OPUS

Flood Risk Assessment & Drainage Strategy

Site at Station Road

Hayling Island, Hants

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1 Introduction

1.1 Instructions were received from Barratt Homes to undertake a Flood Risk Assessment (FRA) for the development of 76 residential dwellings and 1,000 m² of light industrial accommodation (use class B1) with associated parking, access, landscaping and surface water drainage on land at Station Road, Hayling Island, Hants.

1.2 This assessment has been prepared by A P Traves BSC CEng MIStructE MCIHT.

1.3 The client's attention is drawn to the conditions and limitations contained in Appendix D.

2 Development Description & Location

2.1 The development site comprises some 2.8 Ha of land at Station Road, Hayling Island, Hants (grid reference SZ 710 997). The land is identified on the aerial photograph in Appendix A.

2.2 The site use currently comprises agricultural use.

2.3 It is proposed to develop the site for an estate of 76 residential dwellings (2.4Ha) and 1,000 m² of light industrial accommodation (0.4 Ha) (use class B1) with associated parking, access, landscaping and surface water drainage. The proposed layout for the site is shown on Urban Design drawing ST-10-03 rev F, a copy of which is contained in Appendix A.

3 Local Development Documents & Strategic Flood Risk Assessment

3.1 The Partnership for Urban South Hampshire (PUSH) Strategic Flood Risk Assessment (SFRA) has been reviewed (refer to appendix for local mapping) and this indicates the following.

3.2 SFRA Map 1A indicates the site is located wholly within Flood Zone 1 (FZ1).

3.3 SFRA Map 1B indicates no flood zone 3 hazard within the site.

3.4 SFRA Map 1D indicates that the site is not at risk from breaching of defences.

3.5 SFRA Map 1E indicates the site remains wholly within FZ1 inclusive of climate change to 2115AD.

3.6 SFRA Map 1F2 indicates no history of groundwater flooding at the site and indicates a low generic bedrock permeability.

3.7 SFRA Map 1F5 indicates no history of sewer flooding at the site.

3.8 The Environment Agency (EA) historic flood map within the SFRA indicates no historic flood events within the site.

3.9 Flood mapping data has also been reviewed from the EA website (refer to Appendix for local mapping). This indicates the following:

3.10 The EA mapping indicates the site is wholly in FZ1.

3.11 The EA mapping indicates the site is in the lowest classification for river and sea flood risk (FZ1)

3.12 The EA mapping indicates the site is not in an area at risk of flooding from reservoirs.

3.13 The EA mapping indicates the site is at a 'very low' risk of flooding from surface water.

3.14 The EA mapping indicates the site is not located within a groundwater source protection zone.

3.15 The EA mapping indicates the site is not within a surface water or groundwater protection area for drinking water.

3.16 Groundwater attributes are further discussed in section 5.

4 Catchment Flood Management & Shoreline Management Plans

4.1 The site is at an elevation of some 6m AOD and is remote from the influence of tidal flooding. Shoreline Management Plans are not applicable to this location.

4.2 The South east Hampshire Catchment Flood Management Plan summary – December 2009 (CFMP) indicates the site falls within sub-area 1, Portsmouth and Langstone Harbours. The CFMP states that Policy 5 is the preferred policy approach:

- *"Areas of moderate to high flood risk where we can generally take further action to reduce flood risk. This policy will tend to be applied to those areas where the case for further action to reduce flood risk is most compelling, for example where there are many people at high risk, or where changes in the environment have already increased risk. Taking further action to reduce risk will require additional appraisal to assess whether there are socially and environmentally sustainable, technically viable and economically justified options."*

4.3 Overall the CFMP does not present any issues that would prohibit the development of this site with respect to flood issues provided the surface water drainage is based on SuDS principles.

5 Catchment Data

5.1 The site lies in a coastal location remote from terrestrial main rivers and does not lie within a gauged catchment. Surface water drainage of the site currently comprises ditches to the

eastern and western boundaries, both of which drain to the north. The eastern ditch also extends partly along the southern boundary. The ditches constitute surface watercourses and are dry when rainfall is light, typically for much of the summer. The ditches also receive outfall from a few small diameter public surface water sewers of limited catchment and serving some of the urban area immediately to the south.

5.2 The BGS Geology of Britain viewer indicates the site bedrock geology to be London Clay with undifferentiated superficial River Terrace deposits of sand silt and clay.

5.3 The site falls slightly to the north.

5.4 The site soils investigation works to date is reported on by Messrs Wilson Bailey in their report J1510-9/DB/c01 dated 5 June 2015. Reference should be made to this report for full details but particular issues are summarised in the following paragraphs.

5.5 Twelve small diameter boreholes were drilled across the site to depths of up to 5.00m below ground level. The ground conditions have been found to comprise a significant depth of topsoil between 0.40 m and 0.65 m. Underlying the topsoil a soft brickearth type silty clay has been encountered to depths of between 0.95 m and 1.5 m below ground level, beneath which a generally medium to coarse sand with variable gravel content has been encountered to depths of less than about 4.00 m, whereupon stiff grey clay soils of the London Clay have been encountered

5.6 Groundwater was encountered in each exploratory hole at depths of about 1.50 m, although subsequent limited groundwater monitoring has indicated a groundwater rest level at a depth of less than about a metre. Monitoring carried out during the morning and during the afternoon at times consistent with a high and low tide on a non-peak sprint tide indicate that the groundwater is tidally influenced, with a variation of between 0.05m and 0.12 m. Assessed groundwater flow direction is to the northeast. The monitoring suggests that the groundwater is under a sub-artesian pressure, with the groundwater level higher than the base of the overlying (confining) clay. The site has soil permeability within the granular soils underlying the clay, with preliminary falling head tests suggest a permeability in the mid E-5m/s range. Discharge to these granular soils would entail a direct discharge to groundwater as there is no partially saturated zone over the groundwater in which to form a soakaway. It is therefore considered that traditional soakaways would not be viable at this site.

5.7 The current and historical use of the site as open agricultural land is not considered to pose a risk of ground contamination. The adjoining historical site land uses of a railway sidings to the west and a former gas works to the south present potentially significant sources of off site potentially mobile ground contamination, albeit mitigate by the time that has elapsed since the potentially contaminative activities were carried out on these adjoining areas. The ground investigation has not identified any visual or olfactory indications of ground contaminants and elevated concentrations of a wide range of potential soil contaminants have not been detected within the selected representative soil and groundwater samples recovered from the site.

5.8 Discussion with Messrs Wilson Bailey determined that the existing ditches either side of the site are cut down to an invert similar to the base of the clay/top of the underlying sand, and as such will tend to reflect groundwater levels when this becomes elevated and also tends to constrain groundwater levels as surface flows to discharge the groundwater will develop once

ditch invert level is reached. The applicant has instructed Messrs Wilson Bailey to continue monitoring of the groundwater to ensure a robust assessment of the seasonal variations of the groundwater at this site. Based upon the advice of Messrs Wilson Bailey and interim value for the seasonal high groundwater level of 0.75m below existing ground level will be used.

6 Sewerage Authority Data

6.1 The site is not currently connected to the public foul sewer network. The public foul sewer is located to the site frontage within Station Road (200mm DN). An extract of the local sewer plan in contained in Appendix B.

6.2 A capacity check has been undertaken by Southern Water. This identifies that their existing gravity sewer network has capacity to support the proposed development. It also identifies a need to slightly increase the current pumping capacity at Newton Lane Wastewater Pumping Station (WPS). The necessary works to the WPS will be requisitioned from Southern Water to facilitate the development.

7 Walkover Survey

7.1 A site reconnaissance was made on 4th August 2015. The site comprises 2.4Ha of arable field, a small rectangular element of which, immediately affronting Station Road, is not currently laid to crop due to the local geometry. This element is currently fallow. The site slopes gently from South to North.

7.2 The site contains two ditches, both falling to the north. One on the eastern boundary and one on the western boundary. The eastern ditch also extends partly along the southern boundary. The ditches are indicated to support a number of outfalls from the local public surface water sewer system.

7.3 Beyond the application site to the north is an East-West field boundary ditch.

7.4 The land use to the north is farmland. The land use to the west comprises and existing light industrial estate. The land use to the East comprises residential dwellings. The existing land use affronting Station Road to the south of the site comprises a mixture of residential and commercial uses.

8 Source-Pathway-Receptor Assessments

8.1 The site is at an elevation of approximately 6m AOD and is remote from the effects of tidal flooding. The site is not therefore at risk of tidal flooding.

8.2 The EA mapping indicates the site is wholly in FZ1. The site is therefore considered to be at a low risk of fluvial flooding.

8.3 The site is not located in the vicinity of any reservoirs and EA flood risk from reservoirs mapping does not indicate any reservoir flood risk to the site.

8.4 The site is not in a location with sewer flooding incidents and is not considered to be at risk of sewer flooding.

8.5 The SFRA and EA mapping do not indicate the site to be at risk of groundwater flooding.

8.6 The SFRA and EA mapping indicate the site is not within a pluvial or surface water flood risk area.

8.7 The critical flood source is surface water pluvial flooding and run-off within the site. The site surface water system will accord with the principles of CIRIA C697.

8.8 The new flood receptors of the development would be:

- New dwellings
- New commercial units
- Residents in the dwellings
- Employees and visitors of the commercial uses

8.9 The proposed development and existing site classifications to Table 2 of NPPF Technical Guidance are as follows:

• Existing agricultural use	Less vulnerable
• Proposed commercial use	Less vulnerable
• Proposed residential use	More vulnerable

8.10 Overall the site is low flood risk.

9 Flood Probability

9.1 The Environment Agency (EA) flood zones shown on the outputs and included in the Appendix represents current best estimates of zone 2 and zone 3 flooding as defined in Table 1 of the Technical Guidance to the National Planning Policy Framework. It does not take account of potential climate change impacts.

Zone 2	Medium Probability of tidal flooding (0.5%-0.1%)
Zone 3a	High Probability of tidal flooding (>1%)
Zone 3b	Functional Floodplain (>5% probability of flooding)

The flood map does not differentiate between zones 3a and 3b.
Zone 3b is only considered appropriate for water-compatible development.
Zone 3a is additionally considered appropriate for less vulnerable uses.

9.2 The site is located wholly in flood Zone 1 (low risk <0.1%).

10 Climate Change

10.1 Assuming a design life of 100 years, increase in rainfall (Table 5 of NPPF Technical Guidance) due to climate change is +30% to current rates. The SFRA mapping indicates the site would continue to be located in FZ1 in 2115AD.

10.2 Surface water drainage strategy is discussed in section 11. The volumes and flows for this strategy have been derived in accordance with CIRIA C697 and include for climate change effects.

11 Detailed Development Proposals & Surface Water Strategy

11.1 The site soils investigation works by Messrs Wilson Bailey (report J1510-9/DB/c01 dated 5 June 2015) included falling head permeability tests which indicated a permeability of the underlying sand/gravel in the mid E-5 m/s range. Based upon the advice of Messrs Wilson Bailey an interim value for the seasonal high groundwater level of 0.75m below existing ground level has been adopted for consideration of the surface water drainage system. Considering these two parameters in combination leads to a conclusion that whilst surface water by discharge is possible in terms of hydraulic conductivity options for location of the attenuation storage will be constrained by the seasonal high groundwater level. Soakaways would have to be excavated below the clay Brickearth and could therefore be expected to be completely below seasonal high groundwater level at some times of the year, thus rendering the storage volume ineffective at these times. An infiltration basin/pond is however viable based upon the information contained in the Wilson Bailey soils report. At times of low groundwater level it will empty completely, at times of high groundwater it will empty down to the seasonal groundwater level. The operational storage volume that can be relied upon is therefore the volume above the seasonal high groundwater level.

11.2 It is proposed to provide an infiltration basin to the northeast corner of the development. The development will comprise three reticulated surface water catchment areas; one serving the commercial area and two serving the residential area. These will drain to a surface water swale along the northern boundary to the built development area. The swale will discharge to the basin. An impermeable areas schematic is contained in Appendix C :

1 Commercial	2,351m²	(16%)
2 Residential (W)	5,950 m²	(42%)
3 Residential (E)	5,956 m²	(42%)
	14,257	

11.3 Two calculation sheets are included in Appendix C for the sizing of the infiltration basin. The first sheet determines the critical storm period and storage volume required in the basin for an invert size of 49 x 21 m for 14,300m² of impermeable surface with a soil permeability of 3 x 10^{-5} m/sec under a 1% AEP + climate change storm. This indicates a required storage volume of 780 m³, a critical storm period of 6 hours and a half drain down time of 7 hours.

The second sheet determines the water storage level required above a seasonal high groundwater level of 0.75m below existing ground level required to store the 780m^3 attenuation volume. The results demonstrate that an extreme flood depth (EFD) of 0.6m above a seasonal groundwater level of 0.75m below existing ground would store all but a few cubic metres of this volume. These few cubic metres of storage would be provided within the swale volume.

Comparing the log from borehole 5 and the topographic survey indicates that for the basin location:

Top of gravel/sand	approx. 4.0m AOD
Existing GL	5.1-5.2m AOD
Seasonal GWL	approx. 4.35m AOD
(1%AEP + CC) EFD level	approx. 4.95m AOD
Existing GL freeboard	0.2m

In order to improve the basin freeboard it is proposed to raise the basin rim to 5.6m AOD thus increasing freeboard to more than 0.6m. The basin will also have a high level overflow fitted above EFD to convey discharge for events in excess of 1%AEP + CC to the existing eastern ditch.

It should be noted that the existing ground levels in the development built area are approx. 5.4-6.0m AOD so the proposed development will not be at flood risk from an EFD level of 4.95m AOD in the basin and collection system.

A schematic of the proposed drainage system is also contained in Appendix C.

11.4 Water butts should be installed to intercept roof water run-off. These will reduce the annual volume of surface water discharge but will not make any material contribution to regulation of critical run-off as these tend to be full during winter months as there is minimal demand for garden irrigation in these months.

11.5 In summary source control will be provided by:

- Discharge to infiltration basin as outlined in paragraph 11.3
- Provision of water butts as outlined in paragraphs 11.4

11.6 A Water quality assessment has been undertaken using the UKSuDS methodology. Section 3.3 of the CIRIA C697 SUDS Manual identifies the pavement to the commercial area to require 3 treatment stages the residential pavement 2 stages and the roofs one stage. The treatment train for all stages includes the swale and infiltration basin (2 stages). The commercial development discharge will be passed through an oil interceptor prior to discharge to the swale so as to provide the third stage. The assessment results indicate a WQS_{SUDS} of 0.3 compared to a $WQS_{traditional}$ of 5.76, representing a 95% reduction compared to traditional systems. The WQS assessment is contained in Appendix C.

11.6 Foul drainage arrangements for the development are discussed in section 5 and the Foul Sewage and Utilities Assessment report. In summary the site will be served by a gravity foul water system within the development connecting to the existing public foul sewer in Station Road. The existing public foul sewer has capacity for the development. A small increase in pumping capacity at the Newton Lane WPS is required. The modifications to the pumping

station will be requisitioned from Southern Water by S98 requisition. The schematic of the site drainage contained in Appendix C also shows the proposed foul sewer spines.

12 Sequential & Exception Tests

12.1 The site is located wholly within FZ1. The development accords with paragraph 4 of the Technical Guidance to the NPPF. The proposals are therefore considered to meet the sequential test.

12.2 Application of the Exceptions Test is not required on this basis.

13 Flood Risk Management Measures

13.1 The source pathway receptor assessment is contained in Chapter 8.

13.2 Paragraph 8.7 identifies that management of the overland flow from surface run-off is the governing flood source. The management of the storage and conveyance of these volumes and flows is provided for by the surface water strategy set out in Chapter 11. The strategy accords with CIRIA C697 SuDS Manual.

13.3 The surface water strategy mimics the existing run-off regime. There will therefore be no adverse impact on flood flow rates outside the site.

14 Off Site Impacts

14.1 The surface water strategy mimics and improves on the existing run-off regime. There will therefore be no adverse impact on flood flow rates outside the site.

15 Residual Risks

15.1 The proposed surface water strategy for the development provides for flood events up to 1:100 year 2015AD +30% rainfall. The residual flood risk is therefore events in excess of 1:100 year 2015AD +30% rainfall.

APPENDIX A:

Existing & Proposed Site Layout

Aerial view on site

View SW to NE across site

View NE to S across site

View on Western ditch

View on eastern ditch

View on southern ditch

FURNISS WAY
DANCES WAY
SUDS POND
GATE
Proposed culvert to allow access for maintenance vehicles onto adjacent land
Existing watercourse to be retained
Existing watercourse to be retained
Cinema Post & Pedestrian fence
Sub station
Access to sub station
Unit A
Unit B
Unit C
Unit D
Unit E
Unit F
Unit G
Unit H
Unit I
Unit J
Unit K
Unit L
Unit M
Unit N
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APPENDIX B:

SFRA Map Data, EA Data & Sewer Data

APPENDIX C:

Proposed Drainage Data

APPENDIX D:

Conditions & Limitations

OPUS

ENGINEER'S INSPECTION

CONDITIONS AND LIMITATIONS

1. The report is a record of a visual inspection carried out by, or under the direction of a Chartered Structural Engineer and must not be misinterpreted as a Structural Survey such as would be carried out by a Chartered Surveyor. The report is not a Valuation Survey.

2. The inspection is strictly limited to the items requested and these will be detailed in Clause 1 of the report. No consideration will be given to any other aspects or parts of the building.

3. The report is confidential to the Client(s) stated in Clause 1 and has been prepared to their instructions for their own purposes only and it is not permitted to disclose this report to any other parties (except the Clients own Solicitors, Surveyors, Building Societies or Estate Agents) without the prior consent of Opus.

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5. No liability for the contents of this report is accepted to any parties other than the Client(s) stated in Clause 1.1. No parties other than the client stated in Clause 1.1 should rely upon this report.

6. Unless specifically stated otherwise:-

   a) Trial holes will not be excavated prior to the preparation of the report and the depth and construction of the foundations and type of sub-soil will not be inspected.

   b) All external observations will be carried out by eye from the ground level only. Internal inspection is made within the limits of ready accessibility and it is not normal practice to lift floor coverings or floor boards, remove fixtures, panels or plaster, or move heavy items of furniture or bulky goods or materials.

   c) No inspection will be made of any roof voids, floor joists, wall cavities, drainage pipework or any other hidden or inaccessible parts.

   d) No timbers will be checked for damp, rot, infestation by wood-boring insects or other defects.

   e) It should not be construed that any parts of the construction comply with the requirements of the Building Regulations Act or standard practice either current or as current at the time of original construction. No enquiries to any Authorities will be made.

   f) No testing or enquiries into the presence of or susceptibility to pollution, contamination, radiation, methane, radon or other gases or hazardous substances has been carried out.

7. Unless specifically stated otherwise in the report, any recommendations for works given in the report are outline only and are to be confirmed or modified as appropriate at detailed design stage.

8. Where trial holes are specifically included in our instructions the condition of the footing and the founding soil relates only to the point of excavation and does not necessarily confirm a continuation of the same conditions throughout the non-inspected areas of the structure. Whilst such trial pits will usually provide a reasonable indication as to the general state of the foundations and ground conditions, these cannot be determined with complete certainty.

9. Under the Construction (Design & Management) Regulations latest edition, the Client has obligations for ensuring Health and Safety arising from any construction work. If it is proposed to proceed with construction work based upon information or recommendations contained in this report, these regulations probably apply. Further details of any issues arising from our report or the Clients obligations generally are available on request.

10. Unless dealt with more specifically above the Association of Consulting Engineers Conditions of Engagement Short Form Agreement 2002 apply.

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