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Preliminary site/ground condition assessment

Project:	IED - Queensferry WwTW		
Our reference:	ST21	**Your reference:**	B14411
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Subject:	Queensferry WwTW – Preliminary site condition assessment and potential pathways and receptors identification		

This document provides an overview of the ground conditions and potential pathways and receptors to be used by MMB during the investigation and design of secondary containment at Queensferry WwTW.

1 Site location

Queensferry WwTW, CH5 2DU – (53.207036, -3.014992) - https://goo.gl/maps/XxEv8YTJbLvr1jpx9

2 Geology

The geology is shown below as per the BGS Geoindex online viewer (https://mapapps2.bgs.ac.uk/geoindex/home.html)

The ground profile is defined as:

1	MADE GROUND (UNDIVIDED) - ARTIFICIAL DEPOSIT	PROBABLE GRANULAR STONE FILL	PERMEABLE
2	TIDAL FLAT DEPOSITS - CLAY, SILT AND SAND	FINE SILT, SANDS, CLAY HIGH AND FLUCTUATING TIDALLY INFLUENCED GROUNDWATER	PERMEABLE
3	TILL, DEVENSIAN - DIAMICTON	GLACIAL TILL/ BOULDER CLAY	IMPERMEABLE

The groundwater is assumed to be relatively shallow >1m bmgl and tidally fluctuating.

Numerous BGS borehole logs were available for the site (http://mapapps.bgs.ac.uk/geologyofbritain/home.html?) albeit the majority are marked as confidential. A

single BGS borehole record (SJ36NW487) was available and has been used to assess the ground conditions (see circled below and attached document for Borehole record).

BH 1 - Borehole SJ36NW487.pdf

The available borehole data comprises data from ten boreholes constructed across the site. Falling and Rising permeability testing was reported within all ten boreholes. Based on the data the ground conditions are assumed as follows:

- GL-20m – fine sand and silt (Estuarine Alluvium as indicated by Geological mapping) – stratum permeability of 2 x 10^{-5}m/s was recorded.
- >20m - Glacial Till (comprising boulder clay).

Infiltration rates as given in the SuDS manual (https://www.ciria.org/Memberships/The_SuDs_Manual_C753_Chapters.aspx) class silty sand with an infiltration rate of between 1X10^{-5} and 5X10^{-5} m/s rates (see below). This agrees with the available historical test data from the archived BGS borehole.

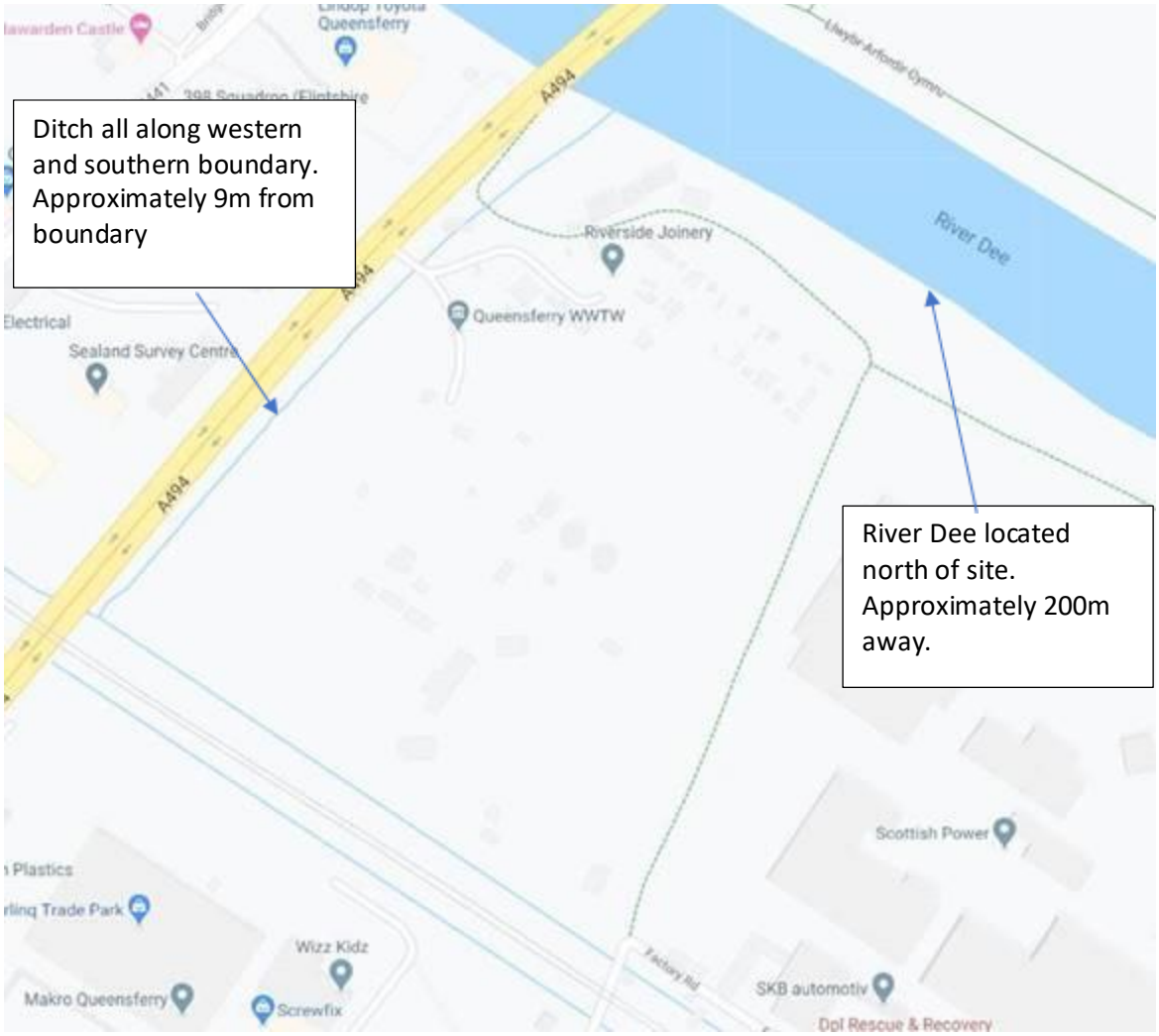
TABLE 25.1 Typical infiltration coefficients based on soil texture (after Bettess, 1996)

Soil type/texture	ISO 14688-1 description (after Blake, 2010)	Typical infiltration coefficients (m/s)
Good infiltration media		
• gravel	Sandy GRAVEL	$3 \times 10^{-4} - 3 \times 10^{-2}$
• sand	Slightly silty slightly clayey SAND	$1 \times 10^{-5} - 5 \times 10^{-5}$
• loamy sand	Silty slightly clayey SAND	$1 \times 10^{-4} - 3 \times 10^{-5}$
• sandy loam	Silty clayey SAND	$1 \times 10^{-7} - 1 \times 10^{-5}$
Poor infiltration media		
• loam	Very silty clayey SAND	$1 \times 10^{-7} - 5 \times 10^{-6}$
• silt loam	Very sandy clayey SILT	$1 \times 10^{-7} - 1 \times 10^{-5}$
• chalk (structureless)	N/A	$3 \times 10^{-8} - 3 \times 10^{-6}$
• sandy clay loam	Very clayey silty SAND	$3 \times 10^{-10} - 3 \times 10^{-7}$
Very poor infiltration media	–	
• silty clay loam	–	$1 \times 10^{-8} - 1 \times 10^{-6}$
• clay	Can be any texture of soil	$< 3 \times 10^{-9}$
• till	described above	$3 \times 10^{-9} - 3 \times 10^{-6}$
Other		
• rock* (note mass infiltration capacity will depend on the type of rock and the extent and nature of discontinuities and any infill)	N/A	$3 \times 10^{-9} - 3 \times 10^{-5}$

For infiltration generally to be considered a rate of 10^{-6} is required. The soil at the WwTW would thus act as a potential pathway as the infiltration rate is $>10^{-6}$m/s.

3 Hydrology

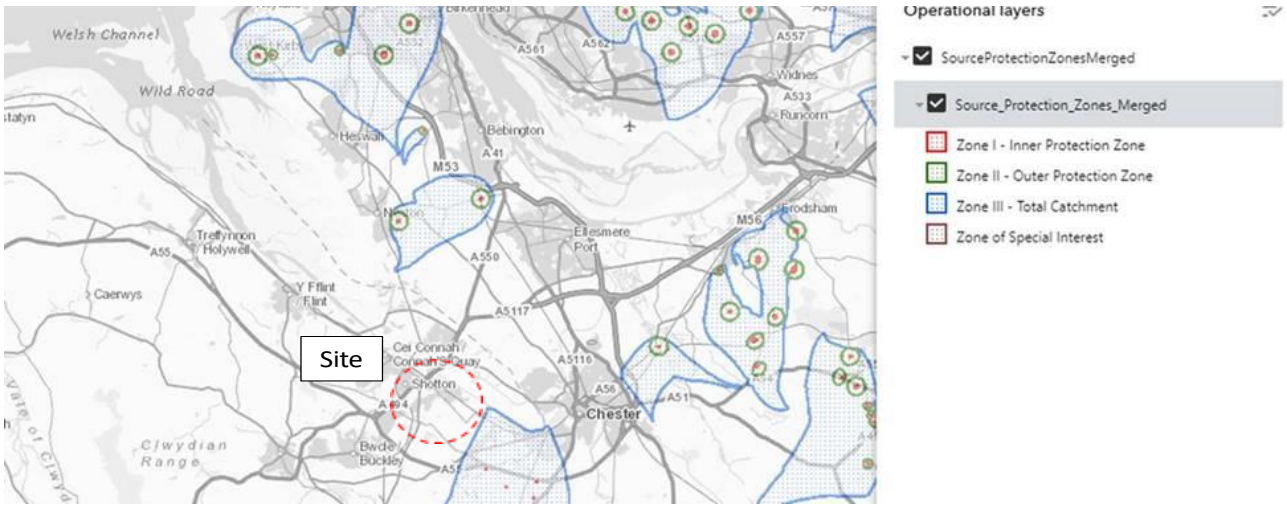
There are watercourse receptors nearby. See image below:



These watercourses could be potential receptors to contaminants if no secondary containment measures are put in place. Especially as limited information is available regarding where surface water drainage connects to.

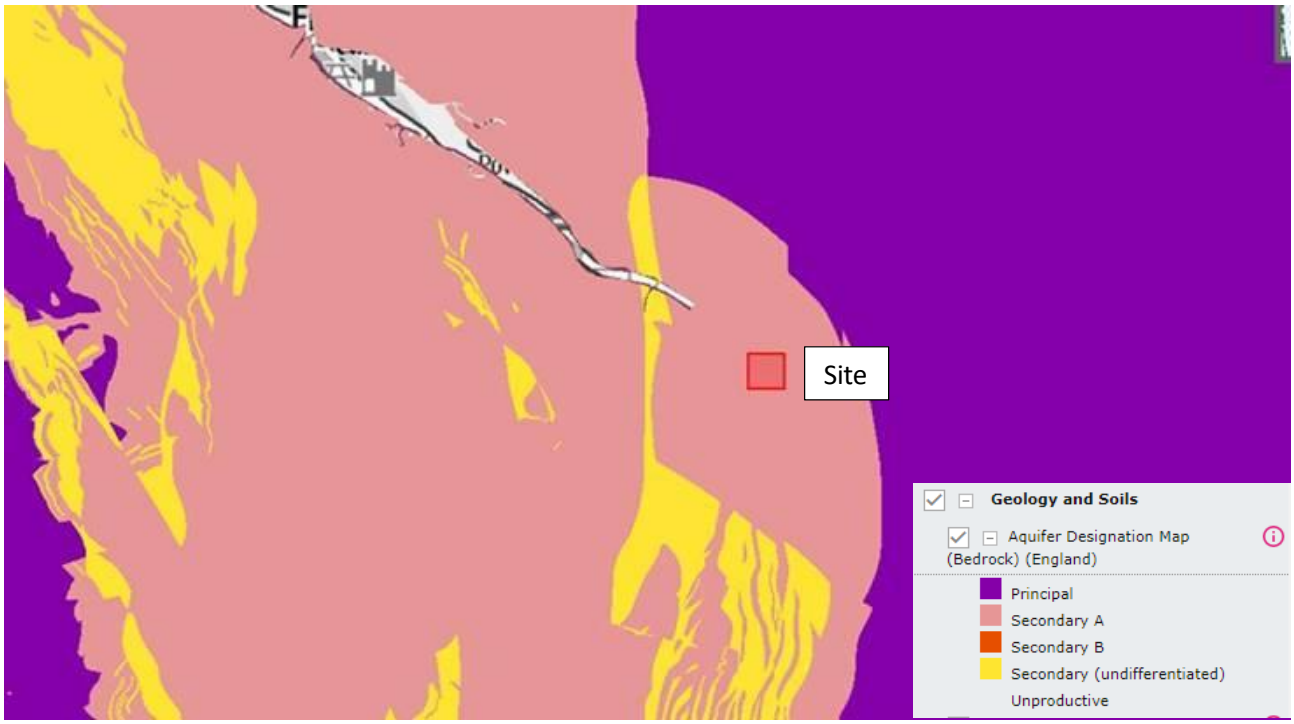
4 Hydrogeology

The site is not within a Source protection zone (https://environment.data.gov.uk/DefraDataDownload/?mapService=EA/SourceProtectionZonesMerged&Mode=spatial).



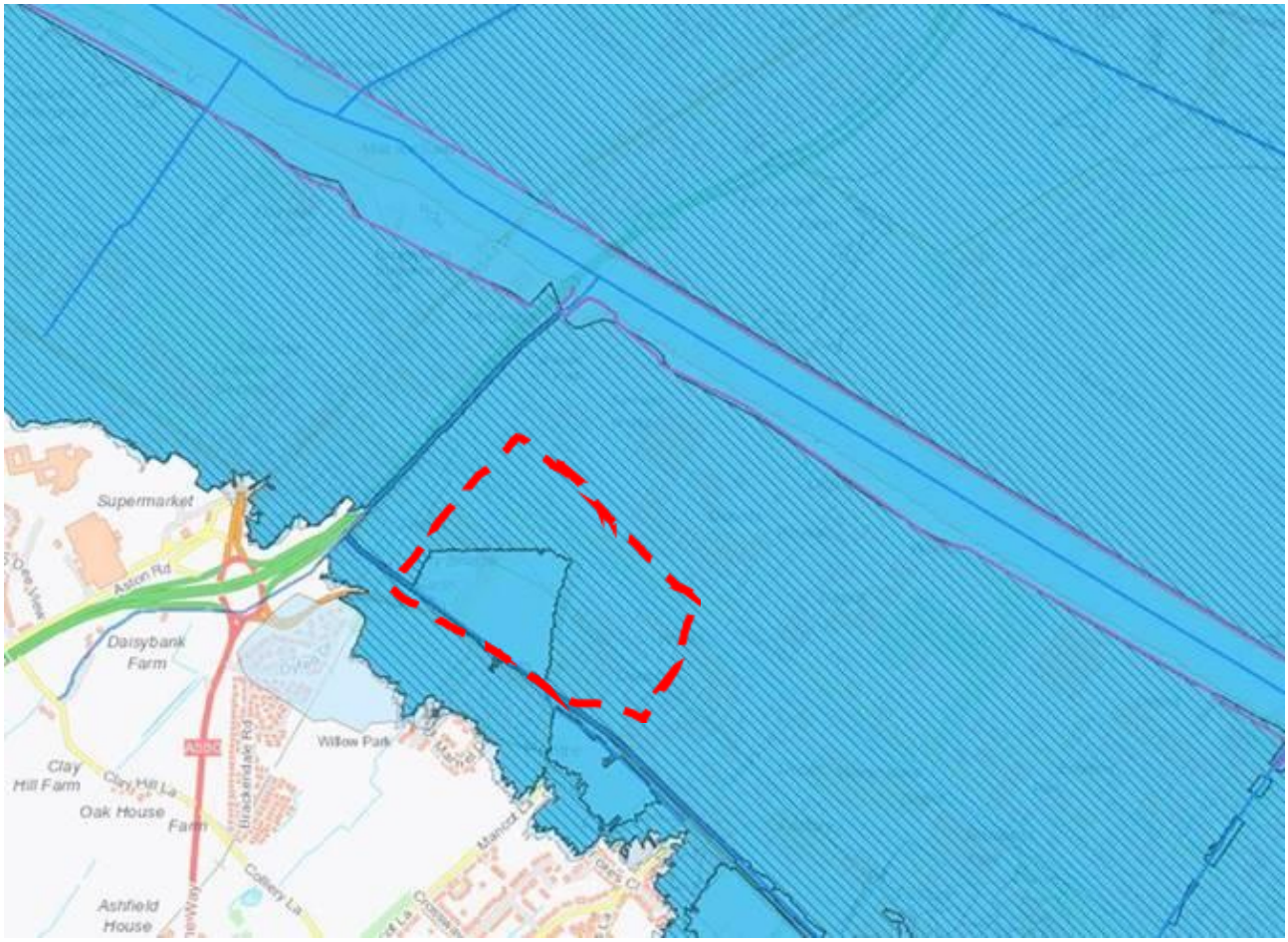
Based on MAGIC Maps the site is underlain by a Secondary A aquifer (https://magic.defra.gov.uk/magicmap.aspx). *Secondary A aquifers are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers*. The bedrock can thus act as both a potential pathway and a receptor due to its permeability.

The bedrock is locally however at great depth and capped by relatively impermeable Glacial Till. It is therefore considered that the bedrock would not be considered a receptor from potential contamination.



5 Flood risk

Based on Wales long term flooding maps, the works is situated within flood zone 3 (https://maps.cyfoethnaturiolcymru.gov.uk/Html5Viewer/Index.html?configBase=https://maps.cyfoethnaturiolcymru.gov.uk/Geocortex/Essentials/REST/sites/Flood_Risk/viewers/Flood_Risk/virtualdirectory/Resources/Config/Default&layerTheme=0):



The site also has some localised surface water flooding on site. It should be noted a lot of the localised flooding is around the digesters and digested and imported sludge storage tanks. These areas could be a potential pathway for contaminants to the ground or drainage network.

6 Conclusions

- The ground conditions at the site indicate that the soil will act as a pathway and the underlying groundwater as a potential receptor. The soil will not be able to aid in acting as a buffer (i.e. bunding without a liner) as its permeability is high enough to allow for infiltration.
- There are watercourses in close proximity to the site – ditch and River Dee. These will need to be considered as receptors and what impact contamination will have.
- The site is within flood zone 3 and there is localised surface water flooding on site. With the relatively shallow groundwater, management of surface water runoff would need to be considered. This is to ensure the run off over the ground and roads do not pollute further downstream or 3rd party land in case of loss of containment. Consideration should also be made to ensure the secondary treatment area (sludge treatment) is isolated from the rest of the site as much as possible to limit influence of surface water runoff from rest of the site and impact on treatment works process.