PANATTONI

Former Akzo Nobel Site, Slough

Remediation Scheme for Contamination

December 2019

First Panattoni

FORMER AKZONOBEL SITE - SLOUGH

REMEDIATION SCHEME FOR CONTAMINATION

BUCKINGHAM

Buckingham Group Contracting Limited
Silverstone Road
Stowe
Buckingham
MK18 5LJ

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Author:	 Brendon Ford *BSc MSc FGS CGeol*
Client:	First Panattoni Ltd
Contractor:	Buckingham Group Contracting Limited Blackpit Farm Silverstone Road Stowe Buckinghamshire MK18 5LJ Contact: Tim Brown Telephone: 01280 823355
Site Address:	Former AkzoNobel Site, Wrexham Road Slough, Berkshire SL2 5DS

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1.0 INTRODUCTION

1.1 Background

Buckingham Group Contracting Limited (BGCL) is contracted by First Panattoni Ltd to complete infrastructure and enabling works for commercial / industrial redevelopment at the former AkzoNobel Site, Slough. The site covers an area of approximately 33 acres near the Slough City centre and is located off Wrexham Road, Slough, Berkshire SL2 5DS. The site is centred on National Grid Reference (NGR) 498684, 180207 and is at an elevation of approximately 29 to 31m above ordnance datum (AOD) and is generally flat lying with a slight fall to the south. A Site location plan is included as **Figure 1**.

The site is located within a mixed commercial and residential area and is bounded to the north by the Grand Union Canal and the south by a railway line. Wexham Road forms the western site boundary and the east of the site is bounded by a Cadent Gas property (former Gas works) and Uxbridge Road beyond.

The proposed works are divided into 3 Phases as shown on **Figure 2**. Phase 1 and Phase 2 area located in the northern section of the site and will be redeveloped for mixed use comprising part B2/B8 sui generis and/or data centre use (and associated infrastructure) and Phase 3 will be redeveloped for part multi-storey residential apartments with associated access and car parking and limited soft landscaping.

Historically the site has been used for paint and coating manufacture from 1919 until operation ceased in 2018. Prior to this the site was utilised for brickearth excavation and brick making in the late 1800s as well as for a US/Canadian Army Storage Base between 1914-1918.

Most recently the site has mainly been used for the production and distribution of latex and alkyd resins, water based paints and solvent based finishes. The site contains several bulk material storage tank farms (solvents, petroleum and resins), plus drum storage, substation and boiler plants.

The site has a long history of intrusive ground investigation, interpretation and risk assessments as summarised in the following documents:

- Arcadis , “AkzoNobel, Phase II Environmental Site Assessment, The Former ICI Paints, Slough, Wrexham Road, Slough SL25DS”, dated 12 February 2009
- Arcadis “AkzoNobel, Slough Manufacturing Unit, Soil and Ground Water Investigation, dated November 2015
- Arcadis, Non-technical Environmental Summary dated May 2018
- Arcadis, “AkzoNobel, Slough Manufacturing Unit, Further Environmental Investigation Report”, Dated June 2018
- Arcadis, “AkzoNobel, Slough Manufacturing Unit, Detailed Quantitative Risk Assessment”, dated September 2018
- Arcadis, SMU Groundwater Monitoring Factual Report- Updated, dated 18 September 2018
- Arcadis, “AkzoNobel, SMU, Geotechnical Appraisal Ground Investigation Report”, dated October 2018

In the interpretative reports and the DQRA, areas of soil and groundwater contamination which will require remediation are identified and assessed.

1.2 Purpose of the Report

The purpose and aims of the Remediation Scheme for Contamination are to:

- Consider the range of options for methods of management of contamination and choose a preferred option for remediation

- Propose a remediation scheme for the protection of human health and the aqueous environment based on the results of existing investigations and the further investigations proposed in this report
- Propose any additional investigation necessary to cover gaps in information so that full assessment of the site can be made
- Describe the outline remediation methodology by which remediation will be carried out
- Propose a method of validation that will demonstrate that soil contamination and risks to the aqueous environment have been reduced to an acceptable level.
- Propose monitoring that will indicate that risks to human health and the environment have been reduced to an acceptable level
- Propose methods for dealing with any previously unrecorded ground or groundwater contamination
- Present an outline of the Validation Report
- List further documentation needed for compliance with legislation or standard guidance
- Through the strategy set out I this document this document, provide support for the discharge of any contamination related planning conditions that Slough Borough Council may require as part of the planning permission for the site, assuming the currently proposed uses as described in Section 1.0 above and shown on Figure 2.

The report will be a reference document for site management staff during the demolition, earthworks and construction periods. Should any ground conditions or contamination be encountered during the works has not been previously identified encountered an assessment will be made and any changes to this remediation strategy will be proposed for agreement with the client and the regulatory authorities.

2.0 ENVIRONMENTAL SETTING

2.1 Description of Site and Environs

The site is located off Wrexham Road, Slough, Berkshire SL2 5DS and covers an area of approximately 33 acres near the Slough City centre. The site is at an elevation of approximately 29 to 31m above ordnance datum (AOD) and is generally flat lying with a slight fall to the south.

The site is located within a mixed commercial and residential area and is bounded to the north by the Grand Union Canal and the south by a railway line. Wexham Road forms the western site boundary and the east of the site is bounded by a Cadent Gas property (former Gas works) and Uxbridge Road beyond.

Historically the site has been used for paint and coating manufacture from 1919 until operation ceased in 2018. Most recently the site has mainly been used for the production and distribution of latex and alkyd resins, water based paints and solvent based finishes. These activities were undertaken in numerous buildings across the site, supported by several bulk material storage tank farms (solvents, petroleum and resins), plus drum storage, substation and boiler plants.

The location of the site is shown on **Figure 1** and the site layout before demolition is shown on the plan in **Appendix A**.

2.2 History

Reference to historical mapping shows that the site was open fields from 1876. It is understood that the site was then used for brickearth excavation and brick making activities in the late 1800s. Between 1914 and 1918 the site was used as a US/Canadian Army military storage area during the First World War, although no evidence of munitions has ever been detected.

The site was then utilised for the manufacture of nitrocellulose-based varnish between 1919 and 1926, with the historical 1925 OS map showing the site as a “Paint and Varnish Works” with a gas works adjacent to the site in the east. By 1932 expansion of the site has occurred and the site was taken over by Nobel Chemical Finishes.

Further expansion occurred and by 1956 the buildings on the site occupy the majority of the footprint, with tanks in the northwest, northeast and southeast. Further tanks are present from 1971 then the site remains essentially unchanged until the demolition of several buildings between 1998 and 2007 when the manufacture of industrial and woodcare products was transferred out of Slough. The site layout has remained unchanged since this time, with all operations ceasing by 2018.

A layout showing the most recent features of the works before closure is attached in **Appendix A**.

Additional information on the site history including historical maps is given in the 2009 Environmental Site Assessment listed in Section 1.1.

2.3 Geology and Hydrogeology

The geology is shown on the British Geological Survey (BGS) map 269 1:50,000 Series and on the BGS website. The site is underlain by between 5m and 9m of the Taplow Gravel Member, underlain by up to 39m thickness of the Lambeth Group. The underlying bedrock is the Seaford and Newhaven Chalk Formation.

Made ground overlies the natural soils in much of the site as a result of previous development. Asphalt and concrete hardstanding covers former roads and yards and beneath former buildings there are extensive reinforced concrete slabs.

Historical investigations using trial pits and boreholes as listed in Section 1.1 above have confirmed the geological sequence shown on the BGS maps and site-specific information is summarised in **Table 1**.

An historical investigation point location plan is presented in **Figure 3**.

Table 1 Summary of Geology

Horizon	**General Thickness**	**Description**
Made Ground:	Typically, 1.0 to 1.5m, locally up to 3.4m	Sandy gravelly clay with fragments of brick, flint and concrete. Made ground is notably more granular in the northwestern, northeastern and southeastern areas of the site and more cohesive through the site centre
Taplow Gravel Member	5.5 to 8.2m	Gravelly sands and sandy gravels with variable clay content
Lambeth Group	Maximum thickness encountered 8.9m	Firm to stiff grey mottled red-orange clay
Seaford and Newhaven Chalk	Not proved	Chalk with nodular flint beds

The Taplow Gravel member is classified by the Environment Agency as a Principal Aquifer and the Lambeth Group as a Secondary A aquifer. The Seaford and Newhaven Chalk is classified as a Principal Aquifer. It is considered that the more cohesive and lower permeability strata of the Lambeth Group are acting as an aquiclude between the Taplow Gravel Member and the deeper Chalk aquifer.

The site is located within a Zone III (Total Catchment) groundwater source protection zone (SPZ), with the Zone II (Outer Protection) and Zone I (Inner Protection) located approximately 80m to the southwest and 915m to the west of the site respectively. The closest groundwater abstraction for the site is located 1.25km west. Review of regional boreholes (SU98SE87, SU98SE95 and SU98SE888) suggests that the abstraction is from the Chalk Aquifer.

Generally unconfined groundwater is present in the Taplow Gravel Member at levels of between 21.09mAOD and 27.82mAOD with an average depth of 2.2m. Within localised variations the groundwater gradient is to the southwest. In the DQRA the chosen hydraulic gradient for the model was 0.0006 based on groundwater level monitoring and measured hydraulic conductivities.

Groundwater quality has been affected by former activities on the site. In the DQRA it was considered that contaminated groundwater posed a potential risk to controlled waters, and human health (via vapour risk to occupants of future buildings). The main contaminants of concern identified were benzene, toluene, ethylbenzene and xylenes (BTEX), Total Petroleum hydrocarbons (TPH), naphthalene, tert-butyl alcohol and chlorinated hydrocarbons.

2.4 Surface Water

The nearest surface waters to the site are the Grand Union Canal along the northern site boundary and the culverted course of the Dachett Brook, which is understood to be present beneath Uxbridge Road immediately east of the site. The Canal is not considered to be a likely receptor due to its elevated position in relation to the site coupled with its upgradient location. Similarly, the Dachett Brook is not considered a receptor due to its location up-hydraulic gradient from the site.

2.5 Ground Gas

There is potential for generation of ground gas and vapours from hydrocarbon contamination in the soils and groundwater on the site to impact in site end users.

A single round of ground gas monitoring was undertaken by Arcadis between 5 and 8 August 2015 from 42 boreholes. Methane concentrations ranged from below detection to a maximum of 35.3%

in borehole BHAN08. Methane was present at levels above 10% in BHAN01, BHAN03, BHAN06, BHAN07, BHAN11, BHAN12 and BHAN17, which are all located in areas of elevated soil and groundwater hydrocarbon contamination and visual/olfactory evidence of contamination was observed in the boreholes.

Carbon dioxide concentrations ranged from 0.1% to 16.4%, with the higher values again associated with areas of known hydrocarbon contamination in the north of the site. Oxygen levels ranged from near atmospheric to a minimum of 0.8% in BHAN06

Flow rates ranged between -12.9l/hr to 0.01l/hr but was generally zero/close to zero in most locations.

Further ground gas monitoring is required to inform the ground gas design in the final development. understand whether there are sources of carbon dioxide and methane (bulk gases) that may present a risk to future structures and its mitigation measures, if required. As such further bulk ground gas monitoring comprising six events at least 2 weeks apart and with one within a rainfall event will be performed. This will inform the design of ground gas protection measures in the final development, if required.

3.0 RISK ASSESSMENT AND OPTIONS APPRAISAL

3.1 Identified Pollutant Linkages

Over the various ground investigations, the following four main Potential Areas of Concern (PAOC) have been identified with respect to potential risk to controlled waters, based on both soil and groundwater concentrations:

PAOC1 North-eastern Boundary of Site, adjacent to and north of the former Gas Works Boundary. Historic solvent and oil storage and industrial use since the 1930s. Identified contamination includes dissolved phase BTEX, TPH, chlorinated solvents, alcohols and naphthalene as well as free phase hydrocarbon, elevated TPH concentrations and asbestos in the unsaturated soils. Buried paint tins and gross shallow paint contamination have been recorded also. As the largest source area its dimensions were used as the source area in the Arcadis DQRA.

PAOC 2 Located in the northwest of site, with the historic Tank Farm A considered to be the likely source area. Identified contamination includes dissolved phase BTEX, TPH and alcohols, as well as free phase hydrocarbon and elevated TPH concentrations in unsaturated soils. Buried paint tins and gross shallow paint contamination have also been recorded.

PAOC 3 Located adjacent to the northern site boundary and associated with the former Resin Plant Area. Identified contamination includes dissolved phase BTEX, TPH and alcohols, and elevated TPH and PAH (predominantly naphthalene) in unsaturated soils.

PAOC 4 Located on the eastern site boundary with the former gas works and hydraulically downgradient of PAOC 1. Identified contamination includes dissolved phase BTEX, TPH and naphthalene. No significantly impacted unsaturated soils or historical land use in this area to suggest an active source, and groundwater contamination could represent either a down gradient continuation of the dissolved phase Plume in PAOC 1 or/and contamination from the former gasworks site.

Locations of the PAOC are shown on **Figure 4**.

Identified receptors include site demolition and earthworks/construction personnel, site end users post development and controlled waters in the underlying Principal Aquifer.

The plausible pollutant linkages identified in the Arcadis DQRA report are summarised in **Table 2**. These include those which were subject to detailed quantitative assessment (Section 3.2) and a further four, related to asbestos, landscape soils, potable water supply infrastructure and gross paint contamination are also listed.

Table 2 Plausible Pollutant Linkages

Pollutant Source	Pollutant Receptors	Pollutant Pathways
Elevated Total Petroleum Hydrocarbons, PAH, alcohol, BTEX and Chlorinated Solvents in unsaturated Soils	Human Health of site construction workers and site end users post development	Dermal contact, ingestion and dust and vapour inhalation
	Controlled waters in the Taplow Gravel Member Principal Aquifer	Leaching via rainfall infiltration and vertical migration through the unsaturated soils to the underlying aquifer
Free Phase Hydrocarbons in soils and as LNAPL on the water table	Human Health of site construction workers and site end users post development	Dermal contact, inadvertent ingestion and vapour inhalation
	Controlled waters in the	Release of shorter chain, more

Pollutant Source	Pollutant Receptors	Pollutant Pathways
	Taplow Gravel Member Principal Aquifer	mobile/soluble constituent chains lengths via incident rainfall infiltration and degradation with subsequent downward migration to the underlying Principal Aquifer
Elevated dissolved and TPH, PAH, alcohol, BTEX and Chlorinated Solvents in Groundwater in the Taplow Gravel Member	Human Health of site end users post development	Vapour inhalation via generation and migration of vapours through permeable strata with accumulation in unventilated areas of the final development
	Controlled waters in the Taplow Gravel Member Principal Aquifer (both beneath the site and the adjacent gasworks site)	Vertical and lateral migration down hydraulic gradient.
Gross Paint Contamination	Human Health of site end users post development	Gross contamination, dermal contact, vapour inhalation
	Controlled waters in the Taplow Gravel Member Principal Aquifer (both beneath the site and the adjacent gasworks site)	Ongoing source of contamination, vertical and lateral migration down hydraulic gradient.
Asbestos in made ground	Human Health of site demolition and construction workers, service personnel and neighbouring residents. Site end users	Release and inhalation of fugitive fibres during demolition and ground disturbance. Release of fugitive fibres from exposed impacted soils.
Contaminants in landscape/garden areas	Plants used in landscaping areas, site end users	Vegetative uptake and bioaccumulation of phytotoxic contaminants in landscaping areas Consumption of garden vegetables grown in impacted soils
Organic and inorganic contaminants in site soils	Site end users, water supply infrastructure Concrete	Penetration and tainting of water supply pipelines Aggressive ground attach on below ground concrete

Further details of the site conceptual site model are included in the 2018 Arcadis DQRA Report referenced in Section 1.1.

3.2 Summary of DQRA and Identified Contamination Source Areas

Further DQRA assessment of the plausible pollutant linkages was undertaken by Arcadis in 2018 for both controlled waters and human health, focusing on the four identified Potential Areas of Concern and identified contaminants of concern. Given the larger dimensions and levels of contamination in PAOC1 this was used by Arcadis as the source zone in the assessment.

3.2.1 Controlled Waters

Following initial screening against measured concentrations, groundwater quality standards, detection limits and a Low Density Residential Human Health Generic Assessment Criteria (GAC) the following Contaminants of Concern (CoC) were subjected to further assessment :

- Speciated TPH
- Benzene

- Toluene
- Ethylbenzene
- Sum Xylene
- PAH
- Chlorinated VOC
- Phenolics
- Tert-butyl alcohol

The DQRA derived site Specific Action Criteria(SSAC) protective of controlled waters based on a compliance point of 50m downgradient from the adopted source area of PAOC1. Assessment of analytical soil and groundwater results against these SSAC identified a theoretical risk to controlled waters from measured concentrations of benzene, naphthalene, Tert-Butyl Alcohol ITBA) , vinyl chloride and cis-1, 2-dichloroethene (cis-DCE) in soil and groundwater.

Toluene and Trichloroethene (TCE) concentrations in soil in excess of the calculated SSAC were encountered at one location each (BHAN207 and TP104) respectively. Neither toluene nor TCE were measured in the groundwater above the modelled groundwater SSACs of 48,400ug/l and 49ug/l respectively and the maximum encountered groundwater concentration over the wider site was 3ug/l. On this basis Arcadis concluded that toluene and TCE in soils are not considered a risk to controlled water, although it is noted that TCE can act as an ongoing source of cis DCE and vinyl chloride.

Results for cis DCE and naphthalene and TBA were reassessed by Arcadis against groundwater concentrations, as well as source area geometry and spatial location. Exceedances of the SSAC for cis-DCE and naphthalene in unsaturated soils were encountered in one and six samples respectively, with no associated exceedances of the groundwater SSAC at those locations. Site wide exceedances of cis DCE, naphthalene and TBA in groundwater were limited to two locations in each instance with the lateral distribution suggesting rapid attenuation of the concentration.

Given this, coupled with the isolated nature of the exceedances, and the fact that the average concentrations in groundwater are below the SSAC, Arcadis concluded that these determinands are not considered a significant risk to groundwater. These determinands in soil will therefore not be considered further in respect to controlled waters.

Soil and groundwater benzene and vinyl chloride concentrations were further assessed by Arcadis initially through direct comparison of modelled source area concentrations against measured concentrations in groundwater in the Taplow Gravels in borehole GM105. Borehole GM105 is located 55m down gradient and was therefore considered a suitable location to validate the modelled concentrations. Benzene and VC concentrations at GM105 were found to be below the laboratory Method Detection Limit of 1ug/l, suggesting that attenuation was occurring more rapidly than estimated in the initial DQRA model. In view of this a further review of literature values for degradation half-lives for both benzene and vinyl chloride was undertaken. Subsequently predicted concentrations were calculated using a range of degradation half-lives and average and maximum source area concentrations and compared against the measured concentrations in GM105. Result of this reassessment indicated that a half-life of 100 days for both benzene and vinyl chloride provided a better match with observed site conditions.

To further assess risk to the aquifer, Arcadis repeated the DQRA using the revised degradation rates and an increased distance to the compliance point. At distances of 95m and 105m none of the measured concentrations of either vinyl chloride or benzene associated with PAOC1 (benzene and vinyl chloride) or PAOC2 – 4 (benzene only) were in excess of the modelled SSAC. On this basis Arcadis concluded that the risk to the aquifer from measured concentrations of benzene and vinyl chloride was considered to be low. It is noted that both the 50m and 105m compliance points are located either within the site, or in the case of PAOC1, beneath the adjacent gasworks site, although it is considered that this groundwater re-enters AkzoNobel site down gradient between 100 – 150m from the down gradient edge of PAOC1.

Notwithstanding the above, BGCL acknowledge that the revised SSAC would still result in ongoing contamination of groundwater in the Taplow Gravel Principal Aquifer beneath the site as well as the potential liability of offsite migration of contamination from POAC 1 down hydraulic gradient beneath the adjacent gasworks site. It is noted that the identified areas of gross hydrocarbon contamination in the unsaturated zone (including total TPH in excess of 5,000mg/kg, benzene in excess of the 50m compliance point SSAC, gross paint contamination/buried tins and free phase hydrocarbon) are spatially co-coincident with the higher concentration cores of the groundwater plumes in PAOC1, 2 and 3 and are likely to represent ongoing sources of contamination.

It is further noted that where free phase hydrocarbon is present the rate of aerobic degradation of hydrocarbon in the underlying dissolved phase plumes is significantly reduced or only occurring around the margins of the free phase. While free phase hydrocarbons have been positively identified at 5 locations it is likely to be present as a thin layer or sheen at most locations where recorded groundwater total TPH concentrations are greater than 1mg/l. Free phase trapped in pore spaces in the saturated zone may also be released seasonally at times of falling groundwater levels.

It is good practice to remove free phase and grossly hydrocarbon contaminated soils. In consideration of the above groundwater plumes and unsaturated soil contamination, areas of shallow soil and free phase contamination requiring remediation have been identified as detailed in **Section 3.2.3**.

3.2.2 Human Health

A number of CoC were present in site soils in excess of the Arcadis Human Health SSAC protective of future on-site residents, driven both by the vapour inhalation and dermal contact pathways. In addition, a number of petroleum hydrocarbon CoC were measured in excess of the commercial worker SSAC in soils driven by the vapour intrusion pathway, mainly from PAOC1, but also PAOC2 and 3. Lead and chromium were also noted in excess of the commercial end use SSAC in a limited number of locations, as well as asbestos in soils, albeit at a limited number of locations and generally at less than the laboratory lower limit of quantification of 0.001%.

The DQRA concluded that provision of a suitable thickness of imported topsoil in any landscape areas post development would act to break the exposure pathways in these areas. Direct exposure pathways in the commercial areas would be mitigated through the provision of hardstanding in the form of building slabs, service yard and access infrastructure.

The identified vapour pathway from soil and groundwater to site end users can be mitigated through either the provision of a proprietary vapor proof membrane beneath all site buildings, the design of which would be informed by further pre and post remediation ground gas monitoring, or through remediation of contaminant levels in soils to acceptable concentrations in line with DQRA, derived following further monitoring as proposed.

The Remediation Strategy will address all identified risk to human health. Further pre and post remediation site wide ground gas and vapour monitoring will be required to inform the final gas protection design.

3.2.3 Identified Remediation Areas

BGCL have identified areas requiring remediation based on the Arcadis DQRA SSAC for groundwater and the presence of free phase hydrocarbons which is acting as a continuing source of gross contamination and dissolved phase. While the DQRA SSAC for the majority of the TPH fractions were in excess of the solubility a generic precautionary 1mg/l total TPH concentration has also been adopted to define groundwater plumes as total TPH concentrations in excess of this level are considered indicative of the likely presence of free phase based in the average solubilities of all fractions.

The Arcadis groundwater analytical data from the August 2018 round of testing has been used as it is the most recent and was undertaken in summer when infiltration and groundwater levels are

lower. Hence contamination concentrations are likely to be towards the high end of the annual range of concentrations.

A generic target of 5,000mg/kg has also been used for TPH in unsaturated soils as concentrations above this level are highly visible, malodours and may be acting as an ongoing potential source of dissolved phase contamination.

Table 3 Free Phase and Unsaturated Soil Source Areas

Source Area Reference	Approximate Volume (m^3)	Locations/depth	Determinants	Conc. (mg/kg)
Area A (PAOC2)	2,500	BHAN216/1.7m	Benzene	2.12
		BHAN216/1.7m	Total TPH	8,175
		BHAN12/3.0m		6,780
		BHAN12/3.0m	Free Phase	Up to 0.47m recorded
		GM101		
		BHAN214	Benzene	<0.18*
Area B (PAOC 3)	800	BHAN212/2.1m	Total TPH	6,010
		BHAN212/1.4m	Benzene	<1.8*
		BHAN212/2.10m		<1.8*
Area C (PAOC 1)	4,000	BHAN207/2.1m	Benzene Toluene	80.1 518
		BHAN207/2.1m	Total TPH	6,392
		BHAN04/1-1.2m		7,320
		BHAN207	Free Phase	Up to 0.49m recorded
		BHAN208		
		TP105		
		BHAN208/2.0m	Benzene	<0.18*
Area D (East of PAOC 1)	800	BHAN209/1.6m	Total TPH	4,968
			Benzene	<1.8*
Area E (PAOC1)	800	BHAN206	Benzene	<1.8*

* Benzene laboratory detection limit >one order of magnitude above 105m DQRA SSAC

A summary drawing of the locations of all soil source areas is included in **Appendix B**.

Table 4: Groundwater Plumes (>50m GW SSAC and 1mg/l total TPH, August2018)

Plume	Approximate Area	Locations	Determinants	Conc. (ugl/l)	Comments
Plume 1 (PAOC 2)	2,800m^2 (*60m x 25m*) Core* = 400m^2	BHAN12	Benzene	97	Core located beneath Area A (free phase, benzene, total TPH. Buried paint tins in BHAN10 to the east)
		BHAN214		1,240	
		BHAN216		464	
		GM107		7.0	
		GM101		626	
		GM101	Total TPH	15,700	
		BHAN12		7,740	
		BHAN214		8,130	
		BHAN216		9,910	
		GM107		1,180	
		BHAN215		1,050	
Plume 2 (PAOC 3)	1,400m^2 (*70m x 20m*)	BHAN211	Total TPH	11,700	Core located beneath Area B (total TPH)
		BHAN06		6,980	
		BHAN211	Benzene	159	
		BHAN212		67	
Plume 3 (PAOC 1)	25,000m^2 (170 x 150)	BHAN17	Total TPH	20,600	Core located beneath Area C
		GM115		62,000	
		BHAN206S		217,000	

Plume	Approximate Area	Locations	Determinants	Conc. (ugl/l)	Comments
	Core* = 3,000m^2	BHAN14		105,000	(widespread free phase, benzene, total TPH. Buried paint tins at numerous locations, plus localised chlorinated solvents centred on BHAN17)
		BHAN203		14,000	
		BHAN207S		86,800	
		BHAN04		10,537	
		BHAN11		19,600	
		BHAN202		5,900	
		BHAN209S		79,500	
		BH5		62,000	
		BHAN201		5,130	
		BHAN208		4,410	
		BHAN207S	Benzene	6,100	
		BHAN11		200	
		BHAN04		946	
		BHAN206S		5,580	
		BH5		214	
		BHAN202		722	
		BHAN208S		98	
		BHAN14		1,870	
		BHAN203		323	
		BHAN201		48	
		BHAN209D		10	
		BHAN17		337	
		GM115		722	
		BHAN223		71	
		BHAN203	Sum Xylene	8,290	
		BHAN06S		91,701	
		BHAN207S		9,970	
		BHAN209S		50,500	
		GM115		37,100	
		BHAN17	Cis DCE	1,490	
		BH206S		355	
		BH207S		458	
		BHAN17	Vinyl Chloride	510	
		BHAN206S		23.9	
		BHAN11		12.3	
		BHAN208D		11.5	
		BHAN207D		7.07	
		BHAN207S	Naphthalene	6,070	
		GM115	Tert-Butyl Alcohol	74.9	
Plume 4 (gasworks wall)	5,000m^2 (50 x 100)	GM104	TPH	6,230	No soil source from GI, possible down gradient extent of Plume 3 re-entering site
		BHAN217		1,280	
		GM105		3,370	
		BHAN31		626	
		BHAN218D		3,670	
		BHAN218D	Benzene	158	
		BHAN31		97	
		GM104		56	
		BHAN43		123	

** Core defined as benzene > 1mg/l*

Summary drawings of all groundwater plumes are included in **Appendix C**

Table 5: Asbestos in Made Ground

Location	Depth	Description	Quantification	Approximate Volume (m^2)
BHAN01	0.60	Chrysotile	<0.001	100
BHAN04	0.60	Amosite and Chrysotile	<0.001	100
BHAN25	0.60	Chrysotile	<0.001	100

BHAN31	0.40	Chrysotile	<0.001	100
BHAN42	1.0	Amosite	0.0015	100
BHAN17	0.2 – 1.2	Recorded on log	n/a	100

A location plan of recorded ACM and asbestos fibres in soils is include in **Appendix B**.

Table 6: Observed Paint Contamination

Location	Depth	Description	Comment
BHAN04	0.0 – 1.15m	Solvent odour, white liquid, buried paint tins, wood and slag	Potential contributing source of dissolved phase Plume 3
BHAN10	0.2 – 0.50	Solvent odour, blue liquid and buried paint tins	Potential contributing source of dissolved phase Plume 1
BHAN202	0.1 – 1.25	Buried tins, black staining and strong hydrocarbon odour	Potential contributing source of dissolved phase Plume 3
BHAN208	0.25 – 1.0	Paint tins recovered	Potential contributing source of dissolved phase Plume 3

A location plan of all recorded paint contamination is included in **Appendix B**.

3.3 Options for Remediation

At development sites where major contamination is present a range of options for remediation is considered and a cost effective, beneficial and sustainable solution is chosen. At the AkzoNobel site contamination is predominantly by BTEX, total TPH and free phase hydrocarbons, and to a lesser extent chlorinated hydrocarbon. The site is divided into 3 Phases as shown on **Figure 2**. Phase 1 and Phase 2 area located in the northern section of the site and will be redeveloped for mixed use comprising part B2/B8 sui generis and/or data centre use (and associated infrastructure) and Phase 3 will be redeveloped for part multi-storey residential apartments with associated access and car parking and limited soft landscaping.

The presence of hardstanding and importation of clean topsoil as required will provide a barrier between human receptors and contamination in soil and groundwater, eliminating these pathways post development. The identified vapour pathway from soil and groundwater to site end users will be present but can be mitigated through either the provision of a proprietary vapor proof membrane beneath all site buildings, the design of which will be informed by further pre and post remediation ground gas monitoring, or remediation of contaminant levels in soil to acceptable concentrations in line with DQRA, derived following further monitoring as proposed. Potential risk to the human health of groundworkers during the earthworks and construction periods will be mitigated through the adoption of best practice procedures and standard PPE.

Although the DQRA has shown that the risk to the Taplow Gravel aquifer at chosen compliance points and to surface water is low, there is groundwater contamination in the aquifer in 4 plumes in the northern, upgradient area of the site and offsite contamination of the neighboring downgradient gasworks site from Plume 3 is likely to be occurring, as attested by the presence of Plume 4 where the dissolved phase contamination re-enters the site. While all existing tanks and chemical storage infrastructure are to be cleaned and decommissioned prior to handover of the site, elevated CoC concentrations in the unsaturated soils, free phase hydrocarbons and the presence of gross paint contamination at some locations represent an ongoing source of contamination and potential for additional sources to be present. Furthermore, post development the site is to be split into a commercial enduse in the northern and central areas, with a more sensitive residential end use proposed for the southern, downgradient section of the site.

As such a combined process of source removal/reduction, active treatment and general betterment is considered in order to reduce potential risks and liability.

3.3.1 Options Appraisal

The options for the overall remediation approach are :

A. Source removal of all contaminated soil to Tier 1 levels for off-site disposal and treatment of groundwater to achieve Tier 1 (Environmental Quality Standard EQS).
B. Containment of gross dissolved phase contamination through installation of a bentonite containment barrier along the gas works boundary and between the commercial and residential area of the site.
C. Ongoing treatment of all impacted groundwater migrating offsite through provision of a closely spaced injected permeable reactive barrier (PRB) along the site along the gas works boundary and between the commercial and residential area of the site.
D. Source reduction of grossly impacted soils (TPH >5000mg/kg/other CoC > 50m SSAC) in the unsaturated zone via excavation and offsite disposal or exsitu bioremediation to enable reuse of treated soils at suitable locations in the final development. Source reduction would also include removal of free phase hydrocarbons down to a non-rebounding sheen on the groundwater level and excavation and offsite disposal of all encountered paint tins and associated contamination. Excavated soils containing asbestos could also be reused in less sensitive locations beneath hardstanding following excavation.
E. Source reduction of groundwater contaminants to the 50m compliance point SSAC through dual phase vacuum extraction or pump and treat via an activated carbon water treatment plant.
F. Source reduction of groundwater contaminants through insitu treatment of the plume cores using Oxygen Release Compound (ORC) injection for benzene and hydrocarbons and more targeted chemical oxidation injection for the chlorinated solvents in BHAN17.
G. Natural Monitored Attenuation of the groundwater plumes to demonstrate that they have reached steady state and are stable or shrinking and the contaminant mass is decreasing

Option A has the benefit of certainty and speed for remediation of soil. In view of the size and distribution of the groundwater plumes however the required treatment would be extensive and very probably not achievable. The option would give rise to the disadvantage of environmental impact of vehicles on the road with consequent potential for nuisance and for carbon emissions. The disposal of soil would take up landfill space which could more usefully be used for other wastes that cannot be treated. The cost benefit is poor due to the cost of off-site disposal of soil which is likely to be classified as hazardous, and the cost of extensive groundwater treatment. From both a cost benefit and risk perspective this option would not achieve significantly higher levels of protection than those that could be achieved using alterative options as detailed below.

Option B can high degree of protection from liability as the bentonite barrier along the gasworks site boundary will act to prevent migration of contamination off the site, as well as increasing the flow pathway, and thus create additional time for degradation of hydrocarbon contaminants before they reach the site boundary. The gasworks barrier would also prevent the migration of any offsite contamination associated with the gasworks into the AkzoNobel Site.

As a stand-alone remediation approach, it has the disadvantage of leaving contaminated soil and groundwater on the site at concentrations that could be harmful if circumstances change. Calculation of groundwater flows and the impact of the bentonite wall on groundwater levels would need to be carefully modelled and designed and it is likely that engineered activated carbon treatment gates will be required to maintain current levels and treat contaminated groundwater migrating offsite. The gates would require ongoing management as the activated carbon would need regular replenishing and offsite disposal as a hazardous material. In addition, the presence of numerous service corridors, including mains gas pipelines would necessitate engineered breaches/ crossing points.

It is noted that the underlying strata comprises Lambeth Group rather than London Clay and as such is not considered a 100% aquiclude due to the presence of relatively permeable lenses and sub horizons. As such potential exists for ongoing contaminant migration beneath the bentonite wall. Furthermore, due to the installation methodology of open trench excavation and

simultaneous slurry fill, identification of the final depth is based on observation of arisings in mixed slurry and potential for misidentification of top of Lambeth Group cannot be discounted.

Installation of a bentonite slurry wall would generate circa. 4,000m^3 of mixed arisings, of which a proportion will be grossly contaminated and require treatment or costly offsite disposal. Treatment of arisings via ex-situ bioremediation would be hampered as they would be mixed with low permeability bentonite.

Following installation potential integrity failures would necessitate disruptive excavation and reinstatement /repair.

Option C would comprise the provision of a permeable reactive barrier comprising a line of closely spaced boreholes co-injected with ORC Advanced and Petrofix™ along the boundary of the site to the gasworks and between the future commercial residential areas. This would serve to mitigate risk through interception and treatment of dissolved phase contaminants as well as further enhancing groundwater conditions conducive to degradation of dissolved and free phase contamination in the groundwater plumes and wider aquifer.

Petrofix works by absorbing hydrocarbons from the dissolved phase onto activated carbon particles and stimulating biodegradation by adding both slow and quick release electron acceptors (nitrate and sulphate). As the adsorbed contaminants are degraded by the biofilm growing on the PetroFix particles they renew the adsorption sites, allowing for more contamination to be adsorbed and degraded. This bio-regeneration of the barrier can allow treatment to remain active for years and the product will remain in the soil profile at the site of injection, providing an ongoing permeable enhanced treatment barrier to groundwater. The co-injection of ORC Advanced further enhances the down gradient aquifer environment for ongoing aerobic degredation of contamination.

This method is not reliant on the presence of a lower aquiclude and does not change the underlying groundwater regime. It produces a permeable reactive barrier which treats all contaminated water that flows through it, both leaving site, and entering in from the adjacent gasworks. No engineered treatment gates are required, and the product is introduced to the soil by direct push injection , therefore there are no arisings generated. Hole spacing and injection rate can be controlled to ensure suitable dispersion of product to ensure coverage, even if gaps in the spacing is required to avoid services.

Any potential failures (i.e. elevated concentrations detected in down gradient monitoring) can be easily reinjected.

While the efficacy of a PRB can be overwhelmed by free phase hydrocarbons, the installation could be staged. In this instance the PBR could be installed after free phase and gross contamination removal, but before any potential mobilisation of sorbed phase contamination during any targeted plume injection treatment. It is further noted that under the proposed configuration, dissolved phase contamination in Plume 3 would need to cross the PBR three times before entering the more sensitive residential area of the site.

Option D has the benefits of remediating smaller, more targeted quantities of soil and free phase than Option A and is therefore less costly in terms of expense and time. Removal of free phase hydrocarbon will also enhance the potential for aerobic degradation in the underlying dissolved phase plumes, but it does not address the dissolved phase contamination currently present.

Option E has the benefit of being able to treat water, free phase and vapour but has the disadvantage of expense, time scales and the requirement for significant onsite infrastructure including numerous abstraction wells, vacuum pumps, pipework, treatments units and separators. Offsite disposal of recovered contaminants would be required under dual phase vacuum extraction and the pump and treat system would require a groundwater abstraction licence and discharge consent for the treated waters. It is further noted that the pump and treat system would be unlikely to be able to extract all impacted groundwater.

Option F has the benefit of both treating dissolved phase contamination currently present in the plumes as well as enhancing the groundwater environment to one more conducive to ongoing aerobic degradation. Such injection works would be focused on the core areas of Plumes 1 and 3 (i.e. the plumes located closest to the nearest down gradient boundary and with total TPH and benzene concentrations in excess of 1mg/l) and would best be undertaken following free phase recovery from the groundwater and source removal in the unsaturated zone as outlined in Option D. However, it does not fully address the issue of offsite migration of existing dissolved phase contamination, particularly across the Gasworks Site boundary.

Option G is the least expensive but has the disadvantage of some uncertainty and a commitment to potentially long term post remediation monitoring.

3.3.2 Preferred Option

The DQRA is a document based on a large number of variables with a high degree of uncertainty, and the landowner requires confidence that future liabilities with regards to offsite migration or the quality of controlled water beneath the site or impact to site end users will not arise. As such it is recommended that the remediation approach adopted is a combination of Options C, D and F as follows:

- Localised source removal of gross contamination in the unsaturated zone with associated exsitu bioremediation of soils to DQRA criteria for reuse onsite. Such source removal is likely to include recovery and offsite disposal of buried paint tins, drums and paint waste.
- Localised source reduction through removal of free phase hydrocarbons floating on groundwater down to a non-rebounding sheen
- Provision of a permeable reactive barrier of closely spaced boreholes drilled to the base of the Taplow Gravels, co-injected with ORC Advanced and PetrofixTM in order to provide ongoing attenuation and degredation of dissolved phase contamination in the groundwater and general improvement in aquifer quality
- In-situ use of oxygen release compound products for rapid reduction in concentrations of benzene and enhancement of an environment favourable to ongoing aerobic degradation in the cores of the main groundwater plumes (Plumes 1 and 3). Such treatment would also provide an enhanced environment for the degradation of other hydrocarbon contamination present in the aquifers
- In-situ use of chemical oxidation compounds to promote rapid breakdown of chlorinated hydrocarbons in groundwater (Plume 3, BHAN17)

In order to optimise the efficacy of the direct injection treatment and permeable reactive barrier, remediation works will be phased such that free phase contamination, gross soil contamination sources in the unsaturated zone and all areas of waste tins and containers that could be acting as ongoing source to the dissolved phase contamination will be remediated prior to commencement of the injection treatment works in the cores of Plumes 1 and 3 and installation of the permeable reactive barrier along the northern gasworks boundary at the downstream edge of Plume 3.

Installation of the permeable reactive barrier along the eastern site boundary to the gasworks wall and between the southern residential section of the site could potentially be installed prior to completion of remediation of the northern section of the site, as the plumes do not extent this far to the south and groundwater quality is significantly better in this area.

Remediation works would be complemented by a period of confirmatory down gradient groundwater monitoring from Plume 1,2, 3 and 4 and additional intrusive ground investigations to better delineate the extent of contamination in the unsaturated zone and underlying plumes. Proposed additional ground investigation works are outlined in **Section 4.5**.

Asbestos containing materials and soils containing asbestos fibres will be retained on site and placed in an area where there will be no pathway to sensitive receptors, for example beneath hardstanding.

4.0 GENERAL REMEDIATION PROPOSALS

4.1 Site Clearance

The following site clearance works have been undertaken by AkzoNobel prior to hand over of the site:

- All bulk storage tanks, reactors, paint mixers and associated process vessels to be cleaned, drained and left empty
- All raw material transfer pipelines both inside and on the external pipe bridges will be flushed through, drained and left empty
- All electrical motors will be isolated and gear boxes drained of oil
- All effluent pits associated with the production plant will be drained and left empty
- Steam and condensate system will be isolated and drained
- Gas supplies disconnected
- Nitrogen supply disconnected and nitrogen tanks removed
- Compressed air supplies will be isolated and vented
- Drains and interceptors will remain in operation, but all interceptors will be cleaned

Decommissioning folders will be available for each building including details on how the above activities have been carried out. Asbestos surveys will also be undertaken and provided for each building prior to demolition.

Tanks and bulk storage site are shown on the plan in **Appendix A** and summarised in the following Table. Clearance work by BGCL during the demolition phase will include removal of all decommissioned above ground tanks, with all tanks being opened and inspected by BGCL prior to removal.

Table 7 Known Tanks and Bulk Storage

Plan Reference	Capacity	Liquid	Location
200 and 203	unknown	Solvent Farm	Metal Treatment Area (PAOC1). Above Plume 3
152	unknown	Solvent Farm	
153	unknown	Oil Tanks	
223	unknown	Acid Tanks	
196	unknown	Resin Farm	Resin Plant Area (PAOC 3) Up gradient of Plume 2
210	unknown	Resin latex	
109	unknown	Solvent Farm	Tank Farm A Area
253	unknown	Unknown	Tank Farm B, south of Resin Plant Area
148	unknown	Diesel	Southern site boundary

Any encountered below ground tanks will also be excavated and removed, with soils surrounding the tanks to be remediated if contaminated.

Concrete or other hard surfacing will be cleared of any visible oil or fuel staining before breaking out. Any above ground or below ground pipes leading from tanks, sumps and interceptors will be cleared of contamination as required, with flushing liquids collected and taken off site, and then removed to avoid leaving paths for contaminant migration in the ground.

Waste will be taken off site by a licensed waste contractor.

4.2 Crushing of Hard Materials

Demolition of the remaining site buildings will generate hard materials such as concrete, brick and stone, and additional material will be generated during breaking of ground slabs, roads and buried obstructions/foundations.

These materials will be crushed and sorted on site under a WRAP Protocol to form recycled aggregate for reuse on the site or offsite sale. During sorting and crushing metal reinforcing bars

will be separated and stockpiled for recycling. Other metal debris, wood and other recyclable or compostable material will be placed in separate stockpiles ready for off site disposal by licensed waste contractor.

4.3 Remediation of Soils and Groundwater

The approach to remediation of contamination is as discussed in **Section 3.3** of this report and is for a combination of source removal, containment and general betterment and risk reduction in the long term. The actions proposed in this Remediation Strategy are listed in **Table 8**.

Table 8 Proposed Remediation Actions

Pollutant Source	Actions
Area A	• Further delineation investigation • Skimming of free phase to non-rebounding sheen around BHAN12 and GM101 • Excavation, validation and ex-situ bioremediation of elevated total benzene and TPH>5000mg/kg in soils • Excavation and off-site disposal of paint tins and gross paint contamination in BHAN10
Area B	• Further delineation investigation • Excavation, validation and ex-situ bioremediation of TPH>5000mg/kg in soil
Area C	• Further delineation investigation • Skimming of free phase to non-rebounding sheen in BHAN207, BHAN208 and TP105 • Excavation, validation and ex-situ bioremediation of elevated total benzene and TPH>5000mg/kg in soils • Excavation and off-site disposal of paint tins and gross paint contamination in BHAN04
Area D	• Further delineation investigation around BHAN209 • Excavation, validation and ex-situ bioremediation as required
Area E	• Further delineation investigation around BHAN206 • Excavation, validation and ex-situ bioremediation as required
Plume 1	• Free phase removal and unsaturated source remediation of Area A • Insitu Oxygen Release Compound treatment around BHAN214s • 8 Months down gradient post injection monitoring
Plume 2	• Unsaturated source remediation of Area B • 8 months down gradient groundwater quality monitoring
Plume 3	• Free phase removal and unsaturated source remediation of Area C • Insitu Oxygen Release Compound treatment centred around BHAN206, BHAN207 and BHAN14 • Rapid chemical oxidation treatment of chlorinated solvents in BHAN17 • Downgradient permeable reactive barrier to adjacent gas works site • 8 Months down gradient post injection groundwater quality monitoring
Plume 4	• Upgradient permeable reactive barrier to adjacent gas works site • 8 months down gradient groundwater quality monitoring
Asbestos in soils	• Delineation, supervised excavation and reuse in less sensitive areas of site i.e. beneath hardstanding
Contaminants in landscape/garden areas	• Use imported uncontaminated cover soils.
Contaminants to buried potable water pipes	• Use suitable pipe materials
Aggressive Ground Conditions to concrete	• Use appropriate concrete design class

Details of the method of remediation for each of the items are given in Section 5 for soils and Section 6 for groundwater. A plan showing all remediation areas is included as **Figure 5**.

4.4 Site Specific Acceptance Criteria and Groundwater Guidance Values

Site Specific Acceptance Criteria (SSAC) for soils are for protection of human health and groundwater quality. They comprise two categories, specifically soils for general use in a commercial setting beneath hardcover and cover soils for landscape and /or garden areas. The SSAC are based on published LQM/CEH Suitable for Use, the relevant Water Resource SSAC from the Arcadis DQRA for determinants identified as posing a risk to controlled waters and generic values for the avoidance of gross contamination. These criteria have been adopted rather than the human health generated SSAC in the Arcadis DQRA, as the Arcadis SSAC were driven predominantly by the vapour instruction pathway, which will be mitigated in the final development through provision of appropriate gas protection measures or additional Human Health remediation targets to be informed by further proposed vapour and ground gas monitoring.

In landscape areas the thickness of topsoil and subsoil will be determined by the landscape designers. It is likely that the top 150mm of soil will be topsoil and at least 450mm below will be topsoil or subsoil forming a suitable medium for plant growth. All site generated and imported topsoil will in addition to chemical testing be checked by an environmental specialist to ensure that:

- it is a suitable growing medium
- it is free from obvious contamination e.g. staining, free hydrocarbon, coal
- it has not come from areas where Japanese Knotweed or other invasive or injurious plants are suspected or known to have been growing
- it is not odorous such that it could be considered a statutory nuisance
- it is free from unsuitable material e.g. bricks, slag, glass
- there is no visible asbestos containing material (ACM)

All proposed re-use of remediated soil or imported soil will be subject to a Material Management Plan using the CL:AIRE protocols.

The proposed Site Specific Acceptance Criteria for excavation, remediation and re-use of soils are included in **Appendix D**

Proposed groundwater remediation treatment is for general betterment rather than to achieve compliance with the precautionary Arcadis 50m DQRA GW SSAC and further improvement will be provided through free phase removal, remediation of gross contamination in the overlying unsaturated zone and installation of the permeable reactive barrier. As such monitoring results will be reviewed against the Groundwater Guidance Values (based on the Arcadis 50m DQRA SSAC) in **Appendix D** and groundwater quality indicators to confirm a diminishing trend in contaminant concentrations and an improvement in conditions conducive to demonstrate ongoing degradation within the aquifer environment.

The results of analyses and groundwater level monitoring will be reviewed as the results are received and trends relative to the initial monitoring results will be noted. Where the quality is stable, or contamination is decreasing the groundwater quality will be considered satisfactory. If the results of monitoring show an upward trend or no reduction in concentrations of contaminants or indicators of degradation, risk assessments will be carried out and treatment extended or adjusted if necessary, to suit the groundwater conditions.

4.5 Additional Ground Investigation

Some areas of the site were not accessible during the previous ground investigations, because of buildings and hard ground cover. All areas will become available for investigation when demolition works are complete. Additional investigation will be carried out to complete general coverage of the site and to obtain additional information on the extent of known contaminated areas. The proposed locations of the investigation points are shown on the drawing in **Figure 6**.

The following is proposed:

Delineation

- Delineation trial pits to delineate extent of shallow contamination and free phase in Area A
- Delineation trial pits centered on BHAN10, BHAN04, BHAN202 and BHAN208 to delineate the extent of discarded tins and gross paint contamination
- Delineation trial pits to delineate extent of shallow contamination and free phase in Area B
- Delineation trial pits to delineate extent of shallow contamination in Area D
- Delineation trial pits to delineate extent of shallow contamination in Area E
- Series of evenly spaced trial pits/free phase accumulation sumps across Area C between BHAN208 and BHAN207 to delineate extent of free phase and any associated gross solvent/hydrocarbon contamination
- Delineation trial pits to a depth of approximately 2.5 - 3m to delineate extent of shallow contamination and presence of free phase around TP105 in Area C

Infill Boreholes

- Two boreholes drilled to the base of the Taplow Gravel Formation, north and south of the research laboratory in the southwest of the site to infill site coverage at down gradient area of the site.
- One borehole drilled to the base of the Taplow Gravel Formation, south of the western footprint of the Engineering Works, Personnel and Real Estate Building, immediately north of the western corner of Warehouse and Battery Charging building. This will be located immediately down gradient of the proposed Permeable Reactive Barrier between the commercial and residential areas of the site post development and will form one of the new site wide monitoring boreholes
- One borehole drilled to the base of the Taplow Gravel Formation, adjacent to the canteen and training centre building to infill site coverage in the west of the site post demolition.
- Two boreholes drilled to the base of the Taplow Gravel Formation, in the former Drum Park area in the northwest of the site to infill site coverage
- One borehole drilled to the base of the Taplow Gravel Formation, in the central footprint of the Tin Store in the eastern center of the site post demolition to infill site coverage
- One borehole drilled to the base of the Taplow Gravel Formation, adjacent to the former location of the now dry borehole BHAN39 in the southeast of the site. This will be located immediately down gradient of the proposed Permeable Reactive Barrier between the commercial and residential areas of the site post development, immediately down gradient of the southern extent of Plume 4 and will form one of the and will form one of the down gradient site wide monitoring boreholes
- One new borehole drilled to the base of the Taplow Gravel Formation in the landscaping area immediately south of the Wexham Road entrance. This will be located immediately down gradient of the proposed Permeable Reactive Barrier between the commercial and residential areas of the site post development and will form one of the down gradient site wide monitoring boreholes

All boreholes will be drilled using aquifer protection techniques. Soil samples to be analysed for a standard suite of inorganic and organic contaminant. All boreholes to be provided with installations in the Taplow Gravel aquifer. Low flow groundwater samples to be taken two weeks after completion of boreholes and samples to be analysed for total petroleum hydrocarbons with chain length split (TPHCWG), chlorinated hydrocarbons, BTEX and pH.

The following test suite will apply to soils:

- Metals: arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc
- Polycyclic aromatic hydrocarbons: USEPA 16 speciated
- Total petroleum hydrocarbons CWG split (TPHCWG)
- Volatile organic compounds
- BTEX
- pH, sulphate

Screening for asbestos will be carried out in made ground materials with quantification if asbestos is identified. Polychlorinated biphenyls (PCBs) will only be analysed if there is a suspected potential source of PCBs.

A bulk ground gas assessment will be undertaken around the site to demonstrate current and likely future bulk gas carbon dioxide and methane concentrations . A characteristic situation will be determined, and appropriate recommendations made for migration in future buildings. The assessment should comprise at least 6 monitoring events with at least 2 in a falling or low atmospheric pressure regime.

A soil gas investigation will be preformed with near-source and sub slab monitoring points within the current source areas and at the proposed edge of the source areas. This will allow a determination of likely human heath risk and derivation of appropriate vapour intrusion pathway remediation criteria.

The ground investigation/delineation will be completed before the start of remediation. Results will be assessed in the context of the proposed remediation and any adjustments made to remediation plans as needed to meet the purpose, aims and requirements of this Remediation Strategy.

5.0 REMEDIATION OF KNOWN CONTAMINATION: SOILS

The method of remediation of the features listed in **Table 8** are described in this Section for soils and the method of validation of completed remediation is described. Remediation will not start until the BGCL Mobile Plant Permit Deployment has been approved by the Environment Agency. Movement of soils will not begin until a Materials Management Plan (MMP) has been submitted to and approved by a Qualified Person in accordance with the CL:AIRE Definition of Waste Code of Practice.

5.1 Quarantine and Treatment Area

Before the start of any excavation a quarantine and treatment area will be set up. The area will be on hardstanding such as concrete or asphalt or if no hardstanding is available a level area will be prepared and covered with a low permeability liner such as HDPE. A bund will be placed round the sides of the area to intercept any runoff, or alternatively a concrete bunded former tank base or existing building slab could be utilised. Any water collecting in the quarantine area will be directed to a sump and subsequently removed to a holding tank or recirculated through soils undergoing treatment. Given the potential for odour issues, if possible, the treatment area will be located on hardstanding within one of the existing site buildings.

The location of the quarantine and treatment areas will be specified in the Construction Phase Health, Safety, Environmental and Quality Plan (HSEQ) and in documents supporting the application for deployment of the Mobile Plant Permit. A site layout plan and a drawing indicating the form of the treatment area will be included.

5.2 Remediation of Hydrocarbon and BTEX Contaminated Soils

Hydrocarbon and BTEX impacted soils currently known to be requiring remediation are detailed in **Table 3**. In addition to this it is recognized that because of the industrial history of the site, unknown underground tanks and further areas of gross hydrocarbon and/or BTEX contamination are likely to be encountered.

All areas with BTEX and TPH with total soil concentrations in excess of the SSAC in the unsaturated zone will be excavated under the supervision of an experienced geo-environmental specialist with a photoionisation detector (PID) and the excavated material will be taken to the quarantine area and treated by ex situ bioremediation. Excavation will be limited to the unsaturated zone and cease at the top of the groundwater smear zone.

Validation samples will be taken on four sides on the boundaries of the contaminated soil excavation void and analysed for BTEX/TPH. Sampling will be at a frequency of 1 per 10m horizontally at the same elevation as the original contaminated sample and one 0.5m below the original sample. If the excavation or contaminated zone is greater than 10m x 10m and 1m thick an additional sample will be taken per 10m horizontally, per 1m depth and per 10m x 10m on the base.

The specific methodology for treatment of soils will be provided in the Remediation Implementation Plan (RIP), but the outline approach is described here. Treatment will initially be by placement of soils in windrows and turning the windrows weekly to introduce oxygen to promote the growth of microbes that will degrade hydrocarbons. Soil samples will be taken after one month and if the SSAC has been achieved soils will be returned to the source area or will be added to soils to be reused in the site reprofiling. If the SSAC is not achieved treatment will continue, potentially with the addition of oxygen release compounds (ORC) to promote faster microbial activity.

It is anticipated that the majority of the material will achieve compliance with the SSAC within 3 - 4 months. Material that fails to achieve the SSAC will not be reused and will be disposed of to an offsite facility in accordance with **Section 5.9** of this report.

5.3 Buried Tins and Gross Paint Contamination

Areas where buried paint tins and/or gross paint contamination has been encountered in the Made Ground are listed in **Table 6**. Further preliminary exploratory works in these areas by BGCL has confirmed that some of these areas represent a significant source of dissolved phase, free phase and gross soil contamination.

These will be remediated through additional delineation using trial pits and subsequent excavation of the impacted materials for offsite disposal in accordance with **Section 5.9**. Should delineation investigations confirm the presence of associated free phase, this will be removed in accordance with **Section 6.1** prior to excavation of the contaminated materials and soils.

Validation samples will be taken on four sides on the boundaries of the contaminated soil excavation void and analysed for BTEX, VOCs and speciated TPH. Delineation samples from areas of the paint and paint tin contamination will also be tested for the full metals suite as such additives were historically present in older paints.

Sampling will be at a frequency of 1 per 10m horizontally at the same elevation as the original contaminated sample and one 0.5m below the original sample. If the excavation or contaminated zone is greater than 10m x 10m and 1m thick additional samples will be taken per 10m horizontally, per 1m depth and per 10m x 10m on the base.

5.4 Remediation of Asbestos Containing Made Ground

Locations where asbestos fibres and/or asbestos containing materials have been encountered are listed in **Table 5**. While quantifications to date are low, disturbance of the ground through excavation and processing during the construction phase has the potential to release fibres that could be inhaled by site operatives and/or neighbouring residents. Once inhaled asbestos fibres can accumulate in the lung tissue where they can result in chronic or even fatal damage such as mesotheloima and asbestosis.

As such all site operatives working in contact with the Made Ground will be trained to a minimum Category 3 for asbestos and a licensed asbestos contractor will be on call during works in the made ground on the site.

The licensed asbestos contractor will be appointed for an initial assessment period of one week when remediation earthworks in the Made Ground where asbestos fibres in the Made Ground have been identified. The contractor will establish controlled working conditions with respect to fibre management and ensure that all earthworks are undertaken in accordance with the Control of Asbestos Regulations (CAR2012). The licensed contractor and will provide BGCL with detailed Method Statements and associated Risk Assessments. This will include confirmation of the requirement for HSE Notification of the works. All documentation will be used to inform the creation of a site specific BGCL Asbestos Management Plan which will include detailed guidance on procedures, actions, PPE and site management procedures to manage potential exposure risk and dust/fugitive fibre release.

During this period the licensed asbestos contractor will be supported by an independent analyst who will undertake air quality monitoring at a minimum of 4 fixed perimeter locations around each area for an initial period of one week once work commences in the areas where asbestos has been identified in the Made Ground. Personal monitoring of the site operatives working in contact with the Made Ground will also be undertaken at the discretion of the analyst. For guidance, a background level of <0.010f/cm^3 air will be adopted, consistent with the clearance indicator standard for the reoccupation of buildings following licensed asbestos removal. Any exceedance of this level will result in immediate cessation of the works and re-evaluation of the methodology. Adjustments may be made in order to minimise fibre release.

Any significant visual asbestos fragments will be recovered by the licensed asbestos contractor. Before the start of such work an exclusion zone will be set up with warning tape or Heras fencing.

Only qualified personnel equipped with appropriate personal protective equipment will be allowed into the exclusion zone.

Following lifting of the overlying slab in the areas where asbestos has been encountered the specialist contractor will walk over all exposed made ground to check for visible asbestos containing material (ACM) fragments. Visible ACM will be handpicked and placed in designated bags and placed in a sealable skip or in double bags and sealed at the end of each shift for subsequent removal as waste by a licensed waste contractor.

After surface materials have been checked, made ground material will be excavated systematically whilst the asbestos specialist inspects the soil for visible ACM. Visible ACM will be hand-picked and bagged as in the initial surface pick as required. The soil that has been picked may contain asbestos fibres and will be considered asbestos contaminated until it has been placed at its final destination and covered.

Soils from the asbestos zones will be placed in a designated area that will be beneath hardstanding, away from any planned service corridors and at a depth of more than 1.0m below final ground level. Placed soil will be covered with a high visibility marker membrane and the location recorded by the surveyor. The information will be kept on the site Health and Safety file.

During the course of the works it is possible that degraded asbestos insulation board or lagging may be found in which case there will be a delay while the HSE is informed and licensing procedures are followed before such additional material will be addressed in order to meet the purpose, aims and requirements of this remediation stratgey. Work may continue in other parts of the site whilst the application is in progress.

5.5 Landscape Areas

When the details of the landscape areas are known soils will be checked for compliance with the cover soils SSAC. It is noted that only landscaping areas on the site are limited to localised areas along the western boundary and as such it is unlikely that sufficient topsoil and subsoil can be generated for landscaping in the final development. As such topsoil will need to be imported to the site. Samples of soils to be imported will be tested at the source to check for suitability. If results are satisfactory soils will be imported and then tested at the required frequency.

5.6 Soil Testing Frequencies and Validation Procedure

The soil testing frequencies in **Table 9** will apply. Samples already taken during ground investigations will count towards the total required frequency.

Table 9 Soil Validation Testing Frequencies

Situation	During excavation	At the edge of excavations	At the base of excavations	Before reuse following processing or treatment
Excavation of contaminated soil	1 per 500m^3	1 per 10m length 1 per 1m depth	10m grid	1 per 250m^3
Cover soil, topsoil	1 per 250m^3	1 per 20m length	20m grid	1 per 250m^3
Imported material	-	-	-	1 per 250m^3 for first 2000m^3 from any single source then 1 per 1000m^3. Minimum of 3 for any source

After excavation of soil not meeting the SSAC, or excavation of soil for reuse, the surveyor will set out points that will meet the required sampling frequency for validation including points where sample results are already available. The geo-environmental engineer will direct the sampling as well as performing frequent PID screening of soil samples.

Soil samples will be taken by a qualified environmental specialist. Samples will be taken either directly into glass jars or vials or using a stainless-steel trowel which will be cleaned between sampling points. The samples will be placed in a cool box with ice packs and when returned to the site compound will be kept in a refrigerator until one hour before collection for transport to the laboratory. Samples will be transported to the laboratory in a cool box with ice packs to maintain a temperature between 4^{o}C and 8^{o}C, normally on the same day as sampling.

The project laboratory will be one of the BGCL approved laboratories which is accredited by UKAS for ISO17025 and MCERTS standards for most analytical tests. Chain of custody forms will be used and kept on file or alternatively automatic electronic chain of custody will be in place. Analytical results will be available in pdf and Excel formats and other formats if required. Results will be made available on site for inspection.

5.7 Construction Materials

Soils will not be remediated in relation to potential impact on construction materials. Materials will be chosen that are suitable for the location in an industrial environment.

Buried concrete design will be in accordance with the results of testing as required by the Earthworks Specification and BRE Special Digest 1 'Concrete in Aggressive Ground'.

Buried potable water pipes will be of a design suitable for the chemical environment to avoid attack by organic compounds. PE barrier pipes or metal pipes will be required

5.8 Previously Undetected Contamination

There is potential for previously undetected contamination to be found anywhere on the site due to the previous uses.

During excavations if any material type is seen in a location that was not encountered during the site investigations for that location an assessment will be made by the geo-environmental specialist of any special action to be taken. If the material is potentially contaminated, based on visual or olfactory appraisal, it will be transported to the quarantine area, samples will be taken for testing and on receipt of results a course of action will be proposed for agreement with the client and, if necessary, with the regulatory authorities to ensure that such previously undetected contamination is dealt with in accordance with the purpose and aims of this Remediation Strategy.

The void left after removal of potentially contaminated material will be validated by taking samples on four sides and the base as described above. The extent of the void will be recorded by the surveyor.

Any unanticipated contamination encountered during the additional investigation works and installation of the additional monitoring borehole will be delineated as required and left insitu, samples will be taken for testing and on receipt of results a course of action will be proposed for agreement with the client and, if necessary, with the regulatory authorities to ensure that such previously undetected contamination is dealt with in accordance with the purpose and aims of this Remediation Strategy.

5.9 Waste Disposal

All soils removed from the site should be disposed of at either an appropriately permitted waste management facility, landfill site or soil treatment centre deemed suitable for receiving the soils (in line with relevant legislation and Duty of Care requirements).

Prior to disposal and in accordance with EA Guidance paper WM3, the characteristics of any excavated soils will undergo preliminary classification by the geo-environmental specialist. This would typically be undertaken in consultation with the relevant waste disposal facility and further classification testing and analysis, including Waste Acceptance Criteria (WAC) testing may be required.

All hauliers will hold a waste carrier's licence and the relevant waste transfer notes will be provided for each load removed from site. The disposal site must have a permit to accept the waste and random checks should be made to ensure that the waste is being disposed of at the correct facility.

All material movement records, waste transfer and consignment notes will be retained for inclusion in the Remediation Verification Report.

If required a wheel wash facility, or jet wash will be available to prevent the transport of site soils onto surrounding roads by traffic leaving the site.

6.0 REMEDIATION OF KNOWN CONTAMINATION: GROUNDWATER AND FREE PHASE

The method of remediation of groundwater is described in this Section. Remediation will not start until a BGCL Mobile Plant Permit Deployment has been approved by the Environment Agency.

6.1 Remediation of Free Phase Hydrocarbons

Free phase hydrocarbons have been encountered in BHAN12 and GM101 (Area A/Plume 1) and BHAN207, BHAN208 and TP105 (Area C/Plume 3) at thicknesses of up to 0.49m. Elevated hydrocarbon concentrations in many of the Plume 3 boreholes suggest that free phase is present, at least as a sheen or blebs entrained in the sample matrix over a wider area. Additional free phase delineation in the form of regularly spaced trial pits will be undertaken prior to commencement of the free phase recovery works in both the Plume 1 and Plume 3 areas.

Free phase hydrocarbons will be removed from the groundwater through the excavation of regularly spaced gravel backfilled accumulation sumps/trenches with perforated 900mm – 1010mm diameter HDPE pipes or similar with subsequent skimming of the accumulated product into either holding tanks or directly into mobile tankers for off-site disposal to a licensed facility. Care will be taken to ensure only free phase is removed and that water levels are not depressed in order to avoid creation of a smear zone. If necessary, belt skimmers will be utilised. Following bulk removal of the free phase, further improvement will be facilitated using absorbent mats and booms which will subsequently be disposed of by a licensed waste contractor.

If groundwater with visible free phase needs to be pumped to progress the earthworks before removal of free phase, water will be transferred to holding tanks. Free phase will be separated in the holding tanks and removed using absorbent mats and booms.

The target for free phase removal will be a non-rebounding sheen in the monitoring boreholes for a period of 3 months.

Any additional free phase encountered during the soil remediation or tank removal works will be treated in a similar manner.

6.2 Betterment of BTEX and Hydrocarbon Contaminated Groundwater

Following removal of all free phase, dissolved phase groundwater contamination in the >1mg/l benzene core of Plume 1 (BHAN214) and Plume 3 (BHAN206, BHAN207 and BHAN14) will be treated in situ by oxygen release compound (ORC) through direct injection in an array of 3m – 5m spaced boreholes over the plume core. Injection will penetrate to approximately 1m above the base of the Taplow Gravels, which is at a depth of approximately 6 – 7m below ground level. ORC treatment of the dissolved phase BTEX and TPH will also treat the isolated exceedances of dissolved phase naphthalene and TBA in BHAN207 and GM115 respectively. Further protection to controlled waters down gradient of Plume 3 will be provided through the provision of the permeable reactive barrier along the adjacent gasworks site to both intercept and treat contaminated groundwater migration offsite as discussed in **Section 6.4**.

The injected product will be a commercial product such as ORC Advanced as supplied by Regenesis Ltd. A Method Statement will be prepared for drilling and injection of the chemical oxidation product and full safety precautions to protect the workforce will be observed

Betterment of groundwater quality in Plume 2 will be achieved through remediation of contaminated soils in Area B (BHAN212). Betterment of groundwater quality in Plume 4 will be achieved through provision of the permeable reactive barrier between the adjacent gasworks site and Plume 4 to both intercept and treat continued flow of up hydraulic gradient contamination into the site.

Groundwater monitoring samples will be taken from down gradient monitoring boreholes of Plumes 1,and 3 one month before the start of remediating works, one week after injection, fortnightly for two months and thereafter at monthly intervals for 6 months. Groundwater monitoring will be undertaken one month prior to remediation then monthly in the down gradient monitoring boreholes

in Plumes 2 and 4 during remediation works then monthly for 8 months post remediation as detailed in **Section 6.5**.

6.3 Betterment of Chlorinated Hydrocarbon Contaminated Groundwater

Elevated concentration of vinyl chloride and cis-DCE are present above the DQRA SSAC within the wider extent of Plume 3, with maximum concentrations of 510ug/l and 1,490ug/l respectively in borehole BHAN17. TCE is not present in excess of the DQRA SSAC of 49ug/l at any locations indicating that natural degradation, most likely through anaerobic dichlorination is taking place.

Groundwater in the area of BHAN17 will be treated in situ by chemical oxidation to rapidly breakdown the DCE and vinyl chloride. A Method Statement will be prepared for drilling and injection of the chemical oxidation product and full safety precautions to protect the workforce will be observed. Treatment will be introduced to the aquifer via an array of 3m – 5m spaced boreholes over the plume core (BHAN17) and will penetrate to approximately 1m above the base of the Taplow Gravels, which is at a depth of approximately 6 – 7m below ground level.

Groundwater sampling will be taken from monitoring boreholes within or immediately down gradient one week after injection, fortnightly for two months and thereafter at monthly intervals for 6 months as detailed in **Section 6.5**.

The proposed treatment is for general betterment of groundwater quality. As such monitoring results will be reviewed against the **Appendix D** Groundwater Guidance Values and groundwater quality indicators to confirm a diminishing trend in contaminant concentrations and improvement in conditions conducive to ongoing degradation within the aquifer.

6.4 Permeable Reactive Barrier

Whilst the remediation described in Section 6.1 – 6.3 above will reduce dissolved phase concentrations in the core of Plume 3, down gradient migration of the plume across the site boundary into the adjacent gasworks is still occurring. This groundwater is thought to be passing beneath the gasworks site and re-entering the AkzoNobel site in Plume 4.

Potential risk and liability associated with this will be addressed through the provision of a co-injected ORC Advanced and Petrofix™ Permeable Reactive Barrier along the eastern boundary of the site and between the future commercial residential areas. Direct injection points will be at a nominal spacing of 2m, with product injection over an approximately 4m deep zone from the base of the Taplow Gravels to the smear zone at the highest seasonal level of the water table.

Petrofix works by absorbing hydrocarbons from the dissolved phase onto activated carbon particles and stimulating biodegradation by adding both slow and quick release electron acceptors (nitrate and sulphate). As the adsorbed contaminants are degraded by the biofilm growing on the PetroFix particles they renew the adsorption sites, allowing for more contamination to be adsorbed and degraded. This bio-regeneration of the barrier can allow treatment to remain active for years and the product will remain in the soil profile at the site of injection, providing an ongoing permeable enhanced treatment barrier to groundwater flow. The co-injection of ORC Advanced further enhances the down gradient aquifer environment for ongoing aerobic degredation of contamination through the controlled release of oxygen down gradient of the PRB.

6.4 Groundwater Monitoring

Both site wide and targeted groundwater monitoring will be carried out before, during and after the works. An initial round of groundwater monitoring for level and quality will be completed one month before the start of the works. Monthly monitoring will continue until one month after completion of earthworks in the general boreholes. Boreholes in treatment areas will be monitored in accordance with the Mobile Plant Permit Deployment and as described in the following Table:

Table 10: Groundwater Monitoring

Monitoring	Boreholes	Frequency	Duration	Suite
Site Wide	*Upgradient of PBR* BHAN10, BHAN220, BHAN29, BHAN210, BHAN18 *Downgradient of PRB* BHAN22, BHAN221, BHAN222, New borehole in northwest corner of warehouse and Battery Charging building, New borehole in landscaping area south of Wexham Rd entrance, New borehole near BHAN39 location	Monthly	*Upgradient of PRB* One month before until eight months after completion of remediation and earthworks *Downgradient of PBR* One month before until eight months after completion of remediation and earthworks, quarterly thereafter for 16 months	General
Plume 1	BHAN03, BHAN216, BHAN215 and BHAN35	One month before remediation works, one week after injection, fortnightly for two months and thereafter at monthly intervals for 6 months		Remediation Suite
Plume 2	BHAN211, BHAN212, BHAN24	One month before remediation works, then monthly	8 months post remediation works	Remediation Suite
Plume 3	GM105, GM115, BHAN14, BH206s & d, BH5, BHAN208 & BHAN209	One month before remediation works, one week after injection, fortnightly for two months and thereafter at monthly intervals for 6 months		Remediation Suite
Plume 4	GM106, GM104, BHAN218, New borehole near BHAN39 location	One month before remediation works, then monthly	8 months post remediation works	Remediation Suite

A plan showing the location of all groundwater monitoring boreholes is included as **Figure 7**

Water samples from the general boreholes will be analysed for:

- arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, zinc
- polycyclic aromatic hydrocarbons (PAH)
- total petroleum hydrocarbons (TPH) with CWG split
- volatile organic compounds(VOCs)
- BTEX
- electrical conductivity, pH
- dissolved oxygen, pH, redox, sulphate, Fe (II), Mn (II), TOC/DOC

Water samples from the remediation area boreholes will be analysed for the following suite:

- volatile organic compounds
- total petroleum hydrocarbons (TPH) with CWG split
- BTEX
- ammoniacal nitrogen, nitrate
- dissolved oxygen
- pH, redox, sulphate, Fe (II), Mn (II), TOC/DOC

Some site wide boreholes may become unavailable during earthworks for practical reasons and will be decommissioned. These will not be replaced unless they are within the area of contamination or down hydraulic gradient.

On completion of monitoring the boreholes will be decommissioned in accordance with Environment Agency guidance. Protective covers will be removed, and the installation pipework cut 0.5m below ground level and removed. The pipes will be filled with gravel in the length in the Taplow Formation and a bentonite/soil mix through the made ground.

The results of groundwater analyses will be reviewed as the results are received and trends relative to the initial monitoring results will be noted. Where the quality is stable, or contamination trends are decreasing towards the Appendix D criteria the groundwater quality will be considered satisfactory. If the results of monitoring show an upward trend or no reduction in concentrations of contaminants, further risk assessments will be carried out and treatment extended or adjusted if necessary, to suit the groundwater conditions in order to achieve the purpose and aims of this Remediation Strategy.

7.0 ENVIRONMENTAL MONITORING

Environmental monitoring for dust, odour, noise and vibration will be carried out throughout the works. Monitoring as agreed with the Environment Agency will be required under the Mobile Treatment Permit.

An emissions plan will be developed, but at a minimum vapour monitoring is proposed around the soil treatment area. A photoionisation detector (PID) will be used for vapour monitoring in the treatment area when windrows are being turned.

Air quality monitoring will be carried out by an independent analyst in and around the asbestos remediation areas. Background air quality monitoring will be carried out before the start of works in the asbestos areas.

Controls will be in place to ensure that no contaminated runoff leaves the site. This may require the use of holding ponds and settlement areas in wet weather conditions. If consent is obtained to discharge water to a drain or surface watercourse, samples will be taken in accordance with the consent.

Information on environmental monitoring and controls will be provided in the BGCL Construction Phase HSEQ Plan.

8.0 SUPERVISION AND REPORTING

8.1 Management and Supervision

The works will be supervised by a site manager experienced in earthworks and remediation. All people working on site will receive a site-specific induction relevant to site features including potential contamination and recognition of asbestos containing materials. Excavator drivers will be briefed on areas of potential contamination and procedures to be followed.

Geo-environmental work and geotechnical work will be supervised by a geo-environmental specialist and a geotechnical engineer, respectively. They will work in close co-operation for maximum efficiency.

Before the start of works the geo-environmental specialist will assist in preparation of the following documents relevant to remediation:

- Construction Phase HSEQ Plan
- CL:AIRE Code of Practice Materials Management Plan (MMP)
- Mobile Plant Permit deployment notice for soil and groundwater treatment

The geo-environmental specialist will be present during any earthworks in made ground and shallow soils and will be available at short notice if unexpected contamination is found at other times. The geo-environmental specialist will supervise all matters relating to contamination and potential contamination to check that the strategy is implemented. The work will include:

- Supervision of addition delineation GI
- Supervision of excavation of contaminated soils and movement to the treatment area
- Delineation of extent of contamination
- Supervision of sampling and scheduling of analysis of soils in situ and during treatment for validation and compiling an electronic and a paper dataset of results
- Monitoring of ex-situ bio-remediation progress
- Monitoring with a PID during excavations in contaminated areas
- Noting any unexpected contamination from visual or olfactory evidence and taking appropriate action including directing soils to quarantine area
- Assessing the need for testing and subsequent assessment of results and action on any soils in quarantine
- Groundwater monitoring
- Testing of soils for import at source and after import
- Deciding whether the local authority should be alerted to any unforeseen contamination
- Tracking implementation of soil movement including soil import and compilation of the soil tracking register in accordance with the MMP
- Making use of photographs and surveying to record site conditions and work completed
- Assessing all test results and producing tables, graphs and drawings as appropriate
- Ensuring daily environmental monitoring sheets are completed

The geotechnical engineer will be present as needed during earthworks and foundation construction. The geo-environmental engineer will liaise with the geotechnical engineer on any issues where there is interaction between the different requirements.

A surveyor will be on site to carry out surveys and setting out as needed for geo-environmental and geotechnical purposes. The surveyor will produce plans and sections of the works and of any areas where contamination or unexpected soil types are found and are excavated for treatment or quarantine. The surveyor will record locations of additional ground investigation works, locations of validation soil samples and track volumes of soils moved. A progress drawing will be maintained and made available for reference to all those involved in the project.

If the need arises for additional professional staff, such as an ecologist or archaeologist, suitably qualified personnel known to BGCL will be appointed.

8.2 Verification Plan

All work will be recorded as described in this report. Records will be maintained on site and will be held in the head office of BGCL for two years after completion of earthworks. Interim records will be available on site for reference by the client and the regulators.

On completion of the works a Verification Report will be prepared for the client and the regulatory authorities to demonstrate that works have been completed in accordance with the strategy and specifications. The report will be submitted to the Planning Authority for discharge of any planning conditions associated with contamination remediation and to CL:AIRE as the Materials Management Plan Verification report. The report will also be part of the site Health and Safety File.

The Verification Report will include:

- All factual information including analytical results for soils, treated soils and groundwater monitoring collected during the works
- Details of additional GI and delineation works and testing results
- Details of all soil and groundwater remediation works undertaken (excavation of gross contamination, free phase removal, in situ groundwater treatment, ex situ soil bioremediation)
- Progress graphs of groundwater trends
- Details of ex situ soil bioremediation works
- Survey plans of the level of excavation, validation locations, contamination voids, backfilled areas, and an as-built survey of final levels
- As built survey of Permeable Reactive Barrier
- Summary plans showing test results and compliance with requirements
- Regular records of soil movement within the site
- Daily records of soil import and movement on site
- Photographs of work in progress and completed formation
- Duty of Care documentation for waste material removed from site
- Results of environmental monitoring
- Confirmation that all remediation has been completed in accordance with this Remediation Strategy

The report and data will be produced in paper and electronic formats. This will include drawings in AutoCAD, analytical results and weights/volumes in Excel spreadsheets, pdf certificates of analytical results and copies of paper and text documents in pdf.

A Verification Report will be produced within three months of the completion of the remediation works, with a further addendum on completion of the longer-term groundwater quality monitoring.

BUCKINGHAM

Figures

BGC-00-XX-DR-W-6701 | P01

Originator | Zone | Level | Type | Role | Number | Revision

Figure1: Site Location Plan

Scale 1:1000 (0, 20, 40, 60, 80, 100)

Notes:

Plot 3
Plot 1
Plot 2
Plot 4a
Plot 4b
131824
60385
35000
18 Total Trailer Spaces
36 Total Trailer Spaces
16 Total Trailer Spaces
50 Cars/Cycle Spaces
Resident Office (Existing m)
46900
67730
49523
82619
50000
85351
115 Car/36 Cycle Spaces
Site Office First Floor Offices 2,500sq.m
Pit Offices 2,500sq.m
45 Car Spaces
4 St
5 St
140 Bays
106 Bays
186 Bays
73 Bays
64 Bays
58 Bays
HP Gas Main
LP Gas Main
Pump-station
Proposed Residential:
4/5 storey - 8 apartments /floor
Site Area:12.0174Ac

Rev	Comment	Created By	Date	Checked By	Date	Approved By	Date
1-Rev	1-Comment	1-Saved By	1-Date	1-Checked By	1-Date	1-Approved By	1-Date

Scale at A1	Issuing Office	Project Number
1:1000	STOWE	T19041

Client Approval

- A - Approved
- B - Approved With Comments
- C - Do Not Use

Status	Purpose of Issue
S2	For Information

Project: Slough

Title: Figure 1: Site Location Plan

Client: PANATTONI

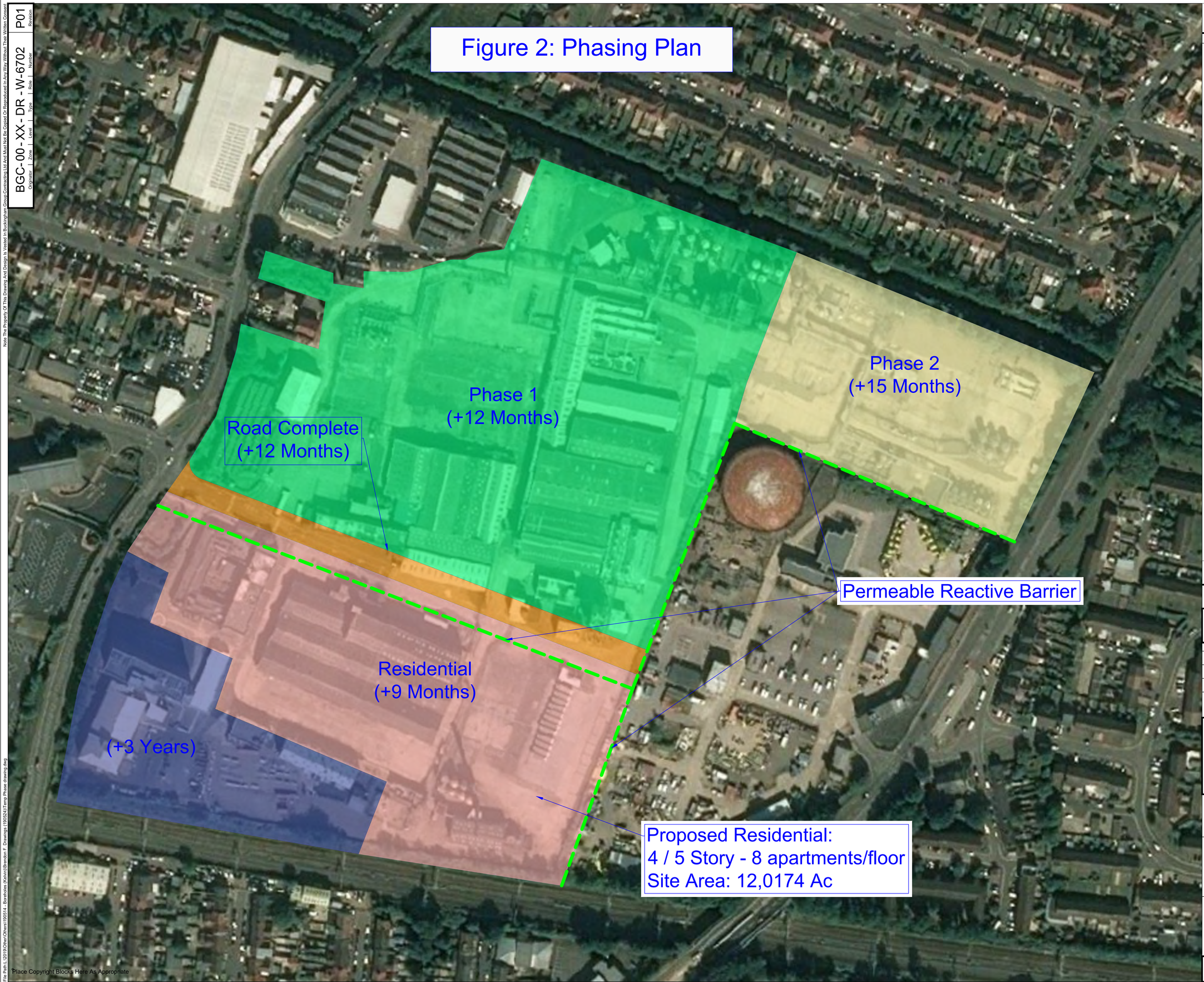
BGC-00-XX-DR-W-6701 | P01

File Path:L:\2019\Other\Others\190514 - Boreholes (Kelvin)\Brendon F. Drawings (190524)\Temp Phase drawing.dwg
Plot Date:30 May 2019 Plot Style: ---- Saved By: Jamshid.ghulam-sarwa on 30 May 2019 | Plot Scale Check 100mm | Sheet Size A1 841 x 594

BGC-00-XX-DR-W-6702 P01

Originator | Zone | Level | Type | Role | Number | Revision

Figure 2: Phasing Plan



SBC PLANNING
RECEIVED : 19.12.19

Scale 1:1000 (0, 20, 40, 60, 80, 100)

Notes:

Rev	Comment	Created By	Date	Checked By	Date	Approved By	Date
P01		J. G. Sarwar	27-Aug-19	N. Cetnarska	27-Aug-19	B. Ford	27-Aug-19

Scale at A1	Issuing Office	Project Number
1:1000	STOWE	T19041

Client Approval

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- B - Approved With Comments
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Status	Purpose of Issue
S2	For Information

BUCKINGHAM Group Contracting
Silverstone Road, Stowe, Buckingham MK18 5LJ
Telephone: 01280 823355 Fax: 01280 812830
www.buckinghamgroup.co.uk

Project: Slough

Title: Figure 2: Phasing Plan

Client: PANATTONI

BGC-00-XX-DR-W-6702 P01
Originator | Zone | Level | Type | Role | Number | Revision

Sheet Size A1 841 x 594

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BGC-00-XX-DR-W-6712 P01

Originator | Zone | Level | Type | Role | Number | Revision

N

SBC PLANNING
RECEIVED : 19.12.19

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Notes:

Rev	Comment	Created By	Date	Checked By	Date	Approved By	Date
P01		J. G. Sarwar	27-Aug-19	N. Cetnarska	27-Aug-19	B. Ford	27-Aug-19

Scale at A1	Issuing Office	Project Number
1:1000	STOWE	T19041

Client Approval

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Status	Purpose of Issue
S2	For Information

BUCKINGHAM Group Contracting
Silverstone Road, Stowe, Buckingham MK18 5LJ
Telephone: 01280 823355 Fax: 01280 812830
www.buckinghamgroup.co.uk

Project: Slough

Title: Figure 3
Site Investigation Plan

Client: PANATTONI

BGC-00-XX-DR-W-6711 P01

Originator | Zone | Level | Type | Role | Number | Revision

File Path:L:\2019\Other\Others\190514 - Boreholes (Kelvin)\Brendon F. Drawings (190524)\Borehole and trialpit location PID2-for other drawings.dwg

SBC PLANNING
RECEIVED : 19.12.19

Scale 1:1000 (0, 20, 40, 60, 80, 100)

Notes:

PAOC - (Potential Areas Of Concern)

Rev	Comment	Created By	Date	Checked By	Date	Approved By	Date
P01		J. G. Sarwar	27-Aug-19	N. Cetnarska	27-Aug-19	B. Ford	27-Aug-19

Scale at A1	Issuing Office	Project Number
1:1000	STOWE	T19041

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S2	For Information

BUCKINGHAM Group Contracting
Silverstone Road, Stowe, Buckingham MK18 5LJ
Telephone: 01280 823355 Fax: 01280 812830
www.buckinghamgroup.co.uk

Project: Slough

Title: Figure 4
Potential Areas Of Concern

Client: PANATTONI

BGC-00-XX-DR-W-6712 P01
Originator | Zone | Level | Type | Role | Number | Revision

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Plot Date:27 August 2019 Plot Style: ---- Saved By: Jamshid.ghulam-sarwa on 27 August 2019
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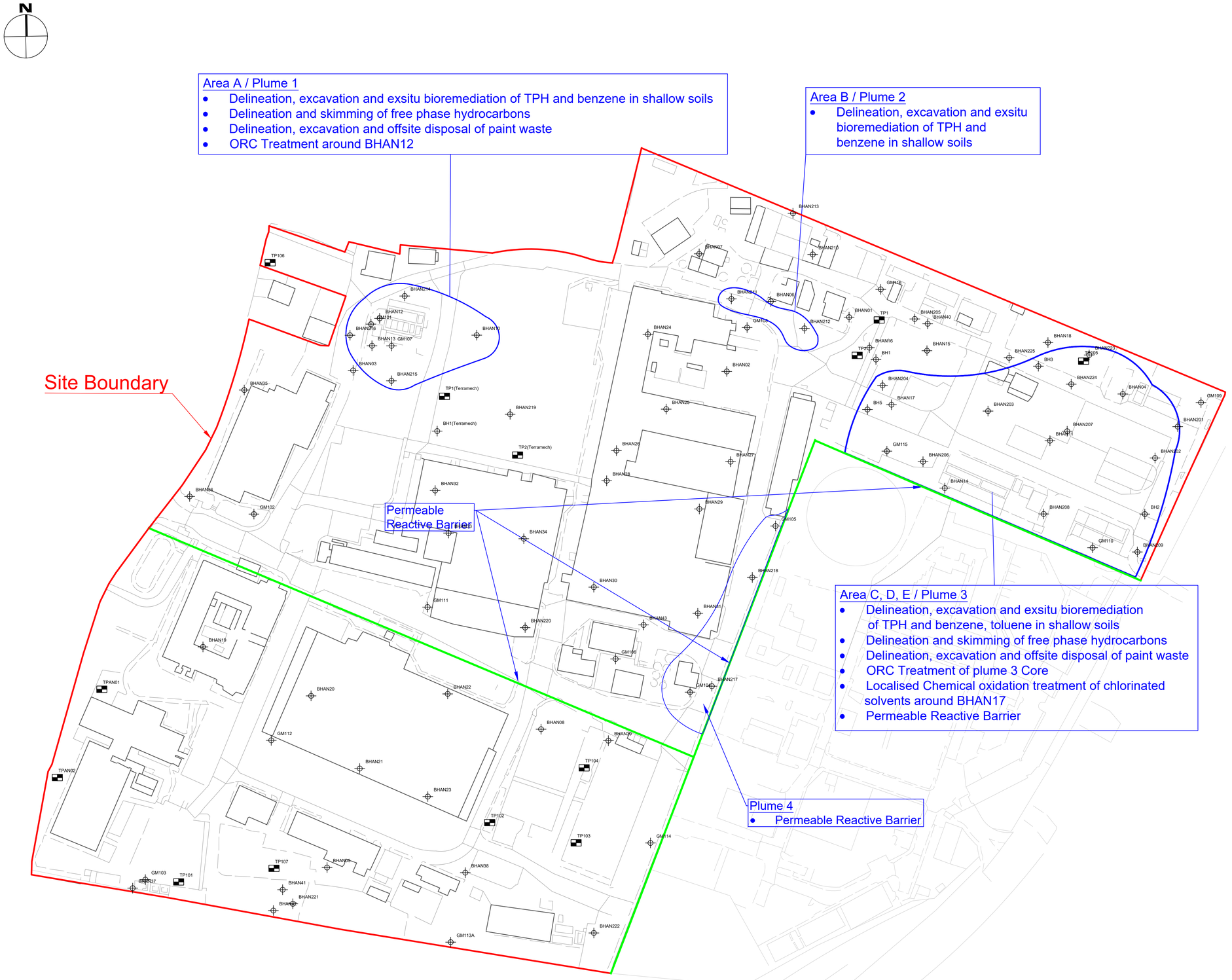
BGC-00-XX-DR-W-6713 P01

Originator | Zone | Level | Type | Role | Number | Revision



SBC PLANNING
RECEIVED : 19.12.19

Scale 1:1000 (0, 20, 40, 60, 80, 100)

Notes:

Permeable Reactive Barrier

Rev	Comment	Created By	Date	Checked By	Date	Approved By	Date
P01		J. G. Sarwar	09-Sep-19	N. Cetnarska	09-Sep-19	B. Ford	09-Sep-19

Scale at A1	Issuing Office	Project Number
1:1000	STOWE	T19041

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BUCKINGHAM Group Contracting
Silverstone Road, Stowe, Buckingham MK18 5LJ
Telephone: 01280 823355 Fax: 01280 812830
www.buckinghamgroup.co.uk

Project: Slough

Title: Figure 5 Remediation Plan

Client: PANATTONI

BGC-00-XX-DR-W-6713 P01
Originator | Zone | Level | Type | Role | Number | Revision

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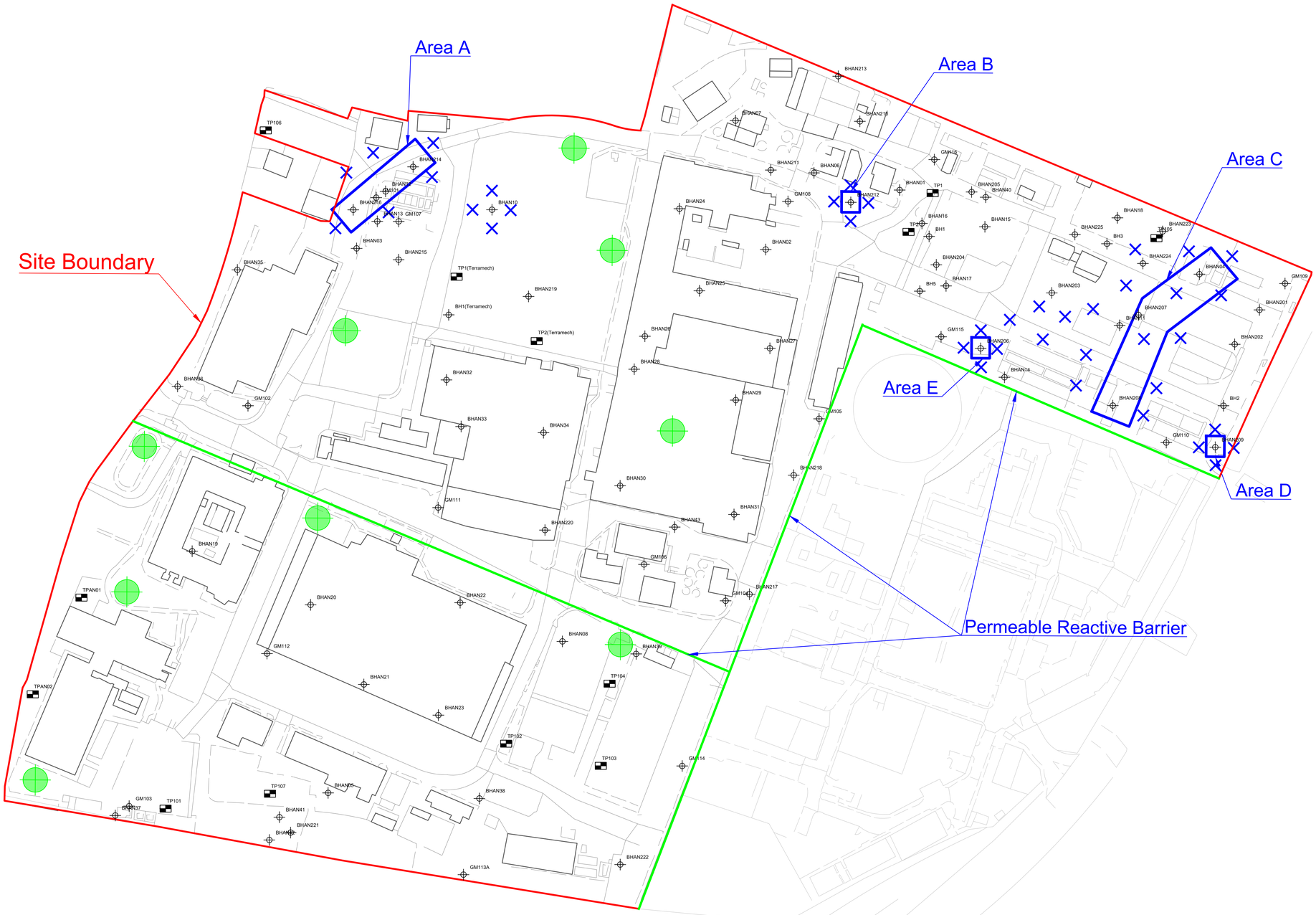
BGC-00-XX-DR-W-6714 P01

Originator | Zone | Level | Type | Role | Number | Revision



Scale 1:1000 (0, 20, 40, 60, 80, 100)

Notes:

- Indicative Trialpit Locations
- New Boreholes

Rev	Comment	Created By	Date	Checked By	Date	Approved By	Date
P01		J. G. Sarwar	09-Sep-19	N. Cetnarska	09-Sep-19	B. Ford	09-Sep-19

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Silverstone Road, Stowe, Buckingham MK18 5LJ
Telephone: 01280 823355 Fax: 01280 812830
www.buckinghamgroup.co.uk

Project: Slough

Title: Figure 6
Additional GI Plan

Client: PANATTONI

BGC-00-XX-DR-W-6714 P01

Originator | Zone | Level | Type | Role | Number | Revision

N

Site Boundary

Permeable Reactive Barrier

BHAN213 BHAN07 BHAN216 GM118 BHAN211 BHAN06 BHAN01 TP1 BHAN205 BHAN40 TP106 BHAN214 BHAN12 GM101 BHAN10 BHAN24 GM108 BHAN212 BHAN18 BHAN223 GM109 BHAN206 BHAN13 GM107 BHAN16 BHAN15 BHAN225 TP105 BHAN03 BHAN215 TP2 BH1 BH3 BHAN35 TP1(Terramech) BHAN02 BHAN224 BHAN04 BHAN204 BHAN17 BHAN203 BHAN219 BHAN25 BH5 BHAN201 BH1(Terramech) BHAN207 BHAN13 TP2(Terramech) BHAN26 GM115 BHAN206 BHAN202 BHAN27 BHAN36 BHAN32 BHAN28 BHAN14 GM102 BHAN29 BHAN208 BH2 BHAN33 BHAN34 GM105 GM110 BHAN209 BHAN30 BHAN218 GM111 BHAN31 BHAN43 BHAN220 BHAN19 GM106 BHAN217 GM104 TPAN01 BHAN20 BHAN22 BHAN08 BHAN39 GM112 TP104 TPAN02 BHAN21 BHAN23 TP102 TP103 GM114 GM103 TP101 TP107 BHAN05 BHAN38 BHAN37 BHAN41 BHAN221 BHAN40 BHAN222 GM113A

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Scale 1:1000 (0, 20, 40, 60, 80, 100)

Notes:

Site Wide

Remediation

Rev	Comment	Created By	Date	Checked By	Date	Approved By	Date
P01		J. G. Sarwar	11-Nov-19	N. Cetnarska	11-Nov-19	B. Ford	11-Nov-19

Scale at A1	Issuing Office	Project Number
1:1000	STOWE	T19041

Client Approval

- A - Approved
- B - Approved With Comments
- C - Do Not Use

Status	Purpose of Issue
S2	For Information

BUCKINGHAM Group Contracting
Silverstone Road, Stowe, Buckingham MK18 5LJ
Telephone: 01280 823355 Fax: 01280 812830
www.buckinghamgroup.co.uk

Project: Slough

Title: Figure 7 Groundwater Monitoring

Client: PANATTONI

BGC-00-XX-DR-W-6715 P01
Originator | Zone | Level | Type | Role | Number | Revision

Appendix A

Existing Site Layout Plan

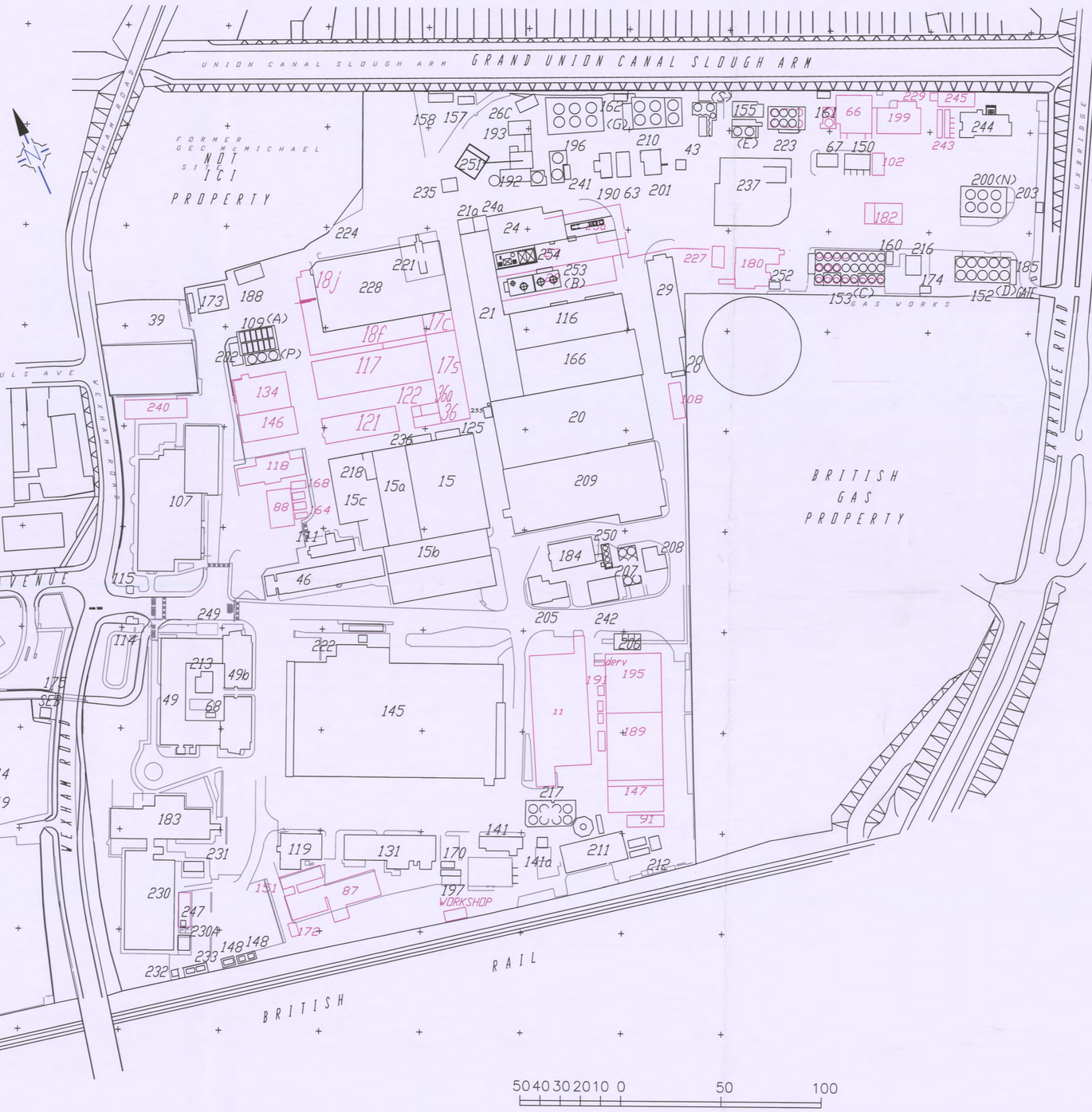
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

A B C D E F G H J K

LEGEND

DO NOT SCALE

11	X10/F	ENGINEERING WORKSHOP	201	X11/B	K40 P.V.A. MANUFACTURE
15	X9/D	FILLING SHOP	202	X8/C	ELECTRODAT STORAGE
15A	X9/D	FILLING SHOP EXTENSION	203	X14/B	SWITCHROOM SOLVENT FARM
15B	X9/E	FILLING SHOP CANOPY	205	X10/E	AMENITY BLOCK
15C	X9/D	FILLING SHOP EXTENSION 1984	206	X11/E	SUBSTATION
17C	X9/C	INDUSTRIAL PAINT PLANT	207	X11/E	SILOS
17S	X9/C	INDUSTRIAL PAINT PLANT	208	X11/E	COMPRESSORS & SWITCHROOM
18F	X9/C	MIXING BAYS	209	X10/D	PAINT MANUFACTURING BUILDING
18J	X8/C	MIXING BAYS	210	X11/B	RESIN LATEX TANK FARM
20	X10/D	TIN STORE	211	X10/G	BOILER PLANT
21NORTH	X10/C	BLENDING AND DRY COLOUR STORE	212	X11/G	GAS BOOSTER & AIR COMPRESSOR HOUSE
21SOUTH	X10/C	BATTERY CHARGING AREA	213	X7/F	H.F.L. STORE
21A	X9/C	ELECT. DIST. VARNISH BLENDING	214	X6/F	AUXILIARY GENERATOR BUILDING
22	X10/C	STORE AND LOCKER ROOM	216	X13/C	LIQUID NITROGEN PLANT
23	X10/C	VARNISH BLENDING	217	X10/G	TANK FARM
23A	X10/C	VARNISH OFFICE	218	X9/G	BAR CODE LABELLING
24	X10/C	VARNISH BLENDING DEPT.			
24A	X10/B	VARNISH BLENDING STORE			
26C	X10/B	SPRINKLER MAIN PUMPHOUSE	221	X9/C	RESIN UNLOADING FACILITIES
27	X9/B	PRODUCTION WORKSHOP	222	X9/E	WEIGHBRIDGE & TRAFFIC BARRIERS
28	X11/C	HEATING PLANT ROOM	223	X12/B	BULK ACID STORAGE
29	X11/C	VARNISH AMENITIES BLOCK	224	X8/C	EMERGENCY GATE FROM FORMER McMICHAEL SITE TO ICI
36	X9/D	TRANSFORMER HOUSE			
36A	X9/D	SUBSTATION			
39	X7/C	WEATHERING AREA	227	X11/C	UNIPRIME STRIPPER
43	X11/B	SOLVENT STILL	228	X9/C	DRUM PARK
46	X8/E	WORKS ENG, WORKS PERSONNEL, ETD, CORP REAL ESTATE	13/B		SODIUM CHLORATE STORE
49	X7/F	R & D LABORATORY	230	X7/G	RESEARCH LABORATORY
49B	X8/F	DEC R&D LAB/TRAINING, R&D ENGINEERING	230A	X7/G	PORTAKABIN TEMP LAB OFFICE ACCOMODATION
63	X11/B	P.V.A.PLANT	231	X7/G	PETROLEUM STORE
66	X12/B	METAL PRE-TREATMENT PLANT	232	X7/H	SWITCH & TRANSFORMER HOUSE
67	X12/B	COMPRESSOR STATION	233	X7/H	CONDENSER COMPOUND
68	X7/F	NITRO CELLULOSE STORE	234	X4/G	PORTACABIN SHOWERS
87	X8/G	LAB. OFFICES,STORES & R & D WORKS	235	X10/C	SUBSTATION
88	X8/E	RECREATION CLUB STORE	236	X10/E	SUBSTATION
91	X11/G	CIVIL ENG. & STORES DRUM CLEANING	237	X13/C	PETROLEUM DRUM PARK
102	X13/B	OFFICE AND AMENITIES	238	X6/G	POST ROOM - TEMP BUILDING
107	X7/D	CANTEEN,TRAINING CENTRE,KITCHEN —	239	X6/H	SUBSTATION
108	X11/D	STORES OFFICE & PAY STATION	240	X8/D	TRAINING CENTRE
109	X8/C	SOLVENT FARM	241	X11/C	BATTERY CHARGE
111	X8/E	MEDICAL DEPARTMENT	242	X11/F	LATEX STORAGE TANK FARM
114	X7/E	GATEHOUSE SOUTH	243	X14/B	SDYA STORAGE TANKS
115	X7/E	GATEHOUSE NORTH	244	X14/B	EFFLUENT SETTLING TANKS & Tank Farm 'F'
116	X10/C	DRY COLOUR STORE	245	X14/B	ACID STORAGE COMPOUND
117	X9/C	PAINT MANUFACTURING PLANT	246	OFF SITE	NORTHGATE HOUSE
118	X8/D	AMENITY BUILDING	247	X8/G	GAS CYLINDER STORAGE FACILITY
119	X8/G	M.P.T. LABORATORY & OFFICES	248	X5/H	NSC - WINDSOR COURT (ex Refinish training centre)
121	X9/D	PAINT DEPT,CONTROL LAB. & OFFICES	249	X8/E	NEW GATEHOUSE/SECURITY BUILDING
122	X9/D	SUBSTATION	250	X12/E	JET WASH FACILITY
125	X9/D	ELECTRICAL SUBSTATION	251	10/B	TMA HANDLING BUILDING (K38)
131	X9/G	SEMI-TECH LABORATORY	252	13/C	GENERAL SWITCHROOM
134	X8/D	PORTABLE MIXER CLEANING BUILDING	253	11/C	TANK FARM 'B'
140	X13/B	DRUM STORE	254	11/C	WATER DISTILLATION UNIT
141	X10/G	ELECTRODAT LAB	255	11/D	15/209 COMPRESSOR HOUSE
141A	X10/G	ELECTRODAT LAB			
145	X9/F	WAREHOUSE & BATTERY CHARGING HOUSE			
146	X8/D	DECANTING & STORAGE			
147	X11/G	PAINT & CARPENTER STORE			
148	X8/H	DERV TANKS			
150	X12/B	N.E.SUBSTATION			
151	X8/G	REGISTRARS			
152	X13/C	SOLVENT STORAGE FARM NO 3			
153	X12/C	OIL STORAGE FARM			
154	X5/F	H.Q. & OFFICE BLOCK			
155	X12/B	WATER COOLING TOWERS			
157	X9/B	SURFACE WATER PUMPING PIT			
158	X9/B	PRESSURE TANK HOUSE			
159	X12/C	STORE			
160	X13/C	L.T. DIST. CENTRE FOR BLD.152 & 153			
161	X12/B	L.T. DIST. CENTRE			
162	X11/B	L.T. DIST. CENTRE			
164	X9/D	CYCLE PARK			
166	X10/C	STORE FOR DRY COLOURS & CONTAINERS			
168	X8/D	CELLULOSE STORE			
169	X6/G	SUBSTATION PETERSFIELD			
170	X9/G	TOXIC & CELLULOSE STORE			
172	X8/G	CYCLE RACK			
173	X7/C	FIRE STATION			
174	X13/C	STORE			
175	X6/F	PUMPING PIT FOR TUNNEL - WEXHAM RD			
178	X5/F	CYCLE RACK			
180	X12/C	SPECIAL RESINS PLANT			
183	X7/G	RESEARCH LABORATORY			
184	X10/E	WORKS LABORATORY			
185	X14/C	PH METER HOUSE			
186	X10/F	BATTERY CHARGING HOUSE			
188	X8/C	PUMP HOUSE WATER SUPPLY			
189	X11/F	STORE BUILDING			
190	X10/B	K37 P.V.A. MANUFACTURING PLANT			
191	X10/F	MALE TOILET BLOCK			
192	X10/B	K38 JUMBO KETTLE			
193	X10/B	THERMEX BOILER			
195	X11/F	STORES BUILDING			
196	X10/B	RESIN STORAGE TANKS			
197	X9/G	PETROLEUM STORE			
199	X13/B	METAL PRETREATMENT PLANT			
200	X13/B	SOLVENT STORAGE FARM			



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J		B11,23 DEMOLISHED	TJC	30/6/97	-		-	-	-
H		B22,23,118 DEMOLISHED	TJC	1/10/96	T		Building 182 Demolished and Building 255 Added	PRS	21/01/10
G		B191,151,87,172 DEMOLISHED	TJC	1/5/95	S		B163, B194 & B27 Demolished B251, B252, B253 & B254 Added	PRS	08/12/08
F		B91,147,189,195 DEMOLISHED	TJC	9/8/94	R		Temp B238 Removed, B121 Demolished	PRS	27/09/05
E		B248/249 ADDED,B66,88,102,164,168,199,229,245 DEMOLISHED	TJC	7/3/94	Q		B250 ADDED	TJC	03/01/03
D		B248 CHANGED TO 194A	BDW	16/8/90	P		B194 , 146 DEMOLISHED	TJC	22/07/02
C		B247/248 ADDED B230B DELETED	BDW	12/7/90	N		B17c, 17s, 36, 36a, 122, 181, 18j, 117 DEMOLISHED	TJC	06/06/01
B		109 BLD NO CORRECTED	TJC	18/6/90	M		B108 DEMOLISHED	TJC	29/06/00
A		GENERAL UPDATE	TJC	5/7/89	L		B180 DEMOLISHED	TJC	01/10/97
-		CERTIFIED ISSUE	TJC	1/7/88	K		B243 DEMOLISHED,CANOPY ADDED,TANKS REMOVED	TJC	16/12/97

ICI Paints
ENGINEERING AND TECHNOLOGY DEPT.
WEXHAM ROAD, SLOUGH SL2 5DS. ENGLAND
Tel: 01753 550000 Fax: 01753 694487

DRAWN BY	Jim Cooper
DATE	15-06-1988
CHKD BY	-
APP BY	-
TITLE	SLOUGH WORKS AND OFFICES SITE PLAN AND BUILDING SCHEDULE
BLDG.No	-
SCALE	
PROJ.No	-
MATL LIST	-
WORKS	SLOUGH
DRG No	SL30400C01
REV	T

Appendix B

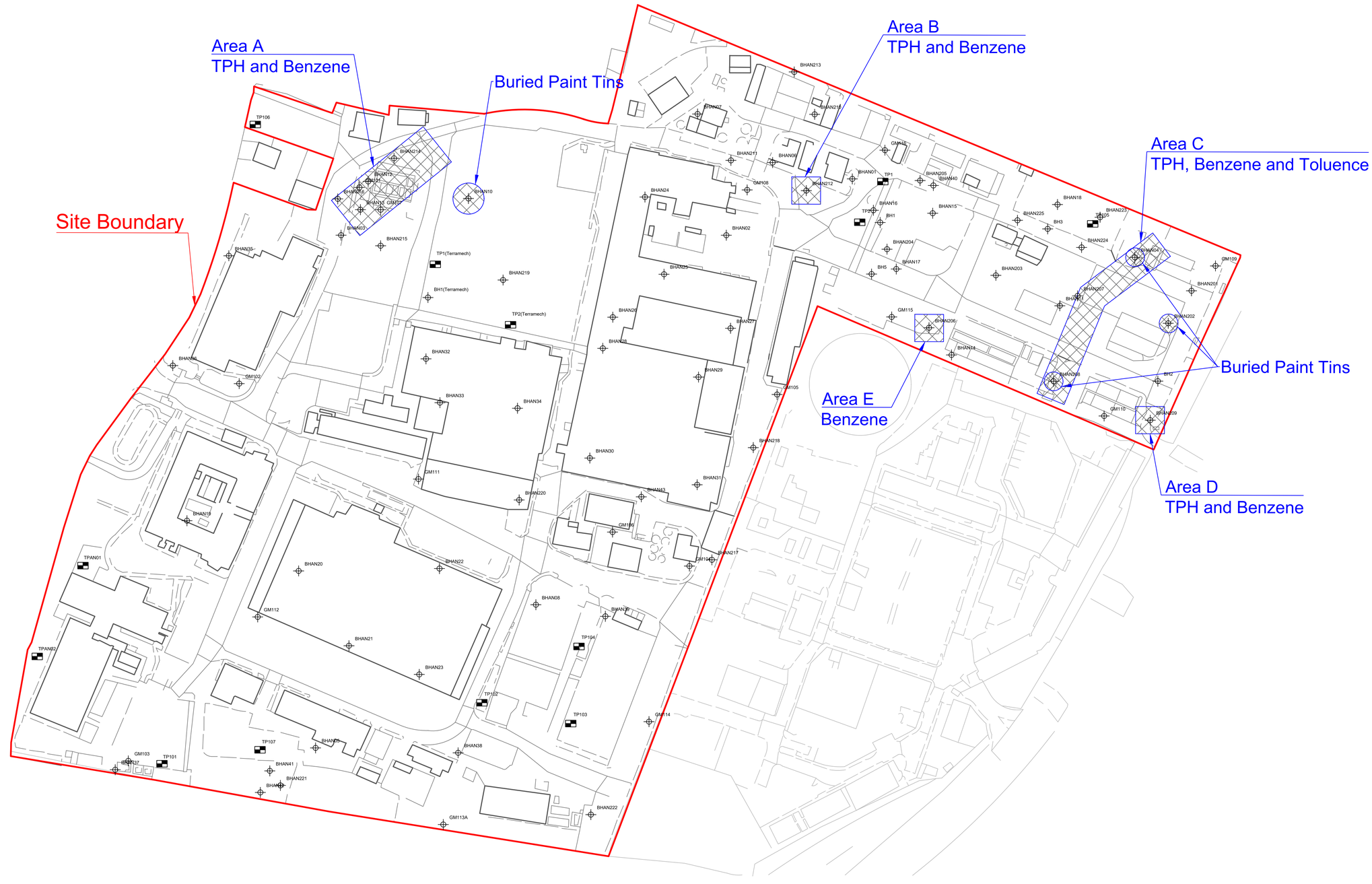
Soil Source Area Drawings

Drawing B1: Unsaturated Soil Source Areas

Drawing B2: Free Phase Hydrocarbons

Drawing B3: Asbestos in Soils

BGC-00-XX-DR-W-6703 | P01
Originator | Zone | Level | Type | Role | Number | Revision



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SBC PLANNING
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Scale 1:1000 (0, 20, 40, 60, 80, 100)

Notes:

Previous Investigation Points

Rev	Comment	Created By	Date	Checked By	Date	Approved By	Date
P01		J. G. Sarwar	09-Sep-19	Natalia Cetnarska	09-Sep-19	B. Ford	09-Sep-19

Scale at A1	Issuing Office	Project Number
1:1000	STOWE	T19041

Client Approval

- A - Approved
- B - Approved With Comments
- C - Do Not Use

Status	Purpose of Issue
S2	For Information

BUCKINGHAM Group Contracting
Silverstone Road, Stowe, Buckingham MK18 5LJ
Telephone: 01280 823355 Fax: 01280 812830
www.buckinghamgroup.co.uk

Project: Slough

Title: Drawing B1 Unsaturated Soil Source Areas

Client: PANATTONI

BGC-00-XX-DR-W-6703 | P01
Originator | Zone | Level | Type | Role | Number | Revision

Sheet Size A1 841 x 594

File Path:L:\2019\Other\Others\190514 - Boreholes\Brendon F. Drawings (190524) CAD\Borehole and trialpit location P02.dwg
Plot Date:09 September 2019 Plot Style: Buckingham - Standard.ctb Saved By: Jamshid.ghulam-sarwa on 09 September 2019
Plot Scale Check 100mm

SBC PLANNING
RECEIVED : 19.12.19

Scale 1:1000 (0, 20, 40, 60, 80, 100)

Notes:

Free Phase Hydrocarbons

Rev	Comment	Created By	Date	Checked By	Date	Approved By	Date
P01		J. G. Sarwar	27-Aug-19	Natalia Cetnarska	27-Aug-19	B. Ford	27-Aug-19

Scale at A1	Issuing Office	Project Number
1:1000	STOWE	T19041

Client Approval

- A - Approved
- B - Approved With Comments
- C - Do Not Use

Status	Purpose of Issue
S2	For Information

BUCKINGHAM Group Contracting
Silverstone Road, Stowe, Buckingham MK18 5LJ
Telephone: 01280 823355 Fax: 01280 812830
www.buckinghamgroup.co.uk

Project: Slough

Title: Drawing B2
Free Phase Hydrocarbons

Client: PANATTONI

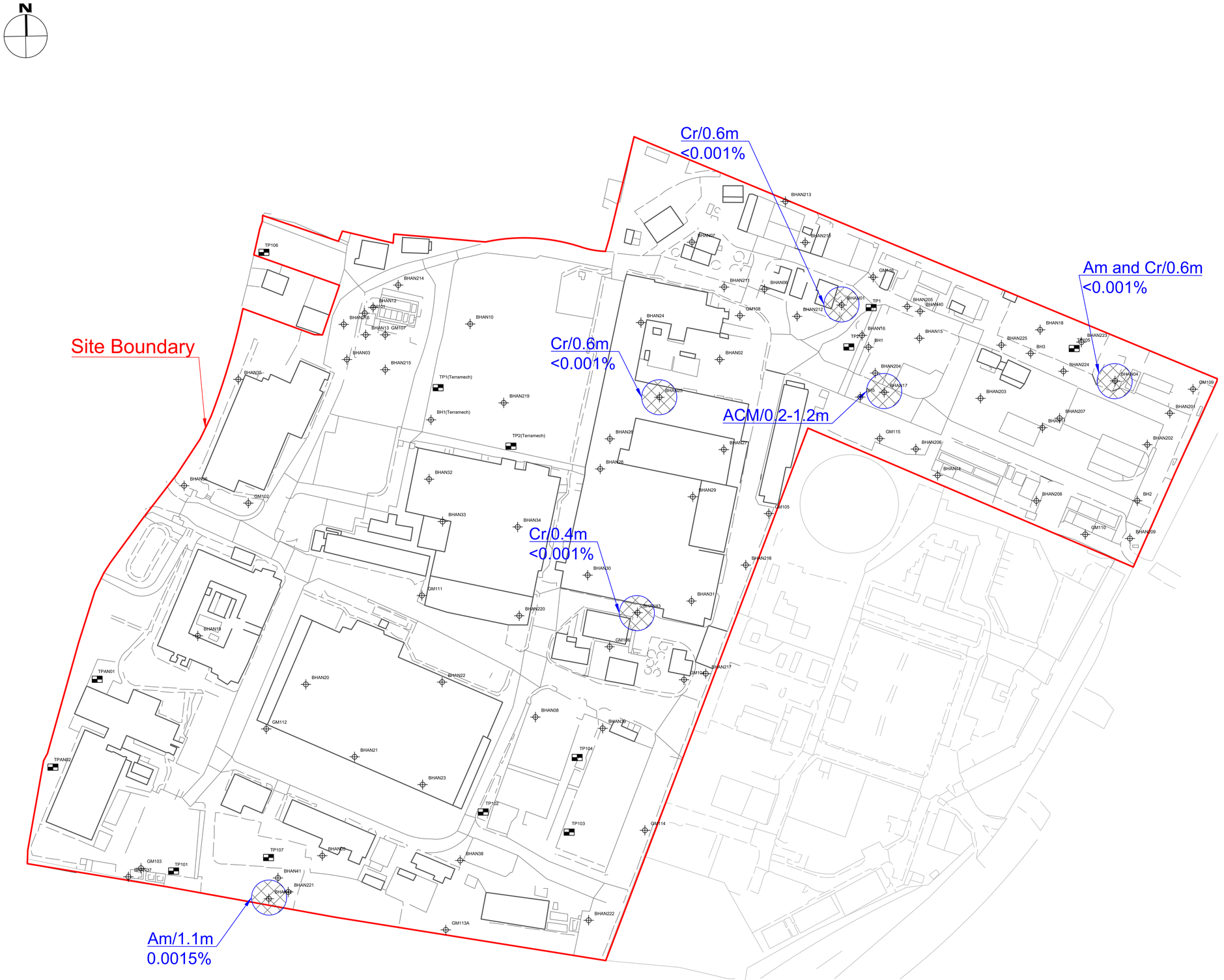
BGC-00-XX-DR-W-6704 P01
Originator | Zone | Level | Type | Role | Number | Revision

Sheet Size A1 841 x 594

File Path:L:\2019\Other\Others\190514 - Boreholes (Kelvin)\Brendon F. Drawings (190524)\Borehole and Insitgt location P02.dwg
Plot Date:27 August 2019 Plot Style: ---- Saved By: Jamshid.ghulam-sarwa on 27 August 2019
Plot Scale Check 100mm

BGC-00-XX-DR-W-6705 P01

Originator | Zone | Level | Type | Role | Number | Revision



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SBC PLANNING
RECEIVED : 19.12.19

Scale 1:1000 (0, 20, 40, 60, 80, 100)

Notes:

Cr - Chrysotile
Am - Amosite
ACM - Asbestos Containing Materials
0.001% Asbestos Fibres
Quantification

Rev	Comment	Created By	Date	Checked By	Date	Approved By	Date
P01		J. G. Sarwar	27-Aug-19	Natalia Cetnarska	27-Aug-19	B. Ford	27-Aug-19

Scale at A1	Issuing Office	Project Number
1:1000	STOWE	T19041

Client Approval

- A - Approved
- B - Approved With Comments
- C - Do Not Use

Status	Purpose of Issue
S2	For Information

BUCKINGHAM Group Contracting
Silverstone Road, Stowe, Buckingham MK18 5LJ
Telephone: 01280 823355 Fax: 01280 812830
www.buckinghamgroup.co.uk

Project: Slough

Title: Drawing B3
Asbestos In Soils

Client: PANATTONI

BGC-00-XX-DR-W-6705 P01
Originator | Zone | Level | Type | Role | Number | Revision

Sheet Size A1 841 x 594

Plot Date:27 August 2019 Plot Style: ---- Saved By: Jamshid.ghulam-sarwa on 27 August 2019 | Plot Scale Check | 100mm

Appendix C

Groundwater Plume Drawings

Drawing C1: TPH in Groundwater >1mg/l

Drawing C2: Benzene in Groundwater

Drawing C3: cis-DCE in Groundwater

Drawing C4: Vinyl Chloride in Groundwater

Drawing C5: Naphthalene and Tert-butyl Alcohol in Groundwater

Drawing C6: Xylene in Groundwater

Scale 1:1000 (0, 20, 40, 60, 80, 100)

N

Plume 1

Plume 2

Plume 3

Plume 4

Site Boundary

8,130
15,700
7,740
9,910
1,180
1,240
1,230
11,700
6,890
1,056
6,230
1,280
3,670
3,370
62,000
20,600
14,000
10,537
19,000
62,000
217,000
105,000
86,800
5,130
5,900
4,410
79,500

BHAN213 BHAN07 BHAN214 BHAN211 BHAN06 BHAN212 BHAN01 BHAN205 BHAN40 BHAN16 BHAN15 BHAN18 BHAN225 BHAN223 BHAN224 BHAN204 BHAN17 BHAN203 BHAN207 BHAN201 BHAN202 BHAN208 BHAN209 BHAN24 BHAN02 BHAN25 BHAN26 BHAN27 BHAN28 BHAN29 BHAN32 BHAN33 BHAN34 BHAN30 BHAN31 BHAN43 BHAN220 BHAN19 BHAN20 BHAN22 BHAN08 BHAN09 BHAN21 BHAN23 BHAN218 BHAN217 BHAN35 BHAN36 BHAN03 BHAN215 BHAN219 BHAN38 BHAN39 BHAN41 BHAN221 BHAN42 BHAN222

TP106 TP216A TP216B TP214A TP10A TP10B TP1 TP1(Terramech) BH1(Terramech) TP2(Terramech) TP115A TP206C TP206B TP206A TP207B TP207A TP207D TP207E TP202C TP202A TP202B TP64A TP64B TP64C TP208A TPAN01 TPAN02 TP194 TP103 TP102 TP107 GM103 TP101 BH37

GM102 GM107 GM108 GM115 GM105 GM110 GM111 GM106 GM109 GM112 GM104 GM114 GM113A GM100

BH1 BH3 BH5 BH2

Notes:

> 1,000-10,000 ug/L

> 10,000-100,000 ug/L

> 100,000 ug/L

6,230 - TPH ug/L

Rev	Comment	Created By	Date	Checked By	Date	Approved By	Date
P01		J. G. Sarwar	09-Aug-19	Natalia Cetnarska	09-Aug-19	B. Ford	09-Aug-19

Scale at A1	Issuing Office	Project Number
1:1000	STOWE	T19041

Client Approval

- A - Approved
- B - Approved With Comments
- C - Do Not Use

Status	Purpose of Issue
S2	For Information

BUCKINGHAM Group Contracting
Silverstone Road, Stowe, Buckingham MK18 5LJ
Telephone: 01280 823355 Fax: 01280 812830
www.buckinghamgroup.co.uk

Project: Slough

Title: Drawing C1
TPH in Groundwater > 1mg/L

Client: PANATTONI

Originator	Zone	Level	Type	Role	Number	Revision
BGC-	00 -	XX -	DR -	W-	6706	P01

File Path:L:\2019\Other\Others\190514 - Boreholes\Brendon F. Drawings (190524) CAD\Borehole and trialpit location P02.dwg
Plot Date:09 October 2019 Plot Style: Buckingham - Standard.ctb Saved By: Jamshid.ghulam-sarwa on 09 October 2019
Plot Scale Check 100mm
Sheet Size A1 841 x 594

Scale 1:1000 (0, 20, 40, 60, 80, 100)

Notes:

> 6.61-1,000 ug/L

> 1,000 ug/L

6,230 - Benzene ug/L

Rev	Comment	Created By	Date	Checked By	Date	Approved By	Date
P01		J. G. Sarwar	27-Aug-19	Natalia Cetnarska	27-Aug-19	B. Ford	27-Aug-19

Scale at A1	Issuing Office	Project Number
1:1000	STOWE	T19041

Client Approval

- A - Approved
- B - Approved With Comments
- C - Do Not Use

Status	Purpose of Issue
S2	For Information

BUCKINGHAM Group Contracting
Silverstone Road, Stowe, Buckingham MK18 5LJ
Telephone: 01280 823355 Fax: 01280 812830
www.buckinghamgroup.co.uk

Project: Slough

Title: Drawing C2
Benzene in Groundwater (>6.61 ug/L)

Client: PANATTONI

Originator	Zone	Level	Type	Role	Number	Revision
BGC-	00-	XX-	DR-	W-	6707	P01

File Path:L:\2019\Other\Others\190514 - Boreholes (Kelvin)\Brendon F. Drawings (190324)\Borehole and trialpit location P02.dwg
Plot Date:27 August 2019 Plot Style: ---- Saved By: Jamshid.ghulam-sarwa on 27 August 2019
Plot Scale Check 100mm
Sheet Size A1 841 x 594

BGC-00-XX-DR-W-6708 | P01

Originator | Zone | Level | Type | Role | Number | Revision

Notes:

> 278-1,000 ug/L

> 1,000 ug/L

6,230 - Cis DCE ug/L

Scale 1:1000 (0, 20, 40, 60, 80, 100)

Rev	Comment	Created By	Date	Checked By	Date	Approved By	Date
P01		J. G. Sarwar	27-Aug-19	Natalia Cetnarska	27-Aug-19	B. Ford	27-Aug-19

Scale at A1	Issuing Office	Project Number
1:1000	STOWE	T19041

Client Approval

- A - Approved
- B - Approved With Comments
- C - Do Not Use

Status	Purpose of Issue
S2	For Information

BUCKINGHAM Group Contracting
Silverstone Road, Stowe, Buckingham MK18 5LJ
Telephone: 01280 823355 Fax: 01280 812830
www.buckinghamgroup.co.uk

Project: Slough

Title: Drawing C3
Cis DCE in Groundwater

Client: PANATTONI

BGC-00-XX-DR-W-6708 | P01

Originator | Zone | Level | Type | Role | Number | Revision

BGC-00-XX-DR-W-6709 P01

Originator | Zone | Level | Type | Role | Number | Revision

Scale 1:1000 (0, 20, 40, 60, 80, 100)

Notes:

> 6.17-100 ug/L

> 100 ug/L

6,230 - Vinyl Chloride ug/L

Rev	Comment	Created By	Date	Checked By	Date	Approved By	Date
P01		J. G. Sarwar	29-May-19	Natalia Cetnarska	29-May-19	B. Ford	29-May-19

Scale at A1	Issuing Office	Project Number
1:1000	STOWE	T19041

Client Approval

- A - Approved
- B - Approved With Comments
- C - Do Not Use

Status	Purpose of Issue
S2	For Information

BUCKINGHAM Group Contracting
Silverstone Road, Stowe, Buckingham MK18 5LJ
Telephone: 01280 823355 Fax: 01280 812830
www.buckinghamgroup.co.uk

Project: Slough

Title: Drawing C4
Vinyl Chloride in Groundwater

Client: PANATTONI

BGC-00-XX-DR-W-6709 P01

Originator | Zone | Level | Type | Role | Number | Revision

Sheet Size A1 841 x 594

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Plot Date:27 August 2019 Plot Style: ---- Saved By: Jamshid.ghulam-sarwa on 27 August 2019
Plot Scale Check 100mm

BGC-00-XX-DR-W-6710 P01

Originator | Zone | Level | Type | Role | Number | Revision

Scale 1:1000 (0, 20, 40, 60, 80, 100)

SBC PLANNING
RECEIVED : 19.12.19

Notes:

6,230 - Concentration in ug/L

Rev	Comment	Created By	Date	Checked By	Date	Approved By	Date
P01		J. G. Sarwar	27-Aug-19	Natalia Cetnarska	27-Aug-19	B. Ford	27-Aug-19

Scale at A1	Issuing Office	Project Number
1:1000	STOWE	T19041

Client Approval

- A - Approved
- B - Approved With Comments
- C - Do Not Use

Status	Purpose of Issue
S2	For Information

BUCKINGHAM Group Contracting
Silverstone Road, Stowe, Buckingham MK18 5LJ
Telephone: 01280 823355 Fax: 01280 812830
www.buckinghamgroup.co.uk

Project: Slough

Title: Drawing C5
(N) and Tert-Butyl Alcohol (TBA) in Groundwater

Client: PANATTONI

BGC-00-XX-DR-W-6710 P01

Originator | Zone | Level | Type | Role | Number | Revision

File Path:L:\2019\Other\Others\190514 - Boreholes (Kelvin)\Brendon F. Drawings (190524)\Borehole and trialpit location P02.dwg
Plot Date:27 August 2019 Plot Style: ---- Saved By: Jamshid.ghulam-sarwa on 27 August 2019
Plot Scale Check 100mm
Sheet Size A1 841 x 594

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Originator | Zone | Level | Type | Role | Number | Revision

Scale 1:1000 (0, 20, 40, 60, 80, 100)

Notes:

> 6,560 - 10,000 ug/L

> 10,000 ug/L

6,230 - TPH ug/L

Rev	Comment	Created By	Date	Checked By	Date	Approved By	Date
P01		J. G. Sarwar	27-Aug-19	Natalia Cetnarska	27-Aug-19	B. Ford	27-Aug-19

Scale at A1	Issuing Office	Project Number
1:1000	STOWE	T19041

Client Approval

- A - Approved
- B - Approved With Comments
- C - Do Not Use

Status	Purpose of Issue
S2	For Information

BUCKINGHAM Group Contracting
Silverstone Road, Stowe, Buckingham MK18 5LJ
Telephone: 01280 823355 Fax: 01280 812830
www.buckinghamgroup.co.uk

Project: Slough

Title: Drawing C6
Xylene in Groundwater

Client: PANATTONI

BGC-00-XX-DR-W-6711 P01

Originator | Zone | Level | Type | Role | Number | Revision

Appendix D

Site Specific Acceptance Criteria and Groundwater Guidance Values

Appendix D1: Site Specific Acceptance Criteria for Soils

Determinand	General Material (mg/kg)	Cover Material / Imported Soils (mg/kg)
Arsenic	640 (1)	40 (3)
Cadmium	190 (1)	11 (3)
Chromium III	8,600 (1)	910 (3)
Chromium Hexavalent	33 (1)	6 (3)
Copper	68,000 (1)	2,400 (3)
Lead	2,330 (2)	310(4)
Mercury	58 (1)	1.2 (3)
Nickel	980 (1)	180 (3)
Selenium	12,000 (1)	250 (3)
Zinc	730,000 (1)	3,700 (3)
Asbestos	<0.001% by weight (5)	No fibres detected (5)
Total Petroleum Hydrocarbons	5,000(6)	500 (6)
Aliphatic >C5-6	5.32(7)	5.32 (7)
Aliphatic >C6 - 8	N/A(8)	100(9)
Aliphatic >C8-10		27(9)
Aliphatic >C10-12		130(9)
Aliphatic >C12 - 16		1100(9)
Aromatic >C5 - 7		70(9)
Aromatic >C7- 8		130(9)
Aromatic >C8 – 10		34(9)
Aromatic >C10 – 12		74(9)
Aromatic >C12 – 16		140(9)
Aromatic >C16 – 21		260(9)
Aromatic >C21 – 35		N/A(10)
Benzene	0.033(13)	0.033(13)
Toluene	70.4 (7)	70.4 (7)
Ethylbenzene	N/A(8)	47(3)
Xylene	N/A(8)	56(3)
Acenaphthylene	N/A(8)	210(12)
Acenaphthene	N/A(8)	170(12)

Determinand	General Material (mg/kg)	Cover Material / Imported Soils (mg/kg)
Fluorene	N/A[8]	170[12]
Phenanthrene	N/A[8])	95[12]
Anthracene	N/A[8]	2,400[12]
Fluoranthene	N/A[8])	280[12]
Pyrene	N/A[8])	620[12]
Benzo(a)anthracene	170[11]	7.2[12]
Chrysene	350[11]	15[12]
Benzo(b)fluoranthene	44[11]	2.6[12]
Benzo(k)fluoranthene	1,200[11]	77[12]
Benzo(a)pyrene	35[11]	2.2[12]
Indeno(1,2,3-cd) pyrene	500[11]	27[12]
Dibenzo(a,h)anthracene	3.5[11]	0.24[12]
Benzo[g,h,i]perylene	3,900[11]	320[12]
Naphthalene	190[11]	2.3[12]
Trichloroethene (TCE)	0.0764[7]	0.0764[7]
cis 1,2-Dichloroethene	0.187[7]	0.187[7]
Vinyl chloride	0.00396[7]	0.00396[7]

Notes:

1. LQM/CIEH S4UL, Commercial End Use
2. Defra C4SL for commercial endues
3. LQM/CIEH S4UL, residential with homegrown produce enduse
4. Defra C4SL residential enduse with plant u33ptake
5. Made Ground containing asbestos has been identified at some locations on the site. If retained on-site for reuse, no visible bulk ACM should be present in the material and the Contractor shall hand-pick visible ACM prior to crushing. Following processing, the Made Ground material may have an ACM content of <0.1% by weight and be considered suitable as General Material as long as it is placed greater than 1.0m below the final development level. If the Contractor encounters significant quantities/hot spots of friable high-risk bulk ACM, advice will be sought be a specialist asbestos consultant.
6. Arbitrary standard for avoidance of gross contamination and to control quality of soils re-used on site or imported on to site.
7. Arcadis Water Resources SSAC based on Source Area 1 and 50m compliance point
8. Excluded as all greater than the generic total TPH 5000mg/kg SSAC
9. LQM/CIEH S4UL, residential with home grown produce enduse. 1% SOM
10. Excluded as all greater than the generic total TPH 5000mg/kg SSAC (PAH will be detected in TPH results)
11. LQM/CIEH S4UL, commercial enduse. 1% SOM
12. LQM/CIEH S4UL, residential with home grown produce enduse. 1% SOM
13. Arcadis Water Resources SSAC based on Source Area 1 and 105m compliance point

Appendix D2: Groundwater Guidance Values

Plumes and Up gradient of PRB: (Source Arcadis DQRA)

Determinant	Groundwater Guidance Values (mg/l)
TPH Aliphatic >C5 – C6	0.453
Benzene	0.00661
Ethylbenzene	131
Toluene	48.4
Sum Xylene	6.56
Naphthalene	0.497
Trichloroethene	0.049
cis 1,2-dichloroethene	0.278
Vinyl chloride	0.00617
Tert Butyl Alcohol	0.0534
Free Phase Hydrocarbons	Reduce to non-rebounding sheen (<1mm) for 3 months

Down gradient of PRB: (Source EQS and/or UKDWS)

Determinant	Groundwater Guidance Values (mg/l)
Benzene	0.001
Ethylbenzene	0.02
Toluene	0.05
Sum Xylene	0.03
Naphthalene	0.002
Trichloroethene	0.01
cis 1,2-dichloroethene	0.05
Vinyl chloride	0.0005
Tert Butyl Alcohol	0.012