



NPPF: Flood Risk Assessment

Rook Farm, Hayling Island

Gladman Developments Ltd

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Rook Farm, Hayling Island

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Contents

Contents	i
Executive Summary	iv
1.0 Introduction	1
1.1 Background	1
1.2 Scope	2
1.3 Aims	2
1.4 Planning Context	3
1.5 Report Structure	3
2.0 Sources of Information	4
2.1 Sources of Information	4
2.2 Consultation and Discussion with Regulators	6
2.3 Site Walkover	6
3.0 Site Location and Description	7
3.1 Location	7
3.2 Land Use	7
3.3 Topographic Information	8
3.4 Soils and Geology	8
3.5 Hydrogeology	11
3.6 Catchment Hydrology	13
3.7 Sewerage Assets	17
3.8 Designated Sites	18
4.0 Flood Risk Assessment	20
4.1 Potential Sources of Flooding	20
4.2 Fluvial Flooding	20
4.3 Tidal Flooding	21
4.4 Groundwater Flooding	22
4.5 Surface Water Flooding	23
4.6 Sewer Flooding	24
4.7 Flooding from Infrastructure Failure	24
5.0 Flood Risk Mitigation Measures	26
5.1 Introduction	26
5.2 Mitigation Measures	26
5.3 Summary of Flood Risk	27
5.4 Flood Guidance and Sequential Test	27
6.0 Site Drainage	29
6.1 Surface Water Drainage	29
6.2 Existing Drainage System	29
6.3 Developable and Impermeable Areas	29
6.4 Greenfield Runoff Rates	30
6.5 Hierarchy of Discharge	31
6.6 Sustainable Drainage Options (SuDS)	31
6.7 Surface Water Management Strategy	33
6.8 Exceedance Routes	35

7.0	Summary and Conclusions	36
7.1	Introduction	36
7.2	Flood Risk	36
7.3	Mitigation Measures	36
7.4	Flood Guidance	37
7.5	Site Drainage	37
7.6	Conclusion	37
	Drawings	1
	Appendix 1 – Topographic Survey	3
	Appendix 2 – SFRA Mapping Extracts	4
	Appendix 3 – Southern Water Correspondence	5
	Appendix 4 – Environment Agency Correspondence	6
	Appendix 5 – Hampshire County Council Correspondence	7
	Appendix 6 – BGS Historical Borehole Records	8
	Appendix 7 – Drainage Calculations	9

Drawings

Drawing 001 - Site Location Plan

Drawing 002 - Surface Water Features

Drawing 003 - BGS Groundwater Susceptibility

Drawing 004 - JBA Surface Water Flooding

Drawing 005 - Environment Agency Flood Zones

Drawing 006 - Geosmart Groundwater Flood Risk

Drawing 007 - Geological Indicators of Flooding

Drawing 008.1 - Environment Agency Complex Surface Water Flood Mapping Flow Path

Drawing 008.2 - Environment Agency Complex Surface Water Flood Mapping 1000-year Depth

Drawing 008.3 - Environment Agency Complex Surface Water Flood Mapping 1000-year Velocity

Drawing 008.4 - Environment Agency Complex Surface Water Flood Mapping 1000-year Hazard

Drawing 101 - Indicative Drainage Drawing

Appendices

Appendix 1 - Topographic Survey

Appendix 2 - SFRA Mapping Extracts

Appendix 3 - Southern Water Correspondence

Appendix 4 - Environment Agency Correspondence

Appendix 5 - Hampshire County Council

Appendix 6 - BGS Historical Borehole Records

Appendix 7 - Drainage Calculations

Executive Summary

This report presents an FRA in accordance with the NPPF and NPPG ID: 7 guidance, for a proposed residential development located on land at Rook Farm, Hayling Island.

The report includes an assessment of the surface water drainage requirements of the Site and details the flood risk and how this could be managed and mitigated to allow the Site to be developed in support of the outline planning application.

The FRA has demonstrated the following:

- The 11.77-hectare (ha) Site is comprised of agricultural (grassed) land with an agricultural building.
- The Site falls in a south easterly direction and is underlain by impermeable bedrock.
- The risk of flooding is assessed as follows:
 - The risk of fluvial flooding is negligible however there is a residual risk of flooding from the onsite land drains.
 - The risk of tidal flooding to the Site is assessed as negligible; however, the risk of tidal flooding to Hayling Island access/egress (Langstone Bridge) is assessed as medium to high.
 - The risk of groundwater flooding is assessed as low below ground and negligible above ground.
 - The risk of surface water flooding is assessed as negligible for most of the Site, with an area of low risk associated with the surface water ponding.
 - The risk of flooding from sewers is assessed as negligible for most of the Site, with an area of low risk along the reach of the onsite assets.
 - The risk of flooding from all other sources is assessed as negligible.
- Flood risk from identified sources can be mitigated to a negligible or low and acceptable level through the following approach:
 - Provide a 4m easement free from development along either side of the onsite and bounding land drains. This easement would provide access for inspection and maintenance purposes, including vehicle access.
 - It is recommended that the number of highway crossings along the route of the land drains is kept to a minimum. Culvert crossings would need to be sized to convey the 100-year plus climate change event, with a freeboard allowance.
 - Undertake maintenance activities to keep the land drains clear from debris and overgrown vegetation to maintain the conveyance of the channels.
 - Set the surface water outfall from the proposed development at an appropriate height (i.e. +300mm) above the bed level of the receiving land drains.
 - Set finished floor levels a minimum of +150mm above external levels.
 - The areas north and south of the Hayling Bridge are covered by flood warnings, which have long lead up times (up to days in advance), which enable temporary bridge closure.
 - Tidal flooding events are often short-lived (a matter of hours for spring tides and for storm surges), so any bridge closure would only be a short-lived event.

- o The Hayling Emergency Planning Framework provides details of an emergency plan if the 'highly unlikely' scenario where a flood event were to prevent access on and off the Island were to unfold. Full details of the Emergency Planning Framework can be found in Appendix 3.
- o The Island and Site provides a safe place of refuge and as such no access/egress to the island would not pose a risk to life.
- o No below surface habitable buildings (i.e. basements).
- o Adoption of a surface water management strategy (see Section 6).
- o Lined attenuation to prevent groundwater ingress.
- o Adoption of a surface water management strategy.
- o Provide a development free easement (3m either side) of onsite/bounding public foul sewer, or re-direct around the Site boundary.

The FRA has considered the potential impact of the development on surface water runoff rates, given the increase in impermeable areas post-development. These rates have been calculated, and it has been demonstrated that surface water can be managed, such that flood risk to and from the Site following development will not increase. This will be achieved through restricted discharge rates and appropriately sized detention basins with outfall to land drain and in turn surface water sewer.

The FRA demonstrates that the proposed development would be operated with minimal risk from flooding and would not increase flood risk elsewhere. The development should therefore not be precluded on the grounds of flood risk and surface water drainage.

1.0 Introduction

1.1 Background

- 1.1.1 Enzygo Ltd was commissioned by Gladman Developments Ltd to carry out a site-specific flood risk assessment (FRA), including a surface water drainage strategy, in support of an outline planning application for a proposed residential development located on Rook Farm, Hayling Island (the 'Site').
- 1.1.2 The proposal is for up to 300 dwellings, public open space, landscaping, sustainable drainage system (SuDS) in the 11.77ha Site, with vehicular access point from St Mary's Road. All matters reserved except for means of access.
- 1.1.3 A site-specific FRA assesses the current and future flood risk to and from a development site. It demonstrates how flood risk will be managed now and over the development's lifetime, taking climate change, drainage, and the vulnerability of its intended users into account.
- 1.1.4 The objectives of a site-specific FRA are to:
- Assess whether a proposed development is likely to be affected by current or future flooding from a range of sources.
 - Assess whether the development will increase flood risk elsewhere.
 - Decide on measures to deal with these effects and risks and assess their appropriateness.
 - Provide enough evidence for the local planning authority to apply (if necessary) the Sequential Test.
 - Decide whether the development will be safe and will pass the Exception Test if applicable.
- 1.1.5 In England, planning applications for development need an FRA¹ for most developments including:
- In Flood Zones 2 and 3 including minor development and change of use.
 - Sites of 1ha or larger in Flood Zone 1.
 - Sites of less than 1ha in Flood Zone 1, including change of use to a more vulnerable class (for example from commercial to residential), and where they could be affected by sources of flooding other than rivers and the sea.
 - Land in Flood Zone 1 in a Critical Drainage Area (CDA) as notified by the Environment Agency.
 - Land in Flood Zone 1 identified in a strategic flood risk assessment as being at increased flood risk in future.
- 1.1.6 An FRA is required for this development, as initial screening using Environment Agency online indicative flood mapping shows that the Site is in Flood Zone 1 but is more than 1ha and is at risk of surface water flooding.
- 1.1.7 The purpose of this FRA is to assess the risk of flooding to the proposed development and where possible provide sufficient mitigation to demonstrate that future users of the

¹ Department for Communities and Local Government (2017). Flood Risk Assessments if You're Applying for Planning Permission [<https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications>].

development would remain safe throughout its lifetime, that the development would not increase flood risk on Site and elsewhere and, where practicable, would reduce flood risk overall.

1.2 Scope

- 1.2.1 Government policy on development and flood risk is set out in the National Planning Policy Framework (NPPF)² and is supported by National Planning Practice Guidance: Flood Risk and Coastal Change [NPPG ID7]³.
- 1.2.2 NPPF paragraphs 148-169 set out the need for an appropriate assessment of flood risk at all levels of the planning process and require the application of a sequential risk-based approach to assess the suitability of land for development in flood risk areas.
- 1.2.3 The FRA should also make allowances for climate change⁴ to minimise vulnerability and provide resilience to flooding and coastal change in the future. The allowances are predictions of anticipated change in:
- Peak river flow by river basin district.
 - Peak rainfall intensity.
 - Sea level rise.
 - Offshore wind speed and extreme wave height.
- 1.2.4 The allowances are based on climate change projections and different scenarios of carbon dioxide emissions to the atmosphere. There are different allowances for different periods of time over the next century.
- 1.2.5 Site-specific FRAs are categorised according to level. Simple Level 1 Screening studies give a general indication of the potential flood risk to a site and identify whether more detailed Level 2 assessment is required or not. A Level 2 assessment is a qualitative appraisal to develop understanding of flood risk to a site and the effects of the site on flooding elsewhere including recommended mitigation measures. Level 3 assessments are more detailed quantitative studies, for example modelling to establish flood levels at a site in the absence of Environment Agency or other data or providing detailed outline drainage designs.

1.3 Aims

- 1.3.1 This FRA aims to provide enough flood risk information to satisfy the requirements of the NPPF, PPG ID7 and regional/local government plans and policies. It describes the potential for the Site to be impacted by flooding, the impacts of the proposed development on flooding elsewhere near the Site, and the proposed measures that could be incorporated into the development to mitigate the identified risks.

² Department for Communities and Local Government (2018). Revised National Planning Policy Framework (published July 2018 and updated February 2019) [<https://www.gov.uk/government/collections/revised-national-planning-policy-framework>].

³ Department for Communities and Local Government (published March 2014, updated August 2021). Planning Practice Guidance ID7-030-20140306; Flood Risk & Coastal Change [<https://www.gov.uk/guidance/flood-risk-and-coastal-change>].

⁴ Department for Communities and Local Government (published February 2016 and updated October 2021). Flood Risk Assessments: Climate Change Allowances [<https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>].

1.4 Planning Context

National Policy

- 1.4.1 The FRA was prepared in accordance with the NPPF and NPPG ID7.

Regional/Local Policy

- 1.4.2 The FRA also considers the following policies in the Havant Draft Local Plan 2036:

- Policy E12: Managing Flood Risk in New Development
- Policy E13: Drainage Infrastructure in New Development

1.5 Report Structure

- 1.5.1 This report is structured as follows:

- Section 2 identifies the sources of information that were consulted
- Section 3 describes the existing Site.
- Section 4 outlines the flood risk to the existing site and proposed development.
- Section 5 details the proposed mitigation measures against identified flooding sources.
- Section 6 assesses the potential impacts of the proposed development on surface water drainage and proposes mitigation for those effects.
- Section 7 presents a summary and conclusions.

2.0 Sources of Information

2.1 Sources of Information

2.1.1 The following information was consulted:

- Ordnance Survey 1:25,000 mapping (Explorer 197: Chichester & the South Downs).
- Detailed topographic survey (Appendix 1).
- Environment Agency online mapping (Flood Map for Planning⁵, Long Term Flood Risk Assessment for Locations in England⁶, Catchment Data Explorer⁷ and Main River Map⁸).
- River Basin District (RBD) Maps⁹ (South East RBD) together with guidance on climate change allowances¹⁰.
- National River Flow Archive¹¹.
- Partnership for Urban South Hampshire Strategic Flood Risk Assessment (SFRA) and associated mapping (Appendix 2)¹².
- South-East Hampshire Catchment Flood Management Plans (CFMP)¹³.
- Hampshire Preliminary Flood Risk Assessment (PFRA)¹⁴.
- Hampshire Groundwater Management Plan¹⁵.
- North Solent Shoreline Management Plan (SMP)¹⁶.
- South East River Basin District River Basin Management Plan (RBMP)¹⁷.
- Hayling Island Emergency Plan (2021)¹⁸ (Appendix 3).
- Havant Borough Council Draft Local Plan 2036 (2016)¹⁹.
- Havant Borough Council Housing Statement (2016)²⁰.
- British Hydrological Society Chronology of British Hydrological Events²¹.
- National Soils Resources Institute (NSRI): Soilscape online mapping²².

⁵ <https://flood-map-for-planning.service.gov.uk/>

⁶ <https://flood-warning-information.service.gov.uk/long-term-flood-risk/>

⁷ <http://environment.data.gov.uk/catchment-planning/>

⁸ <https://environment.data.gov.uk/apps/webappviewer/index.html?id=17cd53dfc524433980cc333726a56386>

⁹ <https://www.gov.uk/government/publications/flood-risk-assessments-river-basin-district-maps>

¹⁰ <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

¹¹ <http://nrfa.ceh.ac.uk>

¹² http://localviewmaps.hants.gov.uk/LocalViewMaps/Sites/push_sfra/#

¹³ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/293859/South_east_Hampshire_Catchment_Flood_Management_Plan.pdf

¹⁴ <http://documents.hants.gov.uk/flood-water-management/watercourses/PFRAREportsavedJan2016.pdf>

¹⁵ <http://documents.hants.gov.uk/flood-water-management/groundwater/GroundwaterManagementPlan.pdf>

¹⁶ <http://www.northsolentsmp.co.uk/CHttpHandler.ashx?id=16230&p=0>

¹⁷ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/500473/South_East_RBD_Part_1_river_basin_management_plan.pdf

¹⁸ [HAYLING ISLAND BRIDGE INCIDENT PLAN \(havant.gov.uk\)](http://HAYLING ISLAND BRIDGE INCIDENT PLAN (havant.gov.uk))

¹⁹ https://www.havant.gov.uk/sites/default/files/documents/The%20Draft%20Local%20Plan%202036_for%20web%20with%20policy%20numbers%20%281%29.pdf

²⁰ <https://www.havant.gov.uk/sites/default/files/documents/Local%20Plan%20Housing%20Statement.pdf>

²¹ <http://www.cbhe.hydrology.org.uk/search.php>

²² <http://mapapps.bgs.ac.uk/geologyofbritain3d/index.html>

- British Geological Survey [BGS] online mapping: Geology of Britain Viewer²³.
- Landmark's Promap: Flood Data package: Additional flood mapping.
- Geosmart 1 in 100-year groundwater flood risk map.
- Southern Water sewer asset plans (Appendix 3).
- DEFRA's Magic Map for identifying Designated Sites²⁴.
- River Levels UK for identifying Flood Alert and Flood Warning areas²⁵.

²³ <http://mapapps.bgs.ac.uk/geologyofbritain/home.html>

²⁴ <http://www.natureonthemap.naturalengland.org.uk/>

²⁵ <https://riverlevels.uk/flood-map#.XclKwPn7RPZ>

2.2 Consultation and Discussion with Regulators

- 2.2.1 Consultation and discussions were undertaken with the Environment Agency, the Local Planning Authority (LPA)/Lead Local Flood Authority (LLFA), and Water Utility.

Environment Agency

- 2.2.2 The Environment Agency is a statutory consultee on flood risk and planning and is directly responsible for the prevention, mitigation, and remediation of flood damage for main rivers and coastal areas; and it has a strategic overview for all forms of flooding.
- 2.2.3 Environment Agency Standing Advice²⁶ and the NPPF/PPG ID: 7 was consulted and reviewed.
- 2.2.4 Correspondence with the Environment Agency is included in Appendix 4.

Lead Local Food Authority (LLFA)

- 2.2.5 LLFAs (unitary authorities or county councils) are Hampshire County Council as the Lead Local Flood Authority (LLFA) is responsible for local flood risk management in their areas and for maintaining a register of flood risk assets. They also have lead responsibility for managing the risk of flooding from surface water, groundwater, and ordinary watercourses.
- 2.2.6 Hampshire County Council as the LLFA was consulted on flood risk issues at this Site. A response had not been received at the time this report was prepared. Instead, the Hampshire County Council online Surface Water Checklist Guidance²⁷ was reviewed.

Water Utility

- 2.2.7 Drainage and sewerage services in the UK are provided by a number of water and sewerage companies. Southern Water is responsible for sewerage in the area of the Site.
- 2.2.8 All sewerage undertakers maintain the 'DG5 register' of properties and external areas (such as gardens, highways, open spaces) which have suffered flooding from public foul/combined sewers. It does not include flooding caused by blockages.

2.3 Site Walkover

- 2.3.1 Enzygo staff carried out a walkover of the Site during March 2018. Observations made were used to inform the Site description.

²⁶ Department for Communities and Local Government (published April 2012 and updated March 2019). Preparing a Flood Risk Assessment: Standing Advice [<https://www.gov.uk/guidance/flood-risk-assessment-standing-advice>].

²⁷ <https://documents.hants.gov.uk/flood-water-management/SurfaceWaterChecklistGuidance.pdf>

3.0 Site Location and Description

3.1 Location

- 3.1.1 The Site is located on land at Rook Farm, Hayling Island, PO11 9DF. The Site is centred on National Grid Reference (NGR) 471949, 099836.
- 3.1.2 The 11.77ha Site location is shown in Drawing 001 and in more detail in Drawing 002.

3.2 Land Use

- 3.2.1 The land use comprises three agricultural (grassed) fields (Figures 3.1 and 3.2), with an agricultural building.
- 3.2.2 The Site is bounded by residential dwellings to the south and east, and grassed fields to the north and west.
- 3.2.3 The Site is currently accessed via gated access off Rook Farm Way to the east of the Site. A second informal access is via gated access of St Mary's Road to the north-east of the Site. Pedestrian access to the Site is via footpaths off Southleigh Grove, Fathoms Reach and Manor Road.

Figure 3.1: Photographs of the Site



Pan looking east across site from north west corner.

Figure 3.2: Aerial Photograph of the Site

Image © 2021 Digital Globe.

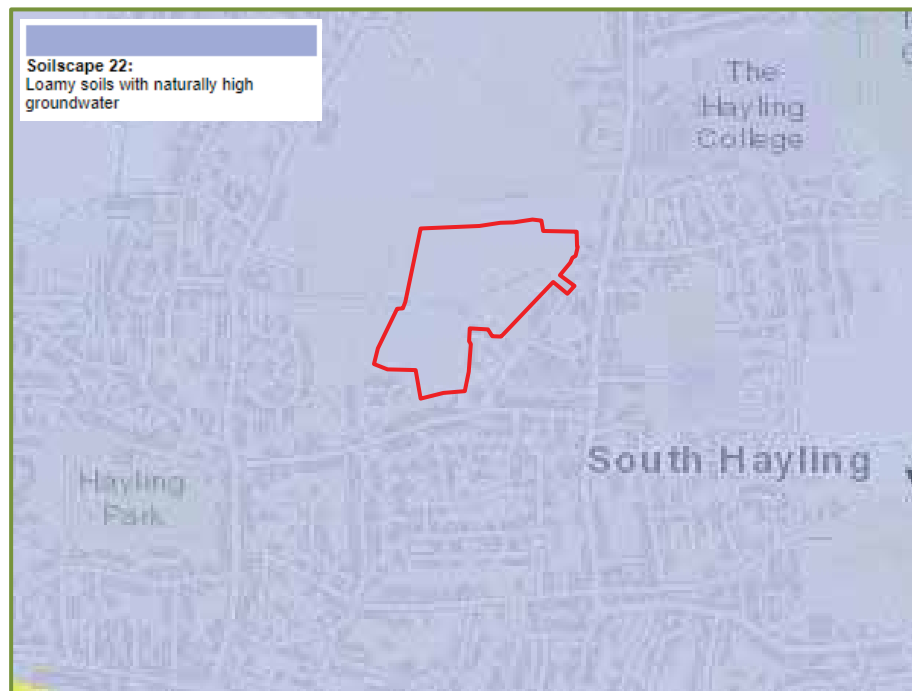
3.3 Topographic Information

- 3.3.1 A topographic survey was carried out during May 2016 (Appendix 1). The survey shows that the Site falls in a south-east direction from 8.44m above ordnance datum (AOD) located in the north-east corner to 6.58mAOD located in the south-east corner. The fall of 1.86m over 450m gives a gradient of 1:242.

3.4 Soils and Geology

Soils Mapping

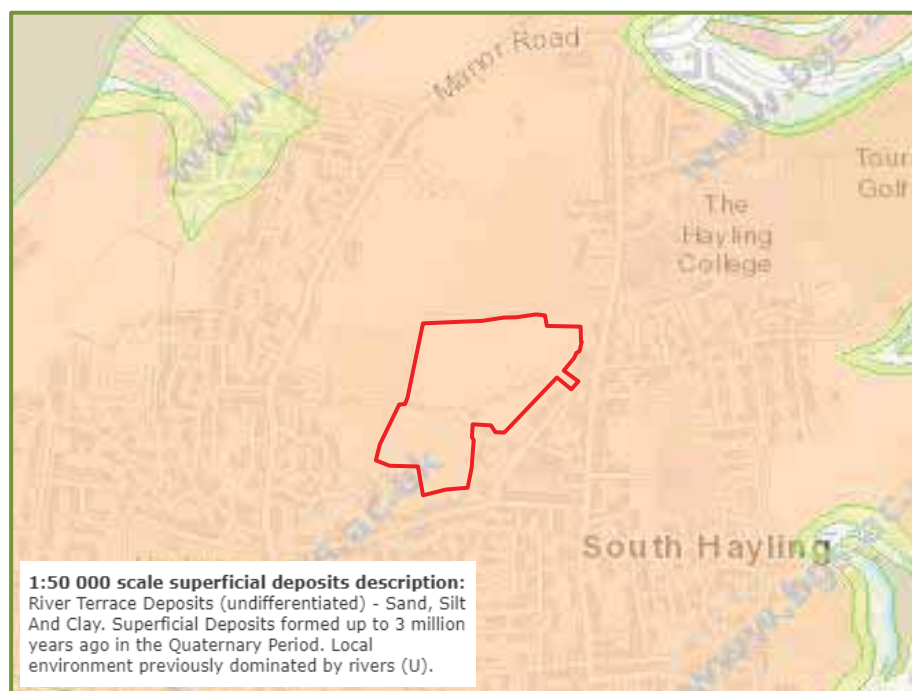
- 3.4.1 The Soilscales online soils map viewer shows the Site is underlain by loamy soils with naturally high groundwater (Figure 3.3).

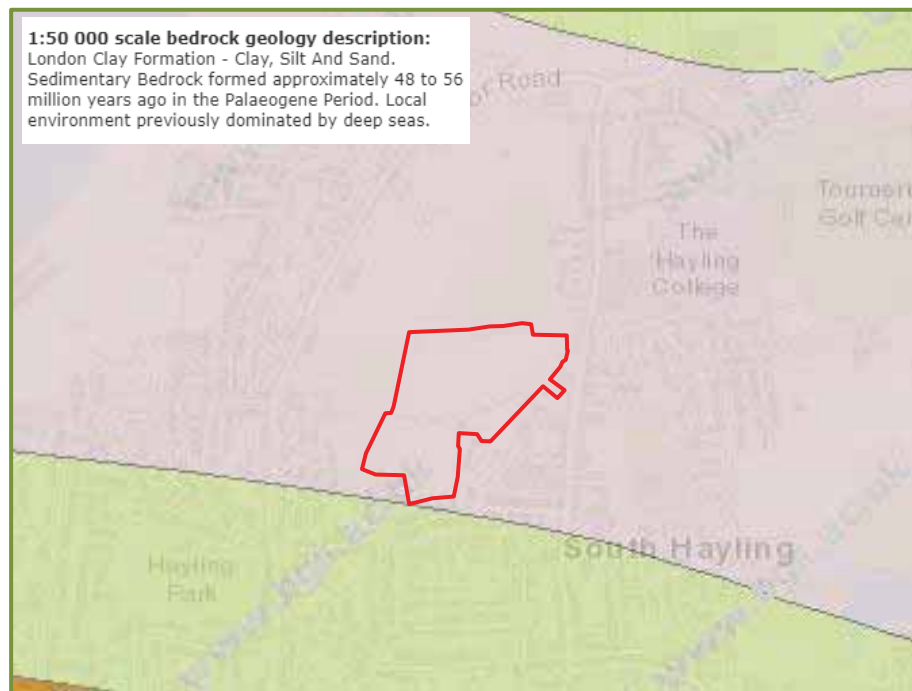
Figure 3.3: Soils Mapping

Soils Data © Cranfield University (NSRI) and for the Controller of HMSO [2021].

Geology Mapping

- 3.4.2 The Geology of Britain online map viewer (Figure 3.4) shows most of the Site is underlain by superficial deposits of River Terrace Deposits – sand, silts and clays. The bedrock beneath the Site is London Clay Formation (clay).

Figure 3.4: Geology Mapping (continues over page)

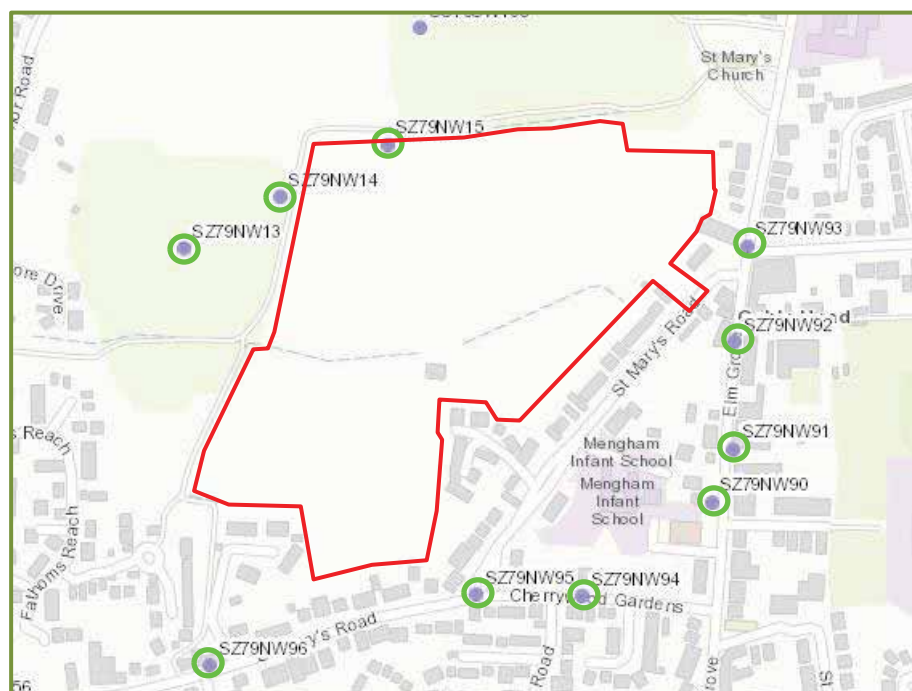


Top: Superficial Deposits. Bottom: Bedrock Geology. Contains British Geological Survey materials © NERC [2021].

BGS Historical Borehole Records

- 3.4.3 The Geology of Britain online map viewer shows 10 boreholes located within the vicinity of the north, east and south of the Site, with one borehole in the northwest corner of the Site (Figure 3.5). Borehole logs recorded Brickearth (superficial windblown deposits) of varying depth, upon Raised Beach deposits on top of London Clay Formation. Borehole locations and summaries are included in Figure 3.5 and Table 3.1 respectively

Figure 3.5: Borehole Mapping



Contains British Geological Survey materials © NERC [2021].

Table 3.1: BGS Borehole Data

Borehole reference	Location	Borehole Depth (m)	Recorded Underlying Deposits	Depth of groundwater (mbgl)
SZ79NW13	1	4.3	Brickearth, Raised Beach, London Clay	2.1
SZ79NW14	2	4.3	Brickearth, Raised Beach, London Clay	2.6
SZ79NW15	3	6.7	Raised Beach, London Clay	3
SZ79NW93	4	2.9	Brickearth, Raised Beach, London Clay	1.9
SZ79NW92	5	3.1	Brickearth, Raised beach, London Clay	1.6
SZ79NW91	6	4.0	Brickearth and Raised beach, London Clay	1
SZ79NW90	7	4.0	Brickearth, Raised Beach	1
SZ79NW94	8	3.4	Brickearth, Raised Beach	0.9
SZ79NW95	9	3.1	Brickearth, Raised Beach	1.1
SZ79NW96	10	3.4	Brickearth, Raised Beach	1.7

Contains British Geological Survey materials © NERC [2021].

3.5 Hydrogeology

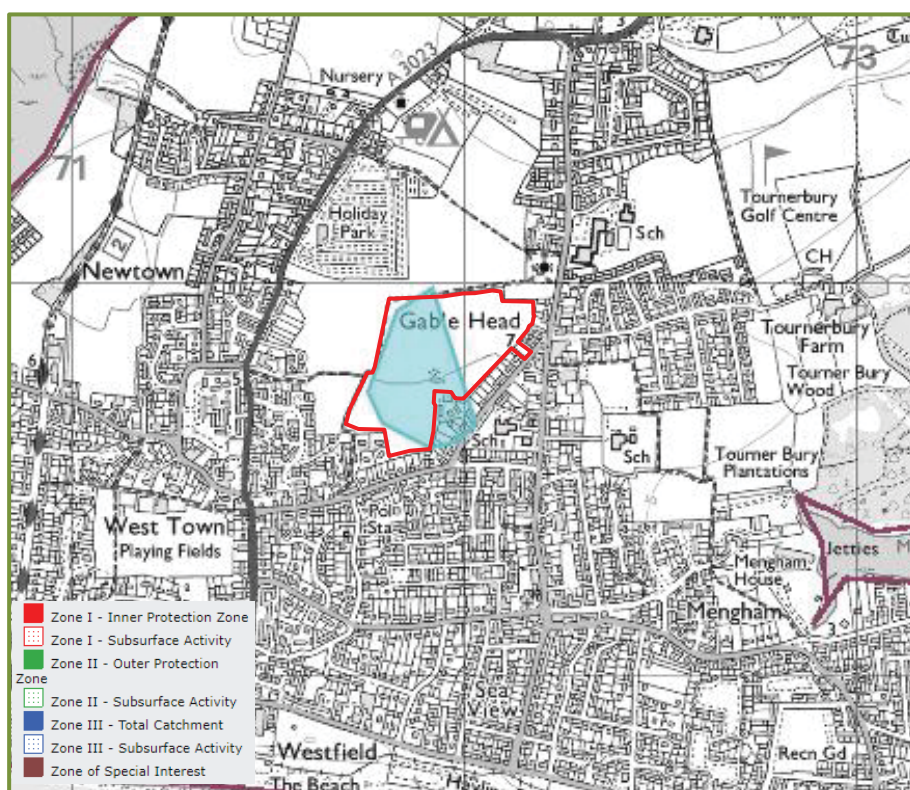
Infiltration Potential

- 3.5.1 Soils mapping indicates that the loamy soils with naturally high groundwater are indicative of low infiltration potential.
- 3.5.2 The infiltration potential of the superficial deposits is likely to be variable dependent on the composition of the sandy, silt and clay.
- 3.5.3 The infiltration potential of the bedrock is likely to be low.
- 3.5.4 BGS online borehole mapping (Figure 3.5 and Table 3.1) shows groundwater ingress was encountered in all 10 of the borehole records at depth of 2.6mbgl or less.
- 3.5.5 Groundwater was struck in 2 of the three trial pits at depths of 2.56m and 2.7mbgl.

Defra Magic Map

- 3.5.6 Defra Magic Map online mapping (Figure 3.6) shows the Site is not located in a groundwater Source Protection Zone (SPZ).

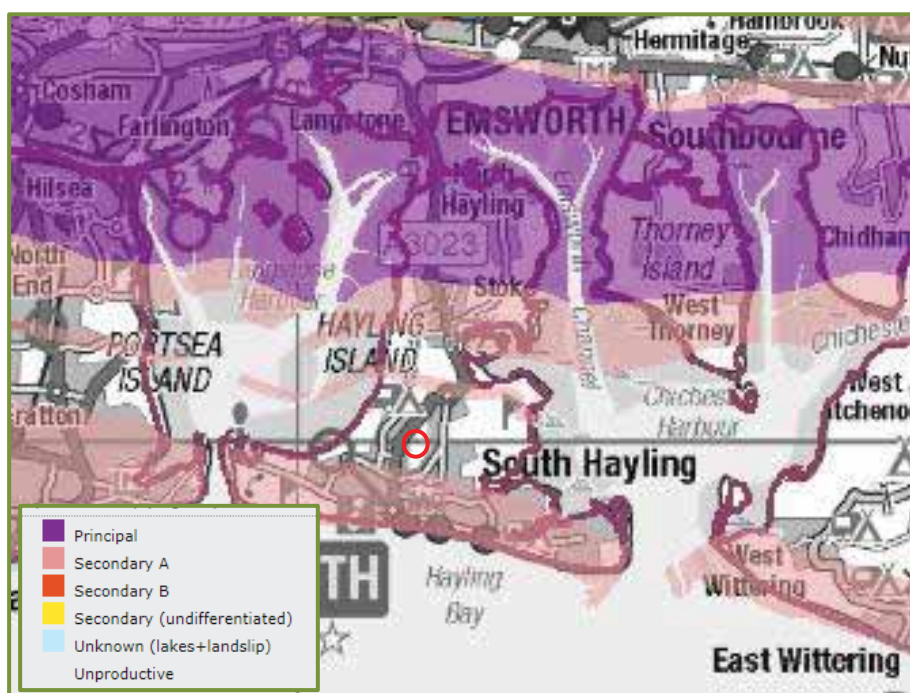
Figure 3.6: Source Protection Zone Map

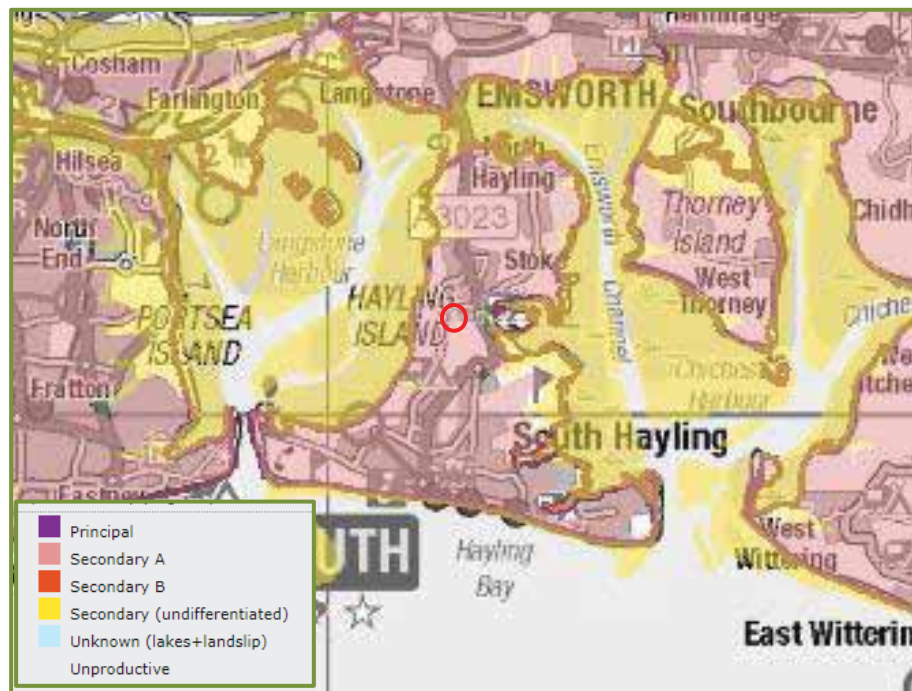


From Magic Map. Contains Environment Agency information © Environment Agency and database right [2021].

3.5.7 The Site is located above both a Secondary A aquifer (superficial deposits) (Figure 3.7).

Figure 3.7: Aquifer Designation Map



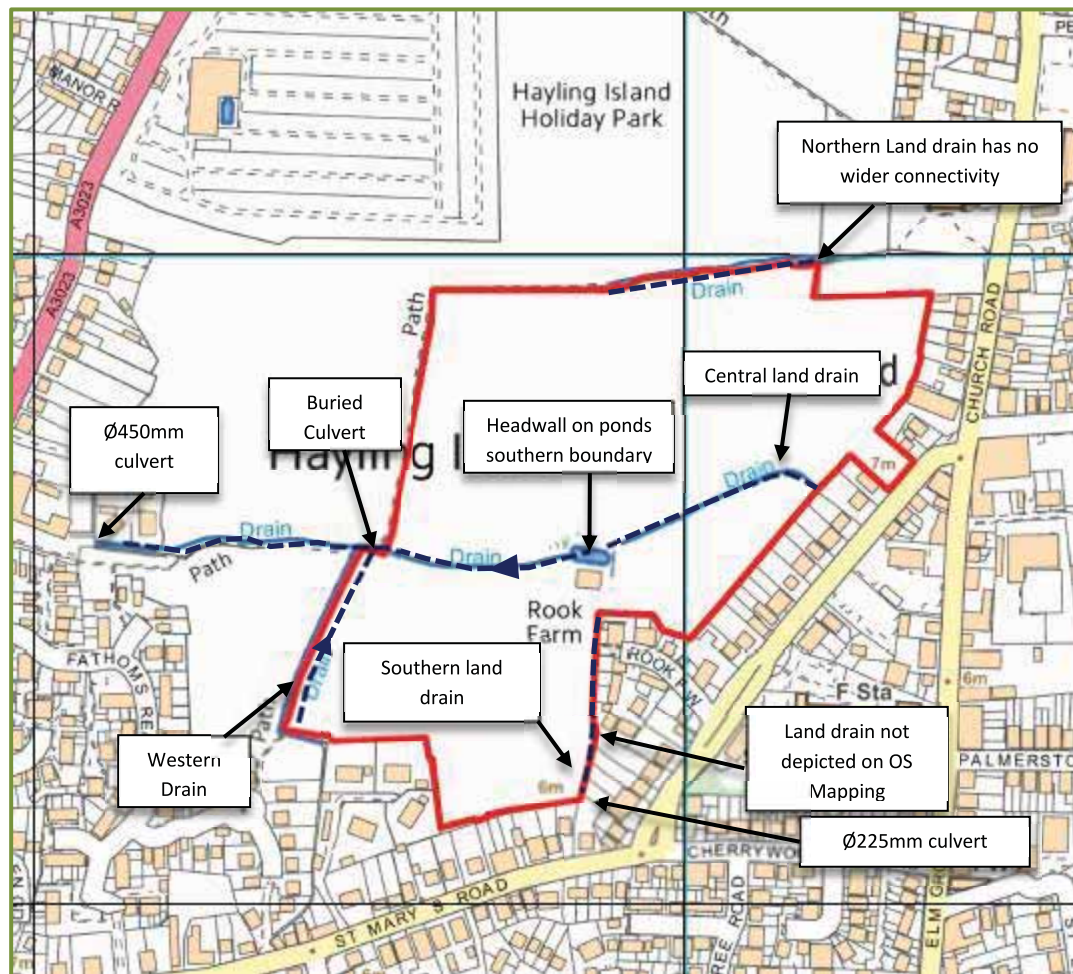


Top: Aquifer Designation (bedrock). Bottom: Aquifer Designation (superficial). From Magic Map. Contains Environment Agency information © Environment Agency and database right [2021].

3.6 Catchment Hydrology

OS Mapping and Topographic Survey

- 3.6.1 OS mapping shows a network of land drains within the Site boundary, which are classified as 'ordinary watercourses', where flood risk work is carried out by the local drainage authority/riparian landowners (Figure 3.8).
- 3.6.2 A land drain conveys flow from the eastern Site boundary in a westerly direction, bisecting the Site. The land drain continues to convey flow in a westerly direction outside the Site's western boundary hereafter referred to as the 'central drain'.
- 3.6.3 A second land drain, hereafter referred to as the western drain, conveys flow north along the Site's western boundary before meeting the previously mentioned land drain at the central western boundary.
- 3.6.4 There is also a small land drain along the Site's northern boundary hereafter referred to as the 'northern drain'.

Figure 3.8: Map of Watercourses*Site Walkover / CCTV Survey*

- 3.6.5 The northern land drain was observed to be dry and was heavily vegetated. The land drain was observed to have no wider connectivity.
- 3.6.6 The central land drain bisecting the Site was found to be carrying low flows. The drain was conveying flows from west to east, entering a pond within the centre of the Site. The drain continues to convey flow west outside the western Site boundary before entering a Ø450mm culvert, which is assumed to convey flow to a surface water sewer in Manor Road.
- 3.6.7 The western land drain was observed to be dry and connects into the central land drain at the central western boundary.
- 3.6.8 A land drain was also observed along the south eastern boundary (not depicted on OS Mapping). The land drain was observed to be carrying low flows and was heavily vegetated. Two Ø225mm culverts were observed to be outfalling into the land drain halfway along its reach. The land drain outfalls from a Ø225mm culvert and conveyed flows south and into a partially collapsed Ø150mm culvert, assumed to convey flows into the public surface water sewer in St Mary's Road.
- 3.6.9 A CCTV survey was carried out during May 2018. The CCTV survey confirmed connectivity of the southern drain to the surface water sewer in St Mary's Road to the south of the Site.

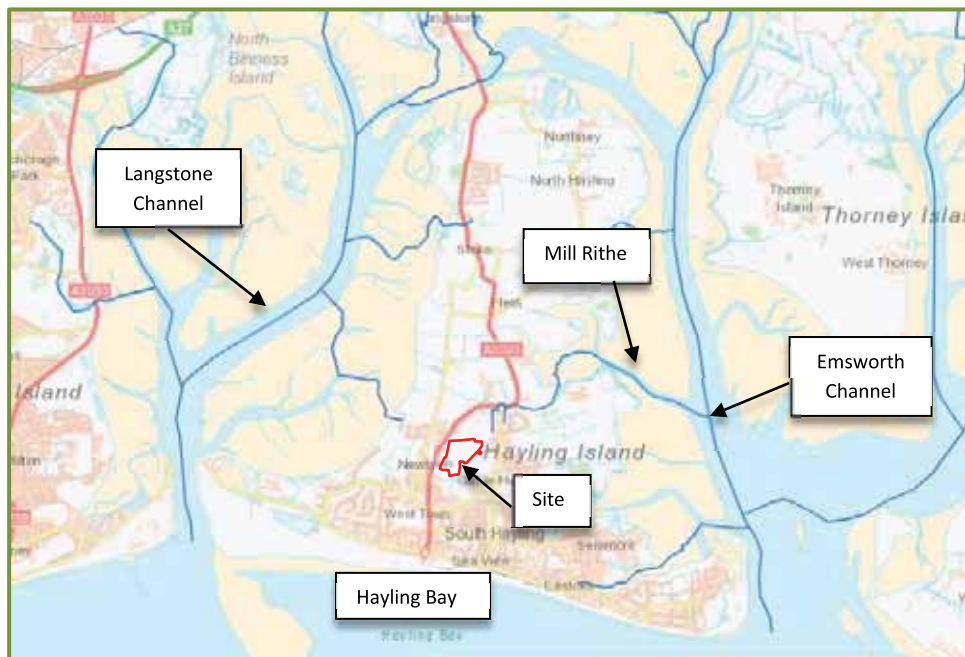
Figure 3.9: Photographs of Land Drainage Network



Top Left: Northern Drain. **Top Right:** Ø450mm culvert from central drain conveying flow west. **Bottom Left:** Western land drain looking north **Bottom Right:** outfall along the southern drains reach

Main River Map

- 3.6.10 Mill Rithe (a 'main river' where flood risk work is carried out by the Environment Agency) conveying flow in an easterly direction 350m to the north of the Site at its nearest point. Mill Rithe is a tributary of Emsworth Channel. Both watercourses are 'main rivers', where flood risk work is carried out by the Environment Agency.
- 3.6.11 The main river map (Figure 3.10) also shows Langstone Channel conveying flows southwards, approximately 1.1km to the west of the Site at its closest point. There is an unnamed tributary of Langstone Channel, conveying flows north-west approximately 800m to the north-west of the Site.
- 3.6.12 The main rivers all discharge to Hayling Bay (sea).

Figure 3.10: Main River Map

Contains Environment Agency information © Environment Agency and database right [2021].

Environment Agency Catchment Data Explorer Mapping

3.6.13 The Site resides in the East Hampshire Rivers Operational Catchment (Figure 3.11), which is in the East Hampshire Management Catchment and South West River Basin District.

Figure 3.11: Catchment Data Explorer



Top Left: East Hampshire Rivers Operational Catchment. Top Right: East Hampshire Management Catchment.
Bottom: South West River Basin District. Contains Environment Agency information © Environment Agency and database right [2021].

3.7 Sewerage Assets

Southern Water Asset Plans

- 3.7.1 Southern Water asset plans show that a Ø525mm public foul sewer conveys flow in a north-east direction through the north-west corner of the Site.
- 3.7.2 A separate surface water and foul sewer network serves the residential dwellings to the east and south of the Site. There is a Ø225mm public surface water sewer conveying flow east within Rook Farm Way 15m to the east of the Site. The surface water sewer joins a Ø225mm surface water sewer in St Mary's Road and conveys flow south west. The surface water sewers converge at a point to the south of the Site. This is deemed to be incorrectly depicted and Southern Water confirmed verbally that their plans are not always accurate. As such it is

deemed the network drains to the east to Church Road before conveying flow south and outfalling into the Solent.

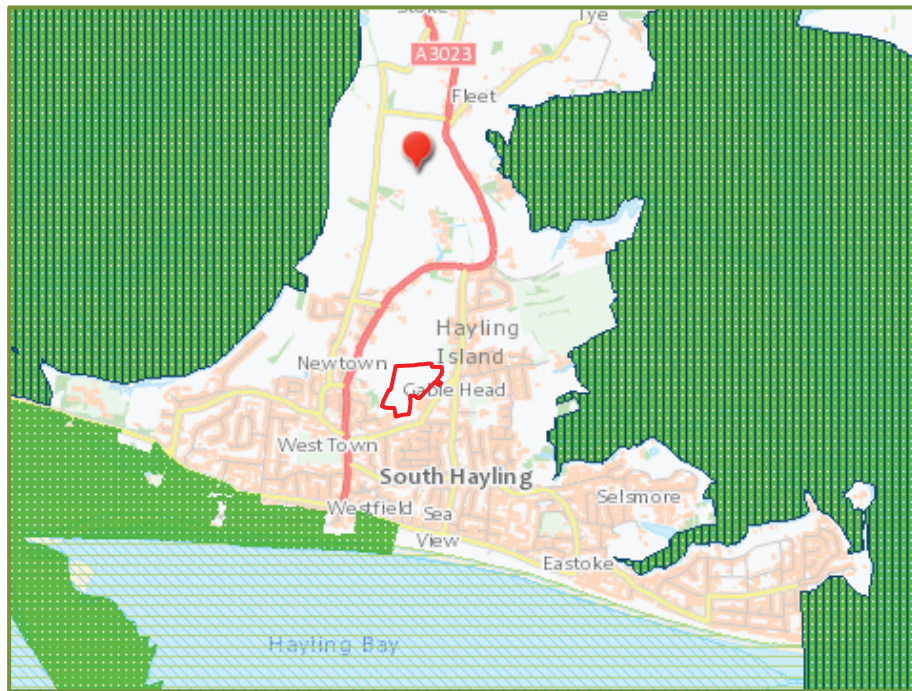
3.8 Designated Sites

- 3.8.1 The DEFRA Magic Map (England and Wales)²⁸ identifies several designated sites (Figure 3.12) within the immediate vicinity of the Site (from a flood risk and drainage perspective). The designated sites are identified in Table 3.2 below.

Table 3.2: Designated Sites

Designated Site Category	Name	Distance / Orientation from Site	Reason for Designation
Site of Special Scientific Interest (SSSI)	Sinah Common	0.75km south	Coastal habitats including endangered plants.
	Chichester Harbour	0.83km east	Wintering wildfowl, waders and breeding birds.
	Langstone Harbour	1.1km west	Intertidal invertebrates and large populations of migrant and overwintering waders and wildfowl.
RAMSAR	Chichester and Langstone Harbour	North, east and west of the Site, nearest point 0.82km east of Site.	over-wintering wildfowl and waders and a wide range of coastal and transitional habitat.
Special Area of Conservation (SAC)	Solent Maritime	North, south, east and west of the Site. Nearest point is 1km south of Site	Estuaries, Spartina Swards (cord-grass) and Atlantic salt meadows.

²⁸ <http://www.natureonthemap.naturalengland.org.uk/MagicMap.aspx>

Figure 3.12: Designated Sites

From BGS GeoIndex Onshore. Contains Environment Agency information © Environment Agency and database right [2021].

- 3.8.2 The Site and wider area are located within a Nitrate Vulnerable Zone (NVZ). Development of the Site would include a SuDS to manage surface water runoff. The use of SuDS would improve the water quality of surface water runoff, thereby offer a betterment to existing conditions.

4.0 Flood Risk Assessment

4.1 Potential Sources of Flooding

- 4.1.1 A summary of the potential sources of flooding and the potential risk posed by each source at the Site is presented in Table 4.1. Each source of flooding and level of risk is then assessed in further detail.

Table 4.1: Potential Risk Posed by Flooding Sources

Flooding Source	Potential Flood Risk at Application Site (Yes/No)	Potential Source	Data Sources
Fluvial	Yes	Unnamed Land Drains	Environment Agency consultation response (Appendix 4), Environment Agency flood mapping (Drawing 005), and SFRA mapping (Appendix 2).
Tidal	Yes	English Channel	Environment Agency consultation response (Appendix 4), Environment Agency flood mapping (Drawing 005), and SFRA mapping (Appendix 2).
Groundwater	Yes	Secondary A Aquifer	BGS mapping (Drawing 003) and Geosmart Groundwater (Drawing 006).
Surface Water	Yes	Poor permeability and Site topography	JBA Surface Water Flooding (Drawing 004) and Environment Agency Complex mapping (Drawing 008.1 - 008.4).
Sewer	Yes	Public foul sewer	Southern Water Asset plans, SFRA mapping, and topographic survey.
Infrastructure Failure	Yes	Reservoir and Pond Flooding	Environment Agency online flood mapping and OS mapping

4.2 Fluvial Flooding

Environment Agency Flood Zone Mapping

- 4.2.1 The Environment Agency Flood Zones are the current best information on the extent of the extremes of flooding from rivers or the sea that would occur without the presence of flood defences, since these can be breached, overtopped and may not be in existence for the lifetime of a development.
- 4.2.2 The Environment Agency flood map (Drawing 005) shows the Site is located within Flood Zone 1; outside the 1 in 1000-year probability of fluvial (river) flooding (0.1% Annual Exceedance Probability [AEP]), at 'low' risk.

SFRA Mapping

- 4.2.3 The SFRA mapping confirms the Site is in Flood Zone 1 (low risk).

Flood History

- 4.2.4 Correspondence with the Environment Agency (Appendix 4) confirmed they hold no records of historical flooding in the immediate vicinity of the Site.
- 4.2.5 The Hayling Island Emergency Plan outlines that parts of Hayling Island have flooded historically including access / egress to the island

Flood Defences

- 4.2.6 Environment Agency online flood mapping and SFRA mapping show that the Site does not benefit from flood defences.
- 4.2.7 SFRA Mapping shows Hayling Island itself to benefit from flood defences. The Emergency Plan identifies new sea defences at Northney foreshore, the island access / egress has not flooded since the construction of these defences.

Flood Warning Service

- 4.2.8 The River Levels UK website (Figure 4.1) shows the Site is not located within an area which receives flood warnings.

Summary Flood Risk

- 4.2.9 The risk of fluvial flooding is assessed as negligible.

Residual Risk

- 4.2.10 Land drainage networks were identified within the Site boundary. Residual flood risk mitigation from this source is described in Section 5.

4.3 Tidal Flooding

- 4.3.1 The Environment Agency online flood map shows the Site and Site access/egress is located within Flood Zone 1; outside the 1 in 1000-year probability of tidal (sea) flooding (0.1% Annual Exceedance Probability [AEP]). The Site is assessed as being at 'low' risk of tidal flooding.
- 4.3.2 Access to Hayling Island from the mainland is served by the A3023. The Environment Agency online flood map shows areas of the A3023, north and south of Langstone are within Flood Zones 2 and 3. Flood Zone 2 is land located between the extents of the 1 in 200-year and 1 in 1000-year (<1% to >0.5% AEP) risk of tidal flooding. Flood Zones 3 is land located within the extent of the 1 in 200-year (>0.5% AEP) risk of tidal flooding.

SFRA Mapping

- 4.3.3 SFRA mapping confirms the Site is within Flood Zone 1, at low risk of tidal flooding. However, access/egress to and from Hayling Island is within Flood Zones 2 and 3, at medium to high risk respectively.
- 4.3.4 SFRA mapping shows that the Site does not flood with the inclusion of climate change up to the year 2115.
- 4.3.5 SFRA Mapping shows the bridge to be defended to a crest tide level up to the 1000-year return period, this was mapped to be the case in the year 2007 and the year 2115.

4.4 Groundwater Flooding

Introduction

- 4.4.1 Groundwater flooding occurs when subsurface water emerges either at surface or in made ground or in subsurface structures such as basements and services ducts. It occurs as diffuse seepage, emergence from new point source springs or an increase in flow from existing springs. It results from aquifer recharge from infiltrating rainfall, from sinking streams entering aquifers from adjacent non-aquifers, or from high river levels or tides driving water through near surface deposits. It tends to occur with a delay following rainfall and can last for several weeks or months. Groundwater flooding or shallow water tables also prevent or reduce infiltration and so can worsen surface water flooding.

BGS Groundwater Flooding Susceptibility Map

- 4.4.1 The BGS Groundwater Flooding Susceptibility Map (Drawing 003) shows that most of the Site is in an area with potential for groundwater flooding of property situated below ground level.
- 4.4.2 The risk of groundwater flooding is likely to be associated with perched groundwater in the River Terrace superficial deposits.
- 4.4.3 The BGS mapping is coarse and should be superseded by the Geosmart groundwater flood risk map.

Geosmart Groundwater Flood Risk Map

- 4.4.4 The Geosmart 1 in 100-year groundwater flood risk map (Drawing 006) shows that the Site is at negligible risk of groundwater flooding and falls within Risk Class 4 (Table 4.2).
- 4.4.5 Mapped classes combine understanding of likelihood, model and data uncertainty, and possible severity. Likelihood is ranked according to whether we expect groundwater flooding at a site due to extreme elevated groundwater levels with an annual probability of occurrence greater than 1%, considering model and data uncertainty. Severity relates to expectations of the amount of property damage or other harm that groundwater flooding at that location might cause (Table 4.2).

Table 4.2: Groundwater Flood Risk Classification (continued over page)

Risk Class	Probability of Groundwater Flooding	Effect
4: Negligible	Annual probability less than 1%.	Negligible unless unusually sensitive use.
3: Low	Annual probability greater than 1%.	Remote possibility of damage to property or harm to sensitive receptors Flooding likely to be limited to seepages and waterlogged ground, damage to basements and subsurface infrastructure, and should pose no significant risk to life. Surface water flooding may be worsened.
2: Moderate	Annual probability greater than 1%.	Significant possibility of damage to property or harm to other sensitive receptors at or near this location. flooding is likely to be in the form of

Risk Class	Probability of Groundwater Flooding	Effect
		shallow pools or streams. Surface water flooding and failure of drainage systems may be worsened when groundwater levels are high.
1: High	Annual probability greater than 1%.	Groundwater flooding will occur which could lead to damage to property or harm to other sensitive receptors at or near this location. Flooding may result in damage to property, road or rail closures and, in exceptional cases, may pose a risk to life. Surface water flooding and failure of drainage systems may be worsened when groundwater levels are high.

Borehole Records

- 4.4.6 BGS online borehole mapping shows groundwater ingress was encountered in all 10 of the borehole records at depth of 2.6mbgl or less.

Flood Risk

- 4.4.7 The risk of groundwater flooding is assessed as low below ground and negligible above ground.
- 4.4.8 Mitigation measures against groundwater flooding are discussed in Section 5.

4.5 Surface Water Flooding

Introduction

- 4.5.1 Surface water flooding occurs following rainfall on ground where infiltration rates are less than the rainfall precipitation rate. This can occur when either:
- Soils or ground materials are naturally of low permeability or have been compacted (infiltration excess runoff);
 - Soils or ground materials are saturated from previous rainfall either directly or from upslope (saturation excess runoff and return flow) or from high groundwater levels.

JBA Surface Water Flood Map

- 4.5.2 The JBA Surface Water Flood Map (Drawing 004) shows most of the Site is located outside the mapped extent of surface water flooding.
- 4.5.3 There is a small area of surface water ponding in the centre of the Site associated with the 1 in 1000-year event). Ponding is likely to be associated with topographic low points.
- 4.5.4 The JBA Surface Water Flood mapping is superseded by the more detailed Environment Agency Complex Surface Water Flood mapping.

Environment Agency Complex Surface Water Flood Mapping

- 4.5.5 The Environment Agency Complex Surface Water Flood Mapping (Drawings 009.1 to 009.4) most of the Site is located outside the mapped extent of surface water flooding.
- 4.5.6 There are two areas of surface water ponding in the centre of the Site, associated with the 1 in 1000-year event. Flood depth is up to 0.30m during the extreme 1 in 1000-year event. The flood velocity is up to 0.25m/s and the flood hazard is 'low' (0.50-0.75) to moderate (0.75-1.25).
- 4.5.7 The ponding is associated with a topographic low point and an existing onsite pond.

Flood Risk

- 4.5.8 The risk of surface water flooding is assessed as negligible for most of the Site, with an area of low risk associated with the surface water ponding.
- 4.5.9 Mitigation measures against surface water flooding are discussed in Section 5.

4.6 Sewer Flooding

Introduction

- 4.6.1 Sewer flooding occurs when urban drainage networks become overwhelmed after heavy or prolonged rainfall due to restrictions or blockage in the sewer network or if the volume of water draining into the system exceeds the sewer design capacity.
- 4.6.2 New sewers are built to the guidelines within Sewers for Adoption²⁹ and have a design standard to the 1 in 30-year flood event. Older sewers were not designed to any standard. Modern sewer systems will only surcharge during rainstorm events with a return period greater than 1 in 30-years (e.g. 1 in 100-years).

Southern Water Asset Plans

- 4.6.3 Southern Water asset plans show there is a Ø525mm public foul sewer conveying flow in a north easterly direction through the north-west corner of the Site. From a COMMERCIALDW Drainage and Water Enquiry (Appendix 4), there are no recorded sewer flooding incidents located within the Site.

Flood Risk

- 4.6.4 The risk of flooding from sewers is assessed as negligible for most of the Site, with an area of low risk along the reach of the onsite sewer.
- 4.6.5 Mitigation measures against sewer flooding are discussed in Section 5.

4.7 Flooding from Infrastructure Failure

Reservoir

- 4.7.1 The Environment Agency online flood mapping shows the Site is located outside the extent of flooding sourced from reservoirs. The risk of flooding from reservoirs is assessed as negligible.

²⁹ WRC (2012) Sewers for Adoption 7th Edition.

Pond

- 4.7.2 A pond has been identified within the southeast of the Site. The pond is small and not impounded. The risk of flooding from pond failure is assessed as negligible.

5.0 Flood Risk Mitigation Measures

5.1 Introduction

5.1.1 The following sources of flooding were identified:

- Residual flooding from onsite land drains.
- Tidal flooding to the access/ egress to Hayling Island.
- Groundwater flooding (below ground).
- Surface water flooding (ponding).
- Sewer flooding

5.2 Mitigation Measures

Residual Flooding from Onsite Land Drains

- Provide a 4m easement free from development along either side of the onsite and bounding land drains. This easement would provide access for inspection and maintenance purposes, including vehicle access.
- It is recommended that the number of highway crossings along the route of the land drains is kept to a minimum. Culvert crossings would need to be sized to convey the 100-year plus climate change event, with a freeboard allowance.
- Undertake maintenance activities to keep the land drains clear from debris and overgrown vegetation to maintain the conveyance of the channels.
- Set the surface water outfall from the proposed development at an appropriate height (i.e., +300mm) above the bed level of the receiving land drains.
- Set finished floor levels a minimum of +150mm above external levels.

Tidal Flooding to the access / egress

- The areas north and south of the Hayling Bridge are covered by flood warnings, which have long lead up times (up to days in advance), which enable temporary bridge closure.
- Tidal flooding events are often short-lived (a matter of hours for spring tides and for storm surges), so any bridge closure would only be a short-lived event.
- The Hayling Emergency Planning Framework provides details of an emergency plan if the 'highly unlikely' scenario where a flood event were to prevent access on and off the Island were to unfold ([HAYLING ISLAND BRIDGE INCIDENT PLAN \(havant.gov.uk\)](https://havant.gov.uk/havant-emergency-planning-framework))
- The Island and Site provides a safe place of refuge and as such no access/egress to the island would not pose a risk to life.

Groundwater Flooding

- No below surface habitable buildings (i.e., basements).
- Adoption of a surface water management strategy (see Section 6).
- Set finished floor levels a minimum of +150mm above external levels.

- Lined attenuation to prevent groundwater ingress.

Surface Water Flooding

- Adoption of a surface water management strategy.
- Set finished floor levels as per above.

Sewer Flooding

- Provide a development free easement (3m either side) of onsite/bounding public foul sewer, or re-direct around the Site boundary.
- Set finished floor levels as per above.

5.3 Summary of Flood Risk

5.3.1 Table 5.1 summarises the probability and level of risk, both with and without mitigation measures.

Table 5.1: Probability and Consequences of All Sources of Flooding (continues over page)

Flooding Source	Potential Source	Probability	Consequence & Impact Without Mitigation	Consequence & Impact with Mitigation
Fluvial	On site land drains	Negligible for most of the Site, residual risk along reach of on-site land drains	Negligible for most of the Site, residual risk along reach of on-site land drains	Negligible
Tidal	English Channel	Negligible	Negligible	Negligible
Groundwater	Secondary A Aquifer	Low below ground, negligible above ground	Low below ground, negligible above ground	Negligible
Surface Water	Poor permeability and Site topography	Negligible for most of the Site but low for areas of surface water ponding.	Negligible for most of the Site but low for areas of surface water ponding.	Negligible
Sewer	Public Foul Sewers	Negligible for most of the Site, low along the reach of public foul sewer	Negligible for most of the Site, low along the reach of public foul sewer	Negligible
Infrastructure Failure	Pond failure	Negligible	Negligible	Negligible

Key: Green - Negligible, Yellow - Low, Orange - Medium and Red - High; based on consequence and impact with mitigation from each flooding source.

5.4 Flood Guidance and Sequential Test

- 5.4.1 The proposal is for residential developments. Table 2 of PPG ID: 7 (not included in this report) classifies the proposed use as 'more vulnerable'.
- 5.4.2 The Environment Agency Flood Zones and acceptable development types are listed in Table 5.2. All development types (including more vulnerable uses) are acceptable in Flood Zone 1

(low risk). Subject to the above mitigation measures, the Sequential Test would be passed, and the Exception Test would not be required as indicated in Table 5.3.

Table 5.2: Environment Agency Flood Zones and Appropriate Land Use

Flood Zone	Probability	Explanation	Appropriate Land use
Zone 1	Low	Less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).	All development types generally acceptable.
Zone 2	Medium	Between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% 0.1%) in any year.	Most development type are generally acceptable.
Zone 3a	High	A 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.	Some development types not acceptable.
Zone 3b	'Functional Floodplain'	Land where water must flow or be stored in times of flood. SFRAs should identify this zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1% flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes).	Some development types not acceptable.

Note: The Flood Zones are the current best information on the extent of the extreme flood from rivers or the sea that would occur without the presence of flood defences, because these can be breached, overtopped and may not be in existence for the lifetime of the development. The identified risk of fluvial flooding is highlighted green.

Table 5.3: Vulnerability and Flood Zone 'Compatibility' as Identified in Table 3 of PPG ID: 7

Flood Risk Vulnerability classification (see Table 1 of PPG ID: 7)	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	Yes	Yes	Yes	Yes	Yes
Zone 2	Yes	Yes	Exception test required	Yes	Yes
Zone 3a	Exception test required	Yes	No	Exception test required	Yes
Zone 3b 'Functional Floodplain'	Exception test required	Yes	No	No	No

Key: Yes: Development is appropriate. No: Development should not be permitted.
The identified risk of fluvial flooding is highlighted green.

6.0 Site Drainage

6.1 Surface Water Drainage

- 6.1.1 Consideration of flood issues is not confined to the floodplain. This is recognised in the NPPF and associated guidance where all proposed development of 1ha or more in flood zone 1 and so outside the floodplain nevertheless requires an FRA. The alteration of natural surface water flow patterns through development can lead to problems elsewhere in a catchment, particularly flooding downstream, and the replacement of permeable vegetated areas by low-permeability roofs, roads and other paved surfaces will increase the speed, volume, and peak flow of surface water runoff. So, the NPPF and associated guidance require an FRA for all proposed development of 1ha or more outside the floodplain in Flood Zone 1.
- 6.1.2 A surface water management strategy for the development is proposed to manage and reduce the flood risk posed by surface water runoff from the Site. The developer will be required to ensure that any scheme for surface water management should build in enough capacity for the entire Site.
- 6.1.3 The surface water drainage arrangements for any development Site should be such that the volume and peak flow rates of surface water leaving a developed Site are no greater than the rates prior to the proposed development unless specific off-Site arrangements are made and result in the same net effect.
- 6.1.4 An assessment of the surface water runoff rates was undertaken to determine the surface water options and attenuation requirements for the Site.

6.2 Existing Drainage System

- 6.2.1 The 11.77ha Site land use comprises three parcels of agricultural (grassed) land with associated agricultural building.
- 6.2.2 The Site is underlain by soils and superficial deposits with naturally high groundwater, and impermeable bedrock. It is likely that drainage is initially through infiltration and through flow to the onsite/bounding drains, depending on the saturation of the ground and groundwater levels. When the ground becomes saturate, overland flow would occur, following the topography of the Site to the topographic low points (i.e. land drains), with a small amount of infiltration to bedrock.

6.3 Developable and Impermeable Areas

- 6.3.1 The proposal is for a residential development with public open space, landscaping, sustainable drainage system (SuDS), with vehicular access point from St Mary's Road.
- 6.3.2 An allowance of 55% impermeable area (inclusive of 10% for urban creep) was applied to the 7.53ha developable area. The existing and proposed impermeable areas are shown in Table 6.1. The proposed development will increase the impermeable surfaces and so increase the amount of runoff.

Table 6.1: Impermeable Area

Area	Existing Buildings and Hardstanding	Proposed Buildings and Hardstanding	Difference
Area (ha)	0	4.14	+4.14
Percentage of Total Site Area (%)	0	35.2	+35.2

6.4 Greenfield Runoff Rates

- 6.4.1 An assessment of greenfield runoff rates was undertaken to determine the attenuation requirements for the proposed development.
- 6.4.2 The runoff rates were calculated using Causeway Flow software, with FEH method inputs (descriptors obtained from the FEH webservice³⁰). This is a recommended methodology for Sites up to 50ha in area and the approach is in line with the current 'industry best practice' guidelines as outlined in the Interim Code of Practice for SuDS³¹, and Environment Agency Report SC030219 – Rainfall runoff management for developments.
- 6.4.3 The following parameters were used in the runoff calculations:
- Developable Area: 7.53ha
 - Average Annual Rainfall (SAAR): 690mm/year
 - Region No.: 7
 - BFIHOST19: 0.682
- 6.4.4 BFIHOST was updated to BFIHOST19 (November 2019) since a number of issues were identified with BFIHOST, which including a tendency to underestimate BFI in clay-dominated catchments.
- 6.4.5 BFIHOST19 is the baseflow index developed using the Hydrology of Soil Types (HOST) classification and is the baseflow proportion of the flow on average. It is estimated based on the daily mean flow data. Baseflow comprises water entering the watercourse through shallow subsurface flow and groundwater flow (mechanisms other than direct surface runoff); hence permeable soils and geology tend to yield a higher baseflow.
- 6.4.6 The Soilsmap online soils map viewer and Geology of Britain online map viewer identified the following:
- Soils: loamy with high groundwater
 - Superficial Deposits: River Terrace Deposits 5 - sand and gravel
 - Bedrock: London Clay Formation
 - Groundwater: 0.9-2.6mbgl.
- 6.4.7 BFIHOST19 value assigned by the FEH webservice is considered to replicate on-site conditions.
- 6.4.8 Table 6.2 shows the calculated greenfield runoff rates. Runoff calculations are included in Appendix 6.

³⁰ Centre for Ecology and Hydrology, Flood Estimation Handbook Web Service [<https://fehweb.ceh.ac.uk/>].

³¹ Office of the Deputy Prime Minister, National SuDS Working Group (July 2004) Interim Code of Practice for Sustainable Drainage Systems [https://www.susdrain.org/files/resources/other-guidance/nswg_icop_for_suds_0704.pdf].

Table 6.2: Greenfield Runoff Rates

Annual Probability (Return Period, years)	Greenfield Runoff (l/s) Developable Area
QBAR	12.26
100% (1)	10.42
3.33% (30)	28.19
1% (100)	39.1

Note: 40% added to the data to account for long-term climate change as stated in 'Flood Risk Assessment: Climate Change Allowance'. The 1 in 1-year, 30-year and 100-year annual probability events are of importance to the Water Companies and the Environment Agency when looking at sewage discharge and flood risk.

6.5 Hierarchy of Discharge

6.5.1 In accordance with requirement H3 of the Building Regulations 2000³² rainwater runoff must discharge to one of the following, listed in order of priority:

- 1. An adequate soakaway or some other adequate infiltration system:** Soils and geology mapping indicate low infiltration potential. There is also shallow groundwater across the Site.
- 2. A watercourse:** There are several land drains within the vicinity of the Site which connect into the public surface water sewers.
- 3. A sewer:** Southern Water asset plans show there is a surface water network serving the surrounding area.

6.5.2 Based on the above the potential route to discharge will be to the onsite land drains which in turn discharges to the public surface water sewer network.

6.6 Sustainable Drainage Options (SuDS)

Choice of SuDS Options

6.6.1 Sustainable water management measures should be used to control the surface water runoff from the proposed development Site, thereby managing the flood risk to the Site and surrounding areas from surface water runoff. These measures will also improve the quality of water discharged from the Site.

6.6.2 Current guidance promotes sustainable water management using SuDS. Options applicable to this Site are identified in Tables 6.3 and 6.4.

Table 6.4: SuDS Options

Green roofs	Infiltration basins
Water butts	Detention basins
Permeable paving	Oversized pipes
Rainwater harvesting	Brown roofs

³² Office of the Deputy Prime Minister, The Building Regulations 2000.

Filter strips	Swales
Wetland Areas	Cellular Storage

Note: SuDS appropriate to the development are highlighted green.

6.6.3 A hierarchy of SuDS techniques is identified³³:

- 1. Prevention** – the use of good Site design and housekeeping measures on individual Sites to prevent runoff and pollution (e.g. minimise areas of hard standing).
- 2. Source Control** – control of runoff at or very near its source (such as the use of rainwater harvesting).
- 3. Site Control** – management of water from several sub-catchments (including routing water from roofs and car parks to one/several large soakaways for the whole Site).
- 4. Regional Control** – management of runoff from several Sites, typically in a detention pond or wetland.

6.6.4 Using SuDS as opposed to conventional drainage systems provides several benefits by:

- Reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream.
- Reducing the volumes and frequency of water flowing directly to watercourses or sewers from developed Sites.
- Improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources.
- Reducing potable water demand through rainwater harvesting.
- Improving amenity through the provision of public open spaces and wildlife habitat.
- Replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.

SuDS Maintenance

- 6.6.5 Detention basins will form the main attenuation feature within the development Site assuming infiltration is proven feasible, or detention basins if proven unfeasible.
- 6.6.6 Maintenance of the SuDS features would be in line with the SuDS Manual (CIRIA C753, 2015), as detailed in Figure 6.1. The maintenance would be undertaken by a private maintenance company.
- 6.6.7 It is standard for SuDS features within a new development to be maintained by a private maintenance company unless the council adopt it. If the maintenance company goes into administration, the Site will be contracted to a new maintenance company. Residents will pay a surcharge to the maintenance company and a number of them would be appointed to its board. This will ensure maintenance throughout the lifetime of the development.
- 6.6.8 Details of other SuDS features and maintenance would be considered further at detailed design, when a detailed layout has been produced. The level of detail provided within this FRA should be sufficient at outline stage to demonstrate that SuDS would be deliverable.

³³ CIRIA (2004) Report C609, Sustainable Drainage Systems – Hydraulic, Structural and Water Quality advice.

Figure 6.1: Detention Basin Operation and Maintenance Requirements (Table 22.1 of the SuDS Manual)

TABLE 22.1 Operation and maintenance requirements for detention basins		
Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly
	Cut grass – for spillways and access routes	Monthly (during growing season), or as required
	Cut grass – meadow grass in and around basin	Half yearly (spring – before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually (as set out in Chapter 23)
Occasional maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial actions	Repair erosion or other damage by reseedling or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

6.7 Surface Water Management Strategy

Drainage Design

- 6.7.1 Surface water runoff would be directed to the drainage system through drainage gullies located around the perimeter of the buildings and through contouring of the hardstanding areas.
- 6.7.2 Landscaped areas should be incorporated into the layout where possible, and the associated gardens of each unit will allow a proportion of the rainfall to infiltrate into the soil substrate.
- 6.7.3 Surface water will be directed to onsite detention basins, positioned to achieve a gravity connection from the developable area with a positive connection to the onsite land drains and in turn the nearby public surface water sewer network.
- 6.7.4 By discharging at the QBAR greenfield runoff rate into the on-site land drains, to which we have riparian right, existing conditions will be replicated with a betterment (Para 6.8).
- 6.7.5 An indicative drainage layout is included in Drawing 011.

Attenuation Requirements

- 6.7.6 Attenuation storage is required to reduce the post-application surface water runoff from the Site to calculated greenfield runoff rates, up to and including the 1 in 100-year (+40%CC) rainfall event, assuming no infiltration losses.
- 6.7.7 The following input parameters were assumed in the calculations:
- Impermeable Area: 4.14ha (35.2%)
 - Cv (proportion of rainfall forming surface water runoff): 75% summer, 84% winter
 - No infiltration losses: 0.00m/hour
 - With outfall at QBAR (6.14l/s to northern land drain and 5.99l/s to southern land drain).
- 6.7.8 The attenuation volume for the 1 in 100-year event (plus climate change) based on the QBAR runoff rate is 3280m³ (1660m³ northern basin, 1620m³ – southern basin)
- 6.7.9 Attenuation calculations are included in Appendix 6. The calculated runoff rates and attenuation volumes will be reviewed at detailed design stage.

6.8 Betterment

- 6.8.1 QBAR is the peak rate of flow from a catchment for the mean annual flood (a return period of approximately 1:2.3 years). This is a betterment compared to existing conditions where runoff sheds into watercourses via overland flow, uncontrolled across all return periods. This approach goes above and beyond the use of complex controls which limit discharge to the corresponding return period for the 1-year, 30-year and 100-year events.
- 6.8.2 A summary of the surface water runoff betterment is included in Table 6.4.

Table 6.4: Difference in Runoff, Pre- and Post-Development

Total Peak flow from Post-Development Scenario (l/s)				Total Peak flow from Pre-Development Scenario (l/s)			
QBAR	30-yr	100-yr	100-yr (+40%CC)	QBAR	30-yr	100-yr	100-yr (+40%CC)
All return periods restricted to XX l/s QBAR rate for the 7.53 ha Site.				12.13	28.19	39.1	54.7
Reduction from existing (l/s)				0.00	16.06	26.97	42.57
Reduction from existing (%)				0.0	-57.0	-69.0	-77.8

- 6.8.3 The detention basins have been designed with a +300mm freeboard allowance. The drainage simulations were re-run with increased climate change allowance, beyond the standard 40% allowance.

6.9 Exceedance Routes

- 6.9.1 Onsite attenuation will be designed with a capacity up to a 1 in 100-year (plus 40% climate change) event, with a +300mm freeboard allowance. This provides a betterment (reduction) in runoff when compared to existing undeveloped conditions, where runoff is uncontrolled across all return periods.
- 6.9.2 A storm event in excess of this design standard would be extreme and would cause the onsite attenuation to overtop (with no sudden deluge) and would then shed overland following the topography, as per existing conditions (Drawing 011).
- 6.9.3 Finished floor levels of new dwellings will be set above external levels, which will mitigate the residual risk of overtopping.

7.0 Summary and Conclusions

7.1 Introduction

- 7.1.1 A site-specific Flood Risk Assessment (FRA), inclusive of an outline drainage strategy, has been prepared for a proposed residential development, located on a 11.77ha Site on land at Rook Farm, Hayling Island.

7.2 Flood Risk

- 7.2.1 The risk of fluvial flooding is negligible however there is a residual risk of flooding from the onsite land drains.
- 7.2.2 The risk of tidal flooding to the Site is assessed as negligible; however, the risk of tidal flooding to Hayling Island access/egress (Langstone Bridge) is assessed as medium to high.
- 7.2.3 The risk of groundwater flooding is assessed as low below ground and negligible above ground.
- 7.2.4 The risk of surface water flooding is assessed as negligible for most of the Site, with an area of low risk associated with the surface water ponding.
- 7.2.5 The risk of flooding from sewers is assessed as negligible for most of the Site, with an area of low risk along the reach of the onsite assets.
- 7.2.6 The risk of flooding from all other sources is assessed as negligible.

7.3 Mitigation Measures

- 7.3.1 Flood risk can be mitigated to a negligible or low and acceptable level through the following approach:
- Provide a 4m easement free from development along either side of the onsite and bounding land drains. This easement would provide access for inspection and maintenance purposes, including vehicle access.
 - It is recommended that the number of highway crossings along the route of the land drains is kept to a minimum. Culvert crossings would need to be sized to convey the 100-year plus climate change event, with a freeboard allowance.
 - Undertake maintenance activities to keep the land drains clear from debris and overgrown vegetation to maintain the conveyance of the channels.
 - Set the surface water outfall from the proposed development at an appropriate height (i.e. +300mm) above the bed level of the receiving land drains.
 - Set finished floor levels a minimum of +150mm above external levels.
 - The areas north and south of the Hayling Bridge are covered by flood warnings, which have long lead up times (up to days in advance), which enable temporary bridge closure.
 - Tidal flooding events are often short-lived (a matter of hours for spring tides and for storm surges), so any bridge closure would only be a short-lived event.
 - The Hayling Emergency Planning Framework provides details of an emergency plan if the 'highly unlikely' scenario where a flood event were to prevent access on and off the Island were to unfold. Full details of the Emergency Planning Framework can be found in Appendix 3.

- The Island and Site provides a safe place of refuge and as such no access/egress to the island would not pose a risk to life.
- No below surface habitable buildings (i.e. basements).
- Adoption of a surface water management strategy (see Section 6).
- Lined attenuation to prevent groundwater ingress.
- Adoption of a surface water management strategy.
- Provide a development free easement (3m either side) of onsite/bounding public foul sewer, or re-direct around the Site boundary.

7.4 Flood Guidance

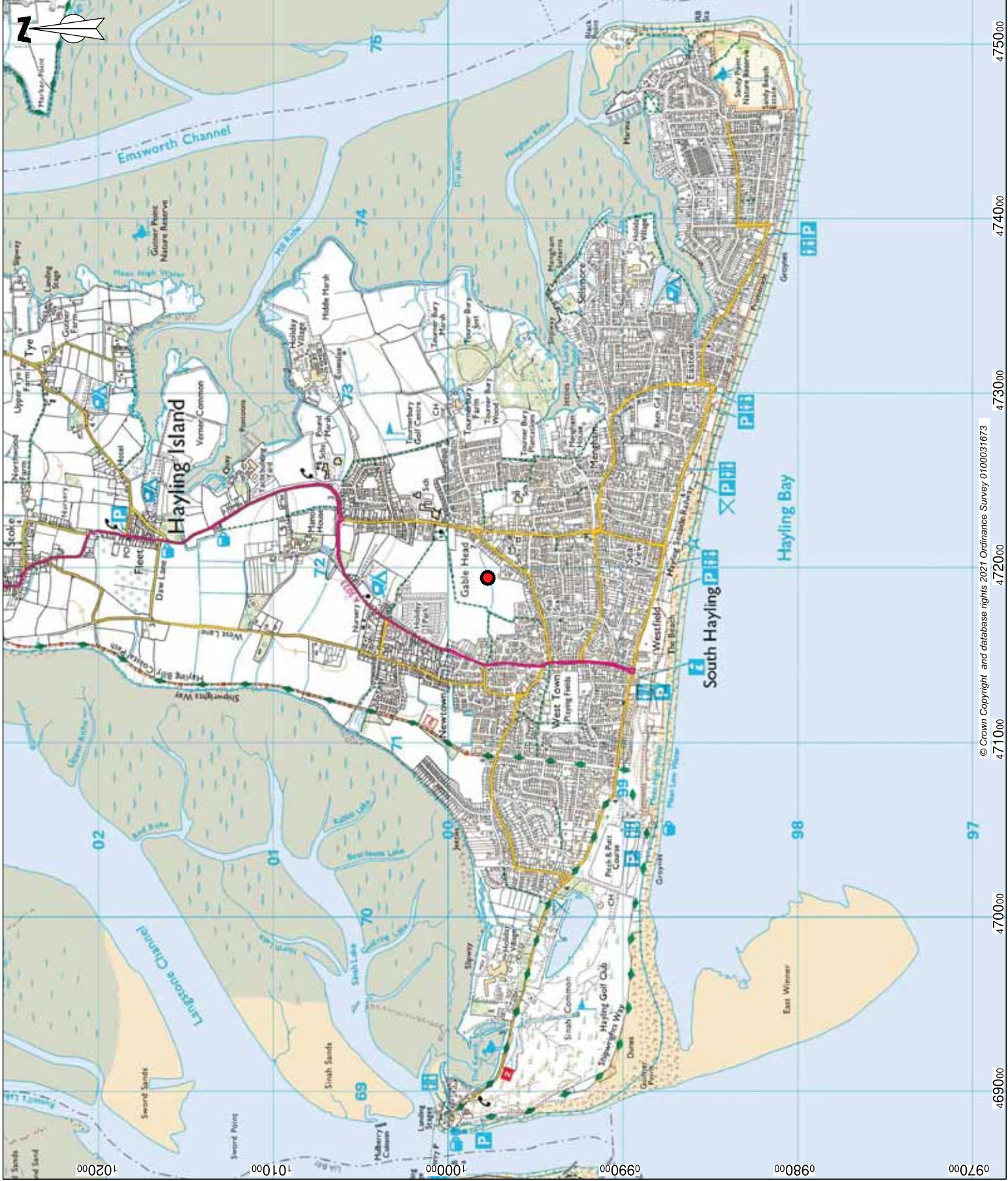
- 7.4.1 The proposed residential use is classified as more vulnerable. More vulnerable uses are considered acceptable in terms of flood risk in Flood Zone 1. Subject to the implementation of the above mitigation measures, the Sequential Test would be passed, and the Exception Test would not be required.

7.5 Site Drainage

- 7.5.1 The proposed development will increase the area of impermeable surfaces and therefore increase the amount of runoff without mitigation.
- 7.5.2 Surface water runoff from the Site will be discharged to QBAR which offers a betterment to existing conditions, whereby runoff is uncontrolled runoff across all return periods.
- 7.5.3 Surface water runoff from the proposed development would be attenuated on-site up to and including the 1 in 100-year event, plus 40% climate change.
- 7.5.4 A SuDS drainage scheme is proposed to manage excess runoff from the development, comprising detention basins with a positive connection to the nearby public surface water sewer network. The onsite attenuation will be designed to maintain runoff at pre-development rates.

7.6 Conclusion

- 7.6.1 This FRA demonstrates that the proposed development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of national policy and guidance.
- 7.6.2 The development should not therefore be precluded on the grounds of flood risk and surface water drainage.



Key

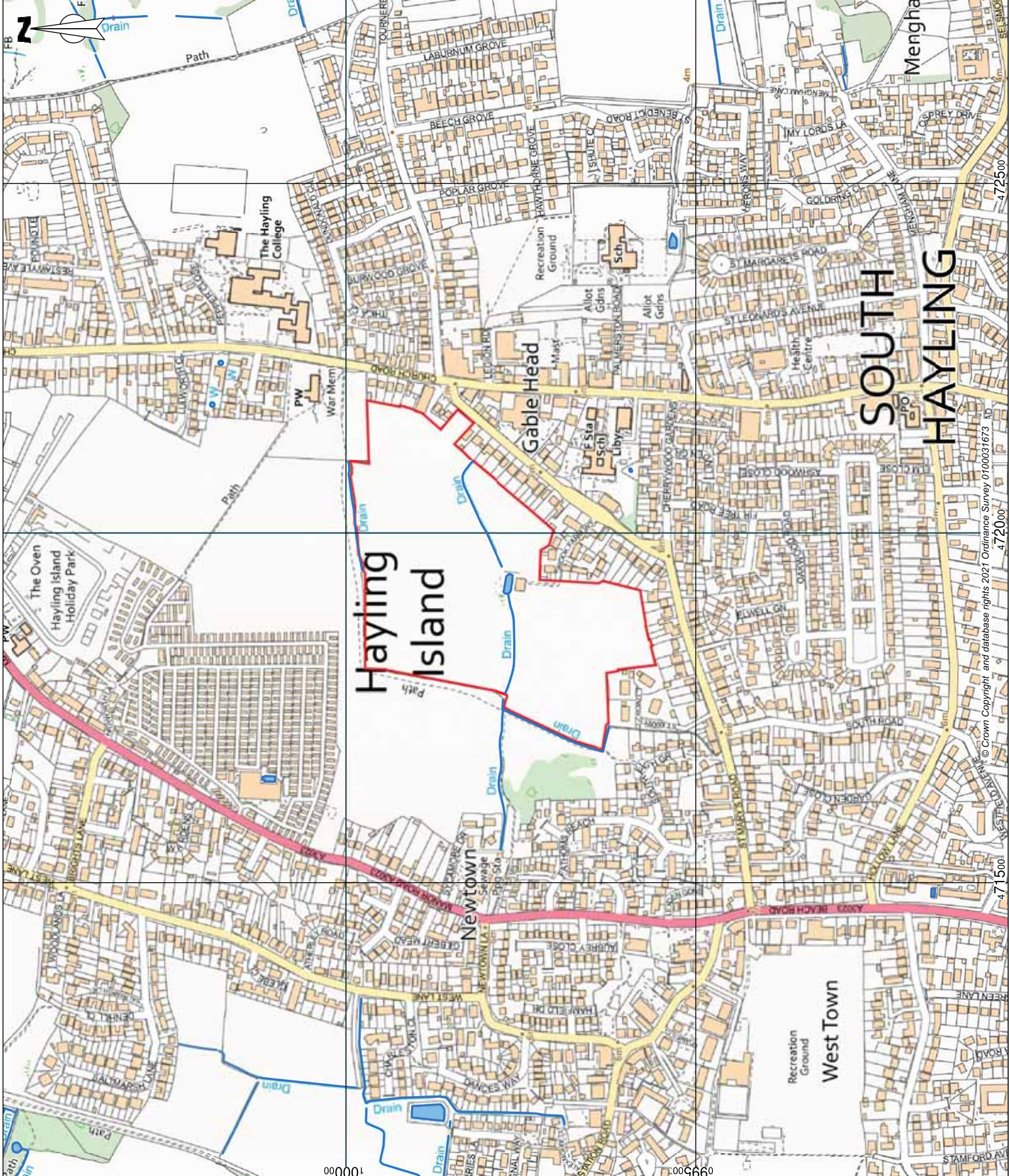


Site Location
(SZ 7194 8977)



Samuel House, 5 Fox Valley Way, Stockbridge, Sheffield, S36 2AA

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SCALE:	1:20,000@A3	PROJECT REF:	SHF.1132.142
DRAWN:	MG	CHECKED:	EOC
DATE:	Oct 2021	PROJECT:	Rook Farm, Hayling Island
TITLE		Site Location Plan	
DRAWING NO:		SHF.1132.142.HY.D.001	



Key



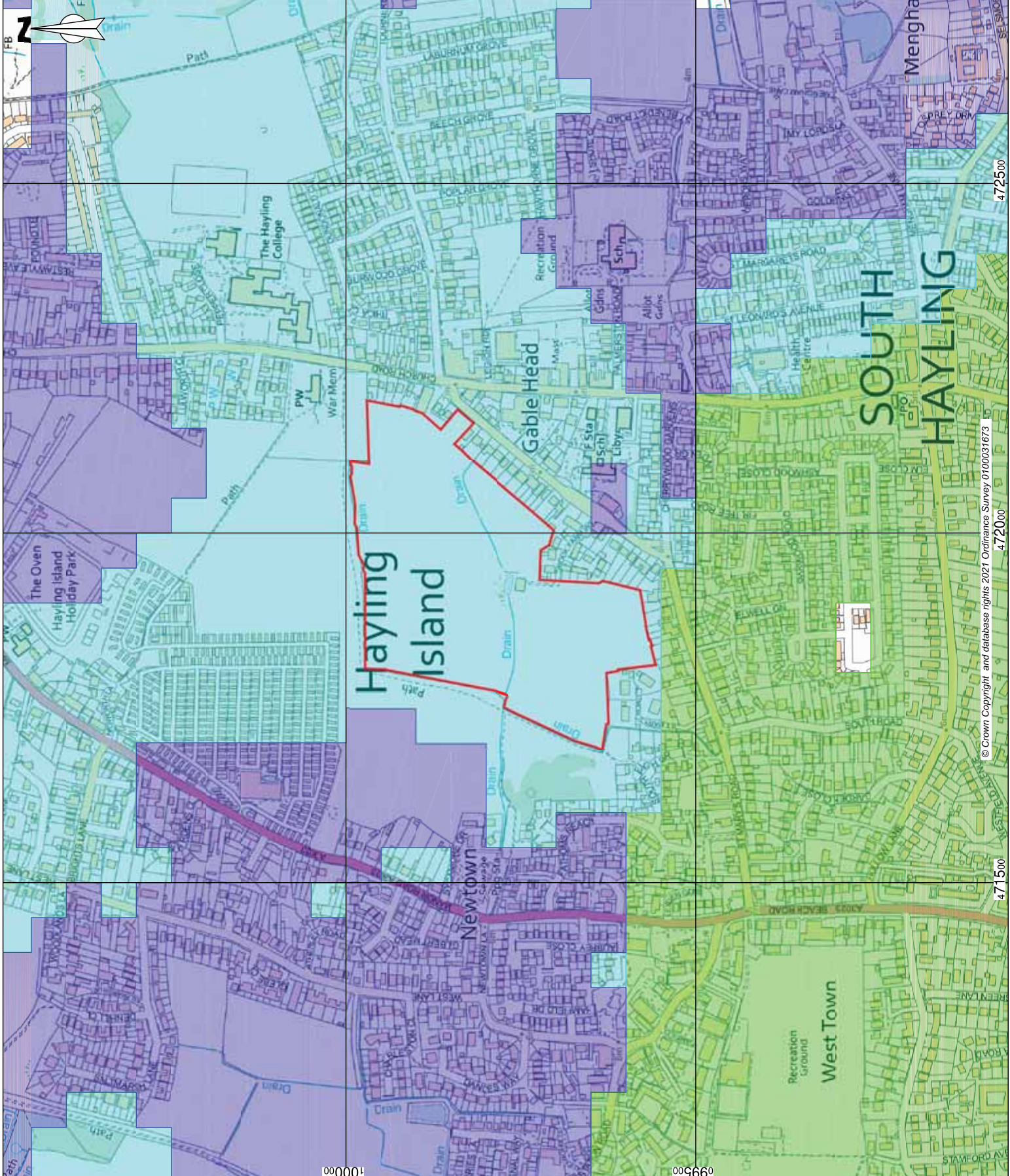
Site Boundary

Surface Water Features

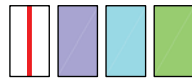


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		TITLE:	Surface Water Features
		DRAWING NO:	SHF.1132.142.HY.D.002



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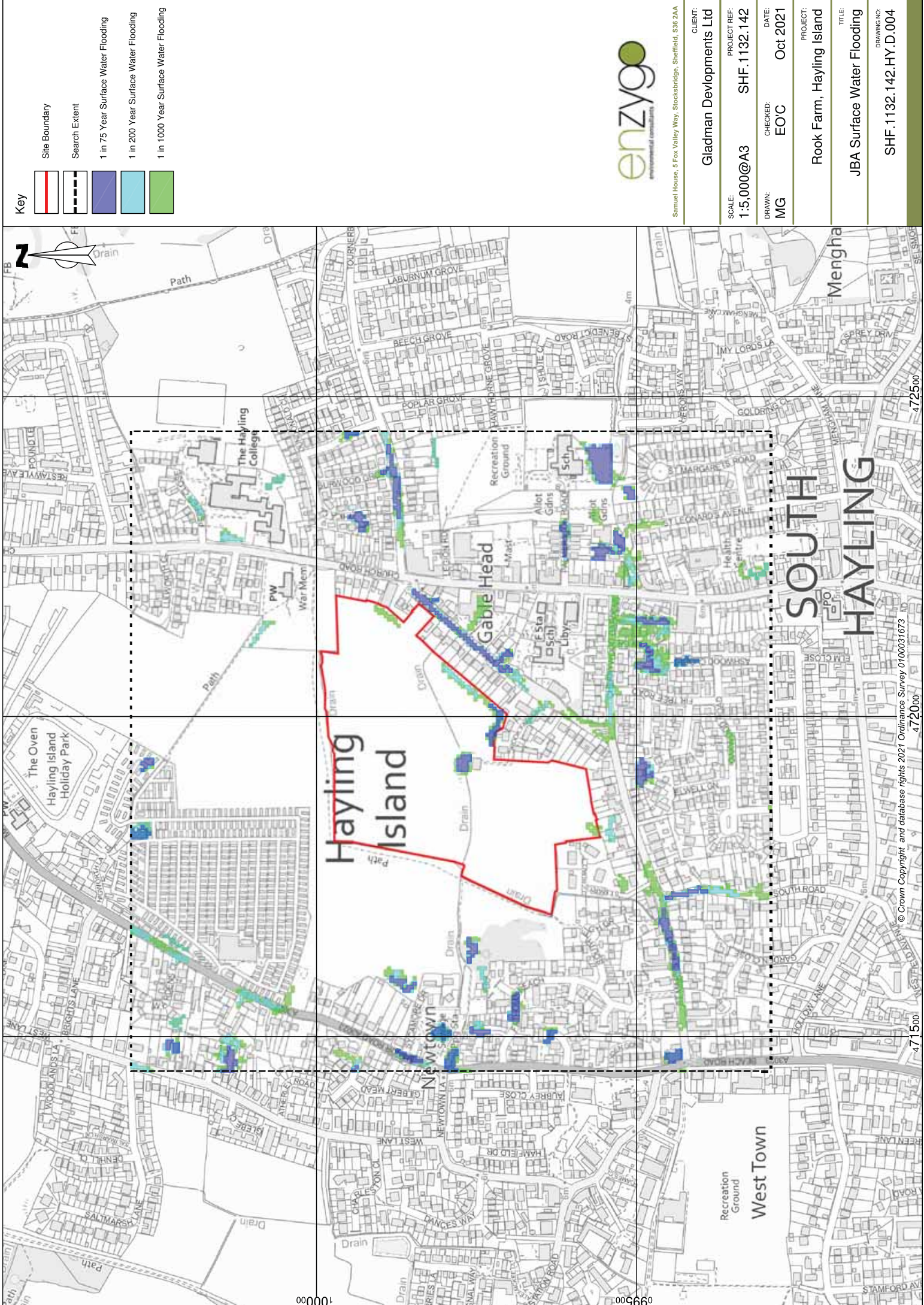
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Potential for Groundwater Flooding of Property Situated Below Ground Level
Limited Potential for Groundwater Flooding to Occur



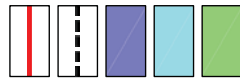
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DATE:			Oct 2021
PROJECT:	Rook Farm, Hayling Island		
TITLE:	BGS Groundwater Flooding Susceptibility		
DRAWING NO:	SHF.1132.142.HY.D.003		

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Key



Site Boundary

Search Extent

1 in 75 Year Surface Water Flooding

1 in 200 Year Surface Water Flooding

1 in 1000 Year Surface Water Flooding



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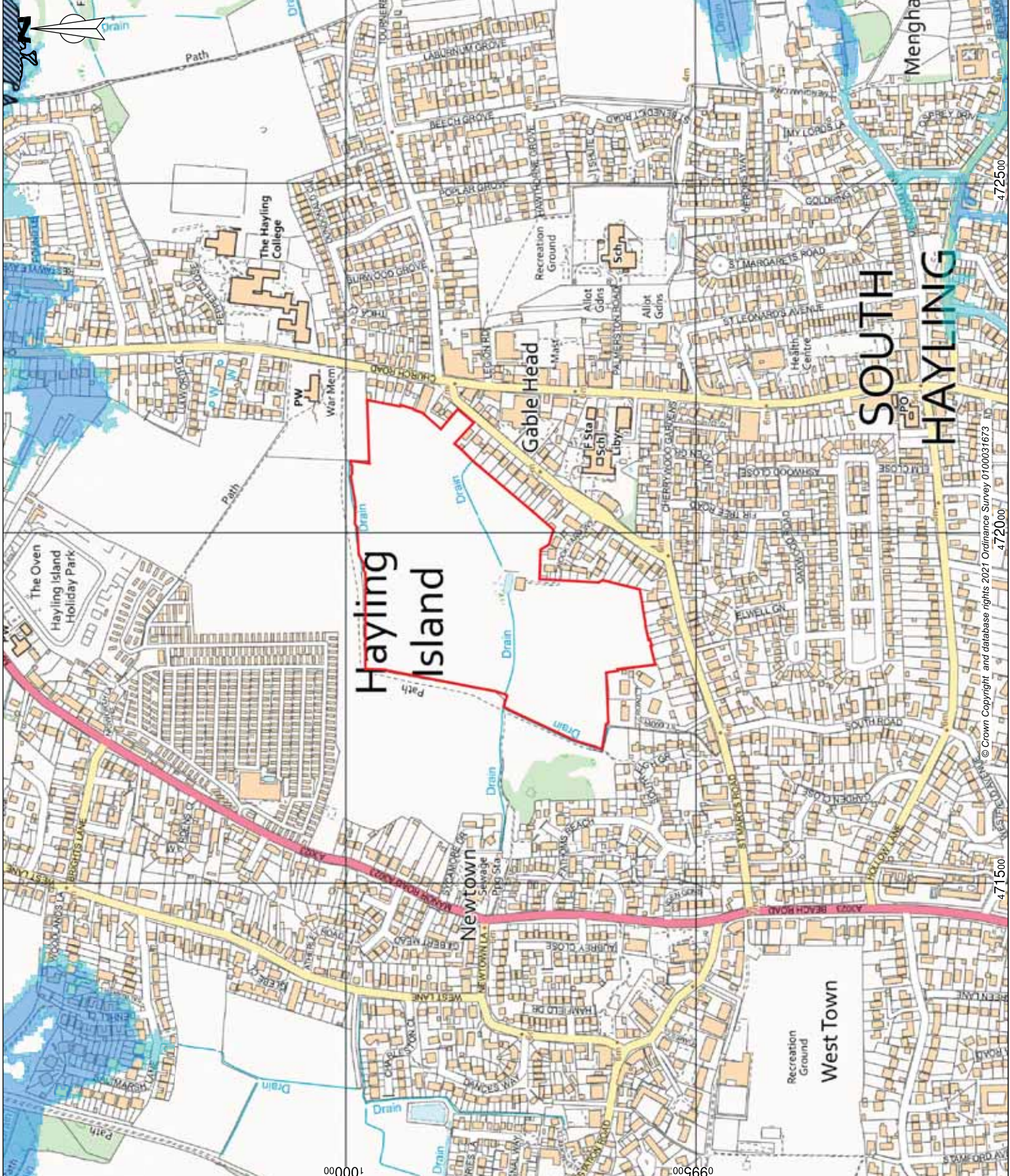
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PROJECT: Rook Farm, Hayling Island

TITLE: JBA Surface Water Flooding

DRAWING NO: SHF.1132.142.HY.D.004

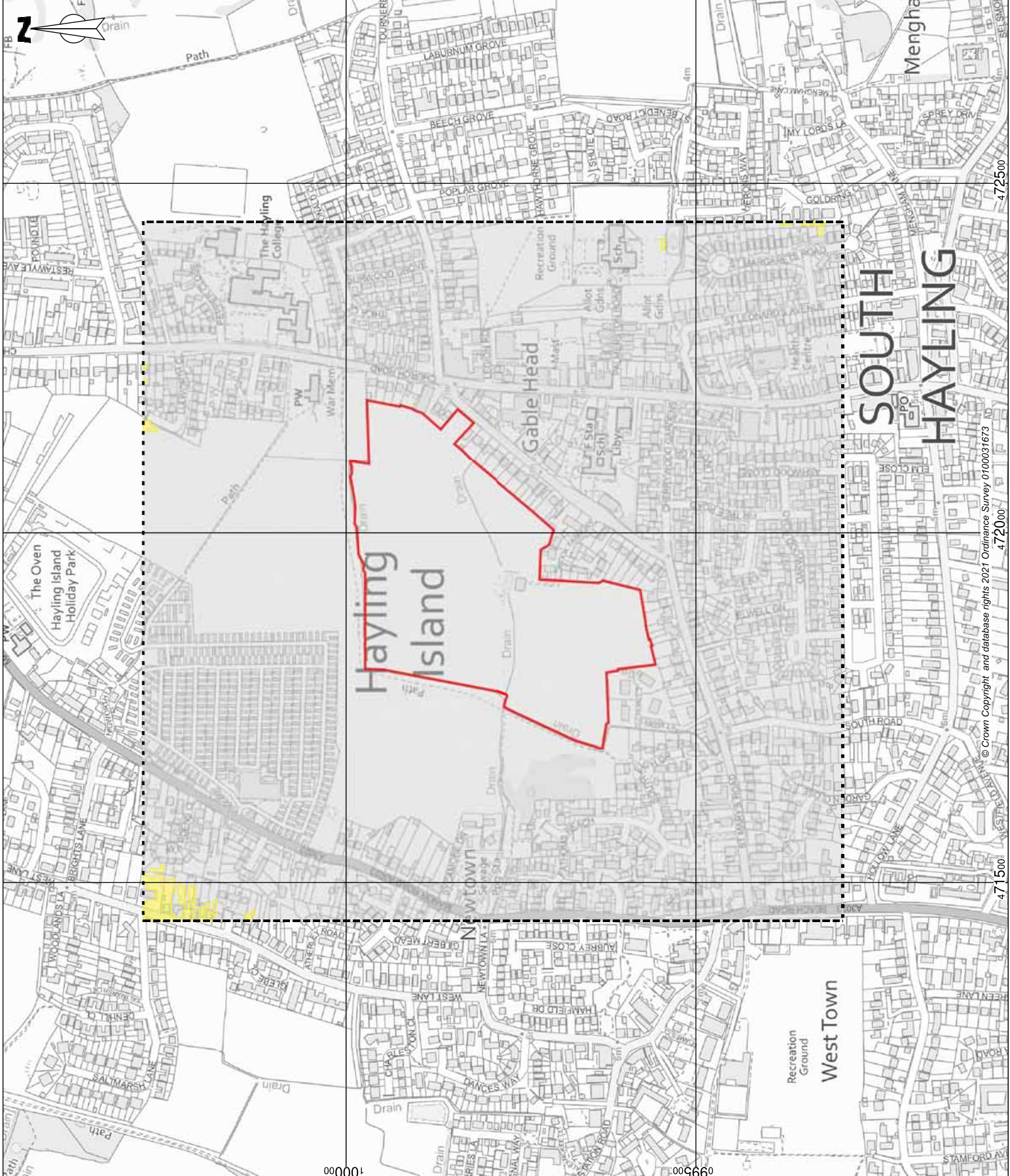
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DATE:	Oct 2021
PROJECT:	Rook Farm, Hayling Island
TITLE:	Environment Agency Flood Zones
DRAWING NO:	SHF.1132.142.HY.D.005



Key

- Site Boundary
- Search Extent
- Class 1 - High Risk
- Class 2 - Moderate Risk
- Class 3 - Low Risk
- Class 4 - Negligible Risk

Notes:

GEOSMART GROUNDWATER FLOOD RISK MAP GW5
Version 2.3© - www.geosmartinfo.co.uk



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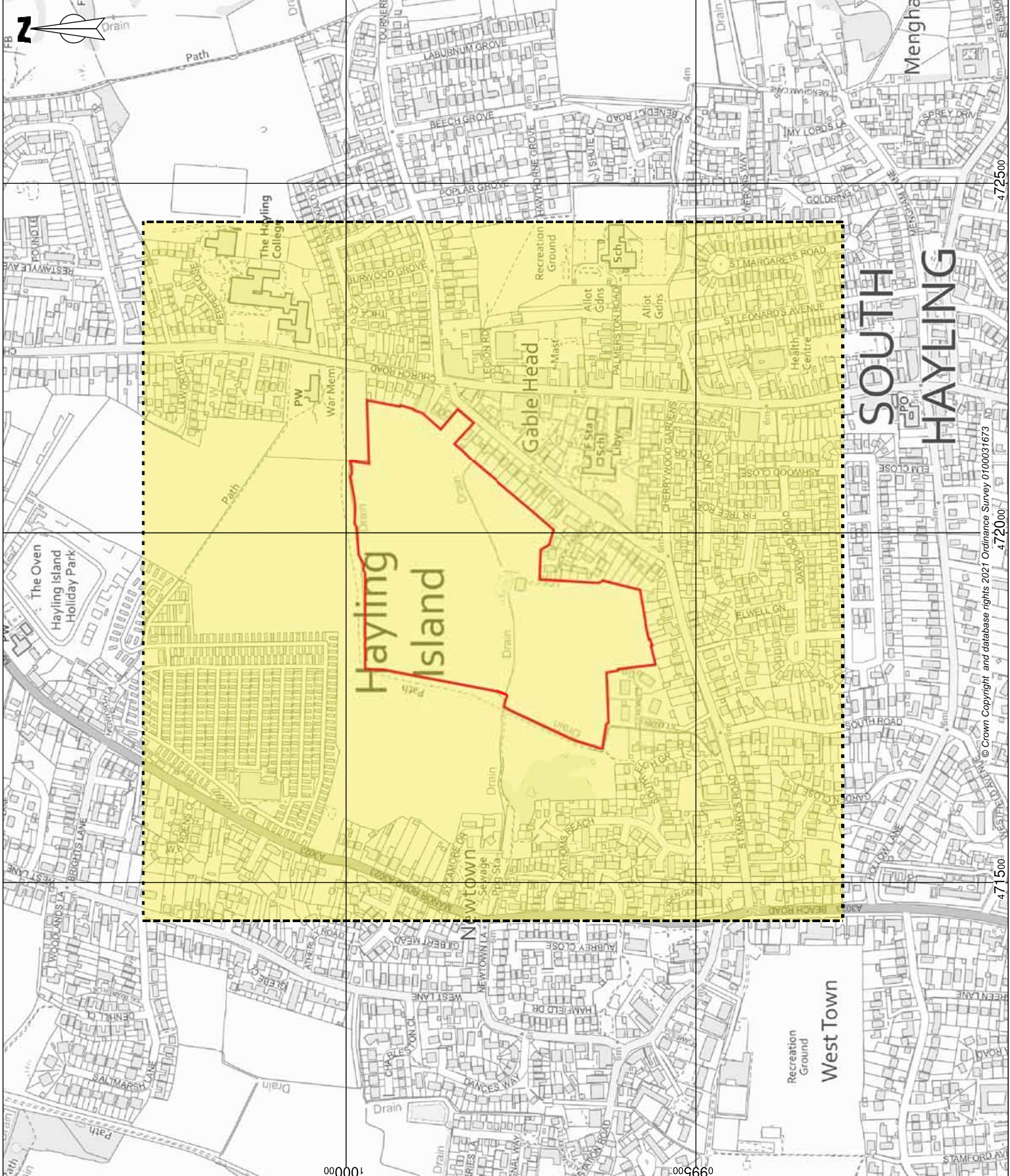
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PROJECT REF: SHF.1132.142

DRAWN: MG
CHECKED: EOC
DATE: Oct 2021

PROJECT:
Rook Farm, Hayling Island

TITLE
Groundwater Flood Risk Map

DRAWING NO:
SHF.1132.142.HY.D.006



Key

- Site Boundary
- Search Extent
- High Potential
- Moderate Potential
- Low Potential

Notes:

GEOSMART SUDS INFILTRATION POTENTIAL MAP SD50
Version 1.0© - www.geosmartinfo.co.uk



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PROJECT REF: SHF.1132.142

DRAWN: MG
CHECKED: EOC
DATE: Oct 2021

PROJECT: Rook Farm, Hayling Island

TITLE: SuDS Infiltration Potential Map

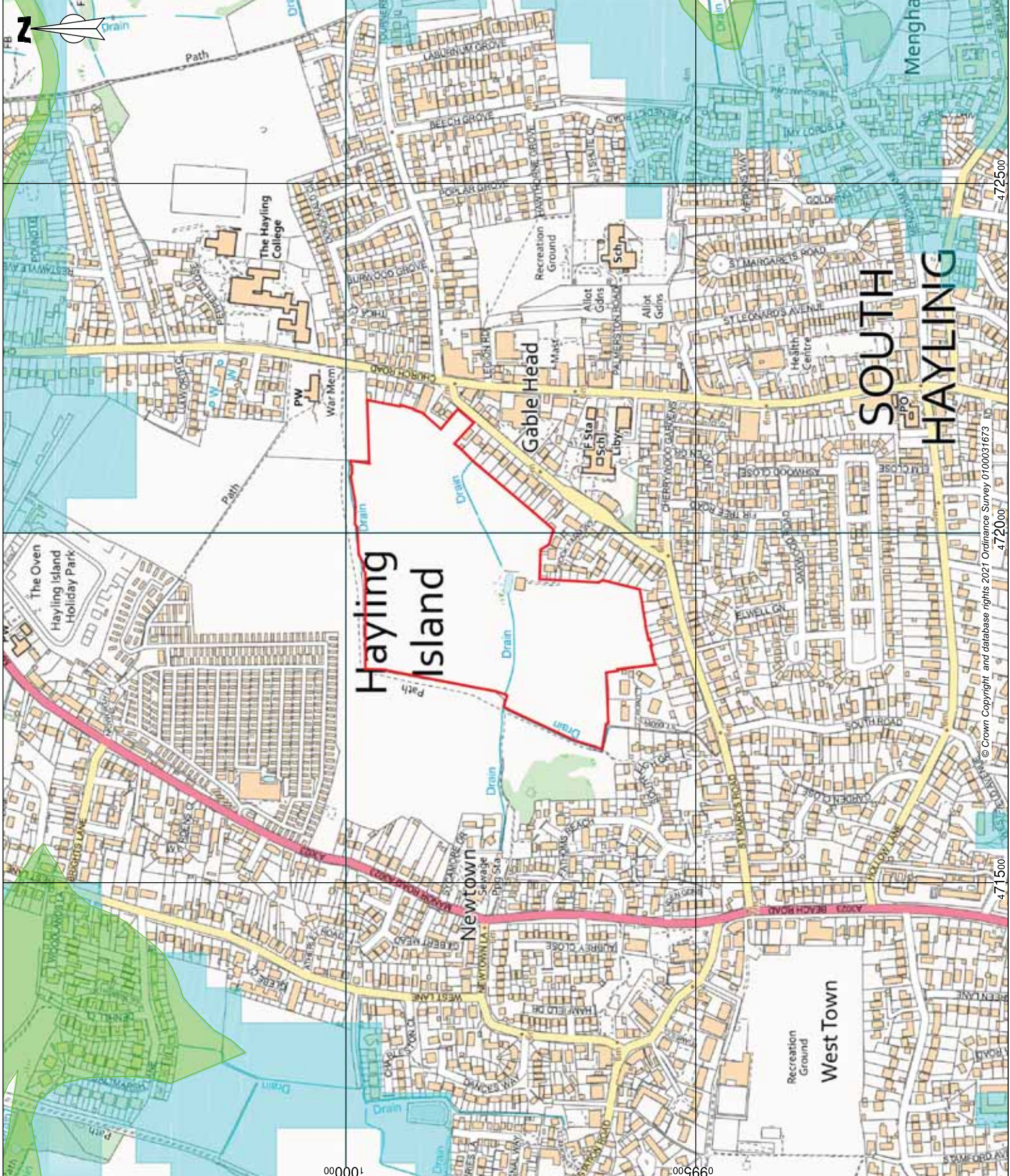
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472500

472000

471500



Key

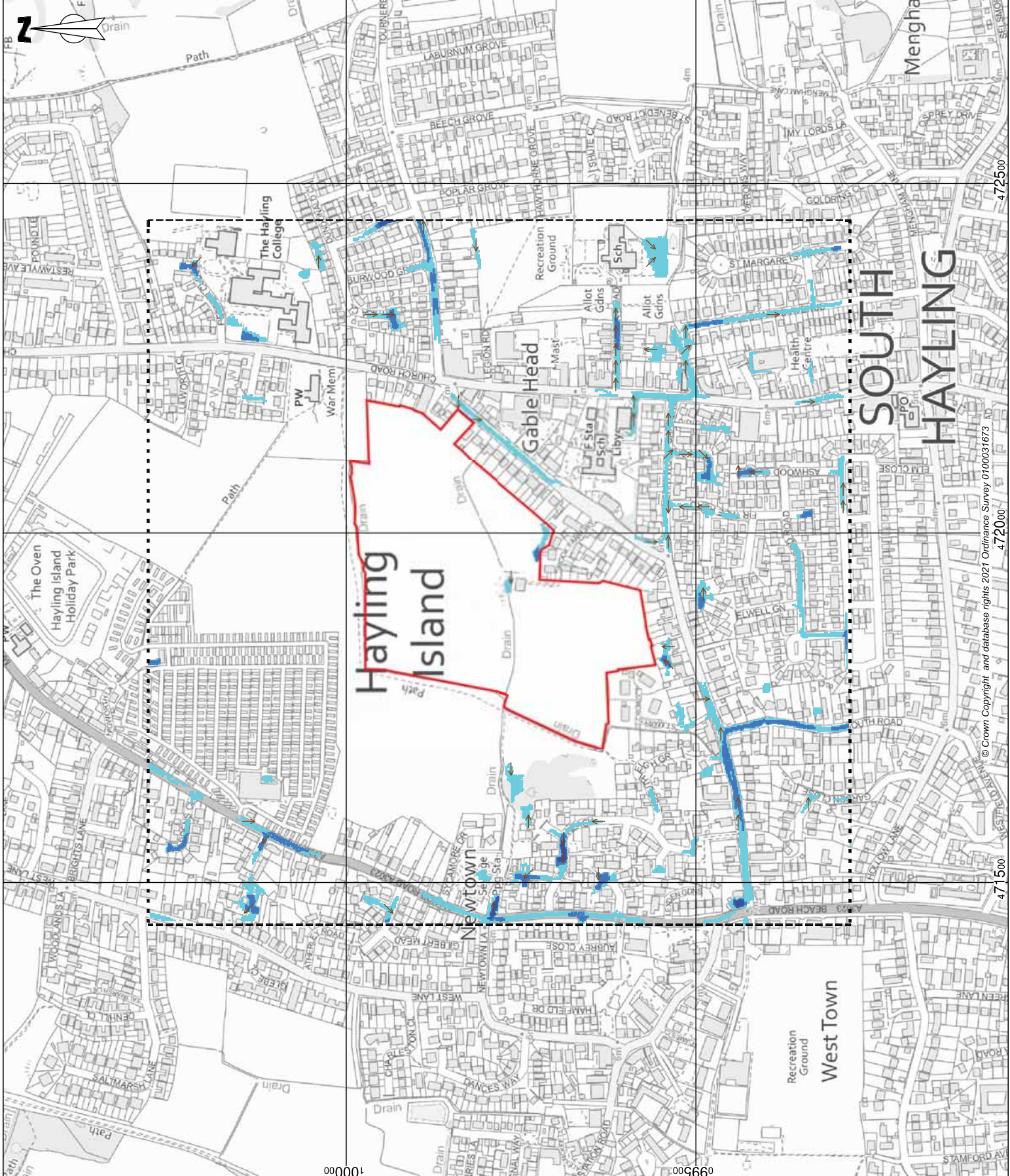


Site Boundary
Geological Indicators of Flooding
from Inland Flooding
Geological Indicators of Flooding
from Coastal Flooding

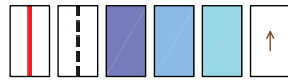


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DRAWN:	MG	CHECKED:	EOC
DATE:	Oct 2021	PROJECT:	Rook Farm, Hayling Island
TITLE:		Geological Indicators of Flooding (based on geological deposits)	
DRAWING NO:		SHF.1132.142.HY.D.008	



Key



- Site Boundary
- Search Extent
- 30 Year Extent
- 100 Year Extent
- 1000 Year Extent
- Flow Direction



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SCALE:	1:5,000@A3	PROJECT REF:	SHF.1132.142	
DRAWN:	MG	CHECKED:	EOC	DATE: Oct 2021
PROJECT:	Rook Farm, Hayling Island			
TITLE:	Environment Agency Surface Water Flow Paths			
DRAWING NO:	SHF.1132.142.HY.D.009.1			