

BROMODEDECANE SPILLAGE INVESTIGATION, CONTRACT CHEMICALS SITE, KNOWSLEY

1. Introduction

AMEC was commissioned by Contract Chemicals Ltd on 5th April 2012 to undertake an intrusive investigation of a spillage of 1-bromododecane on the Contract Chemicals Ltd property located at Knowsley Business Park, Prescot. The site is located at approximate National Grid Reference 342978, 396733.

The recent spillage occurred at the western boundary of the Contract Chemicals site, and was observed to have flowed overland onto the adjacent property, occupied by Matalan Ltd.

The spillage is understood to have comprised the loss of the contents of an intermediate bulk container (IBC) containing 1-bromododecane only, which was damaged on contact with the ground following toppling from a forklift. The spillage is understood to have been witnessed to flow downslope onto the Matalan site down to a large fire water storage tank forming part of the Matalan site infrastructure, and subsequently drained away towards the north-west.

AMEC has previously undertaken exploratory works in the same area with respect to the delineation of an overspill of process waste from trade effluent drainage on the Contract Chemicals Ltd. site onto the Matalan Ltd. site. The findings of this investigation were presented within a final interpretative report dated January 2011.

The purpose of this report is to provide an outline interpretation of the soil and groundwater sample data relevant to the recent 1-bromododecane spillage, and to compare these data with baseline data collected during the delineation of the earlier trade effluent spillage.

The scope of the investigations undertaken by AMEC were in general accordance with that agreed in advance in discussions between the Environment Agency and Contract Chemicals. The scope of investigation comprised the following:

- The advancement of four boreholes by dynamic sampling methods, to be placed within the known area of the spill to assess the potential for vertical migration through the underlying strata; and
- The advancement of six hand dug pits within the upper 0.5m of the soil profile, to be dug on the periphery of the known spill area to assess the lateral extent of the contamination.

Due to access constraints within the Matalan Ltd site, it was considered that a hand held dynamic sampling rig would be required to advance the dynamic sampling holes.

Two of the dynamic sampling holes (nominally one on the Contract Chemicals site and one situated at the toe of the slope on the Matalan Ltd. site) were proposed to be installed with a monitoring standpipe in order to allow the collection of shallow groundwater for subsequent analysis.

The area of the spillage is located within Zone III (Total Catchment) of a groundwater Source Protection Zone, to be protective of a potable water abstraction point located approximately 1.1km to the north-east at Moss Side. According to online mapping published by the Environment Agency, the site is immediately underlain by a Secondary A Aquifer associated with drift geology, which overlies a Principal Aquifer associated with bedrock.

Knowsley Brook, a Main River, passes beneath the area of the spillage within an underground culvert (see below), flowing from north to south along the boundary between the Contract Chemicals and Matalan sites before being diverted towards the west to the south of the area of the spillage. No chemical quality information with relation to Knowsley Brook is available from the Environment Agency.

2. Details of Site Investigation

2.1 Constraints to Proposed Scope of Work

As described above, due to the potential for damage to be caused to the effluent drainage network and culverted Knowsley Brook within the boundary of the Contract Chemicals site, the proposed dynamic window sampling hole at that location was substituted with a hand dug pit. At this location, due to instability of the sidewalls of the pit (due to significant coarse gravel content) the hand dug pit was abandoned at 0.7m bgl. A black plastic duct was noted at a depth of 0.1m bgl at this location, in the western face of the pit, which is anticipated to be associated with electrical cabling supplying the perimeter lighting of the Contract Chemicals site (the cabling was identified as having been terminated by the site representative, and was visibly cut at a short distance to the south, where an effluent drain manhole had been built up. The site representative identified that the built up manhole was the source of the 2010 drainage overflow.

Dynamic window sampling hole WS01 was not originally intended to be installed for groundwater sampling, however following the substitution of the proposed window sampling hole within the Contract Chemicals site with a hand dug pit, this was selected for installation in order to provide groundwater data from as close to the source to the spillage as possible.

Black plastic ducting was noted at 0.50m bgl in the centre of hand dug pit HDP02, trending approximately north-south. This was considered likely to be associated with the perimeter sensors, however was not identified during service clearance. No damage was done to the ducting during excavation. It was noted that the orientation of the duct appeared to lead directly beneath the marked position of HDP03, which was subsequently repositioned approximately 1m towards the south to avoid damage to the duct. No other exploratory holes were required to be repositioned as a result of the duct.

Proposed dynamic window sampling hole WS03 was intended to be installed for groundwater sampling. However, due to ground conditions making hand excavation difficult, the service inspection pit was halted at 0.40m bgl. As the service inspection pit was of insufficient depth, the hole was not advanced by mechanical means.

Sampling location WS04 was originally intended to be advanced as a hand dug pit, but following the abandonment of WS03 as a dynamically sampled hole this was selected as a substitute. Ground conditions, although enabling easier excavation than those at WS03, were also difficult and it was not possible to advance the service inspection pit past 0.80m bgl. This was considered to be insufficiently protective to allow for continuation of the hole by dynamic window sampling methods, however, was of sufficient depth to allow the installation of a monitoring standpipe.

Prior to the undertaking of intrusive works, AMEC attended the site with a specialist service clearance contractor, Amethyst Surveys Ltd, and a representative of Contract Chemicals on 22 June 2012. During this time the Contract Chemicals representative identified that at the location proposed for investigation by dynamic sampling methods within the boundary of the Contract Chemicals site, a trade effluent drain carrying liquid collected from within the site was likely to be present at a depth of approximately 1.5m below ground level (m bgl). Due to a high level of water within the closest inspection manhole, and the inability of the service clearance contractor to reliably identify the location of the drain, it was considered too great a risk to be able to advance the planned exploratory hole by dynamic sampling means.

Combined with the above, the Contract Chemicals representative also identified that the proposed exploratory location within the Contract Chemicals boundary, and possibly exploratory holes on the Matalan site close to the common boundary, were also likely to be positioned directly above a culvert containing Knowsley Brook, anticipated to be present at a depth of circa 2m below ground level (bgl) and witnessed via an access grid located to the south along the Contract Chemicals site boundary. Furthermore, restrictions with respect to the use of petrol engine equipment were also in place on the Contract Chemicals site, which would have made the use of a dynamic sampling rig problematic.

On the Matalan Ltd. site, the potential for the culverted brook to extend onto the higher part of the slope forming the eastern site boundary resulted in the repositioning of two proposed window sampling holes further downslope to the toe of the slope.

At the time of the exploratory investigations on 27 June 2012, it was discovered that access to the proposed exploratory locations on the Matalan site could be achieved by tracked 'terrier' dynamic window sampling rig. This was used instead of a hand-held dynamic sampling rig due to its greater power and it posing fewer manual handling risks.

A plan showing the exploratory hole locations is provided as Figure 1.

2.2 Ground Conditions Encountered

Made Ground was encountered in all exploratory hole locations, extending to a depth of between 0.35m bgl (HDP06) and 0.80m (WS04). However, the base of Made Ground was not proven in the majority of exploratory holes as these were primarily concerned with shallow sampling.

The composition of Made Ground was noted to be highly variable across the site, with three main types noted:

- Granular fill (HDP01): Light grey coarse gravel of limestone and other lithologies;
- Clayey gravelly sand with pockets of clay/sandy gravelly clay (HDP02, HDP03, HDP04, HDP05, HDP06, WS01, WS02, WS04; and
- Clayey sandy gravel with brick, concrete, slag and occasional metal rivets (WS03).

Natural ground was encountered in HDP06 from 0.35m bgl, WS01 from 0.50m bgl, and WS02 from 0.70m bgl. Natural ground comprised typically red brown silty gravelly fine sand with low sandstone and mudstone cobble content, overlying red brown weathered mudstone in WS01 and WS02.

Exploratory hole logs are provided as Appendix A, and site investigation photographs are included as Appendix B.

2.3 Observations of Contamination

Soil arisings at HDP01 were noted to have a light to strong chemical odour from throughout the exploratory hole (from surface to 0.70m bgl).

Soil arisings from HDP04 between surface and 0.20m bgl were noted to have a possible chemical odour.

Soil arisings from WS01 taken from between the surface and 0.60m bgl were noted to have a chemical odour.

No observations of visible contamination (e.g. hydrocarbon sheens or dark staining) were noted in soils, and during groundwater sampling on 11 July 2012 no visual or olfactory evidence of contamination was noted.

2.4 Chemical Analytical Data

Following the spillage of contaminated water from the Contract Chemicals Ltd effluent drain in 2010, AMEC (as Entec UK Limited) undertook shallow soil sampling to delineate the extents of the spill and determine the impact on soil and water quality on the Matalan Ltd site. A full summary of these works is provided in the subsequent report, 'Trade Effluent Overspill Sampling – Final Interpretive Report', issued in January 2011.

The analysis scheduled as part of the 2010 investigations included SVOC tentatively Identified Compounds (TICs), as part of which bromododecane can be identified. The concentrations of bromododecane recorded in 2010 have, therefore, been considered within this report as representative of baseline conditions prior to the recent spillage event.

Table 1 Bromododecane Concentrations, 2010 AMEC Site Investigations

Exploratory Location	Depth (m bgl)	Bromododecane Concentration (mg/kg)	Leachable Bromododecane Concentration (mg/l)
HDP1	0.10	Not detected	Not tested
	0.80	Not detected	Not tested
HDP2	0.10	Not detected	Not detected
	0.70	10.523	Not tested
HDP3	0.10	27.605	Not tested
	0.60	Not detected	Not tested
HDP4	0.10	Not detected	Not tested
	0.70	Not detected	Not tested
HDP5	0.10	Not detected	Not tested
	0.50	Not detected	Not tested

The results of soil and groundwater analysis undertaken as part of the 2012 investigations are presented as Appendix C.

Although it was not possible for the analytical laboratory to differentiate between 1-bromododecane, 2-bromododecane and 3-bromododecane, Contract Chemicals Ltd has confirmed that the recent spillage which was to be investigated would comprise 1-bromododecane only, and that other derivatives of lauryl bromide, which would include 2-bromododecane and 3-bromododecane, are not likely to be present. As such, samples of soil and groundwater collected during the 2012 sampling were submitted for specialist analysis of bromododecane as an SVOC TIC only.

During the exploratory works on 27 June, standing water was noted within HDP02 at a level of 0.4m bgl, after a period of approximately two hours. A sample of this was collected and submitted for chemical analysis alongside the soil samples.

A groundwater level monitoring and sampling visit was undertaken on Wednesday 11 July 2012. Samples of groundwater were taken from the monitoring installations in WS01 and WS04, and submitted for analysis of bromododecane as an SVOC TIC.

The methodology and results of chemical analysis are presented as Appendix C, and a summary table is provided below.

Table 2 Bromododecane Concentrations, 2012 AMEC Site Investigations

Exploratory Location	Depth (m bgl)	Bromododecane Concentration (mg/kg)	Bromododecane Concentration (mg/l)
HDP01	0.40	2,500.00	Not tested
	0.70	640.00	Not tested
HDP02	0.27	Not detected	Not tested
	0.40	Not tested	Not detected
HDP03	0.10	1,300.00	Not tested
	0.40	410.00	Not tested
HDP04	0.20	Not detected	Not tested
	0.40	Not detected	Not tested
HDP05	0.30	Not detected	Not tested
HDP06	0.20	Not detected	Not tested
WS01	0.35	61.00	0.980
	0.80	10.00	Not tested
WS02	0.20	Not detected	Not tested
	0.50	Not detected	Not tested
WS03	0.40	Not detected	Not tested
WS04	0.80	Not detected	Not detected

The results of analysis have confirmed the presence of 1-bromododecane both within the Contract Chemicals site (HDP01) and on the adjacent Matalan site (HDP03 and WS01). The results appear to demonstrate that the extent to which 1-bromododecane has impacted shallow soils on the Matalan site is minor, having been identified only within approximately 4.5m of the site boundary.

Concentrations of bromododecane recorded in the 2012 sampling event range up to 2,500.000 mg/kg in soil within the Contract Chemicals site boundary and 1,300.000 mg/kg in soil within the Matalan Ltd. boundary. These concentrations are substantially greater than those identified in SVOC TIC analysis during the 2010 investigation

(27.605 mg/kg in soil maximum) and therefore are considered likely to reflect contamination by the recent spill rather than pre-existing contamination associated with the 2010 effluent drain overspill.

Bromododecane was not encountered within shallow groundwater in sampling locations HDP02 and WS04. However, a bromododecane concentration of 0.980 mg/l was identified in the sample retrieved from WS01. Only limited quantities of perched shallow groundwater have been identified at the site, and groundwater recharge rates were noted to be poor during the sampling event on 11th July. The available data are not considered to indicate a significant impact to groundwater quality from the recent spillage.

3. Conclusions and Recommendations

The results of recent sampling and analysis undertaken by AMEC demonstrate the presence of detectable concentrations of bromododecane within shallow soils on the Matalan site, adjacent to the Contract Chemicals site boundary. These concentrations are significantly greater in concentration than those previously recorded in the same area, suggesting a demonstrable impact from the recent spillage. It is, however, noted that the affected areas are localised in lateral and vertical extent. Low permeability clay deposits are likely to have retarded downward migration through underlying strata and runoff across the surface appears to have affected only two small areas. These two areas relate to the locale of WS01 and HDP03, near to the point of the spillage and HDP01, some 12 m to the south. As such it appears likely the spillage directly affected the former, with some possible, secondary effect on the latter, potentially as spilt material flowed southward along the hardstanding in the Contract Chemicals site, before entering the Matalan site at a second point.

The results of shallow groundwater analysis are generally considered not to show the presence of significant contamination with bromododecane on the Matalan site. However, perched groundwater retrieved from WS01, in close proximity to the common boundary between the Contract Chemicals and Matalan sites and the point of the recent spillage, has been found to be impacted by bromododecane (0.980mg/l).

Although there is currently insufficient toxicological information on bromododecane, to quantitatively assess the risk to environmental and human receptors, the limited extent of the impact is likely to indicate risks to controlled waters, referenced earlier in this report, is unlikely to be significant. Although it is not possible to quantify risks to site users, in the commercial context of the Matalan site, some potential for significant harm cannot be discounted, if direct contact with impacted soils were to take place.

On the basis of the above it is therefore recommended that limited remedial action may be required, involving treatment of affected soils, likely by source removal, to depths able to mitigate against direct exposure.

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Figure



Appendix A

Trial Pit Log

Logged ML Checked MW		Start 27/06/2012 End 27/06/2012	Equipment, Methods and Remarks Hand dug Sampling by AMEC. Terminated due to sidewall collapse.	Dimensions and Orientation Width 0.45 m Length 0.60 m	Ground Level - Coordinates - National Grid - Chainage -
Samples and Tests			Strata		
Depth	Type & No.	Date Records	Description	Depth, Level/ (Thickness)	Legend Backfill/ Instruments
0.40	ES 1		1 MADE GROUND: Light grey subangular coarse GRAVEL of limestone. 0.10 m Black plastic ducting, western face of pit 0.10-0.60 m Grey brown 0.40 m Terram	(0.60)	
0.70	ES 2		2 MADE GROUND: Grey slightly sandy clayey GRAVEL. Gravel is angular fine to coarse of mixed lithologies. EXPLORATORY HOLE ENDS AT 0.70 m	0.60 0.70	
Depth	Type & No.	Records Date			
Groundwater Entries No. Struck Post Strike Behaviour 1 0.30 Damp			Depth Related Remarks * From to (m) 0.00 0.70 Chemical odour throughout	Stability Unstable Shoring None Weather Overcast	
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:25			Project Contract Chemicals, Knowsley Project No. F2019-12 Carried out for AMEC	Trial Pit HDP01 Sheet 1 of 1	

Trial Pit Log

Logged ML Checked MW/	Start 27/06/2012 End 27/06/2012	Equipment, Methods and Remarks Hand dug Sampling by AMEC.	Dimensions and Orientation Width 0.30 m Length 0.40 m	Ground Level Coordinates National Grid Chainage		
Samples and Tests			Strata	Depth, Level/ (Thickness)	Legend	Backfill/ Instruments
Depth	Type & No.	Date Records	Description			
0.27	ES 1		1 MADE GROUND: Grass over grey clayey gravelly SAND with pockets of firm grey brown sandy gravelly clay. Gravel is subangular fine to coarse of sandstone.	(0.50)		
0.40	W 1			EXPLORATORY HOLE ENDS AT 0.50 m		
Depth	Type & No.	Records Date				
Groundwater Entries No. Struck Post Strike Behaviour (m) 1 0.27 Rose to 0.40 m after 160 minutes. Seepage			Depth Related Remarks * From to (m)	Stability Stable Shoring None Weather Overcast		
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:25			Project Contract Chemicals, Knowsley Project No. F2019-12 Carried out for AMEC	Trial Pit HDP02 Sheet 1 of 1		

Trial Pit Log

Logged ML Checked MW		Start 27/06/2012 End 27/06/2012	Equipment, Methods and Remarks Hand dug Sampling by AMEC.	Dimensions and Orientation Width 0.25 m Length 0.35 m	Ground Level - Coordinates - National Grid - Chainage -
Samples and Tests			Strata		
Depth	Type & No.	Date Records	Description	Depth, Level/ (Thickness)	Legend
0.10	ES 1		1 MADE GROUND: Grey brown sandy clayey TOPSOIL with pockets of firm sandy clay and lenses of red brown fine sand.	0.20	
0.40	ES 2		2 MADE GROUND: Firm grey brown mottled slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to subangular fine to coarse of sandstone and siltstone and occasional plastic and red brick. EXPLOATORY HOLE ENDS AT 0.50 m	(0.30) 0.50	
Depth	Type & No.	Records Date			
Groundwater Entries No. Struck Post Strike Behaviour (m) None observed (see Key Sheet)			Depth Related Remarks * From to (m)		Stability Stable Shoring None Weather Overcast
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:25			Project Contract Chemicals, Knowsley Project No. F2019-12 Carried out for AMEC		Trial Pit HDP03 Sheet 1 of 1

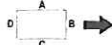
Trial Pit Log

Logged ML Checked MW		Start 27.06.2012 End 27.06.2012	Equipment, Methods and Remarks Hand dug Sampling by AMEC.	Dimensions and Orientation Width 0.32 m Length 0.37 m 	Ground Level Coordinates National Grid Chainage	
Samples and Tests			Strata	Depth, Level (Thickness)	Legend	Backfill/ Instruments
Depth	Type & No.	Date Records	Description			
0.20	ES 1		1 MADE GROUND: Grass over grey brown slightly gravelly sandy clayey TOPSOIL. Gravel is subangular fine to coarse of sandstone and igneous lithologies. Possible light chemical odour.	0.20		
0.40	ES 2		2 MADE GROUND: Firm grey brown and brown mottled slightly gravelly sandy CLAY with pockets of red brown and blue grey clay, brown fine and medium sand and grey clayey fine and medium sand.	(0.30) 0.50		
			EXPLORATORY HOLE ENDS AT 0.50 m			
Depth	Type & No.	Records Date				
Groundwater Entries No. Struck Post Strike Behaviour (m) None observed (see Key Sheet)			Depth Related Remarks * From to (m)	Stability Stable Shoring None Weather Overcast		
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:25			Project Contract Chemicals, Knowsley Project No. F2019-12 Carried out for AMEC	Trial Pit HDP04 Sheet 1 of 1		

Trial Pit Log

Logged ML Checked MW		Start 27.06.2012 End 27.06.2012	Equipment, Methods and Remarks Hand dug Sampling by AMEC.		Dimensions and Orientation Width 0.30 m Length 0.38 m 		Ground Level Coordinates National Grid Chainage	
Samples and Tests			Strata					
Depth	Type & No.	Date Records	Description			Depth, Level/ (Thickness)	Legend	Backfill/ Instruments
0.30	ES 1		1 MADE GROUND: Grass over brown slightly gravelly sandy clayey TOPSOIL. Gravel is subangular fine to coarse. 2 MADE GROUND: Soft to firm dark grey brown slightly sandy slightly gravelly CLAY with low cobble content. Gravel is subangular fine and medium. 3 MADE GROUND: Soft to firm grey brown and brown mottled slightly gravelly sandy CLAY with pockets of red brown sandy clay and clayey fine and medium sand. Gravel is angular to subangular fine to coarse. EXPLORATORY HOLE ENDS AT 0.60 m			0.15 0.40 0.60	 	
Depth	Type & No.	Records Date						
Groundwater Entries No. Struck Post Strike Behaviour (m) None observed (see Key Sheet)			Depth Related Remarks * From to (m)			Stability Stable Shoring None Weather Overcast		
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:25 (c) ESG www.esg.co.uk 426 4527 07 2012 15 28 43			Project Contract Chemicals, Knowsley Project No. F2019-12 Carried out for AMEC			Trial Pit HDP05 Sheet 1 of 1		

Trial Pit Log

Logged ML Checked MW		Start 27/06/2012 End 27/06/2012	Equipment, Methods and Remarks Hand dug	Dimensions and Orientation Width 0.30 m Length 0.30 m 	Ground Level Coordinates National Grid Chainage	
Samples and Tests			Strata	Depth, Level (Thickness)	Legend	Backfill/ Instruments
Depth	Type & No.	Date Records	Description			
0.20	ES 1		1 MADE GROUND: Grass over grey brown slightly gravelly sandy clayey TOPSOIL. Gravel is angular to subangular fine to coarse.	0.10		
0.40	ES 2		2 MADE GROUND: Firm grey brown slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to subangular fine to coarse of sandstone, siltstone and mudstone. Cobbles are siltstone and mudstone.	0.35		
			3 Firm red orange brown mottled grey silty CLAY. EXPLORATORY HOLE ENDS AT 0.50 m	0.50		
Depth	Type & No.	Records Date				
Groundwater Entries No. Struck Post Strike Behaviour (m) None observed (see Key Sheet)			Depth Related Remarks * From to (m)	Stability Stable Shoring None Weather Overcast		
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:25 (c) ESG www.esg.co.uk 425 4227/07/2012 15.28.45 			Project Contract Chemicals, Knowsley Project No. F2019-12 Carried out for AMEC	Trial Pit HDP06 Sheet 1 of 1		

Window Sampler Hole Log

Drilled IH Logged ML Checked MW	Start 27/06/2012 End 27/06/2012	Equipment, Methods and Remarks Terrier Hand dug inspection pit to 1.20m. Window sampling to 2.30m. Terminated on refusal. Sampling by AMEC.		Depth from to Diameter Casing Depth	Ground Level Coordinates National Grid Chainage			
Samples and Tests			Strata					
Depth	Type & No	Records	Date Casing	Time Water	Description	Depth, Level/ (Thickness)	Legend	Backfill/ Instruments
0.35	ES 1				MADE GROUND: Grey brown slightly gravelly clayey SAND. Gravel is subangular fine to coarse of sandstone and igneous lithologies. Chemical odour.	(0.60)		
0.80	ES 2				Red brown silty gravelly fine SAND with low cobble content. Gravel is subangular fine to coarse of sandstone.	0.60 0.80		
1.00	ES 3				Red brown slightly gravelly silty fine SAND. Gravel is subangular fine and medium of sandstone. (possible weathered bedrock)	(0.50) 1.30		
					Stiff friable red brown gravelly silty CLAY. Gravel is angular fine to coarse of mudstone. (possible weathered bedrock)	(0.50) 1.80		
					Red brown angular fine to coarse GRAVEL of mudstone. (possible weathered bedrock)	(0.50) 2.30		
EXPLORATORY HOLE ENDS AT 2.30 m								
Depth	Type & No	Records	Date Casing	Time Water				
Groundwater Entries No. Struck Post strike behaviour Depth sealed (m)					Depth Related Remarks * From to (m)		Chiselling Depths (m) Time Tools used	
1	0.35	Seepage						
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.					Project Contract Chemicals, Knowsley Project No. F2019-12 Carried out for AMEC		Borehole WS01 Sheet 1 of 1	

Window Sampler Hole Log

Drilled IH Logged ML Checked MW	Start 27/06/2012 End 27/06/2012	Equipment, Methods and Remarks Terrier Hand dug inspection pit to 1.20m. Window sampling to 2.00m. Terminated on refusal. Sampling by AMEC.		Depth from to Diameter Casing Depth	Ground Level Coordinates National Grid Chainage
Samples and Tests				Strata	
Depth	Type & No	Records	Date Casing	Time Water	Description
0.20	ES 1				MADE GROUND: Grass over slightly gravelly sandy clayey TOPSOIL. Gravel is angular to subangular fine to coarse of sandstone and igneous lithologies.
0.50	ES 2				MADE GROUND: Grey brown slightly clayey fine and medium SAND with occasional pockets of firm red brown mottled grey clay.
					Firm friable red brown slightly sandy CLAY, locally sandy.
					Dark red brown fine SAND.
					Red brown silty fine SAND. (possible weathered bedrock)
					Red brown mottled blue grey angular fine to coarse GRAVEL of mudstone. (possible weathered bedrock)
					EXPLORATORY HOLE ENDS AT 2.00 m
Depth	Type & No	Records	Date Casing	Time Water	
Groundwater Entries No. Struck Post strike behaviour 1 0.50 Seepage			Depth sealed (m)		Depth Related Remarks * From to (m)
					Chiselling Depths (m) Time Tools used
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:50			Project Contract Chemicals, Knowsley Project No. F2019-12 Carried out for AMEC		Borehole WS02 Sheet 1 of 1

Window Sampler Hole Log

Drilled IH Logged ML Checked MW	Start 27/06/2012 End 27/06/2012	Equipment, Methods and Remarks Terrier Hand dug inspection pit to 0.40m. Terminated on AMEC instruction. Sampling by AMEC.		Depth from to Diameter Casing Depth	Ground Level Coordinates National Grid Chainage			
Samples and Tests			Strata					
Depth	Type & No	Records	Date Casing	Time Water	Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments
0.40	ES 1				MADE GROUND: Grass over dark red brown and red grey brown clayey sandy GRAVEL with low cobble content. Gravel is angular fine to coarse of brick, concrete, sandstone, slag and occasional metal rivets. Cobbles of brick. EXPLORATORY HOLE ENDS AT 0.40 m	(0.40) 0.40		
Depth	Type & No	Records	Date Casing	Time Water				
Groundwater Entries No. Struck Post strike behaviour None observed (see Key Sheet)					Depth sealed (m) Depth Related Remarks * From to (m)	Chiselling Depths (m) Time Tools used		
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.					Project Contract Chemicals, Knowsley Project No. F2019-12 Carried out for AMEC	Borehole WS03 Sheet 1 of 1		

Window Sampler Hole Log

Drilled IH Logged ML Checked MW	Start 27/06/2012 End 27/06/2012	Equipment, Methods and Remarks Terrier Hand dug inspection pit to 0.80m. Terminated on AMEC instruction. Sampling by AMEC.		Depth from to Diameter Casing Depth	Ground Level Coordinates National Grid Chainage
Samples and Tests				Strata	
Depth	Type & No	Records	Date Casing	Time Water	Description
0.30	ES 1				MADE GROUND: Firm red grey brown mottled slightly sandy gravelly CLAY with low cobble content. Gravel is angular to subangular fine to coarse of sandstone, brick, slag and igneous lithologies. Cobbles are of sandstone and brick. EXPLORATORY HOLE ENDS AT 0.80 m
0.80	ES 2				
Depth Type & No Records Date Casing Time Water Depth, Level/ (Thickness) Legend Backfill/ Instruments					
Groundwater Entries No. Struck Post strike behaviour (m) None observed (see Key Sheet) Depth sealed (m) Depth Related Remarks * From to (m) Chiselling Depths (m) Time Tools used					
Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:50 (c) ESG www.esg.co.uk 4/26/4127/07/2012 15:28:57 Project Contract Chemicals, Knowsley Project No. F2019-12 Carried out for AMEC Borehole WS04 Sheet 1 of 1					

Appendix B

Site Investigation Photographs – Contract Chemicals Ltd



Arisings from HDP01



HDP01 excavation (duct
visible to right of image)



Arisings from HDP02



HDP02 excavation
(black duct visible)

Site Investigation Photographs – Contract Chemicals Ltd



Arisings from HDP03



HDP03 excavation



Arisings from HDP04



HDP04 excavation

Site Investigation Photographs – Contract Chemicals Ltd



Arisings from HDP05



HDP05 excavation



Arisings and excavation
HDP06



Arisings from WS01

Site Investigation Photographs – Contract Chemicals Ltd



Deep arisings from
WS01



WS01 excavation



Shallow arisings from
WS02



Deep arisings from
WS02

Site Investigation Photographs – Contract Chemicals Ltd



WS02 excavation



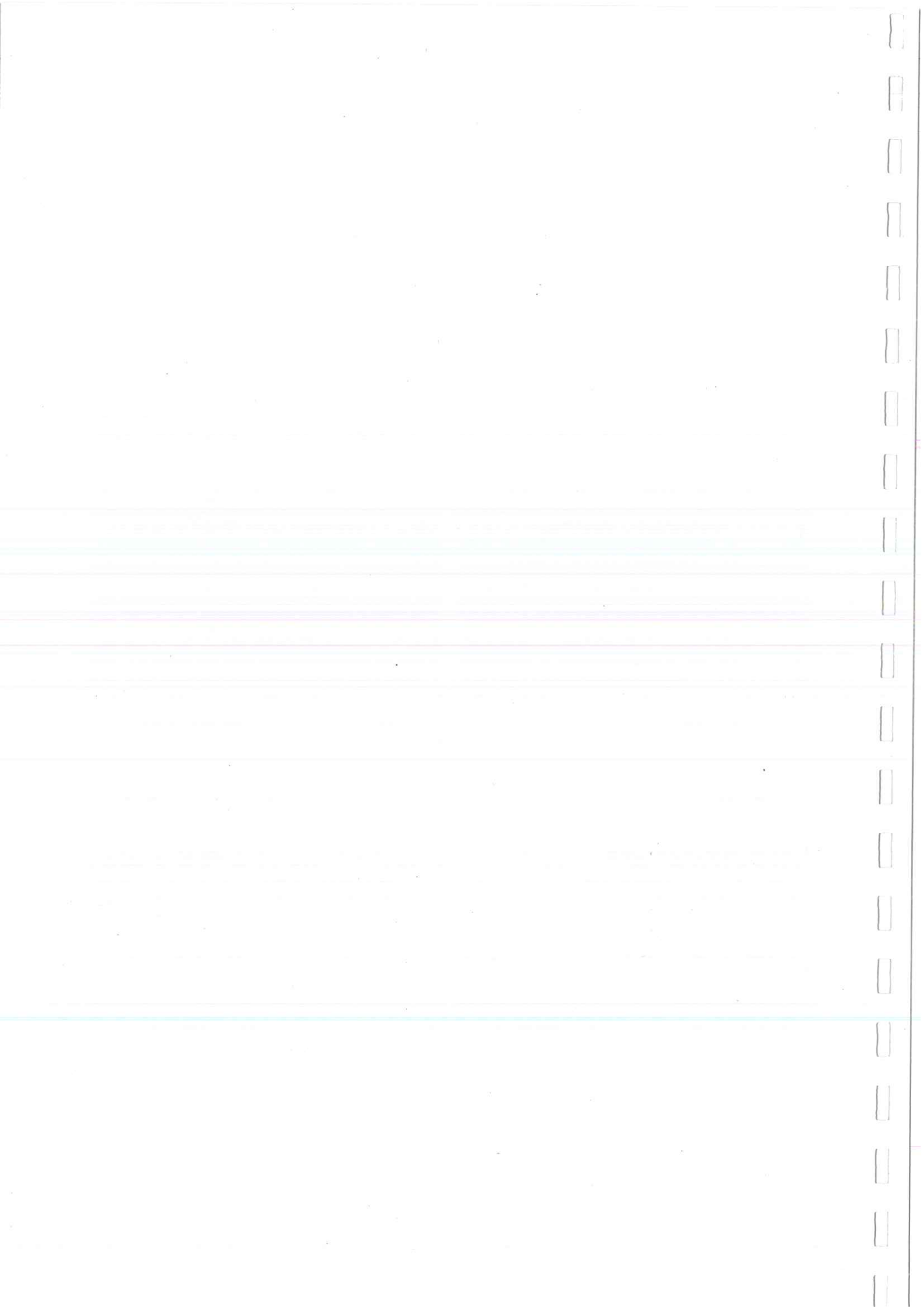
WS03 excavation and
arising



WS04 arising



WS04 excavation



Appendix C



ALcontrol Laboratories

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Non-routine Analysis Report

Date: 24th July 2012

Our Reference:	SDGs 120628-40 & 120714-71(12-126)
Quote Reference:	NRW147
Your Reference:	32144
Location:	Contract Chemicals

Samples from 19 sample events, 18 soils and 1 water, were received on 28th June 2012.
An additional two water samples were received on 14th July 2012.

We are pleased to enclose our non-routine analysis report.

Signed

R Malcolm
Deputy Technical Manager

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1.0 Introduction

Samples from 19 sample events were received on the 28th June 2012. Bromododecane determination was requested on 15 soil samples and one water sample as detailed in table 1. An additional two samples were received on the 14th July 2012, detailed in table 2, for the same analysis. It was noted that the water sample, WS1 – HDP02, had not been delivered in a suitable container for semi-volatile analysis.

Alcontrol Sample Event No	Alcontrol Sample No	Client Sample ID and Depth	Matrix	Analysis Required ?
SE 5797089	5797173	HDP01 (0.4)	Soil	Yes
SE 5797091	5797191	HDP01 (0.7)	Soil	Yes
SE 5797093	5797255	HDP02	Water	Yes
SE 5797092	5797211	HDP02 (0.27)	Soil	Yes
SE 5797094	5797273	HDP03 (0.1)	Soil	Yes
SE 5797095	5797274	HDP03 (0.4)	Soil	Yes
SE 5797099	5797290	HDP04 (0.2)	Soil	Yes
SE 5797101	5797294	HDP04 (0.4)	Soil	Yes
SE 5797104	5797306	HDP05 (0.3)	Soil	Yes
SE 5797108	5797339	HDP06 (0.2)	Soil	Yes
SE 5797109	5797109	HDP06 (0.4)	Soil	No
SE 5797096	5797096	WS01 (0.35)	Soil	Yes
SE 5797097	5797283	WS01 (0.8)	Soil	Yes
SE 5797098	5797283	WS01 (1)	Soil	No
SE 5797102	5797296	WS02 (0.2)	Soil	Yes
SE 5797103	5797299	WS02 (0.5)	Soil	Yes
SE 5797105	5797310	WS03 (0.4)	Soil	Yes
SE 5797106	5797318	WS04 (0.3)	Soil	No
SE 5797107	5797333	WS04 (0.8)	Soil	Yes

Table 1 – Alcontrol reference numbers and client sample IDs, SDG 120628-40

Alcontrol Sample Event No	Alcontrol Sample No	Client Sample ID and Depth	Matrix	Analysis Required ?
SE 5886289	5886295	WS01	Water	Yes
SE 5886290	5886301	WS04	Water	Yes

Table 2 – Alcontrol reference numbers and client sample IDs, SDG 120714-71

2.0 Extraction and Analysis

Soil Extraction

A known mass of sample was extracted into an appropriate solvent using sonication extraction. Very high concentrations of bromododecane were detected in certain samples. Analysis of these samples was repeated using less sample to enable complete extraction to be obtained.

Water Extraction

A known volume of sample was extracted in an appropriate solvent at two different pH values using liquid/liquid extraction.

Analysis

A known volume of extract was spiked with internal standards and analysed using gas chromatography with mass selective detection. 1-Bromododecane was detected by searching for indicative ions and identified by comparing against a library of mass spectra. A positive match (98%) was obtained for 7 of the 18 analysed samples. It should be noted that only 1-bromododecane and 2-bromododecane are present in the mass spectra library. For this reason it cannot be confirmed if 1-bromododecane or another bromododecane isomer is present although it is unlikely that another bromododecane isomer would present the same mass spectrum.

The concentration of bromododecane present in the extract was quantified against the nearest internal standard and this value was then calculated back to give the concentration in the sample. Results from the analysis are summarised in tables 3 and 4.

3.0 Results

Tables 3 and 4 below summarise the results obtained from the soil and water samples. For convenience the soil results have been reported in mg/Kg rather than the more common $\mu\text{g/kg}$. The water sample has been reported in the normal units of $\mu\text{g/L}$.

Alcontrol Sample No	Client Sample ID and Depth	Matrix	Mass of Sample (g)	Bromododecane (mg/Kg)
5797173	HDP01 (0.4)	Soil	1.08	2500
5797191	HDP01 (0.7)	Soil	1.12	640
5797211	HDP02 (0.27)	Soil	10.18	<1
5797273	HDP03 (0.1)	Soil	1.01	1300
5797274	HDP03 (0.4)	Soil	1.10	410
5797290	HDP04 (0.2)	Soil	10.10	<1
5797294	HDP04 (0.4)	Soil	10.07	<1
5797306	HDP05 (0.3)	Soil	10.05	<1
5797339	HDP06 (0.2)	Soil	10.20	<1
5797096	WS01 (0.35)	Soil	10.00	61
5797283	WS01 (0.8)	Soil	10.04	10
5797296	WS02 (0.2)	Soil	10.16	<1
5797299	WS02 (0.5)	Soil	10.06	<1
5797310	WS03 (0.4)	Soil	10.11	<1
5797333	WS04 (0.8)	Soil	10.14	<1

Table 3 – Summary of soil results, positive results are highlighted in bold

Alcontrol Sample No	Client Sample ID and Depth	Matrix	Volume of Sample (ml)	Bromododecane ($\mu\text{g/L}$)
5797255	HDP02	Water	150	<10
5886295	WS01	Water	150	980
5886301	WS04	Water	150	<10

Table 4 – Summary of water results, positive results are highlighted in bold

4.0 Conclusion

Bromododecane was found to be present in 7 of the 18 analysed samples with concentrations ranging from 10mg/Kg to 2500mg/Kg in the soils and at 980 $\mu\text{g/L}$ in the waters.

