

Five Fords Waste Water Treatment Works AAD

Permit Variation: Site Condition Report

19 February 2019

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19 February 2019

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1 Introduction

This report forms the update to the site condition report for the Five Fords Wastewater Treatment Works (WwTW) following the proposed variation to the permitted operational boundary. The site condition report¹ issued in 2011 to support the original permit application remains valid for the existing site boundary and should be read in conjunction with this report.

1.1 Background

The permit variation is required to take account of the proposed changes at the Five Fords site, which include the addition of an Advanced Anaerobic Digestion (AAD) facility to the current Anaerobic Digestion (AD) process which takes place at the site. As part of this change, the AAD and sludge treatment processes will require the importation of an increased amount of sludge and cake from other WwTW satellite sites around North Wales. This will cause Five Fords to subsequently exceed the current T21 exemption (recover wastes at a wastewater treatment works), which covers the site and allows the treatment of up to 100,000 cubic metres of waste over any 12-month period.

It is now planned to install a Cambi thermal hydrolysis process (THP) plant, a form of AAD technology, at Five Fords WwTW, and for Five Fords to become a treatment centre for all sludge produced in North Wales, taking on additional satellite sites to those already importing liquid sludge into Five Fords. This will also allow the other digesters around north wales, many in a deteriorating condition, to be decommissioned.

1.2 Site details

1.2.1 Name of the applicant

Dŵr Cymru Welsh Water (DCWW) is the applicant for the variation of an Environmental Permit for the operation of the Five Fords Wastewater Treatment Works (WwTW) Combined Heat and Power (CHP) Facility.

1.2.2 Activity address

The address for the Plant is:

Five Fords WwTW Gas to Grid Facility
Cefn Road
Adenbury
Wrexham
LL13 0PA

1.2.3 National grid reference

The centre of the site is located at National Grid Reference SJ 36432 47916. The proposed extension to the site covers an area of approximately 1.35 Ha, resulting in a total operational area of approximately 1.75 Ha. The location of the site is shown in Appendix A1.

¹ Arup (2011) Five Fords Combined Heat and Power Project: Environmental Regulations Permit Application – Site Condition Report. Ref: REP/140/11. Job no: 124348-10

1.2.4 Document reference

The environmental permit that this application relates to is EPR/AP3139FT.

This document is Version 2 of the Five Fords Facility SCR. This version updates Version 1 to record the condition of the site in the proposed extension to the operational boundary.

Version 1¹ of the document was produced in August 2011 to support the original application for an Environmental Permit for the operation of the installation.

1.2.5 Document references for site plans

Site details are covered under Appendix A, including the following maps:

- A.1 Site location plan with installation boundaries;
- A.2 Location of key receptors;
- A.3 Sources of emissions/releases, and monitoring points.
- A.4 Site drainage
- A.5 Site surfacing.

2 Condition of the land at permit issue

2.1 Environmental setting

2.1.1 Geology

The published geological map for the area, BGS Sheet 121 (1973 and 1990) and BGS Geology viewer (2019) show the site as located on superficial deposits comprising Alluvium associated with the River Clywedog in the northernmost section of the site, River Terrace Deposits covering the majority of the site and Glacial Till of the Devensian Period in the southern section of the site. The underlying solid geology is indicated to comprise the Salop Formation (Warwickshire Group) of the Permian and Carboniferous Period (mudstone, sandstone and conglomerate).

Ground investigation of the area in October 2016 by Environmental Scientifics Group (ESG) confirmed the geological sequence underlying the site as being:

- Made ground;
- River Terrace Deposits;
- Glacial Till (where present); underlain by
- Salop Mudstone Formation.

The made ground varied in thickness up to 3.2m but was generally 0.8m to 1.5m thick over the main THP construction site, reflecting the use of this area as a construction compound. The made ground in this area comprised sand and gravel of limestone and concrete. There was some ash, clinker, brick and slag noted as being present in some locations around the wider WwTW site.

The River Terrace Deposits were described as silty sand, and the Glacial Till as sandy clay.

2.1.2 Hydrogeology

The Environment Agency has classified the River Terrace Deposits as a Secondary A aquifer, the Alluvium as a Secondary undifferentiated aquifer, and the Salop Mudstone Formation as a Secondary A aquifer. The Alluvium is classified as unproductive strata, likely minimising hydraulic connectivity between the River Terrace Deposits and Salop Mudstone.

During the 2016 ground investigation, piezometers were installed in four boreholes into the superficial deposits. Groundwater elevations were recorded as follows:

- BH1601 (installed in River Terrace Deposits) – 1.96m to 2.31m below ground level (bgl) (39.93m to 39.58m above ordnance datum (AOD))
- BH1602 (installed in Glacial Till) – 2.17m to 2.42m bgl (40.11m to 39.86m AOD)
- BH1603 (installed in Glacial Till) – 1.67m to 1.84m bgl (42.44m to 42.27m AOD)
- BH1605 (installed in Glacial Till) – 1.70m to 1.82m bgl (40.96m to 40.84m AOD)

These results indicate that the groundwater flow in the superficial deposits is in a roughly northerly direction, towards the River (Afon) Clywedog.

The site is not within a groundwater source protection zone.

2.1.3 Surface water

A pond lies approximately 45m to the south east of the original permitted boundary (105m to the southeast of the proposed extension to the boundary). Additionally, there is evidence of an old sludge lagoon 60m to the east of the original and proposed permitted boundaries.

Approximately 310m to the north of the proposed boundary, lies the River (Afon) Clywedog running east to west in direction. It discharges into the River Dee (Afon Dyfrdwy) approximately 4.5km to the west.

The site is not located within a flood zone.

2.2 Pollution history

2.2.1 Pollution incidents that may have affected land

There are no known pollution incidents to water or land within the proposed permitted boundary.

Within 250m of the proposed boundary, there was a substantiated pollution incident in 2010 comprising a category 2 (significant) incident to water due to the release of final effluent sewage materials, 215m to the north west.

2.2.2 Historical land-uses and associated contaminants

From review of the historical development of the site, it is considered that the sewage treatment works; first observed on the 1912 historical plan, and the associated sludge beds constructed to the east of the permitted boundary by 1974 are the main potential sources of contamination on the site. Sludge lagoons may have also leaked or overflowed, waste material (such as sludge or screenings) may have been buried and built upon historically, on or near the site and any chemicals or fuel used on the site may have leaked or spilled. Other limited sources of contamination may include the historical railway line with associated tanks 70m to the south of the boundary.

It is also anticipated that made ground will be present in the shallow subsurface of the site. Made ground is therefore also considered a potential source of contamination.

Contamination associated with the above land uses includes:

- Sewage treatment works – sewage sludge can potentially contain elevated levels of nitrogen (predominantly in the form of ammonium and organic-N), metals and metalloids (including Hg, Cu, Ni, Pb, Zn, As, Cd, Se, Mo, Co, Cr and Ag), phosphate, pathogens, and organic compounds (including polychlorinated biphenyls (PCB), polycyclic aromatic hydrocarbons (PAH), total petroleum hydrocarbons (TPH), organochlorine pesticides, phthalate esters, surfactants, furans, chlorobenzenes, solvents, phenols and dioxins). Additionally, a wide variety of materials may be screened from raw sewage, including; textiles, plastics, metals, wood or other plant fragments.
- Chemical storage and use – chemicals associated with the works might include aluminium sulphate, ferric chloride or sulphate, lime, polymeric substances (generally biodegradable), petroleum hydrocarbons such as fuel oils or lubricating oils, pesticides and herbicides.
- Made ground – contaminants may be varied depending on the source of the made ground, but may include; metals, semi-metals, inorganic chemicals, PAH, TPH and asbestos, as well as ground gases (carbon dioxide (CO₂) and methane (CH₄)).
- Railway land - metals, semi-metals, inorganic chemicals, herbicides, PAH, TPH, volatile and semi-volatile organic compounds (VOC and SVOC) and asbestos.

2.2.3 Any visual/olfactory evidence of existing contamination

During the 2016 ground investigation, when drilling BH1604 near some redundant tanks, the driller noted “contamination in shell” at 12.7m bgl in the top of the Salop Formation (fine grained sandstone), however no testing was undertaken to identify the contamination. An additional borehole was drilled as a result of this find, however no other signs of contamination were noted during the ground investigation.

No other signs of contamination have been identified on the proposed site.

2.2.4 Evidence of damage to pollution prevention measures

Table 1 lists equipment that has the potential to result in pollution to the environment, either directly or indirectly, should it degrade or breakdown. Under the DCWW environmental management plan, and to maintain ISO14001 accreditation, the equipment is regularly inspected to assess degradation or damage. It is important to note that not all of the valves and operating pipework is included in the list but they are all inspected by a gas leak detector on a monthly basis by internal staff.

Table 1: Equipment maintenance schedule

Equipment	Maintenance Frequency:
Gas Holder	6 Monthly
Flare Stack	Annually
Siloxane Filters	Annually
CHP Engines	As needed based on condition monitoring
Carbon Filters	3 Yearly media change
Membranes	10 Yearly membrane change
Propane Tanks	Weekly inspection upon deliveries
Grid Entry Unit Calibration Gases	Upon re-delivery
Whessoe Valves	Annually
Gas Overpressure Vent	Annually

Source: Five Fords Gas to Grid Facility Environmental Management Plan

No damage to installation infrastructure, or the sealed drainage systems, is known to have occurred since the permit was granted.

2.3 Evidence of historical contamination

No significant contamination was identified to be present on the site based on ground investigation data assessed during Version 1 of the Site Condition Report. No known contamination of the existing or proposed site has been identified and no contamination events have occurred, since the issue of Version 1 of this report.

2.4 Baseline soil and groundwater reference data

An intrusive ground investigation was undertaken in October 2016 in the location of the proposed extension to identify conditions on the site prior to the commencement of a permit variation. The investigation and an assessment of the contamination results are described in a report in Appendix B, but are summarised here for reference.

The scope of the investigation was specified by Mott MacDonald Ltd and comprised cable percussion boreholes (to 15m bgl), two rotary follow on boreholes (to a maximum of 23.8m bgl), trial pits (to 4.5m bgl) and in-situ testing and laboratory testing.

Ten samples of made ground were submitted for laboratory analysis for metals, speciated polycyclic aromatic hydrocarbons (PAH), BTEX compounds (benzene, toluene, ethylbenzene, and xylene), total petroleum hydrocarbons (TPH) and asbestos. The concentrations were compared to generic screening values protective of human health for a commercial end use². There were no exceedances of any criteria.

Leachate analysis of the soil samples identified widespread but marginal exceedances of metals (copper, iron and manganese) as well as large exceedances of ammoniacal nitrogen and phenol against water quality standards (Environmental Quality Standards (EQS) and Drinking Water Standards (DWS)). It should be noted that the leachate exceedances were found in multiple samples, indicating that the contamination is widespread in the area and representative of baseline conditions on the site.

Groundwater samples from the superficial deposits identified slightly elevated concentrations of metals, ammoniacal nitrogen and phenol when compared to water quality standards. These were similar to those determinands identified as exceeding water quality standards in the leachate.

Ground gas monitoring was undertaken on four occasions in November 2016. Concentrations of methane were all <0.1%v/v except for a single occasion where a concentration of 0.1%v/v was recorded in BH1605. Concentrations of carbon dioxide were generally <0.1%v/v with a maximum concentration of 0.4%vol recorded in BH1603. Concentrations of carbon monoxide were all <0.1ppm except for a single occasion where a concentration of 1.6ppm was recorded in BH1603. Concentrations of hydrogen sulphide were all <0.1ppm. Flow rate was recorded on all occasions to be <0.1l/hr.

² Land Quality Management (LQM)/ Chartered Institute of Environmental Health (CIEH) (2015) The LQM/CIEH S4ULs [Suitable for use levels] for Human Health Risk Assessment

3 Existing permitted activities

3.1 Permitted activities

A summary of the current permitted activities as part of the Facility is shown in Table 2.

Table 2: Permitted activities

Table S1.1 Activities

Activity reference	Activities listed in Schedule 1 of the EP Regulations	Description of the specified activity	Limits of specified activity
A1	Section 1.2 A (1) (a) – Refining gas where this is likely to involve the use of 1000 or more tonnes of gas in any 12-month period.	Refining of bio-gas produced from AD of Sewage Sludge prior to direct injection into National Gas Grid.	From receipt of raw bio-gas to entry to the National Grid including gas odourisation.
Directly Associated Activity			
A2	Propane Storage and Transfer Plant	Addition of propane to bio-methane to enhance calorific value of gas.	Storage and transfer of propane.
Description of activities for waste operations		Limits of activities	
A3	R1: Use principally as a fuel or other means to generate energy.	Treatment operations shall be limited to: 1. Burning of waste as a fuel for CHP production of hot water and electricity, from the receipt of raw materials to the despatch of products and waste. 2. Operation of a Waste Gas Burner (flare stack) from the receipt of biogas to the release of combustion products. 3. Storage of biogas arising from the AD process at Five Fords WwTW prior to combustion in the CHP engines and supplementary firing in the boilers or flaring. 4. Siloxane removal using a granular activated carbon filter, which will remove siloxane from the biogas deriving from the anaerobic digester prior to its combustion in the CHPs and the boiler. 5. Discharge of condensate from the gas pipelines and gas storage bag and from the siloxane removal media regeneration process, from collection to the point of discharge to the adjacent WwTW.	

Source: Environmental Permit

The Five Fords CHP is not subject to Control of Major Accidents Hazards Regulations (1999) (COMAH).

3.2 Non-permitted activities undertaken

Non-permitted activities undertaken at the sludge treatment works are as follows:

- The indigenous primary sludge and imported sludge is pumped through sludge screens and held in a screened sludge holding tank.

- The screened sludge is then pumped to gravity belt thickeners and thickened to 6%. Indigenous SAS (surplus activated sludge) is also thickened to 6% using a separate stream of thickeners.
- Polyelectrolyte is used as a thickening agent for the sludge. There are separate polymer make up and dosing plants for both the raw sludge and the SAS.
- Both the thickened raw sludge and SAS is then pumped to a thickened sludge holding tank prior to being pumped to the digesters via a sludge / water heat exchanger.
- Both digesters displace sludge into a common weir box where it gravitates to the post digestion storage tank.
- Lime slurry is then added to the sludge to achieve an enhanced product in line with HACCP (Hazard Analysis and Critical Control Points) requirements.
- Limed sludge is then pumped to the dewatering plant which consists of 3No. centrifugal centrifuges which will operate in a duty/assist/standby configuration.
- Polymer for sludge dewatering is dosed from a second batch make up system
- The cake is dewatered in centrifuges to 23-30% dry solids and then conveyed by a series of screw conveyors to a number of cake bays. The cake is then removed by a specialist contractor and spread on the local land bank.

3.3 Document references

The environmental risk assessment for the permitted activities is contained in Appendix C of the 'Application to vary an installation permit to include waste operation as a DAA'.

4 Changes to the activity

4.1 Changes to the activity boundary

A figure showing the existing and proposed permitted boundaries is presented in Appendix A.1.

The change comprises an increase in the permitted operational area from approximately 0.4 Ha to 1.75 Ha.

No changes to the current Facility are anticipated, although the digesters, which are currently outside the gas-to-grid permit boundary, will be brought within the permitted site.

4.2 Changes to the permitted activities

It is now planned to install a Cambi THP plant, a form of AAD technology, at Five Fords WwTW.

The main changes to the sludge treatment activities to be included in the varied permit are summarised as follows:

- Increased sludge treatment: the quantity of sludge treated at the site will increase to 104,465m³/annum.
- THP: a Cambi THP plant will be installed prior to the current digesters. This will increase the yield of gas obtained from the digestion of sludge and result in a higher quality end product for use as fertilizer. This will include two new boilers (1.567MWth each, with dual burners which can run on either biogas or natural gas) to provide steam to heat the THP streams.
- Liquor Treatment Plant (LTP): a new LTP will be included within the new permit. This will reduce pollutants in the post digestion dewatering centrate to acceptable levels before being pumped back to the WwTW.

Details pertaining to the sludge and cake that will be imported into the Plant are displayed in Table 3. These figures are based on a worst-case scenario and were derived from Tables 3.10 and 4.2 of the Basis of Design Report (document ref DCWW-4791-S-201-MMB-06-XX-RP-CX-11001). The treatment capacity is 47tDS/day.

Table 3: Quantity of sludge and cake imported to the Plant

Stream	Concentration (%DS)	tDS/year	Volume (m ³ /year)	Comment
Imported – Existing LIQUID sludge imports	3.8	1,500	39,420	The concentration and delivery volumes are variable – especially the concentration. The concentration of 3.8%DS is based on measured values
Imported – proposed imported cake	20 (minimum)	13,009 (worst case including Queensferry – Phase 2 average)	13009*100/20 = 65,045	The % DS should be higher than this (i.e. volume lower) this value is used to be conservative. Also, density assume 1t/m ³ which is also conservative.
Total	N/A	14,509	104,465	Marginally over the 100,000m ³ “limit”

The proposed AAD plant will include the following changes:

- Cake import facility to receive dewatered sludge from the satellite sites;
- Cake silos for storage of cake prior to treatment in THPs;
- Pre-THP dewatering facility for on-site sludge and liquid imports to allow for combined storage with imported cake in silos;
- One new additional gas holder;
- Demolition of existing sludge buffer tanks prior to post digestion dewatering;
- Re-use of existing pre-digestion sludge storage tanks for sludge storage upstream of the Pre-THP dewatering facility;
- New post-digestion tank to the north of the cake export building;
- Extensions and modification of the current cake export building to cater for increased production of cake;
- Automated de-gritting system for existing digesters;
- Removal of the current standby boiler (1.5MWth) located with the current CHP engines; and
- Modification of the current CHPs (2.82MWth total), so that they no longer recover heat for the digesters.

The stages to the process in the LTP are as follows:

- Only post-THP dewatering liquors are pumped to the LTP balance tank for buffering before being pumped forward for treatment.
- The LTP feed pumps then pump the liquors to the LTP moving bed biofilm reactor (MBBR).
- Before entering the reactor, the flow (warmed via the sludge coolers) passes through a static mixer where the low temperature final effluent is added to dilute and warm the liquors. Caustic soda is then dosed to add alkalinity to promote the conversion of ammonia into nitrogen gas.
- Flow passes into the reactor, where it is mixed and treated utilising Anammox (anaerobic ammonia oxidation) technology. Air is added to the reactor using a blower and air distribution grid, and the flow is mixed using a paddle mixer, which keeps the media and ammonia oxidising bacteria in suspension.
- Flow then passes forward to the LTP clarifier complete with half-bridge scraper. In this tank, effluent is wired over and discharged to the THP return pumping station where flow is discharged back to the main WwTW for further treatment. The sludge settled in the LTP clarifier is returned to the reactor as part of a returned activated sludge system.
- When this sludge volume increases beyond a set volume, surplus activated sludge is diverted to the THP return pumping station and pumped to the main WwTW for settlement.

Removal of:

- Standby boiler

4.3 Dangerous substances

In order to undertake operational activities, the following chemicals/materials listed in Table 4 are used, they are stored in either a bund/spill tray/gas tank unless otherwise stated that they are part of the process.

Table 4: Chemicals used

Chemical	Grade	Quantity/Process
Glycol	Mono Ethylene Glycol	20 Litre Drums
Bio Gas	60 % CH ₄ , 38% CO ₂ , 2% N ₂ & O ₂ .	(From the Gas Holder)
Bio-Methane Gas	mainly CH ₄	(Injected at the GEU)
Hydrogen Sulphide	H ₂ S	(H ₂ S is removed through the ACFs)
Liquefied Propane Gas (LPG)	C ₃ H ₈	3 x 9000L (water capacity)
Odorant for gas	Odorant NB	40kg
Compressed Nitrogen	99.99% N ₂	Approx. 10 x 50L cyl.
Calibration Gas	Type 4 Calibration Gas Mixture	Various 10L and 50L cylinders
Oil	Engine Oil	30L
Helium Gas	99.999%	50L x 2

Source: Five Fords Gas to Grid Facility Environmental Management Plan

5 Measures taken to protect land

5.1 Land

There will be no point source emissions to land as part of the activities carried out on site.

5.2 Water and drainage

The water used at the Plant will be contained in a closed circuit; all wastewater streams will either be recycled within the process or captured and rerouted to the adjacent WwTW.

There is one-point source release of wastewater from the BIP, which is discharged to the head of the on-site Five Fords WwTW (to sewer). This is limited to the small amounts of condensate present in the biogas feed to the BIP. The wastewater stream is directed to the WwTW drainage system and returned to the head of the works.

The remainder of the process water, through the final effluent, will be diverted and further treated, through filtration and disinfection, for reuse within the THP.

As such, there are no known direct potentially contaminated discharges to controlled surface waters and no significant impacts. All drainage (surface water or foul water) will be captured by the onsite drainage system and returned to the head of the WwTW.

The AAD site will be covered in impermeable surfacing in order to contain any spillages and prevent mobilisation into the underlying groundwater. Site access roads will be built with kerbing to channel any surface spillages into the drainage network and prevent adjacent areas from being inundated. Any sewage spillages that occur will be limited in extent due to the site being secure with impermeable paving. There is sufficient capacity at the WwTW to handle the additional water input from the increased site area of the site.

The stormwater drainage of potentially contaminated areas from within the Plant boundary will be routed into the sewage treatment process with no discharge outside of the site. There will therefore be no risk of polluted runoff affecting off-site features due to the creation of a new hardstanding and plant area.

Any areas of the facility where there is a risk of contamination of surface water, groundwater or discharge of process waters, are located on impermeable concrete surface. All surface water from these areas drain to the WwTW internal drainage system and are returned to the head of the works for treatment prior to discharge as final effluent.

The drainage system within the AAD site directs all surface water back to the head (intake) of the works and on through the treatment process. Any increase in run-off will only affect flow through the WwTW and will not impact on neighbouring sites.

There are no direct releases to controlled waters or public sewers of emissions arising from the Plant. As such, no monitoring or reporting for the additional Plant is required.

5.3 Waste

Five Fords WwTW has a designated waste management area that is located behind the offices next to the workshop. All skips and containers are located on a hardstanding to prevent leaching into the ground. Skips and containers are clearly labelled. All waste from the Facility is sorted at this waste area at the main site, other than the gas cylinders.

5.4 Management systems

DCWW has an Environmental Management System (EMS) Policy accredited to ISO14001.

In line with the EMS Policy, the Five Fords AAD and sludge treatment plant (STP) will be operated in accordance with the DCWW Quality Management System (QMS) EMS. The QMS was last audited in February 2017 and passed with no non-conformities.

DCWW has established and maintained documentation that defines and describes how the QMS is established, implemented and maintained in accordance with ISO 9001:2008 and ISO/IEC 17025:2005 and monitoring emissions to air, land and water (MCERTS) Standards.

An Accident Management Plan, in the form of Environmental Emergency Procedures (Issue 05, 15th March 2015) and Site Emergency Plan (Version 2, October 2015), and Environmental Management Plan (Five Fords Waste Water Treatment Works – G2G Facility Environmental Management Plan, Issue 05, 22 November 2017) forms part of DCWW's QMS.

An Accident Risk Assessment has been carried out for the installation, as has a Fire Risk Assessment (dated 19/06/2015) in accordance with the Regulatory Reform (Fire Safety) Order, 2005, these are implemented in accordance with the EMS requirements and is regularly reviewed.

In addition, an Environmental Risk Assessment has also been produced, in accordance with the EPR H1 guidance, and all risks identified by these assessments will be incorporated into the QMS.

5.5 Complaints and incidents

All pollution incident calls or emails are input into DCWWs online control system (SAP) by a Pollution Incident Advisor (PIA). This is then sent to the Waste Water Scheduling Team who allocates a Network Crew or contractor to respond to the incident; they have 4 hours to respond. After attending the incident, the operational crew provides feedback via SAP; the pollution incident details along with remedial actions taken or required are also verbally communicated to the Responsible Officer (RO). The SAP incident remains open until all follow-up work has been completed.

Following each incident, the relevant Pollution technician/Environmental Performance Officer reviews the findings and investigates details of the incident. If the root cause of the incident is identified, the appropriate remedial action is undertaken and the job is closed on SAP. If the root cause is not obvious, an enhanced investigation is instigated and the findings reviewed for appropriate remedial action. Every category 1 and 2 pollution incidents are formally reviewed by the Head of Wastewater (Network).

6 Pollution incidents that may have had an impact on land, and their remediation

There are no known pollution incidents associated with the Installation since the existing permit was issued.

Groundwater data are considered in Section 7 to assess whether the water quality has deteriorated since the permit has been active.

7 Soil gas and water quality monitoring

Based on groundwater elevations collected during the 2016 investigation, results indicate that the groundwater flow in the superficial deposits is in a roughly northerly direction, towards the River (Afon) Clywedog. The monitoring was therefore downgradient of the existing permitted boundary and should capture any contamination released by the existing installation.

The 2016 monitoring collected samples of groundwater encountered in the superficial deposits. These were analysed at the ESG Burton on Trent laboratory for inorganic parameters, metals, speciated PAH, TPH, gasoline range organics (GRO, includes BTEX and aliphatic carbon ranges), phenols, and VOC.

The results identified slightly elevated concentrations of limited metals (copper, lead, manganese (larger exceedances) and zinc) as well as ammoniacal nitrogen when compared to water quality standards (EQS and DWS). These were similar to those determinands identified as exceeding water quality standards in the leachate of soil samples from the site. It should be noted that the leachate exceedances were found in multiple samples, indicating that the elevated levels are widespread in the area and representative of baseline conditions on the site.

Additionally, some exceedances of the water quality standards for PAH and TPH were identified. The source of these hydrocarbons cannot be directly attributed to a particular source / land use, however, as elevated concentrations of contaminants were also identified prior to the issue of the existing permit, degradation of the groundwater quality underlying the site is not considered to be attributed to the existing permitted processes.

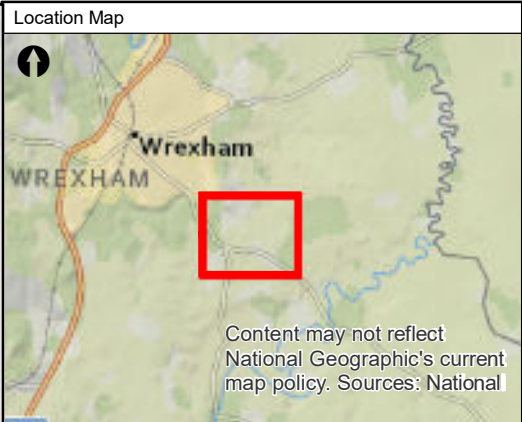
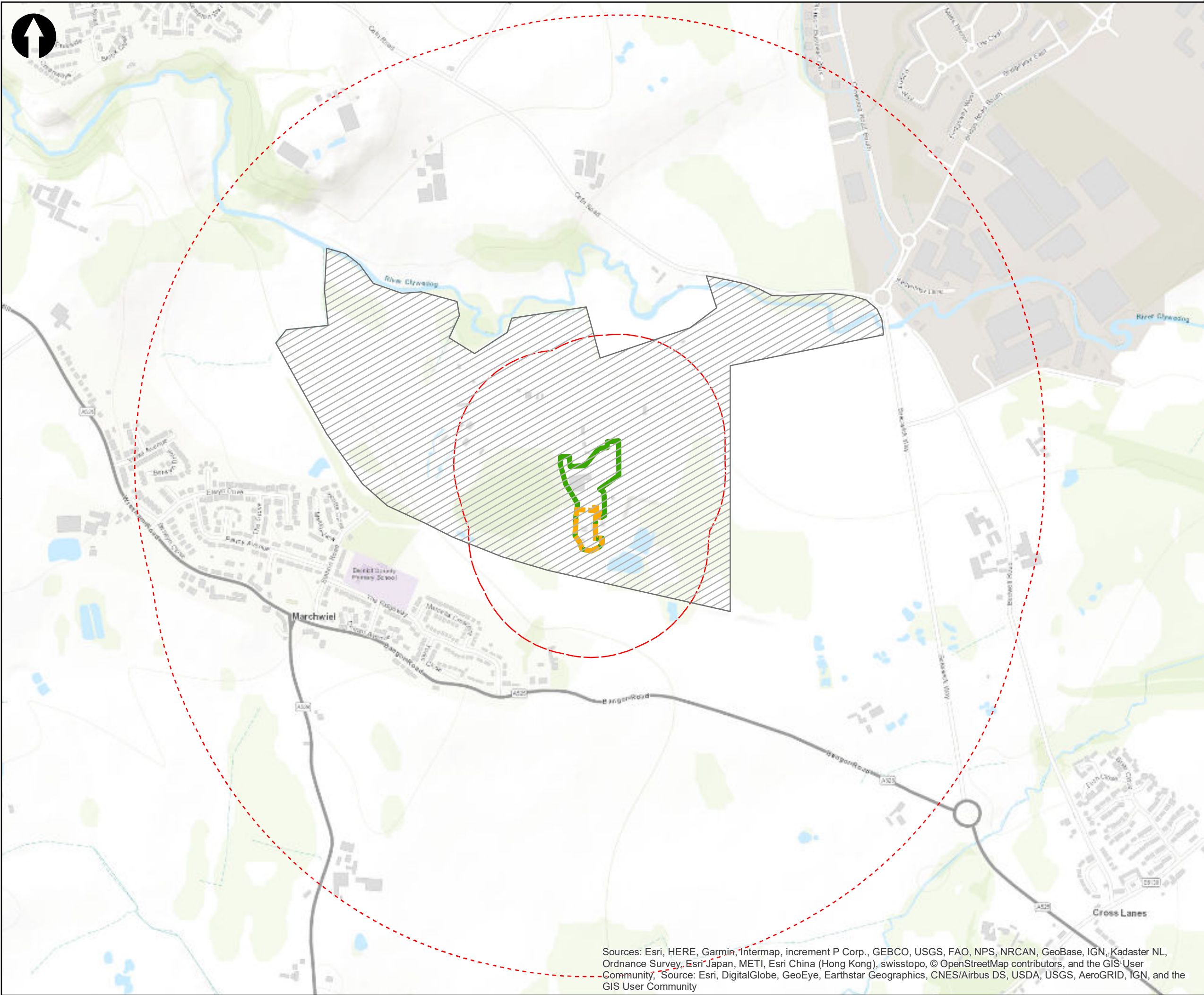
Water quality criteria applied are also very conservative for the location due to the presence of Secondary A aquifers that are unlikely to be abstracted for drinking water, and the closest significant surface water feature is a river over 300m from the proposed boundary. It is therefore likely that natural dilution and attenuation would reduce the concentrations of the contaminants prior to them reaching the river.

Appendices

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A. Figures

A.1 Installation boundary



Legend					
Boundary type					
	Existing installation				
	Proposed installation				
	Welsh Water land				
	250m buffer				
	1km buffer				

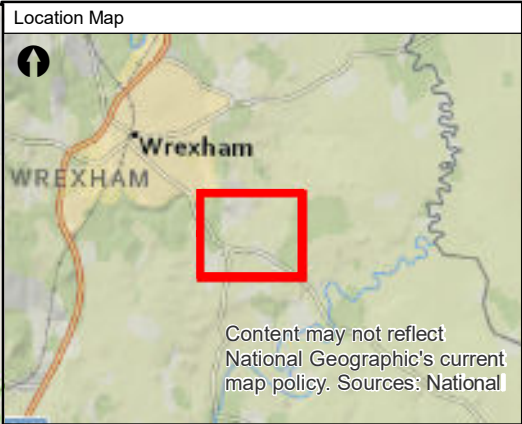
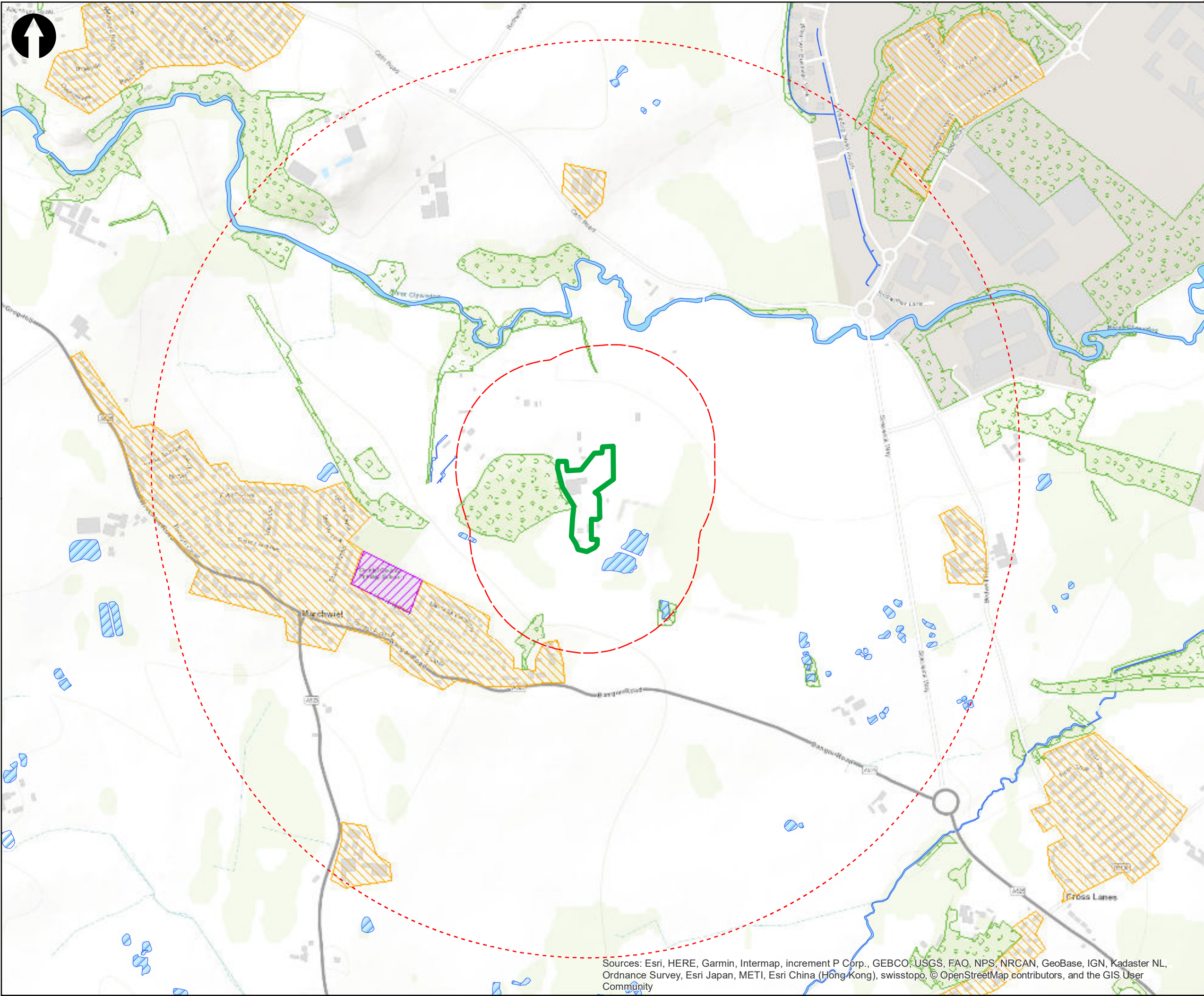
01	31/01/2019	First Issue	SG	AM	AM
Rev	Date	Description	Drawn	Ch'kd	App'd



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Project Title		
Five Fords Environmental Permitting		
Map Title		
Site location plan		
Scale at A3	MM Project No.	Status
1:8,407	398168	INF
GIS File		
FiveFords_mapping_SLP.mxd		

A.2 Location of receptors



Legend

Boundary type

- Proposed installation
- 250m buffer
- 1km buffer

Sensitive land uses

- Residential
- School
- Rivers
- Inland water
- Tree cover

01	31/01/2019	First Issue	SG	AM	AM
Rev	Date	Description	Drawn	Ch'kd	App'd

Dŵr Cymru
Welsh Water

M M
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Project Title

Five Fords Environmental Permitting

Map Title

Location of receptors

Scale at A3 1:8,799	MM Project No. 398168	Status INF
------------------------	--------------------------	---------------

GIS File
FiveFords_mapping_receptors.mxd

Drawing No. MMD-398168-Env-GIS-00003	Rev 01
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A.3 Sources of emissions and monitoring points.

NOTES:

1. NO DIMENSIONS ARE TO BE SCALED FROM THIS DRAWING.
2. EXISTING DRAINAGE INFORMATION TAKEN FROM 1ST HORIZON SURVEY. (JUNE 2016) AND AS-BUILT DRAWINGS PROVIDED BY DCWW (OCTOBER 2012).

INDICATES EMISSION POINT.

EMISSIONS TO AIR:

- A1 - EXISTING CHP STACK 1.
A2 - EXISTING CHP STACK 2.
A3 - EXISTING DUAL FUEL BOILER STACK (TO BE REMOVED)
A4 - EXISTING SILOXANE VENT.
A5 - EXISTING WASTE GAS BURNER.
A6 - EXISTING BIOMETHANE PLANT STACK.
A7 - EXISTING DIGESTER 1 GAS RELIEF VALVE.
A8 - EXISTING DIGESTER 2 GAS RELIEF VALVE.
A9 - EXISTING GAS HOLDER PRESSURE RELIEF VALVE.
A10 - GAS HOLDER PRESSURE RELIEF VALVE.
A11-12 - COMPOSITE STEAM BOILER STACK.

BOUNDARY KEY:

- EXISTING PERMIT BOUNDARY.
PROPOSED PERMIT BOUNDARY.

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:

CONSTRUCTION:

NO RISK IDENTIFIED

MAINTENANCE / CLEANING / OPERATION:

NO RISK IDENTIFIED

DECOMMISSIONING / DEMOLITION:

NO RISK IDENTIFIED

REFER TO THE DHEMR & IMS SUMMARY FOR FURTHER DETAILS. IT IS ASSUMED THAT ALL THE WORKS ON THIS DRAWING WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WHO HAS CARRIED OUT A COMPREHENSIVE RISK ASSESSMENT.

C02	01.06.18	AB	BOUNDARY UPDATED	CB	CB	01.06.18
C01	27.10.17	SJR	FIRST ISSUE	CB	NB	19.04.8

Rev.	Date.	Drawn	Description.	Chkd	Appd.	Date.
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Ty Awen, Spooner Close, Coed Kernew, Newport, NP108FZ

Project Name: FIVE FORDS AAD

Drawing Title: ENVIRONMENTAL PERMIT - FIVE FORDS AAD EMISSION POINTS

Suitability: CONSTRUCTION Suitability Code: A

Originator: SJR Designer: DB Date: 27.10.17

Internal Project Number: 363735NN26 Scale: As indicated@ A1 Rev: C02

Drawing Number: 4791-S-201-MMB-06-XX-DR-NX-06202

Dwr Cymru Cyl gives this information as to the position of its underground apparatus by way of general guidance only on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon in the event of excavations or other works made in the vicinity of the company's apparatus and any onus of locating the apparatus before carrying out any excavations rests entirely on you. It must be understood that the furnishing of the information is entirely without prejudice to the provision of the New Roads and Streetworks Act 1991 and of the Company's right to be compensated for any damage to its apparatus.

Dwr Cymru Cyl has no duty to identify private apparatus and the information as to the position of the private apparatus is given by way of general guidance only on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon. No all private apparatus is identified but their presence should be anticipated.

AAD SITE PLAN

1 : 250

A.4 Site drainage

NOTES:

- 1. NO DIMENSIONS ARE TO BE SCALED FROM THIS DRAWING.
- 2. ALL DIMENSIONS ARE SHOWN IN MILLIMETRES (mm), UNLESS NOTED OTHERWISE.
- 3. ALL LEVELS ARE SHOWN IN METRES (m) RELATIVE TO A.O.D, UNLESS NOTED OTHERWISE.
- 4. EXISTING DRAINAGE INFORMATION TAKEN FROM 1ST HORIZON SURVEY, (JUNE 2016) AND AS-BUILT DRAWINGS PROVIDED BY DCWW (OCTOBER 2012).



AAD SITE PLAN

1 : 250

BOUNDARY KEY:

- PROPOSED PERMIT BOUNDARY
- HISTORIC DRAINAGE
- NEW DRAINAGE

C04	18.02.19	DR	FOR CONSTRUCTION	DB	DB	18.02.19
C03	11.07.18	AB	DRAINAGE AMENDED	DB	DB	11.07.18
C02	01.06.18	AB	BOUNDARY UPDATED	CB	CB	01.06.18
C01	17.04.18	IH	FIRST ISSUE	CB	NB	18.04.18

Rev.	Date.	Drawn.	Description.	Chkd.	Apptd.	Date.
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Ty Awen, Spooner Close, Coed Kernaew, Newport, NP108FZ

Project Name: FIVE FORDS AAD

Drawing Title: ENVIRONMENTAL PERMIT - FIVE FORDS AAD PROPOSED SITE DRAINAGE

Suitability:	Suitability Code:
FOR CONSTRUCTION	A

Originator:	Designer:	Date:
SJR	CB	27.10.17

Internal Project Number:	Scale:	Rev.
363735NN26	As indicated@ A1	C04

Drawing Number:
4791-S-201-MMB-06-XX-DR-NX-06201

Dwr Cymru Cyf gives this information as to the position of its underground apparatus by way of general guidance only on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon in the event of excavations or other works made in the vicinity of the company's apparatus and any onus of locating the apparatus before carrying out any excavations rests entirely on you. It must be understood that the furnishing of the information is entirely without prejudice to the provision of the New Roads and Streetworks Act 1991 and of the Company's right to be compensated for any damage to its apparatus.

Dwr Cymru Cyf has no duty to identify private apparatus and the information as to the position of the private apparatus is given by way of general guidance only on the strict understanding that it is based on the best information available and no warranty as to the correctness is relied upon. Not all private apparatus is identified but their presence should be anticipated.

A.5 Site surfacing

NOTES:

- 1. NO DIMENSIONS ARE TO BE SCALED FROM THIS DRAWING.
- 2. ALL DIMENSIONS ARE SHOWN IN MILLIMETRES (mm), UNLESS NOTED OTHERWISE.
- 3. ALL LEVELS ARE SHOWN IN METRES (m) RELATIVE TO A.O.D, UNLESS NOTED OTHERWISE.
- 4. WHITE AREAS WITHIN THE PERMIT BOUNDARY ARE PROCESSING UNITS/ STRUCTURES ON CONCRETE FOUNDATIONS.



AAD SITE SURFACING PLAN
1 : 500

Work in Progress
Not for External Use

KEY

- STONE
- GRASS
- CONCRETE
- PERMIT BOUNDARY

C01	18.02.19	DR	FOR CONSTRUCTION	DB	DB	19.02.19
Rev.	Date.	Drawn.	Description.	Chkd.	Appt.	Date.



Project Name: FIVE FORDS AAD

Drawing Title: AAD SITE SURFACING PLAN

Suitability, FOR CONSTRUCTION	Suitability Code: A
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Originator: BSW	Designer: CB	Date: 11.02.19
Internal Project Number: 363735NN26	Scale: 1 : 500@ A1	Rev. C01

Drawing Number: 4791-S-201-MMB-06-XX-DR-NX-06204

Dwr Cymru Cyf gives this information as to the position of its underground apparatus by way of general guidance only on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon in the event of excavations or other works made in the vicinity of the company's apparatus and any onus of locating the apparatus before carrying out any excavations rests entirely on you. It must be understood that the furnishing of the information is entirely without prejudice to the provision of the New Roads and Streetworks Act 1991 and of the Company's right to be compensated for any damage to its apparatus.

Dwr Cymru Cyf has no duty to identify private apparatus and the information as to the position of the private apparatus is given by way of general guidance only on the strict understanding that it is based on the best information available and no warranty as to the correctness is relied upon. Not all private apparatus is identified but their presence should be anticipated.

B. Contamination report

Project:	Five Fords Wastewater Treatment Works AAD		
Our reference:		Your reference:	
Prepared by:	C Williams	Date:	05/04/17
Approved by:		Checked by:	
Subject:	Review of soil contamination		

1 Introduction

Mott MacDonald Bentley have been commissioned by Dŵr Cymru Welsh Water to design and build a new Thermal Hydrolysis Plant to augment the existing Anaerobic Digestion Facility at the Five Fords Wastewater Treatment Works. A ground investigation has been undertaken at the proposed construction site to determine any constraints on the development and to inform foundation design. This report reviews the results of this ground investigation with regards risks to sensitive receptors from soil bound contamination.

1.1 Description of the Site

The main Thermal Hydrolysis Plant will be located directly adjacent to the existing WwTW to the east on land that has previously been under agricultural production. There are also some modifications to existing plant within the WwTW. The location of the THP has recently been used as a construction compound for previous developments on the wider WwTW and comprises a level platform of granular material.

1.2 Ground Investigations

In August 2016, Environmental Scientifics Group was commissioned by JN Bentley Limited (JNB), to carry out a ground investigation at the THP site. The investigation was required to obtain geotechnical and geo-environmental information to aid the design and construction of the plant.

The scope of the investigation was specified by Mott MacDonald Ltd and comprised cable percussion boreholes and two rotary follow on boreholes, trial pits, in-situ testing and laboratory testing. An additional borehole (BH1606) was undertaken at the location of CBR1604 after contamination was found at BH1604. An additional four trial pits were undertaken (TP1609 to TP1612) to assess site ground conditions. The investigation was performed in accordance with the contract specification and the general requirements of BS 5930 (2015), BS EN 1997-2 (2007), BS EN ISO 22475-1 (2006) and other relevant related standards identified below. The fieldwork took place between 1 October and 20 October 2016.

2 Ground Investigations

2.1 Geology

The ground investigation has confirmed the geological sequence as being:

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We accept no responsibility for the consequences of this document being relied upon by any other party, or being used for any other purpose, or containing any error or omission which is due to an error or omission in data supplied to us by other parties.

This document contains confidential information and proprietary intellectual property. It should not be shown to other parties without consent from us and from the party which commissioned it.

- Made Ground
- River Terrace Deposits
- Glacial Till
- Salop Mudstone Formation

The Made Ground varies in thickness up to 3.2m but is generally 0.8m to 1.5m thick over the main THP construction site reflecting the use of this area as a construction compound. The Made Ground in this area comprises sand and gravel of limestone and concrete. There is some ash, clinker, brick and slag noted as being present in some locations around the wider WwTW site. The trial pit located in the sludge beds (TP1611) records 3.6m of Made Ground comprising clay and silt with a mixed assemblage of rock, slag and demolition rubble.

The River Terrace Deposits are described as silty sand and the Glacial Till as sandy clay.

2.2 Groundwater

Piezometers were installed in boreholes 1601, 1602, 1603 & 1605. Groundwater levels were recorded as follows:

- BH1601 – 1.96m to 2.31m depth
- BH1602 – 2.17m to 2.42m depth
- BH1603 – 1.67m to 1.84m depth
- BH1605 – 1.698m to 1.82m depth

2.3 Ground Gas Monitoring

Ground gas monitoring was undertaken on four occasions in November 2016. Concentrations of methane were all <0.1%vol except for a single occasion where a concentration of 0.1%vol was recorded in BH1605. Concentrations of carbon dioxide were generally <0.1%vol with a maximum concentration of 0.4%vol recorded in BH1603. Concentrations of carbon monoxide were all <0.1ppm except for a single occasion where a concentration of 1.6ppm was recorded in BH1603. Concentrations of hydrogen sulphide were all <0.1ppm. Flow rate was recorded on all occasions to be <0.1l/hr.

BS8485 provides a framework to determine appropriate ground gas parameters that can be used to identify a range of possible design solutions for protection against the presence of ground gases on a development site. The framework is not prescriptive and professional judgement may be made as to the acceptability of risk and whether there might be benefit in undertaking more rigorous site assessment or adopting conservative measures in design. BS8485 indicates that should methane be encountered exceeding 1%vol or carbon dioxide exceeding 5%vol some level of gas protection for any building type will be required regardless of gas flow rate.

Table 5.5 of CIRIA C665 provides guidance on the extent of gas monitoring needed for a range of situations. For a commercial development (Low Risk) on this site (very low generation potential) the guidance recommends four measurements are taken over a one month period. Table 8.5 presents a risk evaluation matrix based on gas screening values. The results obtained for the Five Fords site suggest a Characteristic Situation 1, Very Low Risk. BS8485 suggests that for any development on a Very Low Risk site no specific gas protection measures are required.

This assessment of gas risk has considered risks from ground gases only. The nature of the activities being undertaken on the site are such that sludge storage buildings and other areas of plant where materials with high organic carbon content are present may generate toxic and flammable gases. These should be subject to a separate risk evaluation and are not within the scope of this report.

2.4 Soil Bound Contamination

Ten samples of the Made Ground were taken and submitted for laboratory analysis for a range of contaminants, summarised in Table 1. The concentrations have been compared to generic screening values protective of human health for a commercial end use. These assessment criteria have been derived using the CLEA model. There are no exceedances of any criteria.

Table 1: Summary of Soil Contaminant Testing

Contaminant	Maximum Concentration (mg/kg)	Generic Screening Value (mg/kg)
Arsenic	11.1	640
Antimony	2.5	7,400
Beryllium	1.3	12
Boron	3.2	240,000
Cadmium	4.0	190
Chromium	587	8,600
Copper	104	68,000
Lead	195	2,330
Mercury	1.1	1,100
Nickel	37	980
Selenium	2.1	12,000
Vanadium	37	9,000
Zinc	278	73,000
Acenaphthene	0.10	97,000
Acenaphthylene	0.13	97,000
Anthracene	0.10	540,000
Benz[a]anthracene	0.58	170
Benzo[a]pyrene	0.79	35
Benzo[b]fluoranthene	1.17	44
Benzo[ghi]perylene	0.70	4,000
Benzo[k]fluoranthene	0.32	1,200
Chrysene	0.57	350
Dibenz[ah]anthracene	0.16	3.6
Fluoranthene	0.60	23,000
Fluorene	0.10	68,000
Indeno[123-cd]pyrene	0.93	510
Naphthalene	0.17	460
Phenanthrene	0.24	22,000
Pyrene	0.57	54,000
Benzene	<0.01	47
Toluene	0.01	110,000
Ethylbenzene	0.11	13,000
Xylene	0.30	14,000
Aliphatic EC 05-06	<0.2	3,200
Aliphatic EC >06-8	<0.2	7,800
Aliphatic EC >08-10	35	2,,000
Aliphatic EC >10-12	154	9,700
Aliphatic EC >12-16	215	59,000

Contaminant	Maximum Concentration (mg/kg)	Generic Screening Value (mg/kg)
Aliphatic EC >16-35	776	1,600,000
Aromatic EC >08-10	7.0	3,500
Aromatic EC >10-12	24	16,000
Aromatic EC >12-16	47	36,000
Aromatic EC >16-21	49	28,000
Aromatic EC >21-35	57	28,000

Source: ESG 2017 and Mott MacDonald

One sample from trial pit TP1610 has tested positive for asbestos fibres with the laboratory report recording the presence of chrysotile fibres in a sample from 1.3m depth. A sample from the sample location taken from 0.7m depth did not record any asbestos fibres present. Trial pit 1610 is located on the southern area of the main construction pad close to the sludge lagoons. Mott MacDonald are not insured to give advice in relation to asbestos and so no further comment on any remediation of this material will be provided. The advice of a specialist asbestos contractor should be sought.

3 Conclusions

The ground investigation has demonstrated that the bulk of the site is underlain by Made Ground, largely comprised of granular rock and demolition materials such as brick and concrete. There is some slag and clinker noted which may be derived from imported materials used to create development platforms in the past. Slag is commonly used in wastewater treatment as a substrate to support bacterial colonies in filter beds.

Gas monitoring has indicated that no specific gas protection measures are required with regards ground gases.

There are no concentrations of contaminants present in the samples tested which would give rise to any concerns with regard to human health excepting that a single sample has recorded the presence of asbestos fibres. The significance of this will depend on the degree to which the affected soils are to be disturbed during the works. It was noted that a shallower sample from this location did not record the presence of asbestos. Any disturbance of the deeper Made Ground (>0.7m) in this area should be undertaken with the knowledge that asbestos may be present. A specialist contractor should be consulted to manage the risk from exposure to asbestos.

