



Drainage Strategy Calculations for The Orchard, Huyton

Prepared for Alderley Group Ltd

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1. INTRODUCTION

1.1. *General*

1.1.1. This report has been prepared on instruction received from Alderley Group Ltd and relates to the proposed development The Orchard, Huyton.

1.1.2. The report outlines the initial drainage design philosophy in relation to the proposed development.

1.1.3. This report is prepared solely for the benefit of the Client. This report may not be assigned without prior written permission from Clancy Consulting.

1.1.4. This report is for Planning Application purposes only and does not constitute a construction-ready design.

1.2. *Report Structure*

1.2.1. The drainage strategy will provide justification of the discharge method in accordance with the National Planning Practical Guidance, considering the following (in order of preference), with evidence provided where possible;

1. Discharge by Infiltration
2. Discharge to Watercourse
3. Discharge to Surface Water Sewer
4. Discharge to Combined Sewer

1.2.2. The drainage strategy will discuss proposed SUDs techniques and comply with the 'Non-Statutory Technical Standards for Sustainable Drainage Systems'

1.2.3. Sources of information:

- Lead Local Flood Authority Surface Water Management Guidance.
- Non-statutory technical standards for sustainable drainage systems.
- Public Sewer Records.
- Topographical Survey.
- Architectural Drawings.
- National Library of Scotland for Historic Maps
- Google

2. LOCAL POLICY

Full details are found in the LLFA's surface water management guidance report and supporting information. In summary this indicates:

- Consideration of the site area should be made together with EA flood maps to determine the flood zone and whether a Flood Risk Assessment is required.
- Drainage Strategy should follow SUDS hierarchy – i.e. in preferential order – Use on Site*, Infiltration, Watercourse, Surface Water Sewer, Combined Sewer. Infiltration tests are required to demonstrate whether a soakaway is feasible. It should be noted that Utilities companies also apply this strictly and detailed consideration of the hierarchy will need to be demonstrated in supporting documentation.
- Appropriate discharge rates should be calculated for the 30 and 100 year flood events for use in drainage design. In line with NPPF this should be attenuated to greenfield rates for greenfield sites/ site area and as close as possible to greenfield rates for brownfield areas (50% betterment on existing). Climate change should be considered appropriately.
- A conceptual drainage layout should be prepared indicating runoff areas and calculations provided including attenuation. Interceptors/ filtration may also be deemed appropriate in accordance with SUDS hierarchy/ guidance.
- Calculations should show no flooding during the 1 in 30 year storm events and flooding in the 1 in 100 year storm event (plus climate change) is held on the development and without being detrimental to property.

3. SUSTAINABLE URBAN DRAINAGE SYSTEMS (SUDS)

Any new drainage for the development should be designed in accordance with the non-statutory technical guidance for the design of sustainable drainage systems.

3.1. *Surface Water Disposal Hierarchy*

3.1.1. The disposal of surface water should be considered in the following order of priority;

1. Discharge to be used on site.
2. Infiltration into the subsoil via soakaways or permeable paving.
3. Discharge to a water course or the sea.
4. Discharge to a surface water sewer.
5. Discharge to a combined sewer.

3.1.2. If it is not possible to use discharge on site or discharge to a soakaway, then surface water should be controlled with the use of Sustainable Drainage Systems (SuDS) and considered using the SuDS Hierarchy.

Most Sustainable	SUDS technique	Flood Reduction	Pollution Reduction	Landscape & Wildlife Benefit
	Living roofs	✓	✓	✓
	Basins and ponds - Constructed wetlands - Balancing ponds - Detention basins - Retention ponds	✓	✓	✓
	Filter strips and swales	✓	✓	✓
	Infiltration devices - soakaways - infiltration trenches and basins	✓	✓	✓
	Permeable surfaces and filter drains - gravelled areas - solid paving blocks - porous paviers	✓	✓	
	Tanked systems - over-sized pipes/tanks - storm cells	✓		
	Least Sustainable			

Table 1 - SuDS Hierarchy (Environment Agency)

3.2. *Disposal Strategy*

3.2.1. Use on Site

Under the Design and Construction Guidance document (2020), use of surface water generated on site is now the preferred first option in the SUDS hierarchy.

At this stage, and given the site size, layout and use, positioning of a greywater tank may prove difficult and would require further input from the M&E consultant to determine the feasibility. It would have to be used in conjunction with other options on the SUDS hierarchy as opposed to being the sole option and may only offer a small overall reduction into the existing infrastructure.

3.2.2. Infiltration

It is understood that the ground conditions consist of clays which by their nature, offer little infiltration and for this reason soakaways are not considered feasible.

3.2.3. Discharge to a Water Course

There are no watercourses within the vicinity of the site boundary that would not entail crossing third party land.

3.2.4. Discharge to a Surface Water Sewer

There are no surface water sewer within the vicinity of the development that would not entail crossing third party land. The closest surface water sewer is to the East of the development but would entail passing through private residential gardens.

There are likely to be highway drains in the adopted highway but local authorities do not usually accept discharge from private developments and often they do not have adequate capacity to take the additional discharge of the increased risk of liability from flooding.

3.2.5. Combined/ Foul Sewer

There is a foul sewer which passes through the site along the West boundary, running in a North to South direction. Currently, discharging into this sewer at a controlled rate is currently the most feasible option to be considered with further investigations required.

3.3. SuDS Strategy

3.3.1. Living Roof

A significant area of the site receiving surface water is roof area. A sustainable solution to control run-off at its source is to provide green, blue or brown roof areas. These roof areas retain part of the rainwater, slow down the speed of run-off and also help to reduce water pollution whilst providing a habitat for nature.

Any roof system would impose additional weight onto the roof structure which would need to be designed accordingly to accommodate the additional weight.

This is not currently part of the architects proposals who would need to advise of the end use of the roof before any detailed design could be undertaken.

3.3.2. Ponds/Basins and Swales

There are areas within the grounds to construct a pond but these are not currently part of the architect's scheme. There may be a long term maintenance issue with the pond as the property being developed is not a single family dwelling and may pose safety risks if there are small children living here.

3.3.3. Infiltration/ Permeable Surfaces

As noted in 4.2.2, the ground conditions are likely to be clay and not support infiltration.

Permeable surfaces such as permeable paving such as the resin bound finishes, tree pits and other soft borders can be accommodated and have been proposed to offer some removal of rainwater via vegetation extraction.

3.3.4. Landscaped Areas

There are areas of grass proposed within the development to offer a reduction on the total area taking rainfall.

3.3.5. Tanked System

Typically, a cellular storage crate system or oversized pipes would be considered as a means to provide additional attenuation storage to control rainfall up to 1 in 100 year change events with an allowance for climate change for existing sites undergoing complete redevelopment.

In this instance, the tanked system will be in the form of the chambers and pipes of the system with a flow control fitted downstream – this will act as the primary SuDS arrangement.

3.3.6. Pollution

The development does not contain 50 spaces or an area for parking greater than 800m² therefore a petrol interceptor is not required.

4. DRAINAGE STRATEGY

4.1. *Surface Water Drainage*

- 4.1.1. As the site is currently undeveloped and has remained so for in excess of 12 months, the development reverts to greenfield and a greenfield run off rate of 5l/s is applied.
- 4.1.2. This restricted limited flow will be maintained using flow control systems – in this case an orifice plate.
- 4.1.3. The peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 2 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.
- 4.1.4. Following preliminary assessment by calculation using initial layouts and assumed rainwater pipe locations, the development will require an approximate total of 154 cubic metres of storage provided by the attenuation tank. Storage is provided for storm events up to and including 1 in 100 year plus climate change.
- 4.1.5. If flood waters in the 1 in 100 year plus climate change could be held above ground within the car park – as allowed – then the storage volume could reduced further. Further level information would be required to ensure this flood water is contained on the development and away from property.
- 4.1.6. This is currently a theoretical design based on the information we have been provided to date and will require confirmation of assumptions made (including invert level of the outfall of the existing sewer) – which will be undertaken during detailed design.
- 4.1.7. Outline proposals are shown on the Drainage Strategy drawing located in Appendix A.
- 4.1.8. Preliminary calculations have been included in the Appendix B.

4.2. Development Foul Water Drainage

- 4.2.1. Foul water will be collected in a separate system to surface water. This will be collected via pipes & inspection chambers.
- 4.2.2. All proposed below ground foul water drainage will comply with Building Regulations Part H:2010, BS EN 12056-2:2000 and BS EN 752:2008.
- 4.2.3. The proposed foul sewer system has been designed to handle this flow rate.
- 4.2.4. United Utilities approval for the flow rate entering the public sewer will be required to proceed with detailed design.

4.3. Flood Risk within the Development

- 4.3.1. As per Environment Agency Flood Maps, the development is currently in Flood Zone One with a low probability of flooding. Very low risk of Surface Water Flooding and from Rivers and Seas.
- 4.3.2. The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event.
- 4.3.3. The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.
- 4.3.4. The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100-year rainfall event are managed in exceedance routes that minimise the risks to people and property.
- 4.3.5. Initial architectural levels have been designed to be sympathetic to the existing levels with no vast areas of landscaping resulting in significant or abrupt level changes.
- 4.3.6. Architectural levels will be designed such that in the event of a more extreme rainfall event water will discharge away from buildings.

5. **MAINTENANCE & CONSTRUCTION**

5.1. *Maintenance Considerations*

- 5.1.1 This section is intended to give an overview of the operation and maintenance for the drainage features included with the drainage strategy and in relation to typical details.
- 5.1.2 Where proprietary products are specified, the manufacturer's instructions and recommendations should be followed in priority to this document unless specifically noted otherwise due to project constraints.
- 5.1.3 The surface water network has been designed to accommodate the 1 in 100-year storm rainfall event plus an allowance for climate change particular to the requirements of the development.
- 5.1.4 As the flows are generally being attenuated on site, there will be a period after storm events where the network is still partially or fully surcharged and is draining down.
- 5.1.5 Where this surcharging is still present after 48hrs appropriate action should be taken.
- 5.1.6 A suitable maintenance strategy should be adopted to ensure the drainage network is cleaned regularly and the routine maintenance and cleansing regime should be documented.
- 5.1.7 No large shrubs should be planted over any geocellular tanks within 3m in all directions and 6m from small/ medium specimen tree planting. Larger trees should not be planted within 20m of the tanks.
- 5.1.8 It is advisable that above ground signage is installed detailing size and depth of any below ground structures to make any future works manageable.
- 5.1.9 It is assumed that the maintenance of the drainage network will be the responsibility of an on-site facilities management team.
- 5.1.10 A copy of the final construction drainage layout should be provided in the final Operations and Maintenance Manual.
- 5.1.11 It is recommended that the drainage system is inspected as a minimum twice a year, with the system also being inspected after any major storm event.
- 5.1.12 Significant sediment deposition is likely in areas used for storage, so a post clean-up operation may be required including the removal of litter, vegetation, sewerage debris and larger objects.
- 5.1.13 Long-term management practices include monthly sweeping of external paved areas. The sweeping program will remove sand and contaminants directly from paved surfaces before they become mobilised during storm events and transported to the drainage system.

- 5.1.14 During the winter months, drainage features such as gullies and channels should be cleared of ice, snow, debris or litter.
- 5.1.15 Sediment/material removal should be undertaken in consultation with the environmental regulator to confirm appropriate protocols; especially where run-off is taken from potentially contaminated areas such as the filter drains and the upstream/downstream chambers.
- 5.1.16 Pumping should only be used to facilitate drainage for those parts of the site where it is not reasonably practicable to drain water by gravity.

5.2. Construction

- 5.2.1 Components must be designed to ensure structural integrity of the drainage system and any adjacent structures or infrastructure under anticipated loading conditions over the design life of the development taking into account the requirement for reasonable levels of maintenance.
- 5.2.2 Damage to the drainage system resulting from associated construction activities must be minimised and must be rectified before the drainage system is considered to be completed.
- 5.2.3 The materials, including products, components, fittings or naturally occurring materials, which are specified by the designer, must be of a suitable nature and quality for their intended use.
- 5.2.4 The detailed design of the system and product selection for the storage and pipe solution will be made at the detailed design stage when all the site constraints can be considered. There are numerous products available for storage of water below ground and care will be needed to ensure that the right product is chosen for the final loading conditions.

6. CONCLUSIONS AND RECOMMENDATIONS

- 1.1. This report gives details of the Drainage Strategy which has been undertaken in relation to the proposed redevelopment at The Orchard, Huyton.
- 1.2. The existing site is predominantly a maintained grassed area with an area of vegetation. No existing connections off the development have been currently confirmed.
- 1.3. The proposed development provides an opportunity to reduce local area flood risk by controlling surface water on site. Following the SuDS and water disposal hierarchy it has been determined the most viable solution will be to control surface water using flow controls and stored on site in an attenuation tank before being discharged to the public sewer system at a controlled rate.
- 1.4. The proposed development is such that there is no option for infiltration, although some of the area is proposed to be free draining through the existing pathway of the grass and proposed permeable paving.
- 1.5. There are no watercourses or surface water sewers within close proximity that wouldn't entail crossing third party land.
- 1.6. The proposed system will be designed to control surface water run-off for all storms up to and including the 100 year plus climate change event. Water will be stored on site below ground before being discharged at the agreed flow rate. Final run-off rates will be dependent on approval by United Utilities
- 1.7. A total of 154 cubic metres of attenuation storage is required for the for the development, with additional volume on offer from the pipes and chambers.
- 1.8. Should existing connections prove inconclusive or inadequate, a new connection will be required from the development into the assumed existing combined sewer with preliminary details shown on the Drainage Strategy drawing. These may require temporary sewer diversions and road closures to form the connection safely.
- 1.9. A Wastewater Pre-Development Enquiry has been submitted to the Local Water Authority for comment on the proposed drainage strategy presented within this report. At the time of writing, no response has been received.
- 1.10. The proposed system will be designed to meet the Sustainable Drainage Systems Non-statutory technical standards for sustainable drainage systems, March 2015.

APPENDIX A

Drainage Strategy Drawing

DESIGN ASSUMED GRAVITY SYSTEM IS POSSIBLE. DESIGN SHOWN IS A CONCEPT ONLY SUBJECT TO CONFIRMATION OF ALL LEVELS (COVER AND INVERT).

EXISTING CONNECTIONS FROM THE SITE TO THE PUBLIC SEWER ARE SUBJECT TO CONFIRMATION AND PROOF OF USE.

ALL EXISTING UNITED UTILITIES INFRASTRUCTURE LEVELS AND SIZES TO BE CONFIRMED.

DRAINAGE NOTES

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT CLANCY CONSULTING, ARCHITECTURAL AND OTHER ENGINEERS DRAWINGS AND SPECIFICATIONS.

DO NOT SCALE THIS DRAWING.

EXISTING DRAINAGE AND LEVELS SHOWN ON THIS DRAWING TO BE CONFIRMED BY THE CONTRACTOR ON SITE PRIOR TO COMMENCEMENT OF THE DRAINAGE WORKS. THE ENGINEER IS TO BE NOTIFIED OF ANY DISCREPANCIES.

COVER LEVELS TO BE CHECKED AGAINST ARCHITECT'S PROPOSED EXTERNAL WORKS LEVEL / DETAIL DRAWINGS.

RWP S/P POSITIONS ARE TO BE CONFIRMED BY ARCHITECT - SET OUT IS TO BE PROVIDED BY THE ARCHITECT.

ALL CONNECTIONS INTO EXISTING SEWERS ARE VIA MANHOLES. ANY SADDLE CONNECTION IS SUBJECT TO CONFIRMATION FROM LOCAL WATER AUTHORITY.

ALL OUTGOING AND INCOMING PIPES AT MANHOLE JUNCTIONS TO BE CONNECTED SMOOTH TO SMOOTH UNLESS SPECIFIED OTHERWISE.

ALL INTERNAL CONNECTIONS TO CONSIST OF STANDARD REST BEND WITH APPROPRIATE ADAPTOR TO CONNECT TO ABOVE GROUND DRAINAGE.

EXTENT OF TREES TO BE REMOVED TBC - DRAINAGE TO BE ADJUSTED ON CONFIRMATION AS REQUIRED.

ALL PAVEMENT ADJACENT TO SORT LANDSCAPING TO BE CONSIDERED FOR REMOVAL. SURFACE WATER TO DRAIN OFF INTO THE LANDSCAPING - KERBS SET FALL AWAY FROM BUILDINGS.

CONNECTION TO NEAREST SUIVU SEWER (WOULD ENTAIL CROSSING THIRD PARTY LAND AND NOT POSSIBLE.

INVERT LEVEL OF TANK SET AT 31.780m

HYDRO-BRAKE FLOW CONTROL (CTL-SHF-0096-6000-1353-5000) RESTRICTED TO 50L/S PER LFLFA GUIDELINES. DESIGN HEAD = 1.353m

GEODELLULAR ATTENUATION TANK SET 0.8M BELOW THE SURFACE AS PER TYPICAL LOADED INSTALLATION DETAILS - 154m³ EVENTS UP TO AND INCLUDING FOR STORM YEAR'S CLIMATE CHANGE - BASED ON 1% AEP 100 YEAR STORM. TANK BASED ON PLAN AREA 16m x 7.2m

SUGGESTED BIN STORE POSITION TO BE RELOCATED TO AVOID EASEMENT

FORM NEW CONNECTION TO UJ SEWER AT NODE 2404. UJ TO CONFIRM DETAILING & WHETHER CWM1 NEEDS TO BE A SET AT LEVEL TO SUIT NODE 2404

ROAD & CAR PARK DRAINAGE TO BE TAKEN DIRECTLY INTO THE ATTENUATION TANK - ALL CULLED PIPES HAVE TO BE SUBJECT TO CONFIRMATION OF LEVELS AND POSITIONING OF GULLIES TO SUIT EASEMENT.

SUGGESTED OVERLAND FLOW BASED ON MINIMAL TOPOGRAPHICAL & PROPOSED LEVEL. INFORMATION AVAILABLE

BACKDROP FROM FW14 TO FW15 AT 32.246m

BACKDROP FROM FW13 TO FW14 AT 32.986m

POP UPS FOR SWP & RWP SUBJECT TO CONFIRMATION - DRAINAGE TO BE ADJUSTED ONCE CONFIRMED AS REQUIRED.

FW11 6000 CL 33.600m TBC IL 32.604m TBC

FW12 6000 CL 33.600m TBC IL 32.487m TBC

FW13 6000 CL 33.600m TBC IL 33.000m TBC

FW14 6000 CL 33.600m TBC IL 32.396m TBC

THE CONTRACTOR MUST ALLOW FOR ANY FEES REQUIRED FOR PERMITS, SEWER CONNECTIONS AND APPLICATIONS.

MANHOLES, RODDING EYES ETC. TO BE ENCASED IN S.R.C.

SULPHATE RESISTANT CEMENT (C20-D02) AND PRECAST CONCRETE PRODUCTS MUST BE USED OR LABORATORY REPORT PROVIDED THAT SUCH PRECAUTIONS ARE NOT NECESSARY.

ALL ADAPTABLE SEWER WORKS AND MATERIAL TO BE IN ACCORDANCE WITH SEWERS FOR ADOPTION 6TH EDITION. THE RELEVANT BRITISH EUROPEAN AND ELECTRICAL SPECIFICATION AND AFTERMARKED.

ALL NEW PIPES UP TO BE V.C. TO BS EN 256-1, 1991 EXTRA STRENGTH GRADE

ALL PIPES TO BE 150 DIA. MIN FALL 1 : 150 (UNO)

STRENGTH OF VITRIFIED CLAY PIPES TO BE 40kN/m FOR 100 - 150mm DIA. 48kN/m BY 225mm DIA AND 74kN/m FOR 300mm DIA. ALL CONCRETE PIPES TO BE CLASS F20 CONCRETE TO BS EN 1916.

IF PLASTIC PIPES ARE TO BE USED, THE FOLLOWING APPLIES:

a. ALL ADAPTABLE SEWERS TO BE BS1 KITEMARKED CERTIFIED WS 4-35-01 AND BS EN 13476

b. BEDDING AND BACKFILL MATERIAL TO CONFORM TO THE REQUIREMENTS OF WATER INDUSTRY SPECIFICATION 448-02 (TABLE A2)

c. ALL CHEMICAL AND CREEP RESISTANCE CERTIFICATION PROVIDED.

SEWER PIPES TO BE Laid IN MAX. 3m LENGTHS UNLESS THERE IS A SPECIFIC OPERATIONAL NEED TO LAY LONGER LENGTHS

SEWERS SHOULD BE Laid IN CLASS 5 BEDDING (150mm GRANULAR BED AND SURROUND), WHERE DEPTH OF COVER AT TOP OF THE SEWER IS LESS THAN 1.2m IN HIGHWAYS AND VERGES (OR LESS THAN 900mm IN NONE VEHICULAR ACCESS AREAS) THEN A CONCRETE SLAB SHOULD BE PROVIDED ABOVE THE GRANULAR BED AND SURROUND.

SEWERS MUST HAVE 5m CLEARANCE FROM TREES AND HEDGES, ALSO REFER TO FIGURE 2.3 ON PAGE 33 IN SEWERS FOR ADOPTION 6TH EDITION FOR RESTRICTIONS ON TREE PLANTING ADJACENT TO SEWERS.

INSPECTION CHAMBERS TO BE PVC 600mm DIA. AT 600mm DEEP MAX. UNLESS INVERTS ARE PROVIDED. ALL PIPES TO BE 150mm DIA. BETWEEN INSPECTION CHAMBERS Laid AT 1:150 UNO, FALL FROM SW/MP/OUTLET TO FIRST INSPECTION CHAMBER TO BE FALLEN TO SUIT.

MANHOLES SHALL BE TYPE 1 OR 2 WITH 120mm DIAMETER OF 150mm DIA. RINGS WITH THE OPENING SITED OVER THE CHANNEL WHERE DEPTH OF COVER TO PRE SOFFITS IS 1-1.15m SHALL BE USED.

MANHOLE COVERS MUST HAVE A CLEAR OPENING OF 600mm AND SHALL BE CLASS D400 TO BS EN 124 WITH 150mm DEEP FRAMES IN HIGHWAY UNO.

COVER SLABS MUST CARRY THE BS1 KITEMARK, WHERE THE CLEAR OPENING OF THE KITEMARKED PRODUCT IS DIFFERENT TO THAT OF THE COVER AND FRAME, A LOAD BEARING SLAB SHOULD BE FITTED ABOVE THE COVER SLAB TO BRING THE SIZE DOWN TO 600x600mm.

THE CHAMBER SIZE OF THE MANHOLES WITH MORE THAN ONE CONNECTION IN THEM MAY NEED TO BE INCREASED IN INCREMENT TO ACCOMMODATE THE CONNECTIONS AND THE BENDS.

PLASTIC CHANNEL SECTIONS IN MANHOLES ARE NOT ACCEPTABLE AND CLAYWARE IS PREFERABLE. PLASTIC CHANNELS ARE DIFFICULT TO SET IN CONCRETE AND A SATISFACTORY FINISH CANNOT BE OBTAINED ON THE BENCHING.

SEWERS SHOULD BE A MINIMUM 1m AND MANHOLES 0.5m FROM KERB FACES AND SERVICE MARGINS WHERE POSSIBLE.

FILLED GROUND MUST BE COMPACTED IN LAYERS OF MAX. 150mm

THE FIRST MANHOLE UPSTREAM FROM THE CONNECTION TO THE PUBLIC SEWER SHOULD WHEN CONSTRUCTED BE FITTED WITH A SCREEN IN ORDER TO PREVENT DEBRIS ENTERING THE PUBLIC SEWER. THE SEWER SHOULD NOT BE REMOVED UNTIL IMMEDIATELY PRIOR TO THE OCCUPATION OF THE PREMISES TO BE SERVED BY THE SEWER.

DO NOT PRICE OR CONSTRUCT FROM THIS DRAWING

THE ORCHARD, HUYTON

COMPLETE CONSTRUCTION (2019) Ltd

Client

Project

Office

Discipline

Title

Scale @ A1

Status

Job Number

Originator

Building/Zone

Level

Type

Discipline

Drawing No.

Revision

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4/8152	CCL	A	DRN
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Type	Discipline	Drawing No.	Revision
DR	C	050	P01

Job Number	Originator	Building/Zone	Level
4/8152	CCL	A	DRN
Type	Discipline	Drawing No.	Revision
DR	C	050	P01

Job Number	Originator	Building/Zone	Level
4/8152	CCL	A	DRN
Type	Discipline	Drawing No.	Revision
DR	C	050	P01

Job Number	Originator	Building/Zone	Level
4/8152	CCL	A	DRN
Type	Discipline	Drawing No.	Revision
DR	C	050	P01

Job Number	Originator	Building/Zone	Level
4/8152	CCL	A	DRN
Type	Discipline	Drawing No.	Revision
DR	C	050	P01

Job Number	Originator	Building/Zone	Level
4/8152	CCL	A	DRN
Type	Discipline	Drawing No.	Revision
DR	C	050	P01

Job Number	Originator	Building/Zone	Level
4/8152	CCL	A	DRN
Type	Discipline	Drawing No.	Revision
DR	C	050	P01

Job Number	Originator	Building/Zone	Level
4/8152	CCL	A	DRN
Type	Discipline	Drawing No.	Revision
DR	C	050	P01

Job Number	Originator	Building/Zone	Level
4/8152	CCL	A	DRN
Type	Discipline	Drawing No.	Revision
DR	C	050	P01

Job Number	Originator	Building/Zone	Level
4/8152	CCL	A	DRN
Type	Discipline	Drawing No.	Revision
DR	C	050	P01

Job Number	Originator	Building/Zone	Level
4/8152	CCL	A	DRN
Type	Discipline	Drawing No.	Revision
DR	C	050	P01

Job Number	Originator	Building/Zone	Level
4/8152	CCL	A	DRN
Type	Discipline	Drawing No.	Revision
DR	C	050	P01

Job Number	Originator	Building/Zone	Level
4/8152	CCL	A	DRN
Type	Discipline	Drawing No.	Revision
DR	C	050	P01

Job Number	Originator	Building/Zone	Level
4/8152	CCL	A	DRN
Type	Discipline	Drawing No.	Revision
DR	C	050	P01

Job Number	Originator	Building/Zone	Level
4/8152	CCL	A	DRN
Type	Discipline	Drawing No.	Revision
DR	C	050	P01

Job Number	Originator	Building/Zone	Level
4/8152	CCL	A	DRN
Type	Discipline	Drawing No.	Revision
DR	C	050	P01

Job Number	Originator	Building/Zone	Level
4/8152	CCL	A	DRN
Type	Discipline	Drawing No.	Revision
DR	C	050	P01

Job Number	Originator	Building/Zone	Level
4/8152	CCL	A	DRN
Type	Discipline	Drawing No.	Revision
DR	C	050	P01

Job Number	Originator	Building/Zone	Level
4/8152	CCL	A	DRN
Type	Discipline	Drawing No.	Revision
DR	C	050	P01

Job Number	Originator	Building/Zone	Level
4/8152	CCL	A	DRN
Type	Discipline	Drawing No.	Revision
DR	C	050	P01

Job Number	Originator	Building/Zone	Level
4/8152	CCL	A	DRN
Type	Discipline	Drawing No.	Revision
DR	C	050	P01

Job Number	Originator	Building/Zone	Level
4/8152	CCL	A	DRN

APPENDIX B

Initial Drainage Model Calculations



Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	1.000	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Adoptable Manhole Type

Max Width (mm)	Diameter (mm)	Max Width (mm)	Diameter (mm)
374	1200	749	1500
499	1350	900	1800

>900 Link+900 mm

Max Depth (m)	Diameter (mm)	Max Depth (m)	Diameter (mm)
1.500	1050	99.999	1200

Circular Link Type

Shape	Circular	Auto Increment (mm)	75
Barrels	1	Follow Ground	x

Available Diameters (mm)

100 | 150 | 225 | 300 | 375 | 450 | 525 | 600

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1		5.00	34.000	600	58.427	84.323	1.000
2	0.033	5.00	34.000	900	38.295	88.284	1.234
3	0.020	5.00	33.800	900	20.638	68.647	1.152
4	0.057	5.00	33.600	1200	19.978	35.314	1.051
5	0.000	5.00	33.600	1200	-1.309	33.993	1.466
6			34.200	1200	-0.515	58.581	2.460
7			34.200	1200	-3.784	65.512	2.482
Depth/Area 1	0.107	5.00	33.600		-0.658	49.020	1.820
9		5.00	33.600	600	42.255	8.581	0.750
10	0.022	5.00	33.600	900	-0.649	7.261	1.074

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	2	23.900	0.600	33.000	32.841	0.159	150.0	150	5.49	50.0
1.001	2	3	26.500	0.600	32.766	32.648	0.118	225.0	225	6.00	50.0
1.002	3	4	22.300	0.600	32.648	32.549	0.099	225.0	225	6.42	50.0
1.003	4	5	9.800	0.600	32.549	32.505	0.044	225.0	225	6.61	50.0
1.004	5	Depth/Area 1	15.041	0.600	32.434	32.372	0.062	242.6	225	6.91	50.0
1.006	6	7	3.300	0.600	31.740	31.718	0.022	150.0	300	7.08	50.0
1.005	Depth/Area 1	6	9.562	0.600	31.780	31.740	0.040	239.1	300	7.07	50.0
2.000	9	10	37.400	0.600	32.850	32.601	0.249	150.0	150	5.76	50.0
2.001	10	5	20.800	0.600	32.526	32.434	0.092	225.0	225	6.16	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.818	14.5	0.0	0.850	1.009	0.000	0.0	0	0.000
1.001	0.867	34.5	6.0	1.009	0.927	0.033	0.0	63	0.651
1.002	0.867	34.5	9.6	0.927	0.826	0.053	0.0	81	0.746
1.003	0.867	34.5	19.9	0.826	0.870	0.110	0.0	123	0.897
1.004	0.835	33.2	23.9	0.941	1.003	0.132	0.0	141	0.906
1.006	1.281	90.6	43.2	2.160	2.182	0.239	0.0	146	1.266
1.005	1.012	71.6	43.2	1.520	2.160	0.239	0.0	168	1.058
2.000	0.818	14.5	0.0	0.600	0.849	0.000	0.0	0	0.000
2.001	0.867	34.5	4.0	0.849	0.941	0.022	0.0	51	0.581

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	23.900	150.0	150	Circular	34.000	33.000	0.850	34.000	32.841	1.009
1.001	26.500	225.0	225	Circular	34.000	32.766	1.009	33.800	32.648	0.927
1.002	22.300	225.0	225	Circular	33.800	32.648	0.927	33.600	32.549	0.826
1.003	9.800	225.0	225	Circular	33.600	32.549	0.826	33.600	32.505	0.870
1.004	15.041	242.6	225	Circular	33.600	32.434	0.941	33.600	32.372	1.003
1.006	3.300	150.0	300	Circular	34.200	31.740	2.160	34.200	31.718	2.182
1.005	9.562	239.1	300	Circular	33.600	31.780	1.520	34.200	31.740	2.160
2.000	37.400	150.0	150	Circular	33.600	32.850	0.600	33.600	32.601	0.849
2.001	20.800	225.0	225	Circular	33.600	32.526	0.849	33.600	32.434	0.941

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	600	Manhole	Adoptable	2	900	Manhole	Adoptable
1.001	2	900	Manhole	Adoptable	3	900	Manhole	Adoptable
1.002	3	900	Manhole	Adoptable	4	1200	Manhole	Adoptable
1.003	4	1200	Manhole	Adoptable	5	1200	Manhole	Adoptable
1.004	5	1200	Manhole	Adoptable	Depth/Area 1		Junction	
1.006	6	1200	Manhole	Adoptable	7	1200	Manhole	Adoptable
1.005	Depth/Area 1		Junction		6	1200	Manhole	Adoptable
2.000	9	600	Manhole	Adoptable	10	900	Manhole	Adoptable
2.001	10	900	Manhole	Adoptable	5	1200	Manhole	Adoptable



Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1	58.427	84.323	34.000	1.000	600		0	1.000	33.000
2	38.295	88.284	34.000	1.234	900		1	1.000	32.841
3	20.638	68.647	33.800	1.152	900		0	1.001	32.766
4	19.978	35.314	33.600	1.051	1200		1	1.001	32.648
5	-1.309	33.993	33.600	1.466	1200		0	1.002	32.648
6	-0.515	58.581	34.200	2.460	1200		1	1.002	32.549
7	-3.784	65.512	34.200	2.482	1200		0	1.003	32.549
Depth/Area 1	-0.658	49.020	33.600	1.820			1	2.001	32.434
9	42.255	8.581	33.600	0.750	600		2	1.003	32.505
10	-0.649	7.261	33.600	1.074	900		0	1.004	32.434
							1	1.005	31.740
							0	1.006	31.740
							1	1.005	31.780
							0	2.000	32.850
							1	2.000	32.601
							0	2.001	32.526

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	20.000	Drain Down Time (mins)	240
Ratio-R	0.400	Additional Storage (m³/ha)	20.0
Summer CV	1.000	Check Discharge Rate(s)	x
Winter CV	1.000	Check Discharge Volume	x

Storm Durations

15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	10	0
30	0	10	0
100	40	10	0

Node 6 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	31.740	Product Number	CTL-SHE-0100-5000-1353-5000
Design Depth (m)	1.353	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	5.0	Min Node Diameter (mm)	1200

Node Depth/Area 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	31.780
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.96	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	116.5	0.0	1.320	116.5	0.0	1.321	0.0	0.0

Other (defaults)

Entry Loss (manhole)	0.250	Entry Loss (junction)	0.000	Apply Recommended Losses	x
Exit Loss (manhole)	0.250	Exit Loss (junction)	0.000	Flood Risk (m)	0.300

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year +10% A 15 minute summer	141.566	40.058
2 year +10% A 15 minute winter	99.345	40.058
2 year +10% A 30 minute summer	91.753	25.963
2 year +10% A 30 minute winter	64.388	25.963
2 year +10% A 60 minute summer	61.301	16.200
2 year +10% A 60 minute winter	40.727	16.200
2 year +10% A 120 minute summer	37.449	9.897
2 year +10% A 120 minute winter	24.880	9.897
2 year +10% A 180 minute summer	28.672	7.378
2 year +10% A 180 minute winter	18.637	7.378
2 year +10% A 240 minute summer	22.636	5.982
2 year +10% A 240 minute winter	15.039	5.982
2 year +10% A 360 minute summer	17.235	4.435
2 year +10% A 360 minute winter	11.203	4.435
2 year +10% A 480 minute summer	13.550	3.581
2 year +10% A 480 minute winter	9.003	3.581
2 year +10% A 600 minute summer	11.088	3.033
2 year +10% A 600 minute winter	7.576	3.033
2 year +10% A 720 minute summer	9.878	2.647
2 year +10% A 720 minute winter	6.639	2.647
2 year +10% A 960 minute summer	8.113	2.136
2 year +10% A 960 minute winter	5.374	2.136
2 year +10% A 1440 minute summer	5.891	1.579
2 year +10% A 1440 minute winter	3.959	1.579



Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +10% A 15 minute summer	268.706	76.035
30 year +10% A 15 minute winter	188.566	76.035
30 year +10% A 30 minute summer	174.929	49.499
30 year +10% A 30 minute winter	122.757	49.499
30 year +10% A 60 minute summer	116.589	30.811
30 year +10% A 60 minute winter	77.459	30.811
30 year +10% A 120 minute summer	70.438	18.615
30 year +10% A 120 minute winter	46.797	18.615
30 year +10% A 180 minute summer	53.298	13.715
30 year +10% A 180 minute winter	34.645	13.715
30 year +10% A 240 minute summer	41.604	10.995
30 year +10% A 240 minute winter	27.641	10.995
30 year +10% A 360 minute summer	31.221	8.034
30 year +10% A 360 minute winter	20.295	8.034
30 year +10% A 480 minute summer	24.324	6.428
30 year +10% A 480 minute winter	16.160	6.428
30 year +10% A 600 minute summer	19.756	5.404
30 year +10% A 600 minute winter	13.498	5.404
30 year +10% A 720 minute summer	17.490	4.687
30 year +10% A 720 minute winter	11.754	4.687
30 year +10% A 960 minute summer	14.215	3.743
30 year +10% A 960 minute winter	9.416	3.743
30 year +10% A 1440 minute summer	10.161	2.723
30 year +10% A 1440 minute winter	6.829	2.723
100 year +40% CC +10% A 15 minute summer	488.233	138.153
100 year +40% CC +10% A 15 minute winter	342.620	138.153
100 year +40% CC +10% A 30 minute summer	320.551	90.705
100 year +40% CC +10% A 30 minute winter	224.948	90.705
100 year +40% CC +10% A 60 minute summer	214.603	56.713
100 year +40% CC +10% A 60 minute winter	142.577	56.713
100 year +40% CC +10% A 120 minute summer	129.587	34.246
100 year +40% CC +10% A 120 minute winter	86.094	34.246
100 year +40% CC +10% A 180 minute summer	97.729	25.149
100 year +40% CC +10% A 180 minute winter	63.526	25.149
100 year +40% CC +10% A 240 minute summer	75.977	20.078
100 year +40% CC +10% A 240 minute winter	50.477	20.078
100 year +40% CC +10% A 360 minute summer	56.677	14.585
100 year +40% CC +10% A 360 minute winter	36.841	14.585
100 year +40% CC +10% A 480 minute summer	43.979	11.622
100 year +40% CC +10% A 480 minute winter	29.219	11.622
100 year +40% CC +10% A 600 minute summer	35.604	9.738
100 year +40% CC +10% A 600 minute winter	24.327	9.738
100 year +40% CC +10% A 720 minute summer	31.433	8.424
100 year +40% CC +10% A 720 minute winter	21.125	8.424
100 year +40% CC +10% A 960 minute summer	25.432	6.697
100 year +40% CC +10% A 960 minute winter	16.847	6.697
100 year +40% CC +10% A 1440 minute summer	18.055	4.839
100 year +40% CC +10% A 1440 minute winter	12.134	4.839

Results for 2 year +10% A Critical Storm Duration. Lowest mass balance: 99.49%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	1	33.000	0.000	0.0	0.0000	0.0000	OK
15 minute summer	2	10	32.840	0.074	8.4	0.0911	0.0000	OK
15 minute summer	3	11	32.743	0.095	13.4	0.0971	0.0000	OK
15 minute summer	4	11	32.710	0.161	27.4	0.3734	0.0000	OK
15 minute summer	5	11	32.609	0.175	32.3	0.1974	0.0000	OK
120 minute summer	6	88	32.060	0.320	4.9	0.3623	0.0000	SURCHARGED
120 minute summer	7	88	31.765	0.047	4.9	0.0000	0.0000	OK
120 minute summer	Depth/Area 1	88	32.061	0.281	26.0	31.7440	0.0000	OK
15 minute summer	9	1	32.850	0.000	0.0	0.0000	0.0000	OK
15 minute summer	10	11	32.610	0.084	5.6	0.0915	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	0.0	0.000	0.000	0.0000	
15 minute summer	2	1.001	3	8.3	0.607	0.240	0.3615	
15 minute summer	3	1.002	4	13.2	0.565	0.382	0.5168	
15 minute summer	4	1.003	5	27.2	0.974	0.790	0.2735	
15 minute summer	5	1.004	Depth/Area 1	32.1	1.047	0.967	0.4603	
120 minute summer	6	1.006	7	4.9	0.650	0.054	0.0247	50.7
15 minute summer	Depth/Area 1	1.005	6	7.2	0.360	0.100	0.5244	
15 minute summer	9	2.000	10	0.0	0.000	0.000	0.0082	
15 minute summer	10	2.001	5	5.2	0.317	0.150	0.4847	

Results for 30 year +10% A Critical Storm Duration. Lowest mass balance: 99.49%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	1	33.000	0.000	0.0	0.0000	0.0000	OK
15 minute summer	2	12	32.926	0.160	15.9	0.1956	0.0000	OK
15 minute summer	3	12	32.906	0.258	25.1	0.2627	0.0000	SURCHARGED
15 minute summer	4	11	32.857	0.308	47.5	0.7160	0.0000	SURCHARGED
15 minute summer	5	11	32.750	0.316	54.7	0.3578	0.0000	SURCHARGED
120 minute winter	6	118	32.403	0.663	5.3	0.7498	0.0000	SURCHARGED
30 minute summer	7	66	31.766	0.047	5.0	0.0000	0.0000	OK
120 minute winter	Depth/Area 1	118	32.403	0.623	33.9	70.5059	0.0000	SURCHARGED
15 minute summer	9	1	32.850	0.000	0.0	0.0000	0.0000	OK
15 minute summer	10	11	32.763	0.237	10.6	0.2573	0.0000	SURCHARGED

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	0.0	0.000	0.000	0.1225	
15 minute summer	2	1.001	3	15.4	0.662	0.446	0.9263	
15 minute summer	3	1.002	4	24.0	0.610	0.696	0.8869	
15 minute summer	4	1.003	5	44.9	1.129	1.302	0.3898	
15 minute summer	5	1.004	Depth/Area 1	54.4	1.376	1.638	0.5714	
30 minute summer	6	1.006	7	5.0	0.655	0.055	0.0252	61.3
15 minute winter	Depth/Area 1	1.005	6	10.7	0.392	0.150	0.6733	
15 minute summer	9	2.000	10	0.0	0.000	0.000	0.3292	
15 minute summer	10	2.001	5	10.1	0.352	0.293	0.8272	

Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 99.49%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	12	33.714	0.714	5.8	0.2020	0.0000	FLOOD RISK
15 minute summer	2	12	33.707	0.941	28.9	1.1528	0.0000	FLOOD RISK
15 minute summer	3	12	33.639	0.991	39.0	1.0090	0.0000	FLOOD RISK
15 minute summer	4	12	33.492	0.943	84.2	2.1908	0.0000	FLOOD RISK
15 minute summer	5	12	33.159	0.725	94.2	0.8205	0.0000	SURCHARGED
180 minute winter	6	176	33.066	1.326	5.3	1.4994	0.0000	SURCHARGED
30 minute winter	7	265	31.766	0.047	5.0	0.0000	0.0000	OK
180 minute winter	Depth/Area 1	176	33.066	1.286	45.5	145.4820	0.0000	SURCHARGED
15 minute summer	9	12	33.184	0.334	6.9	0.0945	0.0000	SURCHARGED
15 minute summer	10	12	33.182	0.656	19.3	0.7130	0.0000	SURCHARGED

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute summer	1	1.000	2	-9.4	-0.534	-0.651	0.4208	
15 minute summer	2	1.001	3	24.2	0.672	0.701	1.0539	
15 minute summer	3	1.002	4	37.7	0.948	1.094	0.8869	
15 minute summer	4	1.003	5	79.0	1.986	2.290	0.3898	
15 minute summer	5	1.004	Depth/Area 1	94.7	2.381	2.853	0.5921	
30 minute winter	6	1.006	7	5.0	0.655	0.055	0.0252	71.4
15 minute summer	Depth/Area 1	1.005	6	11.9	0.409	0.166	0.6733	
15 minute summer	9	2.000	10	-6.9	-0.467	-0.476	0.6584	
15 minute summer	10	2.001	5	15.8	0.418	0.458	0.8272	