



**New Settlement Area, Heyford Park
Oxfordshire**

**Bovis Phases B1 & B2A
Remediation Earthworks
Completion Report**

For: Urban Regen Ltd.

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1. Introduction

1.1. Planning permission for the redevelopment of the former RAF/USAF Upper Heyford airbase was granted by Cherwell District Council (CDC) on the 2nd November 2012, reference 10/01642/OUT. The site, converted to commercial and residential uses is known as Heyford Park, and is divided between the Flying Field Area (FFA) and New Settlement Area (NSA). Urban Regen Ltd. (UR) was instructed by the consortium of Dorchester Heyford Park Group Ltd and Bovis Homes to carry out demolition, remediation and preparatory earthworks across the NSA to prepare various zones for residential development. Dorchester Group and Bovis have divided the site into a number of development phases, and the UR works are referenced to these various phases.

1.2. The above planning consent contains the following conditions relating to contamination remediation:

- 24 *No operational development approved by this planning permission shall take place (or such other date or stage in development as may be agreed in writing with the Local Planning Authority), until the following components of a scheme to deal with the risks associated with contamination of the site shall each be submitted to and approved, in writing, by the local planning authority:*
- (a) A preliminary risk assessment which has identified:*
 - (i) -all previous uses.*
 - (ii) -potential contaminants associated with those uses.*
 - (b) A conceptual model of the site indicating sources, pathways and receptors.*
 - (c) Potentially unacceptable risks arising from contamination at the site.*
 - (d) A site investigation scheme, based on (1) to provide information for a detailed assessment of the risk to all receptors that may be affected, including those off site.*
 - (e) The site investigation results and the detailed risk assessment (2) and, based on these, an options appraisal and remediation strategy giving full details of the remediation measures required and how they are to be undertaken.*
 - (f) A verification plan providing details of the data that will be collected in order to demonstrate that the works set out in (3) are complete and identifying any requirements for longer-term monitoring of pollutant linkages, maintenance and arrangements for contingency action.*
- Any changes to these components require the express consent of the local planning authority. The scheme shall be implemented as approved.*
- 25 *Prior to occupation of any new build dwellings, a verification report demonstrating completion of the works set out in the approved remediation strategy and the effectiveness of the remediation shall be submitted to and approved, in writing, by the local planning authority. The report shall include results of sampling and monitoring carried out in accordance with the approved verification plan to demonstrate that the site remediation criteria have been met. It shall also include any plan (a "long-term monitoring and maintenance plan") for longer-term monitoring of pollutant linkages, maintenance and arrangements for contingency action, as identified in the verification plan, and for the reporting of this to the local planning authority.*
- 26 *If during development contamination not previously identified is found to be present at the site then no further development within 20m of the contamination shall be carried out until the developer has submitted to and obtained written approval from the local planning authority for an addendum to the method statement. This addendum to the*

method statement shall detail how this unsuspected contamination will be remediated (if necessary) and thereafter this will be carried out as approved before any development within 20m recommences. Following completion of any such additional remediation, a verification report shall be submitted within 3 months of the completion of the works for the approval of the Local Planning Authority in writing.

- 1.3. A Remediation Strategy (ref: EED10658-109_S_12.2.3_FA, September 2012) prepared by Waterman Energy, Environment and Design Ltd. (Waterman) on behalf of Dorchester Group, together with a Demolition and Remediation Method Statement produced by Vertase F.L.I Ltd. were submitted to the Local Planning Authority (Cherwell District Council). The Council subsequently approved the discharge of Condition 24 on 2/11/12. Whilst the role of Waterman has changed within the remediation scheme, and Vertase FLI is no longer involved in the site, the principles of the remediation strategy remain the same, and have been adopted by UR in their role as Principal Contractor to Dorchester Group and Bovis.
- 1.4. For clarity, it is proposed to re-submit an updated Remediation Strategy that reflects the changed contractual circumstances with respect to contamination remediation, however the works undertaken to date have complied in all material respects to the requirements set down in the existing approved Remediation Strategy.
- 1.5. Smith Grant LLP (SGP) has been instructed by UR to advise upon the implementation of the remediation works and to carry out all necessary inspections and monitoring of the works and to prepare all necessary verification reports as the preparatory earthworks in each phase are completed by UR. This verification reporting is intended to assist in the discharge of Condition 25 (although some aspects can only be completed by the developers). SGP also assesses whether the requirements of Condition 26 relating to previously unidentified contamination need to be invoked.
- 1.6. The site location is shown below and the site boundary that makes up the Bovis Phase B1 & B2A area is marked on Drawing D02. A development layout plan provided by Bovis to UR shows a total of 78 detached and terraced houses with private gardens and access roads across the site (as reproduced on the Urban Regen completed levels drawing in Appendix D).

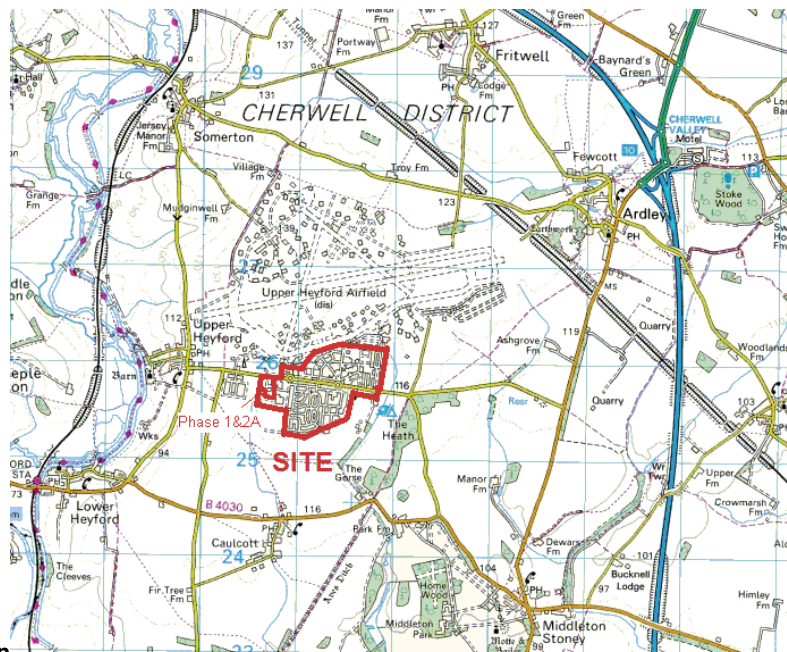


Figure 1.1 Site Location

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- 1.7. SGP has inspected the UR preparatory earthworks carried out to date, and has collected samples of the stripped or replaced soil surfaces and stockpiled soils for determination of compliance with previously agreed quality standards. This report describes the works carried out, drawing conclusions and making recommendations concerning the further works required by Bovis in order to fully discharge Planning Conditions 25 and 26.

2. Remediation Strategy

2.1. Expected Contamination

- 2.1.1. The wider development comprises an area of the former Upper Heyford Airbase, latterly developed and used by the United States Airforce, which has been decommissioned and is used in part for civilian purposes, including commercial and residential uses as part of Heyford Park. Identified known or potential contamination sources determined from the historical uses of the site and site investigations were generally found to be minor, consisting of low-level but pervasive contamination hydrocarbons associated with bulk fuel storage tanks and the potential for asbestos in pipe laggings and gaskets, insulation board and cement-bound products, or as dispersed fibre in made ground. The key identified contamination hot-spots were associated with bulk underground fuel storage tanks (USTs).
- 2.1.2. Natural background contamination may be present in the bedrock and soils. The site lies within or adjacent to the "ironstone domain" as described in DEFRA Technical Guidance

Sheet TGS01 "Arsenic", July 2012; the site lies within 1km of mapped outcrops of ironstones within the Jurassic sedimentary rocks. Within the ironstone domain, the natural background concentration of arsenic is reported to be 220 mg/kg. The natural background concentration of vanadium within the ironstone domain is reported by BGS to be >128 mg/kg. Both values substantially exceed the Remediation Strategy Table B1 criteria for cover soils.

2.2. Remediation Objectives and Approach

2.2.1. The key contamination remediation objectives are to:

- create a significant betterment of the groundwater environment thereby protecting groundwater quality at and beyond the site boundary;
- remove/remediate significant pollution sources such as hydrocarbon hot-spots, if present, that pose a risk to man and the environment, to the extent feasible;
- break significant or potentially significant future pollutant linkages resulting from the change of landuse, in particular related to shallow garden soils and human exposure;
- carry out further soil investigations/inspections to complete gaps in the existing investigation coverage;
- respond appropriately to contingencies in particular the discovery of previously undisclosed contamination;
- remove development constraints and prepare the site physically to enable residential development;
- manage all emissions to air and water to protect surface waters and groundwater and the atmosphere during the remediation works;
- provide appropriate additional protection measures where necessary, to be implemented during construction, including building gas barriers, water mains protection, and garden / open space soil quality and thickness.

2.2.2. The general requirements for garden and landscaped soils taken from the approved Remediation Strategy are as follows:

- provision of 600mm of clean soil cover over made ground materials within garden and landscaped areas;
- materials to be used as the garden/landscape soils must be suitable for use and validated, to comply with contamination targets set out in the Remediation Strategy at a rate of 1 sample per 500m³;
- imported soils used for cover purposes to comply with contamination targets set out in the approved Remediation Strategy at a rate of 1 sample per 250m³ with a minimum of 3 samples per source;
- in areas where natural uncontaminated soils are present following the site re-grade, clean topsoil may be required as a growing medium but there will be no requirement for a full 600mm of placed soil cover;

2.2.3. It is confirmed that the Phase B1 & B2A site be classed as “Green” under the NHBC classification scheme with no special measures required to address risks posed by ground gas.

2.3. Site Characterisation

The Phase 1 and 2A site extends to about 2.86 ha and was previously occupied by a former supermarket building (building 581), roads, car parking, recreational areas and grassland. The site slopes down slightly to the west. Areas of stripped

2.3.1. 1 underground storage tank (UG-NSA-08) was present within the site, located adjacent to the south west corner of building 581. Ground adjacent was previously investigated by borehole BH-NSA-21 with no significant finding of hydrocarbon contamination. The UST was inspected by SGP on 20th November 2013 and was found to be water filled with a layer of heating oil floating on top. The tank was of steel and estimated volume of 4900 (US) gallons, or 18,550 litres based on a gauge maximum contents. A PID reading for VOCs within the tank headspace measured 6.0 ppm.

2.3.2. Elsewhere, and outside service trenches, the site was found to generally have a thin veneer of made ground or natural topsoil to around 0.3m depth over sandy clayey gravel derived from the weathered limestone at around 1 m depth.

2.4. Phase-specific Strategy

2.4.1. It was concluded that the phase B1 area posed minimal risk of contamination, and had no known history of potential contaminative use. The area had been largely stripped of topsoil by others on behalf of Bovis at the commencement of the UR remediation contract. The B2A area was considered to have a minor risk of contamination associated with the former supermarket building, associated heating oil storage and plant, and car parking drainage.

2.4.2. The site-wide strategy of ensuring clean cover soils to 600mm depth would be an adequate approach to both phases, with recovered topsoils tested for suitability for reuse. No requirement for hydrocarbon remediation of soils or groundwater was identified pending additional investigation of the former UST location adjacent to building 581 after emptying and removal of the tank. The verification measures specific to dealing with USTs as set down in the approved Remediation Strategy were to be invoked with regard to the UG-NSA-08 location.

3. Description of Works

- 3.1. In order to prepare the site physically for development, UR needed to modify ground levels, remove obstructions to foundations and services, and remove / treat any identified deleterious materials.
- 3.2. The supermarket structure was subject to asbestos surveys and stripping by specialist contractors; asbestos containing construction materials, timber, scrap metal, plastic and other deleterious materials were removed from the site; this work is reported elsewhere.
- 3.3. All masonry, brick and concrete structures were processed on site to generate recovered aggregate to be used at a later date. SGP estimates the stockpile to be approximately 2000 m³.
- 3.4. Following turnover, trim specifications were carried out in gardens, car parks and drives trimmed to original ground levels less 200mm;
- 3.5. Stripped turf and “topsoil” was placed in a temporary stockpile for classification to determine its potential for re-use as garden topsoil. SGP estimates the stockpile volume to be approximately 1500m³.
- 3.6. The locations of stockpiles are shown on drawing D02.

4. Inspections and Testing

- 4.1. SGP attended the site on 5 occasions during and following the remediation earthworks. The dates and activities carried out in the Phase B1 and B2A areas during SGP attendance, cross referenced to the photographic record (Appendix A), and Analysis Results (Appendix B) are summarised in the table below.

Table 4.1 SGP Inspection Summary

Date	SGP Activities	Record
20/11/2013	Inspection of ground conditions. Development commenced within phase B1 (plots 1-9). 3 samples taken in-situ of stripped surfaces and submitted to Jones Environmental for a standard suite analysis.	Photos: 1-5 Analytical laboratory ref: 13/10844 samples BOV P3-4, BOV P6, BOV P9

Date	SGP Activities	Record
18/12/2013	Inspection of ground conditions. 6 samples taken in-situ of stripped subsoil surfaces, along with a further 3 samples of stripped topsoil stockpiled in two separate locations on north and south end of phase B1 and B2A submitted to Jones Environmental for a standard suite analysis.	Photos: 6-19 Analytical laboratory ref: 13/11985 samples 581-SS1-West, 581-SS2-West, 581-TS1-West, 582-SS1-West – 582-SS4-West, 582-TS1-West, 582-TS2-West, Bovis-SP1(TS)-1
07/02/2014	Inspection of ground conditions. 7 samples taken in-situ of stripped surfaces, 2 samples of site generated crush and 1 sample of site generated stone for asbestos screen only, 2 samples of site generated subsoil and submitted to Jones Environmental for a standard suite analysis.	Photos: 20-43 Analytical laboratory ref: 14/2706 samples BOV-581-SS1 – BOV-581-SS6, BOV-582-West-SS5, BOV-Crush1-S4, BOV-581-West-SUB1, BOV-581-West-SUB2
25/02/2014	Inspection of ground conditions. 7 samples taken in-situ of stripped surfaces, 2 samples of site generated crush taken and submitted to Jones Environmental for a standard suite analysis. Inspection of completed site - development commenced on plots in phase B2a	Photos: 44-50 Analytical laboratory ref: 14/3241 samples BOV-581-West-SS3 – BOV-581-West-SS7, BOV-582-West-SS6, BOV-582-West-SS7, BOV-Crush1-4, BOV-Crush1-5
13/03/2014	Inspection of ground conditions. 3 samples taken in-situ of stripped surfaces for additional retest and submitted to Jones Environmental for a standard suite analysis.	Photos: 51-56 Analytical laboratory ref: 14/3839 sample BOV-582-West-SS8, BOV-581-SS7, BOV-581-SS8

4.2. Validation of Cover Soils

- 4.2.1. Sampling and analysis was carried out to determine the suitability of recovered soil strip and retained in-situ material for the potential of use within the garden / landscaping cover layer. Because the site surface was left at least 200mm below finished garden level, validation of the retained / replaced soils was carried out to a minimum depth of 400mm (at least 600mm below finished garden level).
- 4.2.2. A total of 23 samples (excluding three re-samples) were taken from the stripped or replaced soil surfaces. On the worst case assumption of the soils forming the lower 400mm of the garden / landscaping cover layer, and a total site area of 2.86ha, the volume of validated soil is effectively 11,440 m³, and the test rate is equivalent to 1 sample per 497m³, achieving the specified rate of 1 sample per 500m³.
- 4.2.3. Sampling of stripped and stockpiled topsoil was carried out from the separated stockpiles, with 3 representative samples collected from land to the west of building 582 and 1 sample from both of the topsoil stockpiles to the west of building 581. The total stockpile volume is

estimated to be around 1,500m³, so the required minimum sampling rate of 1 per 500m³ was achieved.

4.2.4. 2 additional samples were also collected from two site generated “subsoil” stockpiles at the request of Bovis to determine potential for reuse.

4.2.5. All samples were collected by SGP geo-environmental consultants and were placed in appropriate laboratory-provided containers and stored in cooled boxes. Samples were delivered to the laboratory (Jones Environmental) within 24 hours of collection. SGP retains chain of custody documentation.

4.2.6. The results provided in laboratory certificates 13/10844, 13/11985, 14/2706, 14/3241 and 14/3839 (all in Appendix B) are summarised in the table below and are compared to assessment criteria for garden cover soils:

Table 4.2 Analysis Summary for cover soils

Contaminant	Samples	Range of Concentrations (mg/kg unless stated)	Residential Use	
			Screening criteria* (mg/kg unless stated)	Exceedences
SOM	23	<0.2-3.1	-	-
pH	23	7.87-10.92	WRAS <5>8	18 Samples
asbestos fibre*	17	NFD	<0.001%	none
antimony	12	<1-7	550	none
arsenic	24	4.4-204.8	32	4 (BOV-581-SS3, BOV-581-SS4, BOV-581-SS5, BOV-581-SS6)
barium	23	10-91	1300	none
beryllium	23	<0.5-7	51	none
cadmium	23	<0.1-1.2	10	none
chromium	23	3.5-231.7	3000	none
chromium IV	23	<0.3	4.3	none
cobalt	23	1.1-22.2	240	none
copper	23	3-25	300	none
lead	23	7-52	450	none
mercury	23	<0.1-0.3	1	none
molybdenum	23	<0.1-3.5	670	none
nickel	23	2.4-80.9	130	none
selenium	23	<1	350	none
vanadium	23	16-210	75	3 (BOV-581-SS4, BOV-581-SS5, BOV-581-SS6)
water soluble boron	23	0.4-5.5	291	none
zinc	23	6-206	300	none
naphthalene	25	<0.04	1.5	none
acenaphthylene	25	<0.03-0.42	210	none
acenaphthene	25	<0.05-14.63	170	none

Contaminant	Samples	Range of Concentrations (mg/kg unless stated)	Residential Use	
			Screening criteria* (mg/kg unless stated)	Exceedences
fluorene	25	<0.04-0.84	160	none
phenanthrene	25	<0.03-50.93	92	none
anthracene	25	<0.04-11.38	2300	none
fluoranthene	25	<0.03-175.16	260	none
pyrene	25	<0.03-150.86	560	none
benzo(a)anthracene	25	<0.06-125.55	3.1	2 (BOV-581-SS2, BOV-582-West-SS6)
chrysene	25	<0.02-158.75	6	2 (BOV-581-SS2, BOV-582-West-SS6)
benzo(bk)fluoranthene	25	<0.07-237.92	-	-
benzo(a)pyrene	25	<0.04-148.53	0.83	4 (BOV-582-SS4-West, BOV-581-SS1, BOV-581-SS2, BOV-582-West-SS6)
indeno(123cd)pyrene	25	<0.04-71.07	3.2	3 (BOV-582-SS4-West, BOV-581-SS2, BOV-582-West-SS6)
dibenzo(ah)anthracene	25	<0.04-12.54	0.76	3 (BOV-582-SS4-West, BOV-581-SS2, BOV-582-West-SS6)
benzo(ghi)perylene	25	<0.04-72.46	44	1 (BOV-582-West-SS6)
aliphatic C5-C6	23	<0.1	30	none
aliphatic C6-C8	23	<0.1	73	none
aliphatic C8-C10	23	<0.1	19	none
aliphatic C10-C12	23	<0.2	93	none
aliphatic C12-C16	23	<4	740	none
aliphatic C16-C21	23	<7	1000	none
aliphatic C21-C35	23	<7	1000	none
aromatic C6-C7	23	<0.1	0.08	none
aromatic C7-C8	23	<0.1	120	none
aromatic C8-C10	23	<0.1	27	none
aromatic C10-C12	23	<0.2	69	none
aromatic C12-C16	23	<4-12	140	none
aromatic C16-C21	23	<7-1193	250	1 (BOV-582-West-SS6)
aromatic C21-C35	23	<7-4200	890	1 (BOV-582-West-SS6)
benzene	23	<0.05	0.08	none
toluene	23	<0.05	120	none
ethylbenzene	23	<0.05	65	none
o-xylene	23	<0.05	45	none
m-xylene	23	<0.05	44	none
p-xylene	23	<0.05	42	none
methyl tert butyl ether	23	<0.05	49	none

* not included in approved Remedial Strategy but proposed in SGP draft revised Strategy, R1742-R01 Table 6.2

4.2.7. No occurrences of asbestos fibre were identified.

4.2.8. Four samples (BOV-581-SS3, BOV-581-SS4, BOV-581-SS5, BOV-581-SS6) were found to exceed the 32 mg/kg screening criteria for arsenic, at 204.8 mg/kg, 71.9 mg/kg, 39.1 mg/kg

and 105.2 mg/kg respectively, with three of these samples (BOV-581-SS4, BOV-581-SS5, BOV-581-SS6) also exceeding the 75 mg/kg vanadium criterion, at 178 mg/kg, 88 mg/kg and 210 mg/kg respectively. Samples BOV-581-SS3 and BOV-581-SS4 were located below a proposed landscaping / balancing pond area, and sample BOV-581-SS6 was located in a low lying area greater than 600mm below finished garden level, therefore these results do not apply to garden cover soil validation, and the material will be retained below the pond / 600mm cover when this is placed by Bovis during the development phase. However, sample BOV-581-SS5 was determined to lie within the cover soil validation. All samples comprised apparently natural clayey gravel derived from the weathered bedrock.

4.2.9. An additional sample (BOV-581-SS8 - arsenic 160 mg/kg, vanadium 369 mg/kg) was collected at the same location as BOV-581-SS5 as a check, however this showed substantially higher contamination levels. In view of the published likelihood of naturally elevated concentrations of arsenic and vanadium in the area, and the absence of any identified anthropogenic material in the samples, it was determined that a statistical estimate should be carried out of the sample mean taking the phase B1 and B2a area data (excluding samples BOV-581-SS3, BOV-581-SS4 and BOV-581-SS6) as a single averaging area. The results, shown below, indicate that there is no significant risk to human health from the likely concentrations of arsenic and vanadium within the site subsoils if the duplicate result of BOV-581-SS8 is excluded.

Table 4.3 Statistical Analysis of Arsenic and Vanadium Concentrations

statistic	arsenic (mg/kg)	vanadium (mg/kg)
criterion	32.0	75.0
no. of samples	21	21
Grubbs outlier test for highest value (P0.05)	BOV-581-SS8 (max. value 160.0) is an outlier	BOV-581-SS8 (max. value 369) is an outlier
arithmetic mean, including outlier	22.2	61.1
upper confidence limit (UCL 0.95) including outlier	34.5 (fail)	88.5 (fail)
arithmetic mean, excluding BOV-581-SS8 outlier	15.3	45.8
upper confidence limit (UCL 0.95) excluding BOV-581-SS8 outlier	18.3 (pass)	52.7 (pass)

4.2.10. The location of the BOV-581-SS8 outlier is below a proposed garage unit between Bovis plots 28 and 29. The statistical analysis including the results for this sample gives marginal failures of the arsenic and vanadium screening levels. The soil sampled was of natural appearance from an area of the site remote from identified historical contaminative activities, identical in appearance to other soils around the phase, and mineralisation is therefore likely to be of natural origin. Typically the bio-accessibility of naturally occurring arsenic associated with

ironstones (normally present in the form of arsenopyrite) will be low, and the risk to future residential use is therefore considered also likely to be low. The options for dealing with this area will be one or more of the following:

- review ground levels following building construction to determine unfilled cover depth available, and hence future exposure potential for residents;
- collect additional samples for further testing and statistical analysis of the local area, including physiologically-based extraction tests (PBET), with further detailed quantitative risk assessment;
- excavate the subsoil / weathered rock to 600mm below finished garden levels if it is concluded that residual arsenic or vanadium concentrations are unacceptable, or that further testing and risk assessment is uneconomic.

4.2.11. With respect to arsenic concentrations in the soil cover to POS land, there is no specified separate quality standard for such land use in the Remediation Strategy, although the extent of human exposure, and consequent risk to health will be reduced compared to residential garden use. DEFRA has published provisional Category 4 Screening Levels (C4SLs) for arsenic that signify that land is definitely not Contaminated Land under Part IIA of the Environmental Protection Act 1990 by virtue of it posing no significant possibility of serious harm to man. Two of the arsenic C4SLs are issued for public open space land uses within residential areas and in open parkland, at 79 and 168 mg/kg respectively. The average concentration of samples BOV-581-SS3 and BOV-581-SS4 is 138 mg/kg which is less than the parkland C4SL.

4.2.12. Four raised concentrations of benzo(a)pyrene were encountered in excess of the 0.8 mg/kg screening criterion (BOV-582-SS4-west, BOV-581-SS1, BOV-581-SS2, BOV-582-west-SS6) at 3.77 mg/kg, 0.99 mg/kg, 8.19 mg/kg, 148.53 mg/kg respectively, including a number of other related PAHs. This is likely to have been the result of the inclusion of relatively small proportions of coal / clinker mixed up within the generally natural clayey sand and gravel. Additional samples were collected from three of the four locations (the slight exceedance of the criterion at BOV-581-SS1 was not deemed to merit re-testing) as follows and as shown on drawing D02:

- BOV-582-SS7-west - 0.59 mg/kg, adjacent to BOV-582-SS4-west;
- BOV-582-SS8-west - 0.28 mg/kg, adjacent to BOV-582-west-SS6;
- BOV-581-SS7 - 3.75 mg/kg, adjacent to BOV-581-SS2.

4.2.13. In the re-testing, only BOV-581-SS7 was found to still exceed the criterion for benzo(a)pyrene. However, the DEFRA provisional C4SL gives a standard for benzo(a)pyrene in garden soil of 5.0 mg/kg, which is not exceeded. The characteristics of all 5 elevated samples (see twin ratio plots in Appendix B) shows a typical coal / coal ash source of probable low availability, therefore unlikely to represent an unacceptable risk to human health; one sample, BOV-SS4-

-
- west, just falls within the coal tar classification, however this sample contained a relatively low concentration of PAHs, and the result is not considered significant.
- 4.2.14. TPH concentrations of the heavy end aromatic fraction (C16-C21 and C21-C35) were also above the soil guideline criteria of 250 mg/kg and 890 mg/kg respectively in 1 sample, where concentrations of 1,193 mg/kg and 4,200 mg/kg were recorded in BOV-582-west-SS6. The elevated concentrations within the sample are likely to also be attributed to the same fragment of coal / clinker mixed up within the natural sands and gravels causing the elevated PAHs. The additional sample (BOV-582-SS8-west) collected from this location confirms this, with a benzo(a)pyrene concentration of 0.28 mg/kg.
- 4.2.15. Soil pH values ranged from 7.87 within BOV-582-west-SS7 to alkaline at 10.97 within BOV-P6, with a total of 18 samples exceeding the WRAS trigger pH value of >8. Elevated concentrations of pH in the majority of samples are likely to be attributed the ubiquitous presence of carbonate limestone identified across the NSA, although the highest pH values are probably also indicative of concrete fragments; the hydroxides in freshly exposed concrete will undergo carbonation over a period of days, with an accompanying reduction in pH.
- 4.3. Validation of Tank Removal
- 4.3.1. SGP attended the site on the 25th February 2014 to inspect and validate soils following removal of the underground heating oil storage tank UG-NSA-8 associated with the former supermarket (see drawing D02). Prior to arrival on site UR arranged to have the tank and associated infrastructure emptied and cleaned; this work was carried out by specialist sub-contractor KpH Environmental Services Ltd. and will be reported separately by UR.along with waste disposal records.
- 4.3.2. Following emptying and degassing the tank was removed by hydraulic excavator and the surrounding concrete vault, cradle and slab were broken out. Concrete was deemed to be uncontaminated and was removed for crushing.
- 4.3.3. SGP screened the excavation arisings with a PID calibrated for isobutyldiene to identify residual volatile hydrocarbon contamination. Readings were below the limit of detection (<0.1 ppm). No olfactory or visual evidence of hydrocarbon contamination was identified. Due to heavy rain at the time, a small pool of rainwater formed in the base of the excavation; this was observed to free from oil sheen or emulsion, and the slopes were free from fuel staining.
- 4.3.4. Four composite samples were collected for validation purposes from the locations indicated in Drawing D02 (UG8-1 – UG8-4) and at the OS grid coordinates in Table 4.4 below. Samples were collected by excavator bucket from the base and west, north and east sidewalls of the excavation to confirm the absence of residual hydrocarbon concentrations and significant fuel

contamination. The southern side of the excavation was formed of bedrock and could not be sampled. The spacing of samples is consistent with the Remediation Strategy requirement of 1 sample per 15m² of excavation surface area. Entry to the excavation was not attempted due to the depth and unstable nature of the side slopes which comprised fractured rock to the south, and loose boulders, cobbles and gravel of weathered bedrock on the remaining faces.

Table 4.4 UG-NSA-8 Validation Sample Coordinates (centre points)

Sample No.	North Coordinate	East Coordinate	Height Coordinate
UG8-1	450886.6	225743.9	122.00
UG8-2	450889.9	225744.4	122.02
UG8-3	450889.6	225742.4	121.08
UG8-4	450892.3	225743.2	122.00

4.3.5. All samples were submitted for full TPHCWG banding and BTEX analysis. The results of the validation testing (Report ref: 14/3241) are compared to assessment criteria (unsaturated material >250m from the down-gradient boundary) set out in Table B3 of the Waterman Remediation Strategy (EED10658-109_S_12.2.3_FA), as summarised within Table 4.5 below:

Table 4.5. Verification of Tank Removal

Contaminant	Samples	Range of Concentrations (mg/kg unless stated)	Table B3	
			Screening criteria* (mg/kg unless stated)	Exceedences Concentration & location
Aliphatic C5-C6	4	<0.1	-	-
Aliphatic C6-C8	4	<0.1	-	-
Aliphatic C8-C10	4	<0.1	240	None
Aliphatic C10-C12	4	<0.2 -2.5	1000	None
Aliphatic C12-C16	4	<4 - 62	1000	None
Aliphatic C16-C21	4	<7 - 107	1000	None
Aliphatic C21-C35	4	<7 - 26	1000	None
Aromatic C6-C7	4	<0.1	-	-
Aromatic C7-C8	4	<0.1	-	-
Aromatic C8-C10	4	<0.1	-	-
Aromatic C10-C12	4	<0.2	23	None
Aromatic C12-C16	4	<4 - 31	1000	None
Aromatic C16-C21	4	<7 - 65	1000	None
Aromatic C21-C35	4	<7 - 55	1000	None

4.3.6. The residual concentrations of hydrocarbons present following the exercise do not exceed the agreed assessment criteria for the site. Concentrations of BTEX compounds were all below the limit of detection of 5 µg/kg except for toluene in UG8-4 at 25 µg/kg, over three orders of magnitude less than the Table B1 validation criteria for reuse in the saturated zone or cover soil.

4.3.7. In conclusion, no significant residual fuel contamination has been detected around the UG-NSA-8 tank position. The excavation has been temporarily backfilled with the mixed granular arisings on the instructions of Bovis, pending the construction of the wetland system in this part of the site.

4.4. Validation of Site Generated Crushed Aggregate

4.4.1. Sampling analysis was carried out to determine the suitability of crushed recovered aggregate for potential reuse during the development phase.

4.4.2. Approximately 2,000m³ of crushed aggregate was generated on site. UR initially collected 3 samples from stockpile and had these delivered by courier to Jones Environmental Laboratories. SGP attended site on one additional occasion to collect a further sample to achieve a sampling frequency of 1 per 500m³. The results provided in the laboratory certificates 14/2345 and 14/2706 (Appendix B) are summarised in the table below:

Table 4.6. Asbestos Screening Summary for Recovered Aggregate

Contaminant	Samples	Range of Concentrations (mg/kg unless stated)	Residential Use	
			Screening criteria (mg/kg unless stated)	Exceedances Concentration & location
asbestos fibre	4	NFD	<0.001%*	none

* not included in approved Remedial Strategy but proposed in SGP draft revised Strategy, R1742-R01 Table 6.2

4.2.1 All samples collected from stockpile were reported as containing 'no fibres present' and are considered acceptable for unconstrained use on site without special precautions (subject to any additional requirements of stakeholders).

4.2.2 The stockpile was sampled for grading analysis, with 2 samples delivered to Nicholls Colton (ref: BOV-CRUSH1-1 and BOV-CRUSH1-2). The laboratory certificate of analysis is provided in Appendix. Both samples met the grading requirements for class 6F2 material.

4.3 Unknown Contamination

4.3.1 No previously unknown contamination was encountered within the Bovis Phase 1 and 2a area, with the exceptions of the elevated apparently natural concentrations of arsenic and vanadium in some samples. Otherwise, ground conditions were found to be as expected and consistent with the preceding site investigations.

5. Conclusions and Recommendations

5.1. Verification of Remediation

- 5.1.1. The site stripped/fill surfaces and recovered stockpiled materials have been inspected and sampled by SGP in accordance with the approved Remediation Strategy. The types of materials encountered during the additional assessment and remediation works carried out in Phase 1 and 2a were consistent with those described in the site characterisation.
- 5.1.2. On the basis that UR has stripped and / or filled the overall Phase 1 and 2A area to 200mm below finished garden level (although it is known that parts of the site have been left lower), SGP has validated and sampled the remediated surfaces to an average depth of 400mm (see photographs in Appendix A). A sampling frequency of 1 per 500m³ of potential cover soil material has therefore been achieved.
- 5.1.3. There were 4 initial exceedences of the arsenic screening criterion. Some of these samples also exceeded the vanadium screening level. 2 samples of the above samples were located within future POS area, 1 sample was from below the surface at >600mm below finished levels, and 1 sample was taken from the area of a garage. A re-sample of the latter showed a substantial increase in both arsenic and vanadium. Statistical analysis of all the samples from the residential housing area showed a marginal exceedence of the upper confidence limit (P0.95) for arsenic and vanadium criteria, although these were met if the second re-sample is excluded as a statistical outlier. It is recommended further examination of this area take place following confirmation of levels and future cover thickness, although it should be noted that the presence of naturally elevated arsenic and vanadium are characteristic of the area and these elements are likely to be in low solubility / low bio-availability minerals.
- 5.1.4. With respect to the arsenic concentrations in the POS area, there will be further ground disturbance associated with the construction of balancing ponds, and the area should be further considered following these works. However it is noted that the average arsenic concentration in this part of the site does not exceed the DEFRA provisional limit (C4SL) for parkland soil that can be considered in a Part IIA context to be definitely not Contaminated Land.
- 5.1.5. Exceedences of the soil cover screening criterion for benzo(a)pyrene were found in 4 locations, however after re-sampling there was only a single minor exceedence. This concentration was less than the DEFRA provisional limit (C4SL) for garden soils that can be considered in a Part IIA context to be definitely not Contaminated Land. The polycyclic aromatic hydrocarbons including benzo(a)pyrene appear to be associated with coal or coal ash and are likely to be of low significance in terms of solubility and bio-availability.

5.1.6. One underground fuel storage tank was located within the site, UG-NSA-8, alongside the former supermarket building. The tank contents were removed for specialist treatment and the tank and surrounds were removed in accordance with the Remediation Strategy requirements. The tank surrounds were validated, again in accordance with the Strategy, and no significant hydrocarbon contamination was found. No further remediation was required. The tank excavation has been temporarily back-filled but the area will be subject to further earthworks to form the balancing ponds and landscaping in this area.

5.2. Recovered Materials

5.2.1. A total of approximately 1200m³ topsoil stripped from grassed areas during the remediation works has been stockpiled and retained on site. SGP has sampled this to determine the potential for reuse as cover soil. A total of three samples were collected achieving a sampling frequency of >1 per 500m³. Testing indicates that the stockpiled topsoil is suitable for reuse within the development however any further necessary assessment of these materials following placing in gardens and landscaping will be the responsibility of the developer.

5.2.2. Approximately 2000m³ recovered aggregate was generated on site. A total of 4 samples were collected from this stockpile for asbestos screening purposes only. No samples were found to contain asbestos. The sampling frequency of 1 per 500 m³ has been achieved.

5.3. Ground Gas / Vapour Hazards

5.3.1. No significant sources of hydrocarbon vapours were identified on or adjacent to the site. The former underground storage tank (UG-NSA-8) location was not significantly contaminated.

5.3.2. Significant amounts of degradable organic materials were not reported during the site turnover and there is no evidence to revise the classification of the site in respect to risks to development from hazardous ground gas.

5.4. Water Main Risk Assessment

5.4.1. No significant risks have been identified with respect to the laying of water mains, however the requirements of the water services provider, including risk assessment, should be followed.

5.4.2. In this respect, the guidance issued by Albion Water has been followed to the extent possible, i.e. in the absence of information on actual pipeline routes. However, SGP has carried out walkover inspections of the proposed areas surrounding building plots where it is anticipated that mains may be placed, and has carried out PID screening on the exposed soils. No evidence of volatile substances or organic contamination has been found following the regrading works to date.

5.4.3. Further assessment should be carried out when the pipeline routes are confirmed, and following the completion of groundworks / prior to trench excavation.

5.5. Sulphates and Concrete

5.5.1. No specific testing has been undertaken for potentially aggressive conditions to concrete. Reference should be made to the preceding site investigation reports.

5.6. Further Requirements

5.6.1. In order to secure completion of remediation in the Phase B1 and B2A area in accordance with the Remediation Strategy, the developer is required to complete the agreed garden / landscaping cover system by placing a minimum further 200mm of clean, validated soils in all garden and landscaped areas (up to 600mm in areas where the UR remediation works have left lower ground levels at handover), and subject to the further assessment around the area between plots 28 and 29.

5.6.2. With the adoption of the above normal practices for Brownfield development, and on the information available to it, SGP concludes that the preparatory remedial works have been completed in accordance with the agreed strategy. In the event that any previously undisclosed contamination or suspect materials are identified then this should be assessed by an appropriately qualified and experienced person.

5.7. Long-term Management and Monitoring

5.7.1. No specific requirements for long-term monitoring or management have been identified within the site. Residual contamination has been found to be of low significance, low mobility and stable, and is unlikely to become a pollution source in the future.

5.8. Limitations

5.8.1. SGP reserves the right to alter any of the foregoing information in the event of new information being disclosed or provided and in the light of changes to legislation, guidelines and responses by the statutory and regulatory authorities.

5.9. This report has been prepared by Smith Grant LLP, for the sole and exclusive use of Urban Regen Ltd. and Bovis Homes, and the benefit of this report may not be assigned to any third party without the prior agreement in writing of Smith Grant LLP.

5.10. Reasonable skill, care and diligence have been exercised within the timescale and budget available, and in accordance with the technical requirements of the brief. Notwithstanding the efforts made by the professional team in undertaking the assessment and preparing this report, it is possible that other ground conditions and contamination as yet undetected may exist. Reliance on the findings of this report must therefore be limited accordingly. Such

reliance must be based on the whole report and not on extracts which may lead to incomplete or incorrect conclusions when taken out of context. This report reviews and relies upon site investigations largely conducted by others. If errors or omissions in previous work have been noted then these have been duly noted, however SGP accepts no responsibility for advice given on the basis of incorrect factual information provided to it.

DRAWINGS



- Approx Stockpile Locations
- Unremediated Road
- Pond/Landscaped Area

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Project:
Bovis Phase 1 & 2A Upper Heyford

Drawing:
Soil Validation Location Plan

Drawn:	GC	Checked:	AFS
Date:	20/03/2014	Scale:	1:1250 @ A3
Job No:	R1742	Drg No:	D01



124.62

124.58

124.56

124.75

124.79

124.49

124.53

124.50

124.51

124.59

124.53

124.57

124.44

○ + FH
PUMPS FE HT 2.2M

UG8-1

UG8-2

UG8-4

UG8-3

124.52

124.46

124.68

124.62

124.71
124.58

124.68

124.49

124.52

124.45

124.43

124.39

124.43

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124.63

124.56

124.72

124.71

124.60

124.59

124.57

124.47

124.59

124.60

124.71

124.72

*LP

124.68

124.67

124.59

124.68

124.65

124.65

124.55

124.57



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Project:

Bovis Phase 1 & 2A, Upper Heyford

Drawing:

Tank Validation Plan - UG8

Drawn:

GC

Checked:

AFS

Date:

02.04.2014

Scale:

1:250 @ A4

Job No:

R1742

Drg No:

02

APPENDIX A.

Site Photographs



1. cover validation 20/11/13 – P1-P9



2. cover validation 20/11/13 – P1-P9



3. cover validation 20/11/13 – P1-P9



4. cover validation 20/11/13 – P1-P9



5. cover validation 20/11/13 – P1-P9



6. cover validation 18/12/13 – B581-SS1-West



7. cover validation 18/12/13 – B581-SS1-West



8. cover validation 18/12/13 – B581-SS2-West



9. cover validation 18/12/13 – B581-SS2-West



10. cover validation 18/12/13 – B582-SS1-West



11. cover validation 18/12/13 – B582-SS1-West



12. cover validation 18/12/13 – B582-SS2-West



13. cover validation 18/12/13 – B582-SS2-West



14. cover validation 18/12/13 – B582-SS3-West



15. cover validation 18/12/13 – B582-SS3-West



16. cover validation 18/12/13 – B582-SS4-West



17. cover validation 18/12/13 – B582-SS4-West



18. 18/12/13 – B582 West-Site generated topsoil



19. 18/12/13 – B582-Site generated topsoil



20. cover validation 07/02/14 – B581-SS1



21. cover validation 07/02/14 – BOV-5SS1



22. cover validation 07/02/14 – B581-SS1



23. cover validation 07/02/14 – B581-SS2



24. cover validation 07/02/14 – B581-SS2



25. cover validation 07/02/14 – B581-SS2



26. cover validation 07/02/14 – B581-SS3



27. cover validation 07/02/14 – B581-SS3



28. cover validation 07/02/14 – B581-SS3



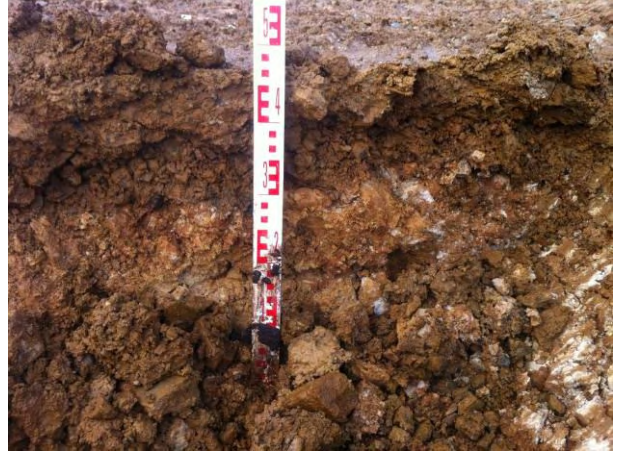
29. cover validation 07/02/14 – B581-SS4



30. cover validation 07/02/14 – B581-SS4



31. cover validation 07/02/14 – B581-SS4



32. cover validation 07/02/14 – B581-SS5



33. cover validation 07/02/14 – B581-SS5



34. cover validation 07/02/14 – B81-SS5



35. cover validation 07/02/14 – B581-SS6



36. cover validation 07/02/14 – B581-SS6