



Castell Bach Engineering Ltd.



172-RP-001 – Drainage Strategy

Margam Youth Club, Port Talbot

Revision 2 – 15th October 21



REVISION TRACKING

Revision	Date	Revision Purpose	Description of Revision / Key Changes
A	2 nd October 2021	Internal Check	Initial draft for internal checking
1	7 th October 2021	Issued for Review	Incorporated internal comments.
2	25 th October 2021	Issued for Information	Incorporated minor changes.



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1 Introduction

1.1 Project Background

The Client proposes to extend and modify an existing community youth club building in Margam, South Wales. The works also includes the provision of new carparking facilities.

Castell Bach Engineering Ltd. has been appointed by the Client's Architect to complete a drainage strategy for the site to support the SAB application.

This report provides strategy for use as part of a SAB application. This report has been prepared based on infiltration testing carried out by the Client.

1.2 Scope of document

The scope of this document is to provide a drainage strategy to support the SAB submission for the proposed development as outlined in Section 1.1.

This drainage strategy investigates and advises on the most appropriate drainage solutions for the scheme incorporating practical, and where possible sustainable, drainage solutions. The document is intended to provide a drainage solution for the Client's scheme as illustrated in the Architect's proposed block plan (20-322P/107).

This report has been informed by guidance from publicly available information, known site constraints, mindful of existing infrastructure and current best practice and industry standards.

Soakaway Infiltration Testing has been carried out by Terra Firma on behalf of the Client.

This document will support the SAB submission by demonstrating compliance with SuDS standards and provide supplementary information for the project's proposal.



1.3 Location

The proposed development is at:
Margam Youth Club
Port Talbot
SA13 2DT

Grid Reference:
278187E, 187458N

The site consists of community buildings, playing fields and parking, see Figure 1.1 below.

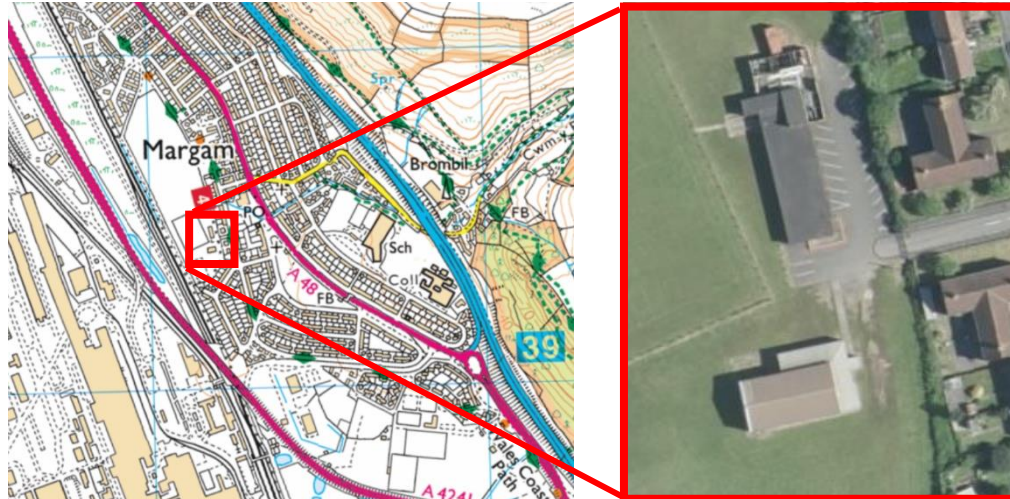


Figure 1.1 – Proposed Development Location (Source: <https://www.bing.com/maps>)

1.4 General Assumptions and exclusions

To support the applications that will follow for this site, further details of how drainage will be controlled will be provided along with hydraulic calculations for the proposed scheme.

The following assumptions and exclusions have formed the basis of this work and drainage strategy report:

1. The proposed development consists of the extension of an existing building, new patio area and additional carparking spaces;
2. The increase in site area is 0.12 Ha (1,184 m²)
3. Only surface water runoff is to be considered for this development;
4. Soil infiltration is assumed to be sufficient to support a soakaway to the south of site;
5. Water table is assumed to be below any proposed soakaway design.



1.5 Client Documentation

REF	DOCUMENT TITLE	DOCUMENT REFERENCE	REVISION/DATE
A-1	General Notes	201101-01-01	P01
A-2	Plan on Foundation Blockwork & Column GA	201101-01-02	P02
A-3	Plan on Roof Steelwork GA	201101-01-03	P02
A-4	Sections and Steelwork Elevations	201101-01-04	P02
A-5	Sections and Steelwork Elevations	201101-01-05	P02
A-6	Structural Details Sheet 1of2	201101-01-06	P02
A-7	Structural Details Sheet 2of2	201101-01-07	P02
A-8	Masonry Details	201101-01-08	P01
A-9	Existing Building Demolition Plan	20-322P/111	D
A-10	Substructure Plan	20-322/P112	Rev D
A-11	Proposed Floor Plan	20-322/P113	D
A-12	M & E Plan	20-322P/114	D
A-13	Proposed Roof Plan	20-322/P115	D
A-14	Proposed Elevations	20-322/P116	D
A-15	Proposed Sections	20-322/P117	D
A-16	Kitchen M & E Plan	20-322P/118A	D
A-17	WW Maps	N/A	30/06/21
A-18	Infiltration Results	16926 (Letter to Client from Terra Firma)	1 st September 2021
A-19	Carparking Plans	20-322P/106	C
A-20	Block Plan	20-322P/107	C

Table 1.1 – Client documentation



1.6 References

REF	DOCUMENT TITLE / SOURCE	DOCUMENT NUMBER / WEBLINK	REVISION
1	Bing Maps (website)	Bing.com/maps	May 2021
2	Google Maps (Website)	www.google.co.uk/maps	May 2021
3	Recommended non-statutory standards for sustainable drainage (SuDS) in Wales – designing, constructing, operating and maintaining surface water drainage systems	https://gov.wales/docs/desh/publications/151230-SuDS-standards-en.pdf	2017
4	Ciria SuDS Manual 2015	Ciria C753	2015
5	BRE Digest 365 – Soakaway Design by Stephen L Garvin	BRE Digest 365	Feb 2016
6	Recommended non-statutory standards for sustainable drainage (SuDS) in Wales – designing, constructing, operating and maintaining surface water drainage systems by Welsh Assembly Government	ISBN: 978 1 4734 8768 0	2017
7	Building Regulations Document - Drainage and Waste Disposal Approved Document H	Building Regulations – Approved Document H	2010
8	Sewers for Adoption 7th Edition	7 th Edition	2012
9	British Water – Code of Practice -Flow and Loads – 4, Sizing Criteria, Treatment Capacity for Sewage Treatment Systems	ISBN 978-1-903481-10-3	2013
10	Cranfield Soil and Agrifood Institute “Soil Scapes”.	http://www.landis.org.uk/soil-scapes/	2018
11	Urban Drainage by David Butler, Christopher Digman, Christos Makropoulos and John W. Davies.	ISBN 978-1-4978-5058-5	4 th Edition
12	Designing Attenuation Storage for Redeveloped Sites – Susdrain.org fact sheet	Ciria publication “Susdrain Fact Sheet”	January 2015

Table 1.2 – References and attachments



2 Proposed Development

2.1 Existing Site

2.1.1 General

The existing site is approached from the east off Knight Road. The Client site is bounded to the west by the A4241 and to the north, east and south by housing. The site consists of a number of community buildings, paved parking areas, playing fields and gravel parking areas.

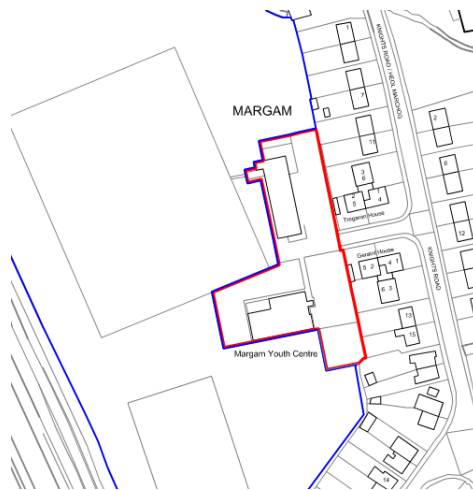


Figure 2.1 – Site Location Plan (Extract from Client provided site plan)

2.2 Existing Drainage Systems

The site is crossed by a sewer, this is assumed to be a combined system and at the time of writing this report, is assumed to not be suitable for a surface water discharge.



2.3 Predevelopment Surface Water Runoff

Based on available site data, there are no clear flow paths for surface water in the areas to be developed. The site is, in general, level with no obvious falls.

The Client has not reported any previous site flooding events. Reviewing NRW flood maps it can be seen that there is a small risk of flooding from surface water, small water courses and sea as shown in Section 2.3.1.

2.3.1 Surface Water and Small Water courses – Flood Zone 2

Some of the site is in an area with 0.1% to 1% (1 in 1000 or 1 in 100) chance of flooding from surface water and/or small watercourses in a given year, including the effects of climate change.

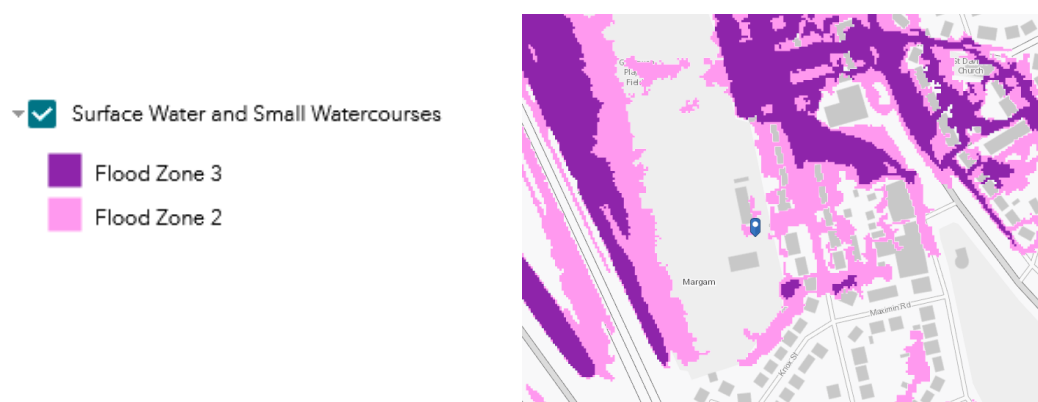


Figure 2.2 – Extract from NRW Flood risk maps – Surface Water

2.3.2 Sea – Flood Zone 2

The entire site is within an area with 0.1% to 0.5% (1 in 1000 to 1 in 200) chance of flooding from the sea in a given year including the effects of climate change.

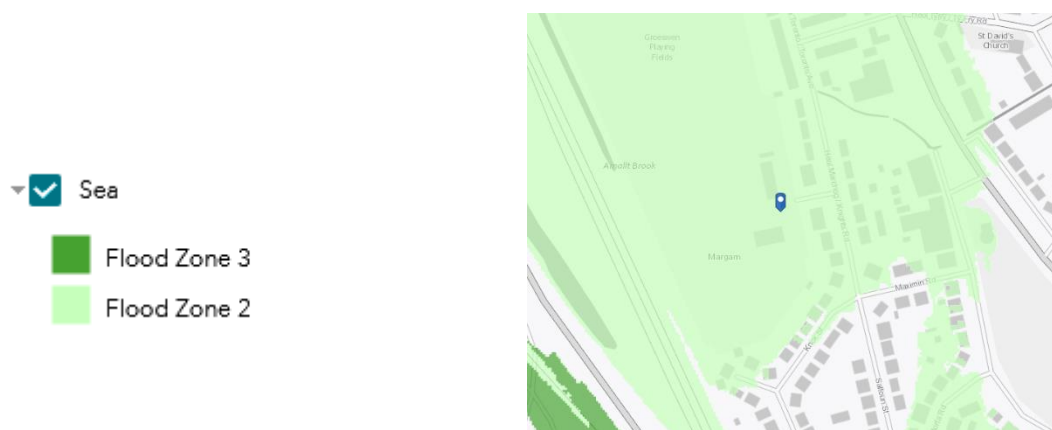


Figure 2.3 – Extract from NRW Flood risk maps - Sea



2.4 Infiltration

Infiltration testing has been undertaken by a specialist 3rd Party Consultancy. Trial Pits were excavated in 3 locations on site to ascertain if any areas would be suitable for the installation of a soakaway system. Location of trial pits were suggested by Castell Bach Engineering Ltd. and can be seen in Figure 2.4 below.



Figure 2.4 – Extract from Infiltration Report (Ref A-18)

The following infiltration rates were recorded as part of the testing by others.

INFILTRATION RATES		
TRIAL PIT	DEPTH RANGE OF TEST	INFILTRATION RATE
TP1	1.5-2.0	FAIL*
TP2	1.5-2.1	1.21x10 ⁻⁰⁴
TP3	0.7-1.2	FAIL*

*Too little water intake to calculate infiltration rate

Table 2.1 – Summary of Findings by Terra Firma (See Appendix C)



2.5 Proposed Development

The proposed development is an extension to an existing youth club building along with conversion of an existing unmarked gravel carpark to a hard surfaced parking area for up to 30 cars.

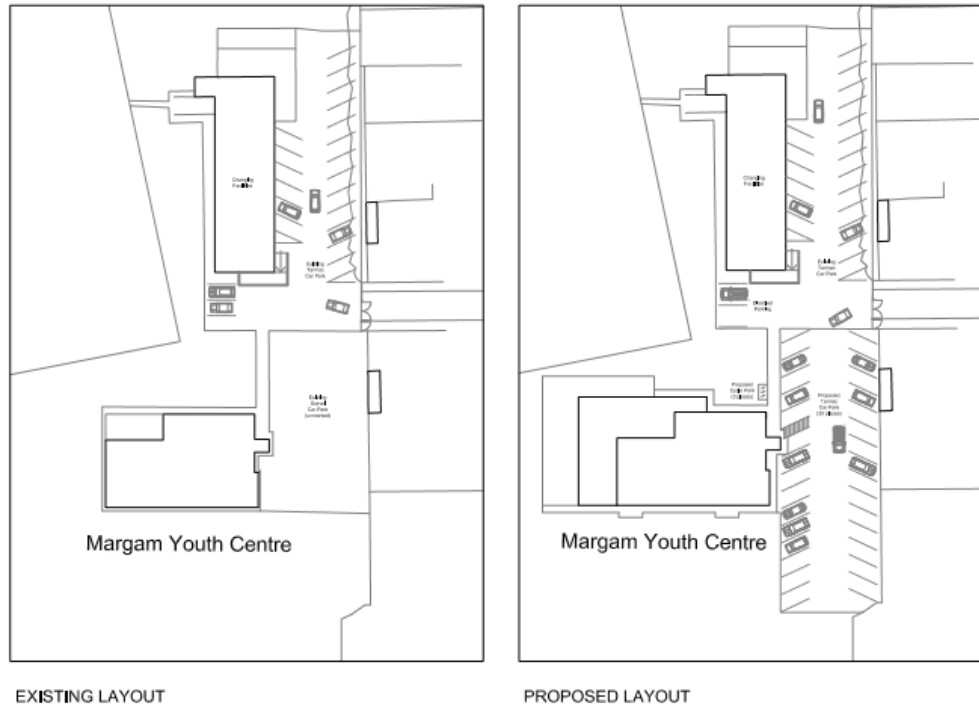


Figure 2.5— Proposed Development (Ref A-20)

The increase in surface areas which will require consideration of drainage due to the new development is estimated as follows:

- | | | |
|-----------------|---|-------------------|
| 1) Roof area | = | 219m ² |
| 2) Patio Area | = | 180m ² |
| 3) Parking Area | = | 785m ² |

Total increase in area is = 1,184m²



3 Drainage Strategy Development

Surface water drainage systems are to be provided for the site.

Additional impermeable roof, patio and carpark surface water run-off will be collected and directed to a soakaway.

The proposed parking areas will maximise the use of permeable paving, whilst providing a cost-effective use of impermeable surfaces in areas where high vehicle loadings may be encountered. Permeable surfaces shall be utilised within parking bays, with the approach routes being surfaced using impermeable surfaces. Discrete permeably surfaced parking areas shall be interconnected with piping.

As the parking area is in an area where soakaway tests failed, the subbase for the paving shall utilise an overflow pipe system into the common soakaway.

Parking subbase shall operate as an attenuation area, where slow infiltration may occur over time. However, the design shall be based on the premise that infiltration doesn't occur, and all waters shall overflow to soakaway which will be sized to suite.

It is proposed that the drainage systems will be designed in accordance with recommended non-statutory standards for sustainable drainage (SuDS) in Wales - designing, constructing, operating and maintaining surface water systems published by the Welsh Assembly Government in 2017, Building Regulations Document H 2002, Sewers for Adoption 7th Edition, BRE Digest 365 and Ciria's SuDS Manual where appropriate and will comply with any further Local Authority Design Guides and requirements of statutory undertakers.

"Drainage systems should be considered at the earliest stages of site design to influence the layout of the roads, buildings and public open spaces. Planning of a new site layout should be informed by the topography and the requirements of surface water management systems to both effectively drain and treat the runoff. Any existing watercourses, ditches, and other drainage features both within and adjoining the site should help inform proposals. By doing so, biodiversity, amenity and cost effectiveness can be maximised through using areas of land for a range of multifunctional purposes in addition to surface water management e.g. landscaping, car parking, recreational areas, rainwater harvesting etc"
Reference 3.

3.1 Sustainable Urban Drainage Systems (SUDS) Principals

The principals which underpin the design of surface water management schemes striving to meet the requirements of sustainable urban drainage schemes include:

- Manage water on, or close to, the surface and as close to the source of the runoff as possible.
- Treat rainfall as a valuable natural resource.
- Ensure pollution is prevented at source, rather than relying on the drainage system to treat or intercept it.
- Manage rainfall to help protect people from increased flood risk, and the environment from morphological and associated ecological damage resulting from changes in flow rates, patterns and sediment movement caused by the development.



- Take account of likely future pressures on flood risk, the environment and water resources such as climate change and urban creep by considering a 1 in 100-year storm plus 30% increase for climate change.
- Use the SuDS Management Train, using drainage components in series across a site to achieve a robust surface water management system (rather than using a single “end of pipe” feature, such as a pond, to serve the whole development).
- Maximise the delivery of benefits for amenity and biodiversity.

3.2 Design Storm Return Period

The surface water system will be designed to a 1 in 100-year storm. To allow for the effects climate change, an additional 30% will be applied to the rainfall amount. Storm durations up to and including the 6-hour storm will be considered.



4 Standard S1- Surface Water Run-Off Destination

The aim of surface water runoff design is to ensure that runoff is treated as a resource and managed in a way that minimises negative impact of the development on flood risk, the morphology and water quality of receiving waters and the associated ecology

Means of surface water disposal have been explored in the hierarchical order recommended by non-statutory standards for sustainable drainage (SuDS) in Wales - designing, constructing, operating and maintaining surface water systems published by the Welsh Assembly Government in 2017 which is, in part, echoed by Building Regulations Document H, 2002.

4.1.1 Priority Level 1 – Rainwater Collected for Use

Integrating rainwater harvesting systems can offer a reduction in run-off volume. This method alone will not be adequate enough to deal with site wide generated run-off, and isn't practical to deal with run off from paving.

As the scheme proposed is large area, with roof, patio and parking, it is assumed that rainwater collection will be unfeasible to be included in design considerations. Client may still wish to install these systems, but not benefit has been considered by using these in the drainage design philosophy.

4.1.2 Priority Level 2 - Discharge to Ground

As has been discussed in section 2.4 above, currently, the assumption here is that infiltration is sufficient in area surround TP2 of the soakaway tests. Therefore priority level 2 applies.

4.1.3 Priority Level 3 - Discharge to Watercourse

The site will discharge to the subsoils by infiltration, watercourse options not considered.

4.1.4 Priority Level 4: Discharge to surface water sewer, highway drain or another drainage system

The site will discharge to the subsoils by infiltration, surface water sewer exploration has not been undertaken.

4.1.5 Priority Level 5: Discharge to a combined sewer.

The site will discharge to the subsoils by infiltration, combined sewer exploration has not been undertaken.

4.2 Greenfield Discharge Rates

The proposed strategy is to allow all surface water to dissipate by infiltration up to and including the 1 in 100-year storm (+30% allowance for climate change). Under this design criteria, there will be no discharge from site.



4.2.1 Sustainable Urban Drainage Systems (SUDS)

The SuDS approach mimics natural drainage, managing surface water at or close to the surface and as close to its source as practicable, controlling the flow (volume and rate) and providing a range of additional benefits.

The most effective SuDS use a series of various drainage components, working as a 'management train' to control flow rates, reduce volumes of run-off as well as to provide treatment to protect the receiving environment. They are recognised to deliver a range of important benefits including, but not limited to;

- Contributing to the delivery of Water Framework Directive, Local Flood Risk Management and Local Biodiversity Action Plan objectives;
- Adding social, economic and environmental value by improving the quality of urban design, adding enhanced amenity space and providing habitats and wildlife corridors;
- Contributing to health and wellbeing through access to green space, reduced urban temperatures, improved air quality and noise buffering;
- Help strengthen communities by providing a focus for environmental education and public engagement in environmental protection close to home;
- Helping to improve the adaptability of the drainage system to development pressures; and
- Supporting development resilience to climate change.

For the development, there is limited scope for extensive surface SuDS systems in a "train". However, what is considered to be practical, is the introduction of permeable paving and soakaway, for the containment and controlled discharge of any additional surface water collected from the extended roof and the parking area.

The Client has not specified a product for the permeable paving, however utilisation of "Hydropave" permeable paving systems could be suitable. This type of paving is manufactured by Tobermore, more information on which can be found in Appendix D.



5 Standard S2 – Hydraulic Control- Permeable Paving / Soakaway

This report investigates the suitability of introducing Hydropave permeable paving into the overall drainage strategy for the site. It does not look into the structural suitability of the paving system. Permeable paving will be utilised around carparking areas.

The structural design of all paving is the responsibility of others.

Below in figure 3.2 is an illustration of how the work flows between hydraulic design and structural design of permeable paving should be implemented. The depth of sub-base depends on the loading category (CBR value), the infiltration rate of the ground and how much water needs to be retained.

At this stage of the project, a structural design for paving hasn't been received, so this report shall present a suitable construction of paving based on hydraulic design only.

Client shall ensure that Principal Contractor/ Principal Designer reviews and verifies the proposed paving hydraulic design meets the paving structural requirements of the project.

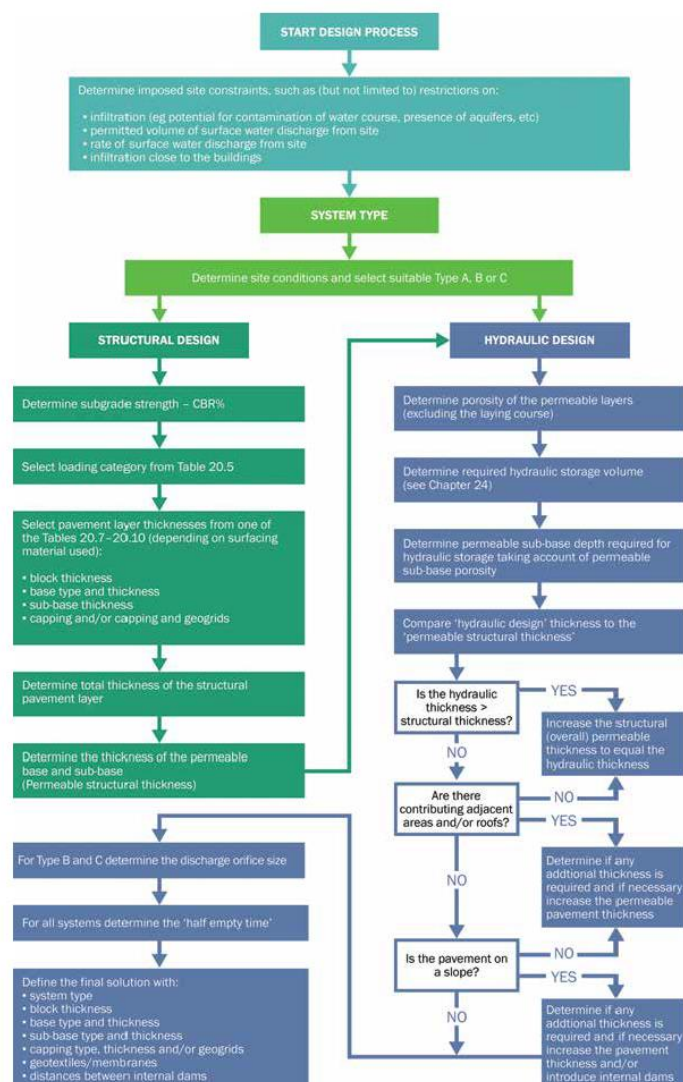


Figure 20.19 Pervious pavement design flow chart (after Interpave, 2010)

Figure 3.2 – Paving workflow for structural and Hydraulic Design (Ref 4).



5.1.1 Soakaway Requirements

A single soakaway shall be utilised to cater for all the additional surface water run off for the development. This soakaway has been sited within an area of proven infiltration capabilities.

Permeable paving shall be utilised within the carpark to help capture and convey surface water to the single soakaway.

The sub base of the permeable paving construction shall allow slow infiltration; however, the hydraulic design of the overall system doesn't take into consideration of this infiltration and is considered a beneficial, not essential, part of the design. The depth of the subbase will be based on hydraulic and structural design considerations. Hydraulically there is no required depth, however an invert to the overflow of 50-100mm above the sub base depth has been recommended. This allows an element of slow infiltration, with any overflow being conducted to the soakaway for infiltration as per design.

The scope of this document is only considering hydraulic design. Based on a 1 in 100-year storm + 30% allowance for climate change,

There are numerous suppliers of permeable paving systems, but a typical permeable paving system would have 30% voids within the structure of the paving. The *Tobermore Hydropave* permeable paving system suggested has a specific void of 30% minimum.

It is recommended that to ensure soakaway performance throughout the lifetime of the paving, an inspection should be undertaken before the autumn and at the end of winter each year with the permeable paving maintained in accordance with the manufacturers' recommendations (see Appendix E for more information).



6 Standard S3- Pollution Mitigation

A simple qualitative index approach has been used to assess potential pollution hazards (in line with Chapter 26: Water Quality Management of CIRIA SuDS Manual 2015).

Suitable pollution hazard indices for the land use have been evaluated in table 3.2 below:

RISK INDICES				
Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Non-residential car parking with infrequent change (<300 traffic movements/day).	Low	0.5	0.4	0.4
Other roofs (Typically commercial / industrial roofs)	Low	0.3	0.2	0.05

Table 3.2 – Risk Indices

Suitable pollution mitigation indices for the land use have been evaluated in table 3.3 below:

MITIGATION INDICES			
Land Use	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Permeable Paving	0.7	0.6	0.7
Silt trap (estimated – proprietary product)	0.4	0.4	0.4

Table 3.3 – Risk Indices

Roof run off will run through a silt trap prior to entering the soakaway, silt trap shall be selected based on ability to deal with the low-level risk indices from roof (and patio) run off.

As indicated in Table 3.3, the proposed permeable paving is capable of mitigating any potential hazards identified on the carpark area. A geotextile membrane could be utilised to separate the porous/permeable structural layers from the subgrade and aid with potential contamination control.



7 Standard S4- Amenity

On a project of this nature, there is limited opportunity to incorporate major enhancements of high-quality open space. However, it is considered that the use of permeable paving will provide a softened landscaping to other more traditional “harder” forms of paving which would have typically been used prior to implementation of SUDS requirements.



8 Standard S5- Biodiversity

Natural habitats in the remainder of the site will be undisturbed for the most part. The site will not be dissected by the proposed works and as such the surrounding habitat remains linked.



9 Health and Safety

The Asset owner is ultimately responsible for conducting a suitable and sufficient assessment of the SuDS for the use, inspection and maintenance of the system. However, whilst Castell Bach under CDM Regs 2015, is not the Principal Designer on this project, we understand the importance of working with all project stakeholders in identifying, removing, elimination, reducing and communicating any foreseen risks.

Health and safety of SuDS starts with design. Risk assessments at the design stage are an important step and should include the identification of any hazards in the design, suitable actions to eliminate or reduce the risks to builders, maintainers and users of the SuDS systems and the information regarding the residual risks in order that they may be effectively controlled on site (Ref 4).



10 Conclusion

10.1 Conclusion

Means of surface water disposal have been explored in the hierarchical order dictated by recommended non-statutory standards for sustainable drainage (SuDS) in Wales - designing, constructing, operating and maintaining surface water systems published by the Welsh Assembly Government in January 2016 which is echoed by Building Regulations Document H, 2002.

A storm return period of a 1 in 100-year storm have been used as a basis for design. To allow for the effects climate change, an additional 30% has been applied to the rainfall amount. Storm durations up to and including the 6-hour storm have been considered.

Permeable paving coupled with soakaway have been utilised based on information from infiltration testing which has been undertaken. Pollution mitigation has been considered utilising a simple qualitative index approach.

Proposed drainage schematic can be seen in Appendix C. This is illustrative only and will be refined once feedback is received from the pre-application process.

10.2 Ongoing Inspections and Maintenance of Drainage infrastructure

10.2.1 Soakaways

As with any drainage system, the asset owner must incorporate this design into their ongoing maintenance regime. It is recommended that the permeable paving is inspected twice a year, both before the autumn and after winter. Any maintenance to the permeable paving must be in accordance with the manufacturer's recommendations. Silt traps should be inspected annually and emptied as required. See Figure 5.1.

The maintenance of the permeable paving should be in accordance with the manufacturer's recommendations (See section 10.2.2).



The SUDS Manual (CIRIA) (See Ref 4) offers the following advice with regards to infiltration system maintenance:

CIRIA SuDS Manual 2015

TABLE 13.1 Operation and maintenance requirements for soakaways		
Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect for sediment and debris in pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	Annually
	Cleaning of gutters and any filters on downpipes	Annually (or as required based on inspections)
	Trimming any roots that may be causing blockages	Annually (or as required)
Occasional maintenance	Remove sediment and debris from pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	As required, based on inspections
Remedial actions	Reconstruct soakaway and/or replace or clean void fill, if performance deteriorates or failure occurs	As required
	Replacement of clogged geotextile (will require reconstruction of soakaway)	As required
Monitoring	Inspect silt traps and note rate of sediment accumulation	Monthly in the first year and then annually
	Check soakaway to ensure emptying is occurring	Annually

Figure 5.1 – Operation and Maintenance Requirements for Soakaways

10.2.2 Permeable Paving

As a guide, the following inspection and maintenance regime should be considered for the permeable paving. This requirement can be revisited and refined once the detailed design has been completed by the Principal Designer.

- recommended inspection is once a year during heavy rains. This can be a by the home owner.
- Recommended maintenance for aesthetics of joints is annually, or more frequently at the discretion of the home owner. This maintenance is basic and doesn't require specialist tools, but should homeowner wish to bring in a Contractor to do the work, an estimate of £500
- Working life is shown as 15 years till the 400mm/hour infiltration (as per guidelines) is lost, so long-term renewal works will be needed then. Cost for this could be £5000.

See Appendix E for further information on the maintenance and inspection of Tobermore Hydropave paving.



Appendix A – NRW FLOOD MAP



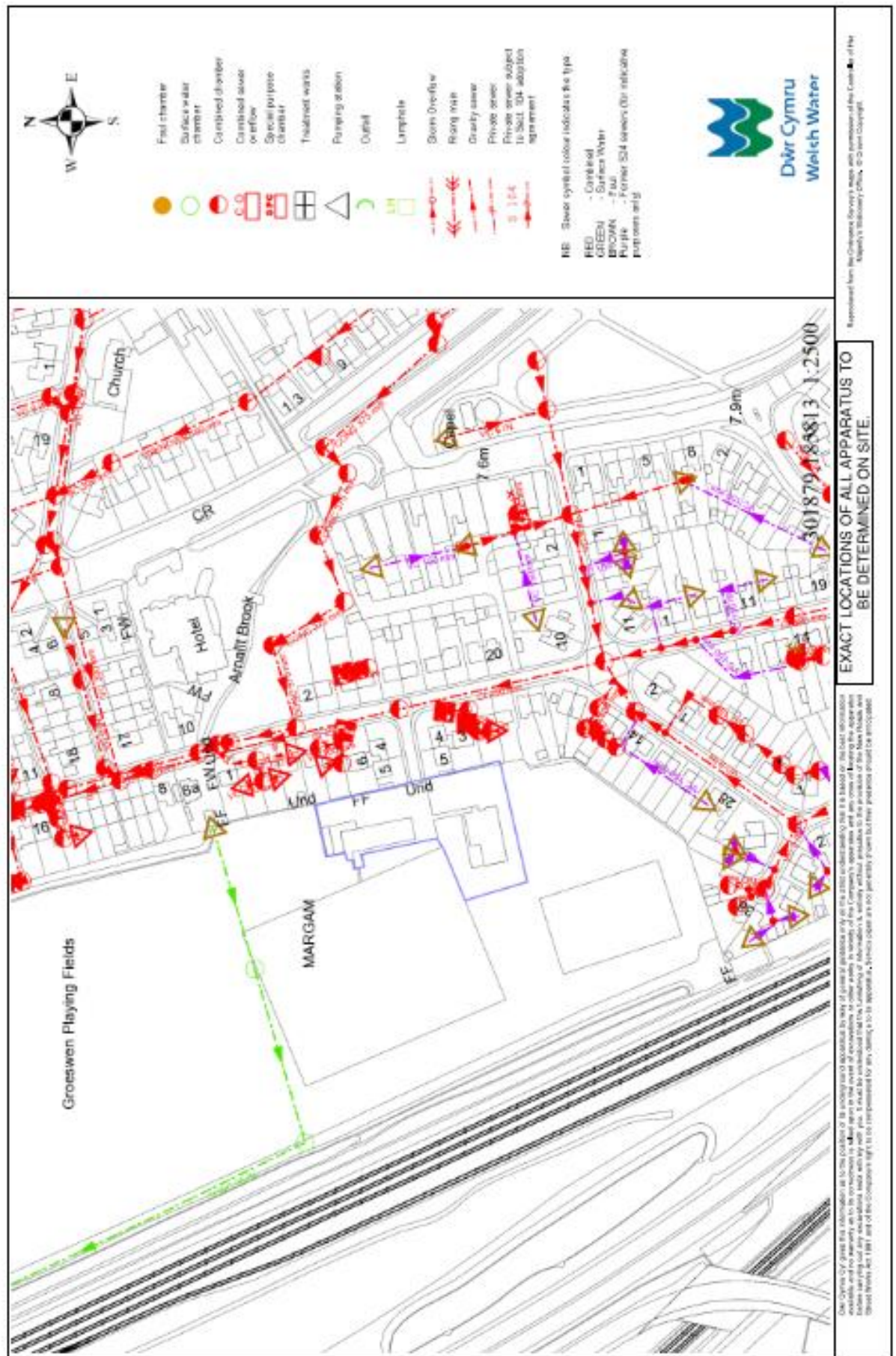


Appendix B – Welsh Water Maps



2021/6/541694/584332

Appendix 3 - Extract of the Public Sewer Map for the area surrounding the property/plot [30/06/2021]





Appendix C– Infiltration Results

Our Ref: 16926

Your Ref:

Contact: Elliot Sampson

1st September 2021

CJ Construction (Wales) Ltd.
P.O Box 71, The Builders Yard
Somerset Lane
Taibach
Port Talbot
SA13 1UA

For the attn. of Alex Holland

Dear Alex

SOAKWAY TESTING: Margam Youth Centre, Port Talbot.

1.0 Introduction

CJ Construction is proposing the extension of Margam Youth Centre and associated stormwater drainage.

Terra Firma Wales Ltd have been commissioned by CJ Construction to undertake soakaway testing at the site to aid in the design of the project's sustainable urban drainage scheme.

1.1 Limitations and Exceptions of Investigation

CJ Construction have requested that in-situ soakaway testing be performed at the site.

The report has been conducted and this report has been prepared for the sole internal reliance of CJ Construction and its design and construction team. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Terra Firma (Wales) Limited. If an unauthorised third party comes into possession of this report, they rely on it at their peril and the authors owe them no duty of care and skill.

The report represents the findings and opinions of experienced geotechnical and geoenvironmental consultants. Terra Firma (Wales) Limited does not provide legal advice and the advice of lawyers may also be required. The subsurface geological profiles, any contamination and other plots are generalised by necessity and have been based on the information found at the locations of the exploratory holes and depths sampled and tested.

2.0 Site Work

Site investigation works were undertaken on 23rd of August 2021 and comprised the excavation of three trial pits and three soakaway tests.

The fieldworks were supervised by Terra Firma (Wales) Limited on a full time basis, who also logged the trial pits to the requirements of BS5930.

The position and depth of the soakaway tests was determined by CJ Construction and set out by Terra Firma Wales Ltd.

The trial pit logs are presented in **Annex A** and their locations are shown on **Drawing 01**.

Soakaway test were carried out in trial pits TP01 to TP03 in accordance with BRE DG 365:2016. The excavation sides were squared using the excavator bucket and dimensions recorded within the test section. The trial pit was partially filled with clean water using a dedicated bowser with a 75mm diameter outlet and the fall in level recorded against time. The results are presented in **Annex B**.

3.0 Ground Conditions

The ground conditions encountered by the exploratory holes TP01 and TP03 can in general be summarised as shown in **Table 3.1**.

Table 3.1 Summary of Typical Ground Conditions (TP01, TP02 & TP05)

Depth (m)			Thickness (m)	Stratum
0.00	-	0.20/0.30	0.20/0.30	Slightly sandy slightly gravelly clayey SILT. (MADE GROUND)
0.20/0.30	-	1.20/>2.00	1.00/>1.80	Slightly sandy gravelly clayey SILT. (MADE GROUND)

The ground conditions encountered by the exploratory holes TP02 can in general be summarised as shown in **Table 3.2**.

Table 3.2 Summary of Typical Ground Conditions (TP03 & TP04)

Depth (m)			Thickness (m)	Stratum
0.00	-	0.30	0.30	Slightly sandy slightly gravelly clayey SILT. (MADE GROUND)
0.30	-	1.60	1.30	Slightly sandy gravelly clayey SILT. (MADE GROUND)
1.60	-	>2.10	>0.50	Orangish brown mottled black slightly gravelly sandy CLAY

4.0 Soakaway Test Results

During the site investigation four soakaway tests were undertaken in general accordance with BRE DG 365:2016, where applicable.

Three fills were achieved in trial pit TP02. The remaining trial pit soakaways (TP01 and TP03) were filled only once due to limited or negligible infiltration, **Table 4.1** summarises the results.

Table 4.1 Summary of Soakaway Results

Trial Pit	Depth Range of Test (m)	Infiltration Rate (ms ⁻¹)
TP01	1.50-2.00	Too little water take to calculate infiltration rate.
TP02	1.50-2.10	1.21x10 ⁻⁰⁴
TP03	0.70-1.20	Too little water take to calculate infiltration rate.

It is therefore considered that Sandy Clay soils in the vicinity of TP02 at a depth in excess of 1.60m are suitable for soakaway stormwater drainage.

Proposed soakaways should be positioned at least 5.0m away from any structure.

Soakaway calculation sheets are presented in **Annex B** for reference.

We trust that the above is to your satisfaction, however, if you have any queries or require any further information please do not hesitate to contact us.

Yours sincerely

for: **Terra Firma (Wales) Ltd**



Mr E. Sampson

enc.

Annex A – Trial Pit Logs

Annex B – Soakaway Results

Drawing 01 – Test Locations

ANNEX A
Trial Pit Logs

Trial Pit Log

Trial Pit No:
TP01
 Sheet 1 of 1

Project Name: **Margam Youth Centre**

Project No:
16926

Co-ords: -
 Level:

Date:
23/08/2021

Location: **Margam Youth Centre**

Dimensions: **2.00**

Depth
2.00

0.60

Scale:
1:25

Logged:
ES

Client: **CJ Construction**

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.20			MADE GROUND. Grass over slightly sandy slightly gravelly clayey SILT. Sand is fine to coarse. Gravel is angular and subangular fine to coarse of mixed lithologies
							MADE GROUND. Slightly sandy gravelly clayey SILT with frequent concrete fragments (<300m x 300mm x 300mm). Sand is fine to coarse. Gravel is angular and subangular fine to coarse of mixed lithologies
				2.00			End of Pit at 2.000m

Stability: **Stable**

Remarks:

Trial Pit Log

Trial Pit No:
 TP02
 Sheet 1 of 1

Project Name: Margam Youth Centre

Project No:
 16926

Co-ords: -
 Level:

Date:
 23/08/2021

Location: Margam Youth Centre

Dimensions:

1.50

Depth

0.60

2.10

Scale:

1:25

Logged:
 ES

Client: CJ Construction

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.30			MADE GROUND. Grass over slightly sandy slightly gravelly clayey SILT. Sand is fine to coarse. Gravel is angular and subangular fine to coarse of mixed lithologies
				1.60			MADE GROUND. Slightly sandy gravelly clayey SILT with frequent concrete fragments (<300mm x 300mm x 300mm), rare wood fragments (<30mm x 30mm x 50mm). Sand is fine to coarse. Gravel is angular and subangular fine to coarse of mixed lithologies
				2.10			Orangish brown mottled black slightly gravelly sandy CLAY with frequent ashy pockets (<10mm x 20mm x 20mm). Sand is fine to coarse. Gravel is angular and subangular fine to coarse of mixed lithologies.
							End of Pit at 2.100m

Stability: Stable

Remarks:

Trial Pit Log

Trial Pit No:
TP03
 Sheet 1 of 1

Project Name: **Margam Youth Centre**

Project No:
16926

Co-ords: -
 Level:

Date:
23/08/2021

Location: **Margam Youth Centre**

Dimensions:

1.50

Depth
 1.20

0.60

Scale:
 1:25

Logged:
 ES

Client: **CJ Construction**

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.30			MADE GROUND. Slightly sandy slightly gravelly clayey SILT. Sand is fine to coarse. Gravel is angular and subangular fine to coarse of mixed lithologies	
							MADE GROUND. Slightly sandy gravelly clayey SILT with frequent concrete fragments (<300m x 300mm x 300mm). Sand is fine to coarse. Gravel is angular and subangular fine to coarse of mixed lithologies	1
				1.20			End of Pit at 1.200m	2
								3
								4
								5

Stability: **Stable**

Remarks:

ANNEX B
Soakaway Results

SOAKAWAY TEST



Site Name: Margam Youth Centre
Project Number: 16926
Date: 23/08/2021
Engineer: Elliot

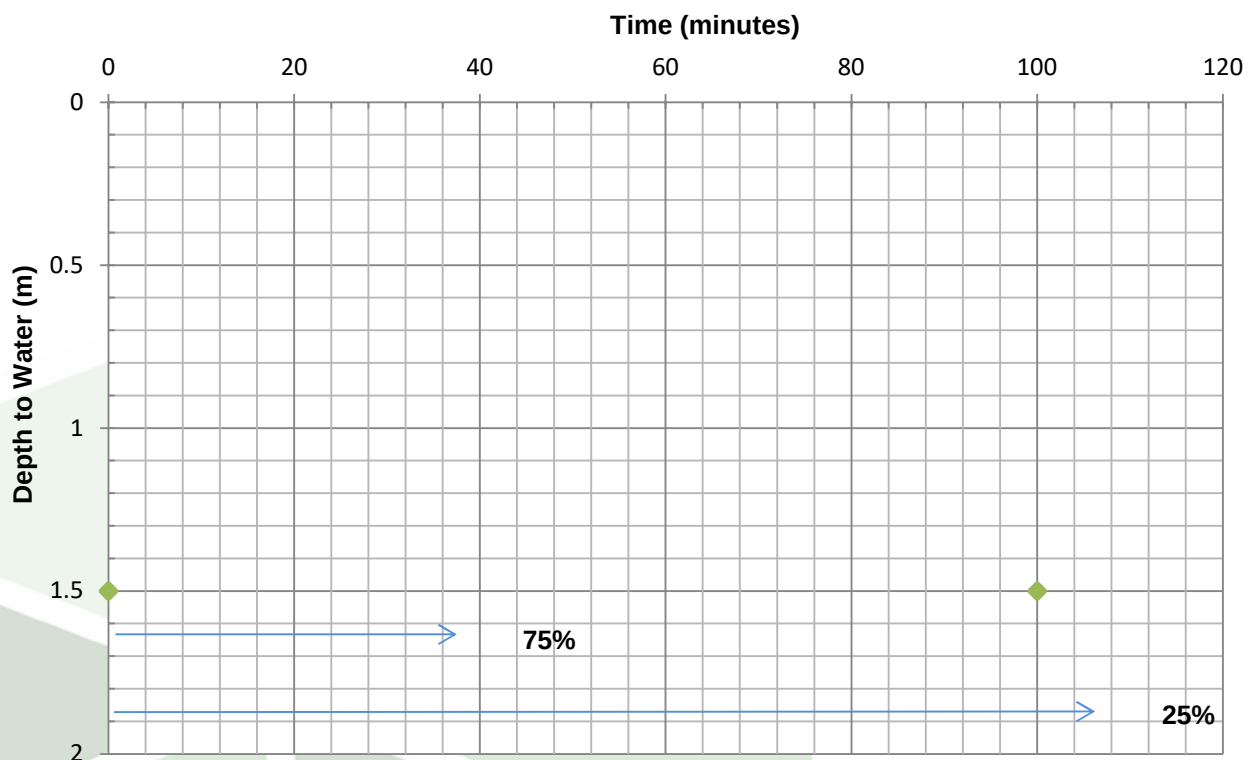
Borehole: TP01

TEST 1

Length	2.00 m
Width	0.60 m
Depth	2.00 m
Fill Level	1.50

V_{p75-25} 0.071 m³
 a_{p50} 0.754 m²
 t_{p75-25} 0 minutes

Soil Infiltration Rate, f insufficient flow to calculate infiltration rate



REMARKS:

Test carried out in general accordance with BRE DIGEST 365 (2016)

SOAKAWAY TEST



Site Name: Margam Youth Centre
Project Number: 16926
Date: 23/08/2021
Engineer: Elliot

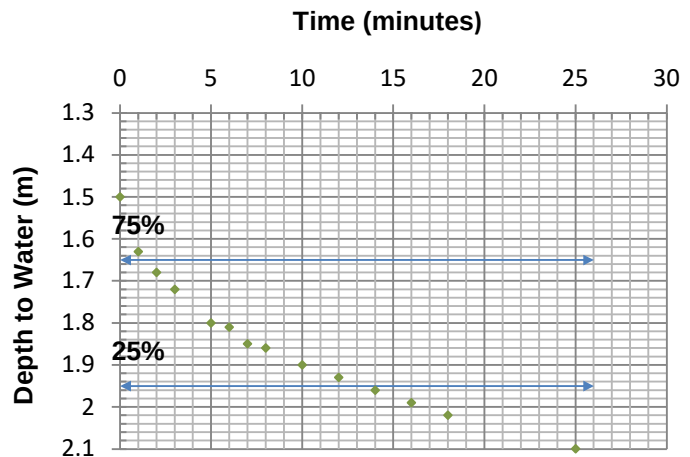
Trial Pit: TP02

TEST 1

Length 1.50 m
Width 0.60 m
Depth 2.10 m
Fill Level 1.50 m

V_{p75-25} 0.27 m³
 a_{p50} 2.16 m²
 t_{p75-25} 12 minutes

Soil Infiltration Rate, f 1.74E-04 ms⁻¹

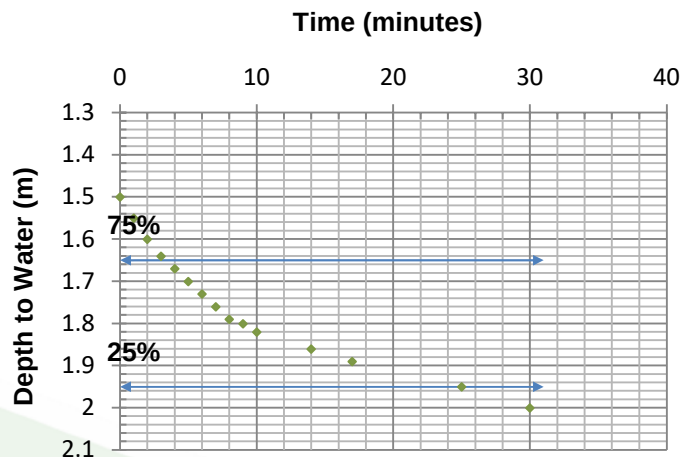


TEST 2

Length 1.50 m
Width 0.60 m
Depth 2.10 m
Fill Level 1.50 m

V_{p75-25} 0.27 m³
 a_{p50} 2.16 m²
 t_{p75-25} 21.75 minutes

Soil Infiltration Rate, f 9.58E-05 ms⁻¹

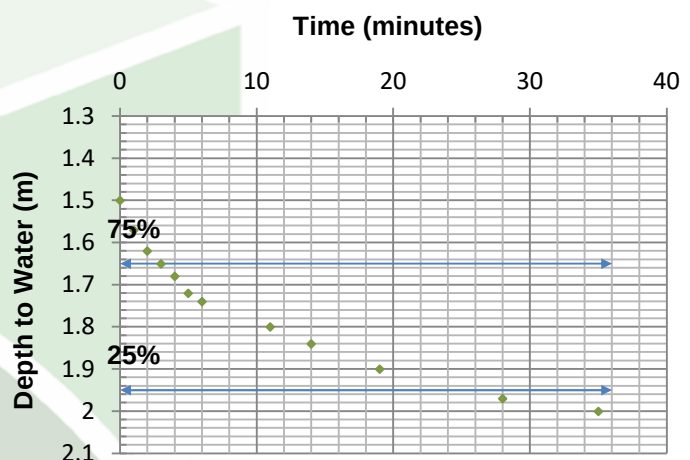


TEST 3

Length 1.50 m
Width 0.60 m
Depth 2.10 m
Fill Level 1.50 m

V_{p75-25} 0.27 m³
 a_{p50} 2.16 m²
 t_{p75-25} 22 minutes

Soil Infiltration Rate, f 9.47E-05 ms⁻¹



REMARKS:

Test carried out in accordance with BRE Digest 365 (2016)

SOAKAWAY TEST



Site Name: Margam Youth Centre
Project Number: 16926
Date: 23/08/2021
Engineer: Elliot

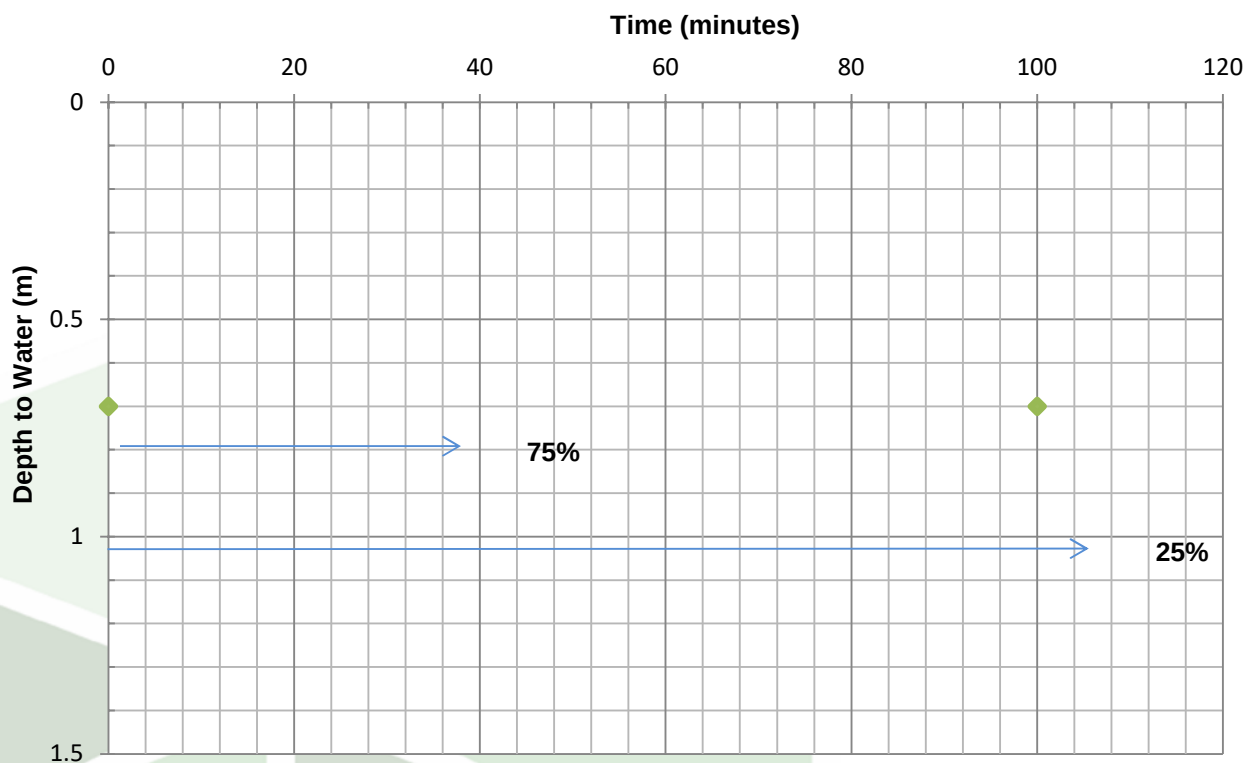
Borehole: TP03

TEST 1

Length	2.00 m
Width	0.60 m
Depth	1.20 m
Fill Level	0.70

V_{p75-25}	0.071 m ³
a_{p50}	0.754 m ²
t_{p75-25}	0 minutes

Soil Infiltration Rate, f insufficient flow to calculate infiltration rate



REMARKS:

Test carried out in general accordance with BRE DIGEST 365 (2016)

DRAWINGS





Appendix D – Soakaway Sizing Calculations

Soakaway Design calculation			
Project Number	172	By	GWP
Project Title	Margam Youth Club	Checked	JW
Calculation Reference	172-CA-001	Rev	
Calculation description	Clean Stone Soakaway	Date	01/10/2021



This set of calculations is based on methods set out within BRE Digest 365 & The Modified Rational Method.

The site determined soil infiltration rate used in this design is 0.3409 m/hr (0.0000947 m/s).

Site location = X: 278171, Y: 187472
M5-60 = 17 mm (5 year, 60 minute rainfall total)
Rainfall ratio = 0.3 (ratio of M5-60 minute to M5-2 day total rainfalls)

Area = 1184 m²
% run-off = 95 %

Width =	7.00 m	Type =	Clean Stone Pit
Length =	7.00 m	Porosity =	0.3
Depth =	2.00 m	Water storage provided =	29.40 m ³

$$\ln(M5-D)=\ln D+\ln\left(1.06\frac{M5-60\text{min}}{48r}\right)+\left[\frac{\ln\left(\frac{721}{1+15D}\right)\ln\left(\frac{48r}{1.06}\right)}{\ln\left(\frac{721}{16}\right)}\right]$$
$$\ln\left(\frac{MT-D}{M5-D}\right) = C_r(\ln(T) - 1.5)$$
$$C_r = J_0 + J_1 (M5 - D) + J_2 (M5 - D)^2$$

The constants J0, J1 and J2 are dependent on M5-D and are referenced direct from Volume 1 of the Wallingford Procedure, Table 6.1.

Soakaway Design calculation

Project Number	172	By	GWP
Project Title	Margam Youth Club	Checked	JW
Calculation Reference	172-CA-001	Rev	A
Calculation description	Clean Stone Soakaway	Date	01/10/2021



Page 2/2

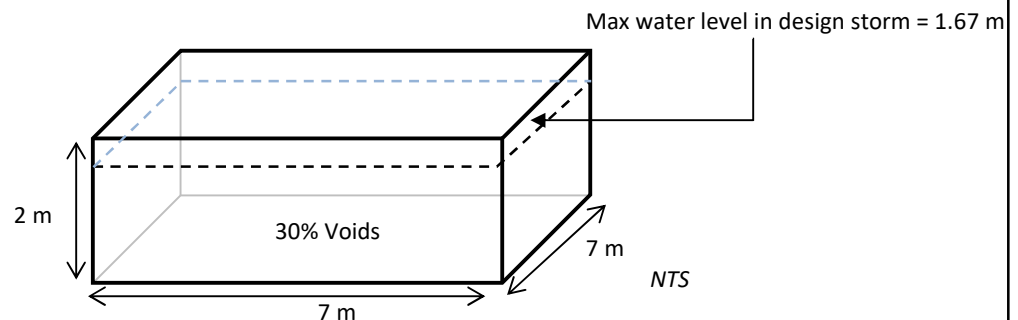
Inflow/Outflow Calculations

Storm Duration, D (min)	M5-D Rainfall (mm)	M100-D rainfall (mm)	M100-D + 30% CC (mm)	Rainfall Intensity (mm/hr)	Inflow (m ³)	Outflow (m ³)	Storage Required (m ³)
5	5.43	9.75	12.68	152.14	14.26	2.19	12.07
10	8.03	14.92	19.40	116.40	21.82	4.38	17.45
15	9.77	18.64	24.23	96.92	27.25	6.56	20.69
30	13.11	25.78	33.51	67.03	37.70	13.13	24.57
60	17.00	34.16	44.41	44.41	49.95	26.25	23.70
120	21.61	43.83	56.97	28.49	64.09	52.50	11.58
240	27.18	54.44	70.78	17.69	79.61	105.00	-25.40
360	31.00	60.85	79.11	13.18	88.98	157.51	-68.53
600	36.52	69.98	90.97	9.10	102.32	262.51	-160.19
1440	48.24	87.99	114.38	4.77	128.66	630.02	-501.36

Maximum storage required = 24.6 m³
 Storage provided = 29.4 m³
 Storage utilisation = 83.6 %

Therefore, storage = OK
 Half empty time = 0.47 hr
 Max water level = 1.67 m

Soakaway Design Summary



Type of Soakaway = Clean Stone Pit
 Water Vol Provided = 29.4 m³
 Design Return Period = 100 Yr
 Climate Change = 30 %
 Critical storm = M100-30 + 30% allowance for climate change
 Water Vol Required = 24.57 m³
 Half empty time = 0.47 Hours



Appendix E– Tobermore Hydropave Datasheets



Hydropave Permeable Paving Maintenance Guidelines

v1.0

Guidelines for the maintenance of Tobermore Hydropave Permeable Paving

To ensure optimum performance of Hydropave permeable paving, Tobermore provide the following maintenance guidelines.

These guidelines are provided as a general maintenance regime but may be altered if necessary depending on the specific paved area or any factors which may impact the paving.

Hydropave permeable paving relies upon its ability to infiltrate surface water through its joints into a sub-base beneath. Hydropave Permeable Paving requires much less maintenance than is perceived by many however maintenance of the pavement should be carried out when necessary to ensure the infiltration of the paving is maintained and the paving is kept looking at its best. During design, construction and after construction care should be taken to ensure that the paved area is protected and maintained to minimise clogging of the joints.

With age and use, detritus and silt collects in jointing material at the top of the joints. This forms a thin crust like layer over the joints however this does not severely impact the ability of the joints to infiltrate surface water. Research has demonstrated that whilst the infiltration rate of the joints decreases over time it stabilises and still exceeds UK & Ireland hydrological requirements.

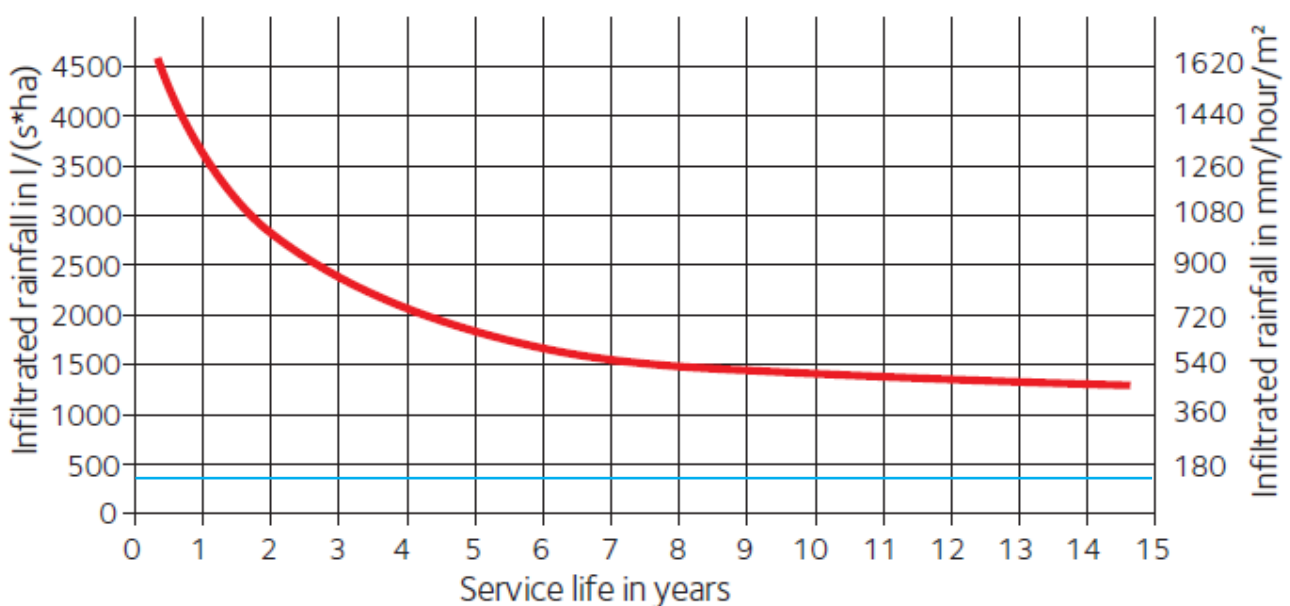
Rainfall experienced in the UK & Ireland is typically 20mm per hour with an extreme rainfall event being 75mm per hour. Research has concluded that the infiltration capacity of a newly installed Hydropave Concrete Block pavement is over 4,000mm per hour. The bedding course and sub-base aggregates will have even higher infiltration capacity.

The UK guidelines require the infiltration rate of the surface joints to be 400mm an hour which is only 10% of the actual rate of newly installed permeable paving. Even allowing for clogging over the long term there is a large factor of safety built in. See Figure 1.

Figure 1.

©Dr. Soenke Borgwardt.

“Long-term in-situ infiltration performance of permeable concrete block pavements”



Red Line: Reduction in surface infiltration over time

Blue Line: 100mm/hour extreme storm

General Maintenance Guidelines

Routine visual inspections.

A major benefit of permeable paving over traditional drainage systems is the ability to quickly and cost effectively assess that it is working correctly. This can be done by visually inspecting the paving during heavy rainfall or following heavy rainfall.

In general, routine visual inspections are all that is required to determine whether or not remedial maintenance is required. Any infiltration issues are shown up by water ponding on the surface of the paving. If ponding is not visible then remedial action is not required. If ponding is visible see section on Remedial Action for ponding.

In the unlikely event that individual blocks are damaged these should be removed and replaced. See section on structural maintenance.

Frequency: Once a year during or following heavy rainfall.

Remedial maintenance for ponding.

If surface water ponding is visible the joints should be brushed and vacuumed.

Brushing and vacuuming should be carried out in a manner which ensures that the paving blocks are not damaged and that jointing material is not removed from the joints. Any jointing material which is removed must be replaced, refer to Figure 2 for correct grading of jointing material. The size of sweeper used will be dependent on the overall size of the paved area. A range of large mechanical sweepers are now available as well as smaller lightweight equipment. These are available from specialist companies.

The structural integrity of permeable paving will be compromised if the joints are not filled to the top with jointing aggregate.

It is good practice to complete a trial area first and then any adjustments to suction rates can be made if necessary.

The effectiveness of Hydropave Permeable Paving is not significantly compromised by moss, leaves or weeds on the surface as these are not impenetrable barriers.

Frequency: As and when required.

Maintenance for aesthetics of the joints.

To help maintain the overall appearance of the paving joints it is recommended that the surface of the paving including the joints is brushed and vacuumed at least once a year. Brushing the paving either mechanically or manually helps to agitate the jointing material and breaks up the thin layer of crust. Brushing also helps to prevent any vegetation growing in the joints.

Joints must be topped up with jointing material if any is removed during the brushing or vacuuming process, refer to Figure 2 for correct grading of jointing material.

Frequency: Recommended annually however maintenance for aesthetics of the joints can be carried out at the discretion of the developer/client.

Maintenance for aesthetics of the paving blocks.

Brushing with soapy water and a stiff brush will revive the colour of concrete block permeable paving.

For a deeper clean of the block surface a pressure washer can be used to maintain the appearance and colour of the paving blocks. A pressure washer set to a light / medium pressure should be all that is required to remove general dirt and grime. **High pressure should not be used as this can damage the surface of the blocks.**

Tips:

- Hold the lance of the pressure washer at a 30 to 45 degree angle to the paved surface to avoid removal of the jointing material.
- After cleaning is finished ensure that any jointing material which has been removed is topped up with the correct material, refer to Figure 2 for correct grading of jointing material.

Maintenance during the winter months.

Hydropave Permeable Paving generally requires less de-icing than conventional concrete block paving.

The controlled use of conventional road de-icing techniques can be used without affecting the overall performance of the paving.

Some de-icing salts may leave temporary discoloration after the thaw. Normal weathering should soon remove this discoloration from the paving.

De-icing salts should be applied before snow or ice develops as this helps protect the concrete surface.

It is unlikely that the levels of chloride in the ground will increase significantly by employing conventional de-icing techniques.

Frequency: As required during winter.

Controlling weeds.

Weeds tend not to establish in areas which receive regular trafficking by vehicles. If weeds are an issue they can be dealt with by using a weed killer containing Glyphosate. The manufacturer's instructions should always be followed and adequate Health & Safety measures should also be put in place when handling chemicals.

Frequency: As required.

Structural Maintenance.

If a visual inspection has indicated that individual blocks have been damaged these blocks should be removed and replaced with new blocks.

If rutting of the surface has occurred the area needs to be lifted and reinstated immediately as it may be a hazard to users.

Any blocks which are removed need to be reinstated correctly ensuring that the correct sub-base, bedding and jointing aggregates are used. The installation method should be in accordance with BS 7533 Part 3. In particular, the joints should be filled to the top to ensure structural integrity, refer to Figure 2 for correct grading of jointing material. Any geotextiles or impermeable membranes which are damaged during the reinstating process should be replaced. If the blocks are not damaged they can be lifted, cleaned and re-used.

Frequency: As required

Jointing Material in Accordance with BS 7533 Part 13

Figure 2.

BS Sieve Size (BS EN 993-1) mm	Percentage Passing
14	100
10	98-100
6.3	80-99
2.0	0-20
1.0	0-5

Guidelines to minimise maintenance and ensure the long-term performance of Hydropave Permeable Paving.

Pre- construction (Design stage)

- It is essential that the system is designed correctly by a qualified engineer. Refer to BS 7533 Part 13
- The design and detailing of the project should ensure that soil from soft landscaping is prevented from spilling onto the paving.

During construction.

- It is essential that the paving is installed by an experienced contractor who is familiar with installing permeable paving and its components. Refer to BS7533 Part 3
- Mud / soil and other contaminants should be prevented from entering the sub-base, bedding course and jointing aggregates.
- Do not allow muddy construction traffic to use the paved area once completed.
- Do not allow soft landscaping to spill onto the paving surface. See Figure 3.

After construction.

- Do not store materials which may clog up the permeable joints such as soil and mulch on top of the paving.
- The joints between permeable paving should be filled to the top with the correct aggregate, refer to Figure 2 for correct grading of jointing material.

Figure 3.



Maintenance overview

SCHEDULE	ACTION	FREQUENCY
Routine visual inspection	Visually inspect the paving for ponding during heavy rainfall or following heavy rainfall.	Once a year
Remedial maintenance for ponding	Brush / vacuum joints Replace any lost jointing material	As required
Structural Maintenance	Replace damaged blocks Repair any rutting	As required
Maintenance for aesthetics of the joints	Brush / vacuum joints as required Replace any lost jointing material	Recommended once a year
Maintenance for aesthetics of the paving blocks	Brush with soapy water Light pressure wash	As required
Weed control	Treat with weedkiller	As required
Maintenance during the winter months	De-icing salts	As required during winter
WARNING !	Do not replace the jointing grit with kiln dried sand as this will block the joints and prevent infiltration. Do not store materials which may clog up the permeable joints such as soil and mulch on top of the paving.	

Further information on the maintenance of permeable paving can be found at www.circia.org

Important Information

Any technical information provided by Tobermore in relation to any product (whether before or after order) is provided by way of GUIDANCE ONLY and, to the fullest extent permitted by law, without liability on the part of Tobermore for any loss or damage suffered as a result of relying upon it. Such technical information should not be relied upon in substitution for obtaining independent expert advice prior to using any product from both a suitably qualified engineer and building contractor, in particular, as to the suitability of the product for use at the intended site for the intended scheme.



Appendix F– Initial Drainage Schematic

