GREATER CAMBRIDGE PARTNERSHIP

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Member of the SNC-Lavalin Group

Cambridge South East Transport Phase 2

Surface Water Drainage Strategy Report

Greater Cambridge Partnership

5212868-ATK-HDG-WHL_SCHME-RP-CD-000001

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Client signoff

Client	Greater Cambridge Partnership
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Glossary

Acronym	Definition
AEP	Annual Exceedance Probability
AOD	Above Ordnance Datum
ATK	Atkins
BGS	British Geological Survey
BIM	Building Information Modelling
BRE	Building Research Establishment
CBC	Cambridge Biomedical Campus
CCC	Cambridgeshire County Council
CSET	Cambridge South East Transport
EA	Environment Agency
FCA	Francis Crick Avenue
FSR	Flood Studies Report
GCP	Greater Cambridge Partnership
GI	Ground Investigation
HQPT	High Quality Public Transport
LIDAR	Light Detection and Ranging
LLFA	Local Lead Flood Authority
SPZ	Source Protection Zone
SuDS	Sustainable Drainage Systems
TWAO	Transport and Works Act Order

Executive Summary

The Cambridge South East Transport scheme aims to deliver a new High Quality Public Transport route and associated infrastructure between a travel hub facility near the A11 Junction and Cambridge Biomedical Campus (CBC), southeast of Cambridge. The route will also comprise a new Active Travel Path (ATP) for pedestrians, cyclists and equestrians generally three metres wide, would be built alongside the new public transport route. The scheme aims to provide a dedicated public transport corridor for people travelling to Cambridge from towns and villages to its southeast, whilst providing additional transport capacity for developments proposed and planned within Greater Cambridge, to alleviate the impact of future growth along the corridor.

The route will connect to the existing guided busway at the CBC along Francis Crick Avenue (FCA). The route will run via Sawston, Stapleford.

The purpose of this report and accompanying drawings is to present a drainage strategy for the proposed scheme following Guidance from CIRIA SuDS Manual (C753) and Cambridgeshire County Council Surface Water Drainage Guidance for Developers (November 2019). This report demonstrates that the proposed scheme can be effectively drained and can protect downstream areas from increased flood risk. It assesses the alignment against existing overland flow paths. Where the scheme bisects overland flow paths, methods of interception are indicated with routes provided under the scheme to ensure it does not negatively impact existing drainage catchments.

The proposed HQPT Route is divided into six sections. Section 1, i.e., Francis Crick Avenue is approximately 630m long in total with a 10m wide carriageway and 1.5m wide footways on either side. For Francis Crick Avenue surface water runoff from the road and footway is proposed to be collected and conveyed using carrier drain, filter drain, slot drain and ditches to the existing attenuation basins. Based on the high point and low point the runoff from chainage 20 to chainage 140 is conveyed to the existing attenuation basin on the north portion. The runoff from the other part of the networks i.e., runoff from chainage 140 to 480 is conveyed to the existing attenuation basin on the south portion. The surface water discharge rate into the ponds will be restricted to a maximum of 2 l/s/ha using a flow control device. This flow rate value is based on the impermeable catchment areas only, calculated using the FSR method. Infiltration is not considered due to ground conditions being anticipated to have low permeability. Infiltration should be considered at the next stage of design when results of ground investigation are available with the drainage strategy modified to suit, and attenuation volumes recalculated as necessary.

For sections 2 to 6, it is proposed that the surface water from the route enters filter drains and swales along the route or via carrier pipes where private land, embankments, cuttings or bridge structures do not allow for a swale or filter drains. The full length of the route from Section 2 to Section 6 is divided into seven catchments. This catchment division is based on the high and low points along the route and the availability of outfall locations. The catchments levels range from 14.475mAOD to 37.618mAOD with undulating landscape. It is proposed that the required surface water attenuation will be provided using a combination of filter drains, permeable pavements, conveyance swales and ponds, based on the maximum storage required which is estimated by considering FSR Rainfall, impermeable area of the catchment, maximum allowable discharge and 40% climate change. Based on the storage assessments, the requirement of ponds needs assessment. If the available storage from the proposed filter drains, swales and permeable pavements is observed to be greater than the storage requirement, then ponds are not proposed. Alternatively, ponds or larger carrier pipes are proposed to accommodate the storage requirement.

Appropriate water treatment is to be provided and treatment levels will be checked against the minimum water quality management requirements as set out in the CIRIA guide together with the CIRIA simple index approach method to ensure that adequate water quality is included.

1. Introduction

1.1. Background

Greater Cambridge Partnership are proposing the A1307 Cambridge South East Transport Phase 2 Scheme. This will involve constructing a new High Quality Public Transport (HQPT) route and associated infrastructure between a travel hub facility near the A11 Junction and Cambridge Biomedical Campus (CBC), southeast of Cambridge. Atkins Limited, a member of the SNC Lavalin Group, has been commissioned by Greater Cambridge Partnership to prepare a surface water drainage strategy for Cambridge South East Transport Public Transport and Active Travel Proposed Scheme (CSET).

The scheme aims to provide a dedicated public transport corridor for people travelling to Cambridge from towns and villages to its southeast, while providing additional transport capacity for developments proposed and planned within Greater Cambridge to alleviate the impact of future growth along the corridor.

The scheme comprises of three key elements including a new High Quality Public Transport (HQPT) route or priority measures between the A11 Travel Hub and Cambridge, a new Travel Hub site off the A1307 / A11 and new cycling / walking facilities via a parallel active travel corridor.

This report focuses on the surface water drainage strategy for the Francis Crick Avenue and HQPT route between the Dame Mary Archer Roundabout and A11 Travel Hub.

1.2. Proposed Works

The proposed works for the scheme are listed below:

- A new dedicated HQPT route approximately 7.3m wide between the A11 Travel Hub and Cambridge Biomedical Campus (See Table 1-1), the majority of which is to be a dedicated transport route. However, within the CBC it utilises existing roads such as Francis Crick Avenue (FCA).
- Earthworks to form the dedicated HQPT route between the A11 Travel Hub and Cambridge, including cuttings / embankments along the HQPT route alignment.
- Potential modifications to culverts and ditches along the scheme.
- A new Travel Hub site off the A1307 / A11 and associated ancillary infrastructure.
- Construction of a new active travel route for cycling / walking facilities, running adjacent to or in proximity of the HQPT route.
- Ancillary works including signal-controlled junctions, junction upgrades, tie-ins to existing infrastructure, lighting, and landscaping.
- Upgrades to Francis Crick Avenue to create segregated HQPT lanes along the road.

A common understanding of how the route has been divided and referred to is summarised below in Table 1-1

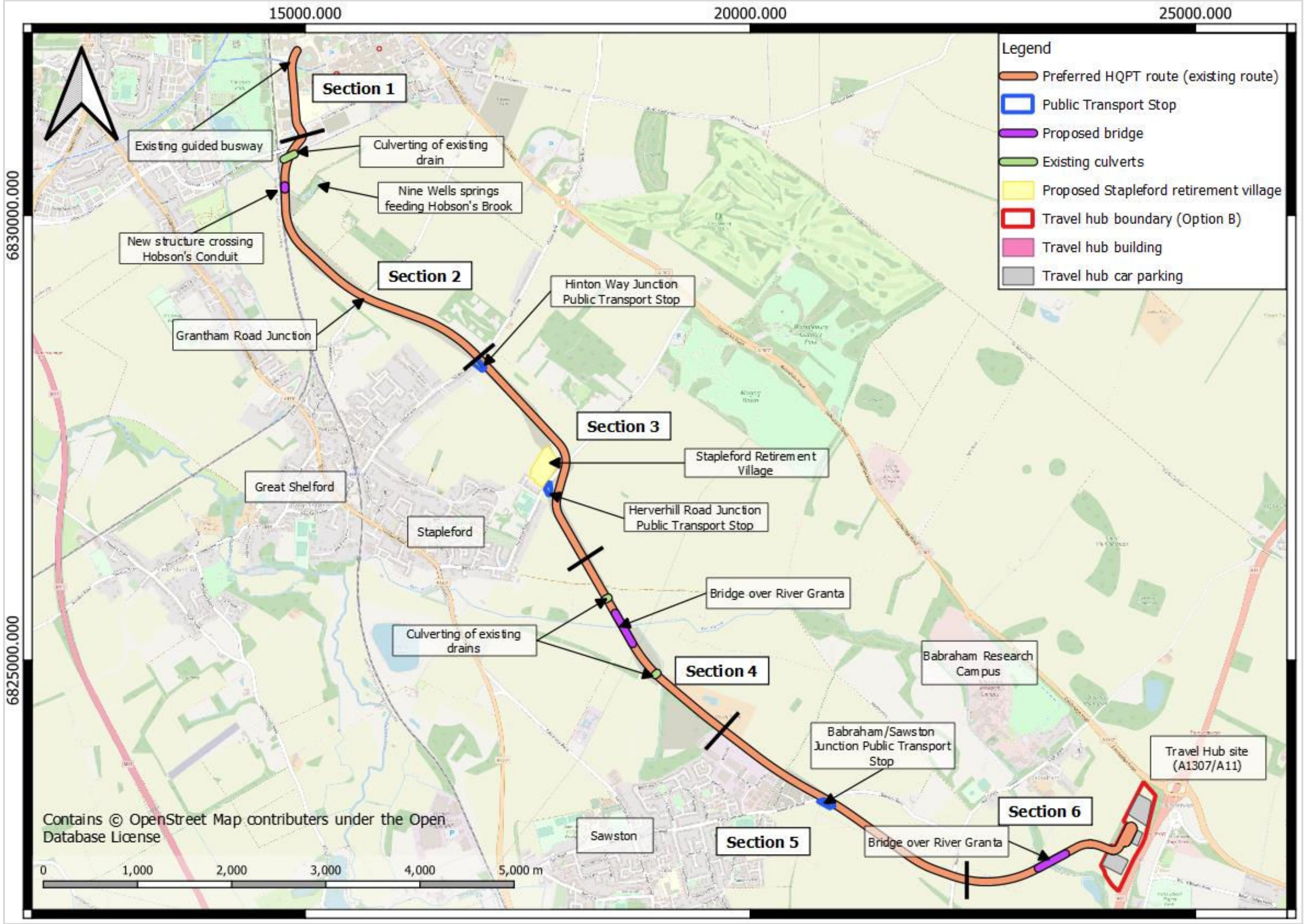

Figure 1-1 - Summary of general arrangement along preferred route alignment

Table 1-1 – Summary of Sections

Section	Chainage (m)	Description of the section
Section 1	20 to 500	Approximately 0.5 km of public service route along Francis Crick Avenue. It is likely to consist of segregated PT lanes and new, segregated active travel measures with PT stops forming an interchange with the proposed Cambridge South Station and other public transport services on the CBC.
Section 2	500 to 2800	Approximately 2.3 km of public service route commencing at the roundabout on Dame Mary Archer Way through to Hinton Way. Some 0.5 km of this route runs parallel to the National Rail railway line and passed the Nine Wells Nature Reserve.
Section 3	2800 to 4600	Approximately 1.8 km of public service route commencing at Hinton Way to 840 m beyond Haverhill Road.
Section 4	4600 to 6065	Approximately 1.4 km of public service route commencing from the end of section 3 to West way.
Section 5	6065 to 8065	Approximately 2 km of public service route commencing at the end of section 4 which runs to the south-east of Sawston. This includes the stop provisions at Haverhill Road and Sawston Road and the design of the crossing with Sawston Road.
Section 6	8065 to 9269	Approximately 1.2 km of public service route commencing from the end of section 5 to A11 Travel Hub.

Table 1-2 – Changes in the division of sections

Section	Extent of section as per Mott Macdonald			Extent of Section as per Atkins			Difference between the extent of sections of Mott Macdonald & Atkins (m)
	Start Chainage (m)	End Chainage (m)	Chainage Extent (m)	Start Chainage (m)	End Chainage (m)	Chainage Extent (m)	
Section 1	20	500	480	20	500	480	-
Section 2	500	1890	1390	500	2800	2300	910
Section 3	1890	2780	890	2800	4600	1800	910
Section 4	2780	3755	975	4600	6065	1465	490
Section 5	3755	6855	3100	6065	8065	2000	-1100
Section 6	6855	9269	2414	8065	9269	1204	1210

1.3. Scope of works

The purpose of this report and accompanying drawings is to present a drainage strategy for the proposed scheme. This report demonstrates that the proposed scheme can be effectively drained and can protect downstream areas from increased flood risk.

It assesses the alignment against existing overland flow paths. Where the scheme bisects overland flow paths, methods of interception are indicated with routes provided under the scheme to ensure it does not negatively impact existing drainage catchments.

This report underlines the design philosophy where the proposed drainage drawings can be found in Appendix A – Proposed Drainage Drawings.

1.4. Basis of design

Following Guidance from CIRIA SuDS Manual (C753) and Cambridgeshire County Council Surface Water Drainage Guidance for Developers (November 2019), a drainage network utilising SuDS structures is proposed to:

- Ensure that surface water drainage is managed as close to the source as possible and to maintain natural ground conditions.
- Provide at-source pollution control without the need for proprietary treatment systems where possible.
- Limit discharge rates to greenfield run-off rates to protect downstream watercourses and areas.
- To attenuate run-off up to the critical rainfall event and minimise flooding for the exceedance rainfall event.

1.5. Assumptions

1.5.1. General Assumptions

The Scope set out in this note relates to the work required up to the submission of the TWAO application, as follows:

- Based on current information and discussions with GCP, the scope below relates to the 12 month duration between 1 April 2022 and 3 April 2023. The programme is not fully agreed and that any changes identified and agreed between GCP and Atkins will be reflected in future compensation events.
- The work to develop the design changes and related assessments does not reflect any additional updates / revisions from the due diligence process or pre-application changes arising from public consultation/stakeholder engagement or third-party representations.
- Atkins will be able to defend the design changes as noted in section 2.4 and would be in a position to defend additional issues raised as part of due diligence, where the client has agreed for Atkins to make subsequent design alterations and revise related assessments and documents. It is anticipated that issues raised as part of due diligence will trigger a discussion with the client to agree how the issue is to be treated for the TWAO application.
- Limitations of models and data for future exchanges – requirements will be detailed in the project BIM Execution Plan (BEP). These are to be agreed with GCP and CCC (as eventual asset owner). The design development will follow the format of the MMD design, where there are no contract specific Employers Information Requirements (EIR).

1.5.2. Drainage Specific Assumptions

The following supporting information will be available to support the drainage review:

- Available ground investigation information (inc. confirmation of groundwater levels and infiltration testing in accordance with BRE365).
- Topographical survey / LIDAR Data - confirm the level of existing outfalls and existing catchments.
- Drainage survey of existing infrastructure.
- As-built drainage design information for existing infrastructure.
- Design flood levels for watercourses which cross the scheme.
- Calculations and/or hydraulic models used to design and size assets such as attenuation ponds, filter drains, combined kerb drainage, gullies, carrier drains, attenuation tanks, permeable paving, filter trenches, swales and foul water drainage.
- Calculations used to determine existing and proposed discharge rates.
- Existing and proposed catchments areas for the scheme in AutoCAD version 2013.
- Available information on the size, level and location of existing and proposed utilities.
- AutoCAD 2013 versions of the 17no. drainage general arrangements drawings.
- Proposed 3D surface for the proposed scheme.
- Correspondence with the Environment Agency, Lead Local Flood Authority and Internal Drainage Board.

1.6. References

The following documents have been used to inform the drainage strategy proposed in this document:

● Cambridgeshire County Council Surface Water Drainage Guidance for Developers (June 2021).

● Cambridgeshire County Council - SuDS Design & Adoption.

● Water UK - Design and Construction Guidance – DCG (March 2020).

● Sewers for Adoption 7th Edition.

● CIRIA SuDS Manual (C753), 2015;

● Design Manual for Roads and Bridges (DMRB) - CG 501 Design of highway drainage systems (March 2020).

● DMRB - CD 531 Reservoir pavements for drainage attenuation (March 2020).

● BRE365 Soakaway Design (2016)

● Department for Environment, Food and Rural Affairs (DEFRA), Sustainable Drainage Systems, Non-statutory technical standards for sustainable drainage systems (March 2015).

● Mott MacDonald information in ProjectWise and/or GCP SharePoint

2. General Basis of Design

2.1. Geology

The A1307 Cambridge South East Transport - Phase 2, Ground Investigation Report indicates that the scheme is underlain by superficial deposits of Alluvium, River Terrace Deposits and Glaciogenic Deposits of the Lowestoft Formation. Superficial deposits overlie bedrock of the White Chalk Subgroup, from youngest to oldest, (Middle Chalk) comprising the Newpit Chalk Formation and Holywell Nodular Chalk Formation. This is further underlain by the Grey Chalk Subgroup (Lower Chalk) comprising the Zig Zag Formation and the West Melbury Marly Chalk Formation.

2.2. Hydrology

The CSET scheme crosses or passes near to several water features as noted below:

- Section 1: Existing ponds to the west of Francis Crick Avenue.
- Section 2: Hobsons Brook which is fed by the Nine Wells Springs and is a protected heritage asset.
- Section 5 & 6: River Granta including its associated flood plain is crossed twice, once between Stapleford and Sawston and again just south of Babraham before the route enters the Travel Hub location.

There are also a number of smaller ditches which feed into the River Granta along the route.

2.3. Hydrogeology

The CSET Scheme is situated on outcropping chalk except where it crosses the River Granta, where there are superficial River Terrace Gravels and Alluvium associated with the River Granta valley.

From the CBC to Sawston the route is situated on Grey Chalk Sub-Group formations, and from Sawston to the Travel Hub site the area is underlain by White Chalk Sub-Group formations.

The Travel Hub Site is largely situated on outcropping chalk but may have some areas of River Terrace Gravels around the edge of the site.

There are springs emerging from the Totternhoe Stone at the base of the Zig Zag Formation in the Nine Wells nature reserve. There are no other identified springs within the Scheme study area, the area is typical of a chalk catchment.

All options are underlain by the chalk formations described briefly above, and all form a single Principal Aquifer as defined by the Environment Agency (EA). This aquifer provides a high level of groundwater storage, supports conveyance of good quality groundwater in the area and is used by several groundwater abstractions for public water supplies. Groundwater in the chalk flows broadly from the high topographic areas (e.g., under the Gog Magog hills) north / north westwards towards the River Granta and River Cam valleys. Any shallow groundwater in the superficial deposits is likely to be flowing under topographic control towards and along the River Granta Valley.

There are three abstractions and associated SPZ1 within 400m of the route between Sawston and Babraham. There are other SPZ1 (abstractions) further south, but these are hydraulically upgradient of the Scheme. The route crosses the SPZ2 and SPZ3 associated with the two public abstractions near Babraham and one abstraction in Sawston.

2.4. Flood Risk

As noted in Section 2.2 above, the route crosses the River Granta at two locations but the scheme has been designed to utilise bridges and embankments whereby some of the abutments will be located within the floodplain to reduce the structural size of the river crossings. Where piers etc are to be located in the floodplain, compensation has been identified. The rest of the route sits primarily in Flood Zone 1.

2.5. Ground investigation report

A ground investigation was designed and specified by Mott MacDonald and was undertaken by Tetra Tech and their subcontractors between 08 February and 04 June 2021. Mott MacDonald provided full time technical supervision during the ground investigation works in order to confirm that the works were in accordance with the issued GI Specification.

The preferred route has been divided into six sections, which will be assessed within this report. These sections are based on the Atkins design development for the proposed works. Current chainages slightly differ to that set out within the Mott MacDonald Corridor Design Report.

Table 2-1 - Route sectioning and chainages

Section	Location	Start Chainage (m)	End Chainage (m)
1	Cambridge Biomedical Campus to Dame Mary Archer Roundabout	0	500
2	Dame Mary Archer Roundabout to Hinton Way. Grahams Fields	500	2800
3	Hinton Way to public footpath leading from Bury Road	2800	4600
4	Public footpath to North Farm	4600	6070
5	West Way to High Street	6070	8070
6	High Street to A11 Travel Hub	8070	9270

Notes

Chainages rounded to the nearest 10m

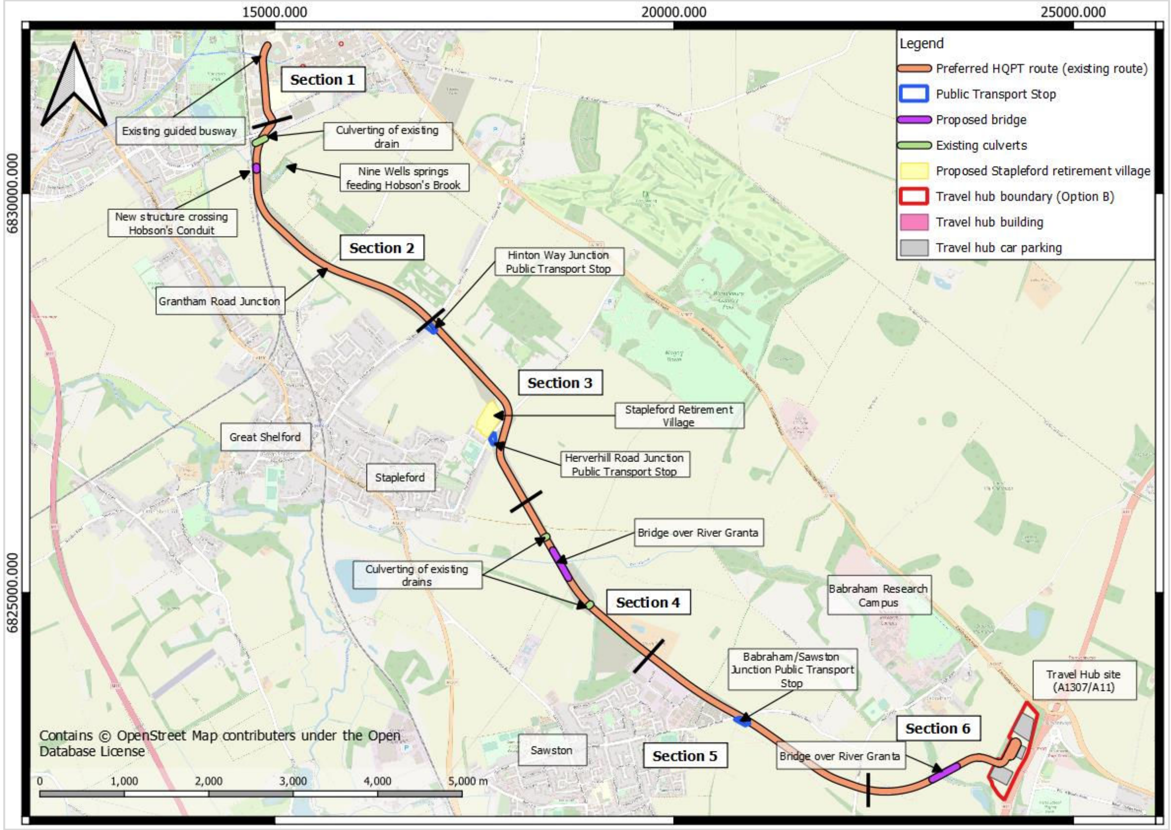

Figure 2-1 - Summary of general arrangement along preferred route alignment

2.5.1. Assumptions and limitations

The ground investigation report has been produced subject to the following assumptions and limitations:

1. The findings contained in this report are based on information obtained from a variety of sources detailed in this report, which are considered to be reliable. No responsibility can be accepted by Atkins for the accuracy of the third-party information including reference data contained within site specific database reports.
2. This report provides factual information pertaining to the ground investigation. This report presents an interpretation of ground conditions and geotechnical parameters to inform design. The interpretation of parameters has been based on Atkins understanding of the scheme, and assumptions about parameters for design.
3. This report is prepared and written in the context of an agreed scope of work and should not be used in a different context. Furthermore, new information, improved practices and changes in legislation may necessitate a re-interpretation of the report in whole or in part after its 6 submissions.
4. Due to the inherent variability of the ground conditions between exploratory hole positions, interpretations are subject to the limitations of only assessing a relatively small proportion of sub-surface conditions at the Scheme.
5. Monitoring data provides information pertaining to specific discrete locations on particular dates. Recorded ground conditions may differ from the recorded results if this monitoring was to be undertaken on other dates.
6. This report should be read considering the legislation, statutory requirements and/or industry good practice applicable at the time the report was written. Any subsequent changes in legislation or guidance may necessitate the findings to be reassessed in light of these circumstances.

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2.5.2. Geomorphology

The scheme sits within the Dissected Till Domain. This is described in BGS Onshore GeoIndex [1] as 'a gently undulating spreads of weathered (Pre-Devensian) till, glaciofluvial and glaciolacustrine deposits, generally lacking constructional features and mainly restricted to interfluves. Widespread periglacial landforms and deposits at surface.' This domain comprises lowlands of the Midlands and East Anglia lying between the Devensian and Anglian glacial limits. In East Anglia, the landscape is a low-lying, relatively flat, dissected till plateau with a coverage of superficial deposits that include various glacial lithofacies laid down by successive Middle Pleistocene advances of the British Ice Sheet.

Table 2-2 - Site geomorphology

Section	Surface geomorphology
1	Low lying ground approximately 16mAOD gently sloping to the south to 14mAOD.
2	Low lying ground at 14mAOD until Ch.1100m where elevation rises to 17mAOD on a lithological bench of the West Melbury Marly Chalk Formation. A marked chainage in elevation at Ch.1850m represents a change in geology to the more competent Zig Zag Chalk Formation. Elevation rising to 28mAOD at Ch.2800m.
3	Elevation rising to 39mAOD at Ch.3300m where it decreases to 23mAOD at Ch. 3700m onto a 200m lithological bench of the Zig Zag Formation. An incised dry valley is noted to the northeast of Section 3. Elevation gently decreases to 19mAOD at Ch.4500mAOD, where superficial deposits of the River Terrace Gravels are mapped. Evidence of historical field boundaries noted by the linear patterns across the agricultural fields. Hummocky ground is noted to the east of Section 3 in areas of dry valleys and a change in geology upslope to the Holywell Nodular Chalk Formation. Within these areas, Head Deposits are likely present, however they have not been mapped on BGS records.
4	Elevation gently increases from 19mAOD to 21mAOD across the section. Lower lying areas are associated with the River Granta. Hummocky ground indicates the presence of superficial deposits of River Terrace Gravels and Alluvium.
5	Elevation generally increases along the section from 21mAOD to 29mAOD as bedrock of the Holywell Nodular Chalk is encountered. Evidence of historical field boundaries noted by the linear patterns across the agricultural fields. Two circular depressions are noted c.370m southwest from Ch.7500m which could be attributed to dissolution features.
6	Elevation decreases at Ch.8300mAOD from 30mAOD to 25mAOD which is attributed to the River Granta. River Terrace Deposits are mapped on BGS records on the flanks of the slope and Alluvial deposits are mapped in proximity to the lower lying areas around the River Granta. Superficial deposits were deposited at lower level as river systems eroded the chalk. Circular depressions are noted c.330m southwest from the Travel Hub Site which could be attributed to a dissolution feature.

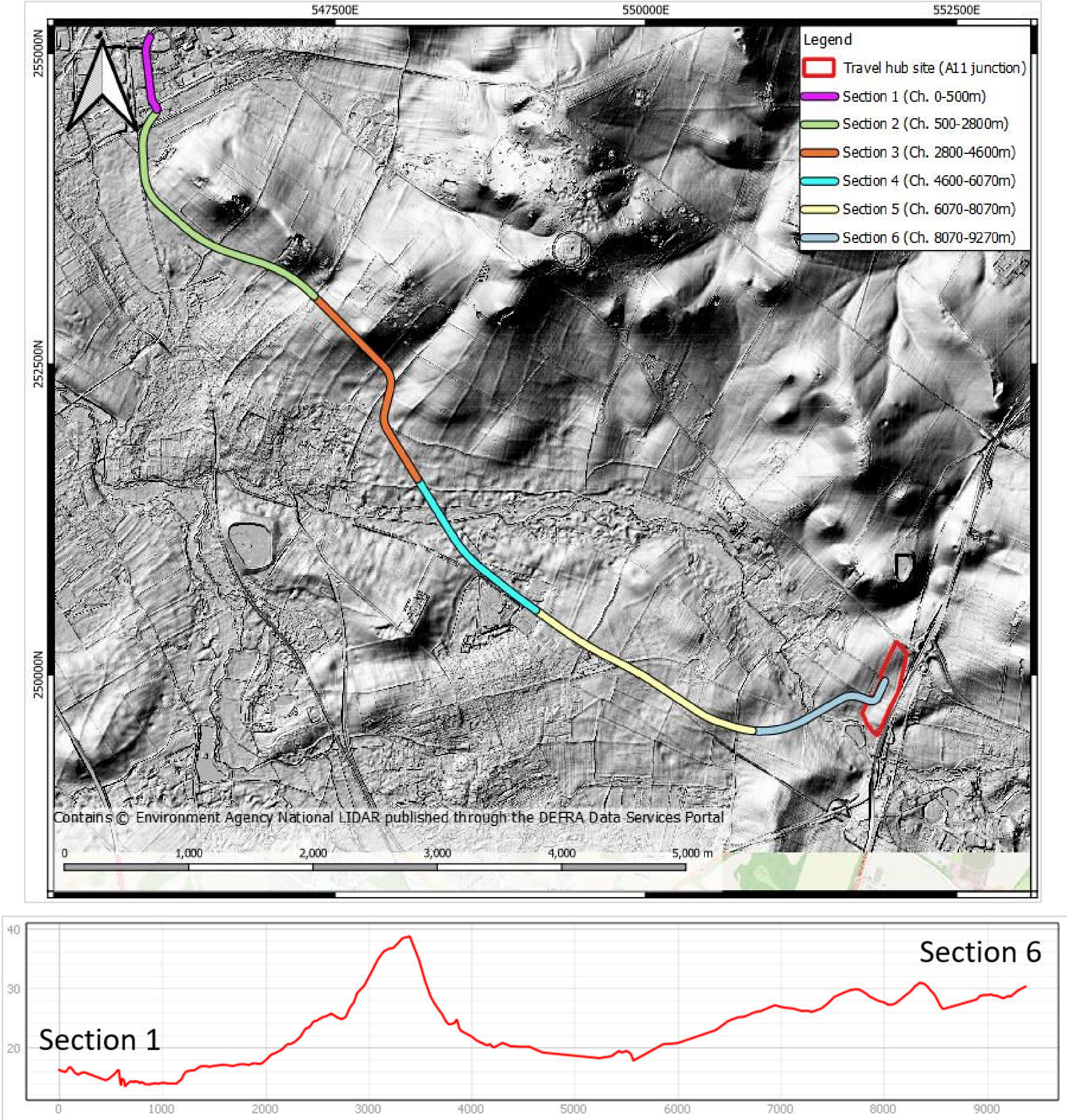


Figure 2-2 - LiDAR DTM across the preferred route alignment (top) and route alignment elevation profile (bottom)

2.5.3. BGS Historical Borehole Records

A search of the BGS GeoIndex shows a 65no. exploratory holes within a 500m radius of the proposed works, of which 26no. were available for review and 39no. records were confidential (attributed to Addenbrooke's Road and Addenbrooke's Treatment Centre along Section 1 of the route alignment). Table 2-3 shows available historical BGS boreholes found within 500m of the site.

Table 2-3 - Summary of available BGS boreholes records with 500m of the route

Section	BGS borehole reference	Date	Grid reference	Depth (m)	Engineering description and depth (m)	Ground water (m bgl)
1	TL45NE23 3	2002	545990, 255300	10	Topsoil (0.0-0.45m), Sandy Clay and Gravel (0.45-1.2m), Clay (1.2-10.0m).	5.8
	TL45SE63	2002	545600, 254250	10	Topsoil (0.0-0.55m), Clay (0.55-1.5m), Sand (1.5-3.5m) Sandy Clay (3.5-10.0m).	3.2
	TL45SE64	2002	545910, 254500	10	Topsoil (0.0-0.6m), Clay (0.6-10.0m).	7.3
	TL45SE65	2002	546500, 245700	10	Topsoil (0.0-0.45m), Sandy Clay and Gravel (0.45-0.9m), Clay (0.9-10.0m).	5.8
2	TL45SE11	May 1960	547230, 253360	35.96	Loose Lower Chalk (0.0-22.5m), Solid Lower Chalk (22.5-2.3m), Soft Lower Chalk (24.3-26.4m). Hard Lower Chalk (26.4m-35.96m)	Not recorde d
	TL45SE15	1929	546580, 253800	33.52	Lower Chalk	29.7
	TL45SE25	unkn own	547250, 253450	37.49	Made Ground (0.0-0.9m), Loose chalk with layer s of chert (0.9-24m), Solid hard chalk (24.0-36.9m) Lower Chalk	Not recorde d
3	TL45SE8	April 1960	547500, 252100	17.37	Made Ground (0.0-2.1m), Lower Chalk (2.1-17.37m)	2.1
	TL45SE10	unkn own	548380, 252080	19.2	Lower Chalk (0.0-19.2m)	15.9
	TL45SE31	Nove mber 1993	548100, 252100	11.0	Grey clay and stone (0.0-0.6m), Firm light grey chalk (0.6-9.96m)	2.85
4	TL45SE36	1958	548910 251340	13.41	Topsoil (0.0-0.6m), Terrace Gravel (0.6-3.0m) Zone Chalk (3.0-4.2m), Barwell Rock (4.2-13.5m), Chalk Marl (13.5-45m)	14.4
	TL45SE56	2005	548310, 251000	15	Orange, brown slightly silty SAND with some fine rounded gravel (0.0-2.3m), Firm brownish grey clayey SILT with occasional gravel (2.3-3.2m), Orangey brown and grey weathered putty CHALK with gravel (3.2-3.6m), Orangey brown and grey weathered putty CHALK (3.6-7.0m), Grey rock and putty CHALK with bands of dark grey chalk (7.0-15.0m)	6.2 rising to 2.61

Section	BGS borehole reference	Date	Grid reference	Depth (m)	Engineering description and depth (m)	Ground water (m bgl)
	TL45SE40	unknown	549510, 250020	unknown	Not available for review	Not recorded
	TL45SE57	2005	549100, 250400	50	Made Ground (0-1.m), Black peaty soil, clay and sand (1-2m), Grey Chalk (2-5m), Soft white chalk and water (5-17m), Soft putty like chalk (17-33m), Medium Chalk (33-35m), Soft chalk (35-43m), Grey mudstone/clay (43-50m)	5.0
	TL55SW14	May 1960	550460, 250050	10.36	River Terrace Gravels onto Middle Chalk (boundary depths not recorded)	7.65 (well record)
5	TL55SW30	1998	550500, 250100	50	Topsoil (0.0-0.4m) Sandy Clay (0.4-1.4m), Putty Chalk (1.4-12.0m), Tough Clay like Chalk with flints (12.0-18.4m), Broken weathered Chalk and flints (18.4-46.0m), Firm chalk and flints (46.0-50.0m)	10.88
	TL55SW34	unknown	550400, 250000	unknown	Chalk	Not recorded
	TL55SW44	2011	550465, 250100	34	Topsoil (0-2.m), Chalk (2-18m), Hard Chalk (18-24m), Chalk (24-34m)	6.0
	TL54NW12	1929	550670, 249240	3.2	Middle Chalk	Dry
	TL54NW17	May 1960	550740, 249830	13.14	River Terrace Gravels onto Middle Chalk (boundary depths not recorded)	10.08
	TL54NW29	1953	55250, 249940	30.48	Topsoil (0.0-0.6m), Chalk (0.2-30.48m)	11.4
	TL54NW30	1957	552010, 249430	32.91	Topsoil (0.0-0.45m), Chalky Clay (0.45-1.95m), Sand and Gravel (1.95-5.7m), Soft Chalk (5.7-13.2m), Hard Chalk (13.2-14.25m), Medium Chalk (14.25-32.91m)	8.4
6	TL54NW37	Unknown	551780, 249330	86	Topsoil and gravel (0.0-7.0m), Chalk – hard with soft banks (7.0-86.0m) Totternhoe Stone at 20.1m (interpreted from lost circulation)	Not recorded
	TL54NW42	1949	552030, 249440	23.77	Topsoil (0.0-0.6m), Chalk (0.6-23.77m)	7.8

Geological records for TL55SW31 and TL55SW32 (Section 5, Church Farm) were duplicate records of TL55SW14 and therefore are not presented above.

2.5.4. Flood Records

A review of the information regarding flood risk and records at the scheme was undertaken in the Preliminary Risk Assessment (PRA) [2]. The PRA indicates that the overall risk of flooding for surface water from the site is low, with a 1 in 1000-year return period, with localised patches of medium and high risk with a return period of 100 to 30 years, indicated close to Addenbrooke Hospital and Sawston. Flood Zone 2 (medium risk) and Zone 3 (high risk) are found to be associated with the River Granta and area around Sawston, as indicated in Figure 2-3, indicating a medium to high risk of flooding. The PRA indicates there is the potential for groundwater flooding of property situated below ground level for the north-western extent of the scheme; for the land adjacent to the River Granta; and, for the land surrounding Sawston shown on the map below as Flood Risk Areas and Flood Warning Areas.

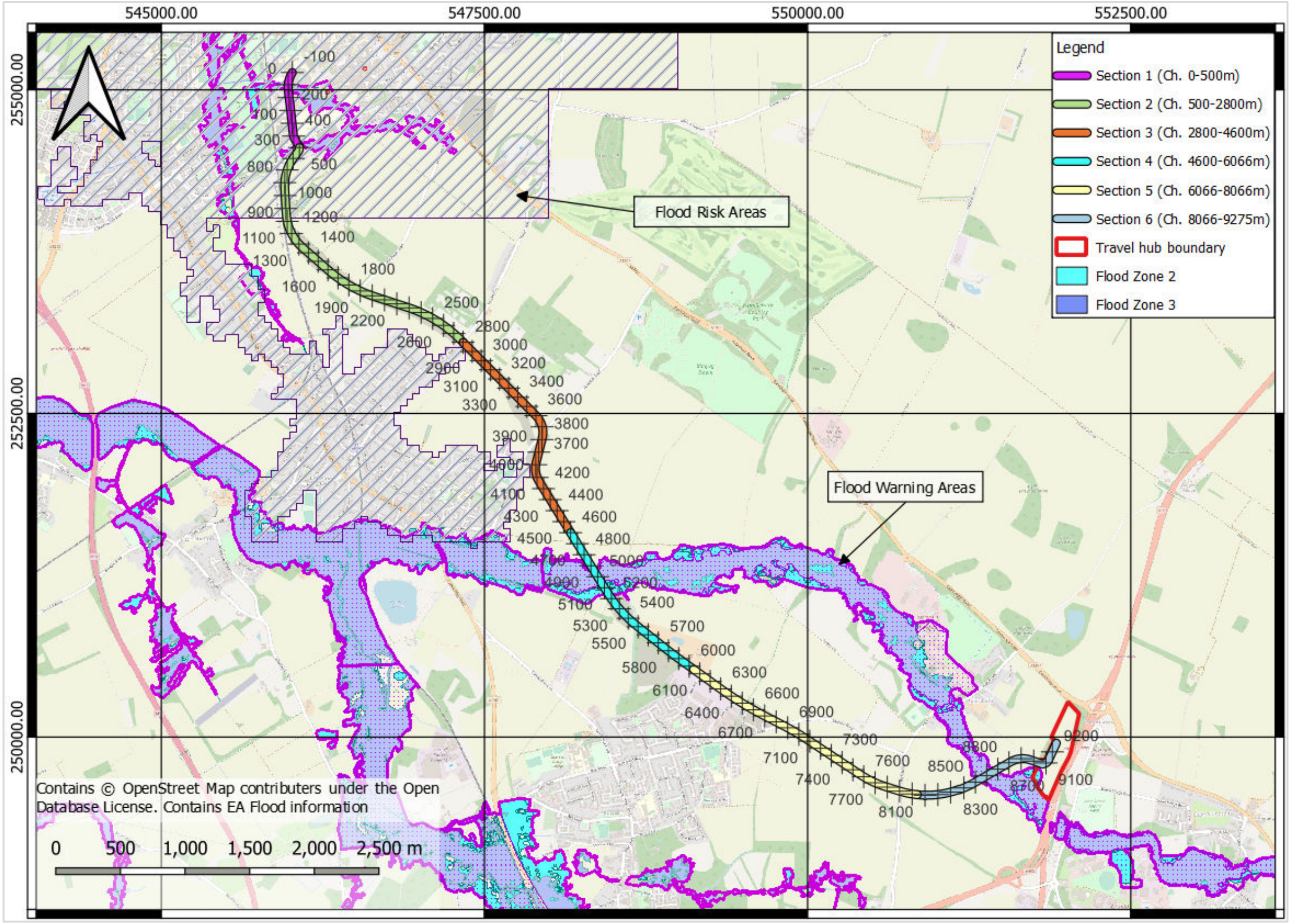


Figure 2-3 - Flood risk around the route alignment

2.5.5. Groundwater Monitoring

45no. dual purpose ground gas and groundwater monitoring standpipes were installed in 36no. boreholes for the purpose of groundwater monitoring and sampling & ground gas monitoring. Four water level monitoring and groundwater sampling visits have been undertaken in the installed boreholes, undertaken on 10 May 2021, 17 to 24 May 2021, 4 June 2021 and 17 October 2021.

Groundwater sampling and ground gas monitoring is discussed in the appended Contaminated Land Assessment Report (Ref. GCP_5210174_A1307 Cambridge South East Transport CLRA).

Details of the monitoring installation type, response zone depths and target stratum are summarised as follows:

- 9no. dual installations for shallow and deep groundwater monitoring across the scheme; and,

- 36no. single slotted standpipes for gas and groundwater monitoring.

97no. groundwater strikes were recorded within 89no. holes during the 2021 ground investigation; When groundwater strikes were encountered during drilling, drilling was stopped for 20-minutes, and the groundwater levels measured at 5-minute intervals during this time.

It should be noted that water was often added to assist with drilling, either as flush for rotary drilling, or to help advance through granular material during cable percussion drilling or dynamic sampling. It is difficult to observe groundwater strikes when water is added during drilling. Therefore, the absence of an observable groundwater strike does not necessarily mean that water was not present during the investigation. Details of depths at which water was added is recorded on the exploratory hole record.

Table 2-4 - Summary of groundwater monitoring results

Location	Easting	Northing	Section	Ground water depth (m bgl)									Targeted Geology
				10/05/2021	17/05/2021	03/06/2021	17/10/2021	13/11/2021	18/12/2021	09/01/2022	27/02/2022	19/03/2022	
BH-PTR-02 D	545993.5	254427	2	1.23	1.04	1.31	1.03	1.04	0.85	1.06	1.06	0.95	WMCH
BH-PTR-02 S	545993.5	254427	2	1.1	0.96	2.36	0.86	0.9	1.05	0.95	0.95	0.88	WMCH
BH-PTR-03A	545993	254368	2	1.1	0.89	1.06	1.16	1.22	0.98	0.91	0.91	0.87	ALV
BH-PTR-04	545964	254349	2	0.9	0.62	0.78	0.8	0.81	0.76	0.64	0.64	0.52	ALV/WMCH
BH-PTR-07	545961	254192	2	0.54	0.5	0.6	0.36	0.36	0.58	0.61	0.61	0.62	WMCH
BH-PTR-08 D	545947	254166	2	0.54	0.56	0.67	0.24	0.37	0.78	0.68	0.68	0.65	WMCH
BH-PTR-08 S	545947	254166	2	0.57	0.61	0.73	0.39	0.42	0.79	0.76	0.76	0.68	WMCH
BH-PTR-10	545959	254147	2	0.54	0.52	0.64	0.26	0.42	0.73	0.65	0.65	0.62	ALV/WMCH
BH-PTR-12	545991	253978	2	1.92	1.99	2.08	1.73	1.78	2.11	2.01	2.01	1.97	WMCH
BH-PTR-13	546317	253581	2	1.97	2.02	2.15	5.04	2.44	2.68	2.23	2.23	2.13	ZZCH
BH-PTR-14	546572	253450	2	3.68	3.71	3.86	4.15	4.19	4.48	3.97	3.97	3.87	ZZCH
BH-PTR-15	547384	252988	3	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	ZZCH
BH-PTR-16	547679	252701	3	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	HCK
BH-PTR-18	547867	252091	3	3.85	4.03	4.16	Dry	Dry	Dry	Dry	Dry	Dry	ZZCH
BH-BP-01	548780	251251	4	n/a	1.05	1.24	1.2	1.18	1.29	n/a	n/a	2.6	ALV
BH-PTR-19	548263	251424	4	2.32	2.36	2.5	2.82	2.85	3.07	2.46	2.46	2.34	RTD
BH-PTR-21	548294	251358	4	1.66	1.64	1.76	1.77	1.8	1.97	1.63	1.63	1.54	RTD
BH-PTR-27	548366	251244	4	0.84	0.81	0.99	0.88	0.91	1.13	0.87	0.87	0.79	RTD
BH-PTR-30	548395	251217	4	1.01	0.99	1.15	1.4	2.32	1.38	1.07	1.07	0.99	ZZCH
BH-PTR-31	548402	251183	4	0.85	0.84	0.91	1.09	1.04	1.13	0.88	0.88	0.82	ZZCH
BH-PTR-33 D	548412	251165	4	0.94	1.04	1.16	1.21	1.16	1.29	1.02	1.02	0.97	ZZCH
BH-PTR-33 S	548412	251165	4	1.05	1.06	1.22	1.23	1.16	1.26	1.04	1.04	0.98	ALV/RTD
BH-PTR-35	548454	251111	4	1.67	1.62	1.73	1.58	1.44	1.56	1.43	1.43	1.36	RTD
BH-PTR-36	548501	251040	4	0.13	0.92	1.13	0.93	0.65	0.74	0.69	0.69	0.6	ALV
BH-PTR-39	548652	250860	4	0.56	0.62	0.78	0.76	0.63	0.91	0.61	0.61	0.56	ZZCH
BH-PTR-41 D	548744	250793	4	1.36	1.26	1.52	1.54	1.43	1.65	1.32	1.32	1.28	ZZCH
BH-PTR-41 S	548744	250793	4	1.41	1.43	1.53	1.69	1.5	1.56	1.31	1.31	1.28	MG
BH-PTR-42 D	548825	250734	4	1.72	1.55	1.75	1.73	1.58	1.76	1.37	1.37	1.3	ZZCH
BH-PTR-42 S	548825	250734	4	Dry	1.49	1.75	Dry	Dry	Dry	Dry	Dry	Dry	MG
BH-PTR-43 D	548906	250675	4	1.41	1.54	1.52	1.77	1.49	1.65	1.01	1.01	0.85	ZZCH

BH-PTR-43 S	548906	250675	4	1.42	1.4	1.49	1.76	1.54	1.45	1	1	0.81	MG
BH-PTR-45	549861	250045	5	5.9	5.89	5.98	5.88	5.69	5.95	5.62	5.62	5.57	HCK
BH-OBC-01	551276	249617	6	Dry	Dry	Dry	Dry	Dry	DRY	n/a	n/a	DRY	RTD
BH-OBC-04 D	551344	249667	6	2.26	2.41	2.8	3.79	3.5	3.76	2.74	2.74	2.6	HCK
BH-OBC-04 S	551344	249667	6	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	RTD
BH-OBC-06	551335	249644	6	2.68	2.96	3.22	4.34	4.06	4.23	3.24	3.24	3.08	HCK
BH-OBC-07	551303	249624	6	3.46	3.7	3.99	5.09	4.83	5	4.09	4.09	3.92	ZZCH
BH-OBC-07	551303	249624	6	3.11	3.34	3.63	4.68	4.38	4.58	3.65	3.65	3.49	HCK
BH-OBC-11 D	551442	249720	6	2.44	2.65	2.91	4.23	3.96	3.99	2.97	2.97	2.85	HCK
BH-OBC-11 S	551442	249720	6	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	RTD
BH-OBC-12	551453	249740	6	2.72	1.98	3.27	4.59	4.31	4.35	3.33	3.33	3.23	HCK
BH-OBC-15	551480	249746	6	3.85	4.12	4.39	6.71	5.43	5.5	4.53	4.53	4.39	ZZCH
BH-TH-01	551883	249837	Travel Hub	5.46	5.82	6.18	7.44	7.14	7.31	6.23	6.23	6.03	HNCK
BH-TH-03	551924	249841	Travel Hub	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	RTD

2.5.6. Soil infiltration rates

Infiltration testing was carried out in the Zig Zag Chalk Formation (Haverhill Road PT Stop) and in the Holywell Nodular Chalk Formation (Travel Hub site).

Table 2-5 - Summary of soil infiltration rates

Stratum	Location	Design soil infiltration rate (m/s)
Zig Zag Chalk Formation	Haverhill Road PT Stop	1.00×10^{-03}
Holywell Nodular Chalk Formation	Travel Hub site	1.69×10^{-04} (north and northeast) 1.72×10^{-05} (centre and southeast)

2.6. Third Party Engagement

Through the course of the outline design there has been ongoing engagement with stakeholders and statutory bodies on the drainage proposals. The proposals have been shared with Cambridgeshire County Council, as Lead Local Flood Authority (LLFA), Cambridge City Council drainage engineers, Hobson's Conduit Trust, Network Rail and their associates who are designing the Cambridge South Station scheme & stakeholders for the Cambridge Biomedical Campus. The salient points of these discussions are noted below and have been incorporated into the design so far as practicable:

- The River Granta has low flows and could benefit from additional surface water runoff generated by the proposals.
- Deep bore soakaways "do not mimic the natural drainage system as would shallow infiltration. These should only be considered as a final option for the disposal of surface water on a par with a sewer."
- Proposals to culvert ditches which cross the scheme will be subject to LLFA/EA approval.

Meeting minutes have been included in the Appendix A capturing the outcomes of the various third-party engagement.

2.7. SuDS Strategy

2.7.1. Drainage Hierarchy

The LLFA requires SuDS to be used, where practicable, to ensure that surface water drainage is managed as close to the source as possible and to maintain natural ground conditions. This is in accordance with the following drainage hierarchy as set out in Cambridgeshire County Council Surface Water Drainage Guidance for Developers May 2019:

- To ground in an adequate soakaway or other infiltration system
- A watercourse
- A surface water sewer, highway drain or other drainage system
- A combined sewer

2.7.2. Infiltration Based Systems

Based on the findings in the Geotechnical Desk Study and technical note "Preliminary Infiltration Rates for Design", infiltration may not be viable at shallow depths of <3.3m. Based on information available from the following sources:

- CIRIA C574 for Chalk Units;
- Barnes (2016) for superficial deposits.

The infiltration rates for depths less than 3.3m are too low for infiltration to be considered. However, for depths of 3.3m and above, then infiltration rates are higher, and so soakaways with bases >3.3m below existing ground level can be considered. The rates for the underlying geology along the HQPT route likely to be encountered can be split into four different zones, as shown in Table 2-6 and Figure 2-4.

Table 2-6 - Proposed soakaway borehole depth based on Infiltration Model Zone

Infiltration Model Zone*	Minimum depth of borehole (m)
Zone 1	3.30
Zone 2	6.30
Zone 3	10.30
Zone 4	4.30

Source: A1307 CSET Phase 2: Preliminary Infiltration Rates for Design, by MM, August 2020

Figure 2-4 - Location plan indicating underlying geology and infiltration modal zones

2.7.3. Watercourse

The route crosses a number of watercourses and ditches which may be suitable for surface water disposal, subject to agreement with the LLFA, EA and Hobson's Conduit Trust who manage Hobsons Brook.

2.7.4. Surface / Combined Water Sewers

Anglian Water asset plans indicate there are no public surface water systems along the length of the HQPT route. There are several foul water sewers including rising mains identified and it's feasible these may be combined sewers but these are unlikely to be suitable for the disposal of surface water runoff from the HQPT route.

2.8. SuDS Elements

For the required volume of storage estimated in each section of the route, it is necessary to determine the most appropriate form of attenuation to be used. In accordance with the 'SuDS Manual' CIRIA report C753 there are four main categories of benefits that can be achieved by SuDS:

- Water quantity – control the quantity of run-off to reduce flood risk and maintain and protect the natural water cycle
- Water quality – manage the quality of the run-off to prevent pollution
- Amenity – create and sustain better places for people
- Biodiversity – create and sustain better places for nature

The SuDS Manual and the EA guidance provide a sustainability hierarchy linking the various types of SuDS, this is summarised in Table 2-7. Systems at the top of the hierarchy provide a greater combination of the four main benefits and are deemed the most sustainable options.

Table 2-7 - SuDS Components

	Component Type	Water Quantity	Water Quality	Amenity	Biodiversity
Most Sustainable	Living or Green Roofs	✓	✓	✓	✓
	Basins and Ponds	✓	✓	✓	✓
	Filter Strips and Swales	✓	✓	✓	✓
	Pervious Pavements	✓	✓		
Least Sustainable	Tanked Systems	✓			
	Surface Storage	✓			

Source: SuDS Manual C753

SuDS can take many forms, both above and below ground. Most SuDS schemes use a combination of SuDS components to achieve the overall design objectives for the site, known as the SuDS Management Train. The use of a sequence of different SuDS components can collectively provide the necessary processes to control the frequency of run-off, the flow rates, and the volumes of run-off, and to reduce the concentration of contaminants to acceptable levels. Outlined below are summaries of some of the main types of SuDS systems that may be applied to the Site, outlining the main benefits and constraints to their application and sustainability for this development.

2.8.1. Living or Green Roofs

Living or green roofs are not applicable to the route as no buildings are proposed along the route.

2.8.2. Ponds and Basins

Pond and basin systems allow the run-off from the development to be treated by biological action and stilling to significantly improve the quality of water discharged from the system.

Basins also provide large areas of open space that can be developed for recreational uses or as new habitat for wildlife.

Both systems do, however, take up developable land and have residual maintenance and liability issues attached to their implementation. However, these may be a suitable option for the site and should be considered further in the design.

2.8.3. Filter Strips and Swales

Often used adjacent to roads and footpaths, swales and filter strips can be used to collect water directly from areas of hardstanding, percolate some of the flow, attenuate and then discharge the flow to either a traditional system or a secondary SuDS device. The use of these systems is more suited to linear applications such as roads as the typical cross section is relatively small and longer runs are required to provide attenuation volume.

Filter strips will be smaller in plan area than swales although a swale can be landscaped and be incorporated into the verge of the carriageway, combining two functions. Land take can be relatively small in comparison to other systems and both types perform well in improving water quality. They are also ideally suited for disposal of water via a secondary infiltration.

A dry swale is a vegetated conveyance channel designed to include a filter bed of prepared soil that overlays an under-drain system. This provides additional conveyance capacity and ensures the maximum level of the flow channel is not exceeded. This is a suitable option for the site and should be considered further in the design.

From CIRIA SuDS Manual (C753), Chapter 18, Bioretention systems, page no. 343, Subsurface storage can be provided by the void space in filter medium and/or drainage layer in the system:

Available attenuation storage in the filter medium and drainage layer of the bioretention system = Volume of system × porosity in the soil/drainage layer

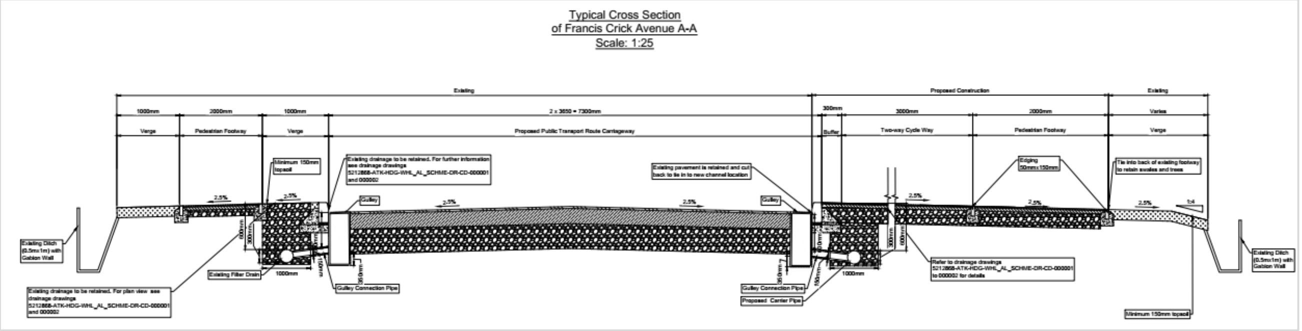


Figure 2-5 – Typical cross section of Francis Crick Avenue

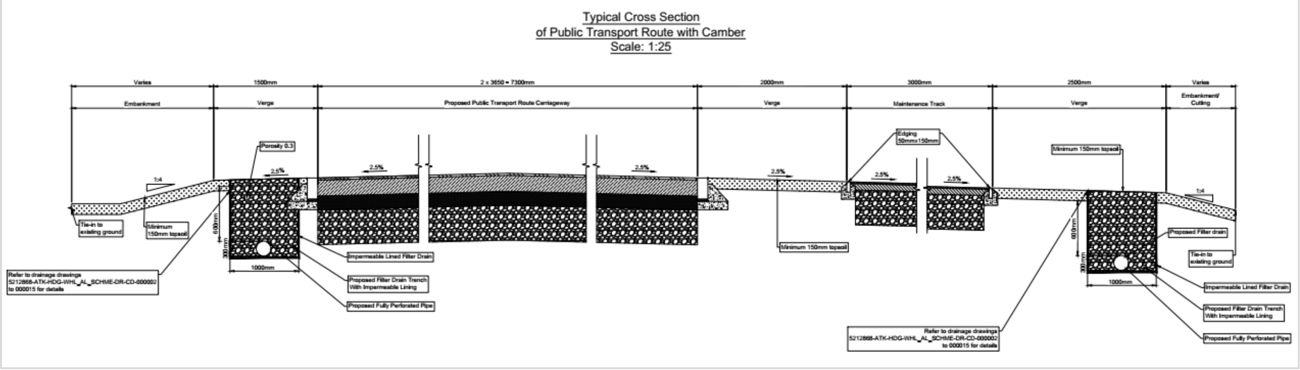
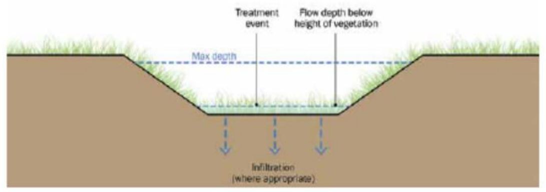


Figure 2-6 – Typical cross section of HQPT Route

A conveyance and attenuation swale acts similarly to a pipe in that it will collect and convey surface water to the next stage in the SuDS management train. They are usually shallow and contain some vegetation which means that they can be used for both attenuation and treatment. If soil conditions allow and they are left unlined they can also provide opportunities for infiltration.



Source: CIRIA SuDS Manual

Figure 2-7 – Conveyance and attenuation swale

2.8.4. Permeable Paving

Large areas of paved hardstanding can be converted to permeable paving to provide significant volumes of storage. These systems also encourage biological treatment of flow and extraction of oils and heavy metals from the run-off.

Land take is reduced as storage is located below car parks and access roads. However, maintenance is potentially a long-term issue and the possibility of the paving being damaged, dug up and not properly reinstated or not regularly swept could lead to compromising the future capacity of the system.

This system negates the need for a separate collection system such as kerbs and gullies and potentially negates the use of a separate oil interceptor. It can also assist in reducing the flood profile of the site by significantly detaining the run-off from the development within the sub-base material. There is no specific amenity provided by the system other than enabling other areas to be utilised for development rather than potentially sterilizing areas with an easement for a sewer or stand-off for a basin.

Permeable paving is considered unlikely to be suitable for the main route however it could be considered in localised areas i.e. for the parking at the drop off / stop locations.

2.8.5. Tanked Systems

2.8.5.1. Storage Crates

Large volumes of storage can be provided under grassed and lightly trafficked areas by using proprietary plastic cellular systems. This will maximise the developable area of the site. The system is formed of modular cells that are stackable to suit the ground levels and conditions and fit together to create a modular underground water tank.

There is no specific mechanism within the system designed to treat flow, but extended detention times will allow sedimentation, reducing the suspended solids within the discharge.

There is no creation of amenity or biodiversity by the installation of these types of systems, indeed by maintaining access to the system small areas may need to be reserved.

2.8.5.2. Oversized Pipework

It is often possible to provide the required volume of storage within the existing drainage pipework. This may be incorporated by using oversized pipe designed to act as inline storage.

As the diameter of larger pipes readily available is limited, the applicability of these types of systems is more suited to less than 200m^3 of attenuation. Above this volume the diameter of pipe required is excessive and difficult to suitably fit into a normal site layout.

There is no intrinsic amenity provided by the use of this system, neither is there any specific level of run-off treatment over and above that of a standard pipe and gully system.

However, due to their traditional nature, the adoption of these types of systems by water authorities is straightforward and does not require any specialist input. The pipes are generally available direct from suppliers with little or no lead in time and the satisfactory long-term performance of these systems is well documented. Oversized pipework could be used as a form of attenuation within sections of the Site.

2.8.6. Surface Storage

The use of roads, public areas and even landscaped areas as additional storage for an extreme rainfall event is becoming a widely accepted form of attenuation. Water spilling from drainage systems can be collected via roads and kerbs and channelled to lower lying areas where it would be stored until the capacity in the existing system returns. These systems have the advantage of requiring little additional infrastructure merely detailing of the proposed roads and grassed areas.

As these systems will only be used in extreme events when the capacity of the adopted drainage system is exceeded (greater than 1 in 30-years), they provide a very efficient way of catering for these events rather than providing permanent capacity.

There is no inherent water treatment capability in this system nor any increase in amenity, however, the costs associated with this provision are relatively small.

These could be a suitable option for the site but ensuring reliability of the PT service would need to be considered in developing proposals of this nature.

2.9. Capture and Conveyance

Most areas present can be described as rural and as such kerb and gullies, linear drains, informal drainage over the edge and grassed surface water channels have been considered in accordance with DMRB CG 501 Table 3.4.

For capture and conveyance systems, the following storm events are to be considered with the associated surcharge requirements as per Cambridgeshire County Council Surface Water Drainage Guidance for Developers June 2021;

- 1 in 1 year + 20% climate change – No surcharge of the drainage system
- 1 in 5 year + 20% climate change – No flooding of the drainage system
- 1 in 30 year + 20% climate change – No flooding of the drainage system. For Swales this means 100 mm of freeboard should be achieved
- 1 in 100 year + 40% climate change - Some short-term flooding managed such that it does not enter buildings or disrupt emergency access routes

2.10. Volume and Attenuation

Following non-statutory guidance from DEFRA and the SuDS manual, where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

The attenuation storage volume is required to be assessed up to the 1% Annual Exceedance Probability (AEP) rainfall event plus 40% in accordance with CCC guidance.

For the critical 3.3% AEP rainfall event there should be no above ground flooding. For the 1% AEP rainfall event +40% climate change, some short-term flooding is permitted however it should be managed such that it doesn't enter buildings or disrupt emergency routes.

2.11. Exceedance Events

The design exceedance event is the 1% AEP rainfall event plus 40% for climate change as per Cambridgeshire County Council Surface Water Drainage Guidance for Developers (November 2019) section 5.5.

2.12. Water Quality Treatment and Pollution Control

Surface water run-off arising from the road requires treatment before discharging to watercourses. It is proposed to use SuDS components to provide close to source / primary treatment of run-off using the simple index method described in CIRIA C753 The SuDS Manual. This method applies a hazard index to the surface being drained (see Figure 2-6) and a mitigation index to SuDS components (see Figure 2-7) such that:

Total SuDS mitigation index ≥ pollution hazard index

Where the mitigation index for a single component is less than the hazard index, SuDS components can be used in sequence using:

Total SuDS mitigation index = mitigation index1 + 0.5 (mitigation index2)

Construction related activities of the proposed drainage systems which include soakaway drains, ponds and surface water drains below ground, will either permit drainage to infiltrate to ground, or connect into existing surface water features.

Pollution of groundwater and surface water is possible from any construction site from:

- Leaks and spills of chemicals and other potentially polluting substances used or stored on the site (e.g. fuel, cement).
- Suspended materials from working areas running off in rainfall and causing high turbidity water to enter existing surface water features.

Adherence to standard pollution control measures that will be set out in the Construction Environmental Management Plan (CEMP) and Code of Construction Practice (CoCP) will ensure risks to water resources from construction are controlled and limited. As there are no direct discharge to surface water bodies being proposed from the site and there will be strict controls on substances that could impact groundwater on site, it is concluded that any incidents on site would not be likely to result in significant effects on water resources from these sources of pollution.

A pollution risk assessment should be undertaken at the next stage of design to confirm the conclusions of the simple index approach.

TABLE 26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.8[2]	0.8[2]	0.9[2]

Notes

1 Motorways and trunk roads should follow the guidance and risk assessment process set out in Highways Agency (2009).

2 These should only be used if considered appropriate as part of a detailed risk assessment – required for all these land use types (Table 4.3). When dealing with high hazard sites, the environmental regulator should first be consulted for pre-permitting advice. This will help determine the most appropriate approach to the development of a design solution.

Source: CIRIA C753

Figure 2-8 – Pollution hazard indices for different land use classifications

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters

Type of SuDS component	Mitigation indices[1]		
	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4[2]	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond[4]	0.7[3]	0.7	0.5
Wetland	0.8[3]	0.8	0.8
Proprietary treatment systems[5,6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Source: CIRIA C753

Figure 2-9 – Mitigation indices for individual SuDS components

3. Section 1 (Francis Crick Avenue)

3.1. Overview

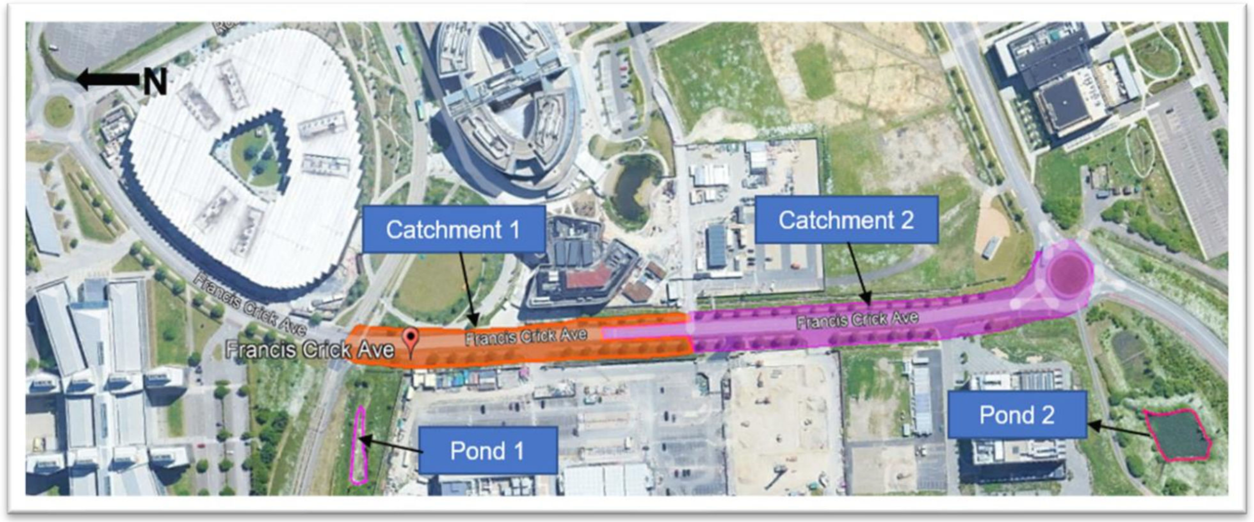
The section between Cambridge Biomedical Campus and Dame Mary Archer Roundabout will involve upgrades to Francis Crick Avenue (FCA) to create a central alignment of the HQPT route, subject to stakeholder agreement. Sections of the existing swales either side of the road will need to be redesigned to accommodate the additional width of the road.

3.2. Existing Scenario

FCA is approximately 630m long in total with a 10m wide carriageway and 1.5m wide footways on either side. The total contributing area to the existing drainage systems on FCA is therefore approximated to be 0.8ha. There are a series of swales on either side of the carriageways, with 2 No. attenuation ponds along the length of FCA.

Based on the levels from the topographical drawing, the drainage network appears to be split into two sub-catchments:

- Catchment 1 – Falls north from a high point near the zebra crossing on FCA to the existing guided bus way junction. A series of gullies drain into swales located on both sides of FCA, which flow along twin 300mm diameter pipes to attenuation pond 2, location adjacent to the watercourse just south of the existing guided bus route. It is assumed that the surface water runoff either infiltrates or discharges into the watercourse from attenuation pond 2, but this will need to be confirmed.
- Catchment 2 – Falls south from a high point near the zebra crossing to the roundabout on Dame Mary Archer Way. A series of gullies drain into swales located on both sides of FCA, which flow through twin 300mm diameter pipes to attenuation pond 3 just north of Addenbrookes Road. It is assumed that the surface water runoff infiltrates into the ground in attenuation pond 3, but this is to be confirmed.



Source: © Google Earth Pro

Figure 3-1 – Layout of catchment areas for FCA

3.3. Drainage Strategy

CCC require SuDS to be used where practicable, ensuring the surface water drainage is managed as close to source as possible.

The feasibility for each SuDS element has been summarised in Table 3-1, outlining suitability of each for FCA.

Table 3-1 - Summary of SuDS suitability for FCA

Component Type	Feasible	Ranking in the SuDS Hierarchy	Additional Comments
Basins and Ponds	✓	Most Sustainable	The existing attenuation ponds 1 and 3 will be kept and used for the proposed drainage strategy.
Filter Strips and Swales	✓	Most Sustainable	Shallow swales are being considered in the grass verges, where the road surface water runoff will drain into. This system will connect into the geocellular units which provides the attenuation up to and during 1% AEP storm event.
Pervious Pavements	✓	Most Sustainable	Permeable paving systems could be incorporated within the pedestrian footpaths and cycle lane; however, they may not be suitable for the carriageways as these are accessed by larger vehicles. It is considered that this method would be of limited benefit from an infiltration perspective due to the underlying ground conditions, however, the system could still be used and the sub-base utilised as a form of attenuation which could make a reduction to the overall run-off and storage requirement for the site. This system should therefore be considered further at the next design stage.
Storage Crates	✓	Least Sustainable	Where the developable footprint is constrained, geocellular units can be advantageous. These systems can be provided below ground within the widths of the pedestrian footways and cycle track, before discharging to the existing attenuation ponds.
Oversized pipework	×		Oversized pipework could be used as a form of attenuation within sections along FCA. However, the pipework is only considered for attenuation volumes of < 200 m^3, and so has not been considered as a viable option for this section.
Surface Storage	✓	Least Sustainable	It is proposed that the areas within the carriageways are utilised for the safe management of flows on the surface for exceedance events only. This could be reviewed at the next design stage when proposed external levels are finalised.

3.4. Surface Water Design proposal

For Francis Crick Avenue surface water runoff from the road and footway is proposed to be collected and conveyed using carrier drain, filter drain, slot drain and ditches to the existing attenuation basins. Based on the high point and low point the runoff from chainage 20 to chainage 140 is conveyed to the existing attenuation

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basin on the north portion. The runoff from the other part of the networks i.e., runoff from chainage 140 to 480 is conveyed to the existing attenuation basin on the south portion.

For the combined catchment areas of 1 and 2, the surface water discharge rate into the ponds will be restricted to a maximum of 2 l/s/ha using a flow control device. This flow rate value is based on the impermeable catchment areas only, calculated using the FSR method. Infiltration is not considered due to ground conditions anticipated to having low permeability. Infiltration should be considered at the next stage of design when results of ground investigation are available with the drainage strategy modified to suit, and attenuation volumes recalculated as necessary.

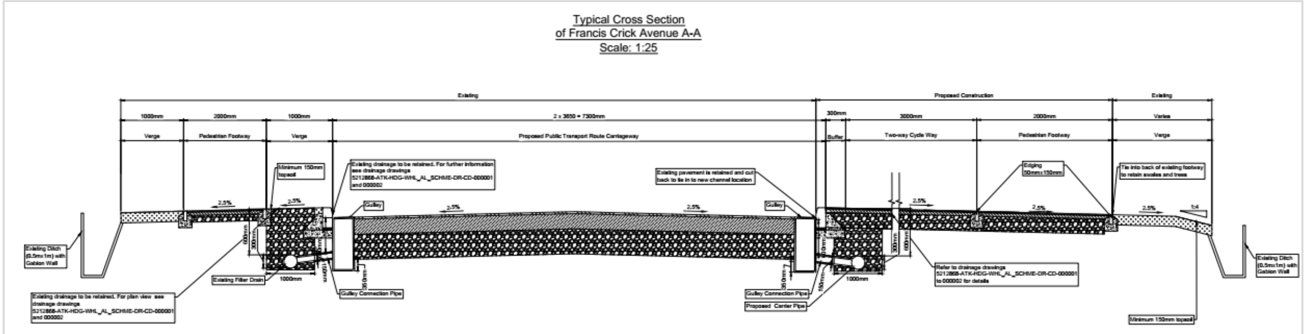


Figure 3-2 – Typical cross section of Francis Crick Avenue including the filter drains

Table 3-2 - Summary of ponds along the Francis Crick Avenue

S.No	Existing pond number	Invert level of pond (m)
1	Existing Pond 1	12.53
2	Existing Pond 2	13.10

3.5. Capture and Conveyance

The surface water runoff from the road is proposed to discharge into the grass verges which will act as filter drains. A perforated pipe at the base of the filter drain will convey the surface water along FCA. From the attenuation crates it will be conveyed south to the southern attenuation pond. By discharging into the filter drain, the surface water runoff will undergo a level of treatment before discharging out to the wider system.

Infiltration along the length of FCA is not viable due to the widened highway construction reducing available space. The proximity of a filtration system to the construction of the highway would increase the risk of undermining the highway. Therefore, any drainage along FCA would be for conveyance / attenuation only.

At detailed design stage, further analysis should be made to utilise tree pits for attenuation and confirmation of the usage of the green verges for drainage along the sides of the paths and carriageways. This will be subject to a maintenance and ownership strategy being agreed with the appropriate stakeholders.

3.6. Volume and Attenuation

The total volume of attenuation required would be in the order of 2588.5 m^3 assuming a discharge rate of 2 l/s/ha. The attenuation volume is an estimation of the volume of the existing swales, plus the volume required to attenuate the additional impermeable area along FCA above the existing impermeable area (1% AEP plus 40% climate change allowance). It is proposed that the required surface water attenuation will be provided using filter drains and ditches. For attenuation purpose, within the filter drain it is assumed both the filter material and subbase would have a void ratio of 30%. The location of utility corridors will be confirmed during detailed design when the carriageway and footway alignments are confirmed.

3.7. Exceedance Events

The design exceedance event is the 1% AEP rainfall event plus 40% for climate change as per Cambridgeshire County Council Surface Water Drainage Guidance for Developers (June 2021) Section 5.10.

For the 1% AEP (1 in 100) rainfall event, plus 40% for climate change, run-off volumes will be contained within the attenuation systems and within the carriageways at a safe depth, if required.

3.8. Water Quality Treatment and Pollution Control

Treatment levels have been checked against the minimum water quality management requirements as set out in the CIRIA guide (see Section 2.11) together with the CIRIA simple index approach method to ensure that adequate water quality is included. (by Mott MacDonald, ref: 403394-MMD-HWA-XX-RP-DR-0553-B CSET Ph2 Drainage Strategy).

Following the steps from Section 2.11, it has been determined that the road and carriageways can be considered as having a medium pollution hazard index (by Mott MacDonald, ref: 403394-MMD-HWA-XX-RP-DR-0553-B CSET Ph2 Drainage Strategy).

A pollution risk assessment should be undertaken at the next stage of design to confirm the conclusions of the simple index approach. Otherwise, the use of petrol interceptors will be reviewed at the next design stage.

3.9. Infiltration

The following infiltration rates have been stated in Mott MacDonald's Surface Water Drainage Strategy Report (ref: 403394-MMD-HWA-XX-RP-DR-0553-B CSET Ph2 Drainage Strategy).

A rate of between 5×10^{-7} m/s to 1×10^{-6} m/s was determined by soakaway tests as part of ground investigation works for a site on the north west of the road boundary.

A rate of 1.2×10^{-5} m/s was taken from the lowest infiltration rate calculated by Soil Technics (TP01).

Rates of 10^{-9} to 10^{-7} m/s of depth range 0.30m to 3.30m and rates of 10^{-5} to 10^{-3} m/s at depths of >3.30m, based on geological maps.

In addition, further infiltration tests were carried out in Haverhill Road PT Stop and Travel Hub site as mentioned in Atkins Ground Investigation Report (ref: 5212868-ATK-GEN-WHL_GT-RP-CE-000001). See Table 4-7.

Further ground investigations on the existing ground conditions should be carried out for the next stage of design, to determine whether infiltration can be considered. Having reviewed the existing data, it has currently been determined that infiltration is not suitable for FCA.

3.10. Biodiversity Benefits

Landscaping is proposed on both sides of the carriageway and will be incorporated within the grass verges. This will provide green corridors adjacent to the route, reducing overall run-off and mitigating against the increase in impermeable area.

Where above and below ground constraints allow and visibility splays are not impacted, trees and shrubs can be incorporated along the green corridors.

3.11. Amenity Benefit

The grassed verges are proposed to include planting that includes shrubs and trees where constraints allow. This will add to the wider green landscape and mitigate against any existing loss of trees and shrubs associated with the construction central alignment carriageway.

The proposed planting and swale will complement the shared pedestrian footway and cycle track that will run adjacent to the route, providing a pleasant environment encouraging active travel along FCA. The green corridors are proposed between the footway / cycle track and PT route providing a buffer zone between bus and pedestrian / cycle traffic and enhancing the experience of active travel users.

4. Section 2 to Section 6 (High Quality Public Transport Route)

4.1. Overview

The route sections between Dame Mary Archer Roundabout and A11 travel hub will comprise the construction of a guided High Quality Public Transport route through arable fields, a junction at the connection with Granham's Road and a Public Transport stop and drop-off area at the junctions at Hinton Way and Haverhill Road. The route crosses the Hobsons Brook and the River Granta twice.

4.2. Existing Scenario and division of catchments

The length of the route is considered to be a greenfield site comprising existing agricultural fields. The full length of the route from Section 2 to Section 6 is divided into seven catchments. This catchment division is based on the high and low points along the route and the availability of outfall locations. The catchments levels range from 14.475mAOD to 37.618mAOD with undulating landscape. Table 4-1 summarises the details of low and high point with reference to chainage and Table 4-2 summarises the information for catchments.

Table 4-1 - Details of the high and low point levels in terms of chainage

Chainage (m)	High Point Level (m)	Low Point level (m)	Remarks
-46.501		15.907	
3	16.8		
78.53		15.415	
134.434	15.835		
352.997		14.475	
480.511	16.338		
540.859		15.472	
605.994	15.933		
742.98		14.593	Catchment 1 – Low Point
924.931	16.646		
1046.17		15.712	Catchment 2 – Low Point
1500.996	17.74		
1697.628		17.05	Since there is no availability of outfall location, it is also considered as catchment 2.
3214.239	37.618		
4584.633		18.977	Catchment 3 – Low Point
4951.059	22.591		
5469.086		19.917	Catchment 4 – Low Point
5821.285	21.51		
5973.507		20.948	Catchment 5 – Low Point
6889.336	27.43		
7195.215		25.903	Since there is no availability of outfall location, it is also considered as catchment 5.

7575.057	30.226		
7952.241		27.406	Catchment 6 – Low Point
8240.802	30.488		
8423.093		28.945	Since there is no availability of outfall location, it is also considered as catchment 6.
8568.835	29.769		Intermediate high point
8785.729		28.306	Intermediate low point
8931.667	29.125		
9056.882		28.620	Catchment 7 – Low Point
9268.994	30.477		

Table 4-2 - Summary of catchments

S.No	Catchment No	Start Chainage (m)	End Chainage (m)	Catchment Area (m^2)	Typical levels range (mAOD)
1	Catchment 1	480	924	6694.065	14.593 – 16.646
2	Catchment 2	924	3212	38809.85	15.712 – 17.74
3	Catchment 3	3212	4952	31213.82	18.977 – 37.618
4	Catchment 4	4952	5818	14032.12	19.917 – 22.591
5	Catchment 5	5818	7575	28982.25	20.948 – 30.226
6	Catchment 6	7575	8575	16791.04	27.406 – 29.769
7	Catchment 7	8575	9268.994	11225.28	28.883 – 30.5

4.3. Drainage Strategy

It is considered that a combination of SuDS could be used along the route. The surface water runoff from the road and footway is proposed to be conveyed within swales and filter drains for the purpose of close to source primary treatment, except where stated otherwise. This would treat the runoff as it passes over the filter strip and through the filter material. As discussed earlier in the report, infiltration at shallow depths is not feasible therefore the filter drains, and swales will be used for conveyance only.

Surface water runoff conveyed via swales is to discharge to ponds or directly into the River Granta and ditches associated with the river along the route. This ensures that surface water is contained and managed close to source and following the topography of the route. Ground conditions are not suitable for infiltration at shallow depths.

Outlined below are summaries of some of the main types of SuDS systems that may be applied to the route, outlining the main benefits and constraints to their application and sustainability for this scheme.

Table 4-3 - Summary of SuDS suitability for Sections 2-6

Component Type	Feasible	Ranking in the SuDS Hierarchy	Additional Comments
Basins and Ponds	✓	Most Sustainable	Ponds are proposed at the low points along the route to allow surface water conveyed via the swales to be attenuated. These are proposed along the HQPT.
Filter Strips and Swales	✓	Most Sustainable	Lined filter strips and conveyance swales are proposed adjacent to the route and within the linear park to collect surface water and discharge it to the ponds. These are proposed along the HQPT and in the Travel Hub area.
Pervious Pavements	✓	Most Sustainable	Permeable paving systems could be incorporated within car parking bays at the car parking drop-offs but may not be suitable for areas accessed by larger vehicles. It is considered that this method would be of limited benefit from an infiltration perspective due to the underlying ground conditions, however, the system could still be used and the sub-base utilised as a form of attenuation which could make a reduction to the overall run-off and storage requirement for the site. Permeable pavements have been proposed along Francis Crick Avenue, parking bays in bus stop areas along the HQPT and within the Travel Hub.
Storage Crates	✓	Least Sustainable	Where the developable footprint is constrained, then storage crate systems could be advantageous. These systems can be provided below ground in the car parking bays before being discharged to ponds with soakaway boreholes located within the site. The use of these systems should be considered further at the next design stage.
Oversized pipework	×	Least Sustainable	Oversized pipework is only considered for attenuation volumes of <200m^3, and so has not been considered as a viable option for the route.
Surface Storage	✓	Least Sustainable	It is proposed that the areas within the carriageways are utilised for the safe management of flows on the surface for exceedance events only. The proposed drainage solutions are sized up to the 1 in 100-year storm event + 40% CC. This could be reviewed at the next design stage when proposed external levels are finalised.

4.4. Surface Water Design Proposal

It is proposed that the surface water from the route enters filter drains and swales along the route or via carrier pipes where private land, embankments, cuttings or bridge structures do not allow for a swale or filter drains.

It is considered feasible to provide the required attenuation for the route in a combination of filter drains, swales and ponds. However, this will be subject to detailed design including hydraulic modelling to ensure there is no / limited flooding along the carriageway and within the drop-off areas.

Appropriate water treatment is to be provided and treatment levels will be checked against the minimum water quality management requirements as set out in the CIRIA guide (refer to CIRIA 753, Table 4.3) together with the CIRIA simple index approach method to ensure that adequate water quality is included. Otherwise, the use of petrol interceptors will be reviewed at the next design stage.

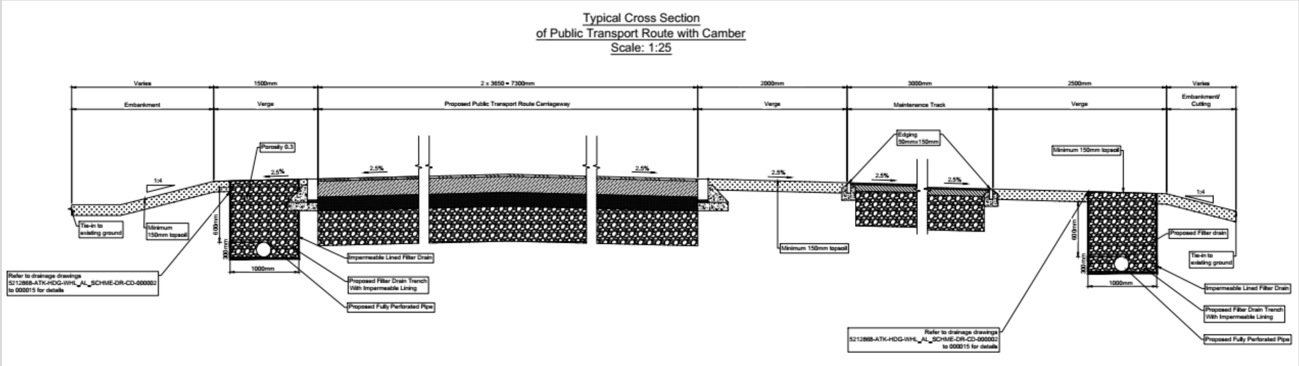


Figure 4-1 – Typical cross section of HQPT route including the filter drains

4.5. Volume and Attenuation

It is proposed that the required surface water attenuation will be provided using a combination of filter drains, conveyance swales and ponds based on the maximum storage required. It is estimated by considering FSR Rainfall, impermeable area of the catchment, maximum allowable discharge that is obtained by 2 l/s/ha discharge limit and 40% climate change.

Based on the storage assessments, the requirement of ponds needs assessment. If the available storage from the proposed filter drains, swales and permeable pavement is observed to be greater than the storage requirement, then ponds are not proposed. Alternatively, ponds or larger carrier pipes are proposed to accommodate the storage requirement. Table 4-4 shows the catchment wise attenuation volumes required along the HQPT route.

Table 4-4 - Catchment wise attenuation volumes required along the HQPT route

Catchment No.	Catchment area (ha)	Discharge (l/s)	Chainage (m)	Total Required Storage (m^3)	Available Storage (filter drains +swales +permeable pavement) (m^3)	Total available storage (m^3)	Pond requirement /carrier pipe for attenuation purpose
Catchment 1	0.67	1.34	480 – 924	629.00	Filter drains = 350.55 Swale = 298.70 Permeable pavement =0	649.252	No need of Pond (Existing Pond is in Flood zone)
Catchment 2	3.88	7.73	924 – 3212	3618.00	Filter drains = 2062.35 Swale = 655.73 Permeable pavement =0	2718.08	New Pond of volume 899.92 m^3 is required & area is available
Catchment 3	3.12	6.21	3212 – 4952	2917.00	Filter drains = 1557.9 Swale = 68.97 Permeable pavement = 155.72	1626.87	Shifting of existing pond to other side of River with volume of 1134.41 m^3 & area is available
Catchment 4	1.40	2.79	4952 – 5818	1307.00	Filter drains = 682.2 Swale = 330.92 Permeable pavement =0	1013.12	New Pond of volume 313.77 m^3 is required & area is available
Catchment 5	2.9	5.79	5818 – 7575	2708	Filter drains = 1578.6 Swale = 234.95 Permeable pavement = 140.85	1954.4	New Pond of volume 753.61 m^3 is required, bigger size of Carrier pipes need to propose for attenuation
Catchment 6	1.68	3.36	7575 – 8575	1564.00	Filter drains = 856.75 Swale = 0 Permeable pavement =0	856.75	New Pond of volume 707.2 m^3 is required, existing pond need to be modified
Catchment 7	1.12	2.24	8575 – 9268.994	11180.00	Filter drains = 547.65 Swale = 228.98 Permeable pavement = 2295.67	547.65	Existing pond can be utilized with volume of 8107.70 m^3

Table 4-5 – Summary of ponds along the HQPT route

S.No	Proposed pond number	Catchment no	Cover level of pond (m)	Invert level of pond (m)	Pond attenuation volume (m^3)	Reference drawing
1	Proposed Pond 1	Catchment 2	14.40	12.90	899.92	5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000003.pdf
2	Proposed Pond 2	Catchment 3	18.58	17.08	1134.41	5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000009.pdf
3	Proposed Pond 3	Catchment 4	19.28	17.78	313.77	5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000010.pdf
4	Proposed Pond 4	Catchment 6	26.17	24.67	707.20	5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000015.pdf
5	Proposed Pond 5	Catchment 7	30.10	28.50	1598.00	5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000016.pdf
6	Proposed Pond 6	Catchment 7	30.10	28.60	1664.00	5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000016.pdf
7	Proposed Pond 7	Catchment 7	28.49	26.99	4845.70	5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000016.pdf

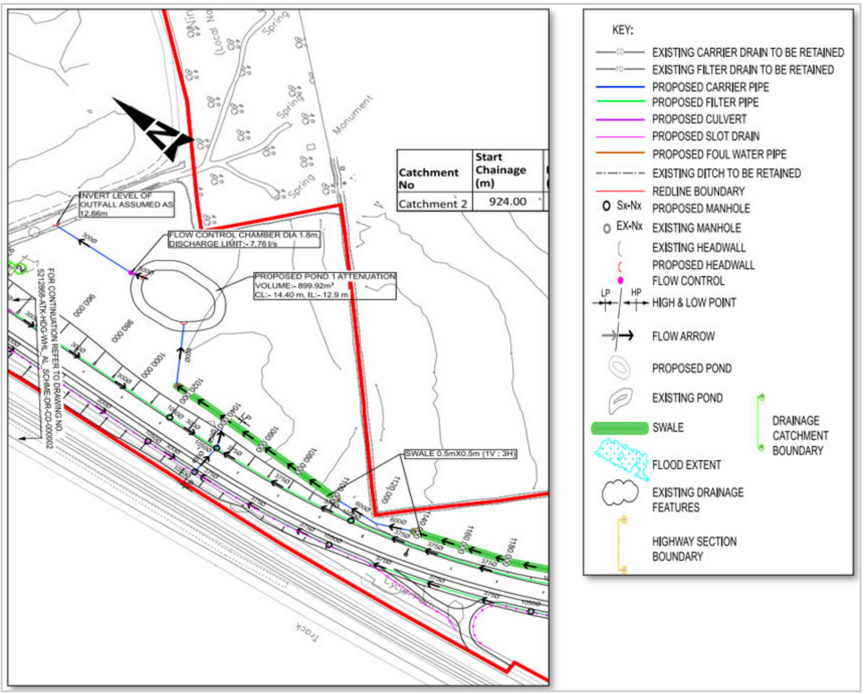


Figure 4-2 – Proposed Pond 1 – layout and discharge location

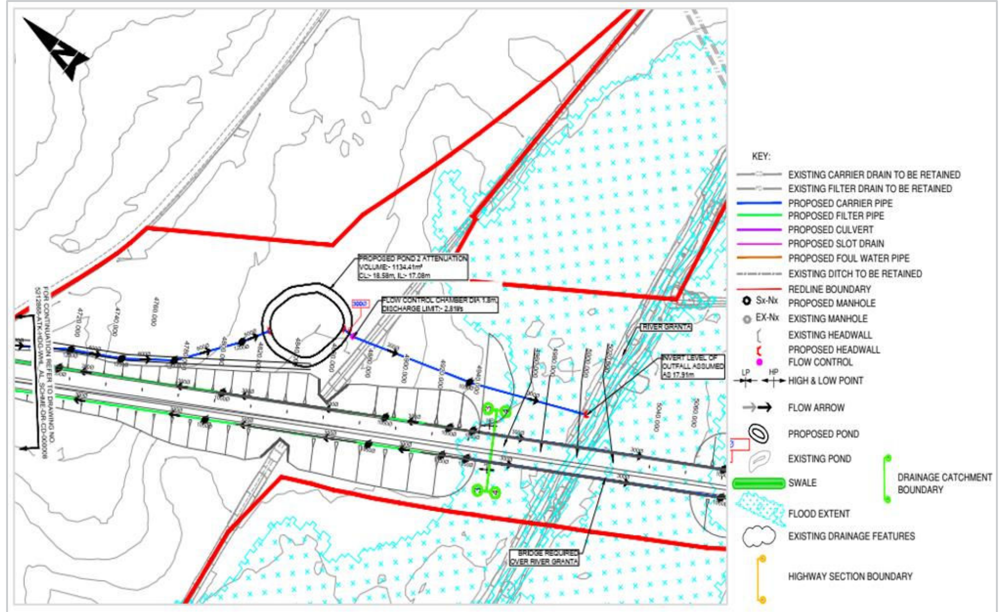


Figure 4-3 – Proposed Pond 2 – layout and discharge location

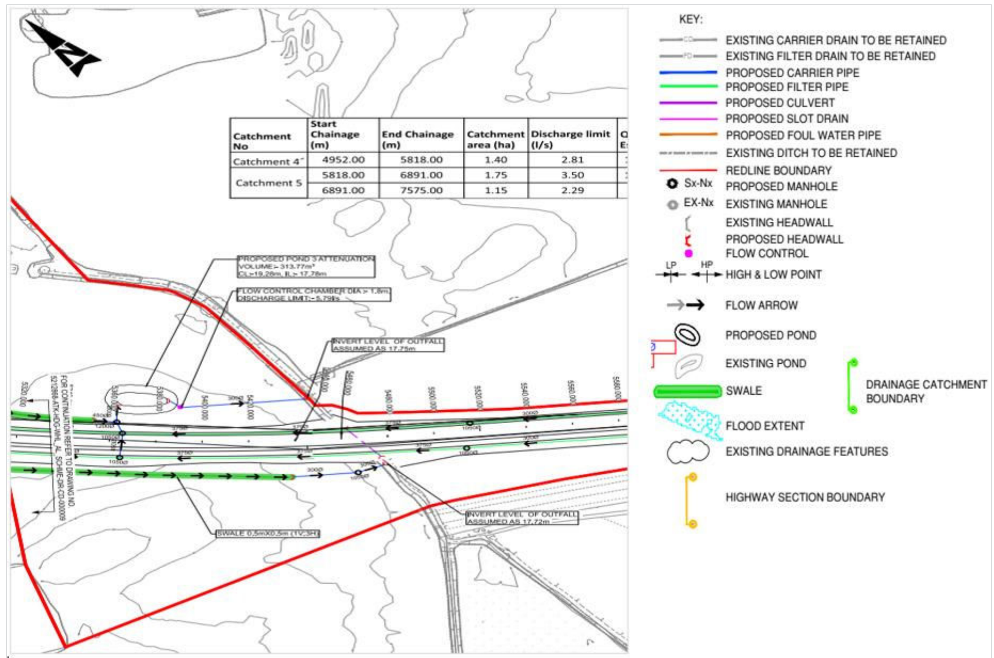


Figure 4-4 – Proposed Pond 3 – layout and discharge location

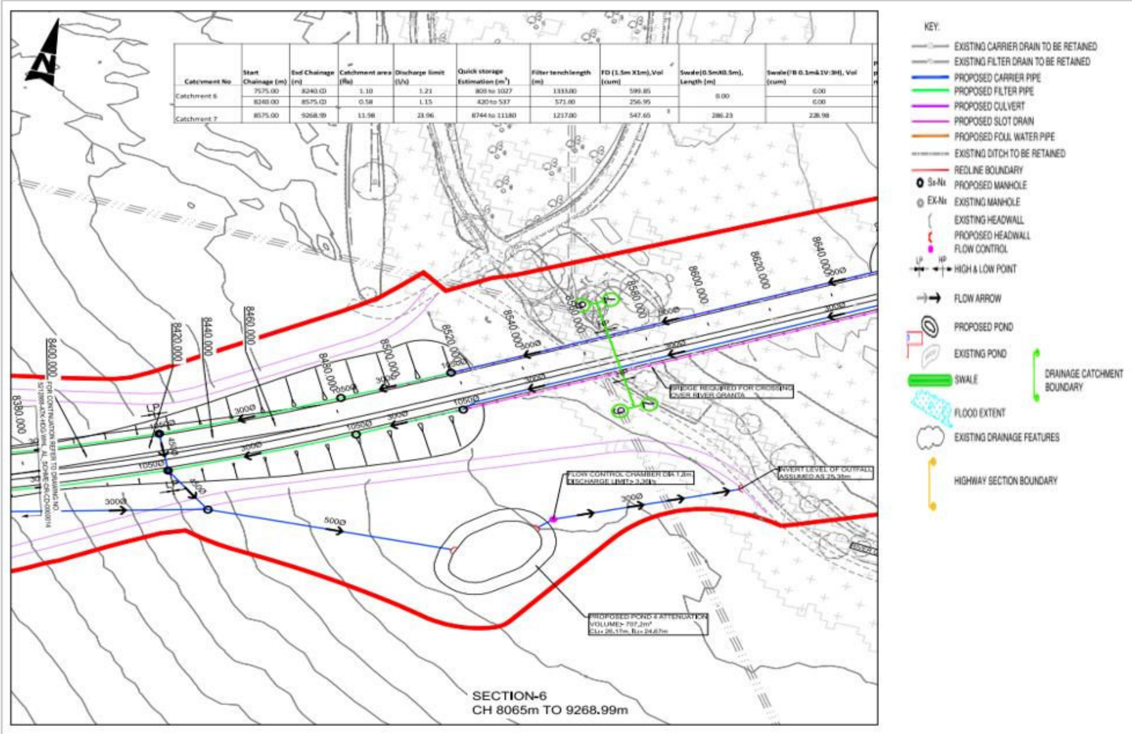


Figure 4-5 – Proposed Pond 4 – layout and discharge location

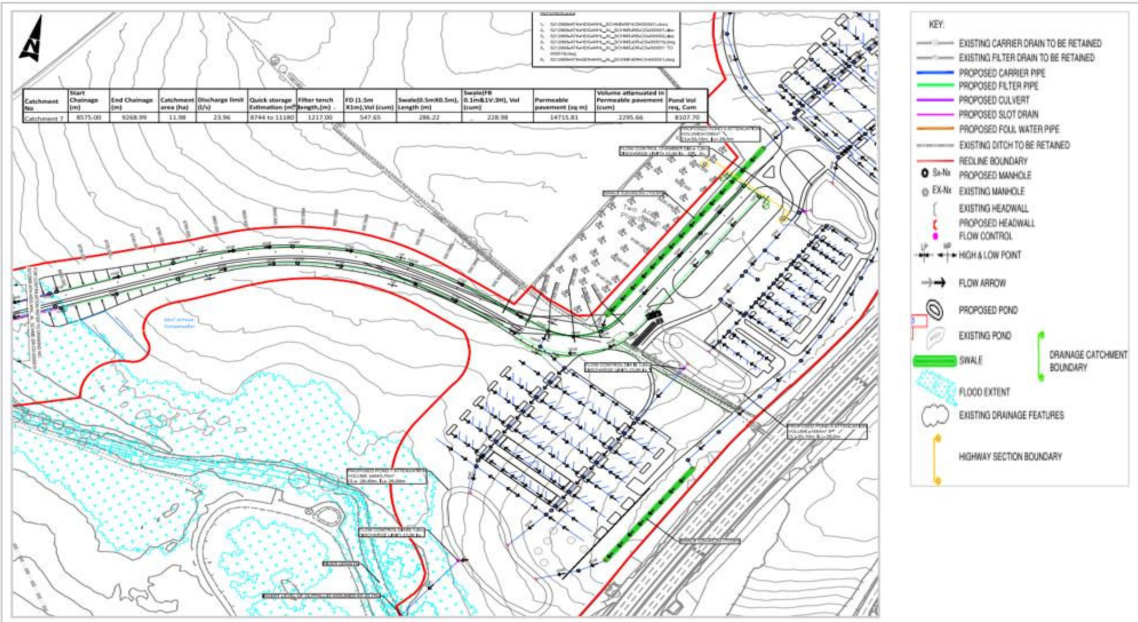


Figure 4-6 – Proposed ponds 5,6 & 7 – layout and discharge location

4.6. Observations from ground investigation report

- According to the ground investigation report (5212868-ATK-GEN-WHL_GT-RP-CE-000001), the below groundwater levels in sections 2 and 4 are very shallow. In section 2, at borehole BH-PTR-08 D, (Location: Easting – 545959, Northing - 254147), the shallow water table level is 0.26 m and water table level is 2.75 m from the finished surface. This borehole location is 64.711 m away from pond 1 location. So, it is recommended that additional research be conducted in the detailed design stage by measuring the ground water table with a new borehole in the proposed location of pond 1 before finalising.
- In section 4, at borehole BH-PTR-36, (Location: Easting – 548501, Northing - 251040) the shallow water table level is 0.13 m and water table level is 2.771 m from the finished surface. This borehole location is 86.79 m away from pond 3 location. So, it is recommended that additional research be conducted in the detailed design stage by measuring the ground water table with a new borehole in the proposed location of pond 3 before finalising.
- In section 4, at borehole BH-PTR-07, (Location: Easting – 545961, Northing - 254192) the shallow water table level is 0.36 m and water table level is 2.833 m from the finished surface. This borehole location is 21.251 m away from swale location. So, it is recommended that additional research be conducted in the detailed design stage by measuring the ground water table with a new borehole before finalising.
- In section 4, at borehole BH-PTR-39, (Location: Easting – 548652, Northing - 250860) the shallow water table level is 0.56 m and water table level is 1.401 m from the finished surface. This borehole location is 86.7 m away from pond 3 location. So, it is recommended that additional research be conducted in the detailed design stage by measuring the ground water table with a new borehole in the proposed location of pond 3 before finalising.

The details of the borehole water table levels with respect to the proposed ponds/swales are summarised in Table 4-6.

Table 4-6 - Borehole water table levels with respect to the proposed ponds/swales

Location	Easting	Northing	Section	10/05/2021	17/05/2021	03/06/2021	17/10/2021	13/11/2021	18/12/2021	09/01/2022	27/02/2022	19/03/2022	Targeted Geology	Topo/Swale/Pond	Topo level	Finished Surface level	Shallow WT level	WT level from Finished surface	Ground water table level	Distance from BH location (m)	Ground Elevation at pond/swale
BH-PTR-36	548501	251040	4	0.13	0.92	1.13	0.93	0.65	0.74	0.69	0.69	0.60	ALV	Swale, near Pond 3	18.472	21.113	0.13	2.771	8.342	86.79	19.34 at pond 3, 19.450 at swale
BH-PTR-07	545961	254192	2	0.54	0.5	0.6	0.36	0.36	0.58	0.61	0.61	0.62	WMCH	Swale	13.971	16.444	0.36	2.833	13.611	21.251	13.991
BH-PTR-08 D	545947	254166	2	0.54	0.56	0.67	0.24	0.37	0.78	0.68	0.68	0.65	WMCH		14.131	15.822	0.24	1.931	13.891		
BH-PTR-10	545959	254147	2	0.54	0.52	0.64	0.26	0.42	0.73	0.65	0.65	0.62	ALV/ WMCH	Near Pond-1	14.07	16.56	0.26	2.75	13.81	64.711	14.426
BH-PTR-39	548652	250860	4	0.56	0.62	0.78	0.76	0.63	0.91	0.61	0.61	0.56	ZZCH	Near Pond-3	18.981	19.822	0.56	1.401	18.421	86.7	19.34
BH-PTR-08 S	545947	254166	2	0.57	0.61	0.73	0.39	0.42	0.79	0.76	0.76	0.68	WMCH		14.131	16.602	0.39	2.861	13.741		

BH-PTR-27	548366	251244	4	0.84	0.81	0.99	0.88	0.91	1.13	0.87	0.87	0.79	RTD		17.436	22.503	0.81	5.877	16.626		
BH-PTR-31	548402	251183	4	0.85	0.84	0.91	1.09	1.04	1.13	0.88	0.88	0.82	ZZCH		17.319	22.098	0.84	5.619	16.479		
BH-PTR-04	545964	254349	2	0.90	0.62	0.78	0.8	0.81	0.76	0.64	0.64	0.52	ALV/ WMCH	Slight issue to Swale	13.939	14.534	0.62	1.215	13.319	11.14	13.987
BH-PTR-33 D	548412	251165	4	0.94	1.04	1.16	1.21	1.16	1.29	1.02	1.02	0.97	ZZCH		17.606	21.954	0.94	5.288	16.666		
BH-PTR-30	548395	251217	4	1.01	0.99	1.15	1.4	2.32	1.38	1.07	1.07	0.99	ZZCH		17.378	22.369	0.99	5.981	16.388		
BH-PTR-33 S	548412	251165	4	1.05	1.06	1.22	1.23	1.16	1.26	1.04	1.04	0.98	ALV/RTD		17.606	21.954	1.04	5.388	16.566		
BH-PTR-02 S	545993.5	254427	2	1.1	0.96	2.36	0.86	0.9	1.05	0.95	0.95	0.88	WMCH	Swale	14.819	15.559	0.86	1.6	13.959	18.885	14.223
BH-PTR-03A	545993	254368	2	1.1	0.89	1.06	1.16	1.22	0.98	0.91	0.91	0.87	ALV	Swale	14.163		0.89	-13.273	13.273	8.095	14.152
BH-PTR-02 D	545993.5	254427	2	1.23	1.04	1.31	1.03	1.04	0.85	1.06	1.06	0.95	WMCH		14.819	15.559	0.85	1.59	13.969		
BH-PTR-41 D	548744	250793	4	1.36	1.26	1.52	1.54	1.43	1.65	1.32	1.32	1.28	ZZCH	No topo available			1.26	1.26	-1.26		
BH-PTR-41 S	548744	250793	4	1.41	1.43	1.53	1.69	1.5	1.56	1.31	1.31	1.28	MG	No topo available			1.31	1.31	-1.31		
BH-PTR-43 D	548906	250675	4	1.41	1.54	1.52	1.77	1.49	1.65	1.01	1.01	0.85	ZZCH	No topo available			1.01	1.01	-1.01		

BH-PTR-43 S	548906	250675	4	1.42	1.4	1.49	1.76	1.54	1.45	1	1	0.81	MG	No topo available			1	1	-1		
BH-PTR-21	548294	251358	4	1.66	1.64	1.76	1.77	1.8	1.97	1.63	1.63	1.54	RTD	Near Pond 2	17.725	22.01	1.63	5.915	16.095	71.478	18.707
BH-PTR-35	548454	251111	4	1.67	1.62	1.73	1.58	1.44	1.56	1.43	1.43	1.36	RTD	Swale	18.329	21.627	1.43	4.728	16.899		
BH-PTR-42 D	548825	250734	4	1.72	1.55	1.75	1.73	1.58	1.76	1.37	1.37	1.3	ZZCH	No topo available			1.37	1.37	-1.37		
BH-PTR-12	545991	253978	2	1.92	1.99	2.08	1.73	1.78	2.11	2.01	2.01	1.97	WMCH	Swale	15.483		1.73	-13.753	13.753		
BH-PTR-13	546317	253581	2	1.97	2.02	2.15	5.04	2.44	2.68	2.23	2.23	2.13	ZZCH	Swale	16.998	17.152	1.97	2.124	15.028		
BH-OBC-04 D	551344	249667	6	2.26	2.41	2.8	3.79	3.5	3.76	2.74	2.74	2.6	HCK	Near to Pond-4	25.34	30.705	2.26	7.625	23.08		
BH-PTR-19	548263	251424	4	2.32	2.36	2.5	2.82	2.85	3.07	2.46	2.46	2.34	RTD	Near Pond 2	18.659	21.139	2.32	4.8	16.339		
BH-OBC-11 D	551442	249720	6	2.44	2.65	2.91	4.23	3.96	3.99	2.97	2.97	2.85	HCK		25.612	30.9	2.44	7.728	23.172		
BH-OBC-06	551335	249644	6	2.68	2.96	3.22	4.34	4.06	4.23	3.24	3.24	3.08	HCK	Near to Pond-4	25.813	30.705	2.68	7.572	23.133		
BH-OBC-12	551453	249740	6	2.72	1.98	3.27	4.59	4.31	4.35	3.33	3.33	3.23	HCK		25.866	30.7	1.98	6.814	23.886		

BH-OBC-07	551303	249624	6	3.11	3.34	3.63	4.68	4.38	4.58	3.65	3.65	3.49	HCK	Near to Pond-4	26.262	30.705	3.11	7.553	23.152		
BH-OBC-07	551303	249624	6	3.46	3.7	3.99	5.09	4.83	5	4.09	4.09	3.92	ZZCH	Near to Pond-4	26.262	30.705	3.46	7.903	22.802		
BH-PTR-14	546572	253450	2	3.68	3.71	3.86	4.15	4.19	4.48	3.97	3.97	3.87	ZZCH		18.69		3.68	-15.01	15.01		
BH-PTR-18	547867	252091	3	3.85	4.03	4.16	Dry	Dry	Dry	Dry	Dry	Dry	ZZCH	Swale			3.85	3.85	-3.85		
BH-OBC-15	551480	249746	6	3.85	4.12	4.39	6.71	5.43	5.5	4.53	4.53	4.39	ZZCH		26.612	30.7	3.85	7.938	22.762		
BH-TH-01	551883	249837	Travel Hub	5.46	5.82	6.18	7.44	7.14	7.31	6.23	6.23	6.03	HNCK	Hub Pond	29.213		5.46	-23.753	23.753		
BH-PTR-45	549861	250045	5	5.9	5.89	5.98	5.88	5.69	5.95	5.62	5.62	5.57	HCK	Swale	26.902	27.251	5.62	5.969	21.282		
BH-PTR-15	547384	252988	3	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	ZZCH		30.808	31.171	0	0.363	30.808		
BH-PTR-16	547679	252701	3	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	HCK		38.781	37.089	0	-1.692	38.781		
BH-PTR-42 S	548825	250734	4	Dry	1.49	1.75	Dry	Dry	Dry	Dry	Dry	Dry	MG				1.49	1.49	-1.49		
BH-OBC-01	551276	249617	6	Dry	Dry	Dry	Dry	Dry	DRY	n/a	n/a	DRY	RTD				0	0	0		
BH-OBC-04 S	551344	249667	6	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	RTD				0	0	0		
BH-OBC-11 S	551442	249720	6	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	RTD				0	0	0		

BH-TH-03	551924	249841	Travel Hub	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	RTD	Hub Pond			0	0	0		
BH-BP-01	548780	251251	4	n/a	1.05	1.24	1.2	1.18	1.29	n/a	n/a	2.6	ALV		18.038		1.05	-16.988	16.988		

4.7. Impermeable membranes

Since the ponds and filter drains are only needed for attenuation, it is recommended to line them with impermeable membranes. These impermeable membranes can prevent weed growth, silt generation, erosion and also reducing maintenance requirements & costs. They can be easily installed, and they are sustainable, durable, and long lasting.

4.8. Exceedance Events

The design exceedance event is the 1% AEP rainfall event plus 40% for climate change as per Cambridgeshire County Council Surface Water Drainage Guidance for Developers (June 2021) Section 5.10.

It is proposed that the attenuation be sized to meet the 1% AEP (1 in 100) rainfall event, plus 40% for climate change, run-off volumes will be contained within ponds close to the outfall and the swale. As such exceedance flows arising from the HQPT route are proposed to be contained within the proposed carriageway at a safe depth.

4.9. Floodplain Compensation Requirements

Flood compensation is to be considered due to the construction of the bridge and associated structural piers. A study of volumes required offset from the construction at Babraham Crossing, has determined a total volume required of approximately 160m³ to be compensated in an additional flood zone area. This has been indicated on drawings and will be subject to further design at the next stage to ensure it is compensated on a level by level basis in line with EA guidance.

There is surface water flooding for the 1 in 1000-year storm located near to Hobson's Conduit. Due to the construction of the HPTQ within this flood zone, floodplain compensation will be required. It is recommended to utilise areas of the field not flooded during the 1 in 1000-year storm event however this option is dependent on discussions with the landowner and EA.

An alternative option would be to introduce additional attenuation to store surface water if this storm event occurs. The first option is the preferrable option at this stage and is to be considered at the next design stage (by Mott MacDonald, ref: 403394-MMD-HWA-XX-RP-DR-0553-B CSET Ph2 Drainage Strategy).

4.10. Water Quality Treatment and Pollution Control

Surface water run-off arising from the road requires treatment before discharging to watercourses. It is proposed to use SuDS components to provide close to source / primary treatment of run-off using the simple index method described in CIRIA C753 The SuDS Manual.

The proposed drainage design elements (e.g. swales and filter strips within the verge) reduce the hazard risk to "acceptable" for hydrocarbons & metals and to just below acceptable for suspended solids. Where suspended solids could enter watercourses, then additional treatment in the form of stop traps would reduce the hazard risks to "acceptable". The final drainage strategy will present more detailed information on the risks to water quality to confirm the hazards are not likely to have any impact on water resources from this low traffic route.

The proposed route is largely underlain by chalk formations which all form a single Principal Aquifer as defined by the EA. This aquifer provides a high level of groundwater storage, supports conveyance of good quality groundwater in the area and is used by several groundwater abstractions for public water supplies. Desktop studies have determined Infiltration to not be appropriate and is to be confirmed with the EA. A pollution risk assessment will be undertaken at the next stage of design to confirm the conclusions of the simple index approach (by Mott MacDonald, ref: 403394-MMD-HWA-XX-RP-DR-0553-B CSET Ph2 Drainage Strategy).

4.11. Infiltration

Infiltration testing was carried out in the out in the Zig Zag Chalk Formation (Haverhill Road PT Stop) and in the Holywell Nodular Chalk Formation (Travel Hub site). Table 4-7 shows the summary of soil infiltration rates.

Table 4-7 - Summary of soil infiltration rates

Stratum	Location	Design soil infiltration rate (m/s)
Zig Zag Chalk Formation	Haverhill Road PT Stop	1.00×10^{-03}
Holywell Nodular Chalk Formation	Travel Hub site	1.69×10^{-04} (north and northeast) 1.72×10^{-05} (centre and southeast)

Infiltration has not been considered viable and the drainage attenuation calculations are currently based on no infiltration within the swales and filter drains.

4.12. Biodiversity Benefits

Landscaping is proposed on both sides of the carriageway and will be incorporated within the verges, swales and filter strips. These will provide green corridors adjacent to the route, reducing overall run-off and mitigating against the increase in impermeable area.

Planting provides an opportunity for a diverse range of plants that are suited to the specific conditions of a SuDS swale (tolerant of varying water levels, slight pollution, etc). The planting mix within the swale will be determined at the next stage of design.

Where above and below ground constraints allow and visibility splays are not impacted, trees and shrubs can be incorporated along the top of the swale and as part of the landscaping design.

4.13. Amenity Benefits

The verges, swales and filter strips are proposed to include planting that includes shrubs and trees where constraints allow. This will add to the wider green landscape and mitigate against any existing loss of trees and shrubs associated with the construction of the route.

The proposed planting and swale will complement the proposed shared pedestrian / cycleway and linear park that will run adjacent to the route, providing a pleasant environment encouraging active travel along the route for both leisure and commuting.

5. Recommendations and conclusions

5.1. Recommendations

It is recommended that the preliminary surface water management systems described in Chapters 3 and 4 are implemented. The proposed drainage design for the scheme will need to be approved and meet the requirements of the LLFA, EA and other relevant stakeholders.

The following recommendations are proposed to be investigated further at the next stage of design:

- The proposed surface water management system is to be discussed further with Cambridgeshire County Council / LLFA.
- Consent from Cambridgeshire County Council and EA may be required for any surface water discharge into the River Granta or it's associated ditches. The discharge rate into the river and ditches is to be confirmed with the EA and LLFA.
- Consent from Hobson's Conduit Trust may be required for any surface water discharge into the Hobson's Conduit.
- A pollution risk assessment should be undertaken at the next stage of design to confirm the conclusions of the simple index approach.
- According to the ground investigation report, the below groundwater levels in few sections are very shallow. So, it is recommended that additional research be conducted in the detailed design stage by measuring the ground water table with a new borehole in the proposed location of filter drains & ponds before finalising
- Since the ponds are only needed for attenuation, it is recommended to line the ponds with impermeable membranes, such as concrete sheets or bodpaves etc, these impermeable membranes can prevent weed growth, silt generation, erosion and also reduce maintenance requirements & costs. They can be easily installed, they are sustainable, durable, and long lasting.

5.2. Conclusions

For the main High Quality Public Transport route, given the anticipated ground conditions on site, it has been determined that infiltration is unlikely to be suitable. It is proposed the route will utilise a combination of filter drains, swales, permeable pavements, and ponds to manage runoff. Some sections of the route may require oversized pipes due to site constraints.

The proposed HQPT Route is divided into six sections. Section 1, i.e., Francis Crick Avenue is approximately 630m long in total with a 10m wide carriageway and 1.5m wide footways on either side. For Francis Crick Avenue surface water runoff from the road and footway is proposed to be collected and conveyed using carrier drain, filter drain, slot drain and ditches to the existing attenuation basins. Based on the high point and low point the runoff from chainage 20 to chainage 140 is conveyed to the existing attenuation basin on the north portion. The runoff from the other part of the networks i.e., runoff from chainage 140 to 480 is conveyed to the existing attenuation basin on the south portion. The surface water discharge rate into the ponds will be restricted to a maximum of 2 l/s/ha using a flow control device. This flow rate value is based on the impermeable catchment areas only, calculated using the FSR method.

The full length of the route from Section 2 to Section 6 is divided into eight catchments. This catchment division is based on the high and low points along the route and the availability of outfall locations. The catchments levels range from 14.475mAOD to 37.618mAOD with undulating landscape. It is proposed that the required surface water attenuation will be provided using a combination of filter drains, permeable pavements, conveyance swales and ponds, based on the maximum storage required which is estimated by considering FSR Rainfall, impermeable area of the catchment, maximum allowable discharge and 40% climate change. Based on the storage assessments, the requirement of ponds needs assessment. If the available storage from the proposed filter drains, swales and permeable pavements is observed to be greater than the storage requirement, then pond is not proposed. Alternatively, ponds or larger carrier pipes are proposed to accommodate the storage requirement.

5.3. Drainage Improvements compared to Mott Macdonald designs

5.3.1. Section 1 (Francis Crick Avenue)

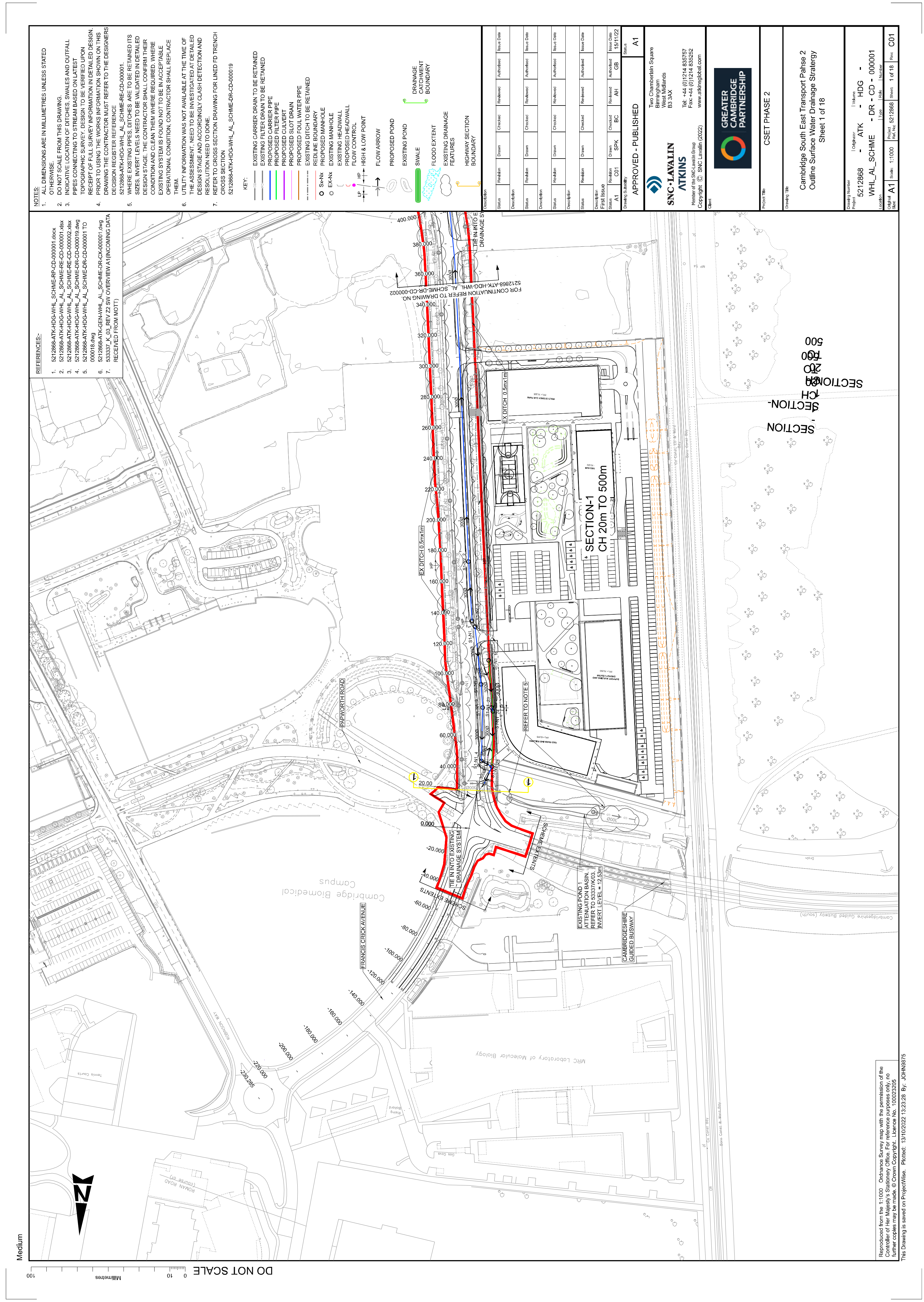
- For Francis Crick Avenue, the existing gabion ditches are utilized on both sides. Existing ponds are also utilized on the North portion and South portion.
- Crates are proposed for attenuation purpose by Mott Macdonald, whereas existing ponds are utilized for attenuation in accordance with Atkins drainage design which lowers the cost.
- All dimensions are also proposed for the pipes, chambers, which are not included in Mott Macdonald's design. The flow control chambers are proposed to limit the discharge rate to 2 l/s/ha. The required diameter of flow control chamber is also proposed for outfall.

5.3.2. Section 2 to Section 6 (High Quality Public Transport Route)

- The full length of the route from Section 2 to Section 6 is divided into seven catchments. This catchment division is based on the high and low points along the route and the availability of outfall locations.
- The drainage features such as drains, conveyance swales and ponds are designed along with the required dimensions which are not included.
- Pipe diameters, chamber diameters, required pond attenuation volumes in each catchment are computed. Flow control chambers are proposed to maintain the limiting discharge rate is designed.
- Probable location of proposed culverts is also identified.

6. Appendices

6.1. Appendix A – Proposed Drainage Drawings



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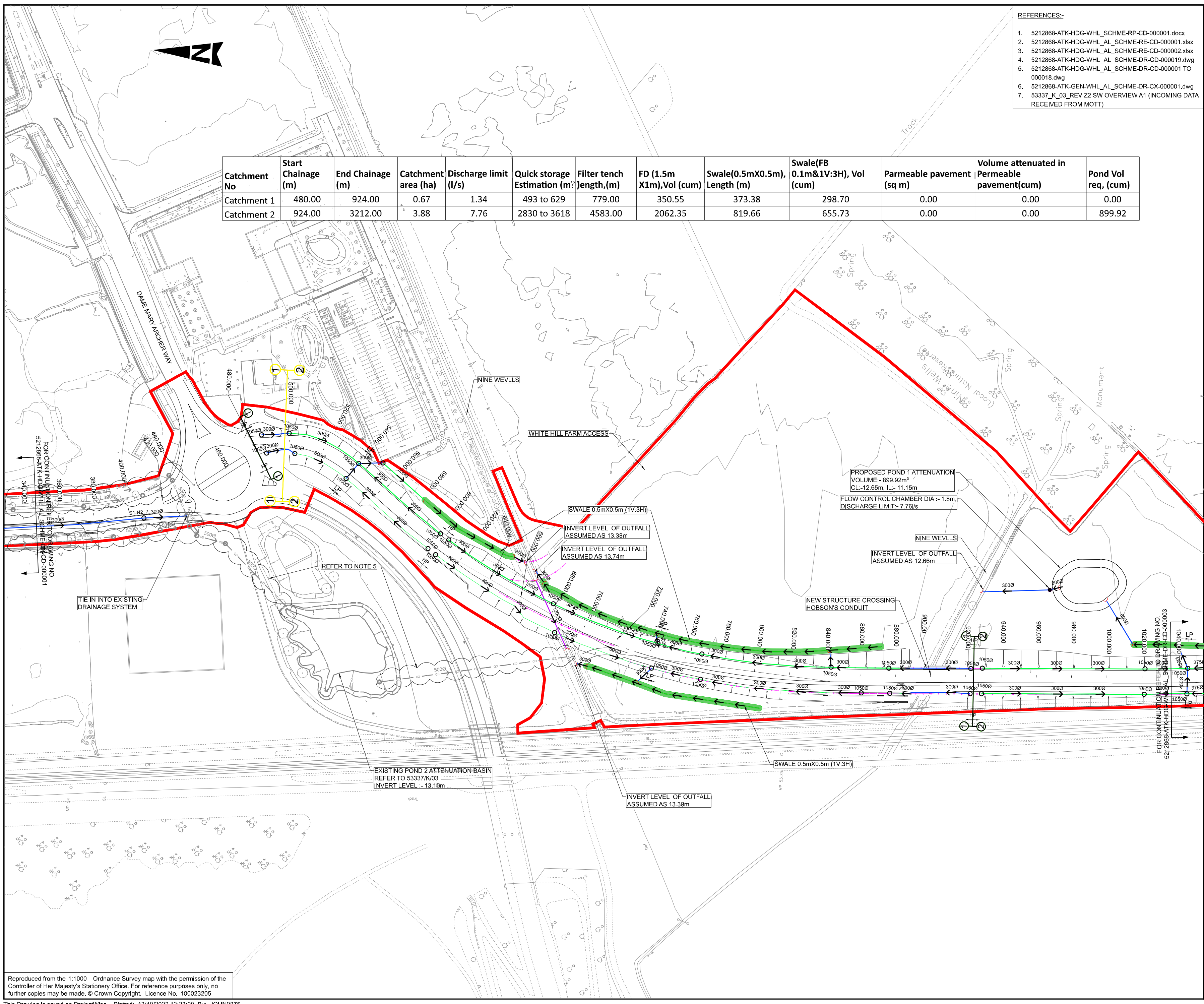

REFERENCES:-

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5. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000001 TO 000018.dwg
6. 5212868-ATK-GEN-WHL_AL_SCHME-DR-CX-000001.dwg
7. 53337_K_03_REV Z2 SW OVERVIEW A1 (INCOMING DATA RECEIVED FROM MOTT)

Catchment No	Start Chainage (m)	End Chainage (m)	Catchment area (ha)	Discharge limit (l/s)	Quick storage Estimation (m³)	Filter tench length,(m)	FD (1.5m X1m),Vol (cum)	Swale(0.5mX0.5m), Length (m)	Swale(FB 0.1m&1V:3H), Vol (cum)	Parmeable pavement (sq m)	Volume attenuated in Permeable pavement(cum)	Pond Vol req, (cum)
Catchment 1	480.00	924.00	0.67	1.34	493 to 629	779.00	350.55	373.38	298.70	0.00	0.00	0.00
Catchment 2	924.00	3212.00	3.88	7.76	2830 to 3618	4583.00	2062.35	819.66	655.73	0.00	0.00	899.92

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
2. DO NOT SCALE FROM THIS DRAWING.
3. INDICATIVE LOCATION OF DITCHES, SWALES AND OUTFALL PIPES CONNECTING TO STREAM BASED ON LATEST TOPOGRAPHIC SURVEY. DESIGN TO BE VERIFIED UPON RECEIPT OF FULL SURVEY INFORMATION IN DETAILED DESIGN.
4. PRIOR TO USING THE WORKS INFORMATION SHOWN ON THIS DRAWING THE CONTRACTOR MUST REFER TO THE DESIGNERS DECISION REGISTER REFERENCE 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000001.
5. WHERE EXISTING PIPES, DITCHES ARE TO BE RETAINED ITS SIZES, INVERT LEVELS NEED TO BE VALIDATED IN DETAILED DESIGN STAGE. THE CONTRACTOR SHALL CONFIRM THEIR CONDITION AND CLEAN THEM WHERE REQUIRED. WHERE EXISTING SYSTEM IS FOUND NOT TO BE IN ACCEPTABLE OPERATIONAL CONDITION, CONTRACTOR SHALL REPLACE THEM.
6. UTILITY INFORMATION WAS NOT AVAILABLE AT THE TIME OF THE ASSESSMENT, NEED TO BE INVESTIGATED AT DETAILED DESIGN STAGE AND ACCORDINGLY CLASH DETECTION AND RESOLUTION NEED TO DONE.
7. REFER TO CROSS SECTION DRAWING FOR LINED FD TRENCH CROSS SECTION 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019

KEY:

- EXISTING CARRIER DRAIN TO BE RETAINED
- EXISTING FILTER DRAIN TO BE RETAINED
- PROPOSED CARRIER PIPE
- PROPOSED FILTER PIPE
- PROPOSED CULVERT
- PROPOSED SLOT DRAIN
- PROPOSED FOUL WATER PIPE
- EXISTING DITCH TO BE RETAINED
- REDLINE BOUNDARY
- Sx-Nx PROPOSED MANHOLE
- EX-Nx EXISTING MANHOLE
- EXISTING HEADWALL
- PROPOSED HEADWALL
- FLOW CONTROL
- LP HP HIGH & LOW POINT
- FLOW ARROW
- PROPOSED POND
- EXISTING POND
- SWALE
- DRAINAGE CATCHMENT BOUNDARY
- FLOOD EXTENT
- EXISTING DRAINAGE FEATURES
- HIGHWAY SECTION BOUNDARY

Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
Description: FIRST ISSUE						
A1	C01	SPK	BC	AH	GB	15/11/22

Drawing Suitability: APPROVED - PUBLISHED — Status: A1

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Client: GREATER CAMBRIDGE PARTNERSHIP

Project Title: CSET PHASE 2

Drawing Title: Cambridge South East Transport Phase 2 Outline Surface Water Drainage Strategy Sheet 2 of 18

Drawing Number: 5212868 - ATK - HDG - WHL_AL_SCHME - DR - CD - 000002

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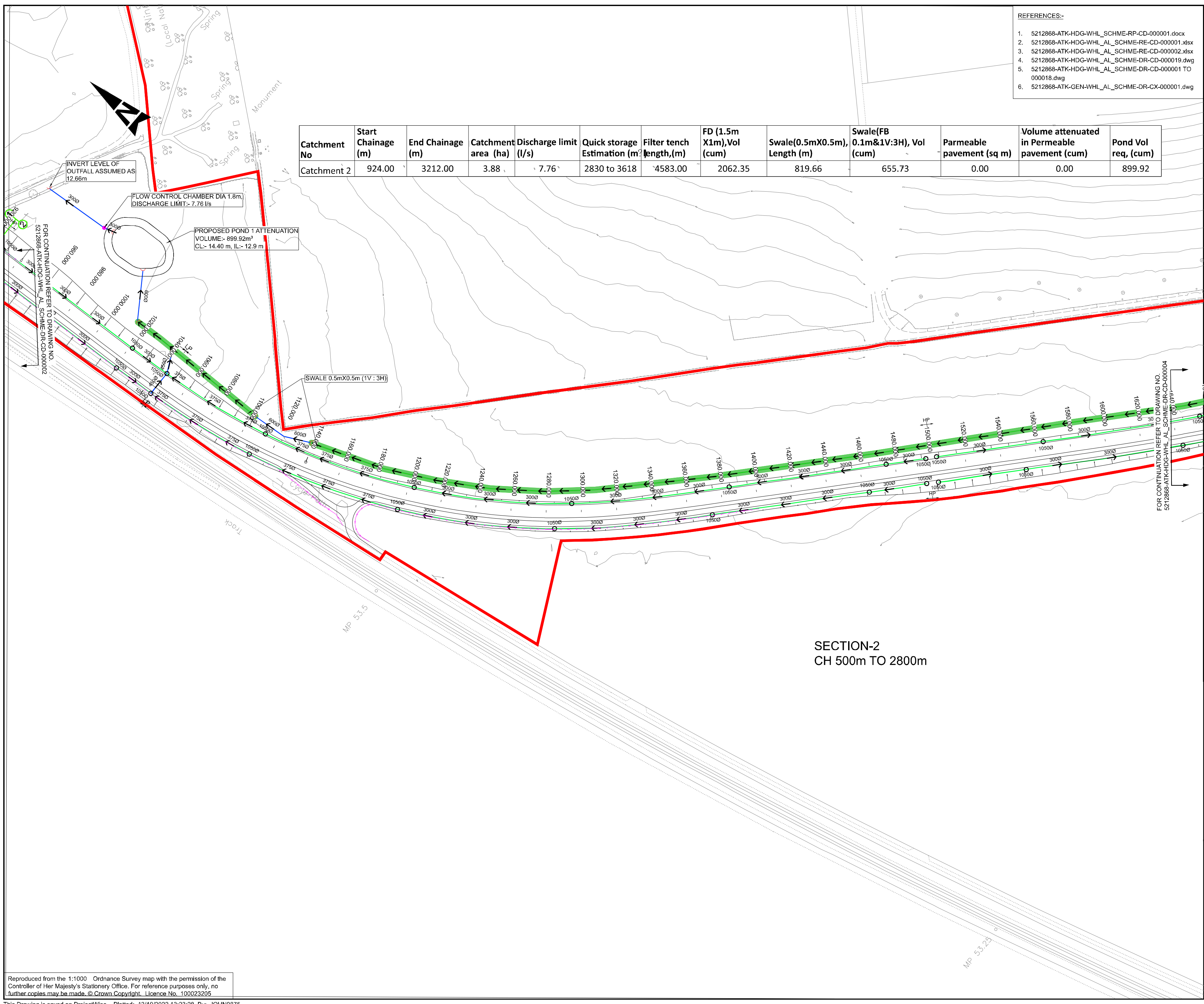

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6. 5212868-ATK-GEN-WHL_AL_SCHME-DR-CX-000001.dwg

Catchment No	Start Chainage (m)	End Chainage (m)	Catchment area (ha)	Discharge limit (l/s)	Quick storage Estimation (m³)	Filter tench length,(m)	FD (1.5m X1m),Vol (cum)	Swale(0.5mX0.5m), Length (m)	Swale(FB 0.1m&1V:3H), Vol (cum)	Parmeable pavement (sq m)	Volume attenuated in Permeable pavement (cum)	Pond Vol req, (cum)
Catchment 2	924.00	3212.00	3.88	7.76	2830 to 3618	4583.00	2062.35	819.66	655.73	0.00	0.00	899.92

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7. REFER TO CROSS SECTION DRAWING FOR LINED FD TRENCH CROSS SECTION 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019

KEY:

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- EXISTING DRAINAGE FEATURES
- HIGHWAY SECTION BOUNDARY

Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
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A1	C01	SPK	BC	AH	GB	15/11/22

Drawing Suitability: APPROVED - PUBLISHED — Status: A1

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Client: GREATER CAMBRIDGE PARTNERSHIP

Project Title: CSET PHASE 2

Drawing Title: Cambridge South East Transport Phase 2 Outline Surface Water Drainage Strategy Sheet 3 of 18

Drawing Number: 5212868 - ATK - HDG - WHL_AL_SCHME - DR - CD - 000003

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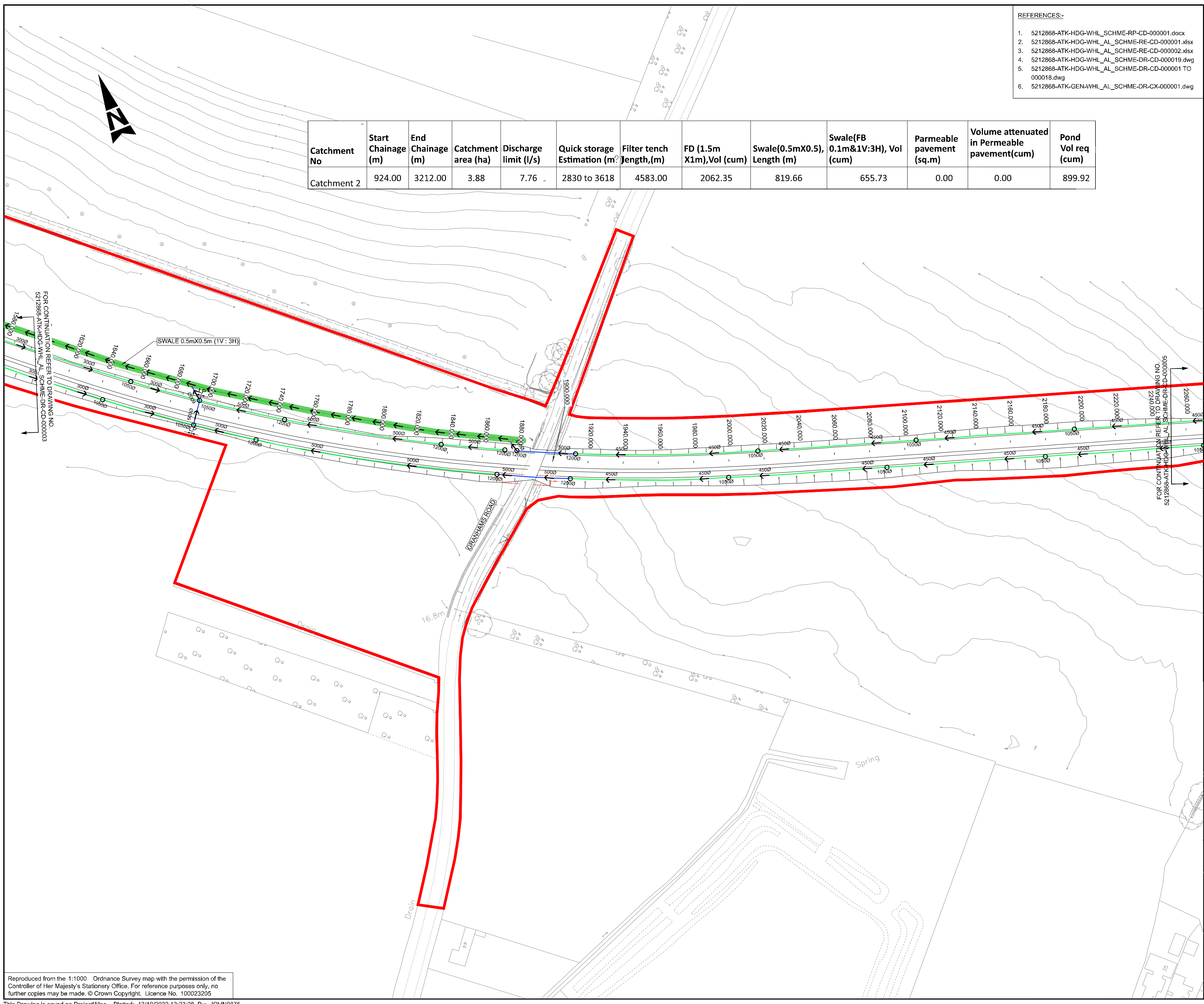

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Catchment 2	924.00	3212.00	3.88	7.76	2830 to 3618	4583.00	2062.35	819.66	655.73	0.00	0.00	899.92

FOR CONTINUATION REFER TO DRAWING NO. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000003

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4. PRIOR TO USING THE WORKS INFORMATION SHOWN ON THIS DRAWING THE CONTRACTOR MUST REFER TO THE DESIGNERS DECISION REGISTER REFERENCE 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000001.
5. WHERE EXISTING PIPES, DITCHES ARE TO BE RETAINED ITS SIZES, INVERT LEVELS NEED TO BE VALIDATED IN DETAILED DESIGN STAGE. THE CONTRACTOR SHALL CONFIRM THEIR CONDITION AND CLEAN THEM WHERE REQUIRED. WHERE EXISTING SYSTEM IS FOUND NOT TO BE IN ACCEPTABLE OPERATIONAL CONDITION, CONTRACTOR SHALL REPLACE THEM.
6. UTILITY INFORMATION WAS NOT AVAILABLE AT THE TIME OF THE ASSESSMENT, NEED TO BE INVESTIGATED AT DETAILED DESIGN STAGE AND ACCORDINGLY CLASH DETECTION AND RESOLUTION NEED TO DONE.
7. REFER TO CROSS SECTION DRAWING FOR LINED FD TRENCH CROSS SECTION 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019

KEY:

- EXISTING CARRIER DRAIN TO BE RETAINED
- EXISTING FILTER DRAIN TO BE RETAINED
- PROPOSED CARRIER PIPE
- PROPOSED FILTER PIPE
- PROPOSED CULVERT
- PROPOSED SLOT DRAIN
- PROPOSED FOUL WATER PIPE
- EXISTING DITCH TO BE RETAINED
- REDLINE BOUNDARY
- Sx-Nx PROPOSED MANHOLE
- EX-Nx EXISTING MANHOLE
- EXISTING HEADWALL
- PROPOSED HEADWALL
- FLOW CONTROL
- LP HP HIGH & LOW POINT
- FLOW ARROW
- PROPOSED POND
- EXISTING POND
- SWALE
- DRAINAGE CATCHMENT BOUNDARY
- FLOOD EXTENT
- EXISTING DRAINAGE FEATURES
- HIGHWAY SECTION BOUNDARY

Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
FIRST ISSUE						
A1	C01	SPK	BC	AH	GB	15/11/22

Drawing Suitability: APPROVED - PUBLISHED — Status: A1

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Fax: +44 (0)1214 835252
www.atkinsglobal.com

Client: GREATER CAMBRIDGE PARTNERSHIP

Project Title: CSET PHASE 2

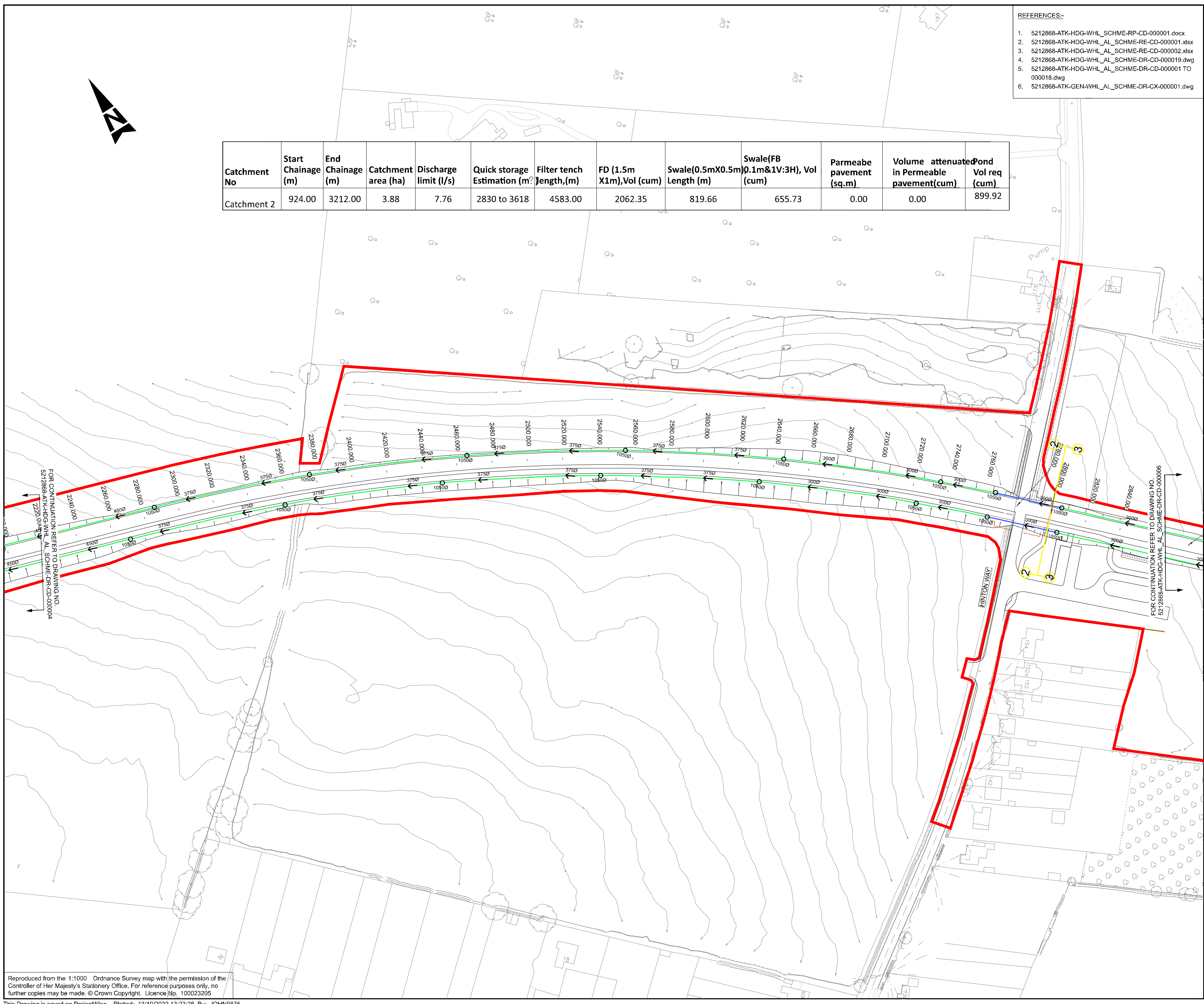
Drawing Title: Cambridge South East Transport Phase 2 Outline Surface Water Drainage Strategy Sheet 4 of 18

Drawing Number: 5212868 - ATK - HDG - WHL_AL_SCHME - DR - CD - 000004

Original Size: A1 | Scale: 1:1000 | Project Ref. No.: 5212868 | Sheet: 4 of 18 | Rev: C01

Medium

DO NOT SCALE



Catchment No	Start Chainage (m)	End Chainage (m)	Catchment area (ha)	Discharge limit (l/s)	Quick storage Estimation (m³)	Filter tench length,(m)	FD (1.5m X1m),Vol (cum)	Swale(0.5mX0.5m) Length (m)	Swale(FB 0.1m&1V:3H), Vol (cum)	Parmeabe pavement (sq.m)	Volume attenuated in Permeable pavement(cum)	Pond Vol req (cum)
Catchment 2	924.00	3212.00	3.88	7.76	2830 to 3618	4583.00	2062.35	819.66	655.73	0.00	0.00	899.92

FOR CONTINUATION REFER TO DRAWING NO. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000004

FOR CONTINUATION REFER TO DRAWING NO. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000006

REFERENCES:-

1. 5212868-ATK-HDG-WHL_SCHME-RP-CD-000001.docx
2. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000001.xlsx
3. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000002.xlsx
4. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019.dwg
5. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000001 TO 000018.dwg
6. 5212868-ATK-GEN-WHL_AL_SCHME-DR-CX-000001.dwg

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
2. DO NOT SCALE FROM THIS DRAWING.
3. INDICATIVE LOCATION OF DITCHES, SWALES AND OUTFALL PIPES CONNECTING TO STREAM BASED ON LATEST TOPOGRAPHIC SURVEY. DESIGN TO BE VERIFIED UPON RECEIPT OF FULL SURVEY INFORMATION IN DETAILED DESIGN.
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7. REFER TO CROSS SECTION DRAWING FOR LINED FD TRENCH CROSS SECTION 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019

Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
FIRST ISSUE						
A1	C01	SPK	BC	AH	GB	15/11/22

Drawing Suitability: APPROVED - PUBLISHED — Status: A1

Client: GREATER CAMBRIDGE PARTNERSHIP

Project Title: CSET PHASE 2

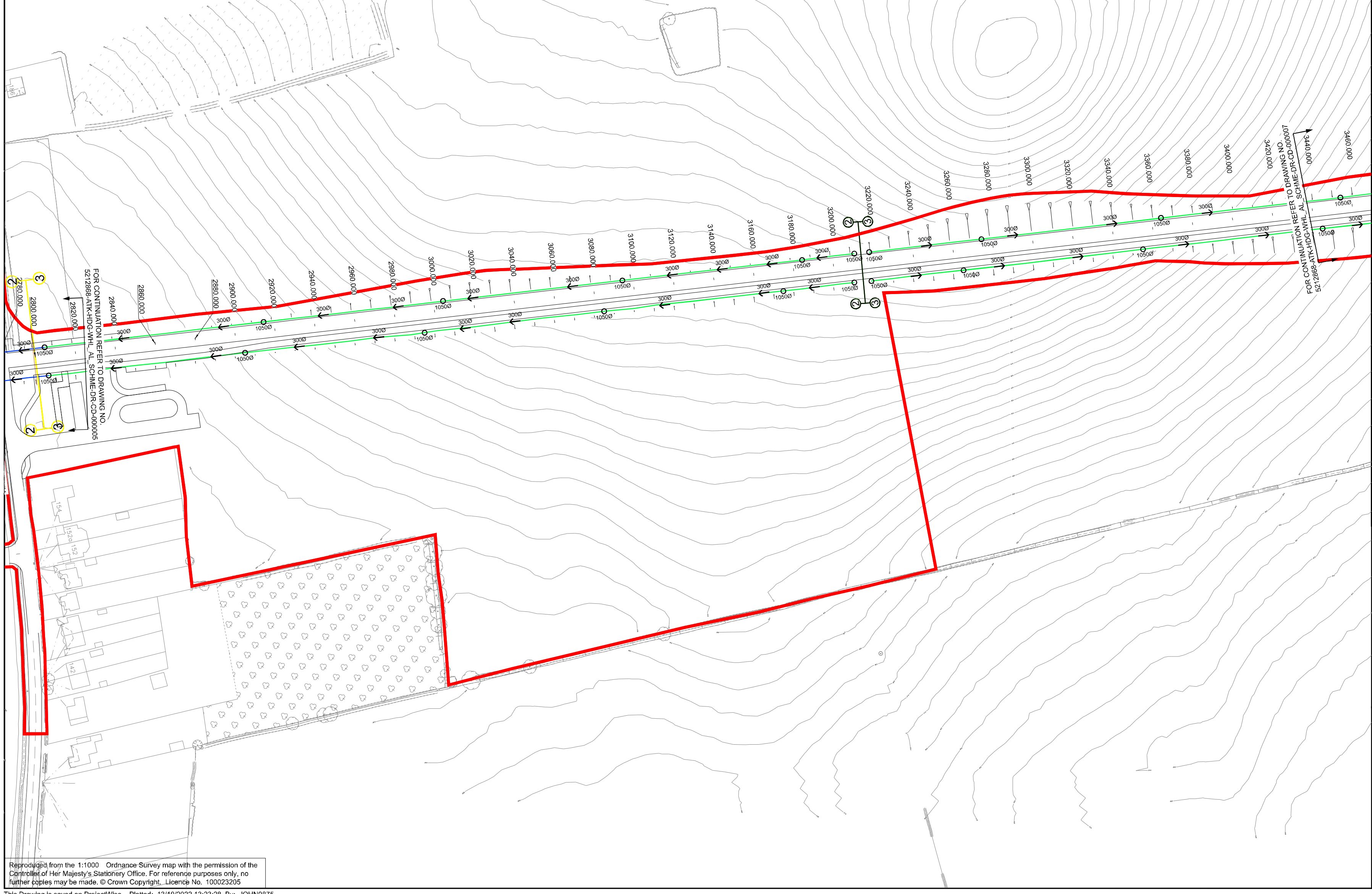
Drawing Title: Cambridge South East Transport Phase 2 Outline Surface Water Drainage Strategy Sheet 5 of 18

Drawing Number: 5212868 - ATK - HDG - WHL_AL_SCHME - DR - CD - 000005

Original Size: A1 | Scale: 1:1000 | Project Ref. No.: 5212868 | Sheet: 5 of 18 | Rev: C01

Medium

DO NOT SCALE



Catchment No	Start Chainage (m)	End Chainage (m)	Catchment area (ha)	Discharge limit (l/s)	Quick storage Estimation (m³)	Filter tench length,(m)	FD (1.5m X1m),Vol (cum)	Swale(0.5mX0.5m), Length (m)	Swale(FB 0.1m&1V:3H), Vol (cum)	Parmeable pavement (sq m)	Volume attenuated in Permeable pavement(cum)	Pond Vol req, (cum)
Catchment 2	924.00	3212.00	3.88	7.76	2830 to 3618	4583.00	2062.35	819.66	655.73	0.00	0.00	899.92
Catchment 3	3212.00	4952.00	3.12	6.24	2281 to 2917	3462.00	1557.90	86.22	68.97	998.21	155.72	1134.41

REFERENCES:-

1. 5212868-ATK-HDG-WHL_SCHME-RP-CD-000001.docx
2. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000001.xlsx
3. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000002.xlsx
4. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019.dwg
5. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000001 TO 000018.dwg
6. 5212868-ATK-GEN-WHL_AL_SCHME-DR-CX-000001.dwg

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
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7. REFER TO CROSS SECTION DRAWING FOR LINED FD TRENCH CROSS SECTION 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019

KEY:

- EXISTING CARRIER DRAIN TO BE RETAINED
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- PROPOSED FILTER PIPE
- PROPOSED CULVERT
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- REDLINE BOUNDARY
- Sx-Nx PROPOSED MANHOLE
- EX-Nx EXISTING MANHOLE
- EXISTING HEADWALL
- PROPOSED HEADWALL
- FLOW CONTROL
- CATCHMENT
- LP HP HIGH & LOW POINT
- FLOW ARROW
- PROPOSED POND
- EXISTING POND
- SWALE
- DRAINAGE CATCHMENT BOUNDARY
- FLOOD EXTENT
- EXISTING DRAINAGE FEATURES
- HIGHWAY SECTION BOUNDARY

Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
FIRST ISSUE						
A1	C01	SPK	BC	AH	GB	15/11/22

APPROVED - PUBLISHED — Status A1

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www.atkinsglobal.com

Client: GREATER CAMBRIDGE PARTNERSHIP

Project Title: CSET PHASE 2

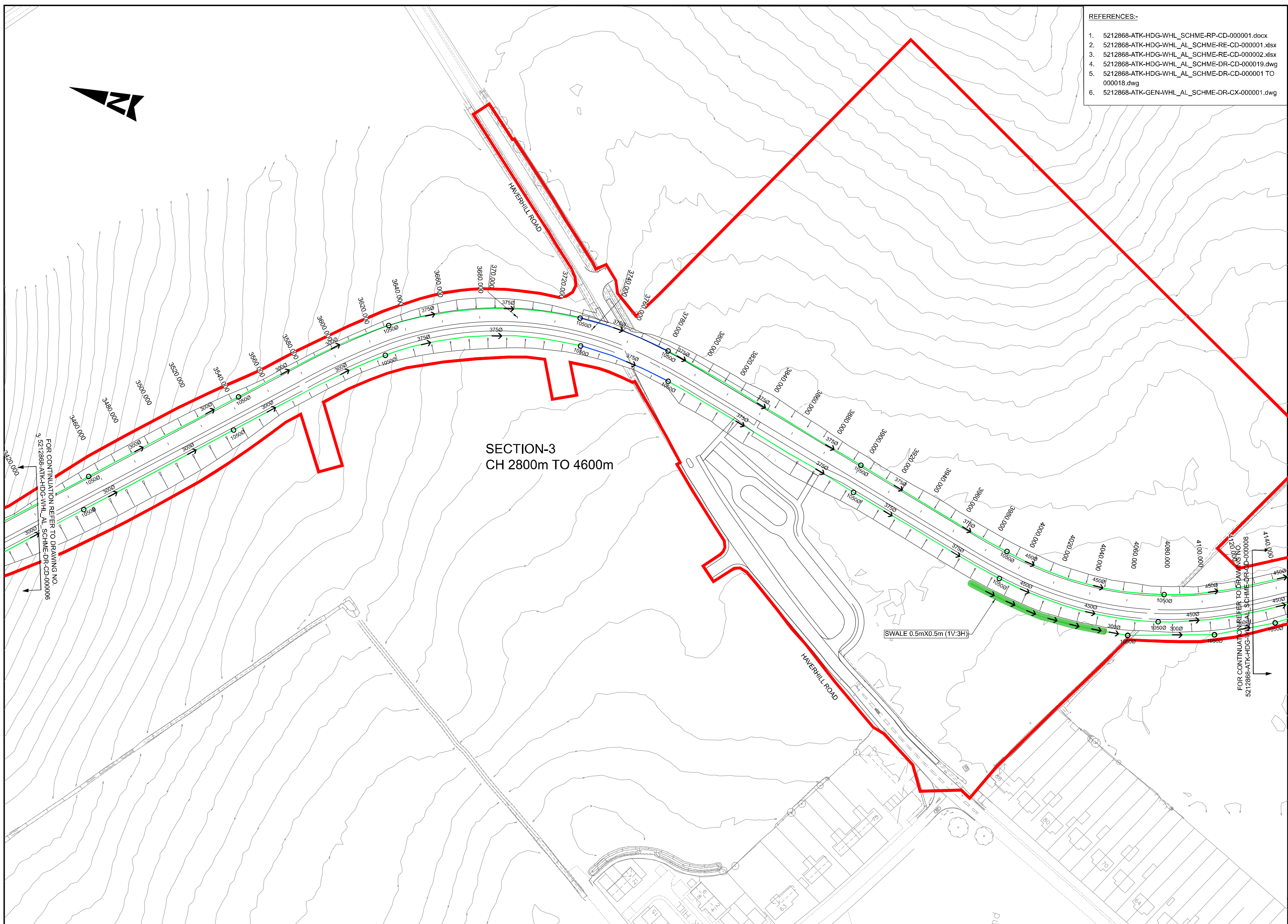
Drawing Title: Cambridge South East Transport Phase 2 Outline Surface Water Drainage Strategy Sheet 6 of 18

Drawing Number: 5212868 - ATK - HDG - WHL_AL_SCHME - DR - CD - 000006

Original Size: A1 | Scale: 1:1000 | Project Ref. No.: 5212868 | Sheet: 6 of 18 | Rev: C01

Medium

DO NOT SCALE



Catchment No	Start Chainage (m)	End Chainage (m)	Catchment area (ha)	Discharge limit (l/s)	Quick storage Estimation (m³)	Filter tench length,(m)	FD (1.5m X1m),Vol (cum)	Swale(0.5mX0.5m), Length (m)	Swale(FB 0,1m&1V:3H), Vol (cum)	Parmeable pavement (sq m)	Volume attenuated in Permeable pavement(cum)	Pond Vol req, (cum)
Catchment 3	3212.00	4952.00	3.12	6.24	2281 to 2917	3462.00	1557.90	86.22	68.97	998.21	155.72	1134.41

REFERENCES:-

1. 5212868-ATK-HDG-WHL_SCHME-RP-CD-000001.docx
2. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000001.xlsx
3. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000002.xlsx
4. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019.dwg
5. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000001 TO 000018.dwg
6. 5212868-ATK-GEN-WHL_AL_SCHME-DR-CX-000001.dwg

NOTES:

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7. REFER TO CROSS SECTION DRAWING FOR LINED FD TRENCH CROSS SECTION 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019

KEY:

- EXISTING CARRIER DRAIN TO BE RETAINED
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- HIGHWAY SECTION BOUNDARY

Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
FIRST ISSUE						
A1	C01	SPK	BC	AH	GB	15/11/22

APPROVED - PUBLISHED — Status A1

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Client: GREATER CAMBRIDGE PARTNERSHIP

Project Title: CSET PHASE 2

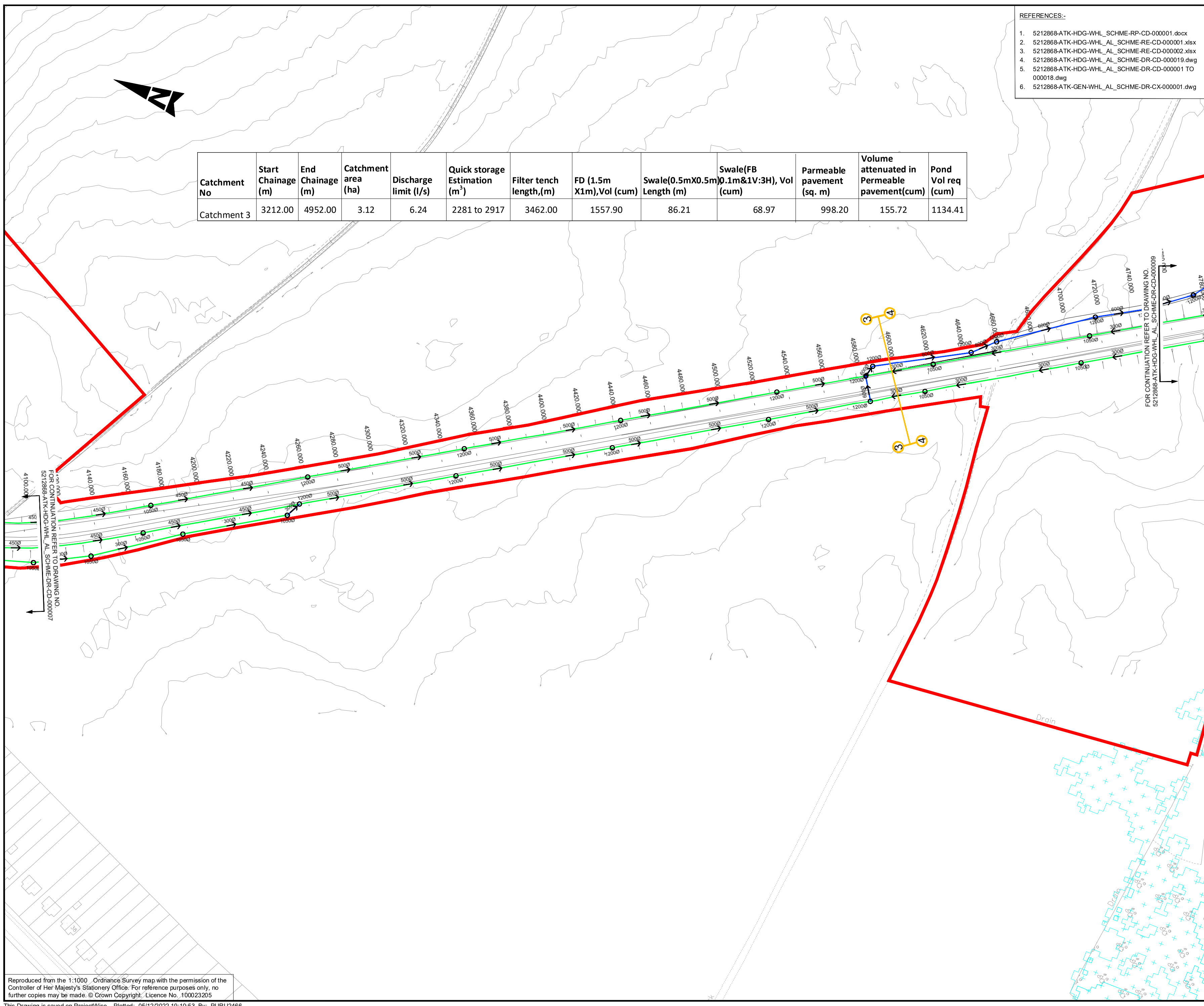
Drawing Title: Cambridge South East Transport Phase 2 Outline Surface Water Drainage Strategy Sheet 7 of 18

Drawing Number: 5212868 - ATK - HDG - WHL_AL_SCHME - DR - CD - 000007

Original Size: A1 | Scale: 1:1000 | Project Ref. No.: 5212868 | Sheet: 7 of 18 | Rev: C01

Medium

DO NOT SCALE



Catchment No	Start Chainage (m)	End Chainage (m)	Catchment area (ha)	Discharge limit (l/s)	Quick storage Estimation (m^3)	Filter tench length,(m)	FD (1.5m X1m),Vol (cum)	Swale(0.5mX0.5m) Length (m)	Swale(FB 0.1m&1V:3H), Vol (cum)	Parmeable pavement (sq. m)	Volume attenuated in Permeable pavement(cum)	Pond Vol req (cum)
Catchment 3	3212.00	4952.00	3.12	6.24	2281 to 2917	3462.00	1557.90	86.21	68.97	998.20	155.72	1134.41

REFERENCES:-

1. 5212868-ATK-HDG-WHL_SCHME-RP-CD-000001.docx
2. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000001.xlsx
3. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000002.xlsx
4. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019.dwg
5. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000001 TO 000018.dwg
6. 5212868-ATK-GEN-WHL_AL_SCHME-DR-CX-000001.dwg

NOTES:

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7. REFER TO CROSS SECTION DRAWING FOR LINED FD TRENCH CROSS SECTION 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019

KEY:

- EXISTING CARRIER DRAIN TO BE RETAINED
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- PROPOSED CARRIER PIPE
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- EXISTING DRAINAGE FEATURES
- HIGHWAY SECTION BOUNDARY

Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
FIRST ISSUE						
A1	C01	SPK	BC	AH	GB	15/11/22

Drawing Suitability: APPROVED - PUBLISHED | Status: A1

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Client: GREATER CAMBRIDGE PARTNERSHIP

Project Title: CSET PHASE 2

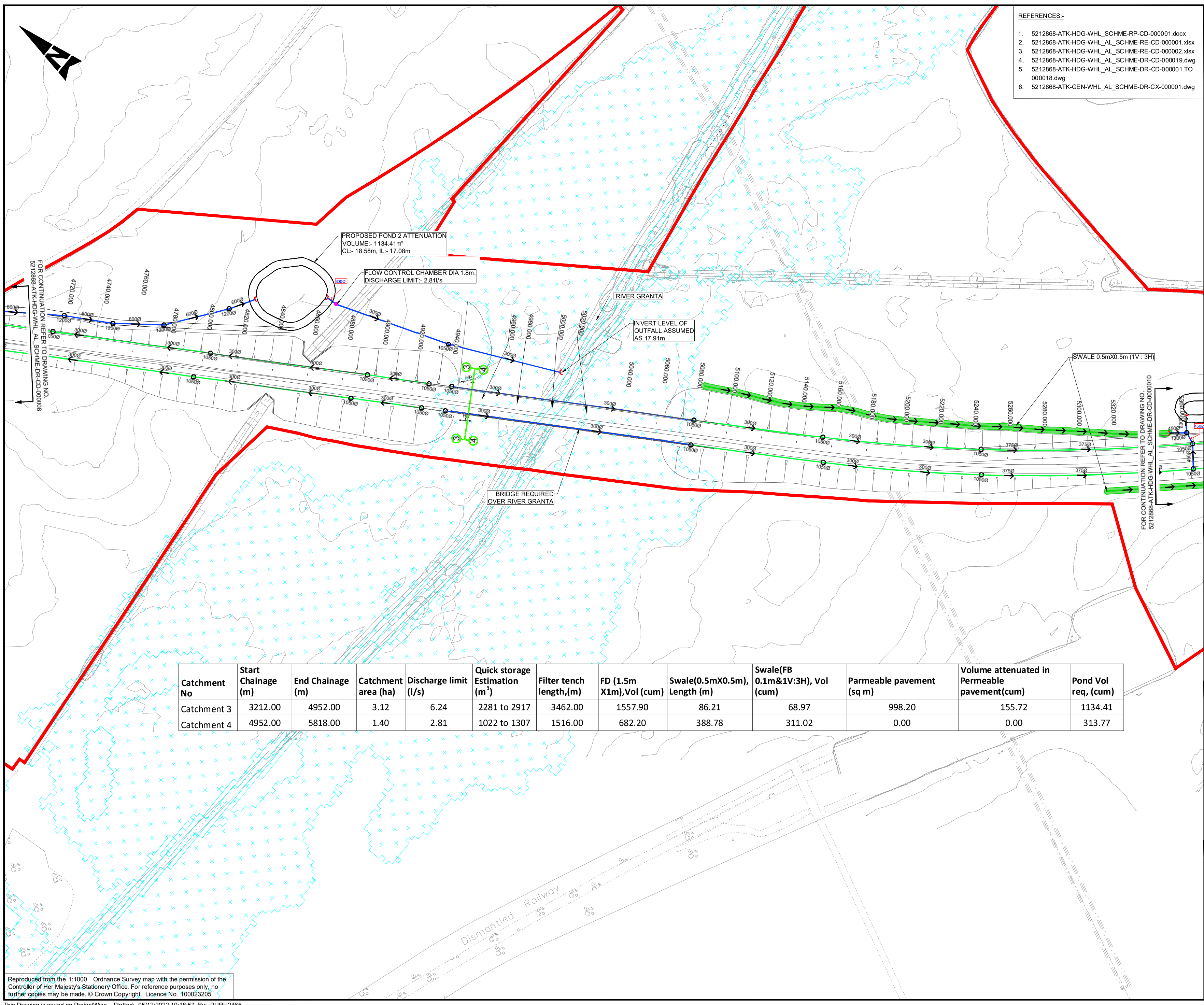
Drawing Title: Cambridge South East Transport Phase 2 Outline Surface Water Drainage Strategy Sheet 8 of 18

Drawing Number: 5212868 - ATK - HDG - WHL_AL_SCHME - DR - CD - 000008

Original Size: A1 | Scale: 1:1000 | Project Ref. No: 5212868 | Sheet: 8 of 18 | Rev: C01

Medium

DO NOT SCALE



Catchment No	Start Chainage (m)	End Chainage (m)	Catchment area (ha)	Discharge limit (l/s)	Quick storage Estimation (m^3)	Filter tench length,(m)	FD (1.5m X1m),Vol (cum)	Swale(0.5mX0.5m), Length (m)	Swale(FB 0.1m&1V:3H), Vol (cum)	Parmeable pavement (sq m)	Volume attenuated in Permeable pavement(cum)	Pond Vol req, (cum)
Catchment 3	3212.00	4952.00	3.12	6.24	2281 to 2917	3462.00	1557.90	86.21	68.97	998.20	155.72	1134.41
Catchment 4	4952.00	5818.00	1.40	2.81	1022 to 1307	1516.00	682.20	388.78	311.02	0.00	0.00	313.77

REFERENCES:-

1. 5212868-ATK-HDG-WHL_SCHME-RP-CD-000001.docx
2. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000001.xlsx
3. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000002.xlsx
4. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019.dwg
5. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000001 TO 000018.dwg
6. 5212868-ATK-GEN-WHL_AL_SCHME-DR-CX-000001.dwg

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- EXISTING DRAINAGE FEATURES
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Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
FIRST ISSUE						
A1	C01	SPK	BC	AH	GB	15/11/22

Drawing Suitability: APPROVED - PUBLISHED | Status: A1

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Client: GREATER CAMBRIDGE PARTNERSHIP

Project Title: CSET PHASE 2

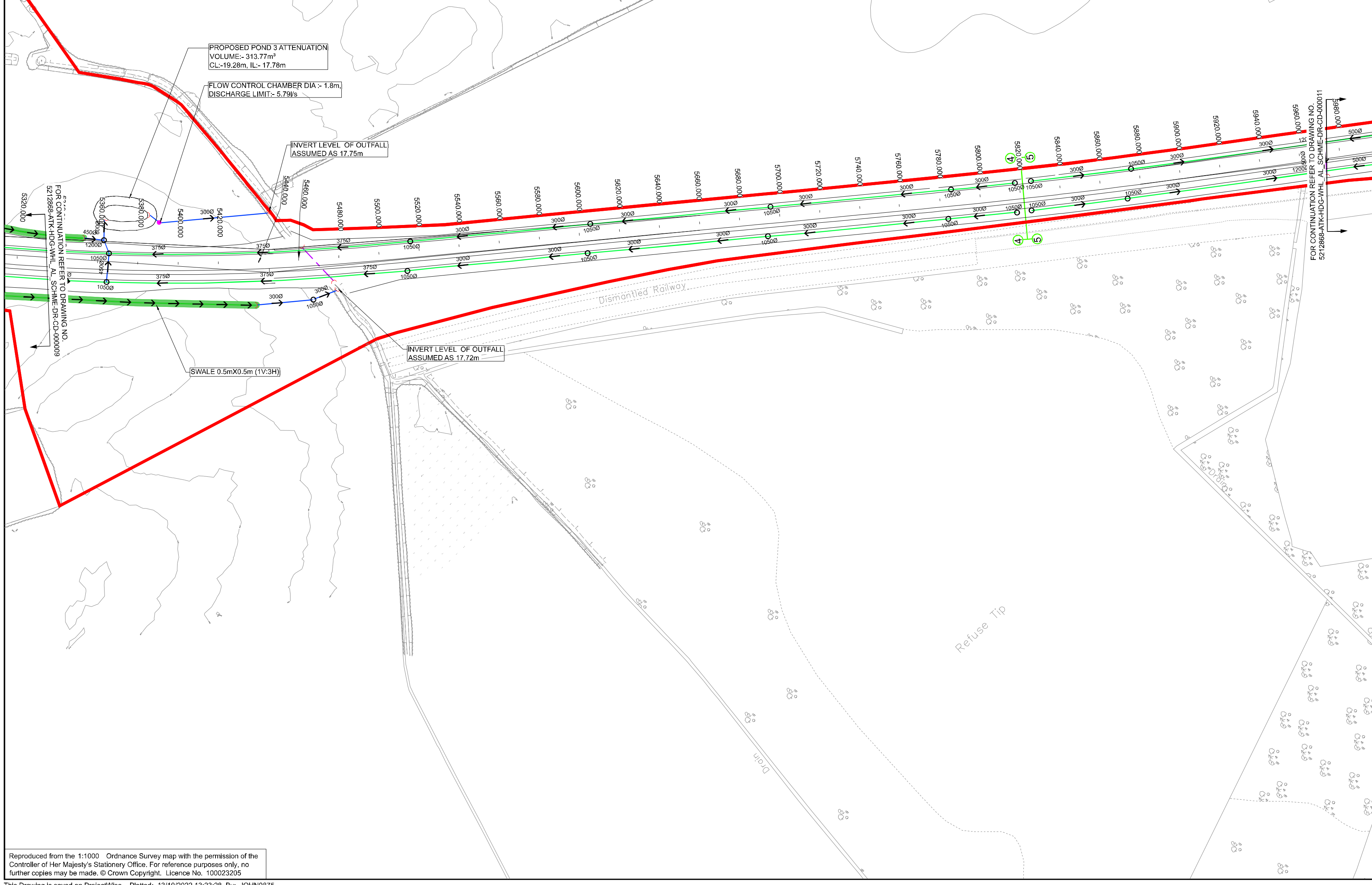
Drawing Title: Cambridge South East Transport Phase 2 Outline Surface Water Drainage Strategy Sheet 9 of 18

Drawing Number: 5212868 - ATK - HDG - WHL_AL_SCHME - DR - CD - 000009

Original Size: A1 | Scale: 1:1000 | Project Ref. No: 5212868 | Sheet: 9 of 18 | Rev: C01

Medium

DO NOT SCALE



Catchment No	Start Chainage (m)	End Chainage (m)	Catchment area (ha)	Discharge limit (l/s)	Quick storage Estimation (m³)	Filter tench length,(m)	FD (1.5m X1m),Vol (cum)	Swale(0.5mX0.5m), Length (m)	Swale(FB 0.1m&1V:3H), Vol (cum)	Parmeable pavement (sq m)	Volume attenuated in Permeable pavement(cum)	Pond Vol req, (cum)
Catchment 4	4952.00	5818.00	1.40	2.81	1022 to 1307	1516.00	682.20	388.78	311.02	0.00	0.00	313.77
Catchment 5	5818.00	6891.00	1.75	3.50	1278 to 1634	2136.00	961.20	293.66	234.93	902.88	140.84	297.01
	6891.00	7575.00	1.15	2.29	1372.00	1372.00	617.40	0.00	0.00	0.00	0.00	456.60

REFERENCES:-

1. 5212868-ATK-HDG-WHL_SCHME-RP-CD-000001.docx
2. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000001.xlsx
3. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000002.xlsx
4. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019.dwg
5. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000001 TO 000018.dwg
6. 5212868-ATK-GEN-WHL_AL_SCHME-DR-CX-000001.dwg

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
2. DO NOT SCALE FROM THIS DRAWING.
3. INDICATIVE LOCATION OF DITCHES, SWALES AND OUTFALL PIPES CONNECTING TO STREAM BASED ON LATEST TOPOGRAPHIC SURVEY. DESIGN TO BE VERIFIED UPON RECEIPT OF FULL SURVEY INFORMATION IN DETAILED DESIGN.
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6. UTILITY INFORMATION WAS NOT AVAILABLE AT THE TIME OF THE ASSESSMENT, NEED TO BE INVESTIGATED AT DETAILED DESIGN STAGE AND ACCORDINGLY CLASH DETECTION AND RESOLUTION NEED TO DONE.
7. REFER TO CROSS SECTION DRAWING FOR LINED FD TRENCH CROSS SECTION 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019

KEY:

- EXISTING CARRIER DRAIN TO BE RETAINED
- EXISTING FILTER DRAIN TO BE RETAINED
- PROPOSED CARRIER PIPE
- PROPOSED FILTER PIPE
- PROPOSED CULVERT
- PROPOSED SLOT DRAIN
- PROPOSED FOUL WATER PIPE
- EXISTING DITCH TO BE RETAINED
- REDLINE BOUNDARY
- Sx-Nx PROPOSED MANHOLE
- EX-Nx EXISTING MANHOLE
- EXISTING HEADWALL
- PROPOSED HEADWALL
- FLOW CONTROL
- LP HP HIGH & LOW POINT
- FLOW ARROW
- PROPOSED POND
- EXISTING POND
- SWALE
- DRAINAGE CATCHMENT BOUNDARY
- FLOOD EXTENT
- EXISTING DRAINAGE FEATURES
- HIGHWAY SECTION BOUNDARY

Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
Description: FIRST ISSUE						
A1	C01	SPK	BC	AH	GB	15/11/22

Drawing Suitability: APPROVED - PUBLISHED | Status: A1

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Client: GREATER CAMBRIDGE PARTNERSHIP

Project Title: CSET PHASE 2

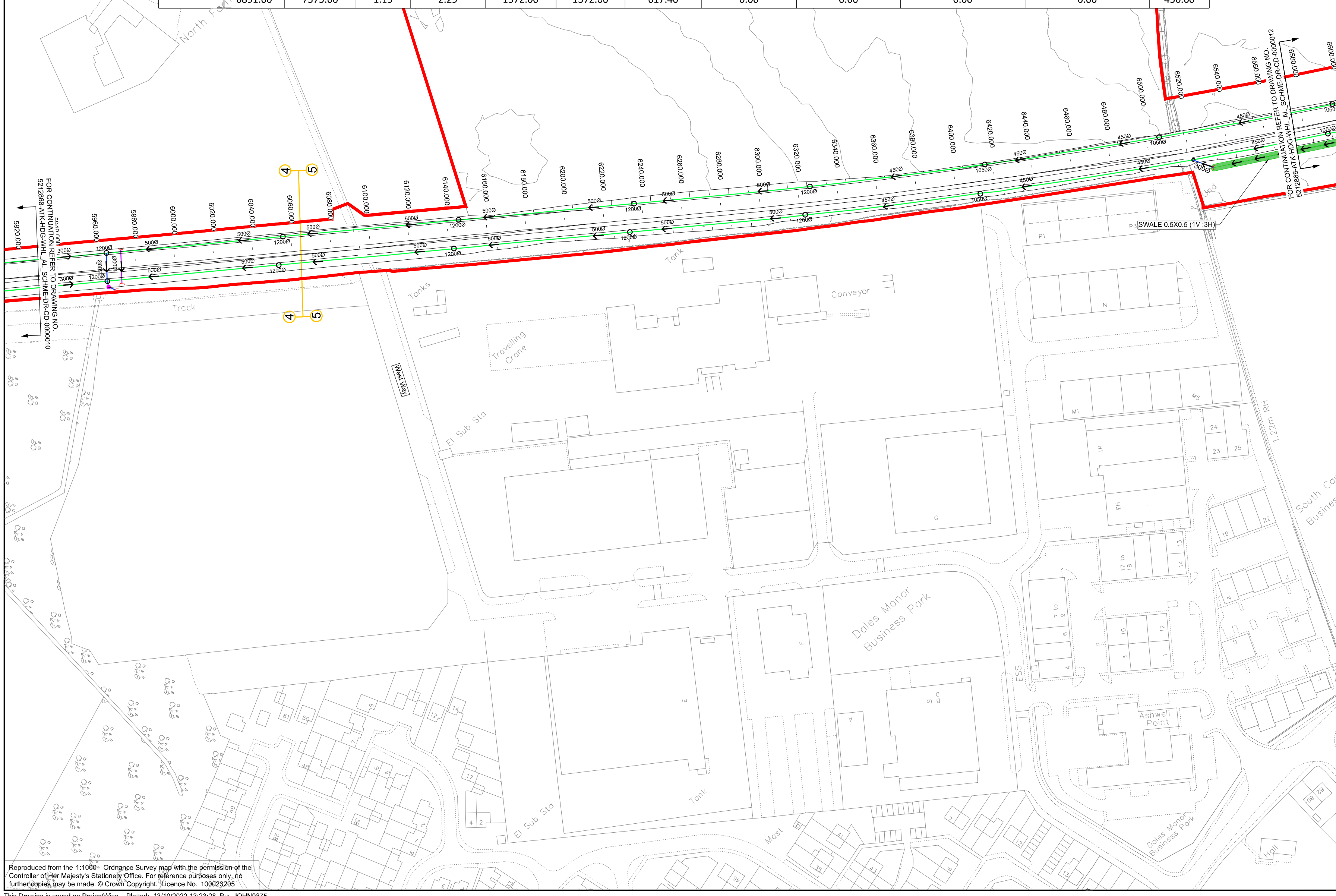
Drawing Title: Cambridge South East Transport Phase 2 Outline Surface Water Drainage Strategy Sheet 10 of 18

Drawing Number: 5212868 - ATK - HDG - WHL_AL_SCHME - DR - CD - 000010

Original Size: A1 | Scale: 1:1000 | Project Ref No.: 5212868 | Sheet: 10 of 18 | Rev: C01

Medium

DO NOT SCALE



Catchment No	Start Chainage (m)	End Chainage (m)	Catchment area (ha)	Discharge limit (l/s)	Quick storage Estimation (m³)	Filter tench length,(m)	FD (1.5m X1m),Vol (cum)	Swale(0.5mX0.5m), Length (m)	Swale(FB 0.1m&1V:3H), Vol (cum)	Parmeable pavement (sq m)	Volume attenuated in Permeable pavement(cum)	Pond Vol req, (cum)
Catchment 5	5818.00	6891.00	1.75	3.50	1278 to 1634	2136.00	961.20	293.66	234.93	902.88	140.84	297.01
	6891.00	7575.00	1.15	2.29	1372.00	1372.00	617.40	0.00	0.00	0.00	0.00	456.60

REFERENCES:-

1. 5212868-ATK-HDG-WHL_SCHME-RP-CD-000001.docx
2. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000001.xlsx
3. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000002.xlsx
4. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019.dwg
5. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000001 TO 000018.dwg
6. 5212868-ATK-GEN-WHL_AL_SCHME-DR-CX-000001.dwg

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
2. DO NOT SCALE FROM THIS DRAWING.
3. INDICATIVE LOCATION OF DITCHES, SWALES AND OUTFALL PIPES CONNECTING TO STREAM BASED ON LATEST TOPOGRAPHIC SURVEY. DESIGN TO BE VERIFIED UPON RECEIPT OF FULL SURVEY INFORMATION IN DETAILED DESIGN.
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7. REFER TO CROSS SECTION DRAWING FOR LINED FD TRENCH CROSS SECTION 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019

KEY:

- EXISTING CARRIER DRAIN TO BE RETAINED
- EXISTING FILTER DRAIN TO BE RETAINED
- PROPOSED CARRIER PIPE
- PROPOSED FILTER PIPE
- PROPOSED CULVERT
- PROPOSED SLOT DRAIN
- PROPOSED FOUL WATER PIPE
- EXISTING DITCH TO BE RETAINED
- REDLINE BOUNDARY
- Sx-Nx PROPOSED MANHOLE
- EX-Nx EXISTING MANHOLE
- EXISTING HEADWALL
- PROPOSED HEADWALL
- FLOW CONTROL
- LP HP HIGH & LOW POINT
- FLOW ARROW
- PROPOSED POND
- EXISTING POND
- SWALE
- DRAINAGE CATCHMENT BOUNDARY
- FLOOD EXTENT
- EXISTING DRAINAGE FEATURES
- HIGHWAY SECTION BOUNDARY

Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
Description: FIRST ISSUE						
A1	C01	SPK	BC	AH	GB	15/11/22

Drawing Suitability: APPROVED - PUBLISHED | Status: A1

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Client: GREATER CAMBRIDGE PARTNERSHIP

Project Title: CSET PHASE 2

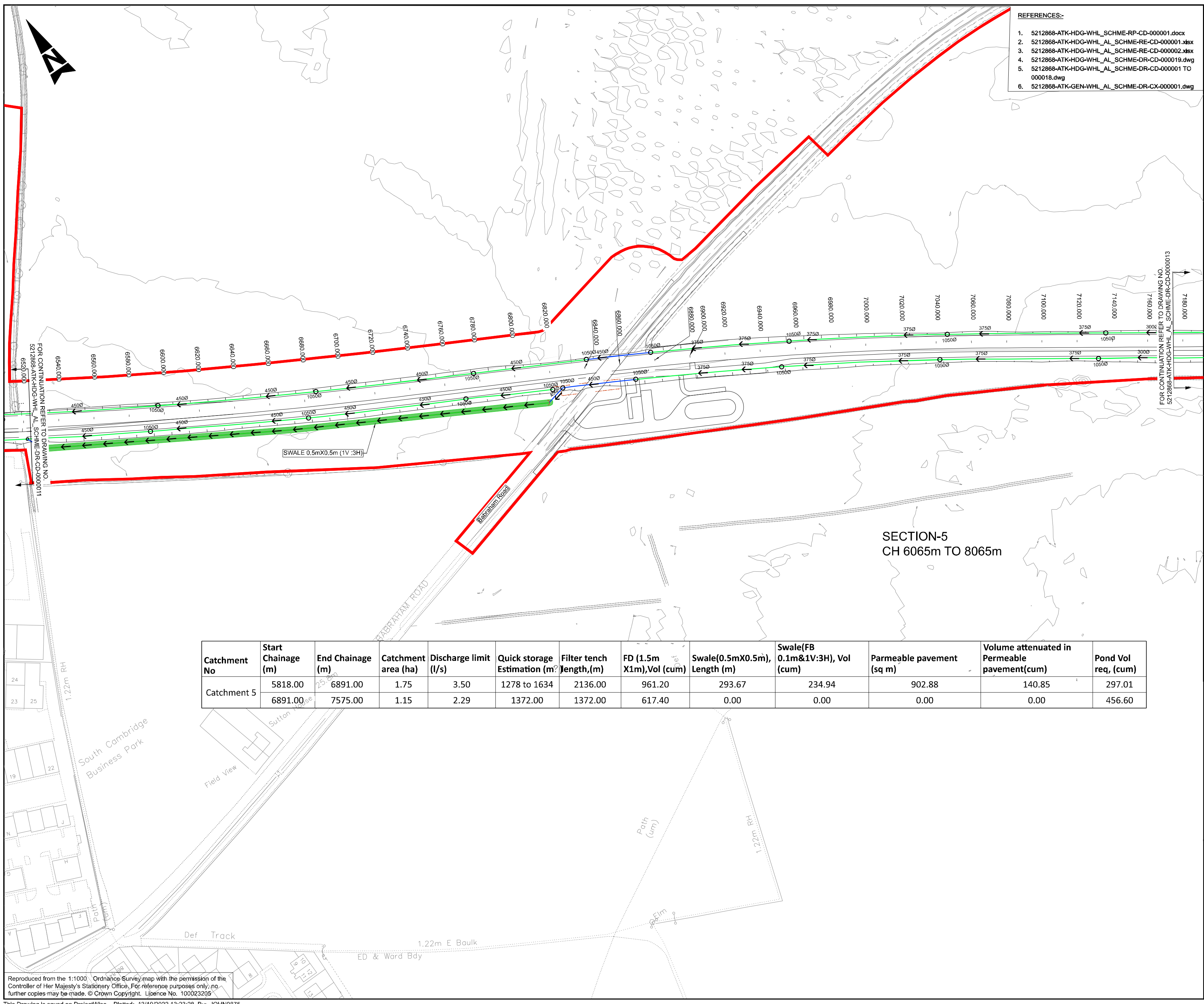
Drawing Title: Cambridge South East Transport Phase 2 Outline Surface Water Drainage Strategy Sheet 11 of 18

Drawing Number: 5212868 - ATK - HDG - WHL_AL_SCHME - DR - CD - 000011

Original Size: A1 | Scale: 1:1000 | Project Ref No.: 5212868 | Sheet: 11 of 18 | Rev: C01

Medium

DO NOT SCALE



Catchment No	Start Chainage (m)	End Chainage (m)	Catchment area (ha)	Discharge limit (l/s)	Quick storage Estimation (m³)	Filter tench length,(m)	FD (1.5m X1m),Vol (cum)	Swale(0.5mX0.5m), Length (m)	Swale(FB 0.1m&1V:3H), Vol (cum)	Parmeable pavement (sq m)	Volume attenuated in Permeable pavement(cum)	Pond Vol req, (cum)
Catchment 5	5818.00	6891.00	1.75	3.50	1278 to 1634	2136.00	961.20	293.67	234.94	902.88	140.85	297.01
	6891.00	7575.00	1.15	2.29	1372.00	1372.00	617.40	0.00	0.00	0.00	0.00	456.60

REFERENCES:-

1. 5212868-ATK-HDG-WHL_AL_SCHME-RP-CD-000001.docx
2. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000001.xlsx
3. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000002.xlsx
4. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019.dwg
5. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000001 TO 000018.dwg
6. 5212868-ATK-GEN-WHL_AL_SCHME-DR-CX-000001.dwg

NOTES:

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2. DO NOT SCALE FROM THIS DRAWING.
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7. REFER TO CROSS SECTION DRAWING FOR LINED FD TRENCH CROSS SECTION 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019

KEY:

- EXISTING CARRIER DRAIN TO BE RETAINED
- EXISTING FILTER DRAIN TO BE RETAINED
- PROPOSED CARRIER PIPE
- PROPOSED FILTER PIPE
- PROPOSED CULVERT
- PROPOSED SLOT DRAIN
- PROPOSED FOUL WATER PIPE
- EXISTING DITCH TO BE RETAINED
- REDLINE BOUNDARY
- Sx-Nx PROPOSED MANHOLE
- EX-Nx EXISTING MANHOLE
- EXISTING HEADWALL
- PROPOSED HEADWALL
- FLOW CONTROL
- LP HP HIGH & LOW POINT
- FLOW ARROW
- PROPOSED POND
- EXISTING POND
- SWALE
- DRAINAGE CATCHMENT BOUNDARY
- FLOOD EXTENT
- EXISTING DRAINAGE FEATURES
- HIGHWAY SECTION BOUNDARY

Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
A1	C01	SPK	BC	AH	GB	15/11/22

Description: FIRST ISSUE

Drawing Suitability: APPROVED - PUBLISHED — Status: A1

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Client: GREATER CAMBRIDGE PARTNERSHIP

Project Title: CSET PHASE 2

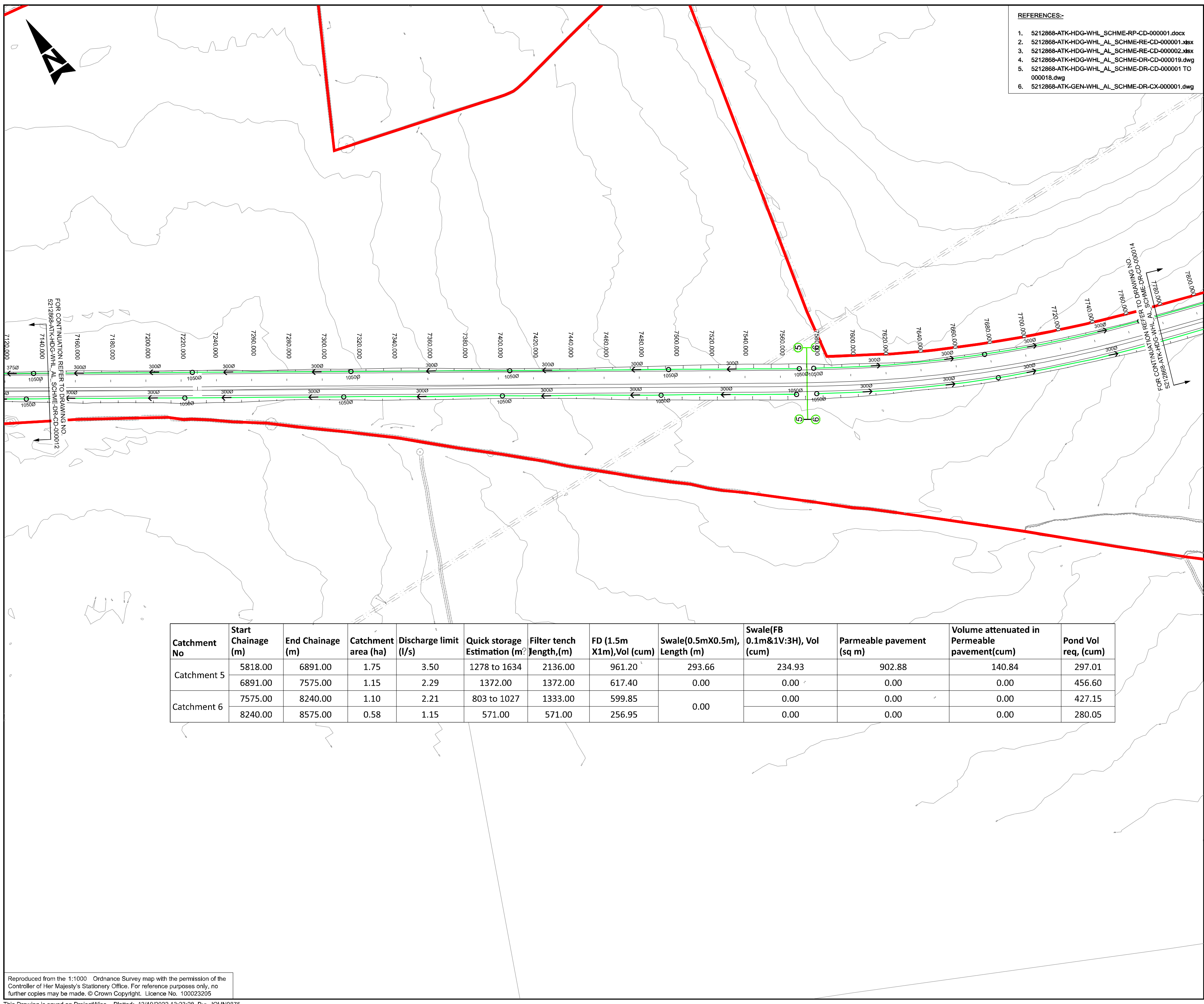
Drawing Title: Cambridge South East Transport Phase 2 Outline Surface Water Drainage Strategy Sheet 12 of 18

Drawing Number: 5212868 - ATK - HDG - WHL_AL_SCHME - DR - CD - 000012

Original Size: A1 | Scale: 1:1000 | Project Ref. No.: 5212868 | Sheet: 12 of 18 | Rev: C01

Medium

DO NOT SCALE



Catchment No	Start Chainage (m)	End Chainage (m)	Catchment area (ha)	Discharge limit (l/s)	Quick storage Estimation (m³)	Filter tench length,(m)	FD (1.5m X1m),Vol (cum)	Swale(0.5mX0.5m), Length (m)	Swale(FB 0.1m&1V:3H), Vol (cum)	Parmeable pavement (sq m)	Volume attenuated in Permeable pavement(cum)	Pond Vol req, (cum)
Catchment 5	5818.00	6891.00	1.75	3.50	1278 to 1634	2136.00	961.20	293.66	234.93	902.88	140.84	297.01
	6891.00	7575.00	1.15	2.29	1372.00	1372.00	617.40	0.00	0.00	0.00	0.00	456.60
Catchment 6	7575.00	8240.00	1.10	2.21	803 to 1027	1333.00	599.85	0.00	0.00	0.00	0.00	427.15
	8240.00	8575.00	0.58	1.15	571.00	571.00	256.95		0.00	0.00	0.00	280.05

REFERENCES:-

1. 5212868-ATK-HDG-WHL_AL_SCHME-RP-CD-000001.docx
2. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000001.xlsx
3. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000002.xlsx
4. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019.dwg
5. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000001 TO 000018.dwg
6. 5212868-ATK-GEN-WHL_AL_SCHME-DR-CX-000001.dwg

NOTES:

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2. DO NOT SCALE FROM THIS DRAWING.
3. INDICATIVE LOCATION OF DITCHES, SWALES AND OUTFALL PIPES CONNECTING TO STREAM BASED ON LATEST TOPOGRAPHIC SURVEY. DESIGN TO BE VERIFIED UPON RECEIPT OF FULL SURVEY INFORMATION IN DETAILED DESIGN.
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7. REFER TO CROSS SECTION DRAWING FOR LINED FD TRENCH CROSS SECTION 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019

KEY:

- EXISTING CARRIER DRAIN TO BE RETAINED
- EXISTING FILTER DRAIN TO BE RETAINED
- PROPOSED CARRIER PIPE
- PROPOSED FILTER PIPE
- PROPOSED CULVERT
- PROPOSED SLOT DRAIN
- PROPOSED FOUL WATER PIPE
- EXISTING DITCH TO BE RETAINED
- REDLINE BOUNDARY
- Sx-Nx PROPOSED MANHOLE
- EX-Nx EXISTING MANHOLE
- EXISTING HEADWALL
- PROPOSED HEADWALL
- FLOW CONTROL
- LP HP HIGH & LOW POINT
- FLOW ARROW
- PROPOSED POND
- EXISTING POND
- SWALE
- DRAINAGE CATCHMENT BOUNDARY
- FLOOD EXTENT
- EXISTING DRAINAGE FEATURES
- HIGHWAY SECTION BOUNDARY

Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
A1	C01	JB	BC	AH	GB	15/11/22

Description: FIRST ISSUE

Drawing Suitability: APPROVED - PUBLISHED — Status: A1

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Client: GREATER CAMBRIDGE PARTNERSHIP

Project Title: CSET PHASE 2

Drawing Title: Cambridge South East Transport Phase 2 Outline Surface Water Drainage Strategy Sheet 13 of 18

Drawing Number: 5212868 - ATK - HDG - WHL_AL_SCHME - DR - CD - 000013

Original Size: A1 | Scale: 1:1000 | Project Ref. No.: 5212868 | Sheet: 13 of 18 | Rev: C01

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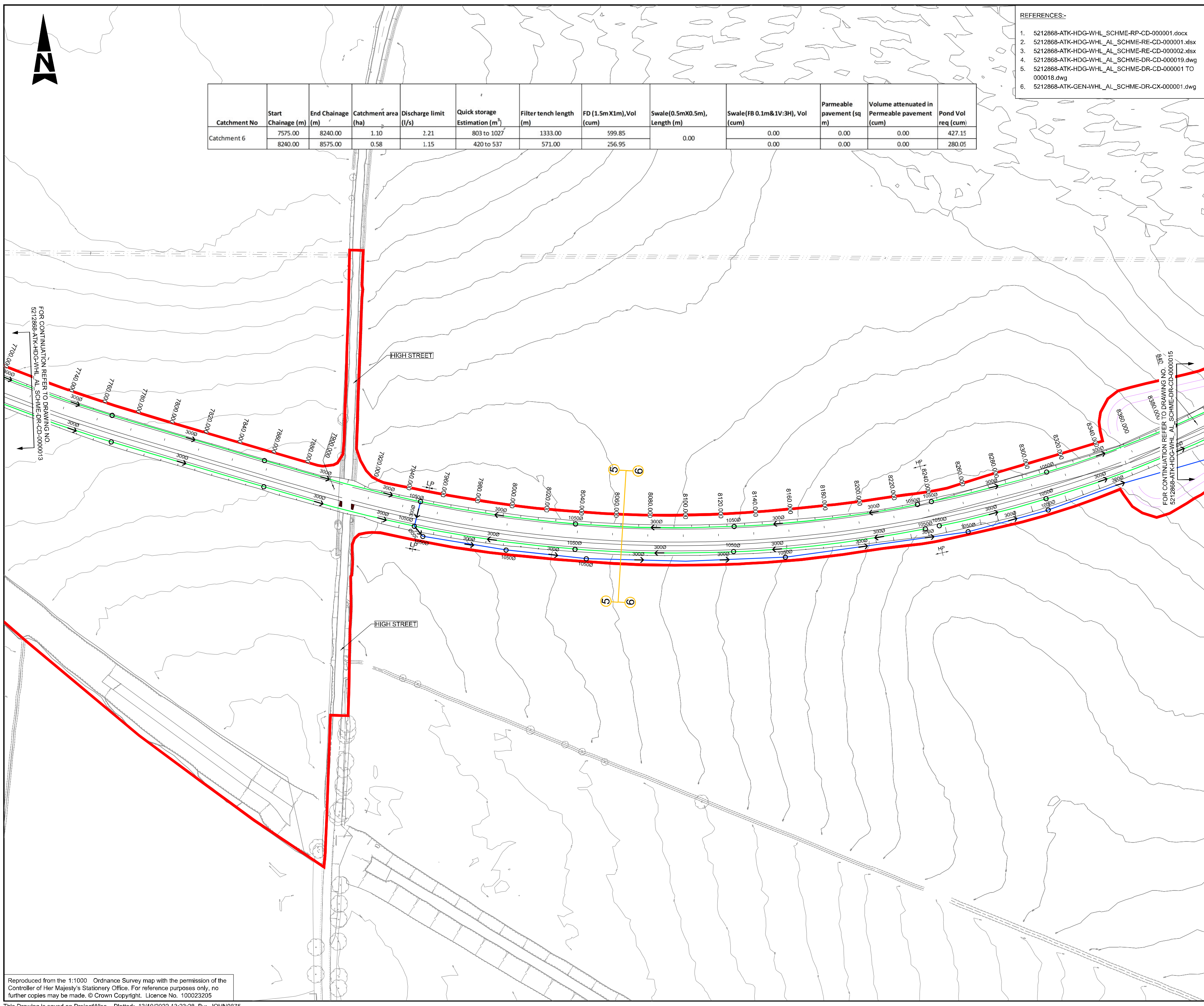
This Drawing is saved on ProjectWise. Plotted: 13/10/2022 13:23:28 By: JOHN9875

DO NOT SCALE



Catchment No	Start Chainage (m)	End Chainage (m)	Catchment area (ha)	Discharge limit (l/s)	Quick storage Estimation (m^3)	Filter tench length (m)	FD (1.5m X1m),Vol (cum)	Swale(0.5mX0.5m), Length (m)	Swale(FB 0.1m&1V:3H), Vol (cum)	Parmeable pavement (sq m)	Volume attenuated in Permeable pavement (cum)	Pond Vol req (cum)
Catchment 6	7575.00	8240.00	1.10	2.21	803 to 1027	1333.00	599.85	0.00	0.00	0.00	0.00	427.15
	8240.00	8575.00	0.58	1.15	420 to 537	571.00	256.95		0.00	0.00	0.00	280.05

REFERENCES:-

1. 5212868-ATK-HDG-WHL_SCHME-RP-CD-000001.docx
2. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000001.xlsx
3. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000002.xlsx
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5. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000001 TO 000018.dwg
6. 5212868-ATK-GEN-WHL_AL_SCHME-DR-CX-000001.dwg

NOTES:

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7. REFER TO CROSS SECTION DRAWING FOR LINED FD TRENCH CROSS SECTION 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019

KEY:

- EXISTING CARRIER DRAIN TO BE RETAINED
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- DRAINAGE CATCHMENT BOUNDARY
- FLOOD EXTENT
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- HIGHWAY SECTION BOUNDARY

Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
Description: FIRST ISSUE						
A1	C01	JS	BC	AH	GB	15/11/22

Drawing Suitability: APPROVED - PUBLISHED — Status: A1

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Client: GREATER CAMBRIDGE PARTNERSHIP

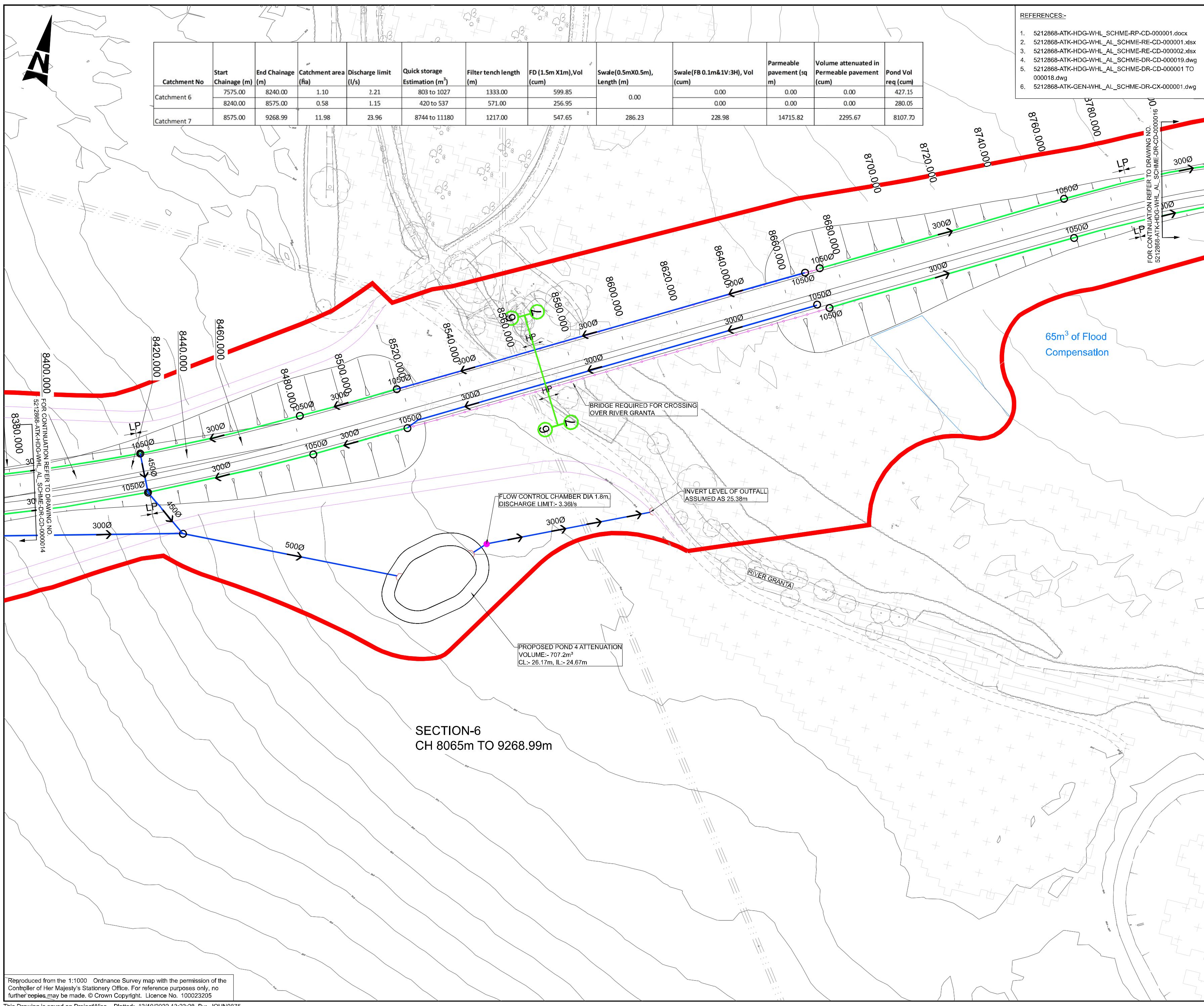
Project Title: CSET PHASE 2

Drawing Title: Cambridge South East Transport Phase 2 Outline Surface Water Drainage Strategy Sheet 14 of 18

Drawing Number: 5212868 - ATK - HDG - WHL_AL_SCHME - DR - CD - 000014

Original Size: A1 | Scale: 1:1000 | Project Ref. No.: 5212868 | Sheet: 14 of 18 | Rev: C01

DO NOT SCALE



Catchment No	Start Chainage (m)	End Chainage (m)	Catchment area (ha)	Discharge limit (l/s)	Quick storage Estimation (m^3)	Filter tench length (m)	FD (1.5m X1m),Vol (cum)	Swale(0.5mX0.5m), Length (m)	Swale(FB 0.1m&1V:3H), Vol (cum)	Parmeable pavement (sq m)	Volume attenuated in Permeable pavement (cum)	Pond Vol req (cum)
Catchment 6	7575.00	8240.00	1.10	2.21	803 to 1027	1333.00	599.85	0.00	0.00	0.00	0.00	427.15
	8240.00	8575.00	0.58	1.15	420 to 537	571.00	256.95		0.00	0.00	0.00	280.05
Catchment 7	8575.00	9268.99	11.98	23.96	8744 to 11180	1217.00	547.65	286.23	228.98	14715.82	2295.67	8107.70

REFERENCES:-

1. 5212868-ATK-HDG-WHL_SCHME-RP-CD-000001.docx
2. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000001.xlsx
3. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000002.xlsx
4. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019.dwg
5. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000001 TO 000018.dwg
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KEY:

- EXISTING CARRIER DRAIN TO BE RETAINED
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- SWALE
- DRAINAGE CATCHMENT BOUNDARY
- FLOOD EXTENT
- EXISTING DRAINAGE FEATURES
- HIGHWAY SECTION BOUNDARY

Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
Description: FIRST ISSUE						
A1	C01	JS	BC	AH	GB	15/11/22

Drawing Suitability: APPROVED - PUBLISHED — Status: A1

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Client: GREATER CAMBRIDGE PARTNERSHIP

Project Title: CSET PHASE 2

Drawing Title: Cambridge South East Transport Phase 2 Outline Surface Water Drainage Strategy Sheet 15 of 18

Drawing Number: 5212868 - ATK - HDG - WHL_AL_SCHME - DR - CD - 000015

Original Size: A1 | Scale: 1:1000 | Project Ref. No.: 5212868 | Sheet: 15 of 18 | Rev: C01

Medium

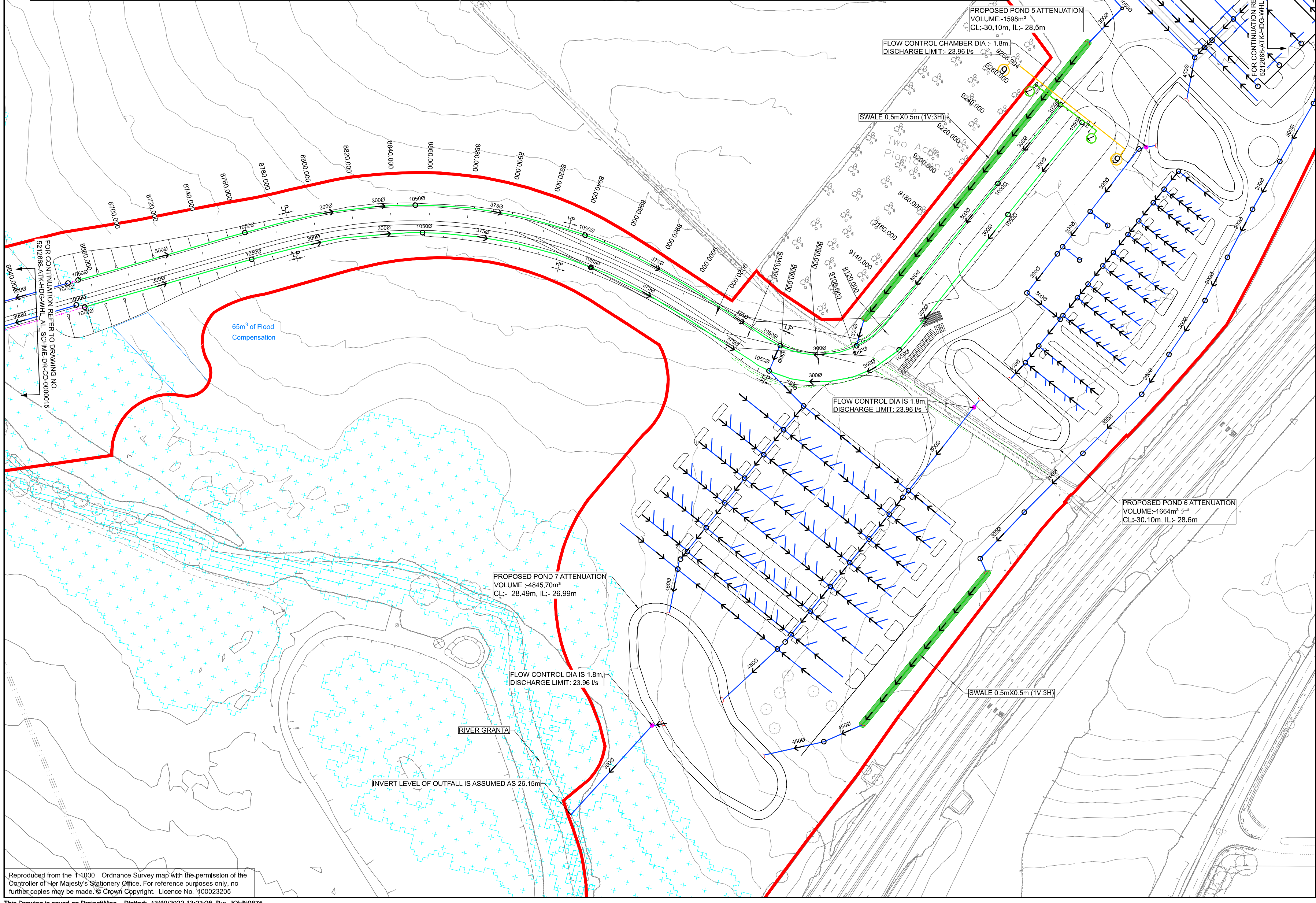
DO NOT SCALE

Millimetres

REFERENCES:-

1. 5212868-ATK-HDG-WHL_SCHME-RP-CD-000001.docx
2. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000001.xlsx
3. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000002.xlsx
4. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019.dwg
5. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000001 TO 000018.dwg
6. 5212868-ATK-GEN-WHL_AL_SCHME-DR-CX-000001.dwg

Catchment No	Start Chainage (m)	End Chainage (m)	Catchment area (ha)	Discharge limit (l/s)	Quick storage Estimation (m³)	Filter tench length,(m)	FD (1.5m X1m),Vol (cum)	Swale(0.5mX0.5m), Length (m)	Swale(FB 0.1m&1V:3H), Vol (cum)	Parmeable pavement (sq m)	Volume attenuated in Permeable pavement (cum)	Pond Vol req, Cum
Catchment 7	8575.00	9268.99	11.98	23.96	8744 to 11180	1217.00	547.65	286.22	228.98	14715.81	2295.66	8107.70



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS STATED OTHERWISE.
2. DO NOT SCALE FROM THIS DRAWING.
3. INDICATIVE LOCATION OF DITCHES, SWALES AND OUTFALL PIPES CONNECTING TO STREAM BASED ON LATEST TOPOGRAPHIC SURVEY. DESIGN TO BE VERIFIED UPON RECEIPT OF FULL SURVEY INFORMATION IN DETAILED DESIGN.
4. PRIOR TO USING THE WORKS INFORMATION SHOWN ON THIS DRAWING THE CONTRACTOR MUST REFER TO THE DESIGNERS DECISION REGISTER REFERENCE 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000001.
5. WHERE EXISTING PIPES, DITCHES ARE TO BE RETAINED ITS SIZES, INVERT LEVELS NEED TO BE VALIDATED IN DETAILED DESIGN STAGE. THE CONTRACTOR SHALL CONFIRM THEIR CONDITION AND CLEAN THEM WHERE REQUIRED. WHERE EXISTING SYSTEM IS FOUND NOT TO BE IN ACCEPTABLE OPERATIONAL CONDITION, CONTRACTOR SHALL REPLACE THEM.
6. UTILITY INFORMATION WAS NOT AVAILABLE AT THE TIME OF THE ASSESSMENT, NEED TO BE INVESTIGATED AT DETAILED DESIGN STAGE AND ACCORDINGLY CLASH DETECTION AND RESOLUTION NEED TO DONE.
7. REFER TO CROSS SECTION DRAWING FOR LINED FD TRENCH CROSS SECTION 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019

KEY:

- EXISTING CARRIER DRAIN TO BE RETAINED
- EXISTING FILTER DRAIN TO BE RETAINED
- PROPOSED CARRIER PIPE
- PROPOSED FILTER PIPE
- PROPOSED CULVERT
- PROPOSED SLOT DRAIN
- PROPOSED FOUL WATER PIPE
- EXISTING DITCH TO BE RETAINED
- REDLINE BOUNDARY
- Sx-Nx PROPOSED MANHOLE
- EX-Nx EXISTING MANHOLE
- EXISTING HEADWALL
- PROPOSED HEADWALL
- FLOW CONTROL
- LP HP HIGH & LOW POINT
- FLOW ARROW
- PROPOSED POND
- EXISTING POND
- SWALE
- DRAINAGE CATCHMENT BOUNDARY
- FLOOD EXTENT
- EXISTING DRAINAGE FEATURES
- HIGHWAY SECTION BOUNDARY

Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
Description: FIRST ISSUE						
A1	C01	JB	BC	AH	GB	15/11/22

Drawing Suitability: APPROVED - PUBLISHED — Status: A1

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Client: GREATER CAMBRIDGE PARTNERSHIP

Project Title: CSET PHASE 2

Drawing Title: Cambridge South East Transport Phase 2
Outline Surface Water Drainage Stratergy
Sheet 16 of 18

Drawing Number: 5212868 - ATK - HDG - WHL_AL_SCHME - DR - CD - 000016

Original Size: A1 | Scale: 1:1000 | Project Ref. No.: 5212868 | Sheet: 16 of 18 | Rev: C01

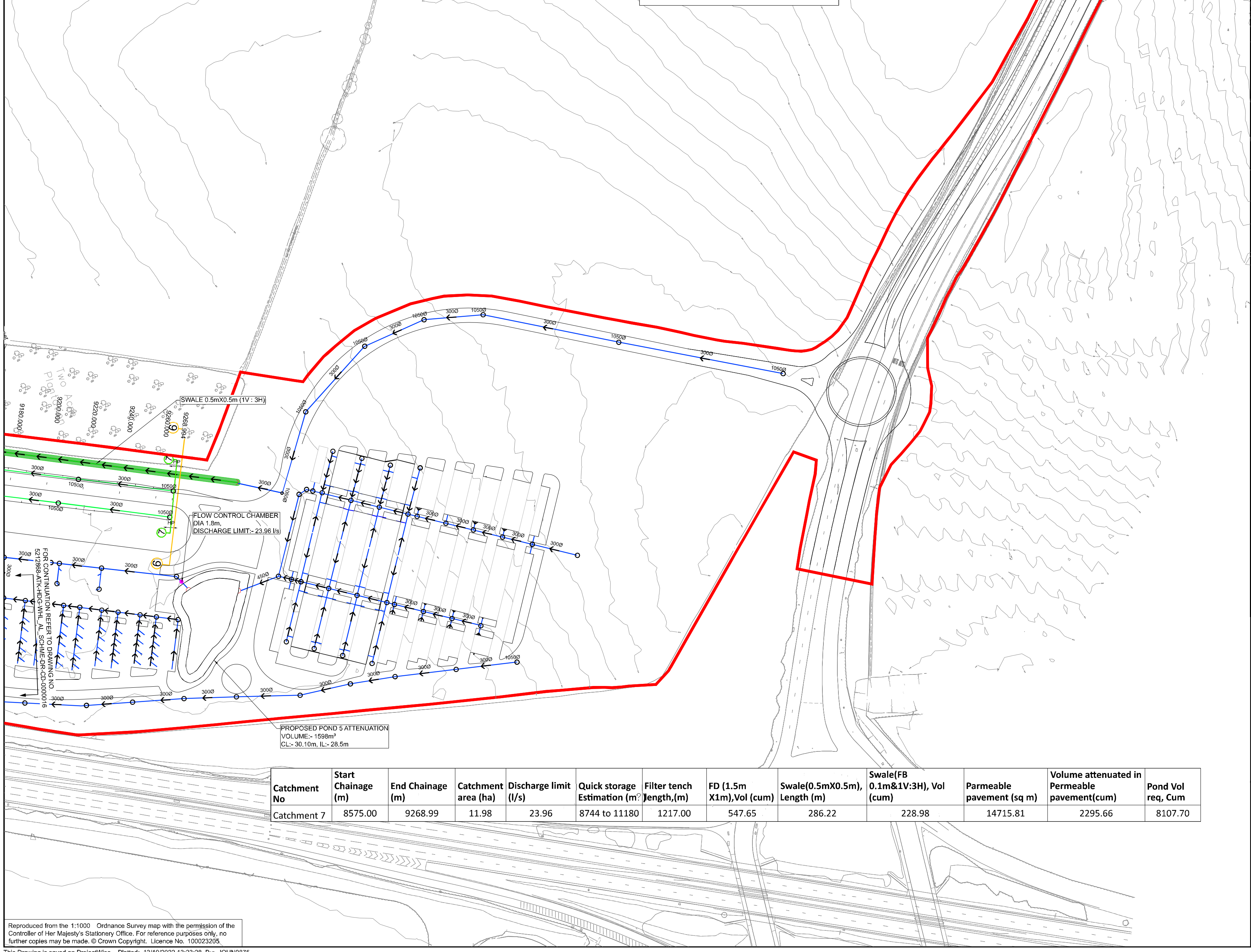
Medium

DO NOT SCALE

Millimetres

REFERENCES:-

1. 5212868-ATK-HDG-WHL_SCHME-RP-CD-000001.docx
2. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000001.xlsx
3. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000002.xlsx
4. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019.dwg
5. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000001 TO 000018.dwg
6. 5212868-ATK-GEN-WHL_AL_SCHME-DR-CX-000001.dwg



Catchment No	Start Chainage (m)	End Chainage (m)	Catchment area (ha)	Discharge limit (l/s)	Quick storage Estimation (m³)	Filter tench length,(m)	FD (1.5m X1m),Vol (cum)	Swale(0.5mX0.5m), Length (m)	Swale(FB 0.1m&1V:3H), Vol (cum)	Parmeable pavement (sq m)	Volume attenuated in Permeable pavement(cum)	Pond Vol req, Cum
Catchment 7	8575.00	9268.99	11.98	23.96	8744 to 11180	1217.00	547.65	286.22	228.98	14715.81	2295.66	8107.70

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS STATED OTHERWISE.
2. DO NOT SCALE FROM THIS DRAWING.
3. INDICATIVE LOCATION OF DITCHES, SWALES AND OUTFALL PIPES CONNECTING TO STREAM BASED ON LATEST TOPOGRAPHIC SURVEY. DESIGN TO BE VERIFIED UPON RECEIPT OF FULL SURVEY INFORMATION IN DETAILED DESIGN.
4. PRIOR TO USING THE WORKS INFORMATION SHOWN ON THIS DRAWING THE CONTRACTOR MUST REFER TO THE DESIGNERS DECISION REGISTER REFERENCE 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000001.
5. WHERE EXISTING PIPES, DITCHES ARE TO BE RETAINED ITS SIZES, INVERT LEVELS NEED TO BE VALIDATED IN DETAILED DESIGN STAGE. THE CONTRACTOR SHALL CONFIRM THEIR CONDITION AND CLEAN THEM WHERE REQUIRED. WHERE EXISTING SYSTEM IS FOUND NOT TO BE IN ACCEPTABLE OPERATIONAL CONDITION, CONTRACTOR SHALL REPLACE THEM.
6. UTILITY INFORMATION WAS NOT AVAILABLE AT THE TIME OF THE ASSESSMENT, NEED TO BE INVESTIGATED AT DETAILED DESIGN STAGE AND ACCORDINGLY CLASH DETECTION AND RESOLUTION NEED TO DONE.
7. REFER TO CROSS SECTION DRAWING FOR LINED FD TRENCH CROSS SECTION 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019

KEY:

- EXISTING CARRIER DRAIN TO BE RETAINED
- EXISTING FILTER DRAIN TO BE RETAINED
- PROPOSED CARRIER PIPE
- PROPOSED FILTER PIPE
- PROPOSED CULVERT
- PROPOSED SLOT DRAIN
- PROPOSED FOUL WATER PIPE
- EXISTING DITCH TO BE RETAINED
- REDLINE BOUNDARY
- Sx-Nx PROPOSED MANHOLE
- EX-Nx EXISTING MANHOLE
- EXISTING HEADWALL
- PROPOSED HEADWALL
- FLOW CONTROL
- LP HP HIGH & LOW POINT
- FLOW ARROW
- PROPOSED POND
- EXISTING POND
- SWALE
- DRAINAGE CATCHMENT BOUNDARY
- FLOOD EXTENT
- EXISTING DRAINAGE FEATURES
- HIGHWAY SECTION BOUNDARY

Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
Description: FIRST ISSUE						
A1	C01	JB	BC	AH	GB	15/11/22

Drawing Suitability: APPROVED - PUBLISHED — Status: A1

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Client: GREATER CAMBRIDGE PARTNERSHIP

Project Title: CSET PHASE 2

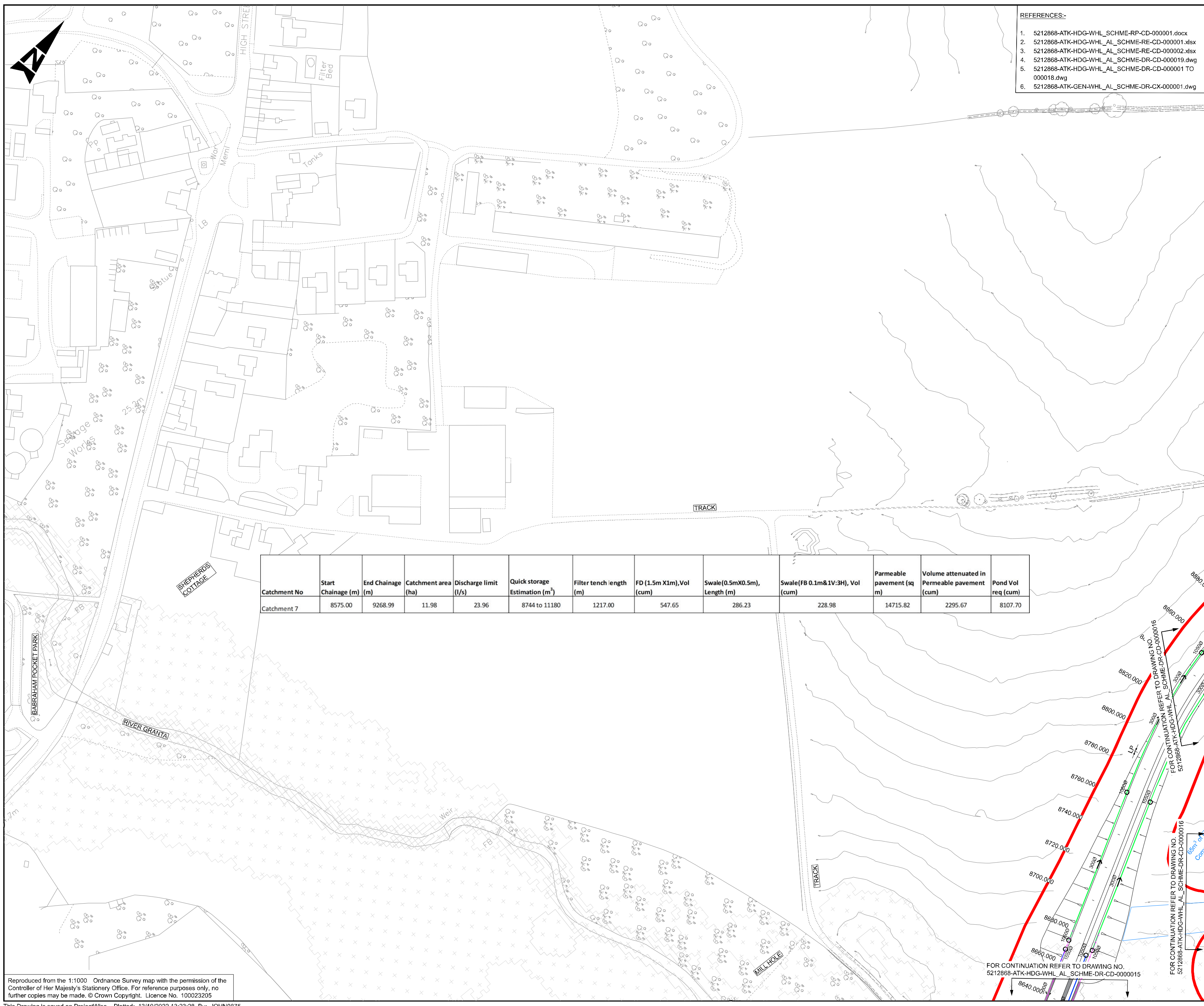
Drawing Title: Cambridge South East Transport Phase 2
Outline Surface Water Drainage Strategy
Sheet 17 of 18

Drawing Number: 5212868 - ATK - HDG - WHL_AL_SCHME - DR - CD - 000017

Original Size: A1 | Scale: 1:1000 | Project Ref. No.: 5212868 | Sheet: 17 of 18 | Rev: C01

Medium

DO NOT SCALE



Catchment No	Start Chainage (m)	End Chainage (m)	Catchment area (ha)	Discharge limit (l/s)	Quick storage Estimation (m^3)	Filter tench length (m)	FD (1.5m X1m),Vol (cum)	Swale(0.5mX0.5m), Length (m)	Swale(FB 0.1m&1V:3H), Vol (cum)	Parmeable pavement (sq m)	Volume attenuated in Permeable pavement (cum)	Pond Vol req (cum)
Catchment 7	8575.00	9268.99	11.98	23.96	8744 to 11180	1217.00	547.65	286.23	228.98	14715.82	2295.67	8107.70

REFERENCES:-

1. 5212868-ATK-HDG-WHL_SCHME-RP-CD-000001.docx
2. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000001.xlsx
3. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000002.xlsx
4. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019.dwg
5. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000001 TO 000018.dwg
6. 5212868-ATK-GEN-WHL_AL_SCHME-DR-CX-000001.dwg

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
2. DO NOT SCALE FROM THIS DRAWING.
3. INDICATIVE LOCATION OF DITCHES, SWALES AND OUTFALL PIPES CONNECTING TO STREAM BASED ON LATEST TOPOGRAPHIC SURVEY. DESIGN TO BE VERIFIED UPON RECEIPT OF FULL SURVEY INFORMATION IN DETAILED DESIGN.
4. PRIOR TO USING THE WORKS INFORMATION SHOWN ON THIS DRAWING THE CONTRACTOR MUST REFER TO THE DESIGNERS DECISION REGISTER REFERENCE 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000001.
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6. UTILITY INFORMATION WAS NOT AVAILABLE AT THE TIME OF THE ASSESSMENT, NEED TO BE INVESTIGATED AT DETAILED DESIGN STAGE AND ACCORDINGLY CLASH DETECTION AND RESOLUTION NEED TO DONE.
7. REFER TO CROSS SECTION DRAWING FOR LINED FD TRENCH CROSS SECTION 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000019.
8. THIS SHEET IS FOR CONSISTENCY PURPOSE ONLY AS THE CONTENT FROM THIS DRAWING IS REFLECTED IN SHEET 16.

KEY:

- EXISTING CARRIER DRAIN TO BE RETAINED
- EXISTING FILTER DRAIN TO BE RETAINED
- PROPOSED CARRIER PIPE
- PROPOSED FILTER PIPE
- PROPOSED CULVERT
- PROPOSED SLOT DRAIN
- PROPOSED FOUL WATER PIPE
- EXISTING DITCH TO BE RETAINED
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- EX-Nx EXISTING MANHOLE
- EXISTING HEADWALL
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- LP HP HIGH & LOW POINT
- FLOW ARROW
- PROPOSED POND
- EXISTING POND
- SWALE
- DRAINAGE CATCHMENT BOUNDARY
- FLOOD EXTENT
- EXISTING DRAINAGE FEATURES
- HIGHWAY SECTION BOUNDARY

Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
FIRST ISSUE						
A1	C01	JS	BC	AH	GB	15/11/22

Drawing Suitability: APPROVED - PUBLISHED — Status: A1

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Client: GREATER CAMBRIDGE PARTNERSHIP

Project Title: CSET PHASE 2

Drawing Title: Cambridge South East Transport Phase 2 Outline Surface Water Drainage Strategy Sheet 18 of 18

Drawing Number: 5212868 - ATK - HDG - WHL_AL_SCHME - DR - CD - 000018

Original Size: A1 | Scale: 1:1000 | Project Ref. No: 5212868 | Sheet: 18 of 18 | Rev: C01

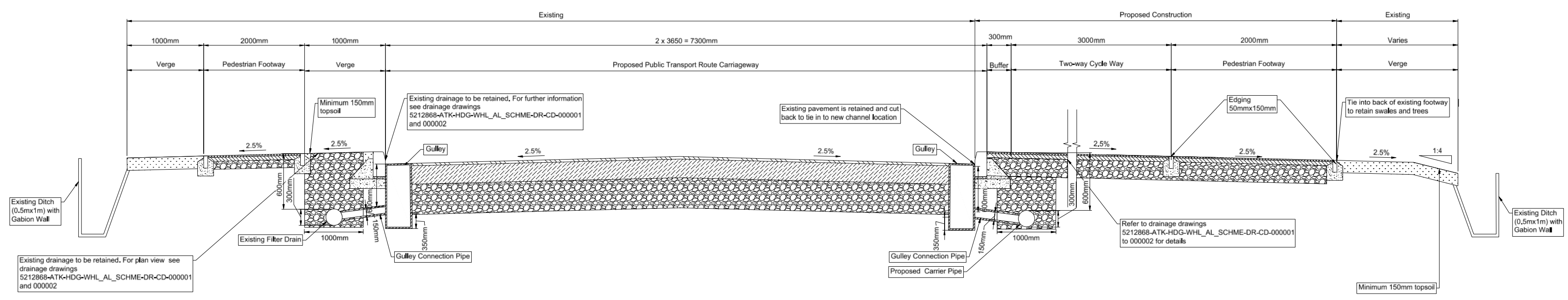
This Drawing is saved on ProjectWise. Plotted: 13/10/2022 13:23:28 By: JOHN9875

Medium

DO NOT SCALE

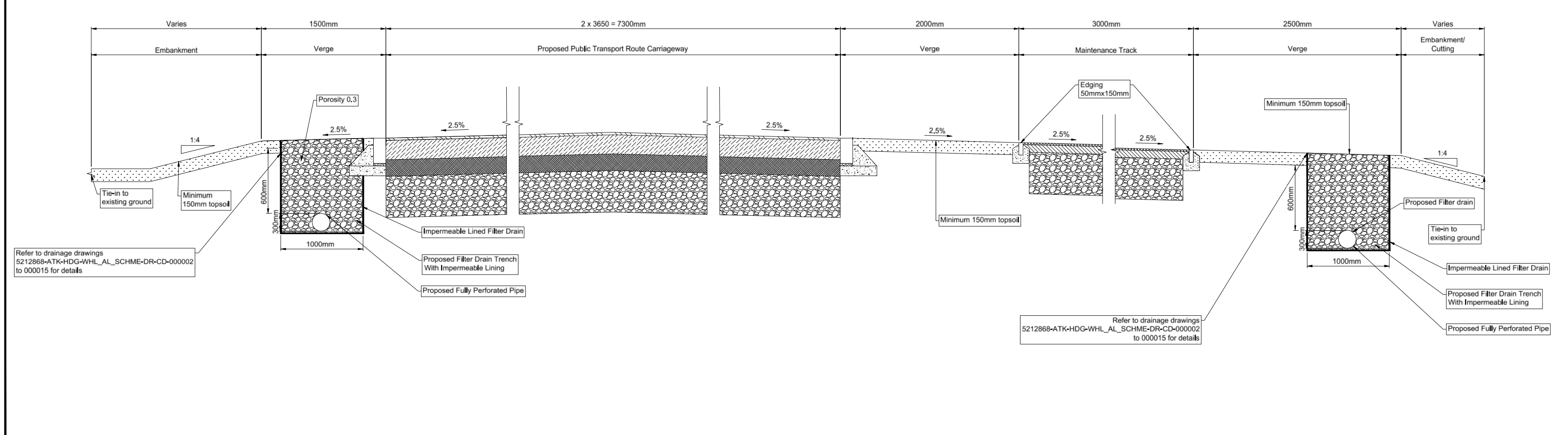
Typical Cross Section of Francis Crick Avenue

Scale: 1:25



Typical Cross Section of Public Transport Route with Camber

Scale: 1:25



Typical Cross Section of Public Transport Route with 5% Superelevation Scale: 1:25

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS STATED OTHERWISE.
2. DO NOT SCALE FROM THIS DRAWING.
3. DRAWING TO BE PRINTED IN COLOUR.
4. ALL WORK ARE SUBJECT TO APPROVAL OF THE LLA AND HIGHWAY AUTHORITY.
5. THIS DRAWING IS TO BE READ IN CONJECTION TO DRAINAGE GA DRAWING NUMBERS 5212868-ATK-HDG-WHL_AL_SCHME_DR-CD-000001 TO 000018.DWG

REFERENCES:-

1. 5212868-ATK-HDG-WHL_SCHME-RP-CD-000001.docx
2. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000001.xlsx
3. 5212868-ATK-HDG-WHL_AL_SCHME-RE-CD-000002.xlsx
4. 5212868-ATK-HDG-WHL_AL_SCHME-DR-CD-000001 TO 000018.dwg
5. 5212868-ATK-GEN-WHL_AL_SCHME-DR-CX-000001.dwg

Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
FIRST ISSUE						
A1	C01	SPK	BC	AH	GB	15/11/22

Drawing Suitability: APPROVED - PUBLISHED — Status: A1

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Client: GREATER CAMBRIDGE PARTNERSHIP

Project Title: CSET PHASE 2

Drawing Title: Cambridge South East Transport Phase 2 Outline Surface Water Drainage Strategy Drainage Details For FCA AND PTR

Drawing Number: 5212868 - ATK - HDG - WHL_AL_SCHME - DR - CD - 000019

Original Size: A1 | Scale: 1:1000 | Project Ref. No: 5212868 | Sheet: 1 of 1 | Rev: C01

This Drawing is saved on ProjectWise. Plotted: 05/12/2022 19:25:07 By: BODD8875

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