



**GRAINGER PLC
PHASES 3B AND 8
BEREWOOD, WATERLOOVILLE**

SUDS DESIGN DOCUMENT

MAY 2019



the journey is the reward

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1 Introduction

- 1.1 This document sets out the design principles and detail for the Strategic SuDS constructed by Grainger Plc for Phases 3B and 8 of the Berewood development, West of Waterlooville.
- 1.2 This document is aimed at a technical reader with an experience in the design of Sustainable Drainage Features.
- 1.3 The development site is located within the Berewood Development, part of the West of Waterlooville Major Development area, OS Ref SU675090. A location plan of the proposed Phase 8 and Phase 3B residential areas is shown on Dwg. GTWVILLE/SK/03 in Appendix B.
- 1.4 The site was formerly arable farmland.
- 1.5 The development proposals are for the construction of 354 new dwellings. (192 in Phase 8 and 162 in Phase 3B). The location of the site is provided in Appendix B. The housing layout for both Phases will be developed following the sale of the land. The housing site boundary is shown in red.
- 1.6 The SuDs storage provision for Phase 8 will be located outside and to the west of the housing site boundary and will form part of the amenity provision in the proposed Town Park. The Town Park is currently under construction.
- 1.7 The SuDs storage provision for Phase 3 will be located outside and to the west and north of the housing site boundary.
- 1.8 The main portion of discharge will be conveyed via the Phase 3I and PRS Western carriageway drainage provision to the River Wallington.
- 1.9 A topographical survey of the existing site was undertaken by Mayer Brown Ltd in November 2016. This is contained in Appendix B of this report. The site slopes predominantly from the south to the north across Phase 8. Ground levels ranging from approximately 60.0mAOD to 45.50 mAOD.
- [Geology](#)
- 1.10 A site investigation has been undertaken on this site, extracts of which can be found in Appendix C. The trial pits recorded superficial deposits of clays and medium-dense sands. As the presence of sands indicate potential infiltration, 2 BRE Digest 365

infiltration tests were undertaken in TP105 & TP106. The drop in water level was found to be very slow. (TP105 dropped 1cm in 3 hours and TP106 recorded no discernible drop over the same time period). The infiltration rates were too slow to record an infiltration value, so designs are based on the assumption that the site has no infiltration potential.

Existing Surface Water

1.11 Drainage on the site includes;

- A filter drain system draining a waterlogged area in the north east corner of Phase 8, which outfalls to the existing ditch within the allotment area to the north of Phase 8. This ditch drains via a pipe which originally discharged to the field ditch network feeding the River Wallington to the north. These ditches have been replaced where required with swales and other SuDs features in accordance with the overall Berewood drainage strategy.
- a ditch along the northern boundary of Phase 3B, which discharges to the existing as built SuDs system for Phase 3I to the west and to an existing piped outfall to the east.
- A filter drain system draining a waterlogged area in the north east corner of Phase 8, which outfalls to the existing ditch within the allotment area to the north of Phase 8. This ditch drains via a pipe which originally discharged to the field ditch network feeding the River Wallington to the north. These ditches have been replaced where required with swales and other SuDs features in accordance with the overall Berewood drainage strategy.

1.12 An analysis of the existing surface water paths was done using WinDes Microdrainage. The surface from the topographical survey was input to the model and analysis of the surface done in order to determine the flow paths. The results can be seen in Figure 1.1 and Figure 1.2.

1.13 The discharge from Phases 3B and 8 will be conveyed to the River Wallington via the SuDs features installed for Phase 1, PRS and Phase 7 schemes. The proposed routing is shown on Dwg. GTWVILLE_P8/SK/02 in Appendix B. The drainage strategy for these completed schemes identified that the hydrobrakes will need to be resized to reflect further development upstream (e.g Phase 3B and Phase 8). The existing hydrobrakes have been reviewed and revised hydrobrakes are proposed in this report as required.

Existing and Proposed impermeable area on site

- 1.14 Pre-development, there was no impermeable area within the site. It is assumed that the redevelopment of the site will result in a 65% impermeable area coverage. The increase in impermeable area will produce a corresponding increase in the total volume of surface water runoff and in the runoff peak rates from the site. Many of the SUDS features are located outside of the Phase 3B and 8 boundaries, so these have been included but at a 90% impermeable area coverage. This is outlined in Table 1-1 below.

	Existing Area (Ha)	Existing Impermeable Area (Ha)	Proposed Impermeable Area (Ha)	Effective Proposed Impermeable Area (Ha)*
Ph3B	3.53	0	2.29	2.51
Ph8	5.25	0	3.92	4.32
Total			5.35	6.83

* Includes a 10% increase for 'Urban Creep'

Table 1.1: Surface cover – existing and proposed



Figure 1.1 – Phase 3B Existing Flood Flow Analysis

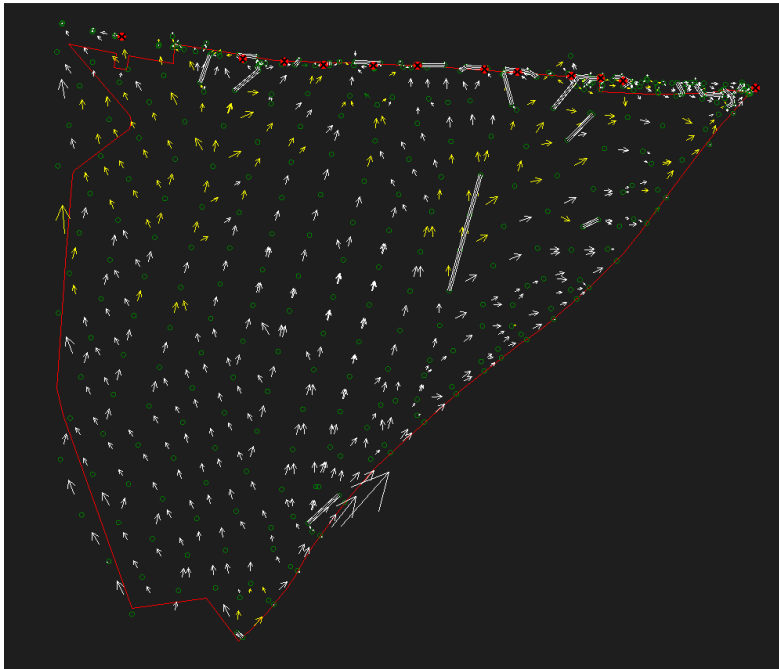


Figure 1.2 – Phase 8 Existing Flood Flow Analysis

2 Principles

Permitted Discharge Rates

- 2.1 The discharge rate for the Berewood development has been agreed at outline planning stage and is written into the S.106. A QBAR rate of 5.06l/s/ha shall be assumed at the outfall of the system to the existing watercourses, except for catchment areas smaller than 1ha, where a minimum rate of 5l/s is permitted. This rate shall not be exceeded for all storm events up to the 1 in 100 year event plus an allowance for climate change, which is agreed as 40% increase in rainfall intensity against the FEH design parameters below.
- 2.2 Phase 8 will discharge to the SuDs features (storage ponds) within the Town Park area via 4 outlets. There are 4 SuDS features which serve this design phase as identified in Appendix B. They comprise of Ponds 8A to 8D and for the purposes of the design are referred to as the Western SuDs System.
- 2.3 The pond for each outlet will be fitted with a hydrobrake, which will restrict flows to the proportional greenfield run-off rate for each respective Phase 8 catchment. Discharge from each pond will be conveyed via a common pipe to the proposed swale located, along the eastern side of the Phase 3I infrastructure.
- 2.4 The above ponds will be fitted with an overflow facility to ensure discharge can continue during exceedance events. During the 1 in 100 year event Ponds will utilise the overflow feature to supplement the hydrobrake discharge. However, the overall greenfield run-off rate from the total catchment for Phases 3B and 8 will be restricted to the proportional greenfield discharge by the hydrobrake in Pond 3B.
- 2.5 Phase 3B comprises of three catchment areas:- 3A, 3B and 3C. 3A and 3B will discharge via two outlets to the Western SuDs System. 3C will discharge via one outlet to two ponds located on the northern boundary of Phase 3B immediately south of Laxton Leaze. The latter will be referred to as the Eastern SuDs System for the purposes of the design. The Eastern SuDs System will convey discharge eastwards then northwards around the Phase 1 development and will connect to the Phase 1 SuDs feature adjacent to Grainger Street and Ellisons Crescent.

- 2.6 The drained areas and their related SuDs feature are identified on Dwg. GTWVILLE_P8/SK/02 in Appendix B and in Table 2.1 below. Table 2.1 also indicates the greenfield run-off rate for each catchment.

Catchment Ref	Effective Impermeable Area (Ha)	Greenfield Run-Off Rate (l/s)	Pond Ref	Location	Description
8A	0.798	4.0	P8A	Town Park	Pond with Overflow
8B	0.724	3.7	P8B		
8C	1.621	8.2	P8C		
8D	0.697	3.5	P8D		
3A	1.149	5.8	P3A		
3B	0.363	1.8	P3B	Adjacent Phase 3I Infrastructure Road	Swale with Waterbreaks
3C	1.517	7.7	P3C	Adjacent Laxton Leaze	Pond (2No Linked)
Total	6.83	34.6			

Table 2.1: Catchment Areas and Related SuDs Features

Rainfall Parameters

- 2.7 The design has been undertaken using Microdrainage WinDes software. As the critical events for the open space SuDS will be in excess of 30 minute duration, the FEH rainfall parameters have been assumed. For the Berewood development, the assumed parameters have been taken directly from exported FEH CD-ROM data as follows:

$$\begin{array}{lll}
 C(1\text{km}) = -0.027 & D1(1\text{km}) = 0.461 & D2(1\text{km}) = 0.293 \\
 D3(1\text{km}) = 0.380 & E(1\text{km}) = 0.306 & F(1\text{km}) = 2.247
 \end{array}$$

Catchment Areas

- 2.8 A permeability factor of 0.65 has been assumed for the whole of the development area. This is considered conservative but will be reviewed in more detail once details of the development layout for Phases 3B and Phase 8 are known. The SuDs ponds were given an impermeable factor of 0.9.
- 2.9 Urban Creep can be described as future urban expansion within a development such as extensions to buildings and paving gardens. These activities increase the impermeable area of a site and often sit outside of the development control process. Therefore, we have allowed a 10% increase in impermeable area on the development site to allow for urban creep.

3 Network Details

- 3.1 The proposed strategic surface water drainage scheme has been modelled using Windes Source Control. Storage ponds have been modelled using the 'Cascade' feature to recognise the utilisation of the overflow facilities when necessary.

Controls

- 3.2 The surface water is attenuated within the SuDS features with the use of flow control devices. The model utilises vortex flow control devices. Specifically, the Hydro International Hydrobrake Optimum® has been specified. Any equivalent alternatives will need to be tested in the model to consider the effect. The controls are scheduled in the WinDes Network Details report, see Appendix A.
- 3.3 In some locations high level overflows, which bypass the online control are inputted as weir overflows. These will be constructed on site as gully weirs as indicated in Appendix B. The controls used for each feature are shown in printouts contained in Appendix A and summarised in Table 3.1 below.

SuDS Features

- 3.4 Detailed drawings showing the surface water drainage layout are contained within Appendix B.
- 3.5 Ponds have been designed to have a side slope between 1 in 5 around the perimeter and 1 in 3 towards the middle.
- 3.6 The SuDS features have been located as best as possible in the areas where the water would naturally collect under the existing topography. This therefore allows the outlets to discharge the water in the same patterns as the existing water flow paths.
- 3.7 The Table 3.1 overleaf shows the respective pond sizes and discharge properties for each of the SuDs features.
- 3.8 As mentioned in Section 2, Ponds 8A to 3B have been modelled as a 'Cascade' system for the higher rainfall events.
- 3.9 The flow control from Pond 3A will have a design discharge rate of 3l/s. it is noted that this is less than the desirable minimum of 5l/s. Therefore, the hydrobrake will be designed to minimise blockage. Furthermore, the outfalls from the ponds are designed

to minimise the ingress of debris in order to avoid blockage at the flow control unit downstream.

- 3.10 The SuDS features will be adopted by Winchester City Council as agreed at outline planning stage and is written into the S.106. for the Berewood development.

Pond	Area (sq.m)	Volume (cu.m)	Design Head (m)	Design Flow (l/s)	Overflow	Hydro-brake optimum® reference
Western Outfall System						
8A	663	686	1.9	5.0	Weir Gully	MD-SHE-0093-5000-1900-5000
8B	640	599	2.0	5.0	Weir Gully	MD-SHE-0092-5000-2000-5000
8C	1156	1453	2.0	5.0	Weir Gully	MD-SHE-0092-5000-2000-5000
8D	859	623	2.0	5.0	Weir Gully	MD-SHE-0092-5000-2000-5000
3A	1942	1665	1.5	3.0	Weir Gully	MD-SCL-0072-3000-1500-3000
3B	540	216	1.5	30.0	Weir Gully	MD-SHE-0230-3000-1500-3000
Eastern Outfall System						
3C	1417	1408	1.5	5.2	None	MD-SHE-0100-5200-1500-5200

Table 3.1: SuDs Pond and Hydrobrake Details

Total Design Discharge Rate for Western and Eastern Networks = 30.0 +5.2 = 35.2l/s

4 Simulation Modelling and Results

- 4.1 The WinDes model was run for return periods of 1 in 1, 30, and 100 plus 40% for climate change. The Model results can be found in full in Appendix A.

Western System - 1 in 30 Year FEH

- 4.2 All pipework and SuDS features operating to expectations. Overflows provided in Ponds 8A to 3A not utilised.
- 4.3 No flooding reported.
- 4.4 The final discharge rates from Pond 3B for the Western System during the most critical rainfall event of 15min is 29.3l/s

Catchment 8A	= 4.3l/s
Catchment 8B	= 4.1l/s
Catchment 8C	= 4.6l/s
Catchment 8D	= 4.1l/s
Catchment 3A	= 2.6l/s
Catchment 3B-1	= 20.8l/s
Catchment 3B-2	= 14.8l/s
Catchment 3B-3	= 29.3l/s

Western System - 1 in 100 Year + 40% Climate Change FEH

- 4.5 All pipework and SuDS features operating to expectations.
- Overflow weirs on Ponds 8A, 8B, 8C and 8D are utilised.
- 4.6 The final discharge rates from Pond 3B for the Western System during the most critical rainfall event of 720min is 30l/s

Catchment 8A	= 5.0 l/s
Catchment 8B	= 4.9 l/s
Catchment 8C	= 5.0 l/s
Catchment 8D	= 4.9 l/s
Catchment 3A	= 2.8 l/s
Catchment 3B-1	= 22.5 l/s
Catchment 3B-2	= 22.6 l/s
Catchment 3B-3	= 30.0 l/s

Eastern System - 1 in 30 Year FEH

- 4.7 All pipework and SuDS features operating to expectations.
4.8 Discharge rate for the most critical rainfall event of 720min would be 5.1l/s

Eastern System - 1 in 100 Year + 40% Climate Change FEH

- 4.9 All pipework and SuDS features operating to expectations.
4.10 Discharge rates for the most critical rainfall event of 960min would be 5.2l/s

Catchment Ref	Permitted discharge rate	Max Discharges for different Return Periods (years)	
		1 in 30	1in 100+40%
Western Network	26.0	29.9	30
Eastern Network	7.7	5.1	5.2
Total	34.7	35.0	35.2

Table 4.1: Maximum Discharges for Different return periods

- 4.11 Tables 3.5 and 4.1 above show the summary of peak discharge rates for different return periods. The total for the peak discharge rates for a 1 in 100 +40CC storm event exceeds the allowable greenfield run off rate by 0.5l/s. However, it is worth noting that this is most conservative figure and makes the assumption that both peaks happen at the same time.
- 4.12 Further analysis was done to determine over what time period the peak cumulative discharge would happen using the hydrographs from both SuDS outfalls. It was found for the combined hydrograph values; the exceedance total volume was less than 1m³ which is very minimal.

5 Overflow and Blockages Analysis

5.1 The network was tested to see the effects of blockages on the system. Each SuDS outlet was tested with a blockage to see the resulting effect on the other SuDS features.

5.2 The cascade of SuDS features were tested with a 1 in 200 year storm event.

5.3 The results of the models can be seen in Table 5.1.

Blocked SuDS	Overflow SuDS	Max Overflow Discharge Rate	Flooding Comments
SuDs 8A	SuDS 8B	8.3 l/s	No flooding in pond or downstream
SuDS 8B	SuDS 8C	11.9 l/s	No flooding in pond or downstream
SuDS 8C	SuDS 8D	11.9 l/s	No flooding in pond or downstream
SuDS 8D	SuDS 3A	6.7 l/s	No flooding in pond or downstream
SuDS 3A	SuDS 3B-1	0 l/s	No flooding in pond or downstream
SuDS 3B-1	SuDS 3B-2	86.8 l/s	No flooding in pond or downstream
SuDS 3B-2	SuDS PRS	60.1 l/s	No flooding in pond or downstream
SuDS 3C	Ditch	8.2 l/s	No flooding occurs in pond

Table 5.1 – Blockage Analysis results

5.4 The analysis shows that there is sufficient capacity in the SuDS overflow features to deal with a blockage in the outfalls of a SuDS feature. It also shows that the extra overflow volume which enters, in general, the next SuDS feature downstream, can be accounted for without flooding the SuDS features.

6 Conclusion

- 6.1 The total discharge rate for the worst case scenario (1 in 100 year return period +40% for climate change) from the Phase 3B and Phase 8 main network will be equal to the equivalent QBAR greenfield run-off rate for critical rainfall events. For all other events the total discharge rate will be significantly less, thus provide betterment to the existing condition. Therefore, it can be stated that the strategic SuDS design is operating within the accepted design criteria.

APPENDIX A: Calculations and Data

All 1 in 100yr +40CC pdf files
All 1 in 30yr pdf files
All 1 in 1yr pdf files

APPENDIX B: Drawings

Location Plan
Routing Plan
Proposed Drainage Layout
Gully Weir Detail
Hydrobrake Detail
Outfall Detail

APPENDIX C: SuDS Maintenance Plan

