



North Wales Prison, Wrexham

Land Quality Statement: Area 1

Final Report for



September 2014

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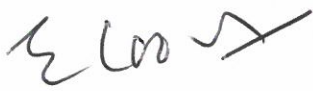
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1.0 INTRODUCTION

1.1 Terms of Reference

In August 2014, Hydrock Consultants Limited (Hydrock) was commissioned by Lend Lease (the Client) to undertake a desk study and ground contamination assessment for part of the development site of the proposed North Wales Prison, off Bridge Road South, Wrexham Industrial Estate, Wrexham.

A site location plan (Drawing 14656/D001), a site survey plan (14656/D002) and a proposed development layout (14656/D003) are presented in Appendix A.

In total, the development site covers approximately 26.7ha and currently comprises an area of open, derelict land which until August 2014 was in large part covered in dense vegetation, although this has now been removed.

It is proposed to build a prison at the site, with the main prison buildings occupying the central and eastern parts of the site; car parking areas and auxiliary buildings in the northwest; and a large, rectangular area of ground in the southwest (the Expansion Zone) which will be walled and included in the grounds of the main prison building.

Planning Permission for the development has been issued by Wrexham County Borough Council (WCBC) which imposed the following Condition 9 in respect of contaminated land:

The reserved matters application shall include a scheme to deal with potential contamination at the site. This scheme shall include a phased investigation approach to identify the extent of contamination and any measures required to remediate the site, including post-development monitoring.

It was subsequently agreed with WCBC that this Condition could be discharged separately for those parts of the site, with a submission for Area 1 being issued for approval separate to a second submission relating to the remaining area.

The part of the site under consideration in this report 002 is Area 1, which comprises the proposed car parking area in the north-western part of the site and the Expansion Zone in the south-western part of the site. These areas are to be subjected to varying degrees of cut-to-fill in order to achieve the required finished ground levels to allow the development to take place.

1.2 Objectives

The objective of this report is to present the findings of a Phase I Desk Study, Phase II Site investigation, Risk Assessment and Outline Remedial Strategy for Area 1, to allow WCBC to discharge Condition 9 for that area and thereby allow works in that area to commence. In particular, the requirement is to assess the contamination status of the soils underlying Area 1, to ensure that the soils used in the cut-to-fill are chemically suitable and will not pose a significant residual risk to human health.



1.3 Scope

The scope of work for this commission comprises:

- a desk study and site walk-over reconnaissance to determine the nature of the site and its surroundings including current and former land uses, geology, hydrogeology, hydrology and geo-environmental data;
- a review of previous site investigation reports for the site, including a reassessment of past chemical soil testing results specific to the areas of the site under consideration (Area 1); and
- reporting.

1.4 Information Provided

The following has been provided to Hydrock by Lend Lease for use in the preparation of this report:

- Travers Morgan Ltd: “Firestone Development Site, Wrexham”, reference 1W35245/contam, dated 31st May 1994;
- Various correspondence from Travers Morgan (and later Symonds Travers Morgan) to the Welsh Development Agency, including report summaries and recommendations for remediation;
- ESI Ltd: “Preliminary Risk Assessment, Former Firestone Site, Wrexham Industrial Estate”, reference 60895R1, dated December 2012;
- ESI Ltd: “Phase 2 Contaminated Land Investigation, Former Firestone Site, Wrexham Industrial Estate”, reference 60895R2, dated December 2012; and
- WYG Environment: “New Prison North Wales, Ground Investigation Factual Report”, Version 3, reference A083839, dated 14th January 2014.



2.0 PRELIMINARY INVESTIGATION (PHASE 1 STUDY)

The reports provided by the Client have been used as the basis for the following desk study for the site. In addition, historical maps have been acquired for the site by Hydrock in order to determine past site use and corroborate statements included in the various reports provided.

Note that the Phase I assessment contained herein covers the whole of the development area, apart from land to the southwest and southeast of the prison boundaries designated as a nature reserve. Features specifically relevant to Area 1 are highlighted in the text.

2.1 Site Referencing

The site is referenced in Table 2.1.

Table 2.1: Site Referencing Information

Item	Brief Description
Site name	North Wales Prison Site, Wrexham.
Site location and grid reference	To the south of Bridge Road South, Wrexham Industrial Estate, Wrexham, Flintshire. The nearest postcode is LL13 3QA, and the approximate National Grid Reference of the site centre is 337900E, 349040N.

A site location plan is provided in Appendix A (Drawing 14656-D001).

2.2 Site Description and Walk-Over Survey

The current site conditions are summarised in Table 2.2.

Table 2.2: Site Description

Item	Brief Description
Site access	The primary access into the site is directly from Bridge Road South via locked steel double gates located on the northwest site boundary. Additional access is available from an unnamed service road serving Spectrum Business Park via locked steel double gates located in the southeastern site boundary.
Land area	The proposed development area extends to approximately 26.7 ha.
Elevation, topography etc.	The development site is approximately rectangular in plan, with the long axis trending northeast-southwest. It is largely flat across the majority of its area, although ground levels in the southwestern half of the site rise gently towards the southwest and south.
Site boundaries	The site boundaries are currently formed by steel palisade fencing on the northwestern, northeastern and most of the southeastern sides; by fencing and industrial units on the southwestern side; and by steel palisade fencing and open land on the southeastern side, with the River Clywedog approximately 200m to the south.
Geomorphic features	There are no notable geomorphic features at the site, other than a drain / stream that runs approximately north-south through the eastern part of the site.



Item	Brief Description
Present land use	The site represents brownfield land formerly occupied by a tyre factory and a Royal Ordnance Factory associated with the manufacture and storage of explosives. All surface structures and the vast majority of subsurface structures were removed following the closure and demolition of the facilities, and ground levels across the site were regraded to create the present day, essentially flat ground profile.
Vegetation	Until recently (August 2014) the site was in large part covered in dense vegetation, although this has now been removed to allow the various stages of ground investigation etc. to be undertaken.
Surrounding land	The site is located on the southern edge of Wrexham Industrial Estate. The development area is bound to the southwest, northeast and east by industrial units. To the southeast is open land leading down to the River Clywedog; this area is to remain undeveloped and will be retained as a nature reserve. A housing estate and industrial units are located to the northwest.

2.3 Site History

Hydrock have acquired and reviewed historical maps for the site, and the key points are summarised in Table 2.3 below.

Table 2.3: Site Description

Map Edition and Scale	Key Points
1872 (1:10,560) & 1872-73 (1:2,500)	The site is shown to be predominantly composed of a number of open fields with ponds of various size scattered throughout. A road runs northeast to southwest through the eastern half of the site, and a chapel, a farmhouse and associated farm buildings run in a line along the southern side of the road. In the southern part of the site a spur runs off the road towards the southeast.
1898 (1:10,560) & 1899 (1:2,500)	The buildings on the southern side of the internal road are indicated to include a smithy.
1909 & 1938 (1:10,560) & 1912 (1:2,500)	No significant change.
1949 (1:10,560)	All previous structures and roads on-site have been removed, and the site is now occupied by a large number of small (mostly c. 8m x 14m or smaller), widely separated buildings connected by a network of roads and served by numerous water hydrants. Three larger (c. 7m x 40m) buildings are located along the northeastern site boundary, each of which is bound on its northwestern, southwestern and southeastern sides by large bunds, presumably for blast protection, and another larger building (c. 8m x 30m) is located in the eastern corner of the site. The internal roads extend off-site and connect up to similar buildings which are located throughout the general area surrounding the site. It is known from other sources (see below*) that the structures occupying the site and the surrounding areas were part of a Royal Ordnance Factory (ROF) site that was established during the Second World War to manufacture and store explosives for
	munitions. However, the relatively small size of the majority of the buildings would suggest they were used for materials storage rather than any manufacturing processes. At this time (1949) at least part of this area, presumably including the site itself, was marked Wrexham Trading Estate, suggesting that the ROF facility had closed following the end of hostilities and the various buildings were now used for other purpose.



Map Edition and Scale	Key Points
1960-64 (1:10,560) & 1959-60 (1:2,500)	No significant change.
1976 & 1977-82 (1:2,500) & 1977-82 (1:10,000)	All but two of the structures formerly occupying the northwestern half of the site have been removed, and this area is now occupied by a large, elongate factory building (i.e. the Firestone Tyre Factory) surrounded by areas of open land, presumably representing roadways and areas of hardstanding for car and lorry parking, and possibly materials storage. The southeastern half of the site remains unchanged.
1983-89 (1:2,500)	No significant change.
1990-93 (1:2,500) & 1992 (1:10,000)	All of the former ROF structures, including the two relict buildings formerly located adjacent to the southeastern side of the tyre factory building, have gone, with the southeastern half of the site now shown to be open land. A large, rectangular building is now shown adjacent and parallel to the southeastern side of the main factory building in the northwest of the site.
1994 (1:2,500)	The site has been cleared of all structures to leave open land.
2002-2014 (1:10,000)	The site is shown to be open land, with a drain running approximately north-south through the eastern part of the site, as today.
* http://www.coflein.gov.uk/en/site/308980/details/MARCHWIEL+ROYAL+ORDNANCE+FACTORY,+WREXHAM/ http://en.wikipedia.org/wiki/Wrexham_Industrial_Estate http://www.theviewfromthenorth.org/rof-wrexham	

2.4 Unexploded Ordnance/Bombs

Due to the site's known past use as a Royal Ordnance Factory, qualified Explosive Ordnance Disposal Engineers were present throughout the excavation of the WYG trial pits and boreholes. In addition, selected soil samples recovered during both the ESI 2012 and WYG 2013 investigations were submitted for chemical testing to determine the presence of explosive substances and their constituent compounds, such as picric acid, nitroglycerine and 2,4,6-trinitrotoluene (TNT).

During the WYG investigation no traces of potential explosives were found within the excavations, and no explosives residues were detected in any of the ESI and WYG soil samples tested. As a consequence, it is considered that the risks from UXO at the site are low.

2.5 Geology

The general geology of the site area is shown on the 1:50,000 geological map of Wrexham (Sheet 121) and is summarised in Table 2.4.



Table 2.4: Geology

Stratigraphic Name	Age	Description
Glacial Till	Devensian	Typically clay and silt with variable amounts of sand, gravel and cobbles, and occasionally boulders, with common discontinuous lenses of sand and / or gravel.
Salop Formation	Westphalian D (Cisuralian Epoch)	Red and red-brown mudstone and sandstone containing beds of pebbly sandstone and conglomerate. Thin limestone beds and caliche in the lower part of the unit.

Given the known site history a variable thickness of Made Ground would be expected beneath most, if not all, of the site.

2.1 Mining or Mineral Extraction

The site is not located within an area where coal or other materials are known to have been mined by underground methods, and no quarries or pits are shown at, or within the immediate vicinity of, the site on the historical maps. Therefore hazards associated with shallow mining at the site are considered to be low.

2.2 Hydrogeology

The aquifer designations given in Table 2.5 are based on the Environment Agency interactive aquifer designation map. Additional information on the hydraulic characteristics of the geological units has been abstracted from Allen *et al* (1997) and Jones *et al* (2000).

Table 2.5: Hydraulic Characteristics of Strata

Stratum	Aquifer Designation	Hydraulic Characteristics
Made Ground	Unproductive strata	Moderate to high porosity because of unconsolidated nature, but permeability likely to be constrained to low where poor sorting and high clay content is present.
Glacial Till	Unproductive strata	Dominated by low permeability clay and silt which is interbedded with moderate to high permeability layers of sand with occasional gravel; overall, this unit is likely to be anisotropic in nature with horizontal permeability greater than vertical permeability (i.e. $k_h > k_v$).
Salop Formation	Secondary A aquifer	Rocks with permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

Reference to the Environment Agency web site shows the following groundwater body beneath the site and the current chemical status (Table 2.6).



Table 2.6: Underlying Groundwater Body

Category	Label / Status
Waterbody ID	GB41101G202400
Waterbody name	Dee Permo-Triassic Sandstone
River basin district	Dee
Current quantitative status	Poor
Current chemical status	Good
Upward chemical trend	No
2015 predicted qualitative status	Poor
2015 predicted chemical status	Good
Overall risk	At risk
Protected area	Yes

The vast majority of the development site lies outside of any groundwater Source Protection Zones (SPZ). However, the whole of the southeastern edge of the development site lies within a SPZ III (total catchment) and SPZ II (Outer Catchment).

There is a single active groundwater abstraction in the vicinity of the site. This licence, Ref. WA/067/0007/006, is a modified version of an earlier licence and became active on 1/04/2012. It allows the abstraction of up to 131,400m³ / annum or 600m³ / day of groundwater from a 144m deep borehole located at the industrial unit immediately adjacent to the eastern corner of the site. The licence is due to expire on 31/03/2022.

2.3 Hydrology and Flooding

The surface water features in the vicinity of the site are listed in Table 2.7 and, where appropriate, are marked on the Site Zonation Plan in Appendix A.

Table 2.7: Surface Water Features

Feature	Location Relative to the Development Site
Drain	On-site, running from north to south through the eastern part of the site.
River Clywedog (Primary River)	Approximately 200m to the southeast.
Various drains	Located throughout the general area.

There are no licensed surface water abstractions within 1km of the site.

The site is in Flood Zone 1, with low probability of flooding. A Flood Zone 2 is located approximately 125m to the southeast of the development site, associated with the River Clywedog.



No further consideration of flood risk is undertaken in this report. Specialist flood risk advice should be sought with regards to drainage and flooding.

2.4 Previous Site Investigations

A number of ground investigations have been undertaken at the site and are reviewed below.

2.5 Travers Morgan Report, May 1994

In May 1994 Travers Morgan issued a site investigation report (Ref. 1W35245/contam) which described two phases of ground investigation at the site undertaken by, or on behalf of, Travers Morgan, as well as an earlier investigation undertaken in 1992 by Subsoil Surveys on behalf of JR Grimley Eve. The key points are summarised below.

2.5.1 1992: Subsoil Surveys

Travers Morgan described this investigation as comprising the drilling of 11 boreholes with laboratory testing. No further information is provided, and the report is not available for review.

2.5.2 November 1993: Travers Morgan

This investigation was undertaken by LTG Ground Engineering on behalf of Travers Morgan, and comprised the following:

- The drilling of 12 boreholes;
- The excavation of 81 trial pits and 10 trial trenches; and
- Laboratory soil and water testing;

The report concluded that there were isolated pockets of soil contamination across the northern part of the site, mostly within the upper 1m of ground.

2.5.3 March 1994: Travers Morgan

This investigation was undertaken to provide greater detail of the soil contamination identified during the November 1993 investigation, and included the excavation of 35 trial pits with chemical soil testing.

2.5.4 Comments

Neither the logs nor the chemical and geotechnical testing results from either of the Travers Morgan investigations were included in the copy of the report provided. However, even if present any such information would be of limited use for the following reasons:

- At the time of the Travers Morgan investigations (and the earlier Subsoil Surveys investigation) the Firestone Tyre Factory was still standing, albeit undergoing demolition. Consequently, the ground conditions that existed at that time were likely to be significantly different to those that exist today, particularly as a Site Investigation Summary report prepared by Symonds Travers Morgan, dated 27/11/1995 (Ref. 35245/REP/04), confirmed that:



- the areas of soil contamination identified by the Travers Morgan investigations had been excavated and removed off-site, with “tips of Made Ground being regraded into low spots”;
 - the factory and all above ground structures had by then been demolished, and areas of hardstanding had been broken up and either removed from site (bituminous materials) or crushed and used as backfill; and
 - buried structures, including foundations and services, had, as far as practical, generally been broken out to a depth of 3m below ground level (bgl).
- The chemical testing described in the report would today be considered to be inappropriate, both in its scope and in terms of the methodology used; for example, the testing would not be MCERTS accredited, which is a prerequisite for all modern day chemical soil testing when assessing risk to human health.

Given the above constraints, the Travers Morgan report is not considered further in this assessment.

2.6 ESI Phase 2 Contaminated Land Investigation Report

The ESI ground investigation took place in October 2012, and involved the excavation of a total of 38 trial pits (as shown on Drawing 14656/D004, presented at Appendix A of this report). Of these, 24 were located within the development footprint of the prison.

Laboratory chemical testing was undertaken on a total of 33 soil samples recovered during the investigation, 8 of which were recovered from Area 1.

A further 5 soil samples were tested for the presence of explosive residues, including nitroglycerine, nitrocellulose and picrate. Four of these samples were taken from trial pits excavated within the development footprint of the prison, 3 of which were from Area 1.

Testing was also on groundwater samples recovered from 4 of the pits, although none of these were located within the development footprint of the prison.

The key findings of the ESI investigation are summarised below.

2.6.1 Ground Conditions

Made Ground

The ESI investigation recorded Made Ground at 33 of the 38 trial pits locations, being absent only in TP8, TP9, TP11 and TP12, all of which were located in the west of the site and outwith the development footprint of the prison, and at TP35, located within the proposed Expansion Zone in the southwest of the development (Area 1).

With the exception of TP35, the Made Ground within the development footprint was found to vary in thickness from 0.3m at TP6 to >1.2m at TP20 and TP23, with the latter trial pit being located within Area 1.



The Made Ground was described as typically consisting of red-brown clayey sand or sandy clay with gravel containing fragments of demolition rubble (bricks, concrete etc.) and locally included fragments of plastic, plaster, charcoal, metal, glass, ash and ceramics. At 7 locations within the development footprint, including TP5 in Area 1, the Made Ground was noted to contain significant amounts of demolition rubble and associated materials; however, it may be noted that in all 7 locations the Made Ground was relatively thin, ranging in thickness from 0.45m to 1.3m.

Alluvium

Material interpreted as representing Alluvium was recorded at 10 locations within the development footprint, with 5 of those locations being in the Expansion Zone in the southwest of the site.

The Alluvium was described as typically comprising orange-red mottled grey sands, silts and clays with rare gravel. Where present, the top of the Alluvium was recorded beneath the Made Ground at depths of between 0.25m and 1.3m bgl, and locally extended down to depths in excess of 1.4m bgl.

Glacial Till

The Glacial Till was encountered at 10 locations within the development footprint where the Made Ground and / or Alluvium was fully penetrated, and typically comprised firm to stiff red-brown clay with occasional gravel and cobbles. Depths to the top of the Glacial Till in the development footprint ranged from 0.3m to 0.9m bgl, with those specifically in Area 1 (6 of the locations) ranging from 0.3m to 0.8m bgl

2.6.2 Contamination Testing

The results of the chemical soil testing carried out by ESI can be summarised as follows:

- Low concentrations of metals were recorded in the Made Ground;
- Low concentrations of more environmentally persistent petroleum hydrocarbons were observed locally;
- Low concentrations of various PAH compounds were detected in approximately 33% of the samples tested;
- All other volatile organic compounds and semi-volatile organic compounds (VOCs and SVOCs) were less than their relevant laboratory limits of detection;
- All explosive compounds tested for were less than their relevant laboratory limits of detection; and
- No asbestos fibres were detected in any of the soil samples tested.

Given the significant thickness (c.40m) of low permeability clays underlying the site, the ESI report concluded that the low concentrations of some contaminants recorded in the shallow groundwater are unlikely to pose a risk to controlled waters.



Further assessment of the chemical soil testing results from the ESI investigation is undertaken in Section 3.0 of this report.

2.7 2013 WYG Investigation

The WYG investigation took place in November 2013 and the data acquired was presented in a Factual Report dated 14/01/2014. The WYG investigation included the following:

- The mechanical excavation of 18 trial pits, with in situ plate bearing and CBR testing at 6 of the trial pit locations;
- The mechanical excavation of a further 12 trial pits;
- The drilling of 19 boreholes with in situ geotechnical testing and 50mm diameter gas and groundwater monitoring standpipes in each borehole;
- The hand-excavation of 4 shallow pits;
- Laboratory soil and groundwater testing; and
- Gas and groundwater level monitoring.

All but 2 of the WYG exploratory holes, WYG TP10 and WYG BH1, were located within the development footprint of the prison, with 12 of the trial pits and 4 of the boreholes being specifically located within Area 1.

The findings of the WYG are summarised below.

2.7.1 Ground Conditions

Made Ground

Made Ground was recorded at surface at all locations except WYGBH2 and WYGTP11, where 0.2m of topsoil was found to directly overlie the Glacial Till.

The Made Ground predominantly comprised clay with varying amounts of sand and gravel, and locally also included cobbles and boulders. The sand locally included ash. Gravel and cobble components were predominantly brick, concrete, sandstone and mudstone, but locally also included metal, plastic, ceramic, clinker, limestone and coal. The boulders included concrete, sandstone and mudstone.

At 7 locations (WYGBH9, WYGBH10, WYGBH10A, WYGBH17, WYGTP7, WYGTP8 and WYGTP20) the Made Ground was represented by gravelly sand or sandy gravel with varying amounts of cobbles. The gravel component predominantly comprised brick, concrete, sandstone and mudstone, and locally also included plastic, metal, limestone and coal.

Where the base of the Made Ground was proven it was found to range in thickness from 0.2m to 2.2m. However, at one location, WYGBH10, the borehole was terminated within the Made Ground at a depth of 4.6m bgl.

In Area 1 the Made Ground varied in thickness from 0.2m to 0.8m.



Alluvium

Material interpreted as representing Alluvium was recorded at 2 locations, namely WYGTP14 and WYGTP15, both of which were located in the Expansion Zone in the southwest of the development footprint. The Alluvium was described as comprising slightly clayey, fine or fine to medium sand.

Glacial Till

The Glacial Till was recorded at all locations where the Made Ground and Alluvium was fully penetrated, at depths ranging from 0.15m to 2.2m bgl across the development footprint generally and at depths of 0.2m to 0.8m bgl in Area 1.

The Glacial Till was indicated on the WYG logs to comprise firm to stiff, silty clay with varying amounts of gravel and localised lenses of clayey gravel or clayey sand.

Groundwater

Perched water was frequently encountered within the shallow Made Ground across the development site. Groundwater was generally absent, but where it was encountered within the Glacial Till the strikes were recorded at depths of between 2.3m and 13.0m bgl.

2.7.2 Asbestos

Asbestos containing materials or loose asbestos fibres were recorded in a number of the soil samples recovered from the development area, as summarised in Table 2.8. The locations are shown on Drawing 14656/D004 in Appendix A (note: for Issue 2 of this report this drawing has been updated to include all site investigation locations completed as at 19 September 2014).

Table 2.8: Asbestos, WYG 2013 Investigation

Location	Depth (m bgl)	Asbestos Results	Level
WYG BH9	0.5	Amosite, chrysotile	Quantifiable
	1.0	Amosite, chrysotile	Quantifiable
WYG BH17	0.2	Chrysotile	Trace
WYG BH10	1.0	Chrysotile	Quantifiable
WYG BH10A	0.5	Chrysotile	Quantifiable
	1.0	Amosite, chrysotile	Quantifiable
WYG BH12	0.5	Chrysotile	Trace
WYG TP17	0.5	Chrysotile	Quantifiable
	1.0	Chrysotile	Trace
WYG BH13	0.5	Chrysotile	Quantifiable
WYG BH14	1.0	Chrysotile	Quantifiable



Location	Depth (m bgl)	Asbestos Results	Level
WYG BH19	0.3	Chrysotile	Quantifiable
WYG HDP1	0.5	Chrysotile	Quantifiable
WYG HDP3	0.5	Chrysotile	Quantifiable
WYG HDP4	0.5	Chrysotile	Quantifiable

2.7.3 Chemical Testing Results

The chemical testing results obtained by WYG during their 2013 site investigation and that are relevant to Area 1 are assessed in Section 3.0.

2.8 Hydrock August 2014 Ground Investigation

At the time of writing ground investigation works are ongoing at the site, under the supervision of Hydrock.

However, a preliminary ground investigation was undertaken by Hydrock across the development area during August 2014. The findings of that preliminary investigation, which comprised the mechanical excavation of 30 trial pits and the drilling of 15 cable percussive boreholes, with gas and groundwater monitoring standpipes in 10 of the boreholes, are summarised below. All exploratory holes were located within the prison development area.

It may be noted that as the locations of the Hydrock exploratory holes were instructed by Tarmac Property Services (TPS) the August 2014 exploratory holes have been prefixed "TPS".

2.8.1 Ground Conditions

Made Ground

Made Ground was recorded at all locations across the development footprint to depths of between 0.1m and >2.8m bgl, with the Made Ground thickness across Area 1 specifically ranging from 0.2m to >2.1m bgl.

The Made Ground was found to comprise sandy clay, locally a very clayey sand, with varying amounts of gravel comprising brick, concrete and sandstone, and locally also including metal and wood, and occasional cobbles of brick and concrete.

Alluvium

Alluvium, comprising firm, brown grey and green, silty, sandy clay was recorded at a single location at the southern corner of the Expansion Zone (TPS TP03) from a depth of 0.2m to 0.7m bgl.

Glacial Till

The Glacial Till was recorded at all locations where the Made Ground and Alluvium was fully penetrated, and comprised firm to very stiff, silty clay with pockets of siltstone. The top of the



Glacial Till was intercepted at depths of between 0.1m and 2.6m bgl across the development area generally, and between 0.2m and 2.4m bgl in Area 1 specifically.

Groundwater

No groundwater was encountered during the excavation / drilling of the exploratory holes.

2.8.2 Asbestos

During the site-wide August 2014 Hydrock investigation a number of the soil samples tested were found to contain asbestos containing materials or loose asbestos fibres. A sample recovered from TPS TP29, located in the area of the proposed car park in the northwest of the site (i.e. in Area 1) did not show visual evidence of asbestos fibres but subsequent testing proved it to contain 0.002 % w/w asbestos (initially identified as chrysotile but subsequently identified by a specialist laboratory as being amosite).

In another instance (Hydrock TP12, also in Area 1), an apparent visual occurrence of asbestos fibres in the trial pit was later shown by testing (on the fibrous material) not to be ACM.

The occurrence of asbestos (as confirmed by later laboratory testing) recorded during the Hydrock August 2014 investigation is summarised in Table 2.9.

Table 2.9: Asbestos, Hydrock August 2014 Investigation

Location	Depth (m bgl)	Asbestos Results	Level
TPS TP29 (Area 1)	0.3	Amosite	0.002% w/w
TPS TP05	1.0	Chrysotile	Detected
TPS TP16	0.1	Chrysotile	Detected
TPS TP18	0.3	Chrysotile, amosite	Detected
TPS TP19	0.3	Chrysotile	Detected
TPS TP22	0.2	Chrysotile	Detected
TPS TP24	0.4	Chrysotile, amosite	<0.001% w/w
TPS TP25	0.5	Chrysotile, amosite	0.002% w/w
TPS TP30	0.3	Chrysotile	<0.001% w/w



3.0 LAND QUALITY ASSESSMENT FOR AREA 1

3.1 Conceptual Model

The various phases of ground investigation undertaken across the development area by ESI (2012), WYG (2013) and Hydrock August 2014, ongoing) has recorded Made Ground across almost all the prison footprint. The thickness of the Made Ground was variable, with deeper Made Ground (>4.6m bgl) being recorded in the northeastern part of the site formerly occupied by the factory building.

The Made Ground typically comprised sandy clay with varying amounts of gravel and cobbles of brick, concrete, sandstone and mudstone. Locally, the Made Ground also included fragments of metal, plastic, timber, clinker, limestone, coal and ceramic, as well as boulders of concrete, sandstone and mudstone.

At 7 of the WYG locations the Made Ground was represented by gravelly sand or sandy gravel with varying amounts of cobbles. The gravel at these locations component predominantly comprised brick, concrete, sandstone and mudstone, and locally also included plastic, metal, limestone and coal.

At 12 locations within the development area where the Made Ground was penetrated it was found to overlie Alluvium, typically comprising sandy, clay.

The top of the Glacial Till was intercepted at all locations where the base of the Made Ground and Alluvium was fully penetrated, at depths of between 0.1m and 2.6m bgl across the development area generally, and depths of between 0.2m and 2.4m bgl in Area 1.

3.2 Preliminary Exposure Model

The preliminary exposure model is used for geo-environmental hazard identification and establishing potential contaminant linkages in line with the Statutory Guidance to Part 2A of the Environmental Protection Act 1990, also known as 'potential pollution linkages' in the Model Procedures of CLR11 (Environment Agency, 2004). This is based on the contaminant-pathway-receptor linkage approach.

3.2.1 Potential Contaminants

- Elevated concentrations of metals and polycyclic aromatic hydrocarbons (PAHs) in the shallow Made Ground;
- Asbestos containing materials and loose asbestos fibres in the shallow Made Ground;
- Possible elevated concentrations of metals within the natural soils.

Previous investigations have not identified significant petroleum hydrocarbon, SVOC or VOC contamination of the shallow soils at the site, and these contaminants are not considered further.

3.2.2 Potential Receptors

- Humans (site end-users and users of neighbouring premises);



- Development end use (buildings, utilities and landscaping);
- Surface water: various ponds to the southeast of the site and the River Clywedog 200m to the southeast.

It is assumed that the on-site drain currently running through the east of the site will be removed as part of the development, and will therefore not constitute a viable receptor post-development.

Due to the significant thickness of low permeability clay underlying the site groundwater in the underlying sandstones is not considered to be at risk from the shallow soils beneath the site.

3.2.3 Potential Pathways

- Humans: ingestion, skin contact, inhalation of dust and outdoor air;
- Humans; inhalation of indoor gases or vapours;
- Plant life: root uptake;
- Surface water: overland flow;
- Surface water: drainage discharge; and
- Buildings: direct contact with substances deleterious to building materials.

3.3 Chemical Soil Quality

The end use of Area 1 may, for assessment purposes, be approximated by a commercial end use.

The results of the chemical testing undertaken on samples of soil recovered from exploratory holes located in Area 1 by ESI (2012), WYG (2013) and Hydrock (August 2014) have been considered together and statistically analysed to determine the chemical quality of the Made Ground across Area 1.

The statistical analysis is presented in Appendix B and demonstrates that the shallow Made Ground does not pose a risk to site end users and is therefore chemically suitable for its intended use.

The statistics presented at Appendix B are based on three end use scenarios, Commercial, Public Open Space, and Residential with Plant Uptake, this being to allow for uncertainties in the final end use of the expansion area. It is only at two trial pits that there are exceedences of the GAC values, both applicable to the Residential with Plant Uptake scenario. However, both pits (WYG TP 03 and WYG TP 09) are located in the future car park area so the result is unimportant.

3.4 Asbestos

Testing to date has shown that the risk of encountering asbestos in Area 1 is low, with occurrences at two places only in a total area of 11.3ha. Nevertheless, additional testing of the soils in situ is ongoing and will be completed before earthworks commence in order to strengthen this conclusion.

The presence of asbestos in soils at concentrations greater than 0.001% w/w are considered to be a risk that requires mitigation and proposals to deal with this risk are presented in Section 4.



4.0 OUTLINE REMEDIATION STRATEGY

4.1 Context

The Land Quality Assessment presented in Section 4 shows that the only potentially unacceptable risks associated with Area 1 are those associated with asbestos. Those risks need to be assessed in the context of:

- The end use of the north-western part of Area 1 as either car parking or other forms of built environment;
- The end use of the south-western part of Area 1 as an expansion area, that an area to be left as grassed open space until such time as there is a requirement (if any) to extend the prison area;
- The bulk earthworks requirements pertaining to Area 1 which will involve:
 - A top-soil strip;
 - Cutting material from the south-western part of Area 1; and
 - Placing the material cut from the south-western part of Area 1 and using it as fill on the north-western part of Area 1 to create new landforms.

It may be noted that testing to date has shown that the risk of encountering asbestos in Area 1 is low and that additional testing with the soils in situ is to be carried out before earthworks commence in order to strengthen that conclusion.

4.2 Outline Remediation Strategy

Risks associated with asbestos in soil relate entirely to the ability of the fibres to become airborne. Therefore, remediation is entirely related to preventing the release process from occurring and the following principles apply:

- During excavation and materials movement activities, soils will be dampened to inhibit release of fibres;
- Site operatives will be trained in respect of asbestos awareness to an extent that fully complies with the Control of Asbestos Regulations 2012.

In terms of materials placement the following criteria are proposed:

- Soils in the depth zone finished ground level to 1m depth must be characterised by 'below limit of detection' that is, < 0.001% w/w;
- Soils containing 0.1% w/w – 0.001% w/w asbestos are considered to be contaminated with asbestos and can only be re-used at depths >1m below finished ground level;
- The boundary between the clean material and the asbestos contaminated materials will be marked with a coloured geotextile to warn future groundworkers. The geotextile marker will be a distinctive, clearly visible marker membrane which separates the soils with residual asbestos >1m depth from the shallower soils. There is a general preference for placing soils



containing 0.1% w/w – 0.001% w/w asbestos where they will not be disturbed in the future. An accurate record of where such soils are placed must be kept in a health & safety file.

- Soils containing >0.1% w/w asbestos must be removed from site for disposal at an appropriate facility.
- provision will need to be made for hand picking of Asbestos Containing Materials where these are observed

These criteria have been used on similar sites to the satisfaction of the relevant local authority.

4.3 Materials Management Plan

The bulk earthworks will be carried out in accordance with a Materials Management Plan (MMP) prepared in accordance with the CI:AIRE Definition of Waste Code of Practice, signed off by a Qualified Person. The MMP will include provision for asbestos testing of soils to ensure that the criteria set out in Section 4.2 above are being met.

4.4 Validation

On completion the ground will be subject to testing to ensure that the criteria proposed in 4.2 above have been complied with. The scope of the validation testing will be agreed with the Local Authority before it is undertaken but a trial pit grid on 75m testing with asbestos testing of soils is proposed.

A Validation Report will be submitted to the Local Authority for approval on completion.



5.0 UNCERTAINTIES AND LIMITATIONS

5.1 General Comments

This report details the findings of work carried out in August 2014. The report has been prepared by Hydrock on the basis of available information obtained during the study period. Although every reasonable effort has been made to gather all relevant information, all potential environmental constraints or liabilities associated with the site may not have been revealed.

The report has been prepared for the exclusive benefit of Lend Lease and those parties designated by them for the purpose of providing geotechnical and geo-environmental recommendations for the site. The report contents should only be used in that context. Furthermore, new information, changed practices or new legislation may necessitate revised interpretation of the report after the date of its submission.

Hydrock has used reasonable skill, care and diligence in the design of the investigation of the site. The inherent variation of ground conditions allows only definition of the actual conditions at the locations and depths of trial pits and boreholes at the time of the investigation. At intermediate locations, conditions can only be inferred.

Groundwater findings described are only representative of the dates on which they were made and levels may vary.

Information provided by third parties has been used in good faith and is taken at face value; however, Hydrock cannot guarantee its accuracy or completeness.

The work has been carried out in general accordance with recognised best practice as detailed in guidance documents such as the CLR 11 Model Procedures (Environment Agency 2004), BS 5930:1999 +A2:2010 and BS 10175:2011+A1:2013. Important aspects of the risk assessment process are transparency and justification. Where the phrase “suitable for use” is used in this report, it is in keeping with the terminology used in planning control and does not imply any specific warranty or guarantee offered by Hydrock.

The chemical analyses reported were scheduled for the purposes of risk assessment with respect to human health as discussed in the report. Whilst the results may be useful in applying the Hazardous Waste Assessment Methodology given in Environment Agency Technical Guidance WM2, they are not primarily intended for that purpose and additional analysis may be required should waste classification be required for consideration of off-site disposal of contaminated soils. Separate analyses will be required to meet the Waste Acceptance Criteria for specific landfill sites.

Unless otherwise stated, the chemical testing carried out for this report was not scoped to comply with the requirements of the water supply company and further work may be required.

The preliminary risk assessment process may identify potential risks to site demolition and redevelopment workers. However, consideration of occupational health and safety issues is beyond the scope of this report.



Please note that notwithstanding any site observations concerning the presence or otherwise of archaeological sites or invasive weeds such as Japanese knotweed, this report does not constitute a formal survey of these potential hazards.

Any site boundary line depicted on plans does not imply legal ownership of land.



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Appendix A

Drawings

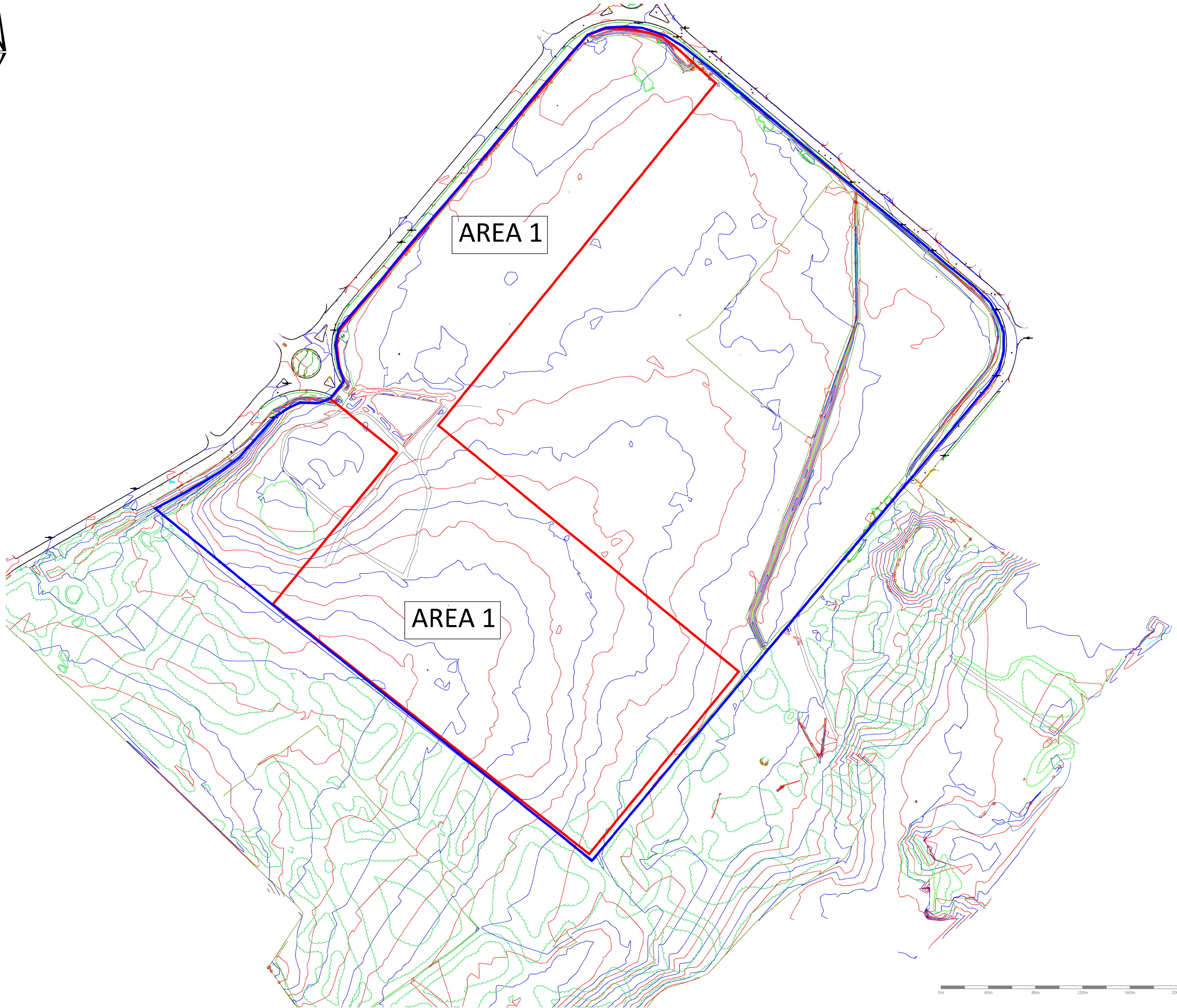
Drawings Included in this report:

C14656-D001 – Site Location Plan

C14656-D002 – Site Layout Plan

C14656-D003 – Proposed Development Plan

C14656-D004 – Ground Investigation Plan



Notes:

DEVELOPMENT FOOTPRINT AREA

AREA 1

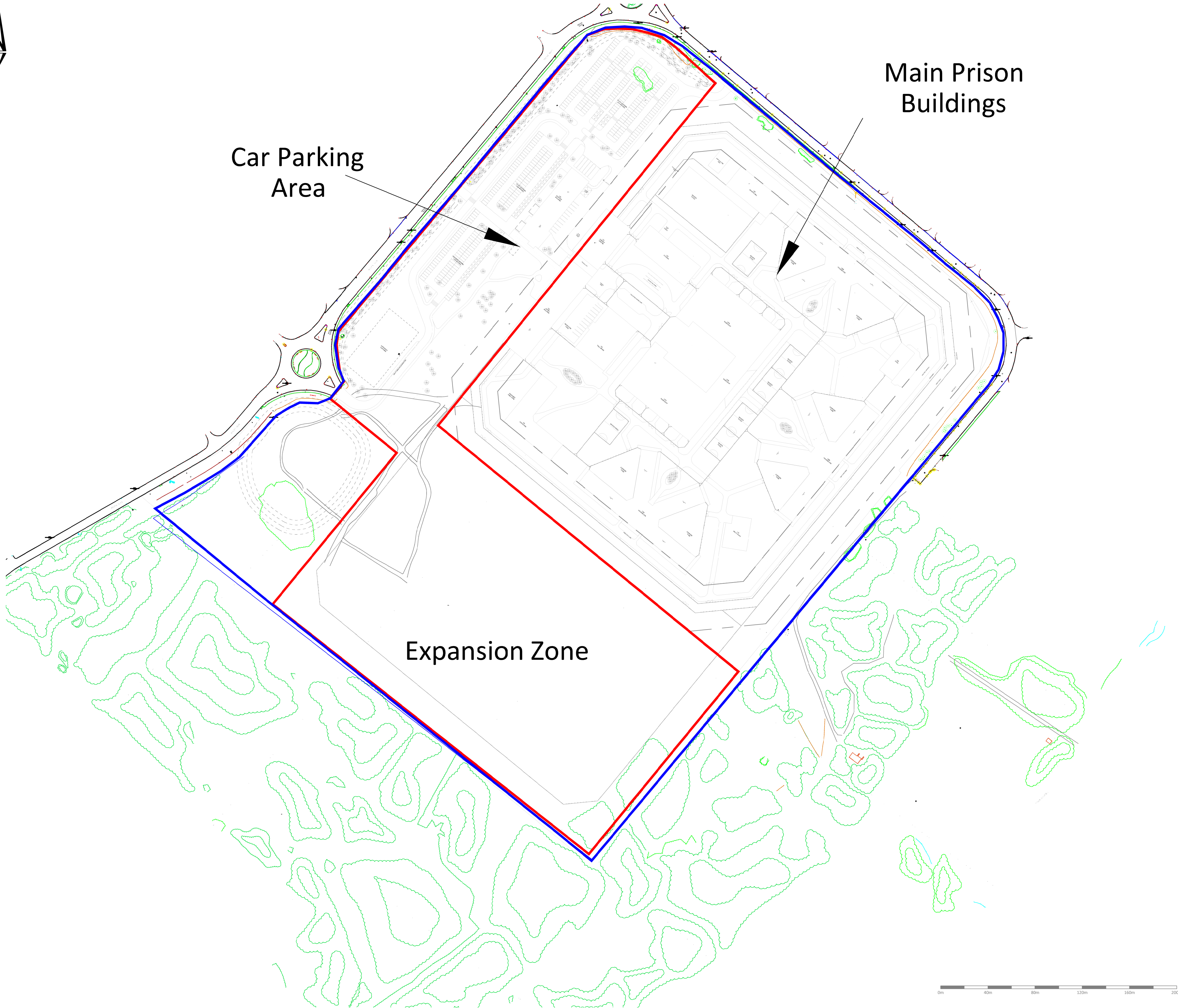
Survey Key (Major Features)

Bushes

Minor Contours (0.5m)

Major Contours (1.0m)

Rev	Date	Description	By	Ckd
Architect :				
Hydrock Hydrock Consultants Ltd 4 Lakeside Festival Park Stoke-on-Trent ST3 3RY T +44 (0)1782 261919 stoke@hydrock.com www.hydrock.com				
Client :				
LEND LEASE				
Project Title:				
NORTH WALES PRISON				
Drawing Title:				
Site Survey Plan				
Drawing Status:				
Final				
Hydrock Job No:				
C/14656				
Drawn	Checked	Scale @ A1	Date	Issue Date
RD	EC	As Shown	25/09/14	25/09/14
Drawing Number:				Revision:
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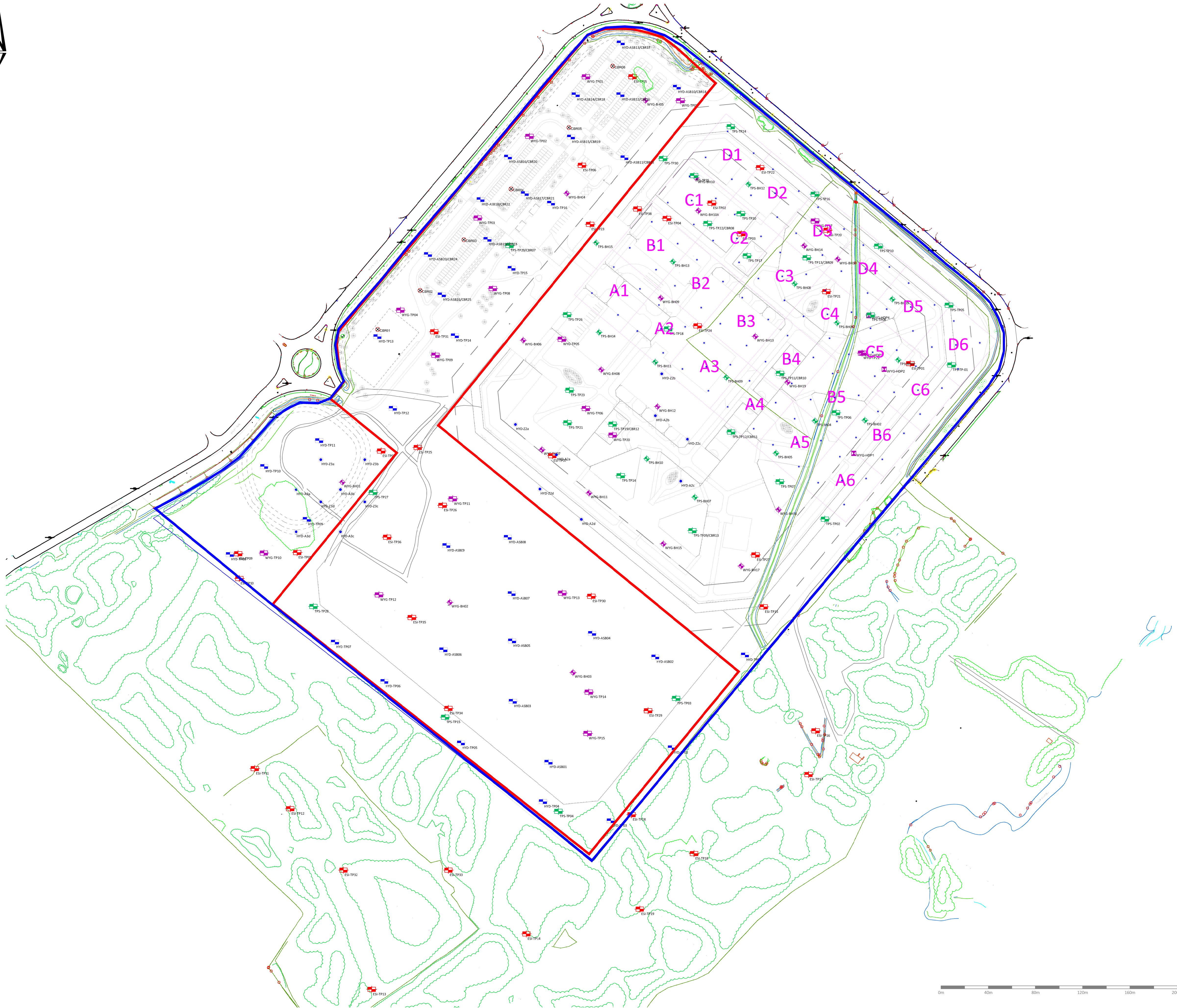
DEVELOPMENT FOOTPRINT AREA

AREA 1

Survey Key (Major Features)

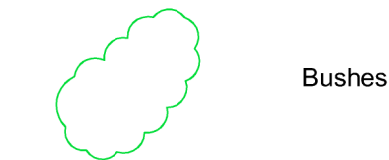
Bushes

Rev	Date	Description	By	Ckd
Architect :				
Hydrock Hydrock Consultants Ltd 4 Lakeside Festival Park Stoke-on-Trent ST3 3RY T +44 (0)1782 261919 stoke@hydrock.com www.hydrock.com				
Client :				
LEND LEASE				
Project Title:				
NORTH WALES PRISON				
Drawing Title:				
Proposed Development Plan				
Drawing Status:				
FINAL				
Hydrock Job No:				
C/14656				
Drawn	Checked	Scale @ A1	Date	Issue Date
LW	EC	As Shown	10/09/14	10/09/14
Drawing Number:				Revision:
14656/D003				-



- Notes:
- DEVELOPMENT FOOTPRINT AREA
 - AREA 1
 - HYD-E6 HYDROCK ASBESTOS TRIALPIT 2014
 - HYD-TP01 HYDROCK TRIALPIT 2014
 - HYD-ASB01 HYDROCK ADDITIONAL ASBESTOS TRIALPIT 2014
 - HYD-ASB01/CBR013 HYDROCK ADDITIONAL ASBESTOS TRIALPIT 2014 AND CBR LOCATION
 - CBR01 CBR TESTING 2014
 - TPS-TP05 TPS HYDROCK TRIAL PIT 2014
 - TPS-TP05/CBR01 TPS HYDROCK TRIAL PIT 2014 AND CBR LOCATION
 - TPS-BH07 TPS HYDROCK BOREHOLE 2014
 - WYG-TP17 WYG TRIAL PIT 2013
 - WYG-HDP2 WYG HAND-DUG PIT 2013
 - WYG-BH13 WYG BOREHOLE 2013
 - ESI-TP30 ESI TRIALPIT 2013

Survey Key (Major Features)



Rev	Date	Description	By	Ckd
Architect :				
Hydrock Hydrock Consultants Ltd 4 Lakeside Festival Park Stoke-on-Trent ST3 3RY T +44 (0)1782 261919 stoke@hydrock.com www.hydrock.com				
Client :				
LEND LEASE				
Project Title:				
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Drawing Title:				
Ground Investigation Plan				
Drawing Status:				
Final				
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C/14656				
Drawn	Checked	Scale @ A1	Date	Issue Date
RD	EC	As Shown	25/09/14	25/09/14
Drawing Number:				Revision:
14656/D004				A



Appendix B

Statistical Analysis

Assessment of Chemicals of Potential Concern to Human Health



All values in mg/kg unless otherwise stated								Soil Type	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	
								Location & Depth	WYG BH5	WYG BH4	WYG TP8	WYG TP9	WYG TP4	WYGTp1	WYGTp2	WYGTp3	WYGTp3	WYGTp7	WYG TP11	WYG BH02	WYG BH02	WYG BH03	WYG TP12	WYG TP13	WYG TP14	WYG TP15
Chemical of Potential Concern	Lab. RL	No. Samples	Min. Value	Max. Value	No. Samples > or = GAC	GAC	US ₉₅	Result of Significance Test	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.5	0.5	0.5	1	0.5	0.5	0.5	0.5	
Arsenic	1	29	2.2	20	0	640	11.49011	POTENTIALLY SUITABLE FOR USE	10.2	8.1	7.5	11.3	9.1	5.5	6.6	11.5	12.5	8.4	8.9	11.4	9.5	8.8	7.4	11.2	5	6.9
Beryllium	0.06	29	0.2	3	0	420	1.707668	POTENTIALLY SUITABLE FOR USE	1.8	1.3	0.9	1.5	1.3	0.6	0.9	2.9	3	0.6	2.2	1.4	1.2	1	0.7	2.1	0.6	0.9
Boron	0.2	29	0.2	1.4	0	190000	0.927902	POTENTIALLY SUITABLE FOR USE	1	1.1	0.4	1.4	1.2	0.6	0.7	1.3	0.8	0.2	0.9	0.8	0.9	0.4	0.6	0.8	0.3	1
Cadmium	0.2	29	0.1	1.1	0	230	0.409653	POTENTIALLY SUITABLE FOR USE	0.1	0.1	0.1	0.2	0.3	1.1	0.6	0.2	0.3	0.3	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.2
Chromium (III)	1	29	9	1005.7	0	8800	208.8753	POTENTIALLY SUITABLE FOR USE	45.1	34	23.1	35.4	32.4	13.4	25.8	64.6	1005.7	14.8	58	41.5	32.3	22.2	18.8	50.2	12.4	23.3
Chromium (VI)	1.2	29	0.3	4	0	35	2.747445	POTENTIALLY SUITABLE FOR USE	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Copper	1	29	5.9	68	0	72000	35.16994	POTENTIALLY SUITABLE FOR USE	29	27	15	26	21	9	25	51	65	12	26	13	11	14	6	25	12	12
Lead	2	29	19	180	0	2330	95.09895	POTENTIALLY SUITABLE FOR USE	25	94	23	179	60	45	57	24	26	19	32	33	32	42	51	29	44	
Mercury, inorganic	0.3	29	0.1	1.3	0	3600	0.396918	POTENTIALLY SUITABLE FOR USE	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Nickel	2	29	6.2	68.4	0	1800	42.00446	POTENTIALLY SUITABLE FOR USE	53.6	36.2	30.7	37.4	35.3	13.6	24.4	52.4	46.8	18.8	68.4	36.2	28	20	15.6	55	14.7	20.2
Selenium	1	29	1	2.3	0	13000	1.456286	POTENTIALLY SUITABLE FOR USE	1	1	1	1	1	1	1	1	2	1	2	2	1	1	1	1	1	1
Vanadium	1	29	14	149	0	3200	58.34172	POTENTIALLY SUITABLE FOR USE	53	42	28	46	39	16	35	55	149	18	65	53	43	25	24	55	14	29
Zinc	2	29	39	155	0	670000	102.8364	POTENTIALLY SUITABLE FOR USE	96	112	73	123	104	155	108	50	65	55	106	98	78	58	49	101	44	98
Cyanide (free)	1	21	0.5	1	0	16000	0.742005	POTENTIALLY SUITABLE FOR USE	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Phenol (total)	2	29	0.0099	2	0	3200	1.560427	POTENTIALLY SUITABLE FOR USE	0.01	0.0099	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Acenaphthene	0.05	25	0.05	0.21	0	85000	0.102585	POTENTIALLY SUITABLE FOR USE	0.05	0.05	0.05	0.21	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
Acenaphthylene	0.05	25	0.03	0.2	0	84000	0.121496	POTENTIALLY SUITABLE FOR USE	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	
Anthracene	0.05	25	0.04	0.56	0	520000	0.168405	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.56	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Benzo(a)anthracene	0.05	25	0.06	1.22	0	89	0.360124	POTENTIALLY SUITABLE FOR USE	0.06	0.06	0.06	1.22	0.06	0.08	0.12	0.09	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Benzo(a)pyrene	0.05	25	0.04	0.95	0	14	0.269054	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.95	0.04	0.05	0.07	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Benzo(b)fluoranthene	0.05	25	0.05	1.14	0	100	0.323538	POTENTIALLY SUITABLE FOR USE	0.05	0.05	0.05	1.14	0.05	0.06	0.11	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Benzo(ghi)perylene	0.05	25	0.04	0.47	0	650	0.1353	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.47	0.04	0.04	0.06	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Benzo(k)fluoranthene	0.05	25	0.02	0.44	0	140	0.171243	POTENTIALLY SUITABLE FOR USE	0.02	0.02	0.02	0.44	0.02	0.02	0.04	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Chrysene	0.05	25	0.02	1.14	0	140	0.307341	POTENTIALLY SUITABLE FOR USE	0.02	0.02	0.02	1.14	0.02	0.06	0.1	0.06	0.05	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Dibenz(a,h)anthracene	0.05	25	0.04	0.2	0	13	0.127345	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.1	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Fluoranthene	0.05	25	0.03	3.31	0	23000	0.802109	POTENTIALLY SUITABLE FOR USE	0.04	0.03	0.03	3.31	0.03	0.07	0.12	0.05	0.05	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Fluorene	0.05	25	0.04	0.2	0	64000	0.128562	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.12	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Indeno(1,2,3.cd)pyrene	0.05	25	0.04	0.43	0	60	0.169827	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.43	0.04	0.04	0.06	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Naphthalene	0.05	25	0.04	0.17	0	200	0.074607	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.17	0.1	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Phenanthrene	0.05	25	0.03	1.39	0	22000	0.361501	POTENTIALLY SUITABLE FOR USE	0.03	0.03	0.03	1.39	0.03	0.03	0.04	0.03	0.1	0.06	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Pyrene	0.05	25	0.03	2.52	0	54000	0.629928	POTENTIALLY SUITABLE FOR USE	0.04	0.03	0.03	2.52	0.03	0.06	0.1	0.05	0.05	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Mean																										
FOC (dimensionless)	0.015								0.002	0.007	0.004	0.012	0.01	0.004	0.011	0.126	0.052	0.004	0.003	0.005	0.006	0.003	0.01	0.003	0.001	0.013
SOM (calculated)	2.52%								0.34%	1.21%	0.69%	2.07%	1.72%	0.69%	1.90%	21.72%	8.96%	0.69%	0.52%	0.86%	1.03%	0.52%	1.72%	0.52%	0.17%	2.24%
pH (su)	8.1								8.72	8.26	8.72	8.3	8.34	8.74	8.45	8.62	8.76	8.83	8.46	7.95	8.06	7.91	7.91	8.22	7.92	7.67
Risk parameter: Human health - commercial (1%SOM) Data set: Area 1: ESI (2012), WYG (2013) and Hydrock (August 2014) investigations combined Client: Lend Lease Site: North Wales Prison, Wrexham Job no.: C14656 Legend: Values in blue are at or below the laboratory reporting limit (where a single value is indicated) and are considered as being at the detection limit for the purposes of statistical analysis, as a conservative estimate. Values in red are equal to, or greater than, the generic assessment criterion (GAC). MG denotes Made Ground NAT denotes natural ground																										

Assessment of Chemicals of Potential Concern to Human Health



All values in mg/kg unless otherwise stated								Soil Type	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
Chemical of Potential Concern	Lab. RL	No. Samples	Min. Value	Max. Value	No. Samples > or = GAC	GAC	US ₉₅	Location & Depth	ESI TP34	ESI TP5	ESI TP6	ESI TP28	ESI TP29	ESI TP30	ESI TP31	ESI TP36	TPS TP03	TPS TP04	TPS TP29
								Result of Significance Test	0.3	0.5	0.2	0.2	0.5	0.3	0.3	0.2	0.1	0.4	0.3
Arsenic	1	29	2.2	20	0	640	11.49011	POTENTIALLY SUITABLE FOR USE	4.6	13	9	6.2	2.2	20	6.2	10	8.8	9.6	5.7
Beryllium	0.06	29	0.2	3	0	420	1.707668	POTENTIALLY SUITABLE FOR USE	0.5	1.4	0.7	0.6	0.5	1.4	0.8	0.9	0.6	0.7	0.2
Boron	0.2	29	0.2	1.4	0	190000	0.927902	POTENTIALLY SUITABLE FOR USE	0.2	0.4	0.2	0.2	0.2	0.2	0.2	0.2	1	0.4	0.2
Cadmium	0.2	29	0.1	1.1	0	230	0.409653	POTENTIALLY SUITABLE FOR USE	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.3	0.2	0.5
Chromium (III)	1	29	9	1005.7	0	8800	208.8753	POTENTIALLY SUITABLE FOR USE	9	41	37	9	10	18	27	21	16.8	22.8	14.8
Chromium (VI)	1.2	29	0.3	4	0	35	2.747445	POTENTIALLY SUITABLE FOR USE	4	4	4	4	4	4	4	4	1.2	1.2	1.2
Copper	1	29	5.9	68	0	72000	35.16994	POTENTIALLY SUITABLE FOR USE	13	25	21	15	5.9	68	28	20	22	25	19
Lead	2	29	19	180	0	2330	95.09895	POTENTIALLY SUITABLE FOR USE	40	180	170	39	25	49	20	37	50	42	140
Mercury, inorganic	0.3	29	0.1	1.3	0	3600	0.396918	POTENTIALLY SUITABLE FOR USE	0.3	0.3	0.3	0.3	0.3	1.3	0.3	0.3	0.3	0.3	0.3
Nickel	2	29	6.2	68.4	0	1800	42.00446	POTENTIALLY SUITABLE FOR USE	14	36	22	15	6.2	28	40	30	22	33	12
Selenium	1	29	1	2.3	0	13000	1.456286	POTENTIALLY SUITABLE FOR USE	1	1	1	1	1	2.3	1	1	1	1	1
Vanadium	1	29	14	149	0	3200	58.34172	POTENTIALLY SUITABLE FOR USE	15	46	40	20	16	34	31	31	23	27	15
Zinc	2	29	39	155	0	670000	102.8364	POTENTIALLY SUITABLE FOR USE	39	110	83	58	39	58	72	68	71	63	86
Cyanide (free)	1	21	0.5	1	0	16000	0.742005	POTENTIALLY SUITABLE FOR USE									1	1	1
Phenol (total)	2	29	0.0099	2	0	3200	1.569427	POTENTIALLY SUITABLE FOR USE	2	2	2	2	2	2	2	2	2	2	2
Acenaphthene	0.05	25	0.05	0.21	0	85000	0.102585	POTENTIALLY SUITABLE FOR USE	0.1		0.1	0.1	0.1				0.1	0.1	0.1
Acenaphthylene	0.05	25	0.03	0.2	0	84000	0.121496	POTENTIALLY SUITABLE FOR USE	0.2		0.2	0.2	0.2				0.1	0.1	0.1
Anthracene	0.05	25	0.04	0.56	0	520000	0.168405	POTENTIALLY SUITABLE FOR USE	0.1		0.1	0.1	0.1				0.1	0.1	0.1
Benz(a)anthracene	0.05	25	0.06	1.22	0	89	0.360124	POTENTIALLY SUITABLE FOR USE	0.2		0.2	0.2	0.2				0.38	0.22	0.1
Benzo(a)pyrene	0.05	25	0.04	0.95	0	14	0.269054	POTENTIALLY SUITABLE FOR USE	0.1		0.1	0.1	0.1				0.32	0.17	0.1
Benzo(b)fluoranthene	0.05	25	0.05	1.14	0	100	0.323538	POTENTIALLY SUITABLE FOR USE	0.1		0.1	0.1	0.1				0.43	0.18	0.1
Benzo(ghi)perylene	0.05	25	0.04	0.47	0	650	0.1353	POTENTIALLY SUITABLE FOR USE	0.05		0.05	0.05	0.05				0.05	0.05	0.05
Benzo(k)fluoranthene	0.05	25	0.02	0.44	0	140	0.171243	POTENTIALLY SUITABLE FOR USE	0.2		0.2	0.2	0.2				0.18	0.13	0.1
Chrysene	0.05	25	0.02	1.14	0	140	0.307341	POTENTIALLY SUITABLE FOR USE	0.05		0.05	0.05	0.05				0.46	0.19	0.05
Dibenz(a,h)anthracene	0.05	25	0.04	0.2	0	13	0.127345	POTENTIALLY SUITABLE FOR USE	0.2		0.2	0.2	0.2				0.1	0.1	0.1
Fluoranthene	0.05	25	0.03	3.31	0	23000	0.802109	POTENTIALLY SUITABLE FOR USE	0.2		0.2	0.2	0.2				0.65	0.22	0.1
Fluorene	0.05	25	0.04	0.2	0	64000	0.128562	POTENTIALLY SUITABLE FOR USE	0.2		0.2	0.2	0.2				0.1	0.1	0.1
Indeno(1,2,3-cd)pyrene	0.05	25	0.04	0.43	0	60	0.169827	POTENTIALLY SUITABLE FOR USE	0.2		0.2	0.2	0.2				0.1	0.1	0.1
Naphthalene	0.05	25	0.04	0.17	0	200	0.074607	POTENTIALLY SUITABLE FOR USE	0.05		0.05	0.05	0.05				0.05	0.05	0.05
Phenanthrene	0.05	25	0.03	1.39	0	22000	0.361501	POTENTIALLY SUITABLE FOR USE	0.2		0.2	0.2	0.2				0.12	0.1	0.1
Pyrene	0.05	25	0.03	2.52	0	54000	0.629928	POTENTIALLY SUITABLE FOR USE	0.2		0.2	0.2	0.2				0.57	0.22	0.1
Mean																			
FOC (dimensionless)	0.015								0.0092	0.028	0.011	0.0096	0.001	0.015	0.0007	0.042	0.02	0.0048	0.0073
SOM (calculated)	2.52%								1.59%	4.83%	1.90%	1.66%	0.17%	2.59%	0.12%	7.24%	3.45%	0.83%	1.26%
pH (su)	8.1								7.3	8.1	7.9	8.4	7	7.6	7.9	8.4	6.8	7.3	7.9
Risk parameter: Human health - commercial (1%SOM) Data set: Area 1: ESI (2012), WYG (2013) and Hydrock (August 2014) investigations combined Client: Lend Lease Site: North Wales Prison, Wrexham Job no.: C14656																			

Assessment of Chemicals of Potential Concern to Human Health

All values in mg/kg unless otherwise stated								Soil Type	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
Chemical of Potential Concern	Lab. RL	No. Samples	Min. Value	Max. Value	No. Samples > or = GAC	GAC	US ₉₅	Location & Depth	WYG BH5	WYG BH4	WYG TP8	WYG TP9	WYG TP4	WYGTP1	WYGTP2	WYGTP3	WYGTP3	WYGTP7	WYG TP11	WYG BH02	WYG BH02
								Result of Significance Test	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Arsenic	1	29	2.2	20	0	79	11.490108	POTENTIALLY SUITABLE FOR USE	10.2	8.1	7.5	11.3	9.1	5.5	6.6	11.5	12.5	8.4	8.9	11.4	9.5
Beryllium	0.06	29	0.2	3	0	93	1.7076677	POTENTIALLY SUITABLE FOR USE	1.8	1.3	0.9	1.5	1.3	0.6	0.9	2.9	3	0.6	2.2	1.4	1.2
Boron	0.2	29	0.2	1.4	0	21000	0.9279023	POTENTIALLY SUITABLE FOR USE	1	1.1	0.4	1.4	1.2	0.6	0.7	1.3	0.8	0.2	0.9	0.8	0.9
Cadmium	0.2	29	0.1	1.1	0	120	0.4096529	POTENTIALLY SUITABLE FOR USE	0.1	0.1	0.1	0.2	0.3	1.1	0.6	0.2	0.3	0.3	0.1	0.1	0.1
Chromium (III)	1	29	9	1005.7	0	1500	208.87534	POTENTIALLY SUITABLE FOR USE	45.1	34	23.1	35.4	32.4	13.4	25.8	64.6	1005.7	14.8	58	41.5	32.3
Chromium (VI)	1.2	29	0.3	4	0	7.7	2.7474446	POTENTIALLY SUITABLE FOR USE	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Copper	1	29	5.9	68	0	12000	35.169944	POTENTIALLY SUITABLE FOR USE	29	27	15	29	21	9	25	51	65	12	26	13	11
Lead	2	29	19	180	0	630	95.098954	POTENTIALLY SUITABLE FOR USE	25	94	23	179	60	45	57	24	26	19	19	32	33
Mercury, inorganic	0.3	29	0.1	1.3	0	470	0.3969179	POTENTIALLY SUITABLE FOR USE	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Nickel	2	29	6.2	68.4	0	290	42.004456	POTENTIALLY SUITABLE FOR USE	53.6	36.2	30.7	37.4	35.3	13.6	24.4	52.4	46.8	18.8	68.4	36.2	28
Selenium	1	29	1	2.3	0	1400	1.4562863	POTENTIALLY SUITABLE FOR USE	1	1	1	1	1	1	1	1	2	1	2	2	1
Vanadium	1	29	14	149	0	440	58.341715	POTENTIALLY SUITABLE FOR USE	53	42	28	46	39	16	35	55	149	18	65	53	43
Zinc	2	29	39	155	0	81000	102.83637	POTENTIALLY SUITABLE FOR USE	96	112	73	123	104	155	108	50	65	55	106	98	78
Cyanide (free)	1	21	0.5	1	0	1600	0.742005	POTENTIALLY SUITABLE FOR USE	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Phenol (total)	2	29	0.0099	2	0	3200	1.560427	POTENTIALLY SUITABLE FOR USE	0.01	0.0099	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Acenaphthene	0.05	25	0.05	0.21	0	15000	0.1025853	POTENTIALLY SUITABLE FOR USE	0.05	0.05	0.05	0.21	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Acenaphthylene	0.05	25	0.03	0.2	0	15000	0.1214965	POTENTIALLY SUITABLE FOR USE	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Anthracene	0.05	25	0.04	0.56	0	74000	0.1684053	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.56	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Benzo(a)anthracene	0.05	25	0.06	1.22	0	18	0.3601236	POTENTIALLY SUITABLE FOR USE	0.06	0.06	0.06	1.22	0.06	0.08	0.12	0.09	0.07	0.06	0.06	0.06	0.06
Benzo(a)pyrene	0.05	25	0.04	0.95	0	2.6	0.2690545	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.95	0.04	0.05	0.07	0.05	0.04	0.04	0.04	0.04	0.04
Benzo(b)fluoranthene	0.05	25	0.05	1.14	0	18	0.3235375	POTENTIALLY SUITABLE FOR USE	0.05	0.05	0.05	1.14	0.05	0.06	0.11	0.06	0.05	0.05	0.05	0.05	0.05
Benzo(ghi)perylene	0.05	25	0.04	0.47	0	120	0.1353003	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.47	0.04	0.04	0.06	0.04	0.04	0.04	0.04	0.04	0.04
Benzo(k)fluoranthene	0.05	25	0.02	0.44	0	26	0.1712431	POTENTIALLY SUITABLE FOR USE	0.02	0.02	0.02	0.44	0.02	0.02	0.04	0.03	0.02	0.02	0.02	0.02	0.02
Chrysene	0.05	25	0.02	1.14	0	26	0.3073412	POTENTIALLY SUITABLE FOR USE	0.02	0.02	0.02	1.14	0.02	0.06	0.1	0.06	0.05	0.02	0.02	0.02	0.02
Dibenz(a,h)anthracene	0.05	25	0.04	0.2	0	2.3	0.1273453	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.2	0.1	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Fluoranthene	0.05	25	0.03	3.31	0	3100	0.8021093	POTENTIALLY SUITABLE FOR USE	0.04	0.03	0.03	3.31	0.03	0.07	0.12	0.05	0.05	0.03	0.03	0.03	0.03
Fluorene	0.05	25	0.04	0.2	0	9900	0.1285617	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.12	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Indeno(1,2,3-cd)pyrene	0.05	25	0.04	0.43	0	11	0.1696274	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.43	0.04	0.04	0.06	0.04	0.04	0.04	0.04	0.04	0.04
Naphthalene	0.05	25	0.04	0.17	0	4100	0.0746075	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.17	0.1	0.04	0.04	0.04	0.04
Phenanthrene	0.05	25	0.03	1.39	0	3100	0.3615013	POTENTIALLY SUITABLE FOR USE	0.03	0.03	0.03	1.39	0.03	0.04	0.03	0.1	0.06	0.03	0.03	0.03	0.03
Pyrene	0.05	25	0.03	2.52	0	7400	0.629928	POTENTIALLY SUITABLE FOR USE	0.04	0.03	0.03	2.52	0.03	0.06	0.1	0.05	0.05	0.03	0.03	0.03	0.03
	Mean																				
FOC (dimensionless)	0.015								0.002	0.007	0.004	0.012	0.01	0.004	0.011	0.126	0.052	0.004	0.003	0.005	0.006
SOM (calculated)	2.52%								0.34%	1.21%	0.69%	2.07%	1.72%	0.69%	1.90%	21.72%	8.96%	0.69%	0.52%	0.86%	1.03%
pH (su)	8.1								8.72	8.26	8.72	8.3	8.34	8.74	8.45	8.62	8.76	8.83	8.46	7.95	8.06
Risk parameter: Human health - POS resi (2.5%SOM)																					
Data set: Area 1: ESI (2012), WYG (2013) and Hydrock (August 2014) investigations combined																					
Client: Lend Lease																					
Site: North Wales Prison, Wrexham																					
Job no.: C14656																					
Legend: Values in blue are at or below the laboratory reporting limit (where a single value is indicated) and are considered as being at the detection limit for the purposes of statistical analysis, as a conservative estimate. Values in red are equal to, or greater than, the generic assessment criterion (GAC). MG denotes Made Ground NAT denotes natural ground																					

Hydrock

Risk parameter: [Human health - POS resi \(2.5%SOM\)](#)
Data set: Area 1: ESI (2012), WYG (2013) and Hydrock (August 2014) investigations combined
Client: Lend Lease
Site: North Wales Prison, Wrexham
Job no.: C14656

Assessment of Chemicals of Potential Concern to Human Health

All values in mg/kg unless otherwise stated								Soil Type	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
Chemical of Potential Concern	Lab. RL	No. Samples	Min. Value	Max. Value	No. Samples > or = GAC	GAC	US _{SL}	Location & Depth	WYG BH5	WYG BH4	WYG TP8	WYG TP9	WYG TP4	WYGTP1	WYGTP2	WYGTP3	WYGTP3	WYGTP7	WYG TP11	WYG BH02	WYG BH02	WYG BH03
								0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Result of Significance Test																						
Arsenic	1	29	2.2	20	0	32	11.490108	POTENTIALLY SUITABLE FOR USE	10.2	8.1	7.5	11.3	9.1	5.5	6.6	11.5	12.5	8.4	8.9	11.4	9.5	8.8
Beryllium	0.06	29	0.2	3	0	51	1.7076677	POTENTIALLY SUITABLE FOR USE	1.8	1.3	0.9	1.5	1.3	0.6	0.9	2.9	3	0.6	2.2	1.4	1.2	1
Boron	0.2	29	0.2	1.4	0	290	0.9279023	POTENTIALLY SUITABLE FOR USE	1	1.1	0.4	1.4	1.2	0.6	0.7	1.3	0.8	0.2	0.9	0.8	0.9	0.4
Cadmium	0.2	29	0.1	1.1	0	11	0.4096529	POTENTIALLY SUITABLE FOR USE	0.1	0.1	0.1	0.2	0.3	1.1	0.6	0.2	0.3	0.3	0.1	0.1	0.1	0.2
Chromium (III)	1	29	9	1005.7	1	630	208.87534	POTENTIALLY SUITABLE FOR USE	45.1	34	23.1	35.4	32.4	13.4	25.8	64.6	1005.7	14.8	58	41.5	32.3	22.2
Chromium (VI)	1.2	29	0.3	4	0	4.3	2.7474446	POTENTIALLY SUITABLE FOR USE	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Copper	1	29	5.9	68	0	2300	35.169944	POTENTIALLY SUITABLE FOR USE	29	27	15	29	21	9	25	51	65	12	26	13	11	14
Lead	2	29	19	180	0	200	95.098954	POTENTIALLY SUITABLE FOR USE	25	94	23	179	60	45	57	24	26	19	19	32	33	32
Mercury, inorganic	0.3	29	0.1	1.3	0	170	0.3969179	POTENTIALLY SUITABLE FOR USE	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Nickel	2	29	6.2	68.4	0	130	42.004456	POTENTIALLY SUITABLE FOR USE	53.6	36.2	30.7	37.4	35.3	13.6	24.4	52.4	46.8	18.8	68.4	36.2	28	20
Selenium	1	29	1	2.3	0	350	1.4562863	POTENTIALLY SUITABLE FOR USE	1	1	1	1	1	1	1	1	2	1	2	1	1	1
Strandium	1	29	14	149	1	74	58.341715	POTENTIALLY SUITABLE FOR USE	53	42	28	46	39	16	35	55	149	18	65	53	43	25
Zinc	2	29	39	155	0	3700	102.83637	POTENTIALLY SUITABLE FOR USE	96	112	73	123	104	155	108	50	65	55	106	98	78	58
Cyanide (free)	1	21	0.5	1	0	750	0.742005	POTENTIALLY SUITABLE FOR USE	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Phenol (total)	2	29	0.0099	2	0	290	1.560427	POTENTIALLY SUITABLE FOR USE	0.01	0.0099	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Acenaphthene	0.05	25	0.05	0.21	0	480	0.1025853	POTENTIALLY SUITABLE FOR USE	0.05	0.05	0.05	0.21	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Acenaphthylene	0.05	25	0.03	0.2	0	400	0.1214965	POTENTIALLY SUITABLE FOR USE	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Anthracene	0.05	25	0.04	0.56	0	4900	0.1684053	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.56	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Benzo(a)anthracene	0.05	25	0.06	1.22	0	4.7	0.3601236	POTENTIALLY SUITABLE FOR USE	0.06	0.06	0.06	1.22	0.06	0.08	0.12	0.09	0.07	0.06	0.06	0.06	0.06	0.06
Benzo(a)pyrene	0.05	25	0.04	0.95	1	0.94	0.2690545	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.95	0.04	0.05	0.07	0.05	0.04	0.04	0.04	0.04	0.04	0.04
Benzo(b)fluoranthene	0.05	25	0.05	1.14	0	6.5	0.3235375	POTENTIALLY SUITABLE FOR USE	0.05	0.05	0.05	1.14	0.05	0.06	0.11	0.06	0.05	0.05	0.05	0.05	0.05	0.05
Benzo(ghi)perylene	0.05	25	0.04	0.47	0	46	0.1353003	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.47	0.04	0.04	0.06	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Benzo(k)fluoranthene	0.05	25	0.02	0.44	0	9.6	0.1712431	POTENTIALLY SUITABLE FOR USE	0.02	0.02	0.02	0.44	0.02	0.02	0.04	0.03	0.02	0.02	0.02	0.02	0.02	0.02
Chrysene	0.05	25	0.02	1.14	0	8	0.3073412	POTENTIALLY SUITABLE FOR USE	0.02	0.02	0.02	1.14	0.02	0.06	0.1	0.06	0.05	0.02	0.02	0.02	0.02	0.02
Dibenz(a,h)anthracene	0.05	25	0.04	0.2	0	0.86	0.1273453	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.1	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Fluoranthene	0.05	25	0.03	3.31	0	460	0.8021093	POTENTIALLY SUITABLE FOR USE	0.04	0.03	0.03	3.31	0.03	0.07	0.12	0.05	0.05	0.03	0.03	0.03	0.03	0.03
Fluorene	0.05	25	0.04	0.2	0	380	0.1285617	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.12	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Indeno(1,2,3-cd)pyrene	0.05	25	0.04	0.43	0	3.9	0.1698274	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.43	0.04	0.04	0.06	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Naphthalene	0.05	25	0.04	0.17	0	3.7	0.0746075	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.17	0.1	0.04	0.04	0.04	0.04	0.04
Phenanthrene	0.05	25	0.03	1.39	0	200	0.3615013	POTENTIALLY SUITABLE FOR USE	0.03	0.03	0.03	1.39	0.03	0.04	0.03	0.1	0.06	0.03	0.03	0.03	0.03	0.03
Pyrene	0.05	25	0.03	2.52	0	1000	0.629928	POTENTIALLY SUITABLE FOR USE	0.04	0.03	0.03	2.52	0.03	0.06	0.1	0.05	0.05	0.03	0.03	0.03	0.03	0.03
Mean																						
FOC (dimensionless)	0.015								0.002	0.007	0.004	0.012	0.01	0.004	0.011	0.126	0.052	0.004	0.003	0.005	0.006	0.003
SOM (calculated)	2.52%								0.34%	1.21%	0.69%	2.07%	1.72%	0.69%	1.90%	21.72%	8.96%	0.69%	0.52%	0.86%	1.03%	0.52%
pH (su)	8.1								8.72	8.26	8.72	8.3	8.34	8.74	8.45	8.62	8.76	8.83	8.46	7.95	8.06	7.91
Risk parameter: Human health - residential with plant uptake (2.5%<i>SOM</i>)																						
Data set: Area 1: ESI (2012), WYG (2013) and Hydrock (August 2014) investigations combined																						
Client: Lend Lease																						
Site: North Wales Prison, Wrexham																						
Job no.: C14656																						
Legend: Values in blue are at or below the laboratory reporting limit (where a single value is indicated) and are considered as being at the detection limit for the purposes of statistical analysis, as a conservative estimate. Values in red are equal to, or greater than, the generic assessment criterion (GAC).											MG denotes Made Ground NAT denotes natural ground											

Assessment of Chemicals of Potential Concern to Human Health

All values in mg/kg unless otherwise stated								Soil Type															
Chemical of Potential Concern	Lab. RL	No. Samples	Min. Value	Max. Value	No. Samples > or = GAC	GAC	US ₉₅	Location & Depth	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
								WYG TP12	WYG TP13	WYG TP14	WYG TP15	ESI TP34	ESI TP5	ESI TP6	ESI TP28	ESI TP29	ESI TP30	ESI TP31	ESI TP36	TPS TP03	TPS TP04	TPS TP21	
								0.5	0.5	0.5	0.5	0.3	0.5	0.2	0.2	0.5	0.3	0.3	0.2	0.1	0.4	0.3	
Result of Significance Test																							
Arsenic	1	29	2.2	20	0	32	11.490108	POTENTIALLY SUITABLE FOR USE	7.4	11.2	5	6.9	4.6	13	9	6.2	2.2	20	6.2	10	8.8	9.6	5.7
Beryllium	0.06	29	0.2	3	0	51	1.7076677	POTENTIALLY SUITABLE FOR USE	0.7	2.1	0.6	0.9	0.5	1.4	0.7	0.6	0.5	1.4	0.8	0.9	0.6	0.7	0.2
Boron	0.2	29	0.2	1.4	0	290	0.9279023	POTENTIALLY SUITABLE FOR USE	0.6	0.8	0.3	1	0.2	0.2	0.4	0.2	0.2	0.2	0.2	0.2	1	0.4	0.2
Cadmium	0.2	29	0.1	1.1	0	11	0.4096529	POTENTIALLY SUITABLE FOR USE	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.3	0.2	0.5
Chromium (III)	1	29	9	1005.7	1	630	208.87534	POTENTIALLY SUITABLE FOR USE	18.8	50.2	12.4	23.3	9	41	37	9	10	18	27	21	16.8	22.8	14.8
Chromium (VI)	1.2	29	0.3	4	0	4.3	2.7474446	POTENTIALLY SUITABLE FOR USE	0.3	0.3	0.3	0.3	4	4	4	4	4	4	4	4	1.2	1.2	1.2
Copper	1	29	5.9	68	0	2300	35.169944	POTENTIALLY SUITABLE FOR USE	6	25	12	12	13	25	21	15	5.9	68	28	20	22	25	19
Lead	2	29	19	180	0	200	95.098954	POTENTIALLY SUITABLE FOR USE	42	51	29	44	40	180	170	39	25	49	20	37	50	42	140
Mercury, inorganic	0.3	29	0.1	1.3	0	170	0.3969179	POTENTIALLY SUITABLE FOR USE	0.1	0.1	0.1	0.3	0.3	0.3	0.3	0.3	0.3	1.3	0.3	0.3	0.3	0.3	0.3
Nickel	2	29	6.2	68.4	0	130	42.004456	POTENTIALLY SUITABLE FOR USE	15.6	55	14.7	20.2	14	36	22	15	6.2	28	40	30	22	33	12
Selenium	1	29	1	2.3	0	350	1.4562863	POTENTIALLY SUITABLE FOR USE	1	1	1	1	1	1	1	1	2.3	1	1	1	1	1	1
Vanadium	1	29	14	149	1	74	58.341715	POTENTIALLY SUITABLE FOR USE	24	55	14	29	15	46	40	20	16	34	31	31	23	27	15
Zinc	2	29	39	155	0	3700	102.83637	POTENTIALLY SUITABLE FOR USE	49	101	44	98	39	110	83	58	39	58	72	68	71	63	86
Cyanide (free)	1	21	0.5	1	0	750	0.742005	POTENTIALLY SUITABLE FOR USE	0.5	0.5	0.5	0.5	0.5								1	1	1
Phenol (total)	2	29	0.0099	2	0	290	1.560427	POTENTIALLY SUITABLE FOR USE	0.01	0.01	0.01	0.01	2	2	2	2	2	2	2	2	2	2	2
Acenaphthene	0.05	25	0.05	0.21	0	480	0.1025853	POTENTIALLY SUITABLE FOR USE	0.05	0.05	0.05	0.05	0.1		0.1	0.1	0.1			0.1	0.1	0.1	
Acenaphthylene	0.05	25	0.03	0.2	0	400	0.1214965	POTENTIALLY SUITABLE FOR USE	0.03	0.03	0.03	0.03	0.2		0.2	0.2	0.2			0.1	0.1	0.1	
Anthracene	0.05	25	0.04	0.56	0	4900	0.1684053	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.04	0.1		0.1	0.1	0.1			0.1	0.1	0.1	
Benzo(a)anthracene	0.05	25	0.06	1.22	0	4.7	0.3601236	POTENTIALLY SUITABLE FOR USE	0.06	0.06	0.06	0.06	0.2		0.2	0.2	0.2			0.38	0.22	0.1	
Benzo(a)pyrene	0.05	25	0.04	0.95	1	0.94	0.2690545	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.04	0.1		0.1	0.1	0.1			0.32	0.17	0.1	
Benzo(b)fluoranthene	0.05	25	0.05	1.14	0	6.5	0.3235375	POTENTIALLY SUITABLE FOR USE	0.05	0.05	0.05	0.05	0.1		0.1	0.1	0.1			0.43	0.18	0.1	
Benzo(ghi)perylene	0.05	25	0.04	0.47	0	46	0.1353003	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.04	0.05		0.05	0.05	0.05			0.05	0.05	0.05	
Benzo(k)fluoranthene	0.05	25	0.02	0.44	0	9.6	0.1712431	POTENTIALLY SUITABLE FOR USE	0.02	0.02	0.02	0.02	0.2		0.2	0.2	0.2			0.18	0.13	0.1	
Chrysene	0.05	25	0.02	1.14	0	8	0.3073412	POTENTIALLY SUITABLE FOR USE	0.02	0.02	0.02	0.02	0.05		0.05	0.05	0.05			0.46	0.19	0.05	
Dibenz(a,h)anthracene	0.05	25	0.04	0.2	0	0.86	0.1273453	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.04	0.2		0.2	0.2	0.2			0.1	0.1	0.1	
Fluoranthene	0.05	25	0.03	3.31	0	460	0.8021093	POTENTIALLY SUITABLE FOR USE	0.03	0.03	0.03	0.03	0.2		0.2	0.2	0.2			0.65	0.22	0.1	
Fluorene	0.05	25	0.04	0.2	0	380	0.1285617	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.04	0.2		0.2	0.2	0.2			0.1	0.1	0.1	
Indeno(1,2,3-cd)pyrene	0.05	25	0.04	0.43	0	3.9	0.1698274	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.04	0.2		0.2	0.2	0.2			0.1	0.1	0.1	
Naphthalene	0.05	25	0.04	0.17	0	3.7	0.0746075	POTENTIALLY SUITABLE FOR USE	0.04	0.04	0.04	0.04	0.05		0.05	0.05	0.05			0.05	0.05	0.05	
Phenanthrene	0.05	25	0.03	1.39	0	200	0.3615013	POTENTIALLY SUITABLE FOR USE	0.03	0.03	0.03	0.03	0.2		0.2	0.2	0.2			0.12	0.1	0.1	
Pyrene	0.05	25	0.03	2.52	0	1000	0.629928	POTENTIALLY SUITABLE FOR USE	0.03	0.03	0.03	0.03	0.2		0.2	0.2	0.2			0.57	0.22	0.1	
Mean																							
FOC (dimensionless)	0.015								0.01	0.003	0.001	0.013	0.0092	0.028	0.011	0.0096	0.001	0.015	0.0007	0.042	0.02	0.0048	0.0073
SOM (calculated)	2.52%								1.72%	0.52%	0.17%	2.24%	1.59%	4.83%	1.90%	1.66%	0.17%	2.59%	0.12%	7.24%	3.45%	0.83%	1.26%
pH (su)	8.1								7.91	8.22	7.92	7.67	7.3	8.1	7.9	8.4	7	7.6	7.9	8.4	6.8	7.3	7.9
Risk parameter: Human health - residential with plant uptake (2.5%SOM)																							
Data set: Area 1: ESI (2012), WYG (2013) and Hydrock (August 2014) investigations combined																							
Client: Lend Lease																							
Site: North Wales Prison, Wrexham																							
Job no.: C14656																							

