



15th December 2022

REF: 5269-OTP4-ICS-CO-C-03.003

OXFORD TECHNOLOGY PARK, UNIT 4 – DRAINAGE STATEMENT

1.0 PROPOSED FOUL DRAINAGE ARRANGEMENT

- 1.1 Foul water flows from Unit 4 is to drain by gravity into the 150mm drain along the main access road, to the north of the plot, using an existing spur.
- 1.2 From there it will be conveyed to a pumping station serving the whole industrial estate, 120m to the northeast, and pumped into the Thames Water sewer.
- 1.3 The pipe network within the site is to remain private.

2.0 PROPOSED SURFACE WATER DRAINAGE STRATEGY

- 2.1 The surface water drainage system for Unit 4 has been designed to accommodate the flows generated by a 1 in 100-year event, plus an allowance of 40% for climate change.
- 2.2 An initial engineering appraisal for the whole park was carried out by Haydn Evans Consulting in November 2013. The ground conditions indicate a topsoil layer of 200-400mm over fractured rock. Non fractured rock was encountered between 1.5 and 2.2mbgl. Infiltration tests to BRE365 were carried out and results were good in general, ranging from 5.5E-6m/s to 1.84E-4m/s. The permeable paving solution for surface water was proposed as a viable alternative. It must be noted that the only test in Unit 4 was the slowest (20mm/hour or 5.5E-6m/s).
- 2.3 In Autumn 2018 (October and November), a groundwater monitoring report was prepared by RSK Environment Ltd. The depth varied within the park but in the only location within Unit 4 (BH3), the water table was found as shallow as 1.11mbgl in October. This is at 68.511mAOD or lower.

Table 1: Enzygo groundwater monitoring data Autumn 2018

Location	X	Y	GL (m)	18.10.18 bgl (m)	aOD (m)	24.10.18 bgl (m)	aOD (m)	31.10.18 bgl (m)	aOD (m)	14.11.18 bgl (m)	aOD (m)
BH1				1.3	-	1.26	-	1.19	-	1.01	-
BH2	447627.305	214814.004	69.118	0.93	68.188	1.1	68.018	1.21	67.908	1.13	67.988
BH3	447539.634	214698.974	69.621	1.11	68.511	1.2	68.421	1.32	68.301	1.27	68.351
BH4	447646.099	214755.091	68.884	0.89	67.994	1.02	67.864	1.12	67.764	1.08	67.804
BH5	447567.268	214619.444	70.344	2.32	68.024	2.34	68.004	2.47	67.874	2.54	67.804
BH6	447662.021	214663.078	69.998	2.34	67.658	2.45	67.548	2.55	67.448	2.56	67.438

Notes: X/Y-grid coordinates, GL-Ground Level, bgl-Below ground level, aOD-Above ordinance datum

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A second round of visits took place in Spring 2019 with values even higher. The monitoring identified groundwater at 0.94mbgl within unit 4 in March. **This is at 68.681mAOD.**

Table 2: RSK groundwater monitoring data Spring 2019

Location	X	Y		25.03.19		09.04.19		23.04.19		07.05.19	
			GL (m)	bgl (m)	aOD (m)	bgl (m)	aOD (m)	bgl (m)	aOD (m)	bgl (m)	aOD (m)
BH1				-	-	-	-	-	-	-	-
BH2	447627	214814	69.118	0.87	68.248	0.89	68.228	-	-	-	-
BH3	447539	214698	69.621	0.94	68.681	1.27	68.351	1.53	68.091	1.37	68.251
BH4	447646	214755	68.884	0.77	68.114	2.82*	66.064*	1.26	67.624	0.90	67.984
BH5	447567	214619	70.344	1.53	68.814	1.89	68.454	2.02	68.324	1.68	68.664
BH6	447662	214663	69.998	1.69	68.308	-	-	2.44	67.558	2.15	67.848

Notes: X/Y-grid coordinates, GL-Ground Level, bgl-Below ground level, aOD-Above ordinance datum
Notes: * results from BH4 on the 9.4.19 have not been considered as part of the overall assessment

- 2.4 Another Phase 2 Geo-Environmental report was produced by Enzygo Ltd in January 2019 for the north-eastern corner only, near plots 1, 3 and 5. The closest test is SA1, with groundwater noted to be at 0.8mbgl.
- 2.5 Further BRE365 tests were carried out in September 2022 in Unit 6, approximately 40m south and to a depth of 0.9m. The most conservative value of the three repetitions was 4.931E-5m/s, which is far higher than the design value used by Simpson of **3.8E-6m/s**.
- 2.6 The SuDS hierarchy has been followed. It says that new developments should utilise sustainable urban drainage systems (SUDS) unless there are practical reasons for not doing so, and should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:
- store rainwater for later use
 - **use infiltration techniques, such as porous surfaces in non-clay areas**
 - discharge rainwater direct to a watercourse
 - discharge rainwater to a surface water sewer/drain
 - discharge rainwater to the combined sewer.
- 2.7 Runoff from the roof is discharged into the open graded crushed rock (OGCR) layer under the permeable paving via a series of perforated pipes. Runoff from other hard landscaping areas is to flow above ground and into the block paving and from there to the OGCR and, eventually, percolate into the ground. See Appendix B for drainage layout.
- 2.8 The road in between the blocks will have a permeable finish but maintain the OGCR underneath to maximise the water storage capacity of the system. See Appendix C for sections. A local deepening in the form of a trench is also proposed to further increase the capacity of the drainage arrangement.
- 2.9 Proposed levels are notably higher than existing topography (70.30mAOD) in order to maximise the buffer between the permeable paving and the highest water table, estimated at least 1.6m+ below (70.30m-68.681m).
- 2.10 The estimated runoff rate from the site is 0 l/s. Some overland flows might be expected for storms beyond the design event, however these are difficult to quantify. Extra water volumes should remain above ground, within Unit 4, until they can also percolate into the ground, and should not impact other buildings.



- 2.11 All parking bays are to be constructed in permeable block paving to increase the water quality. This is where oil spillage is most likely to occur and the open graded crushed rock in the subbase will break down hydrocarbons before they percolate into the ground.
- 2.12 There is only one linear channel on site which prevents any runoff leaving the site via the access bellmouth. To improve water quality, a D-Rainclean by Stormwater Management Ltd has been chosen. It removes oil, sediments and dissolved heavy metals allowing direct infiltration, meeting the 0.8+ mitigation indices requirements of the CIRIA 753 - SUDS manual. Full water quality discussion is in Appendix A.
- 2.13 The surface water networks will remain private, to be maintained as per the SuDS Maintenance Guide produced separately.

Yours sincerely

M. BLANCO
MEng GMICE
DIRECTOR

Authorised by

A. J. GRIFFITHS
BEng (Hons) MCIHT
DIRECTOR



Appendix A- Water quality

According to the CIRIA SUDS Manual, the pollution hazard level for car parks is low, and the simple index approach should be used.

TABLE 4.3 Minimum water quality management requirements for discharges to receiving surface waters and groundwater			
Land use	Pollution hazard level	Requirements for discharge to surface waters, including coasts and estuaries ²	Requirements for discharge to groundwater
Residential roofs	Very low	Removal of gross solids and sediments only	
Individual property driveways, roofs (excluding residential), residential car parks, low traffic roads (eg cul de sacs, home zones, general access roads), non-residential car parking with infrequent change (eg schools, offices)	Low	Simple index approach ³ <i>Note: extra measures may be required for discharges to protected resources¹</i>	
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Medium	Simple index approach ³ <i>Note: extra measures may be required for discharges to protected resources¹</i>	Simple index approach ³ <i>Note: extra measures may be required for discharges to protected resources¹</i> In England and Wales, Risk Screening ⁴ must be undertaken first to determine whether consultation with the environmental regulator is required. In Northern Ireland, the need for risk screening should be agreed with the environmental regulator.
Trunk roads and motorways	High	Follow the guidance and risk assessment process set out in HA (2009)	
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured, industrial sites	High	Discharges may require an environmental licence or permit ³ . Obtain pre-permitting advice from the environmental regulator. Risk assessment is likely to be required ⁵ .	

Table 4.3 of the SUDS Manual CIRIA C753. Page 63.

The method is guided by the land use and SuDS performance evidence. The steps to be followed are outlined below.

BOX 26.2 Steps of the simple index approach

- Step 1** – Allocate suitable pollution hazard indices for the proposed land use
- Step 2** – Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index
- Step 3** – Where the discharge is to protected¹ surface waters or groundwater, consider the need for a more precautionary approach
- Note:**
- 1 Designated as those protected for the supply of drinking water (Table 4.3).

Box 26.2 of the SUDS Manual CIRIA C753. Page 567.

Step 1: Pollution hazard indices are presented in table 26.2 below. These indices range from 0 (no pollution hazard for this contaminant) to 1 (high pollution hazard for this contaminant type).

TABLE 26.2 Pollution hazard indices for different land use classifications

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

Table 26.2 of the SUDS Manual CIRIA C753. Page 568.

Step 2: To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index for each contaminant type that equals or exceeds the pollution hazard index. In this case the principal destination of the runoff is the ground, so table 26.4 should be used.

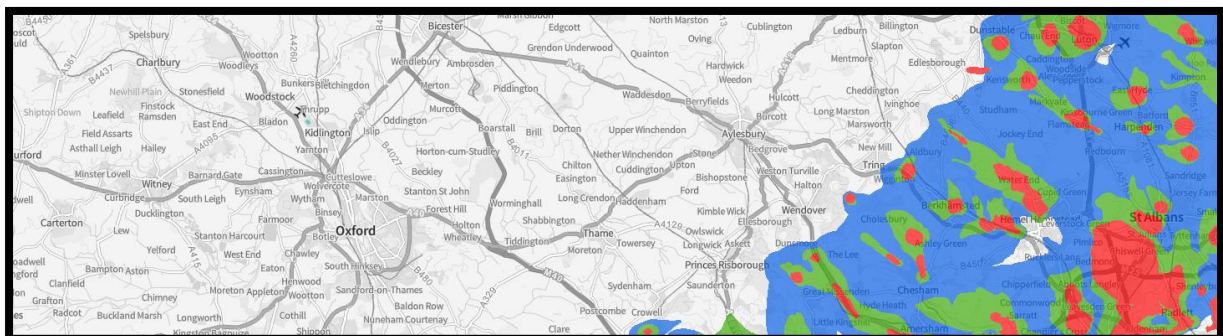
TABLE 26.4 Indicative SuDS mitigation indices for discharges to groundwater			
Characteristics of the material overlying the proposed infiltration surface, through which the runoff percolates ¹	TSS	Metals	Hydrocarbons
A layer of dense vegetation underlain by a soil with good contaminant attenuation potential ² of at least 300 mm in depth ³	0.6 ⁴	0.5	0.6
A soil with good contaminant attenuation potential ² of at least 300 mm in depth ³	0.4 ⁴	0.3	0.3
Infiltration trench (where a suitable depth of filtration material is included that provides treatment, ie graded gravel with sufficient smaller particles but not single size coarse aggregate such as 20 mm gravel) underlain by a soil with good contaminant attenuation potential ² of at least 300 mm in depth ³	0.4 ⁴	0.4	0.4
Constructed permeable pavement (where a suitable filtration layer is included that provides treatment, and including a geotextile at the base separating the foundation from the subgrade) underlain by a soil with good contaminant attenuation potential ² of at least 300 mm in depth ³	0.7	0.6	0.7
Bioretention underlain by a soil with good contaminant attenuation potential ² of at least 300 mm in depth ³	0.8 ⁴	0.8	0.8
Proprietary treatment systems ^{5, 6}	These must demonstrate that they can address each of the contaminant types to acceptable levels for inflow concentrations relevant to the contributing drainage area.		

Table 26.3 of the SUDS Manual CIRIA C753. Page 569.

As mentioned in 2.12, a proprietary product will be used to deal with the runoff generated in impermeable areas that do not go directly into permeable paving. It is a D-Drainclean channel with mitigation indices of 0.8. which are greater than those in Table 26.2 above.

Therefore, the mitigation indices are greater than the hazard indices which means the water quality treatment is adequate.

Step 3: Where the discharge is to protected groundwater, a more precautionary approach is needed. The site falls outside Source Protection Zones and therefore no extra protection measures are needed.



Source Protection Zones map. Oxford is outside any protection zone.



Appendix B- Drainage Layout

DO NOT SCALE

LEGEND

- 150mm 1/100 Surface water drain
- Surface water rodding eye
- Surface water bio-retention drainage channel
- 150mm 1/200 Foul water drain
- Surface water inspection chamber
- Foul water inspection chamber
- Foul water manhole
- 1.0m deep (with varies) soakaway slip trench (L68.68)
- Surface water distribution pipe
- Denotes extent of permeable block paved car park
- Denotes extent of asphalt access road with permeable sub-base
- Denotes extent of impermeable membrane to be laid at a level of 69.48m AOD to prevent soakage within 5m of building
- Site Boundary
- Proposed finished floor level
- Proposed level
- Existing level
- Proposed gradient
- Proposed min. permeable sub base formation level
- INDICATES RESIDUAL RISK AS WARNING

ENGINEERING NOTES

- This drawing to be read in conjunction with all relevant Architects, Engineers and Subcontractors drawings and details.
- This drawing is based on topographical survey by Reynolds Groundwork Services Limited:
Drawing Number RGS-2624-TS-01
Dated 18/09/2019
Site Engineer's GPS survey.
- All levels relate to levels given on survey drawing.
- Refer to Architects drawings for details of all soft landscaping, fences, gates & bollards.
- For lighting, service supplies & ducting requirements, refer to M&E drawings.
- All works to be carried out in accordance with BS EN 752 "Drain and sewer systems outside buildings" and the current edition of The Building Regulations "Approved document H".
- New drainage connections are to be made with appropriate lengths of rodder pipes & couplings.
- All manhole chamber covers to be installed parallel to final kerbs, edgings, paving joints or building lines as appropriate.
- This drawing details all below ground drainage up to finished floor level. For details of drainage above finished floor level, refer to Architects drawings.
- All stack connections under buildings to be minimum 100mm diameter solid PVC-U to BS EN 1401-1/BS4660 & laid at a minimum gradient of 1 in 40 unless otherwise noted. If the stack is greater than 100mm then the diameter of the connection is to be increased to match it.
- All RWP connections to be minimum 100mm diameter solid PVC-U to BS EN 1401-1/BS4660 & laid at a minimum gradient of 1 in 80 unless otherwise noted. If the RWP is greater than 100mm then the diameter of the connection is to be increased to match it.
- All private foul water pipework up to 150mm in diameter to be PVC-U to BS EN 1401-1/BS4660.
- All private surface water pipework up to 150mm in diameter to be laid PVC-U to BS EN 1401-1/BS4660. All private surface water pipework 225mm and above to be structured wall plastic sewer pipe complying with clause 518 of the specification for highway works.
- Plastic chambers shall comply with BS EN 1917 and BS 5911-3.
- On completion of development all drainage shall be jet cleaned and CCTV surveyed.
- Sewers marked to be removed are to be dug out with manholes demolished & void filled with suitable engineering fill material.
- All road gully connections to be minimum 150mm diameter solid PVC-U pipework to BS EN 1401-1/BS4660 and laid at a minimum gradient of 1 in 150.
- All existing services shown are based on Proposed Engineering Layout (12076_502) and Proposed Overall Service Infrastructure Plan (12076_504) by Baynham Meikle. Location of all services in close proximity to works should be confirmed by means of trial pits under supervision of statutory undertaker & in accordance with HSE document "Avoiding Danger from Underground Services".

DESIGNERS RESIDUAL RISK SCHEDULE

CONSTRUCTION

- EXISTING SEWERS / DRAINAGE / SERVICES / OVERHEAD CABLES:
 - REFER TO TOPOGRAPHICAL SURVEY (REF: RGS-2624-TS-01) / STATUTORY UNDERTAKERS RECORDS FOR LOCATION OF EXISTING SEWERS / DRAINAGE / SERVICES & OVERHEAD CABLES.
 - WORKS IN CLOSE PROXIMITY TO EXISTING SEWERS / DRAINAGE / SERVICES / OVERHEAD CABLES: CONTRACTORS PREVENT OVERFLOWS FROM DRAINAGE CHANNEL AT LOWER LEVEL.
 - WORKS AFFECTED BY EXISTING SEWERS / DRAINAGE / SERVICES / OVERHEAD CABLES: CONTRACTOR SHOULD ARRANGE FOR DIVERSION / LOWERING / PROTECTION BY STATUTORY UNDERTAKER WHERE NECESSARY PRIOR TO COMMENCEMENT OF WORKS.
- GROUND CONDITIONS / SOIL CONTAMINATION / REMEDIATION
 - THE GROUND INVESTIGATION REPORT (REF: SHF.1733.001.GE.R.001.B) DID NOT IDENTIFY SOIL CONTAMINATION TO BE PRESENT. HOWEVER, CONTRACTOR SHOULD ENSURE SITE PERSONNEL USE APPROPRIATE PPE WHEN CARRYING OUT EXCAVATIONS & THAT CONSTRUCTION HEALTH & SAFETY PLAN INCLUDES METHOD STATEMENT FOR DEALING WITH UNFORESEEN CONTAMINATION IF ENCOUNTERED DURING WORKS.
 - REFER TO GROUND INVESTIGATION REPORT (REF: SHF.1733.001.GE.R.001.B) FOR DETAILS OF UNDERLYING SOILS. WHERE GROUND CONDITIONS ARE FOUND TO DEVIATE FROM THOSE REPORTED IN THE SITE INVESTIGATION REPORT, THE ENGINEER SHOULD BE CONTACTED IMMEDIATELY FOR ADVICE ON HOW TO PROCEED.
 - EXCAVATIONS WHERE ACCESS IS REQUIRED SHOULD BE TEMPORARY SUPPORTED WITH SLOPES BATTERED WELL BACK AND MAINTAINED AT A SAFE ANGLE.
 - CONTRACTORS CONSTRUCTION HEALTH & SAFETY PLAN SHOULD INCLUDE METHOD STATEMENT OUTLINING SAFE METHOD OF WORKING IN OR ADJACENT TO DEEP EXCAVATIONS ADJACENT TO BOUNDARIES / STRUCTURES / EMBANKMENTS / BULK EARTHWORKS.
 - GROUNDWATER WILL BE ENCOUNTERED IN EXCAVATIONS. CONTRACTORS CONSTRUCTION HEALTH & SAFETY PLAN SHOULD INCLUDE METHOD STATEMENT OUTLINING SAFE METHOD FOR DEWATERING EXCAVATIONS DURING GROUNDWORKS. GROUNDWATER IDENTIFIED AT 68.25 AS PER RISK REPORT.
- WORKS ON OR ADJACENT TO HIGHWAY
 - CONTRACTOR SHOULD ENSURE SITE PERSONNEL HAVE APPROPRIATE TRAINING & USE APPROPRIATE PPE WHEN CARRYING OUT WORKS IN THE HIGHWAY AND THE CONSTRUCTION HEALTH & SAFETY PLAN SHOULD INCLUDE METHOD STATEMENT THAT ADOPTS BEST PRACTICE HEALTH AND SAFETY POLICIES FOR ALL SITE PERSONNEL THROUGHOUT THE DURATION OF THE WORKS ON / ADJACENT TO HIGHWAY.
- CONNECTING TO EXISTING MANHOLES / SEWERS
 - CONTRACTORS CONSTRUCTION HEALTH & SAFETY PLAN SHOULD INCLUDE METHOD STATEMENT THAT ADOPTS BEST PRACTICE HEALTH AND SAFETY POLICIES FOR ALL SITE PERSONNEL THROUGHOUT THE DURATION OF SUCH WORKS.
 - CONTRACTOR SHOULD ENSURE SITE PERSONNEL HAVE APPROPRIATE TRAINING & USE APPROPRIATE PPE WHEN MAKING SEWER CONNECTIONS TO EXISTING MANHOLES / SEWERS.
- ACCESS OF MANHOLES / CHAMBERS FOR MAINTENANCE OF DRAINAGE SYSTEM & HIGH PRESSURE JETTING
 - MAINTENANCE CONTRACTOR SHOULD PROVIDE RISK ASSESSMENT AND METHOD STATEMENT THAT ADOPTS BEST PRACTICE HEALTH AND SAFETY POLICIES FOR MAINTENANCE PERSONNEL THROUGHOUT THE DURATION OF SUCH WORKS.
 - MAINTENANCE PERSONNEL SHOULD HAVE APPROPRIATE TRAINING & USE APPROPRIATE PPE.

- REFER TO DRAWING P21-002-103 FOR SECTIONS SHOWN ON THIS PLAN.
- GROUND WATER INTERSPAT AT A LEVEL OF 68.68m AOD FROM RSK SITE INVESTIGATION REPORT 314248-01 (01) DATED JULY 2019
- EARTHWORKS TO BE CARRIED OUT TO EARTHWORKS SPECIFICATION SHF.1733.001.GE.R.002.A BY ENZYGO

Code	Description	Responsible	Date
C4	UPDATED TO SUIT LATEST HARD LANDSCAPING PLAN	GPH	09.08.21
C3	RWP / FOUL POP-UPS UPDATED, LEVELS & DRAINAGE UPDATED TO SUIT LOWER FFL	GPH	05.07.21
C2	SHOWER POP-UPS ADDED	GPH	24.05.21
C1	CONSTRUCTION ISSUE	GPH	17.03.21
P1	PRELIMINARY ISSUE	GPH	09.03.21
MK	REVISION	BY	DATE

DRAWING STATUS: FINAL

DRAWING TITLE: ENGINEERING LAYOUT

PROJECT: UNIT FOUR OXFORD TECH PARK KIDLINGTON OXFORD



Drawn	Ch'd	Scale	Date
GPH	AR	1:250 @ A1	MAR' 2021

Purpose of Issue: CONSTRUCTION

Project Number	Drawing Number	Revision
P21-002	101	C4

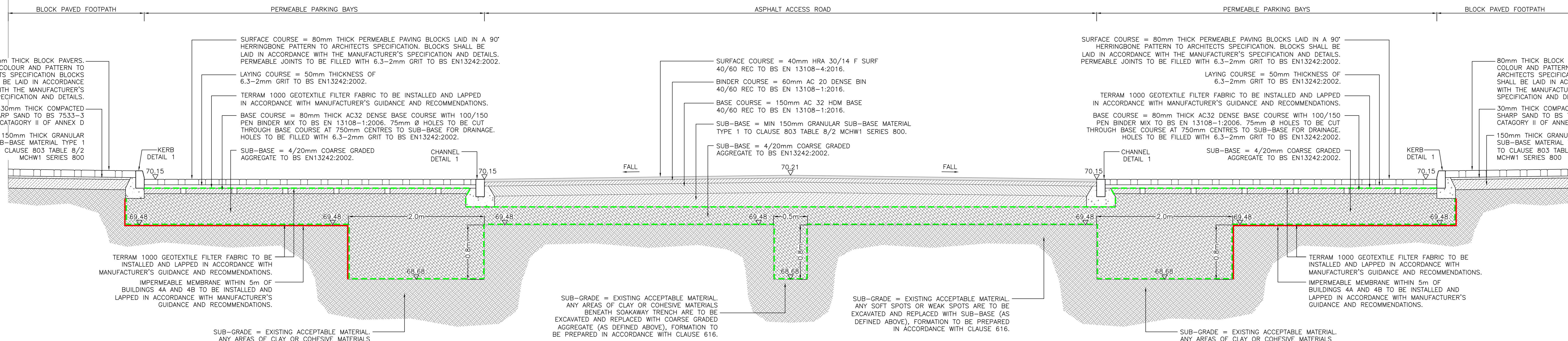




Appendix C- Drainage Sections

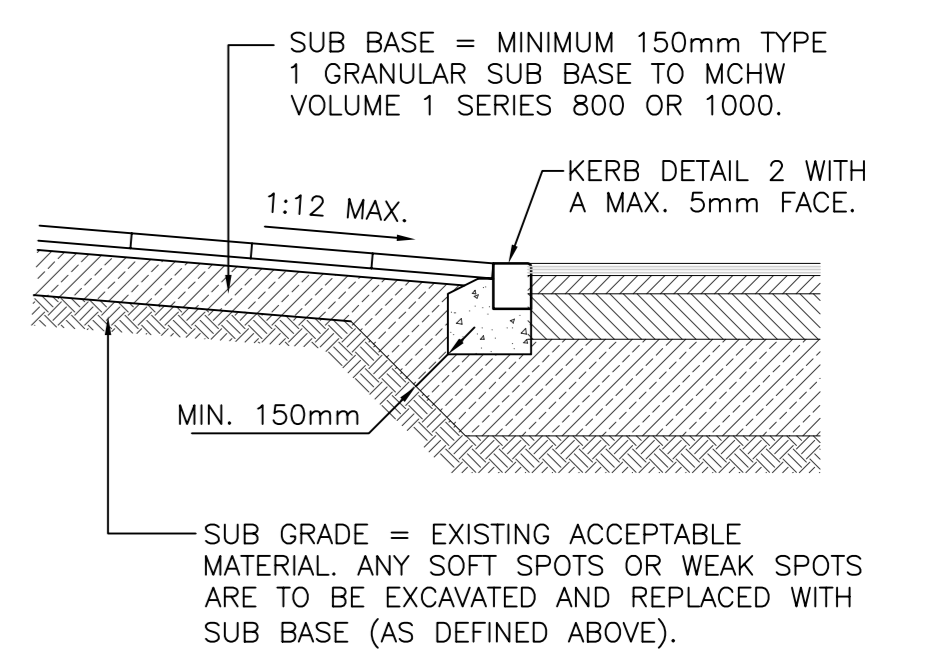
EXTERNAL FINISHES NOTES

- This drawing to be read in conjunction with all relevant Architects, Engineers and Subcontractors drawings and details.
- This drawing is based on topographical survey by Physics Groundwork Services Limited. Drawing Number: 805-2024-15-01. Dated: 18/09/19.
- Unless noted otherwise, clauses refer to The Specification for Highway Works: Volume 1 of the Manual of Contract Documents for Highway Works.
- Refer to Architects drawings for details of all paving types, soft landscaping, fences, gates & bollards.
- For lighting, service supplies & ducting requirements, refer to M&E drawings.
- If surface course is not constructed within 3 days of base course must be cleaned and tack coated prior to laying.
- Carriageway construction 5.0% CBR. Contractor shall achieve a minimum of 5.0% CBR at the course formation level.



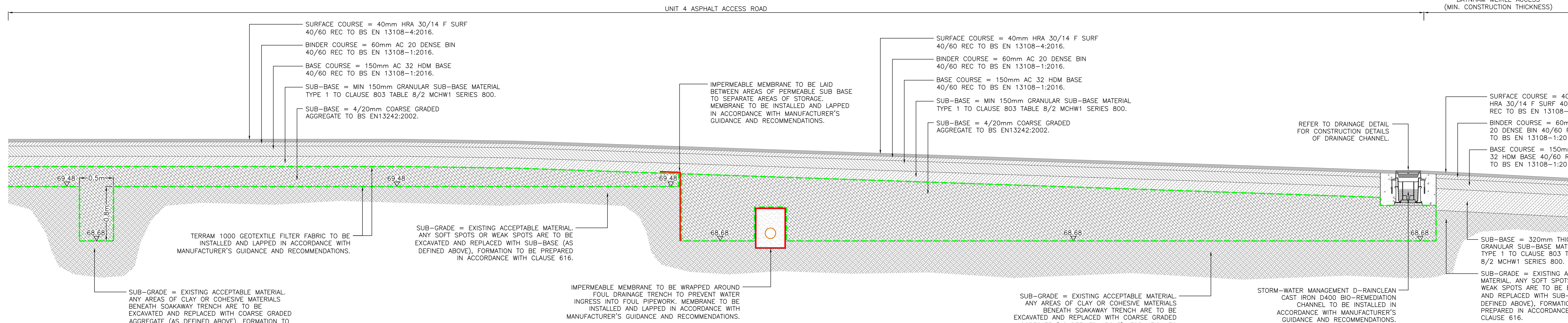
SPECIFICATION ACROSS NEW ACCESS ROAD AT SECTION A-A

SCALE 1:25



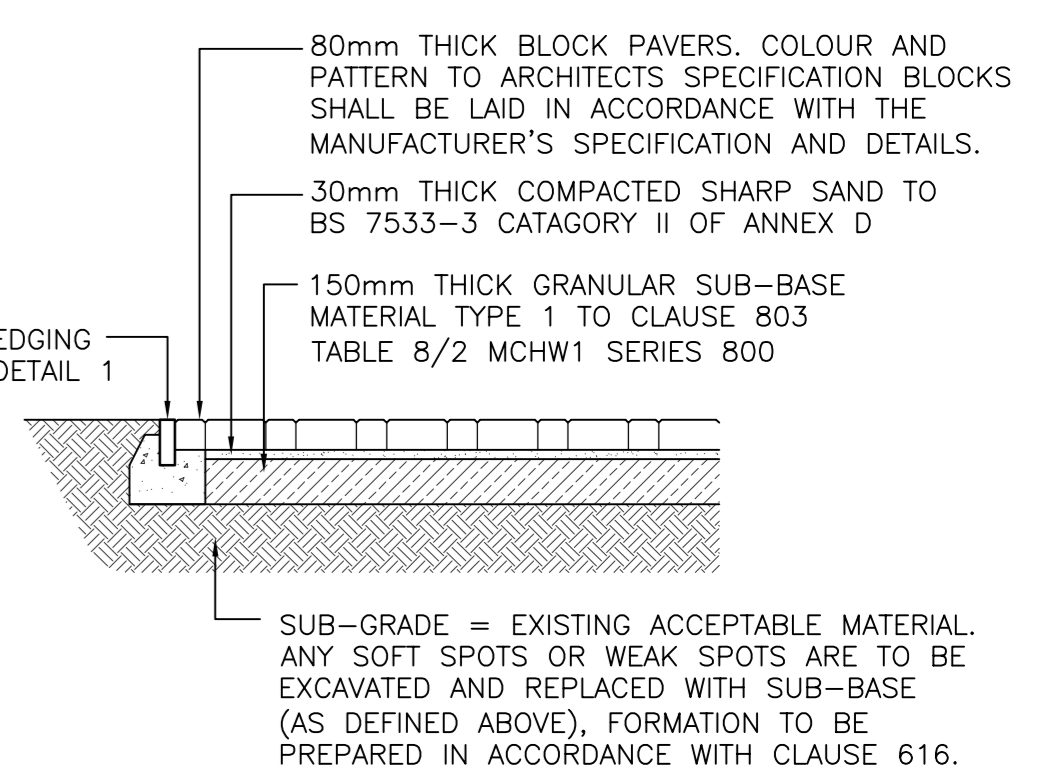
TYPICAL SECTION THROUGH PEDESTRIAN DROPPED KERB

SCALE 1:25



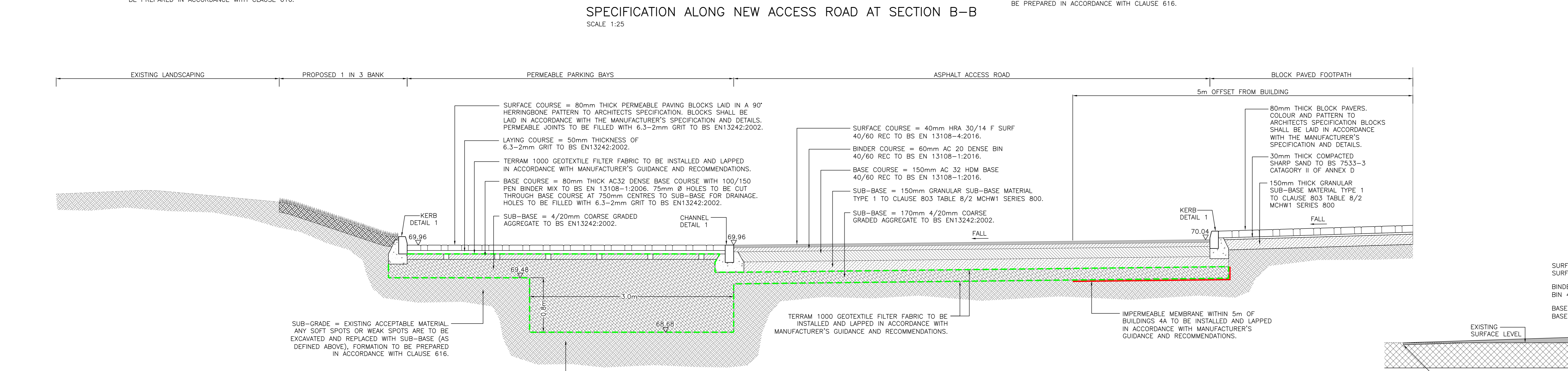
SPECIFICATION ALONG NEW ACCESS ROAD AT SECTION B-B

SCALE 1:25



SPECIFICATION FOR NEW BLOCK PAVED FOOTPATH

SCALE 1:25

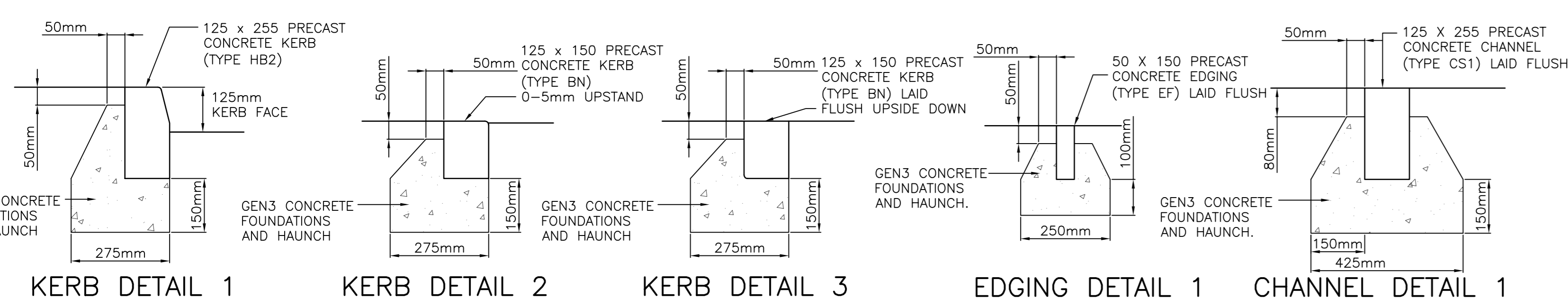
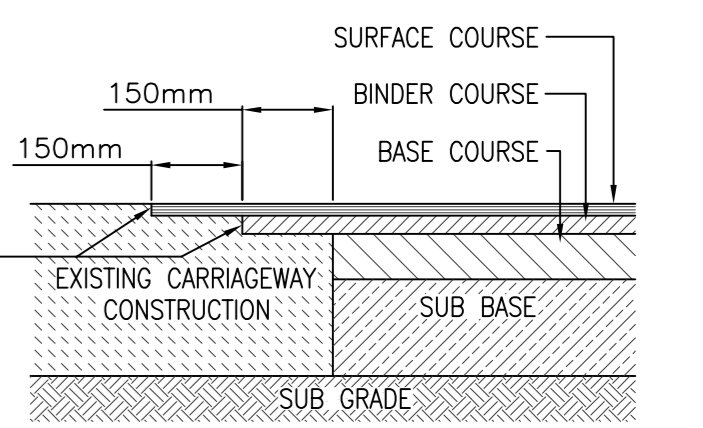


SPECIFICATION ACROSS NEW PARKING BAYS AND ACCESS ROAD AT SECTION C-C

SCALE 1:25

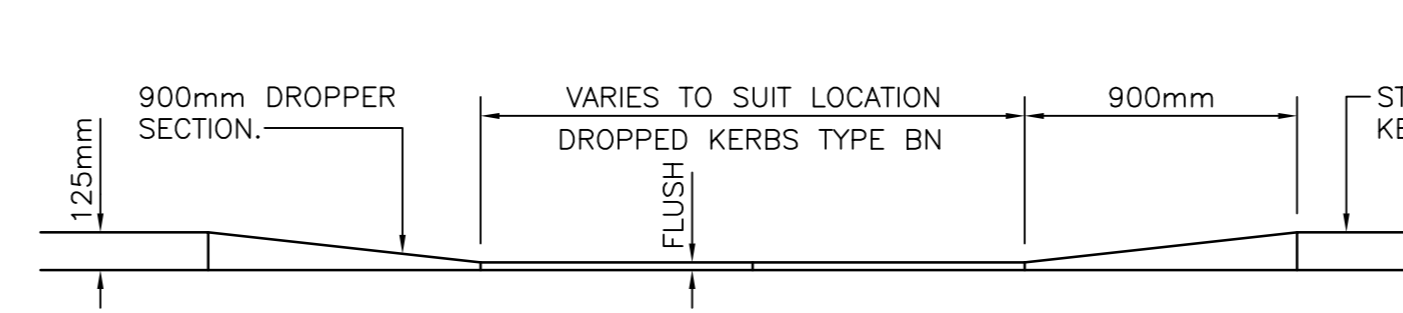
STAGGERED JOINT BETWEEN NEW AND EXISTING CARRIAGEWAY

SCALE 1:25



KERB AND EDGING DETAILS

SCALE 1:10



ELEVATION OF DROPPED PC KERB

SCALE 1:25

SPECIFICATION FOR OVERLAY OF EXISTING ACCESS ROAD

SCALE 1:25

OVERLAY THICKNESS	MINIMUM CONSTRUCTION	NOTES
TYPE 1 (40mm - 99mm)	40mm SURFACE COURSE	WHERE NECESSARY, EXISTING SURFACE COURSE TO BE PLANNED TO ALLOW MINIMUM 40mm THICK SURFACING. EXISTING SURFACE TO BE CLEANED WITH TACK COAT APPLIED PRIOR TO SURFACING. SURFACE COURSE TO BE THICKENED WHERE NECESSARY UP TO OVERLAY THICKNESS OF 99mm THEN CHANGE TO TYPE 2.
TYPE 2 (100mm - 169mm)	40mm SURFACE COURSE 60mm BINDER COURSE	BINDER COURSE TO BE THICKENED WHERE NECESSARY UP TO OVERLAY THICKNESS OF 169mm THEN CHANGE TO TYPE 3. TACK COAT APPLIED PRIOR TO SURFACING.
TYPE 3 (>170mm)	40mm SURFACE COURSE 60mm BINDER COURSE 70mm BASE COURSE	BASE COURSE TO BE THICKENED WHERE NECESSARY UP TO OVERLAY THICKNESS OF 170mm. TACK COAT APPLIED TO PRIOR TO SURFACING.

- REFER TO DRAWING P21-002-102 FOR SECTION LOCATIONS.
- CONTRACTOR SHALL ENSURE FOUNDATION LEVEL OF CAR PARK ACHIEVES A MINIMUM OF 5.0% CBR. CONTRACTOR SHALL COVER OR HIDE TO ENGINEER PRIOR TO LAYING CAR PARK CONSTRUCTION OVER FORMATION.

NO	DESCRIPTION	DATE	BY	DATE
C3	BLOCK PAVED FOOTPATH UPDATED TO SUIT GPH	09/08/21		
C2	SECTION ALLOCATED FOR CHECK FILL FOOTPATH FINISHES CONFIRMED	05/07/21		
C1	SECTION B-B UPDATES CONSTRUCTION ISSUE	01/03/21		
F1	PRELIMINARY ISSUE	08/03/21		

DRAWING STATUS: FINAL

DRAWING TITLE: ROAD CONSTRUCTION DETAILS

PROJECT: UNIT FOUR OXFORD TECH PARK KIDLINGTON OXFORD



Drawn	Checked	Scale	Date
GPH	AR	AS SHOWN	13/01/2021

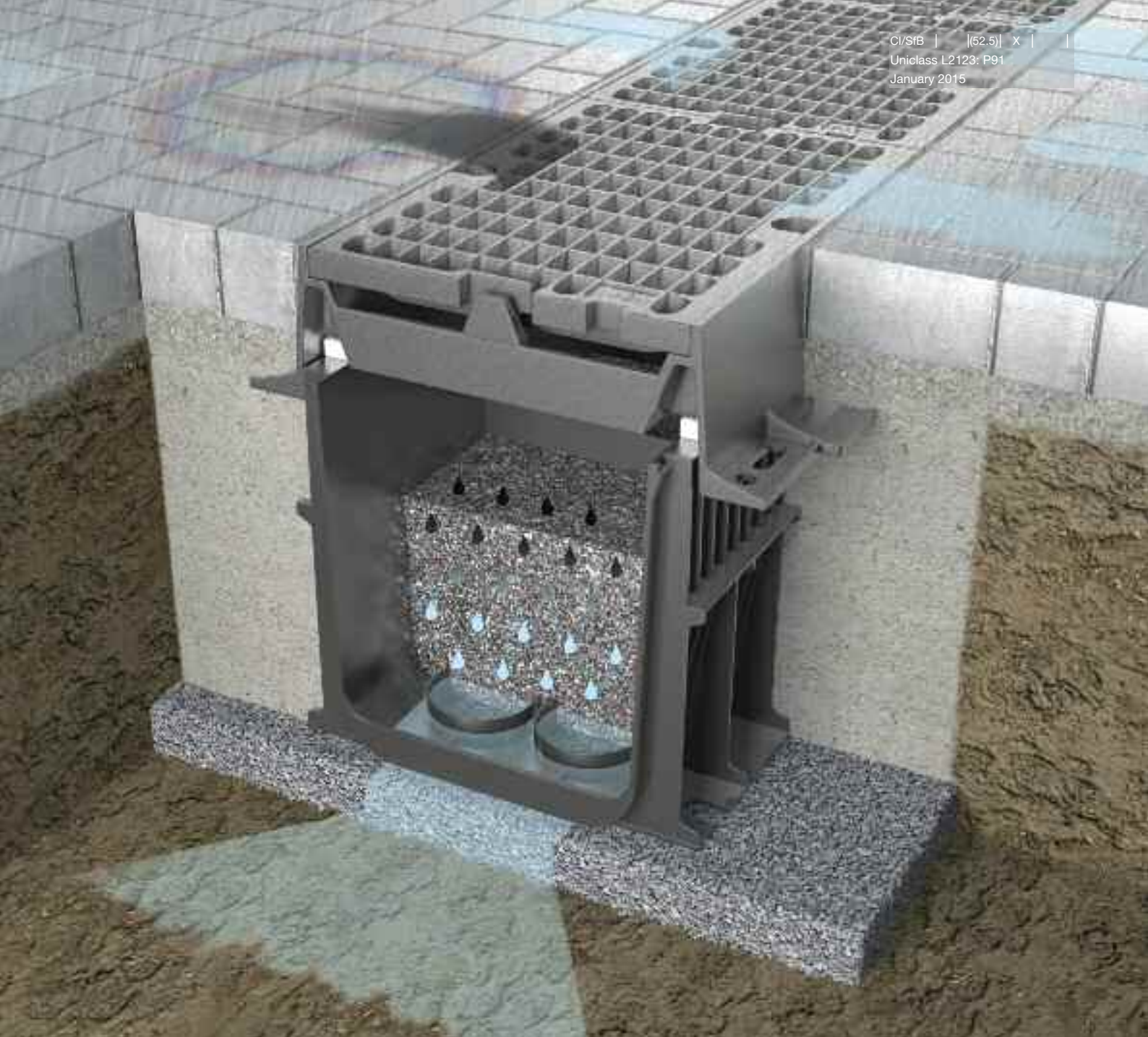
CONSTRUCTION

Project Number	Drawing Number	Revision
P21-002	103	C3



Infrastruct CS Ltd
Consulting Civil Engineers

Appendix D- Filtration Channel D-Rainclean Brochure



D-Rainclean

Bio-remediation channel systems for
surface water pollution control

D-Rainclean

Bio-remediation channel systems for surface water pollution control



With increasingly intense, frequent, and extreme weather events, there is a need to mitigate the flooding and pollution risks caused by uncontrolled surface water run-off. D-Rainclean is a robust, 300mm polypropylene channel drainage system with a unique bio-remediation medium.

The system deals with surface water run-off and treats the flow at source, making it an ideal treatment component in a Sustainable Drainage (SuDs) solution.

- ◆ Forms part of a SuDs solution
- ◆ Excellent hydraulic capacity
- ◆ Long service life 10-20 years – years before media replacement
- ◆ Excellent solids retention and prevents soil migration when laid to a fall
- ◆ Unique filter media – optimised grain size lowers clogging risk
- ◆ Adsorber agents provide a high retention of dissolved pollutants
- ◆ Active soil microbiology, gives a vitalised soil
- ◆ Helps decomposition of organic pollutants
- ◆ Resistant to de-icing salt
- ◆ Simple replacement of filter-media in the event of accidental spillage (e.g. oil spillage)
- ◆ Internal baffle walls allows the system to be laid level or to a fall
- ◆ Simple and easy to lay
- ◆ Suitable for use in a range of trafficked areas with B and D class gratings
- ◆ Non trafficked areas require no concrete reinforcement, reducing installation cost and time
- ◆ Filter media can be used for other applications (e.g. ponds, swales)
- ◆ Eight 100mm holes in the channel base allow infiltration at source
- ◆ Calculable hydraulic capacity over its service life
- ◆ Cast iron grates are fixed via a tamper proof tensioned spring or can be bolted for extra security
- ◆ Emergency overflow allows exceedence events to be accommodated
- ◆ D-Rainclean can be installed in soils with very low permeability when used in combination with geocellular units

Flooding and pollution

The problem

Flooding is an issue that needs no introduction in the UK.

Pluvial flooding has become a regular occurrence as our drainage networks become incapable of coping with increased urbanisation combined with climate change.

Since the turn of the millennium, the construction industry has sought to tackle the problems associated with more intensive rainfall, and in particular the volumes of water generated.

This culminated in the Flood and Water Management Act 2010, which sets out the responsibilities for the design, construction, and maintenance of sustainable drainage systems.

What is perhaps less well known is that, enshrined in this legislation, is the requirement to address surface water quality leaving development sites in order to comply with the Water Framework Directive.

Much of the onus to comply with the FWM Act falls on Local Authorities whose role it is to mitigate and minimise both flood and pollution risk by ensuring that hard-landscaping design and installation 'design-out' and build-out' both flood risk and pollution risk, usually by employing SuDs techniques.

The solution

Stormwater Management Limited offer the highly innovative and proven D-Rainclean porous channel and bio-remediation filter media system that treats the priority pollutants identified by the regulatory authorities (Environment Agency and Highways Authority), principally total suspended solids (TSS) and dissolved heavy metals such as copper and zinc – meeting both these key requirements within a single solution.



The Water Framework Directive 2015



The Water Framework Directive 2015 has identified 44 chemicals, 16 of which are deemed as hazardous and 8 that are bio accumulative. On heavily trafficked

roads and parking areas, heavy metal waste water reaches critical concentrations and regularly exceeds the threshold values for pollution run off. Heavy metal pollution increases the toxicity of river water that can be damaging to aquatic life, reduces the quality of crops and plant life and ultimately this can be damaging to human life.

D-Rainclean

The solution

D-Rainclean comprises a 300mm polypropylene channel system filled with a unique engineered bio-remediation filter media that treats run-off from any impermeable surface.

Using the processes of separation, adsorption, absorption, and bioremediation D-Rainclean allows contaminated run-off to be treated to a sufficient quality to allow infiltration back into the ground at the closest point to its generation, meeting one of the key requirements in drainage hierarchy – 'source control'.

D-Rainclean uses a unique engineered bio-remediation filter media containing selected natural minerals with a high cation exchange and filtration capacity. These media clean surface water as it passes through the filter layers, degrading and diffusing hydrocarbons, and dissolved heavy metal like copper and zinc.

A properly installed D-Rainclean system can drain areas of up to one hectare and the system has been proven to meet the stringent requirements set down by the DIBt.

Cover options **A**

D-Rainclean can be covered by either flush or raised cast iron grill sections, suitable for heavily trafficked areas. The D400 cast iron cover can support HGV traffic. D-Rainclean can also be left open to allow for vegetation growth at car park borders and similar areas.

Bulkheads **B**

Built in to the channels section at 500mm intervals, these ensure dimensional stability and more importantly, limit pollution spillages to a confined section of the system.

Channel units **C**

Robust and durable 500mm length polypropylene sections have an integrated bulkhead at mid point (250mm from either end). Each mid-section has 8 apertures in its base to allow the controlled infiltration of filtered water into the sub-base.

Filter media **D**

This unique engineered bio-remediation mixture lies at the heart of the D-Rainclean system.

Surface water flowing from impermeable areas contaminated with pollutants passes through the D-Rainclean filter media layer where it is treated before being discharged through the base holes.

The remarkable levels of performance are due to selected natural minerals with a high exchange capacity and filtration efficiencies. Diffuse hydrocarbons (oil drops) emitted in trafficked areas are virtually degraded. An accidental oil spill of up to 10 litres can be retained within 1 linear metre of channel for up to 24 hours.

Full details of the filter-media are shown on pages 6-7.

Controlled, **E** pollution-free water

Components & accessories

The D-Rainclean system contains an extensive range of components and accessories allowing designers to achieve a broad spectrum of project criteria.



Filter-media

- ◆ 14 litre sack
- ◆ Code: DRFC005



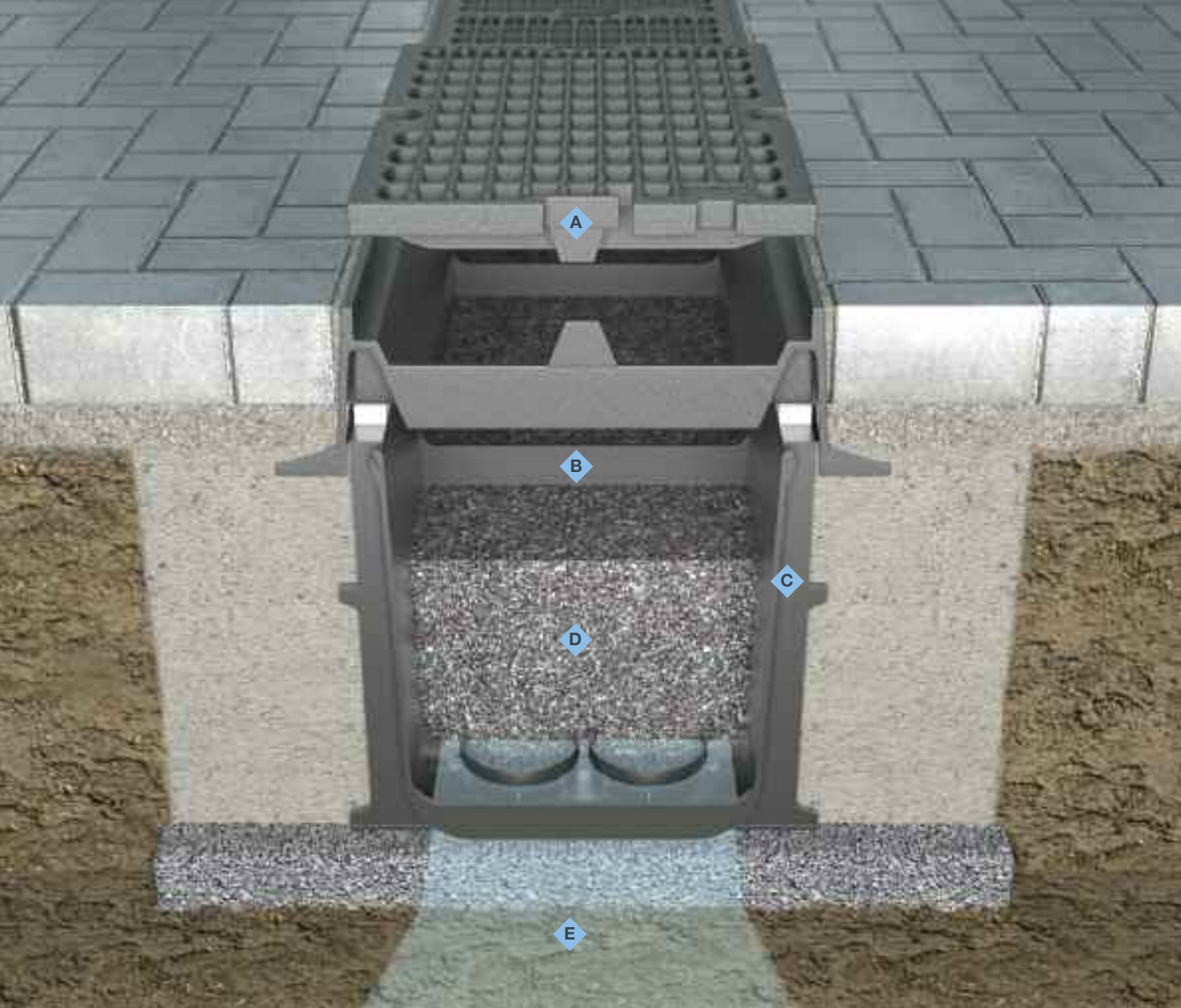
Filter-media

- ◆ 1.5m³ bulk bags
- ◆ Code: DRFC006



Channel

- ◆ Colour: Black
- ◆ Dimensions: 500 x 400 x 366mm with integrated middle bulkhead
- ◆ Material: PP
- ◆ 8 infiltration apertures
- ◆ Code: DRFC001



End piece

- ◆ Can be used for left or right hand ends
- ◆ Dimensions: 250 x 400 x 366mm
- ◆ Code: RH: DRFC002
LH: DRFC003



Emergency overflow unit

- ◆ With 110mm socket connections for left or right hand
- ◆ Dimensions: 500 x 400 x 366mm
- ◆ Code: DRFC004



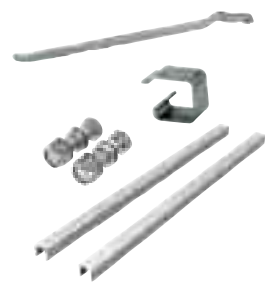
Cast-iron cover

- ◆ Class B125
- ◆ Includes cast iron frame. Connection clamps need to be ordered separately
- ◆ Includes child safeguard
- ◆ Code: DRFC007



Cast-iron cover

- ◆ Class D400
- ◆ Includes cast-iron frame and child safeguard
- ◆ Code: DRFC009



Tools and clips

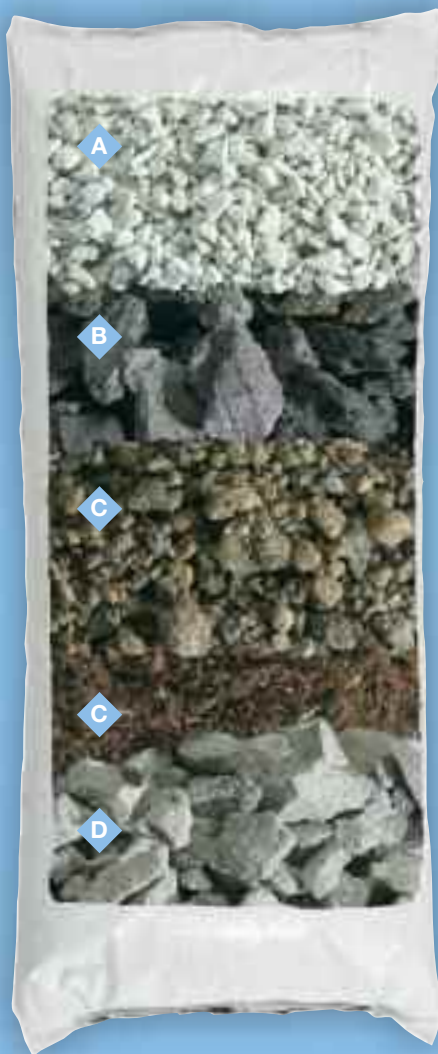
- ◆ Wrench
Code: DRFC011
- ◆ Security bolts:
Code DRFC010
- ◆ Joint Clamps
Code: DRFC008
- ◆ Aluminium rails
Code: DRFC012

Filter media

D-Rainclean Filter Media is a unique series of media that perform different functions in order to clean surface water runoff using the processes of filtration, adsorption, ion exchange, phosphate and retention.

The unique D-Rainclean filter media can be used in other SuDs applications including:

- ♦ Swales
- ♦ Infiltration basins
- ♦ Rain gardens
- ♦ Special Filter Media is available for Innolet gully (see back cover)



Absorption area/exchanger **A**

Water storage/filter **B**

Organic matrix/settlement area **C**

pH-buffer area/acid limiter **D**

Components pictured schematically – grain size not to scale.

Filtration

Many contaminants attach themselves to sediment particles. The smaller the particle, the higher its concentration. The filter-media in D-Rainclean retains these sediments by depth filtration, ensuring they are retained in the upper 5-10cm of the filter media. This significantly reduces the risk of surface clogging (colmatage) and ponding, particularly in extreme events, something which some surface filtration systems, such as permeable paving are prone to.

Heavy metal absorption/desorption and precipitation

D-Rainclean uses a number of processes to remove dissolved heavy metals:

- Nickel – sorption
- Lead, cadmium, copper and zinc – sorption, precipitation and PH balancing
- Chromium – ion exchange

Water retention

Soil microbiology performs a valuable degradation role, particularly during periods of warmer weather. As such the D-Rainclean filter media retains moisture to allow this degradation process to occur. Large pore spaces within strata of the media combined with organic substances and the design of the D-Rainclean channel allow 3.0 litres per linear metre to be stored to ensure that this optimised process can occur.

Soil Testing Values*

Arsenic (As)	10 µg/l
Lead (Pb)	25 µg/l
Cadmium (Cd)	5 µg/l
Chromium (Cr)	50 µg/l
Copper (Cu)	50 µg/l
Nickel (Ni)	50 µg/l
Mercury (Hg)	1 µg/l
Zinc (Zn)	500 µg/l

* Ground Water according to German Federal Soil Conservation Law (Bundesbodenschutzgesetz)

Laboratory testing

Tested independently and compared with natural 'good soil', Filter media has considerably better adsorption properties. On average: 99% adsorption of zinc and 99% of copper based on a 10 years total load input (source: DIBt test report).

Hydraulic capacity

The D-Rainclean filter media has a water permeability coefficient of 9×10^{-4} m/s, the secret to this high permeability rate is due to the graduated grain sizing within the media that produces a widely spaced distribution curve. The coefficient has been derived by testing which allows sufficient detention time for adsorption to occur.

The water reservoir built into the channel design also ensures that soil microbiology continues to occur and does not dry out during extreme dry spells.

Harmful organic materials

D-Rainclean uses an organic matrix and a specific activated carbon that supports bonding and degradation of organic pollutants, as such D-Rainclean degrades mineral oils from impermeable trafficked areas such as car parks.

De-icing salts

The use of de-icing salts can block adsorption and reverse the adsorption of already captured hazardous material.

The performance of the filter-media is not adversely affected by sodium chloride even in shock loads. However frequency and concentration of de-icing will have an effect on overall service life – see Design life on page 7.

Oil bonding and degradation

The large void space within the media allows oil to lose its fluidity and cover the pore space where micro organisms can degrade it. In the event of accidental spillage the internal baffles within the D-Rainclean channel design ensure that 10 litres of oil per linear metre can be retained for up to 24 hours so that it can be removed, professionally disposed, and the media replaced.

Phosphate bonding

The enhanced adsorption capacity within the filter media is crucial to maintaining clean water courses.

pH Value

The carbonate buffer range of the media is above pH 7.2

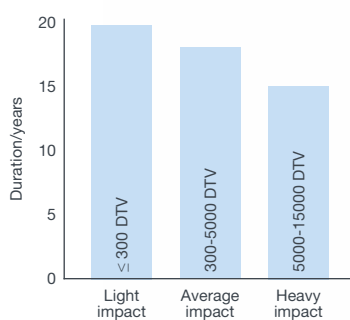
Cation exchange capacity

D-Rainclean filter media acts as an ion exchanger using zeolites and adsorptive elements that ensure bonding with heavy metal ions.

Design life

The design life of the D-Rainclean filter media is a function of its daily use. The Filter media has been tested to DIBt standard approval and based on applications since 2002.

Design life of D-Rainclean filter media**



** DTV = average daily traffic volume

Disposal

The filter media should be removed and disposed in line with local authority and regulatory guidelines.

Planting

The filter media contains sufficient nutrients for selected plants e.g. pachysandra, mahonia, vinca minor or cotoneaster. For further information please contact the Stormwater Management technical department.



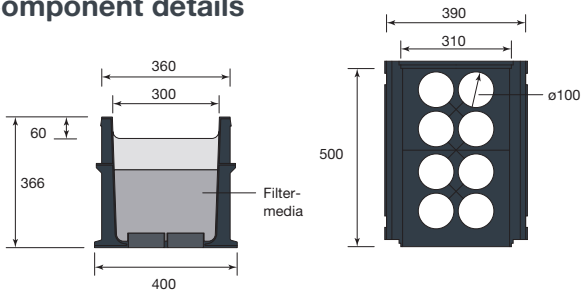
Component and installation details

Stormwater Management provide technical support from concept design right through to the construction phase. We are able to offer site specific design solutions to provide our clients with the most cost effective and environmentally sympathetic solutions. Our engineering department can provide preliminary calculations and CAD details.

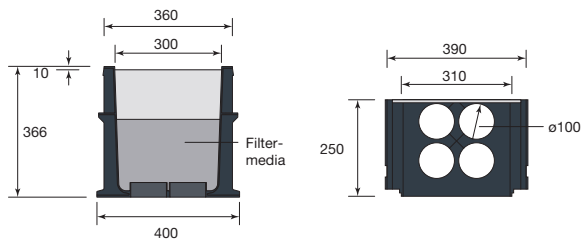
The B125 Cast-iron grate is ideal for occasionally or constantly light trafficked areas.

The D400 cast-iron grate and frame is suitable for heavier trafficked areas and heavy goods vehicles.

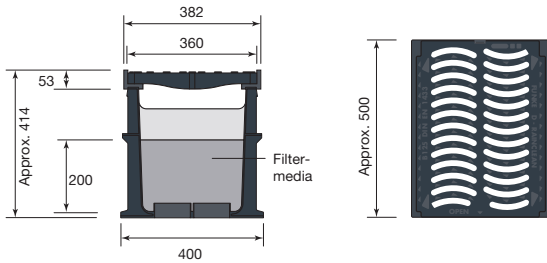
Component details



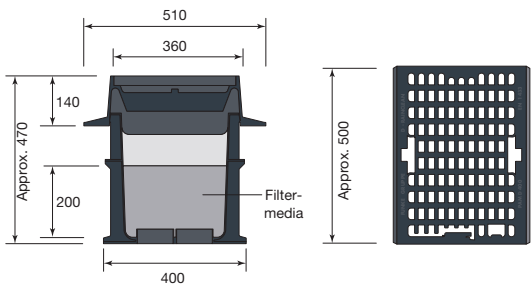
D-Rainclean open



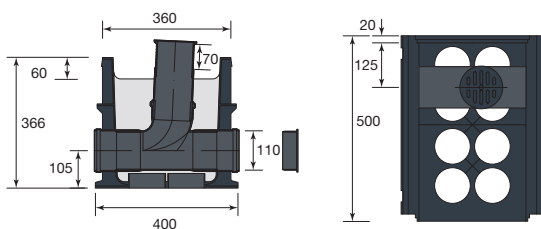
D-Rainclean end unit



D-Rainclean cast-iron – class B125

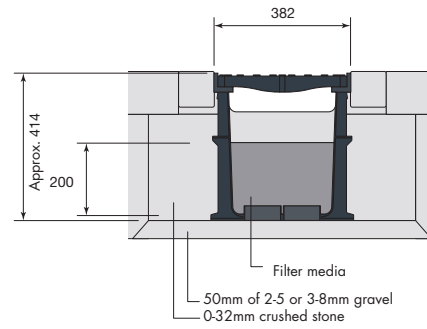


D-Rainclean cast-iron – class D400



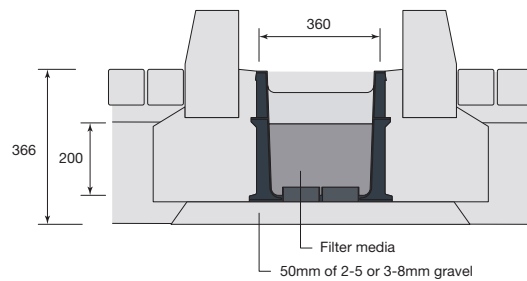
D-Rainclean overflow unit

Installation details

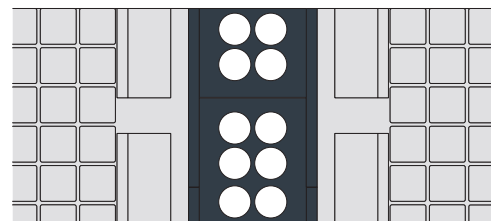


D-Rainclean cast-iron - class B125

No supporting concrete haunching is needed, only compactible materials (e.g. gravel 0-32mm) installed and compacted in layers along both sides of the channel.

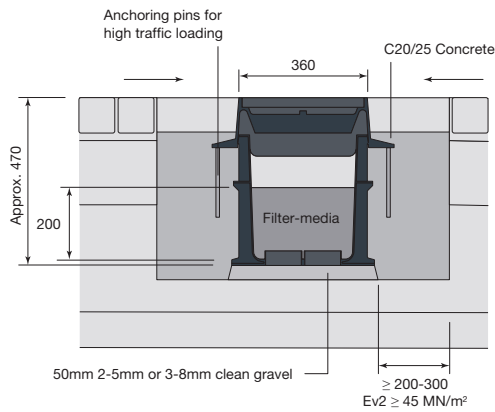


Top view



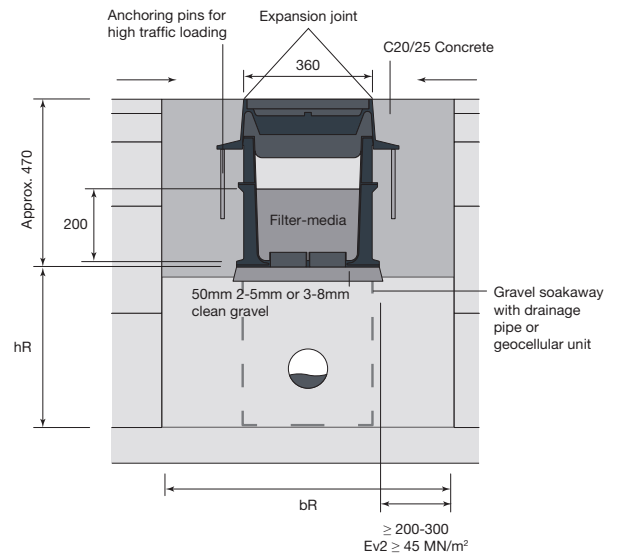
D-Rainclean open with elevated kerbs

The use of D-Rainclean with raised open kerbs is an option between rows of car parks.



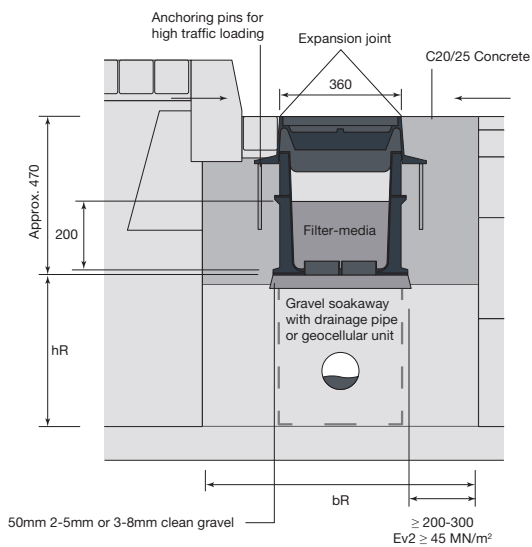
D-Rainclean cast-iron – class D400

The D-Rainclean filter channel has a D400 cast iron cover and frame (500mm × 360mm) is particularly suitable for use in trafficked areas.



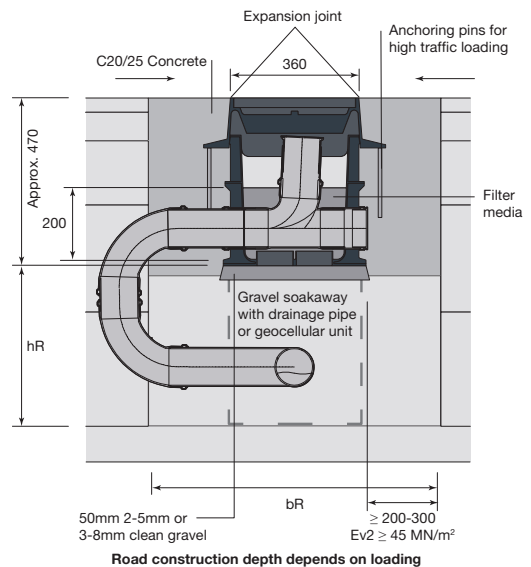
D-Rainclean Class D with perforated drain pipe

Combination with a perforated, high strength carrier pipe allows the D-Rainclean System to be installed in soils with low water permeability.



D-Rainclean Class D abutting kerb with perforated drain pipe

Combination with a perforated, high strength carrier pipe allows the D-Rainclean System to be installed in soils with low water permeability.



Overflow detail for exceedence events

The 110mm overflow pipe connects to a perforated high strength carrier pipe in a trench drain.

Sizing the system

The D-Rainclean system can be sized by our engineering team if the following information is provided:

- ◆ Location of project
- ◆ Design rainfall event
- ◆ Soil infiltration coefficient at the required location
- ◆ Drainage catchment area
- ◆ Surface material type
- ◆ Allowable discharge rate
- ◆ Groundwater level
- ◆ Available area for channel system
- ◆ Receiving water body e.g. ground, watercourse, etc.

From this data our engineers will be able to calculate the quantity of channel required and where necessary, design in exceedence measures to meet the rainfall design criteria.



Worked example for a car park in Witley, Surrey.

The above car park has an impermeable area of 900m² with 38 car spaces. With a run off coefficient of 0.66 this equates to an effective drainage area of 590m². Using the rainfall data for Witley, Surrey:

$N = 0.2 \text{ a}^{-1} = 5 \text{ year storm event}$

The D-Rainclean filter media has an infiltration coefficient of 9×10^{-4} , and it is assumed that the natural soil has the same coefficient.

Using DWA138 method of sizing, this equates to 55m of D-Rainclean channel being needed, in the above example, 27.5m has been designed using a trafficable B125 cast-iron grating, and 27.5m in an open channel design adjacent to a landscaped area.

Not only will the D-Rainclean channel hydraulically control and treat the runoff it also negates the need for positive drainage, silt traps, oil separator and flow control.

Case study: B&Q, South Gloucester



D-Rainclean offered an economical and high-performance alternative to the originally proposed porous paving design concept. The use of conventional tarmac combined with the D-Rainclean system offered time and cost savings without compromising the car park area's ability to control run-off and deal with contaminants. The efficiency of D-Rainclean filter media means that contaminated run-off is effectively treated at source before being returned to the water course – in this case, the river Trym. This removed the need for an expensive Petrol Interceptor and the associated electrical hook up and maintenance ramifications. Independent performance testing of the installation has indicated that the media will perform for 18 years before replacement of the media becomes necessary.

For further information and a copy of the test report, please contact Stormwater Management Ltd directly on sales@storm-water.co.uk



D-Rainclean Specification Clause



The stormwater bio-remediation channel system shall be D-Rainclean by Stormwater Management Ltd. The system shall comply with EN1433 and have been tested and approved for Stormwater treatment in accordance with DIBt requirements. The system shall be designed to remove TSS to sub 63µg and nominated dissolved heavy metals (Zinc and Copper).

NBS Specification



The D-Rainclean bio-remediation channel should be specified in NBS section R17:315. Assistance in completing this clause can be found in the Stormwater Management entry in NBS Plus or a model specification can be downloaded from www.storm-water.co.uk. For further assistance, please contact the Stormwater Engineering Team.

Stormwater Management Ltd



Stormwater Management Ltd are specialists in the design, supply and install of surface water and sustainable drainage systems, whether the requirement is for landscaped, hybrid or more

engineered drainage systems Stormwater Management Ltd are able to offer a solution.

Based in Hinckley, Leicestershire with a team of design and site engineers, Stormwater Management Ltd provide a wide range of drainage solutions for volume control and surface water treatment.

This brochure is produced to give an example of the products we supply and how, subject to your own testing, our products may be used. Nothing in this brochure shall be construed so as to make any ascertain or give any warranty as to the fitness for purpose of any of our products in respect of any specific job. You should satisfy yourself through your own testing as to the suitability of our products for any specific purpose and rely solely on such testing and/or the advice of any professional(s) you commission. While we ensure as far as is possible that all information given in this brochure is accurate at the time of print, information and examples given in this brochure are by way of illustration only and nothing contained in this or any other promotional literature produced by us shall in any way constitute an offer or contract with you or shall be relied upon by you as a statement or representation of fact.

Maintenance

Replacing the filter-media

Where required use the installation wrench open the cast iron cover of the D-Rainclean® filtration channel.

Remove the filter media using a standard suction and rinsing vehicle.

Carefully remove filter media using suction hose. A weak water jet can be used in order to accelerate the process if desired.

Continue removing the media until the openings on the lower edge of the filtration channel are visible.

This will ensure that the substructure gravel remains in situ.

Pour the new filter media into the channel. This requires four standard bags per metre of channel. A 1.5m³ bag is sufficient for approx. 27 linear metres of channel.

When laying the media, ensure that it is evenly spread along the channel to a depth of 200mm.

Once completed, replace the cast iron gratings in their frames and lock in place.

Other products and applications



The D-Rainclean filter-media

This unique and versatile filter media can be used for other sustainable drainage treatment train components, such as:

- ♦ Infiltration basins (shown above)
- ♦ Swales
- ♦ Rain gardens



Innolet

Innolet is a range of point drain cartridges that treat Stormwater run-off from roads and comprise aerobic and anaerobic filter to remove priority pollutants such as

- ♦ Heavy metals – zinc, copper, cadmium and lead
- ♦ Hydrocarbons
- ♦ PAH
- ♦ Phosphates

Technical Support

Stormwater Management design service

Stormwater Management provide full technical support from design right through to installation and commissioning – from product and system selection, design calculations and CAD drawings, we aim to provide clients with all the relevant technical information.

Whether your scheme uses soft, engineered or hybrid drainage systems Stormwater Management have a range of product and system solutions to allow you to meet your objectives.

On site support

Stormwater Management Ltd. now boasts the largest product range of its kind in the UK. Fully conversant in all D-Rainclean solutions as well as other associated products, our well- trained staff are always available to discuss the technical merits of D-Rainclean and to advise which solution would be most suited to a particular application.

Tel 01455 502222

Email sales@storm-water.co.uk