



Dwyer Road Drainage Strategy Report

For Reading Borough Council

Date: 5 September 2024

Doc ref: DWY-HYD-XX-XX-RP-C-7000

DOCUMENT CONTROL SHEET

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Client	Reading Borough Council	
Project name	Dwyer Road	
Title	Drainage Strategy Report	
Doc ref	DWY-HYD-XX-XX-RP-C-7000	
Project no.	26888	
Status	S3	
Date	05/09/2024	

Document Production Record		
Issue Number	P07	Name
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Document Revision Record			
Issue Number	Status	Date	Revision Details
P03	S2	18/04/23	Issued for planning
P04	S2	21/04/23	Issued for planning
P05	S3	05/10/23	Issued for Stage 3B
P06	S3	01/12/2023	Updated to LLFA comments
P07	S3	05/09/2024	Updated to RBC Comments

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1. INTRODUCTION

1.1 Executive Summary

This report has been updated to suit RBC comments as follows:

- Green roofs have been used, refer to section 3.5.
- Rainwater Harvesting has not been deemed suitable for the project, refer to section 3.5.
- Permeable paving has been used preferentially over the use of tree pits at this stage, for the maximisation of pollution control. Refer to section 3.6.

1.2 Preamble

Hydrock have been appointed by Reading Borough Council to provide a Drainage Strategy in relation to the redevelopment of a brownfield site at Dwyer Road, Reading for the approval of Reading Council Lead Local Flood Authority.

The proposed drainage strategy will be in accordance with both national planning policy framework (NPPF) and Building Regulations.

The report is based upon sewer asset information provided by the sewerage undertakers Thames Water in relation to assets within the vicinity of the development site. A CCTV drainage survey has also been undertaken.

The report also highlights the key stakeholders in terms of ownership and maintenance to ensure the drainage system is kept well maintained and reduce the risk of failure.

The information received is summarised within this report. In the event that the information relied upon is subsequently found to be incorrect, Hydrock Consultants Ltd accepts no responsibility for any direct and/or consequential loss that may occur as a result.

1.3 Post Development Surface and Foul Water Management Summary

The proposal includes redevelopment of a brownfield site, a former care home, with 30 residential units, parking and landscaping. Surface water runoff from the redeveloped site is proposed to discharge to the existing Thames Water Sewer, located to the south of Dwyer Road using onsite Sustainable Drainage Systems (SuDS).

Onsite SuDS components in this design will incorporate permeable paving wherever feasible, to improve water quality and attenuation crates to meet the requirements for permitted discharge rates. Opportunity to incorporate further SuDS, e.g. bioretention tree pits will be explored at the detailed design stage.

Surface water runoff will be managed for up to the 1:100 year with 40% climate change allowance in line with the Environment Agency guidance. Discharge into the Thames Water sewer will be limited to 4 l/s using a Hydrobrake flow control. The proposed discharge rate represents a significant betterment over the existing

Foul flow from the development will be discharged by gravity into the existing foul sewer located to the south of the site subject to an agreement with Thames Water.

All onsite drainage and SuDS components will remain private and will be maintained with the engagement of an appropriate management company.

References / Design Codes

- BS EN 752 - Drain and Sewer Systems Outside Buildings.
- Building Regulations Approved Document Part H - Drainage and waste disposals.
- Reading Borough Council Local Plan (November 2019).
- CIRIA C753 - SuDS Manual.
- National Planning Policy Framework (NPPF).
- DEFRA Non-Statutory Technical Standards for Sustainable Drainage.

2. SITE INFORMATION

2.1 Site Location

The site is located approximately 2.5km West of Reading centre in the Southcote ward, Berkshire. The site location details are listed in table 2.1 below.

Table 2.1: Site Referencing Information

Site Address	Dwyer Road
	Dwyer Road
	Postcode: RG30 3PB
	National Grid Reference SU 68070 71822



Figure 1: Site Location with Approximate Red Line Boundary

The site comprises an area of roughly square shaped land of approximately 0.49 Ha in size. It was previously used as the Alice Burrows Care House; the services were closed in 2007 and the building demolished nearly 15 years ago. It is bound by low-rise residential properties to the South, East and West and some ground + 3 storeys flats to the North.

2.2 Topography

The topographical survey indicates that the existing ground level within the development is sloping slightly North to South from 50.90m above ordnance datum (AOD) to 48.70m AOD.

See **Appendix A** for Topographical Survey.

2.3 Existing Sewers

Sewer asset maps obtained from Thames Water shows that there are 225mm dia sewers running along property frontage of Appleford Road and Burghfield Road which both ultimately connect into a 375mm dia

running between Dwyer Road and Holybrook Crescent. Two further storm / gully connections exist along the western and southern site boundaries into these sewers.

A 225mm foul sewer is located within the western site extent, which joins another 225mm sewer running parallel to the 375mm surface water sewer mentioned above.

See **Appendix C** for Sewer Asset Map.

A utilities survey undertaken by Survey Solutions shows a 150mm combined sewer located within the site with few gullies and chambers. These assets are found to be blocked and heavily silted up. See **Appendix A** for topo / utility survey information.

2.4 Geology

British Geological Survey (BGS) mapping indicates the site to be underlain by Lambeth Group bedrock with no superficial deposits. Seaford Chalk Formation and Newhaven Chalk Formation occurs to the immediate south of the site.

Phase 2 ground investigation works have been undertaken by Hydrock at the site. Refer to ground investigation data in **Appendix D**. Works determined the underlying geology to comprise made ground up to 1.7m bgl and top soil over Lynch Gravel Member. Lynch Gravel Member occurred as brown sands with various clay/silt and had thickness of between 1.0 – 4.3m thickness. Lambeth Group was encountered underlying the Lynch Hill Gravel Member across the site of between 0.80m and 2.60m thickness, and comprised brown/multi coloured clays with various sand and gravel factions. Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated) was encountered underlying the Lambeth Group across the site as shallow as at 2.1m depth down to a maximum proven depth of 20.00m bgl (base not proven).

Groundwater was encountered at depths between 12.50m bgl and 13.30m bgl during the investigation.

Site investigation recorded an evidence of a potential dissolution feature at and around the dynamic probing location DP5 where extremely loose ground was encountered between 1.90m – 4m depth bgl. It was suspected that the underlying chalk strata has historically undergone an amount dissolution that has caused the overlying ground to collapse into the void.

A falling head permeability test undertaken within the Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated) at 10m depth recorded permeability rates between 2.39×10^{-5} - 9.15×10^{-5} m/s. It was concluded that infiltration is unlikely to occur at shallow depths.

2.5 Hydrology & Hydrogeology

There are no surface water features in the immediate vicinity of the site. The nearest watercourse relates to the Holly Brook, a tributary of the River Kennet, located 500m to the south. The River Kennet itself is located further to its south.

The underlying Lambeth Group is classed as a 'Secondary A' aquifer Seaford Chalk / Newhaven Chalk Formation is classed as a Principal Aquifer. The site is not located within any groundwater Source Protection Zone (SPZ).

2.6 Flood Risk

The EA floodplain map indicates that the level of flood risk to the site corresponds to a Flood Zone 1 – Low Probability based on Table 1 of NPPF Planning Practice Guidance. This zone has less than a 1 in 1000-year annual probability of flooding.

The site itself is not vulnerable to surface water flooding; however, the adjoining highways will experience flooding in the medium and low risk events.

2.7 Development Proposals

The current development consists of developing 30 new homes with 1 No. apartment block and 15 No. dwellings, parking, access and landscaping. See **Appendix B** for Architect's Layout.

3. SURFACE WATER MANAGEMENT STRATEGY

3.1 Pre-Development Surface Water Drainage

The site in its current states remain derelict with most of the onsite drainage hard to locate. The drainage and utility survey (in **Appendix A**) located a 150mm drain running from the site towards Dwyer Road, with no confirmed connection. It is presumed that the site previously drained via this drain into the public sewer at Dwyer Road / Holybrook Crescent, as discussed above. Refer to **Appendix E** for existing drainage layout.

3.2 Pre-Development Surface Water Run-Off

3.2.1 Brownfield Run-Off Rates

Based on historic records, the previous Alice Burrows care home facility with a large building and access/hardstanding comprised impermeable area as set out in table 3.1 below.

Table 3.1: Pre-Development Catchment Area

Pre-Development Catchment	Area (m ²)
Building / Hardstanding	1670
Soft Landscaping	3250
Total Area	4920

See **Appendix F** for Pre-Development Catchment Plan.

Based on the previous impermeable area and using Modified Rational Method, the previous discharge from the site is calculated as shown in Table 3.2 below and **Appendix I**.

Table 3.2: Previous Brownfield Runoff Rates

Storm Event	Brownfield discharge rate (l/s)
1 in 1 Year	8.3
1 in 30 Year	20.6
1 in 100 Year	26.8

3.2.2 Existing Outfall Pipe Capacity

However, based on the capacity of the existing 150mm outfall pipe (at assumed gradient of 1 in 100 gradient), the existing discharge from the site is determined as 18 l/s. The site is therefore assumed to discharge at 18 l/s maximum rate into the existing public sewer as dictated by the capacity of the outfall pipe.

3.2.3 Greenfield Run-Off Rates

The following table considers what the maximum surface water discharge from the site would be if the site was 'Greenfield' i.e., not developed, calculations in **Appendix I**.

Table 3.3: Equivalent Greenfield Runoff Rates

Storm Event	Greenfield rate (l/s)
1 in 1 Year	0.2
1 in 30 Year	0.5
1 in 100 Year	0.6
QBAR	0.2

3.3 Proposed Discharge Rates

In line with the Non-Statutory Technical Standard for Sustainable Drainage (NTSSD) S2 & S3 (Peak Flow Control), it is a requirement that on new developments that consideration be given to limit discharge as close as reasonably practical to the equivalent 'Greenfield' rate for the corresponding storm event. However, as the greenfield discharge rates from the site is too low to restrict to (Table 3.3 above), it will not be practically feasible to limit the discharge from the development site to such a low rate.

As per NTSSD Policy S3, if greenfield rates are unachievable a higher rate may be allowed for previously developed site which should never exceed the rate of discharge from the development prior to redevelopment for that event.

Accordingly, it is proposed that discharge from the redeveloped site is limited to 4l/s. SuDS measures will be put in place to limit the discharge rate to as low as possible and provide betterment over the existing brownfield rates to ensure the site does not increase flood risk once developed. (Refer to Table 3.4 below and calculations in **Appendix I**).

Table 3.4: Proposed Discharge Rates

Storm Event	Brownfield discharge rate (l/s)	Proposed Discharge Rate (l/s)	% Improvement
1 in 1 Year	8.3	3.8	54%
1 in 30 Year	20.6	4.0	80%
1 in 100 Year	26.8	4.0*	85%

**40% climate change allowance considered for post development scenario*

3.4 Run-off Destinations

An appraisal should be undertaken to confirm the most suitable and sustainable method for managing surface water runoff from the development in accordance with the following hierarchy as highlighted in Part H of Building Regulations and the National Planning Policy Framework (NPPF):

1. Infiltration to the ground using a sustainable drainage system.
2. If this is not feasible, discharge to a watercourse or river; generally, at a controlled rate unless it does not affect flood risk e.g., if to the sea or an estuary.
3. Discharge at a controlled rate to a surface water sewer or drain.
4. Discharge at a controlled rate to a combined sewer system, with the approval from the Water Authority.
5. Only if the above have all been investigated and it has been proved that none of these options are suitable will discharge at a controlled rate to a foul sewer system, with the approval from the Water Authority.

In terms of infiltration SuDS, despite favourable infiltration rates, the Hydrock report concluded that:

'the site is an area with a moderate subsidence risk and use of Suds as a means of surface water drainage is not recommended. Alternative strategies should be sought prior to committing to discharging surface water to the ground. Concentrated flows of surface water could wash-out and/or disturb relict infill to buried solution features, which could lead to ground movements/collapse.'

The study further states that consideration may be given to deep borehole soakaways giving consideration to CIRIA C574 guidance. As per the guidance, *'in areas where dissolution features are known to be prevalent,*

soakaways should be avoided if at all possible but, if unavoidable, should be sited at least 20 m away from any foundations.’ However achieving 20m offset is not feasible within the site.

The discharge of surface water run-off has been considered in accordance with the hierarchical approach:

Table 3.5: SuDS Hierarchy

Method	Reasoning	
Infiltration	The site is in an area where nearby solution features have been identified and there is a risk of sinkholes from collapse of natural dissolution voids in the Chalk. Site investigation works relate that there is an evidence of a potential dissolution feature within the site.	X
Surface water body	There are no surface water bodies within the vicinity of the site.	X
To dedicated surface water sewer (public, highways or otherwise)	As there are potential connection points to the east, west and southern boundary this option will be considered. The site is currently presumed to drain towards public sewers.	✓
To a combined sewer	As there is a dedicated surface water system this has been discounted.	X
To a foul sewer	As there is a dedicated surface water system this has been discounted.	X

3.5 Suitability of SuDS Components

The drainage design should adopt the principles of SuDS where appropriate taking into consideration the site context and location. The principals of SuDS are that they should be designed to maximise the opportunities and benefits that can be secured surface water run-off management in terms of quality, quantity, flood risk, and amenity.

The implementation and selection of SuDS techniques is largely dependent on the site layout and context, and geological conditions. Some SuDS techniques may be more appropriate than others.

The suitability of SuDS components has been assessed as follows:

Table 3.6: Suitability of SuDS Components

Hierarchy	Description	Setting	Required area	Implemented	
Green roofs 	A planted soil layer is constructed on the roof of a building to create a living surface. Water is stored in the soil layer and absorbed by vegetation.	Building	Building integrated.	Yes. Green roofs incorporated across the site.	✓
Rainwater harvesting 	Rainwater is collected from the roof of a building or from other paved surfaces and stored in an over ground or underground tank for treatment and reuse locally. Water could be used for toilet flushing and irrigation.	Building	Water storage (Underground or above ground).	No, as unable to ensure the potential for legionella contamination is avoided and H&S risk is mitigated.	X

Soakaway 	A soakaway is designed to allow water to quickly soak into permeable layers of soil. Constructed like a dry well, an underground pit is dug filled with gravel or rubble. Water can be piped to a soakaway where it will be stored and allowed to gradually seep into the ground.	Open space/ gardens	Dependent on runoff volumes, water table and soils.	No. Evidence of dissolution within the underlying chalk; hence soakaways have not been recommended.	X
Filter strip 	Filter strips are grassed or planted areas that runoff is allowed to run across to promote infiltration and cleansing.	Open space	Minimum length 5m.	No. There is insufficient space on this site to install filter strips. Bioretention tree pits will be considered.	X
Permeable paving 	Paving which allows water to soak through. Can be in the form of paving blocks with gaps between solid blocks or porous paving where water filters through the block itself. Water can be stored in the sub-base beneath or allowed to infiltrate into ground below.	Street / open space	Can typically drain double its area.	Yes. Permeable paving has been incorporated within the parking spaces.	✓
Bioretention area 	A vegetated area with gravel and sand layers below designated to channel, filter and cleanse water vertically. Water can infiltrate into the ground below or drain to a perforated pipe and be conveyed elsewhere. Bioretention systems can be integrated with tree-pits or gardens.	Street / open space	Typically, surface area is 5-10% of drained area with storage below.	No. Ground Investigation report has confirmed that infiltration rates are too poor to consider this as an option. Bioretention tree pits will be considered.	X
Swale 	Swales are shallow depressions designed to convoy and filter water. These can be 'wet' where water gathers above the surface, or 'dry' where water gathers in a gravel layer beneath. Can be lined or unlined to allow infiltration.	Street / open space	Account for width to allow safe maintenance typically 2–3 metres wide.	No. This has not been implemented on this site as there is insufficient space.	X
Hardscape storage 	Hardscape water features can be used to store run-off above ground within a constructed container. Storage features can be integrated into public realm areas with a more urban character.	Street / open space	Could be above or below ground and sized to storage need.	No. Other more sustainable forms of SUDS have been identified.	X

Pond / Basin 	Ponds can be used to store and treat water. 'Wet' ponds have a constant body of water and run-off is additional, while 'dry' ponds are empty during periods without rainfall. Ponds can be designed to allow infiltration into the ground or to store water for a period of time before discharge.	Open space	Dependent on runoff volumes and soils.	No. This has not been implemented on this site as there is insufficient space.	X
Wetland 	Wetlands are shallow vegetated water bodies with a varying water level. Specially selected plant species are used to filter water. Water flows horizontally and is gradually treated before being discharged. Wetlands can be integrated with a natural or hardscape environment.	Open space	Typically, 5–15% drainage area to provide good treatment.	No. This has not been implemented on this site as there is insufficient space	X
Underground storage 	Water can be stored in tanks, gravel or plastic crates beneath the ground to provide attenuation.	Open space	Dependent on runoff volumes and soils.	Yes. Attenuation crates have been specified to satisfy excess requirement to meet permitted discharge rates.	✓

3.6 Post-Development Surface Water Drainage

Based on the current layout (HTA-A_DR_0100, Rev N), the development site comprises 2,460m² (0.246ha) of hard area in form of roof, parking and access road. As such, the development will increase site impermeability when compared to the previous site. See **Appendix G** for Post-Development Catchment Plan.

However, runoff will be managed using sustainable measures to ensure surface water runoff and resulting flood risk does not increase post development as discussed below. Where applicable, the surface water management strategy will incorporate the recommendations of the 'Non-Technical Standards for Sustainable Drainage' and general 'good practice' in terms of managing surface water runoff as per tables 3.5 and 3.6 above.

Accordingly, surface water runoff from roof and road areas will be collected by gullies and pipes and drained to a series of online and offline cellular tanks. Parking spaces will be provided with 'tanked' permeable paving with a discharge into the onsite drainage system. The system will ultimately discharge into the Thames Water surface water sewer to the south (at manhole 2851) via a Hydrobrake flow control. Discharge will be restricted to 4l/s, which provides a reduction of 78% over the existing discharge (18l/s) from the site. Refer to Hydrock drainage layout in **Appendix H**.

Based on invert of the connecting sewer, a gravity connection will be feasible.

As discussed in paragraph 2.4, due to the risk of chalk dissolution, infiltration option is considered unfeasible.

Opportunities to incorporate bioretention tree pits will be investigated at the detailed design stage however, the current site layout dictates that the use of permeable paving is a more effective method of pollution control for the areas adjacent to the tree pits, due to the catchment:SuDS area ratios.

The drainage and storage system in combination will be designed to accommodate the 1 in 100year storm event with 40% allowance for climate change. Refer to Microdrainage network/storage calculations in **Appendix I**.

Thames Water in relation to the site had previously informed that a discharge rate at the greenfield rate of 5l/s per hectare of impermeable area would be acceptable. However, the site is a brownfield land and the proposed discharge of 4l/s offers a significant reduction (of 78%) in runoff previously entering the public sewer.

All drainage and SuDS components will need to be kept out of tree protection zones.

As the drainage and SuDS components are located within private areas (rear gardens, parking), it will be necessary to protect these assets in the long term by placing restrictions on property owners to make any changes to these areas in the future. Accordingly, deeds of properties will include details of site wide drainage system, and include clauses that place legal restrictions on adjusting/amending any site wide drainage elements including permeable paved private driveways.

3.7 Urban Creep

Urban Creep Factor (UCF) is defined as any increase in the impervious area that is drained to an existing drainage system without planning permission being required, such as the construction of patios, small extensions, etc.

As the footprint of the site has been set which includes patios etc, this factor is not applied.

3.8 Interception Storage

Interception can be defined as the capture and retention on site of the first 5mm of the majority of all rainfall events. Interception mechanisms have been assessed to show the site is compliant for zero run-off from the first 5mm for 80% of events during the summer and 50% in winter (Ciria). As per table 3.6 below, permeable paving will provide the required interception storage.

Table 3.7: SuDS for Interception Storage

Systems	Reasoning	
Green roofs	All surfaces that have green / blue roofs	X
Rainwater harvesting	All surfaces drained to RWH systems designed whether for surface water management or just water supply, provided the RWH system design is based on regular daily demand for non-potable water	X
Soakaways / infiltration	Areas of the site drained to systems that are designed to infiltrate run-off for events greater than a 1 month return period.	X
Permeable pavements	All permeable pavements, whether lined or not, can be assumed to comply, provided there is no extra area drained to the permeable pavement.	✓
Filter strips / swales	Roads drained by filters strips / swales, where the longitudinal gradient of the vegetated area is less than 1:100, are suitable for interception delivery for impermeable areas up to 5 times the base of the vegetated surface area receiving the runoff.	X
Infiltration trenches	Roads drained by infiltration trenches can be considered to provide interception	X
Detention basins	Areas of the site drainage to detention basin with a flat base can be assumed to comply. The area of the basin that is assumed to contribute to interception of run-off should be below the outlet of the basin.	X
Bioretention / rain gardens	Areas of the site drainage to unlined bioretention components can be assume to comply where the impermeable area is less than 5 times the vegetated surface area receiving run-off/ They can be designed to deliver interception for larger areas, where suitable infiltration capacity is available.	X
Ponds	Areas drained by ponds (with a permanent water pool that is effectively maintained by the outlet structure) are not assumed to deliver interception	X

3.9 Post-Development Surface Water Volume

In line with the Non-Statutory Technical Standard for Sustainable Drainage S4 – S6 (Volume Control), where reasonably practicable, for brownfield developments the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6-hour rainfall event should be matched as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.

Where there is an increase in the volume of run-off as a result of the development, infiltration or other SuDS techniques should be considered to mitigate volume run-off. However due to the underlying ground conditions (chalk dissolution risk), infiltration techniques have not been considered. As the proposed discharge rate is significantly less than the existing brownfield rate, this criteria is deemed to comply.

3.10 Design Exceedance

In line with the Non-Statutory Technical Standard for Sustainable Drainage S7 – S9 (Flood Risk), adequate drainage / SuDS provision will be made on site to manage runoff for up to the 1:100year + 40% event. Attenuation areas will be distributed across the development with permeable paving and crates. In the event that one part of the system fails through blockage the remainder of the system will still be able to function effectively.

In the event that flows from rainfall exceeding the 1 in 100-year + climate change rainfall event or system failure occur through lack of maintenance, surface water run-off will be directed via exceedance routes away buildings into designated area, such as parking.

Appropriate overland flow routes and raised property threshold will ensure that no internal flooding of properties will occur.

See **Appendix G** for Overland Flow Route Plan.

3.11 Water Quality

The simple index approach has been used as the approach to water quality risk management on this project.

The pollution hazard indices identified for land use classifications within this project (as identified in table 26.2 of Ciria C753 - The SuDS Manual) are as follows.

Table 3.8: Pollution Hazard Indices

Pollution hazard indices for different land use classifications in accordance with CIRIA C753 - The SuDS Manual. Table 26.2				
Land Usage	Level	TSS	Metals	Hydrocarbons
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 (e.g., cul de sacs, home zones and general access roads) and non-residential car parking with infrequent change (e.g., schools, offices) i.e., <300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (e.g., hospitals, retail), all roads except low traffic roads and trunk roads / motorways	Medium	0.7	0.6	0.7
Sites with heavy pollution (e.g., haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways	High	0.8	0.8	0.9

The indicative SuDS mitigation indices for discharges to surface for this project (as identified in table 26.3 of The SuDS Manual), are as follows;

Table 3.9: SuDS pollution mitigation for discharge to surface waters

Indicative SuDS mitigation indices for discharge of surface water			
	Mitigation indices		
Type of SuDS component	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4	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	0.7	0.7	0.5
Wetland	0.8	0.8	0.8
Proprietary treatment systems	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately 1 in 1 year return period event, for inflow concentration relevant to the contributing drainage area		

Based on low pollution land use, a combination of permeable paving with catch pits is deemed to comply with the water quality criteria in line with Ciria C753 - The SuDS Manual guidance.

Consideration will be given to both during construction and post-development water quality treatment to ensure that water quality is not impacted during the construction works.

3.11.1 Quality of Surface Water Run-off: Post-Development

In accordance with Environment Agency Document PPG3 (now withdrawn but considered best practice guidance) the proposed as the car park is less than 50 spaces or 800m² it is considered to be 'low risk' in terms of pollution to the surface water network and as such an oil interceptor is not deemed to be required.

Gullies and drainage channels will be specified with silt traps and catch pits will be incorporated in the drainage system to reduce the risk of silts / debris getting into the surface water network.

3.11.2 Quality of Surface Water Run-off: During Construction

It is anticipated that the during construction adequate provisions will be put in place to ensure the existing drainage is protected to prevent material which could have a negative impact on water quality entering the system. The appointed contractor(s) would be required to implement a Construction Environmental Management Plan (CEMP) for the construction works which will detail the procedures and methods that must be followed to minimise the potential environmental effects of construction activities at the site.

4. FOUL WATER MANAGEMENT STRATEGY

4.1 Pre-Development Foul Water Drainage

Sewer asset maps have been obtained from Thames Water which shows a 225mm dia. sewer running north to south along the western boundary and connecting to the sewer in Holybrook Crescent. This sewer will need to be retained with an appropriate easement (expected 3m either side) which needs to be further confirmed with Thames Water).

A utilities survey undertaken by Survey Solutions shows a 150mm combined drain located within the site. This is recorded to be picked by a public foul sewer as it leaves the site. It is assumed this pipe was present to accommodate the previous development and therefore can be confirmed as redundant.

The exact foul flow from the former care home is unconfirmed, however it is evident that it drained to the Thames Water sewer.

4.2 Post-Development Foul Water Drainage

The below-ground foul drainage system will connect all new soil, waste and ventilating pipes, sanitary appliances and gullies at ground level and discharge to a chamber outside each plot. The drainage will then drain south to discharge into the foul network to the south of Dwyer Road. Based on levels, a gravity connection will be achievable. Refer to **Appendix H** for the Drainage Strategy.

The design of all foul sewers and lateral drains must conform to BS EN 752, BS EN 16933, Building Regulations 2010 Part H, planning policy and best practice guidelines wherever applicable. Sanitary systems within building should be designed in accordance with BS EN 12056-2.

4.3 Post-Development Foul Water Flow Rates

The peak design flow rates should be calculated using Sewerage Section Guidance – Appendix C as below.

Flow per dwelling	= 4000 litres/day (0.046 l/s)
Number of dwellings on site	= 30 residential units
Design Flow rate	= 0.046 x 30 = 1.40 litres/s

Thames Water are to be consulted to discuss on the capability of the existing sewerage system to accommodate the anticipated development flows. Should there be capacity concerns and offsite network reinforcement works are likely, these will be undertaken by Thames Water once planning permission is secured. As per Ofwat charging arrangements Thames Water will be required to undertake any offsite network reinforcement works with the developer liable for developer charges.

5. OWNERSHIP AND MAINTENANCE

Ownership and maintenance liabilities for the foul and surface water drainage system will be clearly defined so that in the event of failure the drainage system appropriate action can be taken to ensure that the drainage system continues to work efficiently.

5.1 Adoption & Ownership

All onsite drainage components including SuDS (permeable paving, cellular tanks) will remain private. Maintenance will be carried out via the engagement of a private management company acting on behalf of the property owners as appointed by the developer.

In order to safeguard the drainage assets in private areas, deeds of properties will include details of site wide drainage system, and will place restrictions on adjusting/amending any site wide drainage elements. The deed will also grant rights to the management company to enter these areas to maintain these assets on a regular basis.

5.2 Maintenance Routine

Regular inspection and maintenance are important for the effective operation of SuDS systems as designed. The proposed SuDS features will require maintenance including litter and debris removal, sediment removal, vegetation maintenance and remediation to any damaged structures.

Regular maintenance of SuDS should be carried out in line with the C753 The SuDS Manual or as per manufacturer's specification, as outlined in tables below.

Table 5.1: Proposed Schedule for Maintenance of Permeable Paving

Permeable Paving - Operation and maintenance requirements in accordance with CIRIA C753 - The SuDS Manual		
Maintenance Schedule	Required Action	Frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface).	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surfaces from adjacent impermeable areas as this area is most likely to collect the most Sediment.
Occasional maintenance	Stabilise and mow contributing and adjacent areas.	As required.
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying.	As required – once per year on less frequently used pavements.
Remedial actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving.	As required.
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material.	As required.

	Rehabilitation of surface and upper substructure by remedial sweeping.	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging).
Monitoring	Initial inspection.	Monthly for three months after installation.
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action.	Three-monthly, 48 h after large storms in first six months.
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually.
	Monitor inspection chambers.	Annually.
Reference should be made to the manufacturer recommendations where applicable		

Table 5.2: Proposed Schedule for Maintenance of Cellular Tanks

Underground Cellular Tanks - Operation and maintenance requirements in accordance with CIRIA C753 - The SuDS Manual		
<u>Maintenance Schedule</u>	<u>Required Action</u>	<u>Frequency</u>
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then annually.
	Remove debris from the catchment surface (where it may cause risks to performance).	Monthly.
	For systems where rainfall infiltrates into the tank from above, check surface or filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary	Annually.
	Remove sediment from pre-treatment structures and / or internal forebays.	Annually, or as required.
Remedial actions	Repair / rehabilitate inlets, outlet, overflows and vents.	As required.
Monitoring	Inspect / check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed.	Annually.
	Survey inside of tank for sediment build-up and remove if necessary.	Every 5 years or as required.
Reference should be made to the manufacturer recommendations where applicable		
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip.	As required.
	Remove and dispose of oils or petrol residues using safe standard practices.	As required.

Table 5.3: Proposed Schedule for Maintenance of Other Drainage Components

Other Drainage Items – Operation and maintenance requirements		
<u>Feature</u>	<u>Maintenance</u>	<u>Frequency</u>
Piped network	Inspection	CCTV survey every 5-10 years.
	Regular Maintenance	Jet clean system fully every 5-10 years. (Recommend prior to CCTV drainage survey is)
	Remedial / Occasional Maintenance	Carry out remedial works as identified in CCTV survey.
Discharge orifice manholes/flow control devices	Inspection	Quarterly
	Regular Maintenance	Remove silt and debris as necessary to prevent build up.
Gully / Drainage Channels	Inspection	Quarterly
	Regular Maintenance	Remove silt and debris as necessary to prevent build up.

The following information should be passed to the development operator to ensure that future maintenance is carried out in a safe and proper manner.

A formal review of the risks should be undertaken on an annual basis.

All inspection and maintenance works should take into consideration the implications of 'lone working'. An assessment should be carried out and the risks mitigated accordingly.

Table 5.4: Preliminary Risk Assessment

Operation	Risks	Mitigating Measures
Access to manholes for Inspection and Maintenance.	1. Confined spaces	1. Entry to confined space to be minimised and, where unavoidable, to be carried out by appropriately trained personnel
Removal of silt from outfall	1. Risk to members of the public 2. Open Water	1. Access to hazardous areas by members of the public to be prohibited. 2. To be carried out by appropriately trained personnel
Removal of silt from drainage channel and gullies	1. Risk to members of the public	1. Access to hazardous areas by members of the public to be prohibited

6. CONSENT / PLANNING

Summary of expected consents required:

- Ordinary Watercourse Consent – Not required.
- **Sewerage Undertaker Consent – Required.**
- Section 104 Adoption - Not Required (all system to remain private)
- **Section 106 Connection – Required.**
- Build Over / Build Near – Not Required

In addition to the above it is anticipated that details of the drainage scheme will need to be approved by Reading Borough Council Lead Local Flood Authority (LLFA) through a formal planning application.

7. CONCLUSION

This report provides details on foul and surface water drainage strategy for the development in accordance with both national and local standards and best practice. The following key items have been summarised below:

- The development is on a previously developed land (former care home), and will incorporate SuDS to reduce runoff rates when compared to the existing brownfield site.
- Attenuation will be provided 'at source' by way of permeable paving and crates prior to discharging into the public sewerage system to restrict the discharge to minimal rate of 4l/s (a reduction of 78% over the existing rate). Catch pits and permeable paving provided across the site will treat runoff prior to its discharge into the public sewer. Bioretention tree pits will also be considered.
- Surface water run-off will be contained within the site for storm events up to and including the 100-year plus 40% climate change. In the event that flows from rainfall exceed the 1 in 100-year rainfall event or system failure through lack of maintenance, surface water run-off will be directed via exceedance routes away buildings towards low-risk areas (e.g. car park).
- Foul flow will be discharged into the existing foul sewer located to the south of Dwyer Road.
- All onsite drainage and SuDS components will be privately maintained by a suitable maintenance company. Deeds of properties will include details of site wide drainage system, and will place legal restrictions on adjusting/amending any site wide drainage elements to safeguard the drainage / SuDS assets located in private areas. The property deeds will also grant legal rights to the management company to enter these areas to maintain these assets on a required basis.
- The proposed discharge rates and connections are subject to an agreement with Thames Water. The proposals are subject to discussion with the LLFA.

Appendix A

Topographical Survey

Appendix B

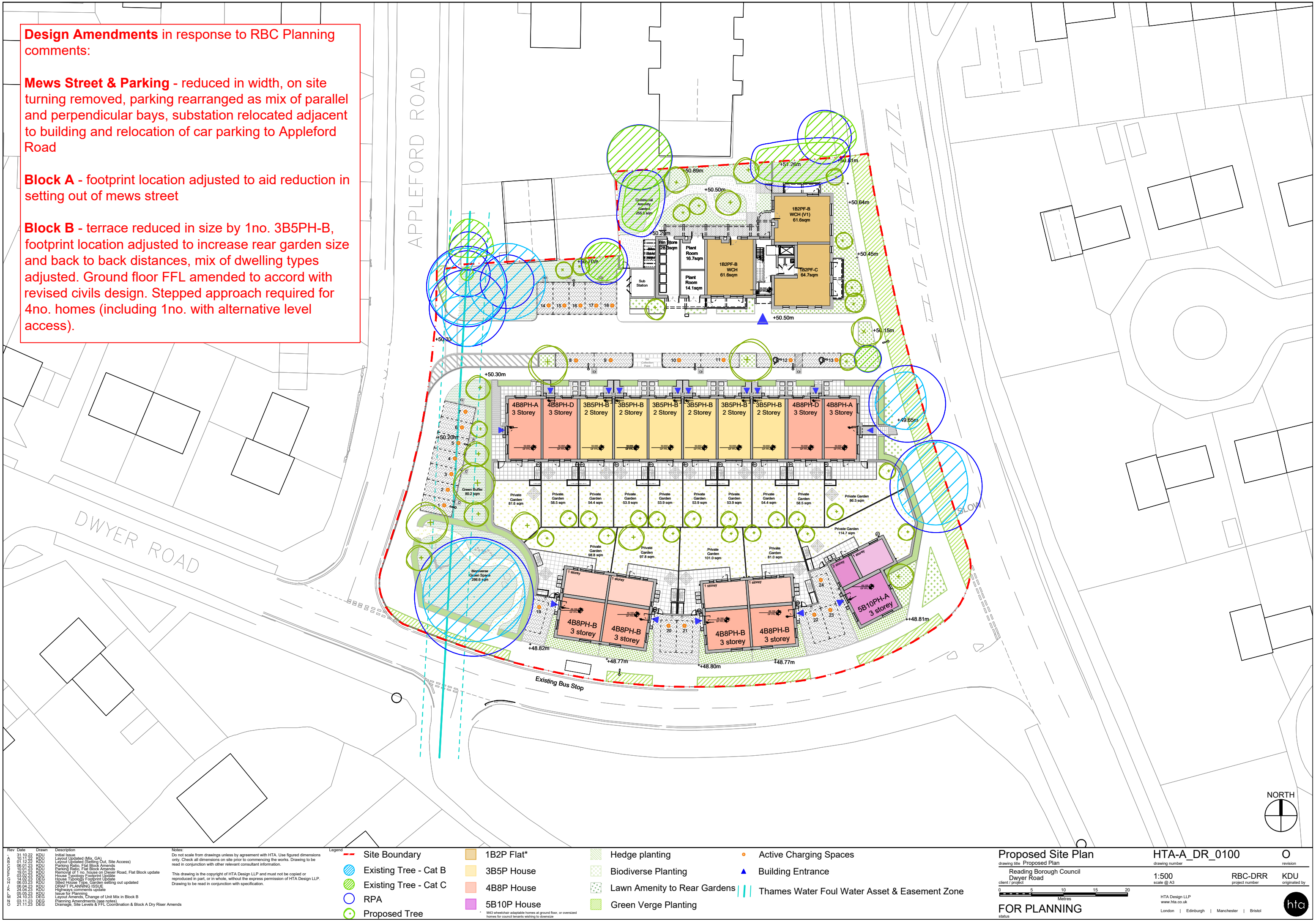
Architects Layout

Design Amendments in response to RBC Planning comments:

Mews Street & Parking - reduced in width, on site turning removed, parking rearranged as mix of parallel and perpendicular bays, substation relocated adjacent to building and relocation of car parking to Appleford Road

Block A - footprint location adjusted to aid reduction in setting out of mews street

Block B - terrace reduced in size by 1no. 3B5PH-B, footprint location adjusted to increase rear garden size and back to back distances, mix of dwelling types adjusted. Ground floor FFL amended to accord with revised civils design. Stepped approach required for 4no. homes (including 1no. with alternative level access).



Rev	Date	Drawn	Description
1	31.10.22	KDU	Initial Issue
2	10.11.22	KDU	Layout Updated (Mix, GA)
3	07.12.22	KDU	Layout Updated (Setting Out, Site Access)
4	06.01.23	KDU	Parking Ratio, Flat Block Amends
5	10.01.23	KDU	Removal of 1 no. house on Dwyer Road, Flat Block update
6	19.01.23	KDU	House Typology Footprint Update
7	14.02.23	DEG	House Typology Footprint Update
8	08.03.23	DEG	House Typology Footprint Update
9	08.04.23	KDU	House Typology Footprint Update
10	05.05.23	KDU	House Typology Footprint Update
11	03.11.23	DEG	House Typology Footprint Update
12	21.11.23	DEG	House Typology Footprint Update

Notes:
Do not scale from drawings unless by agreement with HTA. Use figured dimensions only. Check all dimensions on site prior to commencing the works. Drawing to be read in conjunction with other relevant consultant information.
This drawing is the copyright of HTA Design LLP and must not be copied or reproduced in part, or in whole, without the express permission of HTA Design LLP. Drawing to be read in conjunction with specification.

Legend

- Site Boundary
- Existing Tree - Cat B
- Existing Tree - Cat C
- RPA
- Proposed Tree
- 1B2P Flat*
- 3B5P House
- 4B8P House
- 5B10P House
- Hedge planting
- Biodiverse Planting
- Lawn Amenity to Rear Gardens
- Green Verge Planting
- Active Charging Spaces
- Building Entrance
- Thames Water Foul Water Asset & Easement Zone

* M43 wheelchair adaptable homes at ground floor, or oversized homes for council tenants wishing to downsize

Proposed Site Plan
drawing title: Proposed Plan
Reading Borough Council
Dwyer Road
client / project

HTA-A_DR_0100
drawing number
1:500
scale @ A3

FOR PLANNING
status

HTA Design LLP
www.hta.co.uk
London | Edinburgh | Manchester | Bristol

HTA

HTA-A_DR_0100
drawing number
1:500
scale @ A3

RBC-DRR
project number

KDU
originated by

HTA

Appendix C

Sewer Asset Map

National One Call Plan To Dig
Mill Place
1Mill Road Industrial Estate
WEST LOTHIAN
EH49 7TL

Search address supplied Dwyer Road
Reading
RG30 3PN

Your reference NOC/XJSUM949

Our reference ALS/ALS Standard/2022_4735243

Search date 17 October 2022

Knowledge of features below the surface is essential for every development

The benefits of this knowledge not only include ensuring due diligence and avoiding risk, but also being able to ascertain the feasibility of any development.

Did you know that Thames Water Property Searches can also provide a variety of utility searches including a more comprehensive view of utility providers' assets (across up to 35-45 different providers), as well as more focused searches relating to specific major utility companies such as National Grid (gas and electric).

Contact us to find out more.



Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13



searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk



0800 009 4540

Search address supplied: Dwyer Road, Reading, RG30 3PN

Dear Sir / Madam

An Asset Location Search is recommended when undertaking a site development. It is essential to obtain information on the size and location of clean water and sewerage assets to safeguard against expensive damage and allow cost-effective service design.

The following records were searched in compiling this report: - the map of public sewers & the map of waterworks. Thames Water Utilities Ltd (TWUL) holds all of these.

This search provides maps showing the position, size of Thames Water assets close to the proposed development and also manhole cover and invert levels, where available.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information. The replies contained in this letter are given following inspection of the public service records available to this company. No responsibility can be accepted for any error or omission in the replies.

You should be aware that the information contained on these plans is current only on the day that the plans are issued. The plans should only be used for the duration of the work that is being carried out at the present time. Under no circumstances should this data be copied or transmitted to parties other than those for whom the current work is being carried out.

Thames Water do update these service plans on a regular basis and failure to observe the above conditions could lead to damage arising to new or diverted services at a later date.

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0800 009 4540, or use the address below:

Thames Water Utilities Ltd
Property Searches
PO Box 3189
Slough
SL1 4WW

Email: searches@thameswater.co.uk

Web: www.thameswater-propertysearches.co.uk

Waste Water Services

Please provide a copy extract from the public sewer map.

Enclosed is a map showing the approximate lines of our sewers. Our plans do not show sewer connections from individual properties or any sewers not owned by Thames Water unless specifically annotated otherwise. Records such as "private" pipework are in some cases available from the Building Control Department of the relevant Local Authority.

Where the Local Authority does not hold such plans it might be advisable to consult the property deeds for the site or contact neighbouring landowners.

This report relates only to sewerage apparatus of Thames Water Utilities Ltd, it does not disclose details of cables and or communications equipment that may be running through or around such apparatus.

The sewer level information contained in this response represents all of the level data available in our existing records. Should you require any further Information, please refer to the relevant section within the 'Further Contacts' page found later in this document.

For your guidance:

- The Company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an 'as constructed' record. It is recommended these details be checked with the developer.

Clean Water Services

Please provide a copy extract from the public water main map.

Enclosed is a map showing the approximate positions of our water mains and associated apparatus. Please note that records are not kept of the positions of individual domestic supplies.

For your information, there will be a pressure of at least 10m head at the outside stop valve. If you would like to know the static pressure, please contact our Customer Centre on 0800 316 9800. The Customer Centre can also arrange for a full flow and pressure test to be carried out for a fee.



For your guidance:

- Assets other than vested water mains may be shown on the plan, for information only.
- If an extract of the public water main record is enclosed, this will show known public water mains in the vicinity of the property. It should be possible to estimate the likely length and route of any private water supply pipe connecting the property to the public water network.

Payment for this Search

A charge will be added to your suppliers account.

Further contacts:

Waste Water queries

Should you require verification of the invert levels of public sewers, by site measurement, you will need to approach the relevant Thames Water Area Network Office for permission to lift the appropriate covers. This permission will usually involve you completing a TWOSA form. For further information please contact our Customer Centre on Tel: 0845 920 0800. Alternatively, a survey can be arranged, for a fee, through our Customer Centre on the above number.

If you have any questions regarding sewer connections, budget estimates, diversions, building over issues or any other questions regarding operational issues please direct them to our service desk. Which can be contacted by writing to:

Developer Services (Waste Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

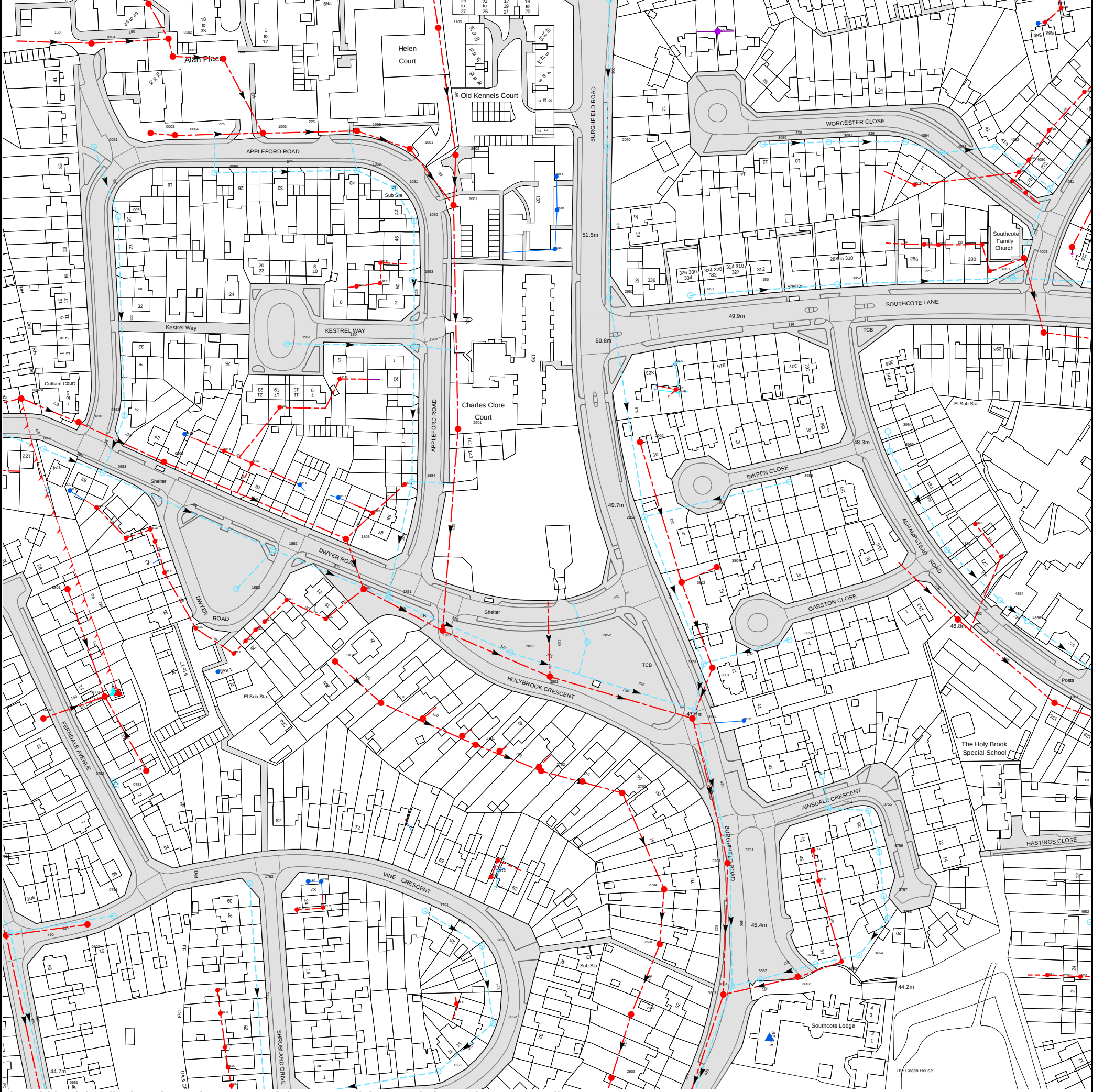
Clean Water queries

Should you require any advice concerning clean water operational issues or clean water connections, please contact:

Developer Services (Clean Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

Asset Location Search Sewer Map - ALS/ALS Standard/2022 4735243



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 468244,171872
The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Based on the Ordnance Survey Map (2020) with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
401J	n/a	n/a
491A	n/a	n/a
4003	48.41	46.73
411J	n/a	n/a
411A	n/a	n/a
411B	n/a	n/a
3601	44.97	42.41
3651	45.05	42.44
3652	n/a	n/a
3602	45.7	42.79
4601	43.4	41.76
461A	n/a	n/a
3653	45.4	43.28
3603	n/a	n/a
3654	n/a	n/a
4652	44.25	43.01
3758	45.14	n/a
3757	45.31	43.91
371B	n/a	n/a
3701	46.23	42.94
3751	46.3	43.4
3756	45.7	n/a
371A	n/a	n/a
3755	45.97	n/a
3754	46.31	44.81
3753	46.37	45.09
371C	n/a	n/a
4701	46.25	44.5
4851	46.4	44.15
3852	47.51	45.52
4856	n/a	n/a
4802	47.29	45.36
4854	47	45.24
3804	47.93	46.8
481B	n/a	n/a
4852	47.7	45.7
481A	n/a	n/a
2603	45.09	43.22
1651	45.5	43.54
2652	45.45	43.82
2602	n/a	n/a
261A	n/a	n/a
2651	45.77	44.23
2601	n/a	n/a
1751	n/a	n/a
171D	n/a	n/a
171C	n/a	n/a
2704	n/a	n/a
271D	n/a	n/a
171A	n/a	n/a
171B	n/a	n/a
271B	n/a	n/a
271C	n/a	n/a
271A	n/a	n/a
2703	n/a	n/a
27MK	n/a	n/a
2702	n/a	n/a
27ML	n/a	n/a
27ME	n/a	n/a
2701	n/a	n/a
27ND	n/a	n/a
3702	47.49	44.2
17NK	n/a	n/a
3752	47.55	44.75
1701	n/a	n/a
2801	n/a	n/a
3801	47.84	44.67
3851	47.91	45.02
1804	n/a	n/a
2851	48.57	45.64
2852	n/a	n/a
1801	48.29	45.2
181G	n/a	n/a
181F	n/a	n/a
1851	48.88	45.98
1802	48.87	45.66
3802	48.52	45.42
1852	48.68	46.35
1803	49	45.83
2853	49.44	n/a
181B	n/a	n/a
081B	n/a	n/a
181D	n/a	n/a
081A	n/a	n/a
0851	n/a	n/a
181A	n/a	n/a
181C	n/a	n/a
0953	49.81	47.72
191A	n/a	n/a
0909	n/a	n/a
091A	n/a	n/a

Manhole Reference	Manhole Cover Level	Manhole Invert Level
0951	n/a	n/a
091B	n/a	n/a
0910	50.08	47.5
0952	n/a	n/a
191C	n/a	n/a
0902A	n/a	n/a
191B	n/a	n/a
1951	50.18	48.98
191D	n/a	n/a
191E	n/a	n/a
9601	45.24	42.83
9651	45.25	43.78
0602	45.46	43.09
0751	45.5	44.11
1752	46.05	43.82
0753	n/a	42.27
0752	n/a	40.77
0701	n/a	n/a
0702	42.43	n/a
0803	42.78	40.85
081H	n/a	n/a
081F	n/a	n/a
181H	n/a	n/a
181E	n/a	n/a
081G	n/a	n/a
181I	n/a	n/a
0801	n/a	n/a
1853	48.37	46.85
081E	n/a	n/a
081J	n/a	n/a
081C	n/a	n/a
081D	n/a	n/a
061A	n/a	n/a
061D	n/a	n/a
061B	n/a	n/a
061C	n/a	n/a
161A	n/a	n/a
3954	48.48	47.78
3953	48.42	n/a
4054	49.66	48.37
401F	n/a	n/a
401D	n/a	n/a
401E	n/a	n/a
4053	49.08	48.05
4052	49.46	47.46
401H	n/a	n/a
4951	48.11	45.89
401G	n/a	n/a
4050	n/a	n/a
401I	n/a	n/a
401C	n/a	n/a
4901	47.9	46.25
401B	n/a	n/a
4051	48.74	46.88
4002	n/a	n/a
401A	n/a	n/a
1954	50.6	47.96
3955	48.59	n/a
2902	n/a	n/a
2901	51.02	48.04
391B	n/a	n/a
391C	n/a	n/a
391A	n/a	n/a
1952	50.81	48.39
2951	51.29	49.1
3951	50.27	n/a
3952	n/a	n/a
1953	50.97	49.52
201C	n/a	n/a
1050	51.32	49.32
201B	n/a	n/a
2001	51.41	49.62
201A	n/a	n/a
2002	51.82	49.92
2050	52.49	50.39
3050	51.59	49.79
3051	50.68	49.08
311A	n/a	n/a
1103	52.7	50.51
2151	54	51.76
0104	54.05	52.55
0051	52.78	n/a
0052	51.7	n/a
0103	53.97	52.67
0003	52.67	50.43
0102	53.13	52.17
0002	52.97	51.93
0004	52.52	50.36
0050	52.02	n/a
0001	52.52	51.21
1003	52.29	50.15
1052	n/a	n/a
1002	52.1	49.9

Manhole Reference	Manhole Cover Level	Manhole Invert Level
191F 1051 1001	n/a 51.46 51.94	n/a 49.62 49.76
The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.		



Asset Location Search - Sewer Key

Public Sewer Types (Operated and maintained by Thames Water)

	Foul Sewer: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.
	Surface Water Sewer: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.
	Combined Sewer: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.
	Storm Sewer
	Sludge Sewer
	Foul Trunk Sewer
	Surface Trunk Sewer
	Combined Trunk Sewer
	Foul Rising Main
	Surface Water Rising Main
	Combined Rising Main
	Vacuum
	Thames Water Proposed
	Vent Pipe
	Gallery

Other Sewer Types (Not operated and maintained by Thames Water)

	Sewer		Culverted Watercourse
	Proposed		Decommissioned Sewer
	Content of this drainage network is currently unknown		Ownership of this drainage network is currently unknown

Notes:

- 1) All levels associated with the plans are to Ordnance Datum Newlyn.
- 2) All measurements on the plan are metric.
- 3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate the direction of flow.
- 4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

	Air Valve		Meter
	Dam Chase		Vent
	Fitting		

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

	Ancillary		Drop Pipe
	Control Valve		Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol. Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

	Inlet		Outfall
	Undefined End		

Other Symbols

Symbols used on maps which do not fall under other general categories.

	Change of Characteristic Indicator		Public / Private Pumping Station
	Invert Level		Summit

Areas

Lines denoting areas of underground surveys, etc.

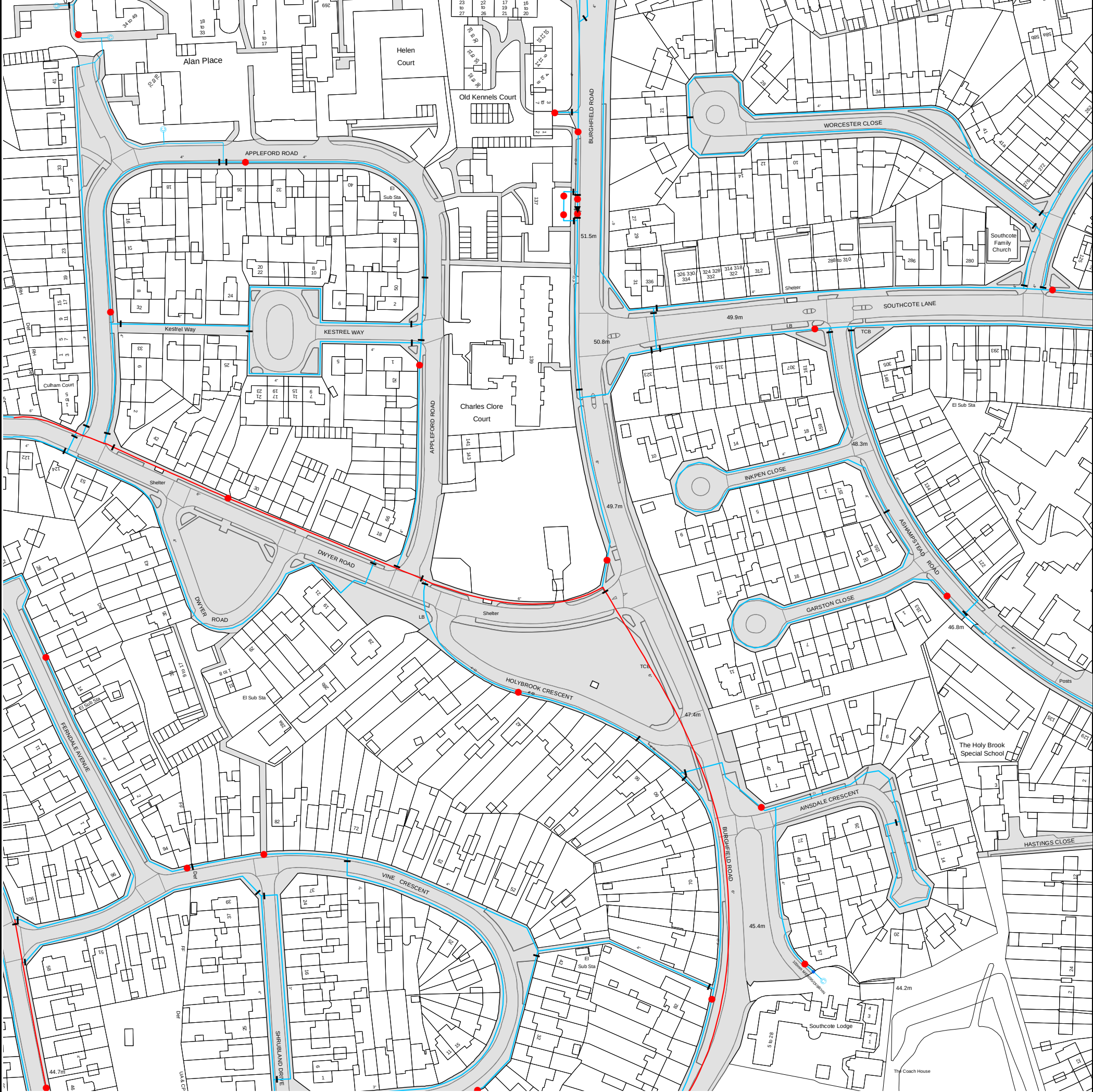
	Agreement
	Chamber
	Operational Site

Ducts or Crossings

	Casement	Ducts may contain high voltage cables. Please check with Thames Water.
	Conduit Bridge	
	Subway	
	Tunnel	

5) 'na' or '0' on a manhole indicates that data is unavailable.

6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in millimeters. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology, please contact Property Searches on 0800 009 4540.



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 468244, 171872.
The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Based on the Ordnance Survey Map (2020) with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.



Asset Location Search - Water Key

Water Pipes (Operated & Maintained by Thames Water)

- Distribution Main:** The most common pipe shown on water maps. With few exceptions, domestic connections are only made to distribution mains.
- Trunk Main:** A main carrying water from a source of supply to a treatment plant or reservoir, or from one treatment plant or reservoir to another. Also a main transferring water in bulk to smaller water mains used for supplying individual customers.
- Supply Main:** A supply main indicates that the water main is used as a supply for a single property or group of properties.
- Fire Main:** Where a pipe is used as a fire supply, the word FIRE will be displayed along the pipe.
- Metered Pipe:** A metered main indicates that the pipe in question supplies water for a single property or group of properties and that quantity of water passing through the pipe is metered even though there may be no meter symbol shown.
- Transmission Tunnel:** A very large diameter water pipe. Most tunnels are buried very deep underground. These pipes are not expected to affect the structural integrity of buildings shown on the map provided.
- Proposed Main:** A main that is still in the planning stages or in the process of being laid. More details of the proposed main and its reference number are generally included near the main.

PIPE DIAMETER	DEPTH BELOW GROUND
Up to 300mm (12")	900mm (3')
300mm - 600mm (12" - 24")	1100mm (3' 8")
600mm and bigger (24" plus)	1200mm (4')

Valves

- General Purpose Valve
- Air Valve
- Pressure Control Valve
- Customer Valve

Hydrants

- Single Hydrant

Meters

- Meter

End Items

Symbol indicating what happens at the end of a water main.

- Blank Flange
- Capped End
- Emptying Pit
- Undefined End
- Manifold
- Customer Supply
- Fire Supply

Operational Sites

- Booster Station
- Other
- Other (Proposed)
- Pumping Station
- Service Reservoir
- Shaft Inspection
- Treatment Works
- Unknown
- Water Tower

Other Symbols

- Data Logger
- Casement:** Ducts may contain high voltage cables. Please check with Thames Water.

Other Water Pipes (Not Operated or Maintained by Thames Water)

- Other Water Company Main:** Occasionally other water company water pipes may overlap the border of our clean water coverage area. These mains are denoted in purple and in most cases have the owner of the pipe displayed along them.
- Private Main:** Indicates that the water main in question is not owned by Thames Water. These mains normally have text associated with them indicating the diameter and owner of the pipe.

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1. All goods remain in the property of Thames Water Utilities Ltd until full payment is received.
2. Provision of service will be in accordance with all legal requirements and published TWUL policies.
3. All invoices are strictly due for payment 14 days from due date of the invoice. Any other terms must be accepted/agreed in writing prior to provision of goods or service, or will be held to be invalid.
4. Thames Water does not accept post-dated cheques-any cheques received will be processed for payment on date of receipt.
5. In case of dispute TWUL's terms and conditions shall apply.
6. Penalty interest may be invoked by TWUL in the event of unjustifiable payment delay. Interest charges will be in line with UK Statute Law 'The Late Payment of Commercial Debts (Interest) Act 1998'.
7. Interest will be charged in line with current Court Interest Charges, if legal action is taken.
8. A charge may be made at the discretion of the company for increased administration costs.

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Ways to pay your bill

Credit Card	BACS Payment	Telephone Banking	Cheque
Call 0800 009 4540 quoting your invoice number starting CBA or ADS / OSS	Account number 90478703 Sort code 60-00-01 A remittance advice must be sent to: Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW. or email ps.billing@thameswater.co.uk	By calling your bank and quoting: Account number 90478703 Sort code 60-00-01 and your invoice number	Made payable to ' Thames Water Utilities Ltd ' Write your Thames Water account number on the back. Send to: Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW or by DX to 151280 Slough 13

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Appendix D

Ground Investigation Report Extract

5. Ground investigation records and data

5.1 Physical ground conditions

5.1.1 Summary of strata encountered

The following presents a summary of the properties of the ground and groundwater conditions encountered by Soils Limited, based on field observations, interpretation of the field data and laboratory test results, taking into account drilling, excavation and sampling methods, transport, handling and specimen preparation.

All relevant data from the investigation discussed in Section 4 are used from this point forward.

Details of the Soils Limited ground investigation works are provided in the logs in Appendix B, a summary of the ground model is presented in Table 5.1 and the individual strata are described in the sections below.

Table 5.1: Strata encountered

Stratum	Depth to top (m bgl)	Depth to base (m bgl)	Thickness (m) (range)	Thickness (m) (average)
Asphalt	GL	0.13	0.13	n/a
Made Ground	GL	0.20 – 1.70	0.20 – 1.70	0.85
Topsoil	GL	0.10 – 0.25	0.10 – 0.25	0.20
Lynch Hill Gravel Member	0.20 – 1.70	1.30 – 4.50	1.00 – 4.30	2.53
Lambeth Group	1.30 – 4.50	2.10 – 6.80	0.80 – 2.60	1.56
Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated)	2.10 – 6.80	>4.00 - >20.00	>0.30 - >13.20	Not proven

5.1.2 Bituminous bound pavement

Asphalt was encountered in TP5 only between GL and 0.13m bgl.

5.1.3 Made Ground

Made Ground was localised but generally found in the southern and eastern parts of site at select locations (BH1 – 2, TP3 – 5 and DP5). Made Ground was encountered from GL and was between 0.20m to 1.70m thick, with an average thickness of 0.85m.

Generally variable composition being either granular or cohesive, with varied sub factions of materials. Anthropogenic elements include: brick, concrete, terracotta pipe, limestone, clinker, slate and asphalt.

5.1.4 Topsoil

Where the Made Ground was not encountered (TP1 – 2), the exploratory holes encountered topsoil overlying the natural soils from GL. The Soils Limited logs have not differentiated between topsoil and Made Ground materials. Hydrock consider that topsoil is likely present across the majority of the site due to observations however the Soils Limited logs indicate a considerable thickness of

Made Ground from surface, It is recommended that this be revisited as part of a supplementary ground investigation, if it is desired to reuse the material.

Topsoil, were noted on the logs, was between 0.10m and 0.25m thick, with an average thickness of 0.22m. The topsoil comprised brown slightly gravelly silt.

For the purposes of this report, topsoil is defined as the upper layer of an in situ soil profile, usually darker in colour and more fertile than the layer below (subsoil), which is a product of natural chemical, physical, biological and environmental processes, but does not imply compliance with BS 3882:2015. Reuse of topsoil as a growing medium at the site should be determined by the landscape architect or the landscape Contractors.

5.1.5 *Lynch Hill Gravel Member*

Whilst the BGS maps indicate no superficial deposits to be present on site, the investigation has found sands and flint gravels near surface across the whole site. Hydrock consider the rounded gravels and sands to be part of the Lynch Hill Gravel Member which is noted to be 900m to the north east on BGS mapping.

Lynch Hill Gravel Member was encountered underlying the Made Ground or topsoil across the site. Lynch Hill Gravel Member is between 1.00m and 4.30m thick, with an average thickness of 2.53m.

This generally consisted of brown sands with various clay/silt and gravel factions and multi coloured clays with various sand and gravel factions.

5.1.6 *Lambeth Group*

Lambeth Group was encountered underlying the Lynch Hill Gravel Member across the site and is between 0.80m and 2.60m thick, with an average thickness of 1.56m where the base was proven.

This generally consisted of brown/multi coloured clays with various sand and gravel factions, and brown sands with various clay and gravel factions.

5.1.7 *Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated)*

Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated) was encountered underlying the Lambeth Group across the site down to a maximum proven depth of 20.00m bgl (base not proven).

This generally consisted of structureless chalk recovered as white gravelly silt. Clasts of weak to moderate density. Grade Dm.

5.2 *Visual and olfactory evidence of contamination (soil)*

In addition to the more common man-made constituents described above in Section 5.1.3, visual and olfactory evidence of contamination was noted in TP5, with a slight hydrocarbon odour observed in the Made Ground between 0.13m – 0.40m bgl.

5.3 *Evidence of potential dissolution features and dynamic probe data*

There is evidence of a potential dissolution feature at and around the dynamic probing location DP5 where between 1.90m – 4m depth bgl extremely loose ground was encountered with a possible void below 4m to around 6m.

A trial pit was undertaken at this location (TPDP5) to determine the material present and/or identify a shallow void. The materials encountered in the trial pit were noted to be Made Ground to 0.50m bgl, over sand and gravel to 1.6m bgl underlain by variable layers of sand and clay. What is thought to be Lambeth Group (laminated sandy clay) was encountered between 3.7m and 4m towards the base of the trial pit.

It is suspected that the top of the chalk is encountered below a depth of 4m and has historically undergone an amount dissolution that has caused the overlying ground to collapse into the void, which has subsequently then bulked and loosened.

No evidence of a hollow was observed in the ground surface suggesting that the shallower coarser materials are offering some arching capacity.

The rest of the dynamic probe locations did not indicate further similar loose ground conditions however due to encountering one potential dissolution feature, more may be present on site.

5.4 Groundwater

5.4.1 Groundwater observations and levels

Groundwater encountered during the investigation is listed in Table 5.2. A groundwater observation represents the depth at which groundwater was first observed and is likely to be deeper than the actual water table level at that location.

Table 5.2: Groundwater occurrence

Stratum	Date	Location	Fieldwork		Comment
			Groundwater observation (m bgl)	Rose to after 20 mins (m bgl)	
Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated)	14/03/23	BH1	13.30	12.50	Groundwater strike
	15/03/23	BH2	12.50	12.50	

5.4.2 Permeability tests

The results of permeability testing using falling head analysis is summarised in Table 5.3. The results sheets are presented in the Soils Limited factual report presented in Appendix B.

Table 5.3: Permeability test results

Stratum	Borehole No.	Base of test (m bgl)	Permeability Coefficient (k) (m/s)		
			Run 1	Run 2	Range
Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated)	1	10.00	8×10^{-5}	9.15×10^{-5}	2.39×10^{-5} - 9.15×10^{-5}
	2	10.00	2.39×10^{-5}	-	n/a

Where less than two tests were possible in a particular location the results provided should be considered indicative only and should not be used for design purposes. Multi-day testing should be undertaken.

The tests undertaken in BH1 and BH2 at 20.00m and 15.00m bgl respectively had limited infiltration area available due to the depth of casing in the borehole.

5.4.3 Groundwater summary

In general, groundwater was not encountered at shallow depths, being present between 12.50m – 13.30m bgl in the deep boreholes during the field works. Post works monitoring notes that shallow wells are for the most part dry and the deeper well reporting groundwater levels between 9.10m – 9.17m bgl.

The Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated) recorded permeability rates between 2.39×10^{-5} - 9.15×10^{-5} m/s.

5.5 Ground gases

Records from the gas monitoring boreholes are presented in the Soils Limited factual report, presented in Appendix B, and summarised in Table 5.4.

Three monitoring visits have been undertaken and the monitoring programme is complete. The data are assessed in Section 7.6.

Table 5.4: Range of ground gas data

Stratum	Methane (%)	Carbon dioxide (%)	Oxygen (%)	Steady flow rate (L/hr)
Made Ground	0.0	0.1 – 3.5	16.1 – 21.2	0.0
Lynch Hill Gravel	0.0	2.4 – 3.4	16.1 – 17.6	0.0
Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated)	0.0	0.0 – 0.1	16.7 – 21.0	0.0

5.6 Geotechnical data

5.6.1 Introduction

Laboratory test results are contained in the Soils Limited factual report presented in Appendix B with *in situ* test results shown on the relevant exploratory hole log or datasheet in the Soils Limited factual report presented in Appendix B. The following sections summarise the main findings and provide interpretation where appropriate.

5.6.2 Plasticity

The volume change potentials in terms of NHBC Standard (Chapter 4.2) with respect to building near trees have been determined from the results of plasticity index tests on samples of soil. These are summarised in Table 5.5.

Table 5.5: Volume change potential

Stratum	No. of tests	Plasticity Index			Modified Plasticity Index			Plasticity designation	Volume Change Potential
		Min.	Max	Av.	Min.	Max	Av.		
Lynch Hill Gravel Member	3*	25	29	27	25	29	27	Non-plastic - Medium	Non-plastic - Medium
Lambeth Group	1	27	27	-	27	27	-	Medium	Medium

*One out of 3 tests reported as non-plastic.

5.6.3 Particle size distribution

Particle Size Distribution test (PSDs) results are summarised in Table 5.6.

Table 5.6: PSD results summary

Stratum	No. of tests	Silt/Clay %	Sand %	Gravel %	General description
Made Ground	1	24	52	24	Silty/clayey gravelly SAND
Lynch Hill Gravel Member	2	5 - 7	18 - 90	3 - 77	Silty/clayey sandy GRAVEL and slightly gravelly slightly silty/clayey SAND.

5.6.4 Soil strength

Table 5.7 summarises information pertaining to the shear strength of the soils according to geological stratum. Factual results are summarised for laboratory tests, field tests (e.g. hand shear vane) and uncorrected Standard Penetration Tests (SPT). Where the SPT is used to infer shear strength by published correlation, this is also tabulated.

Table 5.7: Soil strength results and derived values

Stratum	No. of tests	SPT (N-value) (range)	c_u (kPa)	c' (kPa)	ϕ_i (°)	Method
Lambeth Group	1	-	7	-	-	Triaxial – Laboratory.
Lambeth Group	1	11	49.5*	-	25	SPT – cable percussion.
Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated)	14	6 - 14	27 - 63	-	-	SPT – cable percussion.

*Correlation with Stroud (1975) based on 'average' plasticity

5.6.5 Relative density

Table 5.8 summarises information pertaining to the relative density of the granular soils according to geological stratum. Factual results are summarised for laboratory tests, field tests (e.g. SPT, CPT, dynamic probe correlation).

Table 5.8: Relative density results and derived values

Stratum	No. of tests	Method	SPT (N-value) (Range)	ϕ_i (°)
Lynch Hill Gravel Member	6	SPT – cable percussion (Peck et. al. (1967)).	12 - 35	30 - 37
Lambeth Group	2	SPT – cable percussion (Peck et. al. (1967)).	14 - 21	31 - 33

5.6.6 Subgrade stiffness

The subgrade stiffness (CBR) results are summarised in Table 5.9. Topsoil will be stripped and so is not considered. The Made Ground varies considerably in depth and composition and so a value of <2.5% has been inferred as the tests are not carried out adjacent to trial pit locations. It is assumed, from correlation with other holes, that the values reported indicate the Lynch Hill Gravel Member,

Table 5.9: CBR results and derived values

Stratum	No. tests	Method	CBR (%) (Range)
Made Ground	-	<i>Inferred</i>	<2.5%
Lynch Hill Gravel Member	6	<i>in situ</i> TRL DCP test	6 - 40

Where using the IAN method, 'k' has been back calculated from the Equivalent CBR.

5.6.7 Sulfate content

In accordance with BRE (Special Digest 1), the Design Sulfate (DS) classification and the Aggressive Chemical Environment for Concrete (ACEC) classification are presented in Table 5.10. The assessment summary sheets are presented in Appendix C.

Hydrock note that sample ref: 121827-9 on report ref: 121827 has the incorrect location assigned, it is thought this sample noted to be at 5.50m bgl from TP05 should be from BH01 as the trial pit did not extend to this depth and BH01 is missing a scheduled test. This has been assumed for the purposes of the Hydrock report.

Table 5.10: Aggressive chemical environment concrete classification

Stratum	No. tests	DS	ACEC
Made Ground	1	DS-1	AC-1
Lynch Hill Gravel Member	5	DS-1	AC-1
Lambeth Group	2	DS-1	AC-1
Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated)	1	DS-1	AC-1

5.6.1 Saturation Moisture Content Testing

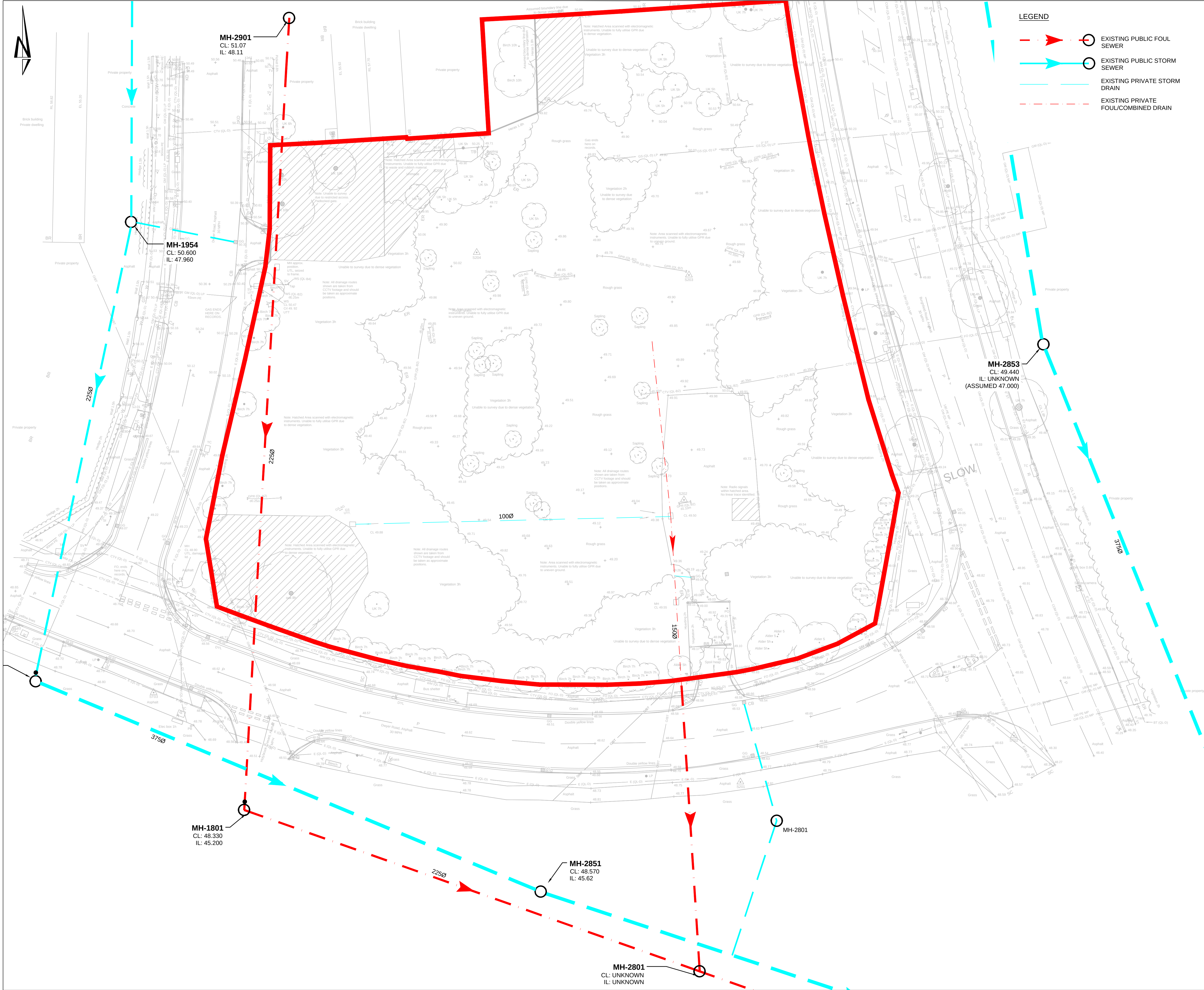
Table 5.11 summarises information pertaining to the density characteristics of the Chalk, based on laboratory test data.

Table 5.11: Saturation Moisture Content Test Results

Parameter Stratum	No. of tests	Saturation Moisture Content (range) Mg/m ³	Dry Density (range) Mg/m ³	Density classification (CIRIA 574)
Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated)	5	28 - 31	1.47 - 1.54	low

Appendix E

26888-HYD-00-ZZ-SK-C-7700 Existing Drainage Layout

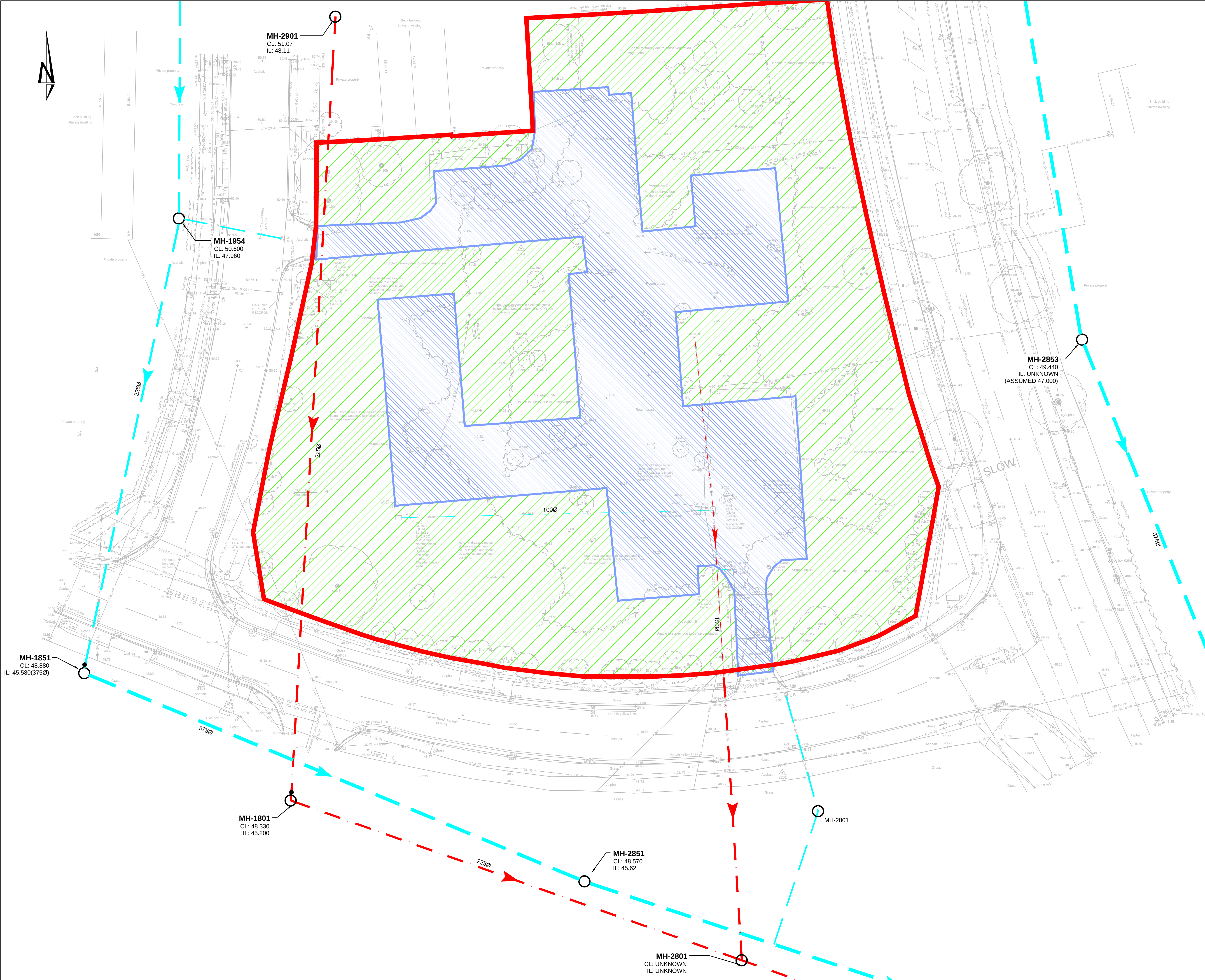


KEY PLAN																																																						
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- All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing. - The DWG file is issued for the purposes of coordination only and do not represent formal drawing issue and are not to be reprinted in any form. Formal issue of drawings is via DWF, Adobe PDF files and/or hard copies and their associated information issue sheets. - Note that all care has been taken with the export of DWG files and their content, but we recommend that you make due dimensional checks before using any DWG file information. Any errors found are to be reported to Hydrock immediately. - All levels are shown in metres above Ordnance Datum (m AOD).																																																						
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Appendix F

26888-HYD-00-ZZ-SK-C-7710 Pre-Development Catchment Plan

26888-HYD-00-ZZ-SK-C-7720 Post-Development Catchment Plan



- NOTES
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LEGEND

- EXISTING PUBLIC FOUL SEWER
- EXISTING PUBLIC STORM SEWER
- EXISTING PRIVATE STORM DRAIN
- EXISTING PRIVATE FOUL/COMBINED DRAIN
- SITE BOUNDARY = 49204m²
- HARDSTANDING = 1670m²
- SOFT LANDSCAPING = 3250m²

P02	EXISTING IMPERMEABLE AREA UPDATED BASED ON HISTORIC RECORDS, KEY UPDATED					
	N. PARAJULI	27/11/23	G. HARDWICK	27/11/23	J.CANDY	27/11/23
P01	UPDATED TO SUIT UPDATED LAYOUT					
	PRELIMINARY ISSUE					
REV	J.NEAL-LONG	22/02/23	J.MAGEE	22/02/23	J.MAGEE	22/02/23
	REVISION NOTES/COMMENTS					
DRAWN BY		DATE	CHECKED BY	DATE	APPROVED BY	DATE

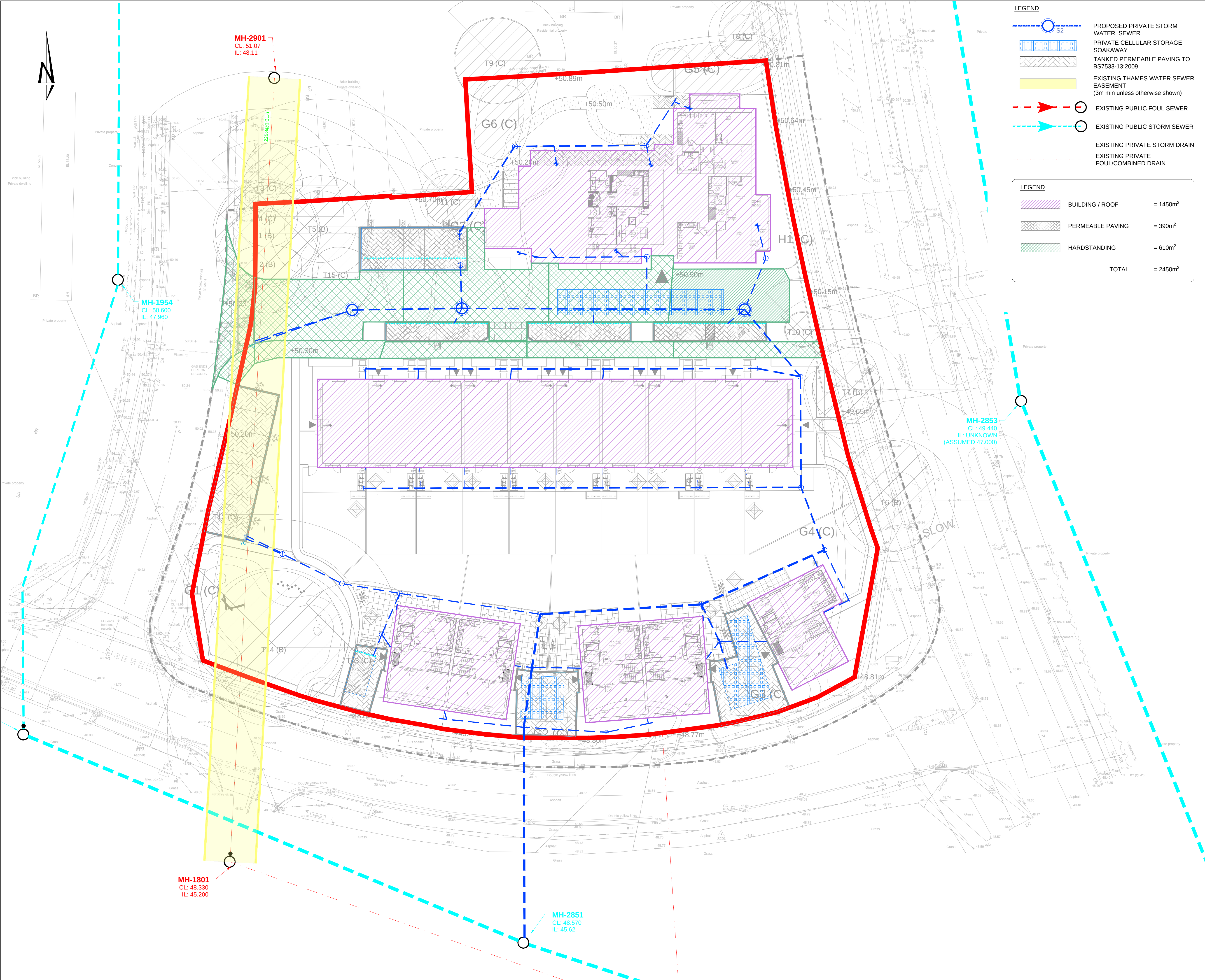
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BS1 4RW
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e: bristolcentral@hydrock.com

CLIENT
READING BOROUGH COUNCIL

PROJECT
DWYER ROAD

TITLE
PRE-DEVELOPMENT CATCHMENT PLAN

HYDROCK PROJECT NO. C-26888-C		SCALE @ A1 1:200	
STATUS DESCRIPTION PLANNING			STATUS S2
DRAWING NO. (PROJECT CODE-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER) 26888-HYD-00-ZZ-SK-C-7710			REVISION P02



- NOTES
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 - All levels are shown in metres above Ordnance Datum (m AOD).

PO2	UPDATED TO SUIT NEW SITE LAYOUT				
	N. PARAJULI	27/11/23	G. HARDWICK	27/11/23	J.CANDY
PO6	UPDATED TO SUIT NEW SITE LAYOUT				
	D.WEBB	05/10/23	D.WEBB	05/10/23	J.MAGEE
PO5	UPDATED TO SUIT NEW SITE LAYOUT				
	J.SHIMMIN	01/09/23	D.WEBB	02/05/23	J.MAGEE
PO4	UPDATED TO SUIT NEW SITE LAYOUT				
	D.WEBB	21/08/23	J.MAGEE	21/08/23	J.MAGEE
PO3	UPDATED TO SUIT NEW SITE LAYOUT				
	D.WEBB	18/04/23	J.MAGEE	18/04/23	J.MAGEE
PO2	UPDATED TO SUIT NEW SITE LAYOUT				
	J.SHIMMIN	27/03/23	J.MAGEE	27/03/23	J.MAGEE
PO1	PRELIMINARY ISSUE				
	J.NEAL-LONG	22/02/23	J.MAGEE	22/02/23	J.MAGEE
REV	REVISION NOTES/COMMENTS				
	DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY



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PROJECT

DWYER ROAD

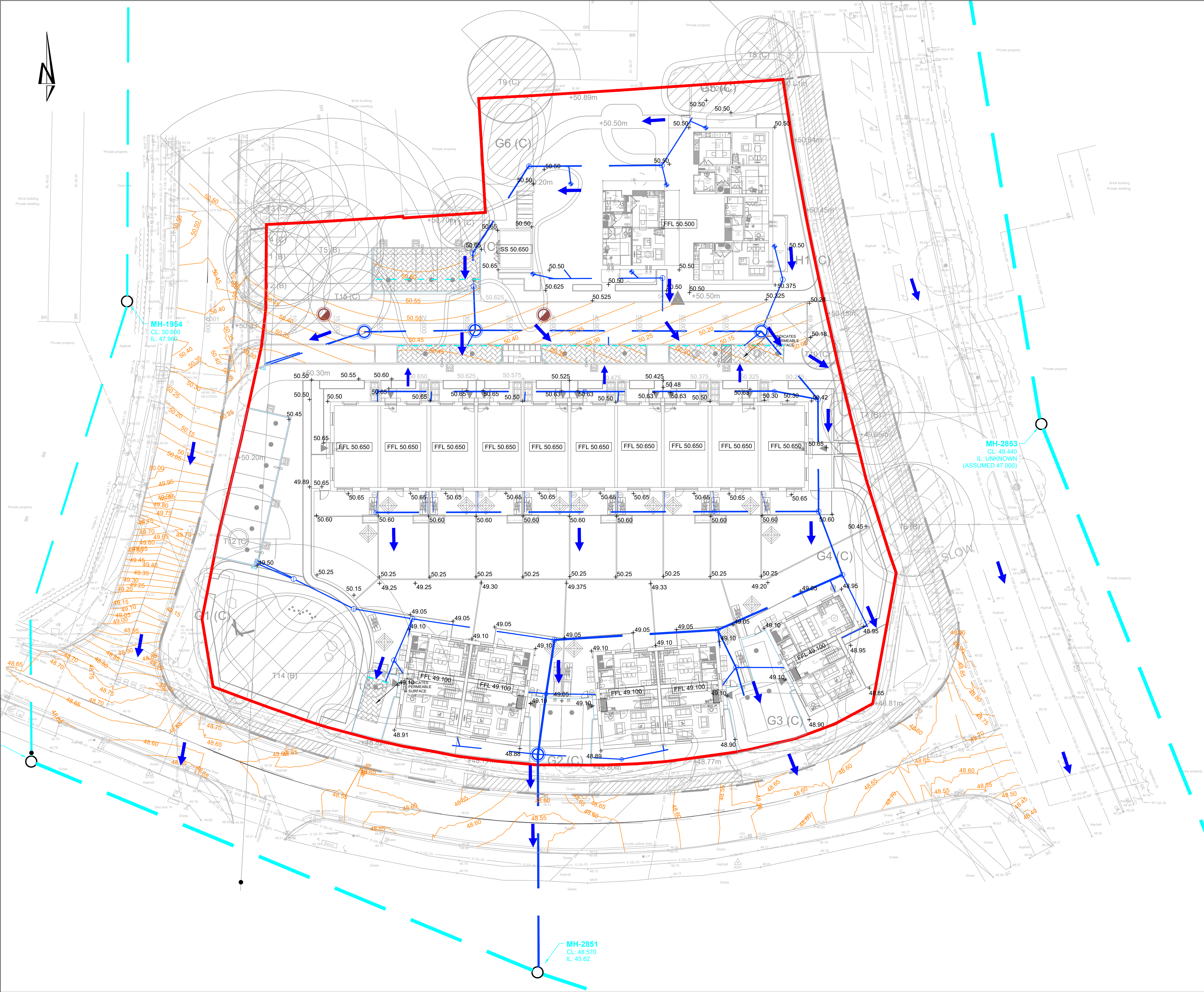
TITLE

POST-DEVELOPMENT CATCHMENT PLAN

HYDROCK PROJECT NO. C-26888-C	SCALE @ A1 1:200	
STATUS DESCRIPTION PLANNING		STATUS S2
DRAWING NO. (PROJECT CODE-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER) 26888-HYD-00-ZZ-SK-C-7720		REVISION P06

Appendix G

26888-HYD-00-ZZ-SK-C-7730 Overland Flow Route Plan



- KEY PLAN
- NOTES
- All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing.
 - The DWG file is issued for the purposes of coordination only and do not represent formal drawing issue and are not to be reprinted in any form. Formal issue of drawings is via DWF, Adobe PDF files and/or hard copies and their associated information issue sheets.
 - Note that all care has been taken with the export of DWG files and their content, but we recommend that you make due dimensional checks before using any DWG file information. Any errors found are to be reported to Hydrock immediately.
 - All levels are shown in metres above Ordnance Datum (m AOD).

LEGEND

- PROPOSED PRIVATE STORM WATER SEWER
- PRIVATE CELLULAR STORAGE SOAKAWAY
- TANKED PERMEABLE PAVING TO BS7533-13:2009
- OVERLAND FLOW ROUTE
- PROPOSED SPOT LEVEL
- PROPOSED ROAD CONTOUR
- FINISHED FLOOR LEVEL
- EXISTING PUBLIC FOUL SEWER
- EXISTING PUBLIC STORM SEWER

P04	UPDATED TO SUIT NEW SITE LAYOUT				
	N. PARAUILI	27/11/23	G. HARDWICK	27/11/23	J. CANDY
P03	UPDATED TO SUIT STAGE 3B MASTERPLAN				
	D.WEBB	05/10/23	J.MAGEE	05/10/23	J.MAGEE
P02	PRELIMINARY ISSUE				
	D.WEBB	18/04/23	J.MAGEE	18/04/23	J.MAGEE
P01	PRELIMINARY ISSUE				
	O.LAUNCHBURY	27/03/23	J.MAGEE	27/03/23	J.MAGEE
REV	REVISION NOTES/COMMENTS				
	DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY

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PROJECT

DWYER ROAD

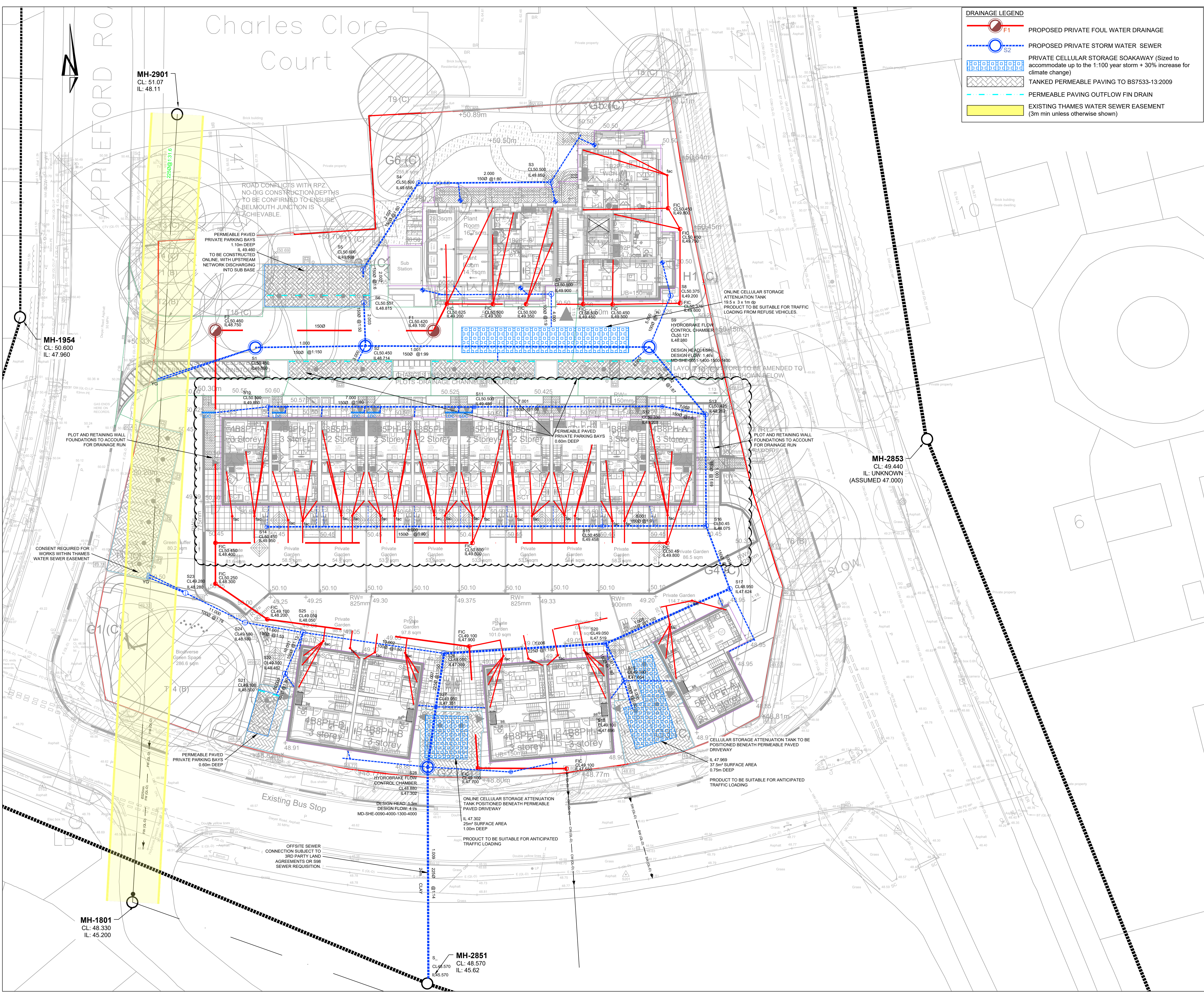
TITLE

OVERLAND FLOW ROUTE PLAN

HYDROCK PROJECT NO. C-26888-C		SCALE @ A1 1:200	
STATUS DESCRIPTION PLANNING			STATUS S2
DRAWING NO. (PROJECT CODE-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER) 26888-HYD-00-ZZ-SK-C-7730			REVISION P04

Appendix H

26888-HYD-00-ZZ-DR-C-7010 Drainage Strategy



DRAINAGE LEGEND

- PROPOSED PRIVATE FOUL WATER DRAINAGE
- PROPOSED PRIVATE STORM WATER SEWER
- PRIVATE CELLULAR STORAGE SOAKAWAY (Sized to accommodate up to the 1:100 year storm + 30% increase for climate change)
- TANKED PERMEABLE PAVING TO BS7533-13:2009
- PERMEABLE PAVING OUTFLOW FIN DRAIN
- EXISTING THAMES WATER SEWER EASEMENT (3m min unless otherwise shown)

- NOTES
- All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing.
 - The DWG file is issued for the purposes of coordination only and does not represent formal drawing issue and are not to be reprinted in any form. Formal issue of drawings is via DWF, Adobe PDF files and/or hard copies and their associated information issue sheets.
 - Note that all care has been taken with the export of DWG files and their content, but we recommend that you make due dimensional checks before using any DWG file information. Any errors found are to be reported to Hydrock immediately.
 - Levels shown in metres above Ordnance Datum (mAOD).
 - All private drainage to comply with current Building Regulations, BS EN-752 Drain and Sewer systems outside Buildings and other relevant British Standards and Codes of Practices.
 - All external drainage within trafficked areas with less than 1.2m cover to have type Z concrete bed and surround. All external drainage within landscaped areas with cover less than 0.6m to have type Z concrete bed and surround. All drainage with greater cover than the minimum required to have type S bed and surround.
 - All drainage to be laid soffit to soffit unless otherwise shown.
 - The Contractor is to verify the line, level and diameter of existing sewers before commencing drainage works.
 - All foul drainage to be minimum 100mm diameter, all surface water drainage to be minimum 150mm diameter unless otherwise shown.
 - Cover levels shown on this drawing refer to approximate surface levels. It is the contractors responsibility to ensure that access covers and frames are set at the final surface levels.
 - Where possible the contractor is to orientate manhole biscuits and covers to locate them parallel to kerbs and paving.
 - The Contractor should comply with hsl(g) 47 "Avoiding Danger from Underground Services" when excavating around existing services.
 - It is the contractors responsibility to determine the location and depth of all existing services, mains and cables prior to construction.
 - Contractor to provide temporary screens in each of the down stream manholes during the construction period of the development in accordance with SFA 2.9.10 and the local sewerage undertakers requirements.
 - All in-situ concrete and precast concrete components to be manufactured using Sulphate Resisting Portland Cement, (SRPC) to BS 4027, if required, subject to soil conditions. Manhole components to be to BS EN 1917:2002.
 - All ironwork to be kite marked by BSI or certified by equal inspection authority.
 - All redundant connections to be capped off and grouted from the down stream manhole.
 - All new drainage pipes to be jetted, CCTV surveyed with DVD recording and any defects highlighted to the supervising officer. Following the rectification of any defects, the drain is to be re-surveyed with CCTV and the recordings made available to the project manager/engineer.
 - Prior to commencing the works the contractor is to confirm details of the existing drainage system as noted on the drawing.
 - Prior to commencing the works the contractor is to undertake the drainage investigation work as noted on the drawing.

P09	UPDATED TO SUIT LOWERED FFL'S (SEE REV CLOUDS)				
	J.SHIMMIN	25/07/24	M.STEWART	25/07/24	M.STEWART
P08	UPDATED TO SUIT LATEST ARCHITECTS LAYOUT				
	G.HARDWICK	17/11/23	G.HARDWICK	17/11/23	G.HARDWICK
P07	UPDATED TO SUIT LATEST LANDSCAPE ARCHITECTS LAYOUT				
	J.SHIMMIN	04/09/23	D.WEBB	04/09/23	J.MAGEE
P06	ISSUED FOR STAGE 3B				
	J.SHIMMIN	17.07.23	D.WEBB	17.07.23	J.MAGEE
P05	UPDATED TO SUIT LANDSCAPE ARCHITECT COMMENTS				
	D. WEBB	18.04.23	J.MAGEE	18.04.23	J.MAGEE
P04	UPDATED TO SUIT LATEST MASTERPLAN				
	D. WEBB	18.04.23	J.MAGEE	18.04.23	J.MAGEE
P03	SUITABLE FOR STAGE 3				
	D. WEBB	06.04.23	J.MAGEE	06.04.23	J.MAGEE
REVISION NOTES/COMMENTS					
DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE

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TITLE

DRAINAGE STRATEGY

HYDROCK PROJECT NO.	SCALE @ A1	STATUS
C-26888-C	1:200	
STATUS DESCRIPTION		S3
SUITABLE FOR STAGE 3B		
DRAWING NO. (PROJECT CODE-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER)		REVISION
26888-HYD-00-ZZ-DR-C-7010		

Appendix I

Existing Brownfield Runoff Calculations

Equivalent Greenfield Rate Calculations

Surface Water Network Calculations

Foul Water Network Calculations

DETERMINATION OF PEAK DISCHARGE RATE USING MODIFIED RATIONAL METHOD

(based on The Wallingford Procedure, Volume 4)

Peak Discharge Rate Calculation

		USER INPUT	CALCULATED OUTPUT
A	0.167 ha	Catchment Area	
T	1 year	Return Period	
D	30 min	Storm Duration	
C	0.98	Runoff Coefficient	
C _V	0.75		
C _R	1.3		
M5-60min	18.6 mm	From Figure A.1	(can be obtained from Microdrainage)
r	0.40	From Figure A.2	(can be obtained from Microdrainage)
Z1	0.8	From Figure A.3a or A.3b for r values between 0.12 and 0.45 From Table A1 for England, Table A2 for Scotland and Northern Ireland	
Z2	0.62		
M5-D	14.88 mm		
MT-D	9.2 mm	Design Rainfall Depth	
ARF	1	From Figure A.4	
i	18 mm/hr	Rainfall Intensity	
Q_p	0.008 m³/sec 8.3 litres/sec	Peak Discharge Rate	

DETERMINATION OF PEAK DISCHARGE RATE USING MODIFIED RATIONAL METHOD

(based on The Wallingford Procedure, Volume 4)

Peak Discharge Rate Calculation

A	0.167	ha	Catchment Area	USER INPUT
T	30	year	Return Period	CALCULATED OUTPUT
D	30	min	Storm Duration	
C	0.98		Runoff Coefficient	
C _V	0.75			
C _R	1.3			
M5-60min	18.6	mm	From Figure A.1	(can be obtained from Microdrainage)
r	0.4		From Figure A.2	(can be obtained from Microdrainage)
Z1	0.8		From Figure A.3a or A.3b for r values between 0.12 and 0.45	
Z2	1.53		From Table A1 for England, Table A2 for Scotland and Northern Ireland	
M5-D	14.88	mm		
MT-D	22.8	mm	Design Rainfall Depth	
ARF	1		From Figure A.4	
i	46	mm/hr	Rainfall Intensity	
Q _p	0.021	m ³ /sec	Peak Discharge Rate	
	20.6	litres/sec		

DETERMINATION OF PEAK DISCHARGE RATE USING MODIFIED RATIONAL METHOD

(based on The Wallingford Procedure, Volume 4)

Peak Discharge Rate Calculation

A	0.167	ha	Catchment Area	USER INPUT
T	100	year	Return Period	CALCULATED OUTPUT
D	30	min	Storm Duration	
C	0.98		Runoff Coefficient	
C _V	0.75			
C _R	1.3			
M5-60min	18.6	mm	From Figure A.1	(can be obtained from Microdrainage)
r	0.4		From Figure A.2	(can be obtained from Microdrainage)
Z1	0.8		From Figure A.3a or A.3b for r values between 0.12 and 0.45	
Z2	1.99		From Table A1 for England, Table A2 for Scotland and Northern Ireland	
M5-D	14.88	mm		
MT-D	29.6	mm	Design Rainfall Depth	
ARF	1		From Figure A.4	
i	59	mm/hr	Rainfall Intensity	
Q _p	0.027	m ³ /sec	Peak Discharge Rate	
	26.8	litres/sec		

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Date 27/11/2023 13:53	Designed by NishaParajuli	
File	Checked by	
Innovyze	Source Control 2020.1.3	
<u>ICP SUDS Mean Annual Flood</u> Input Return Period (years) 100 Soil 0.150 Area (ha) 0.492 Urban 0.000 SAAR (mm) 700 Region Number Region 6 Results 1/s QBAR Rural 0.2 QBAR Urban 0.2 Q100 years 0.6 Q1 year 0.2 Q30 years 0.5 Q100 years 0.6		
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.	Dwyer Road	
.	Surface Water Drainage	
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Date 17/11/2023 12:19	Designed by G Hardwick	
File 26888-HYD-XX-XX-CA-C-0001.MDX	Checked by	
Innovyze	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.500	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.145	4-8	0.101

Total Area Contributing (ha) = 0.246

Total Pipe Volume (m³) = 7.451

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	12.845	0.086	150.0	0.021	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.000	15.384	0.192	80.0	0.023	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	11.978	0.150	80.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.002	3.854	0.693	5.6	0.002	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.003	5.068	0.101	50.0	0.008	0.00	0.0	0.600	o	150	Pipe/Conduit	
S3.000	2.618	1.236	2.1	0.012	5.00	0.0	0.600	o	100	Pipe/Conduit	
S1.001	33.120	0.334	99.2	0.020	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.26	48.850	0.021	0.0	0.0	0.0	0.82	14.5	2.8
S2.000	50.00	5.23	49.850	0.023	0.0	0.0	0.0	1.12	19.9	3.1
S2.001	50.00	5.41	49.658	0.023	0.0	0.0	0.0	1.12	19.9	3.1
S2.002	50.00	5.42	49.508	0.025	0.0	0.0	0.0	4.30	76.0	3.4
S2.003	50.00	5.48	48.815	0.033	0.0	0.0	0.0	1.43	25.2	4.4
S3.000	50.00	5.01	50.000	0.012	0.0	0.0	0.0	5.36	42.1	1.6
S1.001	50.00	6.03	48.714	0.085	0.0	0.0	0.0	1.01	17.8	11.6

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. . .	Dwyer Road Surface Water Drainage	
Date 17/11/2023 12:19 File 26888-HYD-XX-XX-CA-C-0001.MDX	Designed by G Hardwick Checked by	
Innovyze	Network 2020.1.3	

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S4.000	13.004	1.420	9.2	0.010	5.00	0.0	0.600	o	100	Pipe/Conduit	
S5.000	6.483	0.720	9.0	0.009	5.00	0.0	0.600	o	100	Pipe/Conduit	
S6.000	2.673	1.095	2.4	0.007	5.00	0.0	0.600	o	100	Pipe/Conduit	
S1.002	10.235	0.118	86.6	0.009	0.00	0.0	0.600	o	150	Pipe/Conduit	
S7.000	29.102	0.364	80.0	0.015	5.00	0.0	0.600	o	150	Pipe/Conduit	
S7.001	22.220	0.278	80.0	0.011	0.00	0.0	0.600	o	150	Pipe/Conduit	
S7.002	5.127	0.947	5.4	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.003	12.975	0.187	69.5	0.003	0.00	0.0	0.600	o	150	Pipe/Conduit	
S8.000	39.336	0.492	80.0	0.020	5.00	0.0	0.600	o	150	Pipe/Conduit	
S8.001	12.087	1.383	8.7	0.009	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.004	7.841	0.376	20.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.005	15.766	0.105	150.0	0.005	0.00	0.0	0.600	o	225	Pipe/Conduit	
S9.000	3.394	0.042	80.0	0.008	5.00	0.0	0.600	o	150	Pipe/Conduit	
S9.001	4.831	0.060	80.0	0.005	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.006	18.935	0.126	150.0	0.008	0.00	0.0	0.600	o	225	Pipe/Conduit	
S10.000	3.002	0.038	80.0	0.003	5.00	0.0	0.600	o	100	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S4.000	50.00	5.08	49.900	0.010	0.0	0.0	0.0	2.57	20.2	1.4
S5.000	50.00	5.04	49.200	0.009	0.0	0.0	0.0	2.59	20.4	1.2
S6.000	50.00	5.01	49.525	0.007	0.0	0.0	0.0	4.99	39.2	0.9
S1.002	50.00	6.18	48.380	0.120	0.0	0.0	0.0	1.08	19.1	16.2
S7.000	50.00	5.43	49.850	0.015	0.0	0.0	0.0	1.12	19.9	2.0
S7.001	50.00	5.76	49.486	0.026	0.0	0.0	0.0	1.12	19.9	3.5
S7.002	50.00	5.78	49.208	0.026	0.0	0.0	0.0	4.36	77.0	3.5
S1.003	50.00	6.36	48.262	0.149	0.0	0.0	0.0	1.21	21.3	20.2
S8.000	50.00	5.58	49.950	0.020	0.0	0.0	0.0	1.13	19.9	2.7
S8.001	50.00	5.64	49.458	0.028	0.0	0.0	0.0	3.43	60.6	3.9
S1.004	50.00	6.42	48.075	0.178	0.0	0.0	0.0	2.22	39.1	24.1
S1.005	50.00	6.67	47.624	0.183	0.0	0.0	0.0	1.07	42.4	24.7
S9.000	50.00	5.05	47.696	0.008	0.0	0.0	0.0	1.12	19.9	1.1
S9.001	50.00	5.12	47.654	0.013	0.0	0.0	0.0	1.12	19.9	1.7
S1.006	50.00	6.97	47.519	0.203	0.0	0.0	0.0	1.07	42.4	27.5
S10.000	50.00	5.06	48.500	0.003	0.0	0.0	0.0	0.86	6.8	0.4

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. . .	Dwyer Road Surface Water Drainage	
Date 17/11/2023 12:19 File 26888-HYD-XX-XX-CA-C-0001.MDX	Designed by G Hardwick Checked by	
Innovyze	Network 2020.1.3	

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S10.001	5.232	0.412	12.7	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S11.000	7.764	0.100	77.6	0.009	5.00	0.0	0.600	o	100	Pipe/Conduit	
S11.001	6.864	0.130	52.8	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S10.002	16.633	0.332	50.1	0.005	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.007	6.307	0.042	150.0	0.004	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.008	7.274	0.048	150.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.009	24.465	1.732	14.1	0.022	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S10.001	50.00	5.10	48.462	0.003	0.0	0.0	0.0	2.18	17.1	0.4
S11.000	50.00	5.15	48.280	0.009	0.0	0.0	0.0	0.87	6.9	1.2
S11.001	50.00	5.26	48.180	0.009	0.0	0.0	0.0	1.06	8.3	1.2
S10.002	50.00	5.51	48.050	0.016	0.0	0.0	0.0	1.09	8.6	2.2
S1.007	50.00	7.06	47.393	0.224	0.0	0.0	0.0	1.07	42.4	30.3
S1.008	50.00	7.18	47.351	0.224	0.0	0.0	0.0	1.07	42.4	30.3
S1.009	50.00	7.29	47.302	0.246	0.0	0.0	0.0	3.50	139.2	33.3



Micro
Drainage

Innovyze	Network 2020.1.3
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MH Name	MH	MH	MH	MH	Pipe Out			Pipes In			Backdrop (mm)
	CL (m)	Depth (m)	Connection	Diam.,L*W (mm)	PN	Invert Level (m)	Diameter (mm)	PN	Invert Level (m)	Diameter (mm)	
S1	50.450	1.600	Open Manhole	1350	S1.000	48.850	150				
S3	50.500	0.650	Open Manhole	450	S2.000	49.850	150				
S4	50.500	0.842	Open Manhole	450	S2.001	49.658	150	S2.000	49.658	150	
S5	50.600	1.092	Open Manhole	600	S2.002	49.508	150	S2.001	49.508	150	
S6	50.550	1.735	Open Manhole	600	S2.003	48.815	150	S2.002	48.815	150	
S6	50.450	0.450	Open Manhole	450	S3.000	50.000	100				
S2	50.450	1.736	Open Manhole	1200	S1.001	48.714	150	S1.000	48.764	150	50
								S2.003	48.714	150	
								S3.000	48.764	100	
S7	50.500	0.600	Open Manhole	450	S4.000	49.900	100				
S8	50.375	1.175	Open Manhole	450	S5.000	49.200	100				
S10	50.125	0.600	Open Manhole	450	S6.000	49.525	100				
S9	50.125	1.745	Open Manhole	1200	S1.002	48.380	150	S1.001	48.380	150	
								S4.000	48.480	100	50
								S5.000	48.480	100	50
								S6.000	48.430	100	
S10	50.500	0.650	Open Manhole	450	S7.000	49.850	150				
S11	50.500	1.014	Open Manhole	450	S7.001	49.486	150	S7.000	49.486	150	
S12	50.300	1.092	Open Manhole	450	S7.002	49.208	150	S7.001	49.208	150	
S13	50.420	2.158	Open Manhole	600	S1.003	48.262	150	S1.002	48.262	150	
								S7.002	48.262	150	
S14	50.600	0.650	Open Manhole	450	S8.000	49.950	150				
S15	50.600	1.142	Open Manhole	450	S8.001	49.458	150	S8.000	49.458	150	
S16	50.600	2.525	Open Manhole	600	S1.004	48.075	150	S1.003	48.075	150	
								S8.001	48.075	150	
S17	48.950	1.326	Open Manhole	600	S1.005	47.624	225	S1.004	47.699	150	
S18	49.100	1.404	Open Manhole	450	S9.000	47.696	150				
S19	49.100	1.446	Open Manhole	450	S9.001	47.654	150	S9.000	47.654	150	
S20	49.050	1.531	Open Manhole	600	S1.006	47.519	225	S1.005	47.519	225	
								S9.001	47.594	150	
S21	49.100	0.600	Open Manhole	450	S10.000	48.500	100				
S22	49.100	0.638	Open Manhole	450	S10.001	48.462	100	S10.000	48.462	100	
S23	49.280	1.000	Open Manhole	450	S11.000	48.280	100				
S24	49.180	1.000	Open Manhole	450	S11.001	48.180	100	S11.000	48.180	100	
S25	49.050	1.000	Open Manhole	450	S10.002	48.050	100	S10.001	48.050	100	
								S11.001	48.050	100	
S26	49.050	1.657	Open Manhole	600	S1.007	47.393	225	S1.006	47.393	225	
								S10.002	47.718	100	200
S27	49.050	1.699	Open Manhole	600	S1.008	47.351	225	S1.007	47.351	225	
S28	48.880	1.578	Open Manhole	1350	S1.009	47.302	225	S1.008	47.302	225	
SMH-2851	48.570	3.000	Open Manhole	0		OUTFALL		S1.009	45.570	225	

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Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S1	468208.804	171896.605	468208.804	171896.605	Required	
S3	468243.251	171915.880	468243.251	171915.880	Required	
S4	468227.867	171915.762	468227.867	171915.762	Required	
S5	468221.366	171905.701	468221.366	171905.701	Required	
S6	468221.468	171901.848	468221.468	171901.848	Required	
S6	468220.442	171894.459	468220.442	171894.459	Required	
S2	468221.648	171896.783	468221.648	171896.783	Required	
S7	468243.324	171902.832	468243.324	171902.832	Required	
S8	468257.244	171902.645	468257.244	171902.645	Required	
S10	468253.154	171894.523	468253.154	171894.523	Required	
S9	468254.767	171896.654	468254.767	171896.654	Required	
S10	468204.953	171889.723	468204.953	171889.723	Required	
S11	468234.055	171889.623	468234.055	171889.623	Required	
S12	468256.274	171889.737	468256.274	171889.737	Required	
S13	468261.312	171888.786	468261.312	171888.786	Required	
S14	468209.959	171875.689	468209.959	171875.689	Required	
S15	468249.295	171875.782	468249.295	171875.782	Required	
S16	468261.382	171875.810	468261.382	171875.810	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S17	468264.135	171868.469	468264.135	171868.469	Required	
S18	468252.758	171854.486	468252.758	171854.486	Required	
S19	468251.823	171857.748	468251.823	171857.748	Required	
S20	468249.715	171862.096	468249.715	171862.096	Required	
S21	468211.171	171855.788	468211.171	171855.788	Required	
S22	468212.265	171858.583	468212.265	171858.583	Required	
S23	468200.644	171867.989	468200.644	171867.989	Required	
S24	468207.595	171864.532	468207.595	171864.532	Required	
S25	468214.361	171863.376	468214.361	171863.376	Required	
S26	468230.815	171860.938	468230.815	171860.938	Required	
S27	468229.862	171854.703	468229.862	171854.703	Required	
S28	468228.884	171847.496	468228.884	171847.496	Required	
SMH-2851	468228.984	171823.030			No Entry	

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	150	S1	50.450	48.850	1.450	Open Manhole	1350
S2.000	o	150	S3	50.500	49.850	0.500	Open Manhole	450
S2.001	o	150	S4	50.500	49.658	0.692	Open Manhole	450
S2.002	o	150	S5	50.600	49.508	0.942	Open Manhole	600
S2.003	o	150	S6	50.550	48.815	1.585	Open Manhole	600
S3.000	o	100	S6	50.450	50.000	0.350	Open Manhole	450
S1.001	o	150	S2	50.450	48.714	1.586	Open Manhole	1200
S4.000	o	100	S7	50.500	49.900	0.500	Open Manhole	450
S5.000	o	100	S8	50.375	49.200	1.075	Open Manhole	450
S6.000	o	100	S10	50.125	49.525	0.500	Open Manhole	450
S1.002	o	150	S9	50.125	48.380	1.595	Open Manhole	1200
S7.000	o	150	S10	50.500	49.850	0.500	Open Manhole	450
S7.001	o	150	S11	50.500	49.486	0.864	Open Manhole	450
S7.002	o	150	S12	50.300	49.208	0.942	Open Manhole	450
S1.003	o	150	S13	50.420	48.262	2.008	Open Manhole	600

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	12.845	150.0	S2	50.450	48.764	1.536	Open Manhole	1200
S2.000	15.384	80.0	S4	50.500	49.658	0.692	Open Manhole	450
S2.001	11.978	80.0	S5	50.600	49.508	0.942	Open Manhole	600
S2.002	3.854	5.6	S6	50.550	48.815	1.585	Open Manhole	600
S2.003	5.068	50.0	S2	50.450	48.714	1.586	Open Manhole	1200
S3.000	2.618	2.1	S2	50.450	48.764	1.586	Open Manhole	1200
S1.001	33.120	99.2	S9	50.125	48.380	1.595	Open Manhole	1200
S4.000	13.004	9.2	S9	50.125	48.480	1.545	Open Manhole	1200
S5.000	6.483	9.0	S9	50.125	48.480	1.545	Open Manhole	1200
S6.000	2.673	2.4	S9	50.125	48.430	1.595	Open Manhole	1200
S1.002	10.235	86.6	S13	50.420	48.262	2.008	Open Manhole	600
S7.000	29.102	80.0	S11	50.500	49.486	0.864	Open Manhole	450
S7.001	22.220	80.0	S12	50.300	49.208	0.942	Open Manhole	450
S7.002	5.127	5.4	S13	50.420	48.262	2.008	Open Manhole	600
S1.003	12.975	69.5	S16	50.600	48.075	2.375	Open Manhole	600

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd	Diam	MH	C.Level	I.Level	D.Depth	MH	MH DIAM., L*W
	Sect	(mm)	Name	(m)	(m)	(m)	Connection	(mm)
S8.000	o	150	S14	50.600	49.950	0.500	Open Manhole	450
S8.001	o	150	S15	50.600	49.458	0.992	Open Manhole	450
S1.004	o	150	S16	50.600	48.075	2.375	Open Manhole	600
S1.005	o	225	S17	48.950	47.624	1.101	Open Manhole	600
S9.000	o	150	S18	49.100	47.696	1.254	Open Manhole	450
S9.001	o	150	S19	49.100	47.654	1.296	Open Manhole	450
S1.006	o	225	S20	49.050	47.519	1.306	Open Manhole	600
S10.000	o	100	S21	49.100	48.500	0.500	Open Manhole	450
S10.001	o	100	S22	49.100	48.462	0.538	Open Manhole	450
S11.000	o	100	S23	49.280	48.280	0.900	Open Manhole	450
S11.001	o	100	S24	49.180	48.180	0.900	Open Manhole	450
S10.002	o	100	S25	49.050	48.050	0.900	Open Manhole	450
S1.007	o	225	S26	49.050	47.393	1.432	Open Manhole	600
S1.008	o	225	S27	49.050	47.351	1.474	Open Manhole	600
S1.009	o	225	S28	48.880	47.302	1.353	Open Manhole	1350

Downstream Manhole

PN	Length	Slope	MH	C.Level	I.Level	D.Depth	MH	MH DIAM., L*W
	(m)	(1:X)	Name	(m)	(m)	(m)	Connection	(mm)
S8.000	39.336	80.0	S15	50.600	49.458	0.992	Open Manhole	450
S8.001	12.087	8.7	S16	50.600	48.075	2.375	Open Manhole	600
S1.004	7.841	20.9	S17	48.950	47.699	1.101	Open Manhole	600
S1.005	15.766	150.0	S20	49.050	47.519	1.306	Open Manhole	600
S9.000	3.394	80.0	S19	49.100	47.654	1.296	Open Manhole	450
S9.001	4.831	80.0	S20	49.050	47.594	1.306	Open Manhole	600
S1.006	18.935	150.0	S26	49.050	47.393	1.432	Open Manhole	600
S10.000	3.002	80.0	S22	49.100	48.462	0.538	Open Manhole	450
S10.001	5.232	12.7	S25	49.050	48.050	0.900	Open Manhole	450
S11.000	7.764	77.6	S24	49.180	48.180	0.900	Open Manhole	450
S11.001	6.864	52.8	S25	49.050	48.050	0.900	Open Manhole	450
S10.002	16.633	50.1	S26	49.050	47.718	1.232	Open Manhole	600
S1.007	6.307	150.0	S27	49.050	47.351	1.474	Open Manhole	600
S1.008	7.274	150.0	S28	48.880	47.302	1.353	Open Manhole	1350
S1.009	24.465	14.1	SMH-2851	48.570	45.570	2.775	Open Manhole	0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.021	0.021	0.021
2.000	User	-	100	0.023	0.023	0.023
2.001	-	-	100	0.000	0.000	0.000
2.002	User	-	100	0.002	0.002	0.002
2.003	User	-	100	0.008	0.008	0.008
3.000	User	-	100	0.012	0.012	0.012
1.001	User	-	100	0.020	0.020	0.020
4.000	User	-	100	0.010	0.010	0.010
5.000	User	-	100	0.009	0.009	0.009
6.000	User	-	100	0.007	0.007	0.007
1.002	User	-	100	0.009	0.009	0.009
7.000	User	-	100	0.015	0.015	0.015
7.001	User	-	100	0.011	0.011	0.011
7.002	-	-	100	0.000	0.000	0.000
1.003	User	-	100	0.003	0.003	0.003
8.000	User	-	100	0.020	0.020	0.020
8.001	User	-	100	0.009	0.009	0.009
1.004	-	-	100	0.000	0.000	0.000
1.005	User	-	100	0.005	0.005	0.005
9.000	User	-	100	0.008	0.008	0.008
9.001	User	-	100	0.005	0.005	0.005
1.006	User	-	100	0.008	0.008	0.008
10.000	User	-	100	0.003	0.003	0.003
10.001	-	-	100	0.000	0.000	0.000
11.000	User	-	100	0.009	0.009	0.009
11.001	-	-	100	0.000	0.000	0.000
10.002	User	-	100	0.005	0.005	0.005
1.007	User	-	100	0.004	0.004	0.004
1.008	-	-	100	0.000	0.000	0.000
1.009	User	-	100	0.007	0.007	0.007
	User	-	100	0.009	0.009	0.016
	User	-	100	0.006	0.006	0.022
				Total	Total	Total
				0.246	0.246	0.246

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.009	SMH-2851	48.570	45.570	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 2 Number of Storage Structures 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.500	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S9, DS/PN: S1.002, Volume (m³): 2.7

Unit Reference	MD-SHE-0051-1400-1500-1400
Design Head (m)	1.500
Design Flow (l/s)	1.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	51
Invert Level (m)	48.380
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	1.4	Kick-Flo®	0.452	0.8
Flush-Flo™	0.224	1.0	Mean Flow over Head Range	-	1.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.9	0.800	1.1	2.000	1.6	4.000	2.2	7.000	2.8
0.200	1.0	1.000	1.2	2.200	1.7	4.500	2.3	7.500	2.9
0.300	1.0	1.200	1.3	2.400	1.7	5.000	2.4	8.000	3.0
0.400	0.9	1.400	1.4	2.600	1.8	5.500	2.5	8.500	3.1
0.500	0.9	1.600	1.4	3.000	1.9	6.000	2.6	9.000	3.2
0.600	0.9	1.800	1.5	3.500	2.1	6.500	2.7	9.500	3.3

Hydro-Brake® Optimum Manhole: S28, DS/PN: S1.009, Volume (m³): 2.5

Unit Reference	MD-SHE-0090-4000-1300-4000
Design Head (m)	1.300
Design Flow (l/s)	4.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	90
Invert Level (m)	47.302
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.300	4.0	Kick-Flo®	0.796	3.2
Flush-Flo™	0.388	4.0	Mean Flow over Head Range	-	3.5

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.8	0.400	4.0	0.800	3.2	1.400	4.1	2.000	4.9
0.200	3.7	0.500	3.9	1.000	3.5	1.600	4.4	2.200	5.1
0.300	3.9	0.600	3.8	1.200	3.9	1.800	4.7	2.400	5.3

Hydro-Brake® Optimum Manhole: S28, DS/PN: S1.009, Volume (m³): 2.5

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
2.600	5.5	4.000	6.8	5.500	7.9	7.000	8.8	8.500	9.7
3.000	5.9	4.500	7.1	6.000	8.2	7.500	9.1	9.000	9.9
3.500	6.3	5.000	7.5	6.500	8.5	8.000	9.4	9.500	10.2

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Storage Structures for Storm

Porous Car Park Manhole: S6, DS/PN: S2.003

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.8
Membrane Percolation (mm/hr)	1000	Length (m)	12.3
Max Percolation (l/s)	16.4	Slope (1:X)	80.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	49.950	Membrane Depth (mm)	100

Cellular Storage Manhole: S9, DS/PN: S1.002

Invert Level (m)	48.355	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	58.5	0.0	1.000	58.5	0.0	1.001	0.0	0.0

Cellular Storage Manhole: S18, DS/PN: S9.000

Invert Level (m)	47.696	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	37.5	0.0	0.750	37.5	0.0	0.751	0.0	0.0

Porous Car Park Manhole: S21, DS/PN: S10.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	2.5
Membrane Percolation (mm/hr)	1000	Length (m)	5.0
Max Percolation (l/s)	3.5	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	48.500	Membrane Depth (mm)	100

Cellular Storage Manhole: S28, DS/PN: S1.009

Invert Level (m)	47.302	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	25.0	0.0	1.000	25.0	0.0	1.001	0.0	0.0

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 2 Number of Storage Structures 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.600 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.400 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status ON
 DVD Status OFF
 Inertia Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth
									(m)	(m)
S1.000	S1	15 Winter	1	+0%	30/15 Summer				48.896	-0.104
S2.000	S3	15 Winter	1	+0%	100/15 Winter				49.891	-0.109
S2.001	S4	15 Winter	1	+0%	100/15 Summer				49.699	-0.109
S2.002	S5	15 Winter	1	+0%	100/15 Summer				49.532	-0.126
S2.003	S6	15 Winter	1	+0%	30/15 Summer				48.857	-0.108
S3.000	S6	15 Winter	1	+0%					50.014	-0.086
S1.001	S2	15 Winter	1	+0%	30/15 Summer				48.794	-0.070
S4.000	S7	15 Winter	1	+0%					49.917	-0.083
S5.000	S8	15 Winter	1	+0%	100/120 Winter				49.217	-0.083
S6.000	S10	15 Winter	1	+0%	100/180 Winter				49.536	-0.089
S1.002	S9	180 Winter	1	+0%	1/120 Winter				48.545	0.015
S7.000	S10	15 Winter	1	+0%					49.882	-0.118
S7.001	S11	15 Winter	1	+0%					49.527	-0.109
S7.002	S12	15 Winter	1	+0%					49.230	-0.128
S1.003	S13	15 Winter	1	+0%	100/15 Summer				48.307	-0.105
S8.000	S14	15 Winter	1	+0%					49.986	-0.114
S8.001	S15	15 Winter	1	+0%					49.483	-0.125
S1.004	S16	15 Winter	1	+0%	100/15 Summer				48.122	-0.103
S1.005	S17	15 Winter	1	+0%	30/30 Winter				47.693	-0.156
S9.000	S18	60 Winter	1	+0%	30/60 Winter				47.708	-0.138
S9.001	S19	15 Winter	1	+0%	30/30 Summer				47.674	-0.130
S1.006	S20	15 Winter	1	+0%	30/15 Summer				47.593	-0.151
S10.000	S21	30 Winter	1	+0%					48.513	-0.087
S10.001	S22	30 Winter	1	+0%					48.470	-0.093
S11.000	S23	15 Winter	1	+0%					48.309	-0.071
S11.001	S24	15 Winter	1	+0%	100/15 Winter				48.206	-0.074
S10.002	S25	15 Winter	1	+0%	100/15 Summer				48.081	-0.069
S1.007	S26	60 Winter	1	+0%	30/15 Summer				47.528	-0.089
S1.008	S27	60 Winter	1	+0%	30/15 Summer				47.525	-0.050
S1.009	S28	60 Winter	1	+0%	30/15 Summer				47.522	-0.005

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flooded		Half Drain		Pipe	Status	Level Exceeded
		Volume (m ³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)		
S1.000	S1	0.000	0.20			2.6	OK	
S2.000	S3	0.000	0.16			3.0	OK	
S2.001	S4	0.000	0.16			3.0	OK	
S2.002	S5	0.000	0.06			3.2	OK	
S2.003	S6	0.000	0.16		5	3.2	OK	
S3.000	S6	0.000	0.05			1.5	OK	
S1.001	S2	0.000	0.55			9.4	OK	
S4.000	S7	0.000	0.07			1.3	OK	
S5.000	S8	0.000	0.06			1.2	OK	
S6.000	S10	0.000	0.03			0.8	OK	
S1.002	S9	0.000	0.06		130	1.0	SURCHARGED	
S7.000	S10	0.000	0.10			1.9	OK	
S7.001	S11	0.000	0.17			3.1	OK	
S7.002	S12	0.000	0.05			3.1	OK	
S1.003	S13	0.000	0.19			3.8	OK	
S8.000	S14	0.000	0.13			2.5	OK	
S8.001	S15	0.000	0.06			3.5	OK	
S1.004	S16	0.000	0.21			7.1	OK	
S1.005	S17	0.000	0.20			7.6	OK	
S9.000	S18	0.000	0.02		34	0.2	OK	
S9.001	S19	0.000	0.04			0.6	OK	
S1.006	S20	0.000	0.24			9.1	OK	
S10.000	S21	0.000	0.04		12	0.2	OK	
S10.001	S22	0.000	0.02			0.2	OK	
S11.000	S23	0.000	0.18			1.1	OK	
S11.001	S24	0.000	0.15			1.1	OK	
S10.002	S25	0.000	0.21			1.7	OK	
S1.007	S26	0.000	0.24			7.1	OK	
S1.008	S27	0.000	0.22			6.9	OK	
S1.009	S28	0.000	0.03		34	3.8	OK	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 2 Number of Storage Structures 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.600 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.400 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status ON
 DVD Status OFF
 Inertia Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH		Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth
	Name	Storm							(m)	(m)
S1.000	S1	15 Winter	30	+0%	30/15 Summer				49.142	0.142
S2.000	S3	15 Winter	30	+0%	100/15 Winter				49.916	-0.084
S2.001	S4	15 Winter	30	+0%	100/15 Summer				49.725	-0.083
S2.002	S5	15 Winter	30	+0%	100/15 Summer				49.547	-0.111
S2.003	S6	15 Winter	30	+0%	30/15 Summer				49.143	0.178
S3.000	S6	15 Winter	30	+0%					50.023	-0.077
S1.001	S2	15 Winter	30	+0%	30/15 Summer				49.122	0.258
S4.000	S7	15 Winter	30	+0%					49.928	-0.072
S5.000	S8	15 Winter	30	+0%	100/120 Winter				49.227	-0.073
S6.000	S10	15 Winter	30	+0%	100/180 Winter				49.543	-0.082
S1.002	S9	240 Winter	30	+0%	1/120 Winter				48.894	0.364
S7.000	S10	15 Winter	30	+0%					49.900	-0.100
S7.001	S11	15 Winter	30	+0%					49.557	-0.079
S7.002	S12	15 Winter	30	+0%					49.245	-0.113
S1.003	S13	15 Winter	30	+0%	100/15 Summer				48.340	-0.072
S8.000	S14	15 Winter	30	+0%					50.009	-0.091
S8.001	S15	15 Winter	30	+0%					49.499	-0.109
S1.004	S16	15 Winter	30	+0%	100/15 Summer				48.156	-0.069
S1.005	S17	60 Winter	30	+0%	30/30 Winter				47.897	0.048
S9.000	S18	60 Winter	30	+0%	30/60 Winter				47.850	0.004
S9.001	S19	60 Winter	30	+0%	30/30 Summer				47.860	0.056
S1.006	S20	60 Winter	30	+0%	30/15 Summer				47.886	0.142
S10.000	S21	15 Winter	30	+0%					48.526	-0.074
S10.001	S22	15 Winter	30	+0%					48.477	-0.085
S11.000	S23	15 Winter	30	+0%					48.327	-0.053
S11.001	S24	15 Winter	30	+0%	100/15 Winter				48.222	-0.058
S10.002	S25	15 Winter	30	+0%	100/15 Summer				48.107	-0.043

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flooded		Half Drain		Pipe	Status	Level Exceeded
		Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)		
S1.000	S1	0.000	0.47			6.2	SURCHARGED	
S2.000	S3	0.000	0.40			7.3	OK	
S2.001	S4	0.000	0.40			7.3	OK	
S2.002	S5	0.000	0.15			7.9	OK	
S2.003	S6	0.000	0.49		4	9.8	SURCHARGED	
S3.000	S6	0.000	0.12			3.7	OK	
S1.001	S2	0.000	1.32			22.6	SURCHARGED	
S4.000	S7	0.000	0.17			3.2	OK	
S5.000	S8	0.000	0.16			2.9	OK	
S6.000	S10	0.000	0.07			2.1	OK	
S1.002	S9	0.000	0.06			1.0	SURCHARGED	
S7.000	S10	0.000	0.24			4.6	OK	
S7.001	S11	0.000	0.44			8.2	OK	
S7.002	S12	0.000	0.13			8.2	OK	
S1.003	S13	0.000	0.52			10.1	OK	
S8.000	S14	0.000	0.32			6.1	OK	
S8.001	S15	0.000	0.16			8.9	OK	
S1.004	S16	0.000	0.56			19.0	OK	
S1.005	S17	0.000	0.30			11.1	SURCHARGED	
S9.000	S18	0.000	0.13		31	1.7	SURCHARGED	
S9.001	S19	0.000	0.11			1.7	SURCHARGED	
S1.006	S20	0.000	0.31			11.9	SURCHARGED	
S10.000	S21	0.000	0.15		7	0.8	OK	
S10.001	S22	0.000	0.05			0.8	OK	
S11.000	S23	0.000	0.44			2.7	OK	
S11.001	S24	0.000	0.36			2.7	OK	
S10.002	S25	0.000	0.59			4.8	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

										Water	Surcharged	Flooded
US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth	Volume	
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)	(m)	(m³)	
S1.007	S26 60	Winter	30	+0%	30/15	Summer			47.883	0.266	0.000	
S1.008	S27 60	Winter	30	+0%	30/15	Summer			47.881	0.305	0.000	
S1.009	S28 60	Winter	30	+0%	30/15	Summer			47.878	0.351	0.000	

										Half Drain	Pipe
US/MH			Flow /	Overflow	Time	Flow			Level		
PN	Name	Cap.	(l/s)	(mins)	(l/s)	Status	Exceeded				
S1.007	S26	0.47			14.1	SURCHARGED					
S1.008	S27	0.45			13.9	SURCHARGED					
S1.009	S28	0.03			4.0	SURCHARGED					

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 2 Number of Storage Structures 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.600 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.400 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status ON
 DVD Status OFF
 Inertia Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH		Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth
	Name	Storm							(m)	(m)
S1.000	S1	15 Winter	100	+40%	30/15 Summer				49.960	0.960
S2.000	S3	15 Winter	100	+40%	100/15 Winter				50.091	0.091
S2.001	S4	15 Winter	100	+40%	100/15 Summer				50.034	0.226
S2.002	S5	15 Winter	100	+40%	100/15 Summer				49.987	0.329
S2.003	S6	15 Winter	100	+40%	30/15 Summer				49.964	0.999
S3.000	S6	15 Winter	100	+40%					50.032	-0.068
S1.001	S2	15 Winter	100	+40%	30/15 Summer				49.927	1.063
S4.000	S7	15 Winter	100	+40%					49.938	-0.062
S5.000	S8	360 Winter	100	+40%	100/120 Winter				49.858	0.558
S6.000	S10	360 Winter	100	+40%	100/180 Winter				49.858	0.233
S1.002	S9	360 Winter	100	+40%	1/120 Winter				49.858	1.328
S7.000	S10	15 Winter	100	+40%					49.920	-0.080
S7.001	S11	15 Winter	100	+40%					49.590	-0.046
S7.002	S12	15 Winter	100	+40%					49.259	-0.099
S1.003	S13	15 Winter	100	+40%	100/15 Summer				48.529	0.117
S8.000	S14	15 Winter	100	+40%					50.033	-0.067
S8.001	S15	15 Winter	100	+40%					49.514	-0.094
S1.004	S16	15 Winter	100	+40%	100/15 Summer				48.410	0.185
S1.005	S17	120 Winter	100	+40%	30/30 Winter				48.311	0.462
S9.000	S18	120 Winter	100	+40%	30/60 Winter				48.304	0.458
S9.001	S19	120 Winter	100	+40%	30/30 Summer				48.305	0.501
S1.006	S20	120 Winter	100	+40%	30/15 Summer				48.306	0.562
S10.000	S21	15 Winter	100	+40%					48.537	-0.063
S10.001	S22	15 Winter	100	+40%					48.484	-0.079
S11.000	S23	15 Winter	100	+40%					48.349	-0.031
S11.001	S24	120 Winter	100	+40%	100/15 Winter				48.306	0.026
S10.002	S25	120 Winter	100	+40%	100/15 Summer				48.305	0.155

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flooded		Half Drain		Pipe		Level Exceeded
		Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)	Status	
S1.000	S1	0.000	0.66			8.6	SURCHARGED	
S2.000	S3	0.000	0.72			13.3	SURCHARGED	
S2.001	S4	0.000	0.65			11.8	SURCHARGED	
S2.002	S5	0.000	0.24			12.3	SURCHARGED	
S2.003	S6	0.000	0.71		6	14.3	SURCHARGED	
S3.000	S6	0.000	0.22			6.8	OK	
S1.001	S2	0.000	1.94			33.3	SURCHARGED	
S4.000	S7	0.000	0.31			5.8	OK	
S5.000	S8	0.000	0.04			0.7	SURCHARGED	
S6.000	S10	0.000	0.02			0.5	FLOOD RISK	
S1.002	S9	0.000	0.08			1.4	FLOOD RISK	
S7.000	S10	0.000	0.43			8.3	OK	
S7.001	S11	0.000	0.79			14.9	OK	
S7.002	S12	0.000	0.24			14.8	OK	
S1.003	S13	0.000	0.82			16.0	SURCHARGED	
S8.000	S14	0.000	0.57			11.1	OK	
S8.001	S15	0.000	0.29			16.1	OK	
S1.004	S16	0.000	0.91			30.7	SURCHARGED	
S1.005	S17	0.000	0.33			12.3	SURCHARGED	
S9.000	S18	0.000	0.10			1.3	SURCHARGED	
S9.001	S19	0.000	0.09			1.3	SURCHARGED	
S1.006	S20	0.000	0.27			10.1	SURCHARGED	
S10.000	S21	0.000	0.29		8	1.6	OK	
S10.001	S22	0.000	0.10			1.6	OK	
S11.000	S23	0.000	0.79			5.0	OK	
S11.001	S24	0.000	0.21			1.6	SURCHARGED	
S10.002	S25	0.000	0.37			3.0	SURCHARGED	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

										Water	Surcharged	Flooded
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)	Depth (m)	Volume (m³)	
S1.007	S26	120 Winter	100	+40%	30/15 Summer				48.301	0.683	0.000	
S1.008	S27	120 Winter	100	+40%	30/15 Summer				48.298	0.722	0.000	
S1.009	S28	120 Winter	100	+40%	30/15 Summer				48.295	0.768	0.000	

				Half Drain	Pipe		
	US/MH	Flow /	Overflow	Time	Flow		Level
PN	Name	Cap.	(l/s)	(mins)	(l/s)	Status	Exceeded
S1.007	S26	0.44			13.2	SURCHARGED	
S1.008	S27	0.42			13.1	SURCHARGED	
S1.009	S28	0.03			4.0	SURCHARGED	

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FOUL SEWERAGE DESIGN

Design Criteria for Foul - Main

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00	Add Flow / Climate Change (%)	0
Industrial Peak Flow Factor	0.00	Minimum Backdrop Height (m)	0.200
Flow Per Person (l/per/day)	222.00	Maximum Backdrop Height (m)	1.500
Persons per House	3.00	Min Design Depth for Optimisation (m)	1.200
Domestic (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	0.75
Domestic Peak Flow Factor	6.00	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.000	2.796	0.050	55.9	0.000	0	0.0	1.500	o	100	Pipe/Conduit	
F1.001	8.652	0.150	57.7	0.000	0	0.0	1.500	o	100	Pipe/Conduit	
F1.002	7.874	0.100	78.7	0.000	0	0.0	1.500	o	100	Pipe/Conduit	
F1.003	3.437	0.050	68.7	0.000	0	0.0	1.500	o	100	Pipe/Conduit	
F1.004	6.643	0.100	66.4	0.000	0	0.0	1.500	o	100	Pipe/Conduit	
F1.005	3.637	0.050	73.4	0.000	0	0.0	1.500	o	100	Pipe/Conduit	
F1.006	5.597	0.100	56.0	0.000	0	0.0	1.500	o	100	Pipe/Conduit	
F1.007	3.494	0.050	69.9	0.000	6	0.0	1.500	o	100	Pipe/Conduit	
F1.008	25.438	0.350	72.7	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F1.009	24.788	0.350	70.8	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F2.000	22.708	0.300	75.7	0.000	4	0.0	1.500	o	100	Pipe/Conduit	
F2.001	29.988	1.200	25.0	0.000	6	0.0	1.500	o	100	Pipe/Conduit	
F1.010	4.761	0.100	47.6	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F1.011	7.337	0.100	73.4	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F1.012	23.776	0.300	79.3	0.000	2	0.0	1.500	o	150	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.000	49.800	0.000	0.0	0	0.0	0	0.00	0.89	7.0	0.0
F1.001	49.750	0.000	0.0	0	0.0	0	0.00	0.88	6.9	0.0
F1.002	49.600	0.000	0.0	0	0.0	0	0.00	0.75	5.9	0.0
F1.003	49.500	0.000	0.0	0	0.0	0	0.00	0.80	6.3	0.0
F1.004	49.450	0.000	0.0	0	0.0	0	0.00	0.82	6.4	0.0
F1.005	49.350	0.000	0.0	0	0.0	0	0.00	0.78	6.1	0.0
F1.006	49.300	0.000	0.0	0	0.0	0	0.00	0.89	7.0	0.0
F1.007	49.200	0.000	0.0	6	0.0	15	0.39	0.80	6.3	0.3
F1.008	49.100	0.000	0.0	6	0.0	13	0.36	1.03	18.2	0.3
F1.009	48.750	0.000	0.0	6	0.0	13	0.36	1.04	18.4	0.3
F2.000	49.950	0.000	0.0	4	0.0	12	0.33	0.76	6.0	0.2
F2.001	49.650	0.000	0.0	10	0.0	15	0.65	1.34	10.5	0.5
F1.010	48.400	0.000	0.0	16	0.0	19	0.57	1.27	22.5	0.7
F1.011	48.300	0.000	0.0	16	0.0	21	0.49	1.02	18.1	0.7
F1.012	48.200	0.000	0.0	18	0.0	23	0.50	0.98	17.4	0.8

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Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F3.000	26.523	0.500	53.0	0.000	3	0.0	1.500	o	100	Pipe/Conduit	
F1.013	14.223	0.200	71.1	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F1.014	10.342	0.150	68.9	0.000	0	0.0	1.500	o	150	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F3.000	48.450	0.000	0.0	3	0.0	10	0.34	0.91	7.2	0.1
F1.013	47.900	0.000	0.0	21	0.0	24	0.54	1.04	18.4	1.0
F1.014	47.700	0.000	0.0	21	0.0	24	0.55	1.06	18.7	1.0

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Manhole Schedules for Foul - Main

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
FIC1	50.450	0.650	Open Manhole	450	F1.000	49.800	100				
FIC2	50.450	0.700	Open Manhole	450	F1.001	49.750	100	F1.000	49.750	100	
FIC3	50.375	0.775	Open Manhole	450	F1.002	49.600	100	F1.001	49.600	100	
FIC4	50.450	0.950	Open Manhole	450	F1.003	49.500	100	F1.002	49.500	100	
FIC5	50.500	1.050	Open Manhole	450	F1.004	49.450	100	F1.003	49.450	100	
FIC6	50.500	1.150	Open Manhole	600	F1.005	49.350	100	F1.004	49.350	100	
FIC7	50.500	1.200	Open Manhole	600	F1.006	49.300	100	F1.005	49.300	100	
FIC8	50.625	1.425	Open Manhole	600	F1.007	49.200	100	F1.006	49.200	100	
F1	50.420	1.320	Open Manhole	1350	F1.008	49.100	150	F1.007	49.150	100	
F2	50.460	1.710	Open Manhole	1200	F1.009	48.750	150	F1.008	48.750	150	
FIC9	50.600	0.650	Open Manhole	600	F2.000	49.950	100				
FIC10	50.600	0.950	Open Manhole	600	F2.001	49.650	100	F2.000	49.650	100	
FIC11	50.600	2.200	Open Manhole	600	F1.010	48.400	150	F1.009	48.400	150	
								F2.001	48.450	100	
FIC12	50.250	1.950	Open Manhole	600	F1.011	48.300	150	F1.010	48.300	150	
FIC13	49.100	0.900	Open Manhole	600	F1.012	48.200	150	F1.011	48.200	150	
FAC1	49.050	0.600	Open Manhole	225	F3.000	48.450	100				
FIC14	49.100	1.200	Open Manhole	600	F1.013	47.900	150	F1.012	47.900	150	
								F3.000	47.950	100	
FIC15	49.100	1.400	Open Manhole	600	F1.014	47.700	150	F1.013	47.700	150	
FIC16	49.100	1.550	Open Manhole	600		OUTFALL		F1.014	47.550	150	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
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FIC1	468256.949	171912.837	468256.949	171912.837	Required	
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FIC2	468258.340	171910.412	468258.340	171910.412	Required	
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FIC3	468258.340	171901.760	468258.340	171901.760	Required	
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FIC4	468250.468	171901.632	468250.468	171901.632	Required	
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FIC5	468247.031	171901.670	468247.031	171901.670	Required	
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FIC6	468240.388	171901.660	468240.388	171901.660	Required	
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FIC7	468236.752	171901.747	468236.752	171901.747	Required	
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Manhole Schedules for Foul - Main

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
FIC8	468231.155	171901.685	468231.155	171901.685	Required	
F1	468229.580	171898.567	468229.580	171898.567	Required	
F2	468204.142	171898.610	468204.142	171898.610	Required	
FIC9	468256.840	171873.819	468256.840	171873.819	Required	
FIC10	468234.132	171873.820	468234.132	171873.820	Required	
FIC11	468204.145	171873.822	468204.145	171873.822	Required	
FIC12	468204.145	171869.061	468204.145	171869.061	Required	
FIC13	468210.196	171864.911	468210.196	171864.911	Required	
FAC1	468259.740	171867.084	468259.740	171867.084	Required	
FIC14	468233.761	171861.743	468233.761	171861.743	Required	
FIC15	468234.762	171847.555	468234.762	171847.555	Required	
FIC16	468245.103	171847.501			No Entry	

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Area Summary for Foul - Main

Pipe Number	Gross Area (ha)	Pipe Total (ha)
1.000	0.000	0.000
1.001	0.000	0.000
1.002	0.000	0.000
1.003	0.000	0.000
1.004	0.000	0.000
1.005	0.000	0.000
1.006	0.000	0.000
1.007	0.000	0.000
1.008	0.000	0.000
1.009	0.000	0.000
2.000	0.000	0.000
2.001	0.000	0.000
1.010	0.000	0.000
1.011	0.000	0.000
1.012	0.000	0.000
3.000	0.000	0.000
1.013	0.000	0.000
1.014	0.000	0.000
	Total	Total
	0.000	0.000

Free Flowing Outfall Details for Foul - Main

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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F1.014	FIC16	49.100	47.550	0.000	600	0
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Simulation Criteria for Foul - Main

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	0	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.500	Storm Duration (mins)	30
Ratio R	0.400		