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ENVIRONMENTAL

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Additional Ground Investigation Works and Assessment, Splashlands, Stanborough Park

1. INTRODUCTION, PROJECT RATIONALE AND UNDERSTANDING OF THE OBJECTIVES

Harrison Environmental Group (HGE) has recently undertaken and reported on a Ground Investigation (GI), Ref GE22715 dated July 2019, at the proposed "Splashlands" site within Stanborough Park, Welwyn Garden City.

The HGE Report was submitted to the consulting engineer (Conisbee) and we understand the regulatory authorities, in this case the Environment Agency (EA). Rev 2 of the report was submitted following Conisbee comments in email dated 10th June 2019 and was also inclusive of rounds 5 & 6 gas/groundwater monitoring & assessment. Throughout this additional assessment the report will be referred to as GE22715 May 2019 GI Report.

We understand that from a meeting between these parties, and for reasons outlined below, additional Ground Investigation works were requested to support the GE22715 May 20019 GI Report's findings and to provide additional data regarding potential geoenvironmental issues. This report is associated with an additional Phase 2 ground investigation undertaken in July/August 2019.

The GE22715 May 2019 GI Report detailed above should be referred to for full details of the initial geotechnical and geoenvironmental assessment for the subject site. However, the findings and recommendations of the initial report can be summarised as:-

The levels of contaminants detected in the soils are not considered to represent a significant risk to the sensitive receptors identified for the proposed development, all the identified soil concentrations were below Public Park and Residential without Plant Uptake end-user criteria's, however: -

- Asbestos was identified in 6 No. of the 27 No. made ground samples analysed, although this positive identification was confined to the made ground. Additional investigation/sampling was recommended to confirm the frequency and quantity of asbestos, assessing the risk and appropriate actions accordingly.

  The analysis was recommended to be undertaken mainly within the made ground/topsoil that is proposed for reuse in soft landscape areas and to confirm the extent of the made ground associated with likely crushed demolition waste from former onsite structures. A reassessment at this stage could re-evaluate the health risk, based on the percentage present in samples where asbestos is detected. Subsequent planned actions could then be reviewed.

- Concentrations of PCBs in the made ground at TP104 (exceeding the minimum detection limit of the testing equipment) requires further consideration, although the concentrations are unlikely to be considered significant.

- Ammoniacal Nitrogen locally exceeded drinking and environmental criteria in groundwater (WS109, WS108, WS101 and WS103 all located within the south east and east of the site). Additional 1 No.

leachate analysis also exceeded criteria for ammoniacal nitrogen though the sample was also from WS109 at 1.5m which is located very close to or below the groundwater water table.

The source of the elevated concentrations is not currently known and requires further consideration/discussion with the regulators. However, it was recommended that further information regarding the location and the condition of sewage pipes on and in close vicinity to the site should be considered.

- Two groundwater samples (WS105 and WS101) returned TPH concentrations on an initial round of groundwater testing. This was not replicated on a repeat round of testing for TPH CWG. However, it was recommended to take additional groundwater samples from WS105 and WS102 for further TPH CWG analysis to confirm the latest results obtained.
- Mercury marginally exceeded its environmental criteria of 0.007ugl/l with 0.008ugl in WS102 groundwater sample only. All other exploratory groundwater results did not exceed the MDL of the testing equipment. Given the slight exceedance, the concentration is not considered a significant risk to identified receptors.
- Lead exceeded its initial screening criteria in the 2 No. river samples (R1 & R2) and marginally in WS109 groundwater sample. The highest concentrations were recorded within the river samples (both up and down gradient of the site). None of the concentrations exceeded the MAC EQS therefore, the marginal exceedance in WS109 is not considered a significant risk to identified receptors.
- Nitrate NO_3 exceeded drinking water standards in the 2 No. river samples. The concentrations within the groundwater across the site did not exceeding the MDL of the testing equipment and are not considered a significant risk to identified receptors.
- Phytotoxic contaminants in the soils were found to be below screening criteria. No action considered necessary.

We understand that the initial GE22715 May 2019 GI Report was submitted to the Environment Agency for comment by Conisbee. Initial comment was received in an email to Conisbee dated 13th March 2019 which stated.

- Asbestos isn't an issue that we will comment on, you will need to consult the Welwyn-Hatfield contaminated land officer.
- Our Ground Water and Contaminated Land team (GWCL) cannot see the point of arranging a meeting at this point – They would like to see some additional groundwater data before getting drawn into a conversation about the site. You should undertake additional groundwater monitoring, as recommended in the report, to see if the elevated ammoniacal nitrogen concentrations noted in some of the wells persist and that the other concentrations stay the same.

Conisbee responded on the 13th March 2019 stating: -

- Asbestos - We will undertake additional sampling on a 5m x 5m grid in order to obtain further samples. During the works the soil will be moved so it is our proposal that a Geoscientist with a watching brief will be appointed to monitor the earthworks during the construction period in order to identify fragments of Asbestos that may not have been picked up during the sampling exercise. It is also proposed to provide a clear cover of 300mm of imported topsoil within the proposed new fenced children's playground incorporating the splashpad.
- Groundwater Monitoring - We are proposing to undertake additional testing including the sinking of 5 / 8 additional boreholes so that the location of the contamination may be isolated.

Subsequently on the 1st July 2019 it is understood that Conisbee contacted the Environmental Health Officer (EHO) to discuss the identified asbestos concentrations and further investigation proposals. We also understand that Conisbee discussed additional asbestos analysis in a grid across areas of the site where asbestos has currently been identified. This was to further define the extent and quantification of asbestos/asbestos fibres in the made ground soils at the site.

HGE had a meeting with Conisbee on the 5th July 2019 to review the above and define the best approach moving forward. The scope detailed in section 2 below was requested. In additional it was discussed that existing sewage pipes could potentially be the source of the elevated Ammoniacal Nitrogen in the

groundwater and further details (location and condition) of the sewage pipes (and other services) should be obtained before any additional intrusive works were undertaken.

At the time the additional ground investigation commenced onsite (on the 17th July 2019) further information regarding the sewage pipes was still not available. However, at the time of this additional assessment report, further information had been provided by the client and is detailed in section 2.7 of this report.

2. ADDITIONAL JULY 2019 INTRUSIVE GROUND INVESTIGATION

An exploratory hole location plan which details the initial GE22715 May 2019 GI Report exploratory locations and the additional exploratory locations undertaken as part of this assessment (undertaken in July 2019) is presented in Appendix A (HGE Drawing DR002 & 2A). DR002A also details the extent of the proposed earthworks and the approximate location of historical structures identified from the OS maps.

2.1 Service Clearance/Surveying

Pre-intrusive works were undertaken by an independent specialist who cleared proposed exploratory locations utilising a range of techniques including Ground Penetration Radar (GPR).

The service cleared locations were also surveyed in to establish the coordinates of all exploratory positions, the details of which are shown on the appropriate records presented in Appendix C.

2.2 Dynamic Sampling (Windowless Sampler) Boreholes

8 No. additional dynamic sampler boreholes (WS201 to WS208) were initially proposed to be drilled within the site's south eastern and eastern area. These were to further define the extent of elevated Ammonical Nitrogen identified within the groundwater, and to provided additional information of the made ground in the proposed earthworks 'cut' areas. The source material from these 'cut' areas are proposed to be reused as earthworks 'fill' as part of the development and further clarification if the soils are chemically 'fit for purpose' was considered prudent.

WS201 to WS207 were drilled between the 16th and 18th July 2019. The works were undertaken using a dual-purpose tracked rig to depths between 0.30 and 5.20mbgl in order to identify, sample and test the underlying sub-soils.

WS204 was attempted at six locations (WS204 to WS204E) but repeatably refused above the groundwater table. Eventually WS204E was completed and a groundwater installation was installed as detailed in table 2.2 below. WS205 and 205A refused twice within made ground at 1.5mbgl and a groundwater installation was installed in WS205A at 1.5m bgl, 0.50m below the groundwater strike. WS207 could not be continued deeper than 0.30mbgl due to refusal in compacted granular made ground and was not installed. WS208 which was proposed to be undertaken near the existing WS102 borehole was not undertaken due to on site time constraints.

Upon completion, all 6 No. boreholes were installed with groundwater/gas monitoring wells, the details of which are summarised in Table 2.2 overleaf.

A detailed description of all the strata encountered, in-situ testing undertaken, position and types of samples taken along, with any groundwater observations made at the time of drilling are included on the dynamic sampling borehole records presented in Appendix C.

Monitoring Point I.D	Diameter of Installation (mm)	Base Depth of Installation (m)	Response Zone (m depth)		Target Strata
			Top	Base	
WS201	50	50	1.00	5.00	MADE GROUND – COHESIVE. FLUVIAL DEPOSITS - GRANULAR
WS202	50	50	1.00	5.00	FLUVIAL DEPOSITS – GRANULAR. WHITE CHALK SUBGROUP.
WS203	50	50	1.00	3.00	FLUVIAL DEPOSITS - GRANULAR
WS204E	50	50	1.00	4.00	MADE GROUND GRANULAR. FLUVIAL DEPOSITS - GRANULAR
WS205A	50	50	0.50	1.50	MADE GROUND - GRANULAR
WS206	50	50	1.00	3.00	FLUVIAL DEPOSITS – GRANULAR & COHESIVE

Table 2.2: Summary of Additional Phase 2 monitoring installations.

Detailed descriptions of the installations and their corresponding backfill materials are included on the relevant exploratory hole logs presented in Appendix C.

2.3 Hand Excavated (Machine Assisted) Trial Pits

36 No. trial pits (HP201 to HP236) and an additional 3 No. (HP301 to 303) were undertaken by hand digging assisted by a mini excavator between the 17th and 19rd July 2019 to depths between 0.30 and 1.10mbgl. A mini excavator was utilised instead of a larger machine such as a JCB to ensure a small pit could be excavated, thus limiting soil disturbance and potential reinstatement issues. All arisings from the pits were placed on boards and the excavations were terminated if groundwater was encountered. This limited the potential of any potentially contaminated soil left at surface and allowed for the materials to be compacted with the excavator bucket on completion.

The pits were undertaken in order to sample, test and log the underlying soils, and to define the extent of granular crushed demolition waste associated with former buildings/structures which is the likely source of asbestos fibres previously identified in the GE2017 May 2019 GI Report.

Trial pits were also undertaken to provide additional information of the made ground in the proposed earthworks ‘cut’ areas. The source material from these ‘cut’ areas are proposed to be reused as earthworks ‘fill’ as part of the development and further clarification if the soils are chemically ‘fit for purpose’ and asbestos free was considered prudent.

Additionally, HP301 to 303 were undertaken in the vicinity of TP104 which previously identified PCBs in made ground above the minimum detection limit of the testing equipment.

The pits were hindered by compact granular made ground, locally high groundwater/instability and buried structures/services.

The pits were proposed to be undertaken to 1.0mbgl but the above hindrances especially compact made ground resulted in numerous pits refusing above this depth. Additionally, HP225 terminated due to encountering a large metal pipe at 0.50mbgl. HP231 located within the north eastern proposed earthworks ‘cut’ source area, encountered brick and concrete foundations from 0.40m and terminated at 0.60mbgl.

A detailed description of all the strata encountered, position and types of samples taken, tests performed; along with any groundwater observations made at the time of excavation and are included on the trial pit logs presented in Appendix C.

2.4 Ground Conditions

A summary of the geology encountered during both phases of the ground investigations (May 2019 GI exploratory locations and from the additional exploratory locations as detailed above undertaken in July 2019) is presented in Table 2.4 below.

Geology	Depth Below Ground Level (m) Encountered		Thickness (Min / Max) (m)	Thickness (Average) (m)	Site Level Range (maOD) Encountered	
	Upper Boundary	Lower Boundary			Upper Boundary	Lower Boundary
Topsoil	Ground Level	0.01 - 0.20	0.01 - 0.20	0.08	63.13 - 65.10	63.12 - 64.90
Made Ground - Granular	Ground Level - 0.25	0.10 - 2.30	0.05 - 2.30	0.73	63.07 - 65.37	61.12 - 65.07
Made Ground - Cohesive	Ground Level – 0.90	0.15 - 2.20	0.15 - 2.13	0.46	62.44 - 65.31	61.84 - 65.06
Fluvial Deposits - Granular	Ground Level - 2.30	0.50 - 5.00	0.20 - 4.40	1.48	61.12 - 64.88	58.87 - 63.93
Fluvial Deposits - Cohesive	0.20 - 1.50	1.00 - 1.80	0.05 - 1.46	0.68	61.84 - 65.07	61.79 - 64.17
Fluvial Deposits - Silt	1.60 - 2.40	1.80 - 3.00	0.20 - 0.60	0.40	62.56 - 62.97	62.36 - 62.37
White Chalk Subgroup	1.30 - 5.00	3.00 - 5.20	0.20 - 3.15	0.89	59.16 - 63.93	58.59 - 60.79
No Recovery/Null	2.00 - 4.00	3.00 - 4.45	0.40 - 1.45	0.89	59.31 - 61.41	58.91 - 60.41

Table 2.4: Depth/level range of the differing strata encountered during initial Phase 1 and additional Phase 2 ground investigations

The geological sequence encountered during the additional July 2019 ground investigation works was broadly consistent to that as described in the initial GE22715 May 2019 GI Report.

Of note compact granular made ground resulted in numerous exploratory locations refusing above target depth. Additionally, HP225 terminated due to encountering a large metal pipe at 0.50mbgl. HP231 located within the north eastern proposed 'cut' earthworks source area, encountered brick and concrete foundations from 0.40m and terminated at 0.60mbgl.

As within the GE22715 May 2019 GI investigation, the made ground encountered comprised anthropogenic material such as brick and concrete also locally asphalt, possible clinker, roof tile, wood fragments and metal (generally rebar). All of which are visual evidence of potential contamination. Additionally the following olfactory details were recorded

- WS204A - Slight organic odour in granular Fluvial Deposits between 0.85m to 1.00+mbgl.
- WS206 - Weak sulphur odour in cohesive Fluvial Deposits between 0.75m and 1.00mbgl.
- HP227 - Slight organic odour organic in cohesive Fluvial Deposits between 0.80m to 1.00+mbgl.
- HP230 - Slight organic odour organic in cohesive Fluvial Deposits between 1.00m to 1.10+mbgl.

2.5 Monitoring

6 No. rounds of ground gas monitoring and 7 No. rounds of groundwater monitoring were undertaken as part of the initial GE22715 May 2019 GI Report investigation.

During the additional ground investigation which this report is associated with, an additional groundwater monitoring round with associated groundwater sampling was undertaken on the 22nd July 2019.

Groundwater samples were obtained from all borehole installations (GE22715 May GI Report installations and the additional July 2019 installations) using low flow sampling techniques. A peristaltic pump was used

to pump water through a water cell where parameters were monitored using an in situ SmartTroll. A sample was collected after more than one well volume had been purged and either all parameters had stabilised or after two hours. In some instances the recharge rate of the perched water was too slow to maintain a constant head even at the slowest achievable flow rate. Where it was not possible to complete low flow sampling due to very slow recharge time or technical limitations, a groundwater sample was obtained using a dedicated disposable bailer.

Groundwater levels and any free phase NPAL (DNAPL and LNAPL) were also monitored utilising a dual phase interface meter.

The results of the water strikes encountered during the intrusive works are detailed on the relevant records presented in Appendix C.

Volatile Organic Compounds (VOCs) were monitored utilising a PID meter on environmental samples (ES) during the fieldworks. The results are presented on the exploratory logs in Appendix C.

Groundwater details encountered within the boreholes during the intrusive works and subsequently during the groundwater monitoring of the borehole installations are summarised in Table 2.5 below (summary of 8 No. monitoring rounds of the initial May 2019 borehole installations, 1 No. monitoring round of the additional July 2019 installations). The groundwater monitoring records of the additional Phase 2 monitoring round of all the installations at the site is presented in Appendix C.

Exploratory Hole Location	Approximate Water Strike		Standing Groundwater Depth Encountered During Monitoring			
	mbgl	maOD	Shallowest		Deepest	
			mbgl	maOD	mbgl	maOD
WS101	1.50	61.65	0.58	62.57	0.84	62.31
WS102	2.00	63.23	2.58	62.65	2.93	62.30
WS103	2.50	61.96	2.00	62.46	3.05	61.41
WS104	2.00	61.65	1.16	62.49	1.50	62.15
WS105	N/E	-	0.82	62.53	1.00	62.35
WS107	1.00	62.36	0.79	62.57	0.93	62.43
WS108	1.00	62.47	0.95	62.52	1.11	62.36
WS109	2.00	62.16	1.30	62.86	2.20	61.96
WS111	0.70	62.71	0.80	62.61	Dry	Dry
WS201	2.00	62.16	1.80	62.36	1.80	62.36
WS202	1.10	62.49	1.15	62.44	1.15	62.44
WS203	1.20	62.11	0.85	62.46	0.85	62.46
WS204	-	-	No Installation			
WS204A	-	-				
WS204B	-	-				
WS204C	-	-				
WS204D	1.70	61.62	-	-	-	-
WS204E	1.50	61.82	0.80	62.52	0.80	62.52
WS205	1.00	62.19	-	-	-	-
WS205A	1.00	62.19	0.85	62.34	0.85	62.34
WS206	1.60	61.86	1.10	62.36	1.10	62.36
WS207	-	-	No Installation			

Table 2.5: Summary of Groundwater levels during drilling/excavation & monitoring of Phase1 and Phase 2 ground investigations

2.6 Additional Chemical Laboratory Testing with Rationale

Selected soil samples and groundwater samples from the additional July 2019 ground investigation were submitted to a UKAS/MCERTS accredited laboratory for the analyses as detailed in table 2.6 below.

Test Type (exploratory location analysis undertaken with rationale)	Total No. of tests	No. Tests within Proposed Earthworks 'cut/reuse areas'	No. Tests remaining site areas
SOIL			
HSS 6: As, Cd, Cr (Total and VI), Cu, Ni, Zn, Pb, Hg, Se, B, pH, TOC, TPH CWG (inc BTEX), PAH USEPA16, asbestos screen (with ID where found) plus Quantification to 0.001%. (HP231 to TP236, WS201 ,202 and 207 undertaken to provide additional information of the made ground in the proposed earthworks 'cut' areas. The source material from these 'cut' areas are proposed to be reused as earthworks 'fill' as part of the development and further clarification if the soils are chemically 'fit for purpose' was considered prudent. Analysis undertaken from made ground in HP231 0.40m, HP232 0.02m, HP233 0.30 & 0.40m, HP234 0.50m, HP235 0.50m, HP236 0.20m, WS201 0.50m, WS202 0.05m & 0.20m, WS207 0.20m)	12	12	0
Additional asbestos Screen/ID plus quants 0.001% if detected (HP201 to HP230 pits were undertaken in a grid in order to sample, test and log the underlying soils, and to help define the extent of granular crushed demolition waste associated with former buildings/structures which is the likely source of previously locally identified asbestos fibres. At least 1 No. analysis undertaken from made ground in these pits at various depths).	33	0	33
PCB (EC7 SUITE) (HP301 to 303 & HP22/WS205A were undertaken around TP104 which previously identified PCBs in made ground (0.45m) above the minimum detection limit of the testing equipment. Additional analysis undertaken from made ground from HP301 to 303 at 0.40m & HP22/WS205A 0.80m)	4	0	4
LEACHATE. Suite A: As, Cd, Cr, Cu, Ni, Zn, Pb, Hg, B, Se, sulphate, Sulphide, sulphur, chloride, chlorine, NH4 as N, TOC, Calcium hardness, Ph, PAH (speciated), phenols (total), TPH CWG. (Analysis from made ground in WS201 0.50m, HP231 0.40m, HP233 0.30m, HP235 0.20m and HP236 0.50m to provide additional information of the made ground in the proposed earthworks 'cut' areas. The source material from these 'cut' areas are proposed to be reused as earthworks 'fill' as part of the development and further clarification if the soils are chemically 'fit for purpose' was considered prudent). (Also located in area of most elevated Ammonical Nitrogen exceedances in groundwater. Leachate analysis undertaken to obtain additional Ammonical Nitrogen leachate results on the made ground in the area).	5	5	0
WATERS			
Ammoniacal Nitrogen (NH4 as N), Ammonia (NH3), Ammonium (NH4+) (Elevated Ammonical Nitrogen previously identified. Additional analysis undertaken on: Surface water samples RS1 up stream, RS2 down stream, and from all installed boreholes across site - WS101, WS102, WS103, WS104, WS105, WS107, WS109, WS111, WS201, WS202, WS203, WS204E, WS205A, WS206)	16	5	11
Mercury (Total & dissolved) (WS102 previously identified Mercury as slightly exceeding relevant criteria. Additional analysis undertaken from WS102)	1	1	0
TPH CWG (inc BTEX) (WS101, WS105 previously identified TPH as slightly exceeding relevant criteria. Additional analysis undertaken from WS101 & 105)	2	0	2
PCB EC7 suite (WS205A located in close vicinity to TP104 which previously identified PCBs in soil above minimum detection limit of testing equipment. Analysis undertaken from WS205A)	1	0	1

Table 2.6: Summary of Additional Chemical Laboratory Testing Undertaken & Rationale

The results of the above additional analysis are presented in Appendix D and are discussed further in section 3.

GE22715 May 2019 GI Report should be referred to for details of the soil and groundwater chemical analysis and assessment associated with the initial ground investigation.

2.7 Foul Sewer Information and Surveys

GEOTEC Surveys Limited Underground Mapping Survey and associated drawing Ref: 1904S021

On the 9th July 2019 the client provided an underground mapping survey and associated drawing for the subject site, undertaken by GEOTEC Surveys Limited Ref: 1904S021 dated April 2019. This survey detailed the location of the utilities onsite and immediately offsite including foul wewer. The foul sewer was of most interest in this assessment, as it could be a potential Ammonical Nitrogen source (as elevated concentrations have been identified within the groundwater in the south and south eastern area of the site as detailed in GE22715 May 2019 GI Report).

The foul sewer was detailed immediately offsite along the east, south eastern site boundary flowing towards the River Lea to the south west. A foul pipe is also detailed exiting the site area near the site's north eastern corner, but the service was not traced a significant distance into the site (detailed on the survey drawing as 'unable to detect further'). The foul sewer is also detailed from the toilet block onsite flowing offsite to the south. This connects via a manhole to the foul running parallel to the site's south eastern boundary. The foul sewer was not traced further down gradient from this manhole.

HGE discussed this with GEOTEC and it was determined that the client had subsequently instructed a CCTV survey of the foul pipes. As part of this survey the route of the foul would be further defined down gradient to the south west.

The above GEOTEC Report and associated drawing are presented in appendix B.

GEOTEC Surveys Limited CCTV Survey Ref: Cry294 dated 11th July 2019

On the 19th July 2019 after the ground investigation site works had been completed, the client provided a CCTV survey of the foul services on and immediately offsite. It was identified that the foul connected to manhole 12 (# or 3 depending which report is consulted) located adjacent to the River Lea in the site's south western corner, then continued under the boating lake.

(# man hole ID 12 = as defined in the Under Ground Mapping Survey Report / man hole ID 3 = as defined in the plan provided as part of the CCTV Survey).

The report concluded the following:-

- All pipe work was found to be clear and free flowing.
- There is a build-up of scale on the entrance and exit of chambers however, we believe this will have no detrimental effect on the foul system when in full use. This scale could be removed by using specialist cutting equipment if required.
- The survey shows the pipe work from downstream to a certain point and then up stream to the same point to ensure the full run was surveyed as access was restricted due to the push rod camera, depth of the run and size of pipe work.

HGE contacted GEOTEC to determine if the conclusions of the report meant that the foul pipe work surveyed was unlikely to be leaking. GEOTEC responded in an email dated 23rd July 2019 and stated;-

- We found no evidence of possible leaking during the survey, i.e. displaced pipes, cracks in line etc. We dye tested the lines before and after the survey and found no unusual flow problems.
- During the pre clean we had 2 jetting machines and a tanker jetter all operating at full pressure, approximately 1000 litres an hour and had no problems with the flow in any of the lines.

The GEOTEC CCTV Survey/associated drawing and the subsequent emailed correspondence are presented in appendix B.

3 REVISED CONTAMINATION ASSESSMENT

3.1 General

The risks posed to the potential sensitive receptors associated with the site are assessed at this stage. Specific assessment of the short-term exposure to ground workers was not part of the scope of this investigation. Therefore, with regard to these pollutant links, chemical test and ground gas data should be made available for contractor's own risk assessment.

The risk to future site users of the proposed development from ground gases is assessed by considering ground gas data recorded from monitoring. However, no additional gas monitoring has been undertaken as part of this additional assessment and the initial GE22715 May 2019 GI Report should be referred to for the gas assessment of the subject site.

The risks associated with long-term human exposure to soil can be addressed by comparing the laboratory test results with soil generic assessment criteria (GAC) derived using the CLEA model. This specifically applies to dermal exposure and inhalation of contaminated dust, but can be used as a preliminary indication to consider the effects on controlled water, drinking water supply pipes flora and fauna and building structures from soil contamination on the site. Screening values have been published for standard land uses, including commercial, residential (with and without gardens) and public open spaces and the CLEA software initially allows for GAC to be amended for site specific exposure scenarios.

Additionally human exposure to asbestos fibres in soil can be preliminary assessed by comparing test results to industry widely used assessment criteria (criteria - detection limit of asbestos quantification analysis <0.001%). This is discussed further in section 3.2.1.

Risk to controlled waters has been assessed using published screening values (mainly Drinking Water Standards and ecosystem Environmental Quality Standards) compared to results of groundwater and soil leachate analysis.

A summary of the additional soil and groundwater analysis undertaken across the site, along with rationale is presented in section 2.6.

An exploratory hole location plan which details the initial GE22715 May 2019 GI Report exploratory locations and the additional exploratory locations undertaken as part of this assessment (undertaken in July 2019) is presented in Appendix A (HGE Drawing DR002 & 2A). DR002A also details the extent of the proposed earthworks and the approximate location of historical structures identified from the OS maps.

HGE drawing DR009 & 9A - Fieldwork Location with Asbestos Screening' presented in appendix A details the location, depth and results all asbestos screening on soils samples from across the site. DR009B also details the extent of the proposed earthworks for the development (proposed fill areas detailed in green and cut areas in red).

The location of the identified initial GE227125 May 2019 GI Report groundwater exceedances are detailed on HGE drawing GE22715-DR0010A HGE Groundwater Exceedances from Initial the May 2019 Analysis presented in Appendix A.

The location of the identified additional July 2019 groundwater exceedances are detailed on HGE drawing GE22715-DR0010B Groundwater Exceedances from Initial the July 2019 Analysis presented in Appendix A.

3.2 Soil Assessment (Human Health)

Refer to section 2.6 of this report for details on the type, rationale and location of the additional soil analysis. The results of the additional soil analysis are presented in Appendix D.

Refer to the GE22715 May 2019 GI Report for details of the previous soil analysis and assessment undertaken for the site.

The following sections present the human health risk assessment based on the additional July 2019 soil analysis results. However, the results of the initial GE22715 May 2019 GI Report analysis are also discussed.

For an initial screening of the soil chemical test results, with regard to long-term human health risks, the results have been compared to GAC. Land Quality Management Limited and the Chartered Institute for Environmental Health published 'Suitable 4 Use Levels' (S4UL) as GAC for a range of substances, for a range of generic land uses. DEFRA published category four screening levels (C4SL) for six contaminants in March 2014 to assist practitioners in assessing land contamination under part IIA of the environmental protection act 1990. These have also been identified as suitable for use within the planning system, although it should be noted that they assume a higher level of acceptable risk than S4UL and earlier published GAC. Release of a more comprehensive set of C4SL comparison values were anticipated in 2015, but is yet to be received.

The proposed end use is a water based "splashlands" play area and parkland, with construction of a new playground including splash pad with associated, changing room facility, kiosk, outdoor gym, drainage and earthworks/landscaping. The proposed end use is not one of the generic land uses for which S4ULs are available. A 'Public Open Space- Parkland' generic land use is considered to be the most applicable, for the proposed end use. It is assumed that no plants or trees for human consumption (ie fruit trees) will be associated with the proposed development.

For the Public Open Space - Parkland category, a single value is provided for metals, with three values specified for organic contaminants based on the proportion of soil organic matter (%SOM) or the total organic carbon (%TOC) content of the soil. We have based our assessment on a worst case 1% for the assessment.

The additional made ground soil analysis has been considered as part of this assessment. The results of the additional July 2019 soil analysis are summarised in table 3.2.1 below compared to human health 'Public Open Space- Parkland' generic criteria.

3.2.1 Made Ground Deposits

Determinant	No. of Tests	No. of Detects	Maximum recorded concentration (mg/kg)	LQM-CIEH S4UL 2014	DEFRA C4SL 2014	Maximum Exceeds Screening Value?
Arsenic	12	12	28	170	170	No
Boron	12	12	2	46000	-	No
Cadmium	12	3	0.3	560	-	No
Chromium	12	12	33	33000	-	No
Chromium - Hexavalent	12	0	< 4	220	250	No
Copper	12	12	33	44000	-	No
Lead	12	12	44	-	1300	No
Mercury	12	3	0.8	30	-	No
Nickel	12	12	26	800	-	No
Selenium	12	0	< 1	1800	-	No
Zinc	12	12	73	170000	-	No
Acenaphthene	12	1	0.34	29000	-	No
Acenaphthylene	12	0	< 0.05	29000	-	No
Anthracene	12	3	1	150000	-	No
Benzo(a)anthracene	12	7	3.3	49	-	No

Determinant	No. of Tests	No. of Detects	Maximum recorded concentration (mg/kg)	LQM-CIEH S4UL 2014	DEFRA C4SL 2014	Maximum Exceeds Screening Value?
Benzo(a)pyrene	12	7	2.8	11	21	No
Benzo(b)fluoranthene	12	7	3.2	13	-	No
Benzo(ghi)perylene	12	6	1.8	1400	-	No
Benzo(k)fluoranthene	12	7	1.6	370	-	No
Chrysene	12	7	3	93	-	No
Di-benzo(a,h)anthracene	12	2	0.39	1.1	-	No
Fluoranthene	12	7	7.3	6300	-	No
Fluorene	12	1	0.33	20000	-	No
Indeno(1,2,3-cd)pyrene	12	6	1.4	150	-	No
Naphthalene	12	0	< 0.05	1200	-	No
Phenanthrene	12	6	2.8	6200	-	No
Pyrene	12	7	6.6	15000	-	No
Speciated Total EPA-16 PAHs	12	7	35.8	-	-	-
PCB Congener 28	4	0	< 0.001	-	-	
PCB Congener 52	4	0	< 0.001	-	-	
PCB Congener 101	4	0	< 0.001	-	-	
PCB Congener 118	4	0	< 0.001	-	-	
PCB Congener 138	4	0	< 0.001	-	-	
PCB Congener 153	4	0	< 0.001	-	-	
PCB Congener 180	4	0	< 0.001	-	-	
Total PCBs	4	0	<0.007	-	-	
Aliphatic >C5 - C6	12	0	< 0.001	95000	-	No
Aliphatic >C6 - C8	12	0	< 0.001	150000	-	No
Aliphatic >C8 - C10	12	0	< 0.001	14000	-	No
Aliphatic >C10 - C12	12	0	< 1	21000	-	No
Aliphatic >C12 - C16	12	1	3.8	25000	-	No
Aliphatic >C16 - C21	12	0	< 8	450000	-	No
Aliphatic >C21 - C35	12	2	21	450000	-	No
Aliphatic (C5 - C35)	12	2	32	-	-	
Aromatic >C5 - C7	12	0	< 0.001	76000	-	No
Aromatic >C7 - C8	12	0	< 0.001	87000	-	No
Aromatic >C8 - C10	12	0	< 0.001	7200	-	No
Aromatic >C10 - C12	12	1	1.5	9200	-	No
Aromatic >C12 - C16	12	2	8.7	1000	-	No
Aromatic >C16 - C21	12	3	77	7600	-	No
Aromatic >C21 - C35	12	8	120	7800	-	No
Aromatic (C5 - C35)	12	10	200	-	-	
Benzene	12	0	< 0.001	90	230	No
Ethylbenzene	12	0	< 0.001	17000	-	No
MTBE (Methyl Tertiary Butyl Ether)	12	0	< 0.001	-	-	

Determinant	No. of Tests	No. of Detects	Maximum recorded concentration (mg/kg)	LQM-CIEH S4UL 2014	DEFRA C4SL 2014	Maximum Exceeds Screening Value?
o-Xylene	12	0	< 0.001	17000	-	No
p & m-Xylene	12	0	< 0.001	17000	-	No
Toluene	12	0	< 0.001	87000	-	No
pH	12	12	7.7 - 8.6	-	-	
Total Organic Carbon (TOC)	12	12	3.50%	-	-	
Asbestos in Soil	45	3	Detected	-	-	HP208 0.20m HP209 0.50m HP212 0.30m Subsequent quantification All chrysotile <0.001%

Table 3.2.1: Contamination Additional July 2019 Test Result Summary MADE GROUND

Metals and Non-metals (excluding asbestos)

No concentrations exceeded the adopted screening criteria as detailed above as part of this investigation.

Additionally, a further 19 No. made ground samples were analysed for the same chemical suite within the GE22715 May 2019 GI Report and did not exceed criteria (as detailed in section 6.2.1 of the report). Therefore, metals and non-metals concentrations from the made ground soils are not considered to pose a significant risk to proposed or existing human health receptors.

Hydrocarbons

No PAH or TPH CWG speciation concentrations exceeded the adopted screening criteria as detailed above.

Additionally, a further 19 No. made ground samples were analysed from the GE22715 May 2019 GI Report and did not exceed criteria (as detailed in section 6.2.1 of the report).

However, PCB EC7 congeners exceeded the MDL of the testing equipment.in made ground from TP104 at 0.45m. Therefore, as part of this additional assessment HP301 to 303 & HP222/WS205A were undertaken around TP104 and PCB EC7 congener suite of analysis was undertaken at the following depths within the made ground - HP301 to 303 at 0.40m & HP22/WS205A 0.80m. Additionally, groundwater from WS205A was also analysed for PCB EC7 suite.

No PCB congeners from the additional soil or groundwater analysis exceeded the MDL of the testing equipment. It is therefore considered that the concentrations previously identified in TP104 must be localised. Additionally, the ground levels in the area of TP104 are currently proposed to be raised by circa 1.50 to 2.00m reducing to 0.50m to the south west and utilised for open space. As such any direct contact pollutant linkage to proposed end users would be broken.

It is recommended that during redevelopment the localised area of TP104 should be excavated/assessed especially if the soils are proposed to be reused or excavated as part of the development. However, at this stage it is considered hydrocarbon concentrations from the made ground soils are not considered to pose a significant risk to proposed or existing human health receptors.

Asbestos

The GE22715 May 2019 GI Report identified that out of 27 No. shallow made ground soil samples that were screed for asbestos, 6 No. identify asbestos (comprising chrysotile, with the exception of 1 No. sample which comprised chrysotile and amosite). Also 7 No. natural soils were screened for asbestos but no exceedances were identified.

As part of this additional assessment 12 No. additional asbestos screens were undertaken from the made ground in the proposed earthworks 'cut' areas as part of the HSS6 suite as detailed in section 2.6. The source material from these 'cut' areas are proposed to be reused as earthworks 'fill' as part of the development and further clarification if the soils are chemically 'fit for purpose' and asbestos free was considered prudent.

Additionally, a further 33 No. asbestos screens were undertaken at various in a grid from shallow made ground soils (various depths) across and immediately around the former infilled lido and around areas where asbestos was previously identified.

The 45 No. additional asbestos screens identified 3 No. detects in HP208 0.20m, HP209 0.50m, HP212 0.30m. Subsequent quantification identified the loose fibres were all chrysotile at <0.001% by weight.

A summary table detailing the identified asbestos from all the asbestos screens taken to date (78 No.) and the results of the subsequent quantification is detailed in table 3.2.2 below. A table is also presented in appendix E which details a sample description on all samples currently analysed for asbestos.

HGE drawing DR009 & 9A - Fieldwork Location with Asbestos Screening' presented in appendix A details the location, depth and results all asbestos screening on soils samples from across the site. DR009B also details the extent of the proposed earthworks for the development (proposed fill areas detailed in green and cut areas in red).

Sample ID	Sample depth (m)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Total % Asbestos in Sample	Geological Description of Unit
TP106	0.20	Bitumen	Chrysotile	0.002	MADE GROUND/TOPSOIL. Dark brown slightly gravelly fine to coarse SAND. Gravel is sub angular to sub rounded fine to coarse flint with frequent rootlets
TP106	0.40	Loose Fibres	Chrysotile	<0.001	MADE GROUND. Dark brown to greyish brown slightly sandy to sandy sub angular to sub rounded fine to coarse GRAVEL with low to medium cobble content. Gravel is flint, brick, concrete and wood. Cobbles are brick and concrete with occasional rebar
TP106	0.60	Loose Fibres	Chrysotile	<0.001	
TP108	0.25	Loose Fibres	Chrysotile	<0.001	MADE GROUND. Light orangish brown sandy sub angular to sub rounded fine to coarse GRAVEL with low to medium cobble content. Gravel is flint, brick and concrete with occasional possible clinker. Cobbles are brick and concrete with occasional rebar
WS101	0.60	Loose Fibres	Chrysotile & Amosite	<0.001	MADE GROUND. Dark brown greyish brown sandy slightly silty sub angular to sub rounded fine to coarse GRAVEL with medium cobble content. Gravel is flint with brick, concrete and asphalt. Cobbles are of concrete and brick.
WS106	0.60	Bitumen	Chrysotile	<0.001	MADE GROUND. Grey to greyish brown sandy sub angular to sub rounded fine to coarse GRAVEL with low cobble content. Gravel is brick, concrete and flint. Cobbles are concrete and brick.
HP208	0.20	Loose Fibres	Chrysotile	<0.001	MADE GROUND. Grey to brownish grey sandy subangular to subrounded fine to coarse GRAVEL of flint, concrete and brick.
HP209	0.50	Loose Fibres	Chrysotile	<0.001	MADE GROUND. Brown slightly sandy clayey subangular to subrounded fine to coarse GRAVEL with low cobble content. Gravel is flint and concrete with occasional brick and metal rebar. Cobbles are subangular brick and concrete.
HP212	0.30	Loose Fibres	Chrysotile	<0.001	MADE GROUND. Light grey very sandy subangular to rounded fine to coarse GRAVEL with low to medium cobble content. Gravel is flint, concrete and chalk with occasional brick. Cobbles are subangular concrete

Sample ID	Sample depth (m)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Total % Asbestos in Sample	Geological Description of Unit
					and flint.

Table 3.2.2: Summary of all currently identified Asbestos ID and Quantification in MADE GROUND

All asbestos detections are currently located outside the proposed 'cut/reuse' earthworks source areas that are proposed as part of the development. The exceedances are all located within or in close vicinity to the infilled lido. The asbestos identifications are considered to be associated with crushed demolition waste from former onsite structures that was utilised for backfilling.

This crushed demolition material appears to be limited within the proposed 'cut/reuse' earthworks source areas. However, it is considered present locally in the north eastern area, within TP101 between 0.30 to 0.60mbgl, HP232 between 0.20 to 0.40m bgl and HP233 between 0.20 to 0.35mbgl. An asbestos screen was undertaken in the unit in each location, but asbestos was not detected.

Granular made ground was also encountered in the south western proposed 'cut/reuse' earthworks source area but appeared to differ from the demolition waste material (colour, concrete quantities etc.). Where granular made ground was encountered, an asbestos screen was undertaken but asbestos was not detected.

In the GE22717 May 2019 GI Report, the risk of asbestos was undertaken for the site using semi-quantitative methods supplemented by subjective assumptions. This was undertaken utilising the CL:AiRE/JIWG asbestos risk ranking algorithm (2016). Refer to the May 2019 report for full details. The assessment concluded that the following risk of asbestos is associated with the made ground soils.

Asbestos Containing Material	Asbestos Fibre Type	Health Risk
Soil, aggregate, bitumen	Chrysotile, Amosite	Infant (<5 years) - Medium School age (5-16 years) - Low Groundworkers – Low

Copied table 6.2.3c from GE22715 May 2019 GI Report: Risk ranking of ACM.

Notwithstanding the generally low health risk identified in table 6.2.3c above, there is medium risk to younger children.

Following the additional analysis associated with this assessment detailed above, it is considered that the following is still relevant for the demolition waste materials.

The detected asbestos concentrations are generally less than the arbitrary 0.001% threshold, one sample reported a slightly higher value (0.002%), however 13% of made ground samples analysed (9 of 72 No.) recorded identified asbestos present. A further 7 No. asbestos screens were undertaken on natural soils, none of which identified asbestos. This detection rate in the made ground soils suggests higher concentrations may potentially be present. Due to the risk of asbestos locally in the soil across the site (associated with crushed demolition material), it is appropriate to consider further reduction of the potential risk by undertaking further mitigation measures as the construction/earthworks progresses.

No asbestos has currently been identified within the two main material source areas for the proposed earthworks (areas of proposed cut where it is proposed to utilise the cut materials in other areas of the site as fill). This is detailed visual by HGE drawing DR009A & 009B A Fieldwork Location Plan Detailing Asbestos Screening -Initial & Additional Phases, presented in Appendix A. However as detailed above, demolition crushed waste is considered to be locally present within the north eastern source zone, and granular made ground is locally present within the south western source zone. Asbestos screening has been undertaken in these deposits but did not identify asbestos as present.

HG DR009B also details that the areas where asbestos has been identified are located within proposed 'fill' earthwork areas, thus identified asbestos impacted materials would be capped by the materials from the

proposed source areas (where asbestos has not been identified). The level of fill across the former swimming pool area appears to be circa 0.5 to 1m thick and areas of hardstanding. However subsequently Conisbee has stated that between 300 to 500mm of cut/reuse will be required across the infilled lido area to form formations. This differs to that detailed on the Conisbee Earthworks Isopachytes Contours Plan 17116-con-x-xx-DR-C-7005 presented in appendix A. Further clarification is required to enable a mitigation strategy to be produced.

The level of risk is not considered severe enough to warrant further comprehensive remediation, especially if a school child receptor is considered appropriate (instead of the more conservative infant <5 years). However, several actions should be undertaken to reduce and monitor the risk into the future. The actions available are listed below:

1. Installation of a suitable validated soil cover system within soft landscaping/public open space areas above materials identified as containing asbestos. The fill operation of the proposed earthworks within the impacted areas could be suitable, subject to further assessment and finalisation of the proposals (proposed thicknesses of fill confirmed).
2. Soil Inversion. Excavation of asbestos in shallow impacted soils and burying in borrow pits or below validated material or hardstanding (within public open space areas) by trained personnel wearing appropriate PPR/RPE. Works to be undertaken under controlled conditions including dust suppression as necessary. The fill operation of the proposed earthworks within the impacted areas could be suitable, subject to further assessment and finalisation of the proposals (proposed thicknesses of fill confirmed).
3. Documentation of the risk. Areas of the site in which asbestos has been detected, particularly in areas that are to remain unaffected by the proposed construction, should be highlighted as a potential source of risk in the CDM documents, property deeds and building maintenance documentation going forward. Such documentation would alert maintenance workers to the possibility of encountering soils affected by asbestos in order that they can undertake their own risk assessment and mitigation measures.
4. Reassurance asbestos air monitoring. The risk posed from asbestos is considered predominately posed from free fibres in the air, although some bulk asbestos has been noted. A regime of outdoor and indoor air monitoring should be undertaken during construction/operation works, especially in areas where asbestos has been identified where works should be minimised with the potential addition of dust suppression measures.
5. An adequate Materials Management Plan should be produced, stating the objectives of preventing harm to human health and pollution of the environment.

3.2.1 Natural Deposits

No additional July 2019 soil analysis has been undertaken on natural soils. However, the GE22715 May 2019 GI Report analysed 7 No. natural soils samples as detailed in section 6.2.2 of the report. No contaminants analysed exceeded the adopted screening criteria (including asbestos screening) and therefore are not considered to pose a risk to proposed and existing human health receptors.

3.3 Groundwater Assessment

The risk to controlled waters is addressed by comparing the laboratory test data to adopted screening values. As detailed in the initial GE22715 May 2019 GI Report, controlled waters for the subject site are considered as the following:

- The superficial deposits Secondary A aquifer designation (Kesgrave Catchment Subgroup) with the Alluvium a Secondary (Undifferentiated) aquifer. Although correspondence with the EA has stated it is highly likely the superficial deposits are in continuity with the underlying chalk principal aquifer and therefore should be protected as though all a Principal Aquifer.
- The solid geology (Chalk) is designated as a Principal Aquifer.
- The site is located within a Source Protection 3 Zone (Total Catchment) with a Zone 2 (Outer Catchment) located some 450m to the south east. The closest groundwater abstraction is located

some 1480m to the south west of the site (Status: Active) associated with general farming and domestic use.

- The River Lea abuts the site's south, south western boundary. Two surface water abstractions are recorded within 500m of the site, located some 270m (Status: Historical) and 375m (Status: Active) to the north west, both abstractions associated with the River Lea.
- The majority of the site is located within River and Coastal Flooding Zones 2 and 3 with a high confidence rating and a RoFRaS Low to High risk rating.

The groundwater analysis has been considered as part of this assessment. 14 No. additional groundwater samples and 2 No. surface water samples have been analysed from across the site area as part of the additional assessment.

Groundwater samples were obtained and analysed from all borehole installations (GE22715 May GI Report installations and the additional July 2019 installations) and 2 No. River Lea surface water samples, up gradient of the site, 'Sample 'RS1' and down gradient 'Sample RS2.

For details on the type and rationale for the additional groundwater analysis refer to section 2.6 of this report.

Refer to the GE22715 May 2019 GI Report for details of the previous groundwater analysis and assessment undertaken for the site.

The following sections present the controlled waters risk assessment based on the additional July 2019 groundwater and soil leachate analysis results. However, the results of the initial GE22715 May 2019 GI Report analysis are also discussed

The results of the additional water sample analysis are summarised in table 3.3 below and are compared against the appropriate groundwater screening values, which are described in the appended Groundwater Screening Values Datasheet (collectively referred to as the 'applicable standards'). These include U.K. Drinking Water Standards and Environmental Quality Standards (EQS) annual averages (EQS-AA) and maximum allowable concentrations (EQS-MAC). Whilst this represents a conservative remedial target, it is a logical approach to an initial tier 2 assessment of groundwater risk assessment (GWRA), without completing a detailed quantitative risk assessment.

The location of the identified initial GE227125 May 2019 GI Report groundwater exceedances are detailed on HGE drawing GE22715-DR0010A HGE Groundwater Exceedances from Initial the May 2019 Analysis presented in Appendix A.

The location of the identified additional July 2019 groundwater exceedances are detailed on HGE drawing GE22715-DR0010B Groundwater Exceedances from Initial the July 2019 Analysis presented in Appendix A.

Determinant	Max Result	AA-EQS	AA Comment	MAC-EQS	MAC Comment	WHO[1] 2008	WHO[2] 2017	UK Drinking Water	Exceeds Screening Value?	Samples Exceeding	Exceeded Values	No. of Tests	No. of Detects
Metals and Non-Metals													
Mercury	<0.05	-	-	0.07	-	-	6	1.0	No	-_	-	1	0
Ammoniacal Nitrogen (NH4 as N)	13,000	600	Good Quality 90th percentile	-	-	-	500	500	Yes	WS105 WS109 WS204E WS205A	2,200, 13,000, 2'600, 3,400	16	10
Ammonia (NH3)	16,000	600	Good Quality 90th percentile				500	500	Yes	WS105 WS109 WS204E WS205A	2,700, 16,000, 3'200, 4,100	16	10
Ammonium ($NH4^+$)	17,000	600	Good Quality 90th percentile				500	500	Yes	WS105 WS109 WS204E WS205A	2,800, 17,000, 3'400, 4,300	16	10
Hydrocarbons													
Benzene	< 1	10	-	50	-	-	10	10	No	-	-	2	0
Ethylbenzene	< 1	-	-	-	-	-	300	300	No	-	-	2	0
m & p-Xylene	< 1	30	-	-	-	-	500	500	No	-	-	2	0
o-Xylene	< 1	30	-	-	-	-	500	500	No	-	-	2	0
Toluene	< 1	74	-	380	95th Percentile	-	700	700	No	-	-	2	0
MTBE (Methyl Tertiary Butyl Ether)	< 1	-	-	-	-	-	-	-	-	-	-	2	0
Aliphatics >C5-6	< 1	-	-	-	-	15000	-	-	No	-	-	2	0
Aliphatics >C6-8	< 1	-	-	-	-	15000	-	-	No	-	-	2	0
Aliphatics >C8-10	< 1	-	-	-	-	300	-	-	No	-	-	2	0
Aliphatics >C10-12	< 10	-	-	-	-	300	-	-	No	-	-	2	0
Aliphatics >C12-16	< 10	-	-	-	-	300	-	-	No	-	-	2	0
Aliphatics >C16-21	< 10	-	-	-	-	-	-	-	-	-	-	2	0
Aliphatics >C21-35	< 10	-	-	-	-	-	-	-	-	-	-	2	0
Aromatics >C5-7	< 1	-	-	-	-	10	-	-	No	-	-	2	0
Aromatics >C7-8	< 1	-	-	-	-	700	-	-	No	-	-	2	0
Aromatics >C8-10	< 1	-	-	-	-	300	-	-	No	-	-	2	0

Determinant	Max Result	AA-EQS	AA Comment	MAC-EQS	MAC Comment	WHO[1] 2008	WHO[2] 2017	UK Drinking Water	Exceeds Screening Value?	Samples Exceeding	Exceeded Values	No. of Tests	No. of Detects
Aromatics >C10-12	< 10	-	-	-	-	90	-	-	No	-	-	2	0
Aromatics >C12-16	< 10	-	-	-	-	90	-	-	No	-	-	2	0
Aromatics >C16-21	< 10	-	-	-	-	90	-	-	No	-	-	2	0
Aromatics >C21-35	< 10	-	-	-	-	90	-	-	No	-	-	2	0
Total Aliphatics C5-C35	< 10	-	-	-	-	-	-	-	-	-	-	2	0
Total Aromatics C5-C35	< 10	-	-	-	-	-	-	-	-	-	-	2	0
PCB Congener 28	<0.02	-	-	-	-	-	-	-	-	-	-	1	**0**
PCB Congener 52	<0.02	-	-	-	-	-	-	-	-	-	-	1	0
PCB Congener 101	<0.02	-	-	-	-	-	-	-	-	-	-	1	0
PCB Congener 118	<0.02	-	-	-	-	-	-	-	-	-	-	1	0
PCB Congener 138	<0.02	-	-	-	-	-	-	-	-	-	-	1	0
PCB Congener 153	<0.02	-	-	-	-	-	-	-	-	-	-	1	0
PCB Congener 180	<0.02	-	-	-	-	-	-	-	-	-	-	1	0
Total PCBs	<0.14	-	-	-	-	-	-	-	-	-	-	1	0

Table 3.3 Summary of Additional Phase 2 Groundwater Analysis

Notes
All concentrations in ug/l unless stated
1 WHO Petroleum Products in Drinking Water 2008
2 WHO Drinking-Water Quality Guideline 2017
3 Good quality inland and freshwater lakes).
4 Directive establishing a framework for community action in the field of policy -Water Framework Directive AA EQS Priority substance
Based on average Hardness of 317mg CACO3/l waters 64mg CACO3/l leachate

Hydrocarbons

WS101, WS105 previously identified (in the May 2019 GI Report assessment) TPH as slightly exceeding MDL of the testing equipment and also exceeded the adopted UK drinking water standard of 10ug/l provided for reference. Although there is currently no EQS for TPH, a positive detection of hydrocarbons is sufficient to consider a potentially significant risk warranting further assessment. Therefore, as part of the May 2019 assessment further TPH CWG analysis was undertaken on WS101 and 105, the results did not exceed the MDL of the testing equipment.

As part of this assessment additional TPH CWG analysis was undertaken at WS101 and WS105 to confirm the last results obtained. Again the TPH CWG analysis did not exceed the MDL of the testing equipment, therefore it is considered that TPH does not pose a significant risk to controlled water receptors.

WS205A is located in close vicinity to TP104 which previously identified PCBs in soil above MDL of the testing equipment. As part of this additional assessment a PCB EC7 suite was analysis on groundwater from WS205A. The analysis did not exceed the MDL of the testing equipment and therefore PCB's are not considered a significant risk to controlled water receptors.

Metals

WS102 previously identified Mercury as marginally exceeding relevant EQS criteria. Additional mercury analysis was undertaken as part of this assessment from WS102 for confirmation purposes and did not exceed the MDL of the testing equipment. GE22715 May 2019 GI Report in section 6.3.1 details that other metal concentrations from analysis of the groundwater across the site area are not considered a significant risk to controlled water receptors.

Ammoniacal Nitrogen (NH4 as N), Ammonia (NH3), Ammonium (NH4+)

Elevated Ammonical Nitrogen (NH4 as N) was previously identified as locally significantly elevated in the GE22715 May 2019 GI assessment. The report and the EA recommended that additional assessment should be undertaken to determine ''if the elevated ammoniacal nitrogen concentrations noted in some of the wells persist and that the other concentrations stay the same''.

In May 2019 Ammoniacal Nitrogen exceeded drinking water and 90th percentile good quality water framework standards in WS101 (660ugl), WS103 (3,300ugl), WS108 (10,000ug/l) and WS109 (17,000ug/l) compared to the 500ug/l and 600ug/l criteria. WS109 which recorded the highest concentration is in close vicinity to the River Lee. Additionally, concentrations in the up and down stream river samples (RS1 & RS2) recorded significantly lower concentrations of 68 and 57ug/l respectively.

The location of the identified initial GE227125 May 2019 GI Report groundwater exceedances are detailed on HGE drawing GE22715-DR0010A HGE Groundwater Exceedances from Initial the May 2019 Analysis presented in Appendix A.

As part of this assessment additional analysis was undertaken on: Surface water samples RS1 up stream, RS2 down stream, and from all installed boreholes across the site – May 2019 boreholes WS101, WS102, WS103, WS104, WS105, WS107, WS109, WS111, July 2019 boreholes WS201, WS202, WS203, WS204E, WS205A, WS206). Unfortunately, WS108 was unproductive during the additional groundwater sampling round and a groundwater sample could not be retrieved.

Elevated ammonium concentrations were identified in the following locations:-

- WS105 2,800ug/l
- WS109 17,000ug/l
- WS204E 3,400ug/l
- WS205A 4,300ug/l

The location of the identified additional July 2019 groundwater exceedances are detailed on HGE drawing GE22715-DR0010B Groundwater Exceedances from Initial the July 2019 Analysis presented in Appendix A.

The concentrations from WS109 which is located in close vicinity to the River Lee remained significantly more elevated compared to the other exploratory locations and River Lee surface water samples. The groundwater does not appear to be impacting the River Lee which recorded concentrations of 120ug/l up stream and 100ug/l down stream.

Elevated concentrations of ammoniacal nitrogen can be indicative of degradation of organic material, leachate, slurry/sewage or fertiliser. Elevated concentrations are not uncommon due to extensive agricultural land use. As detailed in section 2.7 of this assessment, the foul CCTV survey found no evidence of possible leaking during the survey, i.e. displaced pipes, cracks in line etc. Additionally, WS201 was undertaken (and groundwater analysed) which is located between the foul pipe and WS109 (which identified the highest Ammonium concentrations in groundwater). The groundwater from WS201 did not exceed criteria with a significantly lower concentration of 160ug/l recorded. Therefore, this appears to confirm that the foul sewer pipe in the site's south western area is not the source. WS202 and WS203 were also undertaken (and groundwater analysed) to determine if the ammonium concentrations were migrating from the north off site. Again, the concentrations from these boreholes were significantly lower, recorded at 27 and 39ug/l respectively. Therefore, this suggests that the concentrations are not migrating from the north, north east off site.

Significant total organic carbon (TOC) results have generally not been identified in the soils at the site, however the highest recorded concentrations of TOC (3.5 and 3.8%) were recorded in the made ground of WS201 and HDTP101. These are located in the general vicinity of WS108 and WS109 which recorded the highest ammoniacal nitrogen concentrations. However, average TOC concentrations in the made ground across the site were recorded as 1.55% with an average just within the site's south western area (vicinity of WS109) of 2.1%. Additionally, 7 No. TOC concentrations from the natural fluvial deposits were recorded between 0.3 and 2.9% with an average of 0.84%. It is considered that the recorded TOC concentrations in the soils onsite suggest that the elevated ammoniacal nitrogen in the groundwater are not associated with degradation of organic material from onsite soils.

Additionally, the made ground has been analysed for ammonium leachate as detailed in table 3.4 in this report, and table 6.3.2 in GE22715 May 2019 GI Report. The leachate analysis included ammonium as NH4 from the following exploratory locations;

- WS102 at 1.00m in Fluvial Gravel NH4 =53ug/l
- **WS108 at 1.50m in Fluvial Gravel NH4 = 36ug/l**
- **WS109 at 1.50m in Fluvial Gravel NH4 = 9,600ug/l**
- WS111 at 0.50m in Made Ground NH4 = 33ug/l
- TP102 at 0.70m in Fluvial Gravel NH4 = <15ug/l
- TP109 at 1.30m in Fluvial Gravel NH4 = 20ug/l
- **WS201 at 0.50m in Made Ground NH4 = 55ug/l**
- HP231 at 0.40m in Made Ground NH4 = 21ug/l
- HP233 at 0.30m in Made Ground NH4 = <15ug/l
- **HP235 at 0.20m in Made Ground NH4 = 63ug/l**
- **HP236 at 0.50m in Made Ground NH4 = 18ug/l**

The above details that the leachate concentrations are all significantly below the relevant criteria (500 and 600ug/l) with the exception for WS109 at 1.5m. However, this leachate sample was undertaken from below the groundwater table and is likely associated with the high concentrations identified within the groundwater. Exploratory locations HP235, HP236, WS108, WS109, WS201 as detailed above are in the vicinity of the elevated ammonium concentrations in groundwater. These leachate results, along with the TOC concentrations discussed before suggest that the soils onsite are not the source.

The source for the elevated ammoniacal nitrogen concentrations identified locally within the groundwater has not currently been identified. However, the concentrations suggest that the source is likely within the south western site area, with the highest concentrations identified in WS109 and WS108. Alternatively, it is considered that the concentrations could be migrating from off site (from the south west).

It is recommended that this additional assessment with associated results should be supplied to the EA, so that they may advise whether they are concerned by the detected concentrations. It is known that a main foul sewer is also located under the boating lake immediately to the south west of the site. The associated utility company of the foul sewer should be contacted about any known leaks or incident that has occurred.

3.4 Soil Leachate Assessment

The made ground leachate analysis has been considered as part of this assessment. 5 no. additional made ground samples from within the proposed earthworks 'cut' material source areas were submitted for additional leachate analysis as part of this assessment. For details on the type and rationale for the additional leachate analysis refer to section 2.6 of this report.

Refer to the GE22715 May 2019 GI Report for details of the previous leachate analysis and assessment undertaken for the site.

The results of the 5 No. additional leachate analysis are summarised in table 3.4 below and are compared against the appropriate groundwater screening values, which are described in the appended Groundwater Screening Values Datasheet (collectively referred to as the 'applicable standards'). These include U.K. Drinking Water Standards and Environmental Quality Standards (EQS) annual averages (EQS-AA) and maximum allowable concentrations (EQS-MAC). Whilst this represents a conservative remedial target, it is a logical approach to an initial tier 2 assessment of groundwater risk assessment (GWRA), without completing a detailed quantitative risk assessment.

Determinant	Max Result	AA-EQS	AA Comment	MAC-EQS	MAC Comment	WHO[1] 2008	WHO[2] 2017	UK Drinking Water	Exceeds Screening Value?	Samples Exceeding	Exceeded Values	No. of Tests	No. of Detects
Metals and Non-Metals													
Arsenic	1.9	50	-	-	-	-	10	10	No			5	2
Boron	<10	2000	-	-	-	-	2400	1000	No			5	0
Calcium	25000	-	-	-	-	-	-	-				5	5
Cadmium	<0.008	0.25#	-	1.5	-	-	3	5	No			5	0
Chromium	6.5	4.7	-	32	95th Percentile	-	50	50	Yes	HP231	6.5	5	5
Copper	13	1	M-BAT Bio Available	-	-	-	2000	2000	Yes	WS201 HP231 HP233 HP235 HP236	11 8 13 12 12	5	5
Lead	4.4	1.2	Bio available	14	-	-	10	25	Yes	HP231 HP233 HP235	2 2.4 4.4	5	3
Magnesium	920	-	-	-	-	-	-	-				5	5
Mercury	<0.5	-	-	0.07	-	-	6	1.0	No			5	0
Nickel	4.4	4	M-BAT Bio Available)	34	-	-	70	20	Yes	HP233	4.4	5	5
Selenium	<4	-	-	-	-	-	40	10	No			5	0
Zinc	12	10.9	M-BAT Bio Available	-	-	-	-	-	Yes	HP231 HP235	11 12	5	5
Ammoniacal Nitrogen as N	55	600	Good Quality 90th percentile	-	-	-	500	500	No			5	0
Ammonium as NH4	63	600	Good Quality 90th percentile	-	-	-	500	500	No			5	0
Chloride	1000	250000	-	250000	-	-	250000	250000	No			5	3
Chlorine	<50	2	-	5	95th Percentile	-	5000	-	No			5	0
Total Organic Carbon (TOC)	16 mg/l	-	-	-	-	-	-	-				5	5
pH	7.6-7.8	-	-	6 - 9	95th Percentile	-	6.5 - 9.5	10				5	5

Determinant	Max Result	AA-EQS	AA Comment	MAC-EQS	MAC Comment	WHO[1] 2008	WHO[2] 2017	UK Drinking Water	Exceeds Screening Value?	Samples Exceeding	Exceeded Values	No. of Tests	No. of Detects
Sulphate as SO4	2960	400000	-	-	-	-	250000	250000	No			5	5
Total Sulphur	990	-	-	-	-	-	-	-				5	5
Sulphide	<5.0	-	-	-	-	-	-	-				5	0
Total Hardness	66.5mgCaCO3/l (Ave 56)	-	-	-	-	-	-	-				5	5
Hydrocarbons													
Acenaphthene	< 0.01	-	-	-	-	-	-	-				5	0
Acenaphthylene	< 0.01	-	-	-	-	-	-	-				5	0
Anthracene	< 0.01	0.1	-	0.1	-	-	-	-	No			5	0
Benzo(a)anthracene	< 0.01	-	-	-	-	-	-	-				5	0
Benzo(a)pyrene	< 0.01	0.0002	-	0.27	-	-	0.7	0.01	No			5	0
Benzo(b)fluoranthene	< 0.01	-	-	0.017	-	-	-	-	No			5	0
Benzo(g,h,i)perylene	< 0.01	-	-	0.0082	-	-	-	-	No			5	0
Benzo(k)fluoranthene	< 0.01	-	-	0.017	-	-	-	-	No			5	0
Chrysene	< 0.01	-	-	-	-	-	-	-				5	0
Dibenz(a,h)anthracene	< 0.01	-	-	-	-	-	-	-				5	0
Fluoranthene	< 0.01	0.0063	-	0.12	-	-	-	-	No			5	0
Fluorene	< 0.01	-	-	-	-	-	-	-				5	0
Indeno(1,2,3-cd)pyrene	< 0.01	-	-	-	-	-	-	-				5	0
Naphthalene	< 0.01	2	-	130	-	-	-	-	No			5	0
Phenanthrene	< 0.01	-	-	-	-	-	-	-				5	0
Pyrene	< 0.01	-	-	-	-	-	-	-				5	0
Sum Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Indeno(1,2,3-cd) pyrene	All < 0.01	-	-	-	-	-	-	0.1	No			5	0
Total EPA-16 PAHs	< 0.20	-	-	-	-	-	-	-				5	0
Benzene	< 1	10	-	50	-	-	10	10	No			5	0

Determinant	Max Result	AA-EQS	AA Comment	MAC-EQS	MAC Comment	WHO[1] 2008	WHO[2] 2017	UK Drinking Water	Exceeds Screening Value?	Samples Exceeding	Exceeded Values	No. of Tests	No. of Detects
Ethylbenzene	< 1	-	-	-	-	-	300	300	No			5	0
m & p-Xylene	< 1	30	-	-	-	-	500	500	No			5	0
o-Xylene	< 1	30	-	-	-	-	500	500	No			5	0
Toluene	< 1	74	-	380	95th Percentile	-	700	700	No			5	0
MTBE	<10	-	-	-	-	-	-	-				5	0
Total Phenols (Monohydric)	<0.010	7.7	-	-	-	-	-	-	No			5	0
Aliphatic >C5 - C6	<1.0	-	-	-	-	15000	-	-				5	0
Aliphatic >C6 - C8	<1.0	-	-	-	-	15000	-	-				5	0
Aliphatic >C8 - C10	<1.0	-	-	-	-	300	-	-				5	0
Aliphatic >C10 - C12	<10	-	-	-	-	300	-	-				5	0
Aliphatic >C12 - C16	<10	-	-	-	-	300	-	-				5	0
Aliphatic >C16 - C21	<10	-	-	-	-	-	-	-				5	0
Aliphatic >C21 - C35	<10	-	-	-	-	-	-	-				5	0
Aliphatic (C5 - C35)	<10	-	-	-	-	-	-	-				5	0
Aromatic >C5 - C7	<10	-	-	-	-	10	-	-				5	0
Aromatic >C7 - C8	<10	-	-	-	-	700	-	-				5	0
Aromatic >C8 - C10	<10	-	-	-	-	300	-	-				5	0
Aromatic >C10 - C12	<10	-	-	-	-	90	-	-				5	0
Aromatic >C12 - C16	<10	-	-	-	-	90	-	-				5	0
Aromatic >C16 - C21	<10	-	-	-	-	90	-	-				5	0
Aromatic >C21 - C35	<10	-	-	-	-	90	-	-				5	0
TPH-CWG - Aromatic (C5 - C35)	<10	-	-	-	-	-	-	-				5	0

Table 3.4 Summary of Additional Leachate Analysis

Notes
All concentrations in ug/l unless stated
1 WHO Petroleum Products in Drinking Water 2008
2 WHO Drinking-Water Quality Guideline 2017
3 Good quality inland and freshwater lakes).
4 Directive establishing a framework for community action in the field of policy -Water Framework Directive AA EQS Priority substance
Based on average Hardness of 317mg CACO3/l waters 64mg CACO3/l leachate

No organic/hydrocarbons concentrations exceed the MDL of the testing equipment and/or their relevant criteria from either in initial GE22715 May GI Report assessment or from the additional analysis as detailed in the table above. Therefore, it is considered that the hydrocarbon leachate concentrations within the made ground do not pose a significant risk to controlled water receptors

Heavy metals do not exceed drinking water standards but have locally exceeded the conservative EQS criteria.

In HP231 a Chromium concentration of 6.5ug/l exceed AA EQS of 4.5ug/l. However, the concentration does not exceed the MAC EQS of 32ug/l, therefore it is considered that it does not pose a significant risk to controlled water receptors.

Environmental quality standards for copper, nickel and zinc are based on EQS derived using the Environment Agency metal bioavailability assessment tool (M-BAT). The tool considers a site-specific predicted no effect concentration (PNEC) contingent on the hardness, pH and dissolved organic carbon. The calculated PNECdissolved can be considered a site-specific EQS.

Copper, nickel and zinc exceeded the initial screening criteria, so PNECdissolved were calculated for the site as detailed within the GE22715 May 2019 GI Report assessment. These were calculated utilising average Calcium and pH results and median DOC results obtained from nine water samples across the site. For the purposes of this additional assessment the same PNECdissolved criteria's have been utilised.

The calculated site specific PNECdissolved were calculated as follows

- Copper 28.94ug/l,
- Nickel 15.64ug/l,
- Zinc 40.70ug/l,

The maximum recorded additional leachate concentrations for copper, nickel and zinc do not exceed their site specific PNEC site specific criteria. Additionally, all groundwater and leachate analysis for copper, nickel and zinc from both the initial May 2019 and subsequent July 2019 investigations do not exceed the PNECdissolved criteria.

Therefore, it is considered that the leachate concentrations for copper, nickel, zinc from within the made ground do not pose a significant risk to controlled water receptors.

Lead exceeds its initial criteria of 1.2ug/l in the made ground of HP231, HP233, and HP235 with a maximum concentration of 4.4ug/l. Additionally lead exceeded its initial criteria in 5 No. of the made ground leachate results within the GE22715 May 2019 GI Report assessment, with a maximum concentration of 3.6ug/l. None of the concentrations exceeded the MAC EQS of 14ug/l. Additionally lead concentrations from groundwater analysis across the site (undertaken for the GE22715 May 2019 GI assessment) did not record elevated concentrations. The exception was lead concentrations within the surface water River Lee samples, taken up and down stream of the site. These were recorded as 6.2ug/l 'upgradient' and 7.3ug/l 'down gradient'.

Therefore, lead leachate concentrations associated with the made ground are not considered a significant risk to controlled water receptors.

In summary it is considered that the identified contaminate concentrations from the soil leachate analysis at the site do not pose a significant risk to controlled water receptors.

3.5 Phytotoxic Contamination

As described in British Standard BS3882:2015 'Specification for Topsoil' copper, nickel, and zinc are phytotoxic and could therefore inhibit plant growth especially during initial planting. The maximum concentrations of these contaminants observed in the shallow soils (as shown in table 6.2.1 and 6.2.2) were therefore compared against the screening criteria in BS3882.

38 No. samples have been analysed for nickel, copper and zinc across the site area (Phase 1 = 19 No. within made ground 7 No. within Natural Deposits. Phase 2 10 No. within made ground deposits).

Adopting a general pH value of 7 or above, the following screening values for nickel (110 mg/kg), copper, (200 mg/kg) and zinc (300 mg/kg) are relevant respectively. As the maximum concentrations of these determinands are significantly lower than these screening criteria for both made ground and natural deposits, the phytotoxic risk posed to vegetation is not considered to be significant.

3.6 Mains Water Pipe Assessment

Levels of hydrocarbons within the near surface made ground and natural deposits are unlikely to be high enough to penetrate water bearing service pipes laid within these materials. However, the maximum results summarised in table 6.2.1, 6.2.2 and 6.3.1 and 6.3.2 of the GE22715 May 2019 GI Report and the tables 3.3.1, 3.3 and 3.4 from this additional assessment should be presented to the pipework manufacturers and water services supplier to determine if upgraded barrier pipe is required.

4 CONCLUSIONS & RECOMMENDATIONS

The levels of contaminants detected in the soils from both phases of investigation and assessment are not considered to represent a significant risk to the proposed 'Public Open Space' end use receptors associated with proposed development. All the identified chemical soil concentrations were below the adopted Public Park and the more stringent residential park criteria's, however: -

- The detected asbestos concentrations are generally less than the arbitrary 0.001% threshold, one sample reported a slightly higher value (0.002%), however 13% of made ground samples analysed (9 of 72 No.) recorded asbestos present. A further 7 No. asbestos screens were undertaken on natural soils, none of which identified asbestos. The detection rate in the made ground soils suggests higher concentrations may potentially be present.

  All asbestos detections are currently located outside the proposed 'cut/reuse' earthworks source areas that are proposed as part of the development. The exceedances are all located within or in close vicinity to the infilled lido. The asbestos identifications are considered to be associated with crushed demolition waste from former onsite structures that was utilised for backfilling. This crushed demolition material appears to be limited within the proposed 'cut/reuse' earthworks source areas. However, it is considered present locally in the north eastern area, within TP101 between 0.30 to 0.60mbgl, HP232 between 0.20 to 0.40m bgl and HP233 between 0.20 to 0.35mbgl. An asbestos screen was undertaken in the unit in each location, but asbestos was not detected. Granular made ground was also encountered in the south western proposed 'cut/reuse' earthworks source area but appeared to differ from the demolition waste material (colour, concrete quantities etc.). Where granular made ground was encountered, an asbestos screen was undertaken but asbestos was not detected.

  The areas where asbestos has been identified are located within proposed 'fill' earthwork areas, thus identified asbestos impacted materials would be capped by the materials from the proposed source areas (where asbestos has not been identified). The level of fill across the former lido area appears to be circa 0.5 to 1m thick and areas of hardstanding. However, subsequently Conisbee has stated that between 300 to 500mm of cut/reuse will be required across the infilled lido area to form formations. This differs to that detailed on the Conisbee Earthworks Isopachytes Contours Plan 17116-con-x-xx-DR-C-7005 presented in appendix A. Further clarification is required to enable a final mitigation strategy to be produced. The level of risk is not considered severe enough to warrant further comprehensive remediation, especially if a school child receptor is considered appropriate with associated low risk rating (instead of the more conservative infant <5 years with associated medium risk rating). However, it is considered mitigation should be undertaken to reduce risk into the future.
- Concentrations of EC7 congener PCBs were identified in the made ground at TP104 but additional analysis in soil and groundwater within the area suggests the concentrations are localised. It is recommended that during redevelopment the localised area of TP104 should be excavated/further assessed especially if the soils are proposed to be reused or excavated as part of the development.

However, at this stage it is considered hydrocarbon concentrations from the made ground soils are not considered to pose a significant risk to proposed or existing human health receptors.

- The concentrations of metals and hydrocarbons with groundwater across the site are not considered to pose a significant risk to controlled water receptors.
- The source for the elevated ammoniacal nitrogen concentrations identified locally within the groundwater has not currently been identified. The recent foul CCTV survey found no evidence of possible leaking during the survey of the foul pipe on and in close vicinity to the site, i.e. displaced pipes, cracks in line etc. The identified concentrations suggest that the source is likely within the south western site area, with the highest concentrations identified in WS109 and WS108. Alternatively, it is considered that the concentrations could be migrating from off site (from the south west). It is recommended that this additional assessment with associated results should be supplied to the EA, so that they may advise whether they are concerned by the detected concentrations. Also we understand a main foul sewer is also located under the boating lake immediately to the south west of the site. The associated utility company of the foul sewer should be contacted about any known leaks or incident that has occurred.
- It is considered that the identified contaminate concentrations from the soil leachate analysis do not pose a significant risk to controlled water receptors.
- Phytotoxic contaminants were found to be below screening criteria. No action considered necessary.
- Levels of hydrocarbons within the near surface made ground and natural deposits are unlikely to be high enough to penetrate water bearing service pipes laid within these materials. However, the maximum results of the GE22715 May 2019 GI Report and from this additional assessment should be presented to the pipework manufacturers and water services supplier to determine if upgraded barrier pipe is required.
- No additional gas monitoring has been undertaken as part of this additional assessment and the initial GE22715 May 2019 GI Report should be referred to for the gas assessment of the subject site. It should be noted that the report stated that based on the current GSVs for CO2 and CH4, and in accordance with BS8485:2015, all the worst case GSVs for the exploratory monitoring wells fall into Characteristic Gas situation (CS) CS1 showing 'Very Low Hazard Potential'. However, maximum carbon dioxide concentrations in WS101, 102, 103, 104 and 109 exceed 5%, therefore at this stage it is recommended that within in these areas the site, the categorisation should be increased to a CS2 'Low Hazard Potential'.

It is understood that the EA have stated that the proposed works can be undertaken utilising the Definition of Waste: Development Industry Code of Practice updated in 2011, instead of applying for and working under an Environmental Permit.

Based on the current soil analysis, the soils within the proposed cut/reuse earthwork source zones are chemically 'fit for purpose' considering the proposed 'Public Open Space' end use receptors and leachate concentrations to controlled water receptors. However further clarification is required on the proposed earthworks across areas where made ground has been identified to contain asbestos fibres to enable a final mitigation strategy to be produced. Additionally, the source for the elevated ammoniacal nitrogen concentrations identified locally within the groundwater has not currently been identified. It is recommended that this additional assessment with associated results should be supplied to the EA, so that they may advise whether they are concerned by the detected concentrations.

The Code of Practice has three basic steps

1. Ensuring that an adequate Materials Management Plan (MMP) is in place, covering the use of materials on a specific site
2. Ensuring that the MMP is based on an appropriate risk assessment, that underpins the Remediation Strategy or Design Statement, concluding that the objectives of preventing harm to human health and pollution of the environment will be met if the materials are used in the proposed manner: and
3. Ensuring that materials are actually treated and used as set out in the MMP and that this is subsequently demonstrated in a Verification Report.

To confirm that steps 1 and 2 have been taken, a ‘’Qualified Person’’ reviews the relevant project documents and provides a Deliration to the EA prior to the use or dispatch of materials.

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LIST OF APPENDICES

Appendix A – Drawings

Appendix B - Background Information

Appendix C - Fieldwork Records/Data

Appendix D - Laboratory Test Data

Appendix E – Assessment

LIST OF APPENDICES

Appendix A – Drawings

Conisbee Earthworks Isopachytes Contours Plan	17116-con-x-xx-DR-C-7005
HGE Fieldwork Location Plan	GE22715-DR002
HGE Fieldwork Location Plan & extent of the proposed earthworks	GE22715-DR002A
HGE Fieldwork Location Detailing Asbestos Screening-Initial & Additional Phases	GE22715-DR009A
HGE Fieldwork Location Detailing Asbestos Screening-Initial & Additional Phases & Extent of the Proposed Earthworks	GE22715-DR009B
HGE Groundwater Exceedances from Initial the May 2019 Analysis	GE22715-DR010A
HGE Groundwater Exceedances from Initial the July 2019 Analysis	GE22715-DR010B

Appendix B - Background Information

GEOTEC Surveys Limited Underground Mapping Survey	Ref: 1904S021
GEOTEC Surveys Limited CCTV Survey	Ref: Cry294 dated 11th July 2019

Appendix C - Fieldwork Records/Data

Dynamic Continuous Sample Borehole Records	WS201-207
Dynamic Continuous Sampler SPT Calibration Certificate	
Hand Dug/Machine assisted Trial Pit Records	HP201 to 236 HP301 to 303
Photo Plates of Trial Pit Locations	HP201 to 236
Groundwater monitoring Results	22/07/2019

Appendix D – Laboratory Test Data

Chemical Laboratory Analysis Results

i2 Reports

19-50828-1 soils

19-51084-1 soils

19-51282-1 soils

19-51455-1 ground waters

Appendix E – Assessment

Table detailing Results of all Asbestos Analysis on soil samples across the site area.