

CSH Category 4: Surface Water Run-off
Design for Residential Development at
Land R/O 126 and 126A Elm Grove and
fronting Legion Road, Hayling Island,
PO11 9EH

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Administrative Contact

Mr Chris Gray
Gray Environmental Ltd
35 Newtown Street
Duns
Berwickshire
TD11 3AS

Tel: 01361 882635

Fax:

Email: chris.gray@grayenvironmental.co.uk

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1.0 SUMMARY OF CONTEXT AND OBJECTIVES OF ASSESSMENT

1.1 Reason for and objectives of risk assessment

This document has been produced by Gray Environmental Ltd (Gray Environmental). The aim of the document is to compile the schedule of evidence required to demonstrate that the proposed residential development at Land R/O 126 and 126A Elm Grove and fronting Legion Road, Hayling Island will achieve the mandatory elements and - where possible - credits available with regards to Management of Surface Water Run-off and Flood Risk from developments as detailed in Category 4 of the Code for Sustainable Homes Technical Guide¹.

The key objectives are to:

- Ensure - where there is an increase in impermeable area - that the peak rate of run-off over the development lifetime, allowing for climate change, will be no greater for the developed site than it was for the *pre-development* site. This should comply at the 1 year and 100 year return period events (see Calculation Procedures);
- Use a flow rate of up to 5 l/s to reduce the risk of blockage where the pre-development peak rate of run-off for the site would result in a requirement for the post-development flow rate (referred to as the *limiting discharge*) to be less than 5 l/s at a *discharge point*;
- Ensure the post development volume of run-off, allowing for climate change over the development lifetime, is no greater than it would have been before the development;
- Demonstrate that the flooding of property would not occur in the event of local drainage system failure (caused either by extreme rainfall or a lack of maintenance);
- Ensure there is no discharge from the developed site for rainfall depths up to 5 mm; and,
- Ensure run-off from all hard surfaces shall receive an appropriate *level of treatment* in accordance with The SuDS Manual to minimise the risk of pollution.

¹ Department for Communities and Local Government, Code for Sustainable Homes, Technical Guide, November 2011.

2.0 SUMMARY OF SITE CHARACTERISTICS AND SETTING

2.1 Land use and setting

The site is located in South Hayling, Hayling Island. The site is approximately 15m long by 10m wide, the site area is circa 0.016ha and the National Ordnance Survey (OS) Grid Reference for the site is 472234, 99784. The Site Location Plan is included as Figure 1 in Appendix A.

This partially tarmaced site formerly occupied by a garage, shop unit and concrete area is undergoing development to become two no. two storey detached dwellings with parking areas. Please see Appendix A Figure 2 and Figure 3 for details of the pre and post development site.

The site is bounded to the south and west by hardstanding areas and commercial development. The site is bounded to the north by Legion Road and further afield by hardstanding areas and a two storey terraced residential development. The site is bounded to the east by a two storey detached dwelling and further afield by hardstanding areas and a Royal British Legion Club.

The site is approximately level (Appendix A Figure 4).

BGS Geoindex provides an indication of the superficial and bedrock geology underlying the site:

- 'Sand and gravel, locally with lenses of silt, clay or peat'²; and,
- 'Fine, sandy, silty clay/silty clay. Glauconitic at base'³.

A borehole log referenced SZ79NW92⁴ is available on the BGS Geoindex website for a ground investigation undertaken approximately 25m west of the site (South Hayling Surface Water Drainage). The borehole encountered approximately 0.60m Tarmac overlying CLAY to circa 2.30mbgl and SAND to approximately 3.70mbgl. Standing groundwater level was recorded at circa 1.60mbgl.

The hydrological characteristics of the area are:

Average annual rainfall (AAR) mm 700

Soil runoff coefficient (SPR) 0.37

² <http://www.bgs.ac.uk/lexicon/lexicon.cfm?pub=RTDU>

³ <http://www.bgs.ac.uk/lexicon/lexicon.cfm?pub=LC>

⁴ http://scans.bgs.ac.uk/sobi_scans/boreholes/456051/images/10796137.html

M5-60 mm	17
Rainfall ratio (r)	0.4
Hydrological region (R)	7 ⁵ .

The groundwater beneath the site is not associated with a source protection zone⁶.

⁵ DEFRA/Environment Agency, Flood and Coastal Defence R&D Programme. Preliminary rainfall runoff management for developments, R&D Technical Report W5-074/A/TR/1 Revision E, January 2012.

⁶ <http://maps.environment-agency.gov.uk/wiyby/wiybyController?topic=groundwater&layerGroups=default&lang=en&ep=map&scale=11&x=472219&y=99662#x=472219&y=99662&lg=1,&scale=6>

3.0 FLOOD RISK ASSESSMENT

3.1 Flooding from rivers and sea

The site is 5m At Ordnance Datum (AOD) and a review of the EA's flood map indicates that the site lies within Flood Zone 1 i.e. 'low probability' of rivers and the sea flood risk with less than 1 in 1000 chance of flooding in any one year⁷.

The nearest area that could be affected by sea flooding is circa 500m southeast of the boundary of the site. This area has a predominantly 0.5 per cent (1 in 200) or greater chance of flooding occurring each year and is approximately 5mAOD⁸.

3.2 Flooding from land

Information collection indicates the site will be partially tarmaced, underlain by low permeability superficial deposits and bounded by impermeable areas (section 2.1).

The PUSH EA Surface Water Flood Map⁹ indicates the site is not located in an area susceptible to surface water flooding however the PUSH SFRA Impact of Land Use Change on Surface Water Runoff Map does indicate a moderate impact in the site location. It is noted the impermeable area of the site will decrease post development. The tarmaced area will continue to drain - via nominal fall - towards the north (Legion Road) and the site will continue to be bounded to the east by a brick wall. Post development the rear garden ground will be adjacent to a comparatively small area of off-site hardstanding while the roofs and hardstanding areas bounding the site to the west will either continue to drain to the main sewer that serves the immediate site area (Appendix B) or drain towards Legion Road/Elm Grove.

3.3 Flooding from groundwater

The PUSH EA Groundwater Flood Map¹⁰ indicates the site is located in an area that has a =50% <75% possibility of superficial deposits groundwater flooding. It is noted however that the borehole drilled approximately 25m west of the site (South Hayling Surface Water Drainage) encountered CLAY to circa 2.30mbgl and SAND to

⁷ <http://maps.environment-agency.gov.uk/wiyby/wiybyController?topic=floodmap&layerGroups=default&lang=e&ep=map&scale=6&x=472219&y=99662#x=472219&y=99662&lq=1,&scale=11>

⁸ <http://maps.environment-agency.gov.uk/wiyby/wiybyController?topic=floodmap&layerGroups=default&lang=e&ep=map&scale=6&x=472219&y=99662#x=472219&y=99662&lq=1,&scale=11>

⁹ <http://maps.hants.gov.uk/push/Map.aspx>

¹⁰ <http://maps.hants.gov.uk/push/Map.aspx>

approximately 3.70mbgl with the standing groundwater level was recorded at circa 1.60mbgl.

3.4 Flooding from sewers

The PUSH SFRA EA Surface Water Sewer Flood Map¹¹ indicates the nearest Southern Water observed surface water sewer flooding has been approximately 300m north of the boundary of the site.

3.5 Flooding from reservoirs, canals and other artificial sources

The site is not located in an area at risk of inundation should large reservoir flooding occur¹².

3.6 Conclusion

In conclusion, the development is situated in Zone 1 - low annual probability of flooding (as defined in PPS25 - 'Planning and Flood Risk'¹³) and the site specific Flood Risk Assessment (FRA) indicates that there is low risk of flooding from all sources.

¹¹ <http://maps.hants.gov.uk/push/Map.aspx>

¹² <http://maps.environment-agency.gov.uk/wiyby/wiybyController?value=PO11+9EH&submit.x=9&submit.y=12&lang=e&ep=map&topic=reservoir&layerGroups=default&scale=9&textonly=off#x=472219&y=99662&lg=1,&scale=11>

¹³ Planning Policy Statement 25: Development and Flood Risk Revised March 2010.

4.0 PLANNING AND AGREEMENT OF DESIGN CRITERIA

The characteristics of Sustainable Drainage Systems (SUDS) components and site constraints were reviewed to ensure a complete understanding of hydraulic, water quality, amenity and ecological constraints and opportunities was developed.

4.1 Design criteria

4.1.1 Hydraulic design criteria

- discharges from the site to be limited to pre development flow rates;
- attenuation storage volume required to cater for the 100 year critical event;
- long term storage required to prevent increase in downstream flood risk;
- 10 per cent allowance on rainfall required for climate change (10% additional rainfall is considered to approximate to a 20% increase in runoff for larger events¹⁴); and,
- risk associated with blockage at key locations to be identified and accommodated appropriately.

4.1.2 Water quality design criteria

In accordance with CIRIA 697, 2007¹⁵ Table 3.3, assuming effective pre-treatment is in place, one level of treatment recommended for the roof and two levels of treatment recommended for the parking areas.

4.1.3 Amenity design criteria

There is no space for surface water drainage which has high amenity value within the residential development.

4.1.4 Biodiversity design criteria

There is no space for surface water drainage which has ecological potential within the residential development.

¹⁴ DEFRA/Environment Agency, Flood and Coastal Defence R&D Programme. Preliminary rainfall runoff management for developments, R&D Technical Report W5-074/A/TR/1Revision D, September 2005.

¹⁵ CIRIA C697, The SUDS Manual, 2007.

5.0 SUDS SELECTION

5.1 SUDS characteristics

SUDS characteristics were reviewed to allow appropriate selection of surface water drainage components for the site. The main constraints/opportunities driving SUDS selection are summarised below¹⁶.

CHARACTERISTIC	CONSTRAINT/OPPORTUNITY
Development type (residential)	
Soils (permeable)	Opportunity for retention, wetland, infiltration, filtration and source control.
Area draining to a single SUDS component (0-2ha)	
Groundwater (>1mbgl)	
Site topographic characteristics (0-5%)	
Available head (0-1m)	
Available space (low)	
Ownership/maintenance	Surface water drainage owned and maintained by occupier.
Cost	Designed to minimise capital and maintenance costs.
Public safety	Sealed system for roof drainage means dwelling downpipes are connected directly to soakaway and will not discharge via an open grating to a drain

5.2 SUDs scheme

To take full account of all site constraints and opportunities, together with the benefits offered by a range of SUDS components, SUDS schemes are designed to follow the pre-development drainage paths, using infiltration where possible.

5.3 System design

5.3.1 *Site information*

The site area is circa 160m².

¹⁶ Table 5.4, site characterisation selection matrix, CIRIA C697, The SUDS Manual, 2007.

The impermeable area of the site pre development was approximately 160m² (partially tarmaced site formerly occupied by a garage, shop unit and concrete area). The impermeable area of the site post development is approximately 90m² (two no. two storey detached dwellings with parking areas).

The percentage impermeable area (PIMP) pre development is 100% and PIMP post development is 54%.

5.3.2 *Sur 1: Peak rate and volume of runoff*

'Where a man-made impermeable surface draining to the watercourse and sewers has decreased or remained unchanged post-development, the peak rate of run-off and volume of run-off requirements will be met by default and run-off calculations will not be required. Instead, drawings clearly showing the man-made impermeable surfaces of the site draining to the watercourse and sewers should be provided for the pre- and post-development scenarios. Figures must also be given (ideally on the drawings as well) to show a comparison between the areas of drained man-made impermeable surfaces pre- and post-development'¹⁷.

Appendix A Figure 2 and Figure 3 have been prepared. Pre development surface water runoff from the shop unit fed into the main drain (Appendix B).

Appendix A Figure 3 illustrates the proposed post development surface water drainage scenario whereby:

- Dwellings will drain to geocellular soakaway of 2m³ storage volume via sediment chamber or equivalent treatment device (section 5.3.3, 5.3.4 and Appendix C); and,
- Parking Areas will drain to Legion Road as pre development via existing tarmac nominal fall (section 5.3.3 and 5.3.4).

The impermeable area has not increased as a result of the development and the mandatory elements of these issues have been met by default.

¹⁷ Department for Communities and Local Government, Code for Sustainable Homes, Technical Guide, November 2011.

5.3.3 Sur 1: Demonstrate that the flooding of property would not occur in the event of local drainage system failure (caused either by extreme rainfall or a lack of maintenance)

The value of the maximum depth of water that will occur in storage ($h_{\max}$) for a range of storm durations and intensities has been derived from Table 5.3 of DEFRA/EA R&D Technical Report W5-074/A¹⁸ (Appendix C).

5.3.3.1 Soakaway

Based on an infiltration coefficient of 0.0001m/h for clay¹⁹, a minor inconvenience factor of safety (2) and a void ratio of 0.95 (geocellular system), the maximum depth of water ($h_{\max}$) for the **soakaway** is 2.36m with a time to half empty ($t_{1/2}$) of 3.33hr for the 18 hour 100 year event with a 10% allowance for climate change (Appendix A Figure 3 and Appendix C).

5.3.3.2 Infiltration Testing

Number of test pits

A test pit is proposed in the location of the Soakaway.

Size of test pit

The test surface should be at the same approximate depth as the elevation of the proposed infiltration surface²⁰.

Any smearing to the sides or base of the test pit caused by excavation machinery should, if possible, be removed by hand (taking appropriate safety precautions), as smearing could significantly reduce the recorded infiltration coefficient²¹.

Test procedure

- Excavate trial pit of appropriate size;
- Record the wetted area of the internal surface of the pit including both the sides and the base when the pit would be half full of water;

¹⁸ DEFRA/Environment Agency, Flood and Coastal Defence R&D Programme. Preliminary rainfall runoff management for developments, R&D Technical Report W5-074/A/TR/1 Revision D, September 2005.

¹⁹ CIRIA C697, The SUDS Manual, 2007.

²⁰ CIRIA C697, The SUDS Manual, 2007.

²¹ CIRIA C697, The SUDS Manual, 2007.

- Fill infiltration layer(s) of pit with water;
- Record the water level and time at frequent intervals as the pit empties of water; and,
- Repeat the test twice more, preferably on the same day²².

5.3.4 Demonstrate that the flooding of property would not occur in the event of local drainage system failure (caused by lack of maintenance)

5.3.4.1 Soakaway

Key design criteria for soakaways are:

- Design to meet site drainage requirements - generally 1 in 10 or 1 in 30 year design event;
- Site infiltration rate assumed for design should be based on appropriate site investigations and should include an appropriate factor of safety;
- Appropriate pre-treatment is required;
- If used, fill material should provide >30 per cent void space;
- Minimum distance of 1m from the base to the seasonally high groundwater table; and,
- Minimum distance of 5m from foundations²³.

Approved Document Part H of Building Regulations 2000 states:

'3.26 Soakaways for areas less than 100m² are generally formed from square or circular pits, filled with rubble or lined with dry-jointed masonry or perforated ring units. Soakaways serving larger areas are generally lined pits or trench type soakaway.

The soakaway will be geocellular system - e.g. created from Wavin AquaCell Eco (6LB025) or similar - of approximate dimensions 2.0mx1.0mx1.0m depth (2m³).

Key design criteria for geocellular/modular system are:

- Standard storage design using limiting discharges to determine storage volume;
- Structural design to relevant standards for appropriate surface loadings; and,

²² CIRIA C697, The SUDS Manual, 2007.

²³ CIRIA C697, The SUDS Manual, 2007.

- Appropriate geotextile/geomembrane for wrapping²⁴.

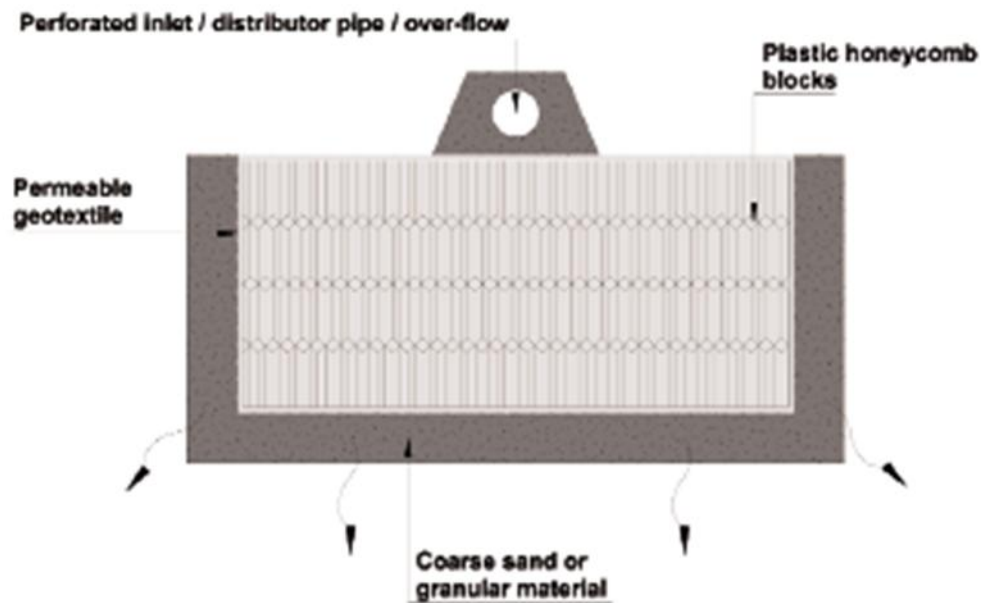


Figure 13.3 Schematic of honeycomb system in soakaway mode

Materials

‘The migration of fines can cause ground settlement around the soakaway and also cause risks of blockage. The top surface should be protected to prevent the ingress of backfill material during and after surface reinstatement. ‘Characteristics of the textile should suit the surrounding particle size and permeability. The textile should be placed so that it can be cleaned or removed and replaced if it becomes blocked.

Minimum soakaway cover of 300mm beneath landscaped area comprising of as dug backfill free from stones or deleterious material. The soakaway will be wrapped in permeable geotextile (a 300g non-woven material will be suitable for most situations).

Maintenance

‘Inspection of the soakaway should be possible²⁵. Where the internal space is left open as a void, inspection would be through opening of a cover²⁶.

²⁴ CIRIA C697, The SUDS Manual, 2007.

²⁵ CIRIA C697, The SUDS Manual, 2007.

²⁶ CIRIA C697, The SUDS Manual, 2007.

'The point of discharge of the drain to the soakaway should be visible, and the access should enable debris and sediments to be cleared from the pit. If pre-formed hollow space soakaways with covers are employed, the cover should either be lockable or only accessible with special keys'²⁷.

Pre-treatment device before inlet to soakaway will be provided in the form of a sediment chamber or similar treatment device.

Maintenance

MAINTENANCE SCHEDULE	REQUIRED ACTION	FREQUENCY
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then 6 monthly.
	Debris removed from catchment surface (where may cause risks to performance).	Monthly.
	Where rainfall infiltrates blocks from above, check surface or filter for blockage by silt, algae or other matter. Remove and replace surface infiltration medium as necessary.	Monthly (and after large storms).
	Remove sediment from pre-treatment structures.	Annually, or as required.
Remedial actions	Repair/rehabilitation of inlets, outlet, overflows and vents.	As required.
Monitoring	Inspect/check all inlets, outlet, vents and overflows to ensure that they are in good condition and operating as designed.	Annually and after large storms.

5.3.5 Sur 1: Ensure run-off from all hard surfaces shall receive an appropriate level of treatment in accordance with The SuDS Manual to minimise the risk of pollution

No credit is available for the development.

²⁷ CIRIA C697, The SuDS Manual, 2007.

- Pre-treatment - yes (section 5.3.4) - Sediment chamber or equivalent treatment device provided before the inlet to the soakaway;
- Treatment of stormwater using infiltration - yes (section 5.3.4) - infiltration techniques that treat smaller events via filtration through the soil and discharge them to groundwater. Rainwater harvesting can also be used;
- Treatment of stormwater using filtration - no - filtering of runoff using a variety of filtration media;
- Treatment of stormwater using detention - no - storing runoff volumes within basins using outflow controls; and,
- Treatment of stormwater using permanent pond volumes - no - Water Quality Treatment Volume (Vt)²⁸.

5.3.6 Sur 1: No discharge to the watercourse for rainfall depths up to 5mm

No credit is available for the development.

During heavy rainfall up to 30mm of rain can occur in 30 minutes with bursts of intensities of up to 150mm/hr for short periods. Pipe networks can absorb rainfall in the region of 50mm/hr from impervious surfaces, but above this rate, rainfall will result in overland flows taking place²⁹.

Therefore, the design criteria for interception storage is taken as an intensity of 30mm/0.5h (0.03m/0.5hr) and a duration of 10 minutes (total rainfall depth = 10mm).

Interception storage is **not** provided whereby no discharge from the site will occur for this depth of rainfall (section 5.3.2).

5.3.7 Sur 2: Flood risk assessment

2 credits are available for the development (section 3.0).

²⁸ CIRIA C697, The SUDS Manual, 2007.

²⁹ DEFRA/Environment Agency, Flood and Coastal Defence R&D Programme. Preliminary rainfall runoff management for developments, R&D Technical Report W5-074/A/TR/1 Revision D, September 2005.

APPENDICES

Appendix A Figures

Figure 1: Site Location Plan

Figure 2: Pre Development Site Plan

Figure 3: Post Development Site Plan

Figure 4: Elevations

Appendix B Information collection

Appendix C Other supporting calculations

Appendix D SUR 1 Summary Report