

Manchester Metropolitan University, Public Realm Phase 1A, Manchester

Verification & Drainage Maintenance Strategy

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Revision: V02

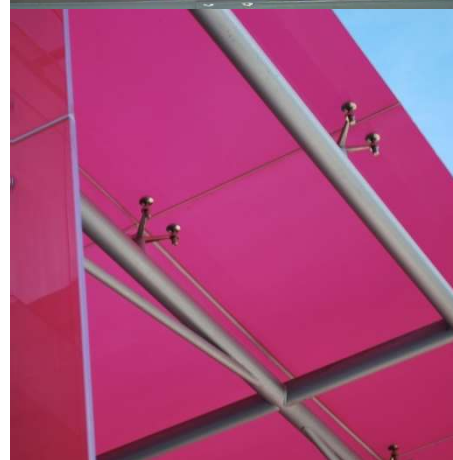
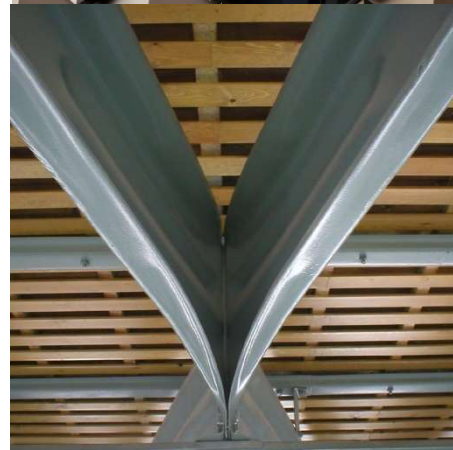
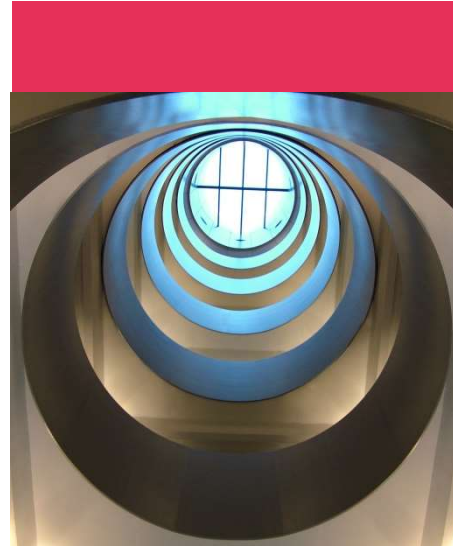
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Client Name: Manchester Metropolitan University

Site Address: Manchester Metropolitan University, Public Realm Phase, Manchester

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Control Sheet

Rev	Description	Issued by	Checked	Date
V01	First Issue	CS	RB	17/10/2024
V02	Updated as per clients' comments	CS	RB	23/10/2024

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Author	Signature	Date
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Reviewed	Signature	Date
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075050-CUR-XX-XX-DR-D-72053_C02 SW Details Sheet 3

075050-CUR-XX-XX-DR-D-72054_C02 SW Details Sheet 4

075050-CUR-XX-XX-DR-D-72055_C02 SW Details Sheet 5

075050-CUR-XX-XX-DR-D-72060_C02 Drainage Notes

075050-CUR-00-XX-DR-D-75001_C07 Pavement Details

Appendix B

Surface Water Drainage Calculations 1-year, 30-year, 100-Year +40%cc

Appendix C

United Utilities Approval – Reference 4977824

Appendix D

Hydro-Brake Manufacturers Information

Polystorm Manufacturers Information

1.0 Introduction

1.1 Project Background

- 1.1.1 Curtins have been appointed by Manchester Metropolitan University to provide a Verification and Drainage Maintenance Strategy for the proposed below ground drainage design for the Public Realm Phase 1A site at Oxford Road, Manchester. The British National Grid co-ordinates for the site is approximately Easting 384271, Northing 397097.

1.2 Scope of the Verification and Maintenance Strategy

- 1.2.1 This report demonstrates the below ground drainage which has been installed for the development site and provides product information to inform future maintenance requirements.
- 1.2.2 This manual is intended to give an overview of the operation and maintenance for the drainage features included with the drainage strategy and in relation to typical details only. Where proprietary products are specified the manufacturer's instructions and recommendations should be followed in priority to this document unless specifically noted otherwise due to project constraints.
- 1.2.3 The recommended operations and frequencies are typical only and should be more frequent initially to ensure that there are no unforeseen issues with the operation and then adjusted to suit the site requirements.

2.0 Drainage Strategy

2.1 Existing Drainage

- 2.1.1 All existing drainage on site has been confirmed as redundant and removed. All pipework was grubbed up and capped off.

2.2 Surface Water Drainage

- 2.2.1 Any new development site drainage should be designed in accordance with current best practice to provide adequate capacity not to flood for the critical 1 in 30-year storm event and flood water generated for up to the critical 1 in 100-year plus climate change storm event shall be constrained within the areas on site so not to cause damage to buildings, essential services or adjoining developments and services.
- 2.2.2 Based on the nature of the development, a lifespan in excess of up to 60 years is anticipated. Therefore, the potential climate change allowance for 2070-2115 ranges between 20% for the central allowance and 40% for the upper end allowance. As such, an allowance of 40% for climate change on peak rainfall intensity has been included in the design.
- 2.2.3 Assessment was completed at preliminary design stage to confirm the most viable method of discharge was connection to the combined public sewer at a restricted rate.
- 2.2.4 The on-site surface water network is based on a pipe system serving the public realm with a flow restriction. The pipe systems connect to the combined outfall connection into Cavendish Street.
- 2.2.5 The proposed flows used the design are restricted to **14.2 l/s**.
- 2.2.6 The proposed network on site requires attenuation to provide capacity to accommodate the volumes generated during the 1 in 100 year +40% design event whilst maintaining the maximum flow restrictions.
- 2.2.7 The external areas are drained via a permeable construction build up, channel drains, gullies and tree pits.
- 2.2.8 The Final Construction Drainage Drawings are enclosed in *Appendix A*.
- 2.2.9 Surface Water Drainage Calculations are enclosed in *Appendix B*.

2.3 Approvals

- 2.3.1 The connection to the public sewer in Cavendish Street has been approved under a Section 106 Agreement referenced 4977824. The correspondence is enclosed in *Appendix C*.

3.0 Verification

3.1 Introduction

3.1.1 The Verification section has been developed with reference to the drainage design details and philosophy provided in section 2 of this report. Manchester City Council requirements are to verify the installation of the Drainage and SuDS to confirm by Photographic record that this has been installed.

3.1.2 The following elements have been recorded:

- Attenuation Tank
- Permeable Paving
- Flow Control Chambers
- Tree Pits

3.1.3 A CCTV Survey has also been provided along with As built record information for each chamber.

3.2 Photographic Information

Attenuation Tank

3.2.1 The attenuation tank is a Polypipe Polystorm-R product. Manufacturers information is enclosed in *Appendix D*.

3.2.2 Surface water tank was installed, photographs are shown in Figure 1 – 4.

Figure 1 – Attenuation Tank Installation



Figure 2 – Attenuation Tank Connection and Breather Pipe Installation



Figure 3 – Attenuation Tank Installation



Figure 4 – Tank Installation



Permeable Paving

3.2.3 Permeable Paving has been installed, photographs are shown in Figure 5 – 8.

Figure 5 – Permeable Paving Installation



Figure 6 – Permeable Paving Installation



Figure 7 – Permeable Paving Installation



Figure 8 – Permeable Paving Installation



Flow Control Chambers

- 3.2.4 The Flow Control Chambers SW14 has been installed, photographs are shown in Figure 9.

Figure 9 – Flow Control Installation



Tree Pits

3.2.5 The tree pits have been installed; photographs are shown in Figures 11-.

Figure 11 – Tree Pit Installation



Figure 12 – Tree Pit Installation



3.3 Survey and As Built information

3.3.1 A survey was completed on the installed drainage network in May 2024.

Caseys have confirmed the drainage was installed as per Curtins design. The variations between the as-built information and the proposed drainage layout were in the manhole invert levels. The drainage model has been updated to suit the as-built levels and confirms all surface water from the site is to be stored within the network up to the 100 year + 40%CC storm event.

4.0 Maintenance Recommendations

4.1 General Maintenance

- 4.1.1 The maintenance strategy should be adopted to ensure the drainage network is cleaned regularly and the routine maintenance and cleansing regime should be documented.
- 4.1.2 A copy of the final construction drainage layout should be provided in the final Operations and Maintenance Manual along with this report.
- 4.1.3 Reference should be made to the following drawings:
- 075050-CUR-XX-XX-DR-D-72001_C10_SW Drainage Strategy GA
 - 075050-CUR-XX-XX-DR-D-72051_C02 SW Details Sheet 1
 - 075050-CUR-XX-XX-DR-D-72052_C04 SW Details Sheet 2
 - 075050-CUR-XX-XX-DR-D-72053_C02 SW Details Sheet 3
 - 075050-CUR-XX-XX-DR-D-72054_C02 SW Details Sheet 4
 - 075050-CUR-XX-XX-DR-D-72055_C02 SW Details Sheet 5
 - 075050-CUR-XX-XX-DR-D-72060_C02 Drainage Notes
 - 075050-CUR-00-XX-DR-D-75001_C07 Pavement Details
- 4.1.4 The maintenance scheduling should begin from the completion date.
- 4.1.5 It is recommended that the drainage system is inspected as a minimum twice a year, with the system also being inspected after any major storm event.
- 4.1.6 Significant sediment deposition is likely in areas used for storage, so a post clean-up operation may be required including the removal of litter, vegetation, sewerage debris and larger objects.
- 4.1.7 Long-term management practices include monthly sweeping of external paved areas. The sweeping program will remove sand and contaminants directly from paved surfaces before they become mobilised during storm events and transported to the drainage system.
- 4.1.8 During the winter months, drainage features such as gullies and channels should be cleared of ice, snow, debris or litter.
- 4.1.9 Sediment/Material removal should be undertaken in consultation with the environmental regulator to confirm appropriate protocols where applicable.

4.2 Responsibilities

- 4.2.1 Maintenance of the private drainage network within the development Ownership Boundary will be the responsibility of the Public Realm Operator: Manchester Metropolitan University

4.3 Components

- 4.3.1 The following components have been included within the drainage design for the proposed development:

- Inspection, Manhole and Catchpit Chambers
- Pipes
- Drainage Channels and Gullies
- Cellular Storage/Attenuation
- Flow Control - Hydrobrake
- Permeable Paving

4.4 Inspection, Manhole and Catchpit Chambers

- 4.4.1 The locations of the chambers are indicated on Curtins drainage drawing 075050-CUR-XX-XX-DR-D-72001
- 4.4.2 Access points have been located at the head of each run, at a change in direction and at a change of pipe size in accordance with Building Regulations Part H.
- 4.4.3 The appropriate barriers and signage should be installed during any opening of manholes to warn site users/pedestrians.
- 4.4.4 When accessing chambers, the latest Health and Safety legislation should be adhered to.
- 4.4.5 The appropriate health and safety equipment must be used when accessing manholes. Confined space certificates must be held by any personnel entering a manhole and the appropriate permits should be obtained from the Facilities Maintenance Manager prior to any access.
- 4.4.6 Sediment/material removal should be undertaken in consultation with the environmental regulator to confirm appropriate protocols; especially where run-off is taken from potentially contaminated areas.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required)	Initial inspection should be provided as post construction CCTV survey.	N/A
	Inspect for evidence of poor operation via water level in chambers. If required take remedial action.	3-monthly, 48 hours after large storms.
Occasional maintenance	Check and remove large vegetation growth near pipe runs.	6 monthly
Remedial actions	Rod through poorly performing runs as initial remediation.	As required.
	If continued poor performance jet and CCTV survey poorly performing runs.	As required.
	Seek advice as to remediation techniques suitable for the type of performance issue and location.	As required If above does not improve performance.

4.5 Pipes

- 4.5.1 The locations of the pipes are indicated on Curtins drainage drawing 075050-CUR-XX-XX-DR-D-72001.
- 4.5.2 Pipes are proprietary products, and the materials can vary across the site and as such where used the manufacture's recommendations should be followed. Regardless of the product used the pipes are fully compliant with the Curtins drainage specification.
- 4.5.3 Pipes are intended to be the main conveyance across the development and where oversized they form the attenuation volume required by the limitation of the discharge rate. They are intended to be dry except for during rainfall events. These have been designed to be self-cleansing where possible for smaller diameter pipes, and for larger diameters the risk is reduced due to the overall pipe size.
- 4.5.4 Access for maintenance is provided through access chambers and manholes.
- 4.5.5 Regular inspection and maintenance is important to identify areas which may have been obstructed/clogged and may not be drainage correctly thus exposing the development to a greater level of flood risk.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required)	Initial inspection should be provided as post construction CCTV survey.	N/A
	Inspect for evidence of poor operation via water level in chambers. If required take remedial action.	3-monthly, 48 hours after large storms.
Occasional maintenance	Check and remove large vegetation growth near pipe runs.	6 monthly
Remedial actions	Rod through poorly performing runs as initial remediation.	As required.
	If continued poor performance jet and CCTV survey poorly performing runs.	As required.
	Seek advice as to remediation techniques suitable for the type of performance issue and location.	As required If above does not improve performance.

4.6 Drainage Channels and Gullies

- 4.6.1 The locations of the drainage channels and gullies are indicated on Curtins drainage drawing 075050-CUR-XX-XX-DR-D-72001.
- 4.6.2 Channels and gullies should be inspected and cleaned in accordance with the manufacturer's details.
- 4.6.3 Channels and gullies installed have removable covers to allow cleaning and clearing of debris and silt.
- 4.6.4 Channel units can be cleaned through the use of a high-pressure hose; this can be fed into the channel system through access units strategically placed along the channel run. The throat section of channel units should be kept clear at all times to ensure uninterrupted flow of surface water into the drainage channel and any debris within the throat should be removed.
- 4.6.5 The appropriate barriers and signage should be installed during any opening of gullies/channel outlet boxes to warn site users/pedestrians.

- 4.6.6 Locking bolts should be replaced and sufficiently tightened, taking care that the bolt heads do not stand above the top surface of the cover or grate. If covers are allowed to move within their frame, this may cause damage to the frame or seating.
- 4.6.7 Sediment\material removal should be undertaken in consultation with the environmental regulator to confirm appropriate protocols; especially where run-off is taken from potentially contaminated areas such as the car park drainage.

4.7 Cellular Storage

- 4.7.1 The location of the attenuation tank is indicated on Curtin's drainage drawing 075050-CUR-XX-XX-DR-D-72001.
- 4.7.2 The attenuation tank is currently specified as geocellular units and are intended for storage of surface water run-off from the site up to and including the 1 in 100 year plus 40% climate change event to reduce the rate of run-off into the downstream network and to minimise flood risk.
- 4.7.3 Access for maintenance has been provided by an access shaft located on the tank and from the manhole chambers downstream of the tank.
- 4.7.4 Geocellular units are proprietary products and therefore manufacturer's recommendations should also be taken into consideration. Additionally, different manufacturers may have different connection types and arrangements which will need to be taken into consideration.
- 4.7.5 Manufacturers information is enclosed in *Appendix C*.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required)	Inspect inlets, outlets and overflows for blockages, and clear if required. If faults persist jetting and CCTV survey may be required.	Monthly and after large storms.
	Check penstocks and other mechanical devices (if present).	Half yearly.
Regular maintenance\inspection	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then six monthly

	Debris removal from catchment surface (where may cause risks to performance)	Monthly
	Where rainfall infiltrates into blocks from above, check surface of filter for blockage by silt, algae or other matter. Remove and replace surface infiltration medium as necessary.	Monthly (and after large storms)
	Remove sediment from pre-treatment structures	Annually (or as required after heavy rainfall events)
Remedial actions	Repair/rehabilitation of inlets, outlet, overflows and vents.	As required.

4.8 Flow Control Units - Hydrobrake

- 4.8.1 The locations of the Flow Control Chambers are indicated on Curtin's drainage drawings 075050-CUR-XX-XX-DR-D-72001.
- 4.8.1 The flow control units are intended for flood control and flow restriction.
- 4.8.2 The flow controls are specified as Hydro-brake or similar approved and are proprietary products; therefore, manufacturer's recommendations should also be taken into consideration.
- 4.8.3 Access for maintenance has been provided by locating within manhole chambers.
- 4.8.4 Manufacturers information is enclosed in *Appendix C*.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Inspect inlets for blockages, and clear if required. If faults persist jetting and CCTV survey may be required.	Monthly and after large storms.

Regular maintenance\ inspection	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then six monthly.
	Debris removal from catchment surface (where may cause risks to performance).	Monthly
	Remove sediment from pre-treatment structures and flow control chambers.	Annually (or as required after heavy rainfall events)
Remedial Actions	Repair/rehabilitation of inlets.	As required.

4.9 Permeable Pavements

- 4.9.1 The locations of the permeable pavements are indicated on Curtin's drainage drawing 075050-CUR-XX-XX-DR-D-72001
- 4.9.2 Permeable pavements contain proprietary products and as such, where used, the manufacturer's recommendations should be followed.
- 4.9.3 The permeable pavements are intended to be water quality and attenuation storage features. These features are intended to be dry except during rainfall events.
- 4.9.4 The surface has been designed to contain gaps where rain can flow through the upper construction layers into the voided stone which makes up the subbase. Where these features are intended to be used as infiltration devices or soakaways any capping also needs to be permeable to permit the flows to the formation. In this instance, all permeable paved areas are fully sealed to permit no infiltration and outlet pipes are provided.
- 4.9.5 Access for maintenance is provided via the surface or via the inspection points which are positioned in various areas across the length of the permeable paved area.
- 4.9.6 Regular inspection and maintenance is important for the effective operation of the permeable pavement.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Initial Inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth. If required take remedial action. Inspect silt accumulation rates and establish appropriate brushing frequencies. Silt can also be caused by adjacent landscaping areas which should be reprofiled to provide a flat area or berm adjacent to the paving.	3-monthly, 48 hours after large storms.
Regular maintenance\ inspection	Brushing and Vacuuming	Three times/year at end of winter, mid-summer, after autumn leaf fall, or as required based on site specific observations of clogging or manufacturers' recommendations.
Occasional maintenance	Stabilise and mow contributing and adjacent areas.	As required and as per landscape architect's specification.
	Removal of weeds	As required.
Remedial Action	Remediate any landscaping which, through vegetation maintenance or soil slip, has	As required.

	been raised to within 50 mm of the level of the paving.	
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users.	As required.
	Rehabilitation of surface and upper sub-structure. This could include replacement of the jointing and bedding material. The upper geotextiles layer may also need replacing if clogged and generally have a life span of 25 years.	As required (if infiltration performance is reduced as a result of significant clogging).

Appendix A

075050-CUR-XX-XX-DR-D-72001_C10_SW Drainage Strategy GA

075050-CUR-XX-XX-DR-D-72051_C02 SW Details Sheet 1

075050-CUR-XX-XX-DR-D-72052_C04 SW Details Sheet 2

075050-CUR-XX-XX-DR-D-72053_C02 SW Details Sheet 3

075050-CUR-XX-XX-DR-D-72054_C02 SW Details Sheet 4

075050-CUR-XX-XX-DR-D-72055_C02 SW Details Sheet 5

075050-CUR-XX-XX-DR-D-72060_C02 Drainage Notes

075050-CUR-00-XX-DR-D-75001_C07 Pavement Details



SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
UNUSUAL SIGNIFICANT HAZARDS

IT IS ASSUMED THAT ALL WORKS WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROVED METHOD STATEMENT.
IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:

CONSTRUCTION
1. EXISTING SERVICES
2. EXISTING ARCHEOLOGY

MAINTENANCE / CLEANING
1. ATTENUATION TANK

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SW3	384253.384	397132.183
SW5	384294.113	397059.22
SW9	384235.274	397079.394
SW10	384229.683	397072.013
SW11	384233.002	397074.136
SW12	OMITTED	
SW13	384333.29	397072.128
SW14	384297.269	397052.864
SW15	384265.228	397035.717
SW16	384254.749	397034.977
SW17	384307.837	397050.706
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SW2A	384220.07	397105.108
SW 15A	384262.211	397041.448

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SERVICES:

- ALL SAINTS PARK WORKING DRAWING REV C DUCT LAYOUT

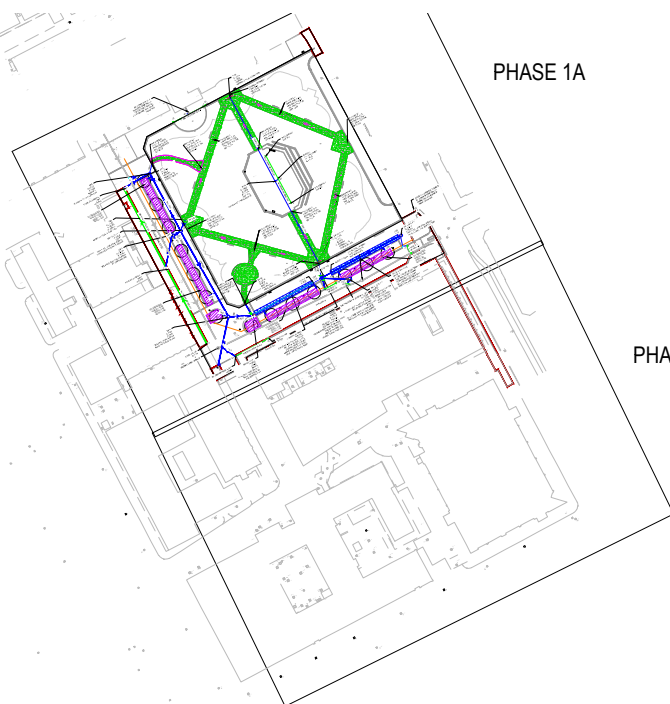
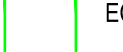
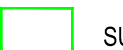
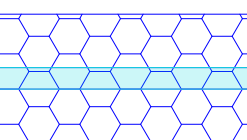
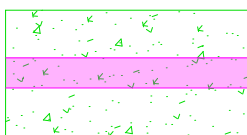
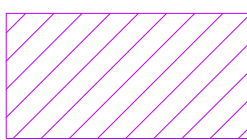
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 - THIS INFORMATION SHOULD BE READ IN CONJUNCTION WITH THE NOTES AND BACKGROUND INFORMATION HELD IN THE PROJECT BUILDING FILE.

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- ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
- FOR GENERAL NOTES REFER TO DRAWING REFERENCE 075050-CUR-XX-XX-DR-D-72060.

KEY

- SURFACE WATER NETWORK
- SEALED FILTER TRENCH AND INSPECTION CHAMBERS, 150DIA
- PERFORATED PIPE FRENCH DRAIN & 450DIA PPIC LAND DRAINAGE INSPECTION CHAMBERS
- ACO FREESTYLE DRAIN (D400 LOAD CLASS) TO ARCHITECT DESIGN, CHANNEL 200mm MULTIDRAIN MD SEE DRAWING FOR SIZE
- EXISTING UU COMBINED SEWER
- ATTENUATION TANK VENT PIPE



C10	FINAL CONSTRUCTION ISSUE	17/10/24	CS	RB
C09	AS CONSTRUCTED	16/08/24	JC	RB
C08	TREE PIT SIZE ADDED AS PER LLFA REQUEST	24/10/23	CS	MW
C07	UPDATED FOOTPATH - CHANGES CLOUDED	15/09/23	KS	MW
Rev:	Description:	Date:	By:	Chkd:



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Status:

FINAL CONSTRUCTION

Project:

MMU LANDSCAPE MASTERPLAN

Dwg Title:

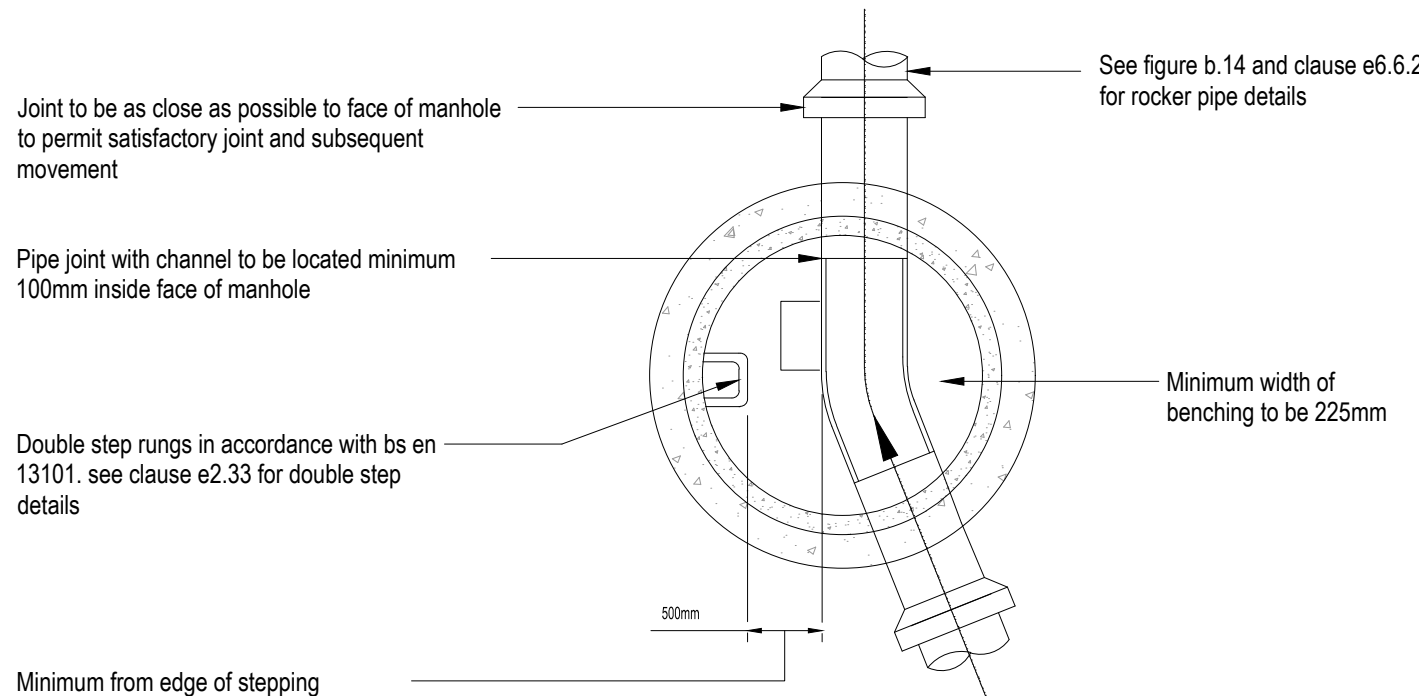
SW DRAINAGE - PHASE 1a

Size:	Date:	Drawn By:	Designed By:	Checked By:
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075050 - CUR - XX - XX - DR - D - 72001 - C10				

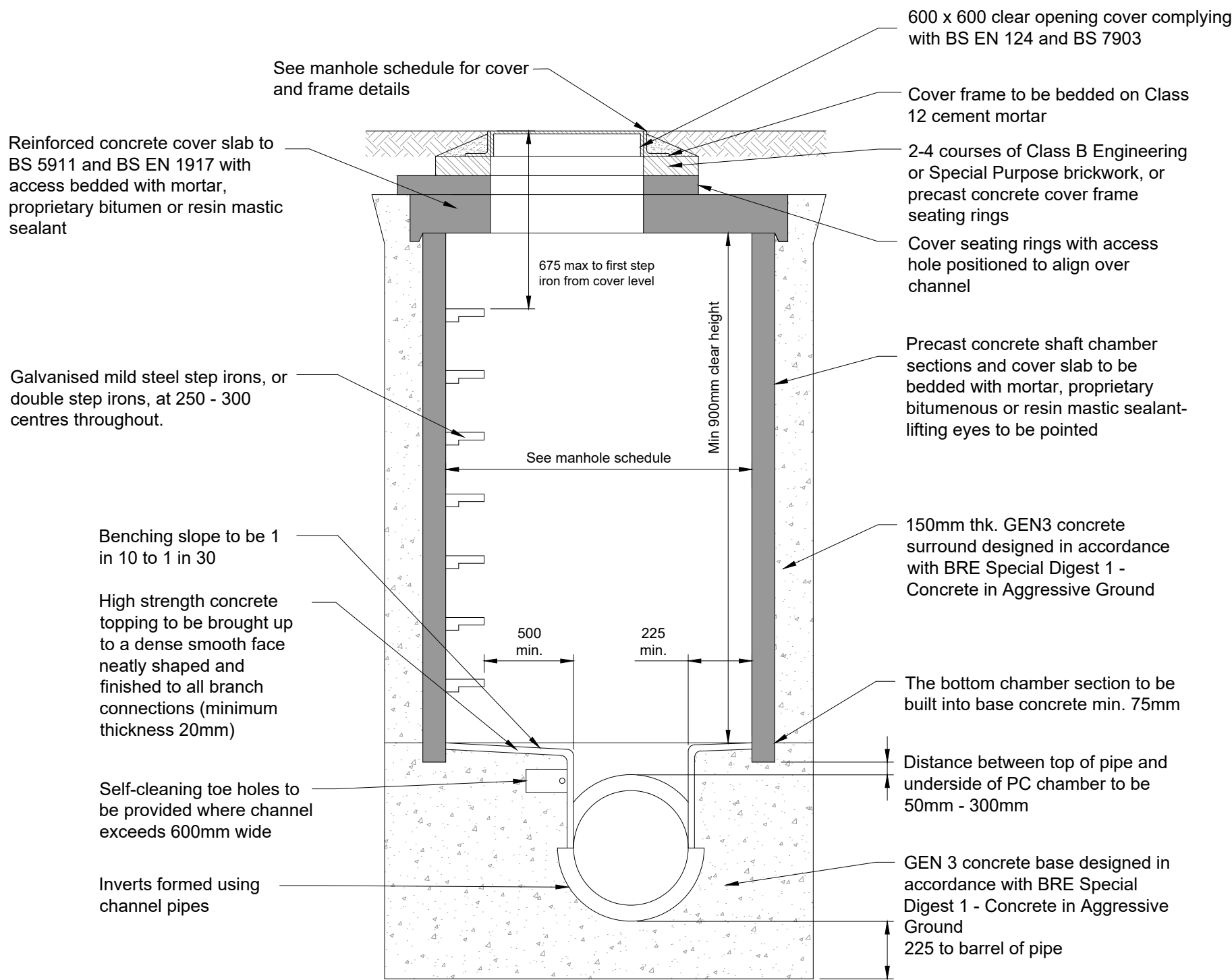
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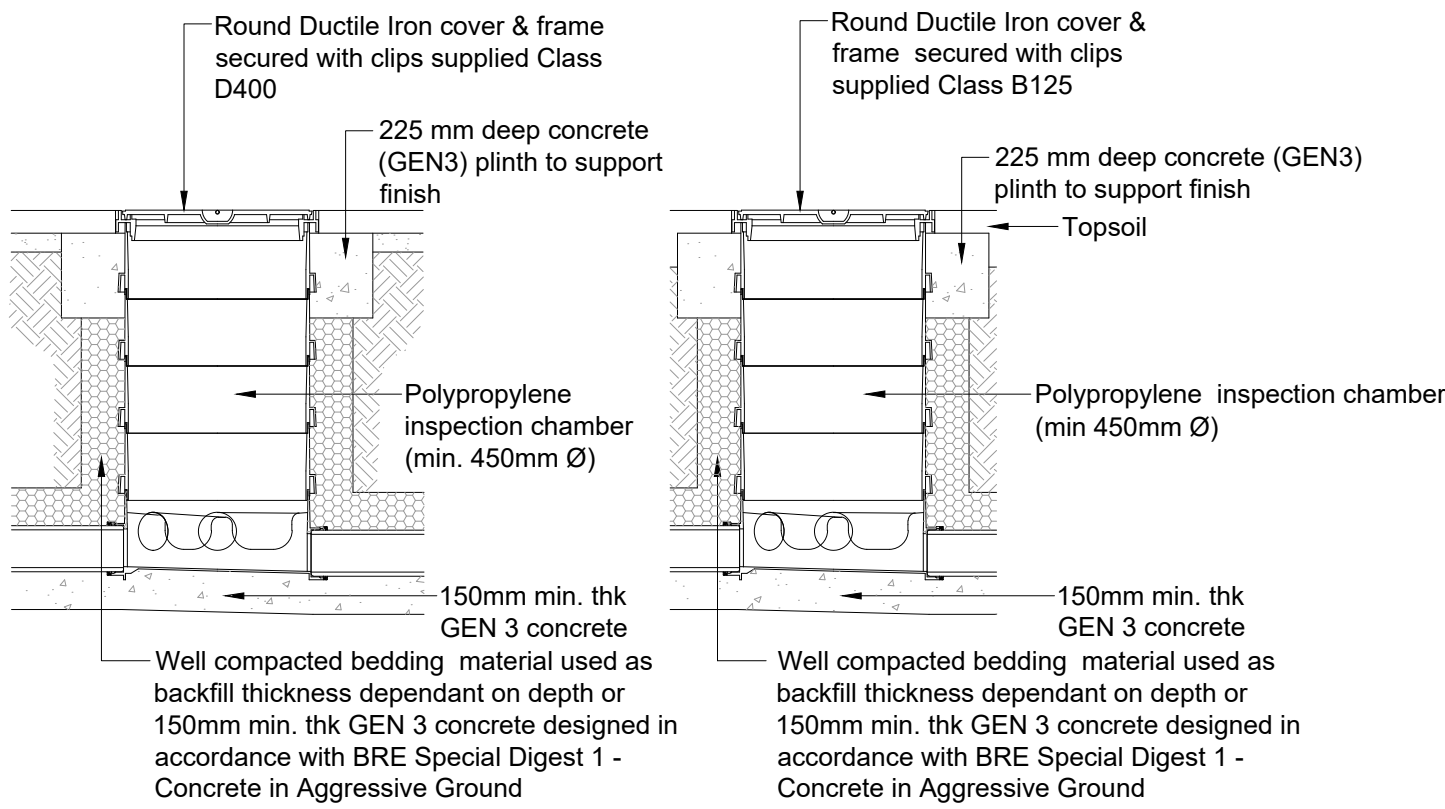


TYPICAL MANHOLE DETAIL - TYPE 2
(MAXIMUM DEPTH FROM COVER TO SOFFIT OF PIPE 3.0 m)



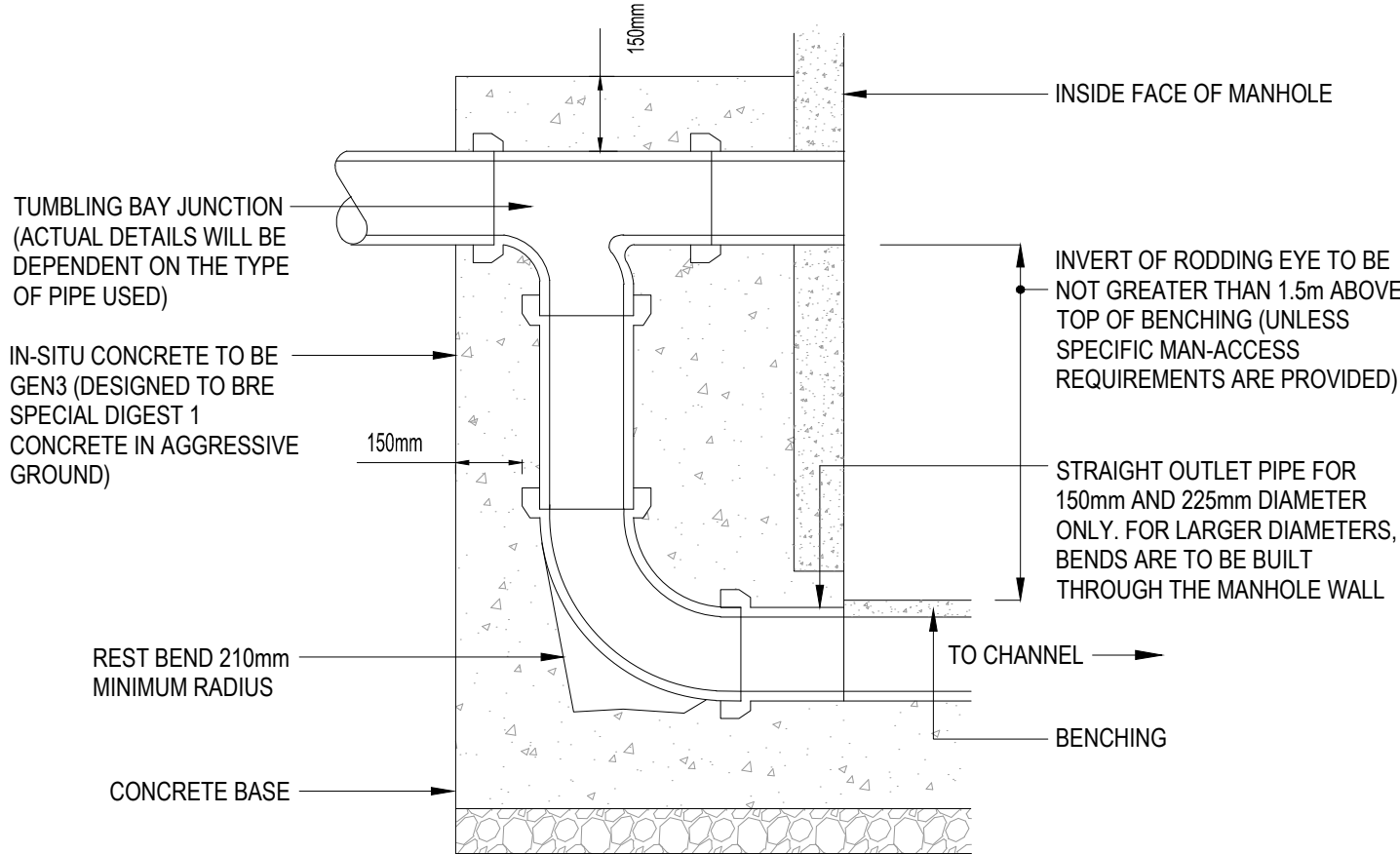
TYPICAL TYPE 2 CONCRETE MANHOLE (PCC) DETAIL

MAX. DEPTH FROM COVER LEVEL TO SOFFIT OF PIPE 3.0m
(SCALE 1:20)

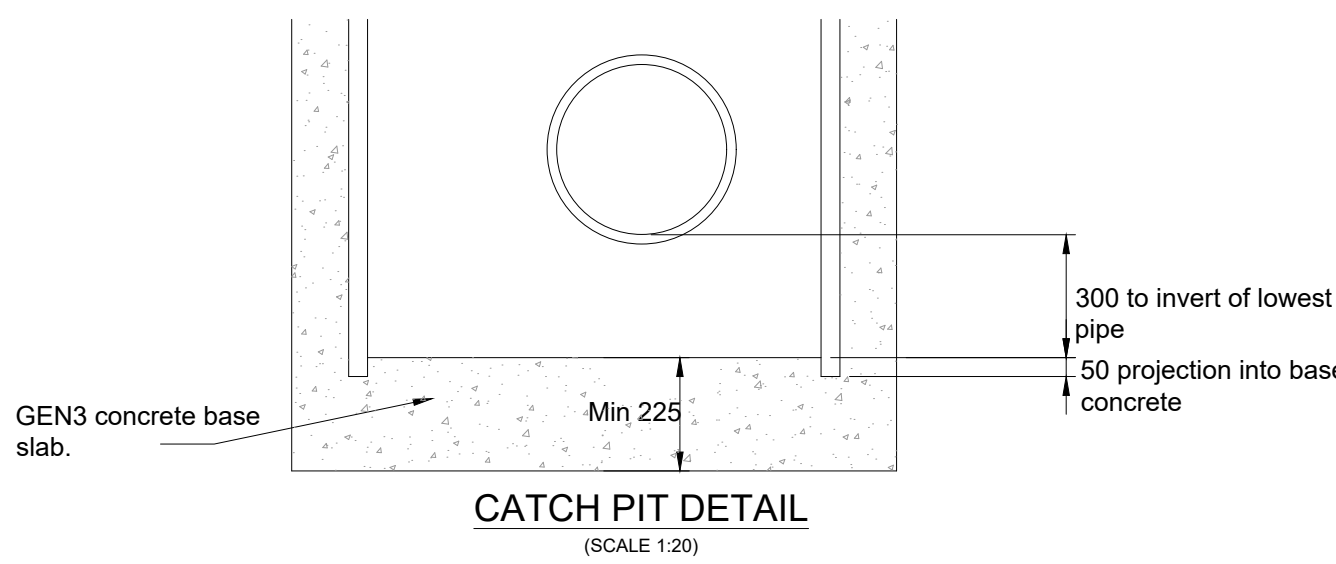


TYPICAL INSPECTION CHAMBER (IC) DETAIL

MAX DEPTH 1.2m

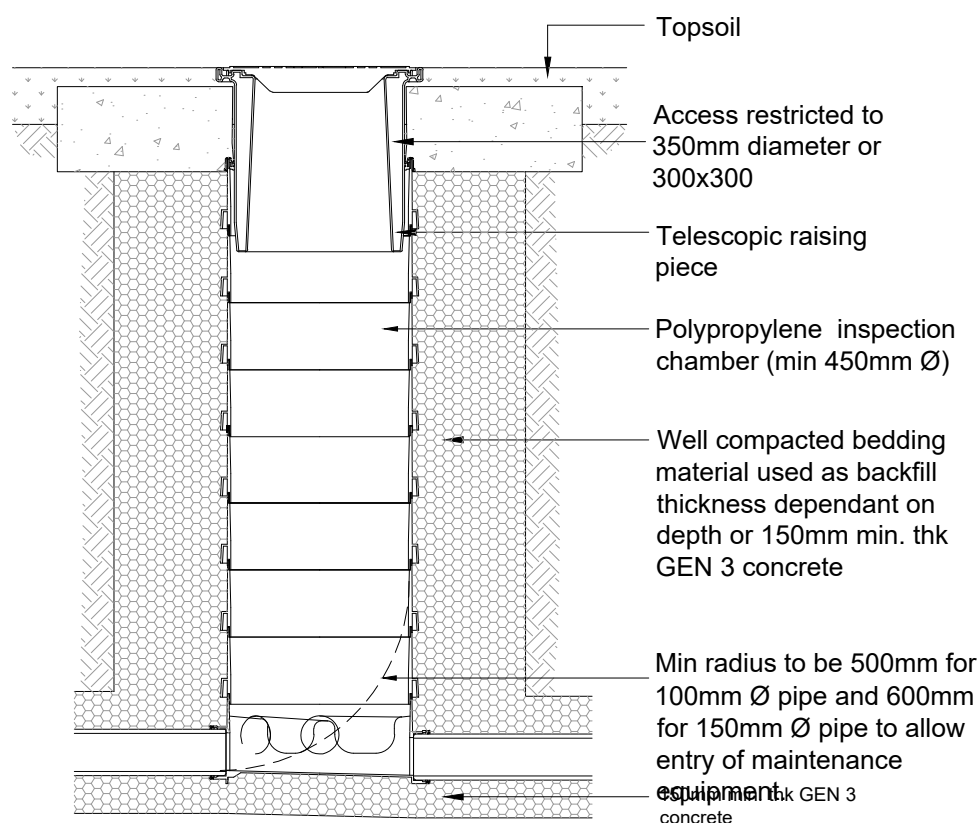


EXTERNAL VERTICAL BACKDROP



CATCH PIT DETAIL

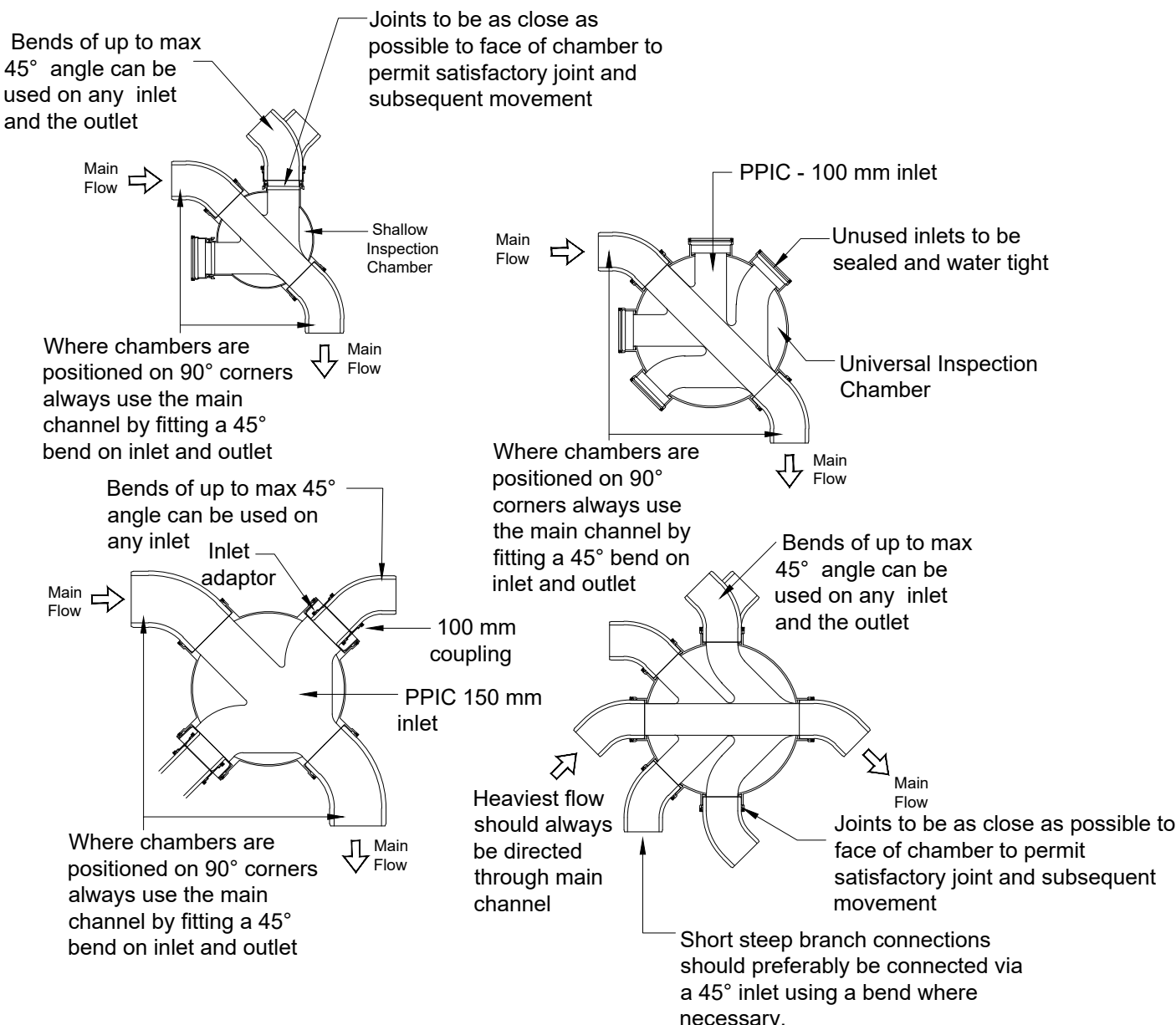
(SCALE 1:20)



Telescopic IC sited in soft landscaped areas

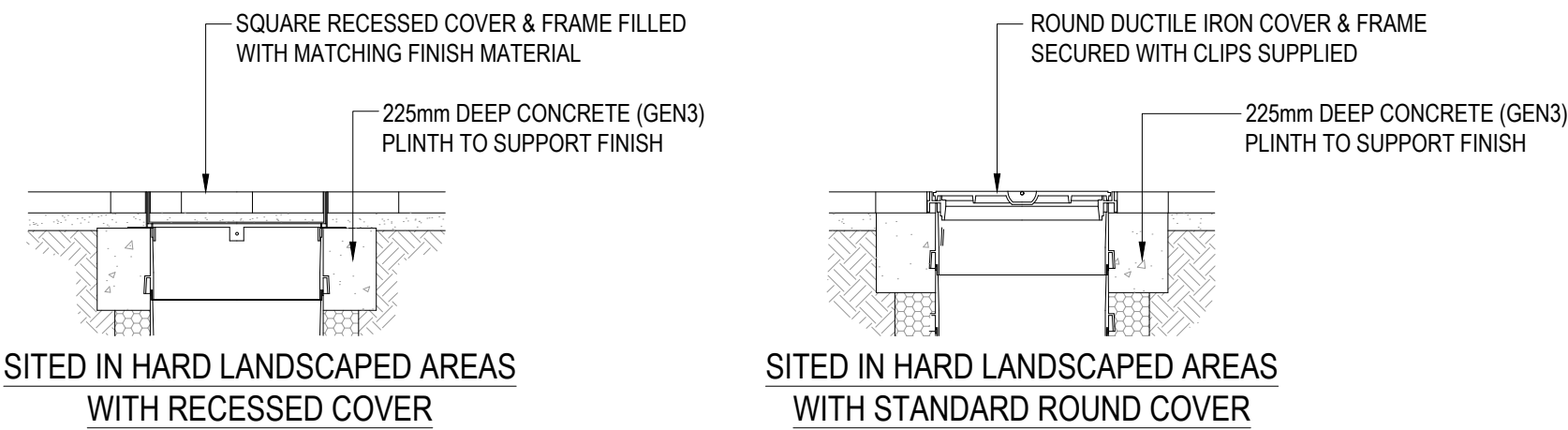
DEEP INSPECTION CHAMBER (IC) DETAIL

DEPTHS BETWEEN 1.2m AND 3.0m
(SCALE 1:20)

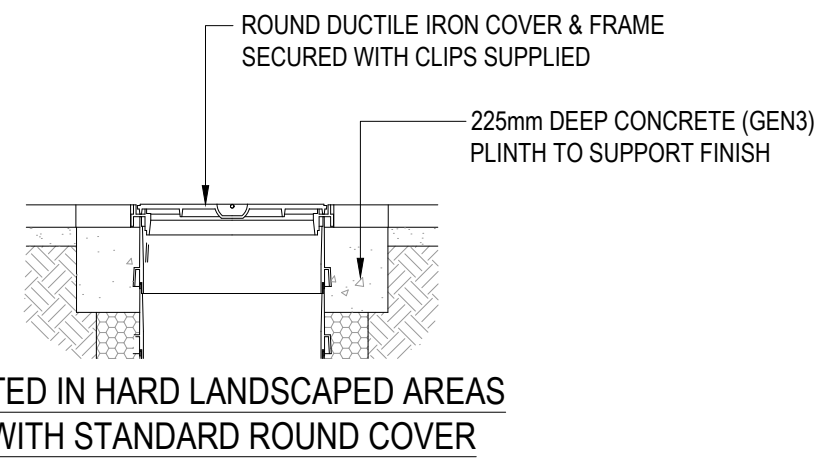


INSPECTION CHAMBER BASE DETAILS

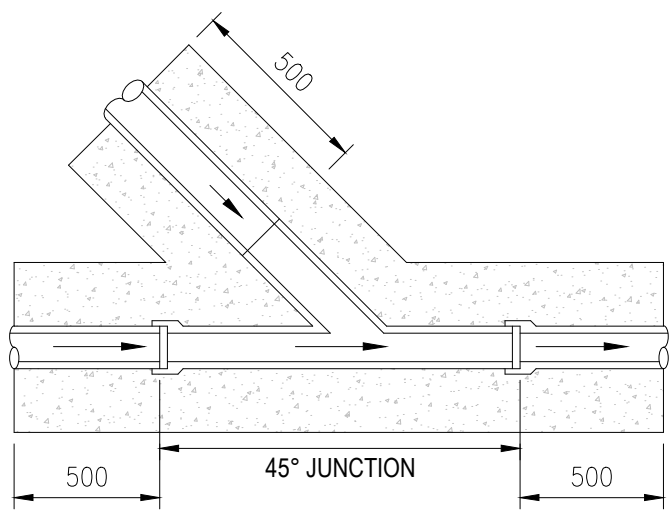
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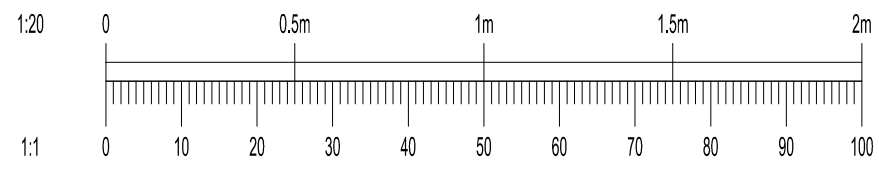
SITED IN HARD LANDSCAPED AREAS
WITH RECESSED COVER



SITED IN HARD LANDSCAPED AREAS
WITH STANDARD ROUND COVER



TYPICAL SADDLE CONNECTION



FINAL CONSTRUCTION NOTE:

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C03	FINAL CONSTRUCTION ISSUE	17/10/24	CS	RB
C02	CONSTRUCTION ISSUE UPDATE	09/05/23	CS	MW
C01	CONSTRUCTION	22/02/23	KS	MW
P03	TENDER	21/01/22	TH	AR
P02	ISSUED	01/09/20	DE	AR
P01	ISSUED	31/03/20	RM	RM
Rev:	Description:	Date:	By:	Chkd:



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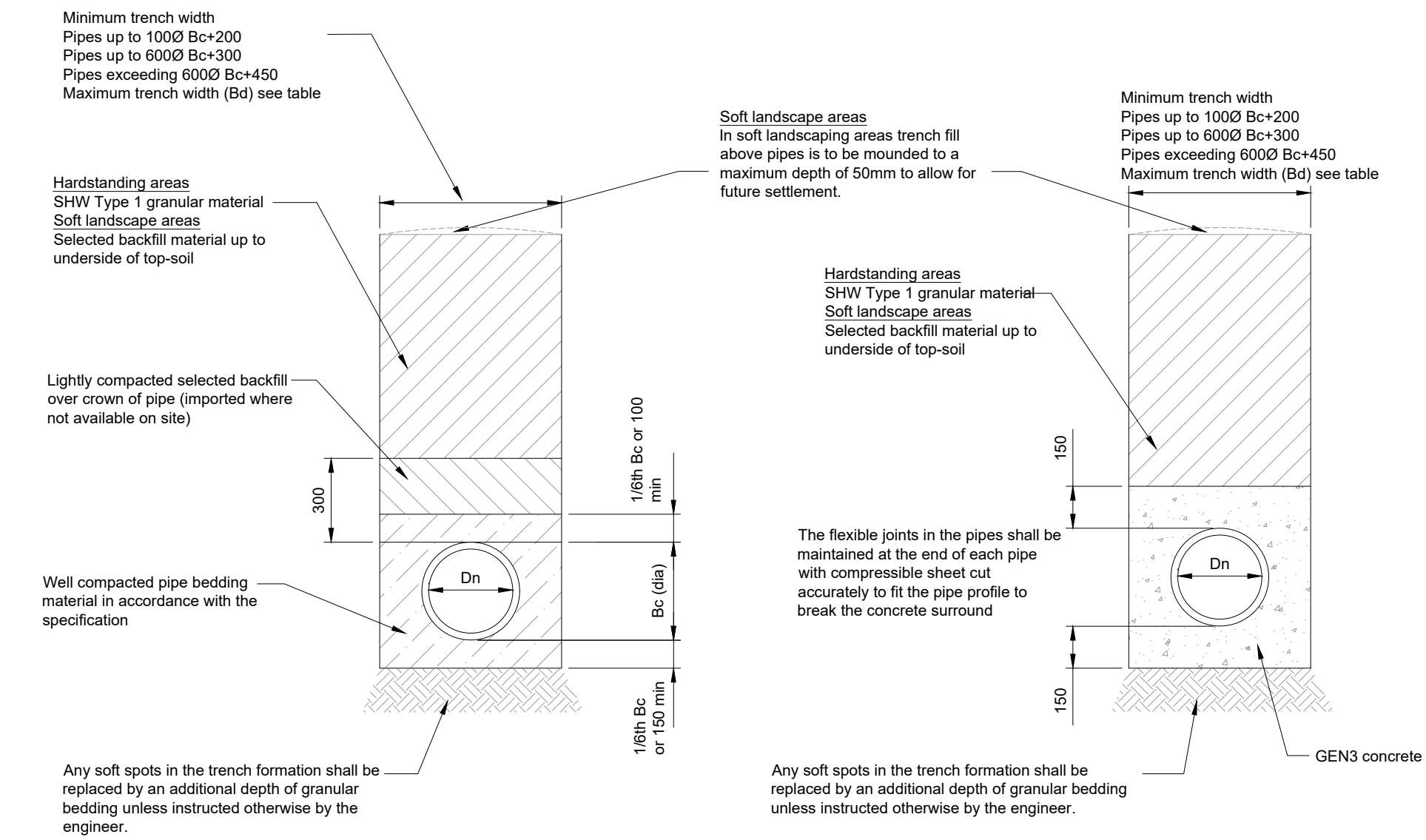
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Status: **FINAL CONSTRUCTION** **A6**

Project: **MMU PUBLIC REALM MASTERPLAN**

Dwg Title: **SW DRAINAGE STRATEGY - PHASE 1a
STANDARD DETAILS SHEET 1**

Drawn By	Designed By	Checked By
KS	MW	AR
Date	22/02/23	Scales @ A1 1:20
Project No - Originator - Function - Spatial - Form - Discipline - Number	Revision	
075050 - CUR - XX - XX - D - Z - 72051	C03	



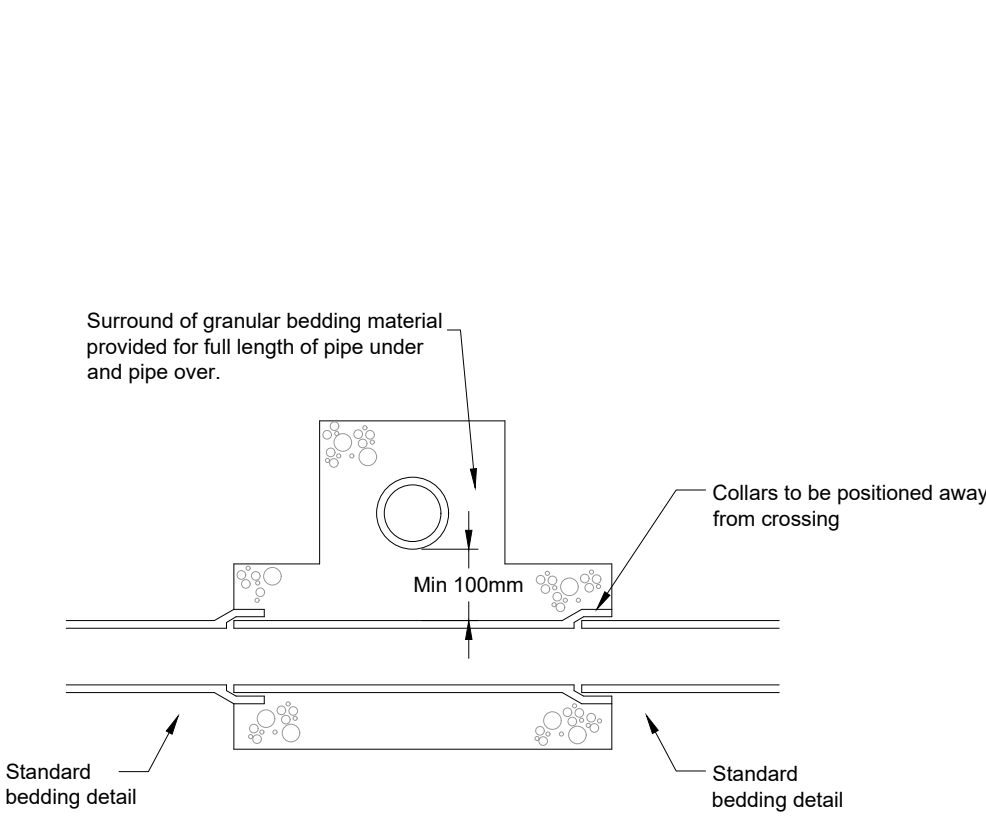
CLASS S - 360° GRANULAR
SURROUND PIPE BEDDING DETAIL
(SCALE 1:20)

CLASS Z - CONCRETE BED AND
SURROUND PIPE BEDDING DETAIL
(COVER < 900mm IN VEHICULAR LOADING AND OPEN FIELD,
COVER < 600mm ELSEWHERE EXCEPT UNDER BUILDINGS.)
(SCALE 1:20)

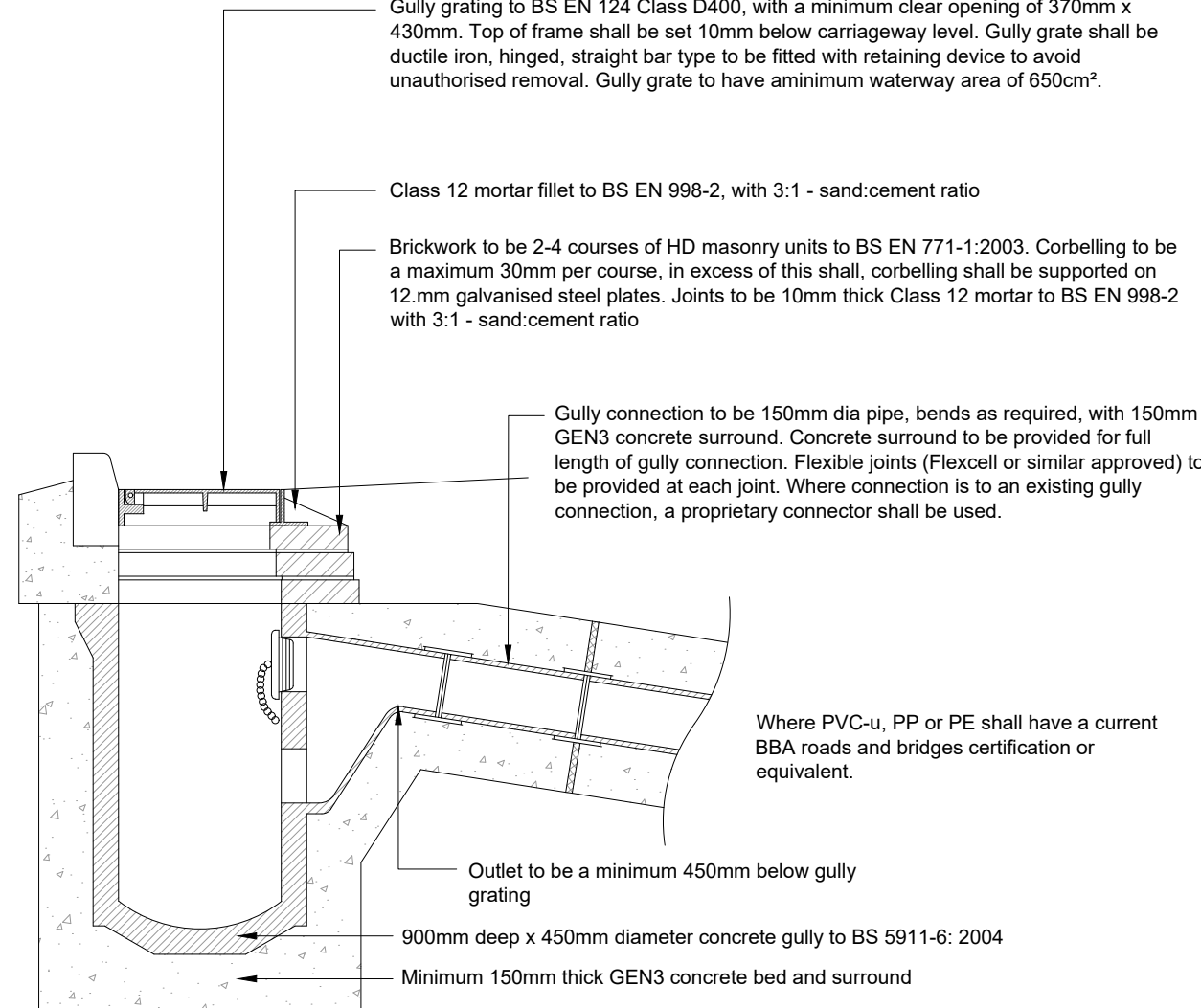
INSTALLATION OF PLASTIC PIPES SHOULD BE
CARRIED OUT AS PER MANUFACTURE GUIDANCE

Dn	Bd
150	0.6
225	0.7
300	0.85
375	1.05
450	1.15
525	1.25
600	1.35
675	1.45
750	1.50

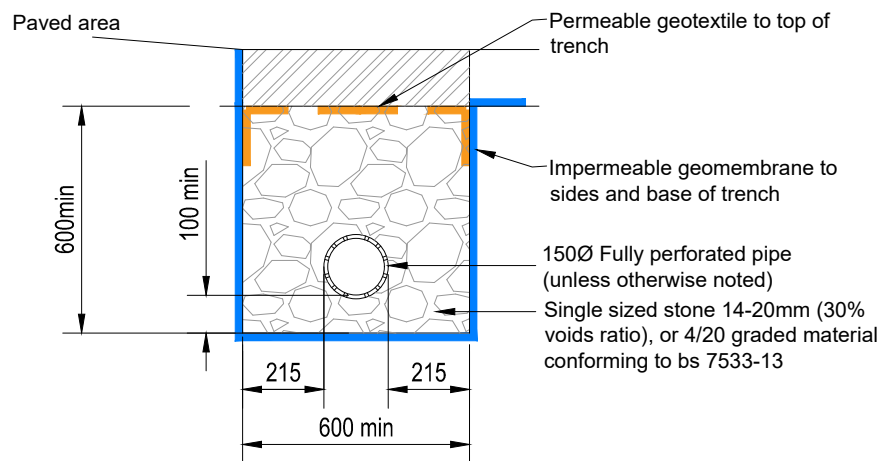
MAXIMUM TRENCH WIDTH



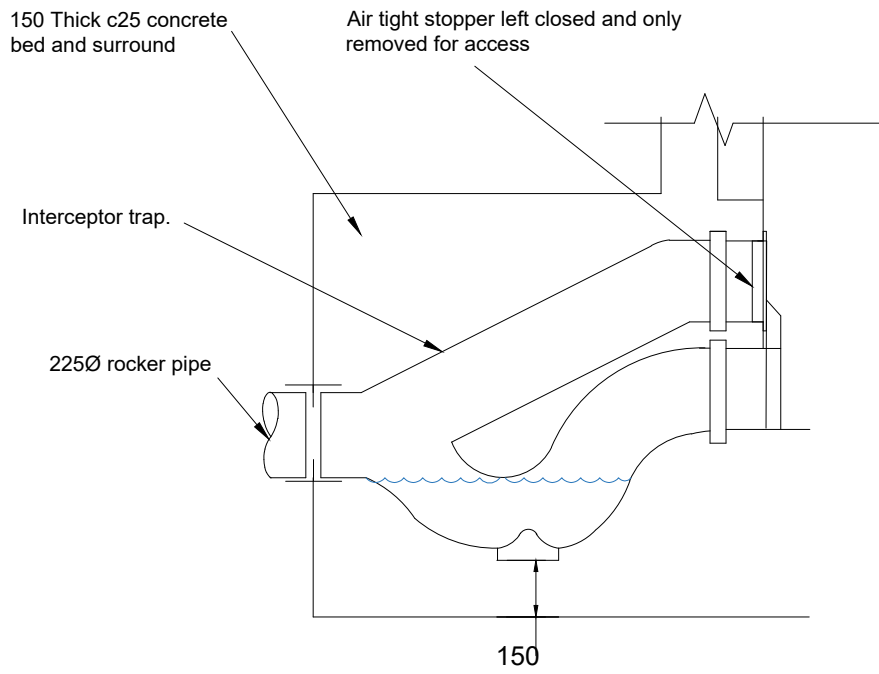
PIPE CROSSINGS DETAIL
(SCALE 1:20)



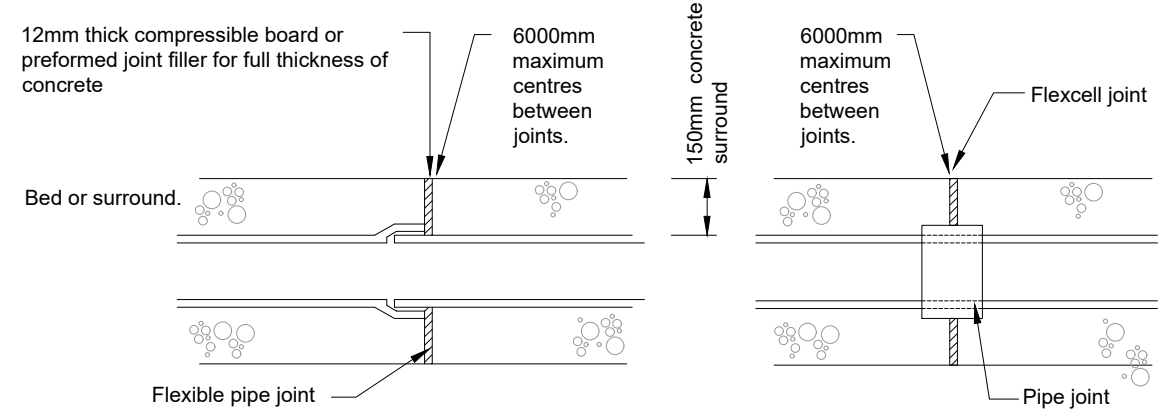
ROAD GULLY(G) DETAIL - TYPE 1
(SCALE 1:20)



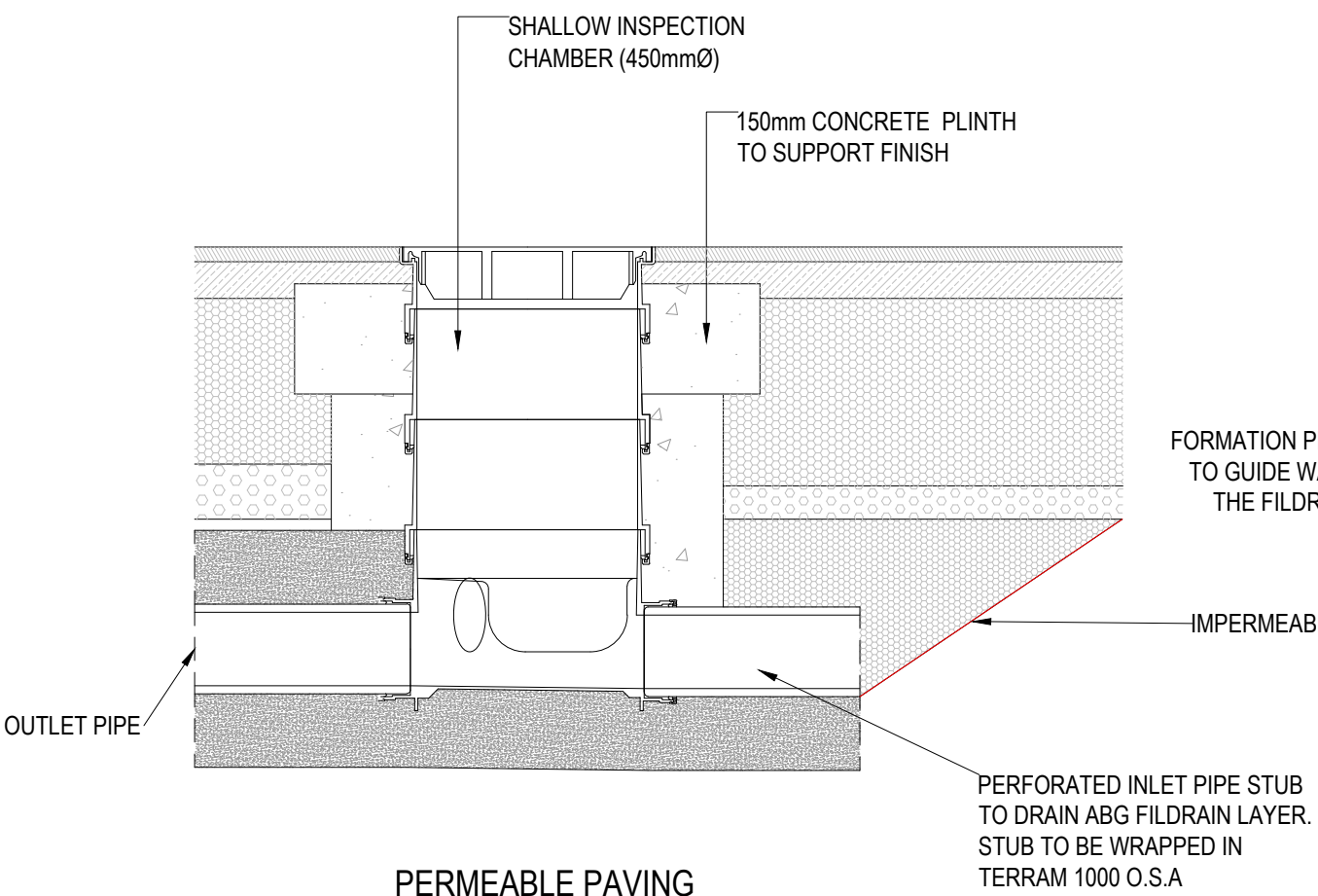
FILTER DRAIN DETAIL
(SCALE 1:20)



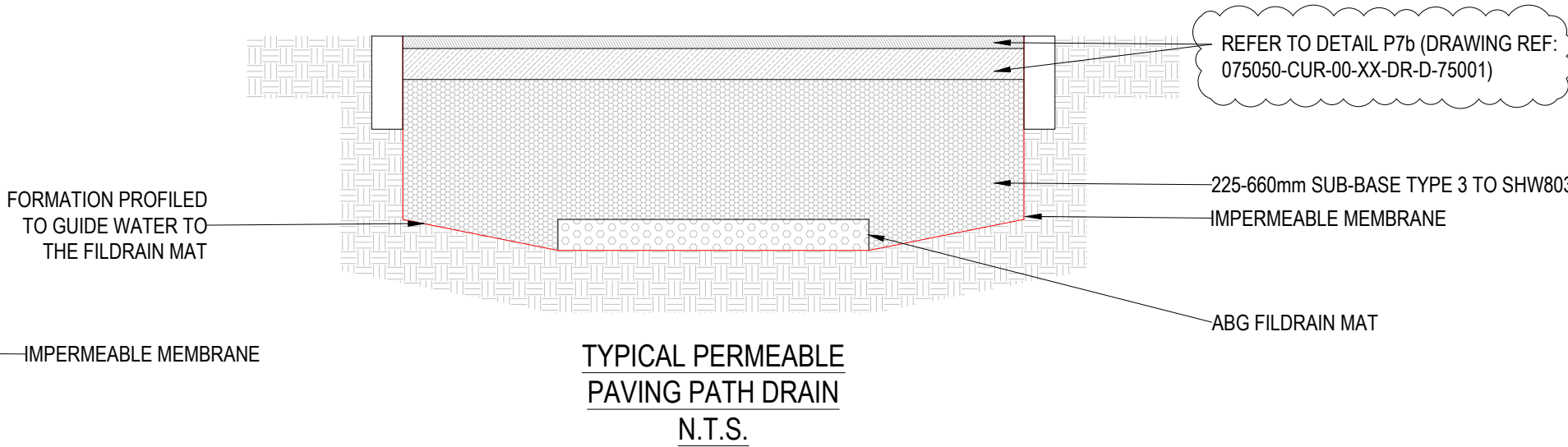
INTERCEPTOR TRAP



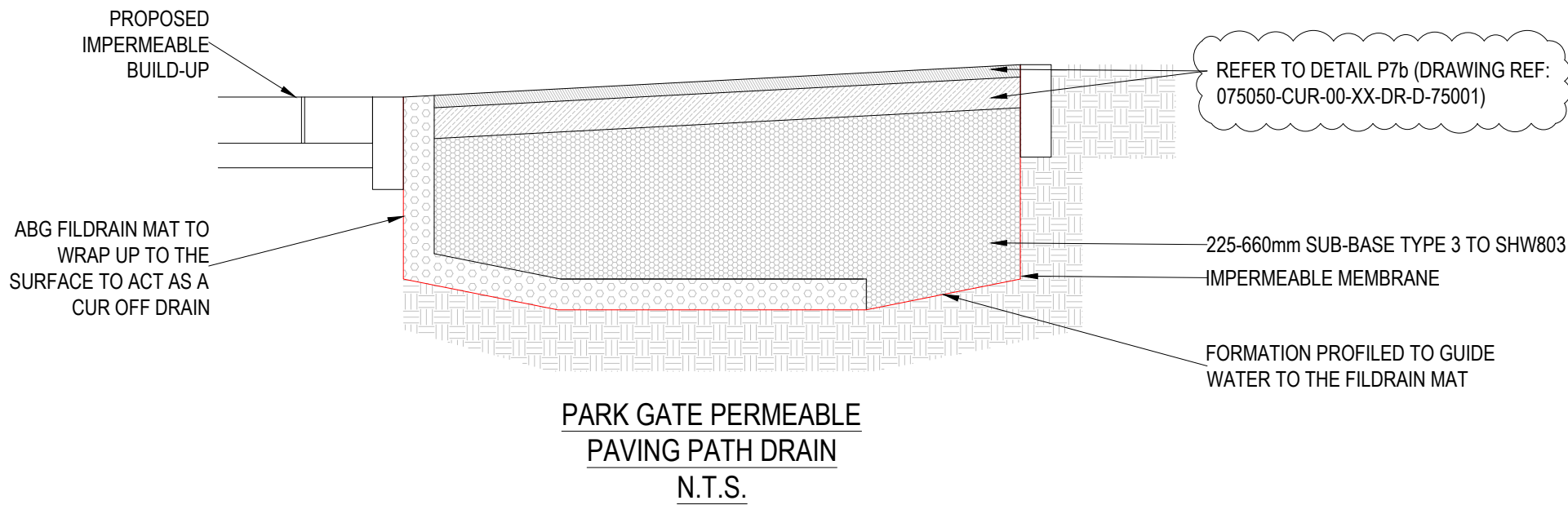
EXPANSION JOINT
FOR CONCRETE BED AND SURROUND
(SCALE 1:20)



PERMEABLE PAVING
CONNECTION



TYPICAL PERMEABLE
PAVING PATH DRAIN
N.T.S.



PARK GATE PERMEABLE
PAVING PATH DRAIN
N.T.S.

GENERAL NOTES:

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- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
- FOR GENERAL NOTES REFER TO DRAWING 075050-CUR-00-ZZ-DR-D-75006.

FINAL CONSTRUCTION NOTE:
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C05	FINAL CONSTRUCTION ISSUE	NYI	CS	RB
C04	LABEL ADDED	24/10/23	KS	MW
C03	CONSTRUCTION ISSUE UPDATE	05/09/23	CS	AR
C02	CONSTRUCTION ISSUE UPDATE	05/05/23	CS	MW
C01	CONSTRUCTION	22/02/23	KS	MW
P04	TENDER	21/01/22	TH	AR
P03	FILTER DRAIN - NOTE ADDED	16/09/22	DE	AR
P02	UPDATED FOR DETAIL DESIGN	01/09/20	DE	AR
P01	FIRST ISSUE	31/03/20	RM	RM
Rev:	Description:	Date:	By:	Chkd:

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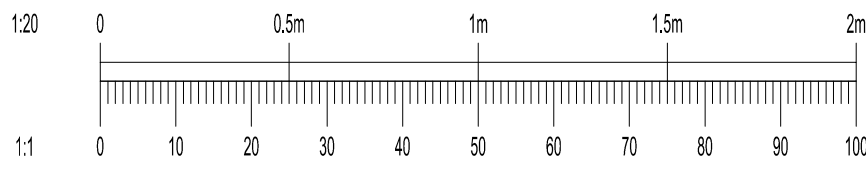
Status: **FINAL CONSTRUCTION** **A6**

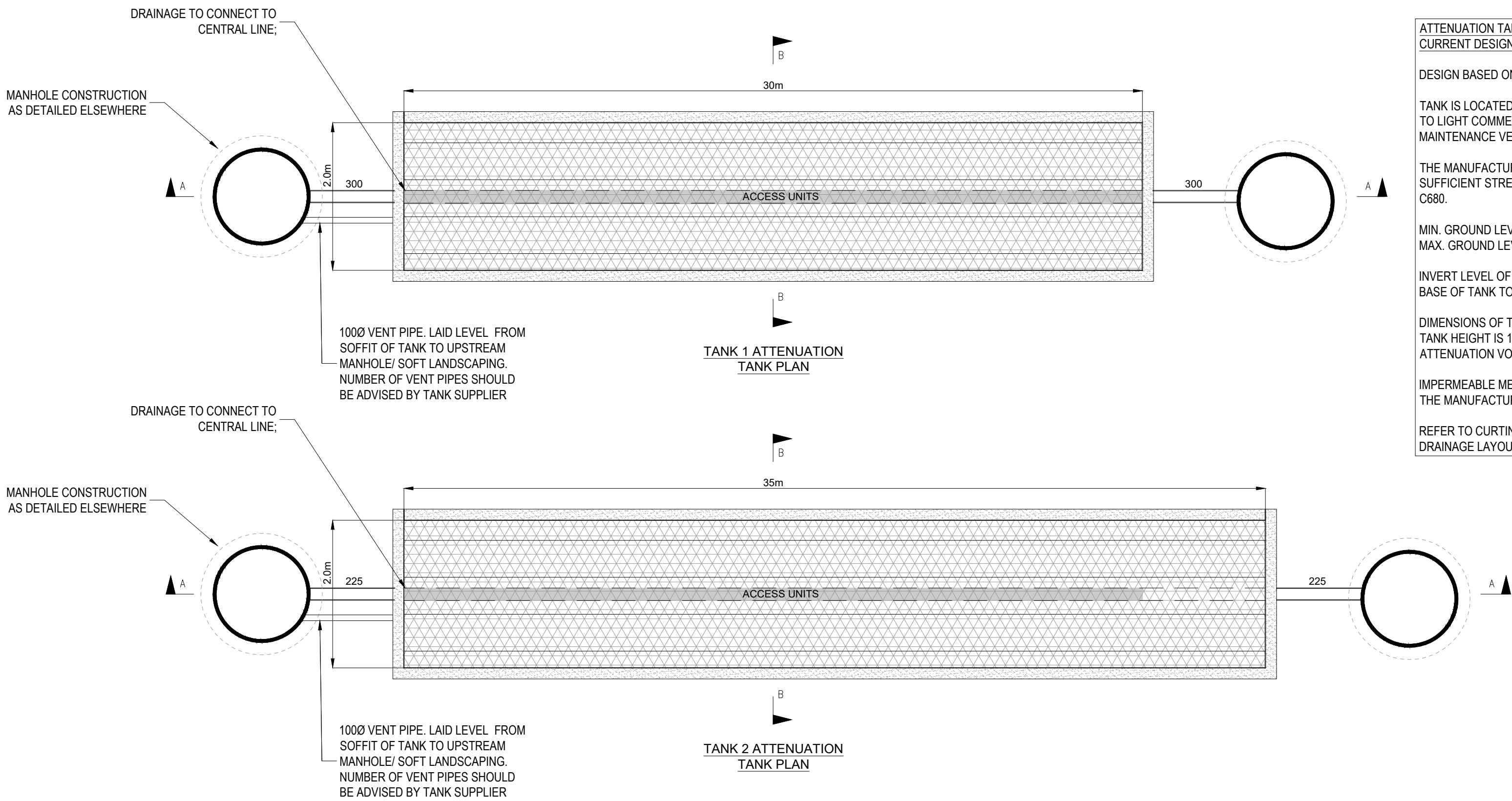
Project: **MMU PUBLIC REALM MASTERPLAN**

Dwg Title: **SW DRAINAGE STRATEGY - PHASE 1a
STANDARD DETAILS SHEET 2**

Drawn By	Designed By	Checked By
KS	MW	AR
Date	22/02/23	Scales @ A1 1:20

Project No - Originator - Function - Spatial - Form - Discipline - Number	Revision
075050 - CUR - XX - XX - D - Z - 72052	C05





ATTENUATION TANK 1
CURRENT DESIGN ASSUMPTIONS

DESIGN BASED ON POLYPIPE POLYSTORM PSM1A 1000LX500WX400D

TANK IS LOCATED WITHIN A HARD STANDING PUBLIC REALM AREA SUBJECT TO LIGHT COMMERCIAL VEHICLES, EMERGENCY VEHICLES AND MAINTENANCE VEHICLES.

THE MANUFACTURER WILL NEED TO CONFIRM THAT THE TANK HAS SUFFICIENT STRENGTH FOR THIS LOCATION IN ACCORDANCE WITH CIRIA C680.

MIN. GROUND LEVEL IS 37.40: MIN COVER IS 1.88m.
MAX. GROUND LEVEL IS 37.57: THEREFORE MAX. COVER IS 2.05m.

INVERT LEVEL OF OUTLET PIPE - 34.35
BASE OF TANK TO BE LAID AT FALL SHOWN IN DRAINAGE LAYOUT.

DIMENSIONS OF TOTAL UNIT ARE 2x30m.
TANK HEIGHT IS 1200mm.
ATTENUATION VOLUME, BASED ON 95% VOID RATIO IS 68.4m³

IMPERMEABLE MEMBRANE, BED AND SURROUND TO BE CONFIRMED WITH THE MANUFACTURER.

REFER TO CURTINS DRAWING 075050-CUR-XX-XX-DR-D-72001 - PROPOSED DRAINAGE LAYOUT FOR TANK & INLET/OUTLET LOCATIONS.

ATTENUATION TANK 2
CURRENT DESIGN ASSUMPTIONS

DESIGN BASED ON POLYPIPE POLYSTORM PSM1A 1000LX500WX400D

TANK IS LOCATED WITHIN A HARD STANDING PUBLIC REALM AREA SUBJECT TO LIGHT COMMERCIAL VEHICLES, EMERGENCY VEHICLES AND MAINTENANCE VEHICLES.

THE MANUFACTURER WILL NEED TO CONFIRM THAT THE TANK HAS SUFFICIENT STRENGTH FOR THIS LOCATION IN ACCORDANCE WITH CIRIA C680.

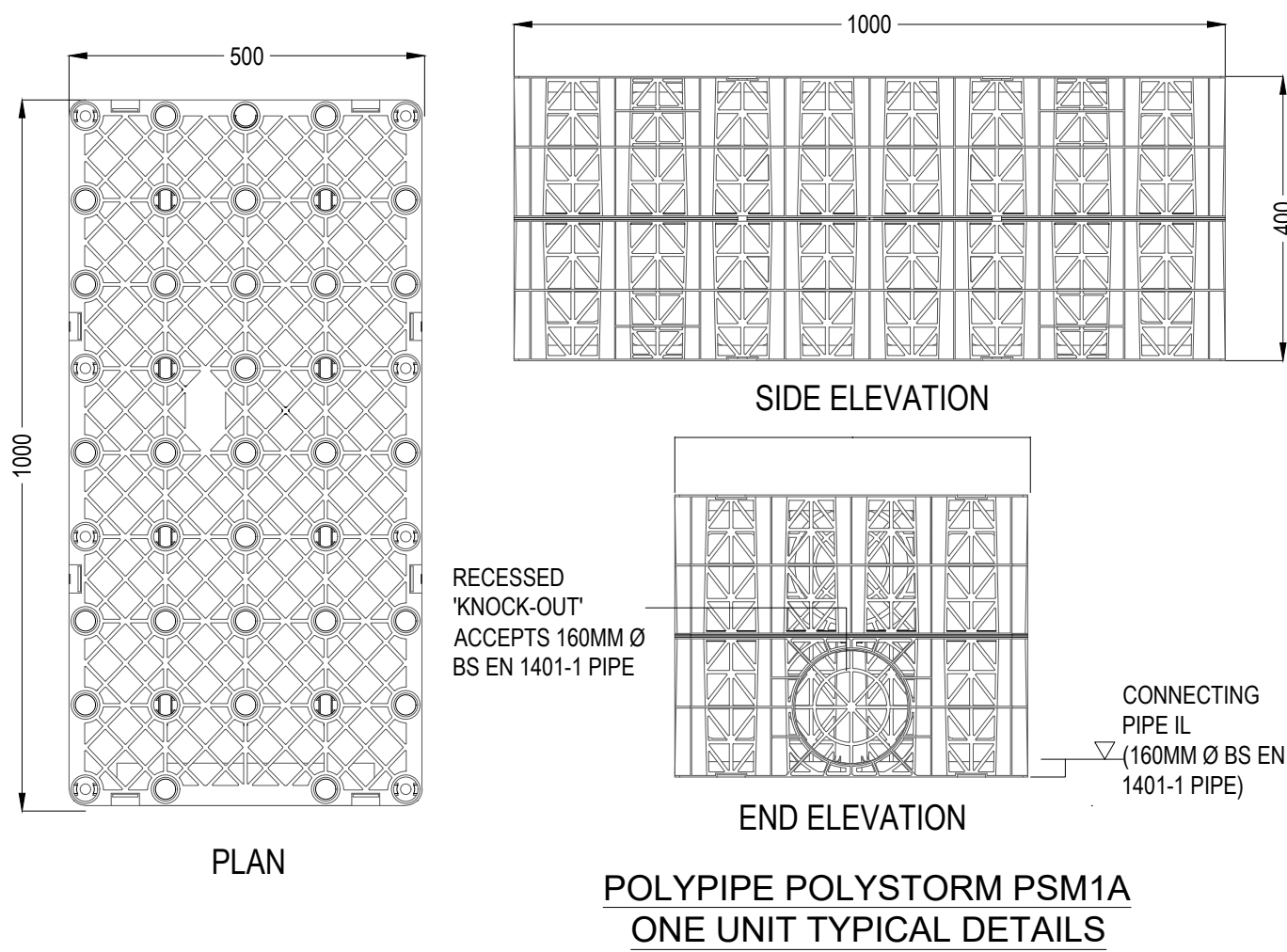
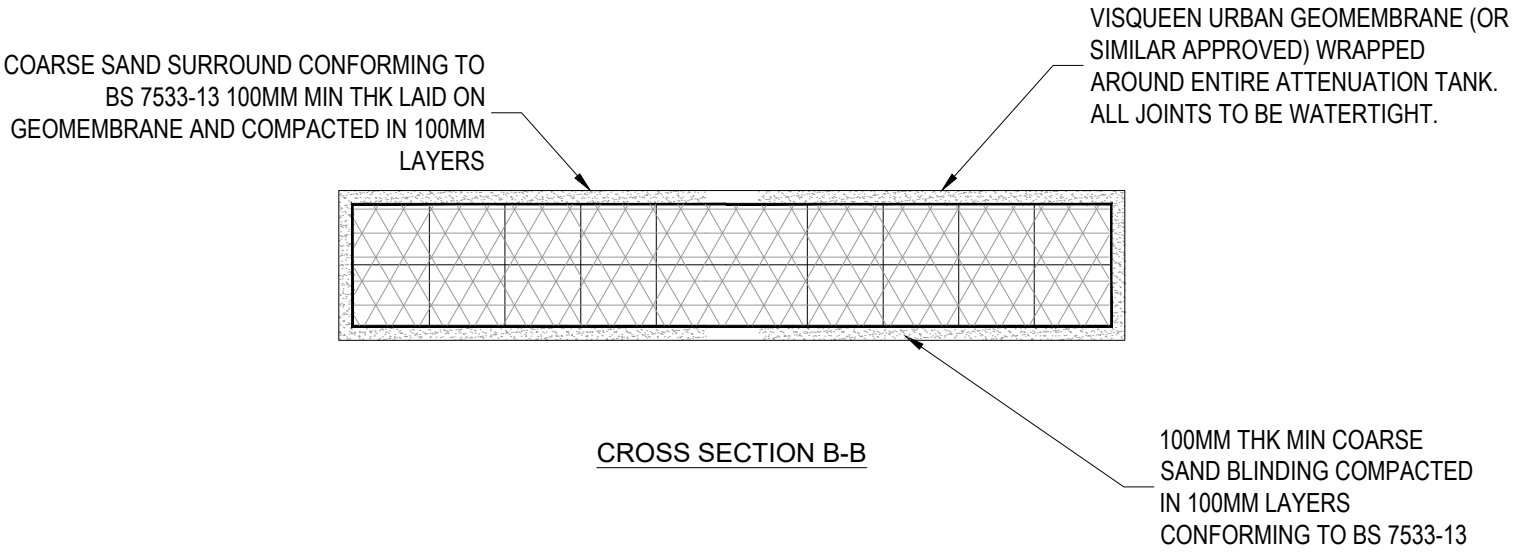
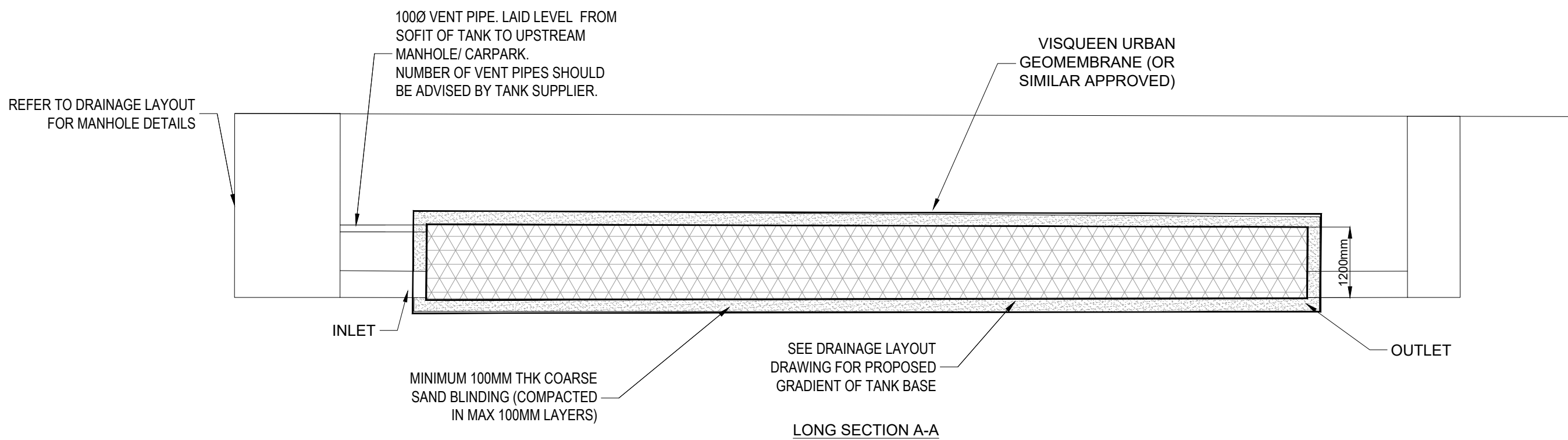
MIN. GROUND LEVEL IS 37.37: MIN COVER IS 0.70m.
MAX. GROUND LEVEL IS 37.57: THEREFORE MAX. COVER IS 1.23m.

INVERT LEVEL OF OUTLET PIPE - 35.46
BASE OF TANK TO BE LAID AT FALL SHOWN IN DRAINAGE LAYOUT.

DIMENSIONS OF TOTAL UNIT ARE 2x35m.
TANK HEIGHT IS 1200mm.
ATTENUATION VOLUME, BASED ON 95% VOID RATIO IS 79.8m³

IMPERMEABLE MEMBRANE, BED AND SURROUND TO BE CONFIRMED WITH THE MANUFACTURER.

REFER TO CURTINS DRAWING 075050-CUR-XX-XX-DR-D-72001 - PROPOSED DRAINAGE LAYOUT FOR TANK & INLET/OUTLET LOCATIONS.



- GENERAL NOTES:
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 - ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
 - REFER TO DRAINAGE LAYOUT 075050-CUR-XX-XX-DR-D-72001 FOR THE LOCATION OF THE ATTENUATION TANK.
 - ATTENUATION TANK TO BE INSTALLED STRICTLY IN ACCORDANCE WITH THE MANUFACTURER'S REQUIREMENTS.
 - WHERE AN ALTERNATIVE ATTENUATION TANK DEVICE IS PREFERRED, IT WILL BE SUBJECT TO REDESIGN TO CONFIRM WHETHER THE SYSTEM HAS CAPACITY.
 - THE DESIGN OF THE TANK SHOULD BE PROVIDED BY THE MANUFACTURER OR SUPPLIER TO ENSURE THE TANK IS SUFFICIENT FOR THE SITE SPECIFIC CRITERIA.
 - THE TANK DESIGN SHOULD INCORPORATE:
 - TANK LOCATED IN PEDESTRIAN AREA
 - SUITABLE MAINTENANCE ACCESS; AND
 - VENTING TO PREVENT TRAPPED AIR POCKETS.
 - THE STRENGTH OF THE TANK SHOULD COMPLY WITH CIRIA C680 STRUCTURAL DESIGN OF MODULAR GEOCELLULAR DRAINAGE TANKS.
 - ACCESS FOR MAINTENANCE SHOULD BE IN ACCORDANCE WITH CIRIA GUIDANCE.
 - VENTING TO THE TANK SHOULD BE CONFIRMED BY THE TANK MANUFACTURER. VENTING SHOULD BE LOCATED WITHIN LANDSCAPED AREAS, OR ROUTED BACK TO THE NEAREST MANHOLE ABOVE THE DESIGN WATER LEVEL.
 - CONSTRUCTION AND INSTALLATION OF THE TANK SHOULD BE STRICTLY IN ACCORDANCE WITH THE MANUFACTURER'S INSTALLATION REQUIREMENTS.
 - THE CONTRACTOR SHALL PROHIBIT THE MOVEMENT OF CONSTRUCTION PLANT ACROSS THE STORAGE TANK AND WHERE NECESSARY PROVIDE ADDITIONAL SUPPORT AND PROTECTION TO THE STRUCTURE. PARTICULARLY POST CONSTRUCTION. TEMPORARY FENCING CAN BE USED TO PROHIBIT TRADE STOCKS, PILING MATERIALS, HEAVY PLANTS ETC.
 - FINAL DESIGN IS SUBJECT TO CONTRACTOR'S DESIGN PORTION

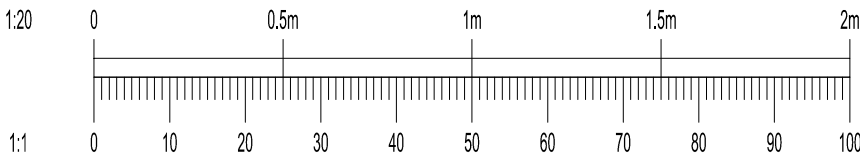
- FINAL CONSTRUCTION NOTE:
- THE INFORMATION ON THIS DRAWING REPRESENTS THE FINAL CONSTRUCTION ISSUE INFORMATION INCORPORATING ANY DETAIL AMENDMENTS ADVISED BY THE CONTRACTOR DURING THE WORKS.
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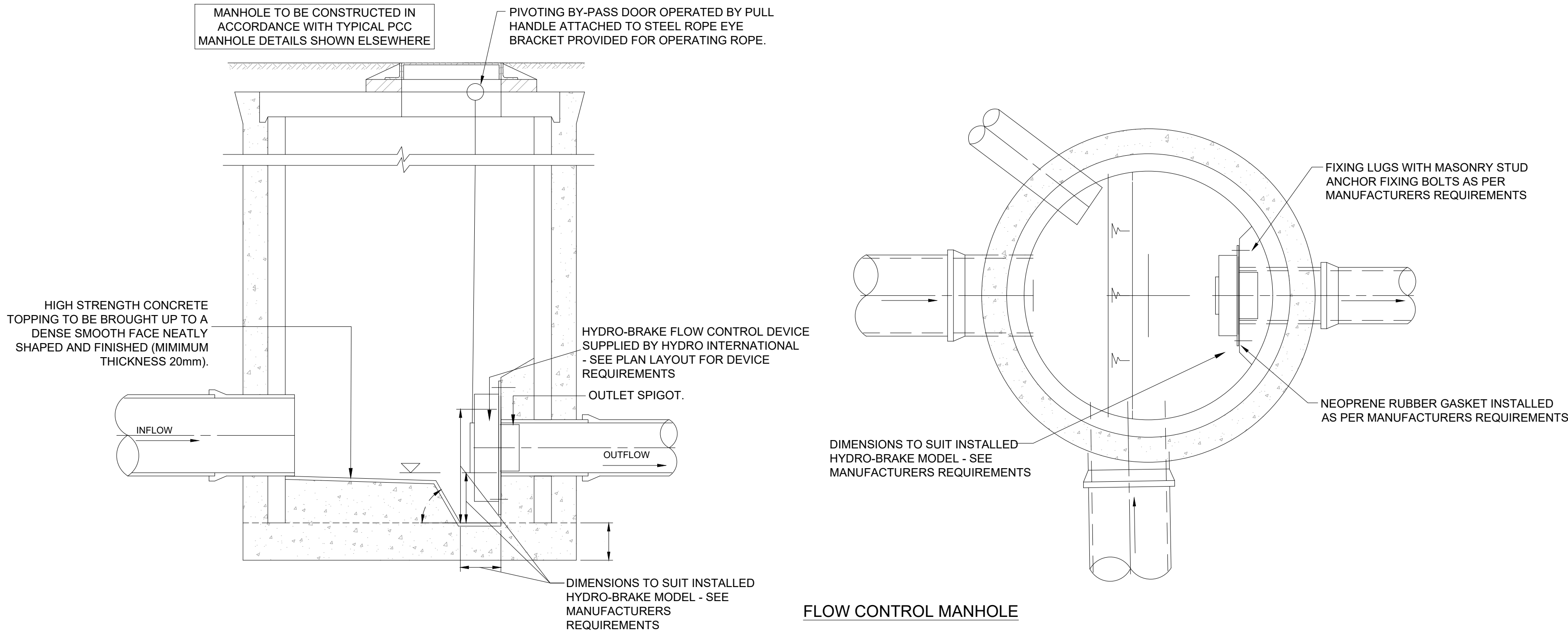
C03	FINAL CONSTRUCTION ISSUE	17/10/24	CS	RB
C02	CONSTRUCTION ISSUE UPDATE	05/05/23	CS	MW
C01	CONSTRUCTION	22/02/23	KS	MW
Rev:	Description:	Date:	By:	Chkd:

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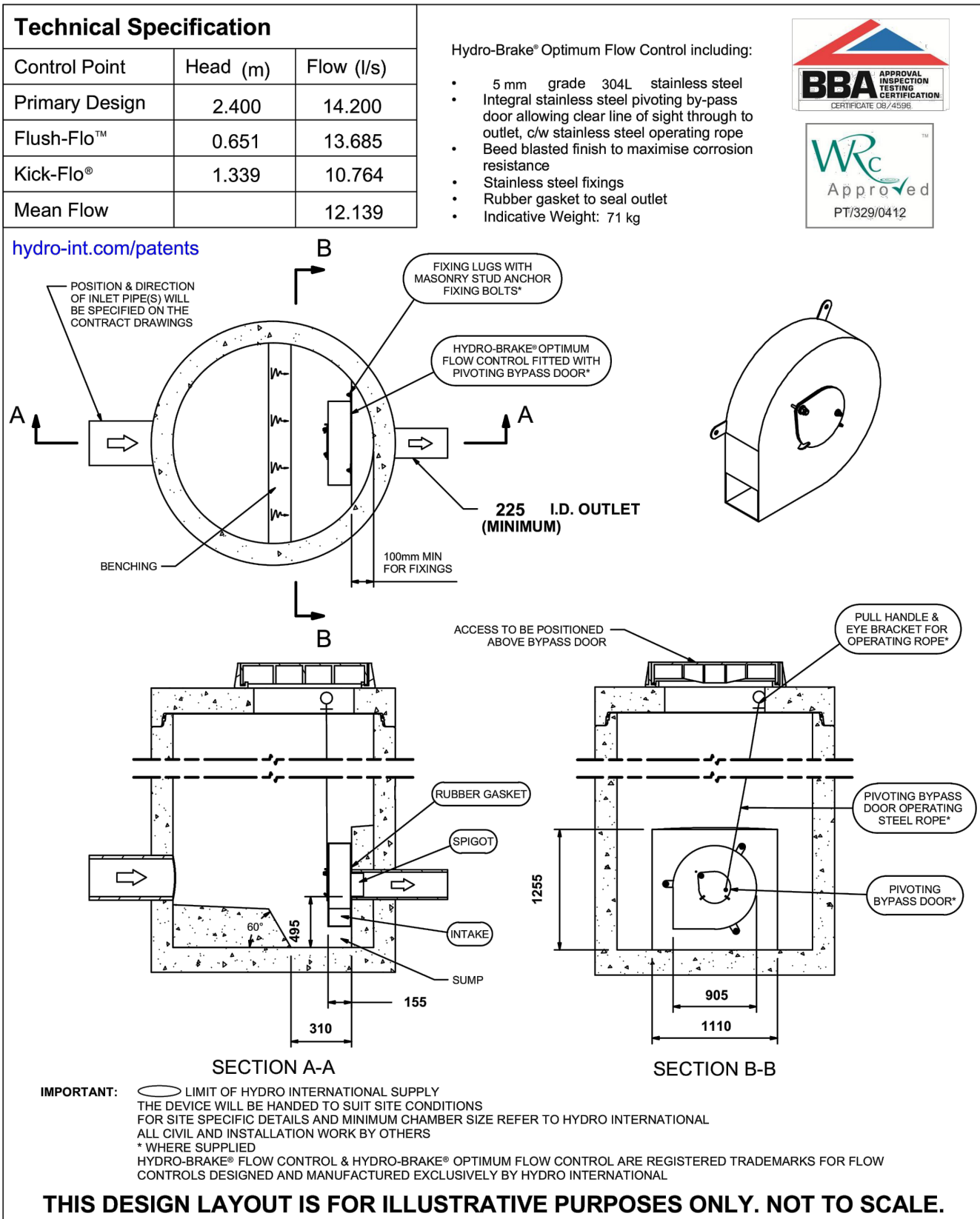
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Status:		FINAL CONSTRUCTION		A6	
Project: MMU PUBLIC REALM MASTERPLAN					
Dig Title: SW DRAINAGE STRATEGY - PHASE 1a STANDARD DETAILS SHEET 3					
Drawn By KS		Designed By MW		Checked By AR	
Date 22/02/23		Scales @ A1 1:20		Revision	
Project No - Originator - Function - Spatial - Form - Discipline - Number 075050 - CUR - XX - XX - D - Z - 72053					C02





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 - ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
 - REFER TO DRAINAGE LAYOUT 075050-CUR-XX-XX-DR-D-72001 FOR THE LOCATION OF THE ATTENUATION TANK.
 - FLOW CONTROL TO BE INSTALLED IN STRICT ACCORDANCE WITH THE MANUFACTURERS REQUIREMENTS, INSTRUCTIONS AND RECOMMENDATIONS.
 - WHERE ALTERNATIVE FLOW CONTROL DEVICE IS PREFERRED, IT WILL BE SUBJECT TO REDESIGN TO CONFIRM WHETHER THE SYSTEM HAS CAPACITY.
 - SURFACE WATER DRAINAGE CONNECTION SUBJECT TO S106 AGREEMENT WITH UNITED UTILITIES
 - FOR FULL DRAINAGE NOTES REFER TO 075050-CUR-00-ZZ-DR-D-75006

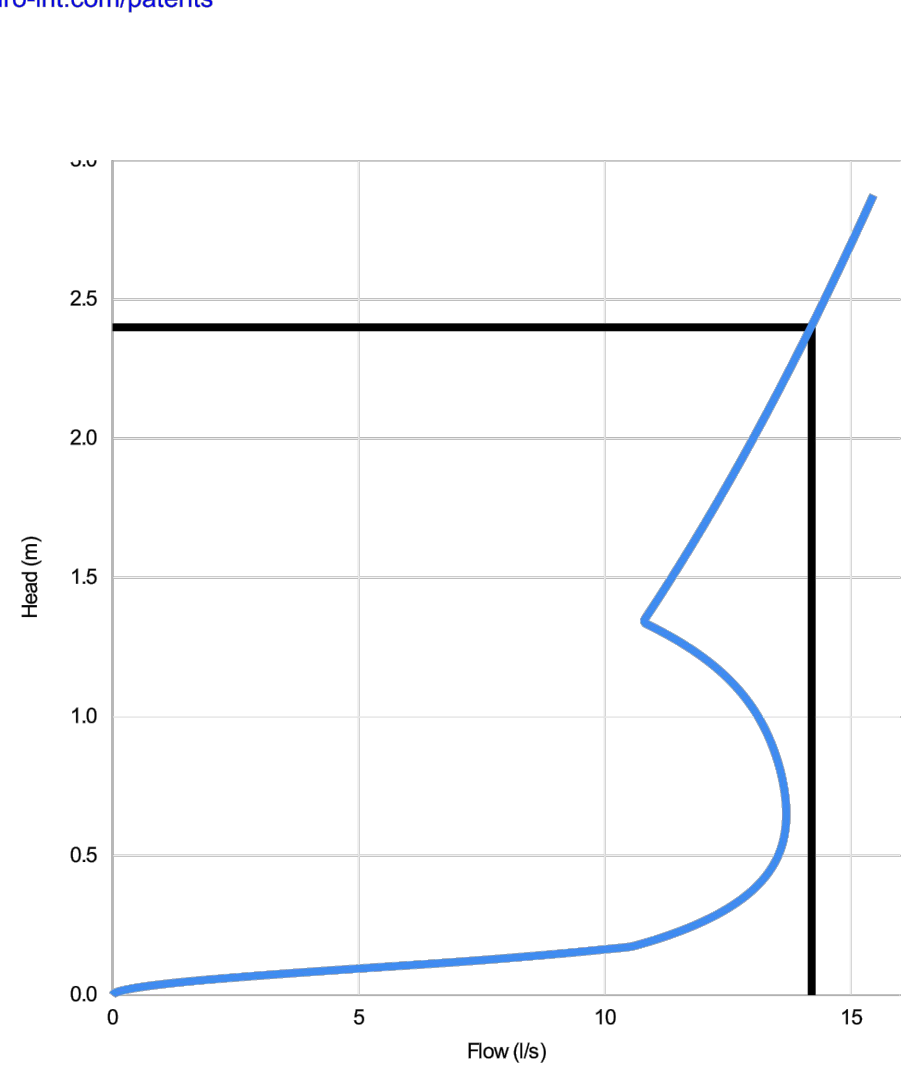


DESIGN ADVICE	The head/flow characteristics of this SHE-0150-1420-2400-1420 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve. The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.	Hydro International
DATE	05/05/2023 09:26	SHE-0150-1420-2400-1420
SITE	MMU PUBLIC REALM	Hydro-Brake® Optimum
DESIGNER	Charlie Smith	
REF	SW14	

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Technical Specification		
Control Point	Head (m)	Flow (l/s)
Primary Design	2.400	14.200
Flush-Flo	0.651	13.685
Kick-Flo®	1.339	10.764
Mean Flow	12.139	

hydro-int.com/patents



Head (m)	Flow (l/s)
0.000	0.000
0.083	3.959
0.166	10.063
0.248	11.785
0.331	12.666
0.414	13.203
0.497	13.508
0.579	13.652
0.662	13.684
0.745	13.638
0.828	13.531
0.910	13.368
0.993	13.138
1.076	12.819
1.159	12.376
1.241	11.769
1.324	10.956
1.407	11.018
1.490	11.319
1.572	11.611
1.655	11.896
1.738	12.173
1.821	12.444
1.903	12.708
1.986	12.967
2.069	13.220
2.152	13.468
2.234	13.711
2.317	13.949
2.400	14.184

DESIGN ADVICE	The head/flow characteristics of this SHE-0150-1420-2400-1420 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	05/05/2023 09:26	SHE-0150-1420-2400-1420
Site	MMU PUBLIC REALM	Hydro-Brake Optimum®
DESIGNER	Charlie Smith	
Ref	SW 14	

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C03	FINAL CONSTRUCTION ISSUE	NYI	CS	RB
C02	CONSTRUCTION ISSUE UPDATE	09/05/23	CS	MW
C01	CONSTRUCTION	22/02/23	KS	MW
Rev:	Description:	Date:	By:	Chkd:



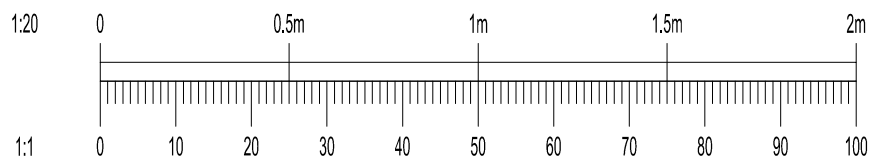
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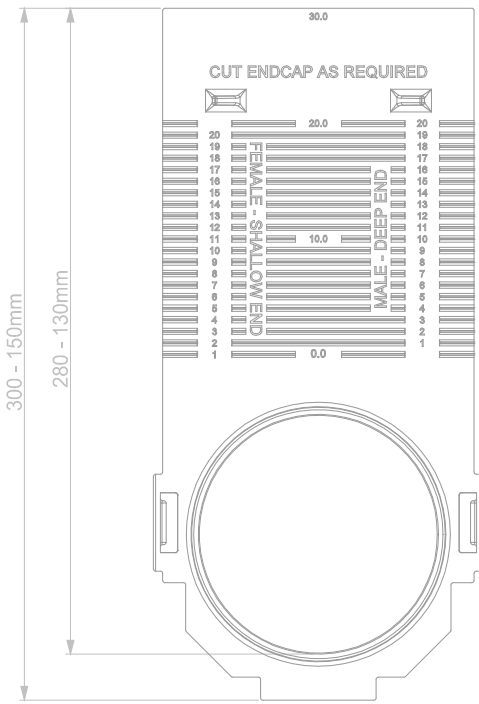
Status:	FINAL CONSTRUCTION	A6
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Project:	MMU PUBLIC REALM MASTERPLAN
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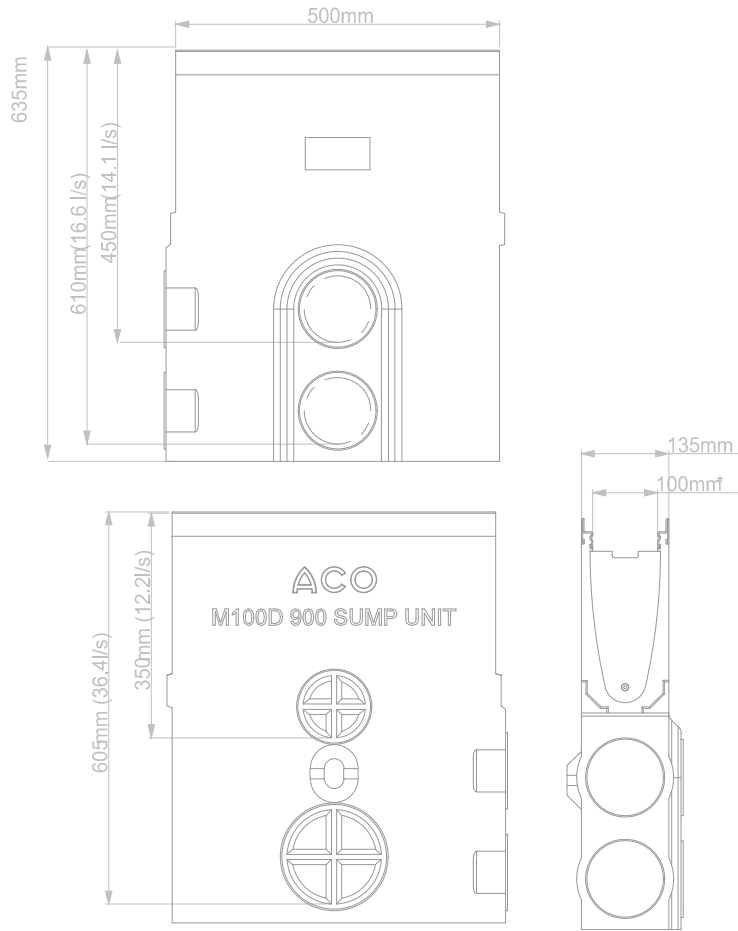
Dwg Title:	SW DRAINAGE STRATEGY - PHASE 1a STANDARD DETAILS SHEET 4
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Drawn By	KS	Designed By	MW	Checked By	AR
		Date	22/02/23	Scales @ A1	1:20
Project No - Originator - Function - Spatial - Form - Discipline - Number					Revision
075050 - CUR - XX - XX - D - Z - 72054					C03

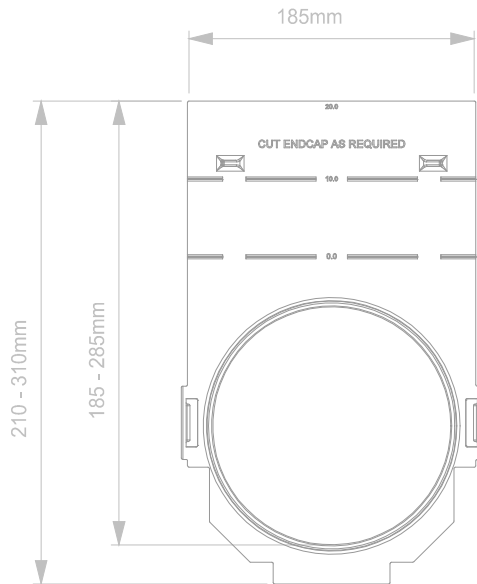




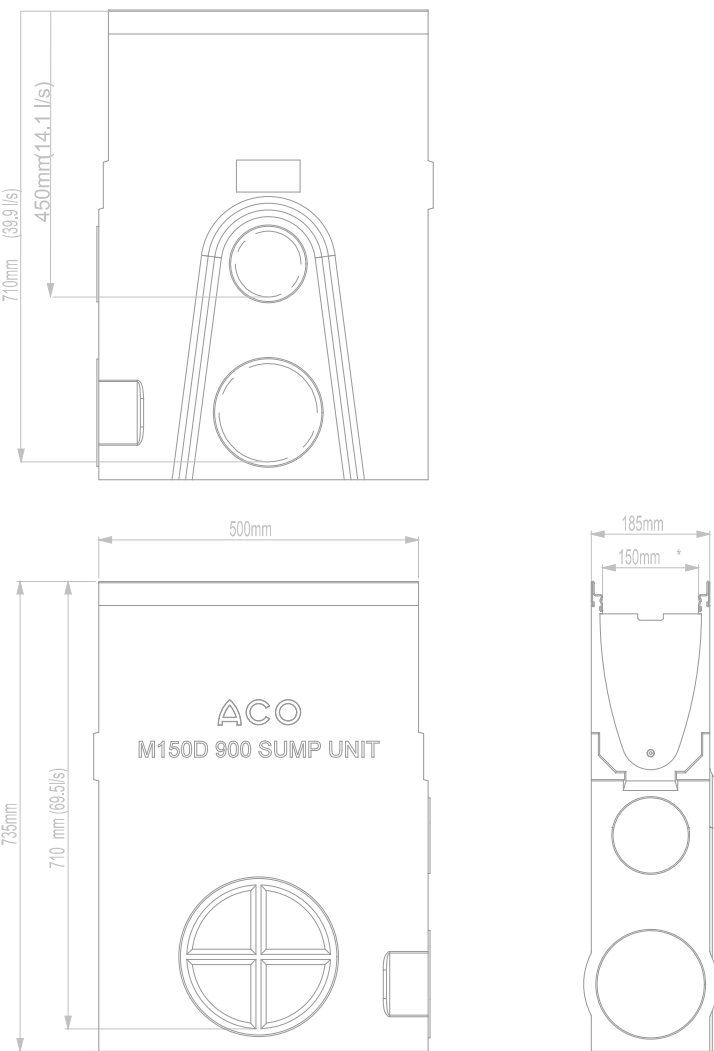
ACO MULTIDRAIN M100D ENDCAP
(N.T.S)



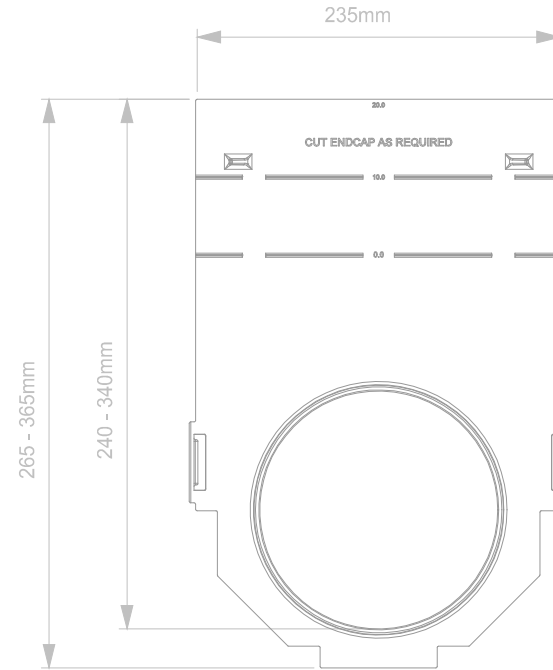
ACO MULTIDRAIN M100D UNIVERSAL
SUMP
(N.T.S)



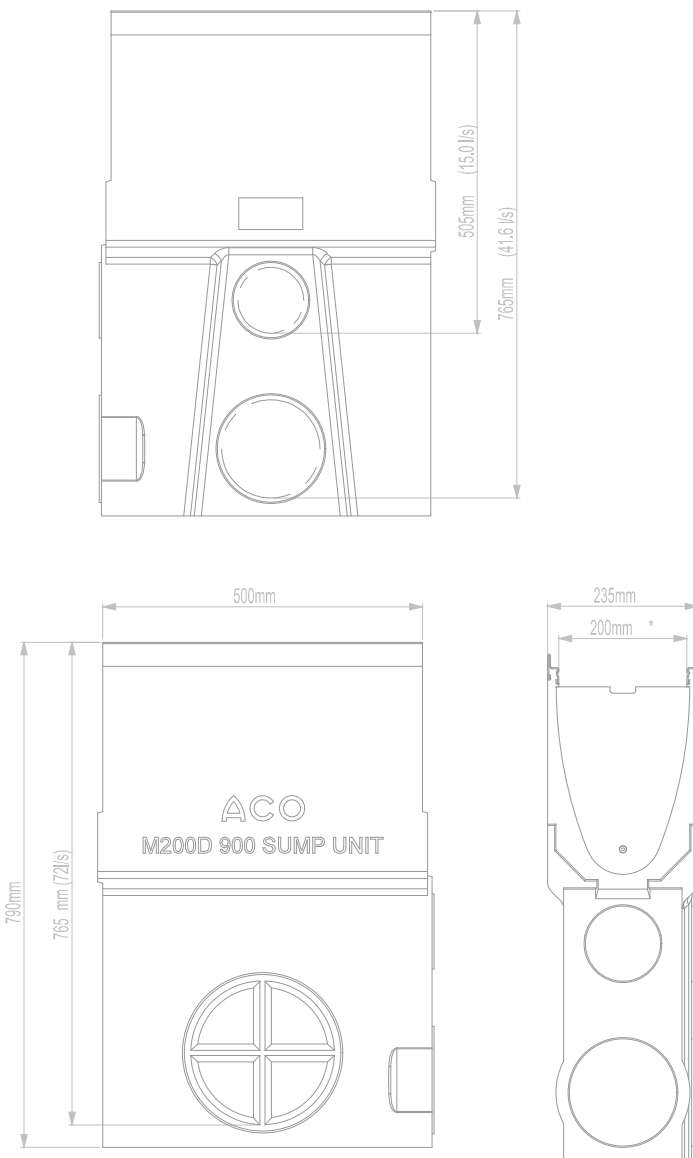
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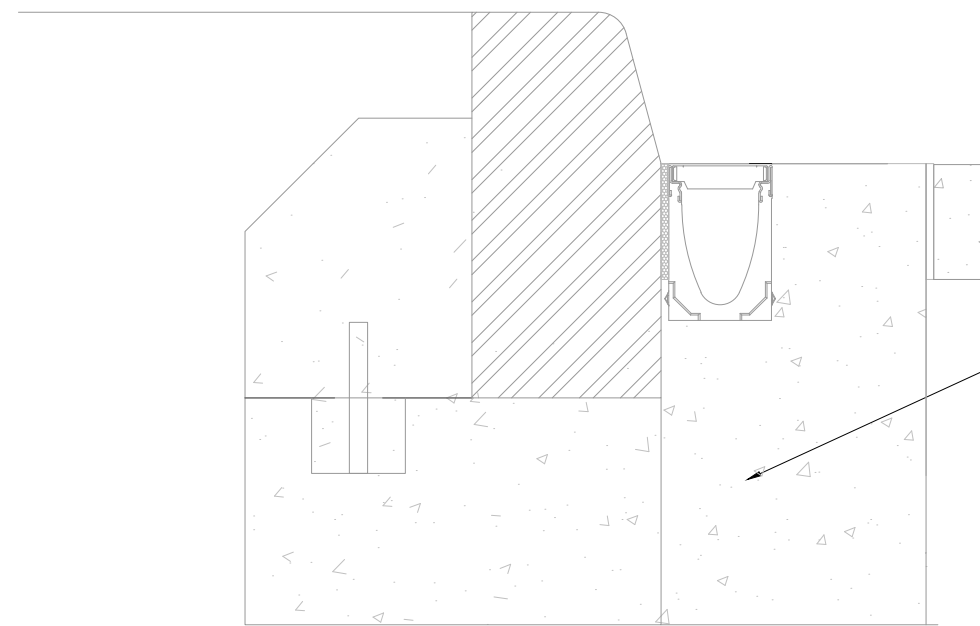
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SUMP
(N.T.S)



ACO MULTIDRAIN M200D ENDCAP
(N.T.S)

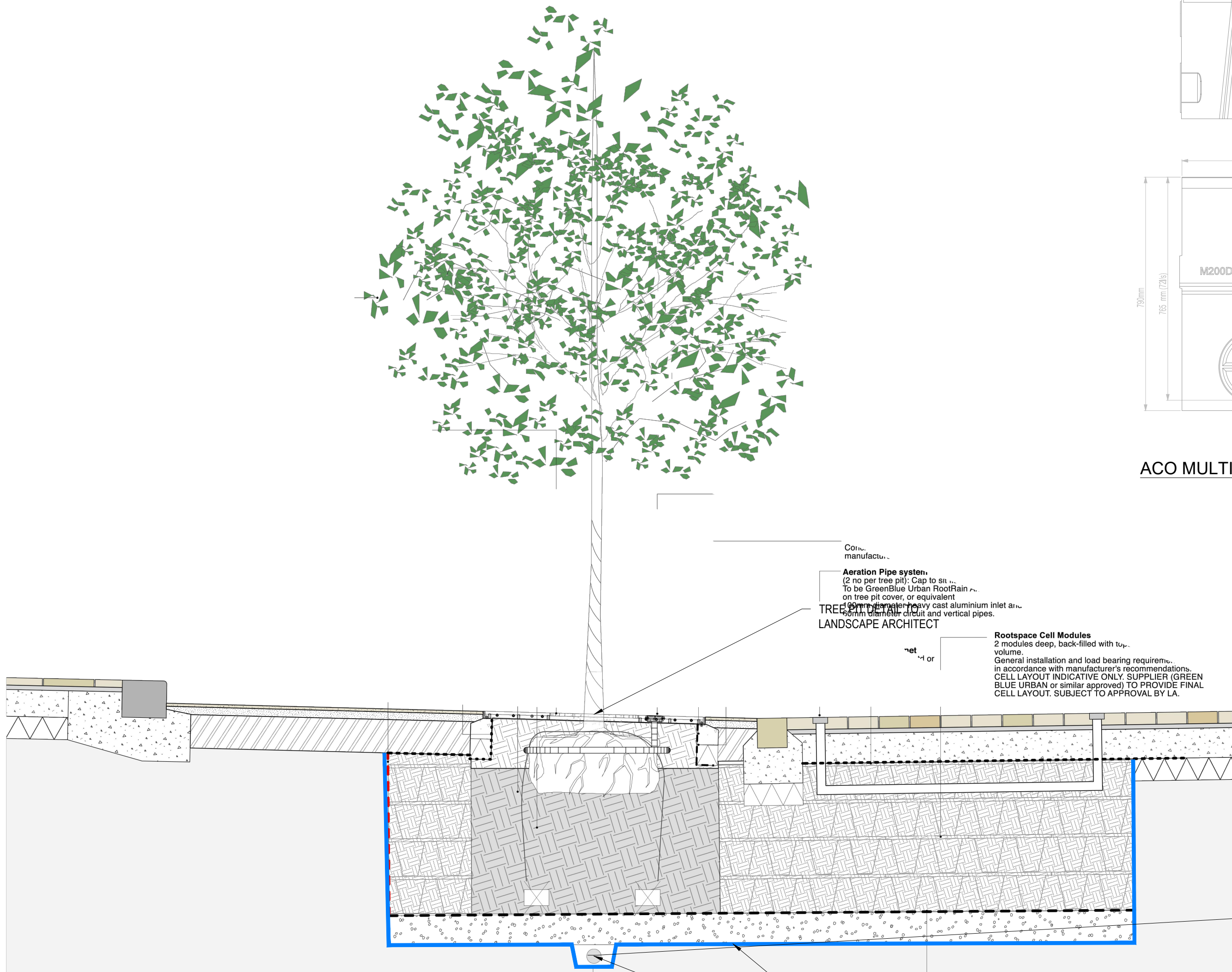


ACO MULTIDRAIN M200D UNIVERSAL
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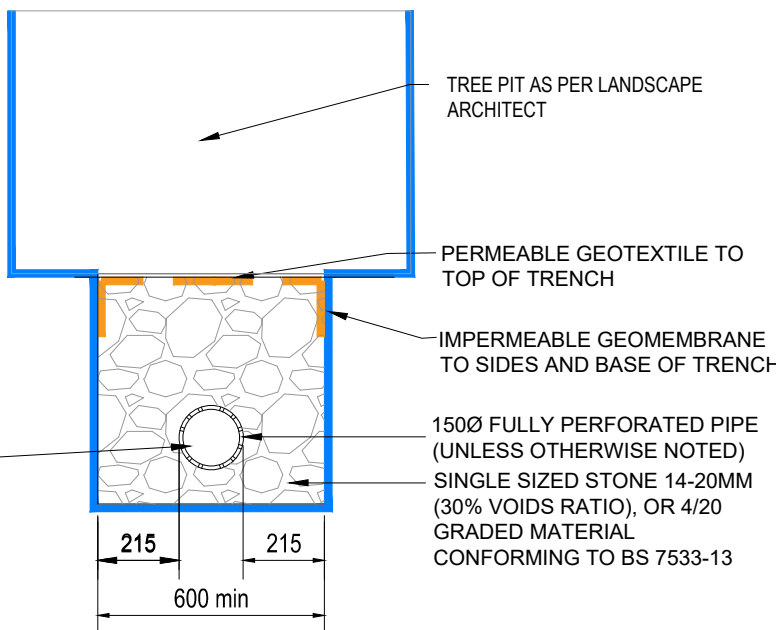


INDICATIVE ACO MULTIDRAIN
(N.T.S)

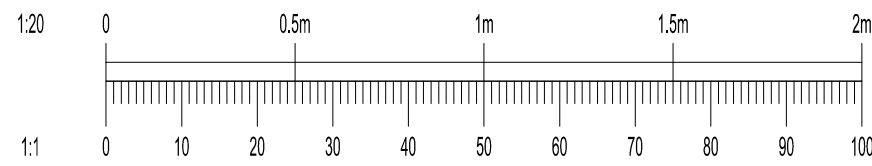
REFER TO:
ACO MULTIDRAIN M100D/DS 10.0 CHANNEL DRAWING 21820
ACO MULTIDRAIN M150D/DS 20.0 CHANNEL DRAWING 21826
ACO MULTIDRAIN M200D/DS 20.0 CHANNEL DRAWING 21830



TREE PIT DETAIL (N.T.S)



PERFORATED PIPE UNDER TREEPIT
(SCALE 1:20)



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 MILLIMETRES UNLESS NOTED OTHERWISE.
- FOR GENERAL NOTES REFER TO DRAWING 075050-CUR-00-ZZ-DR-D-75006.

FINAL CONSTRUCTION NOTE:
1. THE INFORMATION ON THIS DRAWING REPRESENTS THE FINAL CONSTRUCTION ISSUE INFORMATION INCORPORATING ANY DETAIL AMENDMENTS ADVISED BY THE CONTRACTOR DURING THE WORKS.
2. THIS INFORMATION SHOULD BE READ IN CONJUNCTION WITH THE NOTES AND BACKGROUND INFORMATION HELD IN THE PROJECT BUILDING FILE.

C03	FINAL CONSTRUCTION ISSUE	17/10/24	CS	RB
C02	CONSTRUCTION ISSUE UPDATE	09/05/23	CS	MW
C01	CONSTRUCTION	22/02/23	KS	MW
Rev:	Description:	Date:	By:	Chkd:



Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG
0161 235 2384
manchester@curtins.com
www.curtins.com

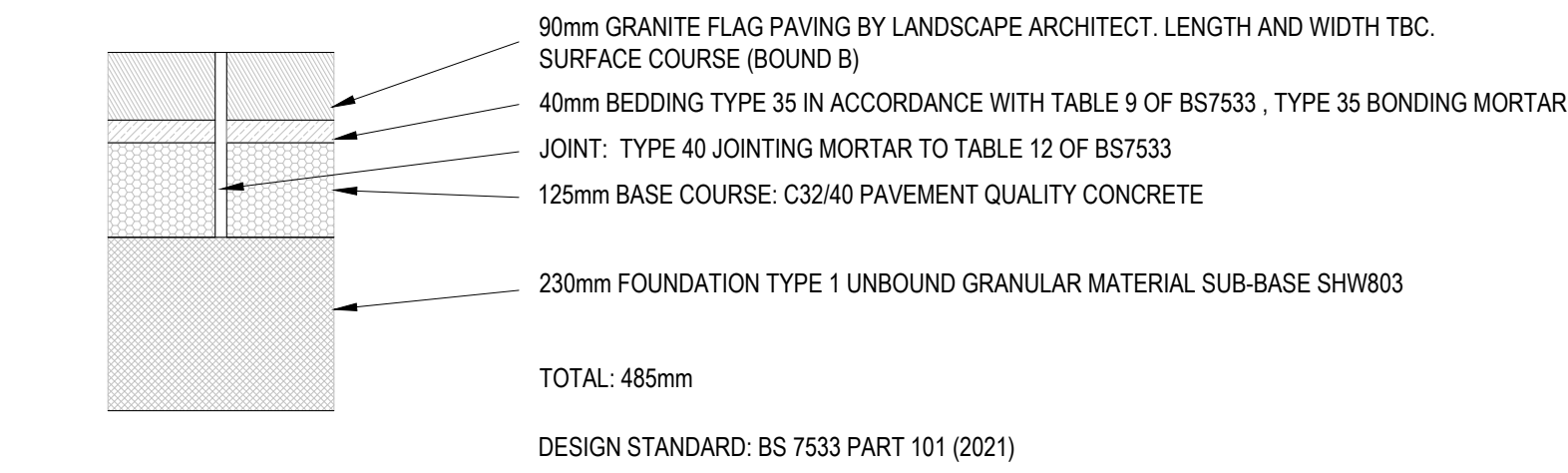
Civils & Structures • Transport Planning • Environmental • Infrastructure • Geotechnical • Conservation & Heritage • Principal Designer
Birmingham • Bristol • Cambridge • Cardiff • Douglas • Dublin • Edinburgh • Glasgow • Kendal • Leeds • Liverpool • London • Manchester • Nottingham

Status: FINAL CONSTRUCTION A6

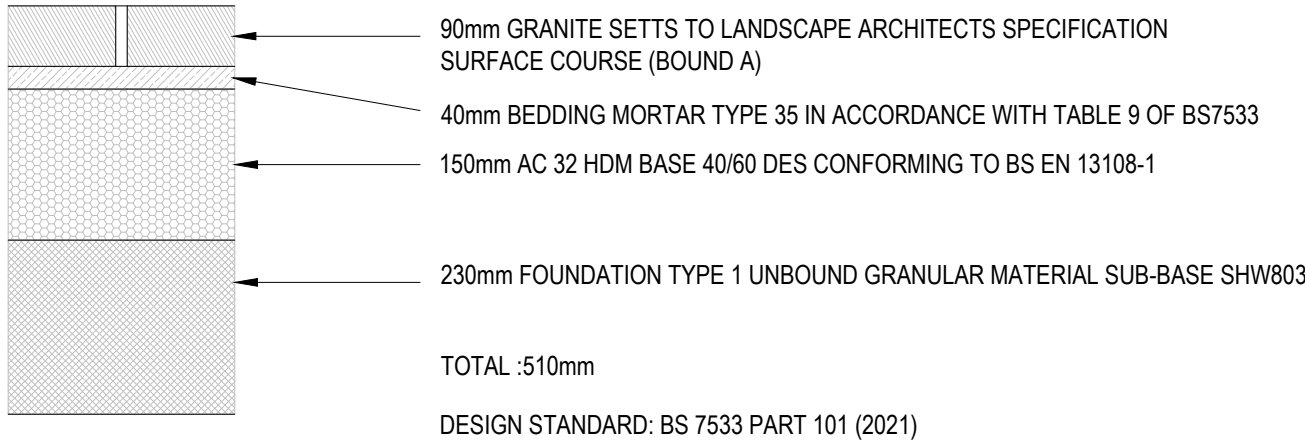
Project: MMU PUBLIC REALM MASTERPLAN

Orig Title: SW DRAINAGE STRATEGY - PHASE 1a
STANDARD DETAILS SHEET 5

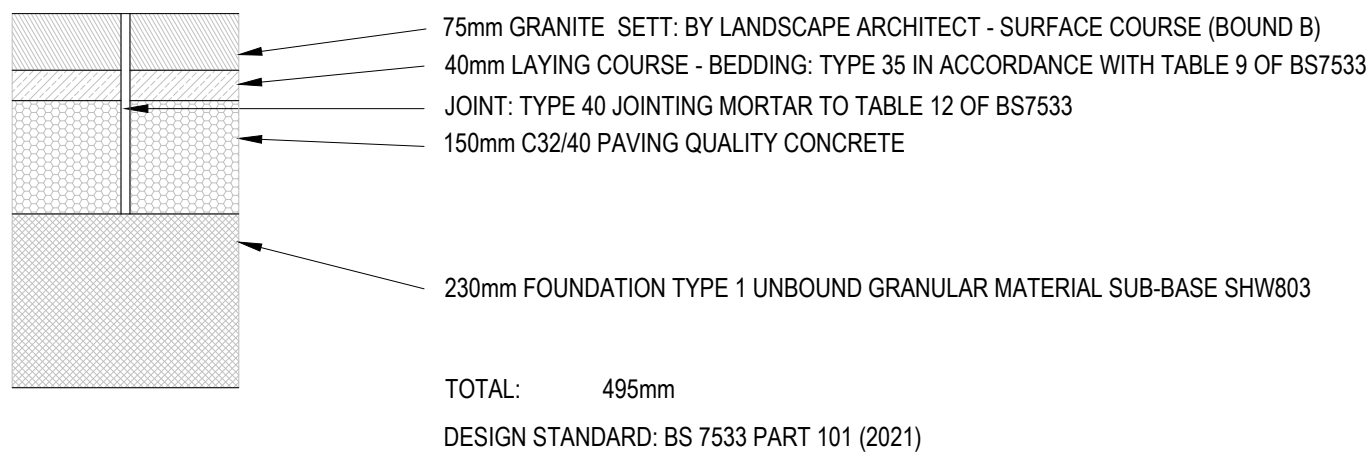
Drawn By	Designed By	Checked By
KS	MW	AR
Date	22/02/23	Scales @ A1
1:20		
Project No	Originator	Function
075050	- CUR - XX - XX - D - Z -	72055
Revision		
C03		



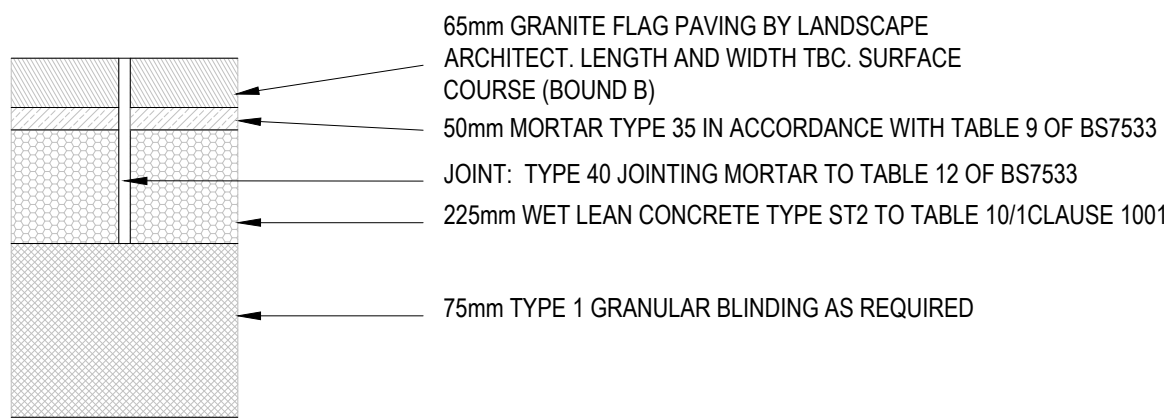
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(Scale: 1:10)



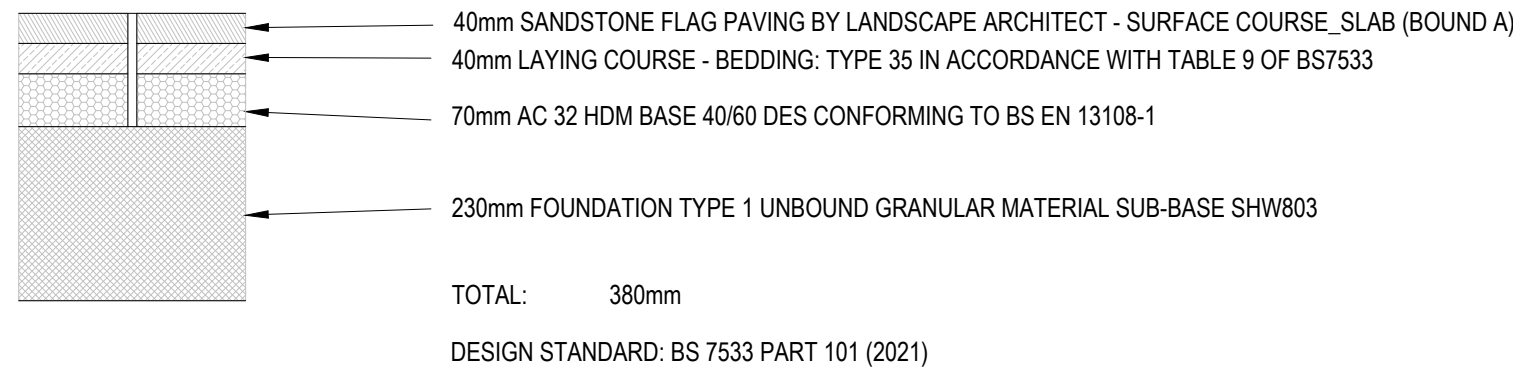
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(Scale: 1:10)



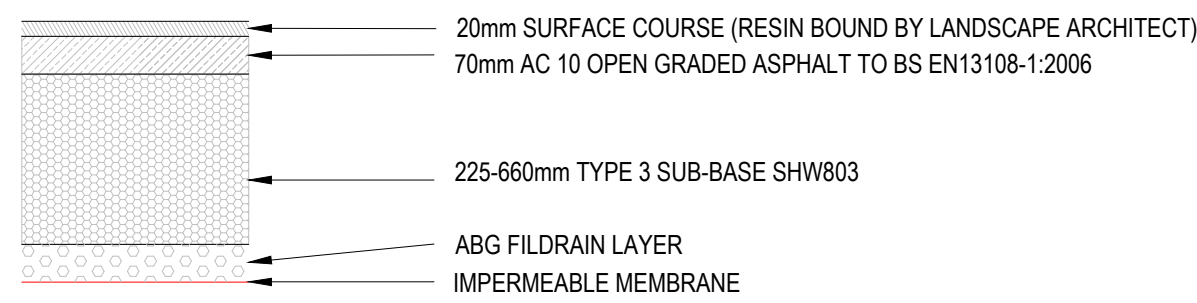
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YORKSHIRE STONE FLAGS
(Scale: 1:10)



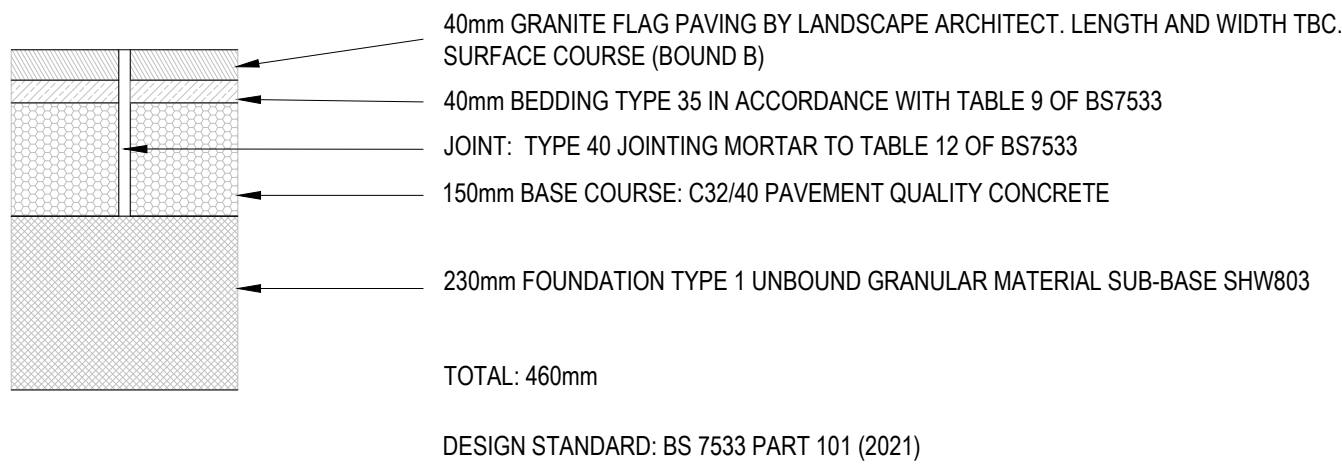
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NATURAL STONE PAVING
(Scale: 1:10)



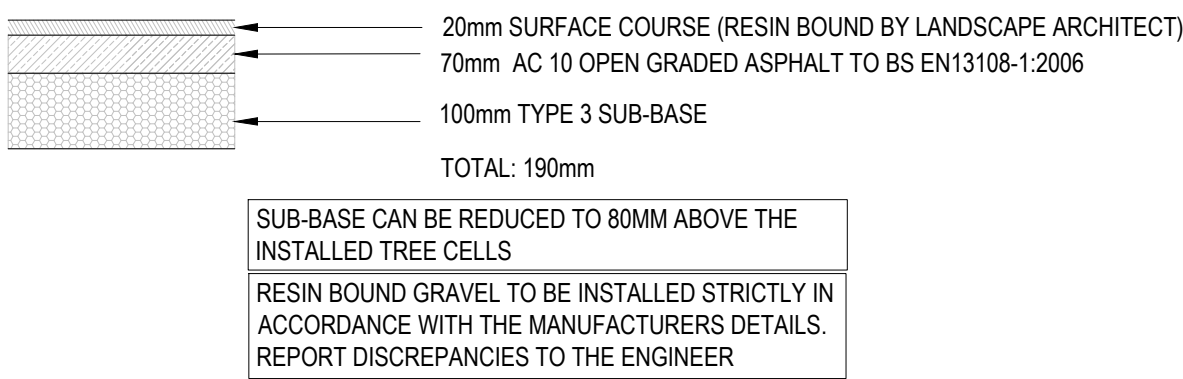
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SANDSTONE FLAG PAVING
(Scale: 1:10)



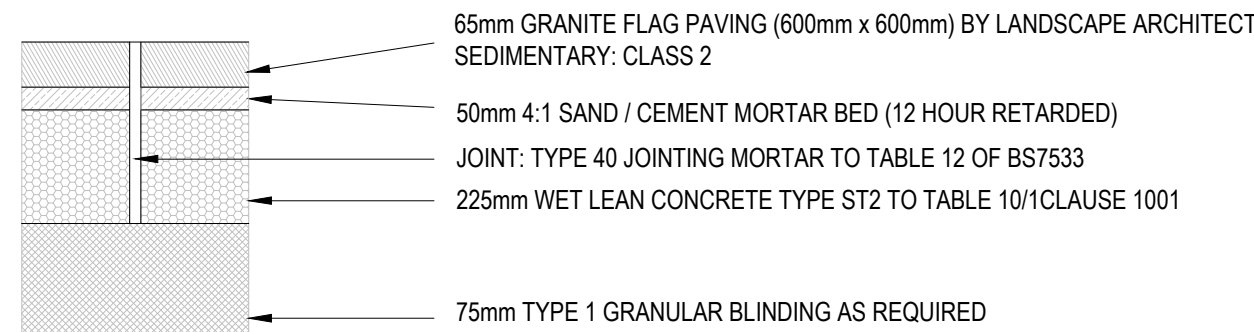
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RESIN BOUND GRAVEL
(Scale: 1:10)



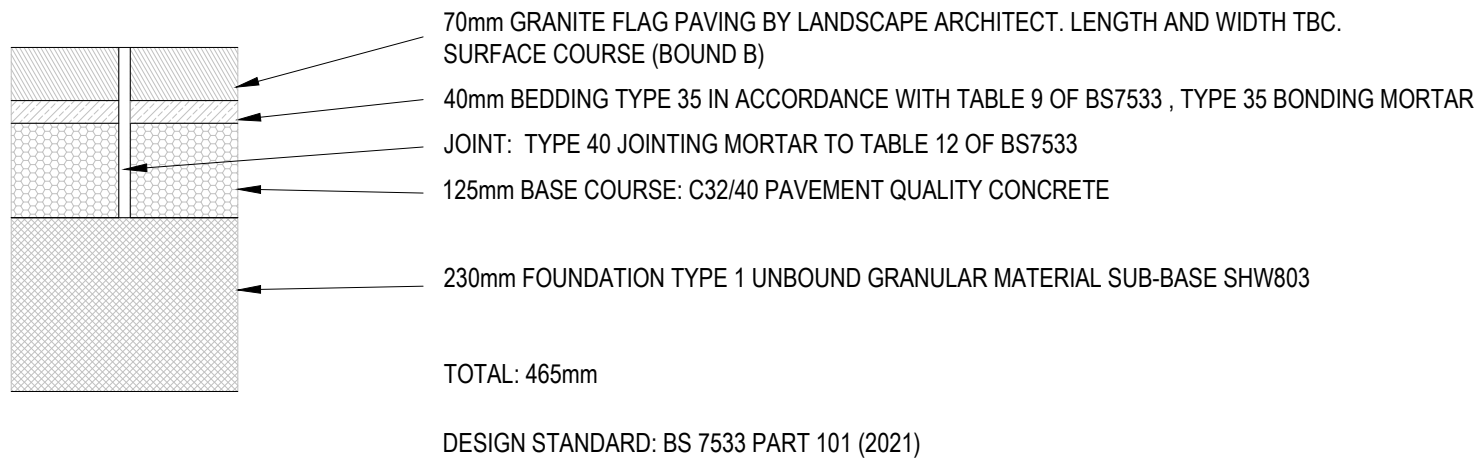
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NATURAL STONE PAVING
(Scale: 1:10)



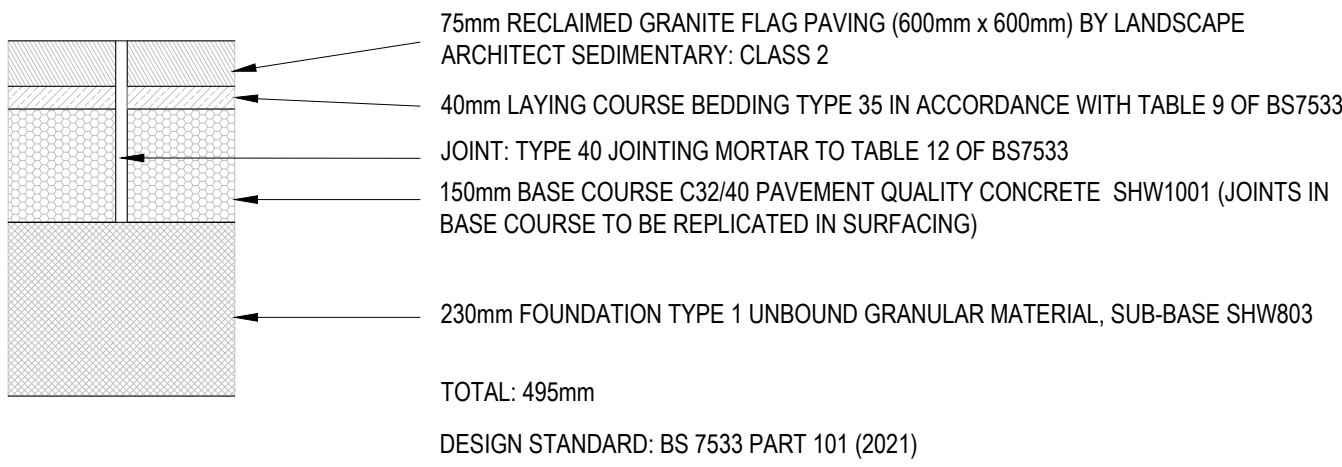
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RESIN BOUND GRAVEL
(Scale: 1:10)



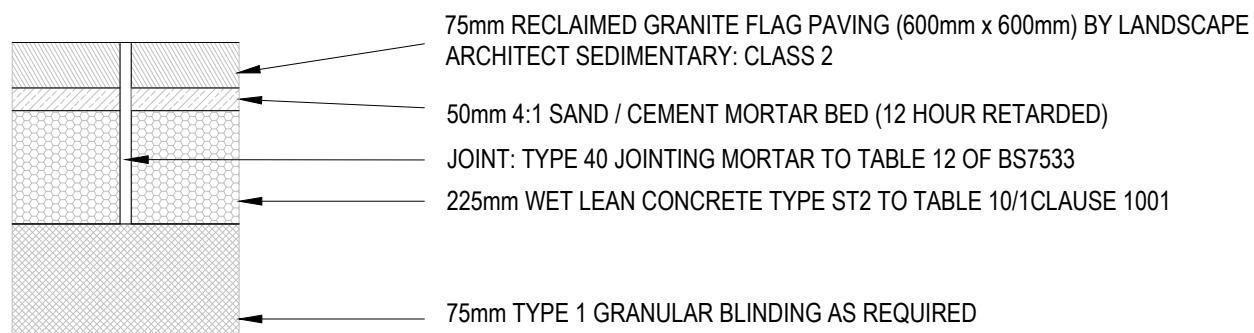
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NATURAL STONE PAVING - S278/ADOPTED AREAS
(Scale: 1:10)



PAVEMENT P1d (VEHICLE DESIGN CATEGORY 5,BOUND) NATURAL STONE PAVING
(Scale: 1:10)



PAVEMENT P9a UNADOPTED AREAS (VEHICLE DESIGN CATEGORY 5)
NATURAL STONE PAVING - RECLAIMED
(Scale: 1:10)



PAVEMENT P9a ADOPTED AREAS
NATURAL STONE PAVING - RECLAIMED
(Scale: 1:10)

RESIDUAL HAZARD REGISTER (RELATES TO CIVIL/STRUCTURAL MATTERS ONLY) MUST BE READ IN CONJUNCTION WITH CURTINS RESIDUAL HAZARD REGISTER- 075050-CUR-00-XX-HA-x-10001. HAZARDS THAT SHOULD BE OBVIOUS TO A COMPETENT CONTRACTOR HAVE NOT BEEN INDICATED ON THIS DRAWING. SHOULD ANY ADDITIONAL HAZARDS BE IDENTIFIED, THE CONTRACTOR SHOULD NOTIFY ALL RELEVANT PROJECT TEAM MEMBERS.		
HAZARD REF No.	ITEM (FEATURE, ELEMENT OR ACTIVITY)	RESIDUAL HAZARD
	Underground Services	GPR Survey has been commisioned and is currently underway
	Ground Conditions	Currently unknown

GENERAL NOTES:

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- ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
- FOR GENERAL NOTES REFER TO DRAWING REFERENCE 075050-CUR-XX-XX-DR-D-72101.
- FOR PAVEMENT EXTENTS AND LOCATIONS REFER TO PLANIT I.E DRAWING REFERENCE 1958-PLA-01A-XX-DR-L-1000
- FOR MOVEMENT JOINT LOCATIONS AND DETAILS, REFER TO DRAWINGS 075050-CUR-01-XX-DR-D-75002, -75003 and 75004.
- ALL MATERIAL WITHIN 450mm OF FINISHED SURFACE TO BE NON FROST SUSCEPTIBLE.
- ROAD FORMATION TO BE CHECKED FOR SOFT SPOTS. SOFT SPOTS TO BE REMOVED AND REPLACED WITH TYPE 1 MATERIAL OR TYPE 6F2 CAPPING MATERIAL.
- CBR VALUES ON SITE TO BE CONFIRMED AT THE PROPOSED FORMATION LEVEL, PRIOR TO FINAL DESIGN AND CONSTRUCTION. REPORT RESULTS TO THE ENGINEER AND ALLOW 5 WORKING DAYS FOR UPADTES, IF REQUIRED.

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION UNUSUAL SIGNIFICANT HAZARDS

IT IS ASSUMED THAT ALL WORKS WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROVED METHOD STATEMENT. IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:

- CONSTRUCTION
- CONTRACTOR TO ENSURE SITE IS SCANNED FOR EXISTING SERVICES THAT MAY BE ON SITE.
 - CONTRACTOR TO ASSESS FOR GROUND CONTAMINATION.
 - CONTRACTOR TO ENSURE SUITABLE MEASURES ARE TAKEN DURING ANY EXCAVATIONS/TEMPORARY WORKS.
 - A SUITABLE TRAFFIC MANAGEMENT PLAN SHOULD BE IN PLACE FOR DURATION OF WORKS.
- NOTE: CURTINS ARE NOT LIABLE FOR ANY OF THE ABOVE.
- MAINTENANCE / CLEANING
- WHERE PROPRIETARY PRODUCTS ARE SPECIFIED, THE MANUFACTURER'S INSTRUCTIONS AND RECOMMENDATIONS SHOULD BE FOLLOWED.
 - THE RECOMMENDED INSPECTIONS OF OPERATIONS AND FREQUENCIES ARE TYPICAL ONLY AND SHOULD BE MORE FREQUENT INITIALLY TO ENSURE THAT THERE ARE NO UNFORESEEN ISSUES WITH THE OPERATION AND THEN ADJUSTED TO SUIT THE SITE REQUIREMENTS.

- DECOMMISSIONING / DEMOLITION
- N/A
 -
 -

FINAL CONSTRUCTION NOTE:

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C08	FINAL CONSTRUCTION ISSUE	17/10/24	CS	RB
C07	UPDATED PAVEMENT P1b	10/05/24	JS	RB
C06	UPDATED PAVEMENT P1b & P9a & P9b	23/01/24	RB	AR
C05	UPDATED BUILD-UP P1d	12/12/23	AR	AR
C04	UPDATED BUILDUP 7A	18/09/23	KS	MW
C03	CONSTRUCTION UPDATE	05/09/23	CS	MW
C02	CONSTRUCTION UPDATE	14/07/23	CS	AR
C01	CONSTRUCTION ISSUE	09/05/23	CS	MW
P09	UPDATED TENDER	20/01/23	KS	SR
P08	TENDER	21/01/22	TH	AR
P07	PAVEMENT CONSTRUCTION P10 REMOVED	02/12/20	AR	AR
P06	ALL SAINTS PAVEMENT CONSTRUCTION ADDED	15/10/20	AR	AR
P05	PAVEMENT CONSTRUCTION 4A & 4B REMOVED	16/9/20	AR	AR
P04	UPDATE TO PAVEMENT P1 CONSTRUCTION	06/08/20	AR	AR
P03	UPDATE TO P.1e LATEST INFORMATIN	30/03/20	AMG	AR
P02	ISSUED FOR CO-ORDINATION	04/03/20	AMG	AR
P01	ISSUED FOR CO-ORDINATION	03/03/20	AMG	AR
Rev:	Description:	Date:	By:	Chkd:



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Status: **FINAL CONSTRUCTION** **CR**

Project: **MMU PUBLIC REALM MASTER PLAN**

Orig Title: **PAVEMENT BUILD UPS**

Size:	Date:	Drawn By:	Designed By:	Checked By:			
A1	20/01/2023	KS	SB	AR			
Scale: 1:10							
Project No:	Originator:	Volume:	Level:	Type:	Role:	Category / Number:	Rev:

075050 - CUR - 00 - XX - DR - D - 75001 - C08

Appendix B

Surface Water Drainage Calculations 1-year, 30-year, 100-Year +40%cc

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	18.100	Minimum Backdrop Height (m)	0.500
Ratio-R	0.361	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
TP1	0.029	5.00	37.000	100	384215.564	397098.127	1.500
W2	0.064	5.00	37.062	1200	384219.167	397100.054	2.212
W10	0.046	5.00	37.197	1200	384233.002	397074.136	1.607
W9	0.030	5.00	36.681	1200	384235.999	397077.674	0.441
W11			37.263	1200	384233.002	397074.136	2.497
TANK2			37.470	100	384314.466	397062.060	2.190
TP2	0.033	5.00	37.020	100	384246.563	397044.880	1.525
JUNC1			37.150	1200	384248.081	397045.589	2.453
W13		5.00	37.370	1200	384331.662	397071.256	1.905
TP4	0.088	5.00	37.350	100	384301.620	397054.157	1.525
W14			37.565	1500	384297.269	397052.864	3.247
SUMP	0.070	5.00	38.205	1200	384274.224	397096.800	0.600
W5	0.036	5.00	37.707	450	384294.113	397059.220	2.138
TANK1	0.012	5.00	37.040	100	384283.331	397045.593	2.650
TP3	0.072	5.00	37.119	100	384267.201	397035.659	1.525
W15	0.092	5.00	37.404	1200	384265.228	397035.717	2.834
W16			37.294	1500	384254.749	397034.977	2.678
31			37.500	1200	384307.837	397050.706	3.254
31_OUT			37.530	1200	384309.141	397048.056	3.304
SW18	0.050	5.00	37.150	450	384255.473	397135.236	0.825
SW19			38.345	450	384275.182	397096.462	2.530

Links (Input)

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	TP1	W2	9.547	0.600	35.500	34.970	0.530	18.0	150	5.07	50.0
1.001	W2	W11	16.874	0.600	34.850	34.766	0.084	200.9	300	5.32	50.0
3.000	W10	W11	3.971	0.600	35.590	34.916	0.674	5.9	150	5.02	50.0
2.003	W9	W11	5.204	0.600	36.240	34.916	1.324	3.9	150	5.02	50.0
1.002	W11	JUNC1	13.739	0.600	34.766	34.697	0.069	199.1	300	5.53	50.0
8.000	TP2	JUNC1	6.802	0.600	35.495	34.800	0.695	9.8	150	5.03	50.0
1.003	JUNC1	W16	16.159	0.600	34.697	34.616	0.081	199.5	300	5.77	50.0
1.004	W16	W15	9.291	0.600	34.616	34.570	0.046	202.0	300	5.91	50.0
9.000	TP3	W15	8.053	0.600	35.594	35.200	0.394	20.4	150	5.06	50.0
1.005	W15	TANK1	36.004	0.600	34.570	34.390	0.180	200.0	300	6.45	50.0
1.006	TANK1	W14	14.488	0.600	34.390	34.318	0.072	201.2	300	6.67	50.0
10.000	W13	TANK2	26.897	0.600	35.465	35.280	0.185	145.4	225	5.41	50.0
10.001	TANK2	W14	19.501	0.600	35.280	35.146	0.134	145.0	225	5.71	50.0
11.000	SUMP	SW19	40.185	0.600	37.605	36.615	0.990	40.6	150	5.42	50.0
11.001	W5	W14	6.645	0.600	35.569	35.140	0.429	15.5	225	6.45	50.0
14.000	TP4	W14	4.521	0.600	35.825	35.520	0.305	14.8	150	5.03	50.0
1.007	W14	31	10.786	0.600	34.318	34.246	0.072	150.0	225	6.84	50.0
1.008	31	31_OUT	2.953	0.600	34.246	34.226	0.020	150.0	225	6.89	50.0
6.000	SW18	SW19	43.496	0.600	36.325	35.890	0.435	100.0	150	5.72	50.0
6.001	SW19	W5	41.777	0.600	35.815	35.569	0.246	170.0	225	6.42	50.0

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
TP1	384215.564	397098.127	37.000	1.500	100				
						0	1.000	35.500	150
W2	384219.167	397100.054	37.062	2.212	1200		1	1.000	34.970
						0	1.001	34.850	300
W10	384233.002	397074.136	37.197	1.607	1200				
						0	3.000	35.590	150
W9	384235.999	397077.674	36.681	0.441	1200				
						0	2.003	36.240	150

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0	100	40	0	0
30	0	0	0				

Node 31_OUT Surcharged Outfall

Overrides Design Area	x	Depression Storage Area (m²)	0	Evapo-transpiration (mm/day)	0
Overrides Design Additional Inflow	x	Depression Storage Depth (mm)	0		

Applies to 30yr, 100yr+40% CC 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440 minute storms

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
0	0.104	180	0.104	360	0.104	540	0.104	720	0.104	900	0.104	1080	0.104	1260	0.104
60	0.104	240	0.104	420	0.104	600	0.104	780	0.104	960	0.104	1140	0.104	1320	0.104
120	0.104	300	0.104	480	0.104	660	0.104	840	0.104	1020	0.104	1200	0.104	1380	0.104

Node W14 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	34.318	Product Number	CTL-SHE-0150-1420-2400-1420
Design Depth (m)	2.400	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	14.2	Min Node Diameter (mm)	1500

Node TP1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	35.500
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.20	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	67.5	0.0	1.000	67.5	0.0	1.001	0.0	0.0

Node TANK2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	35.280
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	70.0	0.0	1.200	70.0	0.0	1.201	0.0	0.0

Node TP2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	35.495
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.20	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	75.0	0.0	1.000	75.0	0.0	1.001	0.0	0.0

Node TP4 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	35.825
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.20	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	75.0	0.0	1.000	75.0	0.0	1.001	0.0	0.0

Node TANK1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	35.400
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	60.0	0.0	1.200	60.0	0.0	1.201	0.0	0.0

Node TP3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	35.594
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.20	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	75.0	0.0	1.000	75.0	0.0	1.001	0.0	0.0

Appendix C

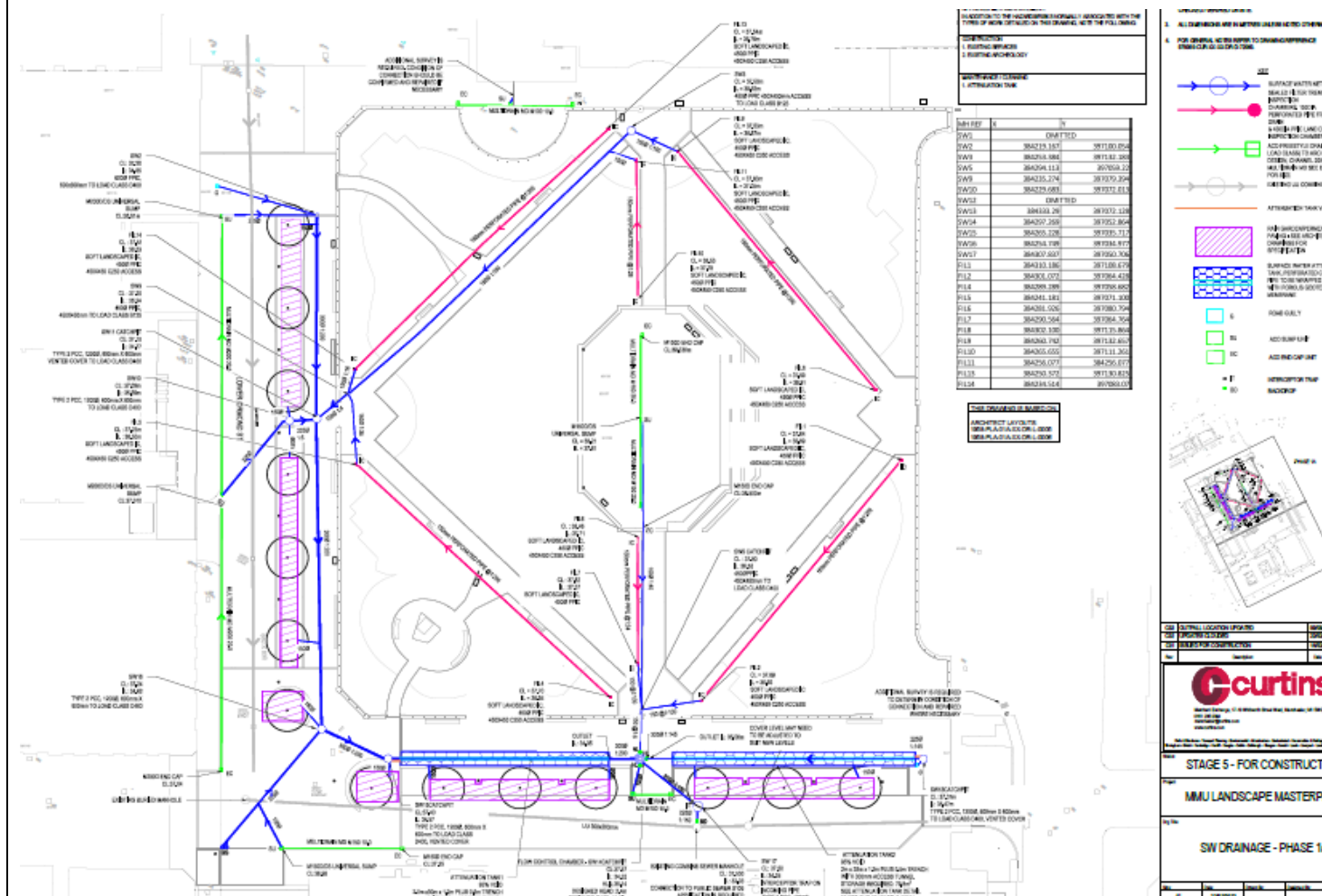
United Utilities Approval – Reference 4977824

S106 Part 1 'Application to connect to a public sewer' Approval Notice



		04017101			
Applicant details					
Applicant name	Marta Wolska				
Applicant address (including postcode)	Curtins Consulting Merchant Exchange 17-19 Whitworth Street West Manchester M1 5WG				
Applicant email	marta.wolska@curtins.com				
Site details: The site / property which is proposed for connection to the public sewer					
Site address (including postcode)	Manchester M15 6HB (All saints park & external)				
APPROVED					
Your application for connection to the public sewer has been approved, to be made via a new connection:					
To a private drain	☐	You may appoint your contractor and advise your appointed building control body (who should inspect the work). United Utilities should be advised when this work is complete.			
Direct to the public sewer	☒	Further action required You may now appoint an appropriately qualified contractor. Your appointed contractor is responsible for obtaining authorisation to work on a public sewer. (The S106 Part 2 application form ' Request for permission to work on a public sewer ' is available on our website; unitedutilities.com).			
Mode of connection approved	Connection into existing manhole				
Sewer connection type	Foul	☐	Surface water	☒	Combined
This approval is valid for 12 months from the date below. This approval does not grant access to third party land, permission should be sought if required between applicant and land owner If the new connection renders access unsafe or is otherwise detrimental to the manhole or sewer, a new/upgraded manhole will be requested.					
Comments					
As per conversion with Mara Wolska 23/11/23 to confirm which combined sewer they are connecting into as we have 2 mapped sewers in Cavendish Street (610x750 and a 1950) Marta advised they have surveyed the sewer and they are connecting to a 300x300mm combined as per the plan below Approval granted for a 225mm surface water connection the combined sewer in Cavendish Street via an existing Manhole Drainage drawing below 075050-CUR-XX-XX-DR-D-72001 REV C03 – flow control restricted to 14.2l/s (discharged at planning) Any connection to an existing manhole should be made soffit to soffit, with a swept bend in the direction of flow. The connection must not be made in the landing area. The exact condition, location and depth of the existing manhole and surrounding services should be established as early as possible to avoid site delays. If the existing manhole is in poor condition but otherwise the connection would be acceptable, the applicant should be aware they may have to rebuild/renew the manhole if it deteriorates as a result of your contractor working on or near it. For low-lying sites, (where the ground level of the site or the level of a basement is below the ground level at the point where the drainage connects to the public sewer), care should be taken to ensure that the property is not at increased risk of flooding. If these circumstances exist it could affect the detailed design of your site and result in the need to incorporate appropriate mitigating measures in your drainage scheme.					

Connections may be made to private lateral drains or to existing neighbouring drain. A part 1 approval does not give permission to access third party land. The applicant must seek permission from the relevant land owner.



Developer Services Inspector	Lynne Berry
Contact number	07881 034558
Date	23/11/2023

United Utilities Inspection Notice

This form is to confirm a new connection has been made
to an existing public sewer under Section 106 of the
Water Industry Act 1991



Site details: Details of the site or premise that have been connected to the public sewer	
United Utilities notification reference (EC/NC/SC/WC)	4977824
Site address	Manchester M15 6HB Cavendish street
Development type	New property

Contractor Details	
Contractor name / Company Name	P casey (land reclamation) ltd
Contractor Email Address	sam.mccloskey@casey.co.uk
Works Supervisor	Sam McCloskey
Confirm sewer 'log on' & 'log off' procedure followed	Yes ☒ No ☐

Principal Contractor Details (if applicable)	
Company name (if applicable)	
Name of Contact for Project	
Email Address	
Number of site inspections conducted by United Utilities	1

Connection details	
Sewer connection type	Surface Water
Surface Water sewer pipesize diameter	225mm
Connecting into:	300mm Existing Sewer Type Combined
Connecting to asset:	Exisitng manhole
Connection Location	Cavendish street Manchester M15 6HB

Outcome	
Connection status	Satisfactory

Comments
I can confirm that the Surface Water Sewer connection is SATISFACTORY - 225mm Surface Water Sewer connecting into the 300mm Combined connected via Exisitng manhole in Cavendish street Manchester M15 6HB

Approved: I confirm the sewer connection detailed above has been
satisfactorily completed and inspected

Developer Services Inspector	Marcus Jones
Date of Inspection	15/01/2024

Appendix D

Hydro-Brake Manufacturers Information

Polystorm Manufacturers Information

Technical Specification

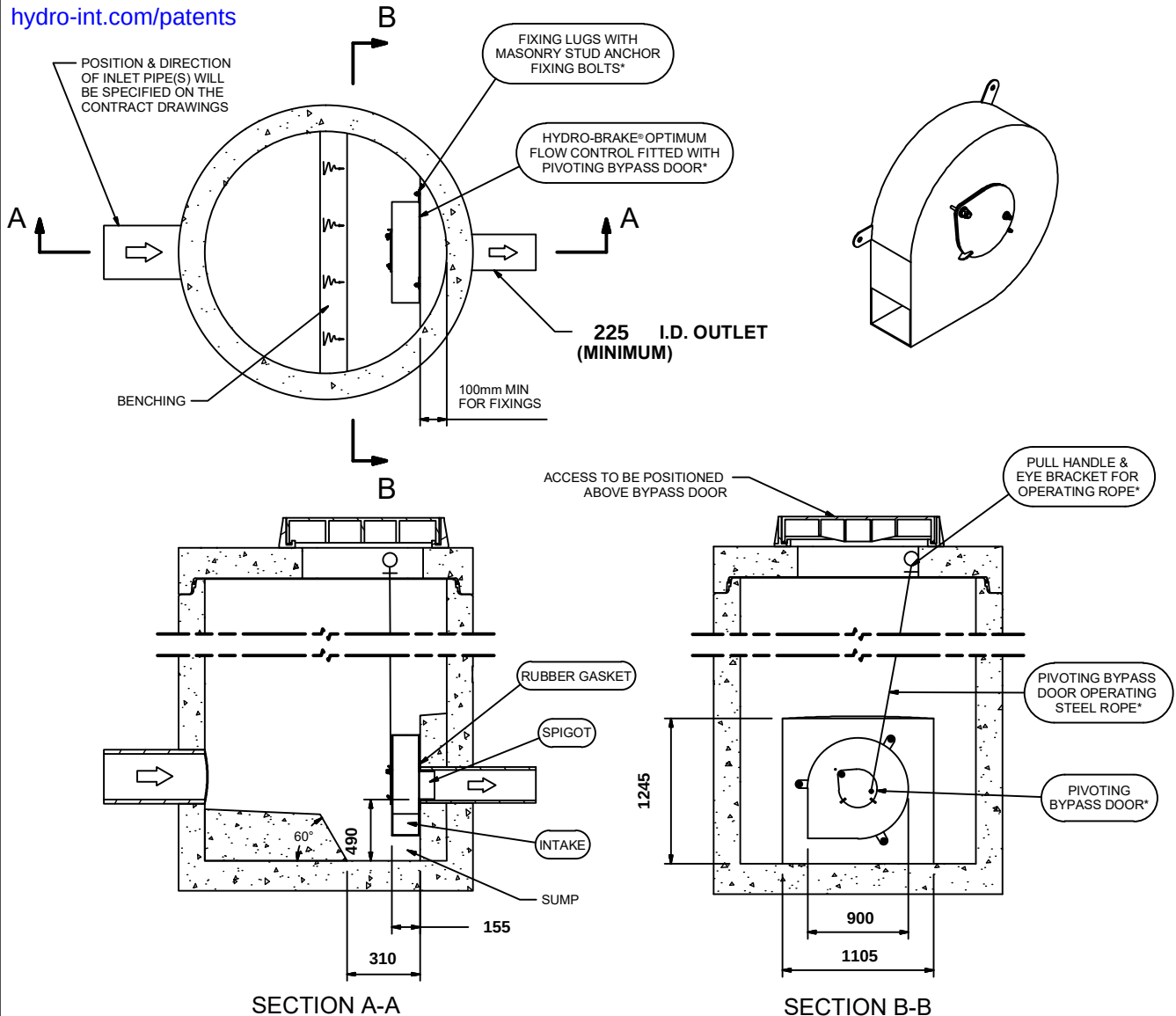
Control Point	Head (m)	Flow (l/s)
Primary Design	2.500	14.200
Flush-Flo™	0.648	13.378
Kick-Flo®	1.330	10.536
Mean Flow		11.977

Hydro-Brake® Optimum Flow Control including:

- 5 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: 70 kg



hydro-int.com/patents



IMPORTANT: LIMIT OF HYDRO INTERNATIONAL SUPPLY
 THE DEVICE WILL BE HANDED 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-0148-1420-2500-1420 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	15/02/2023 11:02	SHE-0148-1420-2500-1420 Hydro-Brake® Optimum
SITE		
DESIGNER	Kiran Sawyer	
REF		

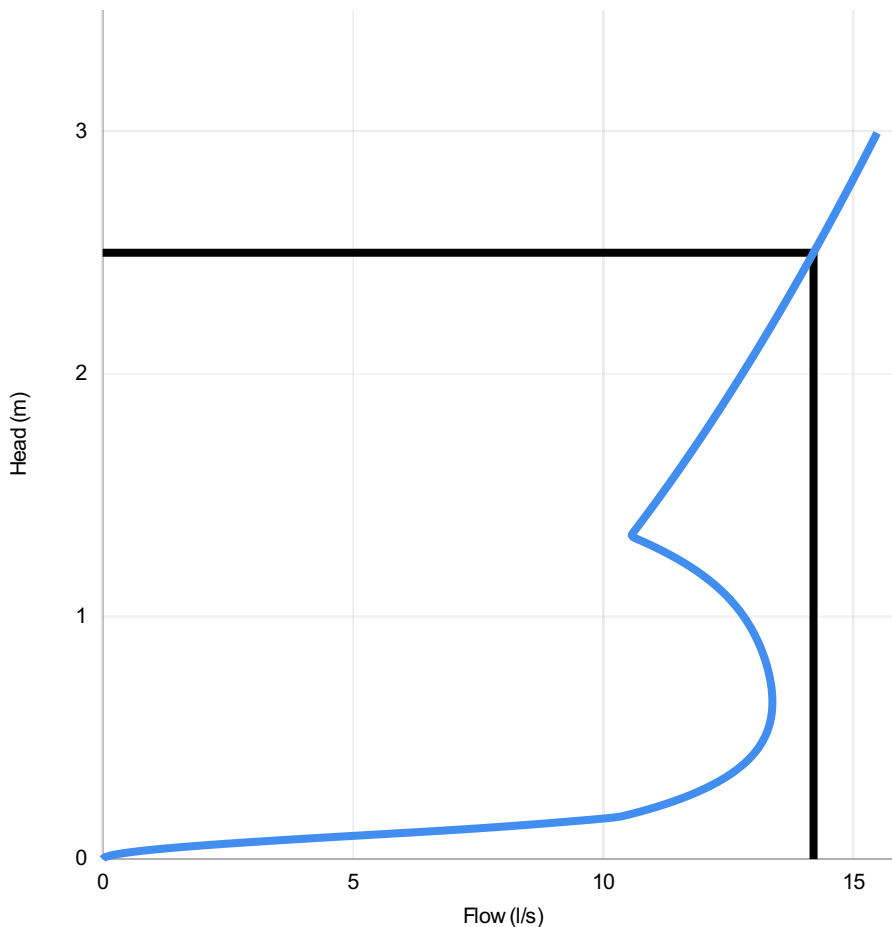
Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	2.500	14.200
Flush-Flo	0.648	13.378
Kick-Flo®	1.330	10.536
Mean Flow		11.977



PT/329/0412

hydro-int.com/patents



Head (m)	Flow (l/s)
0.000	0.000
0.086	4.208
0.172	10.290
0.259	11.668
0.345	12.501
0.431	12.993
0.517	13.257
0.603	13.366
0.690	13.368
0.776	13.296
0.862	13.161
0.948	12.963
1.034	12.681
1.121	12.283
1.207	11.726
1.293	10.961
1.379	10.719
1.466	11.029
1.552	11.330
1.638	11.623
1.724	11.908
1.810	12.186
1.897	12.457
1.983	12.721
2.069	12.980
2.155	13.234
2.241	13.482
2.328	13.726
2.414	13.965
2.500	14.199

DESIGN ADVICE



The head/flow characteristics of this SHE-0148-1420-2500-1420 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 15/02/2023 11:02

Site

DESIGNER Kiran Sawyer

Ref

SHE-0148-1420-2500-1420

Hydro-Brake Optimum®

Preliminary Polystorm Performance Assessment

45336 - Manchester Metropolitan University

1.0 Proposal Brief

The following section details the assumed parameters on which our proposed product offering has been based. Please refer to CIRIA Report C680 (2008; RP782) & BBA Certificate No 06/4297 for further details on typical product testing procedures and the calculation methodology proposed.

1.1 Proposed Polystorm Geocellular Unit

The Polystorm unit(s) proposed, along with the relevant unit characteristic parameters which may be used for design purposes, are given below:

Polystorm unit	- Description - Product Code	Polystorm-R PSM1A
Ultimate compressive strength [kN/m ²]	- Vertical, $X_{k;VC}$	610
	- Lateral, $X_{k;LC}$	63.0
Short term deflection [kN/m ² per mm]	- Vertical, $X_{k;VD}$	60
	- Lateral, $X_{k;LD}$	4.4
Creep equation co-efficient, x [mm] [$x \ln(\text{design life; hrs})$]	- Vertical, $X_{k;VCr}$	0.2798
	- Lateral, $X_{k;LCr}$	1.0192
Allowable deflection [mm]	- Vertical, $\delta_{k;V}$	9.0
	- Lateral, $\delta_{k;L}$	14.0
Allowable creep deformation [mm]	- Vertical, $\epsilon_{k;V}$	9.0
	- Lateral, $\epsilon_{k;L}$	18.0

1.2 Recommended Material and Partial Factor of Safety

Factor of safety	ULS	SLS
Material, $f_{m,*}$	2.75	1.5
<i>(Polypipe recommended factor; based on the minimum values proposed in CIRIA C680; Clause 4.6)</i>		

Partial factor of safety	ULS	SLS
Variable loads, γ_Q	1.6	1.0
Permanent loads, γ_G	1.4	1.0
Lateral earth pressure, γ_e	1.35	1.0
Hydrostatic, γ_u	1.35	1.0
<i>(Based on CIRIA C680, Clause 4.6)</i>		

1.3 Proposed Installation

Idealised details of the proposed Polystorm installation are summarised below (refer to figure 1).

Depths

Depth to structure invert, H	2.430 m
Polystorm structure depth, h_1	1.200 m
Design depth, z ($= H - 0.2m$)	2.230 m
Cover depth, h_c ($= H - h_1$)	1.230 m

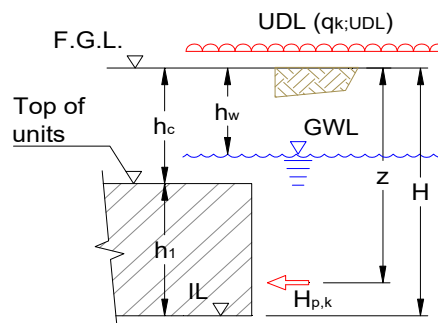


Figure 1) Idealised illustration of installation

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Preliminary Polystorm Performance Assessment

45336 - Manchester Metropolitan University

Assumed ground conditions

Min Soil to Pass

Native soil

Shearing resistance, ϕ	30°	
Density, γ_k	20.0 kN/m ³	[Assumed]

Active earth pressure co-efficient, K_a	0.333
$(= [1 - \sin \phi] / [1 + \sin \phi])$	

Ground water

Depth below FGL, h_w	N/A
Density, γ_w	N/A

1.4 Assumed Transient (Live) Loads

For illustrative purposes, vehicle loading assumed

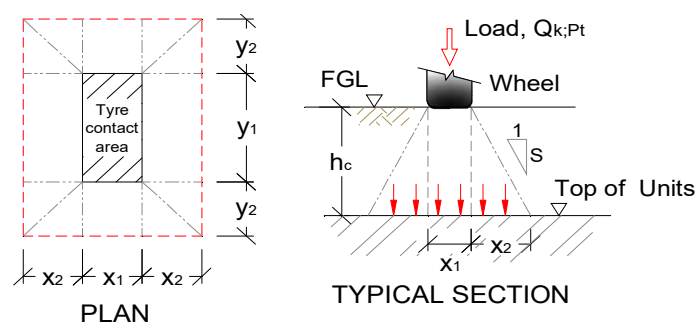


Figure 2) Concentrated load parameters

Loading classification	Parking; no height restriction	[CIRIA C680; Table 4.2]
DIN 1072 classification	9/9	[CIRIA C680; Table 4.2]
Max Gross vehicle weight	< 9,000 Kg	[CIRIA C680; Table 4.2]
Uniformly distributed load, $q_{k;UDL}$	5.0 kN/m ²	[CIRIA C680; Table 4.2]
Concentrated wheel load, $Q_{k;Pt}$	30.0 kN	[CIRIA C680; Table 4.2]
Dynamic load factor, Φ	1.0	[Assumed]
Contact area - Length, y_1	0.260 m	[CIRIA C680; Table 4.2]
- Width, x_1	0.200 m	[CIRIA C680; Table 4.2]
Load distribution, S	1 in 2.0	[Assumed]
Additional load spread, x_2 & y_2	0.615 m	
$(= h_c / S)$		

Unfactored

Imposed load, $q_{k;Pt}$	14.1 kN/m²	[> Uniformly distributed load]
$(= [Q_{k;Pt} \cdot \Phi] / [(x_1 + 2x_2) \times (y_1 + 2y_2)])$		

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Preliminary Polystorm Performance Assessment

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2.0 Assumed Imposed Loading

The following section illustrates how Polypipe would typically expect imposed loads on a proposed Polystorm structure to be derived; in accordance with the guidance given in CIRIA C680 (2008; RP782)

2.1 Vertical Loads Imposed on Upper Structure Face

The following section estimates the vertical imposed load at the Polystorm structure soffit.

Unfactored

Pressure derived from concentrated load gave worst case transient parameter, refer to Section 1.4

Live load, $q_{k,*}$	14.1 kN/m²	[* - Pt; refer to Section 1.4]
Dead load, G_k	24.6 kN/m²	
($= [h_c \times \gamma_k]$)		

Factored

ULS, $V_{d;ULS}$	57.0 kN/m²	[< 221.8 kN/m ² Therefore OK]
($= [q_{k,*}] \gamma_{Q;ULS} + [G_k] \gamma_{G;ULS}$)		
Degree of utilization, Λ_{STR}	26%	($= X_{k;VC} / f_{m;ULS}$; Refer to Section 1.0)
SLS, $V_{d;SLS, \delta}$	14.1 kN/m²	
($= [q_{k;Pt}] \gamma_{Q;SLS}$)		
SLS, $V_{d;SLS, \epsilon}$	24.6 kN/m²	
($= [G_k] \gamma_{G;SLS}$)		

2.2 Lateral Load Imposed at Depth z

The following section estimates the lateral pressure imposed on the proposed Polystorm structure, at design depth z (worst case imposed load assumed to occur at the centre of the unit, due to additional support provided by the unit's external faces)

Unfactored

Live load, $q_{k;UDL}$	5.0 kN/m²
Dead load, W_{Gk}	44.6 kN/m²
Hydrostatic load, U_k	N/A
<u>Where $h_w \leq z$</u>	
($W_{Gk} = [h_w \times \gamma_k] + [(z - h_w) \cdot (\gamma_k - \gamma_w)]$)	
($U_k = [z - h_w] \times \gamma_w$)	
<u>Where $h_w > z$</u>	
($W_{Gk} = z \times \gamma_k$)	
Lateral pressure, $H_{p;k}$	16.5 kN/m²
($= Ka [q_k + W_{Gk}] + U_k$)	

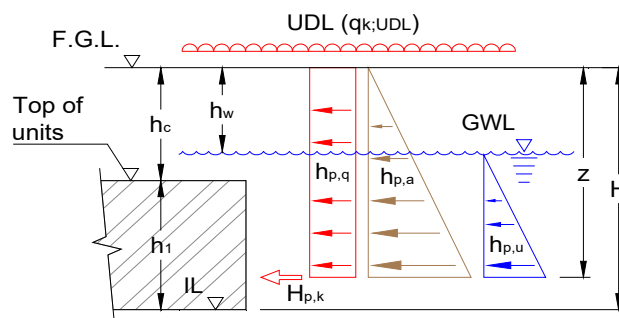


Figure 3) Idealised illustration of lateral pressure(s)

Factored

ULS, $H_{d;ULS}$	22.3 kN/m²	[< 22.9 kN/m ² Therefore OK]
($= Ka [q_k + W_{Gk}] \gamma_{e;ULS} + [U_k] \gamma_{u;ULS}$)		
SLS, $H_{d;SLS}$	16.5 kN/m²	($= X_{k;LC} / f_{m;ULS}$; Refer to Section 1.0)
($= Ka [q_k + W_{Gk}] \gamma_{e;SLS} + [U_k] \gamma_{u;SLS}$)		

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Preliminary Polystorm Performance Assessment

45336 - Manchester Metropolitan University

3.0 Serviceability Limit State Checks (Deflection & Creep)

The serviceability of the proposed Polystorm structure (Section 1.3) may be assessed by predicting possible unit deflection (short term) and creep (long term)

3.1 Vertical Deflection Due to Expected Traffic Loading

The overseeing engineer should be consulted to ensure that the deformation predicted below, would not compromise the structural integrity of any proposed surface pavement. Where excessive deflections are predicted, protective measures may be introduced.

Design strength; $X_{d;VD}$	40.0 kN/m² per mm		
<i>(= $X_{k;VD} / f_{m;SLS}$; refer to Section 1.0)</i>			
SLS, $V_{d;SLS, \delta}$	14.1 kN/m²		
Deflection, δ_V	0.35 mm	[< 1.0 mm	Typically OK]
<i>(= $V_{d;SLS} / X_{d;VD}$)</i>			

3.2 Vertical Creep

Derived creep equation is only valid if expected imposed load(s) do not exceed the creep test load

Creep test load, $X_{d;v,cr}$	162.0 kN/m²		
SLS, $V_{d;SLS, \epsilon}$	24.6 kN/m²	[< 162.0 kN/m ²	Therefore OK]
Degree of utilization, Λ_{STR}	15%		
Creep data limit, t	60 years		[Unit has a durability life in excess of 60yrs]
Estimated unit creep, $\epsilon_{h,c}$	3.7 mm	[< 9.0 mm	Therefore OK]
<i>(= $0.2798 \ln [\text{design life, } t] ; t \text{ in hours}$)</i>			
Degree of utilization, Λ_{STR}	41%		[Refer to Section 1.1; based on test load]

3.3 Lateral Deflection

Design strength; $X_{d;LD}$	2.9 kN/m² per mm		
<i>(= $X_{k;LD} / f_{m;SLS}$; refer to Section 1.0)</i>			
SLS, $H_{d;SLS}$	16.5 kN/m²		
Deflection, δ_L	5.64 mm	[< 14.0 mm	Therefore OK]
<i>(= $H_{d;SLS} / X_{d;LD}$)</i>			
Degree of utilization, Λ_{STR}	40%		[Refer to Section 1.1; based on test load]

3.4 Lateral Creep

Derived creep equation is only valid if expected imposed load(s) do not exceed the creep test load

Test load, $X_{d;v,cr}$	30.9 kN/m²		
SLS, $H_{d;SLS}$	16.5 kN/m²	[< 30.9 kN/m ²	Therefore OK]
Degree of utilization, Λ_{STR}	54%		
Creep data limit, t	60 years		[Unit has a durability life in excess of 60yrs]
Estimated unit creep, $\epsilon_{h,c}$	13.4 mm	[< 18.0 mm	Therefore OK]
<i>(= $1.0192 \ln [\text{design life, } t] ; t \text{ in hours}$)</i>			
Degree of utilization, Λ_{STR}	75%		[Refer to Section 1.1; based on test load]

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