

Unit 6
Belturbet Business Park
Creeny
Belturbet
Co. Cavan
H14AY94

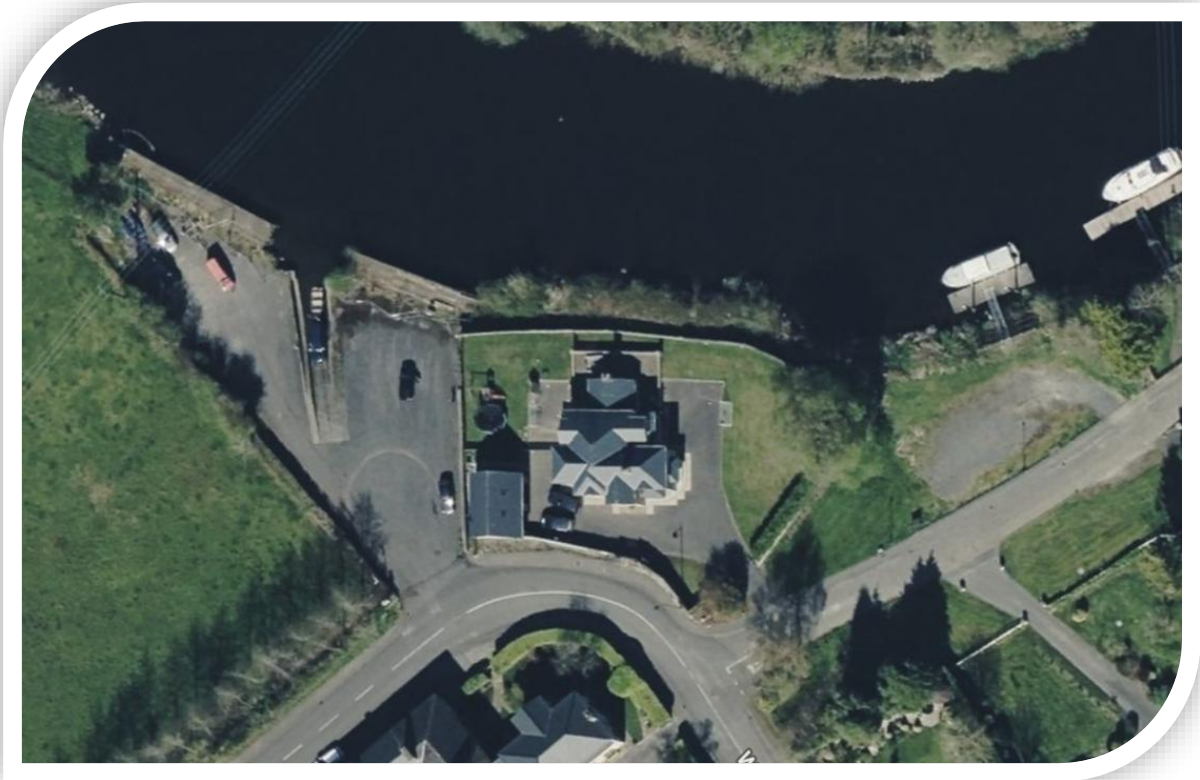
T: +353 49 9522236
E: info@alantraynor.com
W: www.alantraynor.com

2nd Floor
67-70
Meath St
Dublin 8
D08XY53

T: +353 1 6750850
E: dublin@alantraynor.com
W: www.alantraynor.com



Alan Traynor
Consulting Engineers Ltd.



Alan Traynor Consulting Engineers Ltd

CAVAN COUNTY COUNCIL

PROPOSED DEVELOPMENT AT THE DUCKING STOOL JETTY, BELTURBET, CO. CAVAN

Engineering Services Report





Table of Contents

1.0	Introduction.....	2
1.1	Site Description.....	2
2.0	Surface Water Drainage	3
2.1	Surface Water Drainage - Existing	3
2.2	Surface Water Drainage – Proposed	3
Appendix A	- Permeable Paving details.	

1.0 Introduction

Alan Traynor Consulting Engineers Ltd have been engaged by Cavan County Council to carry out engineering services design for the proposed development at The Duckin Stool, Belturbet, Co. Cavan. This report addresses the surface water drainage for this application.

1.1 Site Description

The site has an area of 0.407 hectares and is located along the lawn road in Belturbet, Co. Cavan. There is an existing jetty and boat ramp with most of the surface covered in a tarmac finish. There is an existing 600mm concrete pipe running through the site. The site surrounds and existing dwelling to the northeast and west. The river Erne is located to the north of the site with agricultural land to the west.

2.0 Surface Water Drainage

2.1 Surface Water Drainage - Existing

There appears to be no existing surface water infrastructure on the site. There is an existing surface water sewer in Willow Avenue Road. The River Erne borders the North of the site.

2.2 Surface Water Drainage – Proposed

It is proposed to use permeable paving, perforated pipes, and a suitably sized network to collect all run-off from the proposed hardstand areas. The surface water will be discharged to an outfall into the River Erne. Permeable paving systems will reduce peak discharges into the drainage system and treat run off by providing a 70-90% removal efficiency rate for hydrocarbons and 60-95% removal of suspended solids thereby improving the quality of water being discharged. Due to the size of the runoff areas and the above treatment, we propose that interceptors are not required prior to discharge.

Please refer to Drawing 25-129-102 for the surface water sewer layout and Appendix A for the permeable paving details.

2.3 SuDS Design Introduction

The following surface water drainage review has been prepared to demonstrate the use of Sustainable Urban Drainage Systems to adequately manage rainfall runoff from the development. The proposed surface water design will be in compliance with the SuDS Manual Ciria Report 753 and the SuDS design elements in the development were selected from The Four Pillars of SuDS.

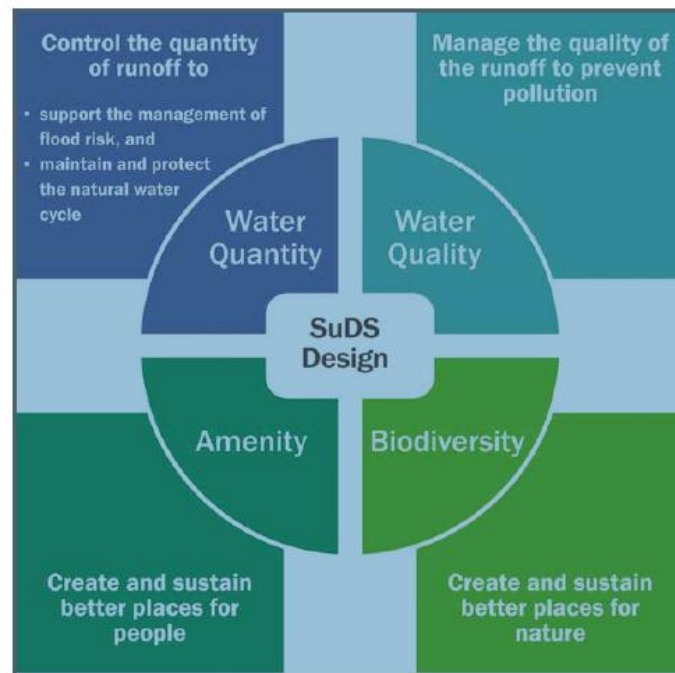


Figure 1 – The Four Pillars of SuDS (Ref – CIRIA Report C753)

2.4 SuDS Treatment Train Selection for Development

In accordance with SuDS Manual Ciria Report 753, the following SuDS elements were chosen:

Permeable Paving – The car parking spaces for all the residential units will be constructed using permeable paving. Permeable paving systems will reduce peak discharges into the drainage system and treat run off by providing a 70-90% removal efficiency rate for hydrocarbons and 60-95% removal of suspended solids thereby improving the quality of water being discharged.

-

Appendix A – Storm Water Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	0.71
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	16.100	Minimum Backdrop Height (m)	0.600
Ratio-R	0.290	Preferred Cover Depth (m)	0.350
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
S1	0.035	5.00	45.720	1200	2920967.079	-105637.939	0.500
S2	0.035	5.00	45.350	1200	2920960.899	-105618.789	0.500
S3			45.350	1200	2920943.788	-105611.565	0.624
OUTLET 1			45.400	1200	2920944.619	-105609.631	0.688
S4	0.015	5.00	46.050	1200	2920987.154	-105645.944	0.500
S5	0.015	5.00	45.350	1200	2920986.387	-105629.509	0.500
S6			45.350	1200	2920972.254	-105623.555	0.602
OUTLET 2			45.300	1200	2920973.130	-105621.491	0.567
S7	0.024	5.00	47.050	1200	2921047.332	-105646.594	0.500
S8			47.100	1200	2921064.410	-105636.350	0.683
OUTLET 3			46.888	1200	2921062.818	-105632.325	0.500

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	S1	S2	20.122	0.600	45.220	44.850	0.370	54.4	150	5.25	50.0
1.001	S2	S3	18.573	0.600	44.850	44.726	0.124	149.8	150	5.62	50.0
1.002	S3	OUTLET 1	2.105	0.600	44.726	44.712	0.014	150.4	150	5.67	50.0
2.000	S4	S5	16.453	0.600	45.550	44.850	0.700	23.5	150	5.13	50.0
2.001	S5	S6	15.336	0.600	44.850	44.748	0.102	150.4	150	5.44	50.0
2.002	S6	OUTLET 2	2.242	0.600	44.748	44.733	0.015	149.5	150	5.49	50.0
3.000	S7	S8	19.915	0.600	46.550	46.417	0.133	149.7	150	5.41	50.0
3.001	S8	OUTLET 3	4.328	0.600	46.417	46.388	0.029	149.3	150	5.49	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.367	24.2	4.7	0.350	0.350	0.035	0.0	45	1.062
1.001	0.819	14.5	9.5	0.350	0.474	0.070	0.0	89	0.873
1.002	0.817	14.4	9.5	0.474	0.538	0.070	0.0	89	0.871
2.000	2.086	36.9	2.0	0.350	0.350	0.015	0.0	24	1.117
2.001	0.817	14.4	4.1	0.350	0.452	0.030	0.0	54	0.701
2.002	0.819	14.5	4.1	0.452	0.417	0.030	0.0	54	0.703
3.000	0.819	14.5	3.3	0.350	0.533	0.024	0.0	48	0.662
3.001	0.820	14.5	3.3	0.533	0.350	0.024	0.0	48	0.663

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	20.122	54.4	150	Circular	45.720	45.220	0.350	45.350	44.850	0.350
1.001	18.573	149.8	150	Circular	45.350	44.850	0.350	45.350	44.726	0.474
1.002	2.105	150.4	150	Circular	45.350	44.726	0.474	45.400	44.712	0.538
2.000	16.453	23.5	150	Circular	46.050	45.550	0.350	45.350	44.850	0.350
2.001	15.336	150.4	150	Circular	45.350	44.850	0.350	45.350	44.748	0.452
2.002	2.242	149.5	150	Circular	45.350	44.748	0.452	45.300	44.733	0.417
3.000	19.915	149.7	150	Circular	47.050	46.550	0.350	47.100	46.417	0.533
3.001	4.328	149.3	150	Circular	47.100	46.417	0.533	46.888	46.388	0.350

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	S1	1200	Manhole	Adoptable	S2	1200	Manhole	Adoptable
1.001	S2	1200	Manhole	Adoptable	S3	1200	Manhole	Adoptable
1.002	S3	1200	Manhole	Adoptable	OUTLET 1	1200	Manhole	Adoptable
2.000	S4	1200	Manhole	Adoptable	S5	1200	Manhole	Adoptable
2.001	S5	1200	Manhole	Adoptable	S6	1200	Manhole	Adoptable
2.002	S6	1200	Manhole	Adoptable	OUTLET 2	1200	Manhole	Adoptable
3.000	S7	1200	Manhole	Adoptable	S8	1200	Manhole	Adoptable
3.001	S8	1200	Manhole	Adoptable	OUTLET 3	1200	Manhole	Adoptable

Simulation Settings

Rainfall Methodology	FSR	Drain Down Time (mins)	240
Rainfall Events	Singular	Additional Storage (m³/ha)	20.0
FSR Region	Scotland and Ireland	Starting Level (m)	
M5-60 (mm)	16.100	Check Discharge Rate(s)	✓
Ratio-R	0.290	1 year (l/s)	2.0
Summer CV	0.750	10 year (l/s)	3.2
Winter CV	0.840	30 year (l/s)	3.9
Analysis Speed	Normal	100 year (l/s)	4.6
Skip Steady State	x	Check Discharge Volume	x

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	20	0	0
10	20	0	0
30	20	0	0
100	20	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.65
Greenfield Method	IH124	Growth Factor 100 year	1.96
Positively Drained Area (ha)	0.441	Betterment (%)	0
SAAR (mm)	1031	QBar	2.4
Soil Index	3	Q 1 year (l/s)	2.0
SPR	0.40	Q 10 year (l/s)	3.2
Region	11	Q 30 year (l/s)	3.9
Growth Factor 1 year	0.83	Q 100 year (l/s)	4.6
Growth Factor 10 year	1.37		

Results for 1 year +20% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)
15 minute winter	S1	10	45.264	0.044	4.7	0.1126	0.0000
15 minute winter	S2	11	44.940	0.090	9.3	0.2277	0.0000
15 minute winter	S3	11	44.826	0.100	9.2	0.1128	0.0000
15 minute winter	OUTLET 1	11	44.798	0.086	9.2	0.0000	0.0000
15 minute winter	S4	10	45.574	0.024	2.0	0.0409	0.0000
15 minute winter	S5	11	44.905	0.054	4.0	0.0943	0.0000
15 minute winter	S6	11	44.807	0.059	3.9	0.0667	0.0000
15 minute winter	OUTLET 2	11	44.786	0.053	3.9	0.0000	0.0000
15 minute winter	S7	10	46.599	0.049	3.3	0.1021	0.0000
15 minute winter	S8	11	46.469	0.052	3.2	0.0582	0.0000
15 minute winter	OUTLET 3	11	46.436	0.048	3.2	0.0000	0.0000

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1	1.000	S2	4.6	0.613	0.192	0.1544	
15 minute winter	S2	1.001	S3	9.2	0.786	0.636	0.2179	
15 minute winter	S3	1.002	OUTLET 1	9.2	0.799	0.635	0.0241	4.3
15 minute winter	S4	2.000	S5	2.0	0.543	0.054	0.0619	
15 minute winter	S5	2.001	S6	3.9	0.642	0.270	0.0935	
15 minute winter	S6	2.002	OUTLET 2	3.9	0.652	0.270	0.0134	1.8
15 minute winter	S7	3.000	S8	3.2	0.631	0.221	0.1020	
15 minute winter	S8	3.001	OUTLET 3	3.2	0.632	0.222	0.0220	1.5

Results for 10 year +20% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)
15 minute winter	S1	10	45.280	0.060	8.3	0.1520	0.0000
15 minute winter	S2	11	45.021	0.171	16.5	0.4317	0.0000
15 minute winter	S3	12	44.868	0.142	14.9	0.1602	0.0000
15 minute winter	OUTLET 1	12	44.825	0.113	14.9	0.0000	0.0000
15 minute winter	S4	10	45.582	0.032	3.6	0.0546	0.0000
15 minute winter	S5	10	44.927	0.077	7.2	0.1328	0.0000
15 minute winter	S6	11	44.831	0.083	7.0	0.0942	0.0000
15 minute winter	OUTLET 2	11	44.806	0.073	7.0	0.0000	0.0000
15 minute winter	S7	10	46.616	0.066	5.7	0.1389	0.0000
15 minute winter	S8	11	46.487	0.070	5.6	0.0796	0.0000
15 minute winter	OUTLET 3	11	46.452	0.064	5.6	0.0000	0.0000

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1	1.000	S2	8.2	0.670	0.338	0.2422	
15 minute winter	S2	1.001	S3	14.9	0.855	1.030	0.3235	
15 minute winter	S3	1.002	OUTLET 1	14.9	0.932	1.029	0.0331	7.6
15 minute winter	S4	2.000	S5	3.6	0.623	0.097	0.0966	
15 minute winter	S5	2.001	S6	7.0	0.739	0.485	0.1462	
15 minute winter	S6	2.002	OUTLET 2	7.0	0.756	0.486	0.0209	3.3
15 minute winter	S7	3.000	S8	5.6	0.720	0.385	0.1544	
15 minute winter	S8	3.001	OUTLET 3	5.6	0.729	0.385	0.0331	2.6

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)
15 minute winter	S1	10	45.289	0.069	10.5	0.1734	0.0000
15 minute winter	S2	11	45.145	0.295	20.8	0.7479	0.0000
15 minute winter	S3	12	44.899	0.173	18.6	0.1952	0.0000
15 minute winter	OUTLET 1	12	44.837	0.125	18.6	0.0000	0.0000
15 minute winter	S4	10	45.585	0.035	4.5	0.0611	0.0000
15 minute winter	S5	10	44.939	0.089	9.0	0.1537	0.0000
15 minute winter	S6	11	44.845	0.097	8.8	0.1094	0.0000
15 minute winter	OUTLET 2	11	44.817	0.084	8.8	0.0000	0.0000
15 minute winter	S7	10	46.626	0.076	7.2	0.1597	0.0000
15 minute winter	S8	11	46.498	0.081	7.0	0.0915	0.0000
15 minute winter	OUTLET 3	11	46.461	0.073	7.0	0.0000	0.0000

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1	1.000	S2	10.3	0.704	0.429	0.2559	
15 minute winter	S2	1.001	S3	18.6	1.054	1.283	0.3270	
15 minute winter	S3	1.002	OUTLET 1	18.6	1.066	1.288	0.0351	9.7
15 minute winter	S4	2.000	S5	4.5	0.655	0.121	0.1153	
15 minute winter	S5	2.001	S6	8.8	0.775	0.609	0.1750	
15 minute winter	S6	2.002	OUTLET 2	8.8	0.796	0.610	0.0249	4.2
15 minute winter	S7	3.000	S8	7.0	0.760	0.487	0.1845	
15 minute winter	S8	3.001	OUTLET 3	7.0	0.772	0.486	0.0395	3.3

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)
15 minute winter	S1	12	45.386	0.166	13.7	0.4193	0.0000
15 minute winter	S2	12	45.289	0.439	25.3	1.1115	0.0000
15 minute winter	S3	12	44.930	0.204	22.4	0.2307	0.0000
15 minute winter	OUTLET 1	12	44.847	0.135	22.5	0.0000	0.0000
15 minute winter	S4	10	45.590	0.040	5.9	0.0699	0.0000
15 minute winter	S5	10	44.957	0.107	11.7	0.1856	0.0000
15 minute winter	S6	11	44.865	0.117	11.4	0.1318	0.0000
15 minute winter	OUTLET 2	11	44.832	0.099	11.5	0.0000	0.0000
15 minute winter	S7	10	46.640	0.090	9.4	0.1890	0.0000
15 minute winter	S8	11	46.513	0.096	9.2	0.1090	0.0000
15 minute winter	OUTLET 3	11	46.474	0.086	9.2	0.0000	0.0000

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1	1.000	S2	12.4	0.816	0.513	0.3542	
15 minute winter	S2	1.001	S3	22.4	1.274	1.550	0.3270	
15 minute winter	S3	1.002	OUTLET 1	22.5	1.277	1.556	0.0361	12.6
15 minute winter	S4	2.000	S5	5.8	0.682	0.158	0.1422	
15 minute winter	S5	2.001	S6	11.4	0.813	0.788	0.2156	
15 minute winter	S6	2.002	OUTLET 2	11.5	0.844	0.791	0.0303	5.4
15 minute winter	S7	3.000	S8	9.2	0.804	0.634	0.2272	
15 minute winter	S8	3.001	OUTLET 3	9.2	0.818	0.633	0.0485	4.3

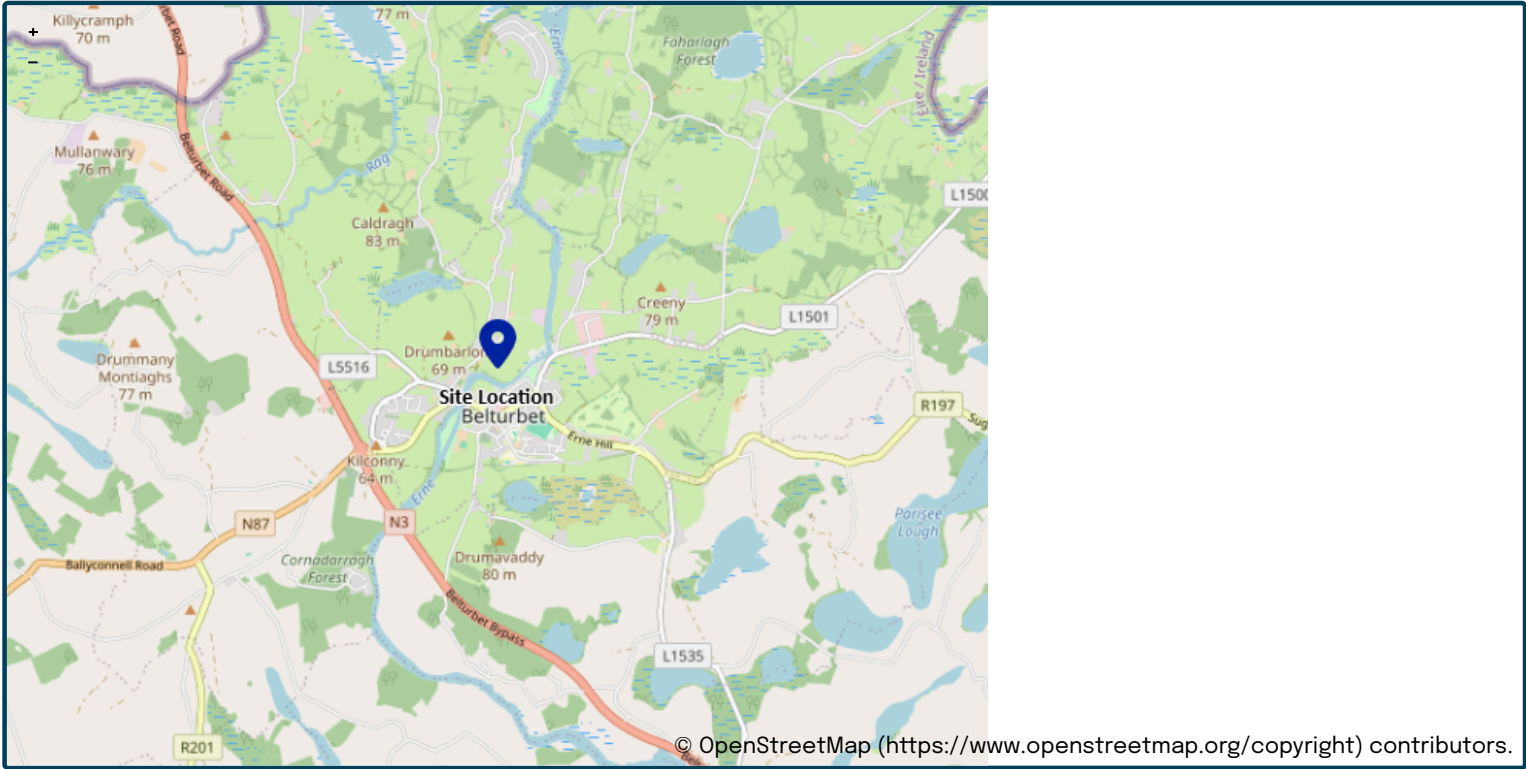
This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance “Rainfall runoff management for developments”, SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Project details

Date	10/06/2026
Calculated by	
Reference	
Model version	2.2.3

Location

Site name	Duckin stool
Site location	belturbet



Site easting (Irish Grid)	236370
Site northing (Irish Grid)	317179
Site easting (Irish Transverse Mercator)	636314
Site northing (Irish Transverse Mercator)	817188

Site details

Total site area (ha)	.407	ha
----------------------	-----------------------------------	----

Greenfield runoff

Method

Method	IH124
--------	-------

IH124

	<u>My value</u>		<u>Map value</u>
SAAR (mm)	1031	mm	1031
How should SPR be derived?	WRAP soil type		
WRAP soil type	3		3
SPR	0.37		
QBar (IH124) (l/s)	1.8	l/s	

Growth curve factors

	<u>My value</u>		<u>Map value</u>
Hydrological region	13		13
1 year growth factor	0.85		
2 year growth factor	0.95		
10 year growth factor	1.4		
30 year growth factor	1.65		
100 year growth factor	1.95		
200 year growth factor	2.15		

Results

Method	IH124	
Flow rate 1 year (l/s)	1.6	l/s
Flow rate 2 year (l/s)	1.7	l/s
Flow rate 10 years (l/s)	2.6	l/s
Flow rate 30 years (l/s)	3.0	l/s
Flow rate 100 years (l/s)	3.6	l/s
Flow rate 200 years (l/s)	4.0	l/s

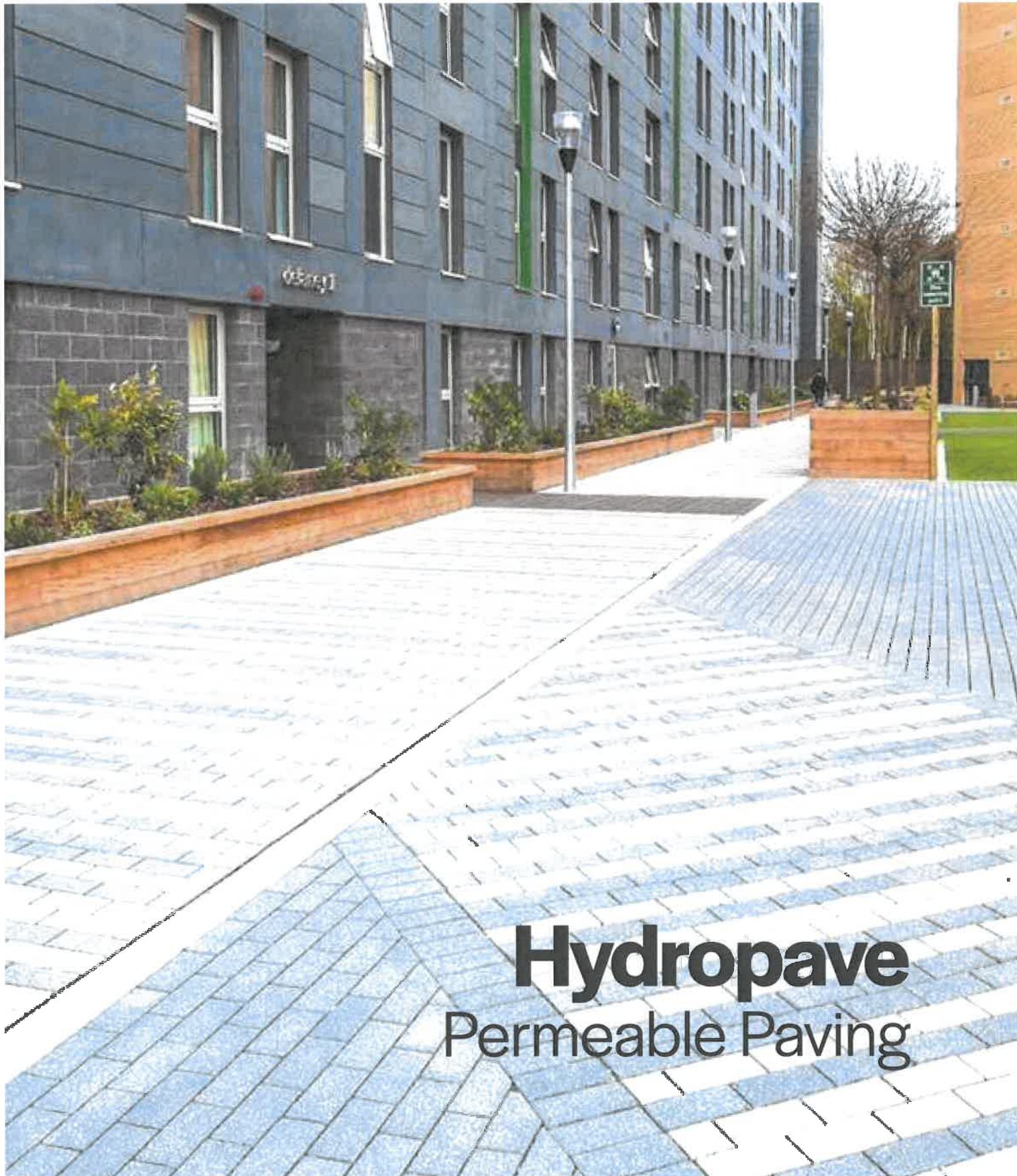
Please note runoff estimation is subject to significant uncertainty. Results are therefore normally reported to only 1 decimal place. Where 2 decimal places are provided, this does not indicate accuracy to this level, it has been adopted to prevent ‘zero’ figures from being reported. Outputs less than 0.01 l/s are reported as 0.01 l/s.

Disclaimer

This report was produced using the Greenfield runoff rate estimation tool (2.2.3) developed by HR Wallingford and available at [uksuds.com](https://www.uksuds.com/) (<https://www.uksuds.com/>). The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at [uksuds.com/terms-conditions](https://www.uksuds.com/terms-conditions) (<https://www.uksuds.com/terms-conditions>). The outputs from this tool have been used to estimate Greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, Centre for Ecology and Hydrology, Wallingford Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

Appendix A

Permeable Paving



Flooding & Pollution

As urban and industrial areas throughout the country have continued to expand, the total area of impermeable surfaces such as roofs, roads, pavements and car parks has increased.

This means that rainfall cannot infiltrate naturally into the ground quickly enough and put our already overloaded drainage systems to an even greater test. The ageing traditional drainage systems are high maintenance and no longer able to cope.

Rainwater which would normally recharge groundwater or wetlands is now washed directly into water courses via conventional drainage systems. With global warming leading to increased levels of rainfall, our ageing drainage systems are no longer able to cope with high volumes of storm water run off. This leads to flash flooding and increased pollution.

Why Permeable Paving?



Pollution Risk

During periods of dry weather heavy metals, hydrocarbons, oil, rubber and other pollutants are deposited on impermeable surfaces. When it rains these pollutants are washed into drainage systems and end up further downstream in rivers where they damage wildlife habitats.



Flooding Risk

The Environment Agency report on the Autumn 2000 floods in the UK, entitled "Lessons Learned, Autumn 2000 Floods" concluded that an estimated 1.85 million homes, 185,000 commercial properties and 5 million people in the UK are now at risk from flooding. The Environment Agency's publication "Policy and practice for the protection of floodplains" states that: "Inappropriate development within floodplains should be

resisted where such development would itself be at risk from flooding or may cause flooding elsewhere." To minimise any increased surface run off, new developments must be carefully located and designed. Where appropriate, storm water source control measures, which also improve water quality, should be incorporated into the development proposal.



Permeable Paving

The solution to flooding problems is the use of more sustainable methods of storm water drainage which take into account quantity, quality and social issues.

These are now referred to as SuDS (Sustainable Urban Drainage Systems). SuDS are made up of a number of structures, which include:

- Permeable pavements
- Swales and filter strips
- Basins and wetlands
- Infiltration devices

Why Permeable Paving?

Sustainable urban Drainage Systems

SuDS are more sustainable because they:

- Deal with run off close to where it falls
- Manage potential flooding at its source
- Protect or enhance water quality
- Provide a habitat for wildlife in urban areas
- Protect water resources from accidental spills and pollution
- Allow new development in areas where existing sewerage systems are at full capacity, enabling new development within existing areas
- Are sympathetic to the environmental setting and the needs of the local community
- Encourage natural groundwater recharge

The inclusion of a permeable paving surface as part of a SuDS solution will not only increase the likelihood of planning proposals being approved but may also offer the developer a 10-15% cost savings over traditional methods due to a significant reduction in drainage costs (pipes, manholes, petrol interceptors etc).

Water quality Improvement

Permeable paving is very effective at removing pollution from runoff. The pollutants may remain on the surface or may be flushed into the underlying pavement layers where a very high percentage of the pollutants are filtered, trapped or degrade over time. Expensive petrol interceptors, which are used in traditional drainage schemes, are generally no longer required due to the natural removal of pollutants through the permeable paving sub-base. For more detailed information on water quality please refer to the Guide to the design, construction and maintenance of concrete block permeable pavements:

Design & Construction of Concrete Block Permeable Pavements, edition 7 produced by Interpave available for download on www.paving.org.uk

Four Elements of Permeable Paving

1. Permeability

The infiltration rate through the joints of newly installed concrete block permeable paving is significantly higher than the typical rainfall rates in the UK and Ireland. Therefore even after allowing for some joint clogging overtime there is still a huge factor of safety built in.

Studies have shown that even without maintenance the long term infiltration capability of permeable paving will exceed UK and Ireland hydrological requirements.

2. Detention

The sub-base thickness should be designed to detain rain falling throughout 24 hours and must provide at least 30% void space. A 4/20mm coarse open graded crushed rock to BS EN13242:2002, value of 100kN or more must be used. If the designer opts to specify alternative materials, a site trial must be undertaken to ensure that the laying course material does not invade the sub-base material. The laying course and jointing material must be a 6.3-2mm grit to BS EN13242:2002. This has been proven in tests to perform best and will not invade the sub-base material. In ground conditions

where water cannot infiltrate into the subgrade, an impermeable membrane must be laid between the subgrade and sub-base and wrapped up the sides to detain the water.

3. Pollution

As water flows slowly into the sub-base it collides with individual aggregate components and deposits pollutants on their surface. The large surface area of the aggregates will ensure effective filtering of the pollutants which are then broken down by natural microbial action.

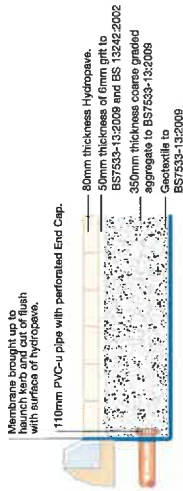
4. Structure

The specification of a permeable paving structure depends upon the hydraulic and traffic loading characteristics and upon the properties of the subgrade. Most pavements in the UK will be required to have a water detention capability rather than infiltration because of the subgrade types. It is recommended to design a permeable paving system to store rainfall occurring during 24 hours.

System Design & Install

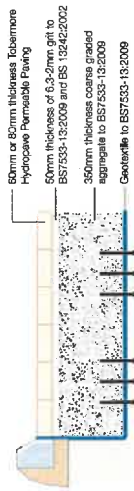
Typical Attenuation System (System C)

The Attenuation system temporarily stores the water in the crushed stone beneath the paving before being slowly released back into the drainage systems. This therefore reduces the peak downstream flow from a result of heavy rainfall.



Typical Attenuation System (System A)

The Infiltration system allows the water to flow slowly through the crushed stone beneath the paving before being slowly released back into the ground through a geotextile.



Bedding layer The blocks are jointed using a 6.3-2mm grit to BS EN7533-13:2009*.

Sub-base A clean 4/20mm coarse graded aggregate** to BS EN13242:2002 must be used for this component. A crushed rock angular stone works best.

- In particular, the material should be categorised as LA30, FZ20 and MDE20 according to table A.3 within this standard. The grit should be insoluble in dilute hydrochloric acid and should be naturally occurring material.
- You must ensure the grit and coarse graded aggregate are compatible. For example, if you use a finer grit it may percolate into the sub-base and may destabilise the pavement. Please refer to the following source of information—BS7533-13:2009 Pavements constructed with clay, natural stone or concrete pavers. Guide for the structural design of permeable pavements.

*Please refer to BS7563 Part 13 for details of system B (Partial infiltration)

Design

What types of systems are available? There are two common types of permeable paving systems: Attenuation and Infiltration.

What system should I use?

Tobermore can introduce you to specialist engineers who can provide design advice for your permeable paving project.

What are the key components of a permeable paving system?

The key components of the system are the sub-base, the bedding layer, the paving blocks and the jointing grit. As long as the system has been adequately designed for the site the most important next step is to get these components right.

How do I design a permeable paving system?

- Please refer to the following source of information:
- BS7533-13:2009 Pavements constructed with clay, natural stone or concrete pavers. Guide for the structural design of permeable pavements.

If you require specialist advice Tobermore can put you in contact with experienced design consultants.

Upper geotextile

An upper geotextile may be used between the sub-base and the bedding layer. Please refer to BS7533-13:2009 for further information.

What if the ground is poor or there will be significant vehicles on the paving?

Various improvement layers can be installed below the permeable paving to ensure the system can meet the structural load on the project. The engineer on the project will design these into it based on the loading category required. The two most common types of improvement layers are Dense Bitumen Macadam (DBM) and Cement Stabilised Coarse Graded Aggregate (CSCGA). Specifications for Dense Bitumen Macadam and Cement Stabilised Coarse Graded Aggregate can be found in BS7533-13:2009. Method statements on how to install these layers can be supplied on request.

What is the ratio required of permeable area (Hydropave) to impermeable to areas (roads, roofs etc)?

Sometimes, water from building roofs or nearby impermeable areas is fed into permeable paving. It is best to do this only in the case of attenuation systems when a typical ratio of 2:1 can be used between impermeable and permeable zones.

Note: A permeable paving design relies heavily on using the correct aggregates. Prior to installation, we would ask you to test both the 4/20mm coarse graded aggregate and also the 6.3-2mm bedding and jointing grit as per the relevant British Standard specification (BS EN 13242:2002). In particular, the material should be categorised as LA20 according to Table 9, SZ18 according to Table 10 and MDE15 according to Table 11 within this standard. The grit should be insoluble in dilute hydrochloric acid and should be naturally occurring material. In our experience, incorrect use of aggregates is one of the most common reasons for failure of a permeable paving system.

Install

How to install a permeable paving system

Please refer to the following sources of information - BS 7533-3:2005 Pavements constructed with clay, natural stone or concrete pavers, Part 3: Code of practice for laying precast concrete paving blocks and clay pavers for flexible pavements.

- Sub-base, 4/20mm aggregate** After putting the required depth of stone in position, it needs to be re-orientated using either a tandem roller or a plate vibrator.
- Bedding layer:** 6.3-2mm laying course material.
- Paving blocks** When the blocks are placed to the chosen pattern they should be plate vibrated before the 6.3-2mm grit is brushed into the joints until they are completely filled.

- Joint filling** All joints must be filled to the top with 6.3-2mm grit. Joints which are not fully filled can lead to possible movement of the blocks after use. We recommend that after a few weeks use that any joints, which have settled and are not full are topped up with grit. Joints should be kept filled at all times. You will need approximately 1 ton of grit for every 100m² of 60mm paving.

Note: Care should be taken that the permeable joints do not become contaminated as work on the scheme is completed. Special care needs to be taken when soft landscaping is carried out so that soil does not enter the joints. When this type of work is being carried out, the surface of the permeable paving should be protected by an appropriate cover to protect the joints from being contaminated.

Adverse weather

Due to the superior drainage capabilities of Hydropave it is possible to install the product in more adverse weather conditions compared to standard paving.

Maintenance

Even after allowing for clogging studies have shown that the long-term infiltration capability of permeable paving will normally substantially exceed UK hydrological requirements. The infiltration rates of permeable paving does decrease but it stabilises over time and even allowing for clogging long term infiltration rates substantially exceed UK rainfall requirements. **Note:** For optimum performance we recommend that paving is cleaned twice a year.

Initial cleaning

When an area has just been paved, allow it to settle for a few weeks. After this, you may wish to lightly hose down the paving to remove any excess dirt. The area should then be treated with a weed killer suppressant, two or three times a year as required.

General dirt

Regular sweeping to prevent the build up of detritus is recommended. Light coloured blocks emphasise tyre marks and oil spills on the pavement. It must be accepted that these products will need more maintenance if the overall appearance is to be maintained. A light power hose at medium pressure is generally all that is required to clean general dirt and grime. Any jointing grit which is removed must be replaced. Do not use high pressure power-washers as aggressive power-washing can damage the product surface. A trial area should be tested before large scale power-washing takes place. Please do not use vacuum sweepers as jointing grit may be removed. Please refer to the following sources of information - Guide to the design, construction and maintenance of concrete block permeable pavements Edition 6 produced by Interpave available for download on www.paving.org.uk

How to clean clogged joints

- After several years use, joints may become clogged with detritus and it may be necessary to clean them. This can be done as follows:
- Remove existing jointing grit and detritus by high pressure water jet.
 - Reset the pavers which will have become displaced.
 - Replace any damaged pavers at this time since they will have been loosened.
 - Apply 6.3-2mm single size grit to the joints, using a stiff brush to sweep the material in ensuring joints are filled.
 - Finish off as above.

Product Range

BLOCK PAVING

 PrimeTop
  Et-Stop

Hydropave Fusion

Permeable paving with natural granite aggregates.

- Functions as a SuDS paving system
- Manufactured with natural granite aggregates
- Superb hard-wearing granite surface
- Vibrant long-lasting colours
- Creates a striking, contemporary look

Sizes

- 200 x 100 x 80mm
- 300 x 200 x 80mm
- 300 x 300 x 80mm
- 600 x 300 x 80mm

Colours Available

- Graphite
- Mid Grey
- Silver



Hydropave Sienna

Striking textured permeable paving.

- Functions as a SuDS paving system
- Granite appearance
- Manufactured with natural granite aggregates
- Superb hard-wearing granite surface
- Vibrant long-lasting colours
- Creates a striking, contemporary look

Duo Sizes

- 208 x 173 x 60mm
- 173 x 173 x 60mm

• Both sizes in one pack

Colours Available

- Graphite
- Sandstone
- Silver



Hydropave Tegula

Permeable paving with traditional styling.

- Functions as a SuDS paving system
- Processed to give an antique appearance
- Vibrant long-lasting colours
- Suitable for both modern or traditional projects

Single Sizes

- 240 x 120 x 80mm

Duo Sizes

- 208 x 173 x 60mm
- 173 x 173 x 60mm

• Both sizes in one pack

Colours Available

- Bracken
- Charcoal
- Cedar
- Heather
- Slate



Hydropave Shannon

Permeable paving with smooth surface.

- Functions as a SuDS paving system
- Superb hard-wearing smooth surface
- Vibrant long-lasting colours

Duo Sizes

- 208 x 173 x 60mm
- 173 x 173 x 60mm

Colours Available

- Bracken
- Charcoal
- Heather



Hydropave Pedesta

Versatile permeable paving.

- Functions as a SuDS paving system
- Superb hard-wearing smooth surface
- Vibrant long-lasting colours

Sizes

- 200 x 100 x 60mm
- 200 x 100 x 80mm

Colours Available

- Bracken
- Charcoal
- Heather
- Brindle



Hydropave 240

Efficient, large format permeable block paving.

- Functions as a SuDS paving system
- Superb hard-wearing smooth surface
- Vibrant long-lasting colours

Sizes

- 240 x 120 x 80mm

Colours Available

- Bracken
- Charcoal
- Natural



Product Range

PAVING FLAGS



Hydropave Mayfair Flags

Granite finish permeable paving flags.

- Functions as a SuDS paving system
- Manufactured with natural granite aggregates
- Superb hard-wearing granite surface
- Vibrant long-lasting colours
- Creates a striking, contemporary look

Sizes

- 400 x 400 x 65mm

Colours Available

- Graphite
- Mid Grey
- Silver



Hydropave Textured Flags

Permeable paving flags with a modern textured surface.

- Functions as a SuDS paving system
- Superb hard-wearing textured surface
- Vibrant long-lasting colours
- Natural appearance

Sizes

- 400 x 400 x 65mm

Colours Available

- Charcoal
- Natural



Hydropave Standard Flags

Non-slip Affordable Permeable Paving.

- Functions as a SuDS paving system
- Superb hard-wearing textured surface
- Vibrant long-lasting colours
- Natural appearance

Sizes

- 400 x 400 x 65mm

Colours Available

- Charcoal
- Natural



Product Range

Catalogue of Designs

Although a full engineering approach will be needed for virtually all pavements, Tobermore's experience suggests that the following standard solutions will be suitable in most circumstances and can therefore be used at project appraisal stage.

Sub-base & Capping Layers

Capping thickness to be sufficient to provide a firm working platform or in the case of low CBR subgrades ground stabilisation may be more cost effective. If CBR is 5% or greater then capping layers are not required. It is advised that all sites need independent inspection and assessment by a suitably qualified engineer prior to project commencement.

The thicknesses of coarse graded aggregate will be suitable for the traffic conditions shown and in the case of Attenuation Designs should be sufficiently thick to meet the attenuation requirements. However, a site specific hydraulic analysis should be carried out.

In the case of Infiltration designs, there is usually no need to check hydraulic capacity but a check must be made on the infiltration capacity of the ground. The ground must be proven to accept 20mm of water in one hour which will have to be sealed up if the pavement is infiltrating water draining towards it from impermeable paving or from downpipes.

Where traffic weights exceed those commonly encountered on public highways, specialised design advice should be sought. Contact the Tobermore Sales Office. Where light vans are included, their maximum capacity is 15kN (3000w).

Loading Categories

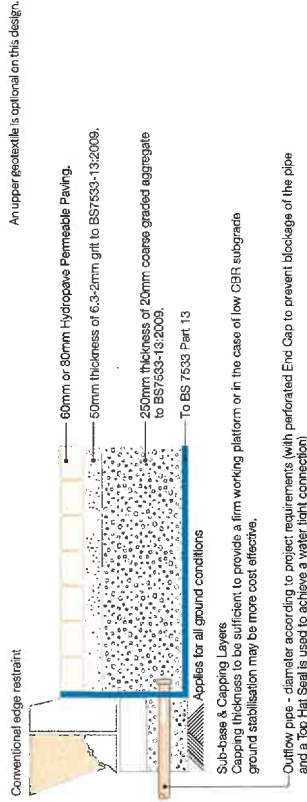
Category/Application	No. of standard axles	Traffic Guide	Application
A/Domestic	0	No Large HGV	• Patios • Private Drives • Decorative Features • Enclosed Playgrounds • Footways with Zero overrun
B/Car Parking	100	Emergency vehicles only	• Car parking bays and aisles • Railway station platforms • External car showrooms • Sports stadium pedestrian routes • Footways with occasional overrun • Private drives • Footway crossover
C/Pedestrian	0.015msa	Large HGV/week	• Town/City pedestrian street • Nursery access • Parking areas to residential development • Motel parking • Garden centre external displays • Crematory/Crematorium • Airport car park (no bus pick-up) • Sports centres
D/Shopping	0.15msa	10 large HGV/week	• Retail development delivery access route • School/college access route • Office block delivery route • Garden centre delivery route • Deliveries to small residential development • Private car park • Airport car park with bus to terminal • Sports stadium access route/forecourt
E/Commercial	1.5msa	100 large HGV/week	• Industrial premises • Light industrial public roads • Light industrial development • Mixed retail/industrial development • Town Square • Footway with regular overrun • Airport landside
F/Heavy traffic	15msa	1000 large HGV/week	• Main road • Distribution centre • Bus station (bus every 5 minutes) • Roundabout • Bus lane

Note: In the case of Attenuation designs, subgrade CBR values are equilibrium moisture content values. In the case of Infiltration designs, subgrade CBR values are soaked values.

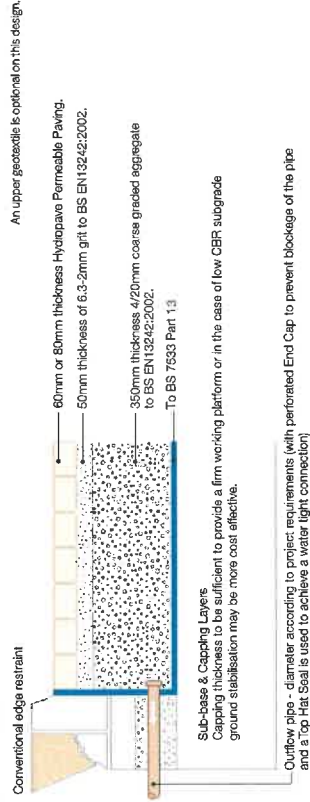


Attenuation Designs

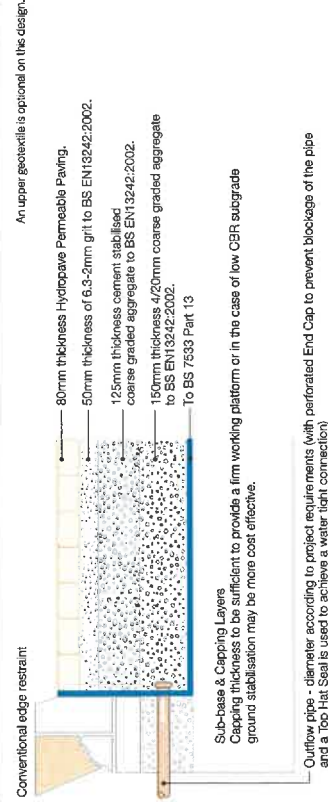
LOADING CATEGORY A: 1-5% CBR



LOADING CATEGORY B: 1-5% CBR

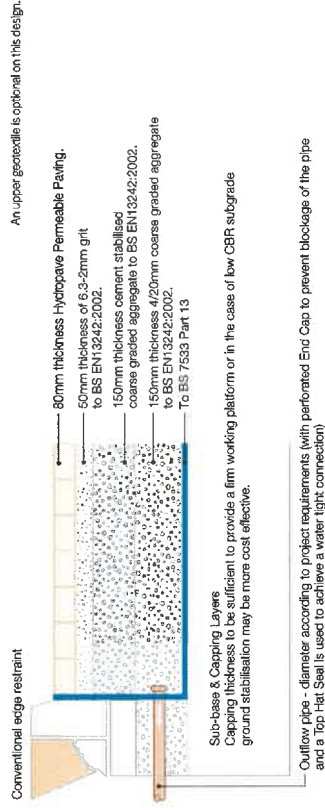


LOADING CATEGORY C: 1-5% CBR

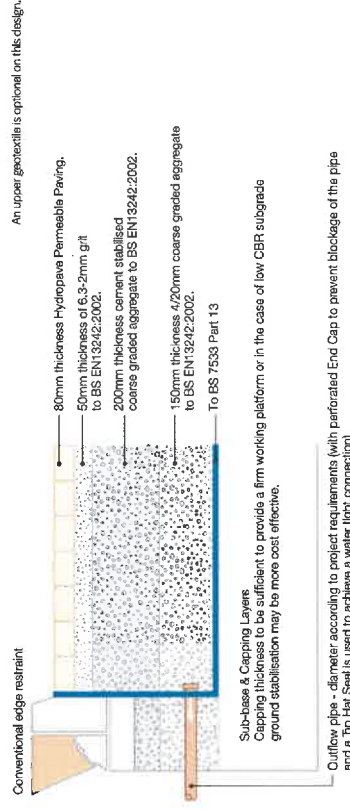


CBM (Dense Blumix Macadam) can be used as an alternative to the cement stabilised coarse graded aggregate. Please refer to BS 7553 Part 13

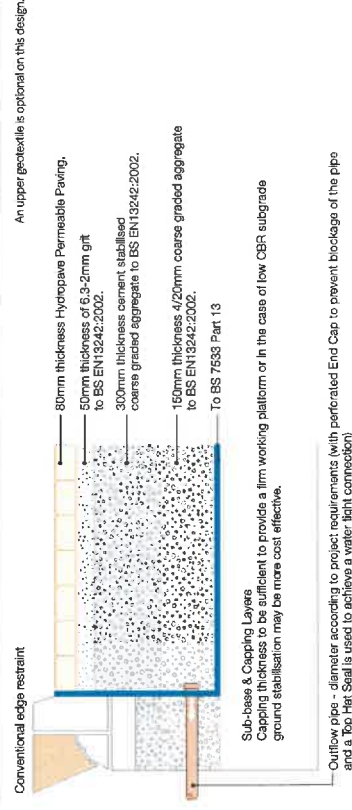
LOADING CATEGORY D: 1-5% CBR



LOADING CATEGORY E: 1-5% CBR



LOADING CATEGORY F: 1-5% CBR

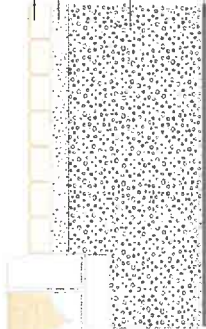


Infiltration Designs

LOADING CATEGORY B: 3 & 4% CBR

Conventional edge restraint

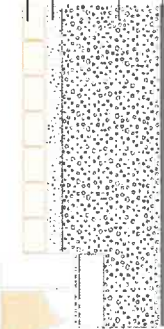
An upper geotextile is optional on this design.



LOADING CATEGORY B: 5% CBR

Conventional edge restraint

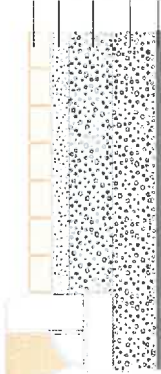
An upper geotextile is optional on this design.



LOADING CATEGORY C: 6% CBR

Conventional edge restraint

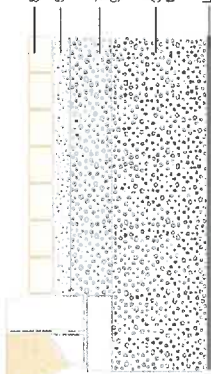
An upper geotextile is optional on this design.



LOADING CATEGORY D: 3 & 4% CBR

Conventional edge restraint

An upper geotextile is optional on this design.



LOADING CATEGORY D: 5% CBR

Conventional edge restraint

An upper geotextile is optional on this design.



LOADING CATEGORY E: 1-5% CBR

Conventional edge restraint

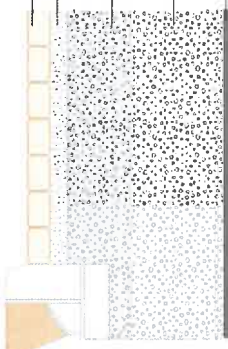
An upper geotextile is optional on this design.



LOADING CATEGORY F: 3 & 4% CBR

Conventional edge restraint

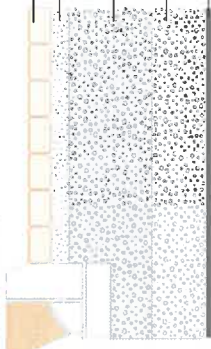
An upper geotextile is optional on this design.



LOADING CATEGORY F: 5% CBR

Conventional edge restraint

An upper geotextile is optional on this design.

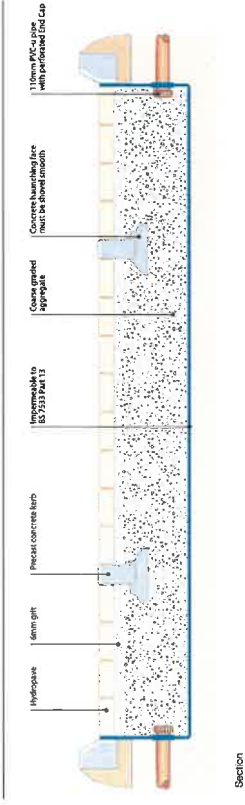


Notes 1 & 2% CBR - ground not suitable.

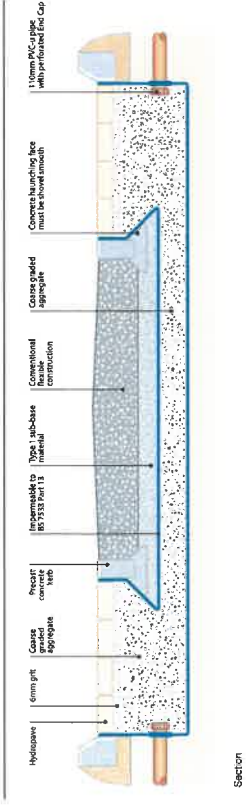
Road Attenuation

There is no specific provision for the adoption of SUDS techniques such as permeable pavements. Existing legislation, such as Section 38 of the Highways Act, 1980 and Section 106 of the Town and Country Planning Act, 1990, can provide a mechanism for their adoption in some cases. Whatever route is taken it is recommended that early consultation be undertaken with the relevant stakeholders to ensure responsibilities for long term maintenance are agreed. Further information can be found in BS7533-13:2009 Pavements constructed with clay, natural stone or concrete pavers guide for the structural design of permeable pavements.

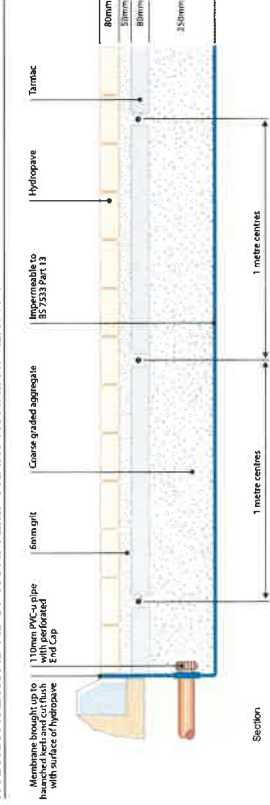
HYDROPAVE ROAD ATTENUATION SYSTEM



HYDROPAVE ROAD ATTENUATION SYSTEM

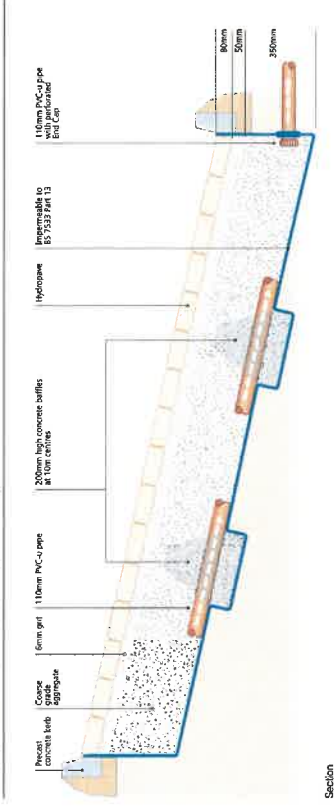


HYDROPAVE ROAD ADOPTION/TEMPORARY RUNNING SERVICE

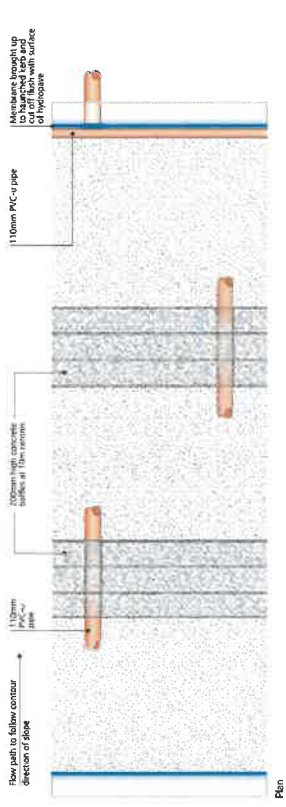


Sloping Site

SLOPING SITES ATTENUATION SYSTEM

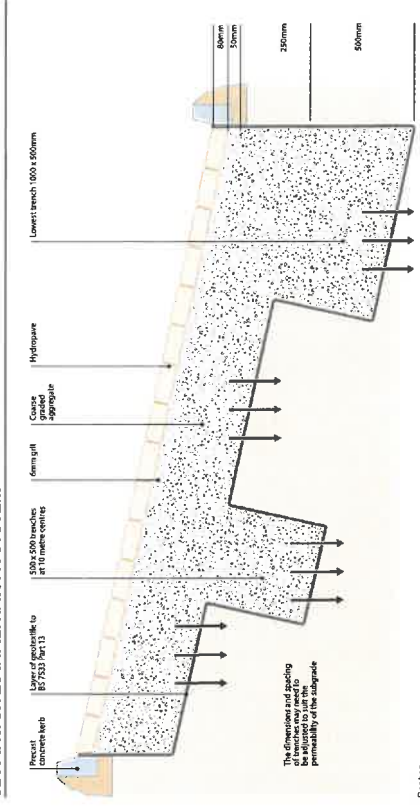


Section



Plan

SLOPING SITES INFILTRATION SYSTEM

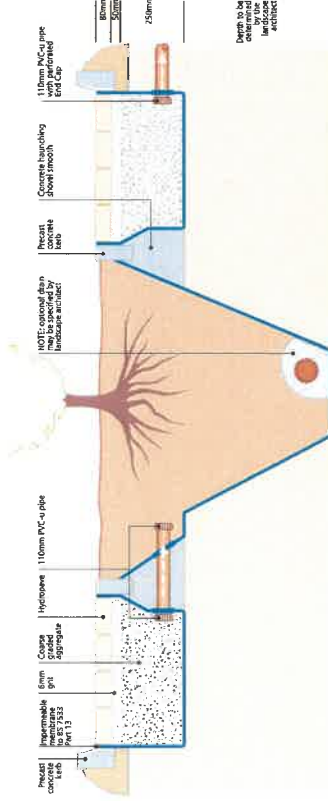


Section

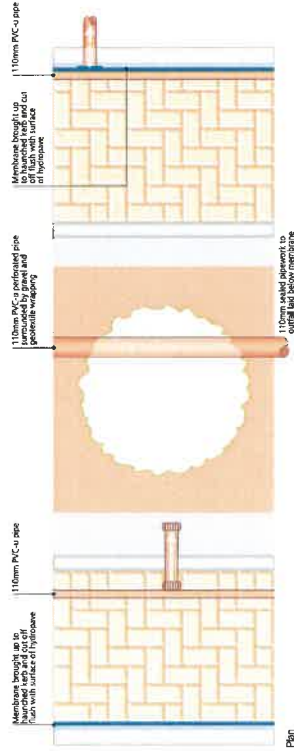
Notes: Lateral restraints are recommended on sloping sites greater than 1 in 20.

Tree Planting

TREE PLANTING ATTENUATION SYSTEM

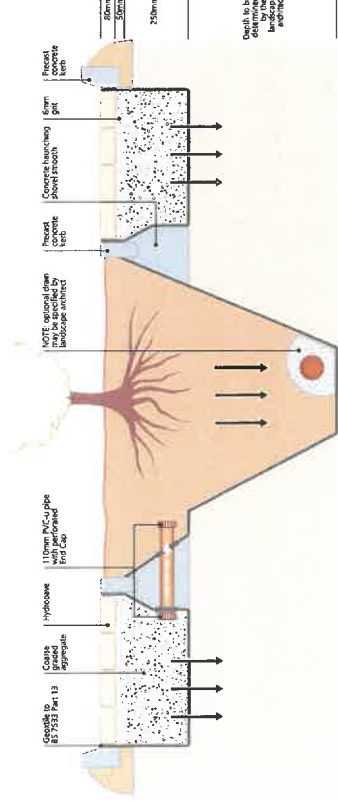


Section



Plan

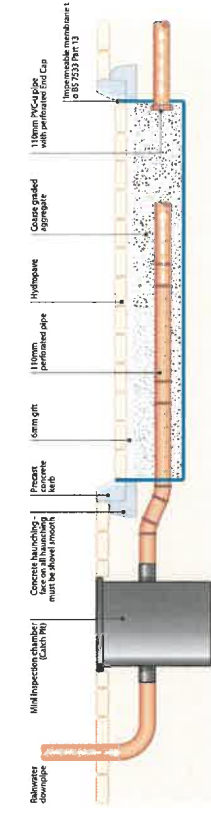
TREE PLANTING INFILTRATION SYSTEM



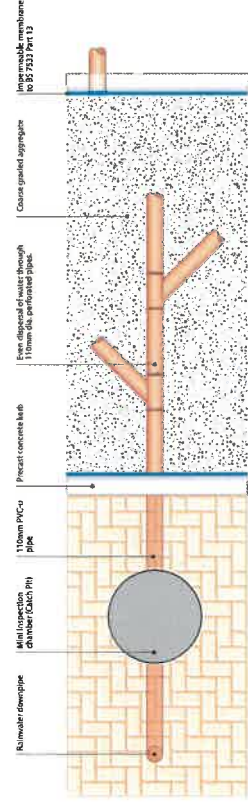
Section

Rainwater Downpipe

DOWNPIPE DRAINAGE INTO ATTENUATION SYSTEM

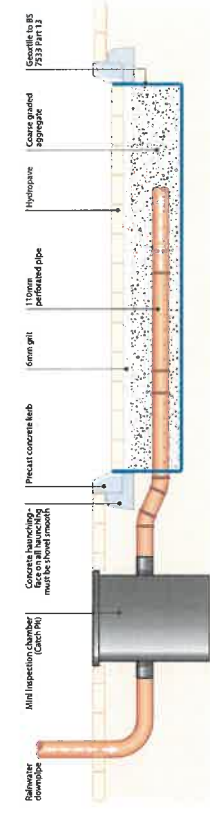


Section

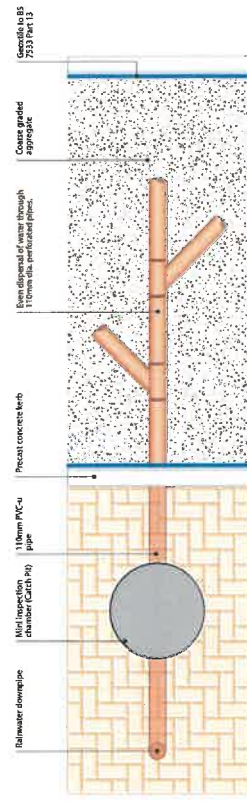


Plan

DOWNPIPE DRAINAGE INTO INFILTRATION SYSTEM



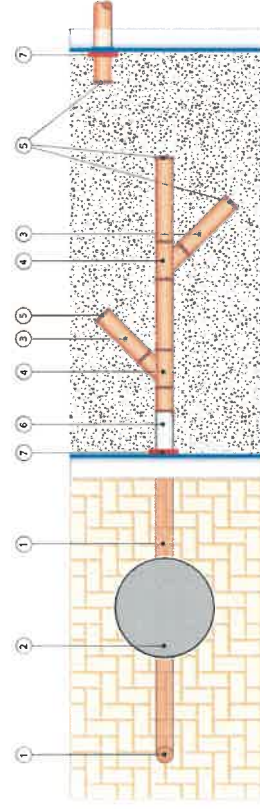
Section



Plan

Paving Utility Items

We have detailed a list of utility items that may be required on certain permeable paving schemes. In this example we have used products and codes from Polypipe. However, other equal or approved items can be used.



APPROVED PRODUCTS

1		UNIVERSAL 110mm diameter UPVC SW pipe	Available from all builders merchants
2		450mm diameter mini inspection chamber 'Catch Pit' with plastic lid	Polypipe reference code: CP45010B
3		100mm diameter Perforated Ridge Drain	Polypipe reference code: RD100X6PEP
4		100mm diameter Perforated Ridge Drain - 450 Junction	Polypipe reference code: JRD100100Y
5		100mm diameter External End Cap - perforate on-site using 6mm drill	Polypipe reference code: EC10591NT
6		110/100mm diameter Adapter	Polypipe reference code: ARD100110
7		110mm Top Hat Seal Joint (Butyl Tape is used to seal the Top Hat to the polythene)	www.radon.co.uk

Water Harvesting

Tobermore Hydropave products can also successfully be used in rainwater harvesting projects. Rainwater harvesting is a system where the rainwater from roofs and hard surfaces is collected through geo-cellular boxes under the paving.

This water is then distributed around the buildings and used for toilet flushing and watering gardens. Permeable paving provides the necessary filtration to remove debris and sediments which will improve the quality of the water. A Rainwater Harvesting system needs to be specially designed.

WATER HARVESTING SYSTEM

