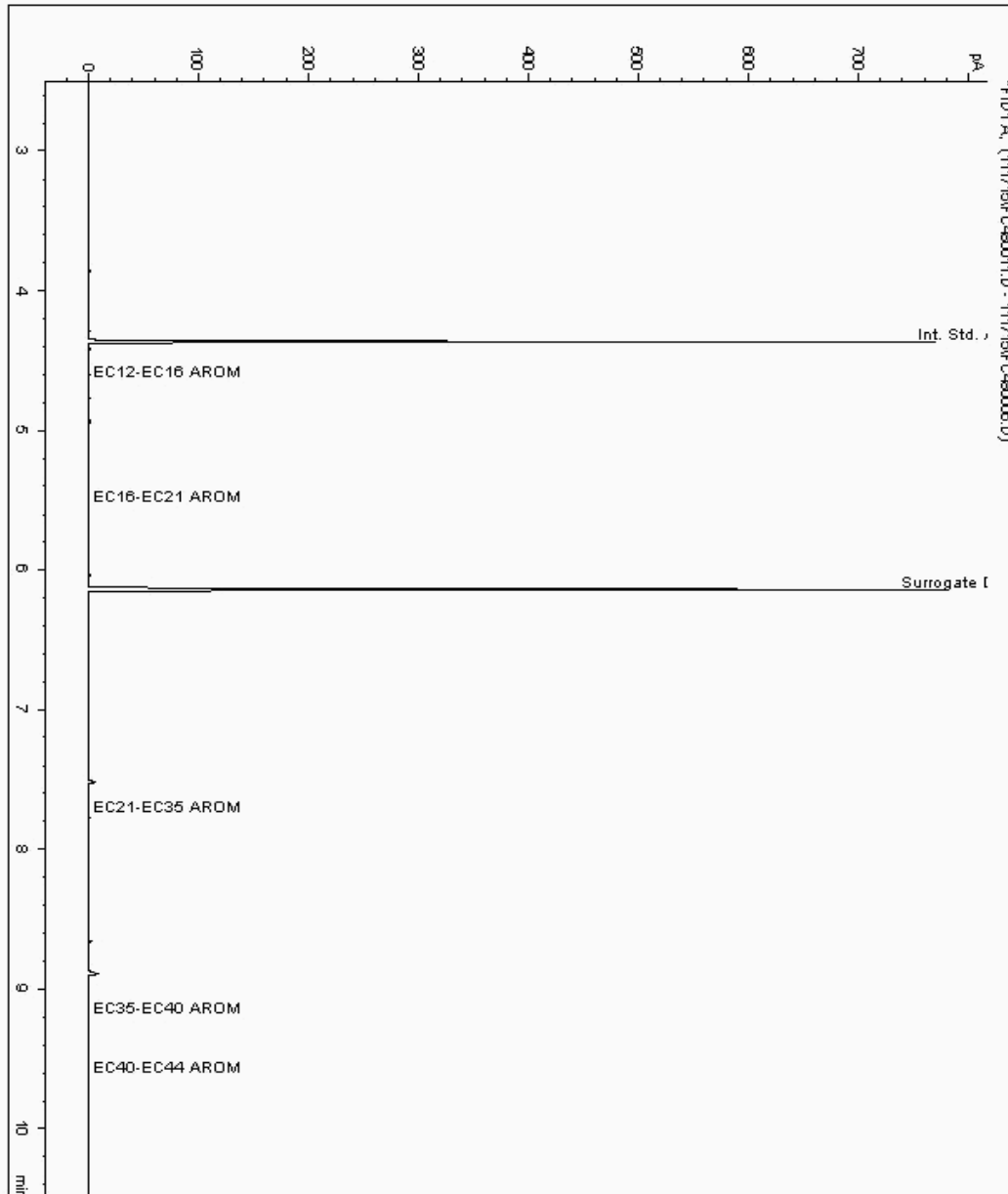
Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 12446012
Sample ID : BH106A

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 11767886-
Date Acquired : 17/11/2015 18:39:39 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

Order Number: 46370079
Report Number: 338729
Superseded Report:

Chromatogram

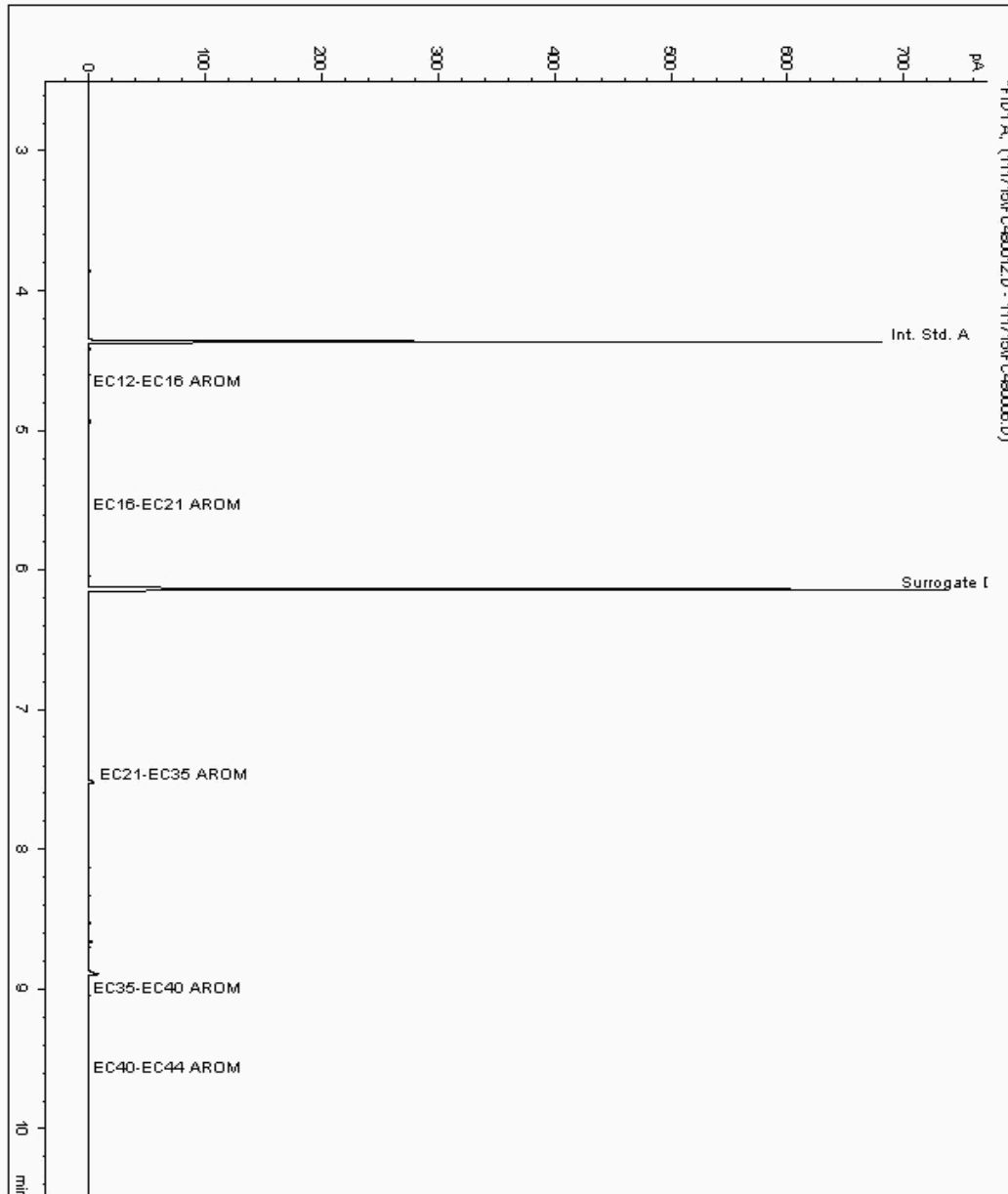
Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 12446022
Sample ID : EQB

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 11767906-
Date Acquired : 17/11/2015 18:58:17 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

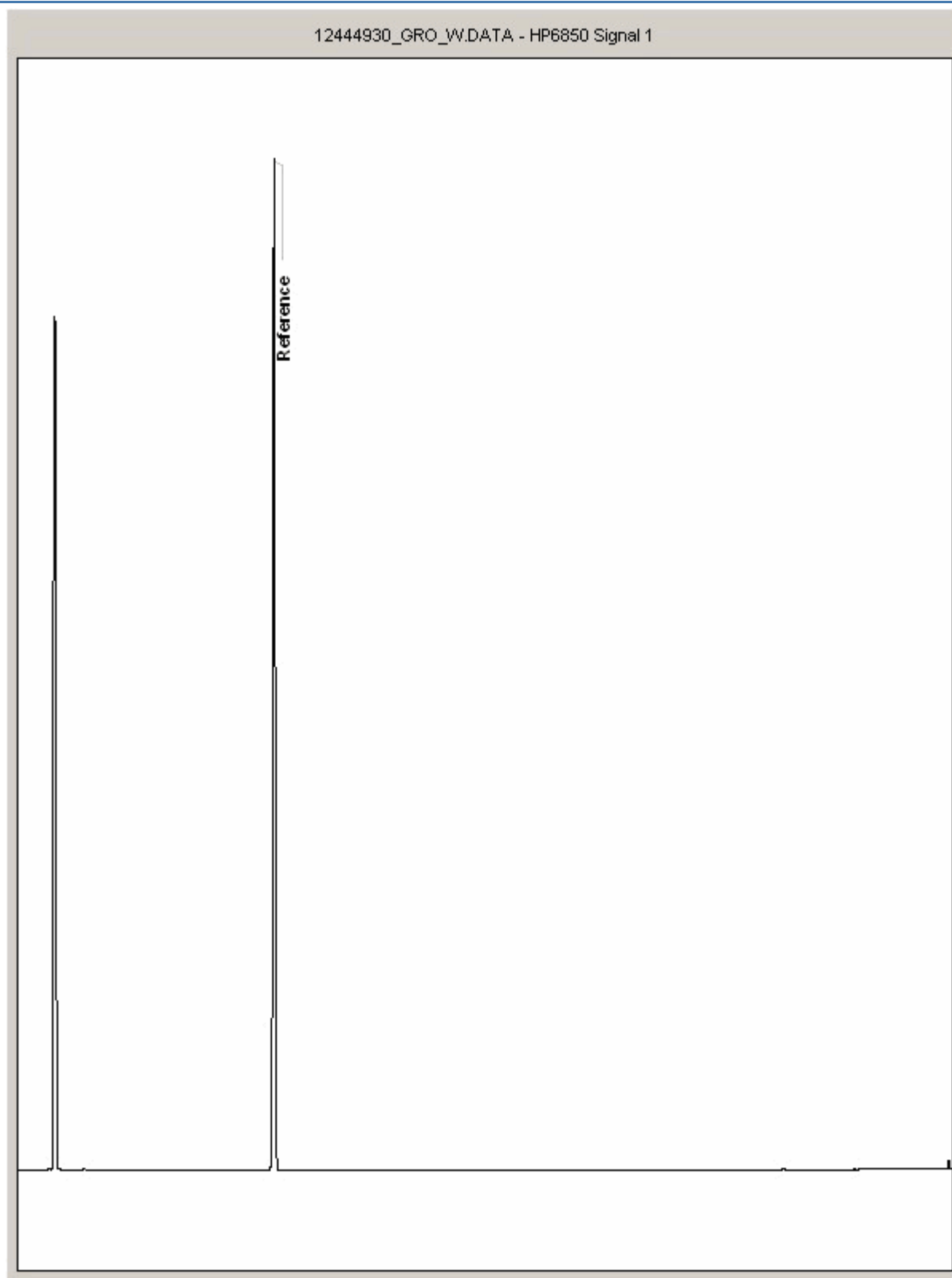
Order Number: 46370079
Report Number: 338729
Superseded Report:

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 12444930
Sample ID : EQB

Depth :





SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

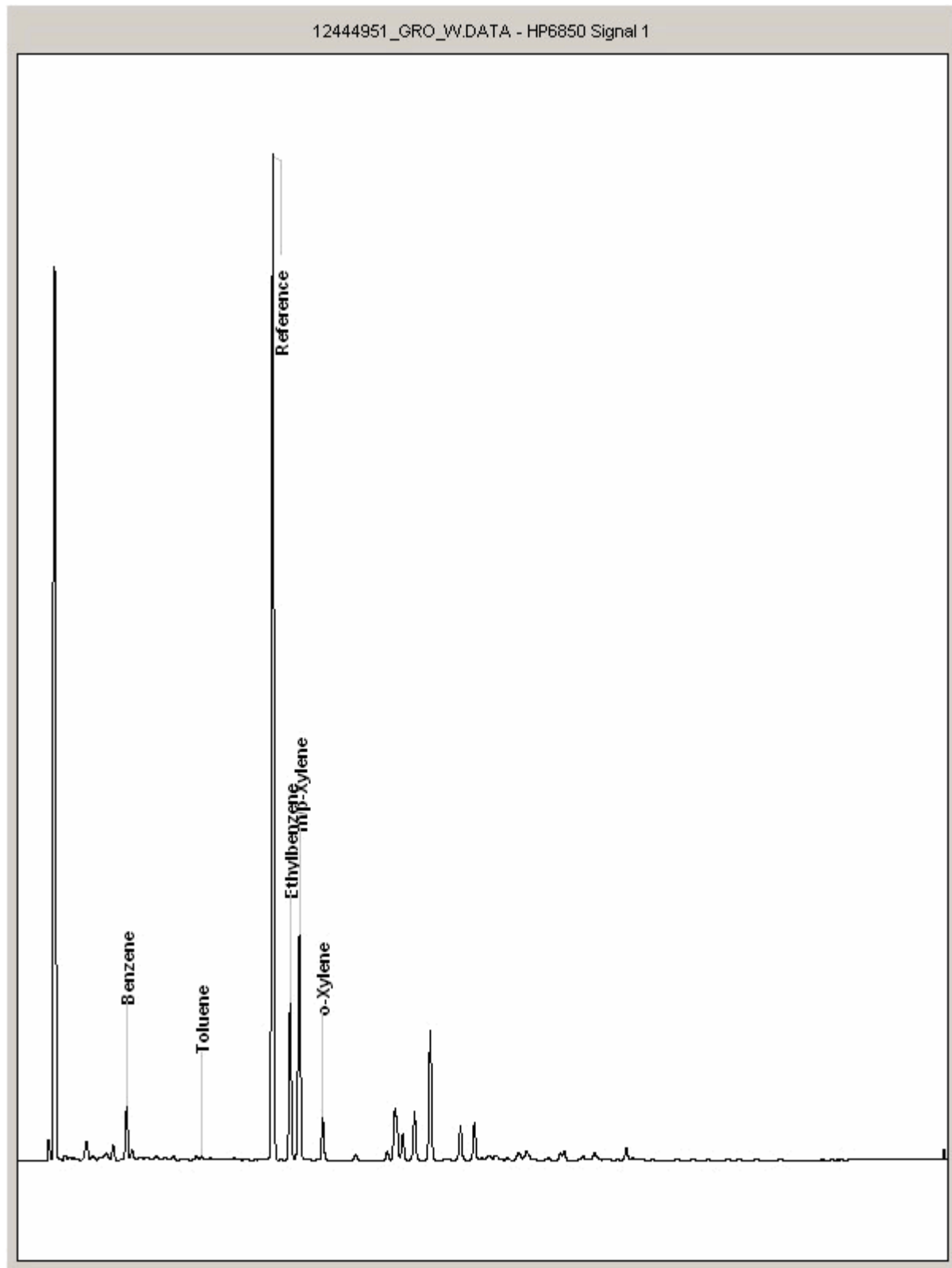
Order Number: 46370079
Report Number: 338729
Superseded Report:

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 12444951
Sample ID : BH102

Depth :





SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

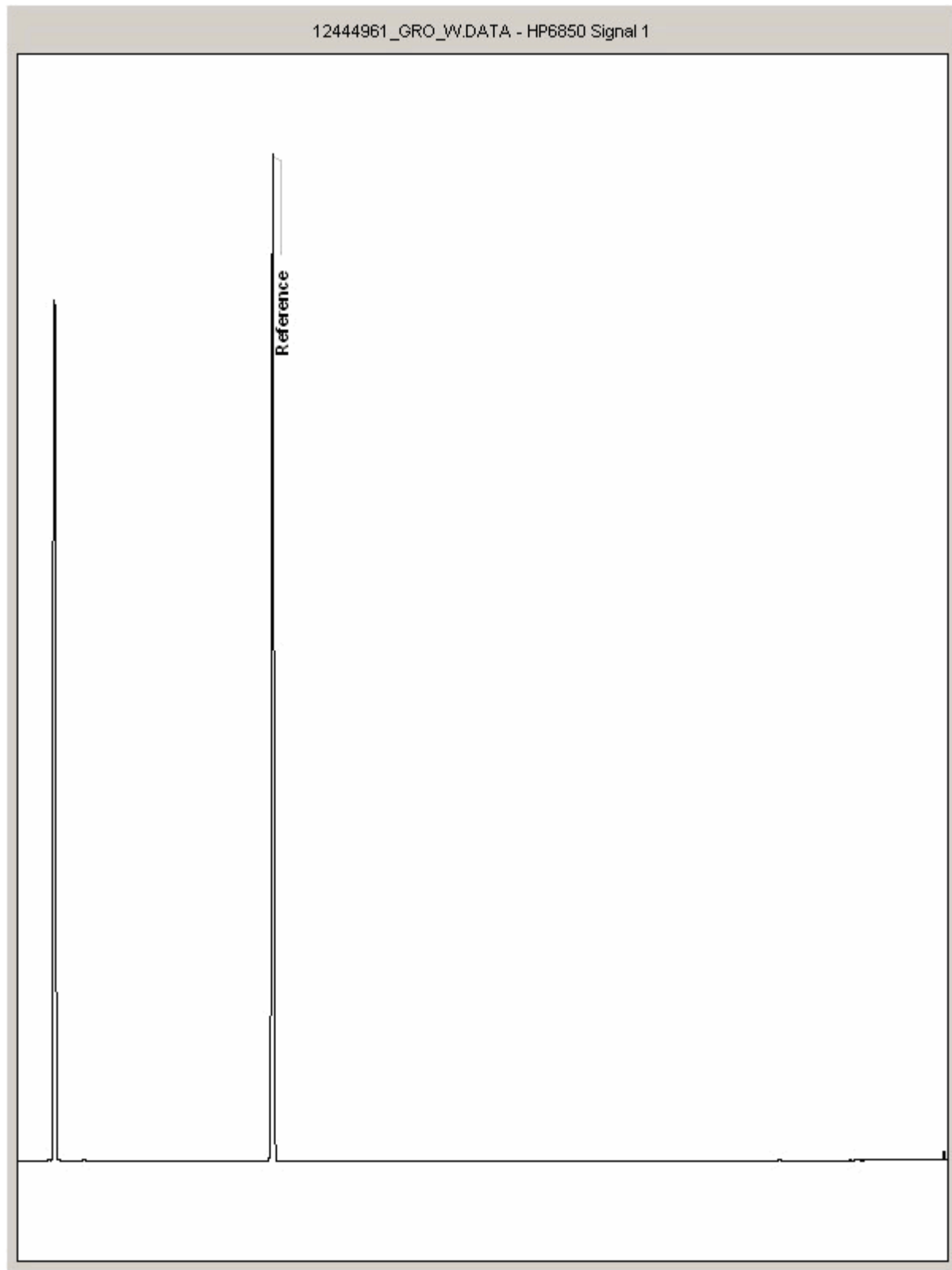
Order Number: 46370079
Report Number: 338729
Superseded Report:

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 12444961
Sample ID : BH105A

Depth :





SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

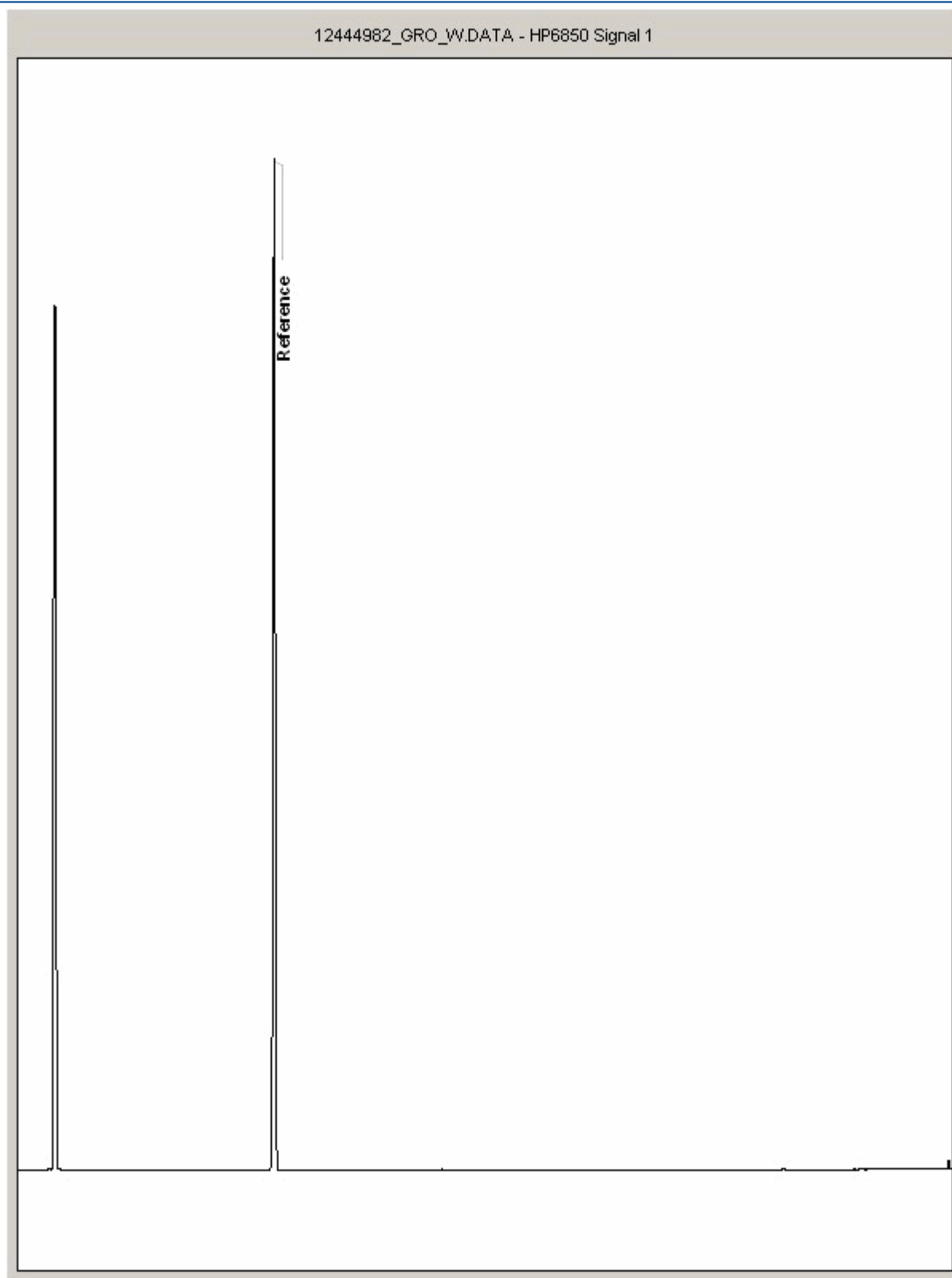
Order Number: 46370079
Report Number: 338729
Superseded Report:

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 12444982
Sample ID : BH102A

Depth :





SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

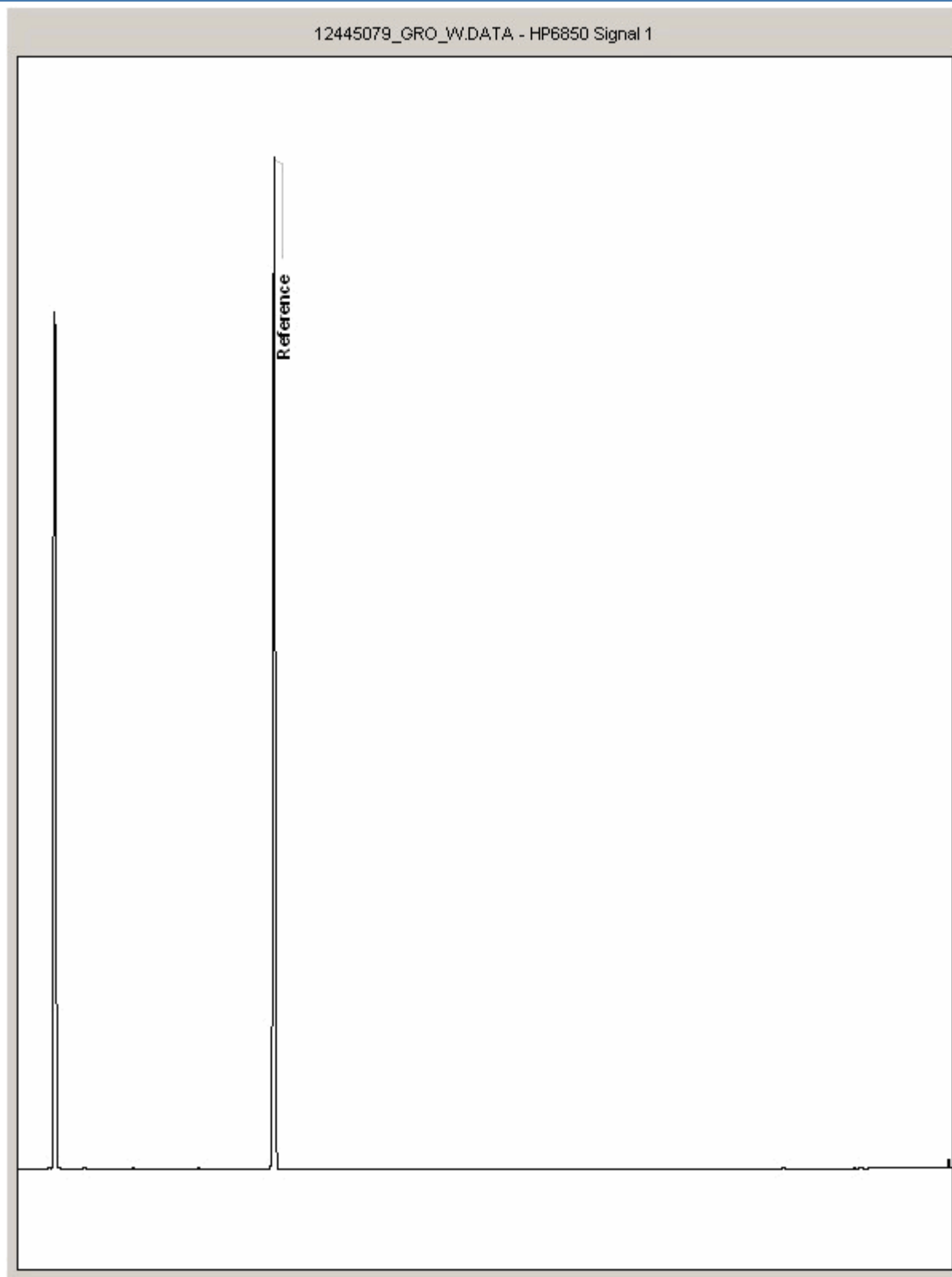
Order Number: 46370079
Report Number: 338729
Superseded Report:

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 12445079
Sample ID : BH106A

Depth :





SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

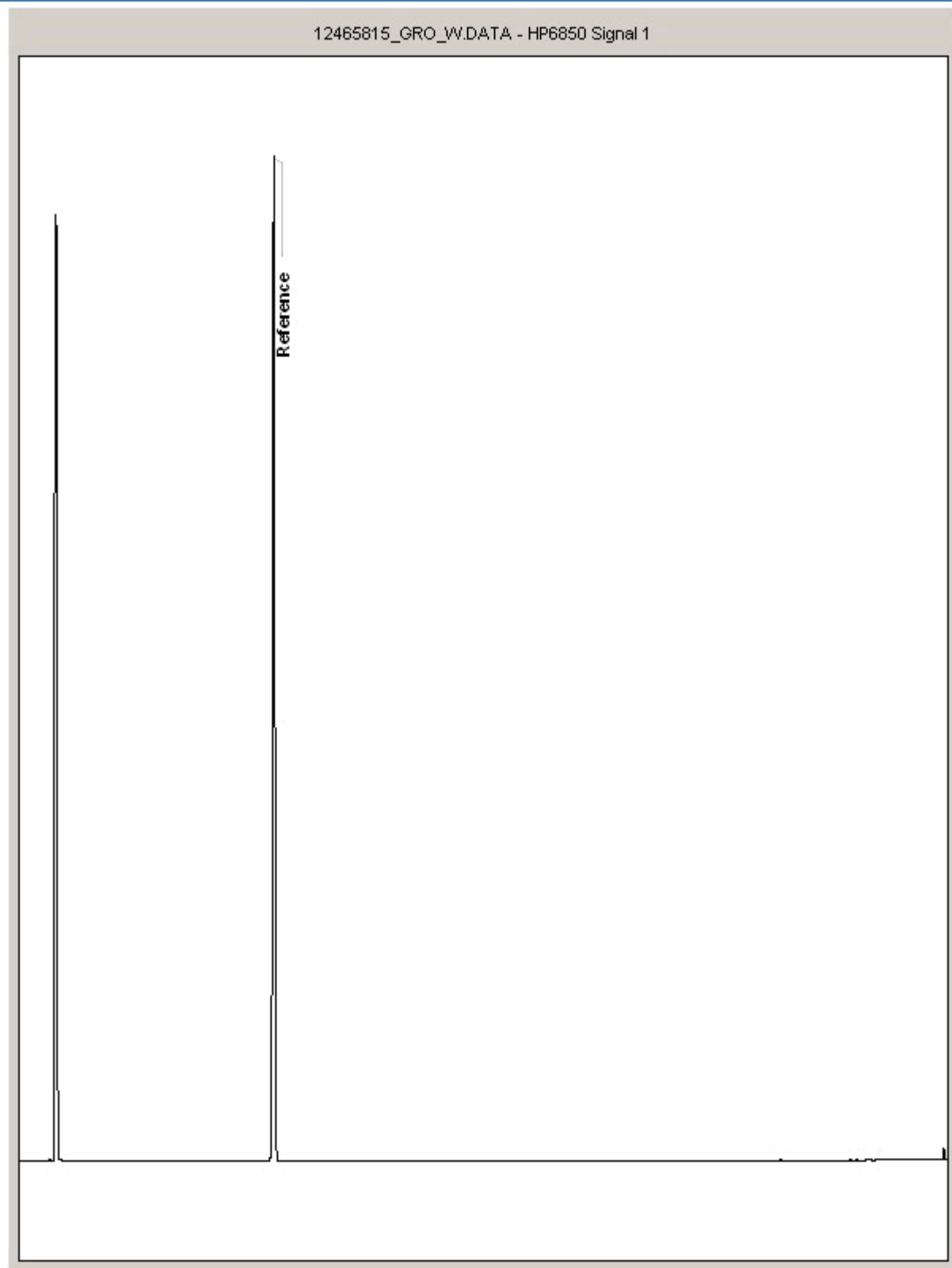
Order Number: 46370079
Report Number: 338729
Superseded Report:

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 12465815
Sample ID : BH103

Depth :





SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

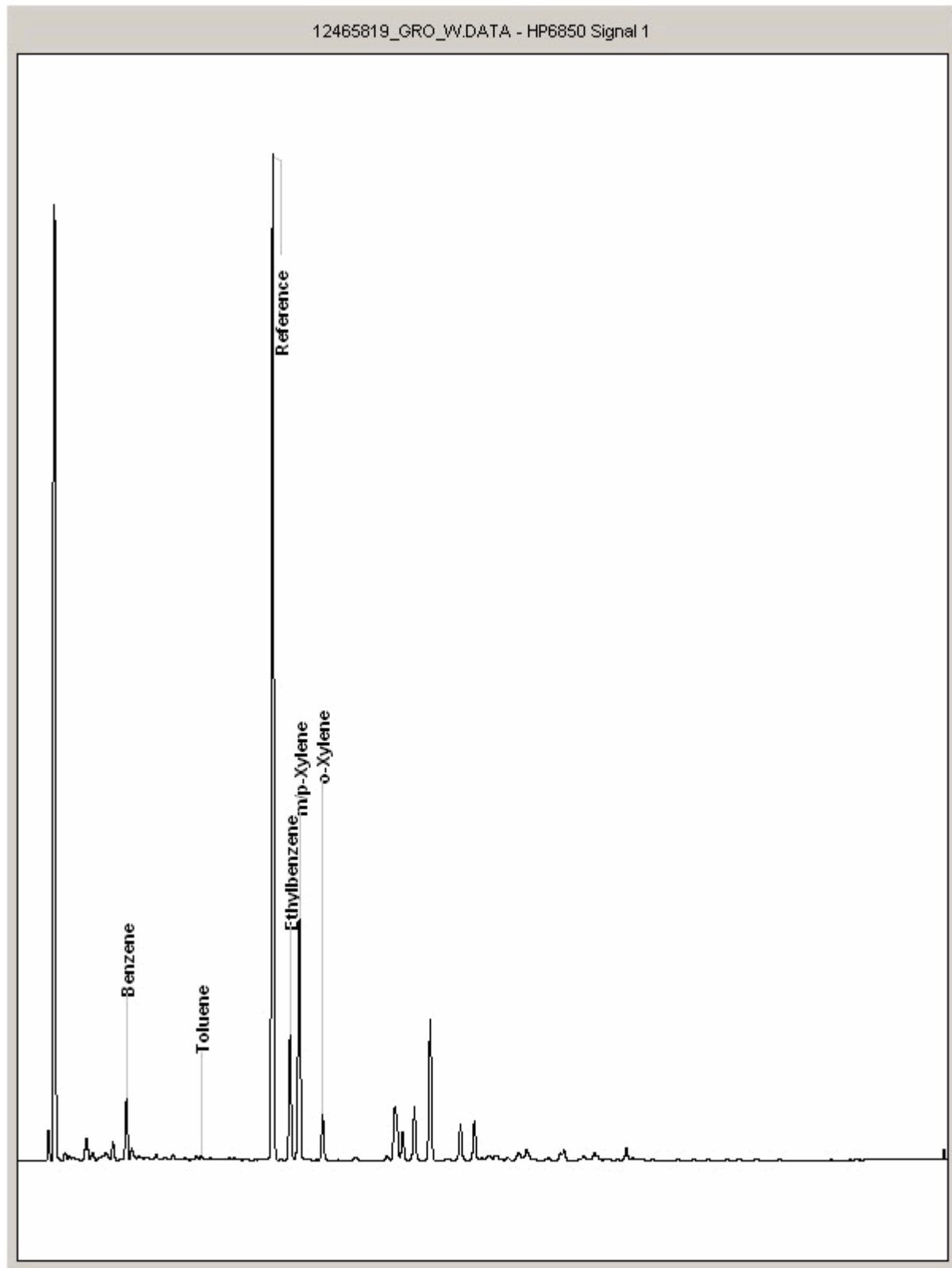
Order Number: 46370079
Report Number: 338729
Superseded Report:

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 12465819
Sample ID : DUP

Depth :





SDG: 151113-72
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Tim Rolfe

Order Number: 46370079
Report Number: 338729
Superseded Report:

Appendix

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA Leach tests, flash point, ammonium as NH₄ by the BRE method, VOC TICS, SVOC TICS, TOF-MS SCAN/SEARCH and TOF-MS TICS.

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

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for both soil jars, tubs and volatile jars. All waters and vials will be discarded 10 days after the analysis is completed (e-mailed). All material removed during an asbestos containing material screen and analysed for the presence of asbestos will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALcontrol Laboratories reserve the right to charge for samples received and stored but not analysed.

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

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

6. When requested, the individual sub sample scheduled will be screened in house for the presence of large asbestos containing material fragments/pieces. If no asbestos containing material is found this will be reported as 'no asbestos containing material detected'. If asbestos containing material is detected it will be removed and analysed by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If asbestos containing material is present no further analysis will be undertaken. At no point is the fibre content of the soil sample determined.

7. If no separate volatile sample is supplied by the client, the integrity of the data may be compromised if the laboratory is required to create a sub-sample from the bulk sample -similarly, if a headspace or sediment is present in the volatile sample. This will be flagged up as an invalid VOC on the test schedule or recorded on the log sheet.

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

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

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

11. A table containing the date of analysis for each parameter is not routinely included with the report, but is available upon request.

12. Results relate only to the items tested

13. **Surrogate recoveries** -Most of our organic methods include surrogates, the recovery of which is monitored and reported. For EPH, MO, PAH, GRO and VOCs on soils the result is not surrogate corrected, but a percentage recovery is quoted. Acceptable limits for most organic methods are 70 -130 %.

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

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

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 14).

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

18. Our MCERTS accreditation for PAHs by GCMS applies to all product types apart from Kerosene, where naphthalene only is not accredited.

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

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

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

22. For all leachate preparations (NRA, DIN, TCLP, BSEN 12457-1, 2, 3) volatile loss may occur, as we do not employ zero headspace extraction.

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

24. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C₄-C₁₀ range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

SOLID MATRICES EXTRACTION SUMMARY

ANALYSIS	D/C OR WET	EXTRACTION SOLVENT	EXTRACTION METHOD	ANALYSIS
SOLVENT EXTRACTABLE MATTER	D&C	DOM	SOX THERM	GRAMMETRIC
CYCLOHEXANE EXT. MATTER	D&C	CYCLOHEXANE	SOX THERM	GRAMMETRIC
THIN LAYER CHROMATOGRAPHY	D&C	DOM	SOX THERM	IATROSCAN
ELEMENTAL SULPHUR	D&C	DOM	SOX THERM	HPLC
PHENOLSBY GCMS	WET	DOM	SOX THERM	GCMS
HERBICIDES	D&C	HBXANEACETONE	SOX THERM	GCMS
PESTICIDES	D&C	HBXANEACETONE	SOX THERM	GCMS
EPH (DRO)	D&C	HBXANEACETONE	END OVEREND	GC FID
EPH (MINOIL)	D&C	HBXANEACETONE	END OVEREND	GC FID
EPH (CLEANED UP)	D&C	HBXANEACETONE	END OVEREND	GC FID
EPH CAG BY GC	D&C	HBXANEACETONE	END OVEREND	GC FID
POB TOT / POB CON	D&C	HBXANEACETONE	END OVEREND	GCMS
POLYAROMATIC HYDROCARBONS (MS)	WET	HBXANEACETONE	MICROWAVE TM218.	GCMS
C8-C40 (C8-C40) EZ FLASH	WET	HBXANEACETONE	SHAKER	GCEZ
POLYAROMATIC HYDROCARBONS RAPID GC	WET	HBXANEACETONE	SHAKER	GCEZ
SEM VOLATILE ORGANIC COMPOUNDS	WET	DOMACETONE	SONICATE	GCMS

LIQUID MATRICES EXTRACTION SUMMARY

ANALYSIS	EXTRACTION SOLVENT	EXTRACTION METHOD	ANALYSIS
PAHMS	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GCMS
EPH	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC FID
EPH CAG	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC FID
MINERAL OIL	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC FID
POB 7 CONGENERS	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GCMS
POB TOTAL	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GCMS
SVOC	DOM	LIQUID/LIQUID SHAKE	GCMS
FREESULPHUR	DOM	SOLID PHASE EXTRACTION	HPLC
PEST COP/OPP	DOM	LIQUID/LIQUID SHAKE	GCMS
TRIAZINE HERBS	DOM	LIQUID/LIQUID SHAKE	GCMS
PHENOLSMS	DOM	SOLID PHASE EXTRACTION	GCMS
TPH by INFRARED (IR)	TCE	LIQUID/LIQUID SHAKE	HPLC
MINERAL OIL by IR	TCE	LIQUID/LIQUID SHAKE	HPLC
GLYCOLS	NONE	DIRECT INJECTION	GCMS

Identification of Asbestos in Bulk Materials

The results for asbestos identification for soil samples are obtained from possible Asbestos Containing Material, removed during the 'Screening of soils for Asbestos Containing Materials', which have been examined to determine the presence of asbestos fibres using Alcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Visual Estimation Of Fibre Content

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

Further guidance on typical asbestos fibre content of manufactured products can be found in MDHS 100.

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

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



SDG:	151113-72	Location:	Shell Hitchin	Order Number:	46370079
Job:	H_URS_WIM-174	Customer:	AECOM	Report Number:	338729
Client Reference:		Attention:	Tim Rolfe	Superseded Report:	

Appendix General

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

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

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

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

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

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

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

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

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

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

11. Results relate only to the items tested.

12. LODs for wet tests reported on a dry weight basis are not corrected for moisture content.

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

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

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

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

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

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

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

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

21. For all leachate preparations (NRA, DIN, TCLP, BSEN 12457-1, 2, 3) volatile loss may occur, as we do not employ zero headspace extraction.

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

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

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

Identification of Asbestos in Bulk Materials & Soils

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

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

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-
- Visual Estimation Of Fibre Content

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

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

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



AECOM
St. George's House
2nd Floor
5 St. George's Road
Wimbledon
Greater London
SW19 4DR

Attention: Bethan Short

CERTIFICATE OF ANALYSIS

Date: 04 March 2016
Customer: H_URS_WIM
Sample Delivery Group (SDG): 160227-59
Your Reference:
Location: Shell Hitchin
Report No: 352050

We received 8 samples on Saturday February 27, 2016 and 8 of these samples were scheduled for analysis which was completed on Friday March 04, 2016. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

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

All chemical testing (unless subcontracted) is performed at ALcontrol Hawarden Laboratories.

Approved By:

Sonia McWhan

Operations Manager





SDG:	160227-59	Location:	Shell Hitchin	Order Number:	60481591
Job:	H_URS_WIM-174	Customer:	AECOM	Report Number:	352050
Client Reference:		Attention:	Bethan Short	Superseded Report:	

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
13002675	BH102			26/02/2016
13002678	BH103			26/02/2016
13002677	BH102A			26/02/2016
13002680	BH105A			26/02/2016
13002679	BH106A			26/02/2016
13002687	DUP			26/02/2016
13002686	EB			26/02/2016
13002671	TRIP BLANK BcBq3355V			26/02/2016

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



SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 60481591
Report Number: 352050
Superseded Report:

LIQUID Results Legend X Test N No Determination Possible	Lab Sample No(s)		Customer Sample Reference		AGS Reference		Depth (m)		Container	
	13002671	TRIP BLANK							Vial (ALE297)	
	13002686	EB							Vial (ALE297)	
	13002687	DUP							HCl Filtered (ALE25) 1000ml glass bottle	
	13002679	BH106A							Vial (ALE297)	
Anions by Kone (w)	All	NDPs: 0 Tests: 7								
EPH CWG (Aliphatic) Aqueous GC (W)	All	NDPs: 0 Tests: 7								
EPH CWG (Aromatic) Aqueous GC (W)	All	NDPs: 0 Tests: 7								
Ferrous Iron	All	NDPs: 0 Tests: 7								
GRO by GC-FID (W)	All	NDPs: 0 Tests: 7								
Oxygenates (W)	All	NDPs: 0 Tests: 7								
PAH Spec MS - Aqueous (W)	All	NDPs: 0 Tests: 7								
VOC MS (W)	All	NDPs: 0 Tests: 8								

Order Number: 60481591
Report Number: 352050
Superseded Report:

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Order Number: 60481591
Report Number: 352050
Superseded Report:

12:29:40 04/03/2016

Order Number: 60481591
Report Number: 352050
Superseded Report:

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Order Number: 60481591
Report Number: 352050
Superseded Report:

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Order Number: 60481591
Report Number: 352050
Superseded Report:

Page 8 of 44

Order Number: 60481591
Report Number: 352050
Superseded Report:

Customer Sample R

Depth (m)
Sample Type
Date Sampled
Sampled Time
Date Received
SDG Ref
Lab Sample No.(s)
AGS Reference

Page 9 of 44

Order Number: 60481591
Report Number: 352050
Superseded Report:

Page 10 of 44

Order Number: 60481591
Report Number: 352050
Superseded Report:

Page 11 of 44

Order Number: 60481591
Report Number: 352050
Superseded Report:

Page 12 of 44

SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 60481591
Report Number: 352050
Superseded Report:

PAH Spec MS - Aqueous (W)

[illegible]

Order Number: 60481591
Report Number: 352050
Superseded Report:

Page 14 of 44

SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 60481591
Report Number: 352050
Superseded Report:

VOC MS (W)

[illegible]



SDG:	160227-59	Location:	Shell Hitchin	Order Number:	60481591
Job:	H_URS_WIM-174	Customer:	AECOM	Report Number:	352050
Client Reference:		Attention:	Bethan Short	Superseded Report:	

Table of Results - Appendix

Method No	Reference	Description	Wet/Dry Sample ¹	Surrogate Corrected
TM061	Method for the Determination of EPH,Massachusetts Dept.of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)		
TM125	DIN 38405 D17	Determination of Ferrous Iron		
TM174	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	Determination of Speciated Extractable Petroleum Hydrocarbons in Waters by GC-FID		
TM178	Modified: US EPA Method 8100	Determination of Polynuclear Aromatic Hydrocarbons (PAH) by GC-MS in Waters		
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers		
TM208	Modified: US EPA Method 8260b & 624	Determination of Volatile Organic Compounds by Headspace / GC-MS in Waters		
TM245	By GC-FID	Determination of GRO by Headspace in waters		
TM289		Determination of Oxygenates in Waters by Headspace/GC-MS		

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



CERTIFICATE OF ANALYSIS

Validated

SDG:	160227-59	Location:	Shell Hitchin	Order Number:	60481591
Job:	H_URS_WIM-174	Customer:	AECOM	Report Number:	352050
Client Reference:		Attention:	Bethan Short	Superseded Report:	

Test Completion Dates

Lab Sample No(s)	13002675	13002678	13002677	13002680	13002679	13002687	13002686	13002671
Customer Sample Ref.	BH102	BH103	BH102A	BH105A	BH106A	DUP	EB	TRIP BLANK BcBq 3355V
AGS Ref.								
Depth								
Type	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID

Anions by Kone (w)	02-Mar-2016	02-Mar-2016	02-Mar-2016	02-Mar-2016	02-Mar-2016	02-Mar-2016	02-Mar-2016	
EPH CWG (Aliphatic) Aqueous GC (W)	03-Mar-2016	03-Mar-2016	03-Mar-2016	03-Mar-2016	03-Mar-2016	03-Mar-2016	03-Mar-2016	
EPH CWG (Aromatic) Aqueous GC (W)	03-Mar-2016	03-Mar-2016	03-Mar-2016	03-Mar-2016	03-Mar-2016	03-Mar-2016	03-Mar-2016	
Ferrous Iron	02-Mar-2016	02-Mar-2016	02-Mar-2016	02-Mar-2016	02-Mar-2016	02-Mar-2016	02-Mar-2016	
GRO by GC-FID (W)	01-Mar-2016	01-Mar-2016	01-Mar-2016	01-Mar-2016	01-Mar-2016	01-Mar-2016	01-Mar-2016	
Nitrite by Kone (w)	01-Mar-2016	01-Mar-2016	01-Mar-2016	01-Mar-2016	01-Mar-2016	01-Mar-2016	01-Mar-2016	
Oxygenates (W)	02-Mar-2016	02-Mar-2016	02-Mar-2016	02-Mar-2016	02-Mar-2016	02-Mar-2016	02-Mar-2016	
PAH Spec MS - Aqueous (W)	04-Mar-2016	04-Mar-2016	04-Mar-2016	04-Mar-2016	04-Mar-2016	04-Mar-2016	04-Mar-2016	
TPH CWG (W)	03-Mar-2016	03-Mar-2016	03-Mar-2016	03-Mar-2016	03-Mar-2016	03-Mar-2016	03-Mar-2016	
VOC MS (W)	29-Feb-2016	29-Feb-2016	29-Feb-2016	01-Mar-2016	01-Mar-2016	01-Mar-2016	01-Mar-2016	01-Mar-2016



SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 60481591
Report Number: 352050
Superseded Report:

ASSOCIATED AQC DATA

Anions by Kone (w)

Component	Method Code	QC 1348
Chloride	TM184	99.44 : 111.02
Phosphate (Ortho as PO4)	TM184	96.40 : 108.40
Sulphate (soluble)	TM184	102.0 98.82 : 111.38
TON as NO3	TM184	98.0 96.30 : 116.70

EPH CWG (Aliphatic) Aqueous GC (W)

Component	Method Code	QC 1383
Total Aliphatics >C12-C35	TM174	92.29 66.67 : 110.42

EPH CWG (Aromatic) Aqueous GC (W)

Component	Method Code	QC 1384
Total Aromatics >EC12-EC35	TM174	94.67 63.00 : 121.00

Ferrous Iron

Component	Method Code	QC 1369
Ferrous Iron	TM125	95.0 94.00 : 102.00

GRO by GC-FID (W)

Component	Method Code	QC 1338	QC 1347
Benzene by GC	TM245	99.0 79.00 : 121.00	98.0 79.00 : 121.00
Ethylbenzene by GC	TM245	99.5 79.00 : 121.00	98.5 79.00 : 121.00
m & p Xylene by GC	TM245	99.0 79.00 : 121.00	98.0 79.00 : 121.00
MTBE GC-FID	TM245	99.0 80.34 : 118.41	98.5 80.34 : 118.41
o Xylene by GC	TM245	100.0 79.00 : 121.00	99.0 79.00 : 121.00
QC	TM245	78.97 68.28 : 117.60	87.14 68.28 : 117.60



SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 60481591
Report Number: 352050
Superseded Report:

GRO by GC-FID (W)

		QC 1338	QC 1347
Toluene by GC	TM245	99.5 79.00 : 121.00	98.5 79.00 : 121.00

Oxygenates (W)

Component	Method Code	QC 1358
Benzene	TM289	102.0 87.69 : 119.72
Diisopropyl ether	TM289	97.0 80.97 : 117.54
Ethanol	TM289	110.0 59.63 : 150.56
Ethylbenzene	TM289	94.5 84.52 : 113.38
o-Xylene	TM289	95.0 84.40 : 112.41
p/m-Xylene	TM289	98.0 83.20 : 115.01
tert Butanol	TM289	105.0 70.51 : 143.48
tert-amyl methyl ether	TM289	98.0 78.92 : 124.29
tert-butyl ethyl ether	TM289	96.0 78.17 : 124.34
tert-butyl methyl ether	TM289	99.0 81.54 : 119.46
Toluene	TM289	96.0 79.08 : 122.51

PAH Spec MS - Aqueous (W)

Component	Method Code	QC 1307
Acenaphthene by GCMS	TM178	97.0 88.78 : 115.50
Acenaphthylene by GCMS	TM178	98.0 85.27 : 110.71
Anthracene by GCMS	TM178	98.5 86.06 : 112.26
Benz(a)anthracene by GCMS	TM178	97.0 79.25 : 124.25
Benzo(a)pyrene by GCMS	TM178	104.5 83.10 : 128.10
Benzo(b)fluoranthene by GCMS	TM178	108.5 86.00 : 131.00
Benzo(ghi)perylene by GCMS	TM178	87.0 79.96 : 107.30
Benzo(k)fluoranthene by GCMS	TM178	107.5 87.50 : 132.50
Chrysene by GCMS	TM178	102.0 86.00 : 114.60
Dibenzo(ah)anthracene by GCMS	TM178	81.0 68.95 : 111.55
Fluoranthene by GCMS	TM178	100.0 81.15 : 116.55



SDG:	160227-59	Location:	Shell Hitchin	Order Number:	60481591
Job:	H_URS_WIM-174	Customer:	AECOM	Report Number:	352050
Client Reference:		Attention:	Bethan Short	Superseded Report:	

PAH Spec MS - Aqueous (W)

		QC 1307
Fluorene by GCMS	TM178	103.0 90.88 : 112.23
Indeno(123cd)pyrene by GCMS	TM178	95.0 82.25 : 114.75
Naphthalene by GCMS	TM178	94.5 92.00 : 113.00
Phenanthrene by GCMS	TM178	101.5 93.18 : 113.92
Pyrene by GCMS	TM178	99.0 82.25 : 116.15

VOC MS (W)

Component	Method Code	QC 1362	QC 1354
1,1,1,2-Tetrachloroethane	TM208	100.5 77.50 : 122.50	102.5 84.25 : 114.84
1,1,1-Trichloroethane	TM208	100.0 77.50 : 122.50	98.0 84.67 : 111.97
1,1-Dichloroethane	TM208	105.5 77.50 : 122.50	101.0 80.19 : 121.45
1,2-Dichloroethane	TM208	108.0 77.50 : 122.50	101.0 77.68 : 127.05
2-Chlorotoluene	TM208	100.0 77.50 : 122.50	103.0 82.99 : 106.24
4-Chlorotoluene	TM208	102.5 77.50 : 122.50	103.0 83.92 : 115.84
Benzene	TM208	105.0 77.50 : 122.50	103.0 82.30 : 120.49
Bromomethane	TM208	109.5 73.63 : 123.82	105.5 76.16 : 123.35
Carbontetrachloride	TM208	97.0 77.50 : 122.50	100.0 83.96 : 117.98
Chlorobenzene	TM208	101.5 82.01 : 111.65	103.5 85.75 : 114.88
Chloroform	TM208	108.0 77.50 : 122.50	102.5 84.84 : 119.97
Chloromethane	TM208	116.5 69.61 : 144.19	92.5 73.90 : 123.53
Cis-1,2-Dichloroethene	TM208	108.5 89.07 : 125.70	100.5 82.79 : 125.45
Dichloromethane	TM208	112.0 81.94 : 125.20	97.5 79.31 : 122.56
Ethylbenzene	TM208	98.5 76.08 : 108.05	98.5 80.74 : 110.74
Hexachlorobutadiene	TM208	94.0 72.12 : 118.38	88.5 66.89 : 118.01
o-Xylene	TM208	101.5 79.33 : 110.74	101.5 82.64 : 110.48
p/m-Xylene	TM208	98.0 74.83 : 118.29	99.0 80.94 : 113.51
Tert-butyl methyl ether	TM208	110.5 70.43 : 124.31	104.5 59.77 : 129.51
Tetrachloroethene	TM208	94.0 80.60 : 110.75	98.5 83.21 : 115.40



CERTIFICATE OF ANALYSIS

Validated

SDG:	160227-59	Location:	Shell Hitchin	Order Number:	60481591
Job:	H_URS_WIM-174	Customer:	AECOM	Report Number:	352050
Client Reference:		Attention:	Bethan Short	Superseded Report:	

VOC MS (W)

		QC 1362	QC 1354
Toluene	TM208	95.0 80.95 : 110.35	100.5 86.02 : 114.04
Trichloroethene	TM208	96.5 77.32 : 109.93	102.0 83.50 : 113.50
Vinyl Chloride	TM208	111.5 64.36 : 126.94	103.0 63.71 : 124.88

The above information details the reference name of the analytical quality control sample (AQC) that has been run with the samples contained in this report for the different methods of analysis .
The figure detailed is the percentage recovery result for the AQC .
The subscript numbers below are the percentage recovery lower control limit (LCL) and the upper control limit (UCL). The percentage recovery result for the AQC should be between these limits to be statistically in control .



SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 60481591
Report Number: 352050
Superseded Report:

Chromatogram

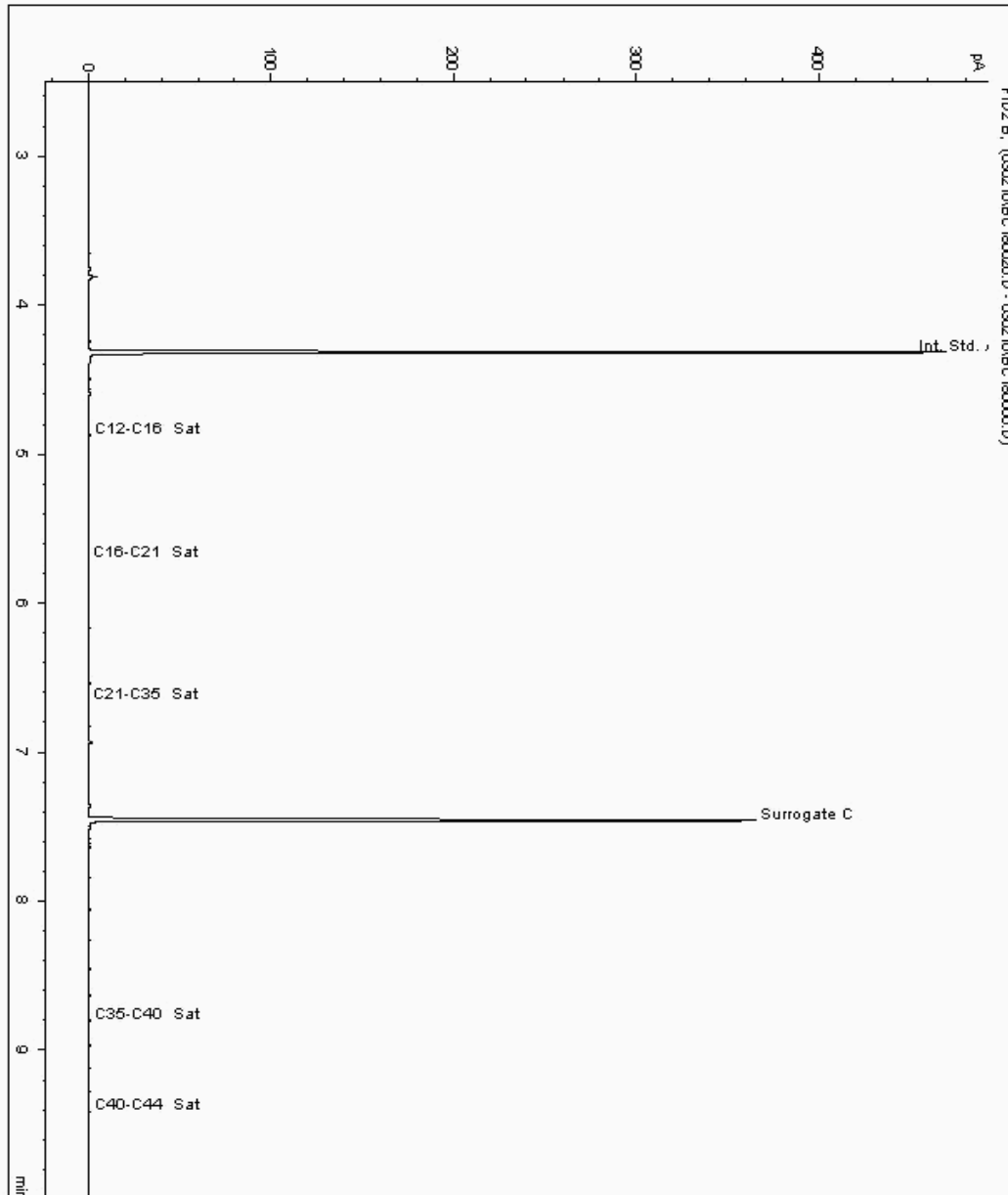
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 13009286
Sample ID : BH106A

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 12261852-
Date Acquired : 02/03/2016 23:53:28 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 60481591
Report Number: 352050
Superseded Report:

Chromatogram

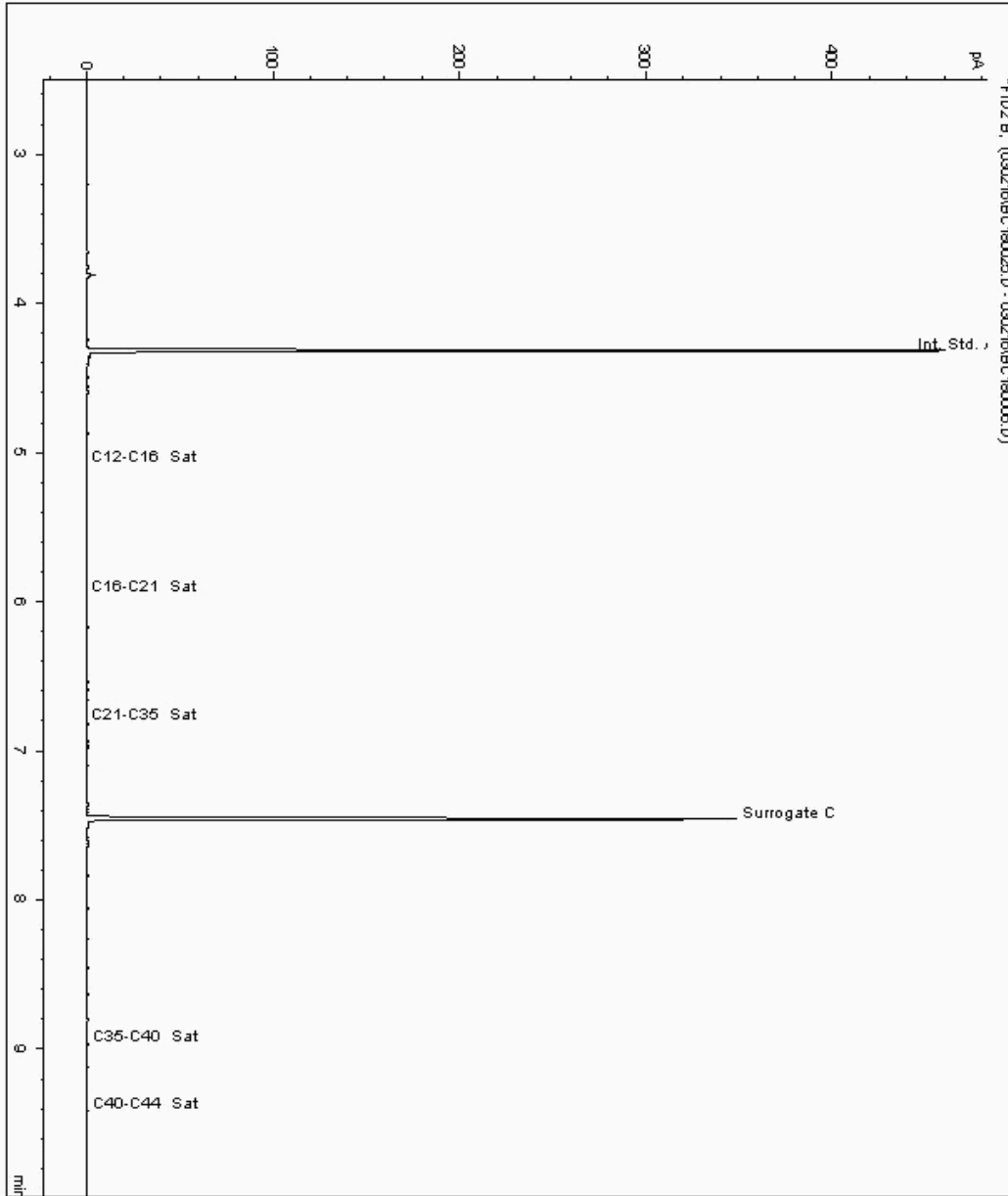
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 13009288
Sample ID : BH105A

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 12261867-
Date Acquired : 02/03/2016 23:34:49 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 60481591
Report Number: 352050
Superseded Report:

Chromatogram

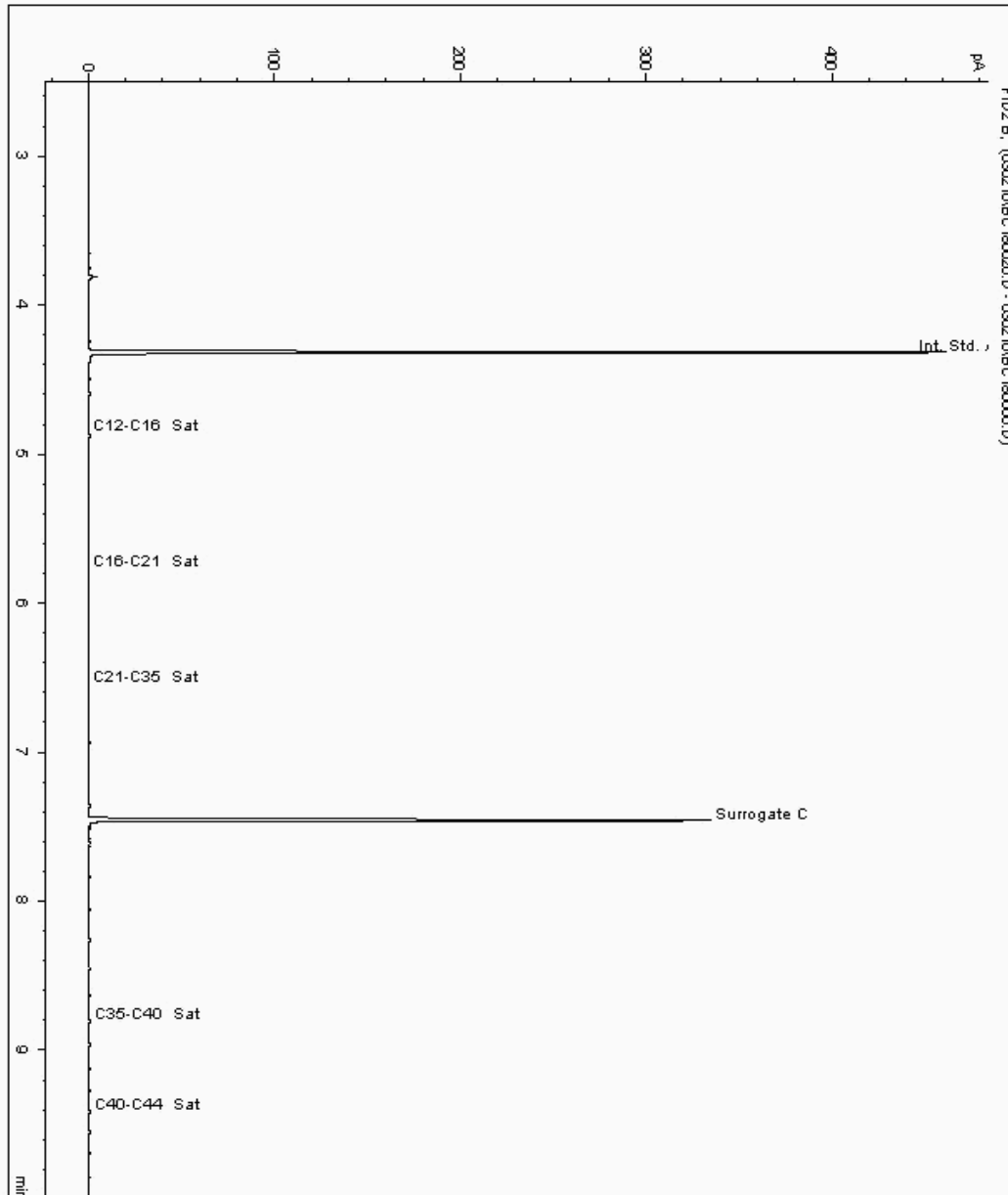
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 13009290
Sample ID : EB

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 12261883-
Date Acquired : 02/03/2016 22:01:07 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 60481591
Report Number: 352050
Superseded Report:

Chromatogram

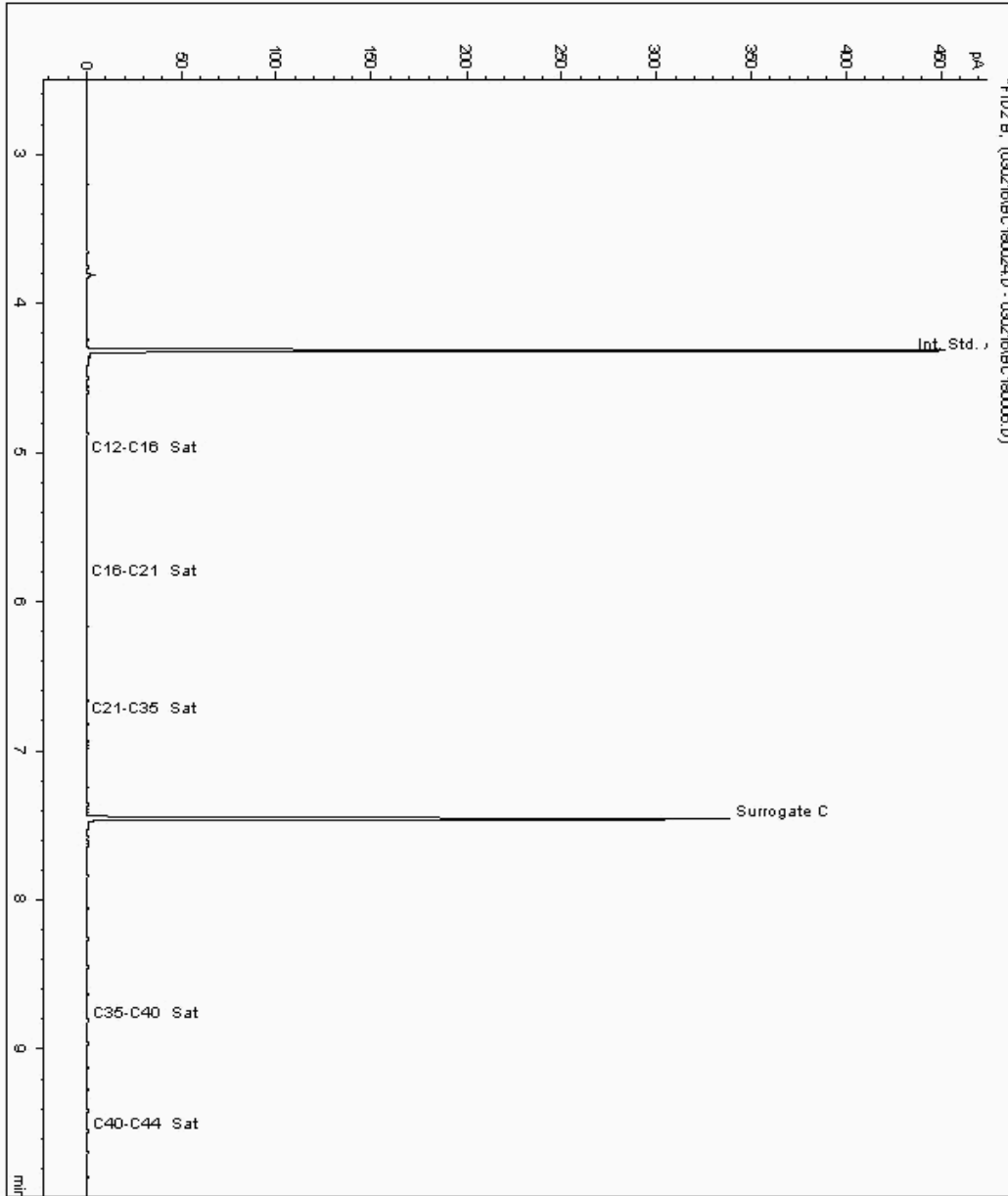
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 13009292
Sample ID : DUP

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 12261893-
Date Acquired : 02/03/2016 23:15:59 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 60481591
Report Number: 352050
Superseded Report:

Chromatogram

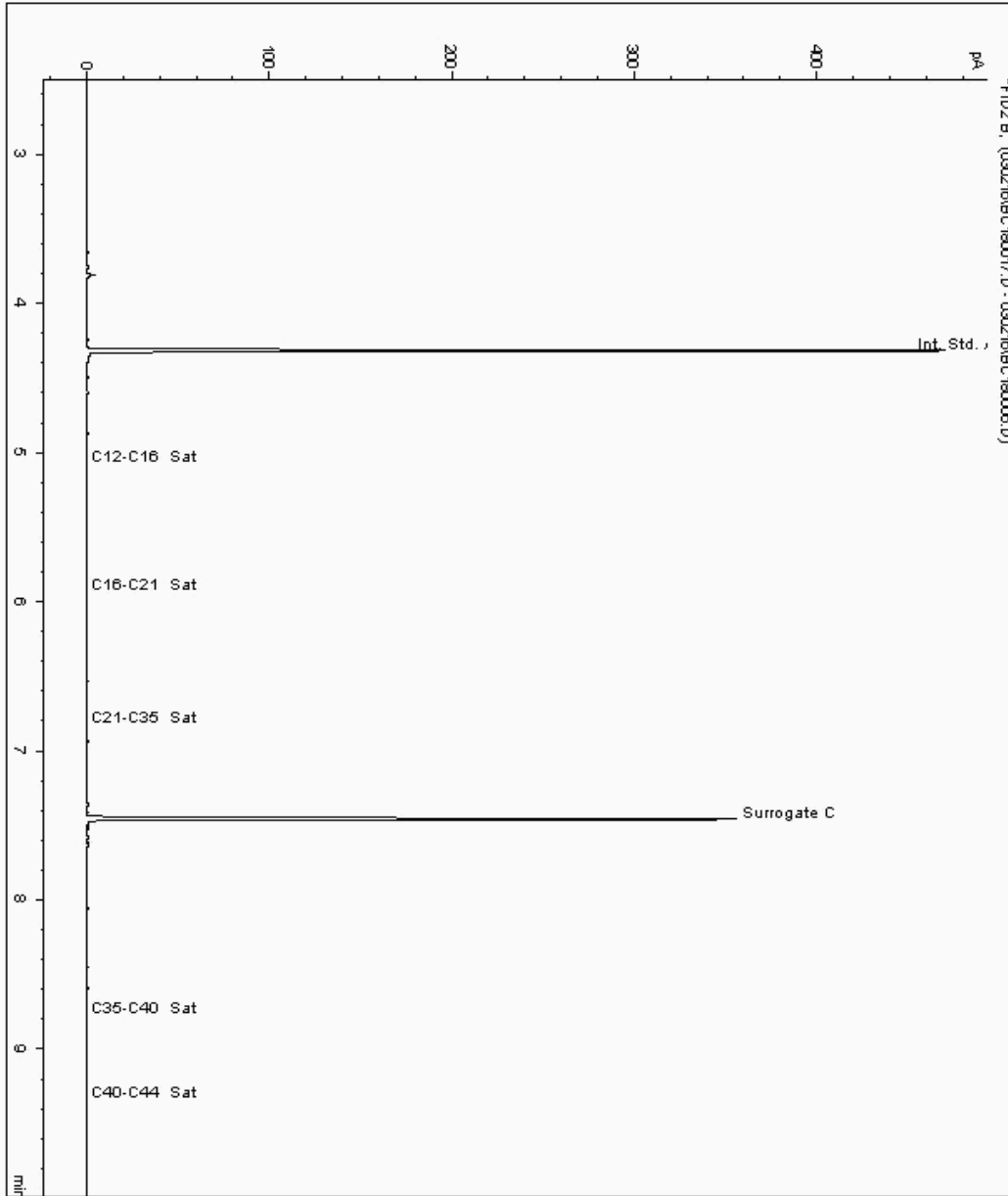
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 13009619
Sample ID : BH102A

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 12261828-
Date Acquired : 02/03/2016 21:05:10 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 60481591
Report Number: 352050
Superseded Report:

Chromatogram

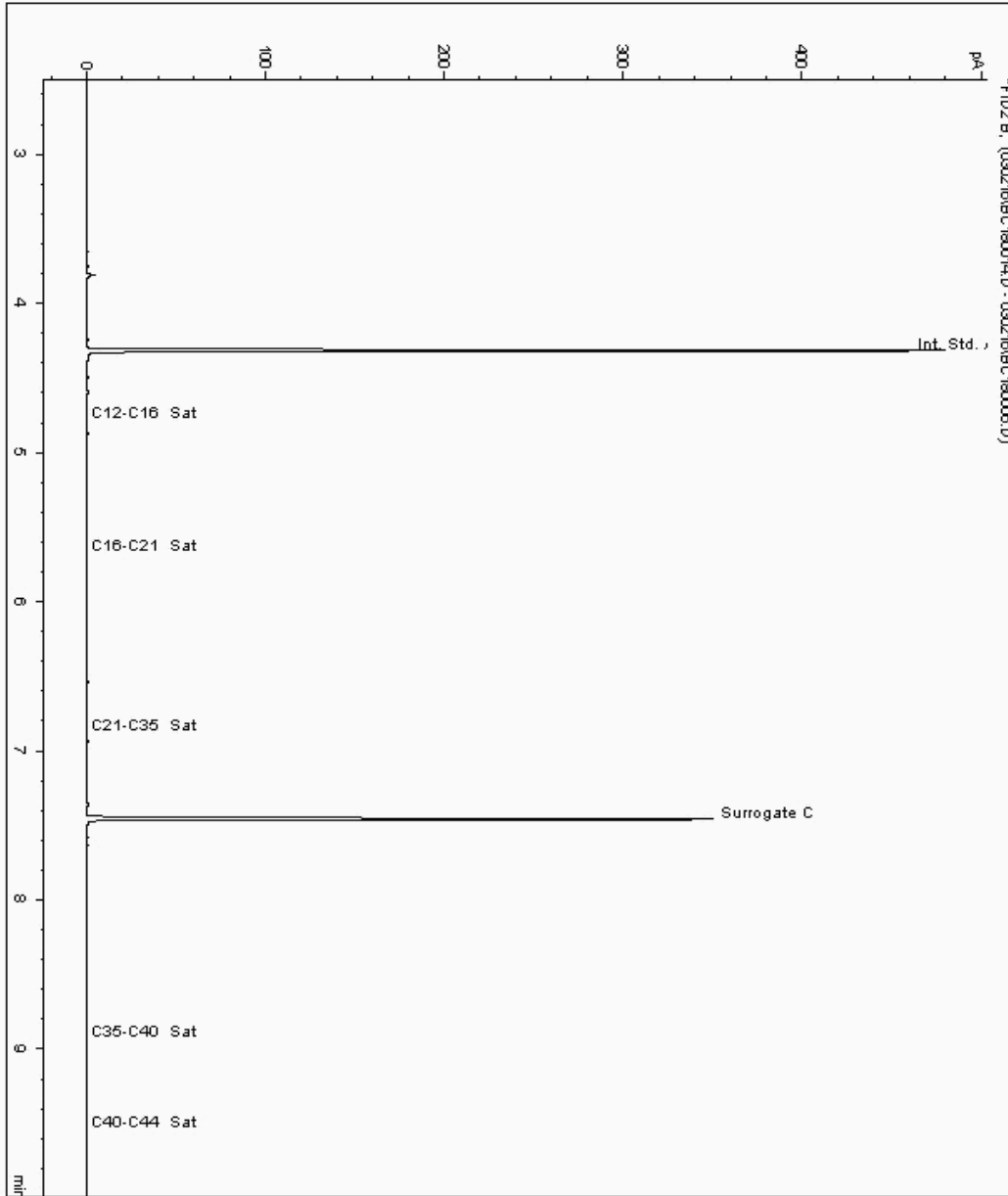
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 13009622
Sample ID : BH102

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 12261814-
Date Acquired : 02/03/2016 20:08:58 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 60481591
Report Number: 352050
Superseded Report:

Chromatogram

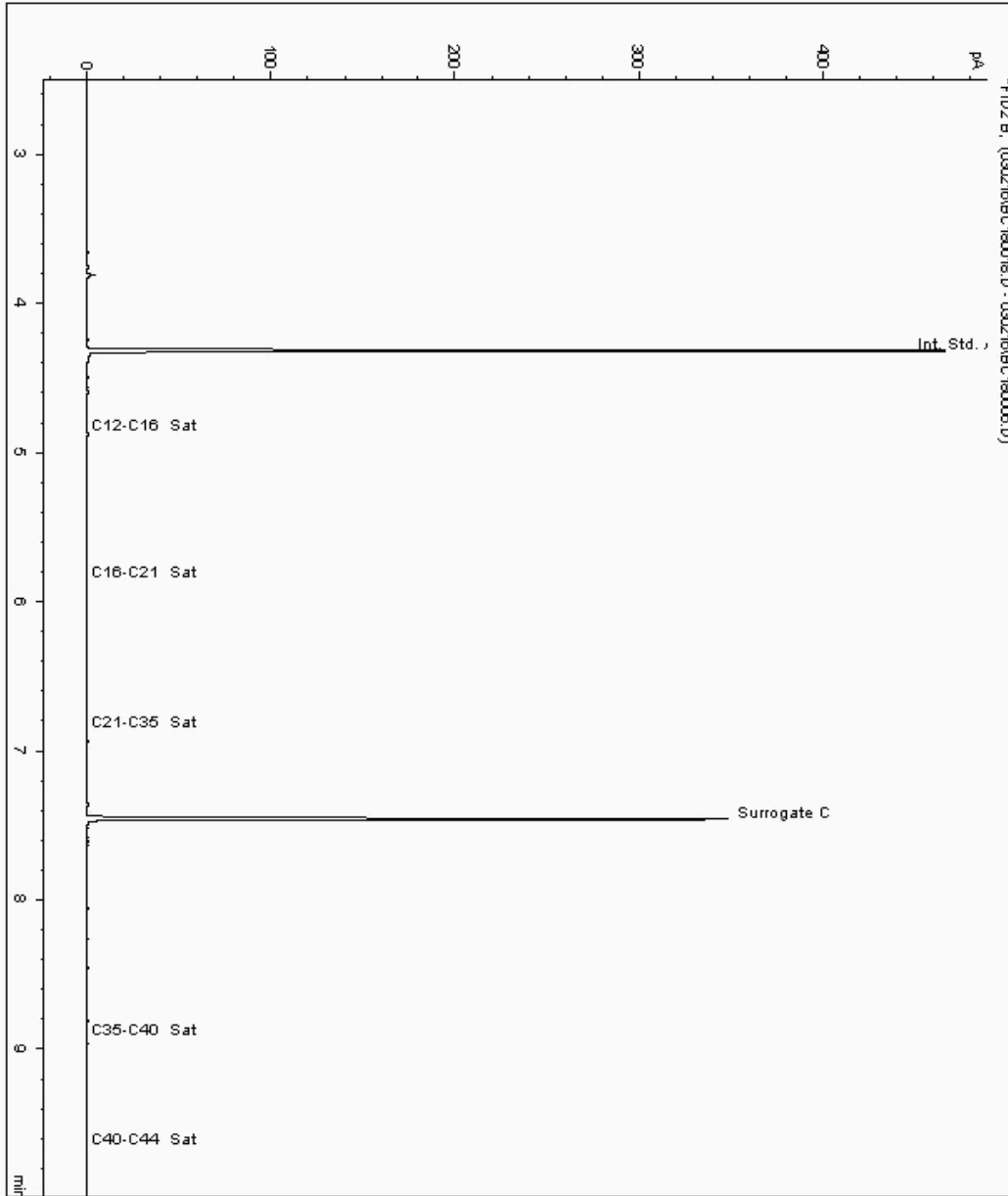
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 13009625
Sample ID : BH103

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 12261842-
Date Acquired : 02/03/2016 21:23:51 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 60481591
Report Number: 352050
Superseded Report:

Chromatogram

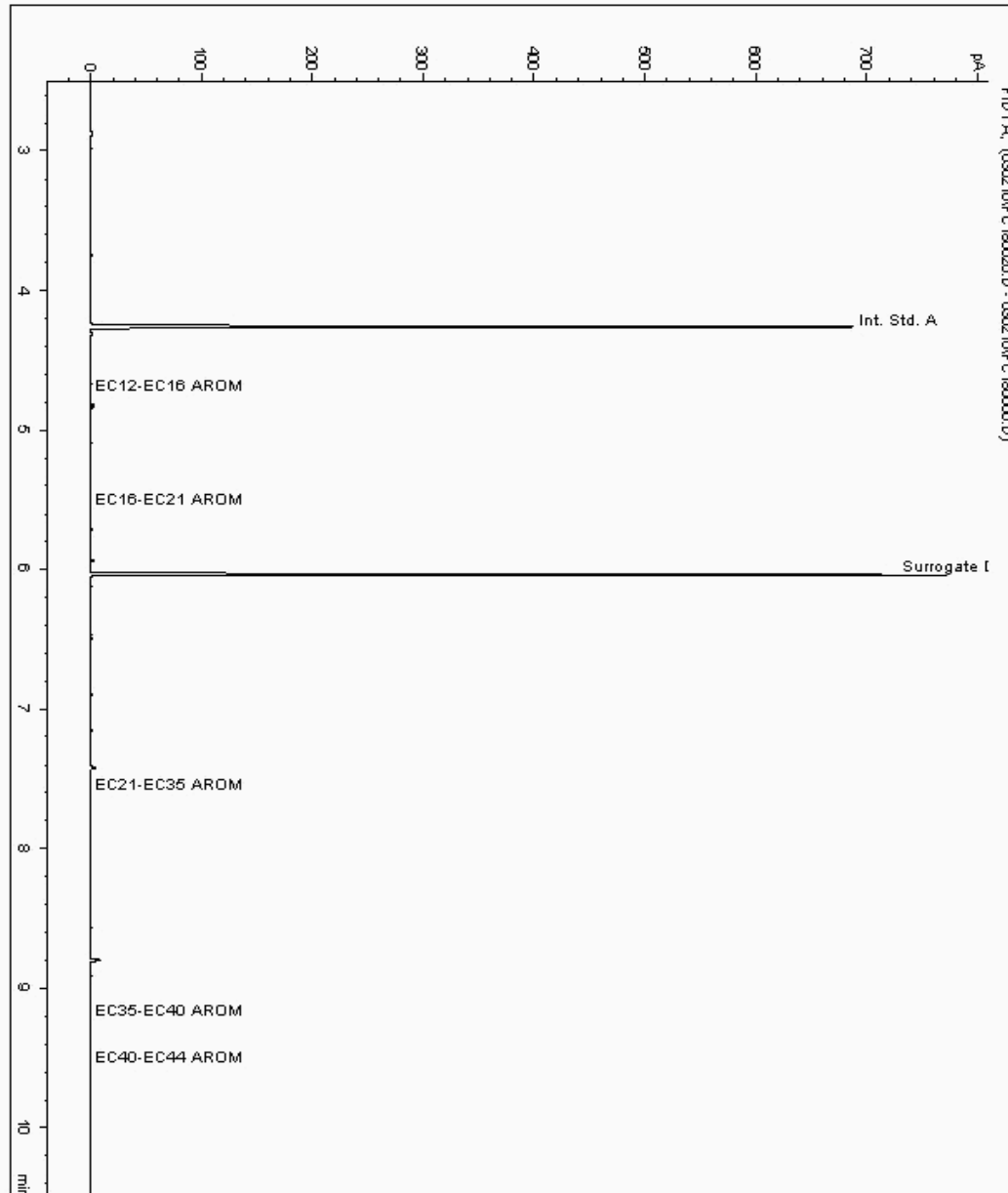
Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 13009286
Sample ID : BH106A

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 12261853-
Date Acquired : 02/03/2016 23:53:28 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 60481591
Report Number: 352050
Superseded Report:

Chromatogram

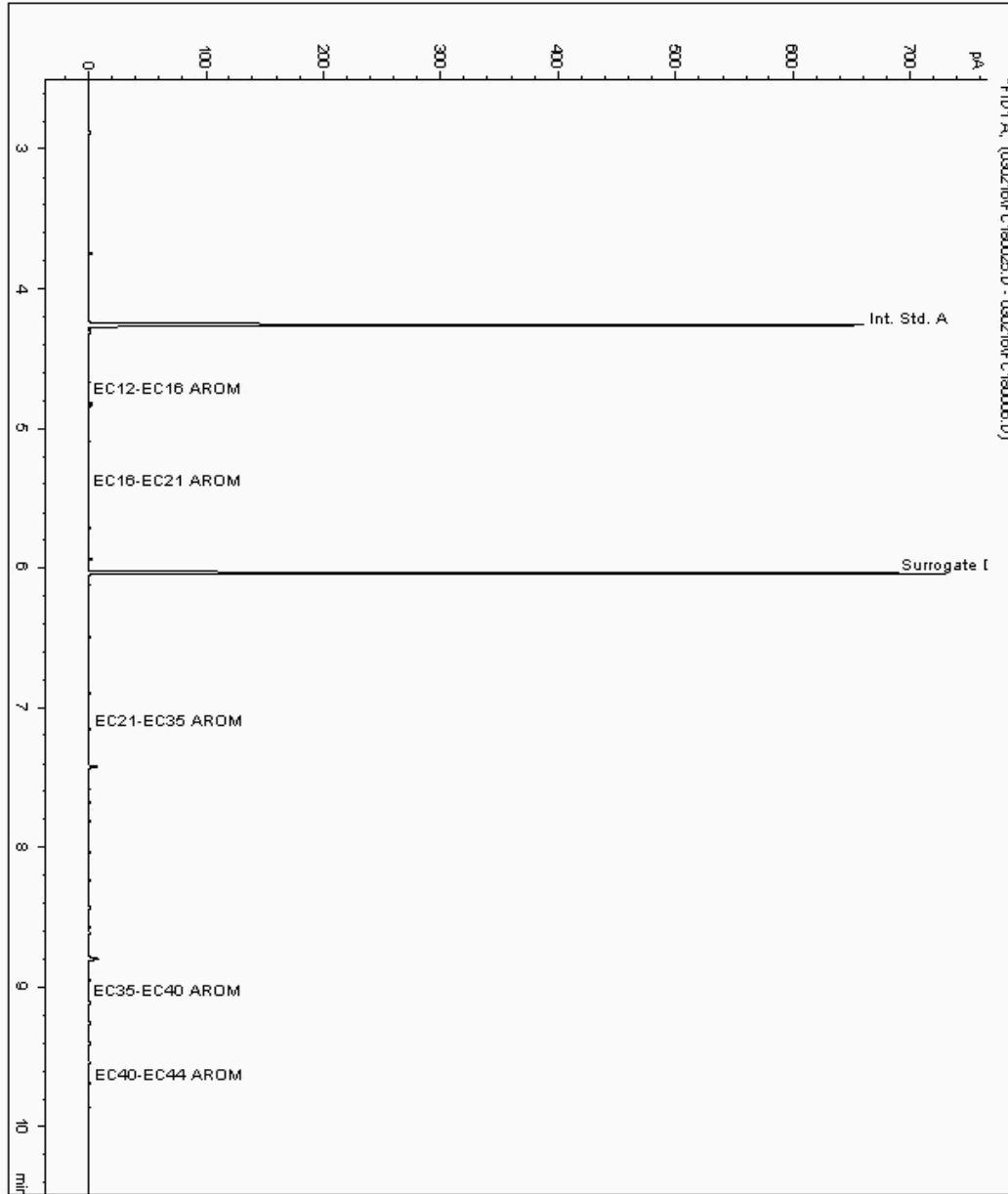
Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 13009288
Sample ID : BH105A

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 12261868-
Date Acquired : 02/03/2016 23:34:49 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 60481591
Report Number: 352050
Superseded Report:

Chromatogram

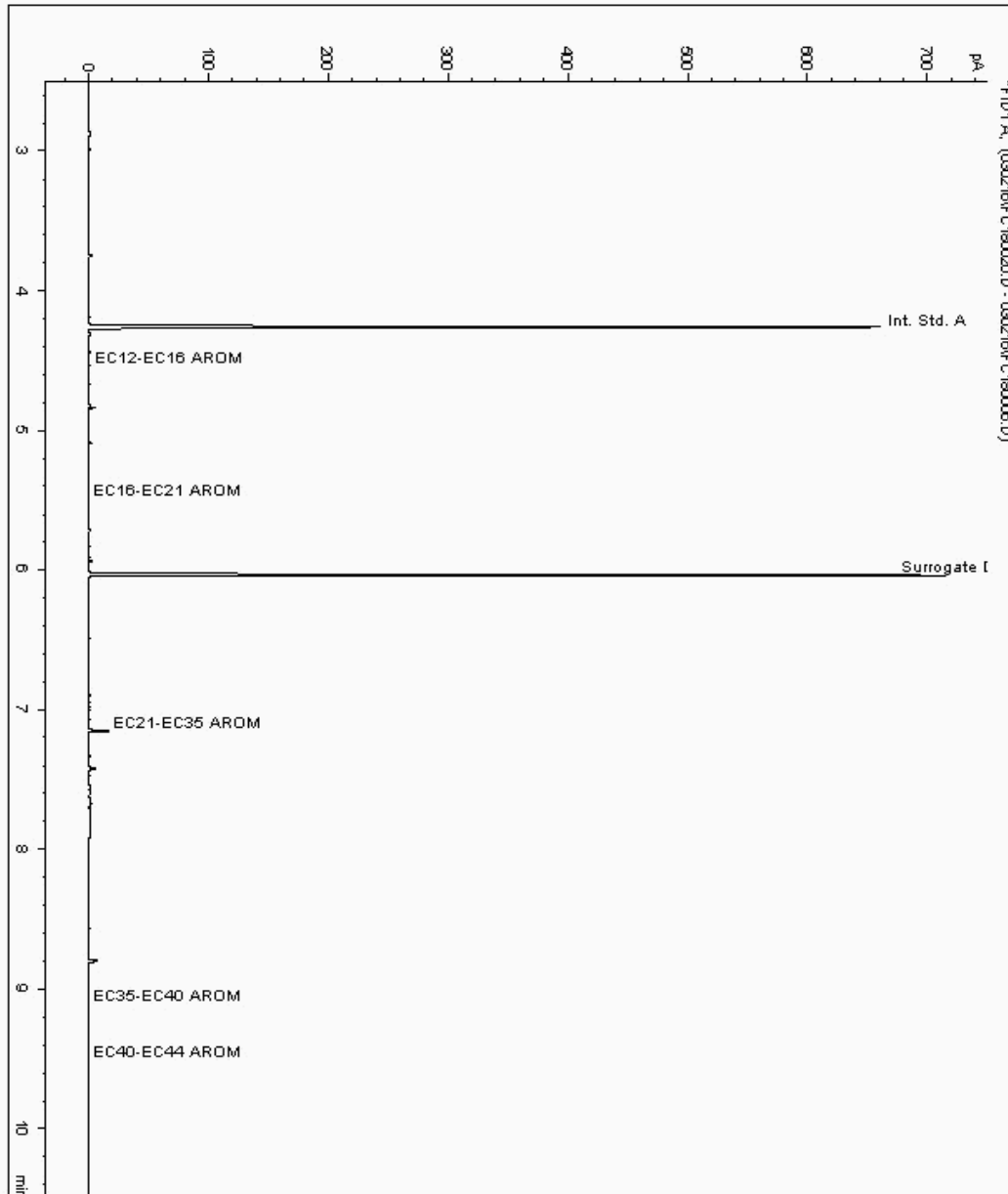
Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 13009290
Sample ID : EB

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 12261884-
Date Acquired : 02/03/2016 22:01:07 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008

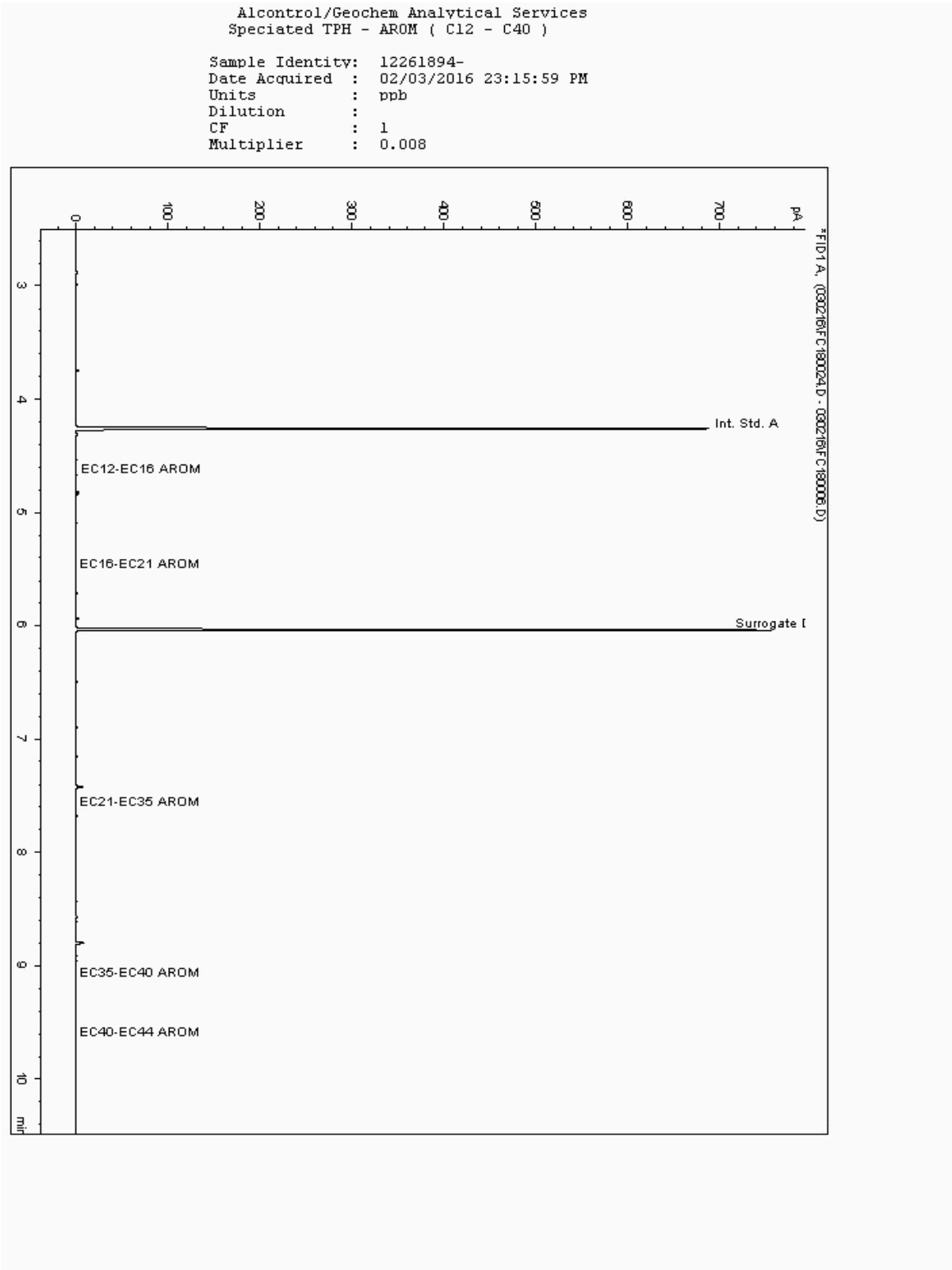




SDG:	160227-59	Location:	Shell Hitchin	Order Number:	60481591
Job:	H_URS_WIM-174	Customer:	AECOM	Report Number:	352050
Client Reference:		Attention:	Bethan Short	Superseded Report:	

Chromatogram

Analysis:	EPH CWG (Aromatic) Aqueous GC (W)	Sample No :	13009292	Depth :	
		Sample ID :	DUP		





SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 60481591
Report Number: 352050
Superseded Report:

Chromatogram

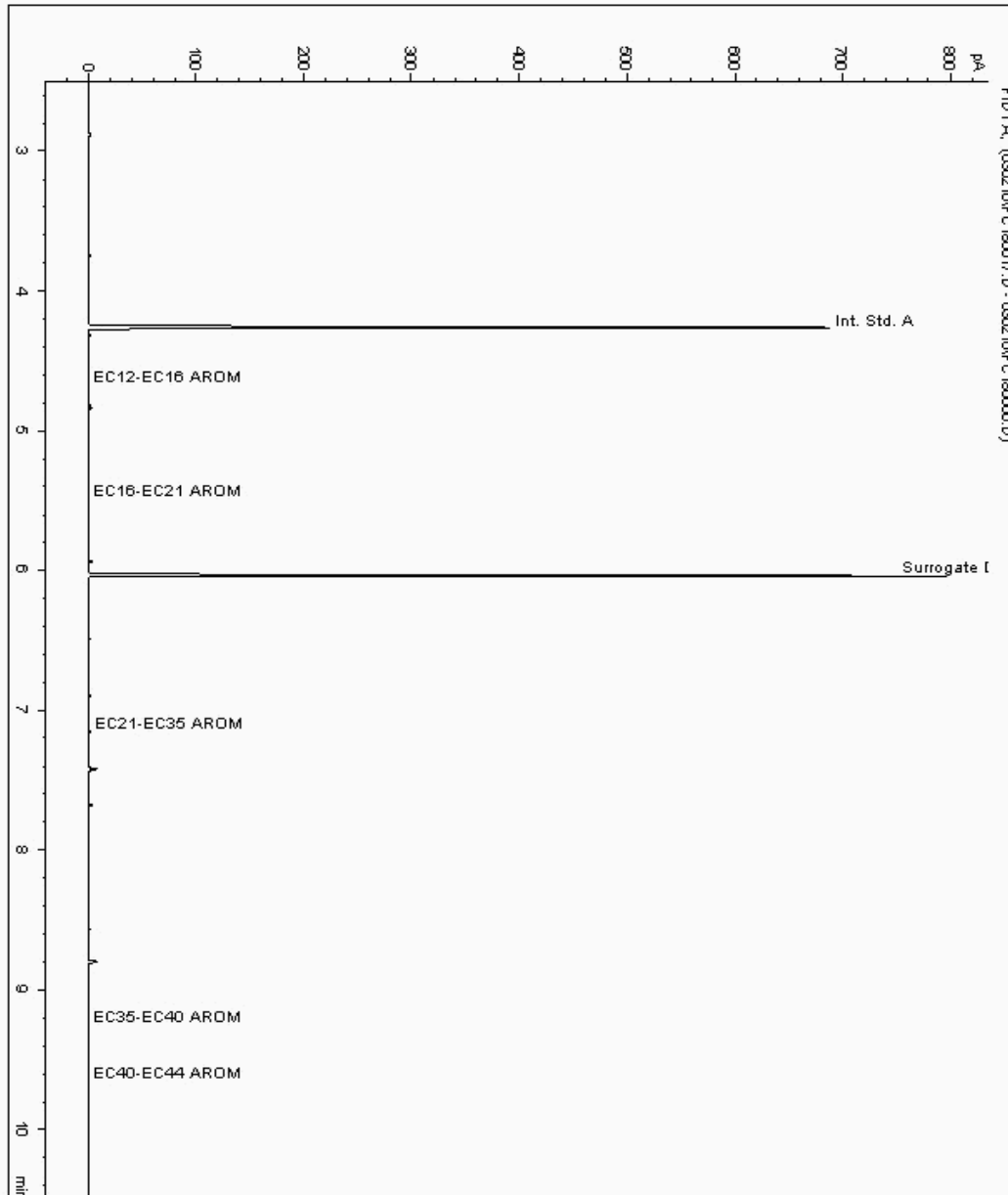
Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 13009619
Sample ID : BH102A

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 12261829-
Date Acquired : 02/03/2016 21:05:10 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 60481591
Report Number: 352050
Superseded Report:

Chromatogram

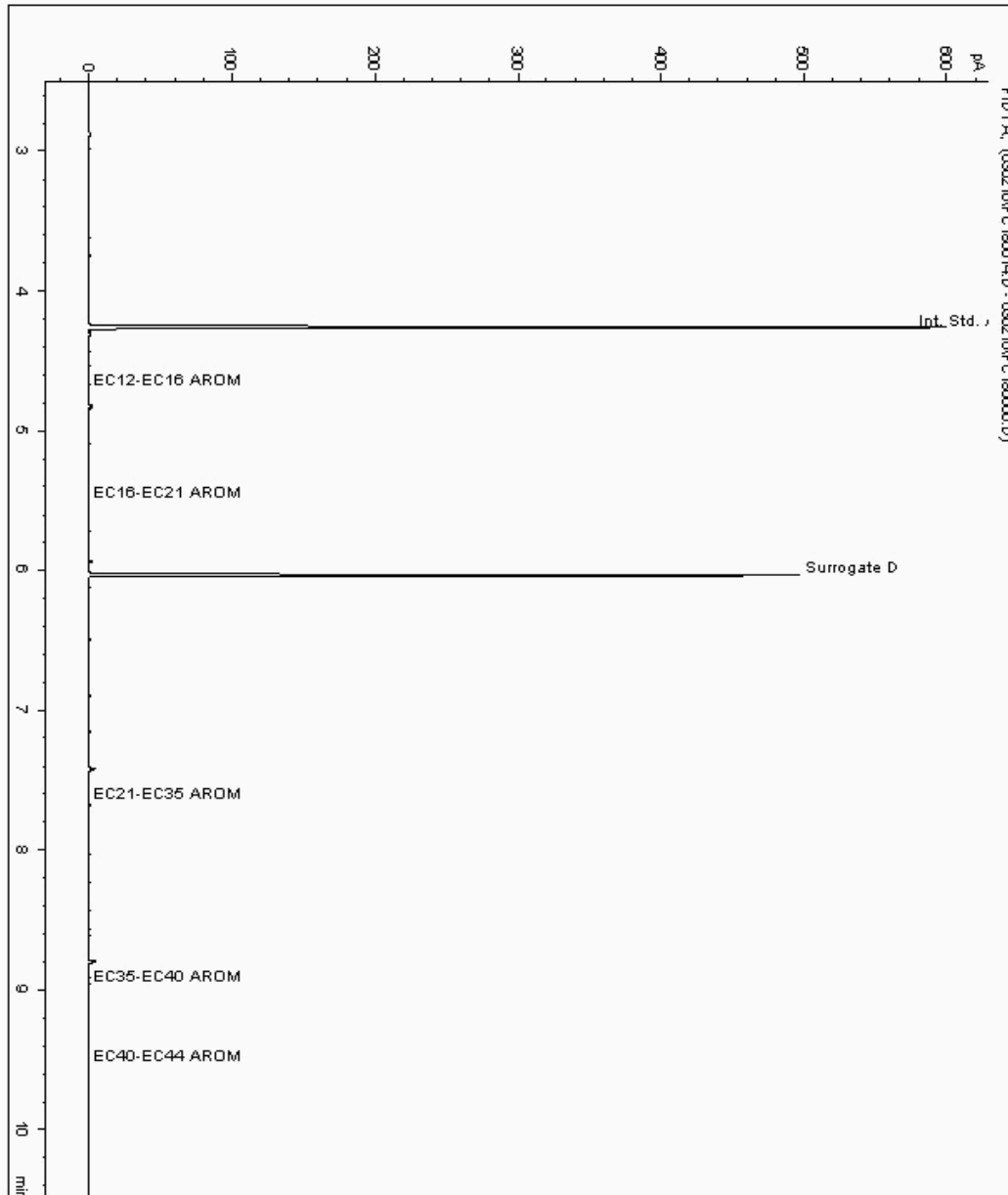
Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 13009622
Sample ID : BH102

Depth :

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 12261815-
Date Acquired : 02/03/2016 20:08:58 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008

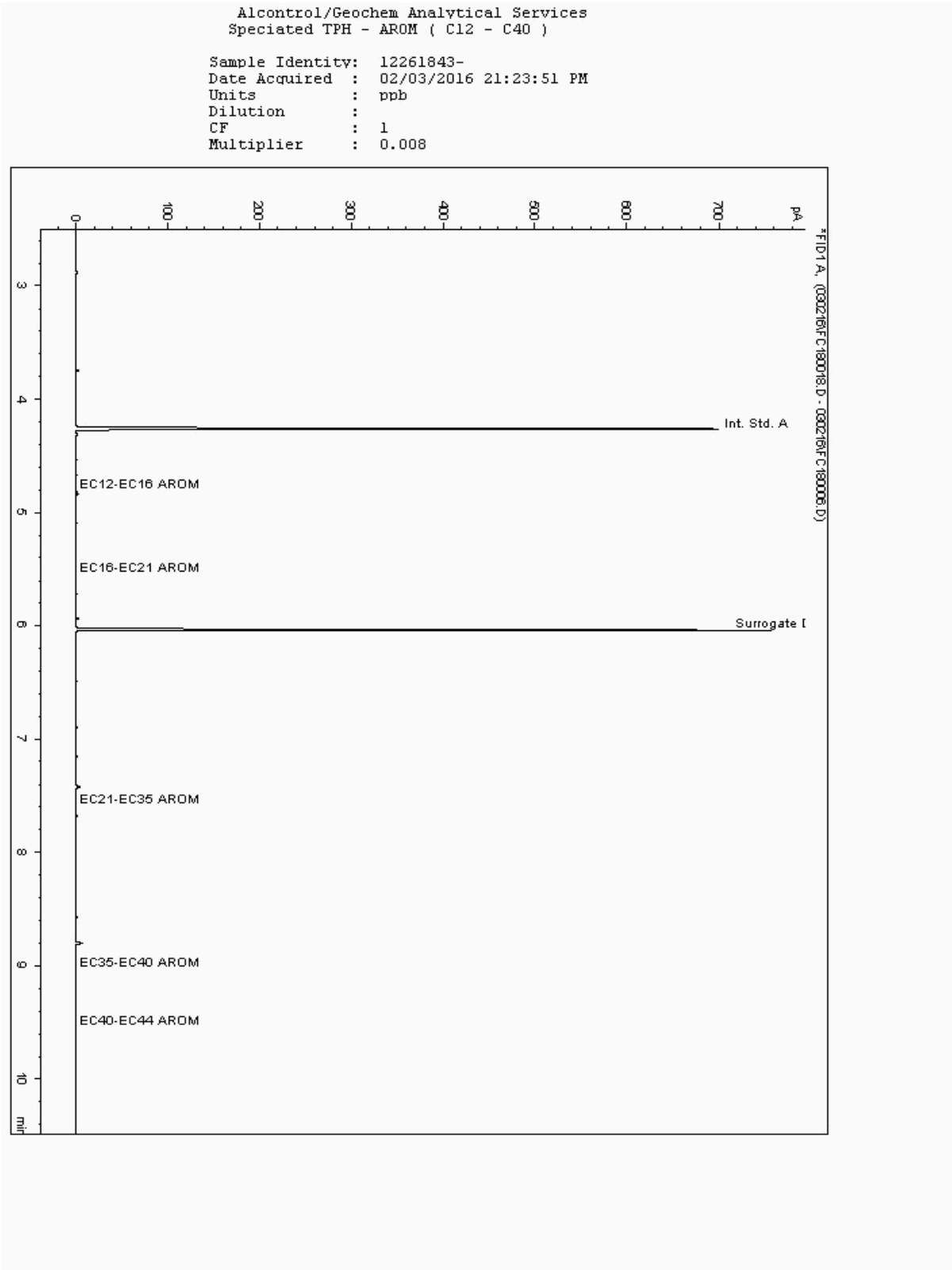




SDG:	160227-59	Location:	Shell Hitchin	Order Number:	60481591
Job:	H_URS_WIM-174	Customer:	AECOM	Report Number:	352050
Client Reference:		Attention:	Bethan Short	Superseded Report:	

Chromatogram

Analysis:	EPH CWG (Aromatic) Aqueous GC (W)	Sample No :	13009625	Depth :	
		Sample ID :	BH103		





SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

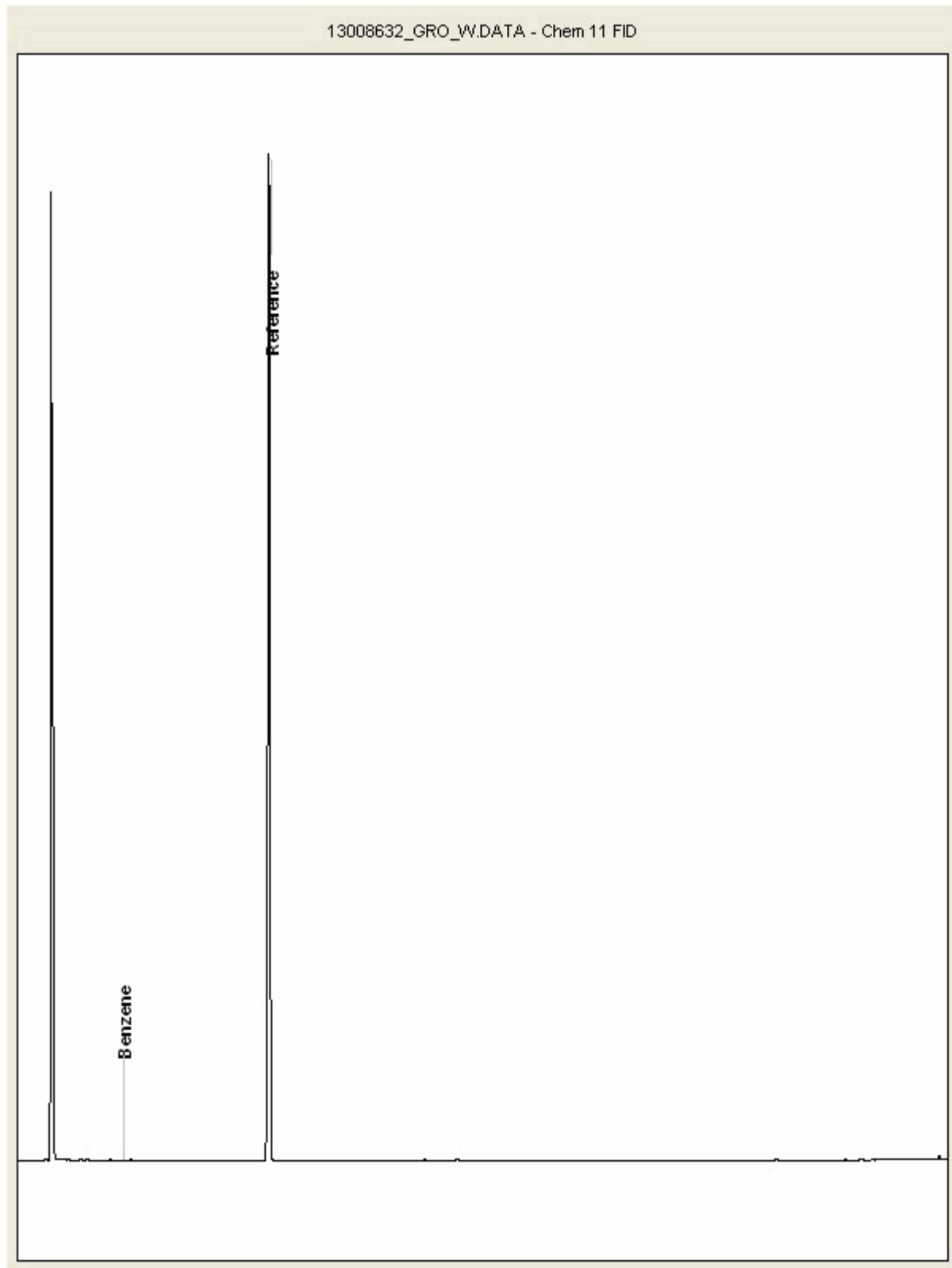
Order Number: 60481591
Report Number: 352050
Superseded Report:

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 13008632
Sample ID : EB

Depth :





CERTIFICATE OF ANALYSIS

Validated

SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

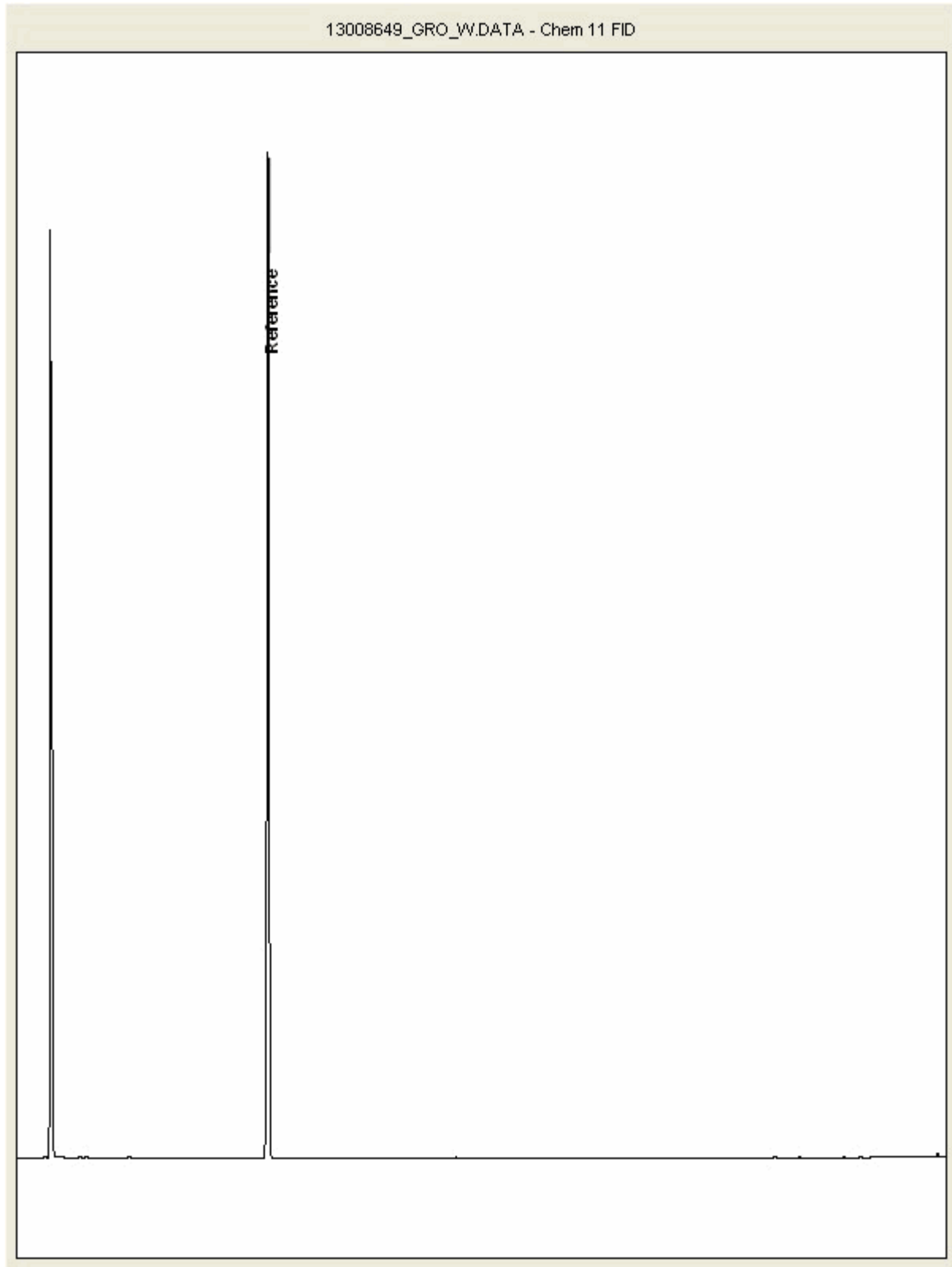
Order Number: 60481591
Report Number: 352050
Superseded Report:

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 13008649
Sample ID : BH106A

Depth :





SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

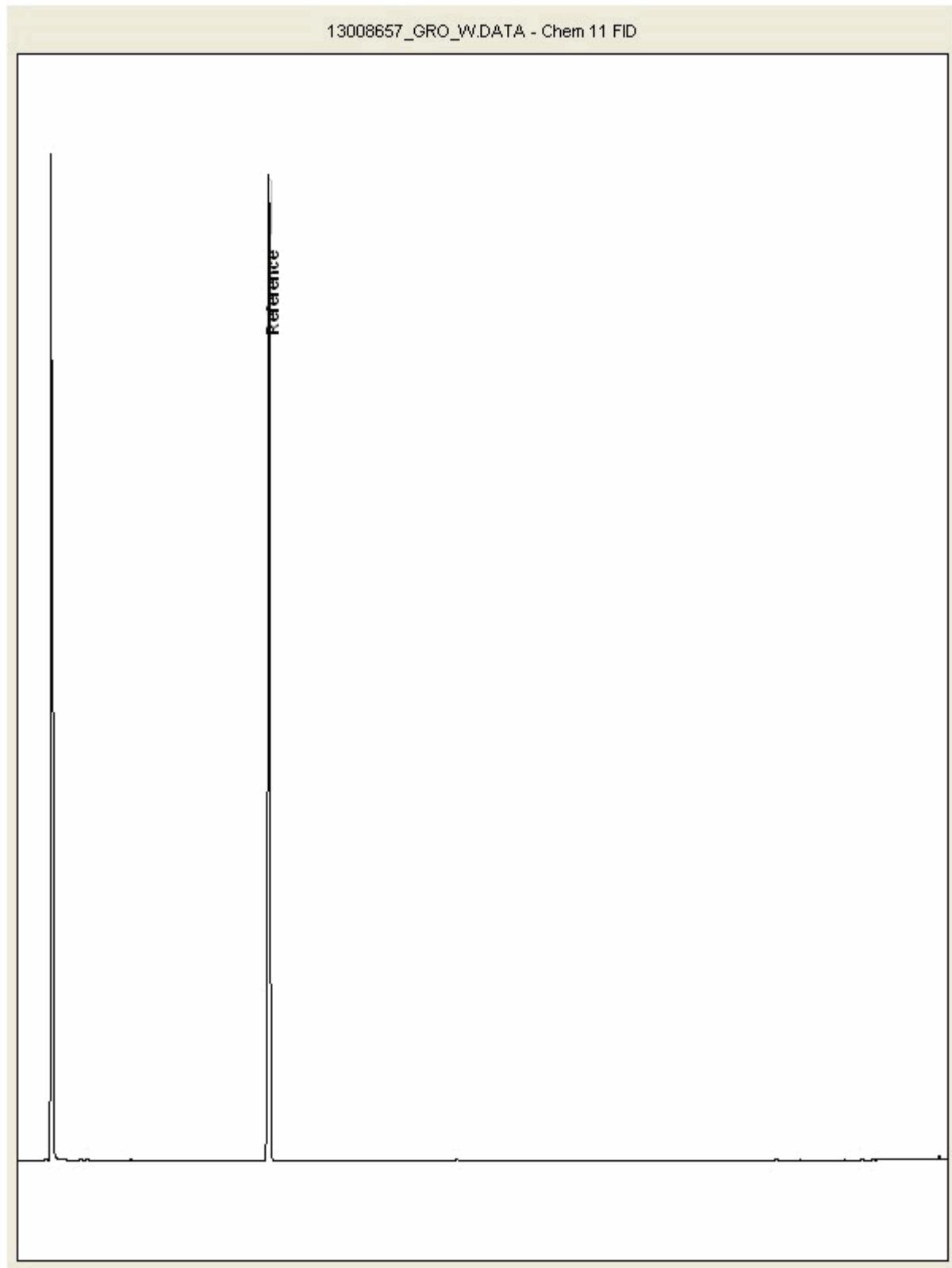
Order Number: 60481591
Report Number: 352050
Superseded Report:

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 13008657
Sample ID : BH105A

Depth :





SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

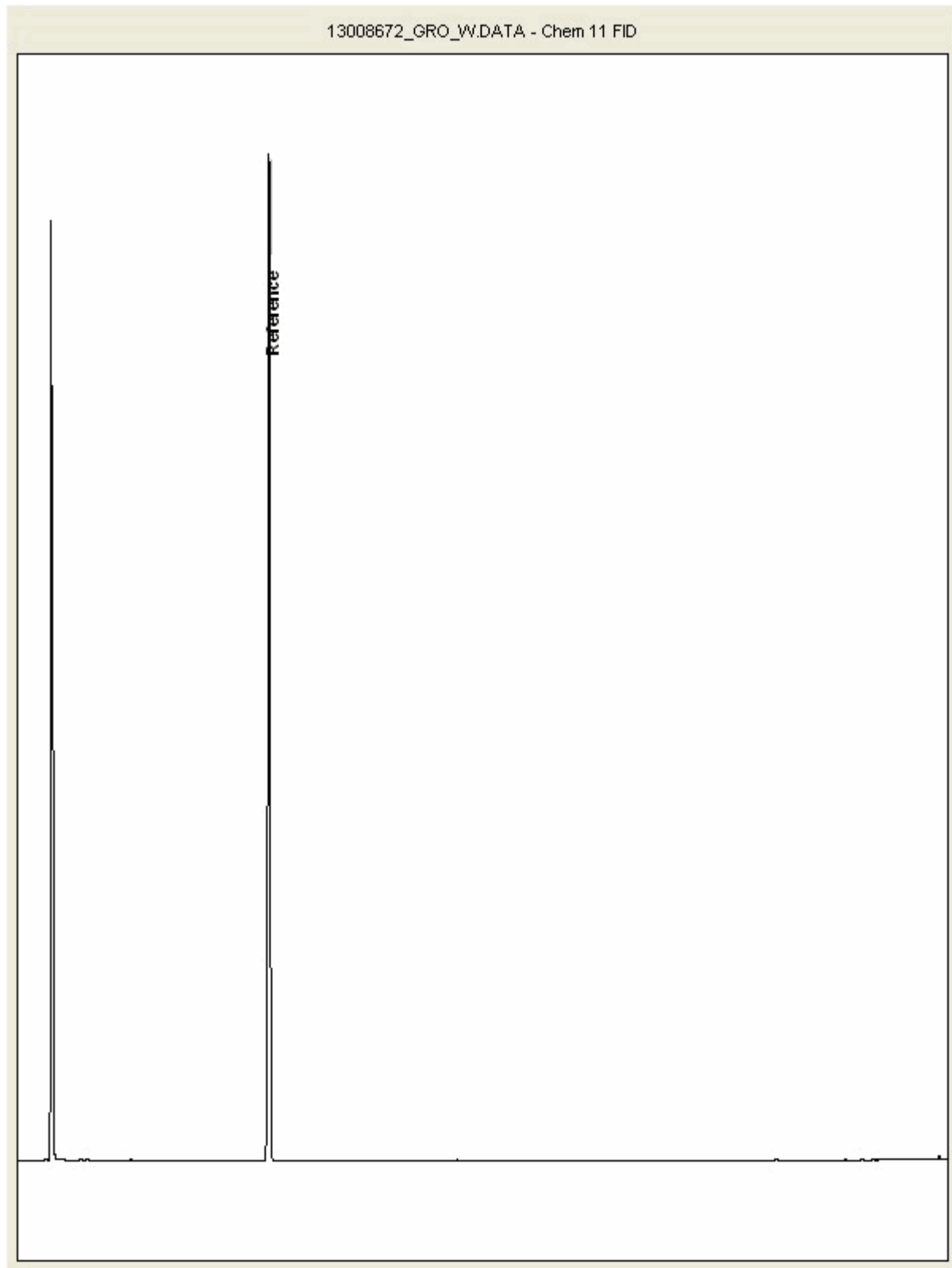
Order Number: 60481591
Report Number: 352050
Superseded Report:

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 13008672
Sample ID : DUP

Depth :





SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

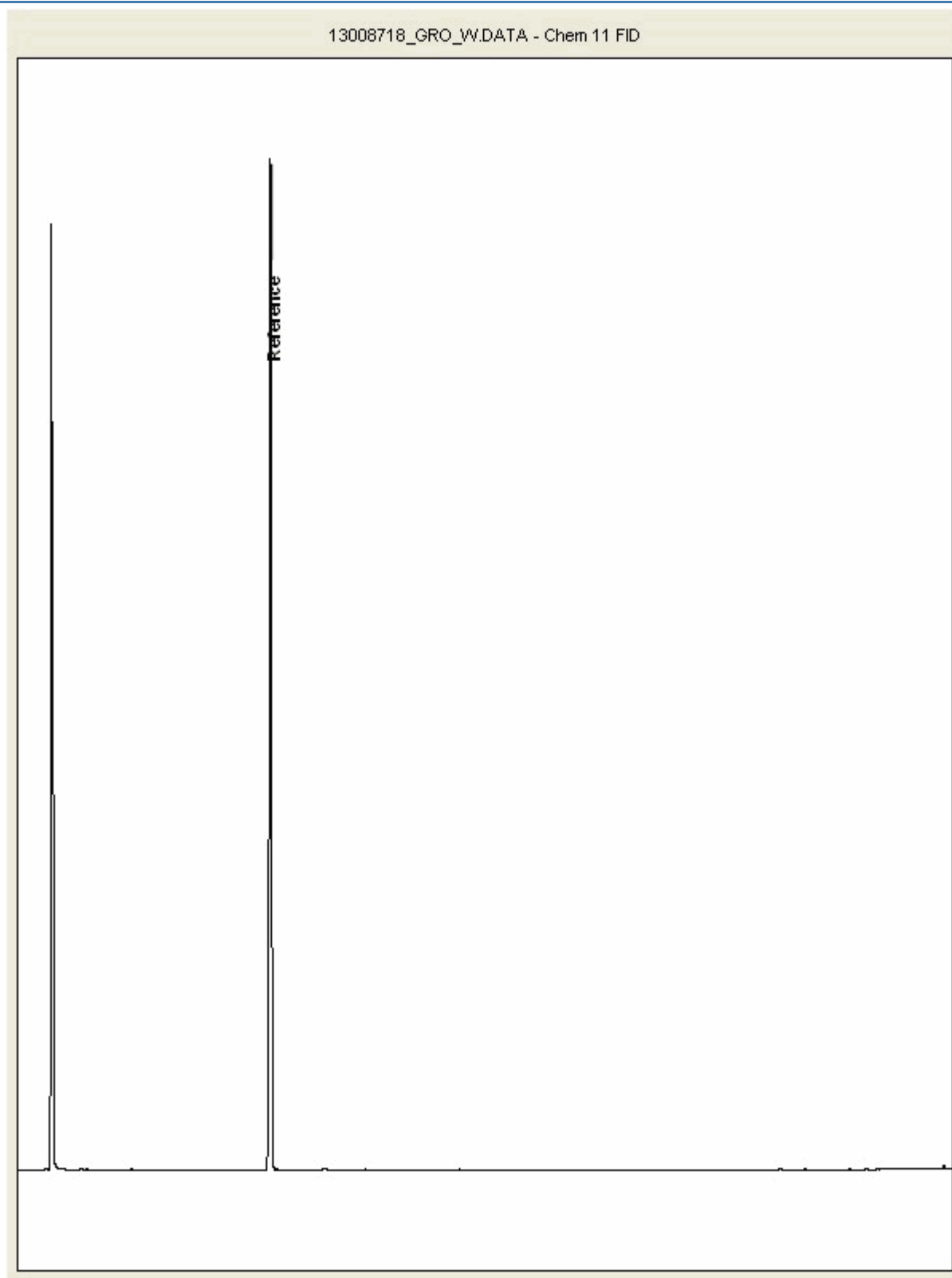
Order Number: 60481591
Report Number: 352050
Superseded Report:

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 13008718
Sample ID : BH103

Depth :





SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

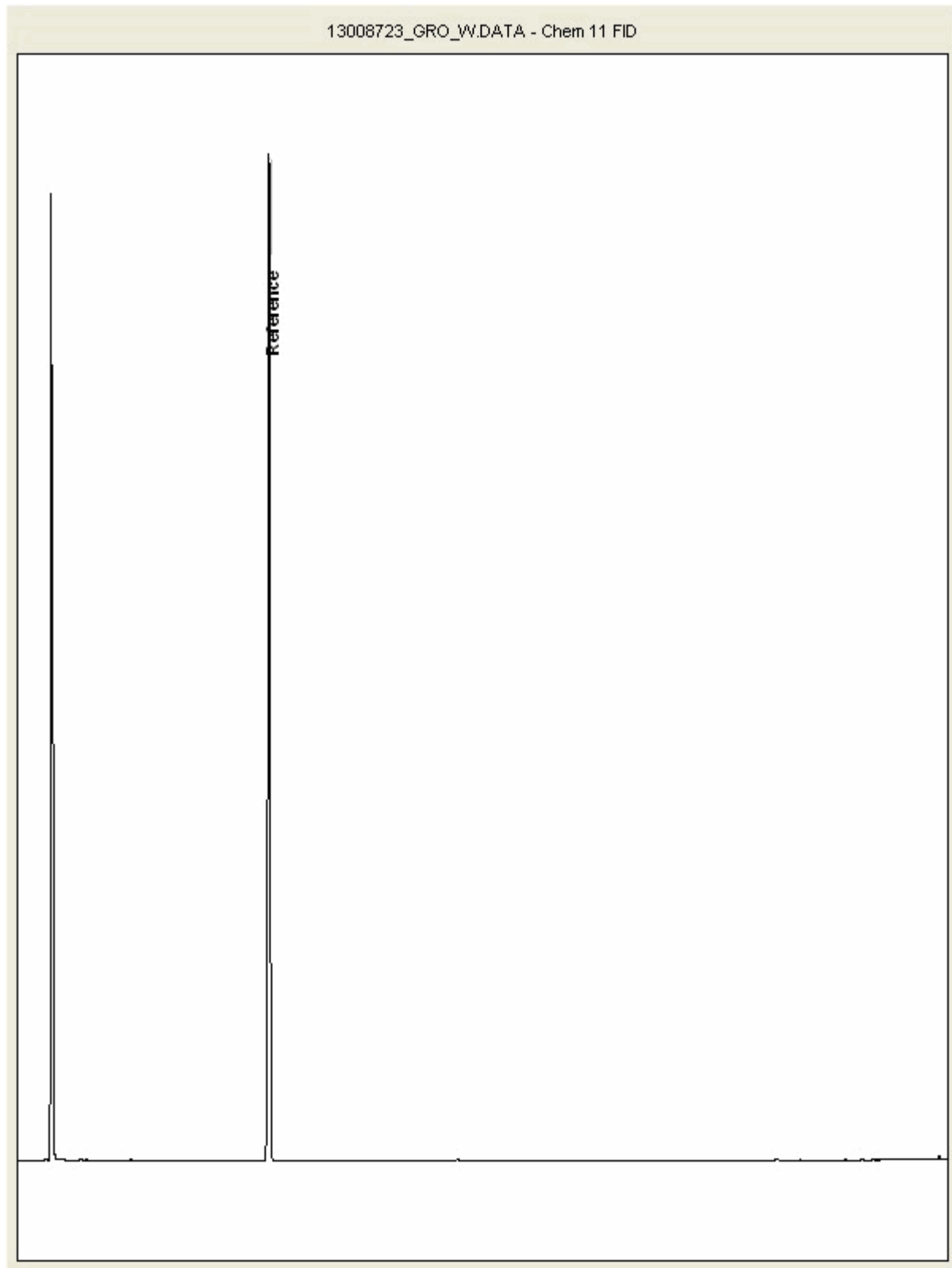
Order Number: 60481591
Report Number: 352050
Superseded Report:

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 13008723
Sample ID : BH102A

Depth :





SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

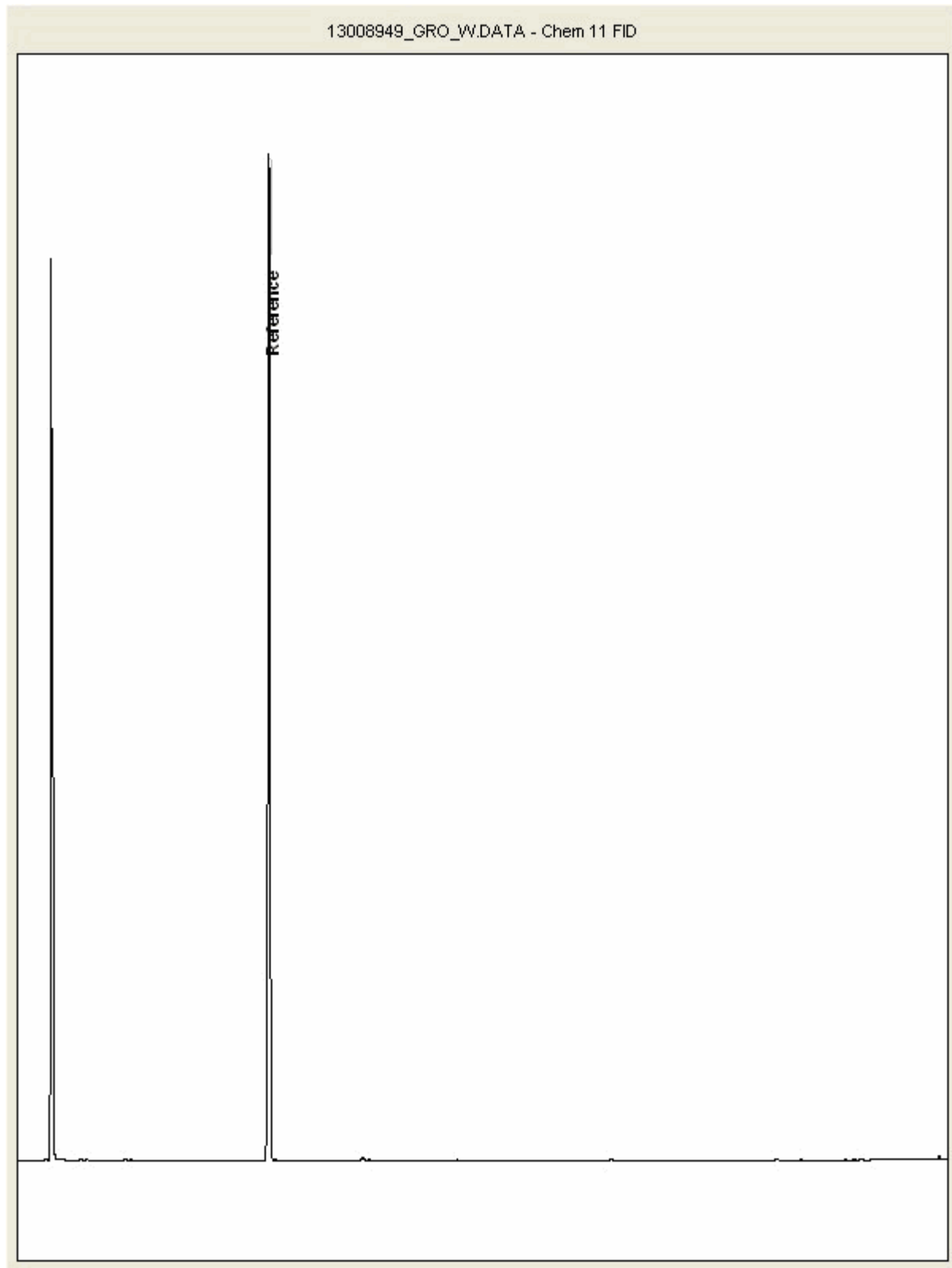
Order Number: 60481591
Report Number: 352050
Superseded Report:

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 13008949
Sample ID : BH102

Depth :





SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 60481591
Report Number: 352050
Superseded Report:

Appendix

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA Leach tests, flash point, ammonium as NH₄ by the BRE method, VOC TICS, SVOC TICS, TOF-MS SCAN/SEARCH and TOF-MS TICS.

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

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for both soil jars, tubs and volatile jars. All waters and vials will be discarded 10 days after the analysis is completed (e-mailed). All material removed during an asbestos containing material screen and analysed for the presence of asbestos will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALcontrol Laboratories reserve the right to charge for samples received and stored but not analysed.

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

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

6. When requested, the individual sub sample scheduled will be screened in house for the presence of large asbestos containing material fragments/pieces. If no asbestos containing material is found this will be reported as 'no asbestos containing material detected'. If asbestos containing material is detected it will be removed and analysed by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If asbestos containing material is present no further analysis will be undertaken. At no point is the fibre content of the soil sample determined.

7. If no separate volatile sample is supplied by the client, the integrity of the data may be compromised if the laboratory is required to create a sub-sample from the bulk sample -similarly, if a headspace or sediment is present in the volatile sample. This will be flagged up as an invalid VOC on the test schedule or recorded on the log sheet.

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

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

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

11. A table containing the date of analysis for each parameter is not routinely included with the report, but is available upon request.

12. Results relate only to the items tested

13. **Surrogate recoveries** -Most of our organic methods include surrogates, the recovery of which is monitored and reported. For EPH, MO, PAH, GRO and VOCs on soils the result is not surrogate corrected, but a percentage recovery is quoted. Acceptable limits for most organic methods are 70 -130 %.

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

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

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 14).

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

18. Our MCERTS accreditation for PAHs by GCMS applies to all product types apart from Kerosene, where naphthalene only is not accredited.

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

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

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

22. For all leachate preparations (NRA, DIN, TCLP, BSEN 12457-1, 2, 3) volatile loss may occur, as we do not employ zero headspace extraction.

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

24. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C₄-C₁₀ range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

SOLID MATRICES EXTRACTION SUMMARY

ANALYSIS	D/C OR WET	EXTRACTION SOLVENT	EXTRACTION METHOD	ANALYSIS
SOLVENT EXTRACTABLE MATTER	D&C	DOM	SOX THERM	GRAMMETRIC
CYCLOHEXANE EXT. MATTER	D&C	CYCLOHEXANE	SOX THERM	GRAMMETRIC
THIN LAYER CHROMATOGRAPHY	D&C	DOM	SOX THERM	IATROSCAN
ELEMENTAL SULPHUR	D&C	DOM	SOX THERM	HPLC
PHENOL/SB/GOMS	WET	DOM	SOX THERM	GCMS
HERBICIDES	D&C	HBXANEACETONE	SOX THERM	GCMS
PESTICIDES	D&C	HBXANEACETONE	SOX THERM	GCMS
EPH (DRO)	D&C	HBXANEACETONE	END OVEREND	GC FID
EPH (MINOIL)	D&C	HBXANEACETONE	END OVEREND	GC FID
EPH (CLEANED UP)	D&C	HBXANEACETONE	END OVEREND	GC FID
EPH CWG BY GC	D&C	HBXANEACETONE	END OVEREND	GC FID
PCB TOT / PCB CON	D&C	HBXANEACETONE	END OVEREND	GCMS
POLYAROMATIC HYDROCARBONS (MS)	WET	HBXANEACETONE	MICROWAVE TM28.	GCMS
C8-C40 (C8-C40) EZ FLASH	WET	HBXANEACETONE	SHAKER	GCEZ
POLYAROMATIC HYDROCARBONS RAPID GC	WET	HBXANEACETONE	SHAKER	GCEZ
SEM VOLATILE ORGANIC COMPOUNDS	WET	DOMACETONE	SONICATE	GCMS

LIQUID MATRICES EXTRACTION SUMMARY

ANALYSIS	EXTRACTION SOLVENT	EXTRACTION METHOD	ANALYSIS
PAHMS	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GCMS
EPH	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC FID
EPH CWG	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC FID
MINERAL OIL	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC FID
PCB 7 CONGENERS	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GCMS
PCB TOTAL	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GCMS
SVOC	DOM	LIQUID/LIQUID SHAKE	GCMS
FREESULPHUR	DOM	SOLID PHASE EXTRACTION	HPLC
PEST COP/OPP	DOM	LIQUID/LIQUID SHAKE	GCMS
TRIAZINE HERBS	DOM	LIQUID/LIQUID SHAKE	GCMS
PHENOLS MS	DOM	SOLID PHASE EXTRACTION	GCMS
TPH by INFRARED (IR)	TCE	LIQUID/LIQUID SHAKE	HPLC
MINERAL OIL by IR	TCE	LIQUID/LIQUID SHAKE	HPLC
GLYCOLS	NONE	DIRECT INJECTION	GCMS

Identification of Asbestos in Bulk Materials

The results for asbestos identification for soil samples are obtained from possible Asbestos Containing Material, removed during the 'Screening of soils for Asbestos Containing Materials', which have been examined to determine the presence of asbestos fibres using Alcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Visual Estimation Of Fibre Content

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

Further guidance on typical asbestos fibre content of manufactured products can be found in MDHS 100.

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

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



SDG: 160227-59
Job: H_URS_WIM-174
Client Reference:

Location: Shell Hitchin
Customer: AECOM
Attention: Bethan Short

Order Number: 60481591
Report Number: 352050
Superseded Report:

Appendix

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

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

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

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

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

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

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

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

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

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

11. Results relate only to the items tested.

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

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

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

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

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

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

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

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

General

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

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

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

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

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

Sample Deviations

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

Asbestos

Identification of Asbestos in Bulk Materials & Soils

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

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

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

Visual Estimation Of Fibre Content

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

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

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

APPENDIX D STAGE 3 TABLES

Table 1a
Groundwater Analytical Results
Compared Against Controlled Waters SSAC
(Model 1: Groundwater in the Chalk)

	Units	Method Detection Limit	10019011_Hitchin_GW_SSAC_Model_1_Chalk	Location Well	BH102A				BH105A				BH106A								
					Sample Type	Normal	29/05/2015	11/11/2015	26/02/2016	Normal	29/05/2015	11/11/2015	26/02/2016	Normal	29/05/2015	11/11/2015	26/02/2016				
																		Date	Date	Date	Date
																		Lab Report Number	294880	320704	338729
BTEX					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1					
Benzene	µg/l	1	747 ^{±1}	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1				
Toluene	µg/l	1	Soi ^{±1}	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1				
Ethylbenzene	µg/l	1	Soi ^{±1}	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1				
Xylene (m & p)	µg/l	1	Soi ^{±1}	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1				
Xylene (o)	µg/l	1	Soi ^{±1}	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1				
Xylene Total	µg/l			0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Oxygenates					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1				
Diisopropyl Ether	µg/l	1	120 ^{±1}	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1				
Ethyl Tert Butyl Ether	µg/l	1	40 ^{±1}	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1				
Methyl Tert Butyl Ether	µg/l	1	30 ^{±1}	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1				
Tert Amyl Methyl Ether	µg/l	1	140 ^{±1}	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1				
Tert Butyl Alcohol	µg/l	10	40 ^{±1}	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10				
Ethanol	µg/l	50	1 100 000 ^{±1}	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50				
PAH					<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015				
Acenaphthene	µg/l	0.015	Soi ^{±1}	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011				
Acenaphthylene	µg/l	0.011	16 000 ^{±1}	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015				
Anthracene	µg/l	0.015	Soi ^{±1}	<0.017	<0.017	0.0173	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017				
Benzo(a)anthracene	µg/l	0.017	Soi ^{±1}	0.0223	0.01	0.0383	0.0212	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	0.01	<0.009	<0.009				
Benzo(b)fluoranthene	µg/l	0.023	Soi ^{±1}	0.0281	<0.023	0.0546	0.0293	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023				
Benzo(g,h,i)perylene	µg/l	0.016	Soi ^{±1}	0.0275	0.02	0.0555	0.0281	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	0.02	<0.016	<0.016				
Benzo(k)fluoranthene	µg/l	0.027	Soi ^{±1}	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027				
Chrysene	µg/l	0.013	Soi ^{±1}	0.0192	<0.013	0.0246	0.0134	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013				
Dibenz(a,h)anthracene	µg/l	0.016	Soi ^{±1}	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016				
Fluoranthene	µg/l	0.017	Soi ^{±1}	0.0185	<0.017	0.0341	0.0254	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	0.02	<0.017	<0.017				
Fluorene	µg/l	0.014	Soi ^{±1}	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014				
Indeno(1,2,3-c,d)pyrene	µg/l	0.014	Soi ^{±1}	0.0261	0.02	0.0276	0.0244	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014				
Naphthalene	µg/l	0.1	874 ^{±1}	<0.1	<0.1	<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	µg/l	0.022	Soi ^{±1}	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022				
Pyrene	µg/l	0.015	Soi ^{±1}	0.0217	<0.015	0.0375	0.0271	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	0.02	<0.015	<0.015				
PAHs (sum of 4)	µg/l			0.0817	0.04	0.1377	0.0818	0	0	0	0	0	0	0	0.02	0	0				
Benzo(b,k)fluoranthene	µg/l			0.0281	0	0.0546	0.0293	0	0	0	0	0	0	0	0	0	0				
PAH 16 Total	µg/l	0.344		<0.344	<0.344	<0.344	<0.344	<0.344	<0.344	<0.344	<0.344	<0.344	<0.344	<0.344	<0.344	<0.344	<0.344				
Benzo(g,h,i)perylene + indeno(1,2,3-cd)pyrene	µg/l			0.0536	0.04	0.0831	0.0525	0	0	0	0	0	0	0	0.02	0	0				
Coal tar (BaP as a surrogate)	µg/l			0.0222	0.01	0.0383	0.0212	0	0	0	0	0	0	0	0.01	0	0				
TPH					<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10				
>EC5-EC7 Aromatics	µg/l	10	7 430 ^{±1}	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10				
>EC7-EC8 Aromatics	µg/l	10	Soi ^{±1}	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10				
>EC8-EC10 Aromatics	µg/l	10	Soi ^{±1}	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10				
>EC10-EC12 Aromatics	µg/l	10	Soi ^{±1}	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10				
>EC12-EC16 Aromatics	µg/l	10	Soi ^{±1}	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10				
>EC16-EC21 Aromatics	µg/l	10	Soi ^{±1}	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10				
>EC21-EC35 Aromatics	µg/l	10	Soi ^{±1}	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10				
>C5-C6 Aliphatics	µg/l	10	Soi ^{±1}	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10				
>C6-C8 Aliphatics	µg/l	10	Soi ^{±1}	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10				
>C8-C10 Aliphatics	µg/l	10	Soi ^{±1}	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10				
>C10-C12 Aliphatics	µg/l	10	Soi ^{±1}	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10				
>C12-C16 Aliphatics	µg/l	10	Soi ^{±1}	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10				
>C16-C21 Aliphatics	µg/l	10	Soi ^{±1}	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10				
>C16-C35 Aliphatics	µg/l			0	0	0	0	0	0	0	0	0	0	0	0	0	0				
>C21-C35 Aliphatics	µg/l	10	Soi ^{±1}	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10				
Misc					<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100				
Ferrous Iron	µg/l	100		38.6	38	39.7	37	38	38	41.9	33.1	7.18	7.29	8.5	10.2						
Nitrate (as NO3-)	mg/l	0.3		74.2	70.2	72.3	70.2	87.8	84.4	86.6	101	39.2	41.9	53.1	47.2						
Sulphate (soluble)	mg/l	2																			

Comments
#1 SSAC URS DQRA 2013
SSAC: Site Specific Assessment Criteria
(blank): No assessment criteria available
Sol: Unacceptable risk not achieved due to calculated target above solubility limit

Key
XXX Exceedance of 10019011_Hitchin_GW_SSAC_Model_1_Chalk

Table 1b
Groundwater Analytical Results
Compared Against Controlled Waters SSAC
(Model 2: Groundwater in the Drift Deposits)

	Units	Method Detection Limit	10019011_Hitchin_GW_SSAC_Model_2_Drift_Deposits	Location				BH102A				BH102				BH103			
				Well															
				Date															
				Sample Type															
				Lab Report Number	01/12/2014 Normal 294880	29/05/2015 Normal 320704	11/11/2015 Normal 338729	26/02/2016 Normal 352050	01/12/2014 Normal 294880	29/05/2015 Normal 320704	11/11/2015 Normal 338729	26/02/2016 Normal 352050	01/12/2014 Normal 294880	29/05/2015 Normal 320704	11/11/2015 Normal 338729	26/02/2016 Normal 352050			
BTEX																			
Benzene	µg/l	1	63.7 ^{#1}		<1	<1	<1	<1		118	12.6	248	<1		<1	<1	<1	<1	
Toluene	µg/l	1	So ^{#1}		<1	<1	<1	<1		9.3	<1	15.4	<1		<1	<1	<1	<1	
Ethylbenzene	µg/l	1	So ^{#1}		<1	<1	<1	<1		347	28.5	551	<1		<1	<1	<1	<1	
Xylene (m & p)	µg/l	1	So ^{#1}		<1	<1	<1	<1		219	39.6	1,080	<1		<1	<1	<1	<1	
Xylene (o)	µg/l	1	So ^{#1}		<1	<1	<1	<1		23.3	2.68	184	<1		<1	<1	<1	<1	
Xylene Total	µg/l				0	0	0	0		242.3	42.28	1,264	0		0	0	0	0	
Oxygenates																			
Diisopropyl Ether	µg/l	1	120 ^{#1}		<1	<1	<1	<1		<1	<1	<1	<1		<1	<1	<1	<1	
Ethyl Tert Butyl Ether	µg/l	1	40 ^{#1}		<1	<1	<1	<1		31.2	12.1	36.4	<1		<1	<1	<1	<1	
Methyl Tert Butyl Ether	µg/l	1	30 ^{#1}		<1	<1	<1	<1		144	24.5	<1	<1		<1	<1	<1	<1	
Tert Amyl Methyl Ether	µg/l	1	140 ^{#1}		<1	<1	<1	<1		<1	<1	<1	<1		<1	<1	<1	<1	
Tert Butyl Alcohol	µg/l	10	40 ^{#1}		<10	<10	<10	<10		<10	21.3	<10	<10		<10	<10	<10	<10	
Ethanol	µg/l	50	1,100,000 ^{#1}		<50	<50	<50	<50		<50	<50	<50	<50		<50	<50	<50	<50	
PAH																			
Acenaphthene	µg/l	0.015	So ^{#1}		<0.015	<0.015	<0.015	<0.015		0.062	<0.075	0.113	<0.015		<0.015	<0.015	<0.015	<0.015	
Acenaphthylene	µg/l	0.011	So ^{#1}		<0.011	<0.011	<0.011	<0.011		0.0135	<0.055	<0.044	<0.011		<0.011	<0.011	<0.011	<0.011	
Anthracene	µg/l	0.015	So ^{#1}		<0.015	<0.015	<0.015	<0.015		<0.015	<0.075	<0.06	<0.015		<0.015	<0.015	<0.015	<0.015	
Benzo(a)anthracene	µg/l	0.017	So ^{#1}		<0.017	<0.017	0.0173	<0.017		<0.017	<0.085	<0.068	<0.017		<0.017	<0.017	<0.017	<0.017	
Benzo(a)pyrene	µg/l	0.009	So ^{#1}		0.0222	0.01	0.0383	0.0212		<0.009	<0.045	<0.036	<0.009		<0.009	<0.009	<0.009	<0.009	
Benzo(b)fluoranthene	µg/l	0.023	So ^{#1}		0.0281	<0.023	0.0546	0.0293		<0.023	<0.115	<0.092	<0.023		<0.023	<0.023	<0.023	<0.023	
Benzo(g,h,i)perylene	µg/l	0.016	So ^{#1}		0.0275	0.02	0.0555	0.0281		<0.016	<0.08	<0.064	<0.016		<0.016	<0.016	<0.016	<0.016	
Benzo(k)fluoranthene	µg/l	0.027	So ^{#1}		<0.027	<0.027	<0.027	<0.027		<0.027	<0.135	<0.108	<0.027		<0.027	<0.027	<0.027	<0.027	
Chrysene	µg/l	0.013	So ^{#1}		0.0192	<0.013	0.0246	0.0134		<0.013	<0.065	<0.052	<0.013		<0.013	<0.013	<0.013	<0.013	
Dibenz(a,h)anthracene	µg/l	0.016	So ^{#1}		<0.016	<0.016	<0.016	<0.016		<0.016	<0.08	<0.064	<0.016		<0.016	<0.016	<0.016	<0.016	
Fluoranthene	µg/l	0.017	So ^{#1}		0.0185	<0.017	0.0341	0.0254		<0.017	<0.085	<0.068	<0.017		<0.017	<0.017	<0.017	<0.017	
Fluorene	µg/l	0.014	So ^{#1}		<0.014	<0.014	<0.014	<0.014		0.109	0.0782	0.248	<0.014		<0.014	<0.014	<0.014	<0.014	
Indeno(1,2,3-c,d)pyrene	µg/l	0.014	So ^{#1}		0.0261	0.02	0.0276	0.0244		<0.014	<0.07	<0.056	<0.014		<0.014	<0.014	<0.014	<0.014	
Naphthalene	µg/l	0.1	1,120 ^{#1}		<0.1	<0.1	<0.1	<0.1		54	6.86	76.5	<0.1		<0.1	<0.1	<0.1	<0.1	
Phenanthrene	µg/l	0.022	So ^{#1}		<0.022	<0.022	<0.022	<0.022		0.0787	<0.11	0.133	<0.022		<0.022	<0.022	<0.022	<0.022	
Pyrene	µg/l	0.015	So ^{#1}		0.0217	<0.015	0.0375	0.0271		<0.015	<0.075	<0.06	<0.015		<0.015	<0.015	<0.015	<0.015	
PAHs (sum of 4)	µg/l				0.0817	0.04	0.1377	0.0818		0	0	0	0		0	0	0	0	
Benzo(b,k)fluoranthene	µg/l				0.0281	0	0.0546	0.0293		0	0	0	0		0	0	0	0	
PAH 16 Total	µg/l	0.344			<0.344	<0.344	<0.344	<0.344		54.2	7.04	77.1	<0.344		<0.344	<0.344	<0.344	<0.344	
Benzo(g,h,i)perylene + Indeno(1,2,3-cd)pyrene	µg/l				0.0536	0.04	0.0831	0.0525		0	0	0	0		0	0	0	0	
Coal tar (BaP as a surrogate)	µg/l				0.0222	0.01	0.0383	0.0212		0	0	0	0		0	0	0	0	
TPH																			
>EC5-EC7 Aromatics	µg/l	10	669 ^{#1}		<10	<10	<10	<10		78	<10	163	<10		<10	<10	<10	<10	
>EC7-EC8 Aromatics	µg/l	10	So ^{#1}		<10	<10	<10	<10		<10	<10	11	<10		<10	<10	<10	<10	
>EC8-EC10 Aromatics	µg/l	10	So ^{#1}		<10	<10	<10	<10		524	18	1,800	<10		148	<10	<10	<10	
>EC10-EC12 Aromatics	µg/l	10	So ^{#1}		<10	<10	<10	<10		152	29	330	<10		64	<10	<10	<10	
>EC12-EC16 Aromatics	µg/l	10	So ^{#1}		<10	<10	<10	<10		30	<10	46	<10		<10	<10	<10	<10	
>EC16-EC21 Aromatics	µg/l	10	So ^{#1}		<10	<10	<10	<10		<10	<10	<10	<10		<10	<10	<10	<10	
>EC21-EC35 Aromatics	µg/l	10	So ^{#1}		<10	<10	<10	<10		<10	<10	<10	<10		<10	<10	<10	<10	
>C5-C6 Aliphatics	µg/l	10	So ^{#1}		<10	<10	<10	<10		22	<10	161	<10		<10	<10	<10	<10	
>C6-C8 Aliphatics	µg/l	10	So ^{#1}		<10	<10	<10	<10		143	40	385	<10		31	<10	<10	<10	
>C8-C10 Aliphatics	µg/l	10	So ^{#1}		<10	<10	<10	<10		260	27	843	<10		28	<10	<10	<10	
>C10-C12 Aliphatics	µg/l	10	So ^{#1}		<10	<10	<10	<10		229	43	495	<10		96	<10	<10	<10	
>C12-C16 Aliphatics	µg/l	10	So ^{#1}		<10	<10	<10	<10		<10	<10	<10	<10		<10	<10	<10	<10	
>C16-C21 Aliphatics	µg/l	10	So ^{#1}		<10	<10	<10	<10		<10	<10	<10	<10		<10	<10	<10	<10	
>C18-C35 Aliphatics	µg/l				0	0	0	0		0	0	0	0		0	0	0	0	
>C21-C35 Aliphatics	µg/l	10	So ^{#1}		<10	<10	<10	<10		<10	<10	<10	<10		<10	<10	<10	<10	
Misc																			
Ferrous Iron	µg/l	100			<100	<100	<100	<100		4,540	9,340	8,920	<100		<100	<100	<100	<100	
Nitrate (as NO3-)	mg/l	0.3			38.6	38	39.7	37		3.13	2.55	<0.3	26.1		22.8	19.6	23.4	27.9	
Sulphate (soluble)	mg/l	2			74.2	70.2	72.3	70.2		50.6	49.9	19.1	39.3		47.2	46.2	53.8	43	

Comments
#1 SSAC URS DQRA 2013
SSAC: Site Specific Assessment Criteria
(blank): No assessment criteria available
Sol: Unacceptable risk not achieved due to calculated target above solubility limit

Key
XXX Exceedance of 10019011_Hitchin_GW_SSAC_Model_2_Drift_Deposits

APPENDIX E QA/QC

Matrix Type	Water
First Sample Date	01/12/2014
Last Sample Date	26/02/2016
Sampling Period (days)	453
Number of Samples Submitted	32
Number of Non QA Samples Submitted	20
Number of Field Blanks	0
Number of Trip Blanks	4
Number of Rinsates	4
Number of Field Duplicates	4
Number of Interlab Duplicates	0
Number of Trip Spikes	0
Number of Lab Duplicates	0
Number of LCSs	0
Number of CRMs	0
Number of Method Blanks	0
Number of Storage Blanks	0
Number of Matrix Spikes	0
Number of Matrix Spike Dupes	0

SDG	141202-63	141202-63		150530-79	150530-79		151113-72	151113-72		160227-59	160227-59	
Field ID	BH106A	DUP	RPD	BH102A	DUP 01	RPD	BH102	DUP	RPD	BH106A	DUP	RPD
Sampled_Date-Time	01/12/2014	01/12/2014		29/05/2015	29/05/2015		11/11/2015	11/11/2015		26/02/2016	26/02/2016	

Parameter	Units	Method Detection Limit												
BTEX														
Benzene	µg/L	1	<1	<1	0	<1	<1	0	248	267	7	<1	<1	0
Toluene	µg/L	1	<1	<1	0	<1	<1	0	15.4	15.8	3	<1	<1	0
Ethylbenze	µg/L	1	<1	<1	0	<1	<1	0	551	696	23	<1	<1	0
Xylene (m)	µg/L	1	<1	<1	0	<1	<1	0	1080	1020	6	<1	<1	0
Xylene (o)	µg/L	1	<1	<1	0	<1	<1	0	184	185	1	<1	<1	0
Misc														
Ferrous Iron	µg/l	100	<100	<100	0	<100	<100	0	8920	5980	39	<100	<100	0
Nitrate (as N)	mg/l	0.3	7.18	7.85	9	38	37.1	2	<0.3	<0.3	0	10.2	10.2	0
Sulphate (S)	mg/l	2	39.2	38.4	2	70.2	69.6	1	19.1	20.2	6	47.2	45.7	3
Oxygenates														
Diisopropyl	µg/L	1	<1	<1	0	<1	<1	0	<1	<1	0	<1	<1	0
Ethyl Tert Butyl	µg/L	1	<1	<1	0	<1	<1	0	36.4	39.6	8	<1	<1	0
Methyl Tert Butyl	µg/L	1	<1	<1	0	<1	<1	0	<1	<1	0	<1	<1	0
Tert Amyl Methyl	µg/L	1	<1	<1	0	<1	<1	0	<1	<1	0	<1	<1	0
Tert Butyl Alcohol	µg/L	10	<10	<10	0	<10	<10	0	<10	<10	0	<10	<10	0
Ethanol	µg/L	50	<50	<50	0	<50	<50	0	<50	<50	0	<50	<50	0
PAH														
Acenaphthene	µg/L	0.015	<0.015	<0.015	0	<0.015	<0.015	0	0.113	0.115	2	<0.015	<0.015	0
Acenaphthylene	µg/L	0.011	<0.011	<0.011	0	<0.011	<0.011	0	<0.044	0.0493	11	<0.011	<0.011	0
Anthracene	µg/L	0.015	<0.015	<0.015	0	<0.015	<0.015	0	<0.06	<0.06	0	<0.015	<0.015	0
Benzo(a)anthracene	µg/L	0.017	<0.017	<0.017	0	<0.017	<0.017	0	<0.068	<0.068	0	<0.017	<0.017	0
Benzo(a)pyrene	µg/L	0.009	<0.009	0.011	20	0.01	<0.009	11	<0.036	<0.036	0	<0.009	<0.009	0
Benzo(b)fluoranthene	µg/L	0.023	<0.023	<0.023	0	<0.023	<0.023	0	<0.092	<0.092	0	<0.023	<0.023	0
Benzo(g,h,i)perylene	µg/L	0.016	<0.016	<0.016	0	0.02	<0.016	22	<0.064	<0.064	0	<0.016	<0.016	0
Benzo(k)fluoranthene	µg/L	0.027	<0.027	<0.027	0	<0.027	<0.027	0	<0.108	<0.108	0	<0.027	<0.027	0
Chrysene	µg/L	0.013	<0.013	0.0149	14	<0.013	<0.013	0	<0.052	<0.052	0	<0.013	<0.013	0
Dibenz(a,h)anthracene	µg/L	0.016	<0.016	<0.016	0	<0.016	<0.016	0	<0.064	<0.064	0	<0.016	<0.016	0
Fluoranthene	µg/L	0.017	<0.017	0.0211	22	<0.017	<0.017	0	<0.068	<0.068	0	<0.017	<0.017	0
Fluorene	µg/L	0.014	<0.014	<0.014	0	<0.014	<0.014	0	0.248	0.237	5	<0.014	<0.014	0
Indeno(1,2,3-cd)pyrene	µg/L	0.014	<0.014	<0.014	0	0.02	<0.014	35	<0.056	<0.056	0	<0.014	<0.014	0
Naphthalene	µg/L	0.1	<0.1	<0.1	0	<0.1	<0.1	0	76.5	75.4	1	<0.1	<0.1	0
Phenanthrene	µg/L	0.022	<0.022	<0.022	0	<0.022	<0.022	0	0.133	0.126	5	<0.022	<0.022	0
Pyrene	µg/L	0.015	<0.015	0.0186	21	<0.015	<0.015	0	<0.06	<0.06	0	<0.015	<0.015	0
PAH 16 Total	µg/L	0.344	<0.344	<0.344	0	<0.344	<0.344	0	77.1	76	1	<0.344	<0.344	0
TPH														
>EC5-EC7	µg/L	10	<10	<10	0	<10	<10	0	163	197	19	<10	<10	0
>EC7-EC8	µg/L	10	<10	<10	0	<10	<10	0	11	10	10	<10	<10	0
>EC8-EC10	µg/L	10	<10	<10	0	<10	<10	0	1800	2070	14	<10	<10	0
>EC10-EC12	µg/L	10	<10	<10	0	<10	<10	0	330	393	17	<10	<10	0
>EC12-EC14	µg/L	10	<10	<10	0	<10	<10	0	46	43	7	<10	<10	0
>EC16-EC22	µg/L	10	<10	<10	0	<10	<10	0	<10	<10	0	<10	<10	0
>EC21-EC35	µg/L	10	<10	<10	0	<10	<10	0	<10	<10	0	<10	<10	0
>C5-C6 Ali	µg/L	10	<10	<10	0	<10	<10	0	161	215	29	<10	<10	0
>C6-C8 Ali	µg/L	10	<10	<10	0	<10	<10	0	385	506	27	<10	<10	0
>C8-C10 Ali	µg/L	10	<10	<10	0	<10	<10	0	843	1000	17	<10	<10	0
>C10-C12 Ali	µg/L	10	<10	<10	0	<10	<10	0	495	590	18	<10	<10	0
>C12-C16 Ali	µg/L	10	<10	<10	0	<10	<10	0	<10	<10	0	<10	<10	0
>C16-C21 Ali	µg/L	10	<10	<10	0	<10	<10	0	<10	<10	0	<10	<10	0
>C21-C35 Ali	µg/L	10	<10	<10	0	<10	<10	0	<10	<10	0	<10	<10	0

*RPDs have only been considered where a concentration is greater than 1 times the EQL.

**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 100 (1-10 x EQL); 50 (10-20 x EQL); 30 (> 20 x EQL))

***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row header relate to those used in the primary laboratory

Chem Name	Units	EQL								
BTEX										
Benzene	µg/L	1	<1	<1	<1	1	<1	<1	<1	<1
Toluene	µg/L	1	1.11	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	µg/L	1	<1	<1	<1	<1	<1	<1	<1	<1
Xylene (m & p)	µg/L	1	1.3	<1	<1	<1	<1	<1	<1	<1
Xylene (o)	µg/L	1	<1	<1	<1	<1	<1	<1	<1	<1
Xylene Total	µg/L	2					<2	<2	<2	<2
Misc										
Ferrous Iron	µg/l	100	<100	<100	<100	<100				
Nitrate (as NO3-)	mg/l	0.3	<0.3	34	<0.3	<0.3				
Sulphate (soluble)	mg/l	2	<2	20.2	<2	<2				
Oxygenates										
Diisopropyl Ether	µg/L	1	<1	<1	<1	<1				
Ethyl Tert Butyl Ether	µg/L	1	<1	<1	<1	<1				
Methyl Tert Butyl Ether	µg/L	1	<1	<1	<1	<1				
Tert Amyl Methyl Ether	µg/L	1	<1	<1	<1	<1				
Tert Butyl Alcohol	µg/L	10	<10	<10	<10	<10				
Ethanol	µg/L	50	<50	<50	<50	<50				
PAH										
Acenaphthene	µg/L	0.015	<0.015	<0.015	<0.015	<0.015				
Acenaphthylene	µg/L	0.011	<0.011	<0.011	<0.011	<0.011				
Anthracene	µg/L	0.015	<0.015	<0.015	<0.015	<0.015				
Benzo(a)anthracene	µg/L	0.017	<0.017	<0.017	<0.017	<0.017				
Benzo(a)pyrene	µg/L	0.009	<0.009	<0.009	<0.009	<0.009				
Benzo(b)fluoranthene	µg/L	0.023	<0.023	<0.023	<0.023	<0.023				
Benzo(g,h,i)perylene	µg/L	0.016	<0.016	<0.016	<0.016	<0.016				
Benzo(k)fluoranthene	µg/L	0.027	<0.027	<0.027	<0.027	<0.027				
Chrysene	µg/L	0.013	<0.013	<0.013	<0.013	<0.013				
Dibenz(a,h)anthracene	µg/L	0.016	<0.016	<0.016	<0.016	<0.016				
Fluoranthene	µg/L	0.017	<0.017	<0.017	<0.017	<0.017				
Fluorene	µg/L	0.014	<0.014	0.02	<0.014	<0.014				
Indeno(1,2,3-c,d)pyrene	µg/L	0.014	<0.014	<0.014	<0.014	<0.014				
Naphthalene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1				
Phenanthrene	µg/L	0.022	<0.022	0.04	<0.022	<0.022				
Pyrene	µg/L	0.015	<0.015	<0.015	<0.015	<0.015				
PAH 16 Total	µg/L	0.344	<0.344	<0.344	<0.344	<0.344				
TPH										
>EC5-EC7 Aromatics	µg/L	10	<10	<10	<10	<10				
>EC7-EC8 Aromatics	µg/L	10	<10	<10	<10	<10				
>EC8-EC10 Aromatics	µg/L	10	<10	<10	<10	<10				
>EC10-EC12 Aromatics	µg/L	10	<10	<10	<10	<10				
>EC12-EC16 Aromatics	µg/L	10	<10	<10	<10	<10				
>EC16-EC21 Aromatics	µg/L	10	<10	<10	<10	<10				
>EC21-EC35 Aromatics	µg/L	10	<10	<10	<10	35				
>C5- C6 Aliphatics	µg/L	10	<10	<10	<10	<10				
>C6- C8 Aliphatics	µg/L	10	<10	<10	<10	<10				
>C8- C10 Aliphatics	µg/L	10	<10	<10	<10	<10				
>C10- C12 Aliphatics	µg/L	10	<10	<10	<10	<10				
>C12- C16 Aliphatics	µg/L	10	<10	<10	<10	<10				
>C16- C21 Aliphatics	µg/L	10	<10	<10	<10	<10				
>C21- C35 Aliphatics	µg/L	10	<10	<10	<10	<10				
TPH Stage 2 HI - Human Health CPU	-									
TPH Stage 2 HI - Human Health HDR	-									

Matrix_Type	Sample_Type	Reg	Leached	Spike_Compounds	Surrogate
Water	Normal	1060	0	0	40
Water	Field_D	204	0	0	8
Water	Rinsate	180	0	0	8
Water	Trip_B	24	0	0	0

SDG	Sample_Type	Matrix_Type	SampleCode	Field_ID	Depth	Sampled_Date_Time	Compound	Recovery %	Unit	LCL	UCL	QA_Flag	Comments
141202-63	Normal	Water	10486024	BH102A	7.000	01/12/2014	GRO Surrogate %		72 %				
150530-79	Normal	Water	11455008	BH102A		29/05/2015	GRO Surrogate %		73 %				
150530-79	Normal	Water	11455011	BH106A		29/05/2015	GRO Surrogate %		74 %				
151113-72	Normal	Water	12433136	BH102		11/11/2015	GRO Surrogate %		73 %				