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Your ref:

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Dear Ramon

**Upper Heyford – Trenchard Circle (Planning Ref. 16/00196/F)
Verification Report Review & Gap Analysis**

SGP understand that site investigation and remediation works have taken place on a parcel of land in the northeast of the Heyford Park development referred to as 'Trenchard Circle'. The site falls outside the area covered by the SGP remediation Strategy (R1742-R01) which extends up to the site's western boundary (Dorchester Phase 2).

Planning consent has been granted for the residential redevelopment of the site (ref. 16/00196/F) with Condition 10 relating to contaminated land. This is worded as follows:

If, during development, contamination not previously identified is found to be present at the site then no further development (unless otherwise agreed in writing with the local planning authority) shall be carried out until the developer has submitted a remediation strategy to the local planning authority detailing how this unsuspected contamination shall be dealt with and obtained written approval from the local planning authority. The remediation strategy shall be implemented as approved.

The following reports have been provided which relate to the site:

- AAe - Phase 2 Environmental Risk Assessment, December 2016 (ref. 163408/ERA/001)
- AAe - Remediation Strategy, February 2017 (ref. 173042/RS/001)
- H Fraser Consulting – Controlled Waters Risk Assessment, June 2017
- AAe Remedial Completion Report, February 2018 (ref. 173042/RCR/001)

As some remedial works have already taken place and been reported, SGP have been instructed to carry out a review of the reported information in order to consider its compliance with the SGP Strategy and provide recommendations for further investigation and/or sampling to confirm with the Strategy requirements.

AAe - Phase 2 Environmental Risk Assessment (ref. 163408/ERA/001)

The site was formerly occupied by 7-pairs of semi-detached residential properties with gardens, a pumping station in the northwest corner and substation in the southeast. An oil pipeline served all the houses provided heating oil with the pipeline buried at an approximate depth of 0.2m running along the north and west of the site. Demolition of the properties and removal of hardstanding were completed prior to the site investigation.



In November 2016 site investigation works were carried out by AAe utilising 7 machine excavated trial-pits (TP01-TP07), 30 verification pits (TP08-TP37) and the collection and submission of representative soil and water (perched) samples for laboratory analysis including metals, fractionated hydrocarbons, polyaromatic hydrocarbons and asbestos. Arisings were screened with a photo-ionisation detector (PID) to measure volatile organic compounds (VOCs) within soils.

Contamination indicators including staining and hydrocarbon odours were observed with a maximum PID reading of 132.3 ppm (TP18 0.9m bgl) and were associated with the oil pipe (consisting of 2 metal pipes) which remained in-situ. It was observed that the pipe lines connected to the former properties via feeder lines. No contamination indicators were recorded outside the area of the oil pipeline.

The report recommended (Table 6.1) a number of further investigation / remedial works to take place these were as follows:

- Installation of boreholes & hydrogeological assessment;
- Remedial Plan (Strategy);
- Pipeline Removal & excavation/treatment of impacted soils and perched groundwater;
- Ground gas risk assessment;
- Capping of site;
- Protection of landscaping, scheme and plants;
- Protection of services and structures;
- Unexpected contamination;
- Waste disposal.

AAe - Remediation Strategy (ref 173042/RS/001)

A Remediation Strategy was produced by AAe for Agetur UK Ltd. The Strategy included proposals to remove contaminated soils and collect validation samples to verify the removal of impacted soils.

It was proposed that the most significantly impacted soils, pipework and hydrocarbon contamination was removed and treated through bio-piling or off-site treatment/disposal. Determination of impacted soils was proposed through visual (staining / discolouration of soils), olfactory (strong hydrocarbon odours) and PID screening every 5m of excavation with soils exceeding 5ppm to be removed.

The Strategy referred to comparison of validation samples to generic screening criteria (residential with homegrown produce) for soils and water screening values for groundwater although no detail was provided on the frequency at which validation samples were to be collected.

The Strategy stated that any exceedances of the remedial validation criteria would require the installation of hydrocarbon vapour resistant membranes in accordance to Gas Characteristic Situation 2 (CS2) within all buildings as well as the placement of a basal geotextile and 600mm clean garden soil cover system within all gardens or a reduced 250mm cover in landscaped areas.

Removal of impacted soils and the remaining pipeline was considered in the report to prevent any potential for further leaching of hydrocarbons into the unsaturated zone and to achieve further improvement on the effects of natural attenuation, Oxygen Release Compounds (ORC) were proposed to be mixed within the soils at the base of the excavation to facilitate enhanced degradation.

It was also stated that water supply pipes as part of the re-development of the site will consist of barrier pipe due to the hydrocarbons reported on site.

Proposals were also made for the installation of 6 groundwater monitoring boreholes into the limestone aquifer to determine the depth of groundwater beneath the site, determine groundwater flow direction, collect water samples to determine and quantify the presence of contaminants within the



aquifer beneath the site and monitoring groundwater quality post-remediation works. This assessment was to be presented within a Detailed Quantitative Risk Assessment to assess residual risks to Controlled Waters and determine any further remedial works required and derive acceptable remedial targets.

The Strategy is considered to be limited with regards to detail on how impacted soils will be removed, handled, stored and how and where validation samples to verify the remediation works will be collected. The requirement for groundwater well installation, sampling and production of a DQRA would typically be produced prior to the writing of a Strategy as the information is used to identify remedial target values and identify whether groundwater treatment is required.

H Fraser Consulting – Controlled Waters Risk Assessment

Six boreholes (BH01 – BH06) were drilled by rotary methods to depths of 10m bgl. Weathered limestone was recorded from the surface typically 1m bgl before rockhead was encountered. Groundwater was recorded at around 2m bgl in each of the boreholes with groundwater flow direction reported to the east.

Two rounds of groundwater monitoring were carried out in the 6 boreholes in February and March 2017, concentrations of hydrocarbons failed to exceed analytical detection limits (<10µg/l). The report confirmed the absence of a dissolved plume of contamination and that depleted oxygen concentrations suggested that active biodegradation is taking place.

The assessment derived Remedial Target Values (RTVs) for fractionated hydrocarbons for soil and shallow groundwater and recommended that remedial works included the removal of free product and that the derived RTVs be adopted for remedial verification criteria.

AAe Remedial Completion Report (ref. 173042/RCR/001)

Remedial works were carried out between October and November 2018 under the supervision of AAe, it is understood that Cherwell District Council were notified of the proposed scope and further assessment, however it is unknown whether the reports were formerly submitted or approved.

The relict pipework and grossly impacted soils were removed, and validation samples were collected, it is noted that no samples were collected from the base where bedrock was present. A series of rectangular validation excavations (VE1 – VE22) or remediation cells were excavated due to shallow groundwater ingress, groundwater in the excavations was pumped into a treatment plant before discharge to ground on the wider site. No information pertaining to the type of treatment or sampling of treated waters prior to discharge is provided. In addition to the validation excavations, 6 trial-pits were excavated outside the remedial excavations to confirm the absence of contamination.

During the remedial works, 2 previously unidentified 4,500 litre below ground oil tanks were encountered, these were removed, and the surrounding soils inspected and tested. No further detail was provided such as the contents of the tanks and their decontamination status prior to removal.

Removed impacted soils were reportedly relocated within the wider Heyford Park area for bio-piling or off-site disposal, it is uncertain whether treatment or disposal took place. If it was the latter no waste transfer tickets were provided in the report, similarly no detail as to storage of impacted soils for treated soil was provided. Metal pipework and tanks were reportedly disposed of off-site for recycling.

Following removal of visually impacted soils and collection of validation samples, ORC was placed in the base of the excavations and the voids were backfilled with suitable fill material. No information is provided on the source or origin of the material although it is stated that verification of backfill material used will be reported under a separate cover. It is uncertain whether this has been reported.



Validation samples were compared against the derived RTVs with 6 exceedances reported. Two of the exceedances (VS06 and VS12) were associated with residual impacted soils along the site boundary where further removal could not take place, whilst further excavation, removal and re-validation was proposed for VS27, VS44, VS56 and VS57.

Remedial works were constrained in the northeast corner due to site boundary fence and existing roadway (Trenchard Circle).

Following the completion of the supplementary remediation works, a round of groundwater sampling was carried out in the existing boreholes (BH1-BH6) with samples submitted for metals, hydrocarbons, PAH, cyanide and ammoniacal nitrogen. Concentrations of hydrocarbons and PAHs were below detection limits in all instances. The report concluded that remedial works have been completed as far as is reasonably practicable with residual soils assessed as not posing a risk to human health or the environment but that a number of outstanding remedial measures are required during the construction stage, these are as follows:

- Validation testing of the backfill material;
- Provision of clean capping layer within areas of proposed soft landscaping;
- Ground gas (VOC) membrane within floorslabs or proposed properties. Membranes to be installed and certified in accordance with BS8485:2015 and CIRIA C735;
- Protection of structures and services (including barrier pipe for potable water supply). Test results to be provided to designer and statutory undertakers to determine are protection for structures and services from recorded ground conditions.

Compliance with SGP Strategy

The SGP Remediation Strategy contains provisions for the remediation of hydrocarbon hotspots associated with historical tanks and pipelines, similar to those encountered on this site. Groundwater investigation, analysis and assessment has concluded that the underlying aquifer has not been impacted by the contamination encountered and as no requirement for groundwater treatment is necessary, it is considered that the works completed are compatible with the SGP Strategy with the following provisions/requirements.

Hotspot Validation

It is a requirement of the SGP Strategy that detailed records are kept during the remedial works, AAe have included a detailed photographic record of each remediation cell including the encountered tanks with a drawing highlighting the extent of remediation works and the location of validation samples. It is considered that the records reported are compliant with the Strategy requirements.

Following the removal of impacted soils, it is a requirement under the SGP Strategy that stripped surface will be sampled at a frequency of 1 composite sample per 15m² of exposed surface and sampled submitted for fractionated hydrocarbon analysis. No sampling frequency was provided in the AAe verification report although 66 validation samples were collected. The remediated area was approximately 2,406m² and sampling was generally limited to the sidewalls of the excavation due to presence of shallow bedrock. This is consistent with the SGP Strategy as there is no requirement to remediate bedrock. It is therefore considered that a sufficient number of samples have been collected to verify the completion of remedial works.

Validation criteria derived for the removal of hydrocarbon hotspots in the SGP Strategy were derived by Waterman (Remediation Strategy New Settlement Area – ref. EED10658-109_S_12.2.3_FA) and



were based on the distance from the southern / south-eastern boundary. As the site is located within 250m of the eastern boundary of Heyford Park, the lower threshold criteria (Watermans Table B2) would apply. This is compared to the derived validation criteria produced by H Fraser Consulting in their site-specific Controlled Waters Risk Assessment for the area under consideration and summarised below:

Table 1. Comparison of SGP Strategy and Validation Concentrations

Petroleum Hydrocarbon Fraction	Derived DQRA Soil Remedial Target Value (mg/kg) **	SGP Strategy Soil Remedial Target Concentration 0-250m (mg/kg) *	Range of Validation Concentrations	Exceedances of SGP Remedial Target Concentrations
Aliphatic C5-C6	2.5	-		
Aliphatic C6-C8	120	-		
Aliphatic C8-C10	500	80	<1 – 40	None
Aliphatic C10-C12	1,900	1,000	<1 – 220	None
Aliphatic C12-C16	11,000	1,000	<1 – 1,100	(1) VS56 (1.55-2.0m bgl)
Aliphatic C16-C21	560,000	1,000	<1 – 830	None
Aliphatic C21-C35	511,000	1,000	<1 – 210	None
Aliphatic C35-C44	454,000	-		
Aromatic C10-C12	20	7	<1 – 23	(1) VS57 (1.55-2.0m bgl)
Aromatic C12-C16	30	120	<1 – 200	(1) VS56 (1.55-2.0m bgl)
Aromatic C16-C21	22	440	<1 – 200	None
Aromatic C21-C35	120	1,000	<1 - 150	None
Aromatic C35-44	100	-		

* Screening Criteria, Hydrocarbon Hot-spots dependent on distance from southern / south-eastern site boundary (from Waterman Tables B2); SGP Strategy

** Derived Remedial Target Values for contamination hotspot remediation in Trenchard Circle; AAe Strategy.

Comparison of the validation dataset to the SGP Remediation Strategy criteria only results in 2 exceedances, VS56 for the aliphatic C12-C16 (1,100 mg/kg) and aromatic C12-C16 (200 mg/kg) hydrocarbons and VS57 for the aromatic C10-C12 (23 mg/kg) hydrocarbons.

The area of both samples were further remediated due to the initial exceedances with additional verification samples (VS73, VS74 and VS66) collected. No exceedances were reported following further remediation and verification suggesting that the residual impacted soils had been sufficiently removed.

This would suggest that whilst the report does not directly refer to the SGP validation criteria, compliance of the validation criteria has been achieved.

Backfill Validation

The AAe verification report recommends that validation testing of the backfill material is required. It is a requirement of the SGP Strategy that backfill material placed within the unsaturated zone is tested to comply with criteris (SGP Strategy – Table 6.3)

Outstanding SGP Remediation Strategy Requirements

1. Validation Formation Soils

Made ground was reported as being either absent or comprised of reworked weathered natural soils. Backfill material following the removal of impacted soils has also taken place and the provenance of



the backfill soils is presently unknown. Providing formation soils are absent of anthropogenic materials such as ash, clinker and slag then the upper 400mm soil profile on the site may be suitable for retention within garden areas. This may largely depend on the material imported as fill within the remediation voids under the SGP Strategy. Validation sampling is required to be completed on a 35m grid spacing which assuming a site area of 11,250m² corresponds to the collection of 9 in-situ samples.

These works have not been completed in the existing validation reporting and are to be completed and reported in accordance with the SGP Strategy unless a 600mm soil cover of clean validated soils is placed over existing site soils.

2. Backfill Validation

It is a requirement under the SGP Strategy that validation of backfill material following tank / contamination removal etc. is verified to comply suitability for reuse. Testing is to comply with the criteria outlined in Table 6.3 of the SGP Strategy. Validation of the backfill could be satisfied by completion of the validation of formation soils (point 1) provided these areas targeted for sampling.

3. Building Gas Protection

The AAe verification report currently recommends that gas protection measures including a VOC membrane is installed and verified in accordance with BS8485: 2015 and CIRIA C735. It is anticipated that this recommendation has been made due to the potential for impacted bedrock to remain and/or constraints to remediation in the northeast although this is not explicitly discussed or confirmed in the report.

It may be possible through post-remediation vapour monitoring to revise this requirement, however in the absence of any further assessment a precautionary approach should be adopted which would entail the installation of a vapour barrier with sub-floor void and verification in accordance with the guidance (which may include integrity testing). Details of proposed gas/vapour protection measures and verification plan should be submitted and approved to the Local Authority in advance of the works commencing.

The SGP Strategy requires that where it is not feasible to remediate all residual hydrocarbons due to adsorption into bedrock then any such areas will be identified and may be classed as NHBC Amber-1 as precautionary measures. The options for the Developer will be to either pursue suitable building as protection measures for Amber 1 or to undertake post-remediation vapour monitoring to re-assess the situation.

The recommendations for vapour protection is therefore compatible with the SGP Strategy in the absence of post-remediation vapour monitoring to confirm the requirement for VOC protection measures. The design and specification of precautionary measures including verification need to be submitted and approved by the Local Authority.

4. Water Mains

The current recommendation in the remedial completion report is the use of barrier pipe for potable water supplies.

The SGP Strategy states that utility provider guidelines require particular assessments and that these should be carried out as appropriate. A Water Pipeline Risk Assessment (PRA) is likely to be required by the utility provider and should be completed as necessary. Due to the potential for impacted bedrock to remain then the reported requirement for barrier pipe within the development may be necessary.



5. *Concrete Protection*

Soil samples during the site investigation works were submitted for pH and Soluble Sulphate however no assessment to determine aggressive ground conditions to concrete were made in the report.

The SGP Strategy states that requirements are specified within the ground investigation reports. This is an outstanding action and the data used in the site investigation report should be made to complete the assessment and advise on the requirement for concrete protection.

Recommendations

It is recommended that the following works are carried out to comply with the SGP Strategy:

- Formation Sampling: Site walkover to inspect formation soils for visual contamination indicators (inclusions of ash, clinker and slag) and formation sampling (9 samples) to determine whether the top 400mm soil may form part of the garden / landscape cover. Samples are to be compared to the capping layer criteria outlined in the SGP Strategy;
- Validation of backfill material. This could be carried out and completed under the formation sampling providing the backfill soils are clean naturally occurring and free from inclusions of ash, clinker and slag;
- Either
 - Post-remediation vapour monitoring utilising shallow vapour probes to determine whether there's a risk of vapour migration into dwellings following the completion of remediation works, or;
 - in the absence of post-remediation monitoring then details on the precautionary protection measures (CS2 specification with VOC membrane) to be installed and details on the proposed verification in line with current guidance are to be submitted and approved by the regulators prior to construction;
- Production of Water Supply Pipeline Risk Assessment in accordance with Utility provider requirements;
- Assessment on concrete classification utilising existing site investigation data;
- Use of suitable soils for cover system / topsoil cover to be verified through sampling at the prescribed testing frequency and sampling suite in accordance with the SGP Strategy;
- Production of supplementary verification reports to satisfy the above recommendations with reference to the SGP Strategy.

It is recommended that the Site Investigation and Controlled Waters Risk Assessment is submitted to the regulators alongside this letter which assesses the compliance of the works under the SGP Strategy in order to partially satisfy Condition 10 of the planning consent which relates to contaminated land.

Limitations

This report review and the recommendations made herein have been largely informed by information prepared by third parties and provided to SGP. The recommendations contained within this report have been made in good faith, based on the totality of the information provided to SGP, however SGP

Ramon Seera
Dorchester Group



accepts no responsibility or liability for errors or omissions caused by information which has been withheld, or where errors or omissions with previous reporting have led to false or unreliable conclusions by others relating to the contamination status and remedial works of the site.

Yours sincerely
for: Smith Grant LLP



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