

Berewood Phase 8a, Waterlooville – SuDS Technical Note

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Introduction

1. This Technical Note has been prepared by Robert West on behalf of Bloor Homes to support a Reserved Matters Planning Application APP/24/00939 for the residential development of Phase 8a at Berewood, Waterlooville, PO7 7AY.
2. The site development proposals at Phase 8a comprise 185 residential dwellings, associated landscaping and drainage.
3. Phase 8a forms part of Phase 8 and comprises residential houses. Phase 8 forms part of the overall site at Berewood, Waterlooville.
4. This document sets out the design principles and detail for the overall site drainage strategy, the strategic SuDS constructed by Grainger Plc for Phase 8 and the Phase 8a drainage systems proposed for Phase 8a. The proposed SuDS for Phase 8 forms part of a wider SuDS strategy for the Berewood development.
5. This Technical Note is to be read in conjunction with all planning, architectural and other reports that accompany the Planning Application for the proposed development.

Design Criteria

6. The surface water design has been undertaken in compliance with Hampshire County Council's (HCC) Drainage and Planning Policy, The SuDS Manual C753, Sewerage Sector Guidance and recognised best practice together with the principles of the following approved Outline Application documents:
 - Proposed Outline Suds Strategy Statement – October 2010 – By Mayer Brown
 - Phase 8 Berewood, Waterlooville - Suds Design Document - March 2020 by Mayer Brown.
7. All surface water drainage systems have been designed to attenuate storm events up to and including the critical 1 in 100-year event, incorporating an allowance for climate change and an additional 10% allowance for urban creep.

Overall Outline Development Site Surface Water Drainage

Site Location

8. The A3 forms the eastern boundary to the overall site itself and originally consisted of approximately 209 hectares of fields and areas of woodland. The site is located mainly within the administrative area of

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Winchester City Council (WCC), but the eastern edge of the site lies within the administrative area of Havant Borough Council (HBC).

9. Existing levels on the overall site vary between 30m & 60m AOD.

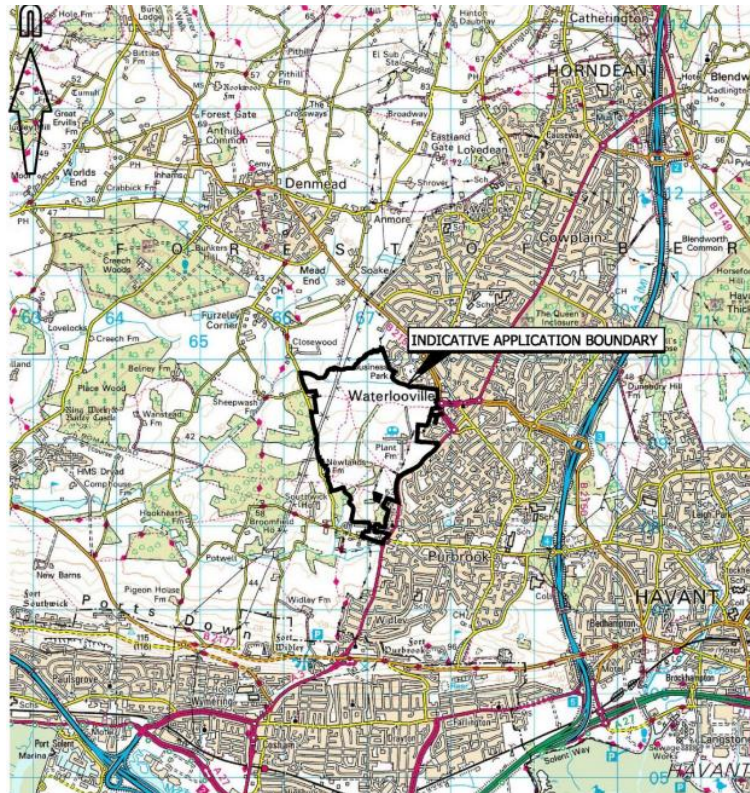


Figure 1: Site Location Plan

Existing Surface Water Drainage, Geology & Hydrogeology

10. The two main receiving waters for run-off from the development site are North Purbrook Stream to the south, and the River Wallington in the central area of the site. Please see Figure 2 overleaf showing the location of the receiving waters.

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Figure 2: Existing Site Main Watercourses

11. Southern Water records indicate that there were no adopted surface water drainage structures on the site. Surface water sewers are located within London Road and within existing urban areas adjacent to the overall site.
12. The site was originally in agricultural use, comprising both arable farming and grazing. The proportion of impervious surfaces is minimal, and as such, surface water runoff has been assessed on a Greenfield basis.

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13. The overall site is not located within a Groundwater Protection Zone, as defined by the Environment Agency's indicative groundwater source protection zone map.
14. The overall site has been the subject of several previous studies and investigations in 2004, 2007 and 2008. The most recent ground investigation was undertaken by Card Geotechnics in 2009/2010 (Ref. 1). The 2010 report summarises the available information and supplements it with the results of recent additional site specific investigation across the proposed development site.
15. Infiltration testing undertaken as part of the ground investigation indicates that the site is unsuitable for infiltration-based drainage. This is primarily due to the predominance of clay soils and the presence of elevated groundwater levels in certain areas during seasonal periods.

Existing Surface Water Drainage, Geology & Hydrogeology

16. Greenfield run-off rates for the site are based on the Institute of Hydrology 124 Report
 - $QBAR = 0.00108 \cdot AREA^{0.89} \cdot SAAR^{1.17} \cdot SOIL^{2.17}$
 - $QBAR = 0.00108 \times 0.50.89 \times 7901.17 \times 0.452.17$
 - Therefore, $QBAR = 0.253 \text{ m}^3/\text{s}$ or 253 l/s for 50 Ha.
 - This equates to 5.06 l/s/Ha .
17. Pro-rating this to the existing site area of 209 Ha results in a $QBAR = 1,057 \text{ l/s}$.

Overall Site Surface Water Drainage Strategy

18. The existing site was predominantly farmland and currently generates surface water run-off equivalent to Greenfield conditions. The proposed development has introduced a significant proportion of impermeable surfaces, necessitating the implementation of high-standard surface water drainage measures. Greenfield run-off rates have been calculated for a range of return periods in accordance with the Institute of Hydrology Report 124, utilising regional growth curves from the Flood Studies Report.
19. For the surface water drainage system design, it was assumed that rainfall intensity will increase as a result of climate change. The applicable climate change allowance applied to the overall site design was agreed with the Environment Agency. To inform the outline SuDS strategy and assess the system's resilience, a sensitivity test incorporating a 30% increase in rainfall intensity was applied during the hydraulic modelling.
20. Attenuation of surface water flows were required on-site to ensure that despite the increase in impermeable surfaces, the site discharge does not increase up to a design storm with a return period of 1 in 100 years plus 30% increase in rainfall intensity (not 30% increase in return period or storage volume). The site

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discharge rate for the 1 in 2 year return period does not exceed 4.40 l/s/ha. For all higher return periods up to the 1 in 100 year storm event, the discharge rate does not exceed 5.06 l/s/ha (QBAR).

21. The proposed drainage strategy was designed to incorporate the principles of sustainable drainage at a site infrastructure level. This means that although the development plots are typically traditionally drained, they are routed to a SUDS system prior to outfall to the receiving waters. The measures considered were swales, attenuation basins, porous paving (with no significant infiltration to the underlying clay geology), basins and wetlands.
22. The overall site has been designed to current best practice for both piped drainage (Part H of the Building Regulations), adoptable sewers (Sewers for Adoption 6th Edition) and Sustainable Drainage (CIRIA C697 – The SUDS Manual), and any subsequent revisions or further publications of best practice.
23. The SuDS strategy split the overall site smaller catchment areas, relative to the proposed plot areas. Each of these catchments is treated separately, with its own treatment train and localised attenuation feature. Flow control devices have been incorporated in each attenuation feature, which restrict discharge rates to existing Greenfield run-off rates. These attenuation features are located outside the plot areas, in adjacent landscaped areas.
24. Discharge rates from these localised attenuation SuDS features are restricted to annual Greenfield run-off rates (QBAR).

25. 'Phase 8 Strategic Surface Water Drainage

Introduction

26. The SuDS system which serves Phase 8 has been constructed by Grainger Plc in preparation of the development of Phase 8a.

Topography

27. A topographical survey of the existing site was undertaken by Mayer Brown Ltd in November 2016. The site slopes predominantly from the south to the north across Phase 8. Ground levels range from approximately 60.0mAOD to 49.80 mAOD.

Geology

28. The existing land use is farming, both arable and grazing. The proportion of impervious areas is very low and existing run-off is assumed as Greenfield.
29. Previous site investigations have been undertaken in the development and indicate superficial deposits of clays and medium-dense sands. As the presence of sands indicates potential infiltration, 2 BRE Digest 365

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infiltration tests were undertaken. The tests indicated a low permeability and concluded that the site was unsuitable for infiltration. This is consistent with the rest of the Berewood development.

Existing Surface Water

30. Existing drainage on the site comprises a filter drain system draining a waterlogged area in the northeast corner of Phase 8, which outfalls to the existing ditch south of the allotment area to the north of Phase 8 and existing bridleway. This ditch drains via a pipe which originally discharged to the field ditch network draining to 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.
31. There is an existing ditch which was situated in the footprint of the proposed SuDS basin and collects run-off from the proposed Phase 8 design catchment as well as a catchment area to the south.

Existing and Proposed Impermeable Area on Site

32. There is currently no impermeable area within the proposed development site.
33. It is assumed that the redevelopment of the site will result in a 65% impermeable area coverage. The increase in the impermeable area will produce a corresponding increase in the total volume of surface water runoff and in the runoff peak rates from the site. There is just one SuDS feature which attenuates Phase 8 which is located outside the catchment area. These have been included but at a 90% impermeable area coverage.
34. Urban Creep can be described as future urban expansion within a development such as extensions to buildings and paving of gardens. These activities increase the impermeable area of a site and often sit outside of the development control process. An allowance of a 10% increase in impermeable area was included within the drainage design to account for potential urban creep across the development site. For allowances refer to Table 1 below.

	Existing Area (Ha)	Existing Impermeable Area (Ha)	Proposed Impermeable Area (Ha)	Effective Proposed Impermeable Area (Ha)*
Phase 8	5.33	0	3.46	3.81
SuDS Area	0.27	0	0.24	0.24
Total	5.60	0	3.70	4.05

Table 1: Allowance for Existing and Proposed

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Permitted Discharge Rates

35. The discharge rate for the Berewood development has been agreed at the outline planning stage and is written into the Section 106 agreement. A rate of 5.06l/s/ha has been applied at the outfall of the system to the existing watercourses.
36. One basin to attenuate the whole of Phase 8 development has been installed as per the approved design. The basin is located in an unused area of the site northwest of the Phase 8a development. Due to the size of the basin and the impact on the local biodiversity, a complex outfall was approved and installed to manage the discharge rates from the basin. The proposed discharge rate was designed to align with the higher greenfield run-off rates which would occur during the 1 in 30 year and 1 in 100 year storm events.
37. As noted in the CIRIA Report C753 growth factors can be applied to the discharge rates in order to represent the higher greenfield run off rates for more intense storm events. The two growth factors that were applied in the analysis were the 1 in 30 year and the 1 in 100 storm events.
38. The growth factors depend on the geographical location of the development. The Berewood development is located within area 7. The following growth factors were applied using the table within CIRIA Report C753:
- For a 1 in 30 year storm event the growth factor is 2.40
 - For a 1 in 100 year storm event the growth factor is 3.19
39. The agreed discharge rates are not exceeded for any storm event up to and including the 1 in 100-year event, with a 40% allowance for climate change. This allowance reflects an increase in rainfall intensity based on FEH (Flood Estimation Handbook) design parameters.
40. Due to using the growth factors, additional analysis was necessary to ensure development discharge volumes did not raise the risk of flooding downstream. This was undertaken by analysing the volume control for a 1 in 100 year, 6 hour storm event as per CIRIA Report C753 which concluded discharge volumes were not greater than the existing situation.
41. The allowable discharge rates are provided below in Table 3.

Storm Event	Growth Factor	Allowable Discharge Rate (l/s)
1 in 30	2.40	68.2
1 in 100	3.19	90.6

Table 2: Allowable Discharge Rates Applying Growth Factors

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Rainfall Parameters

42. The design for Phase 8 was undertaken using Microdrainage WinDes software. As the critical events for the open space SuDS are in excess of 30-minute duration, the FEH rainfall parameters were assumed. For the Berewood development, the assumed parameters exported directly from the FEH CD-ROM data, and were as follows:

- $C(1km) = -0.027$
- $D1(1km) = 0.461$
- $D2(1km) = 0.293$
- $D3(1km) = 0.380$
- $E(1km) = 0.306$
- $F(1km) = 2.247$

Catchment Areas

43. A permeability factor of 0.65 has been assumed for the whole of the development area. This is considered conservative but has been reviewed in more detail now details of the development layout for Phase 8a is known. The SuDS basin was given an impermeable factor of 0.9.

44. A 10% increase in the impermeable area on the development site was applied to account for urban creep for the development of Phase 8a.

Basin	Catchment Reference	Catchment Area (HA)	PIMP	Effective Impermeable Area (HA)	Greenfield Run-off Rate (l/s)
A	Phase 8	5.332	0.714 (with UC)	3.812	27.0
	Basin A	0.274	0.9	0.247	1.4
Total	-	5.606	-	4.086	28.4

Table 3: Catchment Areas and Run-off Rates

SuDs Provision

45. Phase 8a will discharge via one outlet, to a SuDS feature (Basin A) to the northwest of Phase 8a.

46. The basin has been constructed with two hydrobrakes, which restrict flows to the proportional greenfield run-off rate for the catchment assuming the relevant allowable growth factors. The inverts of the hydrobrakes have been designed to ensure run-off rates and volumes do not increase flood risk downstream of the basin. Discharge from the basin is into an existing ditch which currently collects all the greenfield run-off from the Phase 8 design catchment. Surface water is then routed through a series of swales and culverts before being discharged to the river to the north of the site. The existing ditch, which

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runs through Phase 8 has been diverted around the perimeter of the basin to ensure overland flow, from undeveloped land, is not interrupted.

47. The basin has sufficient capacity to attenuate a 1 in 100 year storm event plus 40% climate change allowance. An overflow facility has been provided to ensure discharge can continue during exceedance events or should there be a blockage in the system. The Windes Microdrainage model did not show any use of the overflow system during a 1 in 100 year storm event plus 40% climate change.

SuDS Features

48. Basin A has a total depth of 2m. The max design water depth is 1.9m which leaves 100mm freeboard to be utilised by the overflow weir.
49. Due to the depth of the basin and to allow it to blend into the current terrain, relaxed slopes have been used. The top 1m depth of the internal slopes of the basin are at 1 in 4, with the remaining being at 1 in 3. All cut and fill slopes to existing ground are at 1 in 3.
50. The SuDS features are 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 surface water in the same pattern as the existing surface water flow paths.
51. Information of the installed basin is detailed in Table 4 below:

Basin	Area (m ²)	Volume (m ³)	Design Head (m)	Design Flow (l/s)
A	1958	2384	1.9	28.4 (1 in 30)
			0.9	62.0 (1 in 100)

Table 4: SuDs Basin and Hydrobrake Details

Simulation Modelling and Results

52. The WinDes model was run for return periods of 1 in 1, 30, and 100 plus 40% for climate change. A summary of the Model results can be found below in Table 5:

Return Period (year)	Permitted Discharge Rate (l/s)	Actual Discharge Rate (l/s)	Water Depth (m)	Flooding (m)
1 in 1	28.4	28.3	0.48	None
1 in 30	68.2	53.5	1.19	None
1 in 100 + 40%	90.6	89.0	1.86	None

Table 5: Model Results

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Section Conclusion

53. As per the above information, an approved Strategic SuDS system has been designed and installed to serve Phase 8. For further information on the system please refer to Phase 8 Berewood, Waterloooville - Suds Design Document - March 2020 by Mayer Brown.

Phase 8a 'On Plot' Surface Water Drainage

54. Phase 8a is located within the Phase 8 area of the overall development at Berewood, Waterloooville and comprises 185 residential units.
55. Phase 8a was provided to Bloor Homes as a fully serviced parcel in regard to surface water drainage. A point of connection to the Strategic Drainage System which serves Phase 8 is provided where a connection can be made with a 'free discharge' from the development which then drains into the Strategic System and the through the overall system for the site.
56. The Phase 8 Strategic Drainage System made an allowance for 3.46ha of impermeable area run-off from Phase 8a. It should be noted that after detailed design of the plot the positively drained area of Phase 8a is lower than that anticipated in the Mayer Brown design, with only 2.96ha of impermeable area being proposed, a reduction of 14.5%.
57. The point of connection provided to the Strategic Drainage System is located in the north-western corner of Phase 8a. via an already constructed 600mm pipe laid at a gradient of 1:172. This pipe is then connected to the downstream strategic system where storage is provided together with water quality improvement which comprise the attenuation basin, a proprietary water quality unit (Aqua Swirl) and a long network of swales downstream of the basin to the outfall into the river meeting the target water quality indices set out in the SuDS manual for a medium / low risk development.
58. A drainage system has been designed for Phase 8a which comprises a piped network, with some oversized pipes to prevent any flooding for storms up to and including the 1 in 100 plus 45% climate change events. A copy of the Causeway Flow calculations has been provided as part of the Reserved Matters submission pack provided.
59. As part of the development an existing ditch / French Drain will be abandoned which is located on the northern and eastern site boundary. This ditch served as a cut off drain for overland flows from the undeveloped land and also has an inflow from a small parcel of land to the east of the site. To replace this, ditch / French Drain a cut off drain is proposed along the northern and western boundary of the site which will intercept any overland flows resulting from the undrained landscaped / garden areas of Phase 8a whilst also allowing for a connection from the land drainage in the parcel to the west of Phase 8a. This cut off drain then connects to the existing ditch to the north of the site adjacent to the allotments. Details of the cut

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off drain are included on the Proposed Drainage Plans which form part of the submission for Reserved Matter Approval.

Section Conclusion

60. Based on the above information a suitable surface water drainage system has been design and proposed to serve Phase 8a which accords with the approved overall site and Phase 8 surface water designs together with industry best practice and Local Planning Policies.
61. A reduction in impermeable are of cica 15% compared to that allowed in the original design has been applied therefore providing a betterment over the approved design and further decreasing the risk of flooding onsite and downstream.
62. Phase 8a will discharge at the allowable Greenfield rates through the Strategic Phase 8 SuDS system.
63. More than adequate levels of water quality improvements have been installed to treat run-off before discharging to the river.