



**LAND ELLETRA AVE, WATERLOOVILLE,
HAVANT, PO7 7XW**

COMMERCIAL DEVELOPMENT

Surface Water Management &
Maintenance Schedule

Prepared on Behalf of
Hargreaves Properties Ltd

D2330.2/MMS/1.1

23 June 2025

DOCUMENT CONTROL

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Commercial Development

Document: Surface Water Management & Maintenance Schedule

Client: Hargreaves Properties Ltd

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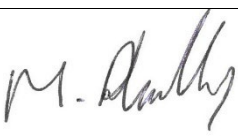
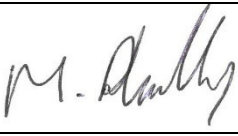
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D2330.2/303	Construction Details - Sheet 4 (Private)

DOCUMENTS

Marshalls Block Paving Maintenance Sheet
Diffuser unit data sheet
Aluline UG4 Grease Trap
Klargester Kingspan Class 1 Bypass
Hydro-International Brochure

1 INTRODUCTION

1.1 Background

- 1.1.1 Bright Plan Civils (BPC) is instructed by Hargreaves Properties Ltd to prepare a management and maintenance strategy for a Commercial Development in relation to Land Elletra Ave, Waterlooville, Havant, PO7 7XW.
- 1.1.2 This management and maintenance statement has been prepared to support an application to discharge conditions relating to planning consent approved in outline by LPA for a Commercial Development.
- 1.1.3 The purpose of this document is to set out the basis of the development's drainage maintenance requirements as well ensuring that those who will be responsible for maintenance tasks and activities have a detailed programme for both inspection and maintenance. This is to ensure that the surface water and foul water drainage networks can operate effectively, and as designed. This document will assist in ensuring that the surface water drainage network is continually maintained for the lifetime of the development to help prevent an increased risk of flooding both on and off-site in accordance with the National Planning Policy Framework (NPPF).
- 1.1.4 The tasks detailed herewith are specific to the components applicable to the development and represent the minimum maintenance and inspection requirements. Additional tasks or varied maintenance frequencies may be deemed appropriate. The specific maintenance needs of the drainage infrastructure implemented on site should be monitored and maintenance schedules adjusted as necessary.
- 1.1.5 Those responsible for maintenance should adhere to current Health and Safety Legislation enforced at the time of the work(s) being undertaken.
- 1.1.6 This report has been prepared for the benefit of Hargreaves Properties Ltd.

2 PROPOSED DRAINAGE STRATEGY

2.1 Surface Water

- 2.1.1 A detailed drainage design for surface water run off was prepared by Bright Plan Civils for the development.
- 2.1.2 The below ground surface water drainage system at the site comprises the following:
- Sections of traditional piped system, with oversize pipes.
 - 1 no. bypass separator.
 - 1 no. flow control units.
 - 1 no. geocellular storage tank within commercial yard (tanked).
 - Permeable pavement within shared carpark areas with diffusers (tanked).
- 2.1.3 The surface water drainage system is shown on drawing **010**.
- 2.1.4 The site is served by a single drainage network. The network collects run-off and discharges to an existing public storm sewer located off site within Elletra Ave at restricted rates in accordance with the planning approved drainage strategy. A geocellular tank, permeable pavements and oversized pipes are utilised to attenuate runoff without exceedance.
- 2.1.5 The proposed surface water drainage system will come under the responsibility of **Hargreaves Properties Ltd**.

2.2 Foul Water Drainage

- 2.2.1 A detailed drainage design for foul water was prepared by Bright Plan Civils for the development.
- 2.2.2 The below ground surface water drainage system at the site comprises the following:
- Sections of traditional piped system.
 - 1 no. grease trap for Block B.
 - 1 no. flow control units.
- 2.2.3 The foul water drainage system is shown on drawing **010**.
- 2.2.4 The site is served by a single drainage network. This shows that the proposed foul sewer network discharges to an existing public foul sewer located off site within Elletra Ave.
- 2.2.5 The proposed foul water drainage system will come under the responsibility of **Hargreaves Properties Ltd**.

3 MANAGEMENT AND MAINTENANCE

3.1 Responsibility for Maintenance

- 3.1.1 The proposed drainage system will fall to the end user being **Hargreaves Properties Ltd** via a Management Company.
- 3.1.2 Infrastructure which is 'shared' but unadopted (i.e. serving more than a single unit and/or falling outside of any individual tenant plot's curtilage) will be the responsibility of the Management Company.
- 3.1.3 The responsibility of any drainage infrastructure supporting a single plot/unit will be the sole responsibility of the owner/occupier of the associated dwelling.
- 3.1.4 Additional maintenance activities beyond this will be the responsibility of the management company, to be appointed by the developer upon completion of the development.

3.2 Funding

- 3.2.1 The funding of the maintenance will be the responsibility of the end users as follows:
- Private systems: **Hargreaves Properties Ltd** will be responsible for funding their own drainage system

3.3 Record Keeping

- 3.3.1 Records shall be kept of maintenance undertaken which will help establish a long term maintenance regime.
- 3.3.2 It is recommended that record keeping include the following information as a minimum:

Date:				
Location/Ref	Action Taken	Silt Depth	Notes/faults	Next inspection

3.4 General Maintenance

- 3.4.1 Maintenance plays an important part in the long-term performance of a surface water drainage system and will be required to ensure that it remains fully operational.
- 3.4.2 The drainage system has been designed to minimise maintenance requirements; however, a number of key tasks will need to be undertaken so that the system remains effective. These operations are summarised in the table below, along with the required frequency of works. The frequencies given below are a minimum, and in order to establish an effective regime, the level of siltation in each of the components should be monitored in the early stages to inform the long term management and

maintenance strategy.

Drainage System feature	Proposed maintenance / remedial works	Required frequency of works
Inlet, Outfall	Inspection, vegetation clearance and additional clearing/cleansing of potential outfall blockages	At least once a year
	Desilting	Year 1, Year 3, then every 5 years
Catch pits, gully sumps and drains, flap valves	Inspection and additional cleansing as required.	Every 6 months
	Desilting	Year 1, Year 3, then every 5 years
Pipework	Jetting to clear blockages	As required

3.4.3 The responsibility of any drainage infrastructure supporting a single unit will be the sole responsibility of the owner/occupier of the associated dwelling.

3.4.4 Additional maintenance activities beyond this will be the responsibility of the management company.

3.5 Flow Control Chambers

3.5.1 A flow control chamber (such as a HydroBrake) or device is self-activating, relying on upstream hydraulic head to generate an air-filled vortex within the centre of the casing. Once the vortex is initiated water drains down through a small opening in the back of the device at the designed restricted flow rate.

3.5.2 The flow control device includes a bypass valve for use should it become blocked. A valve is situated in the front of the unit which is operated from the surface by a release cable situated just under the chamber cover. The valve also provides access of rodding of the downstream pipework.

3.5.3 The flow control chamber will require the following maintenance:

- The sump within the flow control chamber should be monitored for build-up of silts and should be emptied as a minimum on the same regime as specified for catchpits previously within this document.
- The drain down door located on the centre of the unit will require inspection, greasing and opening annually, to ensure it is operating as intended.

3.5.4 The flap valve chamber will require the following maintenance:

- The catchpit chamber should be monitored for build-up of silts and should be emptied as a minimum on the same regime as specified for catchpits previously within this document.
- The hinged door located on the mounted concrete block will require inspection, greasing and opening annually, to ensure it is operating as intended.

Drainage System feature	Proposed maintenance / remedial works	Required frequency of works
Flow Control Chambers	Clean out chamber/sump	Monthly for first 3 months then twice annually
	Inspect flow control unit and remove debris	

3.6 Permeable Pavements & Diffuser Units

- 3.6.1 The areas of permeable paving are designed to allow surface water run-off to percolate through the joints in the block paving surface course and into the sub-base below. This provides a volume of attenuated storage (as it is proposed that the permeable paving will be tanked in view of site constraints) before collected run-off is discharged to the receiving outfall(s).
- 3.6.2 As part of the permeable paving system, diffuser units are used to discharge surface water run-off from the sub-base into the drainage system. These diffuser units are small heavy-duty cellular units which allow more efficient discharge of surface water from the sub-base base of the permeable paved areas.
- 3.6.3 The areas of permeable paving will require additional maintenance measures to ensure they operate as designed. Failure in carrying out this maintenance, could increase the risk of flooding. The additional measures are as follows:

Drainage System feature	Proposed maintenance / remedial works	Required frequency of works
Permeable Pavement	Surface sweeping to reduce silt and debris accumulation.	Quarterly
	Replace broken slabs/blocks	As required
	Removal / management of weed growth	At least once a year
	Silt removal from permeable surfaces, possibly involving raking out of joints, redressing, removal and remedial works.	As required / to be specified by manufacturer
Diffuser units	Inspection and additional cleansing as required.	Annual
	Desilting.	Year 1, Year 3, then every 5 years

3.7 Attenuation Storage Tanks

Drainage System feature	Proposed maintenance / remedial works	Required frequency of works
Upstream & Downstream catchpit chambers	Clean out chamber/sump.	Twice annually for the first 2 years of operation then annually
Inlets & Outlets	Inspection, vegetation clearance and additional clearing/cleansing of potential outfall blockages.	Annually and after large storms
Geocellular Units	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Post-construction, monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance).	Quarterly
	For systems where rainfall infiltrates into the tank from above, check the surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Quarterly, or as required

3.8 Remedial/Repair Actions

- 3.8.1 Significant storm events may cause considerable damage to SuDS and their associated components. As such, it may be necessary to inspect and carry out essential recovery works to return the feature to full working order.

3.9 Accidental Spillages

- 3.9.1 It is not envisaged that any materials are to be stored onsite once the development has been completed, which could cause major spills and potential pollution issues within the drainage system. If this situation alters in the future consultation with a specialist will be required in order to confirm if any upgrades to the existing system are necessary.
- 3.9.2 In the event of a serious spillage, either by volume or of unknown or toxic compounds, the spillage should be isolated with the use of soil, turf or fabric with outlet pipes from chambers downstream of the spillage blocked with a bung/bungs.
- 3.9.3 Minor spillages of fuels and oils from motor vehicles will be dealt with by the deep trapped gullies and sumped linear channels and catchpits, by collecting and biodegrading the hydrocarbons respectively.
- 3.9.4 In the event of localised private spillage, the responsibility lies with the private tenant to clear up any spillage before it enters the drainage network. The primary method of dealing with any spillage of hydrocarbons should be using sand (or equivalent) to soak up the leak and mitigate pollution migration.

Any contaminated waste shall be disposed of by a licensed contractor.

- 3.9.5 The Environment Agency should then be contacted immediately on their incident hotline; **0800 807060**.

3.10 Construction Phasing

- 3.10.1 Management and maintenance of drainage assets during the construction phase is the responsibility of the principle contractor and should be detailed within their Construction Management Plan accordingly.
- 3.10.2 The main contractor is responsible for dealing with all occurrences of groundwater emergence, surface water run-off, and siltation during the construction period.
- 3.10.3 It is recommended that the construction of geocellular tanks and permeable pavements, flow controls and outfall connections are completed prior to the commencement of construction of the buildings and hardstanding areas. This will ensure that flows are controlled and treated during construction. The proposed drainage systems will need a complete maintenance check upon completion of the development and any required remedial tasks undertaken.
- 3.10.4 By constructing these drainage components first, runoff from the construction site and the hardstanding areas will travel overland into the storage. This will ensure that run-off from the site receives the level of treatment required by the SuDS manual.

3.11 Future Alterations to the Development

- 3.11.1 Any future alterations to the drainage installations should be confirmed by a specialist. Where possible any future services are to avoid being located through areas of permeable paving. If new services are required to run through areas of permeable paving, services should be installed below the permeable paving level with the permeable system reinstalled above.

3.12 Emergency Procedures and Contacts

- 3.12.1 The proposed drainage system has been designed robustly to reduce the risk of blockage and the dry storage basins all include freeboard to reduce the likelihood of an occurrence of an emergency situation relating to flooding. However in the event that such a situation does occur, the following organization should be contacted.
- 3.12.2 Flooding related to the Non-adopted drainage system. **Hargreaves Properties Ltd / appointed Management Company [FULL DETAILS TO BE ADVISED IN DUE COURSE]**
- 3.12.3 Emergency situation relating to persons entering a basin. **Emergency Services 999**

DRAWINGS

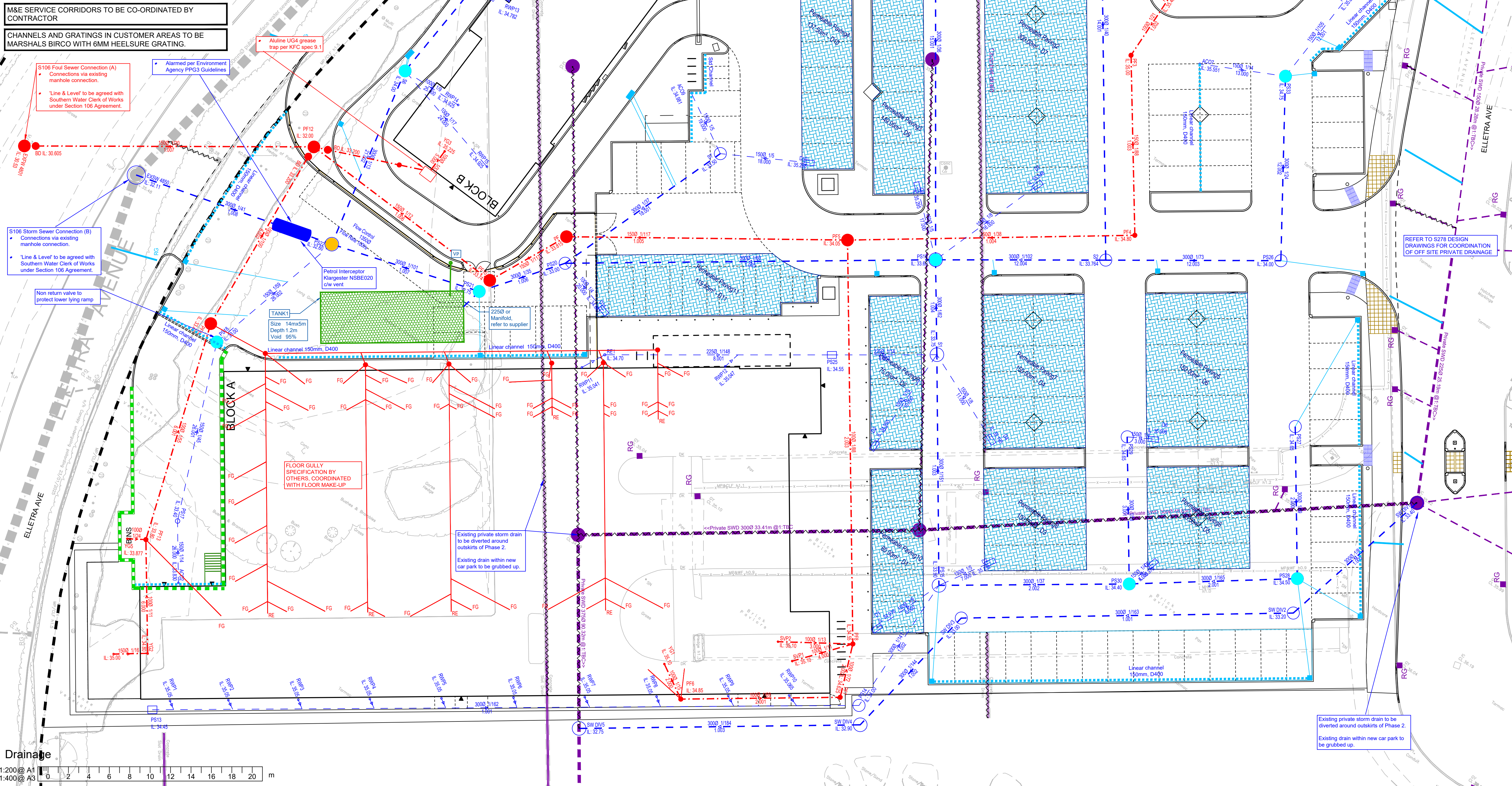
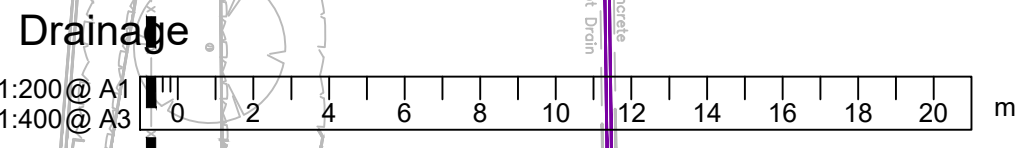
D2330.2/010	Proposed Drainage GA
D2330.2/300	Construction Details - Sheet 1 (Private)
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D2330.2/303	Construction Details - Sheet 4 (Private)

-PRIVATE DRAINAGE KEY-

- Private Surface Water Drainage
- Inspection Chamber (Max 1.2m Depth to invert)
- Precast Concrete Ring Catchpit (Over 1.5m Depth to Soffit)
- Proposed Surface Water Flow Control Manhole
- Floor/Yard Gully 600mm pot, 1000 Lateral (Trapped)
- 450x950 Road Gully & 1500 Lateral (Double gullies must have separate laterals)
- SW Permeable Pavement (Tanked) (Refer to Std Details)
- Diffuser Inlet/Outlet
- SW Storage Tank (Geocellular) (Refer to Std Details)
- Linear Channel (Inc sump)
- Threshold Drain (Refer to Architects Spec)
- Private Foul Water Drainage
- 450x450 Floor/Yard Gully & 1000 Lateral
- Inspection Chamber (Shallow) (Max 0.6m Depth to invert, Svp shall use main channel)
- Inspection Chamber (Max 1.2m Depth to invert) Svp shall use main channel

M&E SERVICE CORRIDORS TO BE CO-ORDINATED BY CONTRACTOR

CHANNELS AND GRATINGS IN CUSTOMER AREAS TO BE MARSHALS BIRCO WITH 6MM HEELSURE GRATING.



NOTES

- This drawing is to be read in conjunction with all other BP Civils drawings, and with all relevant Architect's and Engineer's drawings and specification. Any discrepancies found are to be reported immediately to the Engineer.
- BP Civils accepts no responsibility for inaccuracies in data provided by third parties such as topographic surveys or Ordnance Survey mapping.
- Do not scale, work to figured dimensions only. All dimensions are in millimetres unless noted otherwise and all levels are in metres from the topographic survey datum.
- Any information given regarding existing underground services is given in good faith after consultation with the relevant authority, however accuracy is not certain. The main contractor is responsible for checking all information on site prior to work commencing and taking due care whilst undertaking the works.
- All dimensions to be checked on site. All details and dimensions relating to sub-contractors work must be checked and agreed between the sub-contractor or supplier and the general contractor.
- The electronic information from this drawing can not be guaranteed as dimensionally drawn exact. Figured dimensions must be used for setting out and detailing. BP Civils logos and company information must be removed from copies if information is re-used.
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RESIDUAL HAZARDS

- In addition to the hazards/risks normally associated with the type of work detailed on this drawing, note the following:
- Buried services. Contractor to refer to record drawings and use CAT to locate existing services and undertake necessary precautions and investigation prior to excavating.
 - Working in live traffic. Contractor to ensure traffic management is designed, erected and maintained to protect the workforce and the public. Contractor to undertake necessary precautions and ensure suitable traffic management is in place prior to commencement.
 - Excavations close to existing structures. Contractor to prepare method statement to ensure stability of existing structure.
- It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved risk assessment and method statement

PO2	10.06.25	Issue for tender
PO2	04.06.25	Issue for tender
PO1	27.05.25	Issue for tender
Rev.	27.02.25	Original Issue

Rev.	Date	Amendments
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BP CIVILS

Infrastructure Design and Transport Planning Consultants
2 West Barn, Norton Lane, Chester, West Sussex PO20 3AF
Tel: 01243 210418
www.bpcivils.co.uk enquiries@bpcivils.co.uk

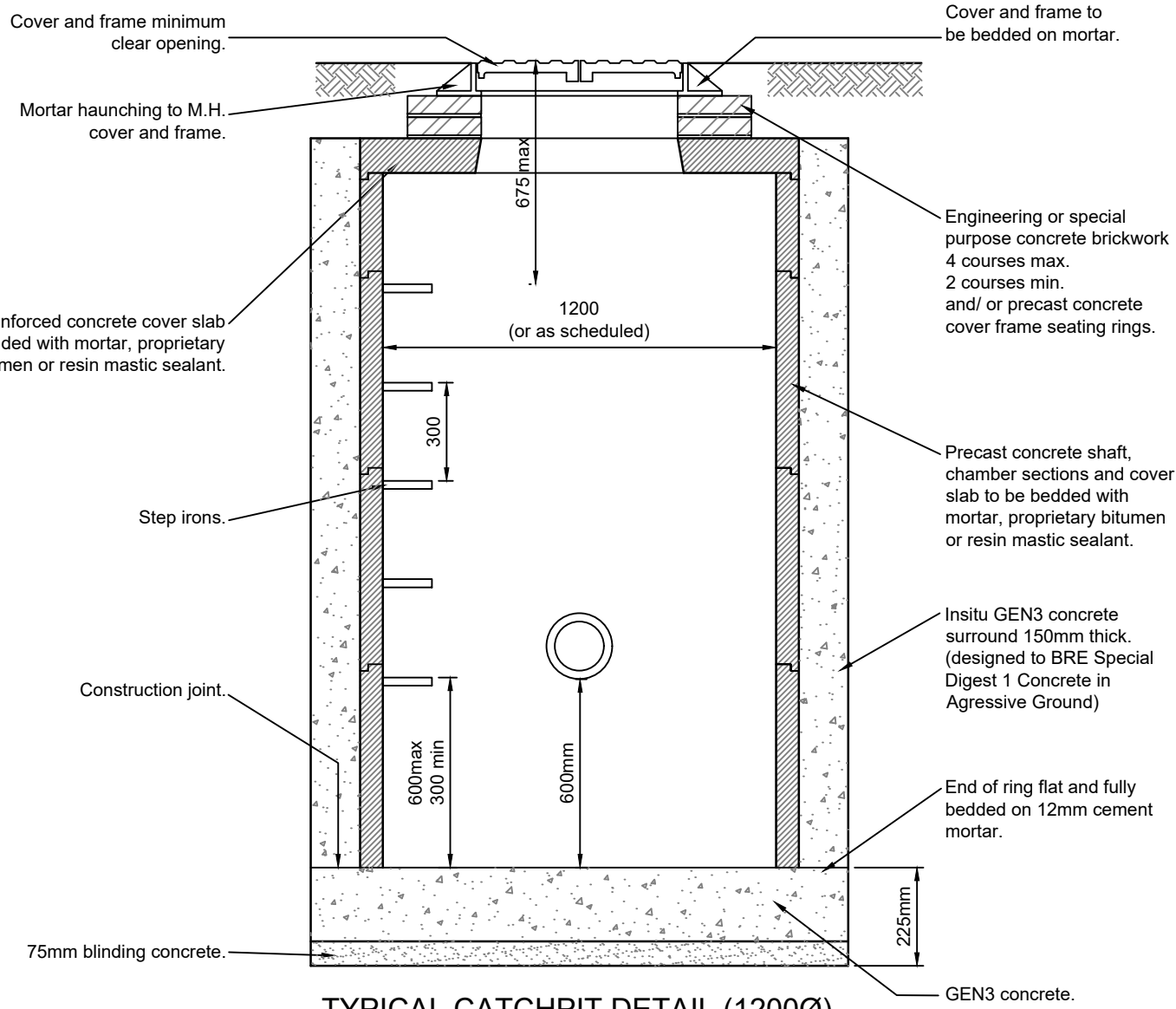
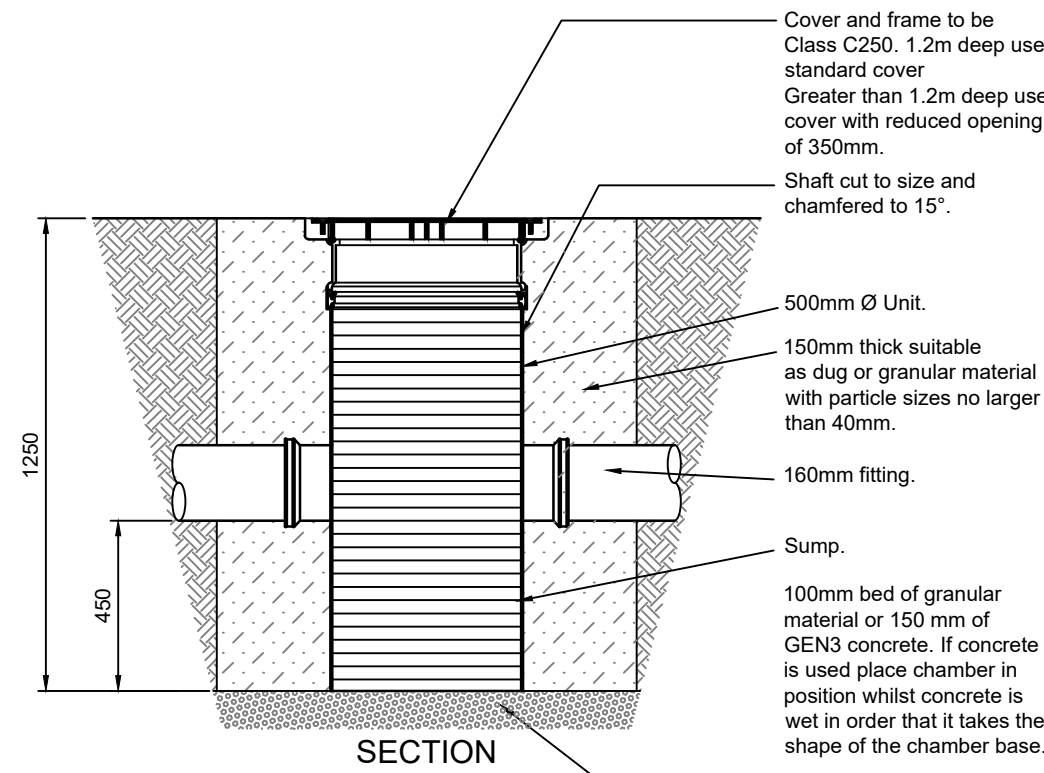
Drawing Status **FOR TENDER
NOT FOR CONSTRUCTION**

Client **Hargreaves Properties Ltd.
On Site**

Project **Waterlooville, Havant,
PO7 7XW (Phase 2)**

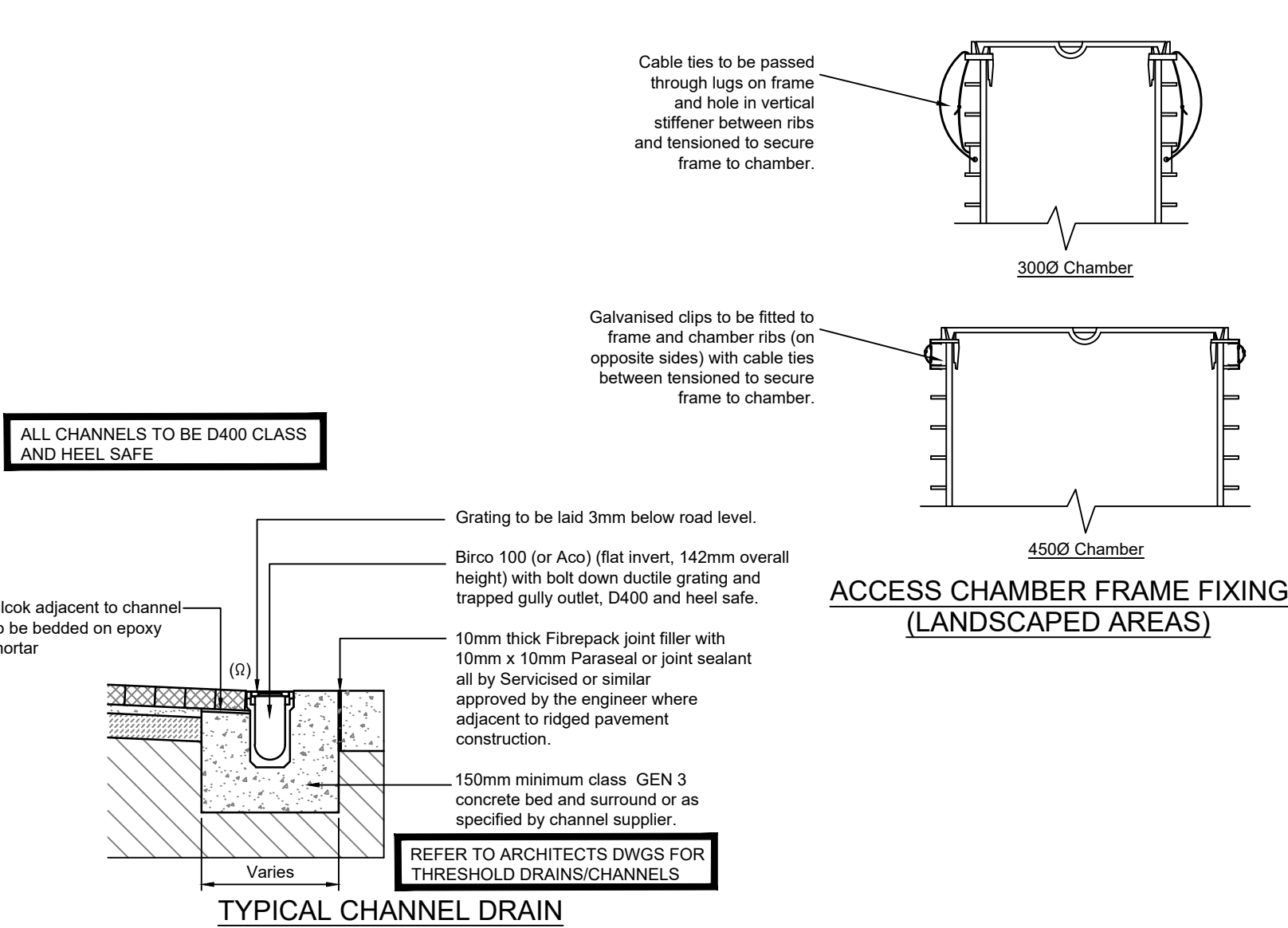
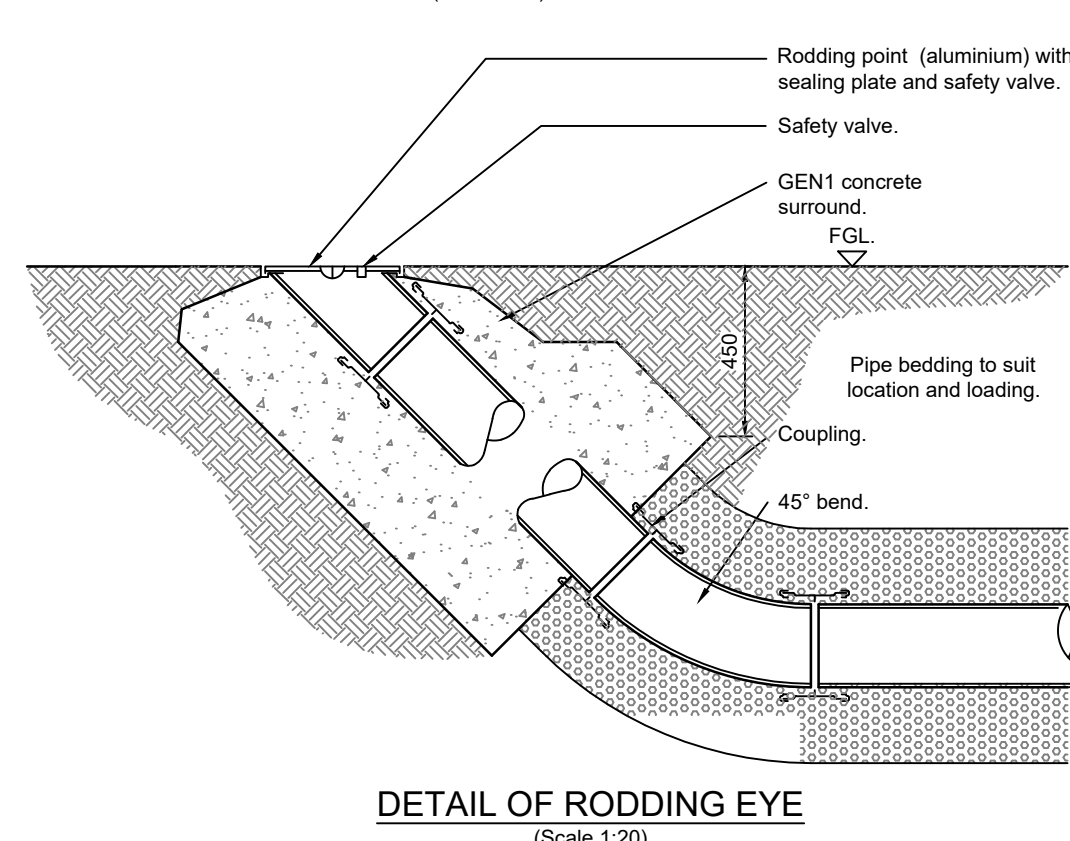
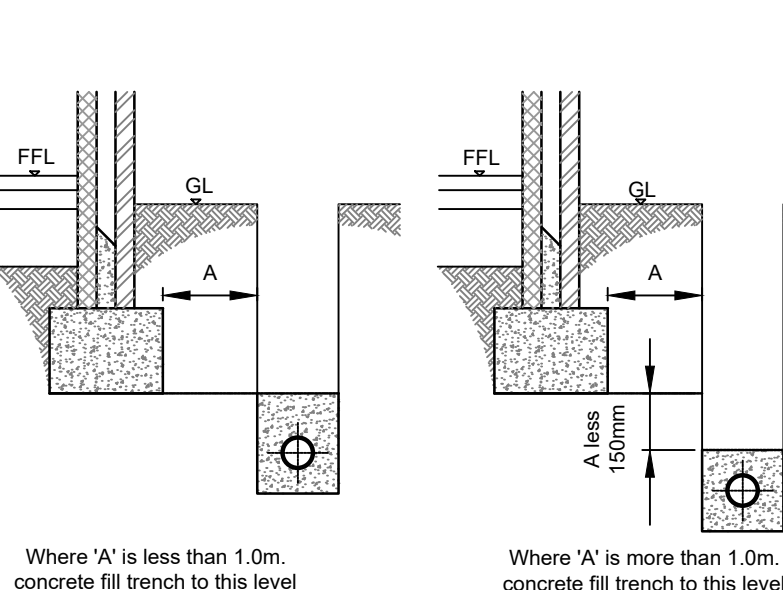
Drawing Title **Drainage**

Scale at A1	Date	Drawn By	Checked By	Project No.
1:200	May '25	JHL	MJA	D2330.02
Drawing Code				
000-BPC-WD-ZZ-D-C	010			P03



POLYPROPYLENE SHALLOW SILT TRAP DETAIL (500Ø)
(Scale 1:20)

Depth to invert 1.25m (standard unit)
Silt Traps installed greater than single unit depth to be extended using inspection chamber shaft units.



DETAIL OF PIPE RUNS NEAR BUILDINGS
(Scale 1:10)

Table 11 Minimum dimensions for access fittings and inspection chambers						
Type	Depth to invert from cover level (m)	Internal sizes		Cover sizes		
		Length x width (mm x mm)	Circular (mm)	Length x width (mm x mm)	Circular (mm)	
Rodding eye	As drain but min. 100					Same size as pipework ¹
Access fitting small	150 diam.	0.6 or less, except where situated in a chamber	150 x 100	150	150 x 100 ¹	Same size as access fitting
large	225 x 100		225 x 100	225	225 x 100 ¹	
Inspection chamber shallow	0.6 or less	225 x 100	190 ²	—	190 ¹	
deep	1.2 or less > 1.2	450 x 450	450	Min. 430 x 430 Max. 300 x 300 ³	430	Access restricted to max. 350 ³

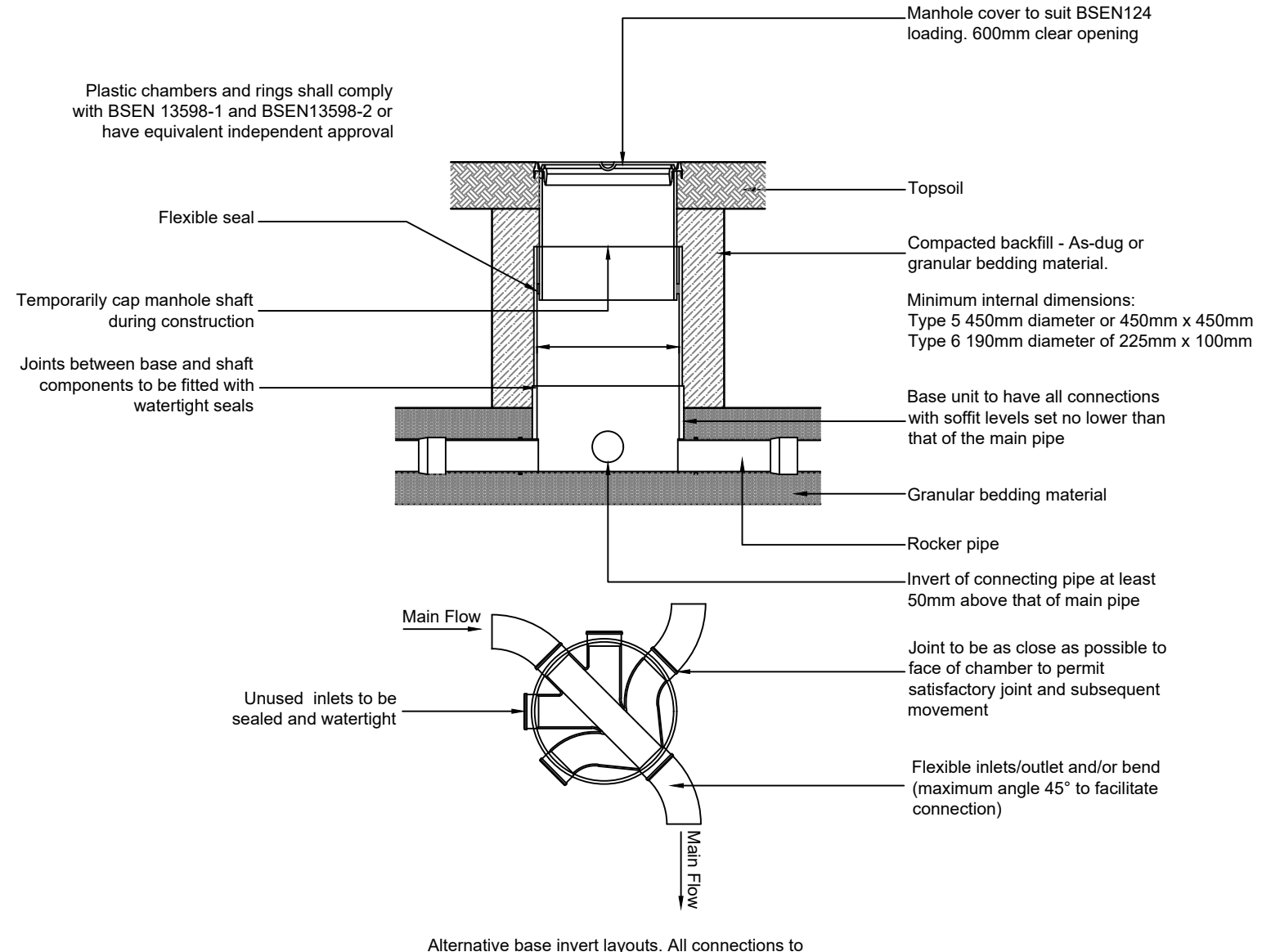
Notes:
1. The clear opening may be reduced by 20mm in order to provide proper support for the cover and frame.
2. Drains up to 150mm.
3. A larger clear opening cover may be used in conjunction with a restricted access. The size is restricted for health and safety reasons to deter entry.

BUILDING REGULATIONS MINIMUM DIMENSIONS FOR ACCESS FITTINGS AND INSPECTION CHAMBERS

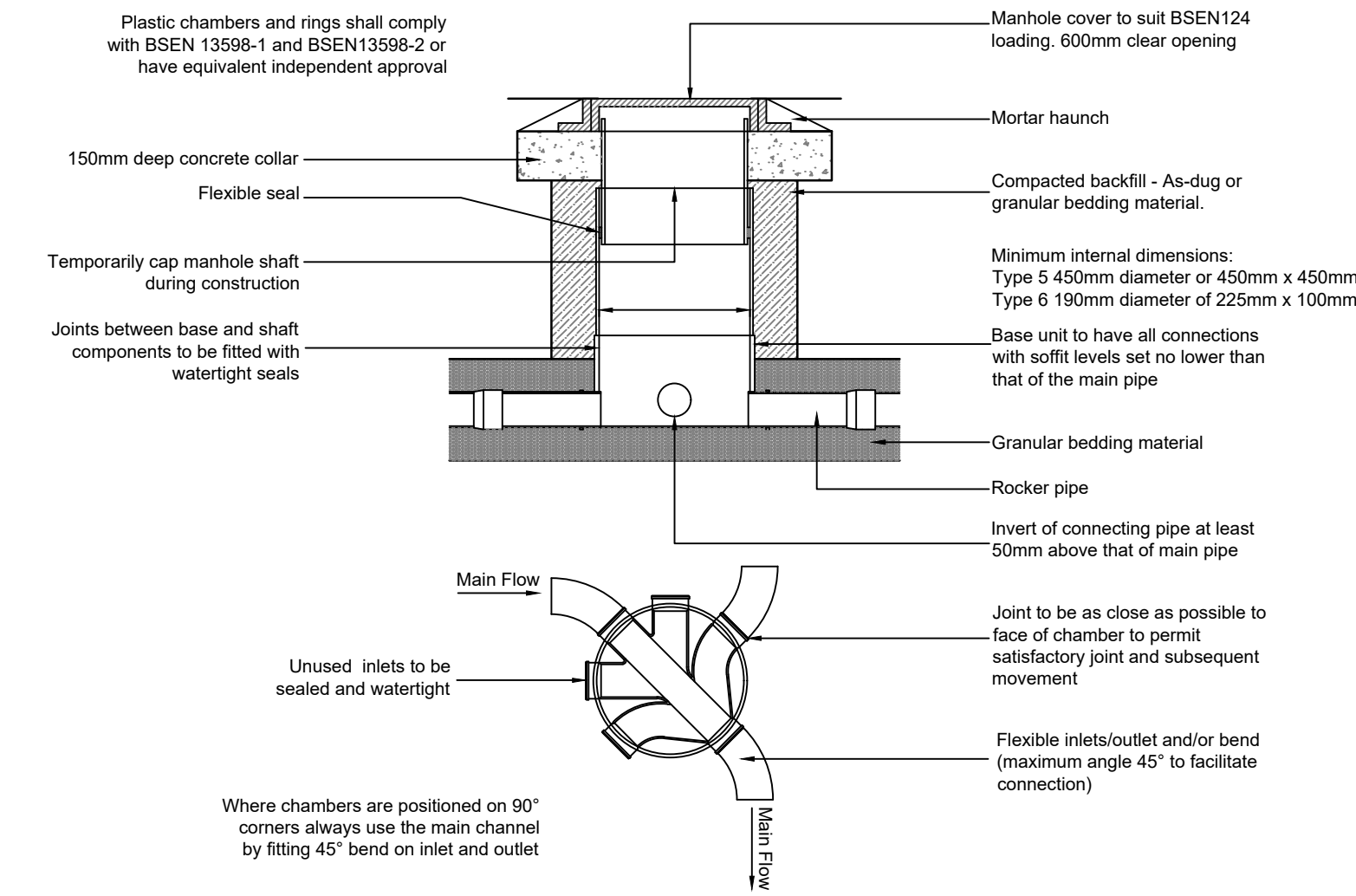
Table 12 Minimum dimensions for manholes						
Type	Size of largest pipe (DN)	Min. internal dimensions ¹	Min. clear opening size ¹	Rectangular length and width	Circular diameter	Circular diameter
Manhole						
< 1.5m deep to soffit	≤ 150	750 x 675 ²	1000 ¹	750 x 675 ²	na ³	
	225	1200 x 675	1200	1200 x 675 ²		
	300	1200 x 750	1200			
	>300	1800 x (DN-450)	The larger of 1800 or (DN-450)			
>1.5m deep to soffit	≤ 225	1200 x 1000	1200	600 x 600	600	
	300	1200 x 1075	1200			
	375-450	1350 x 1225	1200			
	>450	1800 x (DN-775)	The larger of 1800 or (DN-775)			
Manhole shaft ⁴						
> 3.0m deep to soffit of pipe	Steps ⁵	1050 x 800	1050	600 x 600	600	
	Ladder ⁶	1200 x 800	1200			
	Winch ⁶	900 x 800	900	600 x 600	600	

Notes:
1. Larger sizes may be required for manholes on bends or where there are junctions.
2. May be reduced to 600 by 600 where required by highway loading considerations, subject to a safe system of work being specified.
3. Not applicable due to working space needed.
4. Minimum height of chamber in shafted manhole 2m from benching to underside of reducing slab.
5. Min. clear space between ladder or steps and the opposite face of the shaft should be approximately 900mm.
6. Winch only – no steps or ladders, permanent or removable.
7. The minimum size of any manhole serving a sewer (i.e. any drain serving more than one property) should be 1200mm x 675mm rectangular or 1200mm diameter.

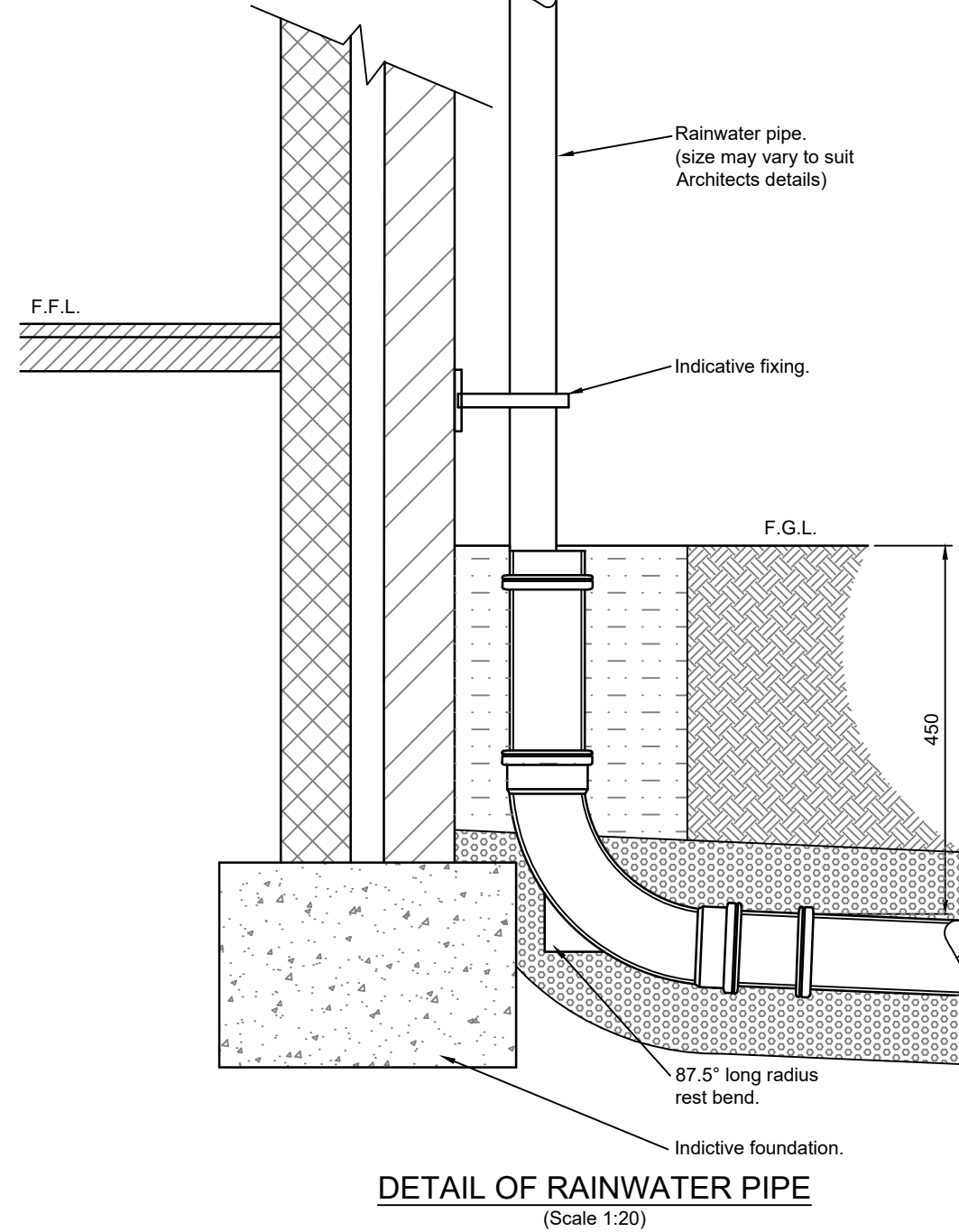
BUILDING REGULATIONS MINIMUM DIMENSIONS FOR MANHOLES



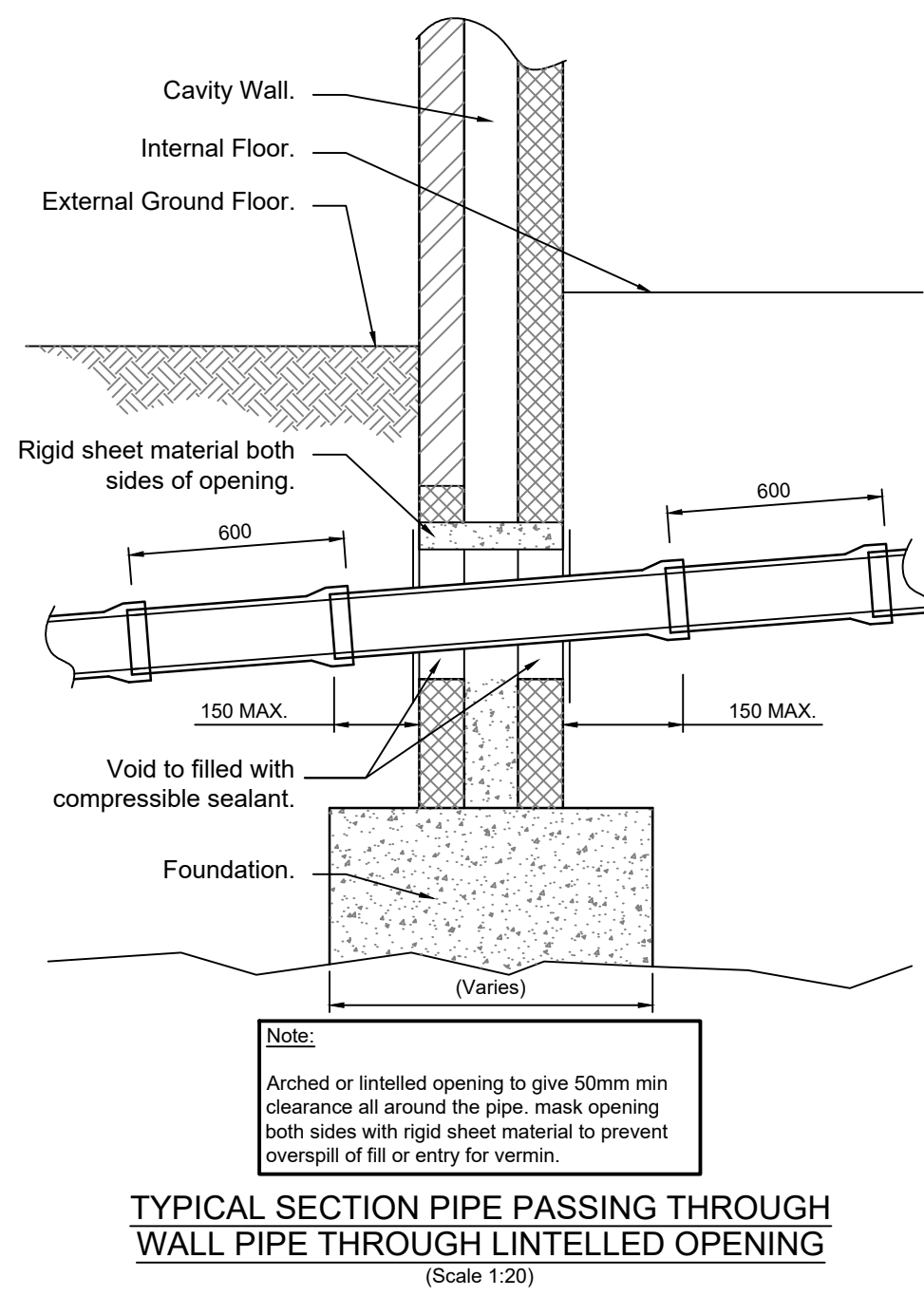
TYPICAL ACCESS CHAMBER FRAME FIXING (LANDSCAPED AREAS)
(Scale 1:20)



TYPICAL ACCESS CHAMBER DETAIL - TYPE 5 & 6 (FOOTPATHS AND PRIVATE DRIVES)
(Scale 1:20)



DETAIL OF RAINWATER PIPE
(Scale 1:20)



TYPICAL SECTION PIPE PASSING THROUGH WALL PIPE THROUGH LITTELLED OPENING
(Scale 1:20)

DRAINAGE NOTES:

- All drainage works to be constructed in strict accordance with specification of the Local Authority, Building Regulations, Design and Construction Guidance (published by Water UK, BS5301 & BS EN 752-1).
- For location and setting out of building drainage points refer to architects drawings.
- All pipe runs near buildings to comply with the Building Regulations 2002 part H1. Where a pipe is within 1m of a foundation the trench shall be filled with class gen3 concrete up to the lowest level of the foundation. Where the trench is further than 1m from the foundation, the trench shall be filled with class gen3 concrete to a level below the lowest level for the foundation equal to the distance from the foundation less 150mm. In both cases the pipe shall be bedded and surrounded in 150mm thick class GEN3 concrete.
- Where pipes, external to the structures, have a depth to soffit from ground level of less than 450mm they shall have a class GEN3 concrete encasement (150mm thick).
- Where a pipe, under a carriageway, has a depth of cover of less than 1.2m the pipe shall be laid in a concrete bed and surround.
- In any circumstances where pipes are bedded and surrounded in concrete flexible joints should be provided; compressible boards (fibreglass or polystyrene) shall be provided at a maximum of 8m centres (coinciding with pipe joints). The boards shall be pre-cut to pipe diameter and to a height and width equal to the concrete cross section, a board thickness of 18mm for pipes up to 450mm nominal diameter and 36mm for pipes over 450mm nominal diameter.
- All private building drainage shall be constructed in strict accordance with BS EN 752-1. Four drainage beneath the floor slab shall be laid, shall be laid no flatter than 1:40. Unless otherwise specified below ground building drainage external to the building shall be 100mm diameter and shall be laid at a minimum gradient of 1 in 100 for foul drains and 1 in 80 for surface water drains.
- All building drains shall be laid in conjunction with 'non adoptive bedding details' (class d, n or b) unless otherwise specified.
- All pipes, bends and junction for private building drainage shall be UPVC conforming to BS4560, BS EN 13598 and BS EN 1401 as appropriate and shall be laid in accordance with the manufacturer's specification.
- All pipes, bends and junction materials for adoptable drainage shall be verified clay, extra strength or super strength to BS EN 255, with flexible joints and kitemark certified.
- All back inlet gullies to be roddable or connected to inspection chambers.
- All gully connections other than at manholes to be 'y' junctions.
- All road gully connections to be 150mm diameter.
- No low point shall be without a method of drainage.
- All connections to be soffit to soffit unless otherwise noted.
- All concrete and concrete products to be in accordance with BRE 363 for sulphates.
- The locations of all building drainage points shall be cross referenced against the architects drawings during setting out.
- Before connections are made to existing public sewers an application under 106 must be made to relevant sewerage undertaker.
- The precise depth and location and size of existing pipes, watercourses or manholes where connections or diversion are proposed must be confirmed and reported to the engineer before works commence on site.
- Existing drains - any existing drains to be abandoned to be decommissioned in view of building regulations by either building out, infilled or sealed.
- Should ground water be encountered on site during construction BPC shall be informed to determine if additional measures are required with regard to floatation.
- The drainage drainage system shall be fully cleaned on completion of the project using methods that ensure pollution off site does not occur.
- Any existing land drains severed during construction shall be reinstated.

NOTES

- This drawing is to be read in conjunction with all other BP CIVILS drawings, and with all relevant Architects and Engineer's drawings and specification. Any discrepancies found are to be reported immediately to the Engineer.
- BP CIVILS accepts no responsibility for inaccuracies in data provided by third parties such as topographic surveys or Ordnance Survey mapping.
- Do not scale, work to figured dimensions only. All dimensions are in millimetres unless noted otherwise and all levels are in metres from the topographic survey datum.
- Any information given regarding existing underground services is given in good faith after consultation with the relevant authority, however accuracy is not certain. The main contractor is responsible for checking all information on site prior to work commencing and taking due care whilst undertaking the works.
- All dimensions to be checked on site. All details and dimensions relating to sub-contractors work must be checked and agreed between the sub-contractor or supplier and the general contractor.
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- The client shall ensure that all licences, consents and approvals required to implement the works are in place prior to commencing construction.

RESIDUAL HAZARDS

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- Buried services. Contractor to refer to record drawings and use CAT to locate existing services and undertake necessary precautions and investigation prior to excavating.
 - Working in live traffic. Contractor to ensure traffic management is designed, erected and maintained to protect the work area and the public. Contractor to undertake necessary precautions and ensure suitable traffic management is in place prior to commencement.
 - Working in live sewers. Contractor to ensure operatives are familiar and competent with the dangers of working in live sewers.
 - Excavations close to existing structures. Contractor to prepare method statement to ensure stability of existing structure.
- Appropriate risk assessments and method statements should be prepared to manage these risks as required.

P02	05/06/25	For Tender
P01	27/05/25	For Tender
-	-	Original Issue
Rev.	Date	Amendments



BP CIVILS
Infrastructure Design and Transport Planning Consultants
2 West Barn, Norton Lane, Chichester, West Sussex PO20 3AF
Tel: 01243 210418
www.bpcivils.co.uk enquiries@bpcivils.co.uk

Drawing Status
FOR TENDER
NOT FOR CONSTRUCTION

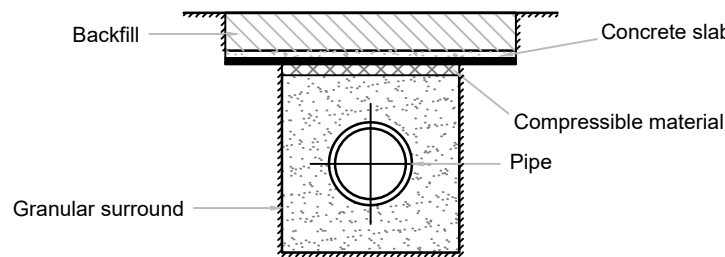
Client
Hargreaves Properties Ltd,
On Site

Project
Waterlooville, Havant,
PO7 7XW (Phase 2)

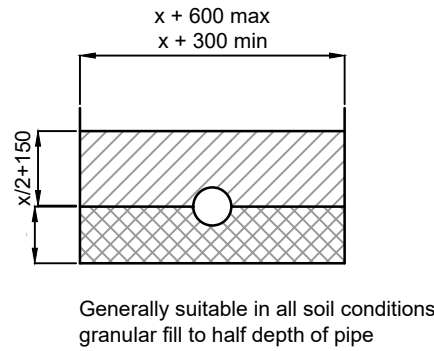
Drawing Title
Construction Details
Sheet 2 of 4

Scale at A1 Date May 25 Drawn By JHL Checked By MJA Project No. D2330.02

Drawing Code 000-BPC-WD-ZZ-D-C 301 P02



PROTECTION FOR PIPES LAID A SHALLOW DEPTHS
Depth of cover less than 0.60m under private gardens and 0.90m under private drives
(Scale 1:20)

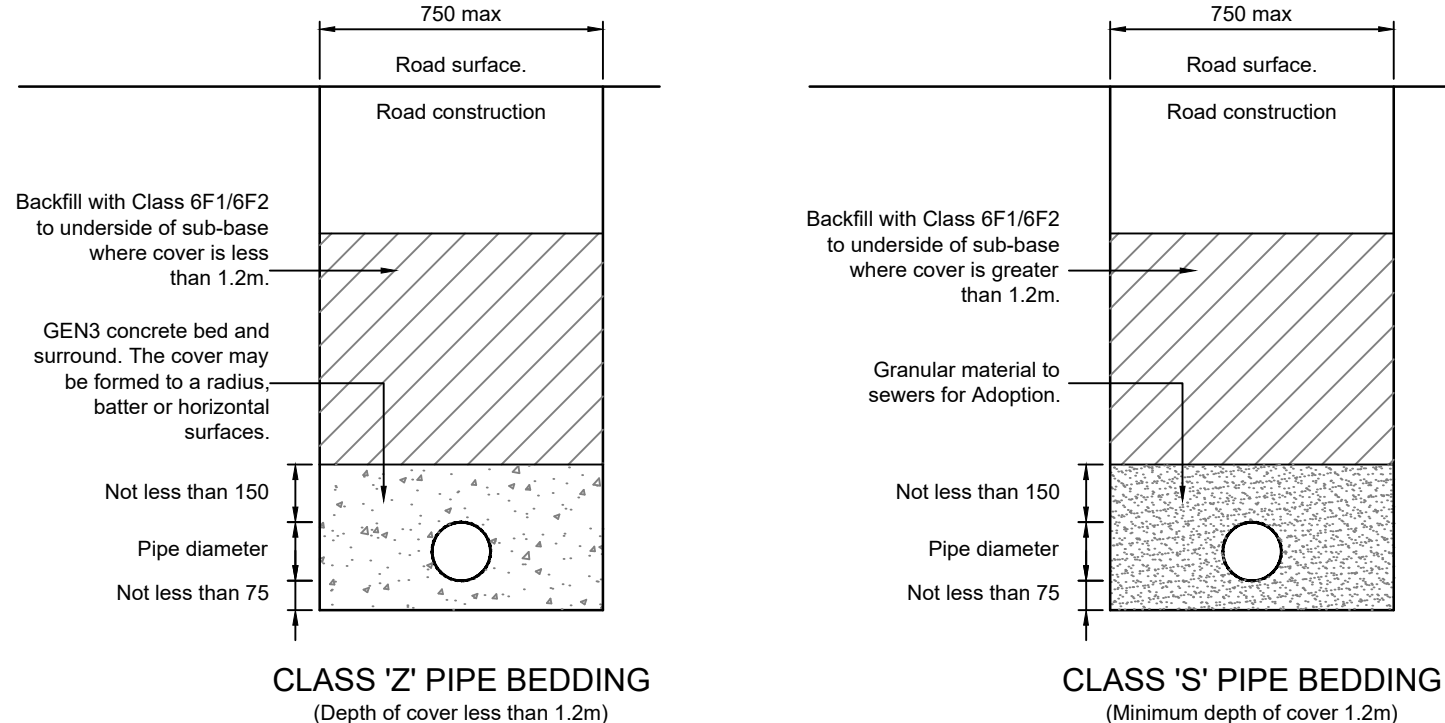


PIPE BEDDING DETAIL UNDER DRIVES AND GARDENS
Min depth of cover 0.6m under private gardens and 0.9m under private drives

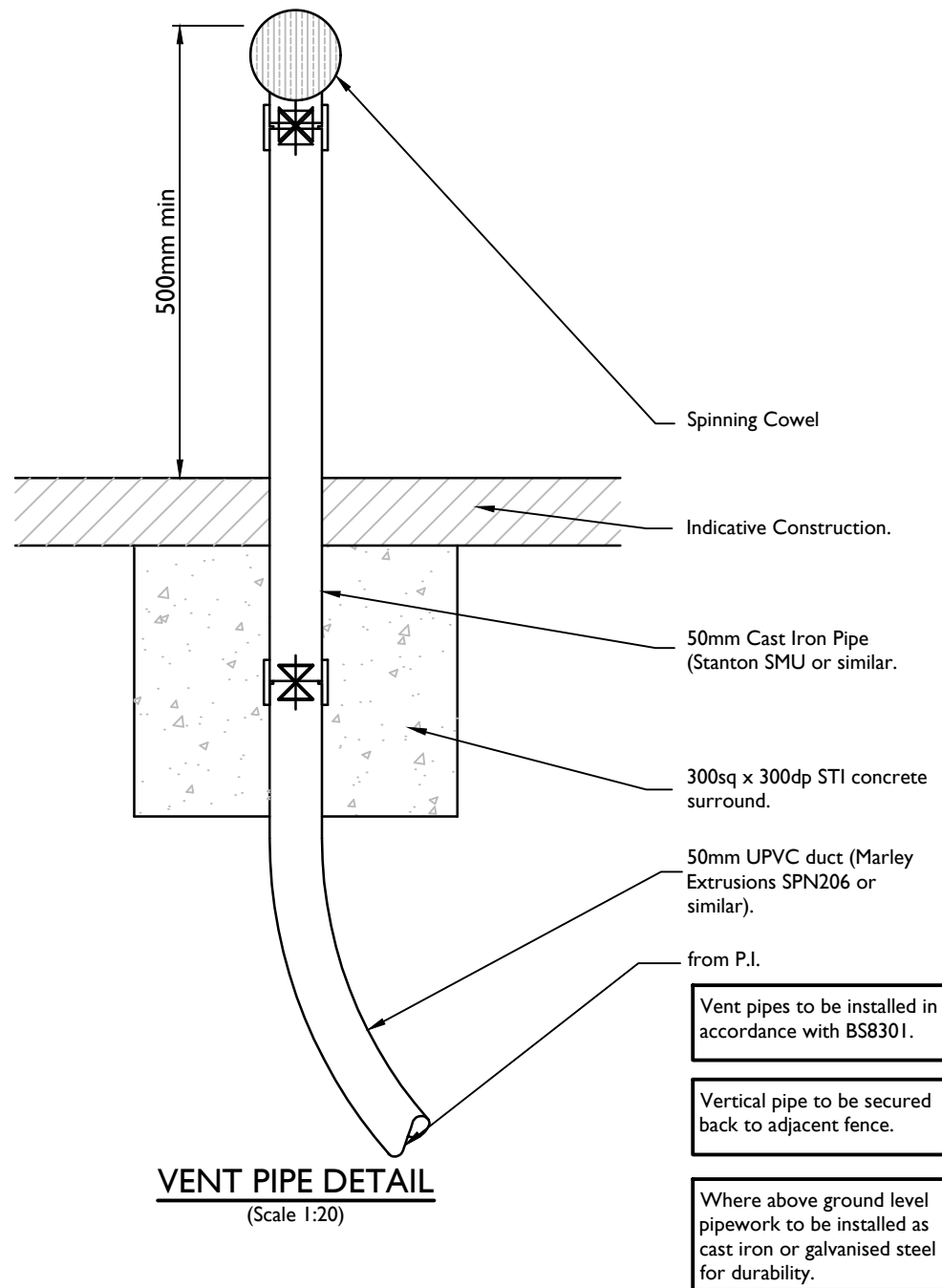
LEGEND:

- Selected fill: free from stones larger than 40mm, lumps of clay over 100mm, timber frozen material and vegetable matter.
- Granular material: should conform to BS 692:1983 table 4 or BS5301:1985 Appendix D. Compaction fraction > 0.3 for class N > 0.2 for class F and B.

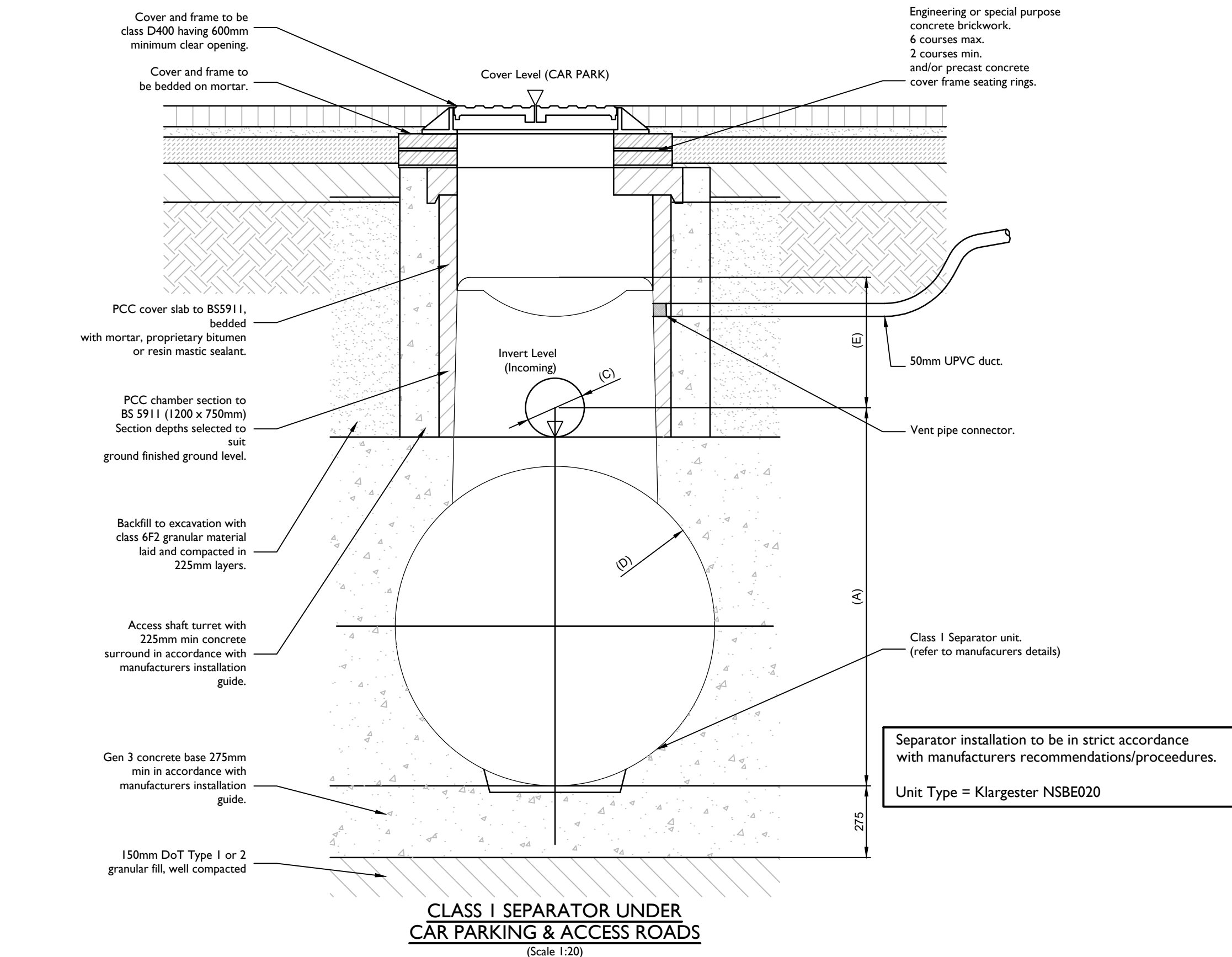
'x' - Denotes external pipe diameter.



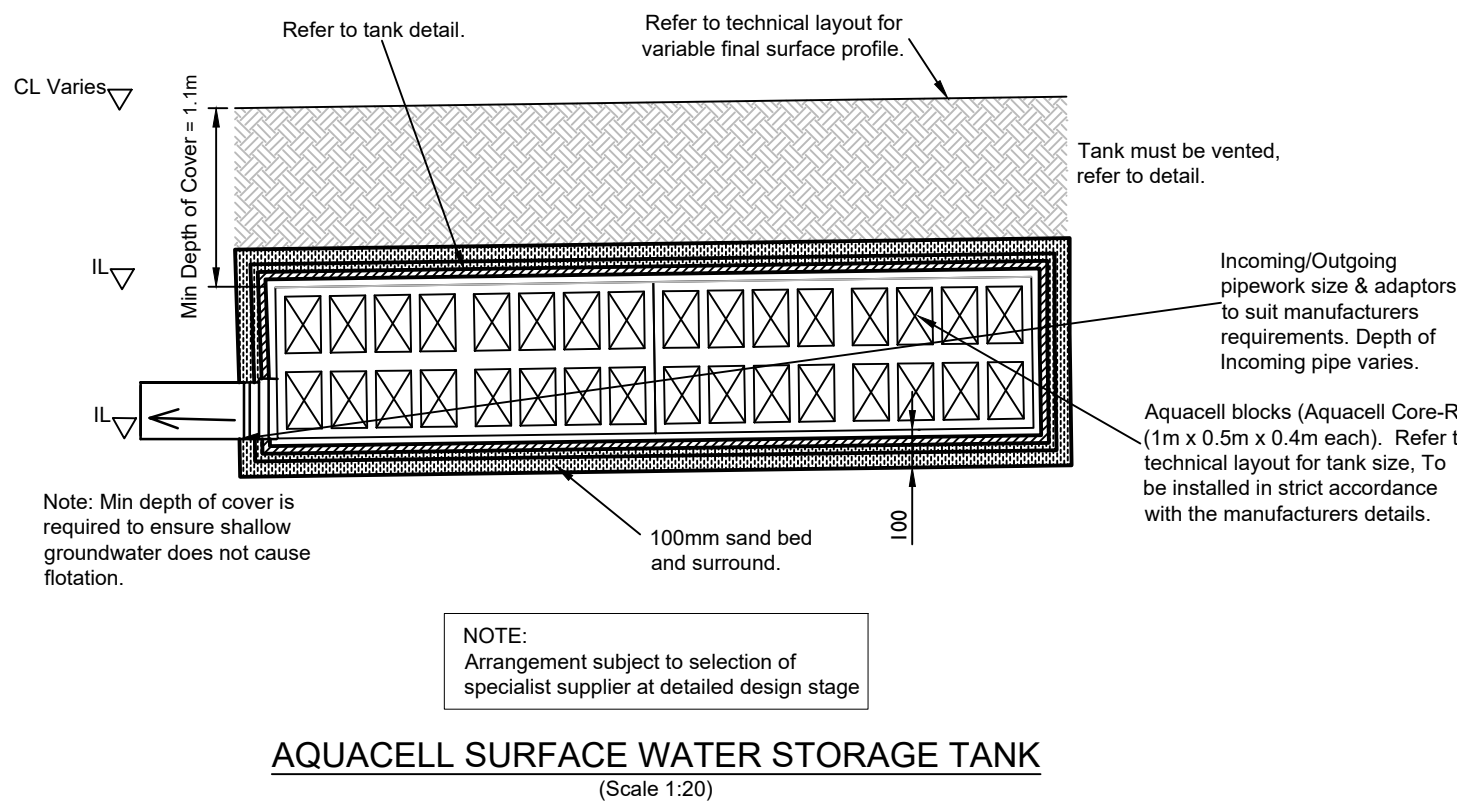
PIPE BEDDING DETAILS (UNDER HIGHWAYS)
(Scale 1:20)



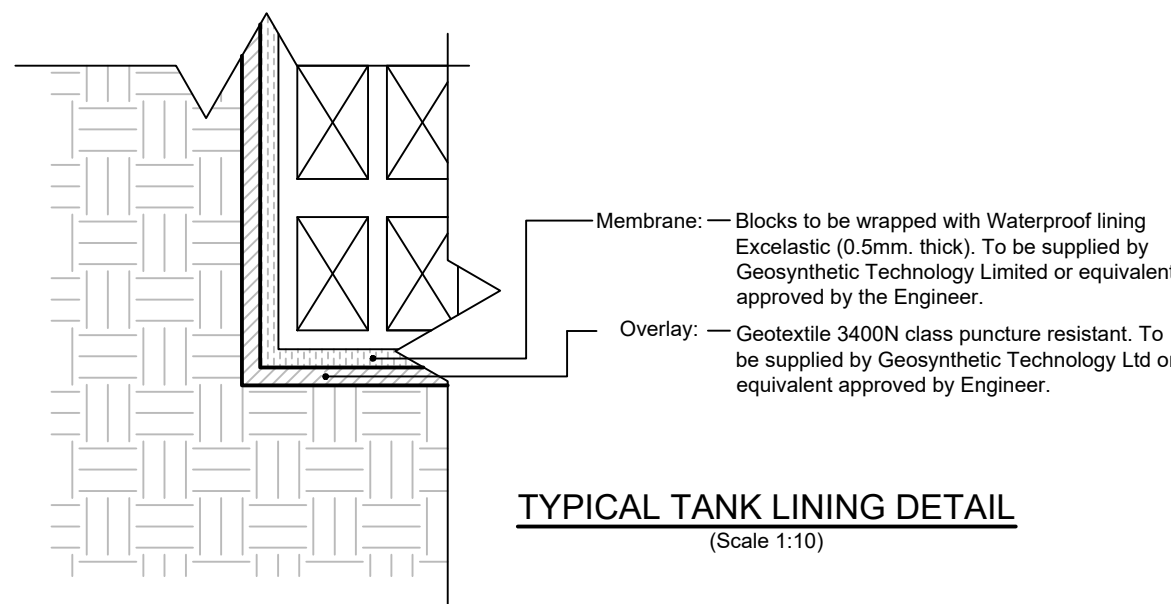
VENT PIPE DETAIL
(Scale 1:20)



CLASS I SEPARATOR UNDER CAR PARKING & ACCESS ROADS
(Scale 1:20)



AQUACELL SURFACE WATER STORAGE TANK
(Scale 1:20)



TYPICAL TANK LINING DETAIL
(Scale 1:10)

DRAINAGE NOTES:

- All drainage works to be constructed in strict accordance with specification of the Local Authority, Building Regulations, Design and Construction Guidance (published by Water UK), BS5301 & BS EN 122-1.
- For location and setting out of building drainage points refer to architects drawings.
- All pipe runs near buildings to comply with the Building Regulations 2002 part H1. Where a pipe is within 1m of a foundation the trench shall be filled with class gen3 concrete up to the lowest level of the foundation. Where the trench is further than 1m from the foundation, the trench shall be filled with class gen3 concrete to a level below the lowest level for the foundation equal to the distance from the foundation less 150mm. In both cases the pipe shall be bedded and surrounded in 150mm thick class GEN3 concrete.
- Where pipes, external to the structures, have a depth to soffit from ground level of less than 450mm they shall have a class GEN3 concrete encasement (150mm thick).
- Where a pipe, under a carriageway, has a depth of cover of less than 1.2m the pipe shall be laid in a concrete bed and surround.
- In any circumstances where pipes are bedded and surrounded in concrete flexible joints should be provided; compressible boards (fibreboard or polystyrene) shall be provided at a maximum of 8m centres (coinciding with pipe joints). The boards shall be pre-cut to pipe diameter and to a height and width equal to the concrete cross section, a board thickness of 18mm for pipes up to 450mm nominal diameter and 35mm for pipes over 450mm nominal diameter.
- All private building drainage shall be constructed in strict accordance with BS EN 122-1. Foul drainage beneath the floor slab shall be laid, shall be laid no flatter than 1:40. Unless otherwise specified below ground building drainage external to the building shall be 100mm diameter and shall be laid at a minimum gradient of (<11s = 1 in 40)-11s = 1 in 80) for foul drains and 1 in 80 for surface water drains.
- All building drains shall be laid in conjunction with 'non adoptive bedding details' (class d, n or b) unless otherwise specified.
- All pipes, bends and junction for private building drainage shall be UPVC conforming to BS4680, BS EN 13358 and BS EN 1401 as appropriate and shall be laid in accordance with the manufacturer's specification.
- All pipes, bends and junction materials for adoptable drainage shall be vitrified clay, extra strength or super strength to BS EN 295, with flexible joints and kitemark certified.
- All back inlet gullies to be roddable or connected to inspection chambers.
- All gully connections other than at manholes to be 'y' junctions.
- All road gully connections to be 150mm diameter.
- All stub stacks to be fitted with air admittance valves where branch drain exceeds 12m except at the head of the run. Soil vent pipes located at the head of a run to terminate to fresh air.
- No low point shall be without a method of drainage.
- All connections to be soffit to soffit unless otherwise noted.
- All concrete and concrete products to be in accordance with BRE 363 for sulphates.
- The locations of all building drainage points shall be cross referenced against the architects drawings during setting out.
- Before connections are made to existing public sewers an application under 106 must be made to relevant sewerage undertaker.
- The precise depth and location and size of existing pipes, watercourses or manholes where connections or diversion are proposed must be confirmed and reported to the engineer before works commence on site.
- Existing drains - any existing drains to be abandoned to be decommissioned in view of building regulations by either building out, infilled or sealed.
- Should ground water be encountered on site during construction BPC shall be informed to determine if additional measures are required.
- The drainage drainage system shall be fully cleaned on completion of the project using methods that ensure pollution off site does not occur.
- Any existing land drains severed during construction shall be reinstated.

NOTES

- This drawing is to be read in conjunction with all other BP Civils drawings, and with all relevant Architect's and Engineer's drawings and specification. Any discrepancies found are to be reported immediately to the Engineer.
- BP Civils accepts no responsibility for inaccuracies in data provided by third parties such as topographic surveys or Ordnance Survey mapping.
- Do not scale work to figured dimensions only. All dimensions are in millimetres unless noted otherwise and all levels are in metres from the topographic survey datum.
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P02	05/06/25	For Tender
P01	23/05/25	For Tender
-	-	Original Issue
Rev.	Date	Amendments



Drawing Status **FOR TENDER**
NOT FOR CONSTRUCTION

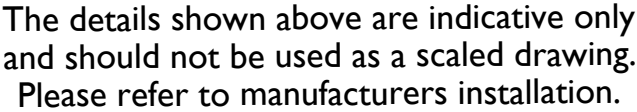
Client **Hargreaves Properties Ltd, On Site**

Project **Waterlooville, Havant, PO7 7XW (Phase 2)**

Drawing Title **Construction Details**
Sheet 3 of 4

Scale at A1	Date	Drawn By	Checked By	Project No.
AS SHOWN	May 25	JHL	MJA	D2330.02

Drawing Code	Drawing No	Rev.
000-BPC-WD-ZZ-D-C	302	P02



000-BPC-WD-ZZ-D-C | 303 | PC

DOCUMENTS

Marshalls Block Paving Maintenance Sheet
Diffuser unit data sheet
Aluline UG4 Grease Trap
Klargester Kingspan Class 1 Bypass
Hydro-International Brochure

Hydro-Brake® Optimum

Vortex Flow Control

Inspired by nature and engineered to deliver the perfect curve, the Hydro-Brake® Optimum is the most advanced vortex flow control available. There is no equivalent to the Hydro-Brake® Optimum when it comes to delivering the best possible hydraulic performance with a passive flow control.

With a wide range of configurations and options available, the Hydro-Brake® Optimum is able to provide precision flow control to suit the vast majority of applications.



Figure 1 - The Hydro-Brake® Optimum is designed and manufactured to deliver precise, repeatable flow control.

Precision Engineered Vortex Flow Controls

Each Hydro-Brake® Optimum is custom configured to suit the application and is manufactured under strict quality assurance procedures to deliver precise flow control to exacting requirements.

Every unit is backed by significant R&D investment to fine-tune the performance, meaning that the Hydro-Brake® Optimum is the only vortex flow control to have been independently certified by the BBA and WRc.



Benefits

- Manufactured from high grade stainless steel.
- Future proof – adjustable or replaceable inlet plates available to alter flow rates post-installation.
- Configurations available to suit a wide variety of installations.
- Large cross sectional area at all heads.
- Simple installation.
- Self-activating.
- No moving parts or external power requirement.

Versatile and Flexible

At Hydro International, we pride ourselves on providing solutions that meet your requirements, rather than providing a standard solution and asking you to compromise on your project needs.

The Hydro-Brake® Optimum offers designers options to precision-engineer a vortex flow control to:

- Minimise upstream storage volumes.
- Maximise internal (inlet & outlet) cross sectional areas to prevent blockages.
- Build-in a climate change factor to allow for future changes in flow rate.

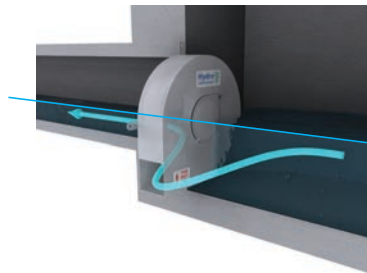
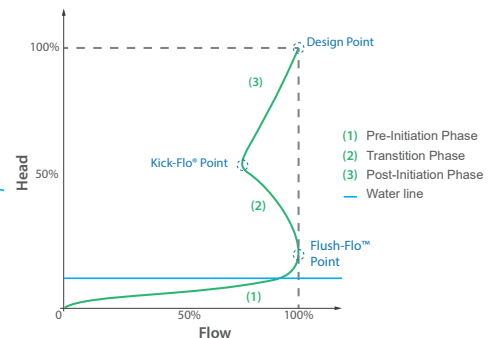
Furthermore, if you need to retrofit a flow control, our dedicated team of engineers can assist with providing a customised Hydro-Brake® Optimum suitable for installation into existing drainage infrastructure.

Operating Principles

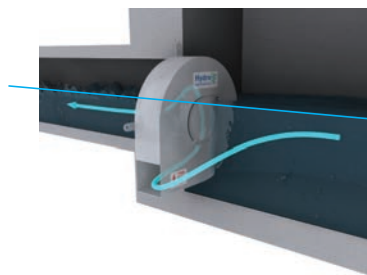
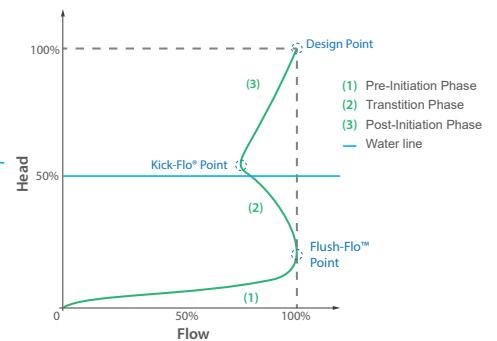
The hydraulic behaviour of the Hydro-Brake® Optimum is described by its hydraulic characteristic curve, which relates the discharge flow from the unit to the hydraulic head acting upon that unit.

The hydraulic characteristic curve consists of three distinct sections, each corresponding to a different governing flow control regime:

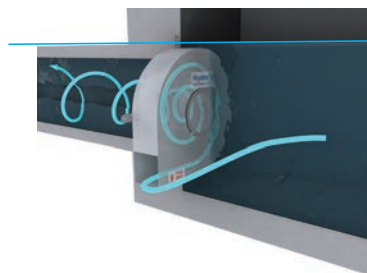
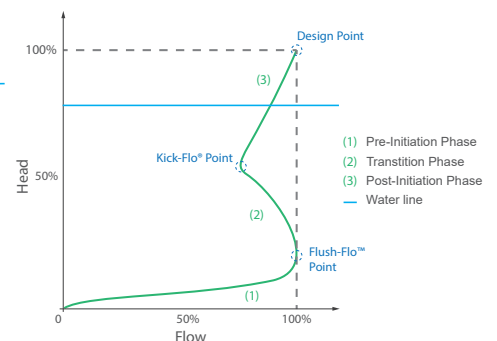
1. The pre-initiation phase – governed by orifice flow and defined on the characteristic curve as the region between the origin and the point at which the vortex begins to have a throttling effect (Flush-Flo™ point). In this region, the depth of water is below the soffit of the outlet orifice of the Hydro-Brake® Optimum.



2. The transition phase – governed by vortex formation and defined on the characteristic curve as the region between the Flush-Flo™ and the point at which the vortex has fully initiated (Kick-Flo® point). In this region the vortex will continually form and collapse. A trapped volume of air inside the Hydro-Brake® Optimum will exert a backpressure and cause the discharge rate to reduce even though the hydraulic head continues to increase.



3. The post-initiation phase – governed by stable vortex flow and defined on the characteristic curve as the region above the Kick-Flo® point. A stable vortex is formed and sustained. An air filled core at the centre of the vortex acts as a pseudo-physical flow restriction by reducing the cross sectional area available for the passage of water.



Design Flexibility

It is possible for the Design Point to be achieved using a number of different flow control configurations, each with a different hydraulic response or characteristic curve.

An in-depth understanding of the flow regimes and interactions at each stage of the hydraulic characteristic curve allows custom configuration of the Hydro-Brake® Optimum to achieve the hydraulic profile best suited to the site requirements.

Design Data

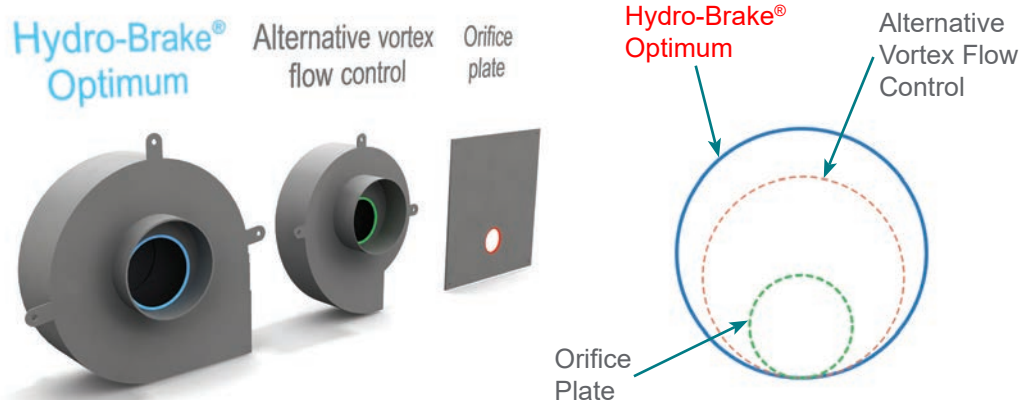
Hydro-Brake® Optimum

Vortex Flow Control

Resilience by Design

Hydro-Brake® Optimum has outlets (clearances) up to 20% larger than competitor products to minimise the risk of blockages. All units are fitted with a pivoting bypass door to enable full access to the internal chamber and the outlet structure in the event that a blockage does occur.

All Hydro-Brake® Optimum units can also be supplied with an adjustable or replaceable inlet to future-proof the device, allowing flows to be altered post-installation, to account for site expansion or climate change.



Expert Design Support Services

Hydro International's professional engineers work with you to provide expert technical and aftersales support to ensure your projects meet exacting design requirements and deliver the very best hydraulic controls for your site.

With over 35 years' experience of flow control knowledge and experience, Hydro International's design support team is available to advise on any aspect of water flow management, including detailed modelling of vortex flow controls and composite outlet structures.

Call the Hydro-Brake® Hotline on: 01275 337937 or email stormwater@hydro-int.com

Online Design Tool

Engineers have the flexibility to try out any number of flow control iterations and explore their impact on hydraulic performance.

Our Online Design Tool allows you to quickly and easily compare a number of different flow control options for your site to develop the most robust and sustainable drainage solution possible.

The new tool now also has the added options to size and design the First Defense® and Downstream Defender® stormwater treatment separators, alongside the existing functionality to size and design Hydro-Brake® Optimum flow controls.

hydro-int.design



Full MicroDrainage® Compatibility

Engineers can carry out sizing and flow rate calculations and conduct hydraulic modelling of drainage networks containing Hydro-Brake® Optimum units using the industry-standard drainage design software, MicroDrainage®.



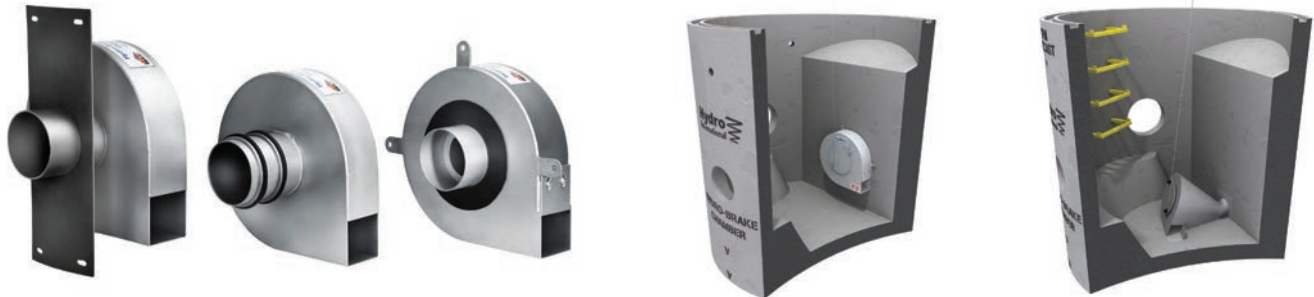
Design Data

Hydro-Brake® Optimum

Vortex Flow Control

Easy to Install

Hydro-Brake® Optimum has a range of mounting options for ease of installation or can be supplied ready fitted into a manhole chamber (with or without a weir wall) for simple plug-and-play installation. There are no set-up or commissioning requirements.



The Hydro-Brake® Flow Control Series

As a brand leader for vortex flow controls for more than 30 years, Hydro International continues to set the standard in flow control management technologies. The Hydro-Brake® Flow Control Series is a comprehensive and versatile toolbox of precision-engineered devices for flow attenuation and control that can help deliver compliant schemes with scalable, precision flow control performance.

Every device in the series is tested and manufactured to exacting standards and wherever possible, independently accredited to provide the reassurance of reliable, repeatable through-life operation.

Hydro-Brake® Orifice



The low-cost option for unconstrained sites (shown with optional screen).

Hydro-Brake® Optimum



The vortex flow control with no equivalent, delivering Nature's Perfect Cuve with no moving parts and independently verified by the BBA and WRc.

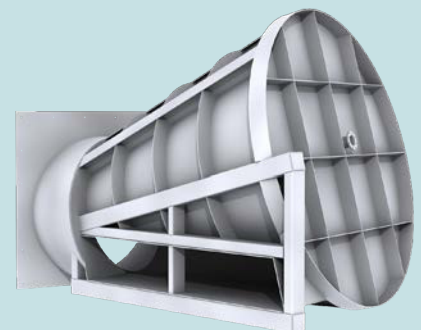
Hydro-Brake® Agile

Precision engineered flow control for highly constrained applications.



Hydro-Brake® Flood Alleviation

The vortex controlled solution to watercourse flooding.



Patent: www.hydro-int.com/patents

Page 4 of 4

Tel: +44 (0)1275 337 937 stormwater@hydro-int.com

Hydro International
Shearwater House, Clevedon Hall Estate, Victoria Road, Clevedon, BS21 7RD
Hydro-Brake® Optimum Flow Control Design Data Sheet D/0519

hydro-int.com

Run-off from building roofs is collected into downpipes and flows into a back inlet gully incorporating an internal filter or catchpit inspection chambers. The back inlet gully or chamber discharges the filtered stormwater into the permeable sub-base via Permavoid Rainwater Diffuser Unit encapsulated in a 2mm mesh fabric. The run-off will then diffuse out of the Permavoid Rainwater Diffuser Unit and into the modified granular sub-base layer. The Permavoid unit is a 150mm deep modular interlocking plastic unit storage system designed for use as a combined drainage component and sub-base replacement system, ideal for shallow infiltration/attenuation.



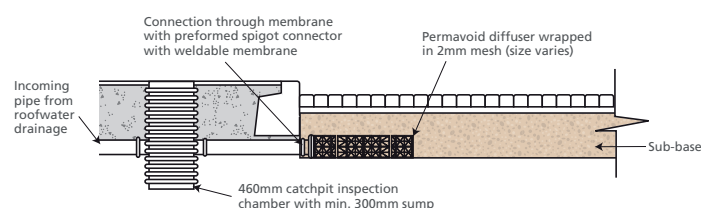
Permavoid Rainwater Diffuser Unit - Configuration Options

	Width				
	354mm	708mm	1062mm	1416mm	2124mm
Length	708mm	✓	✓	✓	✓
	1062mm	✗	✓	✓*	✓
	1416mm	✓	✓	✓	✓
	2124mm	✓	✓	✓	✓

*1062 x 1062mm diffuser unit has a 354 x 354mm central opening.
Depths available are either 150mm or 300mm.
Connections available are either Ø110mm or Ø160mm.

Catchpit: 460mm diameter catchpit with 160mm inlet - PSMST 160
460mm diameter catchpit with 110mm inlet - PSMST 110

Typical Layout - Rainwater downpipe drainage into sub-base reservoir



Technical Support

Detailed guidance and assistance is available.
For further information, please contact our Technical Team on +44 (0) 1509 615 100 or email civils@polypipe.com or visit www.polypipe.com/civils-technical-hub

ELEMENT	VALUE
PHYSICAL PROPERTIES	
Weight per unit	3kg
Length	708mm
Width	354mm
Depth	150mm
SHORT TERM COMPRESSIVE STRENGTH	
Vertical	715kN/m ²
Lateral	156kN/m ²
SHORT TERM DEFLECTION	
Vertical	1mm per 126kN/m ²
Lateral	1mm per 15kN/m ²
TENSILE STRENGTH	
Of a single joint	42.4kN/m ²
Of a single joint at (1% secant modulus)	18.8kN/m ²
Bending resistance of unit	0.71kN/m
Bending resistance of single joint	0.16kN/m
OTHER PROPERTIES	
Volumetric void ratio	95%
Average effective perforated surface area	52%
Intrinsic permeability (k)	Minimum 1.0 x 10 ⁻⁵
Ancillary	Permavoid Permatie
	Permavoid Shear Connector
Material	Polypropylene (PP)

HYDRAULIC PERFORMANCE

3 units wide, 1 unit deep
(1.06m x 0.15m)

FREE DISCHARGE

Gradient (%)	0	1	2	3	4	5
Flow rate (l/m/s)	8	13	15	17	19	21

Permavoid Rainwater Diffuser Unit can be utilised in these SuDS techniques

TECHNIQUES													
Blue-Green roofs	Podium Decks	Trees	Sports Pitches	Cycle Paths	Permeable Paving (sub base & podium)	Bioretention & Rain Gardens	Attenuation Storage Tanks	Infiltration	Swales	Filter Drains	Detention Basins	Ponds & Wetlands	Filter Strips
			✓		✓		✓						

Visit www.polypipe.com/greeninfrastructure

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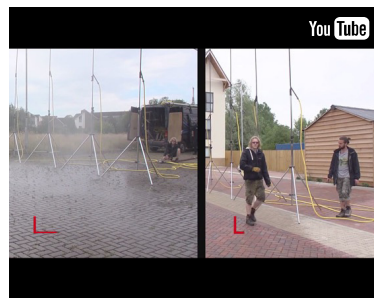


MARSHALLS PRIORA: MAINTENANCE

Maintaining your Marshalls Priora Permeable Paving System is easy: simply ensure that the voids between the blocks don't get blocked and prevent water from flowing through the surface and into the sub-base.

However, it's important to remember that even if the voids do appear to be blocked, it's unlikely to stop the system working. This is because the voids on a Marshalls Priora surface have been specially engineered to be far wider than they need to be – so blocked voids are likely to only slow the flow of water, not stop it completely.

A Marshalls Priora surface made of 200mmx100mm blocks provides infiltration rates in excess of 18,000 litres per second per hectare (l/s/h). The average rainfall event in the UK provides flow at approximately 180 l/s/h. Independent research in 2006 by Soenke Borgwardt concluded that after 10 years, in a worst case scenario with absolutely zero maintenance, a permeable pavement might be reduced to 10% of its original permeability. In Priora's case, this would be 1,800 l/s/h – still TEN TIMES more permeable than it needs to be!



See for yourself!

Visit YouTube and search for "Marshalls Priora Maintenance Test" to see a real time infiltration test on an unmaintained Priora system!



Marshall's
Creating Better Spaces

5 SIMPLE STEPS TO MAINTAIN A MARSHALLS PRIORA SURFACE IN OPTIMUM CONDITION:

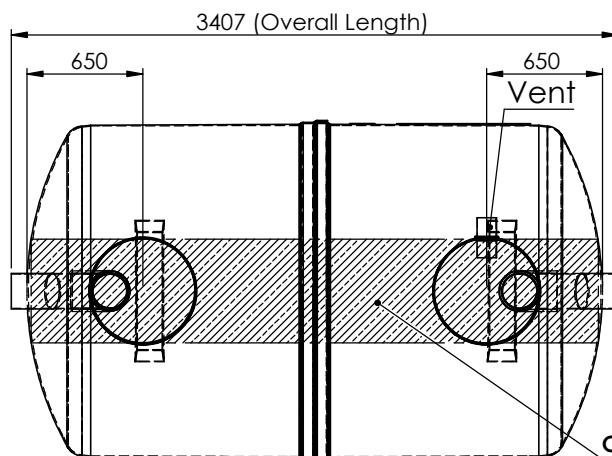
- **NEVER** dump sand, cement, soil or other loose material directly onto a Marshall's Priora surface. This could block the joints or even fall into the sub-base. If you do need to store any loose material on a Marshall's Priora surface, make sure you put down a tarpaulin or impenetrable sheet first.
- Every twelve months or so, undertake a visual inspection to check that the voids aren't blocked with dirt or other debris. This is usually best undertaken after a period of heavy rainfall. If any voids are blocked, ponding on the surface will be apparent.
- If you notice ponding, the joints in that area are blocked. To clear them, either sweep the joints with a stiff brush or vacuum the contaminated aggregate out and replace it. If using an automatic suction brush, angle the brushes at 30° to avoid aggregate migration.
- Any vegetation growing in the joints can be removed manually, or treated with a Glyphosate-based weedkiller. Glyphosate will be neutralised upon contact with the ground, so it will be safe to plant in the area soon after treatment
- For winter maintenance, pure (white) rock salt is an effective and readily available de-icer. However, avoid using salts which contain an additional abrasive such as sand or grit. For heavy ice, should an abrasive be required, mix pure (white) rock salt with 6mm Priora jointing aggregate. This can be brushed safely back into the joints once thawed. (nb – Use of chlorides is highly unlikely to increase chloride levels in the local ground).

Total Working Volume = 6870L

Product	Size
NSG	18

Inlet Invert	Invert
05	0.5m Invert
10	1.0m Invert
15	1.5m Invert

Pipework Orientation	Orientation
x	
A	
B	
C	
D	
E	Refer To TDS0033
F	
G	
H	
K	

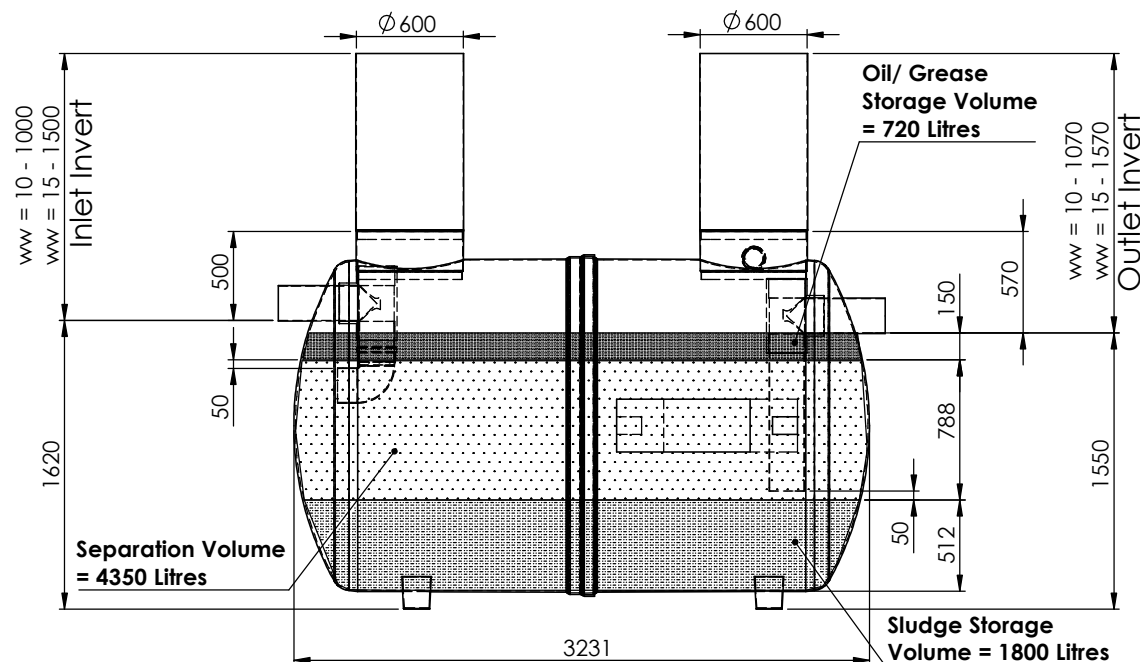
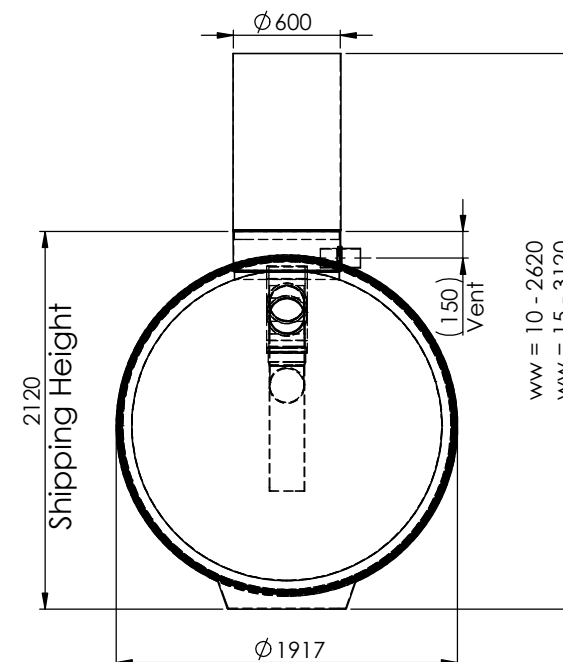


Notes: -

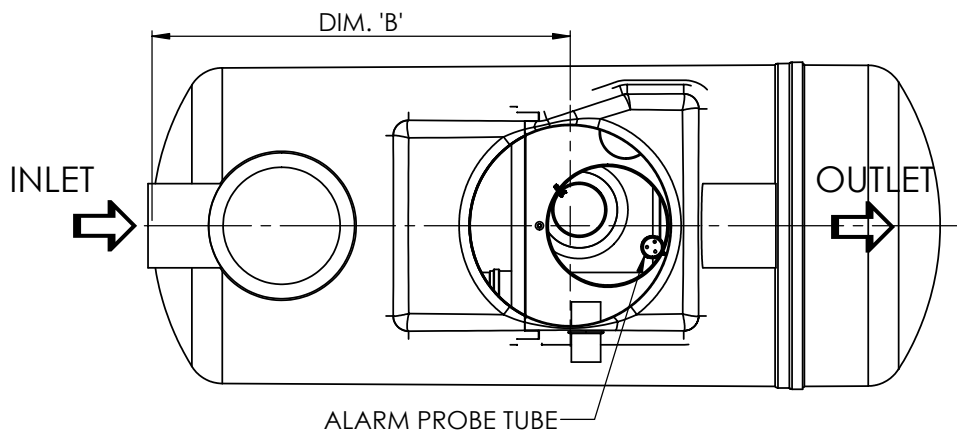
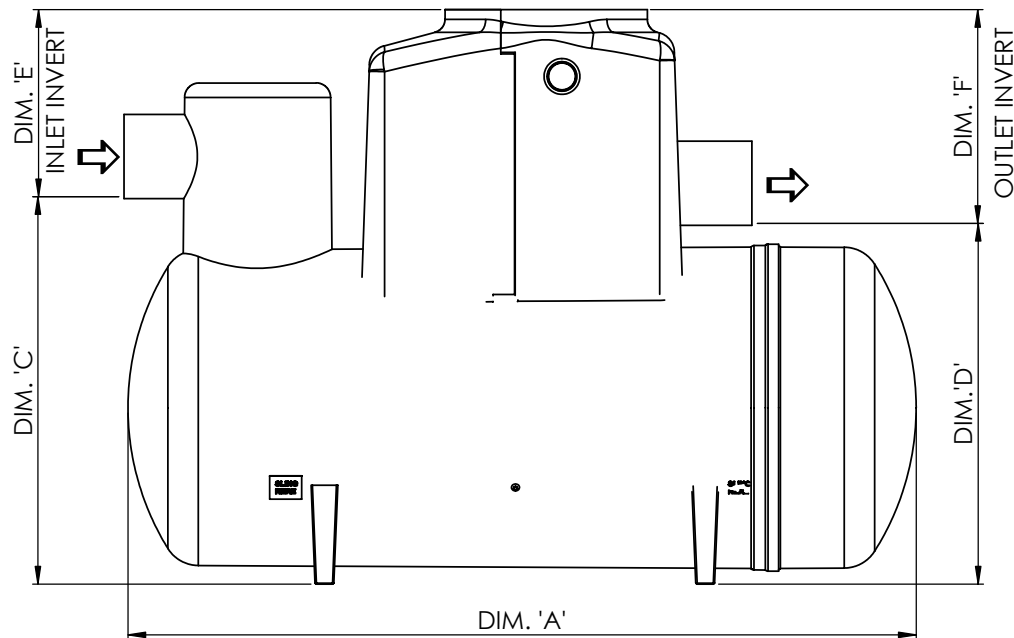
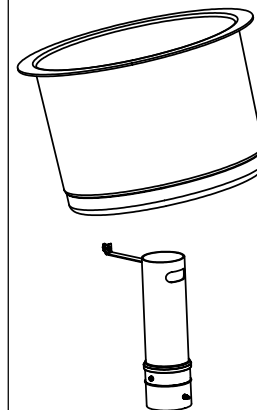
1. Inlet Invert To Be Confirmed By Customer.
2. Pipework Orientation (A, B, C etc.) Dependant On Site Pipework Layout. To Be Specified At Order Stage.
3. Standard Minimum Pipework Size Is Ø200mm.
4. If Required, Extensions Will Be Supplied Loose To Be Fitted On-Site Using Silicon Sealant (Supplied By Others).
5. This Unit Can Be Installed In Either Granular Or Concrete Backfill - Please See Manual For Details.

Standard Connections Size	Connections (Ø)
y	
D	Ø200

z	Branding
K	Klargester

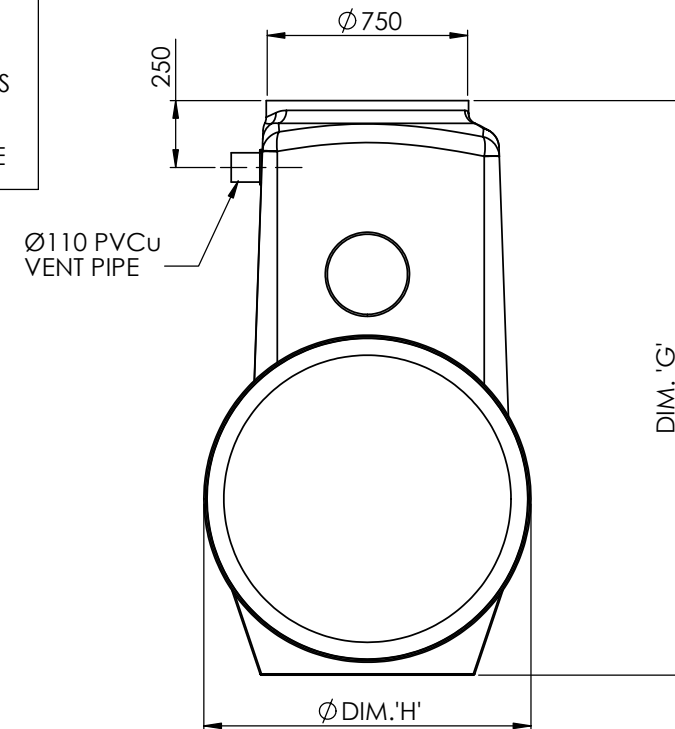


Please Check with Environmental Treatment Systems Limited For The Latest Issue Of This Drawing				Material : Various	Tolerance (unless stated) :	Drawing : DS1272P	Page 1 of 1
Issue	Date	Drawn by	Approved by	Finish :	Thickness : n/a		
03	11/02/16	L.Steward		CC1294 - Overall Dimensions Added	Weight : 277.09 Kg	Surface Area : m²	Ø1.8 NSG18 Grease Separator - 8000L
02	04/09/15	L.Steward		Product Code Updated	Modelled By : Name		
All Dimensions In mm		Scale: Do Not Scale			Kingspan Environmental reserve the right to alter the details of this drawing without prior notice. This drawing is copyright and may not be reproduced or used without the written permission of Kingspan Environmental		
				Third Angle Projection			
T:\Drawing Data\02 - Sales Drawings\DS\DS - 12\DS1272P							



NOTES

1. UNITS ARE SUPPLIED WITH THE STANDARD (MINIMUM) PIPEWORK SIZE, AND ORIENTATION SHOWN ON THE DRAWING. THE STANDARD EN858-1 STATES MINIMUM CONNECTION SIZES, UNITS ORDERED WITH DIFFERENT SIZE CONNECTIONS MAY NOT BE FULLY COMPLIANT WITH THE STANDARD. PLEASE CONSULT OUR SALES DEPARTMENT FOR DETAILS OF AVAILABLE OPTIONS, BUT PLEASE NOTE WE DO NOT ALTER INTERNAL PIPEWORK.
2. ALL UNITS SUPPLIED ARE CLASS 1 AND INCLUDE A COALESCER.
3. EXTENSION PARTS FOR DEEPER INVERTS CAN BE PROVIDED FOR ON SITE ASSEMBLY.
4. ALL UNITS REQUIRE APPROPRIATE CONCRETE BASE, COVER AND FRAME TO SUIT APPLIED LOADINGS.
5. THIS DRAWING SHOULD BE USED FOR DIMENSIONAL INFORMATION ONLY.
6. A Ø76mm TUBE IS SUPPLIED TO HOUSE AN OIL ALARM PROBE.



UNIT	NOMINAL FLOW (l/sec.)	DIM.'A'	DIM.'B'	DIM.'C'	DIM.'D'	DIM.'E'	DIM.'F'	DIM.'G'	DIM.'H'	STD. PIPE Ø	APPROX. EMPTY WEIGHT (kg)	FALL ACROSS UNIT
NSBE010	10.0	2070	1095	1450	1350	700	800	2150	1220	315	160	100
NSBE015	15.0	2950	1560	1450	1350	700	800	2150	1220	315	200	100
NSBE020	20.0	3893	2016	1450	1350	700	800	2150	1220	375	220	100
NSBE025	25.0	3575	1900	1680	1580	700	800	2380	1420	375	300	100
NSBE030	30.0	4265	2263	1680	1580	700	800	2380	1420	450	325	100

Please check with Kingspan Environmental that this drawing is the latest issue

Issue	Date	Drawn by	Approved by	Description
05	24.06.13	T.Kelly		CC1131 - Case Feet Changed
04	13.02.13	T.Kelly		CC981 Phase 2 - NSBE025 & 030 Added

Material : Various

Finish :

Weight :

Tolerance :

Thickness : n/a

Surface Area :

Drawing : DS1155

Page 1 of 2

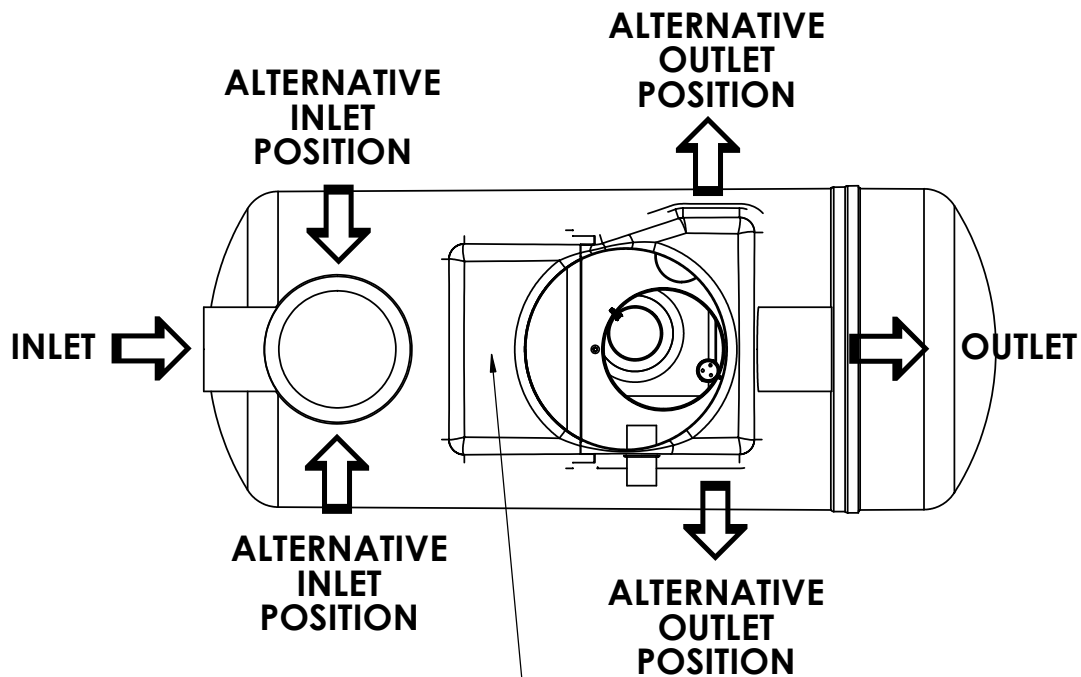
NSBE010 - NSBE030 Bypass Separators

All dimensions in mm

Scale: Not to scale

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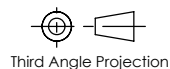


Please Note:-
Due to the physically small size of the NSBE010, the inlet pipe, all orientation options, is fitted directly into this turret.

Pipe Orientation Options		
OPTION A 	OPTION B 	OPTION C
OPTION D 	OPTION E 	OPTION F
OPTION G 	OPTION H 	OPTION K

Material : Various	Tolerance (unless stated) :	Drawing : DS1155 NSBE010 - 030 BYPASS SEPARATORS
Finish :	Thickness : n/a	
Weight : 229.91 Kg	Surface Area : m ²	
Modelled By :		

All Dimensions In mm Scale: Do Not Scale



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015319
NSBE010-NSBE125 Class 1 Bypass Separator
Installation & Maintenance Guidelines



Kingspan Environmental Service Contact Numbers:

GB: 0844 846 0500

NI: 028 3025 4077

IRL: 048 3025 4077

Enclosed Documents

DS1155	NSBE010-NSBE030 Class 1 Bypass Separators
DS1224	NSBE040 & NSBE050 Class 1 Bypass Separators
DS1225	NSBE075-NSBE125 Class 1 Bypass Separators

Issue	Description	Date
03	CC981 Phase 3	Feb. 2014

HEALTH & SAFETY

These warnings are provided in the interest of safety. You must read them carefully before installing or using the equipment.

It is important that this document is retained with the equipment for future reference. Should the equipment be transferred to a new owner, always ensure that all relevant documents are supplied in order that the new owner can be acquainted with the functioning of the equipment and the relevant warnings.

Installation should only be carried out by a suitably experienced contractor, following these guidelines.

We recommend the use of a dust mask and gloves when cutting GRP components.

Electrical work should be carried out by a qualified electrician.

Contaminated surface water can contain substances harmful to human health. Any person carrying out maintenance on the equipment should wear suitable protective clothing, including gloves. Good hygiene practice should also be observed.

Access covers should be selected with reference to the location of the unit and traffic loads to be accommodated. These are not (normally) part of the Separator supply.

When covers are removed precautions must be taken against personnel falling into the unit.

Should you wish to inspect the operation of the equipment, please observe all necessary precautions, including those listed below, which apply to maintenance procedures.

Ensure that you are familiar with the safe working areas and accesses. Ensure that the working area is adequately lit.

Take care to maintain correct posture, particularly when lifting. Use appropriate lifting equipment when necessary. Keep proper footing and balance at all times. Avoid any sharp edges.

OIL ALARM SYSTEMS

PPG3 requires that the oil level alarm be fitted, tested and commissioned by a competent Installer. This is to ensure that the excessive oil probe is calibrated correctly, raising an alarm when 90% of the recommended maximum oil storage volume is reached. Should the oil level alarm fail to provide an early warning, excessive oil could pass through the separator, thus polluting the environment. This could result in substantial cleanup costs and legal action being taken under the water resources act 1991.

MAINTENANCE

The correct ongoing maintenance is essential for the proper operation of the equipment. Operators who rely on oil level alarms to prompt them to service separators between maintenance intervals run the risk of polluting should the alarms not work, hence the ongoing functional assessment of the oil alarm systems is fundamental if pollution incidents are to be avoided.

The removal of sediment and retained oil/grease should be carried out by a contractor holding the relevant permits to transport and dispose of such waste. The contractor must refer to the guidelines in this document.

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Appendices

Separator Maintenance Log

	
<p>Kingspan Environmental College Road North Aston Clinton Aylesbury Buckinghamshire HP22 5EW United Kingdom</p>	
13	
En 858 : Separator systems for light liquids	
GRP Glass Reinforced Plastic Tank	
Bypass Separators NSB003 - NSB150	
Class 1	
Watertightness	Passed
Structural Testing	Passed
Hydraulic Efficiency	Passed

1 Introduction

- 1.1.1 These Guidelines represent Best Practice for the installation of the above Separator Units. Many years of specialist experience has led to the successful installation of thousands of separator units. It must be noted, however, that these Guidelines are necessarily of a general nature. It is the responsibility of others to verify that they are appropriate for the specific ground conditions and in-service loads of each installation. Similarly, any information or advice given by our employees or agents regarding the design of an installation must be verified by a qualified specialist (e.g. Civil engineering consultant).
- 1.1.2 For guidance of Separator selection and application, please refer to the most recent issue of Environment Agency Guidelines pollution prevention guidelines No. 3 (PPG3).and BS En 858

1.2 Handling & Storage

- 1.2.1 Care must be taken to ensure that units are not damaged during delivery and handling on site. Please take care and place unit so that it cannot fall and become damaged
- 1.2.2 The design requirements of these products will frequently mean that the centre of gravity of the unit is "offset". Care must therefore be taken to ensure that the unit is stable when lifting. Rainwater may also collect inside units, particularly if they have been stored on site prior to installation, adding weight and increasing instability. Check units before lifting and pump out any excess water.
- 1.2.3 When lifting units, use webbing slings of a suitable specification. Do not use chains.
- 1.2.4 A suitable spreader bar should be used to ensure that units are stable and that loads are evenly distributed during lifting. When lifting separators, a spreader bar should be used where the slings would otherwise be at an angle > 30 degrees to the vertical.
- 1.2.5 Lifting equipment should be selected by taking into account the unit weight, length and the distance of lift required on site.
- 1.2.6 We accept no responsibility for the selection of lifting equipment.
- 1.2.7 Whenever units are stored or moved on site, ensure that the storage location is free of rock, debris and any sharp objects, which may damage the unit. The units must be placed on ground, which is flat, and level and the unit orientated onto its side with even support. Do not roll separators.

1.3 Site Planning

The following points should be considered before installation of the equipment:

- 1.3.1 The discharge must have the consent of the relevant Environmental Regulator.
- 1.3.2 The installation should have Planning and Building Control approval.
- 1.3.3 Consider installing flow cut-off valves to isolate the separator in an emergency or during site cleaning operations. See Environment Agency Guidelines PPG3.
- 1.3.4 We will fit a tube to receive the alarm probe. This tube provides protection and ensures that the probe is positioned at the correct level to sense the oil build up. The tube design and probe level setting assumes the use of our standard oil alarm system and may not be suitable for other alarm supplier's equipment. The probe tube may be fitted either within the neck or within the body of the unit. It should be extended to ground level when fitted in the body of the tank and you should make provision to extend the tube to the required height before backfilling. Consult the alarm supplier's instructions for their detailed fitting installation instructions.
- 1.3.5 Consider venting of the unit. Comply with local regulations. In the UK, comply with the following regulations. For Petrol Stations: Health and Safety Guidance Note 41 (HS(G)41). For other applications: BS8301: 1985 (obsolescent) BS EN 752 Building Drainage. Adequate ventilation should be provided to the separator. The ventilation pipe should be as short as is practicable and be terminated not less than 2.5m above paving nor less than 1m above the head of an openable window or other opening into a building within a horizontal distance of 3m. Each neck should be vented independently, we advise against joining these below ground prior to their rising as vent stacks.
- 1.3.6 Consider installation of a sampling point downstream of the separator. There is no suitable facility to effectively sample the wastewater from inside the unit.

- 1.3.7 Uncontaminated run off such as roof water should be excluded from separators. (EA Guidelines PPG3.)
- 1.3.8 Ground conditions and water table level should be assessed. If the water table will be above the base of the units at any time of the year, adequate concrete backfill must be provided to avoid flotation. In poorly draining ground, consideration should also be given to the likelihood of flotation due to surface water collecting in the backfill, and an appropriate installation method devised to avoid this.
- 1.3.9 If the discharge is to a soakaway, a porosity test should be carried out as part of the assessment of suitability for sub-soil drainage.
- 1.3.10 The separator must be installed at a level, which will allow connection to the incoming drain and a free discharge at the system outlet. The water table must be below the discharge outlet.
- 1.3.11 Do not install the unit deeper than necessary, ensure that you purchase extension shaft kits. The minimum invert depth of the unit is shown on the customer drawing.
- 1.3.12 Adequate access must be provided for routine maintenance. Vehicles should not be permitted within a distance equal to the depth of the unit, unless suitable structural protection is provided to the installation.
- 1.3.13 There must be at least 1 metre of clear, level ground all around the access covers to allow for routine maintenance.
- 1.3.14 It is essential that a mains water supply is accessible for routine cleansing and refilling after removal of waste material and liquid.
- 1.3.15 Provide electrical supply for alarm system.
- 1.3.16 Installation should only be carried out by suitably qualified and experienced contractors in accordance with current Health and Safety Regulations. Electrical work should be carried out by a qualified electrician, working to the latest edition of IEE wiring regulations.
- 1.3.17 This unit is designed to operate with gravity in and out flows. The unit is not designed to operate with a pumped influent.

2 Installation

2.1 Installation – General

- 2.1.1 When units are installed in unstable ground conditions where movement of the surrounding material and/or unit may occur, the connecting pipework should be designed to minimise the risk of damage from differential movement of the unit(s) and/or surrounding material.
- 2.1.2 For separators with burial depths greater than 1000mm from cover level to the top of the unit, specific site conditions should be taken into consideration and the backfill designed to bear any loads which may be applied during and after installation to prevent the tank being subjected to these loads.
- 2.1.3 The excavation must be deep enough to provide bedding and cover depth as determined by the type of surface pavement and loading. Asphalt and concrete pads should extend a minimum of 300mm horizontally beyond the unit in all directions.
- 2.1.4 In situations where the excavation will not maintain a vertical wall, it will be necessary to shore up the sidewalls of the excavation with suitable trench sheets and bracing systems to maintain a vertical wall from the bottom to the top of the excavation. DO NOT completely remove the shoring system until the backfilling is complete, but before the concrete fully hardens.
- 2.1.5 In areas where the water table is above the bottom of the excavation and/or the excavation is liable to flood, the excavation should be dewatered using suitable pumping equipment and this should continue until the installation is complete.
- 2.1.6 During installation care must be taken to ensure that the body of the unit is uniformly supported so that point loads through the unit are avoided.
- 2.1.7 The concrete Specification is not a site specific installation design.

GENERAL CONCRETE SPECIFICATION IN ACCORDANCE WITH BS EN 206-1 (BS 8500-1)		
TYPE OF MIX		(DC) DESIGN
PERMITTED TYPE OF CEMENT		BS 12 (OPC): BS 12 (RHPC): BS 4027 (SRPC)
PERMITTED TYPE OF AGGREGATE (coarse & fine)		BS 882
NOMINAL MAXIMUM SIZE OF AGGREGATE		20 mm
GRADES: C25 /30 C25 /30 C16 /20		REINFORCED & ABOVE GROUND WITH HOLDING DOWN BOLTS REINFORCED (EG. FOR HIGH WATER TABLE) UNREINFORCED (NORMAL CONDITIONS)
MINIMUM CEMENT CONTENT	C30 C20	270 - 280 Kg/M ³ 220 - 230 Kg/M ³
SLUMP CLASS		S1 (25mm)
RATE OF SAMPLING		READY MIX CONCRETE SHOULD BE SUPPLIED COMPLETE WITH APPROPRIATE DELIVERY TICKET IN ACCORDANCE WITH BS EN 12350-1
NOTE: STANDARD MIXES SHOULD NOT BE USED WHERE SULPHATES OR OTHER AGGRESSIVE CHEMICALS EXIST IN GROUND WATER		

2.2 Separator Installation

- 2.2.1 Excavate a hole of sufficient length and width to accommodate the tank and a minimum 225mm concrete surround and to a depth, which allows for the burial depth of the unit plus concrete base slab and haunch.
- 2.2.2 Construct a suitable concrete base slab appropriate to site conditions. Ensure that the slab is flat and level.
- 2.2.3 When the concrete base slab has set enough to support the installed load, add a concrete haunch so as to provide even support under the unit and then lower the unit onto the haunch using suitable webbing slings and lifting equipment.
- 2.2.4 **Pour no more than 300-mm depth of clean water into the unit, avoiding shock loads. For units with more than one chamber, add water to each chamber simultaneously. DO NOT OVERFILL; the unit is not designed to hold water whilst unsupported.**
- 2.2.5 **Place concrete backfill to approximately 300mm depth under and to the sides of the tank ensuring good compaction to remove voids. DO NOT use vibrating pokers. Continue adding concrete backfill, simultaneously keeping the internal water level no more than 200 mm above the backfill level at all times, until the backfill is just below the underside of the outlet drain, giving sufficient room to connect the inlet and outlet pipework.**
- 2.2.6 Connect inlet and outlet drains and vent pipes when safe access to the backfill can be gained.

2.3 Pipework Connections

- 2.3.1 In all cases, ensure that the outlet pipework level is maintained for correct operation. (Unless specified on the order, the fall across the unit will be as per the customer drawings).
- 2.3.2 Small units are generally fitted with **PVCu spigots** to both the outlet and the inlet.
- 2.3.3 Connect using the same size PVCu socket or a suitable reducer.
- 2.3.4 Larger units are generally fitted with **Our GRP** manufactured sockets.
- 2.3.5 The connecting pipework should be pushed into the socket. Ensure that the seal is secure and watertight before backfilling the pipe.

- 2.3.6 Alternatively, proprietary **flex seal couplings** can be obtained to fit over the outside of the site pipework and the outside of the GRP socket. When using this connection method, please be aware that the outside GRP laminate is not perfectly regular and that you may need to use a sealant on the outside diameter of the GRP. Take care not to over tighten the coupling when connecting to the GRP and ensure that the seal is secure before backfilling the pipe. Drawing 403144 provides the ID of our Bypass GRP sockets. The OD is variable, as the wall thickness can be up to 15-20 mm. If purchasing a flexseal coupling for use with clay /concrete, we suggest that a size 110 mm larger than the ID is selected.

2.4 Oil Level Alarm Neck Fitting

- 2.4.1 We will fit a tube to receive the oil alarm probe. This provides protection and ensures that the probe is positioned at the correct level to sense oil build up.
- 2.4.2 See alarm supplier information and ensure that the probe is placed within the tube and can be accessed from ground level.
- 2.4.3 Continue backfilling with concrete over the tank body to the required level. Build up a shell of concrete, minimum 225mm thick, around the access shaft(s). Temporarily strut the access shaft to avoid distortion.
- 2.4.4 Where we supply an extension shaft to meet a deeper invert requirement, a coalescer extension tube will be required. When fitting, ensure that the tube is extended to just below the surface so that the coalescer can easily be removed. Remove the coalescer from the unit before adding the extension tube. When refitting, ensure that the coalescer is correctly inserted and fully pushed into the base fitting. This is important and you must ensure that the coalescer is correctly located before putting the unit in to operation. Reattach the bracket to the extended neck so it lines up with the hole in the coalescer.
- 2.4.5 It is advisable to seal the joints on the extension shafts (particularly on sites with high ground water) with proprietary sealant or by GRP lamination. Temporarily strut the extension neck(s) to avoid distortion during back filling. Where more than one neck section is required to suit a deep invert, consider back-filling section by section. If the extension neck is too long, it can be trimmed using a fine-toothed saw. The original fixing hole bolting the coalescer to the neck should be sealed.
- 2.4.6 Ensure that the vent socket if cut out, is replaced elsewhere. The maximum recommended inlet invert is 2000mm (using 500mm long extension sections). If you are installing a unit deeper than this then you must make your own arrangements for removing and replacing the coalescer. Consideration must be given to the depth of lift involved.
- 2.4.7 Continue back-filling, ensuring minimum 225mm concrete thickness around the access shaft/ extension neck and alarm access tube (as applicable).
- 2.4.8 Mains powered Alarm Systems. See alarm suppliers installation instructions. Lay 82mm diameter PVCu underground ducting between the alarm panel location and the alarm probe position. The ducting should be 500mm below ground level and fitted with a drawstring for later cable insertion. Any changes of direction should be by long radius bend. If necessary, drill a suitable hole in the access shaft adjacent to the alarm probe terminal box, to accept the ducting and seal.
- 2.4.9 In traffic areas a suitable top slab must be constructed. The top slab should bear on a suitable foundation to prevent superimposed loads being transmitted to the unit and access shafts. Loads applied to covers and frames must bear on the top slab, not the access shaft.
- 2.4.10 The unit should be filled with clean water up to the invert level of the outlet pipe. Ensure the unit identification is placed/ marked inside the neck for future information. The unit is now ready for use.

2.5 Alarm Installation

- 2.5.1 Install the alarm probe and control panel, as per the Suppliers Alarm Installation Guidelines. Ensure that the probe is positioned correctly for the required storage of oil. The table below indicates the maximum volume of oil to be stored and the depth of floating oil expected in the separation chamber.

Unit	Required Minimum Oil Storage volumes in litres	Max. (100%)Depth of floating oil (Static)
NSBE010	150 litres	320mm
NSBE015	225 litres	335mm
NSBE020	300 litres	335mm
NSBE025	375 litres	385mm
NSBE030	450 litres	385mm
NSBE040	600 litres	420mm
NSBE050	750 litres	430mm
NSBE075	1125 litres	430mm
NSBE100	1500 litres	435mm
NSBE125	1875 litres	435mm

3 Operation

- 3.1.1 The unit is sized on treating a defined area and rainfall (5 mm/hour) EN.858 Part 1 and using the factor provided in the Environment agency guidelines PPG3. (0.0018 = 6.5mm/hr) The unit will treat the entire flow i.e. NSBE015 will treat a flow of 15 litres per second. If the flow is greater than this then the excess flow will bypass the main treatment chamber. A NSBE015 unit will work in bypass mode over 15 and up to 150 litres per second. Flows in excess of this will back up on to the site. During a storm, the rain falls and flushes any surface debris, silt or oil into the tank. This first flush, up to the maximum rated flow is fully treated. As the severity of the storm increases, so does the rate of flow increase. The liquid entering the separator after the first flush tends to be cleaner and so, in lower risk applications, is allowed to bypass the oil separation chamber for directly discharge.
- 3.1.2 The bypass unit has three chambers. The entire flow up to the units listed flow rating is fully treated and passes through all chambers. (E.g. NSBE015 treats 15 litres per second.)
- 3.1.3 Flows in excess of this rating will bypass the separation chamber and the liquid passes untreated to the outlet chamber.
- 3.1.4 The first chamber will accumulate silt and grit. The maximum volume that can be retained is the rating x 100 e.g. a NSBE015 is capable of holding 1500 litres of silt.
- 3.1.5 The second / separating chamber is sized to separate oil at the rated flow rate and to accumulate the required oil storage volume. A NSBE015 maximum oil storage volume is 225 litres. An oil probe should be positioned to detect the accumulation of oil when there is no or low flow conditions. The probe should be positioned so that the alarm operates at 90% of the rated oil storage volume.
- 3.1.6 In bypass flow conditions, the flow moves directly from the inlet to the outlet chamber avoiding the separating chamber.
- 3.1.7 Separators are purchased as Class 1 units. Class 1 Bypass Separators are fitted with a removable coalescer which also includes media to further improve the discharge quality. The coalescer media requires maintenance.
- 3.1.8 Bypass Class 1 Separators are not effective for the removal of soluble or emulsified pollutants such as oil/detergent mixes found in vehicle wash effluents. With permission such discharges should be drained to the foul sewer. Consult our technical department for Separation equipment to meet these applications.

4 Maintenance

4.1 Waste Removal and Servicing

- 4.1.1 Separated light liquid **must** be removed from separator when the oil capacity has been reached.
- 4.1.2 An oil level alarm system is available for purchase which gives warning when the separated light liquid/water interface level reaches 90% of the maximum recommended oil storage volume.
- 4.1.3 Separators should be inspected at least every six months or more frequently if experience dictates. A log should be maintained detailing the depth of oil found, any oil volume removed and any silt removal or cleaning carried out. A specimen maintenance log is included in the appendices.
- 4.1.4 Every site is different, in respect to the amount and type of silt generated by the drain design and installation. Frequently, the construction programme itself generates large and perhaps unusual quantities of silt and grit. We do recommend that following the initial installation, an inspection of the separator contents be made to check that building rubble has not entered the unit. Further inspections at 3 and 6 months should be made so as to be able to assess the volumes of silt and oil accumulated. The inspection and emptying programme can then be defined following the first 6 months site experience. We recommend leaving a maximum interval between inspections of 6 months.
- 4.1.5 Alarm probes should be removed and cleaned with water whenever waste material is removed from the separator. Please note the alarm may alert until the liquid level is replaced.
- 4.1.6 **Separator waste is a “special waste” under the terms of The Waste Management Code of Practice. The Code imposes a duty of care on the waste producer to ensure that the Cleansing contractor is registered with the Environment Agency and that the final disposal of the waste is to a licensed facility.**
- 4.1.7 You should consider the purchase of a maintenance service, which includes bi-annual inspections, removal of oil and silt, cleaning of the alarm probe and cleaning or replacement of the coalescer (where appropriate).

4.2 Waste Removal Procedure – Oil & Silt

- 4.2.1 **Oil can only be effectively removed when there is no flow entering the unit. Isolate the unit and prevent flow from entering. Always remove the oil before attempting to remove the coalescer. If this is not done, when the coalescer is withdrawn the oil can coat the media surface and when replaced the oil may be forced through the media, contaminating the effluent.**
- 4.2.2 Remove the access cover and lower the desludging hose in to the separation chamber. Draw off the surface oil.
- 4.2.3 If removing the silt, lower the desludge hose to the base of the tank and empty the contents of the chamber. Ensure that you access and clean both the inlet and the separation compartments.
- 4.2.4 Remove the alarm probe, if fitted, clean with water and replace.
- 4.2.5 Consider the period of time that the coalescer has been installed and consider removing and inspecting (cleaning or replacing) the coalescer media. If removed, ensure that it is correctly replaced and secured into position. Replace the access covers. It is best to lower the water level to aid re-fitting.
- 4.2.6 Re-fill the separator with clean water up to the outlet level.
- 4.2.7 If an alarm is fitted, it will display an alarm condition until the separator is re-filled. Check alarm operation when unit full.

4.3 Checking the Coalescer Assembly

- 4.3.1 Coalescers, where fitted, may be cleaned periodically to maintain efficiency. Coalescers should be checked following a major incident and replaced if necessary. Please contact us if you wish to purchase the coalescer media.
- 4.3.2 Identify the type and size of separator (shown on labels inside the access neck).

- 4.3.3 Assemblies weighing less than 25 Kg may be removed by hand. Heavier assemblies should be lifted by mechanical means. Any lifting device employed must be capable of lifting:
- 4.3.3.a In excess of the maximum assembly weight.
 - 4.3.3.b The assembly completely out of the access shaft.
 - 4.3.3.c Giving a smooth and controlled lift.
 - 4.3.3.d Swinging the assembly to one side clear of the access shaft.

Unit	Dry Weight (Kg)	Wet Weight (Kg)	Silted Weight (Kg)	Number Within unit	Replacement Media Part No.
NSBE010	5.7 kg	≈50 kg	≈60 kg	1	402862
NSBE015	6.2 kg	≈55 kg	≈65 kg	1	402864
NSBE020	6.2 kg	≈55 kg	≈65 kg	1	402864
NSBE025	12.0 kg	≈65 kg	≈75 kg	1	402866
NSBE030	12.0 kg	≈65 kg	≈75 kg	1	402866
NSBE040	21.0 kg	≈100 kg	≈200 kg	1	402885
NSBE050	21.0 kg	≈100 kg	≈200 kg	1	402885
NSBE075	21.0 kg	≈100 kg	≈200 kg	2	402885
NSBE100	21.0 kg	≈100 kg	≈200 kg	2	402885
NSBE125	21.0 kg	≈100 kg	≈200 kg	3	402885

- 4.3.4 Ensure that the area around the access shaft is clear and that there is space to place the assembly once removed. If space is not available it will be necessary to support the assembly over the access shaft. e.g. by scaffold poles and platform.
- 4.3.5 Only remove the access cover when necessary to remove the assembly. Do not leave the access shaft uncovered and unattended.

4.4 Removing the coalescer assembly.

- 4.4.1 Undo and remove the bracket which secures the coalescer to the access shaft.
- 4.4.2 Lift the assembly with a smooth and steady motion. Coalescers will become lighter as water drains from the exposed media. Allow the water to drain completely. Assemblies blocked with fine silt may be very heavy.
- 4.4.3 Fully extract the assembly and set it down adjacent to the access shaft.

4.5 Cleaning the coalescer assembly/ Media Replacement.

- 4.5.1 Hose down the assembly using clean water at normal pressure. If the media is heavily contaminated with oil and silt, it may not be possible to clean it effectively by hosing. Do not allow untreated cleaning water to pass out of the unit. Continue hosing until the water runs clear.
- 4.5.2 To replace the media, undo the banding. Slide media off the core tube and slide new media on. Ensure all the apertures on the core tube are covered by the media. Re-secure or replace banding. Consider replacing media and banding every two years.

4.6 Replacing the coalescer assembly.

- 4.6.1 Position it over the access shaft.
- 4.6.2 Lower the assembly steadily into the access shaft ensuring that the end locates within the sump at the bottom of the tank. Re-secure the bracket.
- 4.6.3 Replace the access cover.

5 Emergencies

- 5.1.1 At sites where there is a high risk of spillage, spill kits containing drain seals, absorbent materials, disposal containers and other appropriate equipment should be held. In the event of a spillage on site, the material should be contained, (if a spill kit is not available, sand or soil may be used) and the Environment Agency notified immediately using the appropriate emergency hotline number listed in the Agency Guideline PPG3. Year 2011 - **0800 80 70 60**

6 Warranty

The company will replace or, at its option, properly repair without charge any goods which are found to be defective and which cause failure in normal circumstances of use **within a period of twelve months from the date of delivery.**

This warranty is conditional upon:

- (a) the Buyer notifying the Company of any claim within Seven days of the failure becoming discernible.
- (b) the Company being allowed a reasonable opportunity to inspect the goods so as to confirm that they are defective.
- (c) the goods not having been modified, mishandled or misused and being used strictly in accordance with any relevant instructions issued by the Company.

The Company's liability under this Clause is limited to the repair or replacement of the defective goods, and does not cover costs of transport, installation or associated site costs, if applicable.

The Company's liability to replace or repair the goods is in lieu of and excludes all other warranties and conditions, and in particular (but without limitation) the Company shall have no liability of any kind for consequential loss or damage.

For any further advice, please us.

A warranty form is included in this package, to register your unit for warranty. Please complete ALL sections of the form, and return it at your earliest convenience.



Site address/location	
	
Separator location	
	
Type of separator	
Nominal Flow	
Total capacity	

[illegible]