



Waste Transfer Compound North Manchester General Hospital

Drainage Management Strategy

For NHS Manchester University

Date 15 March 2024

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1. Introduction

1.1 Development Context

- 1.1.1 This report has been prepared by Hydrock Consultants Limited (Hydrock) on behalf of the NHS Manchester University to support the planning application to construct a new waste transfer compound with associated office/breakroom, covered waste storage and compactors, bins, van parking and associated infrastructure and access. (see Appendix A).
- 1.1.2 The site is currently used as a hospital staff car park and is therefore considered to be 'brownfield'.
- 1.1.3 As the site is less than 1 hectare, there is no Flood Risk Assessment required.

2. Development Description and Location

2.1 Site Location

2.1.1 This site is referenced in Table 1, and a location plan is provided in Figure 1.

Site Referencing Information	
Site Name	Waste Transfer Compound NMGH
Site Address & Location	Crescent Drive, Manchester, M8 5XL
Council Area	Manchester City Council
Approximate Grid Reference	384993E, 402099N
Site Area	The total site area is 0.14ha.
Boundaries & Surrounding Land	The site is bound by Crescent Drive to the west, Crumpsall Jewish Cemetery to the south and additional hospital staff car parking to the remaining areas.
Existing Land Use and Access	The site is currently used as a hospital staff carpark
Elevation and Topography	A topographical survey has been undertaken and indicates that the site has a high point centrally of ~78.3m AOD and falls away from this point in all directions to a level of ~77.4m AOD to the North and West and ~76.5m AOD to the South and East. See Appendix B for the full topographical survey.
Development Proposals	The proposed development is for the construction of a new waste transfer compound with associated office/breakroom, covered waste storage and compactors, bins, van parking and associated infrastructure and access.
Vehicular access	The main vehicular access to the site will be from Crescent Drive to the west.

Table 1: Site referencing information



Figure 1: Site location

3. Drainage Strategy

3.1 Existing surface water runoff

- 3.1.1 The existing site is considered to be 'brownfield' therefore a calculation of the brownfield runoff rate is required.
- 3.1.2 The total site area is approximately 0.14 hectares, of which 0.11 hectares of impermeable area goes to surface water sewer, the remainder enters the existing foul network. Using the modified rational method and a standard rainfall intensity of 50 mm/hr, the impermeable site area would generate a run-off rate of 17.4/s.
- 3.1.3 A 50% betterment on the brownfield rate is required in accordance with Manchester City Council's Local Flood Risk Management Strategy.
- 3.1.4 Applying a 50% betterment to this provides a design run-off rate of 8.7/s. Run-off from the proposed development will not exceed this rate and therefore provide betterment and reduce the flood risk of the downstream catchment.
- 3.1.5 The allowable surface water discharge rate for the proposed developed area discharging into the nearest surface water sewer is 8.7l/s.

3.2 Infiltration

- 3.2.1 The underlying ground conditions typically consist of made ground, up to 6 metres of very clayey fine to medium sand and fine to medium gravel underlain with up to 4m of silty clay. See Appendix C for historic borehole logs found on the British Geological Survey GeoIndex.
- 3.2.2 The Soilscape soils data shows the site to be a mixture of 'Slowly permeable seasonally wet acid loamy and clayey soils with impeded drainage'.
- 3.2.3 Based on this information, infiltration into ground is not considered a feasible.

3.3 Sustainable Drainage Systems (SuDS)

- 3.3.1 Sustainable drainage developed in line with the ideals of sustainable development is collectively referred to as Sustainable Drainage Systems (SuDS). At a particular site, these systems are designed to manage both the environmental risks resulting from the urban runoff and to contribute, wherever possible, to environmental enhancement. Therefore, SuDS objectives are to minimise the impacts from the development on the quantity and quality of the runoff and maximise amenity and biodiversity opportunities (CIRIA C753, 2015).
- 3.3.2 SuDS help to mimic the natural flow of water ensuring that both the quantity and quality of the surface water is dealt with before feeding it into the drainage network. SuDS features usually come with added maintenance, however the benefits they reap are considered to outweigh this. The selection of the most appropriate SuDS features should consider constraints, requirements, and maintenance of the site. It should be remembered that Local Planning Authorities expect SuDS to be investigated on construction projects. The implementation of SuDS features can assist in achieving the drainage requirements set out in the National Planning Policy Framework.

- 3.3.3 A strong design theme is essential if maximum aesthetic benefits are to be gained from the SuDS approach. At a more local scale SuDS should link with the individual plot structure, planting and amenity areas, gaining multiple benefits from a limited area of land.
- 3.3.4 The 'Management Train Approach' should be central to the surface water drainage strategy of a proposed site. The main objective is the treatment and control of runoff as near to source as possible, thus protecting downstream habitats and further enhancing the amenity value of the site. This concept uses a hierarchy of drainage techniques to incrementally reduce pollution, flow rates and volumes of storm water discharge from the site, and is as follows:
- » Prevention - The use of good site design and housekeeping measures to prevent runoff and pollution (e.g. rainwater re-use).
 - » Source Control - Control of runoff at source or as close to source as possible (e.g. soakaways, green roofs, pervious pavements).
 - » Site Control - Management of water in a local area (e.g. ground storage/attenuation, detention ponds/basins).
 - » Regional Control - Management of water from a site or various sites (e.g. wetlands, balancing ponds).
- 3.3.5 The SuDS philosophy for a development site is the promotion of Pollution Prevention and Site Control Techniques. The following design philosophy is proposed:
- » Surface water treatment using the 'Management Train' approach to remove and isolate contamination at all SuDS facilities prior to conveyance.
 - » Surface water discharge into the nearest available surface water sewer.
 - » Site Control features (attenuation) to accommodate the additional surface water runoff generated by the development site before discharging into the watercourse.
 - » Prevention measures in the form of rainwater re-use systems (tbc).
 - » Provision of suitable oil separators in line with Pollution Prevention Guidance 3 criteria (where applicable).
 - » Aim to limit, where possible, the impermeable fraction of development.
- 3.3.6 It is proposed that the development site has two levels of treatment. Prevention is considered as the first level of treatment and the site control as the second.
- 3.3.7 A review of the possible SuDS solutions that are feasible include:
- » Rainwater harvesting tanks
 - » Ground storage/attenuation
 - » Oil separators

3.4 Prevention and Source Control - Principles and Objectives

- 3.4.1 The main objective of prevention and source control is the treatment and control of runoff as near to source as possible. Application of these techniques will require reduction of impermeable areas and techniques to restrict the runoff rates.

- 3.4.2 Prevention measures to be considered, where possible, as part of the overall approach to the management train at this site include rainwater harvesting. Typical examples are given in the SuDS Manual (Ciria C697) and are briefly described in Table 2 below. It must be noted that the effectiveness of each system is dependent on the final design as well as the actual site conditions.

SuDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for us on site?
Retention	Balancing Pond/Swale		Provides both storm water attenuation and treatment. Run-off from each rain event is detained and treated in the pool. The retention time promotes pollutant removal through sedimentation.	Good removal of pollutants, can be used where groundwater is vulnerable, good community acceptability, high ecological, and amenity benefits.	No reduction in run-off volume, land take may limit use in high density sites.	Unsuitable due to lack of available land.
	Sub-Surface Attenuation		Oversized pipes, tank systems and modular geo-cellular systems that can be used to create a below ground storage structure.	Modular and flexible, dual usage (infiltration/storage, high void ratios), can be installed beneath trafficked and soft landscaped areas.	No water quality treatment.	Sub-surface storage can be used.
Infiltration	Infiltration Trench		Surface water run-off can be discharged directly to ground for infiltration by soakaways, basins, or trenches. A prerequisite is that both groundwater and ground conditions are appropriate to receive the quality and quantity of water generated.	Reduces the volume of run-off, effective at pollutant removal, contributes to groundwater recharge, simple and cost effective, easy performance observation.	Requires appropriate pre-treatment, basins require a large flat area, offset from foundations.	Infiltration is not considered to be feasible given the ground conditions.
	Infiltration Basin					
	Soakaway					

	Porous Paving		Block or porous paving allows run-off to infiltrate through to sub base layer. Water can then be infiltrated into ground or conveyed into storage or drainage systems.	Reduces the volume of run-off and if designed for infiltration contributes towards groundwater recharge. Easy to install and retrofit. Simple to manage. If lined can be used where groundwater is sensitive.	Not suitable for heavily trafficked areas or adoptable roads. Requires regular sweeping to prevent clogging with dirt.	Unsuitable due to nature of development.
	Permeable Paving					
Detention	Detention Basin		Surface storage basins that provide flow control through attenuation. Normally dry and in certain situations the land may also function as a recreational facility.	Cater for a wide range of rainfall events, can be used where groundwater is vulnerable, potential for dual land use, easy to maintain.	Land take, little reduction in run-off volume, detention depths constrained by levels.	Unsuitable due to lack of available land.
	Enhanced Dry Swale		Swales are linear vegetated drainage features in which surface water can be stored or conveyed. They can be designed to allow infiltration, where appropriate.	Incorporate into landscaping, good removal of pollutants, reduces run-off rates and volumes, low cost.	Not suitable for steep areas, significant land take, not suitable in areas with roadside parking.	Unsuitable due to lack of available land.
	Enhanced Wet Swale					

Source Control	Green/Brown Roof		Multi-layered system that covers the roof of a building with vegetation cover/landscaping over a drainage layer. Designed to intercept and retain precipitation, reducing the volume of run-off and attenuating peak flows.	Mimics greenfield state of building footprint for high density developments, good removal of pollutants, ecological benefits, insulates buildings, sound absorption.	Additional weight, not appropriate for steep roofs, maintenance of roof vegetation.	Green/Brown roof can be used subject to Architect building specification.
	Rainwater Harvesting		Similar to the use of water butts this prevention method stores rainwater runoff from roofs and external areas in below ground tanks. The water can then be used for irrigation purposes to the soft landscaping areas or alternatively pumped to an internal storage tank where the 'Grey' water can be used for WC's and washing machines.	Harvested grey water will collect and automatically be used for various systems, such as toilet flushing, outside taps etc. The result will be less water usage and cheaper bills and a greener building or commercial premises.	Rainfall is hard to predict and sometimes little or no rainfall can limit the supply of rainwater. It also should have a "mains water" top up to ensure that you don't run out of water.	Rainwater Harvesting can be used.

Filtration	Surface Sand Filter		Structures designed to treat surface water run-off through filtration using a sand bed filter medium. The filters can be designed with or without infiltration. Temporary storage of run-off is achieved through ponding above the filter layer. They are used where particularly high pollutant removal is required.	Flexibility of design, efficient in removing pollutants, suitable for retrofits and in tightly constrained urban locations.	Not for high sediment content, detention times can support algae growth, minimum hydraulic head of 1.2m required, possible odour problems, high capital and maintenance cost.	There is no requirement for high pollution reduction at this site.
	Sub-surface Sand Filter					
	Perimeter Sand Filter					
	Bioretention/ filter swale		Vegetated strips of land designed to accept run-off as overland sheet flow between a hard-surfaced area and a receiving system.	Landscaping features, effective in removing pollutants, flexible layout to fit into landscape, suited for highly impervious areas, good retrofit, capability, effective pre-treatment option.	Requires landscaping and management, large land required, not suitable for steep sites; no significant attenuation or reduction of flows.	No requirement for high pollution reduction; large land areas not available.

	Filter trench/drain		Shallow excavations filled with rubble or stone that create temporary subsurface storage for filtration of storm water run-off. Receive lateral inflow from an adjacent impermeable surface.	Hydraulic benefits achieved with filter trenches, trenches can be incorporated into site landscaping and fit well beside roads and car parks.	High clogging potential without effective pre-treatment, limited to small catchments, high cost of replacing filter material.	Filter drains can't be used.
Conveyance	Conveyance Swales		Formal linear drainage features in which surface water can be stored or conveyed. They can be incorporated with water features such as ponds or waterfalls where appropriate.	Negate the need for underground pipework. Can provide some attenuation. Possible reduction in run-off volume via plant uptake and infiltration.	Potential trip/wheel hazard, disabled access issues.	Could be used where conveyance is required but the lack of formal outside spaces at the site makes the aesthetic aspects unnecessary.
	Rills					

Wetland	Shallow Wetland		Wetlands provide storm water attenuation and treatment. They comprise shallow ponds and marshy areas, covered in aquatic vegetation. Wetlands detain flows for an extended period to allow sediments to settle and to remove contaminants. They can provide significant ecological benefits.	Good pollutant removal and if lined can be used where groundwater is vulnerable. Good community acceptability, ecological and amenity benefits.	Land take is high, requires base flow, little reduction in run-off volume, not suitable for steep sites.	Unsuitable due to lack of available land.
	Extended Detention Wetland					
	Pond Wetland					
	Pocket Wetland					
	Submerged Gravel Wetland					
	Wetland Channel					

Table 2: SuDS considerations

3.5 Surface Water Drainage Strategy

- 3.5.1 Surface Water Drainage Strategies must follow the hierarchy of surface water disposal as set out in Building Regulations - Approved Document H, as listed below;
- » **Option 1** - Into the ground (infiltration)
 - » **Option 2** - To a watercourse
 - » **Option 3** - To a public/private sewer
- 3.5.2 Option 1 infiltration into the ground is not considered feasible, based on the BGS borehole logs.
- 3.5.3 Option 2, to a watercourse is not considered feasible due to there being no available watercourses within the vicinity of the site.
- 3.5.4 Therefore, Option 3 is the preferred method, whereby surface water will discharge into the nearest private surface water sewer within Crescent Drive.
- 3.5.5 Surface water runoff from roofs and external areas will be directed to the below ground gravity network, where it will join the wider private drainage network of carrier drains at a restricted rate of 8.7L/s (see Appendix D Hydrock proposed surface water drainage layout).
- 3.5.6 A hydraulic model has been created using drainage software as part of the preliminary drainage design, which defines pipe sizes and attenuation volumes. Hydraulic calculations have been provided in Appendix E. It is noted that these rates and volumes are preliminary and may change at detailed design stage when more specific information is available.
- 3.5.7 A climate change allowance of 40% has been applied.
- 3.5.8 The proposed drainage layout is designed in accordance with Design and Construction Guidance. No above ground flooding for the 1 in 30-year storm event should occur. An assessment of extreme storm event, the 100-year event plus 40% climate change has been carried out. The storm-water volumes generated by this event are classed as exceedance flooding and will be safely contained on site and directed away from the buildings, where they will sit in the low points of the site and drain into the surface water infrastructure via filter drains as water levels recede.
- 3.5.9 As part of the drainage strategy, we are proposing the following:
- » The proposed drainage system will be a managed gravity system with a flow control set at a permissible maximum discharge rate of 8.7L/s into the nearest surface water sewer within Crescent Drive.
 - » The catchment areas will be drained via drainage channels and then discharge into the new private surface water network. Surface runoff from the roof will also discharge to the new private surface water network.
 - » Pollution treatment measures will be provided in the form of silt traps on drainage elements which will filter and trap silts and debris and mitigate against the risk of pollution entering the sewer network. All separators will be alarmed and remotely monitored at all times to ensure reliability.

3.6 Water Quality

3.6.1 The site mainly comprises of commercial waste, access road, and parking, which have pollution hazard levels of medium in accordance with CIRIA C753 table 26.2 as below.

3.6.2 As the vehicle running area is less than 800m² in area there is no requirement for an oil separator however, all gullies/kerb drain outlets will be trapped.

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

- 3.6.3 Appropriate SuDS mitigation indices in the will be provided for each area of the development in accordance with CIRIA C753 table 26.3, as below.

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

3.7 Foul Drainage Strategy

- 3.7.1 Due to the nature of the development, surface water runoff from the waste facilities will be drained via drainage channels and enter the foul network. This will require trade effluent consent from United Utilities.
- 3.7.2 Foul flows will then outfall via gravity into the nearest foul sewer within Crescent Drive approximately 130m south of the site at an unrestricted rate (see Appendix D). An agreement in principle will be sought from United Utilities at detailed design stage, when more site-specific information is required.
- 3.7.3 A map showing the location of the existing United Utilities public sewer is included in Appendix F.

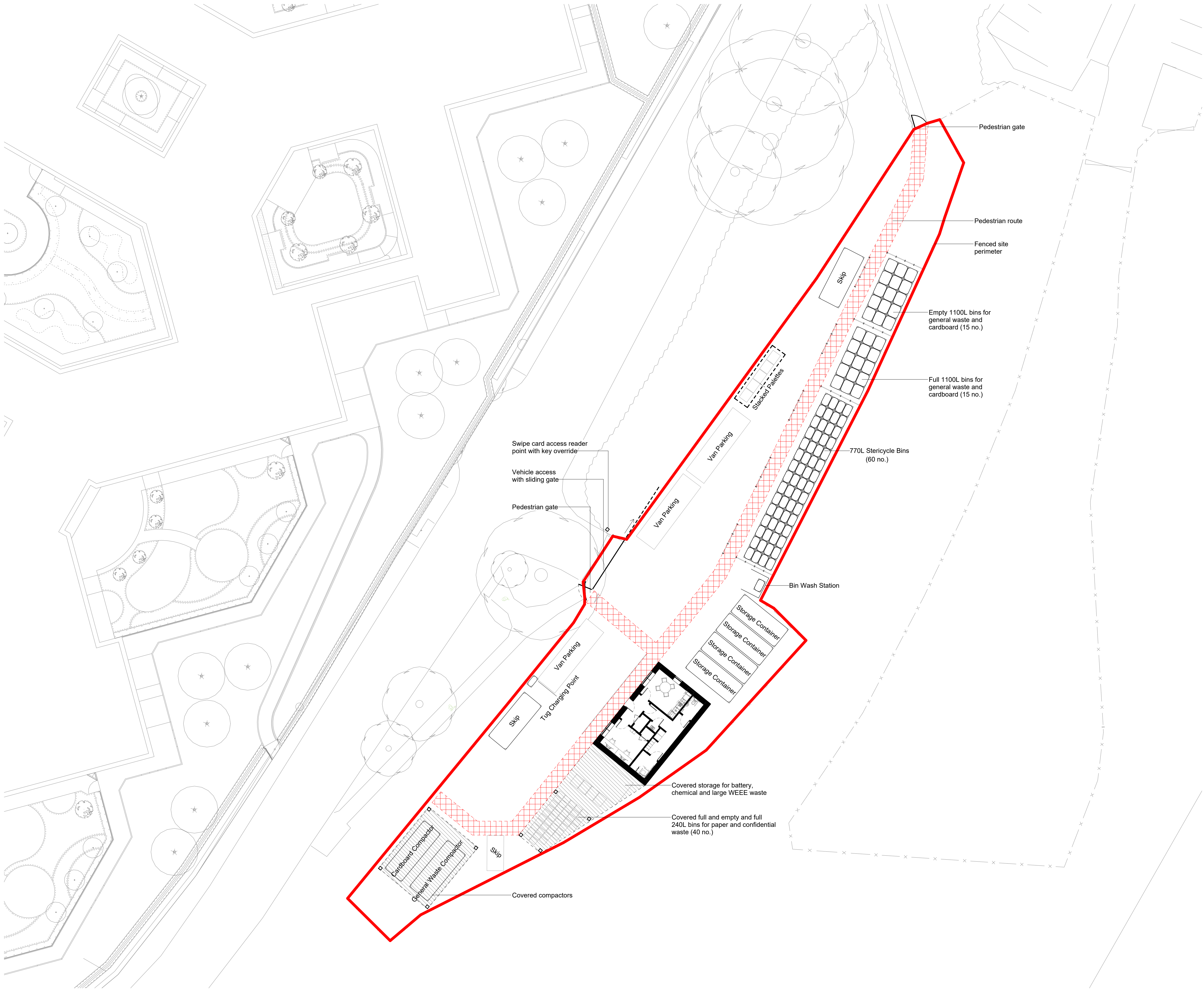
3.8 Management, Maintenance and Residual Risk

- 3.8.1 The proposed drainage layout will be designed in accordance with building regulations. SuDS guidance will be taken from Ciria C753.
- 3.8.2 Run-off from roofs is considered to be generally clean with limited contamination, and will be discharged directly to the proposed drainage infrastructure and new SuDS Facilities. Silt is to be prevented from entering the drainage system by the use of trapped gullies.
- 3.8.3 A private management company will maintain the drainage infrastructure as part of a site-wide management and maintenance schedule as shown in Table 3.
- 3.8.4 Access and egress arrangements to and from the new development, should exceedance flooding occur, will be via the access on to Crescent Drive.
- 3.8.5 Flood risk to people and property can be managed but it can never be completely removed. Residual risk remains after flood management or mitigation measures have been put in place. This relates to a rainfall event beyond what can be fully quantified.

Item	Maintenance	Frequency per year
Gullies	Removal of silt accumulation from mud bucket. Gratings checked for operation/damage – replaced if required.	2
Foul Water Manholes	Manholes covers checked for operation/damage – seating's re-greased or replaced as required. Check for blockages and or damage to invert channel/inlets – jetting pipe runs if blocked, any damage to be repaired. All access ladders & other associated ironworks to be checked for corrosion & fixings to be checked for deterioration. To be repaired or replaced dependant of extent of damage.	1
Surface Water Manholes, Flow Controls	As Above All catch pits/Vortex Separators to have silt/solid accumulation removed & base jetted clean.	1
Drainage Channels	All catch/access pits to have silt/solid accumulation removed. Channel run to be jetted through between access points. Any channel grates to be inspected for damage & replaced as necessary.	2

Table 3: Drainage maintenance

Appendix A

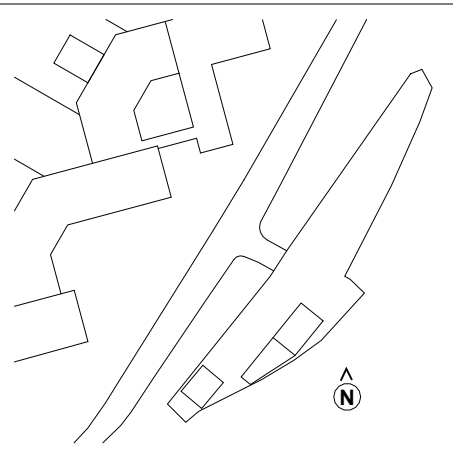


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NOTES

REVISIONS		
REV.	DATE	AMENDMENT
P01	30/11/2023	Issued to Design Team
P02	15/12/2023	Issued to Design Team
P03	18/01/2024	Issued to Arup
P04	08/02/2024	Layout updated
P05	20/02/2024	Building Layout Updated

KEYPLAN



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PROJECT
North Manchester General Hospital

SCALE@A1	DATE	ORIGINATOR	CHECKED	AUTHORISED
1 : 200	20/02/2024	LH	DB	AS

DESCRIPTION
WP1 Waste Transfer Compound
Sketch Layout

STAGE

STATUS	PURPOSE FOR ISSUE	SR NO.
S2	FOR INFORMATION	6512
DRAWING NO.		REV.
23130-SRA-NM171-00-DR-A-SK004		P05

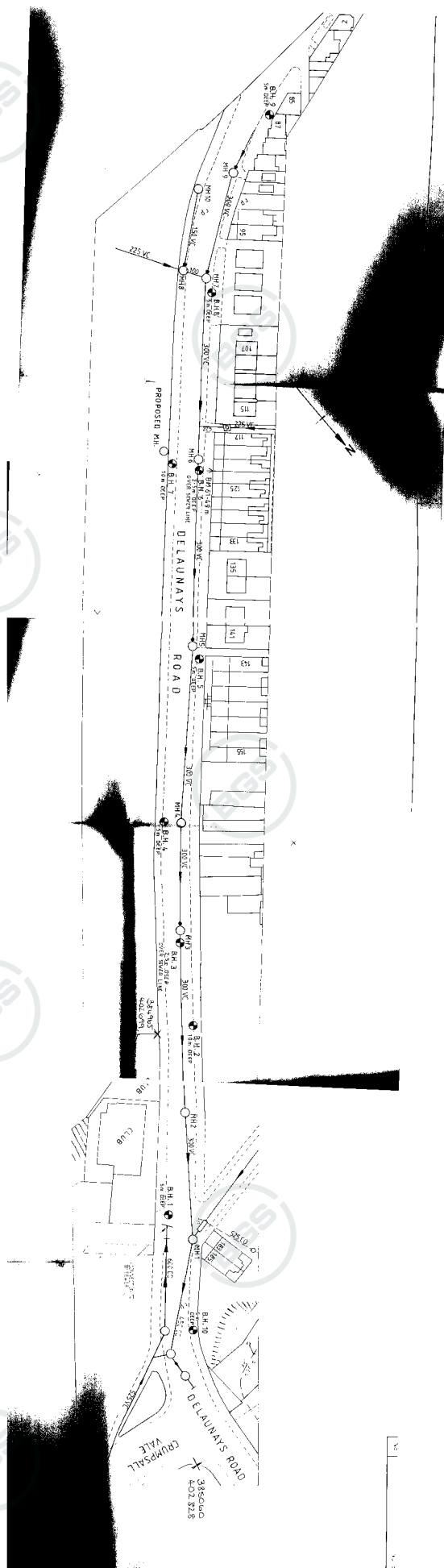
Appendix B

Appendix C

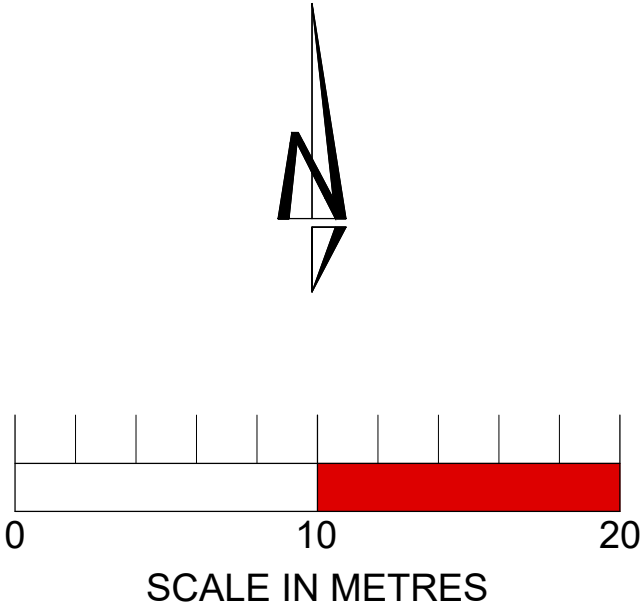
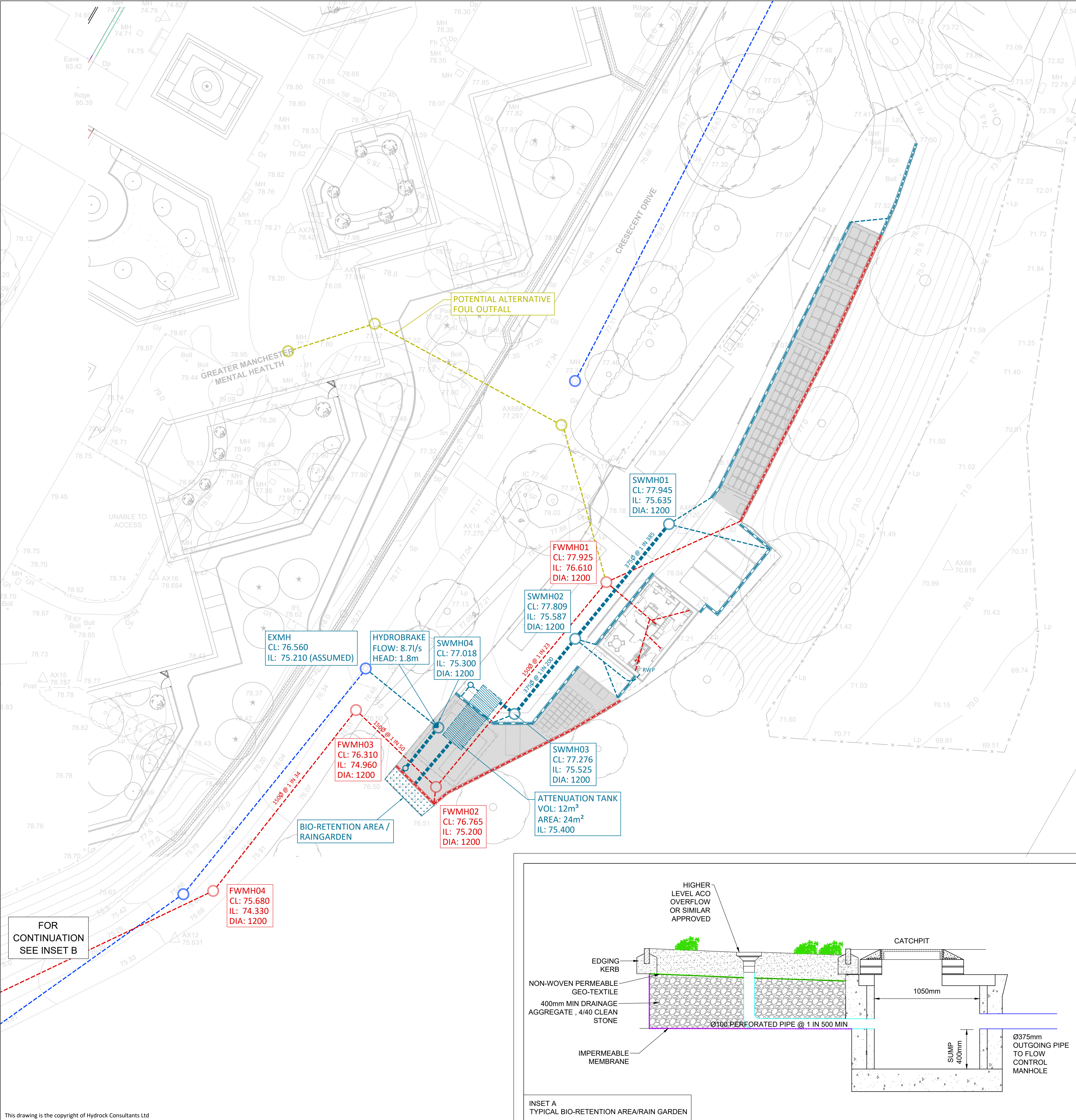


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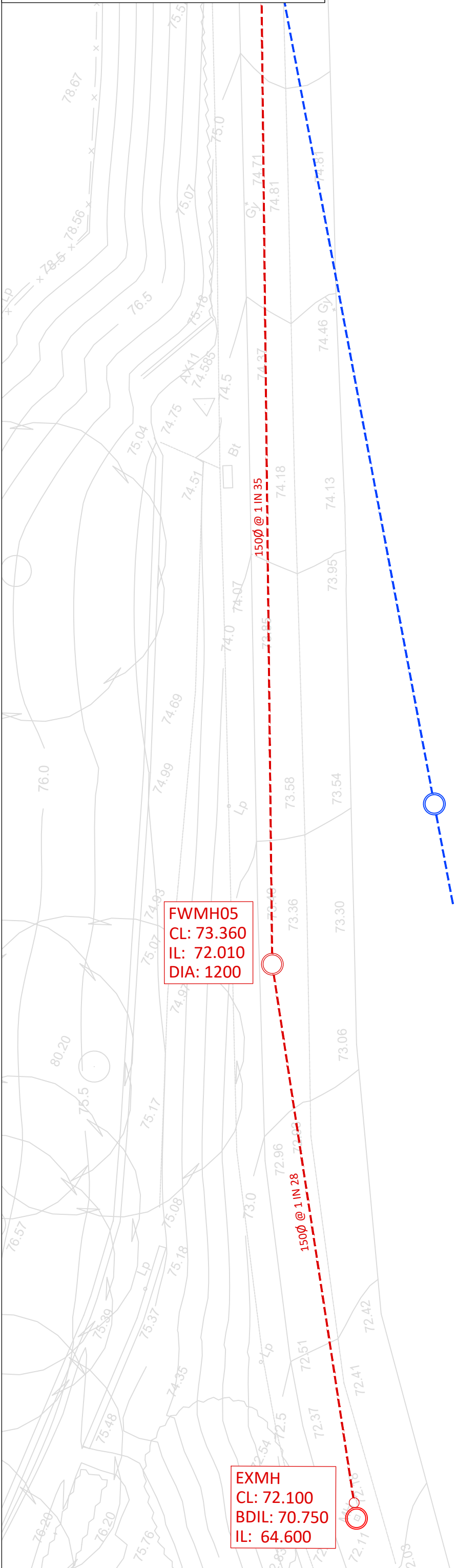
Sampling		Properties			Strata						
Depth	Type	Cu kPa	w%	SPT N	Description	Depth	Level	Legend			
					MADE GROUND: Tarmacadam over stone sets over concrete.	GL					
1.00-1.45	CB			26	MADE GROUND: Comprising soft grey brown silty sandy clay with some fine gravel.	0.70					
1.00-1.50	B					0.90					
2.00-2.45	CB			39	MADE GROUND: Comprising brown and black very clayey coarse SAND with much angular fine to medium gravel of predominantly ash.						
2.00-2.50	B										
3.00-3.45	SD			7		2.90					
3.00-3.50	B				Loose brown and grey very silty very clayey fine to medium SAND with traces of sub-rounded fine to medium gravel above 3.50m.						
4.00-4.50	SD			9							
4.00-4.50	B										
5.00-5.45	SD			6							
5.00-5.50	B										
5.80-6.25	SD			8		5.80					
5.80-6.30	B				Loose light brown silty clayey fine medium to coarse SAND with occasional thin bands of grey silt.						
6.80-7.25	SD			7							
6.80-7.30	B										
7.80-8.25	SD			9							
7.80-8.30	B										
8.50-8.95	CB			26		8.50					
8.50-9.00	B				Soft grey silty sandy CLAY with some sub-rounded fine medium to coarse gravel.						
9.50-9.95	CB			44							
9.50-10.00	B										
					End of Borehole	10.00					
Drilling					Groundwater						
Type	From	To	Size	Fluid	Struck	Behaviour	Sealed	Date	Hole	Cased	Water
Shell and Auger	GL	10.00	0.15	-	2.10	Rose to 2.80m	-	21.3.88	10.00	8.50	2.80
Remarks Service Location Plan excavated to 1.00m.											
Borehole Record					Project Manchester City Council Delanays Road Sewer Renewal Road				Contract E6531/16		
exploration associates									Borehole 9 (1 of 1)		



Appendix D



INSET B
PROPOSED CONNECTION INTO UU MANHOLE

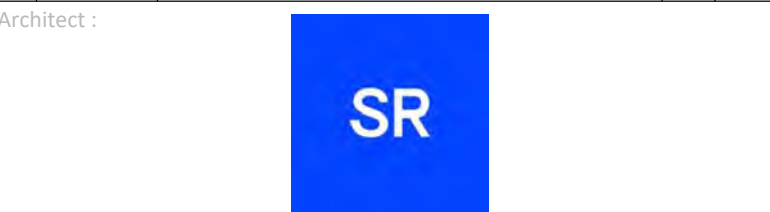


- Notes:**
- All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing.
 - This drawing is to be read in conjunction with all relevant Engineers' and Service Engineers' drawings and specifications.
 - All RWP and pop-up locations are assumed, pending detailed design.
 - Outfall invert levels to be confirmed by survey prior to construction. Final outfall location may be changed for construction.
 - Drainage layout may be subject to change once the detailed design is carried

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING
CONSTRUCTION
MAINTENANCE / CLEANING
DECOMMISSIONING / DEMOLITION
IT IS ASSUMED THAT ALL WORKS WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROVED METHOD STATEMENT

Key:	
---	SURFACE WATER DRAINAGE
---	FOUL WATER DRAINAGE
---	FOUL WATER MANHOLE
---	SURFACE WATER MANHOLE
---	SURFACE WATER CHANNEL DRAIN
---	FOUL WATER CHANNEL DRAIN
---	BIN STORE CATCHMENT DRAINING TO FOUL NETWORK
---	ATTENUATION TANK
---	BIO-RETENTION AREA / RAINGARDEN
---	EXISTING SURFACE WATER DRAINAGE
---	EXISTING FOUL WATER DRAINAGE

P2	13.03.24	REVISED TO LATEST LAYOUT	TF	CF
P1	19.01.24	FIRST ISSUE	BP	CF
Rev	Date	Description	By	Ckd



Project Title:

NORTH MANCHESTER GENERAL HOSPITAL

Drawing Title:

DRAINAGE LAYOUT

Drawing Status:

PLANNING

Hydrock Job No:

C32425

Drawn	Checked	Scale @ A1	Date	Issue Date
BP	CF	1:250	19.01.2024	19.01.2024

Drawing Number:

32425-HYD-XX-XX-DR-D-0500

Revision:

P2

Appendix E

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Micro
Drainage

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Existing Network Details for SW 1.SWS

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
1.000	18.472	0.048	384.8	0.056	5.00	0.0	0.600	o	375	Pipe/Conduit
1.001	12.027	0.062	194.4	0.040	0.00	0.0	0.600	o	375	Pipe/Conduit
1.002	8.040	0.125	64.3	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit
1.003	3.740	0.100	37.4	0.011	0.00	0.0	0.600	o	375	Pipe/Conduit
1.004	11.641	0.090	129.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
1.000	75.635	0.056	0.0	1.05	115.5
1.001	75.587	0.097	0.0	1.18	130.5
1.002	75.525	0.097	0.0	2.26	249.9
1.003	75.400	0.108	0.0	2.97	328.1
1.004	75.300	0.108	0.0	0.88	15.6

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Manhole Schedules for SW 1.SWS

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)
SWMH1	77.940	2.305	Open Manhole	1200	1.000	75.635	375				
SWMH2	77.840	2.253	Open Manhole	1200	1.001	75.587	375	1.000	75.587	375	
SWMH3	77.140	1.615	Open Manhole	1200	1.002	75.525	375	1.001	75.525	375	
TANK	76.900	1.500	Open Manhole	1200	1.003	75.400	375	1.002	75.400	375	
SWMH4	77.020	1.720	Open Manhole	1200	1.004	75.300	150	1.003	75.300	375	
	76.560	1.350	Open Manhole	0		OUTFALL		1.004	75.210	150	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SWMH1	385021.127	402115.239	385021.127	402115.239	Required	
SWMH2	385009.403	402100.964	385009.403	402100.964	Required	
SWMH3	385001.852	402091.603	385001.852	402091.603	Required	

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Date	01/01/0001
File	SW Model Rev 1.MDX

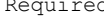
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Manhole Schedules for SW 1.SWS

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
TANK	384995.035	402087.340	384995.035	402087.340	Required	
SWMH4	384992.348	402089.941	384992.348	402089.941	Required	
	384983.313	402097.282			No Entry	

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Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	L*W
1.000	o	375	SWMH1	77.940	75.635	1.930	Open Manhole		1200
1.001	o	375	SWMH2	77.840	75.587	1.878	Open Manhole		1200
1.002	o	375	SWMH3	77.140	75.525	1.240	Open Manhole		1200
1.003	o	375	TANK	76.900	75.400	1.125	Open Manhole		1200
1.004	o	150	SWMH4	77.020	75.300	1.570	Open Manhole		1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	L*W
1.000	18.472	384.8	SWMH2	77.840	75.587	1.878	Open Manhole		1200
1.001	12.027	194.4	SWMH3	77.140	75.525	1.240	Open Manhole		1200
1.002	8.040	64.3	TANK	76.900	75.400	1.125	Open Manhole		1200
1.003	3.740	37.4	SWMH4	77.020	75.300	1.345	Open Manhole		1200
1.004	11.641	129.3		76.560	75.210	1.200	Open Manhole		0

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Innovyze	Network 2020.1.3																																																							
<u>Free Flowing Outfall Details for SW 1.SWS</u> <table border="1"> <thead> <tr> <th>Outfall Pipe Number</th> <th>Outfall C. Level Name (m)</th> <th>I. Level (m)</th> <th>Min I. Level (m)</th> <th>D,L (mm)</th> <th>W (mm)</th> </tr> </thead> <tbody> <tr> <td>1.004</td> <td>76.560</td> <td>75.210</td> <td>0.000</td> <td>0</td> <td>0</td> </tr> </tbody> </table> <u>Simulation Criteria for SW 1.SWS</u> <table border="1"> <tr> <td>Volumetric Runoff Coeff</td> <td>0.750</td> <td>Manhole Headloss Coeff (Global)</td> <td>0.500</td> <td>Inlet Coeffiecient</td> <td>0.800</td> </tr> <tr> <td>Areal Reduction Factor</td> <td>1.000</td> <td>Foul Sewage per hectare (l/s)</td> <td>0.000</td> <td>Flow per Person per Day (l/per/day)</td> <td>0.000</td> </tr> <tr> <td>Hot Start (mins)</td> <td>0</td> <td>Additional Flow - % of Total Flow</td> <td>0.000</td> <td>Run Time (mins)</td> <td>60</td> </tr> <tr> <td>Hot Start Level (mm)</td> <td>0</td> <td>MADD Factor * 10m³/ha Storage</td> <td>2.000</td> <td>Output Interval (mins)</td> <td>1</td> </tr> </table> Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0 Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0 <u>Synthetic Rainfall Details</u> <table border="1"> <tr> <td>Rainfall Model</td> <td>FSR</td> <td>M5-60 (mm)</td> <td>18.000</td> <td>Cv (Summer)</td> <td>0.750</td> </tr> <tr> <td>Return Period (years)</td> <td>1</td> <td>Ratio R</td> <td>0.357</td> <td>Cv (Winter)</td> <td>0.840</td> </tr> <tr> <td>Region</td> <td>England and Wales</td> <td>Profile Type</td> <td>Summer Storm</td> <td>Duration (mins)</td> <td>30</td> </tr> </table>			Outfall Pipe Number	Outfall C. Level Name (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)	1.004	76.560	75.210	0.000	0	0	Volumetric Runoff Coeff	0.750	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.800	Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000	Hot Start (mins)	0	Additional Flow - % of Total Flow	0.000	Run Time (mins)	60	Hot Start Level (mm)	0	MADD Factor * 10m³/ha Storage	2.000	Output Interval (mins)	1	Rainfall Model	FSR	M5-60 (mm)	18.000	Cv (Summer)	0.750	Return Period (years)	1	Ratio R	0.357	Cv (Winter)	0.840	Region	England and Wales	Profile Type	Summer Storm	Duration (mins)	30
Outfall Pipe Number	Outfall C. Level Name (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)																																																			
1.004	76.560	75.210	0.000	0	0																																																			
Volumetric Runoff Coeff	0.750	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.800																																																			
Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000																																																			
Hot Start (mins)	0	Additional Flow - % of Total Flow	0.000	Run Time (mins)	60																																																			
Hot Start Level (mm)	0	MADD Factor * 10m³/ha Storage	2.000	Output Interval (mins)	1																																																			
Rainfall Model	FSR	M5-60 (mm)	18.000	Cv (Summer)	0.750																																																			
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Region	England and Wales	Profile Type	Summer Storm	Duration (mins)	30																																																			
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Online Controls for SW 1.SWS

Hydro-Brake® Optimum Manhole: SWMH4, DS/PN: 1.004, Volume (m³): 2.2

Unit Reference	MD-SHE-0125-8700-1800-8700	Sump Available	Yes
Design Head (m)	1.800	Diameter (mm)	125
Design Flow (l/s)	8.7	Invert Level (m)	75.300
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.800	8.7	Kick-Flo®	1.095	6.9
Flush-Flo™	0.534	8.7	Mean Flow over Head Range	-	7.6

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)	Depth (m)	Flow (l/s)
0.100	4.5	0.600	8.7	1.600	8.2	2.600	10.3	5.000	14.1	7.500	17.1
0.200	7.4	0.800	8.4	1.800	8.7	3.000	11.1	5.500	14.8	8.000	17.7
0.300	8.2	1.000	7.6	2.000	9.1	3.500	11.9	6.000	15.4	8.500	18.2
0.400	8.6	1.200	7.2	2.200	9.6	4.000	12.7	6.500	16.0	9.000	18.7
0.500	8.7	1.400	7.7	2.400	10.0	4.500	13.4	7.000	16.6	9.500	19.2

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW 1.SWS

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	1	Number of Storage Structures	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR M5-60 (mm)	18.000	Cv (Summer)	0.750
Region	England and Wales	Ratio R	0.358	Cv (Winter)

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

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

									Water	Surcharged	Flooded	Half Drain			Pipe
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)
1.000	SWMH1	15 Winter	1	+0%	100/15 Winter				75.713	-0.297	0.000	0.08			6.6
1.001	SWMH2	15 Winter	1	+0%	100/15 Winter				75.667	-0.295	0.000	0.10			10.8

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW 1.SWS

	US/MH	Level
PN	Name	Status Exceeded
1.000	SWMH1	OK
1.001	SWMH2	OK

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW 1.SWS													



Micro
Drainage

Simulation Criteria			
Real Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500
		MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000
		Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000
		Flow per Person per Day (l/per/day)	0.000

<u>Synthetic Rainfall Details</u>			
Rainfall Model	FSR M5-60 (mm)	18.000 Cv (Summer)	0.750
Region	England and Wales	Ratio R	0.358 Cv (Winter) 0.840
Margin for Flood Risk Warning (mm)		300.0	DVD Status OFF
Analysis Timestep	2.5 Second Increment (Extended)		Inertia Status OFF
DTS Status			ON

					Water	Surcharged	Flooded			Half Drain	Pipe
	First (X)	First (Y)	First (Z)	Overflow	Level	Depth	Volume	Flow /	Overflow	Time	Flow
	Surcharge	Flood	Overflow	Act.	(m)	(m)	(m³)	Cap.	(l/s)	(mins)	(l/s)
100/15 Winter					75.761	-0.249	0.000	0.20			16.1
100/15 Winter					75.752	-0.210	0.000	0.21			22.5

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

	US/MH	Level
PN	Name	Status Exceeded
1.000	SWMH1	OK
1.001	SWMH2	OK

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

									Water	Surcharged	Flooded	Half Drain			Pipe
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (1/s)	Time (mins)	Flow (1/s)
1.002	SWMH3	30 Winter	30	+0%	100/15 Summer				75.751	-0.149	0.000	0.15			20.7
1.003	TANK	30 Winter	30	+0%	100/15 Summer				75.753	-0.022	0.000	0.11			13.4
1.004	SWMH4	30 Winter	30	+0%	1/15 Summer				75.859	0.409	0.000	0.61			8.6

	US/MH		Level
PN	Name	Status	Exceeded
1.002	SWMH3		OK
1.003	TANK		OK
1.004	SWMH4	SURCHARGED	

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

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	1	Number of Storage Structures	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR M5-60 (mm)	18.000	Cv (Summer)	0.750
Region	England and Wales	Ratio R	0.358	Cv (Winter)

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

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

									Water	Surcharged	Flooded	Half Drain			Pipe
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)
1.000	SWMH1	30 Winter	100	+40%	100/15 Winter				76.451	0.441	0.000	0.27			22.4
1.001	SWMH2	30 Winter	100	+40%	100/15 Winter				76.448	0.486	0.000	0.32			33.8

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<u>100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW 1.SWS</u>																		
<table><tr><td></td><td>US/MH</td><td></td><td>Level</td></tr><tr><td>PN</td><td>Name</td><td>Status</td><td>Exceeded</td></tr><tr><td>1.000</td><td>SWMH1</td><td>SURCHARGED</td><td></td></tr><tr><td>1.001</td><td>SWMH2</td><td>SURCHARGED</td><td></td></tr></table>				US/MH		Level	PN	Name	Status	Exceeded	1.000	SWMH1	SURCHARGED		1.001	SWMH2	SURCHARGED	
	US/MH		Level															
PN	Name	Status	Exceeded															
1.000	SWMH1	SURCHARGED																
1.001	SWMH2	SURCHARGED																
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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW 1.SWS

									Water	Surcharged	Flooded				Half Drain	Pipe
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)	
1.002	SWMH3	30 Winter	100	+40%	100/15 Summer				76.446	0.546	0.000	0.21			29.5	
1.003	TANK	30 Winter	100	+40%	100/15 Summer				76.443	0.668	0.000	0.10			12.6	
1.004	SWMH4	30 Winter	100	+40%	1/15 Summer				76.442	0.992	0.000	0.61			8.7	

PN	US/MH Name	Status	Level Exceeded
1.002	SWMH3	SURCHARGED	
1.003	TANK	SURCHARGED	
1.004	SWMH4	SURCHARGED	

Appendix F

Existing United Utilities Sewer Map -

