

Drainage Planning Conditions

Subject: Arundel Street, Manchester

Ref: 071713/DPC Rev V02

Date: 12.07.2022

This revision has been prepared to pick up four comments received from the LLFA in June 2022, following review of the original application. Changes in this revision are highlighted in RED.

The Planning Permission Ref: 123261/FO/2019
Condition 5a relates to drainage proposals for the development.

Condition 5a

Notwithstanding the details submitted on the 27 September 2018, (a) the development shall not commence until a scheme for the drainage of surface water shall be submitted for approval in writing by the City Council as the Local Planning Authority. This shall include: • Maximise use of green SuDS in design, e.g., green roof • Details of surface water attenuation that offers a reduction in surface water runoff rate in line with the Manchester Trafford and Salford Strategic Flood Risk Assessment, i.e., at least a 50% reduction in runoff rate compared to the existing rates, as the site is located within Conurbation Core Critical Drainage Area. • Runoff volume in the 1 in 100-year, 6 hours rainfall shall be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but never to exceed the runoff volume from the development site prior to redevelopment. • Evidence that the drainage system has been designed (unless an area is designated to hold and/or convey water as part of the design) so that flooding does not occur during a 1 in 100-year rainfall event with allowance for climate change in any part of a building. • Assessment of overland flow routes for extreme events that is diverted away from buildings (including basements). Overland flow routes need to be designed to convey the flood water in a safe manner in the event of a blockage or exceedance of the proposed drainage system capacity including inlet structures. A layout with overland flow routes needs to be presented with appreciation of these overland flow routes with regards to the properties on site and adjacent properties off site. • Hydraulic calculation of the proposed drainage system. • Construction details of flow control and SuDS elements.	Pre-Commencement
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Proposed Drainage:

The proposed drainage system consists of a separate foul and surface water network. Reference should be made to the following drainage design documents:

- Arundel Street – Detailed Drainage Strategy Report referenced 071713-CUR-00-XX-RE-C-92001 V01. This includes the following information:
 - 071713- CUR-XX-00-DR-C-92500_ **P02 PROPOSED DRAINAGE LAYOUT**
 - Micro-Drainage Calculations: Assumed existing 1, 30 and 100 Year +40%cc events
 - Micro-Drainage Calculations: Assumed Proposed 1, 30 and 100 Year +40%cc events
 - Micro-Drainage Calculations: Assumed Existing SW 100 Yr 6Hr Volumes
 - Micro-Drainage Calculations: Assumed Proposed SW 100 Yr 6Hr Volumes
- 071713-CUR-XX-00-DR-C-92501_ **P02 PROPOSED OVERLAND FLOW ROUTES**

With specific reference to the conditioned points:

Maximise use of green SuDS solution in design, e.g., green roof

As noted within the original submitted Drainage Strategy at planning stage, in following the standard hierarchy of drainage solutions, consideration should firstly be given to the discharge of surface water runoff by sustainable methods such as infiltration. An assessment was completed to establish the most sustainable method of discharge and is summarised below:

Surface Water Disposal	Potential	Description
Infiltration	X	Made Ground is likely to be present across the site. The British Geological Survey (BGS) infiltration report confirms that Groundwater may be vulnerable to contamination. Groundwater is likely to be less than 3m below the ground surface for at least part of the year, which may inundate the infiltration system. Therefore, infiltration is not considered to be a suitable option.
Watercourse	X	The nearest watercourse is the Bridgewater Canal which is approximately 65m north-west of the site beyond 3rd party land. Therefore, discharge to watercourse is not considered to be a feasible option.
Surface Water Sewer	X	There are no surface water public sewers in the vicinity of the site. There is a highway drain (MCC) located adjacent to the site at the junction of Ellesmere Street/Egerton Street however to connect into this would require adoption of the drain by United Utilities under Section 102 agreement. MCC have advised that as there are alternative options for drainage, the solution should utilise connections into the public sewers. Therefore, discharge to a surface water sewer/highway drain is not considered viable.
Combined Water Sewer	✓	The nearest public sewers are located north and west of the development site. It is assumed that there are existing connections into the public sewer network which could be reused where suitable. United Utilities have confirmed that connection can be made into the public sewer network at an unrestricted rate.

Based on the above, the proposals are to discharge surface water to the combined public sewers at a restricted rate. The proposed flow rates will be restricted to a maximum of 50% of the pre-development flow rates with an allowance of 40% climate change for the proposed 100-year event. The restriction of 50% pre-development flow rates is based on Manchester City Council SuDS requirements. The 40% climate change allowance is based on Environment Agency guidance for developments. **Note that SuDS in the form of green roofs and permeable surfacing are included in the layout of the development.**

Therefore, the proposed flow rates should not exceed:

- 1 year = 15.25 l/s
- 30 year = 36.7 l/s
- 100 year + 40%cc = 45.2 l/s

The flow rates currently modelled achieve the 1-year flow restriction of 15.25 l/s.

Use of SuDS has therefore been assessed and the current strategy proposes the use of permeable paving externally **within the parking bays**, which is currently assumed to consist of a 300mm stone layer providing 30% void for attenuation. The permeable paving is currently included in the drainage strategy model. **To further achieve the required attenuation volumes, a geocellular attenuation tank will also be incorporated into the design layout. The proposals also indicate that a roof garden is to be incorporated on building 1, and this would provide additional sustainable benefit. However, this element has not been included in the drainage calculations at this stage until final construction details are available. It is assumed for hydraulic modelling purposes that a worse case scenario of the green roof being fully saturated at the time of the peak storm, thus a full impermeable area has been allocated.**

Refer to drawing 071713-CUR-XX-00-DR-C-92500_P02 PROPOSED DRAINAGE LAYOUT enclosed in Appendix A and proposed Landscape details enclosed in Appendix E.

Details of surface water attenuation that offers a reduction in surface water runoff rate in line with the Manchester Trafford and Salford Strategic Flood Risk Assessment, i.e., at least a 50% reduction in runoff rate compared to the existing rates, as the site is located within Conurbation Core Critical Drainage Area.

The existing site has previous industrial use and would be considered Brownfield. The existing drainage network on site is unknown, however the run-off rate from the existing site has been estimated by creation of an existing assumed model discharging 0.3ha of run-off. The 1 in 1-, 30- and 100-year return periods have been simulated and the flow rates are as follows:

- 1 year = 30.5 l/s
- 30 year = 73.4 l/s
- 100 year = 90.4 l/s

The proposed flow rates will be restricted to a maximum of 50% of the pre-development flow rates with an allowance of 40% climate change for the proposed 100-year event. The restriction of 50% pre-development flow rates is based on Manchester City Council SuDS requirements. The 40% climate change allowance is based on Environment Agency guidance for developments.

Therefore, the proposed flow rates should not exceed:

- 1 year = 15.25 l/s
- 30 year = 36.7 l/s
- 100 year +40%cc = 45.2 l/s

The flow rates currently modelled achieve the 1-year flow restriction of 15.25 l/s up to the 100-year design event.

Refer to Micro-Drainage Calculations: Assumed existing 1, 30 and 100 Year +40%cc events and Assumed Proposed 1, 30 and 100 Year +40%cc events enclosed in Appendix B.

Runoff volume in the 1 in 100-year, 6 hours rainfall shall be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but never to exceed the runoff volume from the development site prior to redevelopment.

The volumes generated from the existing site in the 100 year 6-hour event is approximately 150.926m³. The volumes generated from the proposed site in the 100 year 6-hour event is approximately 173.979m³. The proposed volumes from site in the 100-year 6-hour event is 173.979m³, which exceeds the existing 100-year event volumes by 15%. However, it is noted that the proposed development includes a large area of green roof and also permeable surfacing to the parking area that allow the rainwater to evaporate and soak into the ground, thus reducing the volume of water entering the downstream sewer network. Therefore with this and the fact the majority of the proposed flows are restricted to 1-year peak event, there is an overall post development betterment.

Refer to the Micro-Drainage Calculations: Assumed Existing SW 100 Yr 6Hr Volumes and Assumed Proposed SW 100 Yr 6Hr Volumes enclosed in Appendix B.

Evidence that the drainage system has been designed (unless an area is designated to hold and/or convey water as part of the design) so that flooding does not occur during a 1 in 100-year rainfall event with allowance for climate change in any part of a building.

The system has been designed to accommodate the 100-year event with an allowance of 40% climate change.

Refer to drawing 071713- CUR-XX-00-DR-C-92500_ P02 PROPOSED DRAINAGE LAYOUT enclosed in Appendix A and Micro-Drainage Calculations: Proposed 1, 30 and 100 Year +40%cc events enclosed in Appendix B. **The modelling has identified 1.3m³ of exceedance flooding for the enhanced storm event. This will be retained in the low-lying permeable surfacing area in the centre of the car park and thus not impact on the proposed finish flood levels.**

Assessment of overland flow routes for extreme events that is diverted away from buildings (including basements). Overland flow routes need to be designed to convey the flood water in a safe manner in the event of a blockage or exceedance of the proposed drainage system capacity including inlet structures. A layout with overland flow routes needs to be presented with appreciation of these overland flow routes with regards to the properties on site and adjacent properties off site.

Refer to the Overland Flow Routes drawing enclosed in Appendix C.

The modelling has identified 1.3m³ of exceedance flooding for the enhanced storm event. This will be retained in the low-lying permeable surfacing area in the centre of the car park and thus not impact on the proposed finish flood levels.

Hydraulic calculation of the proposed drainage system.

Refer to the Micro-Drainage Calculations enclosed in Appendix B.

Construction details of flow control and SuDS elements

The construction details are not currently available for the drainage proposals. At present the SuDS proposed on the scheme is permeable paving, the detail of which will be subject to the chosen permeable surface finish. The flow control is currently modelled as a hydro-brake flow control; however, the detailed design should confirm the specific product chosen.

Typical Hydro-brake details for the modelled product is enclosed in Appendix D and proposed Landscape details enclosed in Appendix E.

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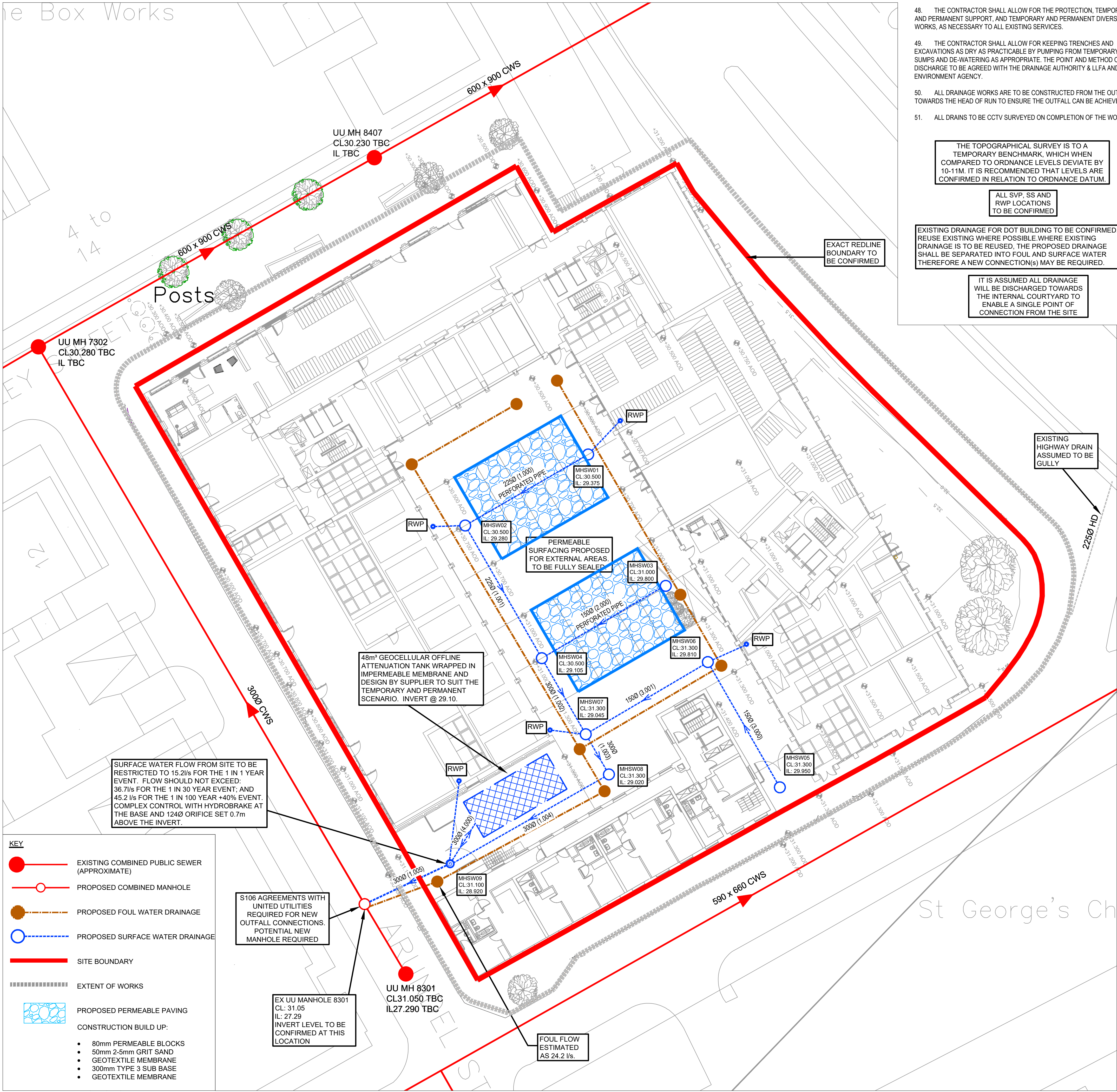


Appendix A

Proposed Drawing:

071713- CUR-XX-00-DR-C-92500_ **P02 PROPOSED DRAINAGE LAYOUT**

ie Box Works



THE TOPOGRAPHICAL SURVEY IS TO A TEMPORARY BENCHMARK, WHICH WHEN COMPARED TO ORDNANCE LEVELS DEVIATE BY 10-11M. IT IS RECOMMENDED THAT LEVELS ARE CONFIRMED IN RELATION TO ORDNANCE DATUM.

ALL SVP, SS AND RWP LOCATIONS TO BE CONFIRMED

EXISTING DRAINAGE FOR DOT BUILDING TO BE CONFIRMED. REUSE EXISTING WHERE POSSIBLE. WHERE EXISTING DRAINAGE IS TO BE REUSED, THE PROPOSED DRAINAGE SHALL BE SEPARATED INTO FOUL AND SURFACE WATER THEREFORE A NEW CONNECTION(S) MAY BE REQUIRED.

IT IS ASSUMED ALL DRAINAGE WILL BE DISCHARGED TOWARDS THE INTERNAL COURTYARD TO ENABLE A SINGLE POINT OF CONNECTION FROM THE SITE

20. BACKFILL TO DRAINAGE TRENCHES UNDER HARDSTANDING AREAS TO BE TYPE 1 SUB BASE MATERIAL. ELSEWHERE BACKFILL TO BE FREE DRAINING READILY COMPATIBLE MATERIAL FREE FROM RUBBISH AND ORGANIC MATTER, FROZEN SOIL, CLAY LUMPS AND LARGE STONES. TO BE COMPACTED IN LAYERS NOT EXCEEDING 150mm THICK.

21. BEDDING AND BACKFILL MATERIALS TO CONFORM TO THE REQUIREMENTS OF WIS 4-08-02 (TABLE A2).

22. WHERE FOUL SEWERS RUN ABOVE SURFACE SEWERS, CONCRETE PROTECTION MAY BE REQUIRED AT CROSSOVERS TO PREVENT ANY POTENTIAL CONTAMINATION.

23. THE FIRST PIPE OUT OF MANHOLES TO BE AS SHORT AS PRACTICABLE SO AS TO PROVIDE A FLEXIBLE JOINT AS CLOSE AS POSSIBLE TO THE OUTSIDE FACE OF THE CONCRETE SURROUND AND CONNECTED TO A LENGTH OF ROCKER PIPE.

24. ALL CONNECTIONS PASSING THROUGH BASES OR EDGE BEAMS TO BE IN SEALED SLEEVES. ALTERNATIVELY CONNECTIONS MAY BE CAST-IN WITH FLEXIBLE JOINTS NOT GREATER THAN 150MM FROM FACE OF CONCRETE.

25. WHERE DRAINAGE PIPES ARE LESS THAN 300mm BELOW THE UNDERSIDE OF THE GROUND FLOOR SLAB, CONCRETE ENCASEMENT IS REQUIRED (CLASS 2). COMPRESSIBLE JOINTS ARE TO BE PROVIDED AT EVERY PIPE JOINT WITHIN THE CONCRETE.

26. WHERE PIPES ARE MORE THAN 300mm BELOW THE UNDERSIDE OF THE SLAB, CLASS 5 BEDDING IS ACCEPTABLE.

27. SEWER PIPES TO BE LAID IN MAXIMUM 3 METRE LENGTHS UNLESS THERE IS A SPECIFIC OPERATIONAL NEED TO LAY LONGER LENGTHS.

28. PLASTIC CHANNEL SECTIONS WILL NOT BE PERMITTED WITHIN MANHOLE CHAMBERS. CLAYWARE CHANNELS SHALL BE USED WITHIN MANHOLES FOR PIPE SIZES UP TO AND INCLUDING 300mm DIAMETER.

29. ALL NEW CONNECTIONS INTO EXISTING MANHOLES (OR INTO EXISTING SEWERS) TO BE 'SOFFITS LEVEL' UNLESS OTHERWISE NOTED.

30. SULPHATE RESISTANT CEMENT (C20-DC2) AND PRECAST CONCRETE PRODUCTS MUST BE USED OR A LABORATORY REPORT PROVIDED TO PROVE THAT SUCH PRECAUTIONS ARE NOT REQUIRED.

31. SEWERS MUST HAVE 5m CLEARANCE FROM TREES AND HEDGES OR TO HAVE SUITABLE ROOT PROTECTION IN ACCORDANCE WITH SFA REQUIREMENTS.

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

33. ALL INTERNAL DRAINAGE CONNECTIONS ARE PROVIDED TO THE PENETRATION POSITIONS SHOWN ON ARCHITECT AND M&E DRAWINGS. REFER TO DIMENSIONED LOCATIONS ON ARCHITECT'S GROUND FLOOR SETTING-OUT PLANS.

34. RAINWATER AND FOUL WATER POP UP LOCATIONS AND SIZES TO BE CONFIRMED BY ARCHITECT AND M&E ENGINEER.

35. ALL UNDERGROUND FOUL DRAINAGE SHOULD BE SUITABLY VENTED AT OR NEAR TO THE HEAD OF RUNS.

36. ALL ACCESS FITTINGS, STACKS, RWPS AND GULLIES TO BE RODDABLE. ALL TO HAVE LOW LEVEL RODDING ACCESS PLATES UNLESS AN ALTERNATIVE MEANS OF ACCESS IS AGREED. ACCESS POINT TO BE ABOVE ANY GROUND FLOOR CONNECTED APPLIANCE SPILL LEVEL.

37. LARGE ACCESS FITTING REQUIRED ABOVE GROUND WHERE GREATER THAN 12M UP TO 22M TO A JUNCTION. SMALL ACCESS FITTING REQUIRED UP TO 12M TO A JUNCTION.

38. ALL GULLY AND CHANNEL DRAIN OUTLETS AND TERMINATION POINTS TO BE TRAPPED AND RODDABLE. INTERNAL GULLIES AND CHANNEL DRAINS TO BE SPECIFIED BY OTHERS.

39. ALL BRANCH CONNECTIONS TO BE MADE WITH SWEEPED BENDS IN THE DIRECTION OF FLOW IN THE MAIN SEWER.

40. WHERE NO W/C'S ARE CONNECTED UPSTREAM, UNDERSLAB FW DRAINAGE TO BE LAID AT 1:40 MIN. AFTER THE CONNECTION OF AT LEAST 1NO WC, A MIN. FALL OF 1:80 APPLIES.

41. ALL INTERNAL COVERS TO HAVE MECHANICALLY JOINTED CORNERS AND DOUBLE SEALED WITH RECESSED TRAY TO ALLOW FOR FINISHES.

42. ALL MANHOLE COVERS IN BLOCK/SLAB AND EXTERNAL PAVING AREAS TO HAVE RECESSED COVERS OF THE APPROPRIATE GRADE TO ACCEPT ARCHITECT'S PAVING PROPOSAL.

43. UNLESS NOTED OTHERWISE IN THE MANHOLE SCHEDULE, ALL MANHOLE, GULLY AND CHANNEL COVERS (IRONWORK) SHOULD BE THE FOLLOWING SPECIFICATION:

- B125 LOAD CLASS IN PEDESTRIAN AREAS
- D400 LOAD CLASS IN VEHICULAR AREAS.

44. COVER LEVELS, GULLY POSITIONS, AND BUILDING LOCATION ARE APPROXIMATE AND SHALL BE CONFIRMED BY ARCHITECT/LANDSCAPE ARCHITECT. CONTRACTOR TO ALLOW FOR ADJUSTMENT TO SUIT AGREED POSITIONS AND FINISHED LEVELS, AND CONFIRM ALL COVER LEVELS ON SITE.

45. OUTFALL CONNECTION(S) SUBJECT TO AGREEMENT WITH THE APPROVING AUTHORITY.

46. THE CONTRACTOR SHALL COMPLY WITH THE FOLLOWING:-
(I). ALL OPERATIONS SHOULD BE CARRIED OUT IN ACCORDANCE WITH THE GENERAL HEALTH AND SAFETY POLICY OF THE DEVELOPER AS REQUIRED BY SECTIONS 2 OF THE HEALTH AND SAFETY AT WORK ACT 1974 AND IN PARTICULAR THE CONSTRUCTION (GENERAL PROVISIONS) REGULATIONS.

(II). THE LOCAL AUTHORITY AND UTILITIES COMPANIES ARE TO BE NOTIFIED PRIOR TO COMMENCEMENT OF WORK ON SITE.

(III). PRIOR TO CONSTRUCTION THE ACTUAL POSITIONS AND DEPTHS OF SERVICES LIKELY TO BE AFFECTED BY THE WORKS SHOULD BE ESTABLISHED BY MEANS OF HAND DIG IN CLOSE LIAISON WITH THE UTILITY COMPANIES. THE CONTRACTOR SHALL IMMEDIATELY ADVISE THE ENGINEER OF ANY SERVICES EXPOSED WHICH MAY AFFECT THE DESIGN.

(IV). ALL OPERATIVES WORKING ON THE HIGHWAY WORKS MUST HAVE STREET WORKS ACCREDITATION.

47. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ENSURING THAT PIPES ARE ADEQUATELY PROTECTED FROM CONCENTRATED LOADING BY CONSTRUCTION TRAFFIC DURING THE CONSTRUCTION PERIOD.

GENERAL NOTES:

- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
- DO NOT SCALE THIS DRAWING. ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS SHALL BE BROUGHT TO THE ENGINEERS ATTENTION IMMEDIATELY. ALL DIMENSIONS MUST BE CHECKED / VERIFIED ON SITE.
- ALL DIMENSIONS ARE IN METRES UNLESS SPECIFIED OTHERWISE.
- FOR GENERAL NOTES REFER TO DRAWING.
- THE CONTRACTOR MAY WISH TO SURVEY ALL EXISTING DRAINAGE PRIOR TO COMMENCEMENT TO CONFIRM LOCATION AND CONDITION OF EXISTING DRAINAGE. POTENTIAL PRE-CLEANINGS TO BE UNDERTAKEN IN ORDER TO FACILITATE SURVEY IF REQUIRED.
- EXISTING SEWER LOCATIONS WHERE THE PROPOSED DRAINAGE IS TO CONNECT, ARE TO BE SURVEYED AND EXACT LEVELS CONFIRMED AND PROVIDED TO ENGINEER PRIOR TO COMMENCEMENT OF WORKS.
- ALL EXISTING SERVICES TO BE LOCATED PRIOR TO COMMENCEMENT OF ANY DRAINAGE WORKS, AND WHERE NECESSARY PROTECTION OR DIVERSIONS TO BE UNDERTAKEN TO AVOID CONFLICT WITH THE PROPOSED WORK.
- ALL EXISTING DRAINS TO BE ABANDONED SHALL BE EITHER GRUBBED OR GROUTED UP. GROUTING TO BE PERFORMED BY CAPPING ALL ENDS / CONNECTIONS AND FILLING THE RETAINING VOID WITH GROUT, IN ACCORDANCE WITH CIVIL ENGINEERING SPECIFICATION FOR THE WATER INDUSTRY 7th EDITION (CESWI) 7TH EDITION.
- ALL SOFT SPOTS TO BE REMOVED FROM BOTTOM OF EXCAVATIONS AND TO BE REFILLED TO FORMATION LEVEL WITH THE SAME MATERIAL AS PERMANENT WORKS WHICH REST IN IT.
- FILLED GROUND MUST BE FILLED AND CONSOLIDATED BEFORE ANY SEWER WORKS ARE CARRIED OUT.
- ALL ADAPTABLE DRAINAGE WORKS INCLUDING WORKS TO EXISTING PUBLIC SEWERS TO BE UNDERTAKEN IN ACCORDANCE WITH "SEWERS FOR ADOPTION 7th EDITION" AND "CIVIL ENGINEERING SPECIFICATION FOR THE WATER INDUSTRY 7th EDITION" AND CONSTRUCTED TO THE RELEVANT STATUTORY UNDERTAKERS DETAILS.
- ALL PRIVATE DRAINAGE WORKS TO BE IN ACCORDANCE WITH "CIVIL ENGINEERING SPECIFICATION FOR THE WATER INDUSTRY 7th EDITION", BS EN 752 2008 DRAIN AND SEWER SYSTEMS OUTSIDE BUILDINGS AND THE BUILDING REGULATIONS APPROVED 'DOCUMENT H'.
- ALL SEWERS, UNLESS AGREED OTHERWISE STATED, SHALL BE:
 - 150mm DIA TO BE VITRIFIED CLAY.
 - 225mm DIA TO BE VITRIFIED CLAY.
 - 300mm DIA TO BE VITRIFIED CLAY.
 - 375mm DIA AND GREATER TO BE CLASS 120 CONCRETE PIPES.
- ALL PIPE DIAMETERS GIVEN ARE NOMINAL INTERNAL PIPE DIAMETERS.
- PIPE MATERIALS IN ACCORDANCE WITH THE FOLLOWING:
 - ALL VITRIFIED CLAY PIPES TO BS EN 295-1.
 - ALL CONCRETE PIPES TO BE TO BS EN 1916.
 - ALL CONCRETE MANHOLES TO BE TO BS EN1917.
- AS AN ALTERNATIVE THE CONTRACTOR MAY USE AN APPROVED UNPLASTICISED POLYVINYL CHLORIDE (PVCU).
- ALL ADAPTABLE DRAINAGE PIPES WILL REQUIRE A MINIMUM OF 1200mm COVER, IN ACCORDANCE WITH SEWERAGE UNDERTAKERS REQUIREMENTS.
- ALL PRIVATE DRAINAGE PIPES WITH A COVER OF LESS THAN 600mm IN NON-TRAFFICKED AREAS AND LESS THAN 900mm IN TRAFFICKED AREAS TO BE BEDDED AND SURROUNDED IN CONCRETE (CLASS 2), COMPRESSIBLE MATERIAL SHALL BE PROVIDED AT EVERY PIPE JOINT. WHERE COVER EXCEEDS THIS DEPTH, PIPES ARE TYPICALLY BEDDED AND SURROUNDED IN CLASS 5. REFER TO PIPE EMBEDMENT DETAILS DRAWING FOR SPECIFIC TYPES.

P02	SW NETWORK UPDATED TO SUIT HYDRAULIC MODEL	11.07.22	OJT	CG
P01	UPDATED PROPOSALS FOR PLANNING	15.03.19	OJT	CG
Rev:	Description:	Date:	By:	Chk:

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Status: PRELIMINARY

Project: ARUNDEL STREET

Orig Title: PROPOSED DRAINAGE LAYOUT

Size:	Date:	Drawn By:	Designed By:	Checked By:
A1	07/03/17	OJT	CG	CG
Scale:	1:200			
Project No:	Originator:	Volume:	Level:	Type:
				Role:
				Category / Number:
				Rev:

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Appendix B

Calculations:

Micro-Drainage Calculations: Assumed existing 1, 30 and 100 Year +40%cc events

Micro-Drainage Calculations: Assumed Proposed 1, 30 and 100 Year +40%cc events – V2

Micro-Drainage Calculations: Assumed Existing SW 100 Yr 6Hr Volumes

Micro-Drainage Calculations: Assumed Proposed SW 100 Yr 6Hr Volumes

Curtins Consulting		Page 1
Merchant Exchange 17-19 Whitworth Street West Manchester M1 5WG	Arundel Street Manchester Assumed Existing	
Date February 2017 File Assumed SW For flows on...	Designed by CG Checked by	
Micro Drainage	Network 2014.1.1	

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)
1.000	o	225	1	21.000	20.000	0.775	Open Manhole	1200
2.000	o	225	2	21.000	20.000	0.775	Open Manhole	1200
2.001	o	225	3	21.000	19.700	1.075	Open Manhole	1200
1.001	o	225	4	21.000	19.650	1.125	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., L*W (mm)
1.000	50.000	142.9	4	21.000	19.650	1.125	Open Manhole	1200
2.000	50.000	166.7	3	21.000	19.700	1.075	Open Manhole	1200
2.001	10.000	200.0	4	21.000	19.650	1.125	Open Manhole	1200
1.001	10.000	200.0		31.000	19.600	11.175	Open Manhole	0

Curtins Consulting		Page 1
Merchant Exchange 17-19 Whitworth Street West Manchester M1 5WG	Arundel Street Manchester Assumed Existing	
Date February 2017	Designed by CG	
File Assumed SW For flows on...	Checked by	
Micro Drainage	Network 2014.1.1	

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

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.366
 Region England and Wales Cv (Summer) 0.750
 M5-60 (mm) 18.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600,
 720, 960, 1440, 2160, 2880, 4320, 5760,
 7200, 8640, 10080
 Return Period(s) (years) 30
 Climate Change (%) 0

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	30	0%	30/15	Summer			
2.000	15 Winter	30	0%	30/15	Summer			
2.001	15 Winter	30	0%	30/15	Summer			
1.001	15 Winter	30	0%	30/15	Summer			

PN	US/MH Name	Water		Flooded		Pipe		Status
		Level (m)	Surch'd Depth (m)	Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	
1.000	1	20.381	0.156	0.000	0.92	0.0	38.3	SURCHARGED
2.000	2	20.429	0.204	0.000	0.97	0.0	37.2	SURCHARGED
2.001	3	20.172	0.247	0.000	1.18	0.0	36.1	SURCHARGED
1.001	4	20.102	0.227	0.000	2.39	0.0	73.0	SURCHARGED

		Page 1
	Arundel Street Manchester Gravity Outfall V2 July 22	
Date 11/07/2022 File Arundel Proposed SW 11....	Designed by PG Checked by	
Innovyze	Network 2017.1.2	

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)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.355	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	0.259	4-8	0.097

Total Area Contributing (ha) = 0.356

Total Pipe Volume (m³) = 4.917

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
1.000	14.000	0.095	147.4	0.097	6.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	15.000	0.100	150.0	0.060	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	5.000	0.035	142.9	0.037	6.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	9.000	0.060	150.0	0.000	0.00	0.0	0.600	o	300	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)
1.000	50.00	6.22	29.375	0.097	0.0	0.0	0.0	1.07	42.7	13.1
1.001	50.00	6.45	29.280	0.157	0.0	0.0	0.0	1.07	42.4	21.3
2.000	50.00	6.10	29.800	0.037	0.0	0.0	0.0	0.84	14.8	5.0
1.002	50.00	6.57	29.105	0.194	0.0	0.0	0.0	1.28	90.6	26.3

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Arundel Street
Manchester
Gravity Outfall V2 July 22



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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
3.000	14.000	0.140	100.0	0.020	4.00	0.0	0.600	o	150	Pipe/Conduit		
3.001	14.000	0.140	100.0	0.046	0.00	0.0	0.600	o	150	Pipe/Conduit		
1.003	4.000	0.025	160.0	0.040	0.00	0.0	0.600	o	300	Pipe/Conduit		
1.004	18.000	0.100	180.0	0.036	0.00	0.0	0.600	o	300	Pipe/Conduit		
4.000	5.000	0.025	200.0	0.000	4.00	0.0	0.600	o	300	Pipe/Conduit		
1.005	9.000	0.060	150.0	0.020	0.00	0.0	0.600	o	300	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)
3.000	50.00	4.23	29.950	0.020	0.0	0.0	0.0	1.00	17.8	2.7
3.001	50.00	4.46	29.810	0.066	0.0	0.0	0.0	1.00	17.8	8.9
1.003	50.00	6.62	29.045	0.300	0.0	0.0	0.0	1.24	87.7	40.6
1.004	50.00	6.88	29.020	0.336	0.0	0.0	0.0	1.17	82.6	45.5
4.000	50.00	4.08	29.100	0.000	0.0	0.0	0.0	1.11	78.3	0.0
1.005	50.00	7.00	28.920	0.356	0.0	0.0	0.0	1.28	90.6	48.2

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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., (mm)	L*W
1.000	o	225	SW01	30.500	29.375	0.900	Open Manhole		1200
1.001	o	225	SW02	30.500	29.280	0.995	Open Manhole		1200
2.000	o	150	SW03	31.000	29.800	1.050	Open Manhole		1200
1.002	o	300	SW04	31.000	29.105	1.595	Open Manhole		1200
3.000	o	150	SW05	31.300	29.950	1.200	Open Manhole		1200
3.001	o	150	SW06	31.300	29.810	1.340	Open Manhole		1200
1.003	o	300	SW07	31.300	29.045	1.955	Open Manhole		1200
1.004	o	300	SW08	31.300	29.020	1.980	Open Manhole		1200
4.000	o	300	TANK	31.100	29.100	1.700	Open Manhole		1200
1.005	o	300	SW09	31.100	28.920	1.880	Open Manhole		1500

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	14.000	147.4	SW02	30.500	29.280	0.995	Open Manhole		1200
1.001	15.000	150.0	SW04	31.000	29.180	1.595	Open Manhole		1200
2.000	5.000	142.9	SW04	31.000	29.765	1.085	Open Manhole		1200
1.002	9.000	150.0	SW07	31.300	29.045	1.955	Open Manhole		1200
3.000	14.000	100.0	SW06	31.300	29.810	1.340	Open Manhole		1200
3.001	14.000	100.0	SW07	31.300	29.670	1.480	Open Manhole		1200
1.003	4.000	160.0	SW08	31.300	29.020	1.980	Open Manhole		1200
1.004	18.000	180.0	SW09	31.100	28.920	1.880	Open Manhole		1500
4.000	5.000	200.0	SW09	31.100	29.075	1.725	Open Manhole		1500
1.005	9.000	150.0		31.050	28.860	1.890	Open Manhole		1500

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)
1.005		31.050	28.860	27.290	1500	0

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<u>Simulation Criteria for Storm</u> Volumetric Runoff Coeff 0.840 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) 720 Foul Sewage per hectare (l/s) 0.000 Output Interval (mins) 6 Number of Input Hydrographs 0 Number of Storage Structures 3 Number of Online Controls 1 Number of Time/Area Diagrams 0 Number of Offline Controls 0 Number of Real Time Controls 0 <u>Synthetic Rainfall Details</u> Rainfall Model FSR Profile Type Winter Return Period (years) 1 Cv (Summer) 0.750 Region England and Wales Cv (Winter) 0.840 M5-60 (mm) 18.000 Storm Duration (mins) 360 Ratio R 0.355		
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Online Controls for Storm

Complex Manhole: SW09, DS/PN: 1.005, Volume (m³): 5.3

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0179-1520-0700-1520
Design Head (m)	0.700
Design Flow (l/s)	15.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	179
Invert Level (m)	28.920
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	15.2
Flush-Flo™	0.279	15.2
Kick-Flo®	0.532	13.3
Mean Flow over Head Range	-	12.4

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)
0.100	6.3	1.200	19.6	3.000	30.4	7.000	45.9
0.200	14.9	1.400	21.1	3.500	32.8	7.500	47.2
0.300	15.2	1.600	22.5	4.000	35.0	8.000	48.8
0.400	14.8	1.800	23.8	4.500	37.0	8.500	50.3
0.500	13.9	2.000	25.1	5.000	39.0	9.000	51.7
0.600	14.1	2.200	26.2	5.500	40.8	9.500	53.2
0.800	16.2	2.400	27.3	6.000	42.6		
1.000	18.0	2.600	28.4	6.500	44.2		

Orifice

Diameter (m) 0.124 Discharge Coefficient 0.600 Invert Level (m) 29.620

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<u>Storage Structures for Storm</u> <u>Porous Car Park Manhole: SW01, DS/PN: 1.000</u> <table><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.00000</td><td>Width (m)</td><td>12.0</td></tr><tr><td>Membrane Percolation (mm/hr)</td><td>1000</td><td>Length (m)</td><td>9.6</td></tr><tr><td>Max Percolation (l/s)</td><td>32.0</td><td>Slope (1:X)</td><td>1000.0</td></tr><tr><td>Safety Factor</td><td>2.0</td><td>Depression Storage (mm)</td><td>5</td></tr><tr><td>Porosity</td><td>0.30</td><td>Evaporation (mm/day)</td><td>3</td></tr><tr><td>Invert Level (m)</td><td>30.000</td><td>Cap Volume Depth (m)</td><td>0.300</td></tr></table> <u>Porous Car Park Manhole: SW03, DS/PN: 2.000</u> <table><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.00000</td><td>Width (m)</td><td>12.0</td></tr><tr><td>Membrane Percolation (mm/hr)</td><td>1000</td><td>Length (m)</td><td>9.6</td></tr><tr><td>Max Percolation (l/s)</td><td>32.0</td><td>Slope (1:X)</td><td>1000.0</td></tr><tr><td>Safety Factor</td><td>2.0</td><td>Depression Storage (mm)</td><td>5</td></tr><tr><td>Porosity</td><td>0.30</td><td>Evaporation (mm/day)</td><td>3</td></tr><tr><td>Invert Level (m)</td><td>30.500</td><td>Cap Volume Depth (m)</td><td>0.300</td></tr></table> <u>Cellular Storage Manhole: TANK, DS/PN: 4.000</u> <table><tr><td>Invert Level (m)</td><td>29.100</td><td>Safety Factor</td><td>2.0</td></tr><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.00000</td><td>Porosity</td><td>0.95</td></tr><tr><td>Infiltration Coefficient Side (m/hr)</td><td>0.00000</td><td></td><td></td></tr></table> <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>40.0</td><td>40.0</td><td>5.200</td><td>0.0</td><td>70.4</td></tr><tr><td>0.400</td><td>40.0</td><td>50.1</td><td>5.600</td><td>0.0</td><td>70.4</td></tr><tr><td>0.800</td><td>40.0</td><td>60.2</td><td>6.000</td><td>0.0</td><td>70.4</td></tr><tr><td>1.200</td><td>40.0</td><td>70.4</td><td>6.400</td><td>0.0</td><td>70.4</td></tr><tr><td>1.201</td><td>0.0</td><td>70.4</td><td>6.800</td><td>0.0</td><td>70.4</td></tr><tr><td>2.000</td><td>0.0</td><td>70.4</td><td>7.200</td><td>0.0</td><td>70.4</td></tr><tr><td>2.400</td><td>0.0</td><td>70.4</td><td>7.600</td><td>0.0</td><td>70.4</td></tr><tr><td>2.800</td><td>0.0</td><td>70.4</td><td>8.000</td><td>0.0</td><td>70.4</td></tr><tr><td>3.200</td><td>0.0</td><td>70.4</td><td>8.400</td><td>0.0</td><td>70.4</td></tr><tr><td>3.600</td><td>0.0</td><td>70.4</td><td>8.800</td><td>0.0</td><td>70.4</td></tr><tr><td>4.000</td><td>0.0</td><td>70.4</td><td>9.200</td><td>0.0</td><td>70.4</td></tr><tr><td>4.400</td><td>0.0</td><td>70.4</td><td>9.600</td><td>0.0</td><td>70.4</td></tr><tr><td>4.800</td><td>0.0</td><td>70.4</td><td>10.000</td><td>0.0</td><td>70.4</td></tr></table>			Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	12.0	Membrane Percolation (mm/hr)	1000	Length (m)	9.6	Max Percolation (l/s)	32.0	Slope (1:X)	1000.0	Safety Factor	2.0	Depression Storage (mm)	5	Porosity	0.30	Evaporation (mm/day)	3	Invert Level (m)	30.000	Cap Volume Depth (m)	0.300	Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	12.0	Membrane Percolation (mm/hr)	1000	Length (m)	9.6	Max Percolation (l/s)	32.0	Slope (1:X)	1000.0	Safety Factor	2.0	Depression Storage (mm)	5	Porosity	0.30	Evaporation (mm/day)	3	Invert Level (m)	30.500	Cap Volume Depth (m)	0.300	Invert Level (m)	29.100	Safety Factor	2.0	Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95	Infiltration Coefficient Side (m/hr)	0.00000			Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	40.0	40.0	5.200	0.0	70.4	0.400	40.0	50.1	5.600	0.0	70.4	0.800	40.0	60.2	6.000	0.0	70.4	1.200	40.0	70.4	6.400	0.0	70.4	1.201	0.0	70.4	6.800	0.0	70.4	2.000	0.0	70.4	7.200	0.0	70.4	2.400	0.0	70.4	7.600	0.0	70.4	2.800	0.0	70.4	8.000	0.0	70.4	3.200	0.0	70.4	8.400	0.0	70.4	3.600	0.0	70.4	8.800	0.0	70.4	4.000	0.0	70.4	9.200	0.0	70.4	4.400	0.0	70.4	9.600	0.0	70.4	4.800	0.0	70.4	10.000	0.0	70.4
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<u>1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)</u> <u>for Storm</u>								
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 Storage Structures 3						
Number of Online Controls 1		Number of Time/Area Diagrams 0						
Number of Offline Controls 0		Number of Real Time Controls 0						
Synthetic Rainfall Details								
Rainfall Model		FSR	Ratio R 0.355					
Region England and Wales Cv (Summer)		0.750						
M5-60 (mm)		18.000 Cv (Winter)	0.840					
Margin for Flood Risk Warning (mm)		300.0						
Analysis Timestep 2.5 Second Increment (Extended)								
DTS Status		OFF						
DVD Status		ON						
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) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	SW01	15 Winter	1	+0%	30/15 Summer	100/15 Winter		
1.001	SW02	15 Winter	1	+0%	30/15 Summer			
2.000	SW03	15 Winter	1	+0%	30/30 Winter			
1.002	SW04	15 Winter	1	+0%	1/15 Winter			
3.000	SW05	15 Summer	1	+0%	100/15 Summer			
3.001	SW06	15 Winter	1	+0%	30/15 Summer			
1.003	SW07	15 Winter	1	+0%	1/15 Summer			
1.004	SW08	15 Winter	1	+0%	1/15 Summer			
4.000	TANK	30 Winter	1	+0%	30/15 Summer			
1.005	SW09	15 Winter	1	+0%	1/15 Summer			
		Water Level	Surcharged Depth	Flooded Volume	Flow / Overflow Cap.	Pipe Flow (l/s)	Status	Level Exceeded
PN	US/MH Name	(m)	(m)	(m³)	(l/s)	(l/s)		
1.000	SW01	29.469	-0.131	0.000	0.29	10.8	OK	3
1.001	SW02	29.453	-0.052	0.000	0.43	16.1	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 Storage Structures	3
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.355
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

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

Profile(s)

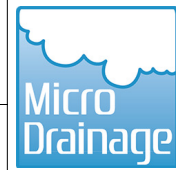
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	SW01	30 Winter	30	+0%	30/15 Summer	100/15 Winter		
1.001	SW02	30 Winter	30	+0%	30/15 Summer			
2.000	SW03	30 Winter	30	+0%	30/30 Winter			
1.002	SW04	30 Winter	30	+0%	1/15 Winter			
3.000	SW05	15 Winter	30	+0%	100/15 Summer			
3.001	SW06	15 Winter	30	+0%	30/15 Summer			
1.003	SW07	30 Winter	30	+0%	1/15 Summer			
1.004	SW08	30 Winter	30	+0%	1/15 Summer			
4.000	TANK	30 Winter	30	+0%	30/15 Summer			
1.005	SW09	30 Winter	30	+0%	1/15 Summer			

PN	US/MH Name	Water Level	Surcharged Depth	Flooded Volume	Flow / Overflow	Pipe Flow	Status	Level
		(m)	(m)	(m³)	Cap. (l/s)	(l/s)		Exceeded
1.000	SW01	30.010	0.410	0.000	0.60	22.4	SURCHARGED	3
1.001	SW02	29.992	0.487	0.000	0.97	36.3	SURCHARGED	

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Arundel Street
Manchester
Gravity Outfall V2 July 22



Date 11/07/2022
File Arundel Proposed SW 11....

Designed by PG
Checked by

Innovyze

Network 2017.1.2

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 Coeffiecient	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 Storage Structures	3
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.355
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

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

US/MH			Return	Climate	First (X)		First (Y)	First (Z)	Overflow
PN	Name	Storm	Period	Change	Surcharge		Flood	Overflow	Act.
1.000	SW01	30	Winter	100	+40%	30/15 Summer	100/15 Winter		
1.001	SW02	60	Winter	100	+40%	30/15 Summer			
2.000	SW03	60	Winter	100	+40%	30/30 Winter			
1.002	SW04	60	Winter	100	+40%	1/15 Winter			
3.000	SW05	15	Winter	100	+40%	100/15 Summer			
3.001	SW06	15	Winter	100	+40%	30/15 Summer			
1.003	SW07	60	Winter	100	+40%	1/15 Summer			
1.004	SW08	60	Winter	100	+40%	1/15 Summer			
4.000	TANK	60	Winter	100	+40%	30/15 Summer			
1.005	SW09	60	Winter	100	+40%	1/15 Summer			

PN	US/MH Name	Water	Surcharged	Flooded			Pipe	Status	Level Exceeded
		Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (1/s)	Flow (1/s)		
1.000	SW01	30.501	0.901	1.419	0.58		21.7	FLOOD	3
1.001	SW02	30.482	0.977	0.000	0.83		30.9	FLOOD RISK	

**360 minute 100 year Winter I+0%
Average Rainfall Intensity 9.847 mm/hr**

Storm Selector

360 minute 100 year Winter I+0%

Time (mins)	US Level (m)	DS Level (m)	Surcharged Depth (m)	Pipe Velocity (m/s)	Pipe Flow (l/s)
6	19.665	19.623	-0.210	0.2	0.2
12	19.679	19.623	-0.196	0.4	0.8
18	19.688	19.623	-0.187	0.4	1.7
24	19.694	19.623	-0.181	0.5	2.4
30	19.696	19.623	-0.179	0.5	2.8
36	19.697	19.623	-0.178	0.5	2.9
42	19.698	19.623	-0.177	0.5	3.1
48	19.698	19.623	-0.177	0.5	3.1
54	19.698	19.623	-0.177	0.5	3.1
60	19.698	19.623	-0.177	0.5	3.1
66	19.698	19.623	-0.177	0.5	3.1
72	19.699	19.623	-0.176	0.5	3.2
78	19.700	19.623	-0.175	0.5	3.3
84	19.701	19.623	-0.174	0.5	3.6
90	19.705	19.623	-0.170	0.5	4.0
96	19.707	19.623	-0.168	0.6	4.3
102	19.712	19.623	-0.163	0.6	5.0
108	19.716	19.623	-0.159	0.6	5.5
114	19.722	19.623	-0.153	0.6	6.5
120	19.726	19.623	-0.149	0.6	7.2
126	19.732	19.623	-0.143	0.7	8.4
132	19.737	19.623	-0.138	0.7	9.2
138	19.743	19.623	-0.132	0.7	10.7
144	19.747	19.623	-0.128	0.7	11.4
150	19.754	19.623	-0.121	0.7	12.9
156	19.758	19.623	-0.117	0.7	13.8
162	19.763	19.623	-0.112	0.8	15.0
168	19.766	19.623	-0.109	0.8	15.7
174	19.770	19.623	-0.105	0.8	16.8
180	19.772	19.623	-0.103	0.8	17.2
186	19.773	19.623	-0.102	0.8	17.6
192	19.771	19.623	-0.104	0.8	17.4
198	19.767	19.623	-0.108	0.8	16.6
204	19.764	19.623	-0.111	0.8	16.1
210	19.759	19.623	-0.116	0.8	14.8
216	19.755	19.623	-0.120	0.8	14.1
222	19.748	19.623	-0.127	0.7	12.6

Total Volumes: Over Overflow (Spill Flow) 0.000m³ Pipe 150.926m³

**360 minute 100 year Winter I+0%
Average Rainfall Intensity 9.971 mm/hr**

Storm Selector

360 minute 100 year Winter I+0%

Time (mins)	US Level (m)	DS Level (m)	Surcharged Depth (m)	Pipe Velocity (m/s)	Pipe Flow (l/s)
6	19.046	18.983	-0.204	0.1	0.1
12	19.064	18.983	-0.186	0.4	0.7
18	19.074	18.983	-0.176	0.5	1.5
24	19.079	18.983	-0.171	0.5	1.9
30	19.083	18.983	-0.167	0.6	2.3
36	19.085	18.983	-0.165	0.6	2.5
42	19.086	18.983	-0.164	0.6	2.6
48	19.086	18.983	-0.164	0.6	2.7
54	19.086	18.983	-0.164	0.6	2.7
60	19.086	18.983	-0.164	0.6	2.7
66	19.087	18.983	-0.163	0.6	2.7
72	19.087	18.983	-0.163	0.6	2.7
78	19.089	18.983	-0.161	0.6	2.8
84	19.091	18.983	-0.159	0.6	3.0
90	19.094	18.983	-0.156	0.6	3.3
96	19.099	18.983	-0.151	0.7	3.6
102	19.110	18.983	-0.140	0.7	4.5
108	19.117	18.983	-0.133	0.7	5.2
114	19.126	18.983	-0.124	0.8	6.0
120	19.134	18.983	-0.116	0.8	7.0
126	19.143	18.983	-0.107	0.8	8.0

Total Volumes: Over Overflow (Spill Flow) 0.000m³ Pipe 173.979m³

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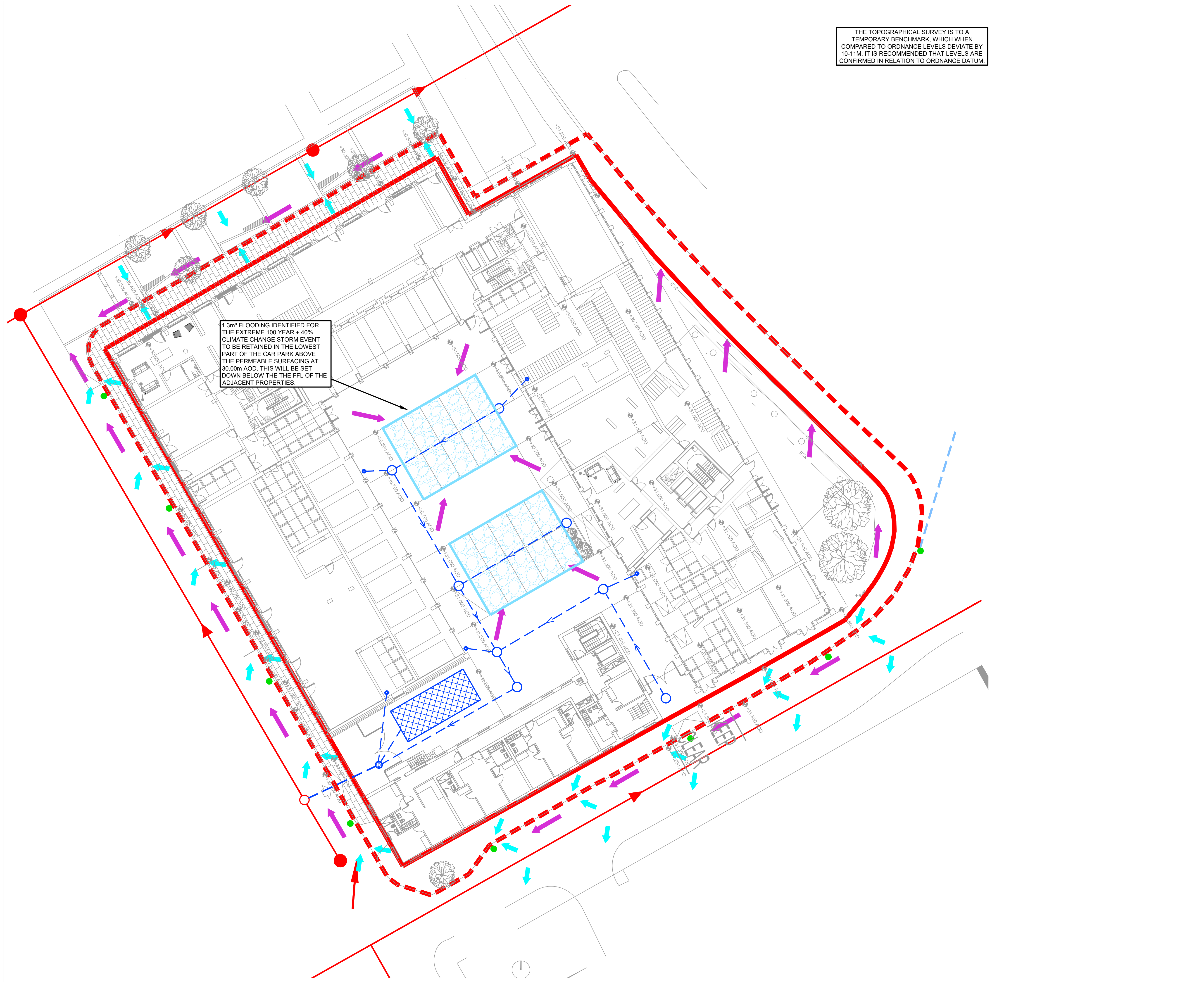
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Appendix C

Proposed Drawing:

071713-CUR-XX-00-DR-C-92501_ P02 PROPOSED OVERLAND FLOW ROUTES



THE TOPOGRAPHICAL SURVEY IS TO A
TEMPORARY BENCHMARK, WHICH WHEN
COMPARED TO ORDNANCE LEVELS DEVIATE BY
10-11M. IT IS RECOMMENDED THAT LEVELS ARE
CONFIRMED IN RELATION TO ORDNANCE DATUM.

1.3m³ FLOODING IDENTIFIED FOR
THE EXTREME 100 YEAR + 40%
CLIMATE CHANGE STORM EVENT
TO BE RETAINED IN THE LOWEST
PART OF THE CAR PARK ABOVE
THE PERMEABLE SURFACING AT
30.00m AOD. THIS WILL BE SET
DOWN BELOW THE THE FFL OF THE
ADJACENT PROPERTIES.

NOTES

- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
- DO NOT SCALE THIS DRAWING. ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS SHALL BE BROUGHT TO THE ENGINEERS ATTENTION IMMEDIATELY. ALL DIMENSIONS MUST BE CHECKED / VERIFIED ON SITE.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.

KEY

- INDICATES THE FLOW ROUTE BASED ON FULL INLET CAPACITY OF COMPONENTS .I.e FALLS AT SURFACE
- INDICATES THE GENERAL GROUND LEVEL FALLS TO THE DRAINAGE SYSTEM
- EXISTING GULLY LOCATIONS TAKEN FROM TOPOGRAPHICAL SURVEY

GROUND LEVELS TO FALL AWAY FROM THE PROPOSED BUILDING LOCATIONS.

P02	EXTRA TEXT ADDED	12.07.22	PG	CG
P01	UPDATED LAYOUT	22.05.19	OJT	CG
Rev:	Description:	Date:	By:	Chkd:

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Structures - Civils - Environmental - Infrastructure - Transport Planning - Sustainability - Expert Advisory Services
Birmingham - Bristol - Cardiff - Douglas - Edinburgh - Kendal - Leeds - Liverpool - London - Manchester - Nottingham

Status:

PRELIMINARY

Project:

ARUNDEL STREET
MANCHESTER

Drg Title:

OVERLAND FLOW ROUTING

Scale:	Size:	First Issue:	Drawn:	Checked:
1:200	A1	22.05.2019	OJT	CG

Drg No:

071713-CUR-XX-00-DR-C-92-501

Rev:

P01

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Appendix D

Proposed Flow Control:
SHE-0182-1530-0520-1530_Design_Drawing
SHE-0182-1530-0520-1530_Hydraulic_Characteristics

Technical Specification

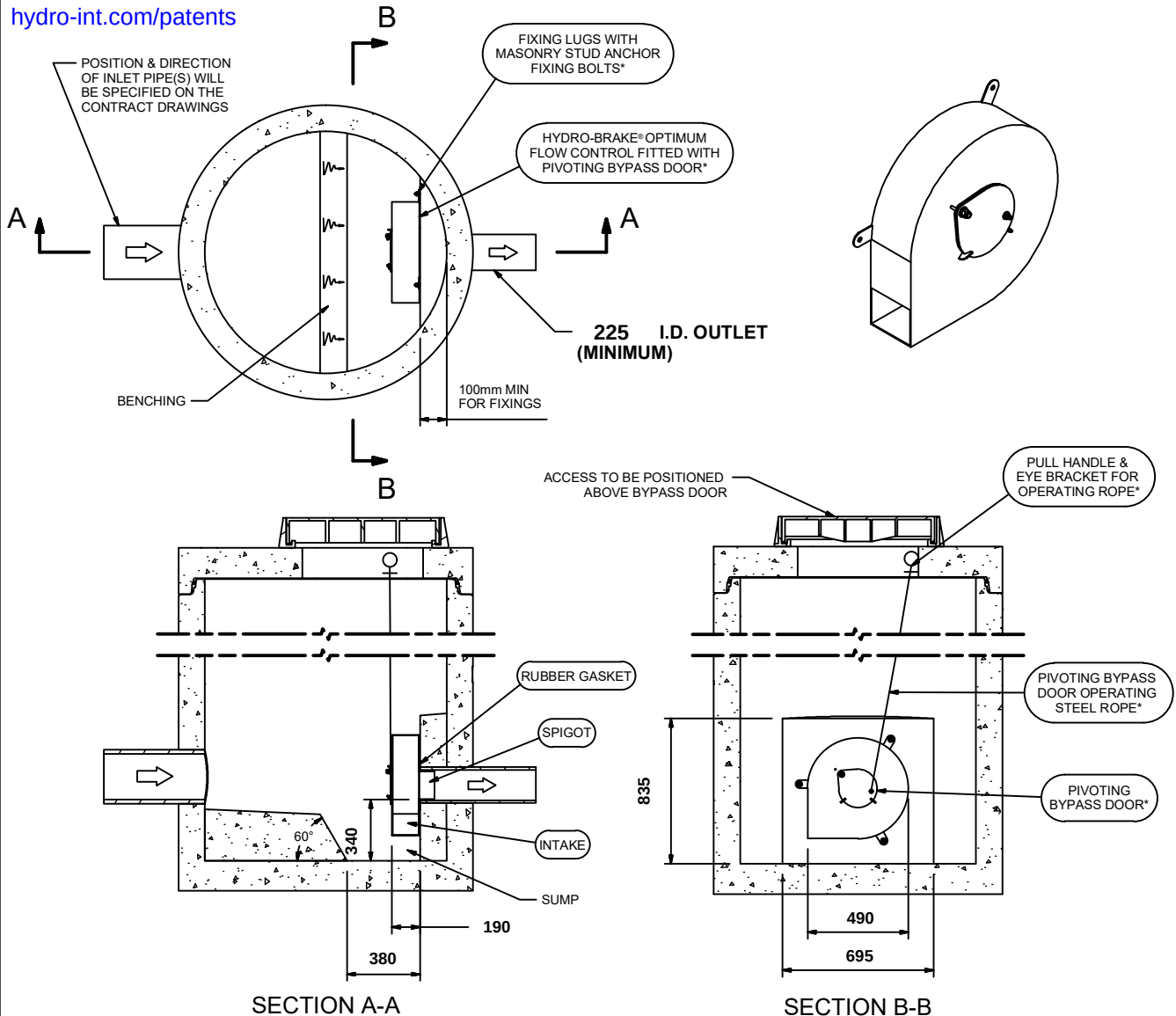
Control Point	Head (m)	Flow (l/s)
Primary Design	0.520	15.300
Flush-Flo™	0.263	15.300
Kick-Flo®	0.428	13.954
Mean Flow		11.839

Hydro-Brake® Optimum Flow Control including:

- 3 mm grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet
- Indicative Weight: 115 kg



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IMPORTANT:

○ LIMIT OF HYDRO INTERNATIONAL SUPPLY

THE DEVICE WILL BE HANDLED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
ALL CIVIL AND INSTALLATION WORK BY OTHERS

* WHERE SUPPLIED

HYDRO-BRAKE® FLOW CONTROL & HYDRO-BRAKE® OPTIMUM FLOW CONTROL ARE REGISTERED TRADEMARKS FOR FLOW CONTROLS DESIGNED AND MANUFACTURED EXCLUSIVELY BY HYDRO INTERNATIONAL

THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.

**DESIGN
ADVICE**



The head/flow characteristics of this SHE-0182-1530-0520-1530 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro
International®

DATE 5/23/2022 1:40 PM

SITE Arundel St

DESIGNER Chloe Grimsley

REF 071713

SHE-0182-1530-0520-1530

Hydro-Brake® Optimum

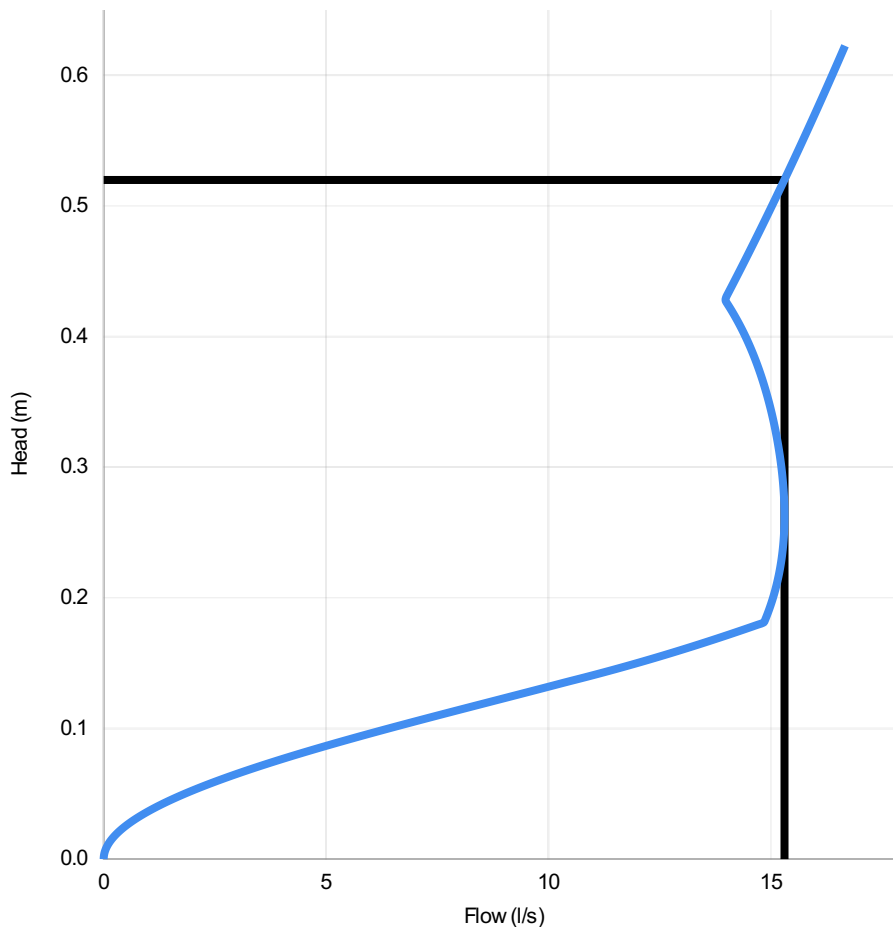
Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	0.520	15.300
Flush-Flo	0.263	15.300
Kick-Flo®	0.428	13.954
Mean Flow		11.839



PT/329/0412

hydro-int.com/patents



Head (m)	Flow (l/s)
0.000	0.000
0.018	0.249
0.036	0.963
0.054	2.087
0.072	3.556
0.090	5.301
0.108	7.236
0.126	9.264
0.143	11.286
0.161	13.094
0.179	14.685
0.197	15.016
0.215	15.157
0.233	15.247
0.251	15.292
0.269	15.298
0.287	15.270
0.305	15.212
0.323	15.128
0.341	15.017
0.359	14.879
0.377	14.708
0.394	14.498
0.412	14.238
0.430	13.988
0.448	14.260
0.466	14.527
0.484	14.788
0.502	15.044
0.520	15.296

DESIGN ADVICE



The head/flow characteristics of this SHE-0182-1530-0520-1530 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.

The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro
International

DATE 23/05/2022 13:40

Site Arundel St

DESIGNER Chloe Grimsley

Ref 071713

SHE-0182-1530-0520-1530

Hydro-Brake Optimum®

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Appendix E

Proposed Landscape Drawings

4.0 HARD LANDSCAPE MATERIALS

DESIGN MATERIALS

Hard materials have been selected to respond to the specific requirements of the setting and also to the functional urban public realm requirements of quality and durability. The contrast between the more functional use of the ground floor and the intimate spaces of the roof garden are reflected in the material combinations.

STREETS: The footpaths to the immediate curtilage of the development will match the materiality on adjacent footways on the surrounding streets. The materiality will comprise of a combination of resin bound gravel and high quality clay pavers laid to the centre of the path. In addition, the pedestrian crossing points will respond to the paving layout established in the area including the installation of tactile paving and drop kerbs.

GROUND FLOOR COURTYARD: This will be paved in high quality vehicle loaded concrete plank and textured clay sett paving to bring a domestic scale to the courtyard and provide contrast and interest within the layout. Planting and trees will be protected by a raised textured kerb.

ROOF GARDENS: The various roof gardens will use clay pavers, composite decking and bound gravel to create distinct areas and to reflect the importance of this communal setting. Clay sett paving will be used in the seating areas and this will breakdown into loose plank footpaths interspersed with planting in the more informal areas of the roof garden. The growing zones, maintenance access paths and plant nursery areas will be paved in resin bound gravel. Within the highest roof garden 'The Residents Room', the routes and gathering spaces will use composite decking for a softer finish.

Planter edges will be in upstand steel to give a crisp contrast to the planting. Seat surfaces and the pergola will be in timber in keeping with creating personal and domestic scaled outdoor living spaces. Raised planters are provided for residents to grow their own produce and carry out home composting.



CLAY PAVERS



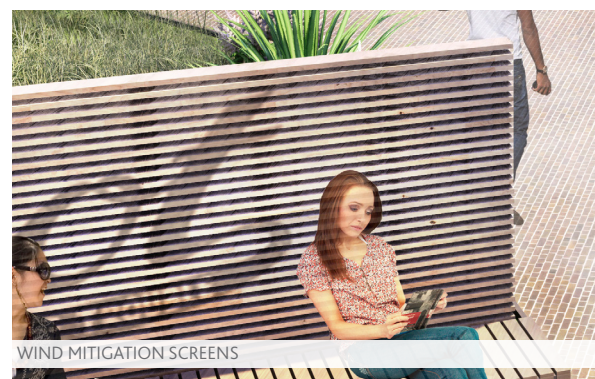
CLAY PAVERS - CONTRASTING COLOURS



STEEL EDGE UPSTAND



RAISED PLANTER



WIND MITIGATION SCREENS



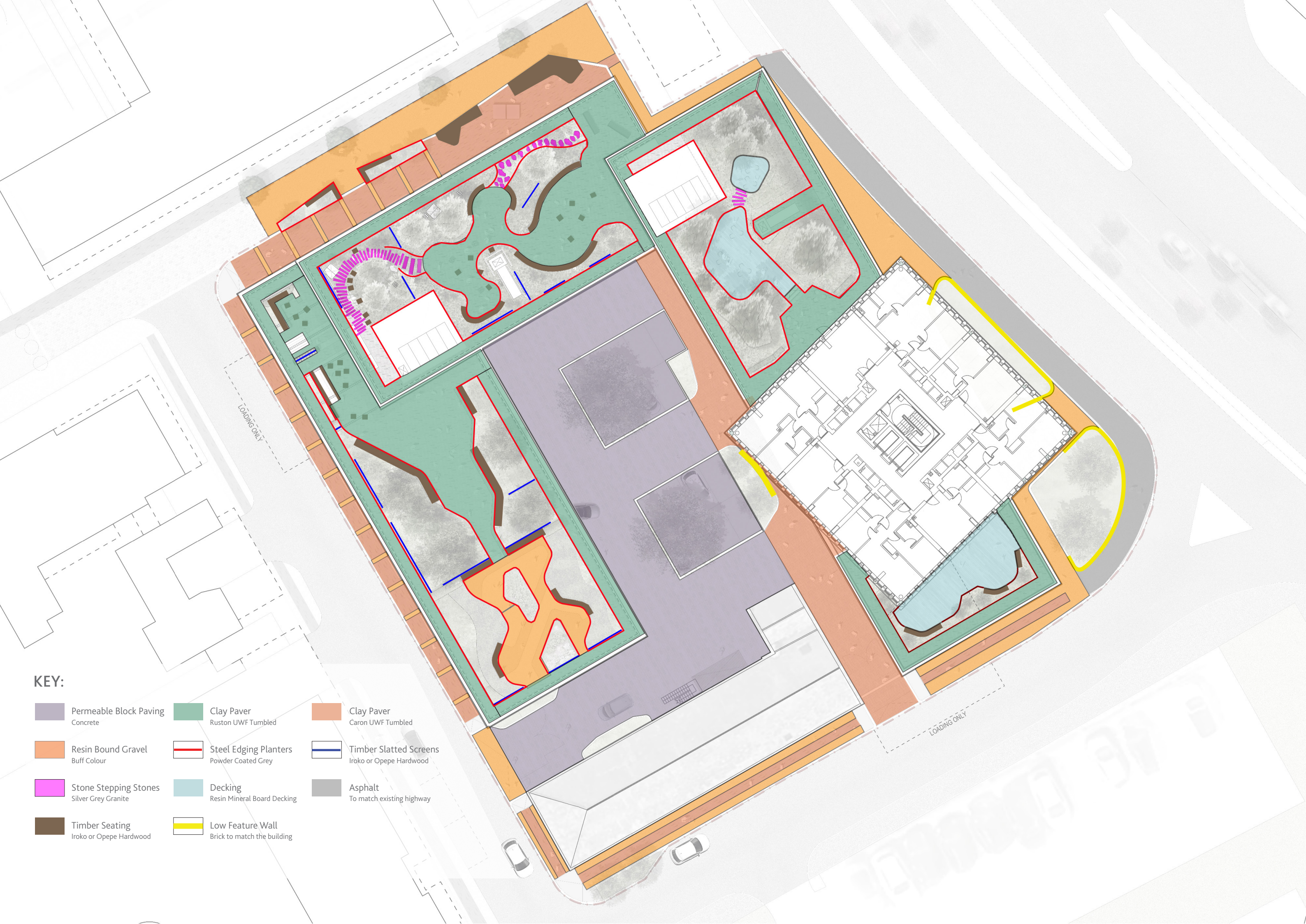
RESIN BOUND GRAVEL



COMPOSITE DECKING

KEY:

- | | | |
|---|---|---|
|  Permeable Block Paving
Concrete |  Clay Paver
Ruston UWF Tumbled |  Clay Paver
Caron UWF Tumbled |
|  Resin Bound Gravel
Buff Colour |  Steel Edging Planters
Powder Coated Grey |  Timber Slatted Screens
Iroko or Opepe Hardwood |
|  Stone Stepping Stones
Silver Grey Granite |  Decking
Resin Mineral Board Decking |  Asphalt
To match existing highway |
|  Timber Seating
Iroko or Opepe Hardwood |  Low Feature Wall
Brick to match the building | |



KEY:

-  Grass
Amenity Turf
-  Shrub Planting
Ornamental / Perennial Varieties
-  Shrub Planting
Shade Tolerant Species
-  Allotment Planting
Herbaceous Varieties
-  Hedges / Screens
Instant Hedges
-  SEDUM CYCLE STORE
Sedum roof covering to Cycles
-  LOW RAISED PLANTERS
Low raised planters integrated
into building facade
-  CLIMBING PLANTING
Climbing planting integrated
into building facade elements

