Eden Deep Geothermal Project Enabling Works

Outline Drainage Strategy

17 April 2020

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Issue and Revision Record

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The consultant will follow accepted procedure in providing the services but given the residual risk associated with any prediction and the variability which can be experienced in flood conditions, the consultant takes no liability for and gives no warranty against actual flooding of any property (client's or third party) or the consequences of flooding in relation to the performance of the service. This report has been prepared for the purposes of promoting the Eden Deep Geothermal Project Enabling Works only.

Contents

Figures

1 Introduction

1.1 Background

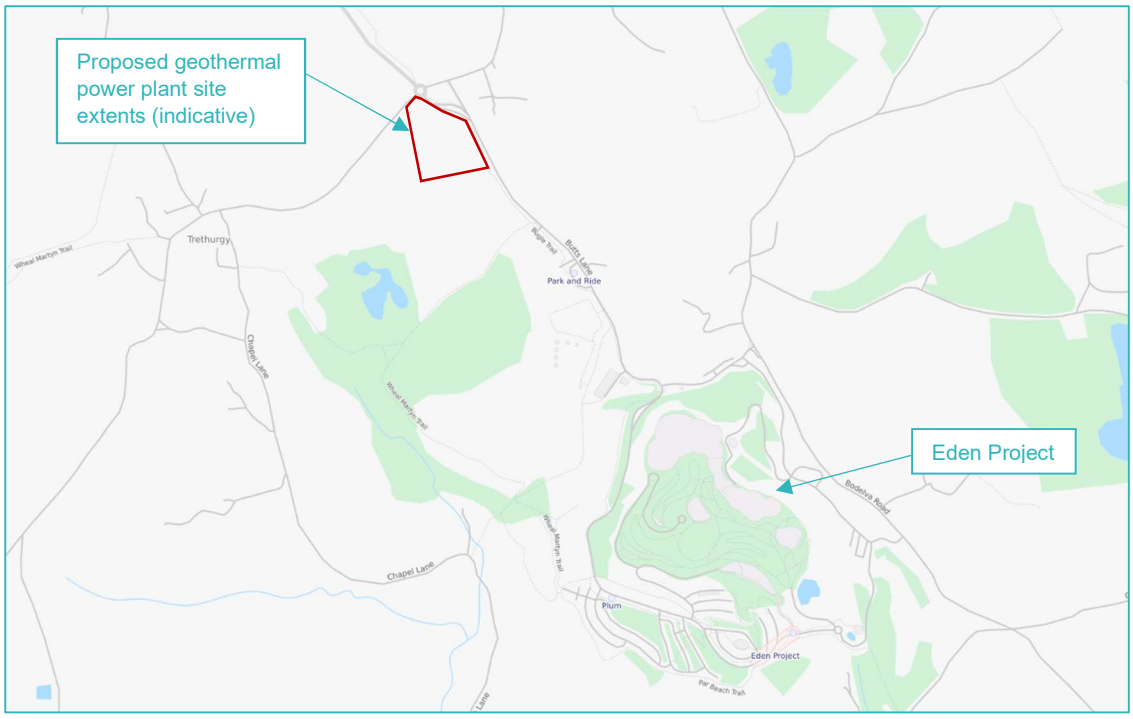
Eden Geothermal Limited (EGL) (the client) are proposing to build the UK's first geothermal power plant at the Eden Project in Cornwall, UK. The plant will drill and test the first 4,500m-deep well of a geothermal energy demonstration system, followed by one year of heat production to demonstrate greenhouse gas savings.

1.2 Site Information

1.2.1 Existing Site

The site is an unoccupied, vegetated, former landfill site located adjacent to the northern entrance of the Eden Project, Cornwall (NGR: SX 04310 55710) with approximate surface area 2.8ha. The site location is shown in Figure 1.1.

Figure 1.1: Site location plan



Background mapping source: OpenStreetMap, 2020

Based on publicly available mapping from the Environment Agency (EA), the site is entirely within Flood Zone 1, meaning that it has a low probability of flooding (less than 0.1% Annual Exceedance Probability (AEP)) from rivers or the sea. The site is also shown to be at very low risk of flooding from surface water or reservoir flooding.

1.2.2 Proposed Site

The proposed site layout has been developed for the enabling works (refer to drawing 417598-MMD-00-XX-DR-0003 General Arrangement). Key elements of the works include: the main access road; a drilling foundation pad and cellars; a settlement lagoon; cuttings and retention pits; and various portable buildings housing offices, security and welfare facilities. It is anticipated that some earthworks will be necessary for the construction of this site infrastructure.

1.3 Purpose of Report

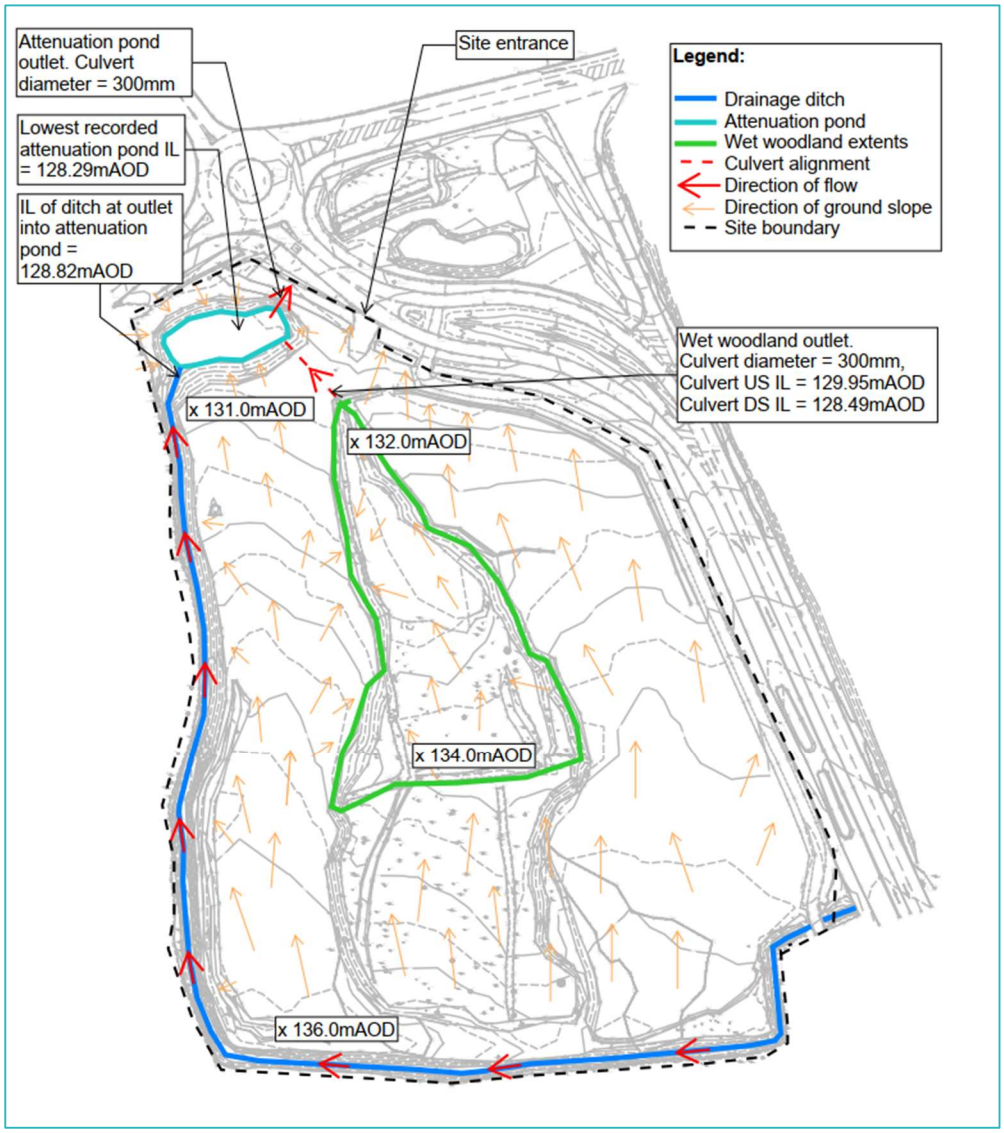
Mott MacDonald have been commissioned on behalf of EGL to produce an outline drainage strategy for proposed site enabling works. This report details the strategy for the surface water and foul drainage elements, with potable water supply being considered separately.

2 Surface Water

2.1 Existing surface water drainage

A plan indicating the existing surface water elements is presented in Figure 2.1. All levels included in this section are taken from available topographic survey data[1].

Figure 2.1: Existing surface water drainage plan



Background mapping source: Eden Tomato Topographic Survey Data (ref 10-1624-001_2 Rev C)

[1] Eden Tomato Topographic Survey Data (ref 10-1624-001_2 Rev C)

2.1.1 Ground levels / flow paths

The ground levels at the site generally fall from south to north from approximately 136mAOD at the southern boundary to 131mAOD at the location of the northern attenuation pond and site entrance, over an approximate length of 200m. The central region of the site, approximately 422m^2 which includes an area of wet woodland, is at a lower level and falls from approximately 134mAOD at the southern end to 132mAOD at the northern end over a length of approximately 160m. Existing flow paths therefore generally flow from south to north towards the northern attenuation pond, with some flows falling towards the central region / wet woodland area.

2.1.2 Groundwater

As summarised in the site design tender document provided by EGL, groundwater was found to be evident at depths of 0.3-3m during ground investigations carried out in 2010 and 2013. Anecdotal evidence suggests that groundwater levels may be lower in the southern areas of the site[2], which is supported by the findings of the 2010 Ground Investigations carried out in association with the scheme[3]; recorded groundwater levels within Exploratory Holes BH01 and BH03 located in the southern end of the site were 133.08-134.45mAOD and 132.15-134.05mAOD respectively. The groundwater table can therefore be assumed to be in the region of 1.5-3m below ground level in the southern areas of the site. The findings also suggest that groundwater levels may be lower in the eastern areas of the site, with groundwater values recorded from BH04 of 131.46-132.53mAOD. Based on available topographic data[4], the groundwater table can therefore be assumed to be in the region of 1.5-3m below ground level in the southern and eastern areas of the site.

2.1.3 Wet woodland

The wet woodland area located in the central north region of the site has approximate area 300m^2. It is assumed that surface water from the west and south of the site currently percolates into the wet woodland area. There is an existing culvert which runs from the northern end of the woodland area and outfalls into the northern attenuation pond. The woodland is not known to have any formal designations.

2.1.4 Drainage assets

2.1.4.1 Ditch

A drainage channel runs along the southern and western boundaries of the site, which then outfalls into the attenuation pond located at the northern boundary. Photographs of the drainage ditch are provided in Figure 2.2. Based on available topographic data[3] the drainage ditch has approximated average top width of 5m, base width of 1-3m and varying depth of approximately 1-1.5m. Along the west site boundary, the ditch bank is higher on the east side due to the addition of land fill by approximately 1-2m. The level of the ditch base falls from around 133.3mAOD at the location of an existing headwall in the southeast corner of the site to around 128.8mAOD at the outlet into the northern attenuation pond, over a distance of around 370m.

[2] Meeting between Mott MacDonald and Eden Geothermal Limited on 2nd April 2020
[3] Eden Geothermal Geoenvironmental Interpretive Report (Buro Happold, July 2010)
[4] Eden Tomato Topographic Survey Data (ref 10-1624-001_2 Rev C)

Figure 2.2: Views of drainage ditch along western site boundary (looking upstream).

Source: Photographs provided by Eden Geothermal Limited, collected on 3rd April 2020

2.1.4.2 Attenuation pond

As noted in the above Sections, there is an existing attenuation pond located at the northern boundary of the site. Based on site observations[5] the pond has approximate depth 300mm, length 35m and width 20m. Based on topographic data[6] and site observations the attenuation pond has been estimated to have a storage volume of 240m^3. The base of the pond gradually falls eastwards, from around 128.82mAOD from the drainage ditch inlet to the lowest surveyed level of 128.29mAOD. A photograph of the attenuation pond is provided in Figure 2.3.

There is currently no known information regarding whether there is an existing flow control device from the attenuation pond, although an obscured headwall was recorded in the northeast corner (refer to Figure 2.4) during the topographic survey. It is therefore assumed that the pond outfalls via a culvert beneath the road into another drainage ditch, before ultimately outfalling into the Treverbyn Stream (designated as a General Quality Assessment (GQA) Grade A (the highest quality) by the Environment Agency)[7]. Based on anecdotal evidence[8] the pond has not been observed to be fully utilised.

[5] Site information and photographs provided by Eden Geothermal Limited and collected on 3rd April 2020

[6] Eden Tomato Topographic Survey Data, reference 10-1624-001_2 Rev C

[7] 026893 Eden Geothermal Geoenvironmental Interpretive Report (Buro Happold, 2010)

[8] Meeting between Mott MacDonald and Eden Geothermal Limited on 2nd April 2020

Figure 2.3: View of attenuation pond at drainage ditch inlet.

Source: Photographs provided by Eden Geothermal Limited, collected on 3rd April 2020

2.1.4.3 Culverts

As noted in Section 2.1.3.2 there is culvert which runs beneath the road and which takes flows from the attenuation pond location in the north of the site (refer to Figure 2.4). The upstream Invert Level (IL) for the culvert is unconfirmed, however based on available topographic data the culvert has a downstream IL of 127.83mAOD. Based on observations made on site[5], the culvert diameter is understood to be 300mm.

There is a second culvert, as noted in Section 2.1.2, which runs from the northern end of the wet woodland area and outfalls into the attention pond (see Figure 2.5). Based on available topographic data this culvert has an upstream IL of 129.95mAOD and downstream IL of 128.49mAOD. Based on observations made on site, the culvert diameter is understood to be 300mm.

Figure 2.4: Upstream inlet to culvert from northern attenuation pond.

Figure 2.5: Upstream inlet to culvert from wet woodland area.

Source: Photographs provided by Eden Geothermal Limited, collected on 3rd April 2020

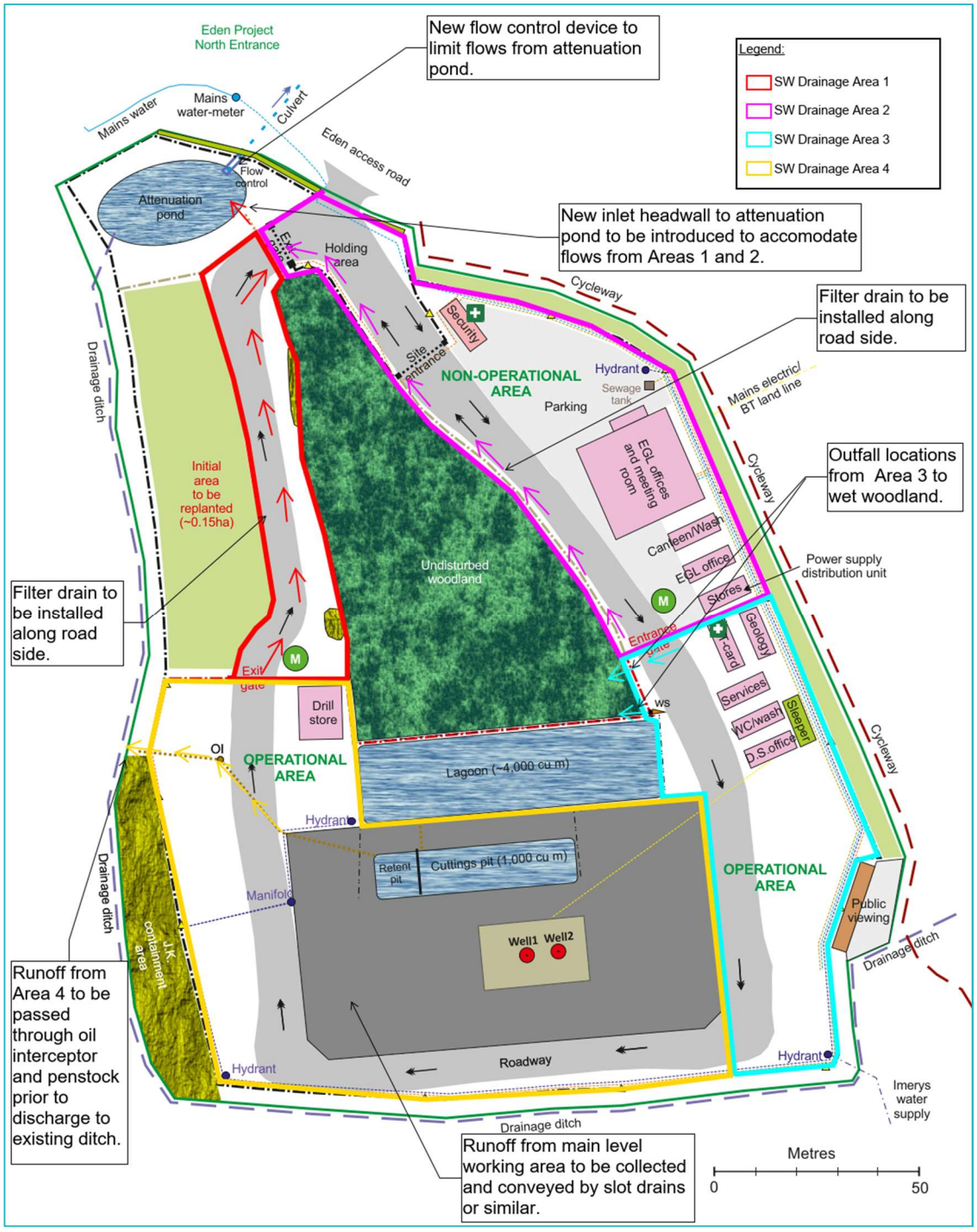
2.2 Proposed surface water drainage

A plan indicating the proposed surface water elements is presented in Figure 2.6. The site has been divided into four surface water drainage areas, which are detailed in the following report Sections 2.2.2 to 2.2.5.

In addition to the four surface water drainage areas, the following areas will make up the remainder of the site as presented in Figure 2.6:

- Undisturbed wet woodland, the purpose of which is to act as a benchmark to enable assessment of how ecological systems within the woodland perform when in close proximity to the proposed geothermal power plant; and
- An area in the northwest of the site in which existing trees are to be retained and further trees are to be replanted.

Figure 2.6: Proposed surface water drainage plan.



Source: Adapted from plans provided by Eden Geothermal Limited, 2020

2.2.1 Overview

The proposed drainage strategy ensures that flows from the site are limited to greenfield runoff rates in line with best practice. It also ensures that any pollution load to the surface water runoff is treated prior to discharge to the surrounding surface water bodies.

It is proposed that the existing northern attenuation pond, detailed in Section 2.1.3.2, is ultimately utilised for storage of all surface water runoff from the developed areas of the site. Initial investigations using Innovyze MicroDrainage software suggest that the maximum storage volume required for the Areas 1-4 is approximately 1400m^3 for the 1% AEP (+40% allowance for climate change) with a limited discharge of 5l/s. It should be noted that this is a more conservative limit on discharge than that stated in an EA consultation note from October 2010, but is in line with current guidance.

Assuming that the northern attenuation pond has an existing storage volume of 240m^3 (refer to Section 2.1.3.2), there may be a requirement to increase the depth of the pond to provide sufficient storage for the developed site, however it should be noted that available storage will also be provided by the existing drainage ditch and proposed piped network for the site.

2.2.2 Surface Water Drainage Area 1

The main access road, which takes up the majority of Area 1, will have bound surfacing and hence will be impermeable. It is proposed that a filter drain is installed along the woodland side of the road to collect surface water runoff and convey the runoff to the northern attenuation pond via a new culvert under the proposed road. A new inlet headwall is to be introduced into the attenuation pond for this connection.

2.2.3 Surface Water Drainage Area 2

Area 2 is ‘Non-operational’ and comprises of surfacing for various portable buildings and vehicle parking. The main access road which runs through Area 2 will have bound surfacing and hence will be impermeable. It is proposed that a filter drain is installed along the woodland side of the road, to collect surface water runoff and convey the runoff to the northern attenuation pond. A new inlet headwall is to be introduced into the attenuation pond for this connection. The remainder of Area 2 will have gravel surfacing, and it would be preferable for any surface water runoff (including from building roofs) from this area to infiltrate directly to the ground. However, as noted in Section 2.1.2, ground water levels may be higher in the northern areas of the site, and hence if infiltration is not feasible in this area a network of perforated pipes connecting to the filter drain will be installed.

There is the potential for installation of an overflow from this area to direct surface water runoff into the wet woodland if necessary, to ensure that the woodland retains enough water to maintain existing habitats. However, whilst no unloading is expected to be carried out in this area, there is the potential for fuel spillage and hence additional surface water pollution prevention measures may be needed to protect the wet woodland.

2.2.4 Surface Water Drainage Area 3

Area 3 is part of the site ‘Operational Area’ and includes surfacing for various portable buildings. In order to maintain sufficient water supply to the wet woodland, it is proposed that surface water runoff is collected and conveyed from this area to the woodland. This is to compensate for the runoff which appears to currently drain to the woodland from Area 4 and which will be redirected as a result of the works.

It is proposed that runoff is collected from the main impermeable road via a filter drain along one side of the road. Further branches of perforated pipes are proposed to extend across the

remainder of the area to collect runoff from the gravelled surface and building roofs. Surface water will then be directed to outfall into the wet woodland at its northern end at two locations as shown in Figure 2.6; one outfall directly into the wet woodland and one outfall pipe through the vertical structure at the lagoon/woodland interface.

The filter material and gravel surfacing will provide some treatment to remove pollution load from the surface water runoff, however additional pollution prevention measures may be required prior to discharge to the woodland.

2.2.5 Surface Water Drainage Area 4

Area 4 comprises the main ‘Operational’ area at the southern end of the site. This is centred around a level working area including a spillage containment area (within which the geothermal drilling rig units will be located), cuttings pit, lagoon and main road. Area 4 is primarily hardstanding and impermeable.

It is proposed that a formal surface water piped network is installed to drain Area 4. This will include slot drains or similar in order to drain the main level working area. The network will include an oil interceptor with inbuilt monitoring and alarm system prior to discharge to the existing drainage ditch along the western site boundary. A penstock will also be included downstream of the oil interceptor and upstream of the drainage ditch, which can be utilised in the case of an emergency to retain any contaminated runoff within the site boundary. It is assumed that the drainage ditch is private, and hence it is not expected that a permit to discharge will be required.

3 Foul water

3.1 Existing foul water drainage

It is understood that there are no existing piped sewers within the vicinity of the site.

3.2 Proposed foul water drainage strategy

Due to the lack of surrounding existing foul sewers, it is proposed that a foul tank is installed in the northeast of the site (refer to Figure 2.6 for location) which is to be regularly emptied by tanker.

Based on portable building plans supplied by Eden Geothermal Limited, the ‘Non-operational’ areas of the site will include 12no. WCs, 3no. urinals, 15 sinks and 2no. showers. Information relating to the foul flows from the ‘Operational’ area of the site is currently unknown. It is proposed that these flows will discharge into the same tank with connections made via pipework in the contractor’s utilities corridor.

4 Conclusions and risks

4.1 Conclusions

Outline surface water and foul drainage strategies have been developed for the Eden Deep Geothermal Project Enabling works and are detailed within this report.

The surface water drainage strategy:

- Utilises existing falls on the site and existing assets where possible
- Ensures that flows from the site are limited to greenfield runoff rates
- Ensures that any pollution load to surface water runoff is treated prior to discharge to the downstream water bodies

The foul drainage strategy:

- Ensures that foul flows are suitably collected and stored on the site prior to removal

4.2 Risks

The following risks are to be passed on to the Contractor:

- High ground water levels at the site may impact the drainage proposals and cause infiltration of surface water runoff from some areas of the site to be unfeasible.
- Additional pollution prevention measures may be required to meet water quality requirements of the receiving watercourse. Requirements will need be agreed with the relevant consenting body.
- Foul flows for the ‘Operational’ areas of the site are currently unconfirmed and should be considered prior to installation of the foul storage tank.

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