Cambridge Waste Water Treatment Plant Relocation Project
Anglian Water Services Limited

Appendix 20.12:Drainage Strategy

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1 Introduction

1.1 Anglian Water Services Limited

1.1.1 Anglian Water Services Limited (the 'Applicant') is the largest regulated water and water recycling company in England and Wales by geographic area, supplying water and water recycling services to almost seven million people in the East of England and Hartlepool.

1.1.2 The Applicant is committed to bringing environmental and social prosperity to the region they serve, through their commitment to Love Every Drop. As a purpose-led business, The Applicant seeks to contribute to the environmental and social wellbeing of the communities within which they operate. As one of the largest energy users in the East of England, they are also committed to reaching net zero carbon emissions by 2030.

1.2 Background

1.2.1 The Applicant is proposing to build a modern, low carbon waste water treatment for Greater Cambridge on a new site area north of the A14 between Fen Ditton and Horningsea within the Cambridge drainage catchment area, to replace the plant on Cowley Road, hereafter referred to as the existing Cambridge Waste Water Treatment Plant (WWTP).

1.2.2 The relocation will enable South Cambridgeshire District Council and Cambridge City Council's long held ambition to develop a new low-carbon city district on Cambridge's last major brownfield site, known as North East Cambridge. The site is an important component of the First Proposals (preferred options) for the new Greater Cambridge Local Plan that were subject to public consultation late last year. The North East Cambridge Area Action Plan has also recently been agreed by the Councils in its Proposed Submission form and will be subject to public consultation prior to submission, once the Development Consent Order is determined. The relocation of the existing waste water treatment facility will enable this new district to come forward and deliver 8,350 homes, 15,000 new jobs and a wide range of community, cultural and open space facilities in North East Cambridge. Further details on this can be found in our Statement of Requirement (Application Document Reference 7.2) which was published in September 2019.

1.2.3 The relocation of the waste water treatment plant will also allow The Applicant to continue providing vital waste water services to customers across Cambridge and Greater Cambridge. The new plant will continue storing and treating storm flows and treating sludge to produce renewable energy. It will be designed to deal with a growing population. It offers the opportunity for a joined-up solution for treating waste water from Cambridge and Greater Cambridge, including Waterbeach. The proposal is for both waste water from the existing Waterbeach waste water treatment plant and future flows from Waterbeach New Town to be treated at the proposed Cambridge waste water treatment plant.

1.2.4 The Proposed Development will be the first waste water project to seek a Development Consent Order that is not specifically named in the National Policy Statement (NPS). 'The Applicant' sought and obtained a direction from the Secretary of State under section 35 of the Planning Act 2008 ("the 2008 Act"), which confirms that the project will be treated as a Nationally Significant Infrastructure Project ("NSIP") when the application is submitted.

1.3 The Proposed Development

1.3.1 This section provides a high-level summary of the Proposed Development. The term Proposed Development refers to the Cambridge Waste Water Treatment Plant (WWTP) Relocation project in its entirety and all works associated with the development.

1.3.2 A detailed description of the Proposed Development can be found in Chapter 2 of the Environmental Statement (App Doc Ref 5.2.2).

1.3.3 The purpose of the proposed WWTP will be to treat all waste water and wet sludge from the Cambridge catchment just as the existing Cambridge WWTP currently does, plus that from the growth indicated and being planned within the catchment in the Local Plan to 2041, with ability to expand beyond to deal with further growth.

1.3.4 As part of its statutory function, the Applicant operates the existing Cambridge WWTP. The existing Cambridge WWTP receives waste water from the Cambridge catchment either directly from the connected sewerage network or tankered to the plant from homes and businesses that are not connected. This waste water is then treated and the treated effluent discharged through an outfall to the nearby River Cam. The existing Cambridge WWTP is an integrated WWTP, as would be the Proposed Development. Integrated WWTP incorporate a sludge treatment function, in the form of a Sludge Treatment Centre (STC), which treats the sludge derived from the waste water from the catchment, and the "wet sludge" produced by other satellite plants which do not have integrated STC.

1.3.5 The Waterbeach New Town development lies to the north of Cambridge. When built out Waterbeach new town will comprise some 11,000 new homes along with associated business, retail, community and leisure uses. Waste water from Waterbeach will ultimately be treated by the proposed Cambridge WWTP once operational. However, the rate of development at Waterbeach New Town may require a new pipeline (rising main) to be built from Waterbeach to the existing Cambridge WWTP to allow treatment of waste water in advance of the proposed WWTP becoming operational. In that case, either a later connection would be made to the proposed WWTP from a point on the pipeline route, or flows diverted from the existing Cambridge WWTP via the transfer tunnel.

1.3.6 In summary the Proposed Development will comprise of:

- an integrated waste water and sludge treatment plant.
- a shaft to intercept waste water at the existing Cambridge WWTP on Cowley Road and a tunnel/ pipeline to transfer it to the proposed WWTP and terminal

pumping station. Temporary intermediate shafts to launch and recover the micro-tunnel boring machine.

- a gravity pipeline transferring treated waste water from the proposed WWTP to a discharge point on the River Cam and a pipeline for storm water overflows.
- a twin pipeline transferring waste water from Waterbeach to the existing Cambridge WWTP, with the option of a connection direct in to the proposed WWTP when the existing works is decommissioned.
- ancillary on-site buildings, including a Gateway Building with incorporated Discovery Centre, substation building, workshop, vehicle parking including electrical vehicle charging points, fencing and lighting.
- environmental mitigation and enhancements including substantial biodiversity net gain, improved habitats for wildlife, extensive landscaping, a landscaped earth bank enclosing the proposed WWTP, climate resilient drainage system and improved recreational access and connectivity.
- Renewable energy generation via anaerobic digestion which is part of the sludge treatment process that produces biogas designed to be able to feed directly into the local gas network to heat homes, or as an alternative potential future option burnt in combined heat and power engines.
- renewable energy generation via solar photovoltaic and associated battery energy storage system.
- other ancillary development such as internal site access, utilities, including gas, electricity and communications and connection to the site drainage system.
- a new vehicle access from Horningsea Road including for Heavy Goods Vehicles (HGV's) bringing sludge onto the site for treatment and other site traffic.

2 Drainage Strategy Overview

2.1 Introduction

2.1.1 This report sets out the drainage strategy to support the Development Consent Order (DCO) application and Environmental Statement (ES) for the proposed Cambridge waste water treatment plant relocation project (CWWTPRP).

2.1.2 This report aims to provide a high-level Outline Drainage Strategy for the CWWTPRP to support the application for development consent.

2.1.3 The report provides details of the drainage requirements for the permanent works and supports the assessment in Environmental Statement Chapter 20 Water Resources (App Doc Ref 5.2.20).

2.1.4 Whilst the report covers the complete project, the main focus is on the drainage requirements, as set out in Section 4, for the proposed WWTP site (which includes the proposed treatment works and surrounding earth banks). The drainage of areas outside of the proposed WWTP site, which accommodates the connecting infrastructure (access road, tunnel and cross-country pipelines), are covered in Section 5.

2.1.5 The strategy aims to demonstrate that the project provides adequate drainage infrastructure and attenuation facilities to control surface water runoff and to manage flood risk to an acceptable level. The aim is that the strategy should be acceptable to the key Water Management Authorities, including the Lead Local Flood Authority (LLFA), and that it demonstrates compliance with appropriate requirements and standards. The strategy also demonstrates how the proposed WWTP supports the Government's key policy objective, cited in Paragraph 2.2.3 of the National Policy Statement for Waste Water, to reduce demand for waste water infrastructure capacity by diverting surface water drainage away from the sewer system by using Sustainable Drainage Systems (SuDS).

2.1.6 The draft drainage strategy has been shared with the Environment Agency (EA), the relevant Internal Drainage Boards (IDB) and the Lead Local Flood Authority (LLFA). Feedback on the draft outline drainage strategy was received from the EA, IDB and LLFA in writing or through meetings in July and August 2022. The feedback received has been taken into account in the drainage strategy. The drainage strategy will be reviewed with these same stakeholders as part of the ongoing Water Resources Technical Working Group to obtain acceptance in principle, with specific points of agreement or disagreement incorporated into their Statements of Common Ground for resolution during the detailed design stage development of the drainage strategy.

2.2 Site Setting

2.2.1 The proposed WWTP site is located approximately 2km to the east of the existing Cambridge WWTP, and 1.5km to the east of the River Cam, within the administrative boundary of South Cambridgeshire District Council. The proposed WWTP lies between the villages of Horningsea to the north, Stow-cum-Quy to the east and Fen Ditton to the south-west.

2.2.2 The proposed WWTP site is bounded by the A14 (to the south), Low Fen Drove Way (an unclassified road and public byway, along the eastern and northern boundaries) and Horningsea Road (to the west). The proposed WWTP is currently farmed agricultural land and is classified as greenfield.

2.2.3 The site entrance is to be via a new access off Horningsea Road to the west.

2.2.4 The site postcode and grid reference are as follows:

- Post code: Horningsea, Cambridge CB5 8TB; and
- Grid Reference: TL 49605 61216.

2.2.5 The WWTP is located within a central portion of the site and is contained within a circular earth bank as indicated in Figure 2.1 below.

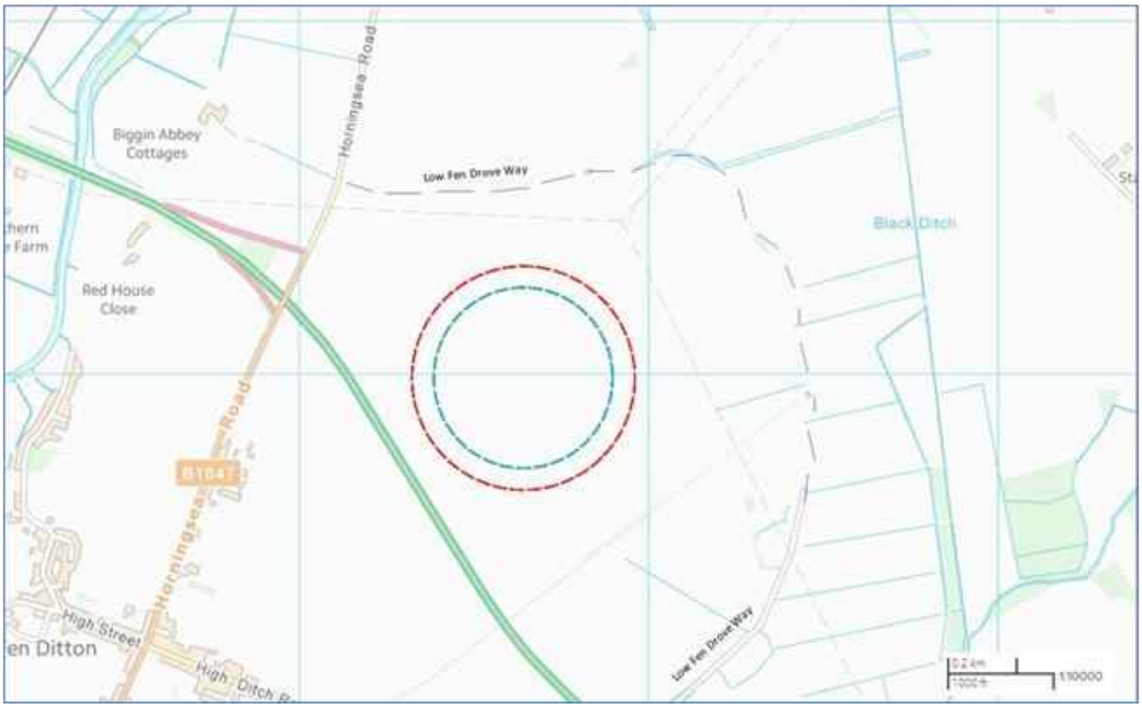


Figure 2.1: Proposed WWTP Location

2.2.6 The topographic elevation of the ground generally falls from west to east across much of the site, towards the set of drainage features that connect to the Black Ditch.

2.3 Existing Drainage

2.3.1 This section covers the existing drainage within the proposed WWTP area. Where there is an interface with existing drainage, in the construction of the proposed WWTP, then the existing drainage will be reinstated.

2.3.2 According to the Environment Agency Risk of Flooding from Surface Water (RoFSW) maps, the risk of surface water flooding on the site is considered to be “Very Low”.

Areas identified to be at "Very Low" risk have a less than 1 in 1,000-year (0.1%) annual risk of flooding from surface water sources. Further details are provided in the DCO application document (Appendix 20.1, App Doc Ref 5.4.20.1) Flood Risk Assessment.

2.3.3 As there is no evidence of overland flow routes across the site, it is considered likely that any additional future rainfall, in the event of climate change, could be adequately managed by onsite drainage, subject to verification of greenfield runoff rates according to the CIRIA 753 SuDS manual (Ref. 6) which provides guidance.

2.3.4 Figure 2.2 below provides details of the local main rivers and ordinary watercourses, which generally drain toward the River Cam (which flows in a north-easterly direction).

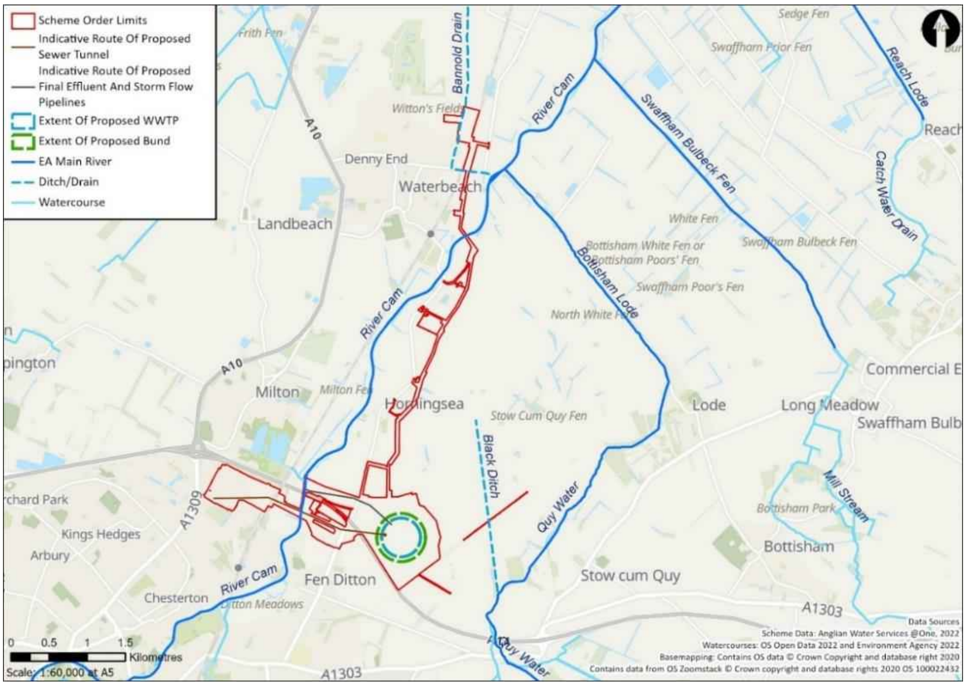


Figure 2.2: Main Rivers and Ordinary Watercourses

2.3.5 The majority of the drainage catchment, downstream of the proposed WWTP, is managed by Swaffham Internal Drainage Board (IDB). Appendix D includes a map of the Swaffham District (Ref. 5) which provides further details of the overland surface water arrangements.

2.3.6 During the 2021 Site Investigation (SI), and specifically the archaeological trial trenching (see Appendix 13.5, App Doc Ref 5.4.13.5 Geophysical and Trial Trenching Surveys), a number of land drains were discovered in the fields within the Proposed WWTP boundary. This series of parallel drainage ditches, which extend in an easterly direction from Low Fen Drove Way, are assumed to discharge to the Black Ditch. This assumption is based on the topographic elevations reducing from west to east, across the majority of the Proposed WWTP area, towards the set of drainage features connected to the Black Ditch.

2.3.7 Within the land required for construction of the Proposed WWTP, topographic elevations vary between 7 metres above ordnance datum (mAOD) and 12mAOD, sloping generally to the east/north-east. The footprint of the Proposed WWTP will be adjusted (by excavation and partial fill) to a ground level of between 9.0mAOD and 10mAOD. It is likely, therefore, that most of the surface water flow will be towards the existing network of land drainage ditches feeding into the Black Ditch. OS mapping indicates that the 5mAOD contour is located at the north-eastern boundary of the site development, and within this area is a prominent land drain draining to the north towards Black Ditch (located to the north-east of Low Fen Drove Way).

2.3.8 The Black Ditch drains in a northerly direction from the development area towards Stow-cum-Quy Fen. The course of the ditch continues in a north-easterly direction along the boundary of Quy Fen before discharging towards Bottisham Fen.

2.3.9 Further details of the downstream drainage system are provided in the Swaffham IDB District Drainage Map (see Appendix D for further details).

2.3.10 DCO application document (Appendix 20.1, App Doc Ref 5.4.20.1) Flood Risk Assessment is also available for the Proposed Development.

2.3.11 Appendix E provides a drawing of the Drainage Strategy for the Proposed WWTP, including the interface with the external landscaping, the attenuation facilities and the discharge arrangement to the local ditch at the site boundary.

3 Proposed Surface Water Drainage Methods

3.1 Sustainable Urban Drainage System (SuDS) Hierarchy

3.1.1 It is recognised that the SuDS hierarchy should be applied, where appropriate, to the Proposed WWTP. The following sets out the justifications relevant to the Proposed WWTP with regards to the SuDS drainage hierarchy:

- **Into the ground (infiltration):** runoff from the permeable areas of the development (or impermeable areas not at risk of contamination) can be allowed to infiltrate to ground, as this represents no change to the existing condition;
    - However, further consideration of this topic indicates that the use of infiltration is likely to be limited on this site due to the low permeability of the undelaying strata (see Sections 4.7 and 4.8 of this report for further details).
- **To a surface water body:** where infiltration is not possible, a series of surface water drains (or a mixture of infiltration and land drains/swales is required in certain events, including landscaped facilities such as ridges and furrows and attenuation facility) may be employed with the proposal being to connect them to the existing drainage ditch outside the Proposed WWTP, which is connected to an existing drainage network (see Appendix D for details) which ultimately discharges further downstream to the River Cam;
- **To a surface water sewer** (highway drain, or another drainage system): see justification above for discharge 'to a surface water body'; and
- **To a combined sewer:** the surface water (of potentially contaminated) drainage system for the new site discharges to the head of the Proposed WWTP (where it will combine with the incoming wastewater), passing through the treatment process before discharging via the proposed new outfall to the River Cam.

3.1.2 **For re-use:** there is very limited availability for water re-use systems across the Proposed WWTP; however, this will continue to be investigated as an opportunity into and throughout detailed design.

- Rainwater Harvesting (RWH) will be used for the larger roofs.

3.1.3 Whilst the SuDS hierarchy can be applied to the majority of the Proposed WWTP it should not be applied to the STC area which is required to comply with the Industrial Emissions Directive (IED) due to a potential contamination risk.

3.1.4 The SuDS measures have been developed using industry standard guidance such as the CIRIA SuDS Manual (Ref 6).

3.2 Other Drainage Considerations

3.2.1 To limit and control the storm discharge into the treatment process, storage is available in the transfer tunnel via the TPS wet well chamber, and the new WRC storm tanks.

3.2.2 Runoff from impermeable areas within the STC area of operations is considered unsuitable for infiltration. The operation of the STC area presents a contamination risk which requires the ability to contain, collect and treat any potentially contaminated surface water, therefore a separate (and self-contained) positively drained system is required to mitigate this contamination risk (by collecting the run-off from the STC area and returning it to the inlet works for treatment). This is a requirement of the IED.

3.2.3 Whilst not part of the area that will be designated under the IED permit, the same principles will be applied to any impermeable areas within the WRC that are also at risk of any potential contamination. This will include, but is not limited to, areas such as the inlet works hardstanding, delivery areas, de-sludge pumps slabs and pump laydown areas.

3.2.4 Areas that require oil interceptors and silt traps, such as the HGV parking bays, will be identified and provided with appropriate facilities. All drainage design is to be based on a 1:100-year storm event with +40% allowance for climate change.

3.2.5 Runoff from the areas of the Proposed WWTP that are contaminated (as part of the treatment process) will be collected in closed systems and returned back to the inlet works for treatment. Details of the types of contamination are provided in the next section.

4 Proposed Drainage System Philosophy for The Proposed WWTP

4.1 Areas Requiring Drainage

4.1.1 Figure 4.1 below provides an overview of the Proposed WWTP including:

- OF (Office / Gateway-building Roof) and WS (Workshop Roof)
- TPS (Terminal Pumping Station) and IW (Inlet Works)
- WRC (Water Recycling Centre), ST (Storm Tanks) and OA (Outlet Area)
- STC (Sludge Treatment Centre) and HGV (Heavy Goods Vehicle Parking)

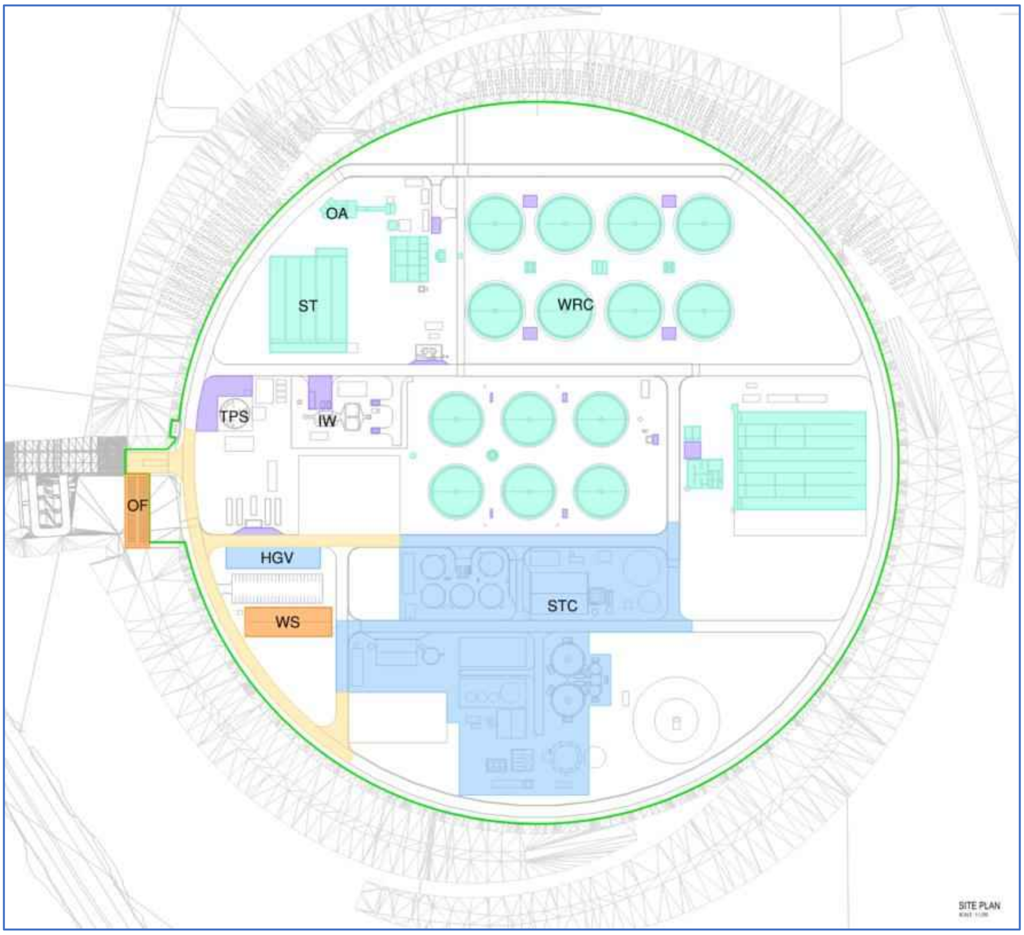


Figure 4.1: Proposed WWTP Drainage Areas Layout.

4.1.2 An explanation of the colour coded areas, and the drainage requirements, are provided in Table 4.1 below.

4.1.3 The information in Figure 4.1 and Table 4.1 originates from the drawing titled 'Main Works Drainage Types and Areas'; a copy of this drawing is appended (Appendix A).

Table 4-1: Drainage Areas & Requirements (see Figure 4.1 above for Location of Areas)

Ref	Symbol	Area m^2 (ha)	Area % (see notes)	Description	Drainage Requirements
1		195,285m^2 (19.5ha)	100%	Area within Circular boundary (500m diameter) of the treatment works.	See breakdown below (areas 2, 3, 4, 5, 6 and 7) for drainage requirements.
2		2,071m^2 (0.2ha)	1% **	Gateway-building (Office) and workshop buildings (impermeable roofs)	Separate self-contained rainwater capture system; uncontaminated Rain-Water Harvesting (RWH) system.
3		4,191m^2 (0.4ha)	2% **	Concrete roads subject to heavy vehicle movements (impermeable area)	Contained drainage area of impermeable roads (assumed uncontaminated drainage flow).
4		9,729m^2 (1.0ha)	5% *	WRC (impermeable area); including inlet works (with dosing and skip handing areas).	Closed drainage system (potentially contaminated drainage flows to be returned to the head of the works for treatment).
5		28,772m^2 (2.9ha)	15% *	STC (impermeable area) and HGV parking area.	Closed drainage system (potentially contaminated drainage flows to be returned to the head of the works for treatment).
6		31,819m^2 (3.2ha)	16% *	WRC process (open topped tanks)	No-run-off (as captured in open topped tanks).
7	Remaining Area	118,703m^2 (11.9ha)	61% **	Area 1 minus areas 2, 3, 4, 5 & 6	Permeable site areas (grass, stone chipped areas and block paved roads) requiring drainage (of

Ref	Symbol	Area m² (ha)	Area % (see notes)	Description	Drainage Requirements
					uncontaminated rainwater).

Notes:
* Areas indicated in red which are potentially contaminated= *36%*
*** Areas indicated in blue are uncontaminated = 64 %*

4.1.4 Table 4.1, above, indicates that the self-contained areas (2, 4, 5 and 6) will require separate drainage provisions. Similarly, due to rainwater capture by these areas, the proposed WWTP will result in an overall reduction of approximately 37% in surface area and respective surface water flow requiring drainage.

4.1.5 Details are provided below, including approximate volumes to be accommodated, of storage and attenuation requirements for Areas 2, 4, 5 and 6:

- **Area 2 (gateway-building and workshop roofs):** there will be a self-contained Rainwater Harvesting System (RWH) providing water for reuse. The RWH systems proposed for each roof are different in nature as described below:
  - Note that the intention of the RWH system is to promote sustainability; but that as far as the surface water drainage strategy is concerned the RWH system will be considered full at all times and further, that any surplus RWH flow will be routed via gravity to the clean area for drainage.
  - **Workshop roof:** The size of the RWH tank for the workshop roof is estimated to be 42m^3. The tank has been preliminarily sized as follows: the total average annual rainfall to be collected on the workshop roof (with area of say 1,000m^2), assuming an 0.9 runoff coefficient and average annual rainfall of 575mm/year, is 518m^3. If all this water was captured the average volume available for daily use would be 1.4m^3/day. Assuming the tank is sized to store 1 month's use, to provide water over the drier month, then the required RWH system would be required to hold 42m^3.
  - **Gateway building:** the roof area will drain to a landscaped rain-garden areas associated with the visitor parking area. Further details of this arrangement are provided in Section 5.1.
- **Areas 4 and 5 (WRC and STC areas):** the runoff from these areas will be contained, as contaminated, and will be forwarded to the head of the works for treatment.
  - Note that the storage required will accommodated by providing a gravity drainage path to the TPS, for use of the tunnel storage (see also Note 2, in Section 4.2, regarding drainage provisions).
  - The rainwater volume to be accommodated during the design storm is estimated to be 1,900m^3 (this is calculated as follows: 38,501m^2 surface area

is assumed to attract 50mm of rainfall depth during a design storm = 1,925m^3 say).

- **Area 6 (WRC open tanks):** drainage is not required here, as the open-topped tanks will accommodate the rainwater.
  - The rainwater volume, to be accommodated during the design storm, is initially estimated to be approximately 1,600m^3 (this is calculated as follows: the 31,819m^2 surface area is assumed to attract 50mm of rainfall depth during a design storm = 1,590m^3 say) equivalent to 50mm in depth.
  - Note that during detailed design the open tanks will be checked to see that they have capacity to accommodate the design storm, and the freeboard adjusted if necessary.

4.1.6 Further details of the drainage strategy for the clean/uncontaminated areas (3 and 7) is therefore required, including:

- **Area 3 (impermeable concrete roads):** roads requiring drainage (of uncontaminated run-off); and
- **Area 7 (permeable site areas - see Note 1):** grass, stone chipped areas and block paved roads requiring drainage (of uncontaminated rainwater).
  - **Note 1:** Although Area 7 is referred to as permeable this only applies to the surfaces. The immediately underlying ground (weathered West Melbury marly chalk) has low permeability; further details of this are provided in Section 4.7.

4.2 Impermeable Areas 4 and 5 (with Contained Drainage System)

4.2.1 The Proposed WWTP drainage system (for Areas 4 and 5, where the surface is impermeable and at risk of contamination) is to be designed to route the runoff back to the head of the works for treatment. This will include any surface water from areas where the surface is impermeable and at risk of contamination, and collected via a network of combined kerb/drainage units, which will form a dedicated site drainage network draining to a pumping station which will return the flow to the head of the works for treatment.

4.2.2 Modelling of the surface water run-off rates from these areas is to be undertaken during the detailed design phase of the project, which will allow the pumping station provision (see note 2) and any attenuation requirements to be sized.

- **Note 2:** current provisions in the WRC design, to forward these contained and potentially contaminated flows, are via a 50l/s pump set to the head of the works for treatment. There is also a flow allowance for site drainage, of 1,080m^3/d, in the design flows for treatment.

4.2.3 Special precautions will be taken in the following areas for the contaminants listed that may present a risk (further consideration of this topic will take place during detailed design):

- **Inlet works (Area 4):** there is a risk of spillage from the grit removal and screenings process (including skip and vehicles movement) and also from incoming tankers (emptying incoming wastewater from various local sources including cess pits).
- **WRC (Area 4):** there is a risk of chemical spillage (such as ferric chloride from the storage tanks and dosing operations), which will be mitigated by returning any surface water in a closed system back to the head of the works for treatment.
- **HGV Parking Bays (Area 5):** there is a risk of oil and diesel spills from the HGV vehicles this area will be provided with an oil interceptor (located close to the parking bays) to capture any oil as soon as possible (as there is a risk of mixing and emulsification further downstream, in particular after any large steps in the drainage path).
- **STC (Area 5):** there is a risk of spillage of sludge and sludge liquors, and thickening/dewatering chemicals (polymers), which will be mitigated by returning any surface water in a closed system back to the head of the works for treatment.

4.3 Permeable Area 7 and Impermeable Area 3 (not at risk of Contamination)

4.3.1 The majority of the site is to have permeable surfaces, including:

- block paving in areas with a low risk of contamination;
  - the roads (and visitor parking bays and paths) will have no kerb, so that runoff can be collected by an arrangement of French drains;
- stone chippings in low risk areas (smaller areas, around buildings, tanks etc); and
- grassed areas (larger open areas).

4.3.2 It is currently assumed that the permeable surfaces will accommodate some of the rainwater runoff, as a form of attenuation storage. In extreme events some areas of the site may be designed to pond to accommodate the rainwater. Estimated storage volumes associated with these areas are provided in a later section of this report (in Section 4.9 and Table 4.5).

4.3.3 The following sections of this report consider:

- rainwater volumes from a design storm event;
- green-field runoff; and
- site permeability.

4.3.4 The consideration of the drainage requirements for clean areas (3 and 7), using equivalent greenfield run-off rates to determine attenuation volumes, follows below.

4.4 Model 1: Estimation of Attenuation Volumes (for Clean Areas 3 & 7)

4.4.1 In order to quantify the drainage requirements for areas 3 and 7, and the approximate volume of rainwater to be accommodated in an attenuation facility, a simple network and catchment arrangement (with an area of 12.3ha) was created in InfoWorks. Further details of the modelling exercise are provided in Appendix B-1.

4.4.2 The resulting rainfall volumes generated requiring temporary storage during a 1 in 100 summer storm event (see Note 3) with climate change allowance for various assumed pumping rates (which represent a range of greenfield runoff rates that are likely to be considered as permitted discharges to local watercourses during storm events) are summarised below in Table 4.2.

- **Note 3:** the summer storms are used in Table 4.2 as these events were found to produce larger volumes, than the winter storms, in the modelling exercise.

Table 4-2: Summer Storm Volumes Required Attenuation (from Appendix B-1)

Greenfield runoff rated (l/s/ha) (see note 4)	Rainwater Volumes Requiring Attenuation for a 1 in 100 year event (m^3)	
	with 20% climate change allowance	with 40% climate change allowance
2.5	11,023	12,906
5	10,806	12,689
10	10,397	12,255
20	9,820	11,640

- **Note 4:** The calculated storage volumes presented in Table 4.2 (approximately 12,000m^3) are considered high and would likely be reduced by further consideration of greenfield runoff rates.

4.4.3 Assuming a worst case (least greenfield runoff rate), a volume of approximately 12,000m^3 is to be accommodated in temporary attenuation storage. Approximately 1/3rd of this volume originates from Area 3, and the remaining 2/3^{rds} from Area 7.

4.4.4 The use of higher rates of greenfield runoff (to match the return period) is seen as an opportunity to potentially reduce the volumes of rainwater requiring attenuation. Further consideration of greenfield runoff rates (at higher flow rates according to return period) is provided in the next section of this report.

4.5 Model 2: Estimation of Attenuation Volumes (for Clean Areas 3 & 7)

4.5.1 A further modeling exercise was carried out using the Wallingford 'Surface Water Storage Volume Estimation' tool. The results of this exercise are provided in the table below.

- Further details of modelling exercise 2, results and data input, are provided in Appendix B-2.

Table 4-3: Summer Storm Volumes Required Attenuation (from Appendix B-2)

Discharge Rate	M1 (m^3/s)		M30 (m^3/s)		M100 (m^3/s)	
(l/s)	+20%CC	+40%CC	+20%CC	+40%CC	+20%CC	+40% CC
50	988	1542	6139	7551	9393	**11347**
122	666	1099	4696	5801	7242	8771
177	532	915	4094	5071	6344	7696

Note: the largest attenuation volume is highlighted yellow

- The discharge rates (equivalent greenfield run-off rates) provided in the table, for various storm return periods (M1, M30 and M100) and climate change allowance (+20% and +40%), assume the following:
  - 50 l/sec discharge rate based on Q_{BAR} of 2.5 l/sec/ha (over the 20 Ha)
  - 122 l/sec discharge rare based on $Q_{(1 in30)}$ of 6.1 l/sec/ha (over the 20 Ha) for the 1 in 30 years case
  - 177 l/sec discharge rate based on $Q_{(1 in 100)}$ of 8.9 l/sec/ha (over the 20 Ha) for the 1 in 100 years case

4.5.2 For a worse case (with the lower equivalent greenfield discharge rate of 50l/s and the 1 in 100 storm and 40%CC) the required attenuation volume is 11,347m^3; say 12,000m^3 in round numbers.

4.5.3 As for model 1, it appears likely that the attenuation volume can be significantly reduced by further consideration of the greenfield runoff rates relative to return period (for example: utilising a staged weir arrangement, each with separate controlled outlets to match the appropriate equivalent green field discharge rate for the return period). However, this optimisation exercise will be left for later stages of the project, following planning consent and during the detailed design stage of the project.

4.6 Estimation of Greenfield Runoff Rates

4.6.1 The estimated greenfield runoff rates are subject to further discussion and agreement with the Lead Local Flood Authority (LLFA) as part of the detailed design development.

4.6.2 The greenfield runoff rates used above (in Sections 4.4 and 4.5) are described in further detail in Appendix C.

4.6.3 Appendix C contains the greenfield runoff rates (see note 5), calculated using the Wallingford 'Greenfield Runoff Rate Estimation' calculation tool (Ref. 15), which are summarised as follows:

- Q_{BAR} (see note 6) = 2.5 l/s/ha;
- 1 in 1 year = 2.2 l/s/ha;
- 1 in 30 years = 6.1 l/s/ha;

- 1 in 100 years = 8.9 l/s/ha; and
- 1 in 200 years = 10.5 l/s/ha.

  - **Note 5:** The 'Rainfall Management for Developments' document (Ref. 8) advises (on page ix) that: "*No allowance for climate change should be applied to calculated greenfield peak rates of runoff from the site for any hydrological region. It is recognised that an increase in rainfall will result in an increase in runoff, but that if the greenfield runoff formula is increased proportionately, that storage volumes will remain largely the same and this is not considered to be a suitable precautionary position*."
  - **Note 6:** Q_{BAR} is a Flood Studies Report (Institute of Hydrology, 1995) term denoting the Mean Annual Flood flow rate for a river (and approximates to a return period of 2.3 years). We are aware that the FEH data is generally preferred (rather than FSR data) in discharge calculations, and we have used FEH data where possible.

4.6.4 The Proposed WWTP is contained within a circular boundary (of approximately 500m diameter) covering an area of 19.6ha. The greenfield runoff flow rates above are per hectare, and indicate flows ranging between 43 l/s (for a 1 in 1 year event) and 174 l/s (for a 1 in 100 year event) for the full Proposed WWTP area (of 19.6ha, as the complete site is effectively impervious due to the WWTP development and the very low permeability of the underlying weathered West Melbury marly chalk strata).

4.6.5 The use of a higher greenfield runoff rate, such as 174 l/s during a 1 in 100 year event, will assist to reduce the attenuation storage required. However, this requires agreement with the regulating authorities as they may require the flows to be limited to a lower return rate.

4.6.6 The agreed greenfield rate of flow (for example at a rate of 174 l/s during a 1 in 100 event), that could be released from the clean storage pond(s) to the wider catchment and/or designated watercourse, will be released in a controlled manner using a variety of means (such as via a hydrobrake or float control valve or similar).

4.7 Consideration of Ground Permeability

4.7.1 Investigations have confirmed that the underlying ground, in particular the Weathered West Melbury Marly Chalk, has a low permeability and is therefore unlikely to provide any capacity to allow surface runoff water to drain via infiltration.

4.7.2 In addition, this means of drainage (using direct deep infiltration SUDS) may not be compliant with the requirements of the Environment Agency (EA) Approach to Groundwater Protection (Ref 4) as the water table is high. Further consideration of Groundwater Protection is provided in the next section (see 4.8).

4.7.3 A ground investigation identified the ground properties and permeability for each of the underlying strata layers in the vicinity of the Proposed WWTP. The underlying ground details are summarised in the table below:

Table 4-4: Indicative Ground Profile and Permeability

Strata - Ground Profile	Layer thickness (m) (see note**)	Indicative Permeability (m/s)
Weathered West Melbury Marly Chalk (WWMC)	0.1 to 2.2	6.7×10^{-9} to 8.5×10^{-11}
West Melbury Chalk (WMC)	3.3 to 13.4	3.7×10^{-5} to 9.6×10^{-9}
Gault Clay (GC)	34 to 36.7	6.1×10^{-7} to 5.1×10^{-10}

Note:
** The thickness of strata indicated were obtained from the records of the exploratory boreholes in the vicinity of the Proposed WWTP.

4.7.4 The permeability of the underlying weathered chalk (WWMC) in the table above is 'poor' and, in this case, it is not considered viable to rely on the permeability of this strata to assist the drainage of the rainwater via infiltration.

4.7.5 Given the nature of the water table (and limited data), further observation of the ground water is proposed (including during the oncoming winter periods) using existing boreholes to determine the potential seasonal fluctuations. Using this information, the Applicant will aim to demonstrate that the drainage proposals in this report do not create a ground water issue to the development (see Note 7).

- **Note 7:** the underlying ground, as relatively impermeable, is not expected to cause a significant problem to the development (as the ground will restrict the movement of groundwater). Further consideration of this topic will likely include additional periods of ground water level monitoring and pump-out trials.

4.7.6 As the underlying strata does not appear to be suitable for infiltration, and given the potential proximity of the ground to the water table, there may not be any scope to provide even partial infiltration. The drainage strategy will therefore proceed on this basis, and not include infiltration (into the underlying strata) as a means of drainage.

4.7.7 The use of SuDS storage, in ponds and swales, is considered in a further section of this report (in Sections 4.8.4 and 4.9); to demonstrate how these facilities will operate according to the high-water table that may be encountered.

4.7.8 In terms of attenuation, the Applicant will also consider (during detailed design) if there is an opportunity to potentially reduce the size of the dedicated offsite attenuation requirements in a number of ways, including:

- Design the drainage networks for 1:30 year storms and allow the remainder of the site in open areas to act as floodplains across the remaining areas.
- Maximising the greenfield runoff rates (by adjusting the discharge rate according to the return period), subject to further consultation and agreement with the LLFA.
- Detailed modelling of the drainage requirements including attenuation facilities and outlet control requirements.

4.8 Compliance with Environment Agency (EA) Approach to Groundwater Protection

4.8.1 The requirements of the EA Approach to Groundwater Protection (Ref 4) are to be followed. It is understood that the particular systems of concern are soakaways and other means of infiltration SUDs.

4.8.2 The Proposed WWTP is on greenfield land and therefore construction in contaminated ground (where infiltration could re-mobilise contaminants to pollute groundwater) is not considered a risk.

4.8.3 The requirements of statements G1 and G9 to G13 (in Ref 4), are considered below:

- G1 - Direct Inputs into Groundwater.
  - Areas that potentially contain hazardous substances will be drained separately (with separate attenuation and redirection to the head of the works for treatment).
  - The clean areas, other than the excess flow from the RWH system, will not have a direct interface with groundwater.
- G2 to G8 - Sewage and Trade Effluent.
  - There will be no direct drainage of waste-water or trade effluent to ground.
  - The underlying strata has a low permeability so drainage to ground will be restricted.
  - Where there is any identified risk (depending on the process and location in the works) we will provide a physical barrier to block the direct flow path to ground.
- G9 – Use of Deep Infiltration Systems +
  - The discharge to groundwater will not be direct.
  - Deep infiltration systems have been investigated, and excluded (except possibly for the rainwater harvesting system which is permitted) from the drainage strategy.
  - Acceptable pollution control measures will be put in place that comply with the requirements of the G9 groundwater position statement to the satisfaction of the Environment Agency.
  - A risk assessment will be undertaken of the drainage system, during detailed design, to identify and mitigate any risks.
- G10 and G11 – Potentially Polluting Discharges
  - Areas with potentially polluting discharges will be self-contained, with separate attenuation storage, and returned to the head of the works for treatment.
  - Should there be any excess contaminated flow it will be routed to the TPS shaft for storage in the tunnel.

- G12 – Discharge of Clean Water
  - There is a Rainwater Harvesting System (RHS), using building roofs (offices and workshop), which will be self-contained to avoid contamination from other drainage systems. The RHS will drain to a storage facility for non-potable use.
  - Any overflow from the RWH system will be self-contained, and may be drained via a soakaway to ground, and if this is not feasible it will be diverted to the main clean drainage system for the site.
- G13 – Sustainable Drainage Systems
  - A Flood Risk Assessment (Appendix 20.1, App Doc Ref 5.4.20.1) has been carried out and this document confirms that proposed development is not within a Source Protection Zone (SPZ).
  - The vegetated slopes of the earth bank surrounding the Proposed WWTP will be surface drained across external landscaped features (ridges and furrows). The ridges and furrows are provided to slow any run-off down any surface flows to greenfield rates and thereby restrict and control drainage flows to the downstream catchment.
  - The drainage of the internal ‘clean areas’ of the proposed development will include filtration through gravel media and attenuation in shallow depressions within the Proposed WWTP site prior to pipe drainage and additional attenuation in an external temporary storage area (grassed, normally dry, ponds) prior to drainage at greenfield rates to the existing local ditch system.

4.8.4 For any infiltration SUDS system there is a requirement to maintain a minimum of 1.2m clearance above peak seasonal groundwater levels. The groundwater levels recorded in the boreholes is high (see Figure 4.2 below for borehole locations). For instance borehole BH-15 (located in the middle of the proposed works) indicates that the groundwater can be as shallow as 1.8m below ground (relative to an existing ground level of 10.5m). The finished ground level is likely to be approximately 1m lower, which would place the groundwater height at approximately only 0.8m below finished surface level.

4.8.5 Any hard surfaces with a risk of oil contamination, such as the HGV parking area, will have oil interceptors.

4.8.6 The RWH system, supplied from roof runoff, will not require an oil interceptor.

4.9 Overview of Drainage Strategy Within the Proposed WWTP Area

4.9.1 This currently assumes 12,000m^3 of storage volume is required (based on calculations 1 and 2 presented in Sections 4.4 and 4.5).

4.9.2 The 12,000m^3 of storage may be accounted for in variety of ways as demonstrated below in Table 4.5.

Table 4-5: Overview of Attenuation Facilities for the Drainage Strategy

Surface Water Attenuation Facilities	Storage Volume (m^3)	Comment
Pipe network (temporary pipe storage; this volume is likely to be limited).	150	Say, 2,000m of pipe x 0.075m^2 csa.
Permeable surfaces across site (temporary capture within various surfaces including grass, gravel, permeable paving, french drains).	2,000	Say 40,000m^2 area x 0.1m depth.
Standing water (grassed areas of lower elevation within the WWT site).	4,000	Say, 100,000m^2 area x 0.1m depth and 20% voids.
Dedicated attenuation storage facility (grassed 'normally dry' shallow depression/pond)	5,850*[1]	Shallow dry pond located north-west of the Proposed WWTP earth bank*[3].
Total Storage Required	**12,000*[2]**	Using the lowest greenfield runoff rate from Table 4.3.

Note:

*[1] The 5,850m^3 pond volume could be increased in size (to accommodate all of the required storage volume of 12000m^3) should the other attenuation facilities listed above not prove to be viable during detailed design.

*[2] This is a conservative approach, the volume could be reduced if the discharge rate is matched to the greenfield run-off rate (for the respective return period).

*[3] In addition to the shallow normally dry pond there is also an arrangement of ridges and furrows (and other landscaping features) outside of the Proposed WWTP earth banks, which will assist to attenuate surface water flows to achieve acceptable greenfield runoff rates.

4.9.3 The use of the landscaped area outside of the Proposed WWTP earth banks, to provide additional storage capacity , is considered in the next section.

4.10 Overview of Drainage Strategy Utilising the External Landscaped Area

4.10.1 **Landscaped area:** The area within the 22ha Proposed WWTP is limited, and, as Areas 3 and 7 are clean, there will be an opportunity to store some (or all) of this volume in 'scrapes' or depressions and seasonal ponds created in the extensive 72ha surrounding landscaped area outside of the Proposed WWTP earth bank.

- **Seasonal Pond(s):** The landscaping around the Proposed WWTP can accommodate temporary ponds (which are otherwise dry). These can be designed to accommodate seasonal variations of runoff storage with the use of weirs and outlet controls.
- **Swales:** The flow from the Proposed WWTP earth bank will be directed towards swales (and ridges and furrows) and utilise the landscaped hillside area (grass and trees) to further delay and disperse any surface flows.

4.10.2 **Greenfield Runoff Rates:** The remaining surface runoff flows to local watercourses, such as the Black ditch, will be managed so as not to exceed equivalent greenfield runoff rates.

4.10.3 **Infiltration**: Figure 4.2 below indicates the depths of the water table (varying between 0.7 and 2.2m below natural ground) measured over the recent winter period and the natural ground levels (from the recent Randall's survey). The proposed WWTP is to be terraced at approximately 9.5m AoD (the 2.2m depth to the water table may reduce to approximately 1m below finished ground level at the proposed WWTP).

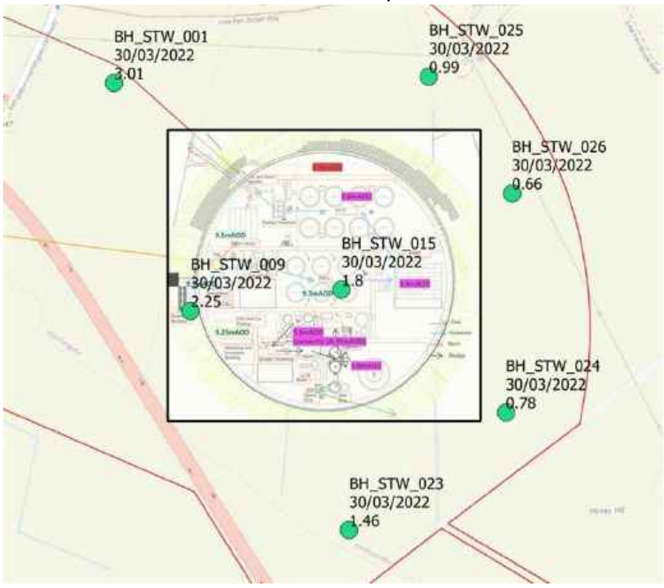
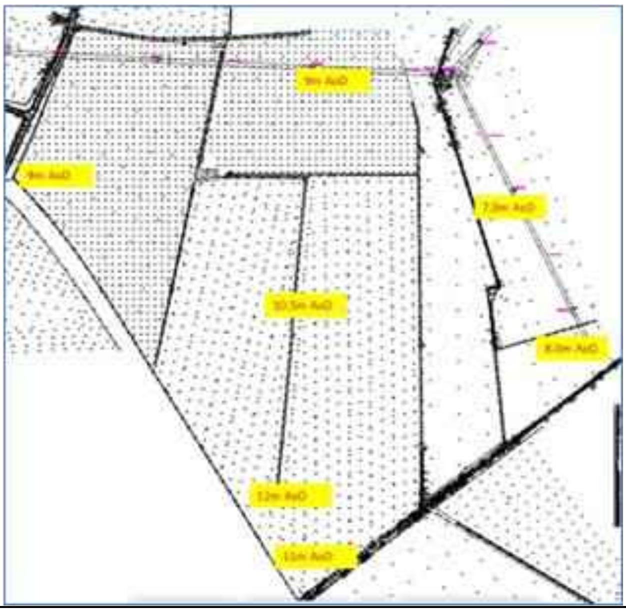
A. Water Table (depths below ground at boreholes)	B. Surveyed Ground Levels
	

Figure 4.2: (A and B) Water Table Depth and Surveyed Ground Levels

4.10.4 The use of infiltration as part of the drainage strategy appears not to be viable for this development due to:

- The limited permeability of the underlying strata; in particular the Weathered West Melbury Marly Chalk.
- The apparent high water-table; which may, subject to further studies, be within 1m of the finished ground level at certain times of the year.

4.10.5 The use of SuDS will be included where possible, including seasonal ponds and swales and the proposed extensive areas of vegetation (grass and trees) outside of the proposed WWTP, to promote and maximise the opportunity for drainage attenuation.

4.10.6 Further investigations and information (such as monitoring seasonal variations in the water table) are required to consider the potential impact of the water table in further detail.

4.11 The Proposed WWTP earth banks

4.11.1 The drainage of the earth banks that surround the proposed WWTP will utilise the ridges and furrows outside of the proposed WWTP earth banksto control and attenuate the runoff to the catchment.

4.11.2 Further consideration of the engineering design of the earth banks will require further consideration, including drainage modelling, during detailed design.

4.12 Drainage Strategy Summary

4.12.1 A drawing providing an overview of the proposed drainage strategy is provided in Appendix E.

4.12.2 The drawing shows the drainage facilities, attenuation facilities and outlet controls.

4.12.3 Further requirements for the design, including confirmation and/or reduction of the currently proposed provision of 12,000m^3 of attenuation storage, is required according to the following guidance:

- The Rainfall Management for Developments guide (Ref. 16) advises that the "approach for sizing stormwater storage must only be used at the planning stage to assist with estimating indicative volumes. Detailed design of the drainage systems requires the use of suitable software to confirm or modify the storage proposals as well as addressing conveyance and the many other aspects of drainage design."
- In this case further detailed modelling is required, in addition to discussions with the regulatory authorities, to further define the drainage requirements of Areas 3 and 7.

5 Proposed Drainage Philosophy (Excluding the Proposed WWTP)

5.1 The access road and visitor parking area

5.1.1 The drainage proposal for the proposed access road from Horningsea Road to the proposed WWTP is to use a series of gullies and a piped system on the 'earth banks' section of the access road, discharging to a newly formed swale on northern side of the access road, with the eastern section of the access road to discharge directly to swale from the carriageway.

5.1.2 This new swale would discharge to the existing watercourse (field ditch) to the north of the Proposed WWTP, ultimately discharging into the River Cam. The rate of discharge from the new swale to existing watercourse would be controlled at greenfield runoff rates by a hydrobrake or similar.

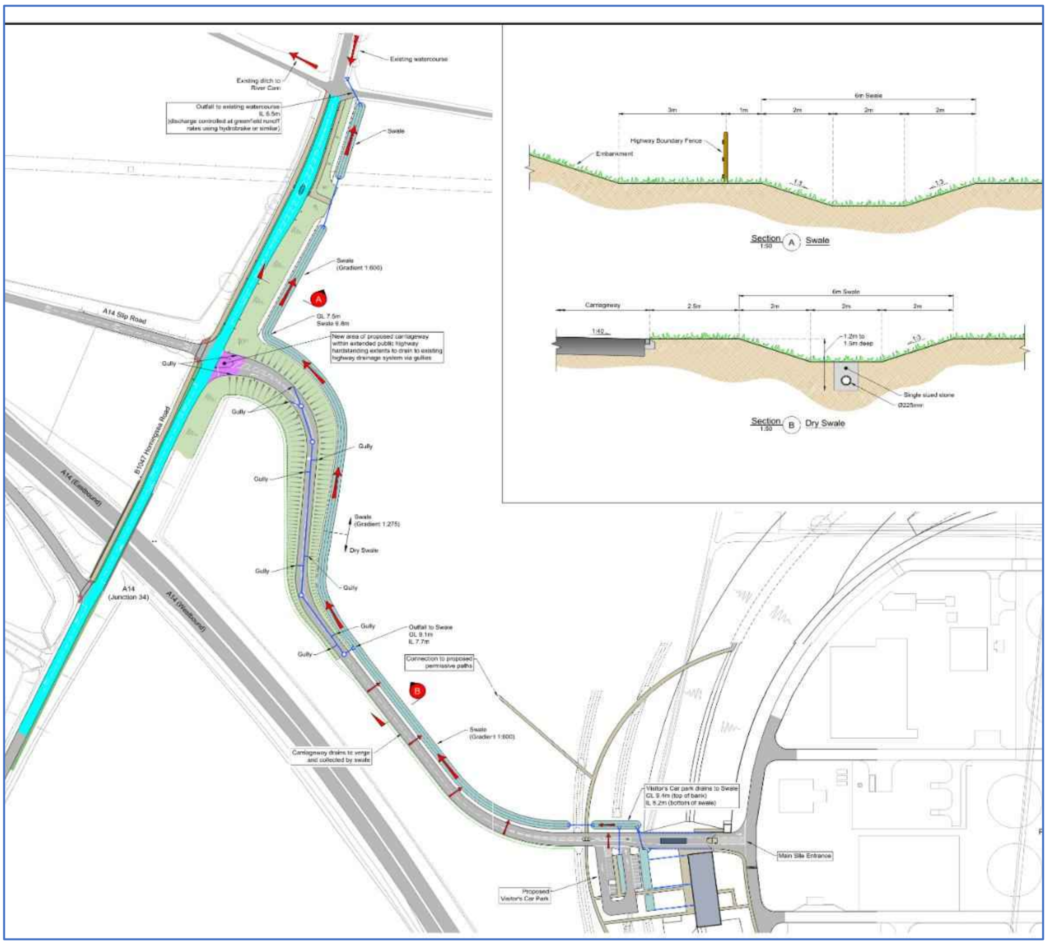


Figure 5.1: Proposed Access Road Surface Water Drainage

5.1.3 The access road from the Horningsea Road terminates at a visitor parking area located adjacent at the entrance to the proposed WWTP. Details of the drainage arrangements for the visitor parking area and interface with the gateway building and the access road are shown below in Figure 5.2.

5.1.4 The proposed drainage arrangements in Figure 5.2 includes use of the following SuDS measures:

- Landscaping, with designated rain-garden areas
- Water supply (to the rain-gardens) supplied from the Gateway building roof via shallow drainage runnels.
- Measures to divert excess flows from the rain-gardens to swales adjacent to the access road.

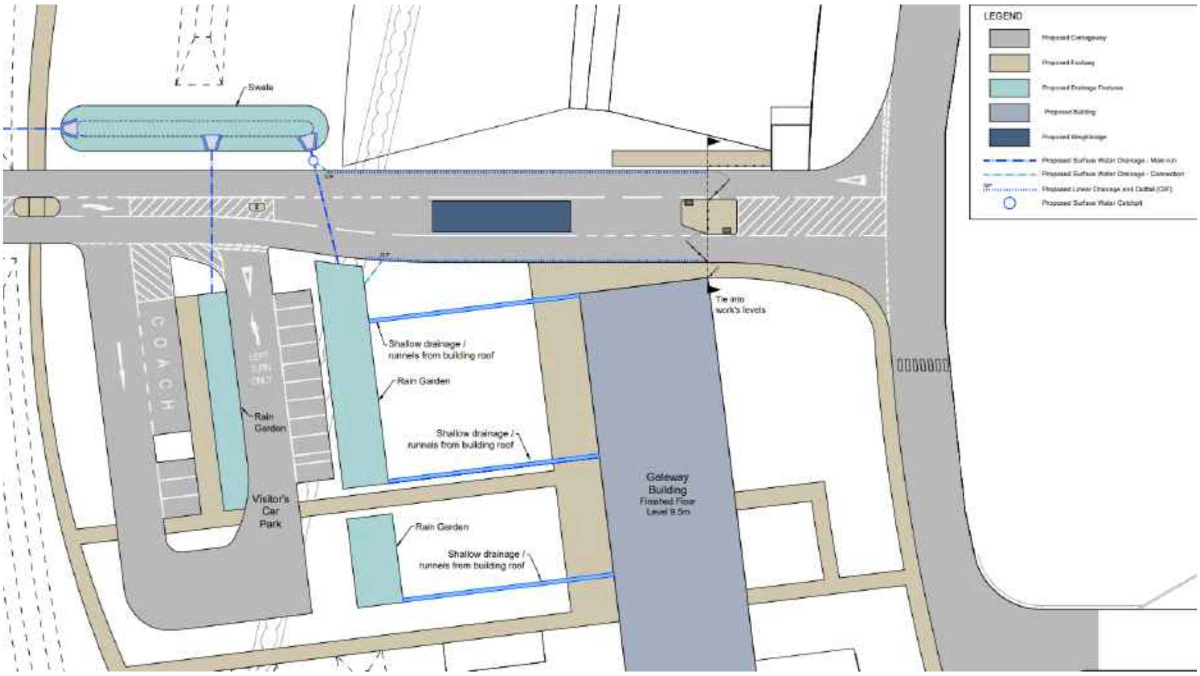


Figure 5.2: Proposed Drainage of Visitor Parking Area

5.2 The Tunnel and Cross-Country Pipelines

5.2.1 The tunnel is located below ground (circa -23m) and will therefore have minimal impact on the surface water drainage. All of the intermediate shafts (2 to 5) along the route of the tunnel, that are required for construction access, are to be broken out and backfilled (on completion of the tunneling works) so that the ground (at surface level) is returned to its previous state.

5.2.2 As with the tunnel, the various cross-country pipelines associated with the project, including the proposed WWTP's outfall pipelines (including the Final-Effluent and Storm pipes) and waste water transfer pipelines (including the dual Waterbeach pipes), should have little impact on surface water drainage in the area as these facilities are located below ground (typically installed in a dedicated buried trench).

5.2.3 Any land drains disturbed or broken during the installation of these pipelines (via open cut) will be replaced and the surface returned to its previous state.

5.3 External Landscaping

5.3.1 The external landscaping, including the proposed arrangement of ridges and furrows, will be used to attenuate and control surface runoff to provide compliance with the agreed levels of greenfield runoff rate.

5.3.2 Any existing drains and ditches, including components of agricultural land drainage systems, that are disturbed during the installation of the Proposed Development will be repaired or replaced where their continued service is required.

6 Management and Maintenance of Drainage

6.1.1 The whole site, including the site drainage system and treatment system and outfall to the River Cam, will be under the ownership and management of the Applicant. Inlets, outlets and (passive) flow control structures will be clearly identifiable, and their functionality easily understood by maintenance contractors.

6.1.2 Table 6.1 below presents typical maintenance activities and associated frequency for inlets, outlets and (passive) flow control structures.

Table 6-1: Inlets, outlets and flow control structures for maintenance

Maintenance schedule	Required Action	Typical Frequency
Routine Maintenance	Remove litter (including leaf litter) and debris from kerb drains, gratings and access chambers.	Start and end of Winter Management Period.
	Inspect inlets, outlets, flow controls for blockages, clogging, standing water and structural damage.	Additional inspection after significant periods of high winds.
Remedial actions	Check flow control and other mechanical devices.	Every 5 years.
Monitoring	Remove blockages and repair structural damage.	As required.
	Inspect for evidence of poor operations.	As required.
	Inspect sediment accumulation rates and establish appropriate removal frequencies.	System designed not to accumulate sediment – annual check.
	Inspect sediment accumulation rates and establish appropriate removal frequencies.	System designed not to accumulate sediment – annual check.

6.1.3 In addition to these passive systems, key components of the drainage strategy are the wet wells and associated pumps which form part of the surface water drainage system. The table below presents the typical maintenance activities and associated frequency for management of the pump sets.

Table 6-2: Pump sets maintenance

Maintenance schedule	Required Action	Typical Frequency
Routine Maintenance	Lift and clean pumps.	When telemetry indicates a problem.
	Test pump monitors.	Automatically monitored.
	Clean and check the operation of the electrodes/float switches, non-return and gate vales and associated electrical connections.	Annual inspection.
	Test all electrical controls.	Automatically monitored.
Remedial actions	Draw down wet well to remove any foreign matter and sediment, which could be detrimental to the smooth running of the equipment.	Automatic cycle when sufficient volume is present in wet well.
Monitoring	Kiosk self-test.	Automated.
	Monitor telemetry.	Automated.

6.1.4 A comprehensive maintenance plan for the complete drainage system will be developed as a Requirement of the DCO. The guidance provided by best practice standards, such as the CIRIA SuDS manual (Ref 6), will be followed where applicable.

7 References

7.1.1 Council, Environment Agency Standards and IDB

- Ref 1: Cambridgeshire County Council, Surface Water Planning Guidance (undated publication)
- Ref 2: Cambridgeshire County Council, Surface Water Planning Guidance, June 2021
- Ref 3: Cambridgeshire Flood and Water Supplementary Planning Document, December 2016
- Ref 4: The Environment Agency's Approach to Groundwater Protection, Feb 2018 (Version 1.2)
- Ref 5: Swaffham IBD District Map (Swaffham District Map – Ely Group of Internal Drainage Boards (elydrainageboards.co.uk)Swaffham District Map – Ely Group of Internal Drainage Boards (elydrainageboards.co.uk)

7.1.2 Industry Standards (Including Guidance Manuals and Procedures)

- Ref 6: The SuDS Manual CIRIA 753, November 2015.
- Ref 7: HR Wallingford Tools for Sustainable Drainage Systems [redacted] including:
  - Wallingford 'Greenfield Runoff Rate Estimation' tool;
  - Wallingford 'Surface Water Storage Volume Estimation' tool;
- Ref 8: Rainfall Runoff Management for Developments (Interim National Procedure Principles), EA, October 2013: Rainfall run-off management for urban developments - GOV.UK (Rainfall run-off management for urban developments - GOV.UK (www.gov.uk))
- Ref 9: National Policy Statement for Waste Water – A Framework document for Planning Decisions on Nationally Significant Waste Water, DEFRA, March 2012: pb13709-waste-water-nps.pdf (pb13709-waste-water-nps.pdf (publishing.service.gov.uk))
- Ref 10: Planning Policy Statement 25 – Development and Flood Risk Practice Guide, National Policy Statement for Waste Water – A Framework document for Planning Decisions on Nationally Significant Waste Water, CCLG, December 2009: pps25guideupdate.pdf (pps25guideupdate.pdf (publishing.service.gov.uk)).
- Ref 11: Highways Construction Details F-series Drawing Set (MCHW VOLUME 3 SECTION 1 - HIGHWAY CONSTRUCTION DETAILS - F SERIES - DRAINAGE (standardsforhighways.co.uk))

8 Appendices

8.1 Appendix A: Main Works – Drainage Types and Areas Drawing

8.1.1 The different drainage areas within the Proposed WWTW are identified on Figure 8.1.

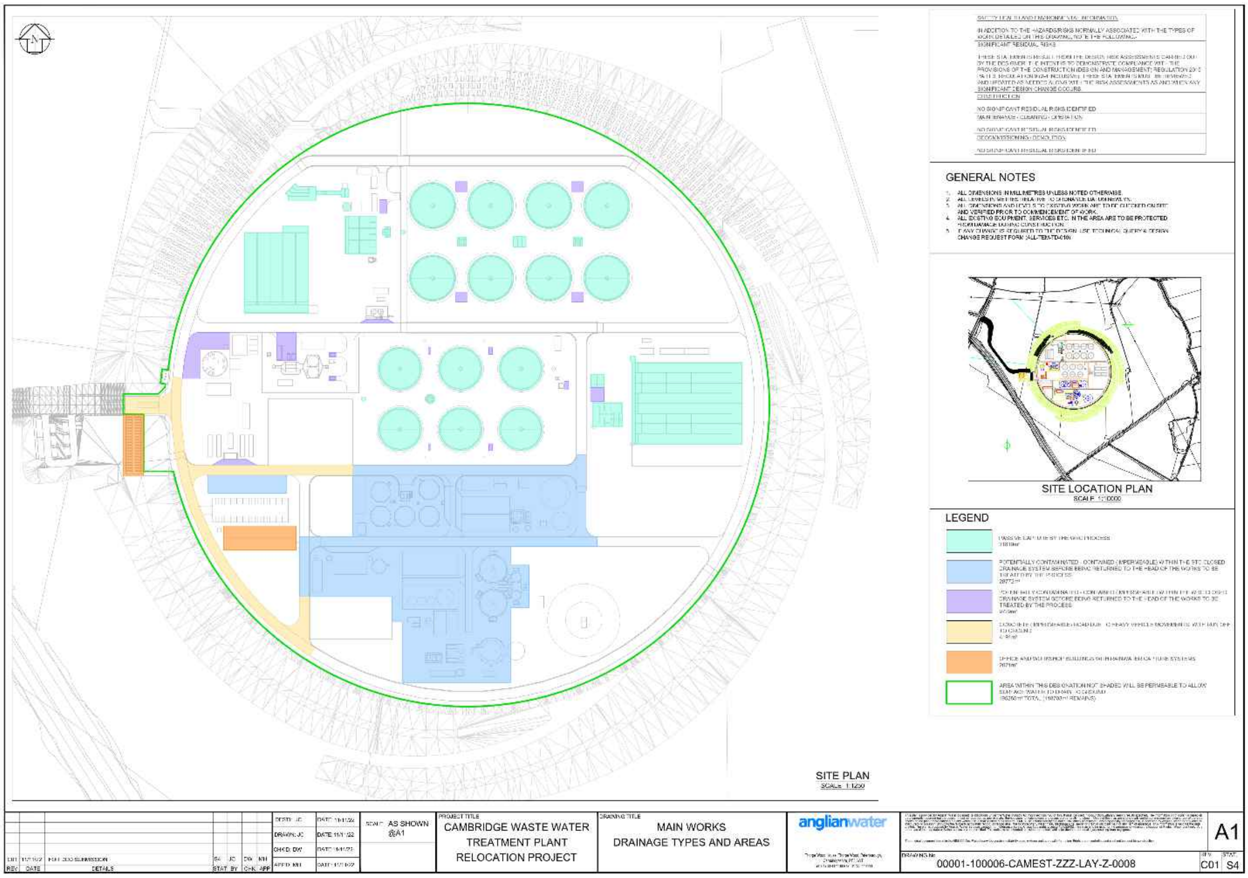


Figure 8.1: Different drainage areas within the Proposed WWTW.

8.2 Appendix B-1: Site Drainage Model 1 (and Attenuation Volumes)

8.2.1 **Model 1 Scope:** Initial Modelling of Greenfield Runoff Rates and Attenuation Volumes was carried out. Details of this model and modelling exercise are as follows:

- In order to quantify the rainwater volumes that apply to the site drainage (areas 3 and 7 in table 4.1) a simple network and catchment arrangement was created using InfoWorks ICM v9.0. An area of 122,894 m² (12.29 ha) was used to represent the catchment and a fixed runoff coefficient of 0.85 assumed.
- The model was then run with 1 in 100-year summer and winter storms for varying durations (30, 60, 90, 180, 360, 480, 600, 960 and 1440 minutes) with 20% (scenario 1) and 40% (scenario 2) climate change allowance.
- The resultant runoff from the sub-catchment was exported to Microsoft Excel and the range of pumped flows (at 2.5, 5, 10 and 20 l/s), which represent the assumed discharge at an equivalent greenfield runoff rate, were deducted from the rainfall hydrograph to determine the attenuation volume required for storm storage.
- The maximum storage for the two scenarios (summer and winter) and the different discharge rates are reported as volume (m³).
- For this region the summer storms tended to provide a worse case (in terms of volume) as indicated below.

8.2.2 **Model 1 Results:** The results of the modelling carried out are provided below in Tables 8.1 and 8.2:

Table 8-1 Summer Storm Required Attenuation Volumes

Summer Storm		Volume (m³)	
Pumping Rate (l/s)	Pumping Rate (m³/s)	100 + 20% CC	100 + 40% CC
2.5	0.0025	11022.6	12905.6
5	0.005	10805.7	12688.6
10	0.01	10396.8	12255.4
20	0.02	9820.1	11640.2

Table 8-2 Winter Storm Required Attenuation Volumes

Winter Storm		Volume (m³)	
Pumping Rate (l/s)	Pumping Rate (m³/s)	100 + 20% CC	100 + 40% CC
2.5	0.0025	7310.7	8640.6
5	0.005	7093.9	8423.6
10	0.01	6661.8	7991.0
20	0.02	6095.4	7343.2

8.3 Appendix B-2: Site Drainage Model 2 (and Attenuation Volumes)

8.3.1 **Model 2 Scope:** Further consideration of Greenfield Runoff Rates and Attenuation Volumes was carried out under a task brief (Task Brief No. 9 and Scope Change No 12). The scope of the task brief was as follows:

- Carry out an assessment of the volumes that would need to be stored for the following three greenfield run-off rates (for a climate change allowance of +20% and +40%):
    - 50 l/sec (based on Q_{BAR} of 2.49 l/sec/ha**) for Q_{BAR} case
    - 122 l/sec (based on $Q_{(1\ in\ 30)}$ of 6.09 l/sec/ha**) for 1 in 30 year case
    - 177 l/sec (based on $Q_{(1\ in\ 100)}$ of 8.85 l/sec/ha**20ha) for 1 in 100 year case
    - **Note:** **The greenfield runoff rates were obtained using results (presented in Appendix C) that were obtained using the Wallingford 'Greenfield Runoff Rate Estimation' tool (Ref. 7).
- Carry out a check of the greenfield runoff rates and the surface water storage requirements estimated using the greenfield runoff tool and the storage estimation tool.
- Review drainage strategy report and provide specialist advice re modelling procedures and flooding potential.

8.3.2 **Model 2 Results:** The calculation process used the Wallingford tool and FEH rainfall rates. The results of this exercise are provided below in Table 8.3.

- The table provides discharge rates (which relate to the level of greenfield runoff) and the storage volumes required for the associated storms (M1, M30 and M100) and climate change (CC) allowances (+20% and +40%).

Table 8-3 Discharge Rate & Attenuation for Design Storms (M1, M30 and M100 & CC)

Discharge Rate	M1 (m^3/s)		M30 (m^3/s)		M100 (m^3/s)	
(l/s)	+20%CC	+40%CC	+20%CC	+40%CC	+20%CC	+40% CC
50	988	1542	6139	7551	9393	11347
122	666	1099	4696	5801	7242	8771
177	532	915	4094	5071	6344	7696

- An example of the results report for the M100 storm (with 40%CC allowance) and 50l/s discharge rate is provided below (other reports are available on request):

HR Wallingford
Working with water

Surface water storage requirements for sites

www.uksuds.com | Storage estimation tool

Calculated by:	Kam Puvanakumar
Site name:	CAMBRIDGE WRC
Site location:	CAMBRIDGE

Site Details

Latitude:	52.22365° N
Longitude:	0.19137° E
Reference:	3927469992
Date:	Jul 20 2022 15:22

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the design of the drainage scheme.

Site characteristics

Total site area (ha):	20
Significant public open space (ha):	0
Area positively drained (ha):	20
Impermeable area (ha):	12.3
Percentage of drained area that is impermeable (%):	62
Impervious area drained via infiltration (ha):	0
Return period for infiltration system design (year):	10
Impervious area drained to rainwater harvesting (ha):	0
Return period for rainwater harvesting system (year):	10
Compliance factor for rainwater harvesting system (%):	66
Net site area for storage volume design (ha):	20
Net impermable area for storage volume design (ha):	12.53
Pervious area contribution to runoff (%):	30

* where rainwater harvesting or infiltration has been used for managing surface water runoff such that the effective impermeable area is less than 50% of the 'area positively drained', the 'net site area' and the estimates of Q_{BAR} and other flow rates will have been reduced accordingly.

Design criteria

Climate change allowance factor:	1.4
Urban creep allowance factor:	1.1
Volume control approach	Flow control to max of 2 l/s/ha or Qbar
Interception rainfall depth (mm):	5
Minimum flow rate (l/s):	50

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Calculate from dominant HOST

Soil characteristics	Default	Edited
HOST class:	--	
BFI HOST:	--	0.949
SPR HOST:	--	0.1

Hydrological characteristics	Default	Edited
Q_{MED}:	--	3.65
Q_{BAR} / Q_{MED} conversion factor:	--	1.124
Rainfall 100 yrs 6 hrs:	--	76.14
Rainfall 100 yrs 12 hrs:	--	85.64
FEH / FSR conversion factor:	1.18	1.11
SAAR (mm):	541	543
M5-60 Rainfall Depth (mm):	20	20
'r' Ratio M5-60/M5-2 day:	0.4	0.4
Hydrological region:	5	5
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 10 year:	1.65	1.65
Growth curve factor 30 year:	2.45	2.45
Growth curve factor 100 years:	3.56	3.56
Q_{BAR} for total site area (l/s):	4.05	4.11
Q_{BAR} for net site area (l/s):	4.05	4.11

Site discharge rates	Default	Edited
1 in 1 year (l/s):	50	50
1 in 30 years (l/s):	50	50
1 in 100 year (l/s):	50	50

Estimated storage volumes	Default	Edited
Attenuation storage 1/100 years (m^3):	12181	11347
Long term storage 1/100 years (m^3):	0	0
Total storage 1/100 years (m^3):	12181	11347

This report was produced using the storage estimation tool developed by HRWallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at http://uksuds.com/terms-and-conditions.htm. The outputs from this tool have been used to estimate storage volume requirements. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

8.4 Appendix C: Greenfield Runoff Calculation

8.4.1 The following greenfield runoff calculation was carried out using the Wallingford 'Greenfield Runoff Rate Estimation' tool (Ref. 7).

HR Wallingford
Working with water

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Joseph Carville
Site name:	CWWTPRP
Site location:	Land south of Low Fen Drove Way

Site Details

Latitude:	52.22615° N
Longitude:	0.19063° E
Reference:	1250504191
Date:	Jun 14 2022 14:04

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 20

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics	Default	Edited
SOIL type:	1	1
HOST class:	N/A	N/A
SPR/SPRHOST:	0.1	0.1

Hydrological characteristics	Default	Edited
SAAR (mm):	541	541
Hydrological region:	5	5
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	2.45	2.45
Growth curve factor 100 years:	3.56	3.56
Growth curve factor 200 years:	4.21	4.21

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	2.49	2.49
1 in 1 year (l/s):	2.16	2.16
1 in 30 years (l/s):	6.09	6.09
1 in 100 year (l/s):	8.85	8.85
1 in 200 years (l/s):	10.46	10.46

8.5 Appendix D: Details of the Swaffham IDB Drainage Area

8.5.1 The following Figure (from Swaffham District Map – Ely Group of Internal Drainage Boards (elydrainageboards.co.uk) provides details of the drainage arrangements within the Swaffham District.

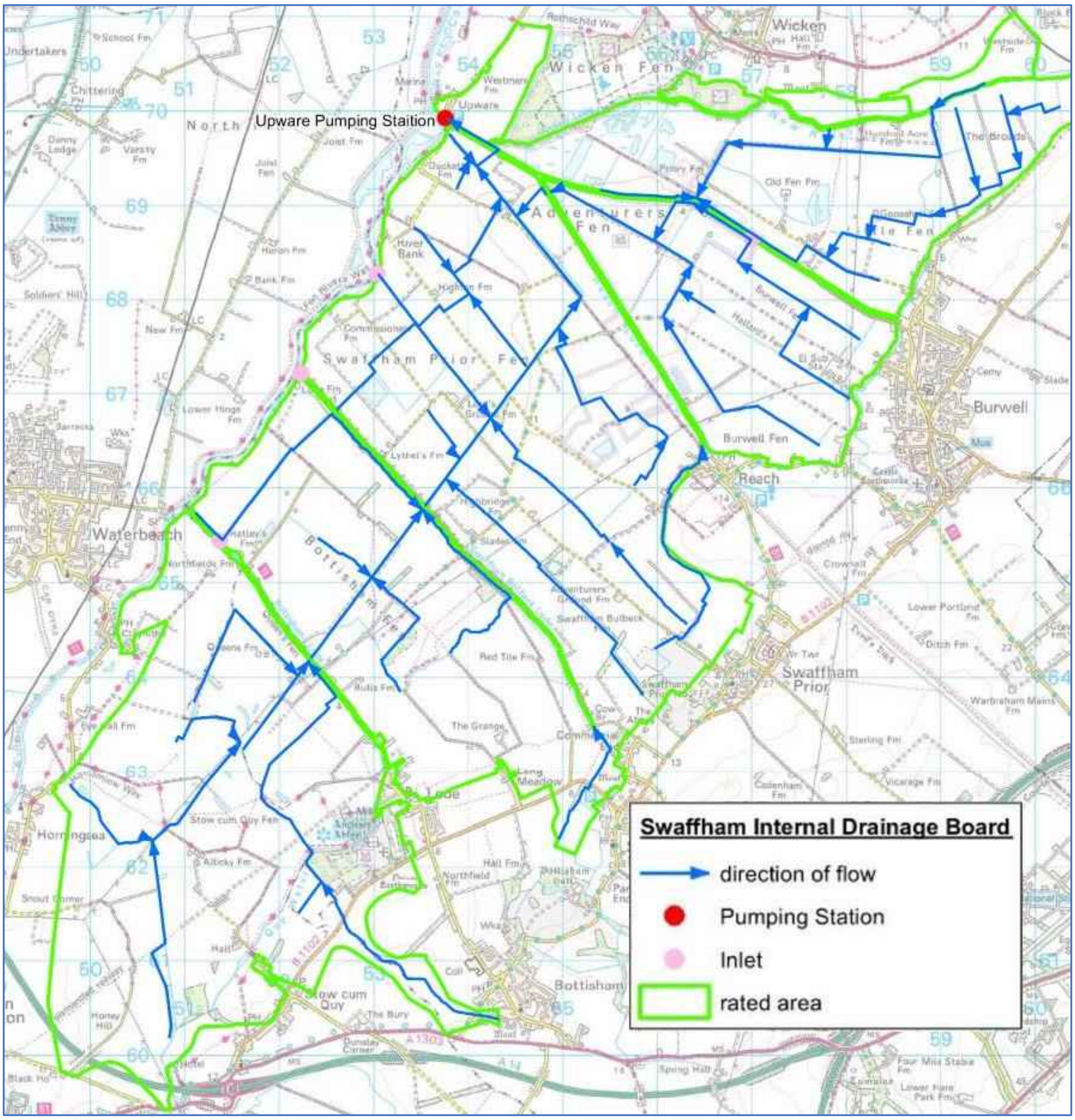


Figure 8.2: Swaffham IDB Catchment Details (Ref: Swaffham IDB – District Map)

8.6 Appendix E: Drawing with Strategic Drainage Details for the Proposed WWTP

8.6.1 The Drawing below provides conceptual details (representing completion of Outline Design) of the strategic drainage arrangements for the Proposed WWTP.

8.6.2 The drainage details shown in the drawing are summarized in Table 4.5 and include:

- Drainage facilities within the proposed WWTP site
  - Dedicated areas to temporarily accommodate shallow areas of standing water (during large storms)
  - Permeable surfaces (providing temporary capture within various surfaces including grass, gravel, permeable paving and French drains)
  - Drainage pipe network located adjacent to the roads (collecting drainage water and providing a link to the main attenuation facility located outside of the proposed WWTP earth banks)
- Drainage facilities located outside of the proposed WWTP earth banks
  - Dedicated attenuation facility (shallow normally dry and shallow storage pond) with a controlled outlet (to limit the outlet flow to match the agreed equivalent greenfield discharge rate)
  - External landscaping, including ridges and furrows (which assist to attenuate flows of surface water from the earth banks)

8.6.3 Further development of these details, following planning consent and during the detailed design phase, will be required.

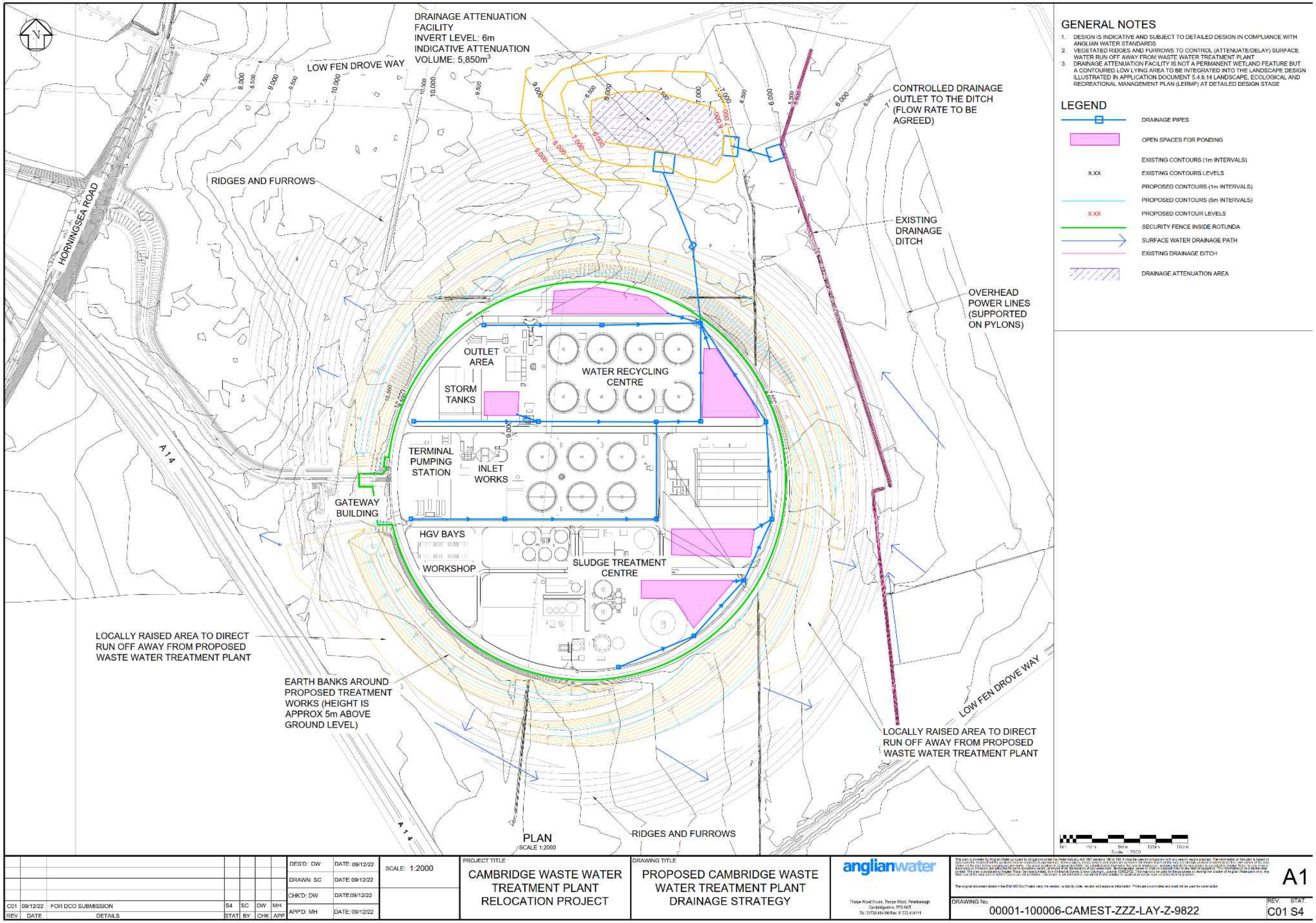


Figure 8.3: Strategic Drainage Plan for the Proposed WWTP Area

8.6.4 Extracts from the above drainage drawing are provided at a larger scale below, including:

- the Legend
- the drainage arrangement within the WWTP area
- the main attenuation facility

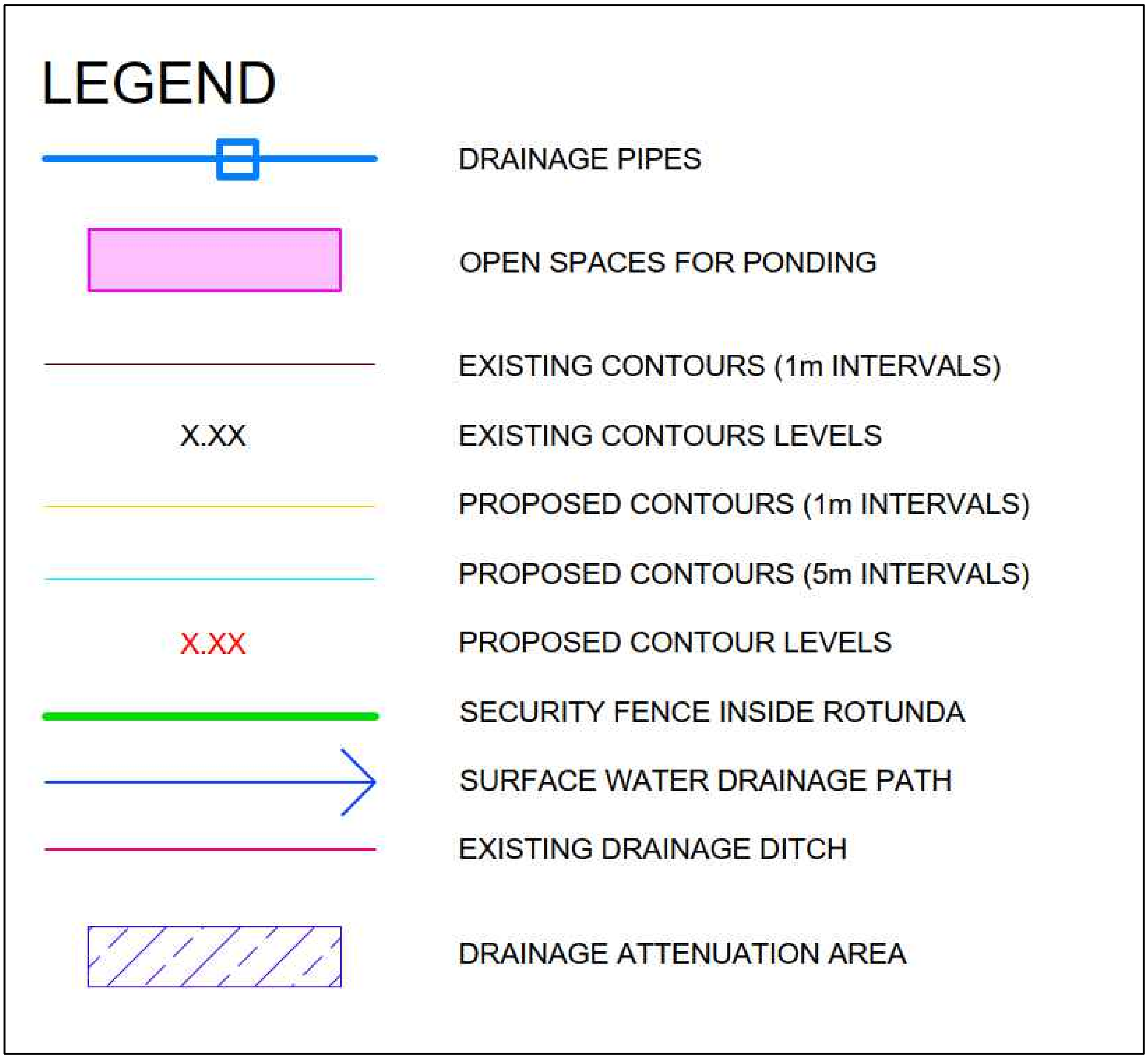


Figure 8.4: Legend (extract from Strategic Drainage Plan Drawing)

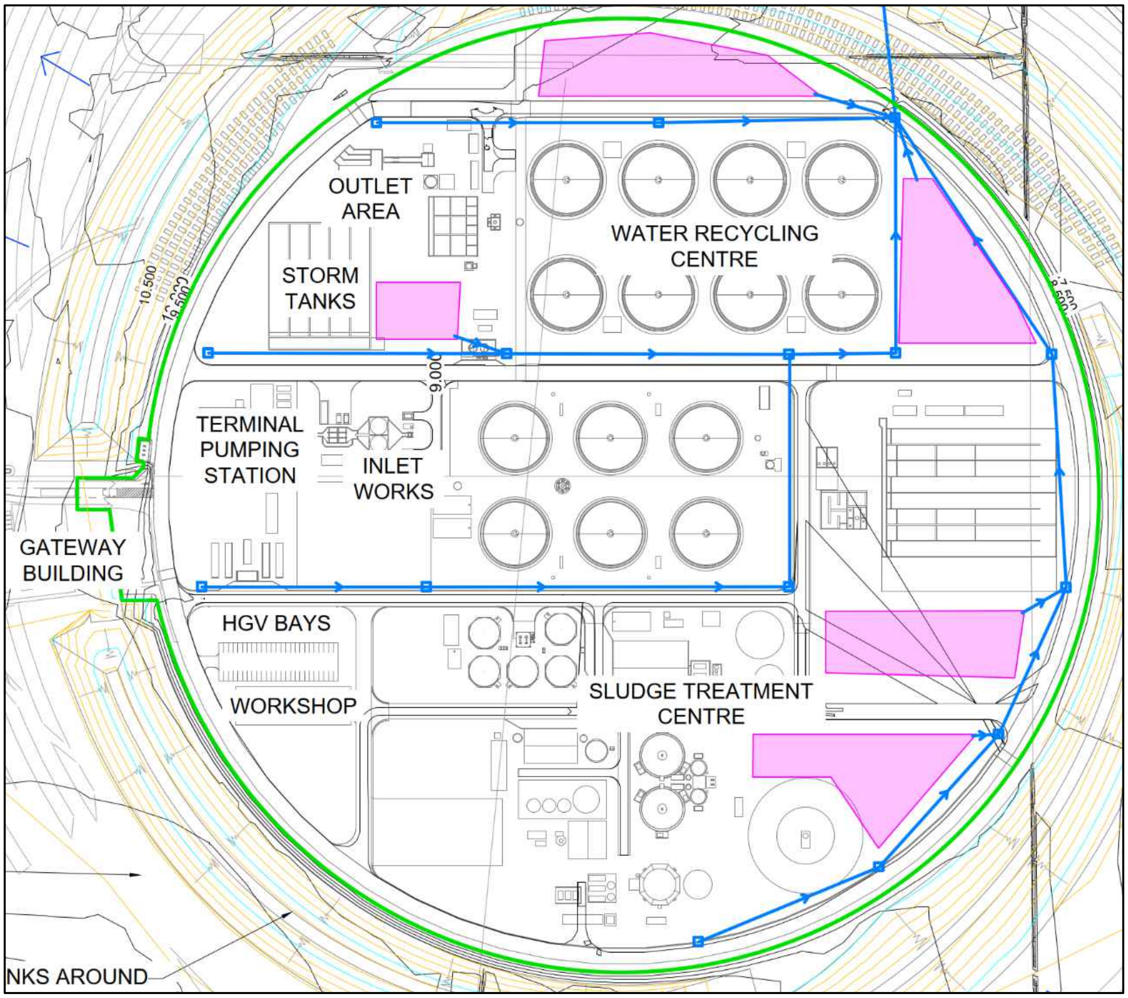


Figure 8.5: Proposed WWTP Drainage Details (extract from Strategic Drainage Plan Drawing)

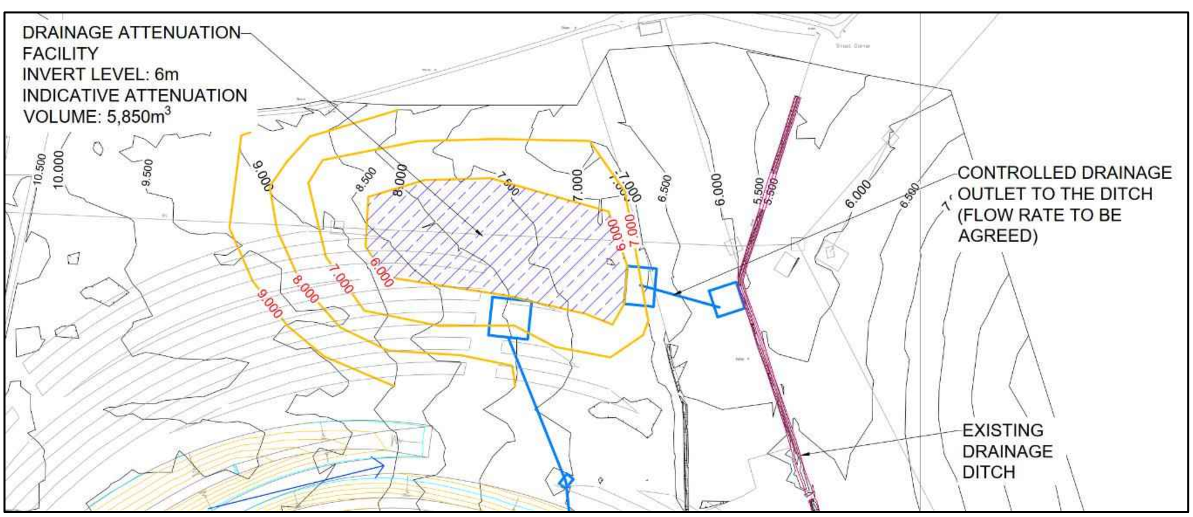


Figure 8.6: External Attenuation Facility (extract from Strategic Drainage Plan Drawing)

Get in touch

You can contact us by:

Emailing at **info@cwwtpr.com**

Calling our Freephone information line on **0808 196 1661**

Writing to us at **Freepost: CWWTPR**

Visiting our website at **www.cwwtpr.com**

You can view all our DCO application documents and updates on the application on The Planning Inspectorate website:

https://infrastructure.planninginspectorate.gov.uk/projects/eastern/cambridge-waste-water-treatment-plant-relocation/