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SCIENCE CENTRAL ENABLING WORKS

Remediation Completion Report

10/07/2014

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Remediation Completion Report

10/07/2014

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1 Project Background

1.1 Introduction

1.1.1 The Science Central site, located at the former Newcastle Brewery site, Corporation Road, Newcastle upon Tyne, has recently undergone enabling works to create a building platform for planned redevelopment by Science Central LLP for mixed use including commercial and residential. As part of the works, remediation of previously identified ground contamination was specified by Mott MacDonald (MM), Science Central LLP's Engineer for the scheme. Hall Construction Services Limited (HCSL) was appointed to undertake the works by Science Central LLP.

1.1.2 WSP was appointed as Remediation Engineer (Rem. E) to monitor the ground remediation works associated with the enabling works at the site. This report summarises the works carried out across the site and provides results of validation testing.

1.1.3 This report has been prepared for the benefit of HCSL only and is not to be relied on by third parties without the written permission of WSP. A copy of the notes and limitations for this report is provided as **Appendix A**.

1.2 Background Reports

1.2.1 The site has been subject to several ground investigations, the results of which were considered to produce the following documents, which should be read in conjunction with this report:

- Mott Macdonald Remediation Strategy ('*Science Central, Phase 1 Infrastructure and Interim Uses, Contaminated Land Remediation Strategy*', May 2011);
- Mott Macdonald Employers Requirements, ('*Science Central Enabling Works (inc. Coal Extraction), Employers Requirements'*, August 2012, Seventh Issue); and,
- WSP Remediation Method Statement ('*Science Central Enabling Works, Remediation Method Statement*', ref:000032738.001-2, October 2012,)

1.2.2 The Remediation Method Statement adopts the remedial objectives, activities and testing and acceptability criteria set out within the Remediation Strategy (which was approved by the Local Authority) and should be read in conjunction with this report.

1.2.3 This report includes all the information previously reported within the interim '*Gateway Handover Report',* Ref.00032738.004 Issue 2 12/04/2013 and therefore supersedes that document.

1.2.4 **Figure MMD-283831-C-DR-00-XX-7001** presented within **Appendix B** identifies the different areas of the site that are referred to in this report.

1.3 Ground Conditions

1.3.1 Prior to commencement of enabling works, previous ground investigations identified ground conditions at the site to comprise a surface layer of Made Ground (crushed concrete) underlain by further Made Ground of varying thickness and composition, Glacial Till and Coal Measures rock. Shallow coal seams were present, including the High Main (which outcrops in the centre of the site) and the Upper and Lower Metal Seam (located approximately 10m below the High Main).

1.3.2 The ground was recorded to be heavily disturbed due to the site's historical use. Previous ground investigations carried out by others identified localised areas of contamination when compared

against a residential with plant uptake end use or hazardous waste thresholds. These localised areas of contamination were defined in the Remediation Strategy report and are referred to as ‘hotspots’.

2 Remediation Works Proposed

2.1 Remediation Objectives

2.1.1 The following remediation objectives were outlined within the Remediation Strategy, as agreed with the Local Authority;

Remediation Objectives	Remedial Activity
Objective 1. Prevent risk of harm to human health.	Treat identified hotspots of contamination which exceed appropriate human health values.
Objective 2. Prevent generation of hazardous wastes during future construction activity.	Remove identified hotspots of contamination which exceed appropriate hazardous waste criteria.
Objective 3. Provide clean cover.	Construction of a 1.5m thick layer of surface soils suitable for residential end use.

2.1.2 These works were to be carried out as part of the main site enabling works which briefly comprised:

- Excavation of Made Ground and natural overburden to remove coal;
- Replacement and compaction of excavated overburden as engineered fill;
- Turnover of Made Ground (excavate, sort and re-compact) outwith the coal extraction area; and,
- Drilling and grouting works outside the coal extraction area.

2.1.3 Figure 1 in **Appendix B** identifies the areas within Site A that were subject to coal extraction and the areas in Sites A, B and C that were subject to turnover of the Made Ground only.

2.2 Planned Remediation Works

2.2.1 Based on the Remediation Strategy, and as outlined in detail in the WSP Remediation Method Statement, the following works were required**;**

- Removal of three contamination hot spots that exceeded human health thresholds, (WS41, BH16B and TP339) to a 5m radius and a depth of 0.5m below the identified contaminant;
- Removal of eight contamination hot spots that exceeded the hazardous waste threshold, (WS9, WS10, WS17, WS40, WS41, WS100, WS105 and BH16B) to a 2m radius and a depth of 0.5m below the identified contaminant – (note that WS41 and BH16B require removal for both hazardous waste and human health criteria); and
- Placement of 1.5m thick layer of clean cover soils at the surface.

2.2.2 In order to confirm satisfactory completion of the above works, validation testing in accordance with the validation testing criteria identified in the Employers Requirements was required. The validation testing criteria is presented in **Table C-1** in **Appendix C**.

3 Remediation Works Undertaken

3.1 Progress of Works

3.1.1 Site works began in October 2012 and were completed in March 2014. Phased handover areas were completed in stages throughout the project, beginning with the '*Gateway Handover Area*' in April 2013, '*Area B*' in September 2013 and '*The Square*' in January 2014, as indicated on **Figure 2** in **Appendix B**. WSP provided full time site monitoring during the enabling works.

3.2 Remediation of Human Health Contamination Hotspots

Three contamination hotspots were remediated, the locations of which were surveyed by the HCSL site engineer using co-ordinates from **Figure** MMD-283831-C-DR-00-XX-7004 in **Appendix B**. Excavated materials were retested and, where the results were below the validation testing criteria for clean cover soils, the material was deemed to be suitable for re-use below the clean fill layer. **Table 3.1** outlines the remedial activity carried out at each of these hotspots.

Table 3.1 – Summary of Remedial Works undertaken on Human Health Hotspots

Hotspot Identity	Contaminant of concern	Works Undertaken
TP339 @66.36m AOD	Benzo(a)pyrene, Dibenzo(ah)anthracene	Excavation of the area around hotspot TP339 began on 22 October 2012 to approximately 0.35m, removing the recycled aggregate. The recycled aggregate was stockpiled on a visqueen sheet adjacent to the excavation. The excavation continued on 24 October to a radius of 5.0m. The majority of the excavation comprised sandy gravel or gravelly sand to a depth of approximately 2.4mbgl. In the north of the excavation a pocket of clay was encountered from approximately 0.4m-1.6mbgl. The excavation was suspended at 2.4mbgl (0.5m below the identified hotspot) within weathered mudstone. The arising's were segregated and sampled accordingly– two samples (ref: Sample 2SW, Sample 3C) were taken of the sandy gravel/gravelly sand and one of the clay (Sample 1). These samples were tested for the contaminants of concern. All three samples recorded concentrations that exceeded the validation testing criteria and the material was subsequently disposed of offsite by HCSL. Two validation samples (Ref. Base 1 SE and Base 2 NW) were taken from the base of the dig and four validation samples (Ref. Side Wall NW, Side Wall South, Side Wall West and Side Wall East) were taken

Hotspot Identity	Contaminant of concern	Works Undertaken
		from the side walls. These six validation samples were tested for the contaminants of concern. Results were below the validation testing criteria and therefore no further excavation was undertaken.
WS41 @ 69.12m AOD	Lead	Hotspot WS41 was excavated on 26 October 2012 to a radius of 5.0m. The excavation comprised 6F2 recycled aggregate from ground level to 0.4mbgl underneath which was heavily disturbed gravelly clay (Glacial Till) with pockets of Made Ground (sandy gravelly clay). The excavation encountered sandstone bedrock at approximately 0.9m and was extended locally to a maximum depth of 1.2m bgl. In this area the ground was heavily disturbed, likely to be associated with the worked High Main seam. Two service trenches comprising loose backfilled gravel trended north to south and east to west through the centre of the excavation at approximately 0.9m. Material removed was stockpiled on visqueen surrounding the excavation. Samples were taken of the gravel (Sample 1), the sandy gravelly clay (Sample 2) and the disturbed clay (Sample 3) and tested for the contaminant of concern. All samples recorded concentrations below the validation testing criteria and were therefore re-used as general fill, below the 1.5m clean cover layer. Two validation samples were taken from the base (Ref. WS41 Base 1 SE and WS41 Base 2 N) and four from the side walls (Ref. WS41 Side Wall 1N, WS41 Side Wall 2E, WS41 Side Wall 3SE and WS41 Side Wall 4NW). All results were below the validation testing criteria and therefore no further excavation was undertaken.
BH16B @ 74.94m AOD	Benzo(a)pyrene	The area of hotspot BH16B was excavated on 01 November 2012 to a radius of 5.0m. Ground conditions were heavily disturbed due to a basement wall and localised areas of historical backfill. Generally, the Made Ground comprised 6F2, overlying clayey sand and clay. The excavation was extended to a depth of 1.8m, 0.5m below the previously identified contaminated material. Material was stockpiled on visqueen surrounding the excavation. The excavated material was segregated into stockpiles of clayey sand and clay and a sample was taken of each (Sample ref. BH16B Sample 1, 0.9m and BH16B Sample 2, 1.50m respectively) and tested for the

Hotspot Identity	Contaminant of concern	Works Undertaken
		contaminant of concern. The analysis for the clayey sand (BH16B sample 1 0.9m) identified elevated levels of Benzo(a)pyrene so was removed off site by HCSL. The analysis of the clay sample (BH16B sample 2, 1.50m) recorded concentrations to be below the validation testing criteria and this material was re-used on site below the 1.5m clean cover layer. Two validation samples were taken from the base (Ref. BH16B Base 1S and BH16B Base 2N) and four from the side walls (Ref. BH16B Sidewall 1E, BH16B Sidewall 2N, Sidewall 3NW and Sidewall 4SW) of the excavation to test for the contaminant of concern. Results were below the validation testing criteria and therefore no further excavation was undertaken.

3.2.1 The results of the validation testing carried out associated with the remediation of the human health and hazardous waste contamination hotspots are provided as **Appendix H**. Photographs taken during the remediation of each hotspot removed are included in **Appendix B**.

3.3 Removal of Hazardous Waste Contamination Hotspots

3.3.1 Eight contamination hotspots were removed in order to mitigate the risk posed by soil previously shown to exceed hazardous waste limits. Excavated materials were retested and, where the results were below the validation testing criteria for clean cover soils, the material was deemed to be suitable for re-use below the clean fill layer. No validation testing of the resultant excavation was required in the Employers Requirements.

3.3.2 The locations of the eight hazardous waste contamination hotspots were surveyed by the HCSL site engineer using co-ordinates from **Figure** MMD-283831-C-DR-00-XX-7004 presented in **Appendix B**. **Table 3.2** summarises the remedial activity carried out at the remaining six hotspots, noting that two (WS41 and BH16B) are addressed by the human helth hotspot removal already discussed.

3.3.3 Remedial works associated with WS41 and BH16B are discussed in Section 3.2 and are not repeated herein.

Table 3.2 – Summary of Remedial Works undertaken (Hazardous Waste Soils Hotspots)

Hostpot Identity	Contaminant of concern	Works Undertaken
WS09 @ 69.29m AOD	Copper, Zinc	An area 2m in radius surrounding the location of WS09 was excavated on 02 November and encountered sandy gravel from ground level to approximately 0.8m. Sandstone bedrock was reached at approximately 0.8 – 1.1m bgl and the excavation was suspended within natural ground. One sample (Ref. WS09 Sample 1) was taken of the excavated material and test results recorded copper and zinc concentrations were below the acceptable limits. The excavated material was re-used as general backfill below the clean cover layer.
WS10 @ 69.19m AOD	Copper, Zinc	An area 2m in radius surrounding the location of WS10 was excavated to sandstone bedrock at 0.8m bgl. The material comprised 0.4m of 6F2 Recycled Aggregate, 0.2m of clay and sandstone below 0.6m bgl. One sample (Ref. WS10 Sample 1) was taken of the material excavated and

Hostpot Identity	Contaminant of concern	Works Undertaken
		tests recorded levels of copper and zinc concentrations below the acceptable limits. The excavated material was re-used below the clean cover layer.
WS17 @ 69.37m AOD	Copper, Zinc	WS17 was located adjacent to the Colliery Lane retaining wall. A radius of 2m was difficult to achieve in the western direction due to the close proximity of the retaining wall and the excavation was only extended to approximately 1.0m in this direction. The excavation comprised sandy gravel to 0.7, underlain by a thin band of Glacial Till and bedrock was encountered at 0.8m. The excavation was abandoned at 1m below ground as solid bedrock was difficult to penetrate. One sample (Ref. WS17 Sample 1) was taken of the arisings and tests recorded copper and zinc concentrations below the acceptable limits. The excavated material was re-used below the clean cover layer.
WS40 @69.57m AOD	Copper, Zinc	The recorded hotspot was located approximately 1m east of the retaining wall adjacent to Colliery Lane. A radius of 2m was difficult to achieve due to the close proximity of the retaining wall and the excavation was approximately 1.5m in radius. The excavation identified gravel to 0.6m, a stiff clay (Glacial Till) to 0.95m and sandstone/coal from 0.95m to 1.2mbgl when the excavation was suspended. During the excavation, a drain was encountered trending north to south. One sample (Ref. WS40 Sample 1) was taken of the arisings and tests recorded Copper and Zinc concentrations below the acceptable limits. The excavated material was re-used below the clean cover layer.
WS100 @ 62.24m AOD	Asbestos Containing Material (ACM)	Surveying of the location of hotspot WS100 identified that, prior to the start of the enabling works, the ground level at this location was already 1m below the identified elevation of the hotspot. As such, it was concluded that the affected ground had already been moved or removed as part of the previous site re-grading/demolition works, carried out by others prior to start of the enabling works contract. As a result, and as agreed with MM, no remediation was undertaken on this area. Subsequently, the Made Ground in this location was excavated and used as backfill below the 1.5 m clean cover layer as part of the Made Ground turnover as part of the main works.
WS105 @ 57.68m AOD	Zinc.	The hotspot was identified adjacent to Corporation Street at a level below that of an adjacent reinforced concrete basement floor left in place after demolition. Excavation could not be carried out as it would potentially undermine the basement and the adjacent road. Remediation of this hotspot was not completed at the request of MM. Subsequently, the Made Ground in this location was excavated and used as backfill below the 1.5 m clean cover layer as part of the Made Ground turnover as part of the main works. The reinforced concrete basement wall that was exposed in this area was 'broken out' to a depth of at least 1.5m below finished level.

3.4 Site Observations

3.4.1 Observations on material arisings from the excavation carried out as part of the enabling works were made by the Remediation Engineer. No materials were noted to be visually different from those expected to be presented based on previous ground investigations. No visual or olfactory evidence of significant ground contamination was noted.

3.5 Placement of Clean Cover

3.5.1 Placement of materials within 1.5m of finished levels was monitored throughout the enabling works. The upper 1.5m generally included natural strata comprising Mudstone, Sandstone, Siltstone or Glacial Till (Clay).

3.5.2 The 1.5m clean cover layer was generally placed as specified across the majority of the site. Exceptions to this include the following:

- A thin boundary strip adjacent to the site hoarding. Due to the underground utility services within the adjacent footpaths and the potential to destabilise the footpath and perimeter site hoarding, a stand-off of approximately 1.5m was applied around the perimeter of the site and site roads. Within this 1.5m stand off the Made Ground was removed, where safe to do so, to a maximum depth of 1m and backfilled using natural material. An area in the east of Site B had a wider stand-off area of 2.0m width as the hoarding fence supports spanned across further onto the site.
- Localised areas which were initially backfilled to the agreed finished level (including placement of the clean cover at 1.5m thick), were subsequently subject to a reduction in ground levels before handover (as per MM instruction). These areas were reduced to 500mm below the new finished level and 500mm clean cover was then placed. As a result, there is potential in these areas for a material type to be present within the top 1.5m which will not necessarily comprise natural strata. Moreover, localised trimming works undertaken at the final stages of the earthworks to provide a gradual level change between areas that had been affected by this late adjustment to finished ground levels may result in a slight reduction up to 200mm in thickness of the clean cover layer placed in the adjacent areas.

3.5.3 **Figure 3** in **Appendix B** highlights areas where the clean cover layer may be less than 1.5m thick.

3.6 Validation Testing of Clean Cover Layer

3.6.1 Sampling and testing was carried out on the soils used as clean cover layer soils prior to placement at the rate of 1 per 2,500m^3 within Site A and B and 1 per every 1,250m^3 in Site C (as detailed in the Employers Requirements). Results are included in **Appendix D**. **Table D-1** in **Appendix D** identifies the sampling carried out at source or from stockpiles of the material used within the clean cover layer prior to placement across the site. All samples tested met the validation testing criteria for the clean cover layer soils.

3.6.2 Validation sampling and testing of the clean cover layer was also carried out on soils placed in the upper 0.5m on an approximate 30m x 30m herringbone grid. A summary of this sampling is provided in **Table E-1** in **Appendix E.** The results of the testing are presented in **Appendix E** and the locations of the validation samples are noted on **Drawing VAL001** in **Appendix B**.

3.6.3 The first area handed over was the 'Gateway' area in the south east of Site A in April 2013. Due to the short timescale between placement of the cover layer and handover of the site to an external contractor, it was not possible to take all the necessary in situ testing validation samples. Seven samples (VS 01 CL – VS 07 CL) were taken from the required locations in situ but samples VS 08 CL and VS 09 CL were taken from a stockpile that was subsequently spread across part of the site. **Drawing Val001** in **Appendix B** indicatively shows the areas where this material was later placed and compacted. As the boundary of the handover area was then increased by agreement with the client, a further batch of sampling was undertaken on the 03 April 2013 as more clean cover material had been placed; VS10CL - VS12CL were taken from the surface material and VS13CL was taken from a stockpile that was ultimately placed in the top 500mm. Again, **Drawing VAL001** indicatively

shows the area where the stockpiled was later placed and compacted. The results show that all thirteen of the samples tested from the Gateway Area meet the validation testing criteria.

3.6.4 Enabling works within Site B were completed and the area handed over on 01 October 2013. Twelve validation samples were taken from Site B between 0.1m and 0.5m below ground level and the chemical analysis results indicate that eleven of the samples met the acceptability criteria. VS 25 CL identified the presence of chrysotile asbestos in a sample of natural sandstone. Upon receipt of the results, a remediation strategy similar to the hotspot removal specification noted in the ER's was adopted. An area 5m in radius was excavated around the location of VS 25 CL to a depth of 0.6m (0.5m below the affected sample). The excavated material was removed from the clean cover layer and placed within the base of the opencast coal excavation. Three further validation samples were subsequently taken from the excavation; one from the side wall adjacent to the cut (ES 3 0.3m), one from material below (ES 1 0.5m) and one from the excavated material (ES 2 0.2m) that had been placed in the excavation. Each sample was tested for the presence of asbestos, and all results confirmed no fibres present. The results of this testing are included in **Appendix H**.

3.6.5 A further area handed over in Site A before final completion was referred to as 'The Square' in the north east of the site. A summary of this sampling is provided in **Table E-1** in **Appendix E.** Eleven clean cover validation samples were taken from this area and all results met the validation testing criteria.

3.6.6 Sixty four samples were collected and analysed on completion of the clean cover layer to the remaining parts of Area A and Area C. A summary of this sampling is provided in **Table E-1** in **Appendix E**. Validation sample VS 43 CL recorded asbestos (amosite) within the sample of siltstone. A re-test on the same sample recorded no fibres present, and a quantification tests did not identify asbestos above the limit of detection (0.001%). No remediation action was therefore taken. All other validation samples tested met the validation testing criteria.

3.7 Unexpected Finds

3.7.1 In some areas, including the excavations for hotspot removal, the ground conditions encountered differed from the conditions reported in the historical ground investigation records at that location. This may be due to inaccurate positioning of historical records in terms of spatial co-ordination and levels. This results in, for example, natural rock strata being encountered in some hotspot excavations at a level where previous investigation data indicated Made Ground would be present.

3.7.2 A previously unidentified underground fuel storage tank was encountered in the west of the site, directly adjacent to Diana Street in Site C. The tank was encountered during the Made Ground turnover and was surrounded by a concrete bund. There was no evidence of any leakage or any staining within the natural strata below or adjacent and as such, in accordance with the ERs, no additional soil testing was warranted. A sample was taken of the small amount of oily water in the bottom of the tank; analysis confirmed this to be weathered diesel. The result is presented in **Appendix D**. HCSL organised for the emptying, degassing, treatment and disposal of the tank and the small volume of oily water.

3.8 Gas & Groundwater Monitoring

3.8.1 A series of combined groundwater and hazardous gas monitoring wells (SP01-SP26) were installed around the perimeter of the site as required in the ERs and as shown on Drawing **VAL002** in **Appendix B**. Thirteen of the wells were installed with shallow response zones in the superficial deposits (odd numbers SP01-SP25) and thirteen of the wells were installed with response zones in

the rock (even number SP02-SP26) to a depth commensurate with the proposed base of the coal extraction excavation. Logs showing ground conditions and installation details are included in **Appendix I**.

3.8.2 Monitoring of the wells was carried out to look for evidence of potential hazardous gas migration during the drilling and grouting works undertaken by Groundshire Ltd. Groundwater levels were also monitored on a daily basis adjacent to any open excavations. This monitoring was carried out by the WSP RE using a GA2000 gas monitor and a Geotech electrical contact dip meter. Gas monitoring was carried out daily in wells in the vicinity of active drilling and grouting operations. Once the works were complete within an area, the monitoring reduced to a monthly basis thereafter. Not all wells were accessible during this monthly monitoring process due to ongoing earthworks activities. A summary of the gas monitoring results is presented in **Appendix F**.

3.8.3 Generally, the gas monitoring records demonstrate no evidence of elevated hazardous gas concentrations which would cause concern. The concentrations of oxygen and carbon dioxide were variable for the initial 2-3 months but did not generally exceed values which would require further action. Carbon monoxide were generally less than 5 ppm, although on occasions short term spikes in concentrations were detected for 1-2 days, with concentrations above 10 ppm and as high as 80ppm on one occasion. The short term Occupational Exposure Limit (OEP) of 200ppm was not exceeded on any occasion.

3.8.4 On 30 November 2012 SP07 recorded high methane readings, peaking at a recorded volume of 100%v/v. Concentrations of methane within the adjacent boreholes were less than 1%. This was reported immediately to HCSL site management. Drilling within the immediate vicinity of SP07 had previously been completed and drilling operations were being carried out elsewhere on the site. To monitor the anomalous result, daily monitoring of SP07 followed and open grouting boreholes in the vicinity drilled by Groundshire were monitored which confirmed low methane levels and methane levels in SP07 gradually reduced to below 1% v/v after one week.

3.8.5 Groundwater levels were monitored throughout progress of the works to assist with ongoing checks on high wall stability. No significant variation in groundwater levels was recorded although some short term variation was noted in some wells (raising and lowering) and a general downward trend was noted in some wells, considered to be due to the dewatering of the opencast excavation. A summary of the groundwater levels are presented in **Appendix F**.

3.9 Groundwater Sampling and Analysis

3.9.1 Groundwater quality sampling and analysis from installed wells SP01-SP26 was carried out to monitor potential deterioration in groundwater quality associated with the works. The sampling carried out is summarised in **Table G-1** in **Appendix G** along with the analysis results. Some of the monitoring wells were either inaccessible or damaged during later stages of the earthworks and as such, not all wells were sampled on every occasion.

3.9.2 An initial round of groundwater sampling was completed on 12 November 2012. These results were used as the baseline results and represent what is regarded as the pre-existing status of groundwater quality beneath the site prior to enabling works commencing.

3.9.3 After the initial baseline analysis in November 2012 a further three monthly analysis rounds were completed in December 2012, January 2013 and February 2013. The results were manually screened against baseline values and indicate conditions to remain similar to the baseline conditions without any significant variation in the concentrations of determinants tested. Based on those initial results, it was agreed with MM that a bi monthly analysis operation would be acceptable on the assumption that

the results continue to align with the baseline results. It was agreed that should deterioration in groundwater become apparent then monitoring would revert to a monthly frequency.

3.9.4 A further five bi monthly sampling and analysis events were carried out and all results were manually screened and noted to be similar to the baseline results. On the basis of these results, no significant deterioration in groundwater quality beneath the site was considered to have occurred during the works period.

4 Concluding Statement

4.1.1 The remediation works required and agreed with the Local Authority are outlined in the Remediation Strategy and the Employers Requirements and are specified in the Remediation Method Statement. Works to address these requirements have been undertaken by HCSL and have been subject to monitoring by WSP.

4.1.2 Works to remove the identified hotspots of contamination exceeding the *human health* remedial targets were completed in general accordance with the Method Statement. Validation sampling and testing identified no exceedences of the agreed validation testing criteria and, on this basis, this remedial activity is considered to have been satisfactorily completed.

4.1.3 Works to remove the identified hotspots of contamination exceeding the *hazardous waste* remedial targets have been completed in general accordance with the method statement. Hotspots at WS 100 and WS 105 were not removed as agreed with the employer's representative as they were either above pre-start ground level and had been removed historically or lay below basement floors scheduled to remain in place.

4.1.4 Provision of a clean cover layer 1.5m thick has been provided to the majority of the site area. Due to variations agreed with the employers representative some localised areas do not have the full thickness of 1.5m of clean cover provided, notably around the site margins where full depth excavation was not possible and in areas where finished handover levels were adjusted after completion.

4.1.5 With the exception of two samples the results of the clean cover validation testing of samples were within the validation testing criteria specified within the Remediation Method Statement. At two isolated locations the clean cover layer material, which comprised natural soils, was initially reported to contain asbestos fibres and additional localised soil removal and replacement /further validation sampling was carried out at these areas. Subsequently validation samples did not detect asbestos and were hence compliant with the validation testing criteria.

4.1.6 The earthworks were monitored regularly by the WSP Remediation Engineer and no unexpected finds with regards ground contamination was observed, with materials encountered being broadly similar to those found in previous ground investigation works. An underground fuel tank was located close to Diana Street in Site C; this was decommissioned and removed by the contractor. No evidence of ground contamination was observed in the vicinity of this tank.

4.1.7 Monitoring of installed perimeter wells generally demonstrated consistently low levels of hazardous gases aside from rare peaks within Carbon Monoxide. An isolated and temporary instance of elevated methane was detected in one well and the works were adjusted so that this did not perpetuate and cause a potential off site migration risk.

4.1.8 Groundwater quality monitoring was carried out in installed perimeter wells during the duration of the works. Not all wells could be monitored on all occasions due to limited access resulting from the live earthworks or damage to the wells. The monitoring data obtained does not indicate any significant deterioration in groundwater quality in the wells during the period of the works.

4.1.9 The works carried out are considered to have been performed in general accordance with the Employers Requirements and Remediation Method Statement, as amended on site by variations agreed with the employers representative, and as specified in the Remediation Method Statement. Based on the available data, it is considered that the remediation objectives agreed for the site have been satisfactorily completed.

WSP UK Ltd