OUTLINE DRAINAGE STRATEGY:7.2

DECARBONISATION

Cory Decarbonisation Project

PINS Reference: EN010128

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Revision ~~A~~B

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 – Regulations 5(2)(a)

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1. INTRODUCTION

1.1. SCOPE AND AIM OF STUDY

1.1.1. WSP has been instructed by Cory Environmental Holdings Limited (hereafter referred to as the Applicant) to prepare an **Outline Drainage Strategy (Document Reference 7.2)**, for the Cory Decarbonisation Project (hereafter, the 'Proposed Scheme').

1.1.2. This document presents the Outline Drainage Strategy for the operational phase, prepared to ensure that foul and surface water drainage have been considered at the early stage of design, that they will comply with national and local policies relevant to flood risk and drainage, and will inform spatial planning across the development.

1.1.3. This Outline Drainage Strategy also considers the disposal route for wastewater generated by the Carbon Capture Facility (associated with process operation) and welfare facilities.

1.1.4. The purpose of this Outline Drainage Strategy is to set out the principles, measures and outcomes for the drainage design of the Proposed Scheme. This Strategy has been prepared having regard to the permanent works proposed within the different Work Numbers set out on the Works Plans as described in Chapter 2 of the **Environmental Statement (ES) Volume 1 (Document Reference 6.1)**.

1.1.5. The principles, measures and outcomes set out in this Strategy will be taken forward as the design of the Proposed Scheme develops and will be used to inform the ~~full~~detailed drainage design for the detailed layout of the project within the Works Plans zones. This detailed drainage design will be presented in the ~~full~~detailed drainage strategy brought forward r which will be prepared for approval and implemented as approved, as secured by **DCO Requirement** (**Document Reference 3.1**).

1.1.6. The Outline Drainage Strategy drawings appended to this Strategy provide an illustration of one way in which the principles, measures and outcomes set out in this Strategy could be delivered, to demonstrate that this is a workable strategy. This Outline Drainage Strategy is based on the indicative site layout presented within the **Engineering Plans (Document Reference 2.5)**. This layout and the drawings are not secured as part of this outline strategy - they are just one example of how the principles, measures outcomes could be delivered in practice.

1.1.7. For the purpose of this Strategy the indicative layout has been used to demonstrate that it is possible that a surface water and foul drainage scheme can be implemented within the Site Boundary in compliance with the local, regional and national policies relevant to flood risk, drainage and pollution prevention.

1.1.8. **Chapter 11: Water Environment and Flood Risk** of the **ES** and the **Outline COCP (Document Reference 7.4)** present the measures that will be implemented for the construction phase drainage (temporary works), to ensure that there are no adverse

impacts (i.e. contaminated runoff) on the environment, including the Mitigation and Enhancement Area, in this phase.

1.1.9. A Flood Risk Assessment has also been undertaken for the Proposed Scheme, provided at **Appendix 11-2: Flood Risk Assessment (Volume 3)** of the **ES**.

1.2. SITE LOCATION

1.2.1. The Proposed Scheme will be located at Norman Road, Belvedere in the London Borough of Bexley (LBB) (National Grid Reference/NGR 549572, 180512). The following figures are available in the Environmental Statement (ES):

- **Figure 1-1: Site Boundary Location Plan (Volume 2) of the ES (Document Reference 6.2);** and
- **Figure 1-2: Satellite Imagery of the Site Boundary Plan (Volume 2) of the ES (Document Reference 6.2).**

1.2.2. The Satellite Imagery of the Site Boundary Plan outlined above has been reproduced in **Figure 1-1** below and is presented in larger format in **Appendix A**.

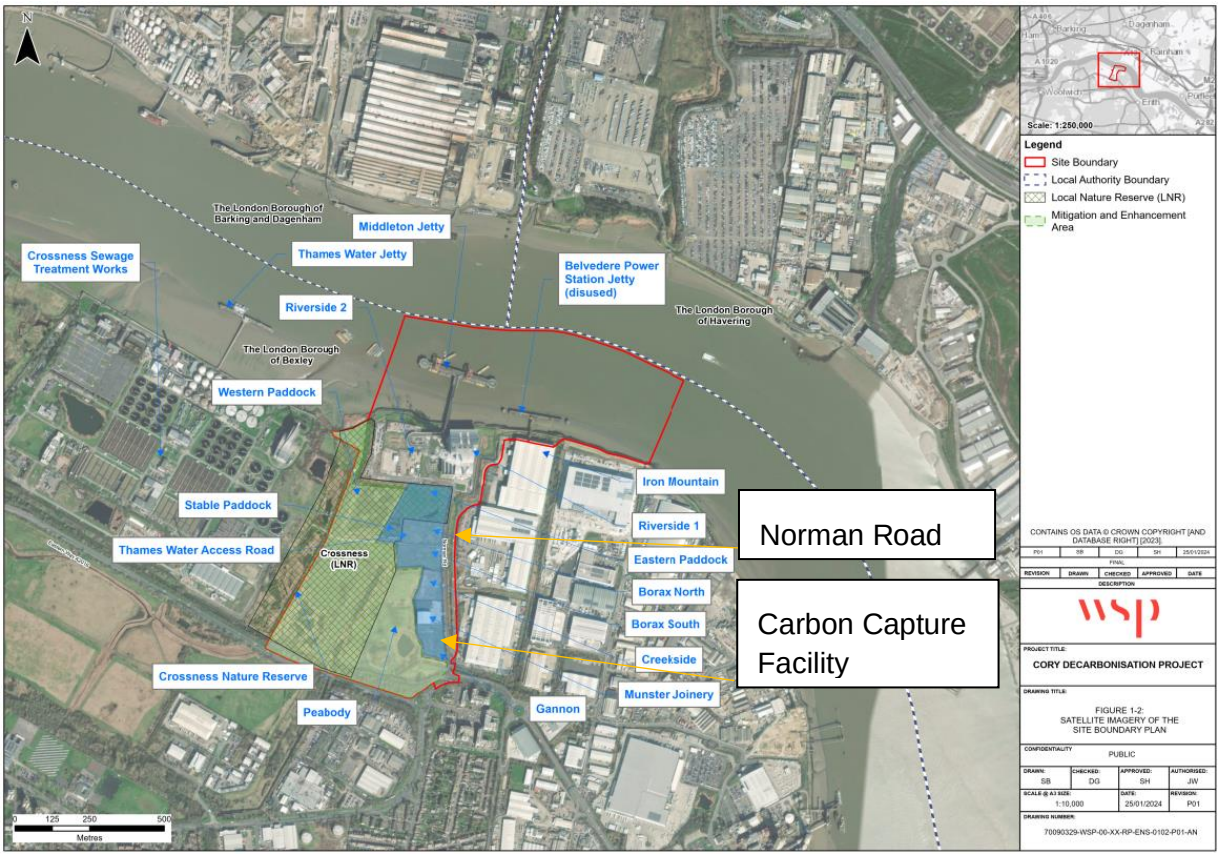


Figure 1-1: Satellite Imagery of the Site Boundary Plan

1.2.3. The Mitigation and Enhancement Area, shown in solid green in **Figure 1-1**, will not be built upon as part of the Proposed Scheme. with improvements to be made to it pursuant to the **Outline Landscape, Biodiversity, Access and Recreation Delivery Strategy** ("LaBARDS").

1.2.4. The Carbon Capture Facility (shown in blue in **Figure 1-1**, the new built form which is subject to this Outline Drainage Strategy), is located to the east of the Mitigation and Enhancement Area, and immediately south of Riverside 1 and Riverside 2, to the west of Norman Road.

1.2.5. The drainage networks for Riverside 1 and Riverside 2 have either already been constructed or designed and are therefore not considered within this Outline Drainage Strategy (as the networks are not connected). No drainage considerations are necessary for the Proposed Jetty.

1.3. PROPOSED SCHEME

1.3.1. The Applicant intends to construct and operate the Proposed Scheme to be linked with the River Thames. It comprises of the following key components, which are shown on the **Works Plans (Document Reference 2.3)** and described below. Further detail is provided within **Chapter 2: Site and Proposed Scheme Description (Volume 1)** of the **ES (Document Reference 6.1)**.

- The Carbon Capture Facility (including its associated Supporting Plant and Ancillary Infrastructure): the construction of infrastructure to capture a minimum of 95% of carbon dioxide (CO2) emissions from Riverside 1 and 95% of CO2 emissions from Riverside 2 once operational, which is equivalent to approximately 1.3Mt CO2 per year. The Carbon Capture Facility will be one of the largest carbon capture projects in the UK.
- The Proposed Jetty: a new and dedicated export structure within the River Thames as required to export the CO2 captured as part of the Carbon Capture Facility.
- The Mitigation and Enhancement Area: land identified as part of the outline **Landscape, Biodiversity, Access and Recreation Delivery Strategy (Document Reference 7.9)** to provide improved access to open land, habitat mitigation, compensation and enhancement (including forming part of the drainage system and Biodiversity Net Gain delivery proposed for the Proposed Scheme) and planting. The Mitigation and Enhancement Area provides the opportunity to improve access to outdoor space and to extend the area managed as the Crossness Local Nature Reserve (LNR).
- Temporary Construction Compounds: areas to be used during the construction phases for activities including, but not limited to office space, warehouses, workshops, open air storage and car parking, as shown on the **Works Plans (Document Reference 2.3)**. These include the core Temporary Construction Compound, the western Temporary Construction Compound and the Proposed Jetty Temporary Construction Compound.
- Utilities Connections and Site Access Works: The undergrounding of utilities required for the Proposed Scheme in Norman Road and the creation of new, or the improvement of existing, access points to the Carbon Capture Facility from Norman Road.

1.3.2. Together, the Carbon Capture Facility, the Proposed Jetty, the Mitigation and Enhancement Area, the Temporary Construction Compounds and the Utilities Connections and Site Access Works are referred to as the ‘Proposed Scheme’. The land upon which the Proposed Scheme is to be located is referred to as the 'Site’ and the edge of this land referred to as the ‘Site Boundary’. The Site Boundary represents the Order Limits for the Proposed Scheme as shown on the **Works Plans (Document Reference 2.3)**.

2. SITE INFORMATION

2.1. SITE TOPOGRAPHY

2.1.1. A topographic survey[1] provided by the Applicant has been reviewed as part of this report and can be found in **Appendix B.**

2.1.2. During the survey, information was recorded on the location and type of land features observed including type of surface finishes, land boundary, access routes and vegetation. All surveyed elevations were recorded in meters Above Ordnance Datum (mAOD). Ground levels and spot levels (e.g. within the ditches/watercourses) are also indicated on the drawing where they were recorded onsite. These levels have been used in this Outline Drainage Strategy to outline the invert levels of the proposed surface water networks.

2.1.3. Ground levels across the Carbon Capture Facility are summarised below:

- 0.43 to 0.93mAOD across Eastern Paddock and Stable Paddock in the north of the Site, falling towards Norman Road to the east;
- 0.40 to 1.70mAOD across the existing compounds within Borax North and Borax South, falling away from Norman Road;
- 0.79 to 1.50mAOD along Thames Water Access Road crossing, falling away from Norman Road;
- 0.55 to 1.28mAOD across Creekside land in the centre of the Site, falling away from Norman Road; and
- 0.5 to 1.48mAOD across Gannon land in the south, falling away from Norman Road.

2.2. HYDROLOGY

2.2.1. The hydrology on the Proposed Scheme comprises a network of statutory Main Rivers, ditches and interconnected watercourses. The following main rivers are referenced in this Outline Drainage Strategy:

- River Thames located north of the Proposed Site boundary;
- Norman Road Stream which flows adjacent to Norman Road and is hydrologically connected to Belvedere Stream, which flows east into an ordinary watercourse in Lower Belvedere; and
- Great Breach Dyke West is hydrologically connected to the wider Crossness Nature Reserve watercourse network via a connecting under the A2016 Eastern Way and is connected to Great Breach Lagoon and Norman Road River, as described below.

2.2.2. The full list and description of the watercourses associated with the Site Boundary is included in Chapter 11: Water Environment and Flood Risk of the **ES (Document Reference 6.1).**

2.2.3. The topographical survey, as referenced above also indicates that Norman Road Stream is culverted within the Carbon Capture Facility before crossing beneath Norman Road.

2.2.4. **Figure 2-1** below shows the interconnectivity of the main rivers and ordinary watercourses within the Site Boundary, including the Carbon Capture Facility, along with the layouts of ponds nearby. The full version is presented in **Appendix B.**

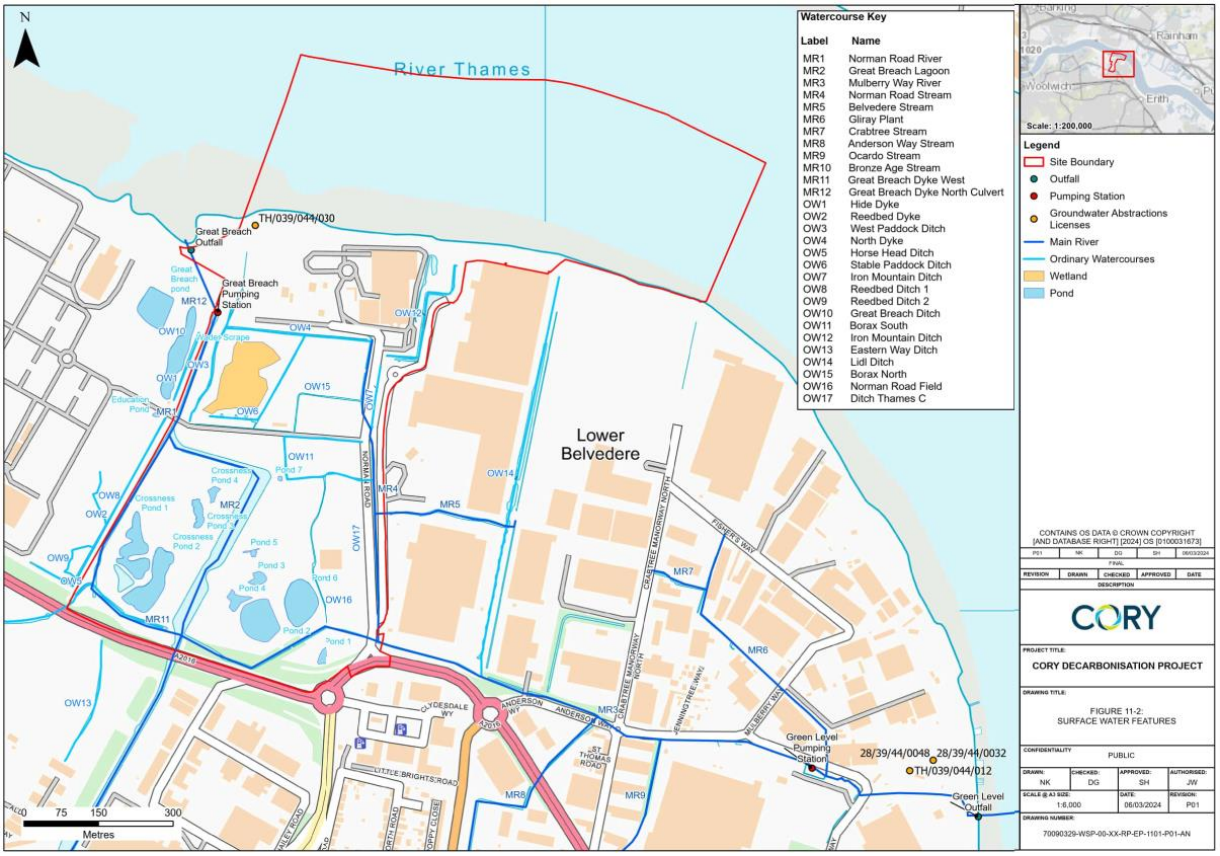


Figure 2-1: Surface Water Features

2.3. EXISTING SURFACE WATER DISPOSAL REGIME

2.3.1. The location of the Carbon Capture Facility, the focus of this Outline Drainage Strategy, comprises relatively flat land to the immediate south of Riverside 1 and Riverside 2. Most of this land is currently being used as construction compounds for Riverside 2 or for other industrial/commercial development, with undeveloped grassland occupying the northern and southern area.

2.3.2. These areas either positively or naturally drain surface water runoff via overland flows/pipes towards a number of interconnecting watercourses, including ditches, leading to the water bodies within, and adjacent to the Site, as dictated by topography (see photographs 2.1 and 2.2 below). These features ultimately flow towards the existing Environment Agency operated surface water pumping stations (Great Breach Pumping Station located in the northwest of the Site Boundary and the Green Level Pumping Station located approximately 1km to the southeast of the Site Boundary).

2.3.3. Discharge rates at the gravity outfalls within the Carbon Capture Facility site are likely to be dictated by the pipe size and gradient, as no formal attenuation (in addition to the gravel sub-base to the compound and the internal ditches) has been observed on Site.

Photograph 2.1: An existing outfall from the compound into a ditch on the western and southern side of Borax North.

Photograph 2.2: An existing outfall from the compound into a ditch to the west of Borax South land.

2.3.4. **Figure 2-2** below shows the pre-existing drainage catchments for the Carbon Capture Facility, which mainly drain towards west and east. The full version of this plan is available in **Appendix B**.

Figure 2-2: Existing Drainage Catchment

2.4. GEOLOGY

2.4.1. BGS Geology Mapping[2] indicates that superficial deposit composition is consistent across the entire site of the Carbon Capture Facility. The superficial deposits are Alluvium which comprises a composition of clay, silt, sand and gravel. The bedrock geology comprises two different formations: London Clay Formation to the north and Lambeth Group south of this.

2.4.2. In addition, there are multiple borehole records available at the BGS GeoIndex Onshore online source[3]. The borehole records range in depth across the whole Site reaching up to 30m+ in depth, with some also having unknown depths. **Table 2-1**

gives an overview of some of the borehole records across the Carbon Capture Facility and an indication of the underlying ground conditions.

Table 2-1: Summary of borehole records

Borehole record	Location	Description
TQ48SE37	Within the northern part of the Carbon Capture Facility (across the Eastern Paddock land) E: 549570, N: 180460	Borehole dug to a depth of 9.45m. Dark brown silty clay topsoil over soft brown peat to 2.90m bgl, soft grey organic silty clay to 6.55m bgl, firm grey sandy clay to 7.67m bgl and fine to coarse gravel to 9.45m bgl. No water level recorded.
TQ47NE123	Within the southern part of the Carbon Capture Facility (across the Gannock land). E: 549620, N: 179980	Borehole dug to a depth of 1.82m. Dark brown friable clayey topsoil over soft and firm brown silty clay to 1.8m bgl[a], and brown, slightly clayey peat to 3.8m bgl. Water was encountered at approximately 1m bgl and remained at this level.

2.4.3. A number of ground investigations (GIs) were undertaken within the Site Boundary, including the proposed Carbon Capture Facility.

2.4.4. **Chapter 17.6: Ground Conditions and Soils (Volume 1)** of the **ES (Document Reference 6.1)** and the **Preliminary Risk Assessment (Appendix 17-1 to the ES)** comprise a thorough assessment of the ground conditions present within the Site Boundary. This assessment considers both published information and the findings of previous GIs.

2.4.5. The above make references to the 2017 WSP Ground Investigation Report[4] and 2021 Doran Consulting Geotechnical Interpretative Report & Contaminated Land Report[5] GI, which have been considered most appropriate in the **ES** to inform the baseline and are further complemented by freely available online data sources[2, 3, 4] where gaps in site specific baseline data exist.

2.4.6. **Chapter 17.6** also makes reference to the in situ permeability tests, namely variable head tests completed within two borehole locations (BH02 and BH10) which recorded an average permeability rating of 2.2x 10^{-4}m/s within the Alluvium Deposits and

[a] m bgl – meter below ground level

1.99x10^{-5}m/s within the Taplow Gravel Member. Both testing locations were located within Riverside 2 (across the area identified on the **Works Plan** as 2A and 2B). These locations are outside of the Carbon Capture Facility area and undertaken within more coarse soils hence indicating better permeability potential. Given their location, these results are not relevant to the built-up area of the Carbon Capture Facility where more cohesive silty clay soils were recorded and observed during various ground investigations. Further discussion on the observed geology and its impact on infiltration potential for surface water disposal is included in **Section 4.2**.

HYDROGEOLOGY

2.4.7. The Site lies within a Secondary A designated bedrock aquifer zone and a Secondary (Undifferentiated) superficial drift aquifer zone[6]. Aquifer designation is a classification regarding the properties of permeable rocks below ground from which groundwater can be extracted. The aquifer classification in this area indicates that in addition to the site being located in an area regarded as valuable in terms of a drinking water resource, the area also plays a role in supporting the flow of groundwater.

2.4.8. **Chapter 17.6: Ground Conditions and Soils (Volume 1)** of the **ES (Document Reference 6.1)** and the **Preliminary Risk Assessment (Appendix 17-1 to the ES)** comprise a thorough assessment of the hydrogeology characteristics present within the Site Boundary. This assessment considers both published information and the findings of previous GIs.

2.4.9. The groundwater levels were noted to be variable across the Site Boundary for the superficial deposits. The average depth to groundwater level from the GI is 1.4m bgl for the entire Site, including the Carbon Capture Facility.

2.5. PROPOSED SITE LEVELS

2.5.1. The levels across the Carbon Capture Facility are proposed to be raised as informed by the breach analysis within the **Flood Risk Assessment (Appendix 11-2: Flood Risk Assessment (Volume 3) to ES (Document Reference 6.1))** undertaken for the Site. This Outline Drainage Strategy has been prepared based on the levels set out in the Flood Risk Assessment.

3. CONSULTATION AND ENGAGEMENT

3.1.1. The Environment Agency (EA) and London Borough of Bexley (LBB), in its role as the LLFA were consulted as part of this study to obtain historic flood records along with any flood risk and drainage information pertinent to the proposed development of the site and to consult on the proposed drainage strategy and design principles. Thames Water Utilities Limited (TWUL) was also consulted in regard to the proposed wastewater disposal scheme.

3.1.2. A summary of these findings is presented below, whereas the full consultation responses are contained within **Appendix C**. Details from their responses have been thereafter used, where relevant, within this report.

3.2. LEAD LOCAL FLOOD AUTHORITY

3.2.1. Pre-application advice was sought from LBB in July-September 2023. Through this engagement, the LLFA has confirmed the following:

- It holds no recorded flood incidents in the vicinity of the Site.
- It holds no details of any flood assets in the area, nor modelling or flood studies for the area.
- It is unable to advise on the ownership of and the required easement from the local watercourse network.
- All ordinary watercourses are under the riparian responsibility.
- It holds no records of the Critical Drainage Areas at the Site and surrounding vicinity.
- It would expect the Bexley SuDS Design guidance and the SuDS Manual C753~~**Error! Bookmark not defined.**~~[10] to be followed, including that above ground SuDS should be maximised where possible.
- It would expect the drainage hierarchy to be followed, whilst accepting that infiltration is discounted and a connection into a water body is proposed.
- It would expect the drainage design to cater for 1 in 100year plus 40% climate change event.
- It would expect the watercourse network up to the River Thames to be explored, and requires a river condition assessment to be undertaken for the Proposed Scheme.
- It accepted, in principle, the approach presented in the preliminary drainage proposals for the Site (discharge limited to greenfield Qbar runoff rate of 3.61l/s and attenuation provided across the CCF).

3.2.2. Additionally, a meeting was held on 28 September 2023 to discuss the required easements from the onsite water network, proposed alterations to the onsite water

network and lower climate change allowances, given the type of proposed development and its expected design lifespan of approximately 50 years.

3.2.3. A note of this meeting is presented in **Appendix C**. Discussions with the LLFA remain on-going and an update will be provided in the relevant Statement of Common Ground during the examination. This includes the following:

- proposed alterations to the ditches (as discussed in **4.7.5** and presented in **Figure 4-5**).
- required easement / access for maintenance (as discussed in **4.7.5** and presented in **Figure 4-5**).
- clarification on the required climate change allowances (whether lower climate change allowance of 25% can be used instead of the currently prescribed 40% by the LLFA).
- details of the implementation of variable flow controls to enhance wetland creation across the Mitigation and Enhancement Area.

Therefore, where the above discussions with the LLFA are ongoing, certain conservative assumptions have been made for the purposes of preparing this Outline Drainage Strategy. These are described further in **Section 4**.

Environment Agency

3.2.4. Engagement was also undertaken with the EA on the proposed approach to the surface water drainage strategy and particularly on the proposed connection into the main river, namely Norman Road Stream, and easement required. This is ongoing at the time of writing and an update will be provided in the relevant Statement of Common Ground during the examination.

Thames Water Utilities Limited

3.2.5. Pre-planning advice was sought from TWUL regarding the location and capacity of the local sewer network. Discussion is in progress to understand the capacity of the foul sewer network and whether a connection into an existing 375mm foul sewer in Norman Road will be feasible. An update will be provided in the relevant Statement of Common Ground during the examination.

3.2.6. In this drainage strategy, an assumption has been made that a connection into the above foul sewer will be possible to dispose of any foul water from the onsite admin blocks (control room, welfare facilities and gatehouse).

3.2.7. Assumptions on process waters are to discharge surplus process water to the sewer. Alternatively, if this solution is not considered feasible due to a lack of capacity of the local foul sewer network, a Zero Liquid Discharge solution will be investigated at the detailed design stage. This option consists of concentrating contaminants to a solid waste, whilst allowing for the release of a source of water supply for the Carbon Capture Facility (and thereby reducing the need for make-up water).

3.2.8. Thames Water have requested a potable water tank to be provided to minimise impact of the Carbon Capture Facility's water demand during the time the Thames Water's water supply network is experiencing peak demand. The final location, configuration and size of such storage will be determined at the detailed design stage but an indicative location is shown as being on the Gannon parcel.

4. OUTLINE SURFACE WATER DRAINAGE STRATEGY

4.1. DESIGN PARAMETERS AND CLIMATE CHANGE

4.1.1. Although the site drainage is unlikely to be proposed for adoption by the statutory water authority (Thames Water), as a best practice, the drainage network for the Proposed Scheme is proposed to adhere to the criteria as set out in the Sewerage Sector Guidance document; SSG Appendix C – Design and Construction Guidance v2.1[7].

4.1.2. The Proposed Scheme will also comply with DEFRA's Non-statutory technical standards for Sustainable drainage systems Section S4[8]:

"Runoff volume from the development in the 1 in 100-year, 6 hours rainfall event should not exceed the greenfield/brownfield runoff volume for the same event".

4.1.3. The Outline Drainage Strategy and the future, detailed drainage design will also be designed to comply with LBB Council's Sustainable Drainage Systems (SuDS) Design & Evaluation Guide[9] and CIRIA C753: The SuDS Manual[10].

4.1.4. To manage risks associated with the long-term impacts of climate change, the peak rainfall intensity used in the design for 1 in 30 year, and 1 in 100 year rainfall events have been increased by climate change allowances in accordance with the current Environment Agency's peak rainfall intensity climate change allowances (May 2022)[11].

~~4.1.5. In determining~~The Planning Practice[12] states that for non-residential uses, the ~~specific~~ lifetime of the development shall be considered to be 75 years. On this basis and in accordance with the climate change allowances ~~to be used,~~specified for the London Management Catchment (within which the Site falls) ~~requires the central level (anticipated climate change growth based on a number of analytical certainty calculations carried out within the national climate change predictions – UKCP19) of 25% to be added - for the expected design lifetime of approximately 50 years.~~

~~4.1.6.~~4.1.5. ~~Although the above criteria suggests that lower values may be used, this Outline Drainage Strategy considers a more conservative 40% a~~ climate change allowance~~, as requested by the LLFA, unless otherwise stated in the relevant Statement of Common Ground during the examination~~ of 40% has been used in the drainage calculations.

~~4.1.7.~~4.1.6. The detailed drainage strategy will be developed alongside the development of flood compensation areas pursuant to the **Flood Risk Assessment (Appendix 11-2: Flood Risk Assessment (Volume 3) to ES (Document Reference 6.1))**, to ensure that the proposed surface water drainage system is not affected by fluvial flooding and that it is designed to work independently from the fluvial flood compensation storage areas that are developed.

4.2. SURFACE WATER DISPOSAL

4.2.1. This Outline Drainage Strategy has been prepared to demonstrate the proposed Carbon Capture Facility can be drained in a sustainable manner, commensurate with local and national policy.

4.2.2. The drainage strategy considered for the Proposed Scheme effectively deals with surface water within the proposed Carbon Storage Facility based on requirements set out in local and national policy. However, it is also recognised that surface water from the area of the Carbon Capture Facility provides a resource that can be used for the Mitigation and Enhancement Area to provide wider benefits to the environment, and/or for rainwater harvesting for onsite reuse as part of the cooling water provision.

4.2.3. The general principle for surface water disposal uses the drainage hierarchy as described in the National Planning ~~Practice~~Policy Guidance: Flood Risk and Coastal Change[13], the SuDS Manual[10], and Building Regulations Document H: Drainage and Waste Disposal Guidance[14]. This hierarchy stipulates that surface water runoff not collected for reuse must be discharged to one or more of the following, in order of priority:

- into ground (via infiltration); or, where not reasonably practicable;
- to a surface water body (watercourse / body); or, where not reasonably practicable;
- to a surface water sewer, highway drain, or another drainage system; or, where not reasonably practicable; and
- to a combined sewer.

4.2.4. As part of this Outline Drainage Strategy, rainwater harvesting has been considered to supplement the water supply to cooling towers located in the central part of the proposed Carbon Storage Facility. Subject to detailed design, clean water from the attenuation tanks may be pumped into a central collection tank located underneath the cooling towers which can then be used in the cooling towers as part of the hybrid cooling system. The water supply derived from the proposed rainwater harvesting system should be considered as an additional benefit in supplementing the water supply for these cooling processes. However, it would not be solely relied upon, as the capacity and volume of water that can be accommodated within the attenuation tanks are subject to detailed design considerations. It should be also noted that the final cooling method used in the cooling processes have not been decided and is subject to further discussions and final design. As such, the final Drainage Strategy will set out to what extent rainwater harvesting has been able to be accounted for within the final drainage design.

4.2.5. Best practice for drainage designs on new developments prioritises SuDS solutions. SuDS aim to reduce the risk of flooding by imitating natural drainage and managing surface water runoff in a more sustainable way. The four pillars of SuDS refer to the

benefits that can be provided using sustainable design, as shown below in **Figure 4-1**.

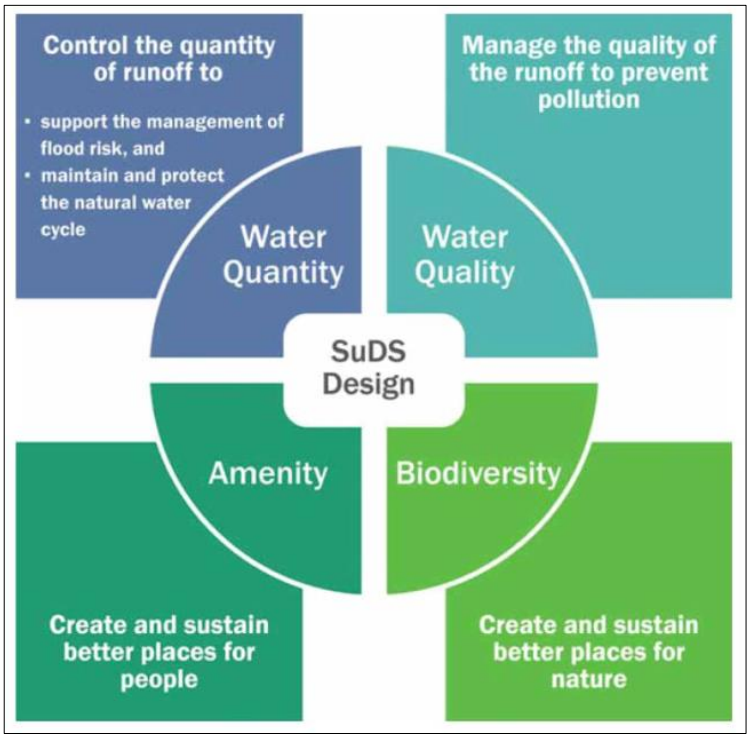


Figure 4-1: Overview of the Four Pillars of SuDS (From the SuDS Manual)[10]

4.2.6. The four pillars of SuDS: Water Quantity, Water Quality, Amenity, and Biodiversity will be used to ascertain the most effective drainage design.

DISCHARGE INTO GROUND VIA INFILTRATION

4.2.7. The levels across the Site are proposed to be raised in respect to the flood level associated with a breach of the River Thames flood defences. The area of the Carbon Capture Facility will be raised on a platform with substantial infill above natural strata. The material for site raising will require compaction and consolidation and will consequently be unlikely to provide suitable infiltration potential.

4.2.8. The Site has been considered unsuitable for the implementation of infiltration-based SuDS based on the following:

- because of the underlying geology;
- the low infiltration potential resulting from the cohesive soil associated with the underlying Alluvium superficial deposits;
- the presence of shallow groundwater levels; and
- potential presence of contamination.

4.2.9. On the basis of the above information, the use of infiltration methods for surface water drainage have been discounted.

DISCHARGE TO A WATER BODY

4.2.10. For this Site, following the surface water disposal hierarchy it is recommended that runoff (where not used on site) should be discharged to a surface water body. Therefore, discharges into the local boundary ditches is proposed. Multiple connections are being considered due to the Site being relatively level and to facilitate a gravity connection into those shallow ditches.

DISCHARGE TO A HIGHWAY DRAINAGE

4.2.11. A highway surface water drain runs adjacent to Norman Road, which will be modified to accommodate the change in levels and the need for access, ultimately leading to discharge into a new watercourse in the south of the Carbon Capture Facility and further into the Mitigation and Enhancement Area. The highway is drained via kerb drains on both sides.

4.2.12. Any proposed roads falling towards Norman Road and ultimately towards this highway drain is proposed to be drained into that asset as part of this Outline Drainage Strategy.

4.2.13. Any future diversions to the Thames Water access road, if necessary, may also require facilitating its drainage into the highway drainage along Norman Road.

DISCHARGE TO A SEWER

4.2.14. No surface water discharge into any public sewer, either a surface water or a combined sewer is being considered as part of this strategy.

4.3. GREENFIELD RUNOFF RATES

4.3.1. In general, this Outline Drainage Strategy, proposes that surface water discharges from the Carbon Capture Facility will be limited to pre-development greenfield runoff rates in accordance with DEFRA's Non-Statutory Technical Standards (NSTS) for Sustainable Drainage Systems[8]. As described in 4.2.10, the surface water discharge is proposed within the boundary ditches on site.

4.3.2. The greenfield runoff rate will be achieved through use of the mean annual flood (QBAR) approach. The QBAR rate has been estimated for the Site (Carbon Capture Facility) based on a per hectare basis using the Institute of Hydrology IH124 methodology[15]. The estimated Q_{BAR} runoff rate is 3.71 l/s/ha, as per the guidance provided by the LLFA.

4.3.3. The estimation method is based on calculations being carried out from the standard percentage runoff coefficient (SPR) and the standard average annual rainfall (SAAR), with the SPR estimation method being based on the soil types. The calculated greenfield runoff values are shown in **Table 4-1** below and are presented in **Appendix E**.

Table 4-1: Calculated greenfield runoff rates.

Return period	Runoff rate (l/s/ha)
Q_{BAR}	3.71
1 in 1-year (100% AEP)	3.15
1 in 30-years (3.33% AEP)	8.53
1 in 100-years (1% AEP)	11.84
1 in 200-years (0.5% AEP)	13.88

4.3.4. The overall strategy involves diverting the majority of surface water originating from the Carbon Capture Facility to the area east of the Great Breach Dyke in the Mitigation and Enhancement Area, as indicated in **Figure 1-1**, by discharging it at the existing Q_{BAR} greenfield runoff, equal to 3.71l/s/ha. Discharging at the Q_{BAR} greenfield runoff rate will contribute to the wetland areas and help fulfil the objectives of the Mitigation and Enhancement Area.

4.4. CATCHMENT CHARACTERISTICS

4.4.1. The proposed strategy is to split the Carbon Capture Facility area into three main drainage catchments, namely North, Central, and South, as indicated in **Figure 4-2** below.

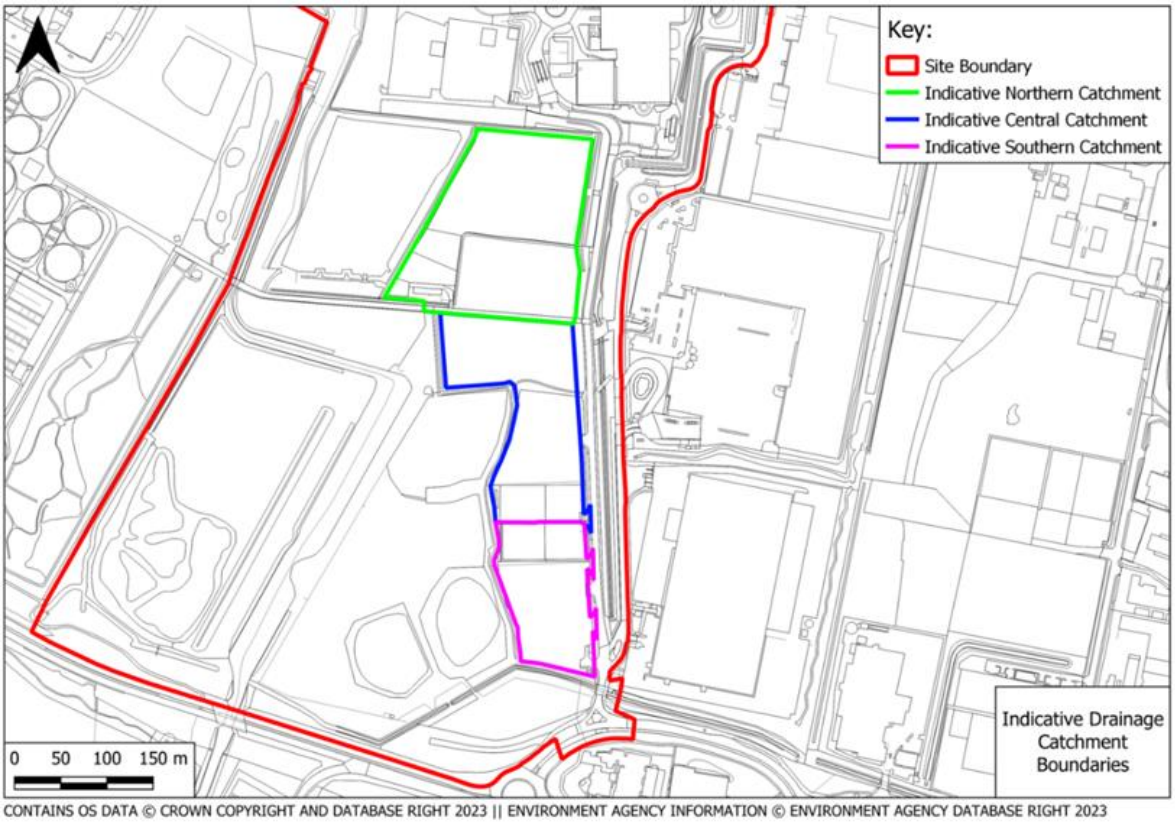


Figure 4-2: Indicative Drainage Catchment Boundaries

4.4.2. Each of the main catchments consist of sub catchments which will drain the surface water via new individual outfalls, mainly into the ditch network to the west. Any internal roads, with gradients towards Norman Road, will drain east via new separate outfalls, one into Norman Road Stream and others into the existing highway drain, both running along Norman Road.

4.4.3. The multiple outfall locations designated for the Carbon Capture Facility will ensure that the appropriate gradients and velocities are achieved within the proposed surface water drainage network. The Outline Drainage Strategy drawings (showing this working in practice with an example layout based on the Indicative Equipment Layout Drawing) are included in **Appendix F**.

4.4.4. It has been assumed that most areas within the Carbon Capture Plant(s) and Supporting Plant work zone as detailed in the **Works Plans (Document Reference 2.3)** included within **Chapter 2: Site and Proposed Scheme Description (Volume 1)** of the **ES (Document Reference 6.1)**, will be constructed on sub-base gravel platforms layered with a permeable geotextile. Whilst the ground beneath may be compacted and unsuitable for infiltration, the presence of coarse strata with significant voids is anticipated to facilitate permeability, allowing for the interception of rainfall and the mitigation of runoff. However, it has been assumed that the Carbon Capture Plant and Supporting Plant equipment itself will be placed on impermeable concrete slabs. For calculation purposes, it has therefore been assumed that this area (referred to as “Compound” in **Table 4-2**) will have an overall impermeability rating of 50%.

4.4.5. Any buildings and hard-surfaced roads have been assumed to be 100% impermeable.

4.4.6. Any car parking (e.g. grass crate) and landscaped areas within the Carbon Capture Facility have been assumed to be fully permeable for the purpose of this Outline Drainage Strategy.

4.4.7. Any areas designated as space for attenuation basins has been assumed to be impermeable, following best industry practice.

4.4.8. A detailed drainage strategy will outline the construction design for external areas to justify the assumptions above.

4.4.9. The contribution of the impermeable areas to each catchment and designated sub-catchment is presented in **Table 4-2** below. The Outline Drainage Strategy drawings are presented in **Appendix F.**

~~4.4.8.~~

Table 4-2: Summary of the proposed drainage catchments and sub-catchments

Catchment Ref	Sub-Catchment Ref	Land Use	Total Area [Ha]	% Imp	Total Imp Area [Ha]
Northern Catchment	N1	Compound*	0.30	50	0.15
	RN1	Road	0.11	100	0.11
	N2	Compound*	1.12	50	0.56
	RN2	Road	0.04	100	0.04
	N3	Compound*+Basin	0.59	N/A	0.32
	RN3	Road	0.09	100	0.09
	N4	Compound*	0.51	50	0.25
	RN4	Road	0.24	100	0.24
	RN5	Road	0.04	100	0.04
Total	-	-	**3.04**	-	**1.80**
Central Catchment	C1	CO2 Storage	0.47	50	0.23
	RC1	Road	0.09	100	0.09
	C2	Compound*	0.33	50	0.17
	RC2	Road	0.05	100	0.05
	C3	Cooling Towers**	0.29	N/A	0
	RC3	Road	0.10	100	0.10
	C4	Sub-Station	0.35	N/A	0.15

Catchment Ref	Sub-Catchment Ref	Land Use	Total Area [Ha]	% Imp	Total Imp Area [Ha]
	RC4	Road	0.06	100	0.06
	RC5	Road	0.04	100	0.04
Total	-	-	**1.78**	**-**	**0.89**
Southern Catchment	S1	Buildings	0.12	100	0.12
	RS1	Road	0.06	100	0.06
	S2	Buildings	0.08	100	0.08
	S3	Building+Basin	0.22	100	0.22
	RS3	Road	0.08	100	0.08
	RS4	Road	0.05	100	0.05
	RS5	Road	0.04	100	0.04
Total	-	-	**0.65**	**-**	**0.65**

*As described in **para 4.4.4**

**Area designated for Cooling processes has been excluded from the contributing catchment on the basis of the surface water being collected for later use in the hybrid cooling system (rainwater harvesting). Should these areas require positive drainage (e.g. a different method of cooling was used at detailed design stage), based on the restricted discharge rate of Qbar the additional storage volume of c. 300m3 for the 1 in 100year plus 40% climate change scenario would be required. The Proposed Scheme can accommodate these volumes within the C3 catchment.

4.5. STORAGE VOLUME REQUIREMENTS

4.5.1. This Outline Drainage Strategy requires attenuation storage because in the worst case scenario all post-development runoff flows will be restricted to the pre-development greenfield Q_{BAR} rate of 3.71l/s/ha. Such storage is to be provided with peak flow control and volume control in accordance with policies set out in DEFRA's NSTS for Sustainable Drainage Systems guidance[8].

4.5.2. Storage volumes have been estimated using 3.71l/s/ha and the details are summarised in **Table 4-3** below. By demonstrating that the Site can accommodate the required volumes even when flows are limited to the Q_{BAR} rate, it ensures that any attenuation, albeit less than the full amount, can still be provided for the variable rates

of greenfield runoff, whilst still providing benefits to the Mitigation and Enhancement Area.

4.5.3. The storage volumes were estimated using the Quick Storage Estimations tool within the MicroDrainage (MD) package, utilizing FEH2013 rainfall methodology data[16], which has been confirmed by the LLFA as the acceptable methodology. The outputs from the MD are presented in **Appendix E**.

4.5.4. The storage volume estimates are based on providing the maximum attenuation required under local and national surface water drainage policy. Altogether, this Outline Drainage Strategy will provide all of the following:

- retention and control of the 1 in 100 year storm event plus climate change within the site, as per NPPF and local policy;
- supporting wetland creation across the Mitigation and Enhancement Area;
- retain volumes of rainwater to be used as part of the hybrid cooling water supply; and
- should it be needed, isolation of the drainage during, or after, any fire fighting incidence such that potentially contaminated water is retained and not released to the downstream Mitigation and Enhancement Area.

Table 4-3: Catchments Total Impermeable Area and Storage Requirements

Area Drained (Outfall Ref)	Total Imp Area [Ha)]	Q_{bar} Discharge Rate [L/Sec]	Required Storage (1 In 100 + 40%Cc) [M^{3*}]	Storage In Piped Network [M^3]	Provided			
					10% Storage On Plot [M^3]	Additional On Plot Storage [M^3]	Modular Crates Vol [M^3]	Pond Volume [M^3]
Total North (Outfall 1-5)	1.80	12.0	2048	112	225	0	1590	220
Total Central (Outfall 6-10)	0.89	7.5	983	69	139	200	667	0
Total South (Outfall 11-12)	0.65	3.3	776	43	85	0	0	660
TOTAL	**3.34**	**22.8**	**3,807**	**224**	**449**	**200**	**2257**	**880**
						3,807		

4.5.5. The indicative maximum storage volume requirements for the Carbon Capture Facility, is based on the indicative layout plan. This Strategy demonstrates that the storage volume of 3,807m^3 for 1 in 100-year return period storm event including a 40% uplift allowance for climate change can be accommodated within the Carbon Capture Facility. The Quick Storage Estimations from Microdrainage are presented in **Appendix E**.

4.5.6. The detailed design layout and its accompanying storage requirements will be presented as part of the ~~final Drainage Strategy~~detailed drainage strategy submitted for approval.

4.5.7. SuDS are proposed to be utilised where possible to manage the runoff volume and flow rates generated by the Proposed Scheme as well as to provide complementary amenity, biodiversity and water quality benefits. Each drainage network would include an appropriate level of treatment. This is discussed in **Section 5** of this report.

4.6. MITIGATION AND ENHANCEMENT AREA WORKS

4.6.1. The runoff from Carbon Capture Facility will effectively be directed to the Mitigation and Enhancement Area, both when discharging at greenfield Q_{BAR} runoff and at increased rates by means of variable flow controls at end of the networks. It should be noted, that the maximum discharge rate from any one location would be restricted to the current 1 in 100 year greenfield flow rates. This is to protect the surrounding watercourse/ditch network and prevent overwhelming the interconnecting drainage features. The Carbon Capture Facility drainage will discharge into the existing watercourse/ditch network and in places to aid connectivity, it is proposed to improve the existing ditches, as set out in the **outline Landscape, Biodiversity, Access and Recreation Delivery Strategy (Outline LaBARDS) (Document Reference 7.9)**. A plan clarifying this concept is shown in **Figure 4-3.** A full version of the plan is also presented in **Appendix F**.

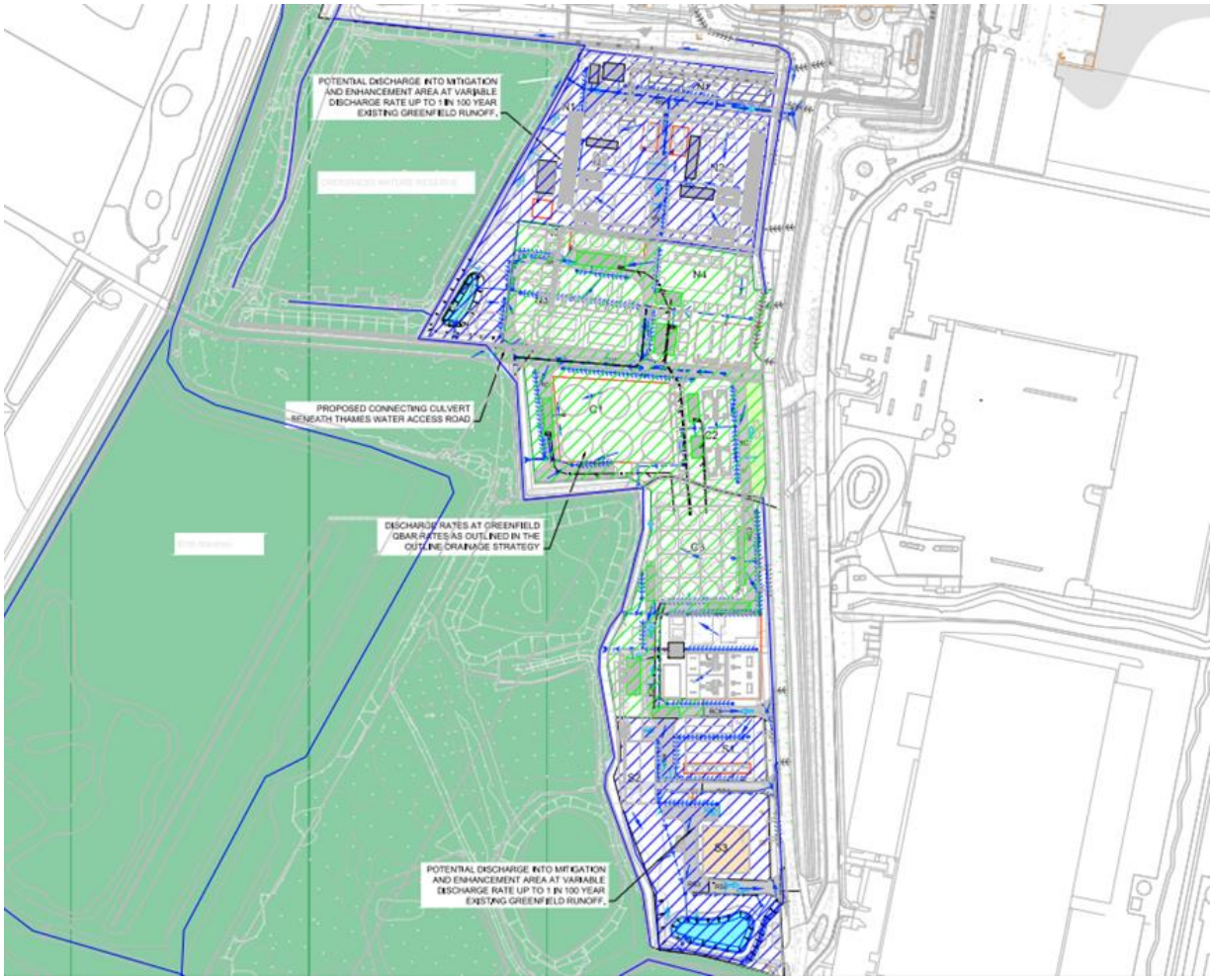


Figure 4-3: Overall Drainage Concept

4.6.2. This approach will improve the water quality in the Mitigation and Enhancement Area by reducing the flows that currently run into the highway drainage features along Norman Road, contributing road runoff/silt into Great Breach Dyke.

4.6.3. As discussed in **Section 4.2** rainwater harvesting will be utilised across the Carbon Capture Facility to assist in cooling processes. These areas are not expected to significantly contribute to the flows into the Mitigation and Enhancement area. Such contribution will only occur when the water within the tanks exceeds the level required for pumping into the cooling towers.

4.6.4. **Figure 4-4** below provides an overview of how the harvesting system within an attenuation tank is assumed to be implemented.

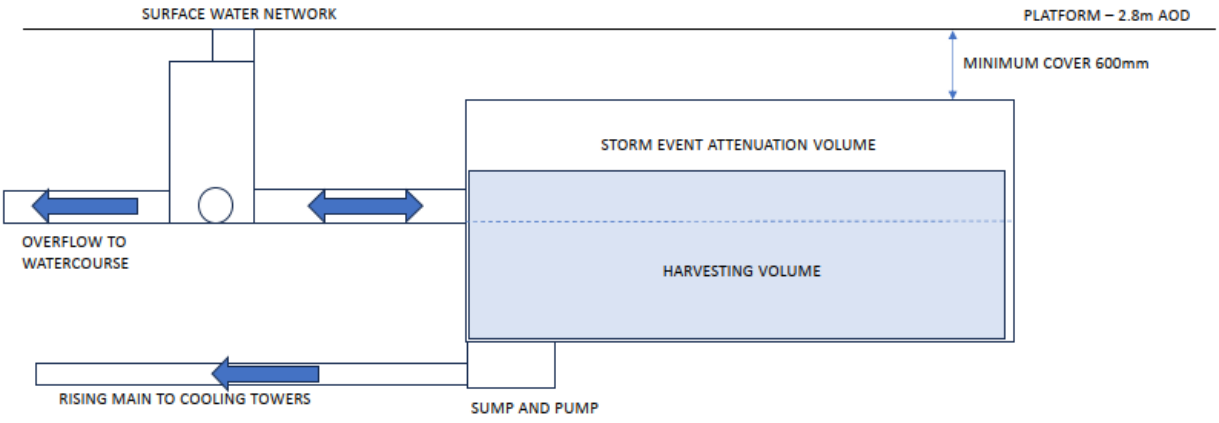


Figure 4-4: Surface Water Storage Concept with Harvesting

4.6.5. However, water from the other catchments (the majority of the Northern Catchment and all of the Southern Catchment, as defined in **Figure 4-2**) can facilitate this approach whenever additional water is needed to support the water network within the Carbon Capture Facility.

4.6.6. In this scenario the flow rates can be increased to 11.84l/s/ha (as shown in **Table 4-1**) with a corresponding reduction in the total attenuation required across the Carbon Capture Facility to approximately 3,460m^{3,} ·This would be subject to approval by the LLFA as part of approving the ~~full Drainage Strategy.~~detailed drainage strategy.

4.6.7. The water directed to the Mitigation and Enhancement Area will enhance and maintain the wet grassland and aquatic habitats with the creation of scrapes and grips (to assist in keeping soils moist within the wetland and to produce some variability in water level and moisture conditions) as described in **Outline Landscape, Biodiversity, Access and Recreation Delivery Strategy (Outline LaBARDS) (Document Reference 7.9)**. The improvements will include:

- additional lengths of channel within the ditch network (e.g. in the south of the Carbon Capture Facility area); and
- a new north-south connection beneath the existing route of the Thames Water Access Road so that the surface water discharged from the northern catchment can flow into the Mitigation and Enhancement Area.

4.6.8. Additionally, as detailed in the **Outline LaBARDS**, the enhancement of the wet grassland habitat across the Mitigation and Enhancement Area requires hydrological manipulation. There are two main methods to improve wet grasslands: those developed on high permeability soils, which are dependent on maintaining high groundwater levels; and those on low permeability soils, which are dependent on retaining surface water in topographic depressions.

4.6.9. Wet grassland enhancement on high permeability ground is dependent upon high water levels in the surrounding drains or rivers to cause high groundwater levels to occur. For low permeability ground (such as present within the Site Boundary), water

levels in the surrounding ditches are not as linked with the underlying groundwater, as the low permeability nature of the soils isolates them from the groundwater levels.

4.6.10. Therefore, to support this Strategy, further works will be required at the detailed design stage to identify areas where water from watercourses/ditches can be linked with the wetland areas. It will also include altering/enhancing the flow controls (weirs, penstocks, sluices, or other similar mechanisms), which exist on the current outfalls of the ditch network into the Great Breach Dyke to ensure there is no increase in flow discharge from the Site Boundary (i.e. both the Carbon Capture Facility and Mitigation and Enhancement Area). This may include alteration of the location of the current outfalls into the Great Breach Dyke may need alteration. This would be confirmed in the ~~full Drainage Strategy~~detailed drainage strategy and full LaBARDS documents.

4.7. IMPACTS TO ORDINARY WATERCOURSES

REMOVAL OF DRAINAGE CHANNELS

4.7.1. This section provides an overview of the changes that are anticipated to be required to existing watercourses to enable development of the Proposed Scheme and implementation of the proposed Outline Drainage Strategy.

4.7.2. The design of the Proposed Scheme requires that section(s) of the existing drainage channels (OW4b, OW7a, OW11a and OW15a) that cross the Carbon Capture Facility area will need to be infilled and stopped up. The potentially affected drainage channel sections are shown in **Figure 4-5** below.

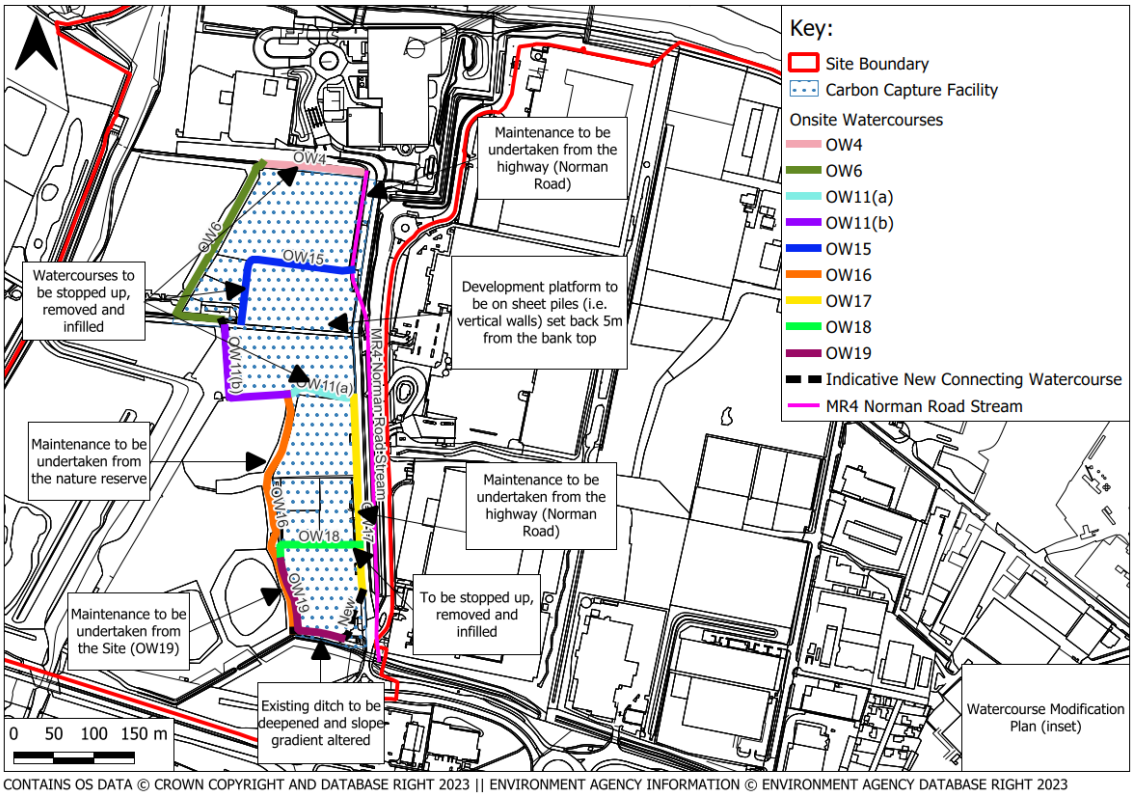


Figure 4-5: Watercourse Modification Plan

4.7.3. The full version of this plan is also presented in **Appendix G**. These watercourses and their associated functions will be replaced by the proposed surface water drainage system across the Carbon Capture Facility, which will provide attenuation and discharge into the watercourses that flow across the Mitigation and Enhancement Area.

4.7.4. These changes are outlined below:

- OW4 – This section of channel is not connected to the main river to the east (which receives surface water discharge from Riverside 1 and 2). It provides field drainage for the area of built development within the Site and connects into OW4 which receives field drainage from the east and flows in a southerly direction. This section of field drain will be infilled and replaced by the surface water drainage system.
- OW15 – This section provides field drainage to part of the Site and outfalls to the section of main river parallel to Norman Road. It will be infilled and replaced by the surface water drainage system.
- OW11(a) – This section provides field drainage to part of the Site and provides connectivity between the highway drainage channel alongside the eastern side of Norman Road and outfalls to the Marsh Dykes. It will be infilled and replaced by a new channel within the south of the Carbon Capture Facility.
- OW18 and 19 – These sections provide field drainage to part of the Site and provide connectivity between the highway drainage channel alongside the eastern side of Norman Road and the water network within the Mitigation and Enhancement Area. It will be partially infilled (OW18) and deepened at the southern end of the OW19 to accommodate connection of the new channel within the south of the Carbon Capture Facility.

4.7.5. Modification to the existing watercourses will also involve construction of a small headwall at each connection of the surface water drainage network into the watercourse.

4.7.6. Assessment of any likely flood risk associated with implementation of these changes is provided within the **Appendix 11-2: Flood Risk Assessment (Volume 3) to ES (Document Reference 6.1)).**

4.7.7. The plan presented in **Appendix G** also provides information on future maintenance and where these watercourses could be able to be accessed from during maintenance. The detailed drainage strategy will set out the final proposals for maintenance access to these watercourses for LBB to consider.

5. WATER QUALITY MANAGEMENT

5.1. INTRODUCTION

5.1.1. To ensure that there are no adverse impacts on the water environment, this section outlines the measures that will be implemented as part of the operational phase to ensure that the water discharged to the water environment is of a suitable quality to prevent degradation of the water environment and associated habitats and where possible provide enhancements. There are three aspects to this, which are addressed in turn:

- quality of the routine runoff;
- quality associated with the spillages/leakages of chemicals used/stored on site; and
- firewater.

5.2. ASSESSMENT OF THE POLLUTION HAZARD LEVEL

5.2.1. The SuDS Manual[10] sets out a common approach to managing the quality of surface water runoff. It describes risks posed by surface water runoff to the receiving environment as a function of:

- the pollution hazard at a particular site (i.e. the pollution source);
- the effectiveness of SuDS treatment components in reducing levels of pollutants to environmentally acceptable levels (i.e. the pollutant pathway); and
- the sensitivity of the receiving environment (the environmental receptor).

5.2.2. Table 4.3 of The SuDS Manual[10] provides the minimum quality management requirements for discharges to receiving surface waters and groundwater based on pollution hazard levels associated with the Proposed Scheme land use.

5.2.3. Based on this guidance and the Proposed Scheme's land uses, the overall pollution hazard level is indicated to be High as shown in **Table 5-1** below along with the Pollution Hazard Indices as indicated in the Table 26.2 of the SuDS Manual[10]

Table 5-1: Pollution Hazard Level and Indices (from The SuDS Manual[10])

Land Use	Pollution Hazard Level Pollution Hazard Level	Requirements for discharge to surface water, including coasts and estuaries	Total Suspended Solids (TSS)	Metals	Pollution Hazard Level Hydro-carbons
Individual property driveways, roofs (excluding residential), residential car parks, low traffic roads (e.g. cul de sacs, home zones, general access roads), non-residential car parking with infrequent change (e.g. schools, offices).	Low	Simple Index approach Note: extra measures may be required for discharges to protected resources.	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. Hospitals, retail), all roads except low traffic roads and trunk roads/motorways.	Medium	Simple Index approach Note: extra measures may be required for discharges to protected resources.	0.7	0.6	0.7
Sites with heavy pollution (e.g. haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals	High	Discharges may require an environmental licence or permit. Obtain pre-permitting advice from the	0.8	0.8	0.9

Land Use	Pollution Hazard Level Pollution Hazard Level	Requirements for discharge to surface water, including coasts and estuaries	Total Suspended Solids (TSS)	Metals	Pollution Hazard Level Hydro-carbons
and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured, industrial sites.		environmental regulators. Risk assessment is likely be required.			

5.2.4. The simple index approach assesses SuDS components to determine whether selected arrangements of SuDS components, and corresponding treatment trains, provide a total pollution mitigation index at least equal to, or greater than, the pollution hazard index.

5.2.5. As discussed above, the proposed discharge route for surface water is via watercourses in and adjacent to the Carbon Capture Facility. Table 26.3 of The SuDS Manual[10] gives the mitigation indices for different treatment options prior to discharge to surface waters. Those applicable to the Outline Drainage Strategy are summarised in **Table 5-2** below.

Table 5-2: Indicative SuDS Mitigation Indices (from The SuDS Manual[10])

Type of SuDS Component	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Pond	0.7	0.7	0.5
Filter drain	0.4	0.4	0.4
Wetland	0.8	0.8	0.8
Swale	0.5	0.6	0.6
Proprietary Treatment Systems – "Downstream Defender" by Hydro International (Mitigation Index	0.5	0.4	0.8

Type of SuDS Component	Total Suspended Solids (TSS)	Metals	Hydrocarbons
factors taken from manufacturers specification)			

5.2.6. The simple index approach has been used to inform an assessment of the pollution mitigation levels in the surface water discharge for the Northern, Central, and Southern catchments and is presented in the following tables. The mitigation indices stated in Table 26.3 of the SuDS Manual are halved for any interventions after the primary SuDS element, as required by the SuDS Manual.

5.2.7. For the Northern and Southern catchments, it is proposed that the following treatment train will be used:

Table 5-3: Indicative SuDS Mitigation Indices (from The SuDS Manual[10]) for Northern and Southern catchment

Type of SuDS Component	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Filter drain	0.40	0.40	0.40
Downstream Defender x 0.5	0.25	0.20	0.40
Pond x 0.5	0.35	0.35	0.25
Total	**1.00**	**0.95**	**1.00+**

5.2.8. For the Central catchment, it is proposed that the following treatment train will be used:

Table 5-4: Indicative SuDS Mitigation Indices (from The SuDS Manual[10]) for Central catchment

Type of SuDS Component	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Filter drain	0.40	0.40	0.40
Downstream Defender x 0.5	0.25	0.20	0.40
Total	**0.65**	**0.65**	**0.65**

5.2.9. As indicated in **Table 5-1**, the total mitigation indices for the highly contaminated sites are 0.8, 0.8, 0.9 for the TSS, Metals, and Hydrocarbons respectively. The simple index approach shows that the use of SuDS alone is not sufficient to meet the

requirement for adequate pollution mitigation in the Central catchment, as further SuDS treatment (i.e. a pond) cannot be accommodated.

5.2.10. Therefore, further pollution prevention measures are recommended. This is included in **Section 5.3** below.

5.3. PROPOSED POLLUTION PREVENTION MEASURES

5.3.1. Following the above assessment, it is proposed that the areas with the highest risk of pollution to the environment will be contained by means of bunding (where the surface water within these areas is only released to the environment once testing has proved it is not significantly polluted). An isolation system (with monitoring) would be applied to all attenuation tanks preventing any inappropriate discharge into the surface water drainage network.

5.3.2. These additional measures will help to mitigate the risk of potential pollution to the Site and adjacent areas, including the Crossness LNR.

5.3.3. The following aspects of the Carbon Capture Facility are identified as requiring pollution prevention measures to collect and control potentially contaminated surface water runoff.

- Chemical Storage and Injection (a part of the Carbon Capture Plant(s));
- Main electrical Infrastructure, including Transformers, and Backup Diesel Generator;
- Solvent Storage;
- Liquefaction and Refrigeration part of the CO2 Compression, Conditioning and Liquefaction Plants;
- Liquified CO2 Storage; and
- Wastewater Treatment Plant.

5.3.4. The indicative location of the proposed bunded areas is also included in the Outline Drainage Strategy drawings in **Appendix F**.

5.3.5. The design of the Proposed Scheme will take into account the relevant regulations, standards, approved codes of practices, design codes and guidance applicable to the systems proposed. An environmental management system will be in place during the operation of the Carbon Capture Facility, in accordance with Environmental Permit requirements.

5.3.6. The Proposed Scheme is to be designed in accordance with Dangerous Substances and Explosive Atmospheres (DSEA) Regulations[17], Control of Substances Hazardous to Health (COSHH) Regulations, HSG140 Safe use and handling of flammable liquids guidance[18], L5 Control of substances hazardous to health ACOP and guidance[19] and CIRIA's Design of containment systems for the prevention of water pollution from industrial incidents[20]. Appropriate design features will be incorporated within the Proposed Scheme, such as containment measures and barriers to prevent damage to

pipelines, pressure monitoring and pressure relief systems to prevent over pressurisation situations and leak detection systems will be installed, features to minimise, isolate or shut down systems in the event of an abnormal plant performance, the surface water drains and attenuation system will contain isolation valves, to be closed in the event of accidental spillage into the uncontaminated surface water drainage system and the inclusion of pollution prevention/control measures, such as the use of bunding.

5.3.7. Operational activities/management regimes will be controlled through adherence to the Environmental Permit, preparation of operational emergency plans, covering chemical leaks, transportation of hazardous/dangerous loads in appropriate vehicles in accordance with relevant legislation and guidance, including The Dangerous Substances (Conveyance by Road in Road Tankers and Tank Containers) Regulations[21] and International Carriage of Dangerous Goods by Road (ADR)[22], and adherence to all relevant approved codes of practice (ACOP) and guidance including, but not limited to, the following: HSG140 Safe use and handling of flammable liquids guidance[18]; L5 Control of substances hazardous to health ACOP and guidance[19] and L138 Dangerous substances and explosive atmospheres ACOP and guidance[23] Furthermore, when the surface water runoff is collected and enters the onsite drainage system, discharge valves at the outfall points will be kept closed initially as the runoff is tested for contamination.

5.3.8. If the runoff meets the water discharge quality standards, it will be discharged to the proposed surface water drainage network. If it fails to meet the standards and unacceptable levels of contamination are detected, the runoff would either be transferred to the Wastewater Treatment Plant for treatment or, if contaminant levels are such that they cannot be treated onsite, to a storage tank prior to removal and treatment offsite under a waste transfer licence to a suitable licensed wastewater treatment facility.

5.3.9. The controls to manage this process would be included in the scheme's Emergency Preparedness and Response Plan (EPRP), to be certified in accordance with ISO 14001, substantially in accordance with the **Outline EPRP** (**Document Reference 7.11)** and approved pursuant to DCO Requirement.

5.3.10. In addition to the measures above:

- Oil storage for the flue gas blower, CO_2 compressor and air compressor unit would be designed in accordance with the Control of Pollution (Oil Storage) (England) Regulations 2001[24]; and
- Rich Solvent/Lean Solvent Heat Exchangers would be individually bunded. The bunds will be designed in accordance with the COSHH/HSE guidance/ GPPs requirements at the detailed design stage.

5.3.11. As part of the detailed design, an assessment of the risk for all the tanker/chemical unloading bays will be undertaken. This will determine whether they are designed as

fully bunded areas or require suitable protection measures to prevent the entry of any spillages to the onsite surface water drainage systems. The bunds, if required, will be designed in accordance with the COSHH/HSE guidance/GPP requirements at the detailed design stage.

5.3.12. There would be additional control measures in accordance with the ISO 14001 certified within the EPRP for the Proposed Scheme in order to control surface water runoff that could become contaminated by chemicals and oil. These would include, but not be limited to, the following:

- A minimum of twice daily checks undertaken to inspect for chemical and oil leakage. Furthermore, there is a constant presence of key operative staff at the Carbon Capture Facility with responsibility to undertake informal checks as part of their other duties and could undertake immediate rectification/pollution prevention measures as required.
- Drip trays, or similar, would be installed under pumps to capture any potential leaks.
- Leakage detection systems will be considered for high-risk areas during detailed design.

5.3.13. The surface water drainage network for the Proposed Scheme set out in this strategy will include oil separators/downstream defenders as required during detailed design in accordance with the standard practice at that time.

5.3.14. Fire water pollution prevention measures will be incorporated within the drainage network for the Proposed Scheme including profiling roads towards attenuation features that will offer containment. This will enable flows from the outfalls to be isolated (e.g. via a penstock or similar), with fire waters retained within the Carbon Capture Facility area. These would consequently be treated on site or transported offsite for treatment/disposal as appropriate.

6. WATERCOURSE CONDITION SURVEY

6.1.1. The LLFA have noted that a river condition assessment would be expected to be undertaken for the Proposed Scheme and to include the watercourse network up to the River Thames.

6.1.2. As proposed in this Outline Drainage Strategy, surface water will be discharged to the surrounding existing watercourses (including the EA main river alongside Norman Road), the ordinary watercourses (effectively draining into the Mitigation and Enhancement Area) and the highway drain alongside Norman Road, all of which will be improved or altered as a result of the Proposed Scheme up to and including the outfalls into the Great Breach Dyke (a main river) – as such an existing river condition assessment is not needed.

6.1.3. The improvements/alterations will ensure a clear flow route from each outfall through to the EA main river network. Furthermore, a suitable maintenance/management plan for these watercourses will be in place for the lifetime of the Proposed Scheme, which will be set out in the detailed drainage strategy brought forward for approval under DCO Requirement.

7. MAINTENANCE AND MANAGEMENT PLAN

7.1.1. A Maintenance and Management plan for drainage network and SuDS elements will be developed at the detailed design stage and presented as part of the detailed strategy. This is to ensure the effective functioning and longevity of these systems to manage surface water runoff efficiently and sustainably.

7.1.2. At this stage it is assumed that all maintenance activities will be carried out by a suitable supplier selected by the Site operator. The appointed company will be responsible for carrying out routine inspections, maintenance and repairs of drainage infrastructure and SuDS features.

7.1.3. All maintenance activities should be in line with the requirements outlined in the CIRIA SuDS Manual C753[10] and should include regular, occasional and remedial maintenance activities.

7.1.4. Typical maintenance measures from SuDS Manual required for the proposed SuDS elements, such as attenuation basin and filter drain, are listed in **Appendix H**. Appendix H also includes the manufacturer's recommendations on maintenance required for the Downstream Defender device.

8. OUTLINE WASTEWATER STRATEGY

8.1.1. Wastewater will be generated by a Water Treatment Plant that provides the cooling water used in the evaporative cooling process (should a hybrid cooling system be selected, further information is provided in **Chapter 2: Site and Proposed Scheme Description** and **Chapter 3: Consideration of Alternatives** of the **ES (Document Reference 6.1)**. The wastewater will include backwash water from an ultrafiltration membrane water recovery process, concentrate from the nanofiltration membrane process and membrane cleaning solutions. Water recovery will be maximised and recycled back into the process following treatment.

8.1.2. Treated wastewater will be discharged to the new connection into the Thames Water foul sewer (with or without treatment, depending on trade effluent consents). The level of treatment will be defined at the next stage of design and subject to trade effluent consent. Should this option not be feasible following further discussion with Thames Water, a Zero Liquid Discharge solution will be investigated at the detailed design phase. This option consists of concentrating contaminants to a solid waste, whilst allowing for the release of a source of water supply for the Carbon Capture Facility (and thereby reducing the need for make-up water).

8.1.3. It is not proposed to recycle wastewater that has been in contact with any amine compounds into the Water Treatment Plant. The volume of amine wastewater effluent is expected to be comparatively small; therefore, the waste will be disposed of safely by specialised appointed contractor(s), taking the waste offsite for disposal via road tanker.

8.1.4. Wastewater from welfare facilities will be routed to the Thames Water foul sewer for treatment at a suitable wastewater treatment works; it is not proposed to treat these flows on-site.

8.1.5. An indicative proposed wastewater disposal route is presented in the Utilities - Drinking Water and Wastewater in **Appendix F**.

9. CONCLUSION

9.1.1. The Outline Drainage Strategy summarised in this document has been undertaken to ensure that foul and surface water drainage are being considered at the early stages of design. This also ensures that they will comply with local, regional and national policies relevant to flood risk and drainage and assist with spatial planning across the development.

9.1.2. The principles, measures and outcomes set out in this Strategy will be taken forward as the design of the Proposed Scheme develops and will be used to inform the full drainage design for the detailed layout of the project within the Works Plans zones. This detailed drainage design will be prepared for approval and implemented as approved, as secured by **DCO Requirement** (**Document Reference 3.1**).

9.1.3. Best practice and policy requirements for drainage designs on new developments should prioritise SuDS solutions. This Outline Drainage Strategy follows this approach, and it is therefore recommending that SuDS are included as part of the drainage design. At the time of writing, Sustainable Drainage Systems (SuDS) are not compulsory. However, in anticipation of upcoming changes to the Flood and Water Management Act 2010[25] and the enforcement of Schedule 3, this may become a requirement, although consequential to the wording of the draft **DCO (Document Reference 7.2)** which applies to the exception given to NSIPs to the Proposed Scheme, the Proposed Scheme is not required to meet the requirement of the Schedule 3. Even though exempt, this Outline Drainage Strategy presents solutions aligned with the forthcoming requirements.

9.1.4. The drawings appended to this Strategy provide an illustration of one way in such the principles, measures and outcomes set out in this Strategy could be delivered, to demonstrate that this is a workable strategy. This is based on the indicative site layout presented within the **Engineering Plans (Document Reference 2.5)**. This layout and the drawings are not secured as part of this outline strategy - they are just one example of how the outcomes could be delivered in practice.

9.1.5. Furthermore, the final drainage layout and corresponding proposed ground levels, will be confirmed prior to the design stage as part of the ~~full Drainage Strategy~~detailed drainage strategy.

9.1.6. The surface water drainage strategy will provide the following:

- retention and control of the 1 in 100 year storm even plus climate change within the site as per NPPF and local policy;
- supporting wetland creation across the Mitigation and Enhancement Area;
- retain volumes of rainwater to be used as part of the hybrid cooling water supply; and

- should it be needed, isolation of the drainage during or after any firefighting incidence such that potentially contaminated water is retained and not released to the downstream ecological areas.

9.1.7. The Environment Agency (EA) and Local Lead Flood Authority (LLFA) were consulted during the development of this Outline Drainage Strategy. Feedback from the LLFA was generally positive, and all requirements raised during consultations were carefully considered and incorporated into the proposed Strategy.

9.1.8. The proposed drainage network is designed to replace the existing open ditch network within the Carbon Capture Facility and ensures the area is drained properly without any detriment to the existing hydrology.

9.1.9. The proposed surface water Strategy is aligned with current local, regional, and national policies and offers additional benefits to the natural environment. It also incorporates a conservative estimate of a 40% increase in climate change allowances, particularly during extreme rainfall events. It also includes a worst-case scenario of using a discharge rate of 3.71l/s/ha (Q_{BAR}). Both these assumptions demonstrate that surface water can be managed on site without increasing in pollution risk and flood risk elsewhere.

9.1.10. The detailed drainage strategy will be developed alongside the development of flood compensation areas pursuant to the **Flood Risk Assessment (Appendix 11-2: Flood Risk Assessment (Volume 3) to ES (Document Reference 6.1))**, to ensure that the proposed surface water drainage system is not affected by fluvial flooding and that it is designed to work independently from the fluvial flood compensation storage areas that are developed.

9.1.11. The proposed wastewater Strategy assumes that wastewater generated by the Water Treatment Plant that provides the cooling water used in the evaporative cooling process (should a hybrid cooling system be selected) will be discharged via a new connection to the Thames Water foul sewer. Should this option not be feasible following further discussion with Thames Water, a Zero Liquid Discharge solution will be investigated at the detailed design phase. This option consists of concentrating contaminants to a solid waste, whilst allowing for the release of a source of water supply for the Carbon Capture Facility (and thereby reducing the need for make-up water).

9.1.12. Wastewater generated by the welfare facilities will be discharged into the local sewer network via a new connection to the Thames Water foul sewer.

9.1.13. **Chapter 3: Consideration of Alternatives to ES (Document Reference 6.1)** discusses all other options considered for the wastewater disposal from the Site.

10. REFERENCES

[1] Topographical Survey by Maltby Survey Ltd, Ref: 23/169/100-Overview, dated December 2023

[2] BGS Geology Viewer; accessed: September 2023, https://geologyviewer.bgs.ac.uk/ Contains OS data © Crown Copyright and database right 2020. Contains British Geological Survey materials © UKRI (2023)

[3] British Geological Survey: GeoIndex Onshore; available at: https://mapapps2.bgs.ac.uk/geoindex/home.html?layer=BGSBoreholes (Accessed: September 2023). Contains OS data © Crown Copyright and database right 2020. Contains British Geological Survey materials © UKRI (2023)

[4] WSP. (2017). 'Riverside Data Centre Ground Investigation Report'

[5] GDG (2021) 'Geotechnical Interpretive Report and Contaminated Land Report 21083-R-002-02'

[6] Aquifer Designation Dataset for England and Wales; accessed: September 2023, available at: https://www.data.gov.uk/dataset/616469ae-3ff2-41f4-901f-6686feb1d5b6/aquifer-designation-dataset-for-england-and-wales © Crown copyright.

[7] Sewerage Sector Guidance document; SSG Appendix C – Design and Construction Guidance v2.1, by Water UK, dated 25 May 2021, SSG-App-C-Des-Con-Guide.pdf (water.org.uk)

[8] DEFRA's Non-statutory technical standards for Sustainable drainage systems Section S4, dated March 2015, Sustainable Drainage Systems: Non-statutory technical standards for sustainable drainage systems (publishing.service.gov.uk)

[9] London Borough of Bexley (LBB) Sustainable Drainage Systems (SuDS) Design & Evaluation Guide, by McCloy Consulting & Robert Bray Associates, dated 2018 Bexley SuDS DESIGN & EVALUATION (flipbuilder.com)

[10] CIRIA C753: The SuDS Manual, dated December 2015, updated in February 2021, Item Detail (ciria.org)

[11] EA peak rainfall intensity allowances, May 2022, Climate change allowances for peak rainfall in England (data.gov.uk)

[12] The Planning Practice Guidance, Ministry of Housing, Communities and Local Government 2024 Planning Practice Guidance

[13] National Planning ~~Practice~~Policy Guidance: Flood risk and coastal change, last updated 25 August 2022, Flood risk and coastal change - GOV.UK (www.gov.uk)

[14] Building Regulations Document H: Drainage and Waste Disposal guidance, dated: 4 December 2010, BR_PDF_AD_H_2015.pdf (publishing.service.gov.uk)

[15] Institute of Hydrology IH124 methodology, by Marshal & Bayliss, June 1994, IH124FloodEstimationofSmallCatchments.pdf (ceh.ac.uk)

[16] The Flood Estimation Handbook (FEH), by UK Centre for Hydrology and Ecology, dated 2013

[17] Dangerous Substances and Explosive Atmospheres Regulations 2022 No. 2776.

[18] HSE (2015) HSG140 Safe use and handling of flammable liquids guidance.

[19] HSE (2013) The Control of Substances Hazardous to Health Regulations 2002. Approved Code of Practice and guidance (L5).

[20] CIRIA (2014) Design of containment systems for the prevention of water pollution from industrial incidents (C736).

[21] The Dangerous Substances (Conveyance by Road in Road Tankers and Tank Containers) Regulations 1981 No. 1059.

[22] Economic Commission for Europe Inland Transport Committee (2023) Agreement Concerning the International Carriage of Dangerous Goods by Road.

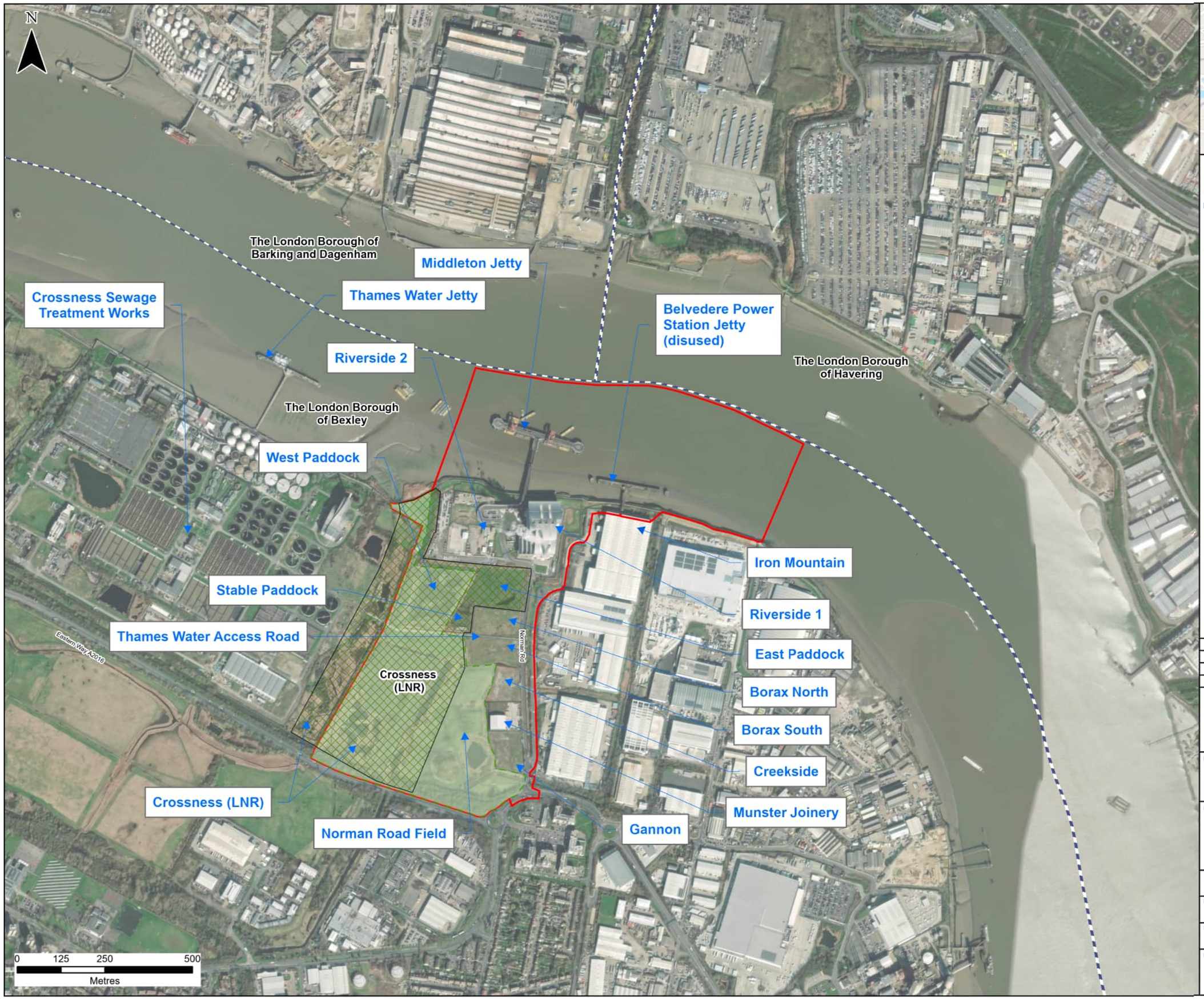
[23] HSE (2013) Dangerous Substances and Explosive Atmospheres Regulations 2002. Approved Code of Practice and guidance (L138).

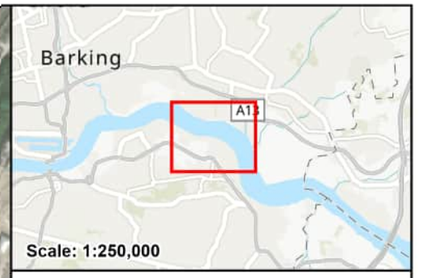
[24] Control of Pollution (Oil Storage) (England) Regulations 2001 by the Secretary of State, dated August 2001

[25] Schedule 3 of the Flood and Water Management Act 2010, by UK Parliament, 11 January 2023

Appendix A

SITE LOCATION





Legend

- Site Boundary
- Local Authority Boundary
- Local Nature Reserve (LNR)
- Mitigation and Enhancement Area

REVISION	DRAWN	CHECKED	APPROVED	DATE
P01	NK	DG	SH	29/02/2024

FINAL

DESCRIPTION

CORY

PROJECT TITLE:

CORY DECARBONISATION PROJECT

DRAWING TITLE:

FIGURE 1-2:
SATELLITE IMAGERY OF THE SITE BOUNDARY PLAN

CONFIDENTIALITY: PUBLIC

DRAWN:	CHECKED:	APPROVED:	AUTHORISED:
NK	DG	SH	JW

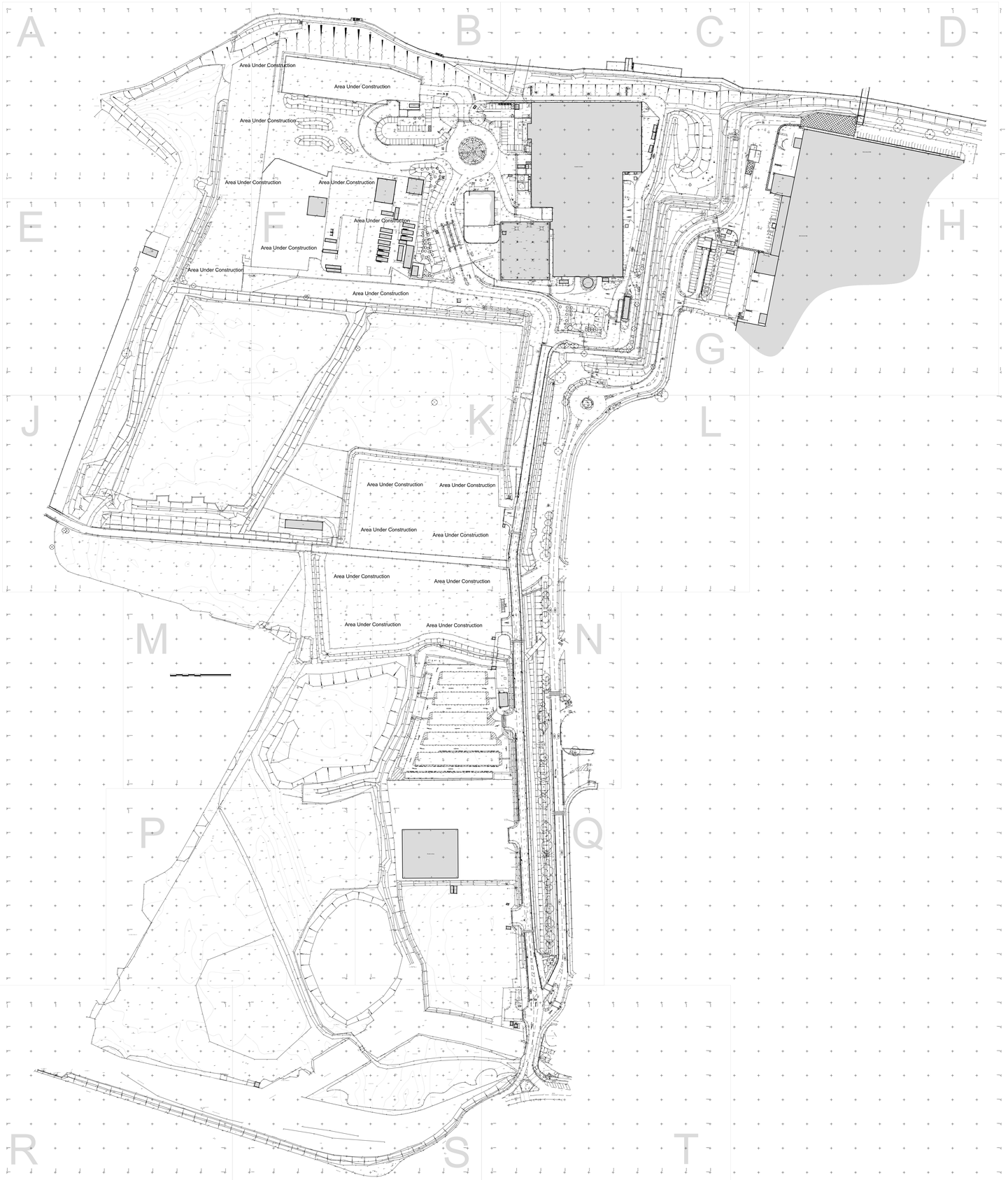
SCALE @ A3 SIZE:	DATE:	REVISION:
1:10,000	29/02/2024	P01

DRAWING NUMBER:

70090329-WSP-00-XX-RP-ENS-0102-P01-AN

Appendix B

SITE INFORMATION



Sheet Layout

23169-100-A	23169-100-B	23169-100-C	23169-100-D
23169-100-E	23169-100-F	23169-100-G	23169-100-H
23169-100-J	23169-100-K	23169-100-L	
	23169-100-M	23169-100-N	
	23169-100-P	23169-100-Q	
23169-100-R	23169-100-S	23169-100-T	

Grid

N
W E
S

LEGEND

BANKING — Top / Bottom

WALL — Width drawn to scale: 0.23m

BUSHES & HEDGES

BUILDING

TREES — MT / 3T / 0.2 / 6 (Multiple Trees/ Trunks / Size / Height of Tree)

OPEN SIDED BUILDING

NOTE:- SPREADS AND HEIGHTS ARE BOX ATED ONLY

GLASS ROOFED

GATES — Single / Double

CONTOURS — 25.00

ABBREVIATIONS (WHERE APPLICABLE)

ARCH HEAD HEIGHT	ARH	MARKER	MKR
ARCH HEAD LEVEL	AHL	MONITORING WELL	MW
ARCH SPRINGER HEIGHT	ASH	NOTICE BOARD	NB
ARCH SPRINGER LEVEL	ASL	NAME PLATE	NP
AIR VALVE	AV	OVERHEAD WIRES	OHW
BED LEVEL	BL	PARKING METER	PM
BELISHA BEACON	BB	RIDGE LEVEL	RID
BOLLARD	B	ROOF LEVEL	RL
BRITISH TELECOM BOX	BTB	ROAD SIGN	RS
BRITISH TELECOM MANHOLE	BTMH	RODDING EYE	RE
BRICKWORK	BKWK	RETAINING WALL	RTW
BUS STOP	BS	RAIN WATER PIPE	RWP
CABLE TV	CATV	SLUICE VALVE	SV
COVER LEVEL	CL	STOP COCK	SC
CABLE MARKER	CM	SOFFIT LEVEL	SOF
COLUMN	C#	STRUCTURAL SLAB LEVEL	SSL
CONCRETE POST	CP	TREE #TUMP	T#
EAVES LEVEL	EAV	SOIL AND VENT PIPE	SVP
ELECTRICAL COVER	ELEC	THRESHOLD LEVEL	TH
ELECTRICITY CONTROL BOX	ECB	TELEGRAPH POLE	TP
ELECTRICITY POLE	EP	TELEPHONE CALL BOX	TCB
EARTH ROD	ER	TOP OF KERB	TK
FLOWER BED	FB	TURNSTILE	TS
FINISHED FLOOR LEVEL	FFL	TRAFFIC LIGHT	TL
FIRE HYDRANT	FH	TOP OF WALL	TW
FLOOR LEVEL	FL	UNABLE TO LIFT	UTL
FLAG STAFF	FS	UNABLE TO SURVEY	UTS
GAS PIPE	GP	VENT PIPE	VP
GAS VALVE	GV	WATER METER	WM
GULLY	G	WATER LEVEL	WL
GATE STOP	GS	WASH OUT	WO
INSPECTION COVER	IC	WASTE PIPE	WP
INVERT LEVEL	IL	WATER TANK	WT
LAMP POST	LP	WATER VALVE	WV

FENCES

BARBED WIRE FENCE	BWF	LARCH LAP FENCE	LLF
CORRUGATED IRON FENCE	CIF	METAL RAILING FENCE	MRF
CLOSE BOARD FENCE	CBF	POST AND CHAIN FENCE	PCF
CHAIN LINK FENCE	CLF	PICKET FENCE	PIF
CHESTNUT PALING FENCE	CPF	POST AND RAIL FENCE	PRF
FENCE POST	FPO	POST AND WIRE FENCE	PWF
INTERWOVEN FENCE	IWF	STEEL PALISADE SECURITY FENCE	SPSF
IRON RAILING FENCE	IRF	TUBULAR STEEL RAIL FENCE	TSRF

REV.	NOTES	DWN	DATE
A	----	---	--/--/--

QMS ISO 9001 REGISTERED

A MEMBER OF THE THE SURVEY ASSOCIATION

QMS ISO 14001 REGISTERED

Notes:

Grid and levels relate to OS GPS Active Network.
Sheet is North orientated unless stated.
Additional Areas Added to Original Surveys 18/010 and 21/110.
Many Ditch/Watercourse Areas Extremely Overgrown
Levels Taken Where Possible.

Maltby Surveys Ltd

2 QUEENS ROAD
HAYWARDS HEATH
WEST SUSSEX
RH16 1EB
Tel: 01444 416246
E-Mail: mls@maltbysurveys.com
WebSite: www.maltbysurveys.com

SURVEYED	LCD	WSP
DRAWN	LCD	
CHECKED	AKM	
		SCALE
		1/1250 (A0 Sheet)

Norman Road, Belvedere, DA17 6JY

TOPOGRAPHICAL SURVEY

Job No	Rev	Drawing Number
23/169	-	23/169/100-Overview

Date : Dec 2023

N

River Thames

TH/039/044/030

Great Breach Outfall

Great Breach Pumping Station

Great Breach pond

MR12

OW10

Wader Scrape

OW3

OW1

OW4

OW12

OW15

OW7

Education Pond

MR1

OW6

OW11

Pond 7

Crossness Pond 4

Crossness Pond 1

MR2

Crossness Pond 3

Crossness Pond 2

OW8

OW2

OW9

OW5

Pond 5

Pond 3

Pond 4

Pond 6

OW16

MR11

Pond 2

Pond 1

OW17

NORMAN ROAD

MR4

MR5

OW14

Lower Belvedere

CRABTREE MANORWAY NORTH

FISHER'S WAY

MR7

MR6

JENNINGTREE WAY

MULBERRY WAY

MR3

ANDERSON WAY

CLYDESDALE WY

A2016

ST THOMAS ROAD

LITTLE BRIGHTS ROAD

MR8

MR9

OW13

Green Level Pumping Station

28/39/44/0048

28/39/44/0032

TH/039/044/012

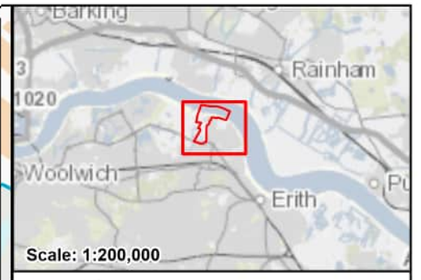
Green Level Outfall

0 75 150 300

Metres

Watercourse Key

Label	Name
MR1	Norman Road River
MR2	Great Breach Lagoon
MR3	Mulberry Way River
MR4	Norman Road Stream
MR5	Belvedere Stream
MR6	Gliray Plant
MR7	Crabtree Stream
MR8	Anderson Way Stream
MR9	Ocardo Stream
MR10	Bronze Age Stream
MR11	Great Breach Dyke West
MR12	Great Breach Dyke North Culvert
OW1	Hide Dyke
OW2	Reedbed Dyke
OW3	West Paddock Ditch
OW4	North Dyke
OW5	Horse Head Ditch
OW6	Stable Paddock Ditch
OW7	Iron Mountain Ditch
OW8	Reedbed Ditch 1
OW9	Reedbed Ditch 2
OW10	Great Breach Ditch
OW11	Borax South
OW12	Iron Mountain Ditch
OW13	Eastern Way Ditch
OW14	Lidl Ditch
OW15	Borax North
OW16	Norman Road Field
OW17	Ditch Thames C



Legend

- Site Boundary
- Outfall
- Pumping Station
- Groundwater Abstractions Licenses
- Main River
- Ordinary Watercourses
- Wetland
- Pond

REVISION	DRAWN	CHECKED	APPROVED	DATE
P01	NK	DG	SH	06/03/2024
FINAL				

DESCRIPTION

CORY

PROJECT TITLE:

CORY DECARBONISATION PROJECT

DRAWING TITLE:

FIGURE 11-2:
SURFACE WATER FEATURES

CONFIDENTIALITY: PUBLIC

DRAWN:	CHECKED:	APPROVED:	AUTHORISED:
NK	DG	SH	JW

SCALE @ A3 SIZE:	DATE:	REVISION:
1:6,000	06/03/2024	P01

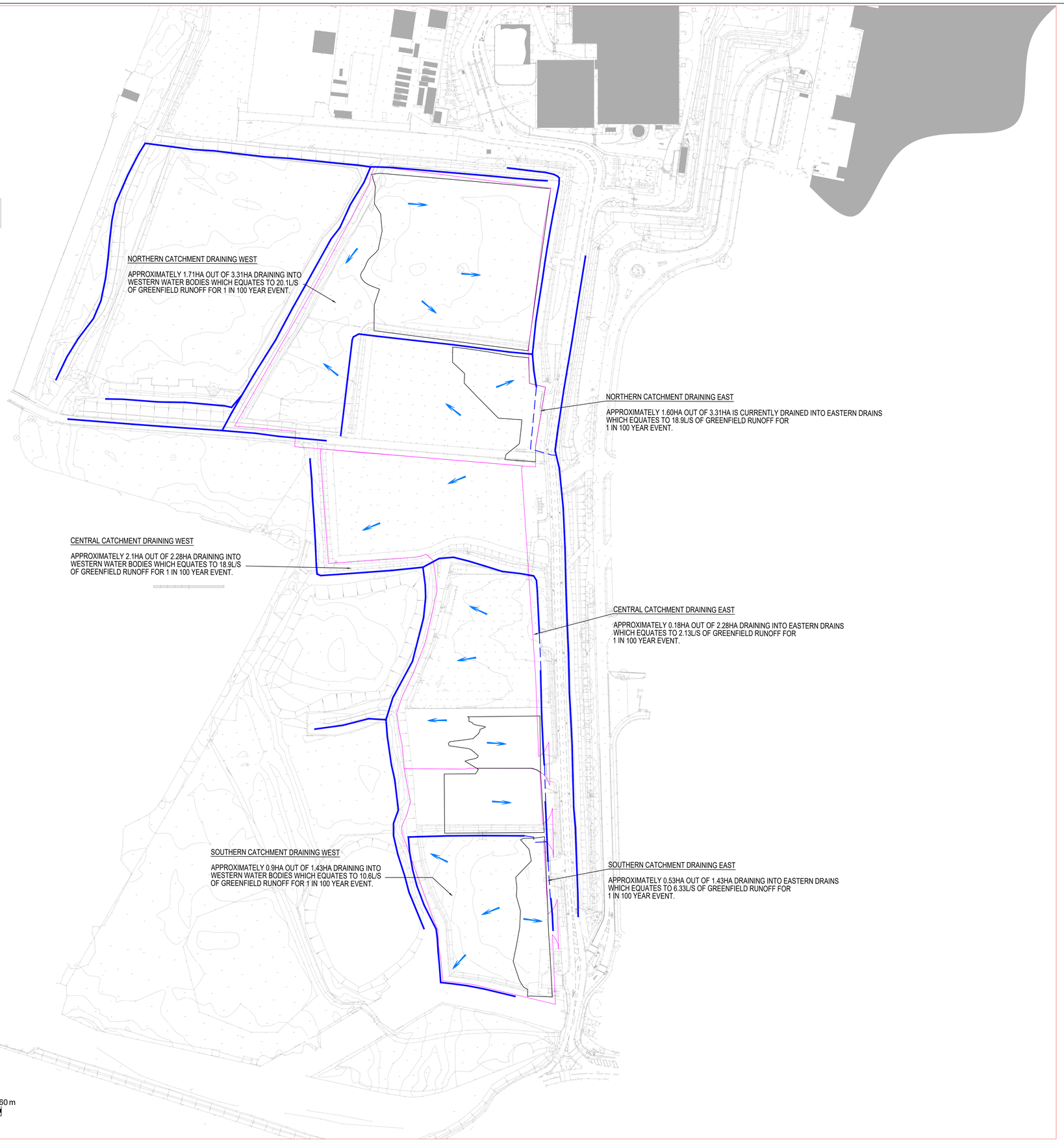
DRAWING NUMBER:

70090329-WSP-00-XX-RP-EP-1101-P01-AN

N

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	3.71	3.71
1 in 1 year (l/s):	3.15	3.15
1 in 30 years (l/s):	8.53	8.53
1 in 100 year (l/s):	11.84	11.84
1 in 200 years (l/s):	13.88	13.88



0 40 80 120 160 m

SCALE 1:1000

Service Layer Credits: Contains OS data © Crown Copyright and database right 2020
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES (mm) AND ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM (mAOD) UNLESS STATED OTHERWISE.
2. DIMENSIONS AND LEVELS SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO COMMENCEMENT OF THE WORKS.
3. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE FOLLOWING OUTLINE SURFACE WATER DRAINAGE STRATEGY DRAWINGS:

   EN010128-01-XX-DG-DR-0001
   EN010128-01-XX-DG-DR-0002
   EN010128-01-XX-DG-DR-0003

4. TOPOGRAPHICAL SURVEY SHOWN HAS BEEN PROVIDED BY THE CLIENT AND WAS UNDERTAKEN IN DECEMBER 2023 BY MALTBY LAND SURVEYS LTD.

Scale: 1:1000

Legend

- PROPOSED DRAINAGE CATCHMENT
- EAST DRAINS CATCHMENT
- OVERLAND FLOW / DRAINAGE FLOW DIRECTION
- OPEN DITCH NETWORK
- APPROXIMATE LOCATION OF CULVERTED WATERCOURSES

REVISION	DRAWN	CHECKED	APPROVED	DATE
P01	AM	CP	CP	04/01/2024
DESCRIPTION: FIRST DRAFT ISSUE				

8 First St, Manchester M15 4GU
T+ 44 (0) 1612 005 000, F+ 44 (0) 161 886 2401
wsp.com

PROJECT TITLE:

CORY DECARBONISATION PROJECT

DRAWING TITLE:

EXISTING DRAINAGE CATCHMENT PLAN

CONFIDENTIALITY: FOR DCO SUBMISSION

DRAWN:	CHECKED:	APPROVED:	AUTHORISED:
AM	AS	CP	VM

SCALE @ A0 SIZE:	DATE:	REVISION:
1:1000	04/01/2024	P01

DRAWING NUMBER: EN010128-01-XX-DG-DR-0004

Appendix C

STAKEHOLDERS CORRESPONDENCE

From: [redacted]
Sent: 02 August 2023 10:23
To: [redacted]
Cc:
Subject: RE: DS Enquiry - Cory Riverside Campus, Norman Road, Belvedere, DA17 6JY

Hi [redacted]

Apologies for the delay in getting back to you. I have answered your bullet points in red with some commentary below:

Any historic records of flooding in the vicinity of the site; We have no recorded flood incidents in the vicinity of the site
Details of any assets or features which could significantly influence local flooding; We do not have any details of any flood assets in the area
Details of any flood management / defence structures at the site or in the surrounding area; We do not have any details of any flood assets in the area
Any hydraulic models available for the area; We do not have any modelling for this area
Any reports/general studies relating to flooding in the area; We not have any flood studies for this area
Any Ordinary Watercourses records, and any local byelaws associated with these features; Bexley does not have any Byelaws for ordinary watercourses
Confirmation of the ownership of the onsite local watercourses/ditches; We currently do not confirmation of ownership however all watercourses are under riparian responsibility
Please confirm whether the Environment Agency (EA) has notified the LLFA of any Critical Drainage Areas that cover the site; We have not been notified of Critical drainage area
Please confirm whether the LLFA requires developments to comply with the London Borough of Bexley SuDS pro-forma guidance and template for surface water drainage strategies;
Any policies or guidance produced specifically by the LLFA pertaining to sustainable drainage systems (SuDS), runoff rates, water quality etc; please see link to Bexley's Sustainable Drainage Design and Evaluation Guide - Bexley SuDS DESIGN & EVALUATION (flipbuilder.com)
Please confirm how the LLFA would prefer to see the site drained; We would expect the discharge hierarchy to followed. Having reviewed the initial information, it is noted that infiltration is not acceptable therefore it proposed utilise the local watercourse network. At stage this is acceptable.
Please could the LLFA provide advice on how they would expect the Climate Change (CC) guidance to be applied with regards to surface water attenuation requirements? Typically, we have been designing attenuation systems for the 100 year + 20%CC event and testing for the 100 year + 40%CC event. We currently expect designs to cater for 100year + 40% for CC
Any specific requests or requirements in regard to open sustainable drainage systems (SuDS) characteristics, such as slope, depths and freeboard or it should be as stated in The SuDS Manual (C753). As stated in the SuDS Manual

Having in review of the initial drawings and notes provided, we are generally happy with the principles proposed. In relation to the SuDS design where possible the applicant should maximise opportunities to provide above ground SuDS. Where possible we would like to minimise the use of below ground tanks as they carry a high maintenance risk however we expect these may required to provide residual attenuation requirements.

In relation to the local watercourse network, as part of any FRA we would expect a summary of the watercourse network up until the discharge to River Thames. We would also require an assessment of the condition of the watercourses running through the site and outline designs for any changes to the network (i.e. any works to the watercourse, diversions etc.). This is required as the local watercourse network is suitable for discharge from the site and ensure the any future watercourse works can be consented at a later stage. We appreciate design in early stages, however following this information we will be in better position to provide more information in terms of easement and consents.

Kind regards,

[redacted]
Senior Flood Risk Consultant
Flood Risk Management - Highways Traffic & Infrastructure
020 3045 3137 | ext. 3137

My working days are Wednesday and Thursday

From: [redacted]
Sent: 20 July 2023 10:42
To: [redacted]
Cc:
Subject: RE: DS Enquiry - Cory Riverside Campus, Norman Road, Belvedere, DA17 6JY

Hi [redacted]

Hope you're well! Thank you for reviewing our enquiry and the preliminary drainage strategy drawings sent previously. Wander if you are able to advice on the below in the meantime.

Looking for an advice on what easement from the ditches/watercourses the LLFA would likely be requiring for maintenance, if the onsite ditches are being concerned?

Also, do the LLFA have any own bylaws for consenting?

Many thanks!

Kind Regards,

[redacted]
Flood Risk Consultant
Water Risk Management & Engineering

8 First Street

Manchester
M15 4RP

wsp.com

From: [redacted]
Sent: Wednesday, July 12, 2023 2:40 PM
To: [redacted]
Subject: RE: DS Enquiry - Cory Riverside Campus, Norman Road, Belvedere, DA17 6JY

Thanks [redacted] drawings received and I am able open to open them.

[redacted]
Senior Flood Risk Consultant
Flood Risk Management - Highways Traffic & Infrastructure
020 3045 3137 | ext. 3137

My working days are Wednesday and Thursday

From: [redacted]
Sent: 12 July 2023 13:34
To: [redacted]
Subject: RE: DS Enquiry - Cory Riverside Campus, Norman Road, Belvedere, DA17 6JY

Good Afternoo [redacted]

Thank you for the update on our enquiry.

Please see enclosed the drainage drawings previously attached and please let me know if any issues with opening them.

Many thanks,
[redacted]

[redacted]
Water Risk Management & Engineering

8 First Street
Manchester
M15 4RP

wsp.com

From: [redacted]
Sent: Wednesday, July 12, 2023 1:22 PM
To: [redacted]
Subject: FW: DS Enquiry - Cory Riverside Campus, Norman Road, Belvedere, DA17 6JY

Dear [redacted]

Thank you for your email.

We are reviewing and will respond to queries below in due course.

I cannot open the drainage drawings attached, are you able to resend as PDF.

Kind regards,

[redacted]
Senior Flood Risk Consultant
Flood Risk Management - Highways Traffic & Infrastructure
020 3045 3137 | ext. 3137

My working days are Wednesday and Thursday

From: [redacted]
Sent: Tuesday, June 27, 2023 1:36 PM
To: Flooding <Flooding@bexley.gov.uk>; [redacted]
Cc: [redacted]
Subject: DS Enquiry - Cory Riverside Campus, Norman Road, Belvedere, DA17 6JY

Dear Sir/Madam,

We have been instructed by our client to undertake a Drainage Strategy for a proposed decarbonisation plant in Belvedere, DA17 6JY. The site is located at the Cory Riverside Campus adjacent to the River Thames in Belvedere in the London Borough of Bexley (LBB). The approximate grid reference is 549592E, 180213N. The site location plan showing red line boundary of the development is attached to this email.

The Drainage Strategy is being prepared in support of the DCO application for this strategic site.

We are writing to request LBB, as the Lead Local Flood Authority (LLFA), to provide any flood risk and drainage data and information with respect to the above site, in addition to any other pertinent information or opinion regarding development at the application site.

The site is currently mostly undeveloped with a central section occupied by Munster Joinery business. A Nature reserve is located to the west. The proposals include a Carbon Capture & Storage (CCS) facility with water treatment facilities, access roads and landscaping. The site is surrounded by local ditches discharging ultimately to Thames River and will be utilised as points of connection for the site's drainage.

The site levels are likely to be raised to comply with the Environment Agency's requirements for minimum flood levels. Sheet piling around the perimeter of the site will be used to achieve the land raising.

The Ground Investigation (GI) report undertaken in the north of the site by WSP in 2017, confirmed the site is underlain by Made Ground over the Alluvium superficial deposits, River Terrace Gravels and London Clay bedrock. The made ground is considered to have contaminative nature due to the site being a former landfill of waste generated from a boric acid production facility. Additionally, shallow groundwater was encountered across the site during the GI. Groundwater was recorded between 0.3 and over 7m below ground level (bgl), and at between 0.14 to 2.63m bgl during the long term groundwater monitoring time recorded mainly within the Made Ground and shallow deposits of the Alluvium. The groundwater levels are highly influenced by the proximity of the local water network and the tidal influence from the Thames River, especially within the River Terrace Gravels deposits.

Given that and the fact the site levels will be raised with imported material and potentially high groundwater levels, infiltration into ground is not considered as feasible solution for this site's surface water drainage.

In order for our Strategy to have sufficient information and to comply with the local and national requirements, please can you supply the following information, where available:

- Any historic records of flooding in the vicinity of the site;
- Details of any assets or features which could significantly influence local flooding;
- Details of any flood management / defence structures at the site or in the surrounding area;
- Any hydraulic models available for the area;
- Any reports/general studies relating to flooding in the area;
- Any Ordinary Watercourses records, and any local byelaws associated with these features;
- Confirmation of the ownership of the onsite local watercourses/ditches;
- Please confirm whether the Environment Agency (EA) has notified the LLFA of any Critical Drainage Areas that cover the site;
- Please confirm whether the LLFA requires developments to comply with the London Borough of Bexley SuDS pro-forma guidance and template for surface water drainage strategies;
- Any policies or guidance produced specifically by the LLFA pertaining to sustainable drainage systems (SuDS), runoff rates, water quality etc;
- Please confirm how the LLFA would prefer to see the site drained;
- Please could the LLFA provide advice on how they would expect the Climate Change (CC) guidance to be applied with regards to surface water attenuation requirements? Typically, we have been designing attenuation systems for the 100 year + 20%CC event and testing for the 100 year + 40%CC event.
- Any specific requests or requirements in regard to open sustainable drainage systems (SuDS) characteristics, such as slope, depths and freeboard or it should be as stated in The SuDS Manual (C753).

I am also attaching our preliminary Surface water drainage strategy drawings (Drainage North, Central and South) for your reference. We would welcome any comments you may have in relation to the proposed strategy and points of discharge. The proposed discharge rates are based on limiting site discharges to the greenfield runoff Qbar rate and utilise the FEH 2013 rainfall data, specific for the site location. The flows will be attenuated across the site via a combination of infiltration trenches, roadside swales where possible and underground geocellular storage cells and an attenuation pond. Filter drains are proposed to convey any flows generated from the proposed roads to provide pre-treatment before reaching the downstream defender and/or petrol interceptors at each outfall. Oil separators are also being considered in areas identified as being at high risk of contamination (to be confirmed following further review).

Your comments are welcome in relation to the water quality, as we understand the local water network is within the LLFA remit. Please advise if otherwise.

We trust the above is clear, however, should you have any queries or require any further information from WSP to be able to answer the above queries, please do not hesitate to get in contact.

Kind Regards,

[redacted]

wsp

[redacted]
Flood Risk Consultant
Water Risk Management & Engineering

8 First Street
Manchester
M15 4RP

Riverside Decarbonisation Project
Meeting Minute following a meeting with Bexley Borough Council (LLFA) on 28 September 2023

PRESENT	**Cory:** [redacted] **Hendeca:** Ki [redacted] **WSP:** [redacted] **LDA Design:** **LBB:** [redacted]
APOLOGIES	[redacted]
DISTRIBUTION	As above plus: [redacted]
CONFIDENTIALITY	Confidential

ITEM	SUBJECT	ACTION	DUE
1	**Introductions / Scheme Principles** Bexley- [redacted] pologies for not being able to attend, she has been leading on this for the LLFA up to now Scoping comments - confirmed we will incorporate within PEIR Meeting with EA last week - spoke about principles around flood risk etc. To meet EA requirements for flood risk associated with a breach of the River Thames flood defences, the development platform requires the raising site levels by 1.5 to 2m from existing, to 2.8m AOD	-	-
2	**Ditch Removal** **Principles:** ▪ Watercourses to be lost provide the land drainage function for the fields. This will be replaced by the	LLFA	3/10/23

	new drainage infrastructure (i.e. existing watercourse will be redundant from a drainage perspective). ▪ Is there a need for consenting for stopping the flow? (WD) — WSP - the DCO will disapply the consents/permissions. So covered by permissive powers. ▪ Working on principle that stopping up / infilling of the ditches is easier than altering/realigning/culverting. In terms of creating a viable development platform that doesn't infringe on other more important watercourses / features OW7(a) ▪ Only land drainage going into it and is approx. half a metre deep. ▪ Conclusion - Bexley okay with stopping it up OW11(a) ▪ Doesn't appear to have connection beyond highway ditch. ▪ Does it discharge into highway ditch? (WD) — Highways ditch and OW11 are very similar in terms of invert level and since are pump controlled can flow both ways (CP) ▪ The OW11(a) does not offer much in terms of flow conveyance. ▪ Conclusion - Bexley okay with stopping it up. WSP – consider that all ditches are interconnected. The site is very flat. A further mitigation measure could be that a connection is provided between yellow ditch and main river on the south of the site. Norman Road itself drains into a highway drain. Rest of land raised up by 2m - changes land drainage regime in area.		
3	**Ditches to Retain** ▪ Local planning policy states 8m easement – WSP requesting if this can be decreased. WD to come back on. Highway drainage: ▪ Can be maintained from Norman Road although may require traffic management – noting that Norman Road will only provide access to the Cory	LLFA	3/10/23

	Site post DCO, [post meeting clarification – Norman Road also provides pedestrian access to the River Thames footpath although the footpath is on the opposite side of the highway than the highway drain] ▪ The drain will remain as it is, no maintenance access is currently available for the proposed development land ▪ Conclusion - Bexley to confirm that the maintenance access is only provided from Norman Road. OW11(b), OW4 and OW4b: ▪ These watercourses will need to be maintained - a 5m buffer strip will be provided. — OW4 this will be provided on the southern side of the ditch (i.e. between the ditch and the development platform) no maintenance access currently existing on the northern / Riverside 2 side) — Current maintenance is challenging due to the slopes on the southern boundary, this could be enhanced as a result of the scheme. — OW11 – this will be provided on the western side via the nature reserve land. ▪ Flood compensation would be provided by widening OW4 to provide same in channel capacity as offered by the other ditches. ▪ Could also do same for OW11(b) but OW4 and 4b would be best. ▪ [post meeting note – this is a general principle – the equivalent lost channel capacity could be provided in other / combination of east – west ditches] Other ditches: ▪ A 5m buffer on one side of the ditches to facilitate maintenance would be provided.		
4	WD outlined that the EA are currently working on developing a hydraulic model for the area - they should be undertaking surveying to facilitate the model build. Spoke to [redacted] nd [redacted](EA). **Action:** WD to speak to EA to confirm timescales / expectations.	LLFA	4/10/23
5	Clarified what was meant by the River Condition Assessment requested by the LLFA (AS)	-	-

	LLFA - We take every development as an opportunity to get a survey completed. This survey is to assesses the physical flow constraints/ conditions of banks/ channel / flow conveyance capacity. This is not a BNG / ecological survey.		
6	**Drainage principles:** ▪ LLFA was happy with the general approach presented in the preliminary drainage strategy. Taking that approach forward. ▪ WSP – what would be recommended in terms of the required climate change. — All SuDS elements were designed to cater for 100yr plus 40% climate change as initially requested by the LLFA. — Latest published climate change allowances by EA suggested 25% climate change to be more appropriate given the type of development and its design life of 50 years. — WD - to come back on email sent by AM to confirm the climate change allowances to be used. ▪ WSP – What FEH rainfall data is currently required by the LLFA? — WD confirmed the FEH2013 will be acceptable. ▪ WD confirmed there is no requirement for the Bexley SuDS proforma to be submitted.	WD	3/10/23
7	**Next Steps** 1 WSP to share the marked up ditches plan to show the proposed alterations and maintenance access to WD [post meeting note – this plan is attached] 2 WD to come back on the following points: Climate Change Allowances, required access for maintenance, further comments re the proposed works and easements.		

Next meeting

Agreed future meetings would be useful, with invitation to be issued as appropriate.

Appendix D

CALCULATIONS

hrwallingford

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Anna Mierzejewska
Site name:	Cory Decarb
Site location:	Belvedere

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.

Site Details

Latitude:	51.50184° N
Longitude:	0.15412° E
Reference:	1869240904
Date:	May 30 2023 10:06

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):	1

Methodology

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

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	559	559
Hydrological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

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):	3.71	3.71
1 in 1 year (l/s):	3.15	3.15
1 in 30 years (l/s):	8.53	8.53
1 in 100 year (l/s):	11.84	11.84
1 in 200 years (l/s):	13.88	13.88

Cory Decarbonisation Project

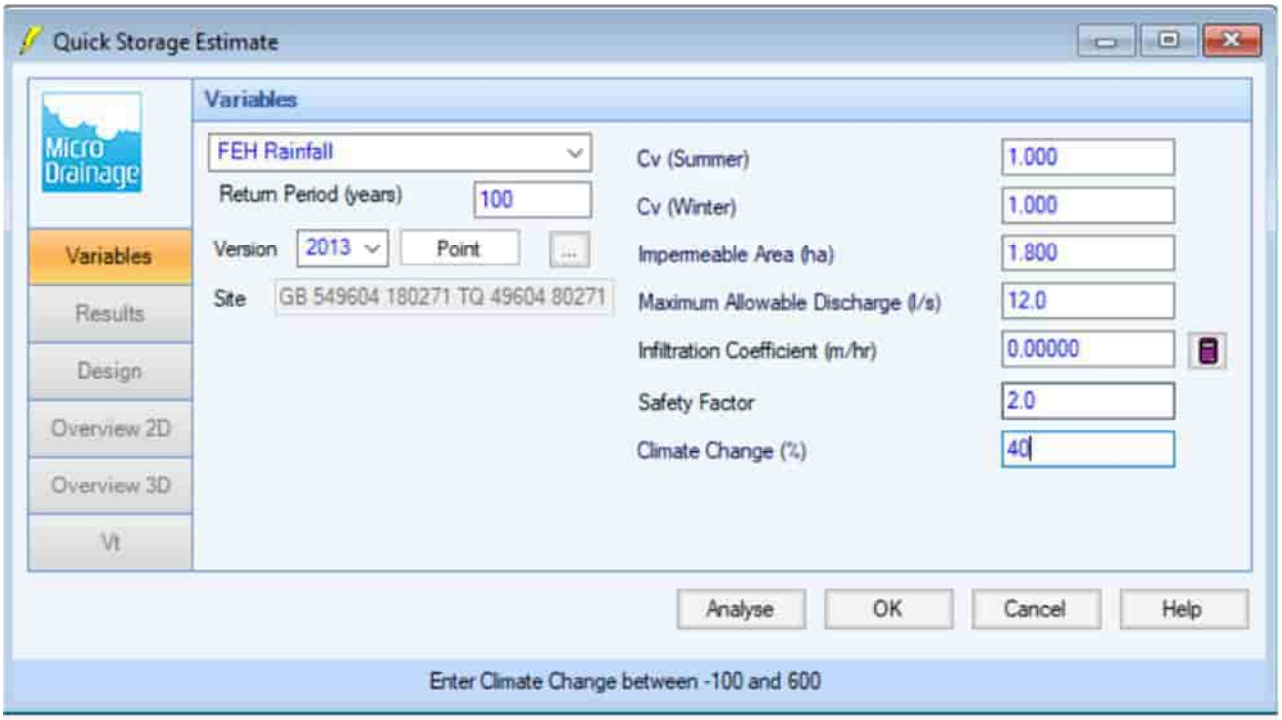
Quick Storage Estimates based on FEH2023 Rainfall Data

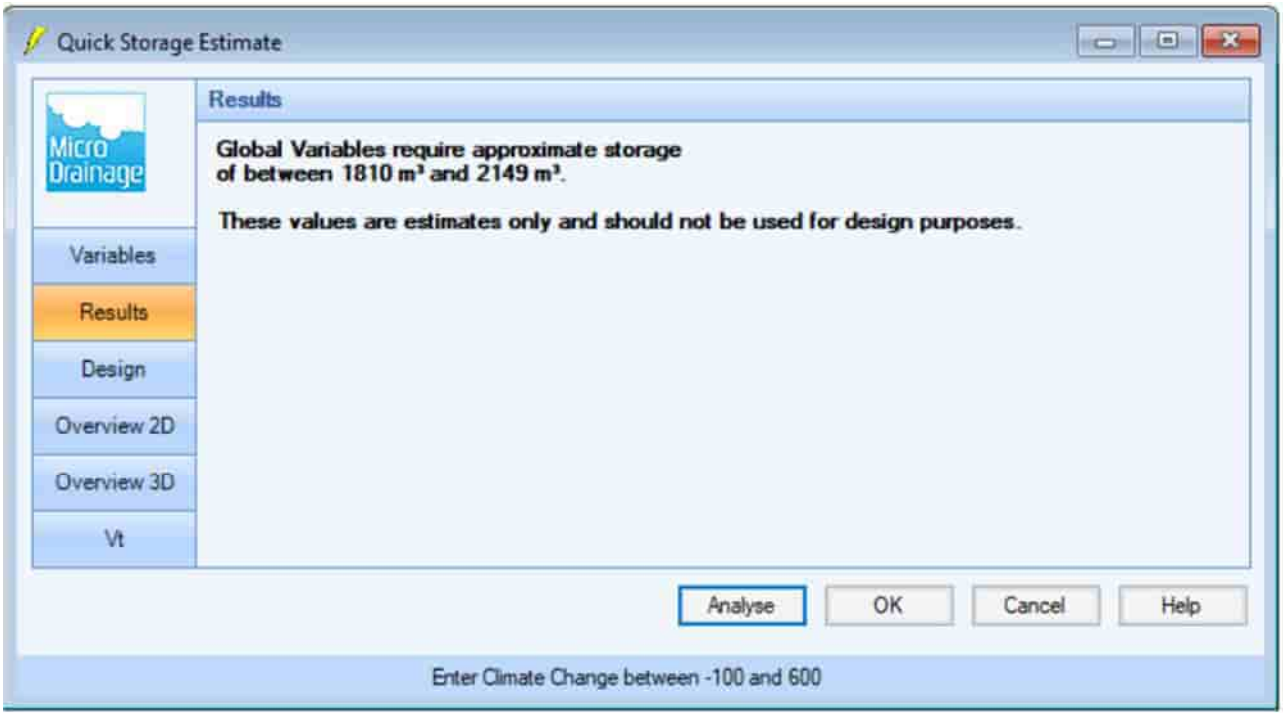
(this should be read in conjunction with the Outline Drainage Strategy report)

Northern Catchment – total

1	2	3	4	5	6	7	8	9	10
				PROVIDED					
CATCHMENT REF	TOTAL IMP AREA (Ha)	PROPOSED DISCHARGE RATE (l/s)	REQUIRED STORAGE (1 in 100 + 40%cc) (m3)	IN PIPED NETWORK STORAGE (m3)	ASSUMED 10% STORAGE ON PLOT	ADDITIONAL ON PLOT STORAGE (m3)	STRATEGIC STORAGE (m3)	CRATE'S VOL (m3)	POND VOLUME (m3)
Total North	1.80	12.0	2048	102	205		1741	1590	220

Column 4 was calculated from the Microdrainage storage lower and higher bound as below





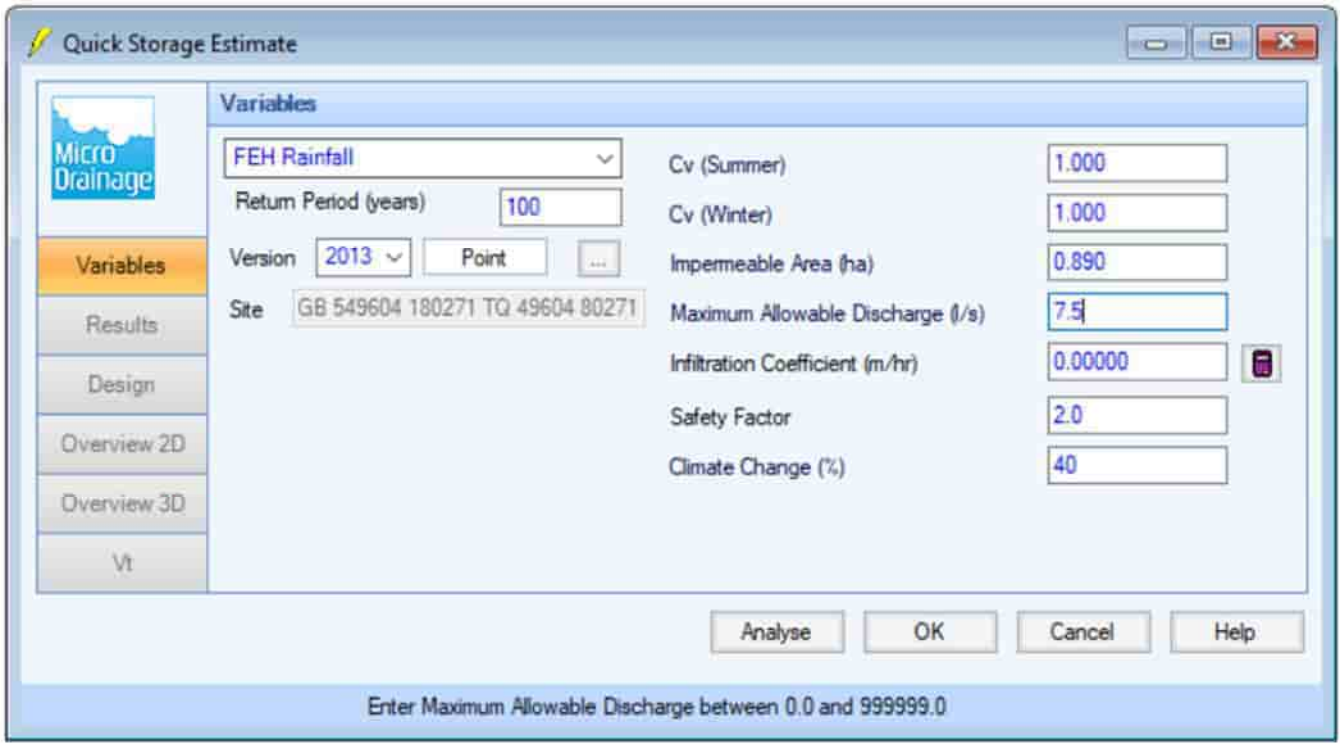
Cory Decarbonisation Project

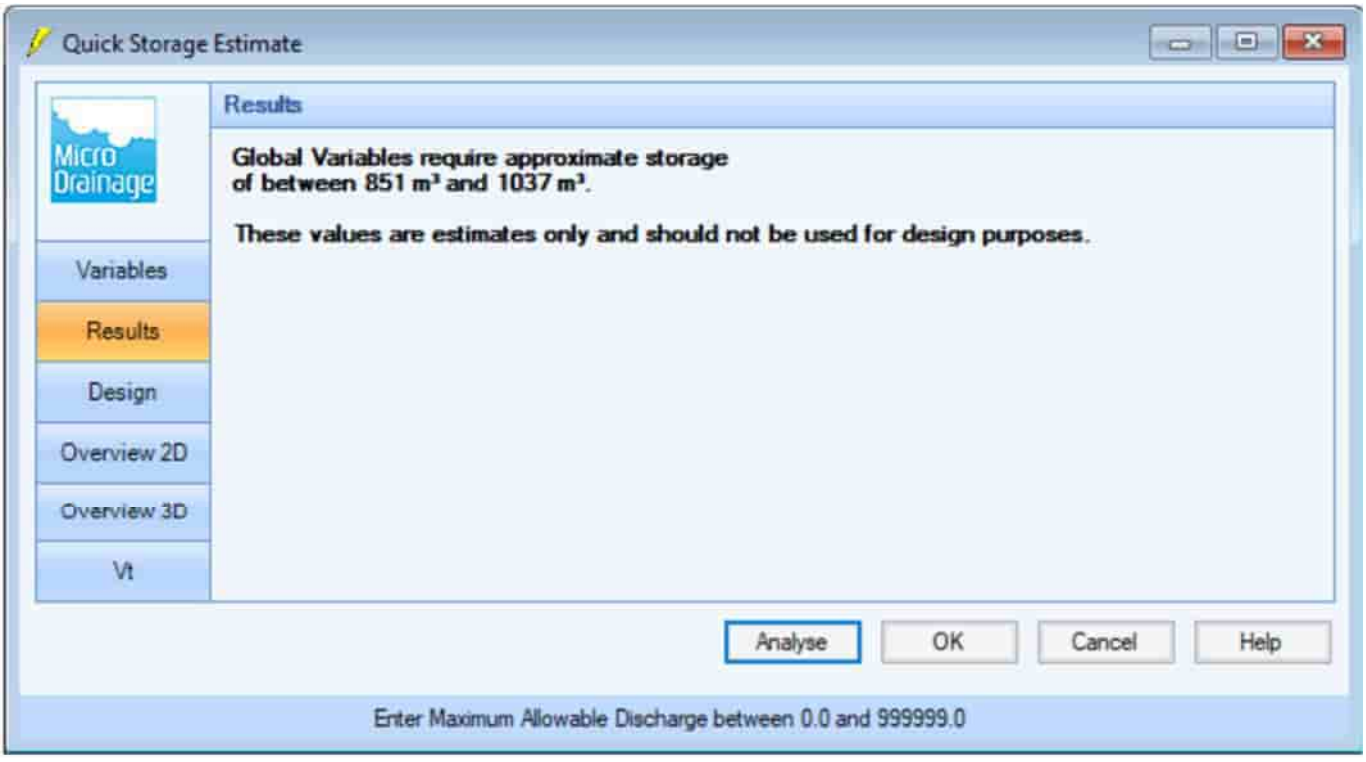
Quick Storage Estimates based on FEH2023 Rainfall Data

(this should be read in conjunction with the Outline Drainage Strategy report)

Central Catchment – total

1	2	3	4	5	6	7	8	9	10
				PROVIDED					
CATCHMENT REF	TOTAL IMP AREA (Ha)	PROPOSED DISCHARGE RATE (l/s)	REQUIRED STORAGE (1 in 100 + 40%cc) (m3)	IN PIPED NETWORK STORAGE (m3)	ASSUMED 10% STORAGE ON PLOT	ADDITIONAL ON PLOT STORAGE (m3)	STRATEGIC STORAGE (m3)	CRATE'S VOL (m3)	POND VOLUME (m3)
Total Central	0.89	7.5	983	49	98	200	636	667	0





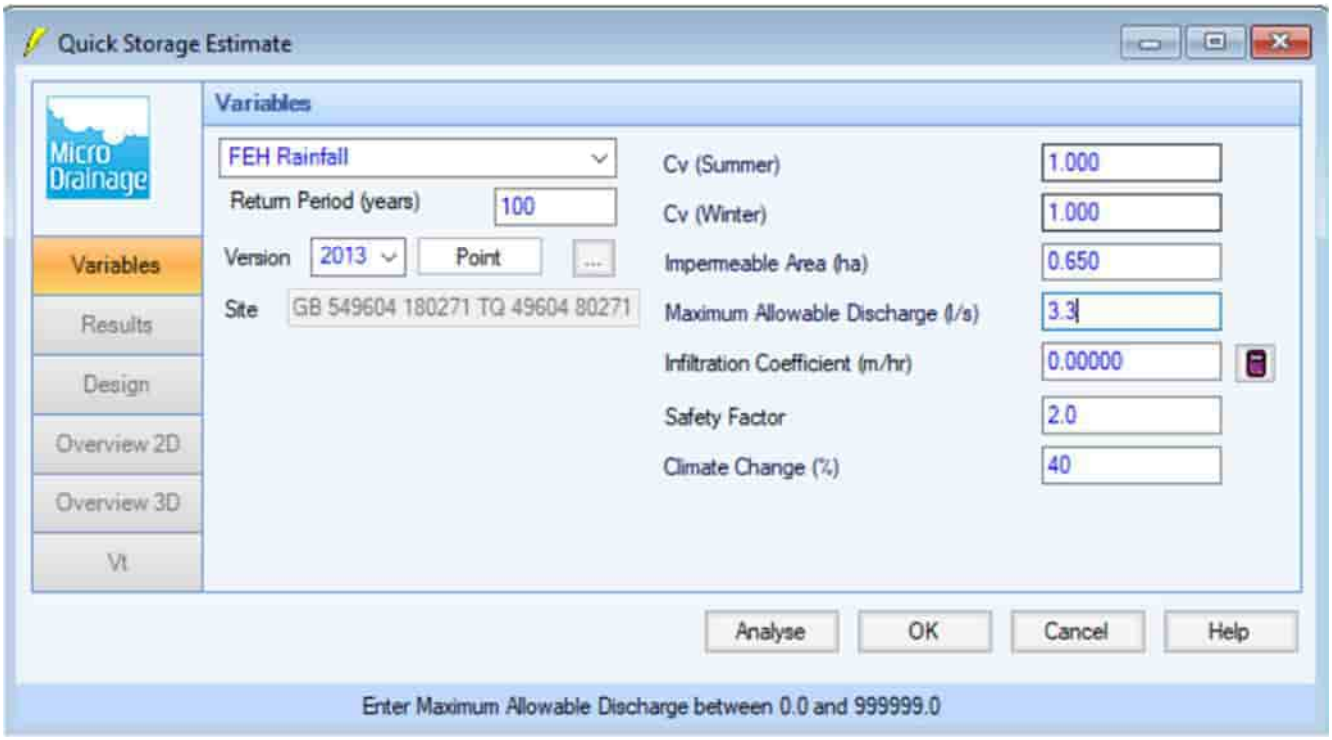
Cory Decarbonisation Project

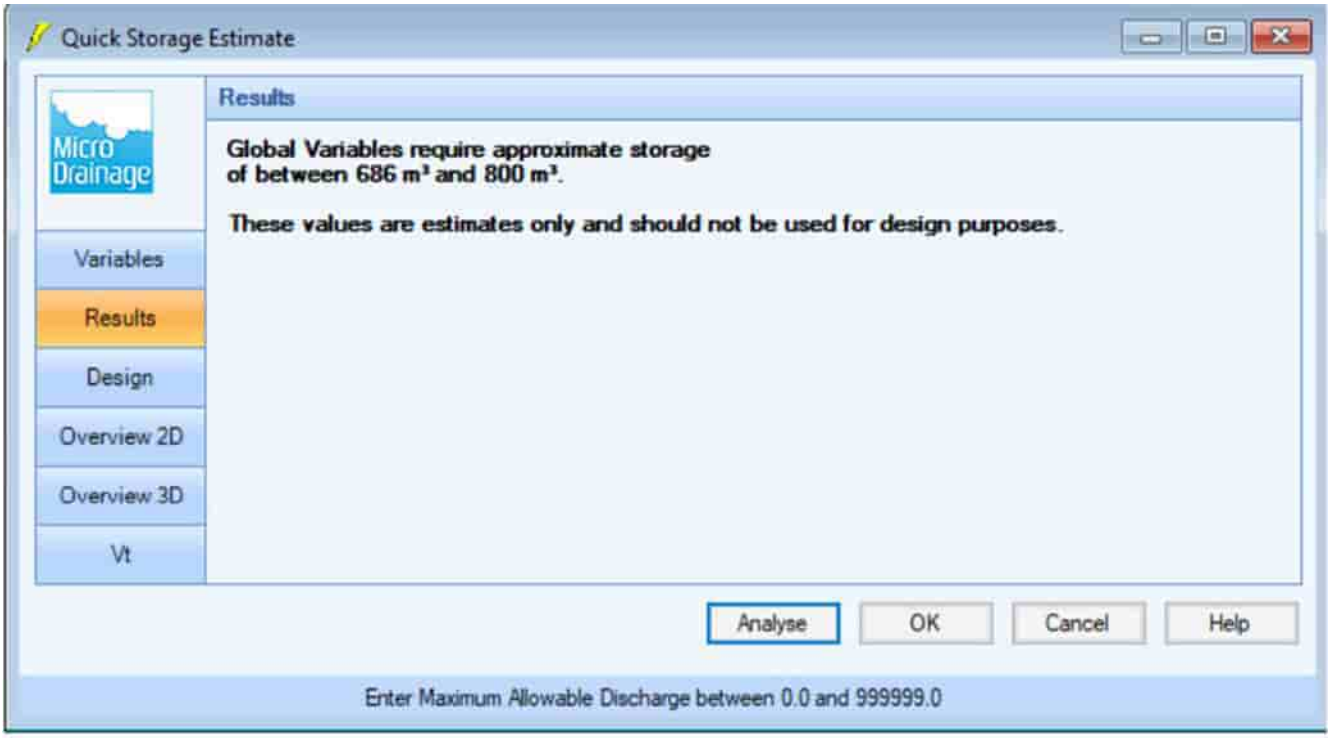
Quick Storage Estimates based on FEH2023 Rainfall Data

(this should be read in conjunction with the Outline Drainage Strategy report)

Southern Catchment – total

1	2	3	4	5	6	7	8	9	10
				PROVIDED					
CATCHMENT REF	TOTAL IMP AREA (Ha)	PROPOSED DISCHARGE RATE (l/s)	REQUIRED STORAGE (1 in 100 + 40%cc) (m3)	IN PIPED NETWORK STORAGE (m3)	ASSUMED 10% STORAGE ON PLOT	ADDITIONAL ON PLOT STORAGE (m3)	STRATEGIC STORAGE (m3)	CRATE'S VOL (m3)	POND VOLUME (m3)
Total South	0.65	3.3	776	39	78		660	0	660





Appendix E

DRAINAGE CATCHMENT PLAN

Key:

- Site Boundary
- Indicative Northern Catchment
- Indicative Central Catchment
- Indicative Southern Catchment

0 50 100 150 m

Indicative Drainage Catchment Boundaries

Appendix F

OUTLINE DRAINAGE STRATEGY DRAWINGS

DO NOT SCALE

NOTES:

1. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL RELEVANT DOCUMENTATION, DRAWINGS AND STANDARD DETAILS.
2. MASTERPLAN INFORMATION SHOWN IS BASED ON THE CURRENT WSP DESIGN DATED JANUARY 2024.

KEY:

- POTENTIAL RAINWATER HARVESTING STORAGE
- PROPOSED MITIGATION AND ENHANCEMENT AREA
- PROPOSED SURFACE WATER CATCHMENT AREAS DRAINING TO WATERCOURSES AT VARIABLE RATES
- POTENTIAL SITE WHERE RAINWATER CAN BE COLLECTED
- WATERCOURSE NETWORK WITHIN THE MITIGATION AND ENHANCEMENT AREA

REVISION	DRAWN	CHECKED	APPROVED	DATE
P01	AM	CP	CP	26/01/2024
DESCRIPTION	FIRST DRAFT ISSUE			

PROJECT TITLE:

CORY DECARBONISATION PROJECT

DRAWING TITLE:

OUTLINE SW DRAINAGE STRATEGY -CONCEPT

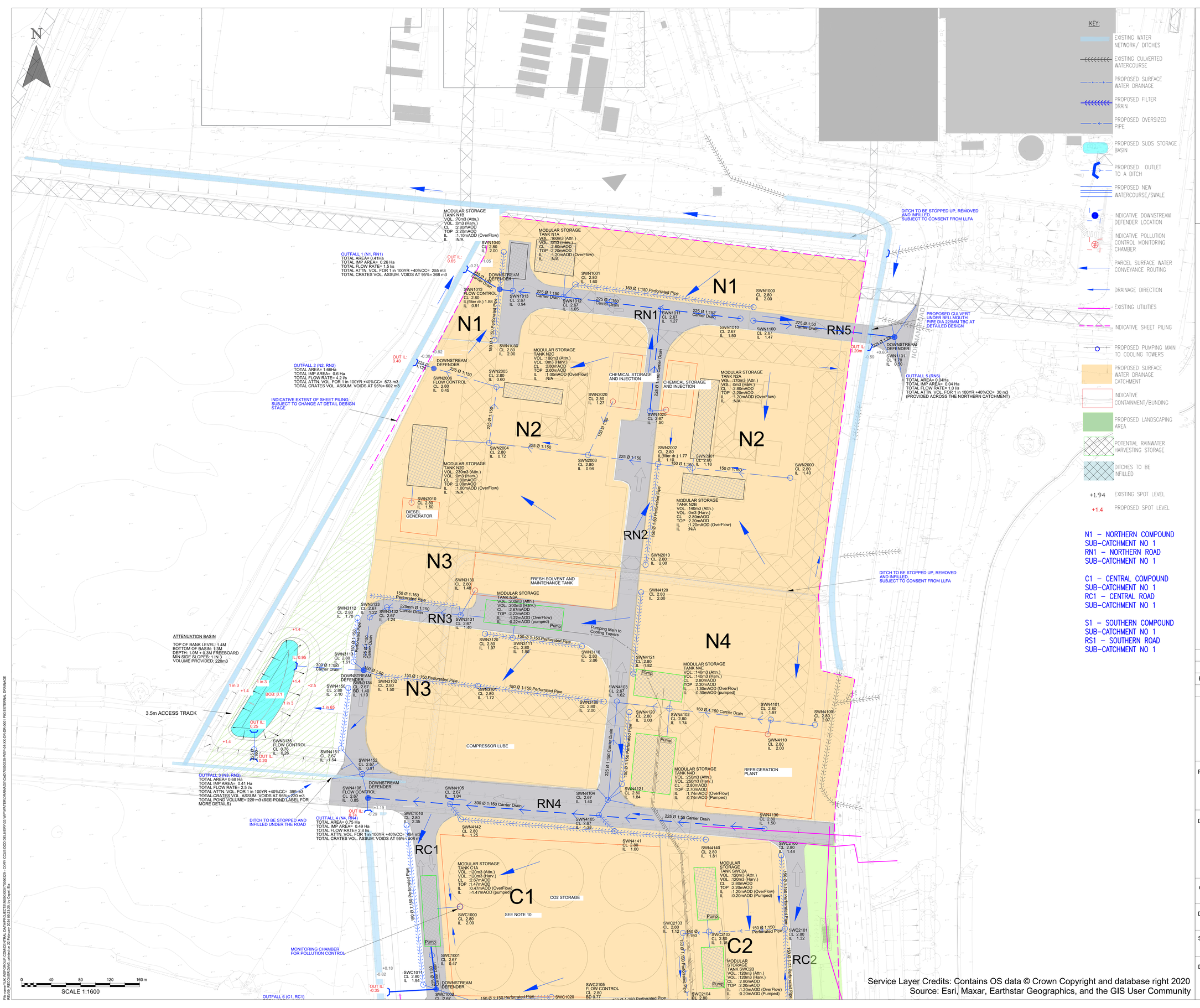
DRAWING STATUS: FOR DCO SUBMISSION

DRAWN:	CHECKED:	APPROVED:	AUTHORISED:
AM	CP	CP	CP

SCALE @ A0 SIZE:	DATE:	REVISION:
1:1000	26/01/2024	P01

DRAWING NUMBER:

EN010128-01-XX-DG-DR-0005



NOTES:

1. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL RELEVANT DOCUMENTATION, DRAWINGS AND STANDARD DETAILS.
2. MASTERPLAN INFORMATION SHOWN IS BASED ON THE CURRENT WSP DESIGN AND LDA LANDSCAPING PROPOSALS RECEIVED OCTOBER 2023.
3. EXISTING LEVELS SHOWN ARE BASED ON THE TOPOGRAPHICAL SURVEY UNDERTAKEN BY MALTBY LAND SURVEYS LTD IN DECEMBER 2023.
4. THE DRAINAGE STRATEGY IS INDICATIVE ONLY AND DETAILS SUCH AS DRAINAGE CONVEYANCE ROUTES, LEVELS, EXTENT AND SIZE OF SUDS FEATURES ETC ARE SUBJECT TO CHANGE DETAILED DESIGN STAGE.
5. ALL POINTS OF CONNECTION ARE SUBJECT TO APPROVAL FROM LLFA. FURTHER CONNECTIVITY ASSESSMENT OF THE EXISTING WATER NETWORK MAY BE REQUIRED.
6. THIS OUTLINE DRAINAGE STRATEGY IS BASED ON THE Qbar RUNOFF RATE, EQUAL to 3.7l/sec/ha.
7. QUICK STORAGE ESTIMATES WERE UNDERTAKEN USING LOCAL FEH 2013 RAINFALL DATA. STORAGE VOLUMES INDICATED FOR THE 1 IN 100YR PLUS 40% CLIMATE CHANGE ALLOWANCES.
8. EARTHWORK GRADINGS FOR SUDS FEATURES HAVE BEEN ASSUMED TO BE MAX. 1 IN 3 SLOPES IN ACCORDANCE WITH GUIDANCE SET OUT IN THE SUDS MANUAL (C753).
9. ALL MODULAR TANKS ASSUMED TO BE 1M DEEP AND HAVE MINIMUM 600MM COVER, SUBJECT TO FURTHER DETAILED DESIGN, FINISHED GROUND LEVELS AND INVERT LEVELS AT DISCHARGE LOCATIONS. PROTECTION MEASURES MAY BE REQUIRED TO PREVENT THE LOAD BEING TRANSMITTED TO THE TANK FROM THE VEHICLES, WHERE MINIMUM ADEQUATE COVER CANNOT BE ACHIEVED.
10. POTENTIAL STORAGE AT SURFACE WITHIN THIS BUNDED CO2 STORAGE AREA. MAXIMUM OF 200m3 TO BE ACCOMODATED ACROSS APPROX. 2,000m2 WITH A BUND WALL MINIMUM 0.15m HIGH. CO2 STORAGE TANKS AND ASSOCIATED EQUIPMENT WILL BE PLACED ON STILTS AND WATERPROOFING WILL BE CONSIDERED IN THE DESIGN, WHERE REQUIRED
11. SURFACE WATER FROM THE COOLING TOWERS AREA WILL BE HARVESTED AND REUSED IN THE COOLING PROCESSES. LOW WALL IS PROPOSED TO PERIMETER OF THE COLLING TOWERS AREA WITH A BASIN PROPOSED UNDERNEATH FOR STORAGE OF COOLING WATER (HYBRID COOLING SYSTEM). IN NORMAL CONDITIONS RAINFALL WILL BE CAPTURED AND DIRECTED INTO THE COOLING SYSTEM BASIN.
12. C3 AREA FORMALLY NOT INCLUDED IN THE DRAINAGE CATCHMENT PLAN, BUT CONNECTED TO UNABLE EMERGENCY OVERFLOW FROM THE COOLING SYSTEM BASIN.

REVISION	DRAWN	CHECKED	APPROVED	DATE
P01	AM	CP	VM	20/02/2024
FIRST DRAFT ISSUE				

8 First Street, Manchester, M15 4GU, UK
T+ 44 (0) 161 200 5000
wsp.com

PROJECT TITLE:

CORY DECARBONISATION PROJECT

DRAWING TITLE:

OUTLINE SW DRAINAGE STRATEGY - NORTH

CONFIDENTIALITY: CONFIDENTIAL

DRAWN:	CHECKED:	APPROVED:	AUTHORISED:
AM	CP	VM	VM

SCALE @ A0 SIZE:	DATE:	REVISION:
1:400	20/02/2024	P01

DRAWING NUMBER:

EN010128-01-XX-DG-DR-0001

N

TOP OF BANK LEVEL: 1.4M
BOTTOM OF BASIN: 1.3M
DEPTH: 1.0M + 0.3M FREEBOARD
MIN SIDE SLOPES: 1 IN 3
VOLUME PROVIDED: 220m3

3.5m ACCESS TRACK

1 in 3
1 in 3
1 in 3
1 in 65
BOB: 0.1
IL: 0.95
+1.4
+2.5
OUT IL: 0.25
SWN3135 FLOW CONTROL CL: 0.76 IL: 0.26
OUT IL: 0.20
SWN4151 CL: 2.67 IL: 1.54
SWN4152 CL: 2.67 IL: 0.91
225 Ø 1:150 Carrier Drain
300 Ø 1:150 Carrier Drain
SWN3113 CL: 2.80 IL: 1.61
SWN3134 CL: 2.67 BD: 1.40 IL: 1.10
SWN3102 CL: 2.80 IL: 1.50
SWN4150 CL: 2.80 IL: 2.10
DOWNSTREAM DEFENDER
150 Ø 1:150 Perforated Pipe

N3

SWN3101 CL: 2.80 IL: 1.72
SWN3111 CL: 2.80 IL: 1.90
SWN3110 CL: 2.80 IL: 2.06
SWN3100 CL: 2.80 IL: 2.00
SWN4103 CL: 2.67 IL: 1.62
SWN4120 CL: 2.80 IL: 2.00
SWN4102 CL: 2.80 IL: 1.74
SWN4121 CL: 2.80 IL: 1.82
Pump
MODULAR STORAGE TANK N4E VOL: :140m3 (Attn.) VOL: :140m3 (Harv.) CL :2.80mAOD TOP :2.30mAOD IL :1.30mAOD (OverFlow) IL :0.30mAOD (pumped)
SWN4101 CL: 2.80 IL: 1.97
SWN4109 CL: 2.80 IL: 2.07
SWN4110 CL: 2.80 IL: 2.00
150 Ø 1:150 Carrier Drain
150 Ø 1:150 Perforated Pipe
225 Ø 1:150 Carrier Drain

N4

COMPRESSOR LUBE
REFRIGERATION PLANT
MODULAR STORAGE TANK N4D VOL: 250m3 (Attn.) VOL: 250m3 (Harv.) CL :2.80mAOD TOP :2.70mAOD IL :1.74mAOD (OverFlow) IL :0.74mAOD (Pumped)
Pump

OUTFALL 5 (N3, RN3)
TOTAL AREA= 0.68 Ha
TOTAL IMP AREA= 0.41 Ha
TOTAL FLOW RATE= 2.5 l/s
TOTAL ATTN. VOL. FOR 1 in 100YR +40%CC= 399 m3
TOTAL CRATES VOL. ASSUM. VOIDS AT 95%= 220 m3
TOTAL POND VOLUME= 220 m3 (SEE POND LABEL FOR MORE DETAILS)

DITCH TO BE STOPPED AND INFILLED UNDER THE ROAD

OUTFALL 4 (N4, RN4)
TOTAL AREA= 0.75 Ha
TOTAL IMP AREA= 0.49 Ha
TOTAL FLOW RATE= 2.8 l/s
TOTAL ATTN. VOL. FOR 1 in 100YR +40%CC= 494 m3
TOTAL CRATES VOL. ASSUM. VOIDS AT 95%= 505 m3

SWN4106 FLOW CONTROL CL 2.67 IL 0.85
DOWNSTREAM DEFENDER
OUT IL: R.14 -0.29
+1.19
SWN4105 CL: 2.67 IL: 1.04
SWN4104 CL: 2.67 IL: 1.40
SWN4105 CL: 2.67 IL: 1.38
SWN4121 CL: 2.80 IL: 1.84
SWN4130 CL: 2.80 IL: 1.50
SWC1010 CL: 2.80 IL: 2.35
SWN4142 CL: 2.80 IL: 1.25
SWN4141 CL: 2.80 IL: 1.60
SWN4140 CL: 2.80 IL: 1.81
SWC2100 CL: 2.80 IL: 1.48

RN4

RC1

MODULAR STORAGE TANK C1A VOL: :120m3 (Attn.) VOL: :120m3 (Harv.) CL :2.07mAOD TOP :1.47mAOD IL :0.47mAOD (OverFlow) IL :-1.47mAOD (pumped)
MODULAR STORAGE TANK SWC2A VOL: :120m3 (Attn.) VOL: :120m3 (Harv.) CL :2.80mAOD TOP :2.20mAOD IL :1.20mAOD (OverFlow) IL :0.20mAOD (Pumped)
150 Ø 1:150 Perforated Pipe
C1
CO2 STORAGE
SEE NOTE 10
SWC1000 CL 2.80 IL 2.00
Pump
SWC2103 CL 2.80 IL 1.12
150 Ø 1:150
SWC2102 CL 2.80 IL 1.17
150 Ø 1:150 Perforated Pipe
SWC2101 CL 2.80 IL 1.32
C2
RC2
MODULAR STORAGE TANK SWC2B VOL: :120m3 (Attn.) VOL: :120m3 (Harv.) CL :2.80mAOD TOP :2.20mAOD IL :1.20mAOD (OverFlow) IL :0.20mAOD (Pumped)

MONITORING CHAMBER FOR POLLUTION CONTROL

SWG1001 CL 2.67 IL 0.47
SWC1011 CL 2.80 IL 1.94
DOWNSTREAM DEFENDER
OUT IL: -0.35
SWC1002 CL 2.67 BD 1.33 IL 6.29
SWC1021 CL 2.80 IL 1.43
150 Ø 1:150 Perforated Pipe
SWC1020 CL 2.80 IL 1.60
SWC2105 FLOW CONTROL CL 2.80 BD 0.77 IL 0.20
DOWNSTREAM DEFENDER
SWC2104 CL 2.80 IL 0.97
Pumping Main to Cooling Towers
SWC2200 CL 2.80 IL 1.52

OUTFALL 6 (C1, RC1)
TOTAL AREA= 0.56 Ha
TOTAL IMP AREA= 0.32 Ha
TOTAL FLOW RATE= 2.1 l/s
TOTAL ATTN. VOL. FOR 1 in 100YR +40%CC= 312 m3
TOTAL CRATES VOL. ASSUM. VOIDS AT 95%= 117 m3
(MODULAR TANK WITHIN RC1)

OUTFALL 7 (C2, RC2)
TOTAL AREA= 0.38 Ha
TOTAL IMP AREA= 0.21 Ha
TOTAL FLOW RATE= 1.4 l/s
TOTAL ATTN. VOL. FOR 1 in 100YR +40%CC= 205 m3
TOTAL CRATES VOL. ASSUM. VOIDS AT 95%= 216 m3

OUT IL: -0.05
+0.35
-0.40
SEE NOTE 11
SEE NOTE 12

C3

RC3

DITCH TO BE STOPPED UP, REMOVED AND INFILLED, SUBJECT TO CONSENT FROM LLFA

SWC3000 CL 2.80 IL 2.30
SWC3001 CL 2.80 IL 2.98
MODULAR STORAGE TANK SWC3B VOL: :0m3 (Attn.) VOL: :120m3 (Harv.) CL :2.67mAOD TOP :1.85mAOD IL :0.85mAOD (Pumped)
SWC3110 CL 2.80 IL 2.35
SWC3111 CL 2.80 IL 2.19
150 Ø 1:150 Perforated Pipe
DOWNSTREAM DEFENDER
OUT IL: -0.00
-0.68
+0.30
FLOW CONTROL SWC3005 CL 2.60 IL 0.35
SWC3005 CL: 2.67 IL: 0.85
SWC3004 CL 2.80 IL 1.96
225 Ø 1:150 Carrier Drain
MODULAR STORAGE TANK SWC3A VOL: :0m3 (Attn.) VOL: :130m3 (Harv.) CL :2.67mAOD TOP :2.07mAOD IL :1.07mAOD (Pumped)
SWC3003 CL 2.80 IL 1.76
SWC3002 CL 2.80 IL 1.86

OUTFALL 8 (C3, RC3)
TOTAL AREA= 0.40 Ha
TOTAL IMP AREA= 0.40 Ha
NOT CONTRIBUTING TO THE DRAINAGE CATCHMENT AND TO BE HARVESTED. SEE NOTE 12

DOWNSTREAM DEFENDER
FLOW CONTROL SWC4015 CL 2.80 IL 0.15
SWC4014 CL 2.80 IL 0.57
SWC4013 CL 2.80 IL 0.60
OUT IL: -0.04
+0.36
-0.76
OIL SEPERATOR TANK SIZE/VOL TBC
SWC4000 CL 3.70 IL 2.95
150 Ø 1:150 Perforated Pipe
SWC4200 CL 3.70 IL 3.25
C4

OUTFALL 9 (C4, RC4)
TOTAL AREA= 0.41 Ha
TOTAL IMP AREA= 0.22 Ha
TOTAL FLOW RATE= 1.5 l/s
TOTAL ATTN. VOL. FOR 1 in 100YR + 40%CC= 206 m3
TOTAL CRATES VOL. ASSUM. VOIDS AT 95%= 216 m3

MODULAR STORAGE TANK SWC4B VOL: :228m3 (Attn.) VOL: :228m3 (Harv.) CL :2.40mAOD TOP :1.80mAOD IL :0.60mAOD (OverFlow) IL :-0.40mAOD (Pumped)
Pump
Pumping Main to Cooling Towers
RC4
SWC4012 CL 2.80 IL 0.80
SWC4011 CL 2.80 BD 2.22 IL 0.85
SWC4010 CL 2.80 IL 2.30
150 Ø 1:150 Perforated Pipe
Bike parking, EV charging and Mobility

PROPOSED EXTENTION OF EXISTING CULVERT UNDER BELLMOUTH PIPE DIA. TO BE THE SAME AS THE EXISTING CULVERT

RC5
DOWNSTREAM DEFENDER
SWC4020 CL 1.20 IL 0.55
OUTFALL 10 (RC5)
TOTAL AREA= 0.04 Ha
TOTAL IMP AREA= 0.04 Ha
TOTAL FLOW RATE= 1.0 l/s
TOTAL ATTN. VOL. FOR 1 in 100YR +40%CC= 28 m3
(1.0/s USED FOR STORAGE ESTIMATE HOWEVER UNLIMITED FLOWS ARE PROPOSED WITH ADDITIONAL STORAGE PROVIDED ACROSS THE CENTRAL CATCHMENT)
SWS1001 CL 2.80 IL 1.90
150 Ø 1:150 Perforated Pipe
SWS1000 CL 2.80 IL 2.20
+0.90
-0.02
OUT IL -0.48

S1

SWS1020 CL 2.60 IL 1.92
150 Ø 1:150 Perforated Pipe
RS1
WATER TREATMENT
SWS1002 CL 2.80 IL 1.74
150 Ø 1:150 Perforated Pipe
SWS1010 CL 2.80 IL 2.20
+1.00
+0.32
OUT IL -0.60
OUTFALL 12 (RS2)
TOTAL AREA= 0.04 Ha
TOTAL IMP AREA= 0.04 Ha
TOTAL FLOW RATE= 1.0 l/s
TOTAL ATTN. VOL. FOR 1 in 100YR +40%CC= 30 m3
TOTAL CRATES VOL. ASSUM. VOIDS AT 95%= m3

S2

RS2
DOWNSTREAM DEFENDER
SWS1031 CL 1.40 IL 0.73
SWS1030 CL 2.60 IL 2.00
150 Ø 1:70 Perforated Pipe
SWS1031 CL 2.00 IL 1.60
PROPOSED CULVERT UNDER BELLMOUTH TO

DITCH AND SECTION OF CULVERT TO BE STORRED UP, REMOVED AND INFILLED

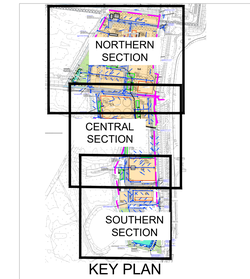
KEY:

- EXISTING WATER NETWORK/ DITCHES
- EXISTING CULVERTED WATERCOURSE
- PROPOSED SURFACE WATER DRAINAGE
- PROPOSED FILTER DRAIN
- PROPOSED OVERSIZED PIPE
- PROPOSED SUDS STORAGE BASIN
- PROPOSED OUTLET TO A DITCH
- PROPOSED NEW WATERCOURSE/SWALE
- INDICATIVE DOWNSTREAM DEFENDER LOCATION
- INDICATIVE POLLUTION CONTROL MONITORING CHAMBER
- PARCEL SURFACE WATER CONVEYANCE ROUTING
- DRAINAGE DIRECTION
- EXISTING UTILITIES
- INDICATIVE SHEET PILING
- PROPOSED PUMPING MAIN TO COOLING TOWERS
- PROPOSED SURFACE WATER DRAINAGE CATCHMENT
- INDICATIVE CONTAINMENT/BUNDING
- PROPOSED LANDSCAPING AREA
- POTENTIAL RAINWATER HARVESTING STORAGE
- DITCHES TO BE INFILLED
- +1.94 EXISTING SPOT LEVEL
- +1.4 PROPOSED SPOT LEVEL

N1 – NORTHERN COMPOUND
SUB-CATCHMENT NO 1
RN1 – NORTHERN ROAD
SUB-CATCHMENT NO 1

C1 – CENTRAL COMPOUND
SUB-CATCHMENT NO 1
RC1 – CENTRAL ROAD
SUB-CATCHMENT NO 1

S1 – SOUTHERN COMPOUND
SUB-CATCHMENT NO 1
RS1 – SOUTHERN ROAD
SUB-CATCHMENT NO 1



KEY PLAN

NOTES:

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2. MASTERPLAN INFORMATION SHOWN IS BASED ON THE CURRENT WSP DESIGN AND LDA LANDSCAPING PROPOSALS RECEIVED OCTOBER 2023.
3. EXISTING LEVELS SHOWN ARE BASED ON THE TOPOGRAPHICAL SURVEY UNDERTAKEN BY MALTBY LAND SURVEYS LTD IN DECEMBER 2023.
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5. ALL POINTS OF CONNECTION ARE SUBJECT TO APPROVAL FROM LLFA. FURTHER CONNECTIVITY ASSESSMENT OF THE EXISTING WATER NETWORK MAY BE REQUIRED.
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12. C3 AREA FORMALLY NOT INCLUDED IN THE DRAINAGE CATCHMENT PLAN, BUT CONNECTED TO UNABLE EMERGENCY OVERFLOW FROM THE COOLING SYSTEM BASIN.

REVISION	DRAWN	CHECKED	APPROVED	DATE
P01	AM	CP	VM	20/02/2024
FIRST DRAFT ISSUE				

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PROJECT TITLE:

CORY DECARBONISATION PROJECT

DRAWING TITLE:

OUTLINE SW DRAINAGE STRATEGY - CENTRAL

CONFIDENTIALITY: CONFIDENTIAL

DRAWN:	CHECKED:	APPROVED:	AUTHORISED:
AM	CP	VM	VM

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1:400	20/02/2024	P01

DRAWING NUMBER:

EN010128-01-XX-DG-DR-0002

SHEET 1 OF 20

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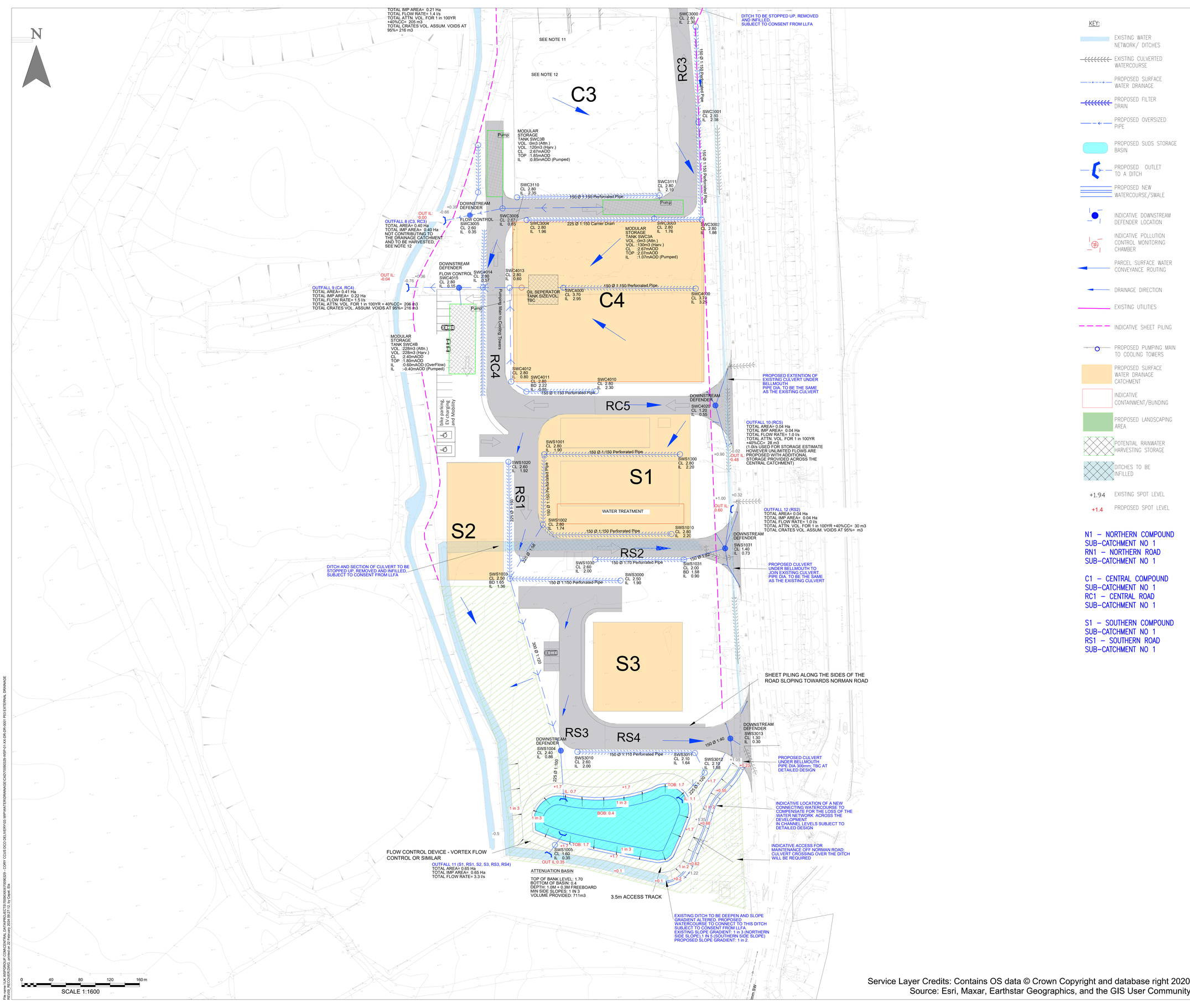

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P01	AM	CP	VM	20/02/2024
DESCRIPTION: FIRST DRAFT ISSUE				

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PROJECT TITLE:

CORY DECARBONISATION PROJECT

DRAWING TITLE:

OUTLINE SW DRAINAGE STRATEGY - SOUTH

CONFIDENTIALITY: CONFIDENTIAL

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AM	CP	VM	VM

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1:400	20/02/2024	P01

DRAWING NUMBER:

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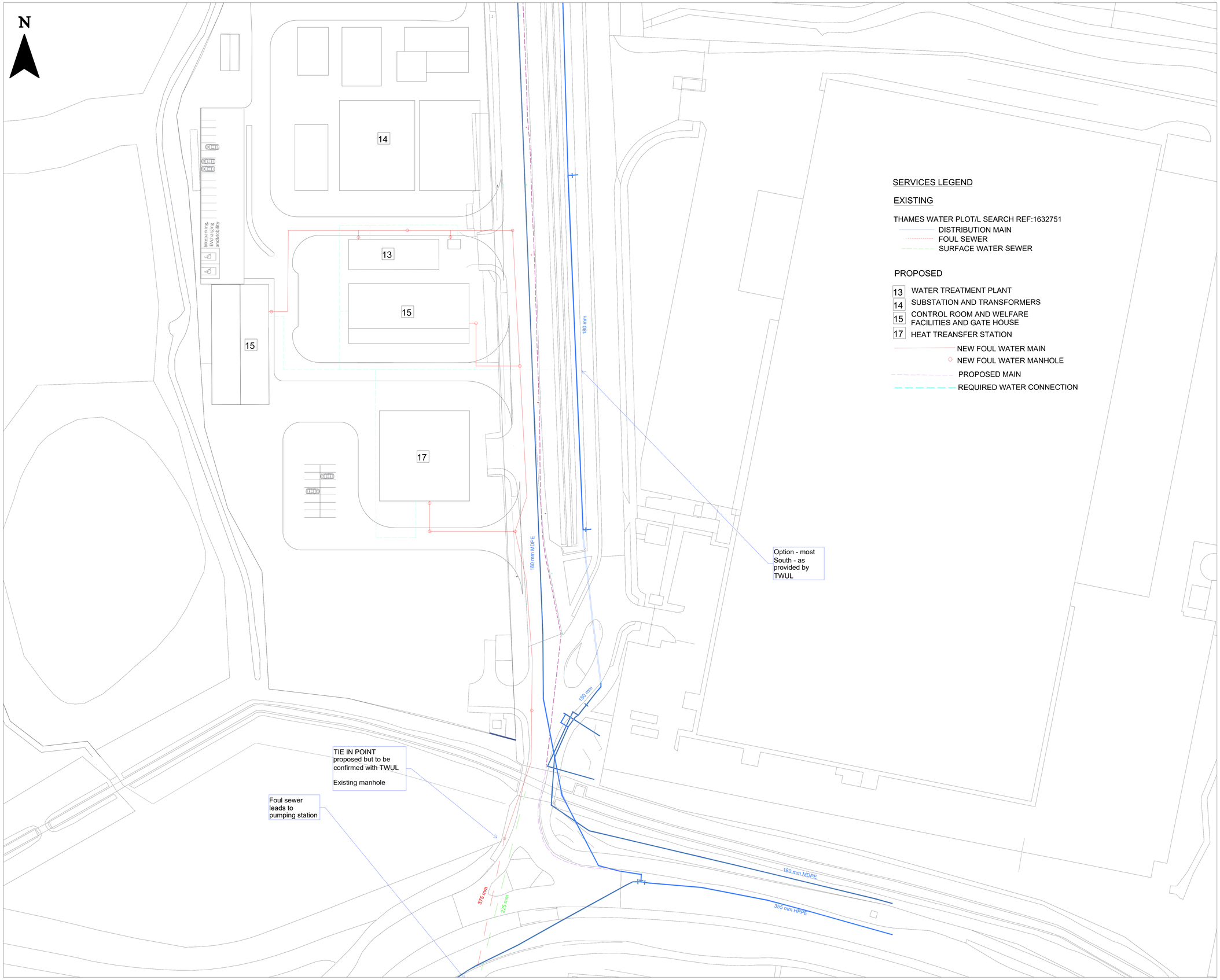

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Legend

DO NOT SCALE

Health and Safety Symbols Legend

- INDICATES A RESIDUAL RISK REQUIRING A COMPULSORY ACTION
- CONVEYS INFORMATION ABOUT A RESIDUAL RISK
- INDICATES A RESIDUAL RISK REQUIRING A SPECIFIC ACTION TO BE AVOIDED.
- WARNS OF A RESIDUAL RISK OR INFORMATION THAT IS UNUSUAL AND CANNOT BE DESIGNED OUT.
- INDICATES AN ENVIRONMENTAL HAZARD.

Construction Risks	Operation/Maintenance Risks	Demolition/Adaptation Risks
	D10. Risk of vehicle fire. Fire strategy to be confirmed at later design stages to ensure adequate emergency vehicle access.	

The table above is provided to assist the Principal Contractor to fulfil their obligations under the Construction (Design and Management) Regulations 2015. Any residual risks identified by the competent Contractor will be aware of but does it absolve the Principal Contractor of their legal responsibilities.

REFERENCE DRAWINGS

FOR DETAILS OF THE INDICATIVE PLANT LAYOUT REFER TO: 70090329-WSP-01-XX-DG-PL-001

NOTES

1. ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE PRIOR TO ANY SITE ACTIVITIES TAKING PLACE.
2. ENGINEER / EMPLOYERS REPRESENTATIVE TO BE INFORMED BY THE CONTRACTOR OF ANY DISCREPANCIES BEFORE ANY SITE WORK COMMENCES.
3. THE CONTRACTOR IS RESPONSIBLE FOR UNDERTAKING A THOROUGH CHECK FOR THE ACTUAL LOCATION OF ANY / ALL SERVICES AND UTILITIES, ABOVE AND BELOW GROUND, BEFORE ANY SITE WORK COMMENCES.
4. ALL UTILITIES AND SERVICES ARE SHOWN INDICATIVELY FOR THE PURPOSES OF THE PRE-FEED DESIGN AND ARE TO BE CONFIRMED AT DETAILED DESIGN STAGE.

REVISION	DRAWN	CHECKED	APPROVED	DATE
P01	TH	MR	MR	15/08/2023
FIRST DRAFT ISSUE				
S0 - WORK IN PROGRESS				

8 First Street, Manchester, M15 4GU, UK
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PROJECT TITLE:

CORY DECARBONISATION PROJECT

DRAWING TITLE:

Utilities - Water and Wastewater

CONFIDENTIALITY: CONFIDENTIAL

DRAWN:	CHECKED:	APPROVED:	AUTHORISED:
PM	MR	MR	MR

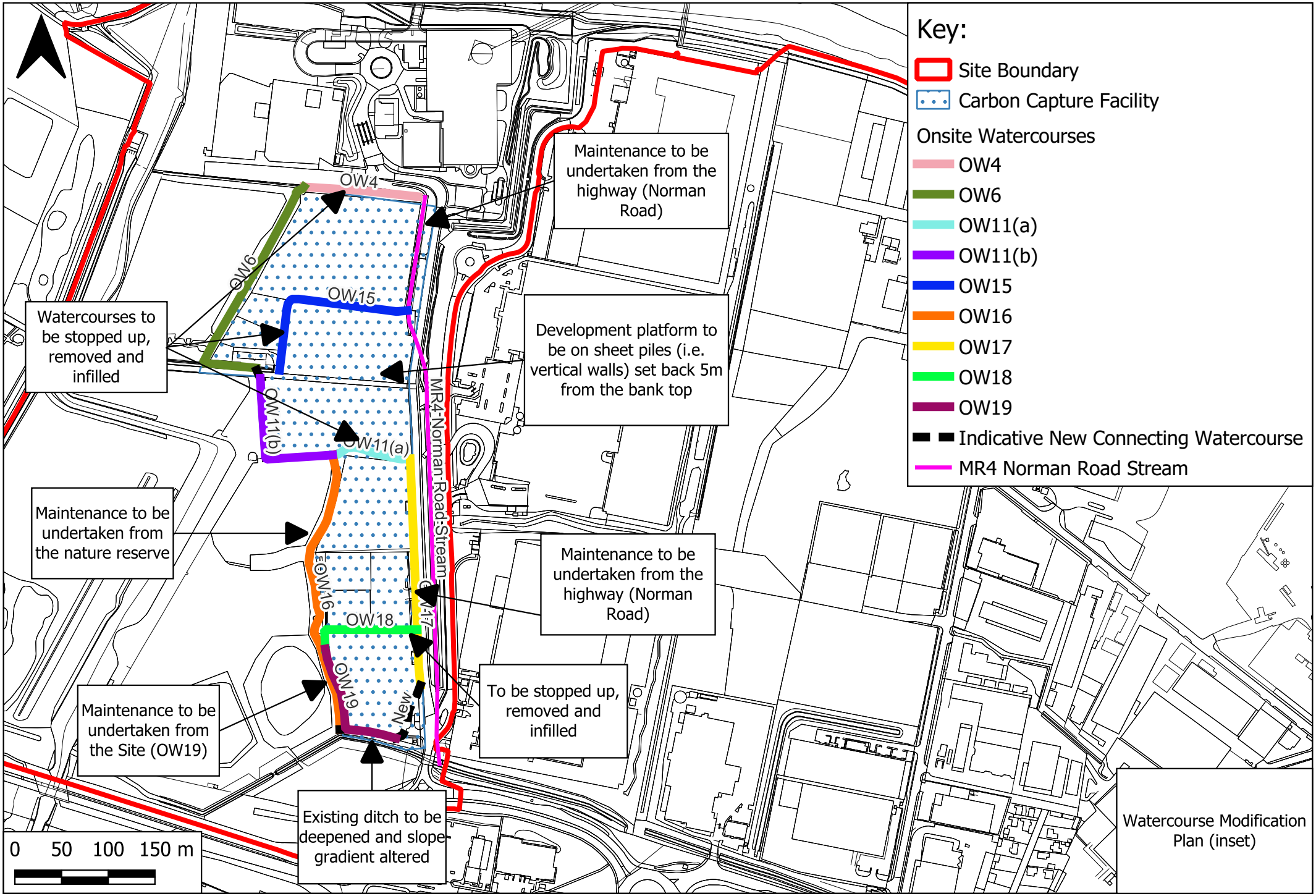
SCALE @ A0 SIZE:	DATE:	REVISION:
1:100 @ A0	16/08/2023	P01

DRAWING NUMBER:

EN010128-01-XX-DG-UT--0001

Appendix G

PROPOSED WATERCOURSE MODIFICATIONS



Appendix H

TYPICAL MAINTENANCE MEASURES

Operation and Maintenance Requirements for Filter Drains (Source: The SuDS Manual, CIRIA 2015)

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly (or as required)
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (eg NJUG, 2007 or BS 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

Operation and Maintenance Requirements for Attenuation Basin (Source: The SuDS Manual, CIRIA 2015)

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly
	Cut grass – for spillways and access routes	Monthly (during growing season), or as required
	Cut grass – meadow grass in and around basin	Half yearly (spring – before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually (as set out in Chapter 23)
Occasional maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

Hydro International®

Operation and Maintenance Manual

Downstream Defender®

Vortex Separator for Stormwater Treatment

Turning Water Around ...®

Table of Contents

Hydro International (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

Downstream Defender® by Hydro International

The Downstream Defender® is an advanced Hydrodynamic Vortex Separator designed to provide high removal efficiencies of settleable solids and their associated pollutants, oil, and floatables over a wide range of flow rates.

The Downstream Defender® has unique, flow-modifying internal components developed from extensive full-scale testing, CFD modeling and over thirty years of hydrodynamic separation experience in wastewater, combined sewer and stormwater applications. These internal components distinguish the Downstream Defender® from simple swirl-type devices and conventional oil/grit separators by minimizing turbulence and headlosses, enhancing separation, and preventing washout of previously stored pollutants.

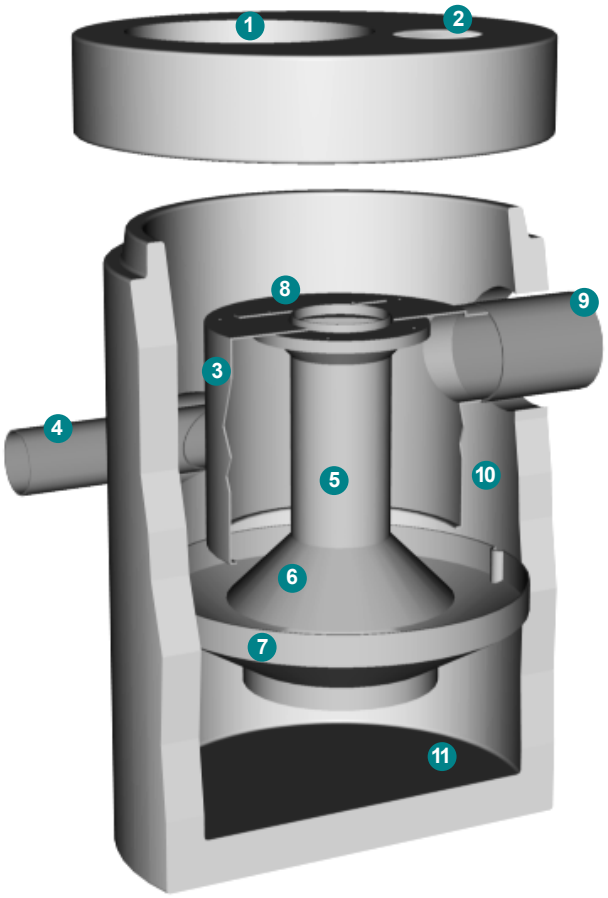
The high removal efficiencies and inherent low headlosses of the Downstream Defender® allow for a small footprint making it a compact and economical solution for the treatment of non-point source pollution.

Benefits of the Downstream Defender®

- Removes sediment, floatables, oil and grease
- No pollutant washouts
- Small footprint
- No loss of treatment capacity between clean-outs
- Low headloss
- Efficient over a wide ranges of flows
- Easy to install
- Low maintenance

Applications

- New developments and retrofits
- Utility yards
- Streets and roadways
- Parking lots
- Pre-treatment for filters, infiltration and storage
- Industrial and commercial facilities
- Wetlands protection



Downstream Defender® Components

1. Central Access Port
2. Floatables Access Port (6-ft., 8-ft. and 10-ft. models only)
3. Dip Plate
4. Tangential Inlet
5. Center Shaft
6. Center Cone
7. Benching Skirt
8. Floatables Lid
9. Outlet Pipe
10. Floatables Storage
11. Isolated Sediment Storage Zone

Operation

Introduction

The Downstream Defender® operates on simple fluid hydraulics. It is self-activating, has no moving parts, no external power requirement and is fabricated with durable non-corrosive components. No manual procedures are required to operate the unit and maintenance is limited to monitoring accumulations of stored pollutants and periodic clean-outs. The Downstream Defender® has been designed to allow for easy and safe access for inspection/monitoring and clean-out procedures. Entry into the unit or removal of the internal components is not necessary for maintenance, thus safety concerns related to confined-space-entry are avoided.

Pollutant Capture and Retention

The internal components of the Downstream Defender® have been designed to protect the oil, floatables and sediment storage volumes so that separator performance is not reduced as pollutants accumulate between clean-outs. Additionally, the Downstream Defender® is designed and installed into the storm drain system so that the vessel remains wet between storm events. Oil and floatables are stored on the water surface in the outer annulus separate from the sediment storage volume in the sump of the unit providing the option for separate oil disposal, and accessories such as adsorbant pads. Since the oil/floatables and sediment storage volumes are isolated from the active separation region, the potential for re-suspension and washout of stored pollutants between clean-outs is minimized.

Wet Sump

The sump of the Downstream Defender® retains a standing water level between storm events. The water in the sump prevents stored sediment from solidifying in the base of the unit. The clean-out procedure becomes more difficult and labor intensive if the system allows fine sediment to dry-out and consolidate. Dried sediment must be manually removed by maintenance crews. This is a labor intensive operation in a hazardous environment.

Blockage Protection

The Downstream Defender® has large clear openings and no internal restrictions or weirs, minimizing the risk of blockage and hydraulic losses. In addition to increasing the system headloss, orifices and internal weirs can increase the risk of blockage within the unit.

Maintenance

Overview

The Downstream Defender® protects the environment by removing a wide range of pollutants from stormwater runoff. Periodic removal of these captured pollutants is essential to the continuous, long-term functioning of the Downstream Defender®. The Downstream Defender® will capture and retain sediment and oil until the sediment and oil storage volumes are full to capacity. When sediment and oil storage capacities are reached, the Downstream Defender® will no longer be able to store removed sediment and oil. Maximum pollutant storage capacities are provided in Table 1.

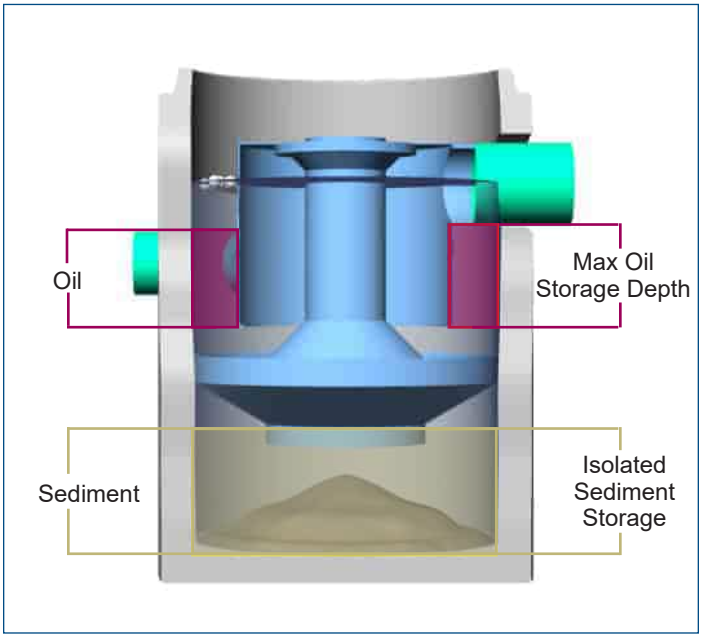


Fig.1 Pollutant storage volumes of the Downswtream Defender®.

The Downstream Defender® allows for easy and safe inspection, monitoring and clean-out procedures. A commercially or municipally owned sump-vac is used to remove captured sediment and floatables. Access ports are located in the top of the manhole. On the 6-ft, 8-ft and 10-ft units, the floatables access port is above the outlet pipe between the concrete manhole wall and the dip plate. The sediment removal access ports for all Downstream Defender® models are located directly over the hollow center shaft.

Maintenance events may include Inspection, Oil & Floatables Removal, and Sediment Removal. Maintenance events do not require entry into the Downstream Defender®, nor do they require the internal components of the Downstream Defender® to be removed. In the case of inspection and floatables removal, a vactor truck is not required. However, a vactor truck is required if the maintenance event is to include oil removal and/or sediment removal.

Determining Your Maintenance Schedule

The frequency of cleanout is determined in the field after installation. During the first year of operation, the unit should be inspected every six months to determine the rate of sediment and floatables accumulation. A simple probe such as a Sludge Judge® can be used to determine the level of accumulated solids stored in the sump. This information can be recorded in the maintenance log (see page 9) to establish a routine maintenance schedule.

The vactor procedure, including both sediment and oil/flotables removal, for a 6-ft Downstream Defender® typically takes less than 30 minutes and removes a combined water/oil volume of about 500 gallons.

Inspection Procedures

Inspection is a simple process that does not involve entry into the Downstream Defender®. Maintenance crews should be familiar with the Downstream Defender® and its components prior to inspection.

Scheduling

- It is important to inspect your Downstream Defender® every six months during the first year of operation to determine your site-specific rate of pollutant accumulation
- Typically, inspection may be conducted during any season of the year
- Sediment removal is not required unless sediment depths exceed 75% of maximum clean-out depths stated in Table 1

Recommended Equipment

- Safety Equipment and Personal Protective Equipment (traffic cones, work gloves, etc.)
- Crow bar or other tool to remove grate or lid
- Pole with skimmer or net
- Sediment probe (such as a Sludge Judge®)
- Trash bag for removed floatables
- Downstream Defender® Maintenance Log

Table 1. Downstream Defender® Pollutant Storage Capacities and Max. Cleanout Depths.

Unit Diameter	Total Oil Storage	Oil Clean-out Depth	Total Sediment Storage	Sediment Clean-out Depth	Max. Liquid Volume Removed
(feet)	(gallons)	(inches)	(gallons)	(inches)	(gallons)
4	70	<16	141	<18	384
6	216	<23	424	<24	1,239
8	540	<33	939	<30	2,884
10	1,050	<42	1,757	<36	5,546
12	1,770	<49	2,970	<42	9,460

NOTES

1. Refer to Dowmstream Defender® Clean-out Detail (Fig. 1) for measurement of depths.

2. Oil accumulation is typically less than sediment, however, removal of oil and sediment during the same service is recommended.

3. Remove floatables first, then remove sediment storage volume.

4. Sediment removal is not required unless sediment depths exceed 75% of maximum clean-out depths stated in Table 1.


Fig.4


Fig.5


Fig.6

Inspection Procedures

1. Set up any necessary safety equipment around the access port or grate of the Downstream Defender® as stipulated by local ordinances. Safety equipment should notify passing pedestrian and road traffic that work is being done.

2. Remove the lids to the manhole (Fig. 4). NOTE: The 4-ft Downstream Defender® will only have one lid.

3. Without entering the vessel, look down into the chamber to inspect the inside. Make note of any irregularities. See Fig.7 and 8 for typical inspection views.

4. Without entering the vessel, use the pole with the skimmer net to remove floatables and loose debris from the outer annulus of the chamber.

5. Using a sediment probe such as a Sludge Judge®, measure the depth of sediment that has collected in the sump of the vessel (Fig.5).

6. On the Maintenance Log (see page 9), record the date, unit location, estimated volume of floatables and gross debris removed, and the depth of sediment measured. Also note any apparent irregularities such as damaged components or blockages.

7. Securely replace the grate or lid.

8. Take down safety equipment.

9. Notify Hydro International of any irregularities noted during inspection.

Floatables and Sediment Cleanout

Floatables cleanout is typically done in conjunction with sediment removal. A commercially or municipally owned sump-vac is used to remove captured sediment and floatables (Fig.6).

Floatables and loose debris can also be netted with a skimmer and pole. The access port located at the top of the manhole provides unobstructed access for a vactor hose and skimmer pole to be lowered to the base of the sump.

Scheduling

- Floatables and sump cleanout are typically conducted once a year during any season.
- If sediment depths are greater than 75% of maximum clean-out depths stated in Table 1, sediment removal is required.
- Floatables and sump cleanout should occur as soon as possible following a spill in the contributing drainage area.


Fig.7 View over center shaft into sediment storage zone.


Fig.8 View of outer annulus of floatables and oil collection zone.

Recommended Equipment

- Safety Equipment (traffic cones, etc)
- Crow bar or other tool to remove grate or lid
- Pole with skimmer or net (if only floatables are being removed)
- Sediment probe (such as a Sludge Judge®)
- Vactor truck (6-inch flexible hose recommended)
- Downstream Defender® Maintenance Log

1. Set up any necessary safety equipment around the access port or grate of the Downstream Defender® as stipulated by local ordinances. Safety equipment should notify passing pedestrian and road traffic that work is being done.
2. Remove the lids to the manhole (NOTE: The 4-ft Downstream Defender® will only have one lid).
3. Without entering the vessel, look down into the chamber to inspect the inside. Make note of any irregularities.
4. Using the Floatables Port for access, remove oil and floatables stored on the surface of the water with the vactor hose or the skimmer net (Fig.9).
5. Using a sediment probe such as a Sludge Judge®, measure the depth of sediment that has collected in the sump of the vessel and record it in the Maintenance Log (Pg.9).
6. Once all floatables have been removed, drop the vactor hose to the base of the sump via the Central Access Port. Vactor out the sediment and gross debris off the sump floor (Fig.6).
7. Retract the vactor hose from the vessel.
8. On the Maintenance Log provided by Hydro International, record the date, unit location, estimated volume of floatables and gross debris removed, and the depth of sediment measured. Also note any apparent irregularities such as damaged components or blockages.
9. Securely replace the grate or lid.

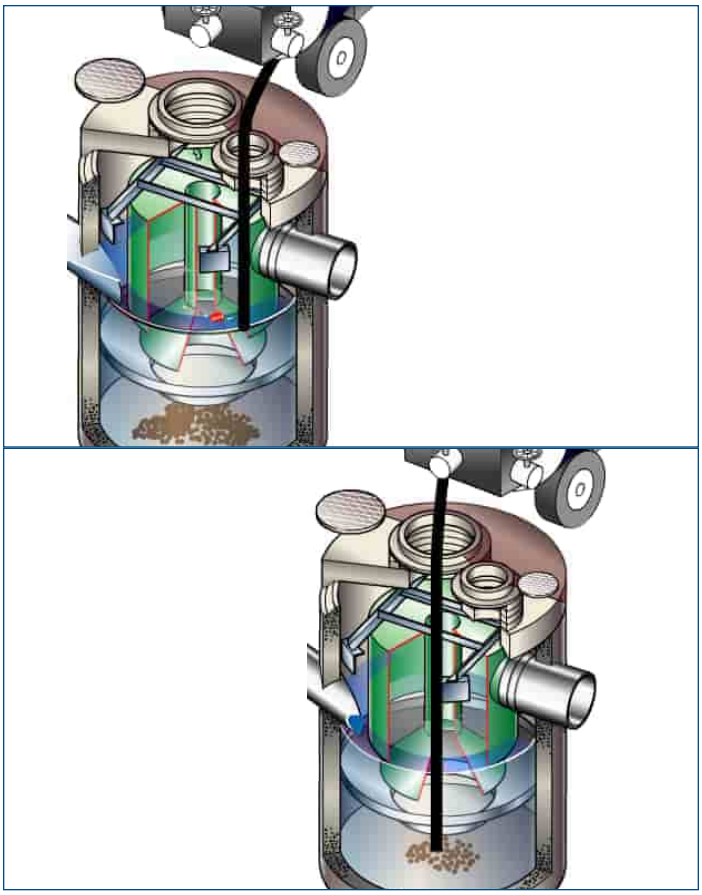


Fig.9 Floatables and sediment are removed with a vactor hose

Maintenance at a Glance

Activity	Frequency
Inspection	- Regularly during first year of installation - Every 6 months after the first year of installation
Oil and Floatables Removal	- Once per year, with sediment removal - Following a spill in the drainage area
Sediment Removal	- Once per year or as needed - Following a spill in the drainage area
NOTE: For most cleanouts it is not necessary to remove the entire volume of liquid in the vessel. Only removing the first few inches of oils/floatables and the sediment storage volume is required.	

Downstream Defender® Installation Log

HYDRO INTERNATIONAL REFERENCE NUMBER:	
SITE NAME:	
SITE LOCATION:	
OWNER:	CONTRACTOR:
CONTACT NAME:	CONTACT NAME:
COMPANY NAME:	COMPANY NAME:
ADDRESS:	ADDRESS:
TELEPHONE:	TELEPHONE:
FAX:	FAX:

INSTALLATION DATE: / /

MODEL (CIRCLE ONE): **4-FT** **6-FT** **8-FT** **10-FT** **CUSTOM**

Hydro International (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

Downstream Defender® Inspection and Maintenance Log

Date	Initials	Depth of Floatables and Oils	Sediment * Depth Measured	Volume of Sediment Removed	Site Activity and Comments

*Note: Sediment removal is not required unless sediment depths exceed 75% of maximum clean-out depths stated in Table 1.

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