
Ansty Garden Community

Environmental Statement

Volume 4

November 2023



APPENDIX B: OTHER TECHNICAL REPORTS

Appendix B1: Flood Risk Assessment and Outline Drainage Strategy

Ansty Garden Community: Flood Risk Assessment and Outline Drainage Strategy

A REPORT FOR FAIRFAX ACQUISITIONS LTD

JULY 2023

P21367_R5_Rev1



Document Control

Title

Ansty Garden Community: Flood Risk Assessment and Outline Drainage Strategy

Client

Fairfax Acquisitions Ltd.

Buncton Barn,

Buncton Lane,

Bolney,

West Sussex,

RH17 5RE



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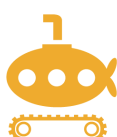
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1 Introduction

1.1 INSTRUCTION

Yellow Sub Geo Ltd (Yellow Sub) was instructed by Fairfax Acquisition Ltd (the Client) to provide a Flood Risk Assessment (FRA) and Outline Sustainable Drainage (SuDS) Strategy for a proposed residential led mixed use development on a parcel of land near Ansty, Mid-Sussex (the Site). Instruction to proceed was provided by email on the 19th July 2022.

1.2 BACKGROUND

The Client is seeking to obtain planning permission for a residential led development at the Site. The development will contain up to 1,450 dwellings (including 30% affordable housing), up to 90 residential care (C2 units), a primary school, new SEND school, sports facilities including all weather hockey pitches and tennis centre, allotments, retail, community and employment uses together with ancillary and associated development including new and enhanced pedestrian/cycle routes, open spaces, and landscaping. In addition to this, the planning application includes a greenfield area to the north; this area will be utilised as a Parkland Reserve (no development in this area). Further details of the proposed development are provided in Section 3.

This report constitutes a FRA and Outline Sustainable Drainage Strategy for the proposed development which is required for the planning application. This report focuses primarily on the proposed housing development area ("the Site ") and with a lesser focus on the proposed Parkland Reserve ("Beechy Bottom Parkland Reserve"), which will not be developed and is considered a water compatible land use (see Figure 1).

1.3 SCOPE OF THE REPORT

The scope of this assessment is as follows:

- Preparation of a FRA, written in line with the National Planning Policy Framework (NPPF) and supporting Planning Practice Guidance (PPG) to satisfy the Mid Sussex District Council (MSDC) and the Lead Local Flood Authority (LLFA, West Sussex County Council) that all potential flood risks to and from the proposed development have been considered and that the proposed development is appropriate, as defined in the NPPF;
- Consideration of appropriate Site-specific flood risk mitigation measures; and,
- Development of an outline SuDS strategy to mitigate the potential increase in runoff and deterioration in water quality released from the Site, as well as providing amenity and biodiversity benefits.

1.4 DATA SOURCES

The main sources of data utilised in this assessment are summarised below:

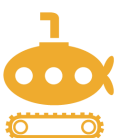
- A topographical survey of the Site;
- Proposed Site development plans as provided by the Client;
- Data collected during a Site walkover;
- Site specific infiltration test data collected in June 2023;
- Southern Water sewer asset location plans;
- Environment Agency (EA) flood risk data;
- The Mid Sussex Level 1 Strategic Flood Risk Assessment (Mid Sussex District Council, 2015);



- The West Sussex LLFA Policy for the Management of Surface Water (West Sussex County Council, 2018);
- A guide for master planning sustainable drainage into developments in southeast of England (AECOM, 2013);
- LiDAR digital terrain model (DTM) data;
- Ordnance Survey mapping; and,
- British Geological Survey (BGS) mapping and borehole logs.

1.5 LIMITATIONS

This report is written strictly for the benefit of the Client and bound by the conditions presented in Appendix A.



2 Site description

2.1 SITE SETTING AND SURROUNDING AREA

The Site is located to the east of Ansty Village in the District of Mid Sussex, closest postcode is RH17 5AG (see Figure 1) The National Grid Reference for the approximate centre of the Site is TQ 29653 23438. The Site covers a total area of approximately 100Ha, and Beechy Bottom Parkland Reserve covers an approximate area of 103Ha.

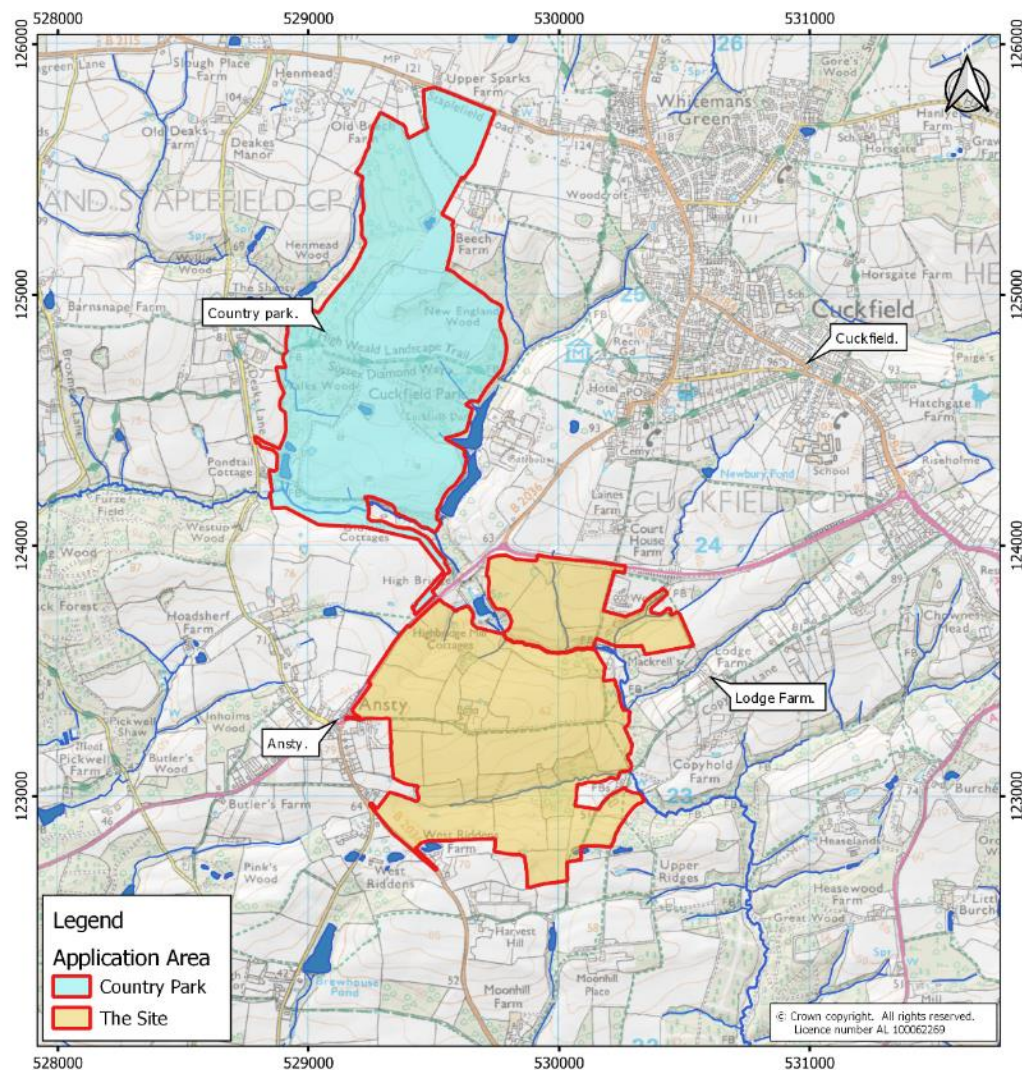
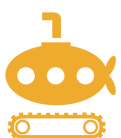


Figure 1 Location plan

Figure 2 presents an aerial image of the Site showing its current land use and condition. The Site currently comprises agricultural fields separated by hedgerows and ditches. There are also wooded areas in parts of the Site, particularly in the vicinity of the watercourses and overland flowpaths.

The village of Ansty lies at the western extent of the Site, and Cuckfield is located approximately 1km to the northeast. The Site is bounded to the south by more agricultural land. The A272 road bounds the Site to the north. A wastewater treatment works is located adjacent to the northern boundary.



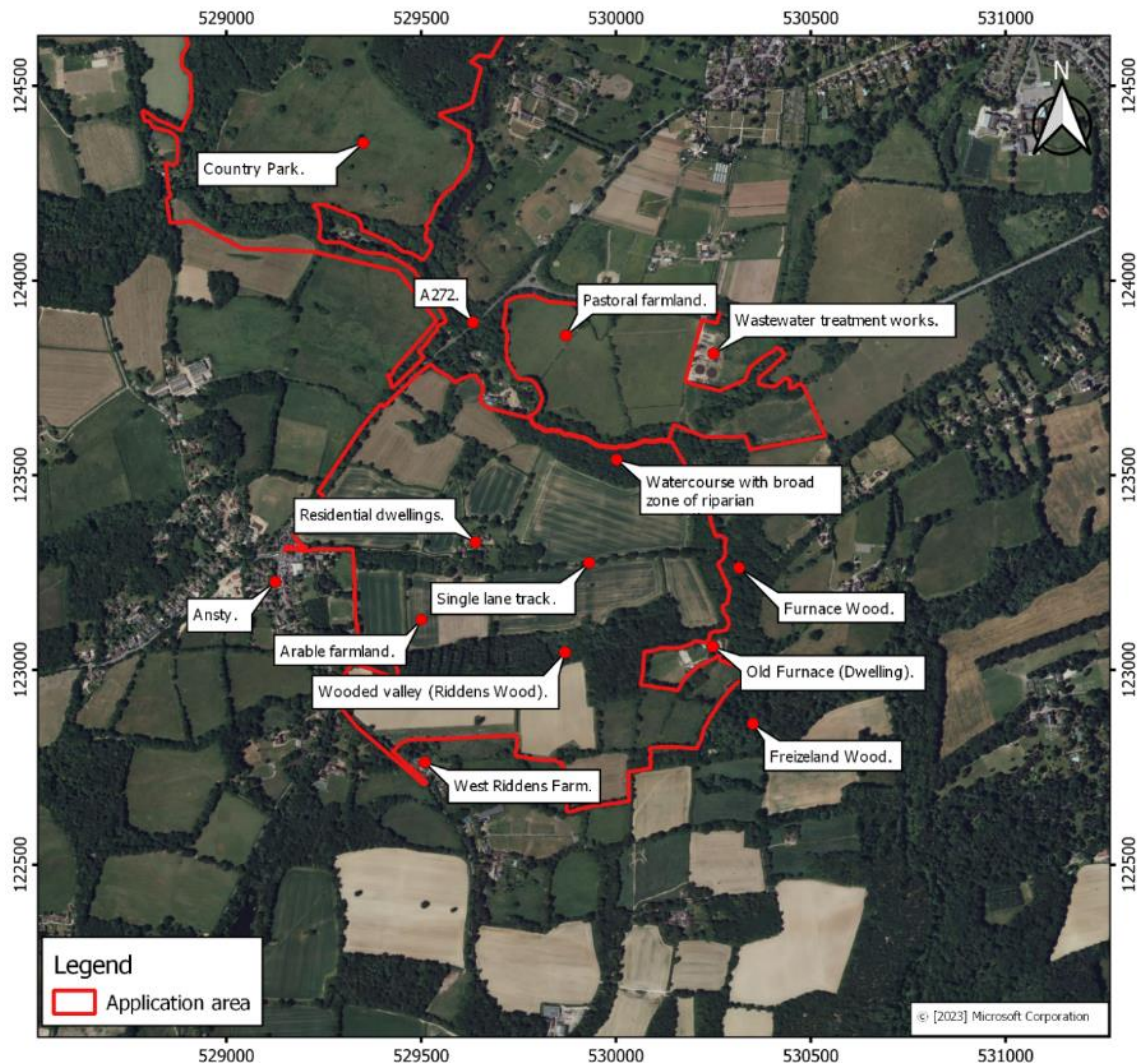


Figure 2 Existing Site layout (development area)

The Beechy Bottom Parkland Reserve area to the north is a mixture of mature woodland and fields and Copyhold Gill flows eastwards through the southern end of this area. The Site and the Beechy Bottom Parkland Reserve are separated by the A272.

2.2 TOPOGRAPHY

Topographical data (from LiDAR) is provided in Figure 3. Ground levels at the Site range between approximately 32.85m and 78.37m above Ordnance Datum (m aOD). The Copyhold Gill valley separates the northern and southern parts of the Site. The areas allocated for development in the proposed plans are located on the elevated parts of the Site, above the valley bottom.

The topography of Beechy Bottom Parkland Reserve falls from an elevated point in the centre (approximately 104m aOD) towards the valleys along the eastern, western and southern boundaries.

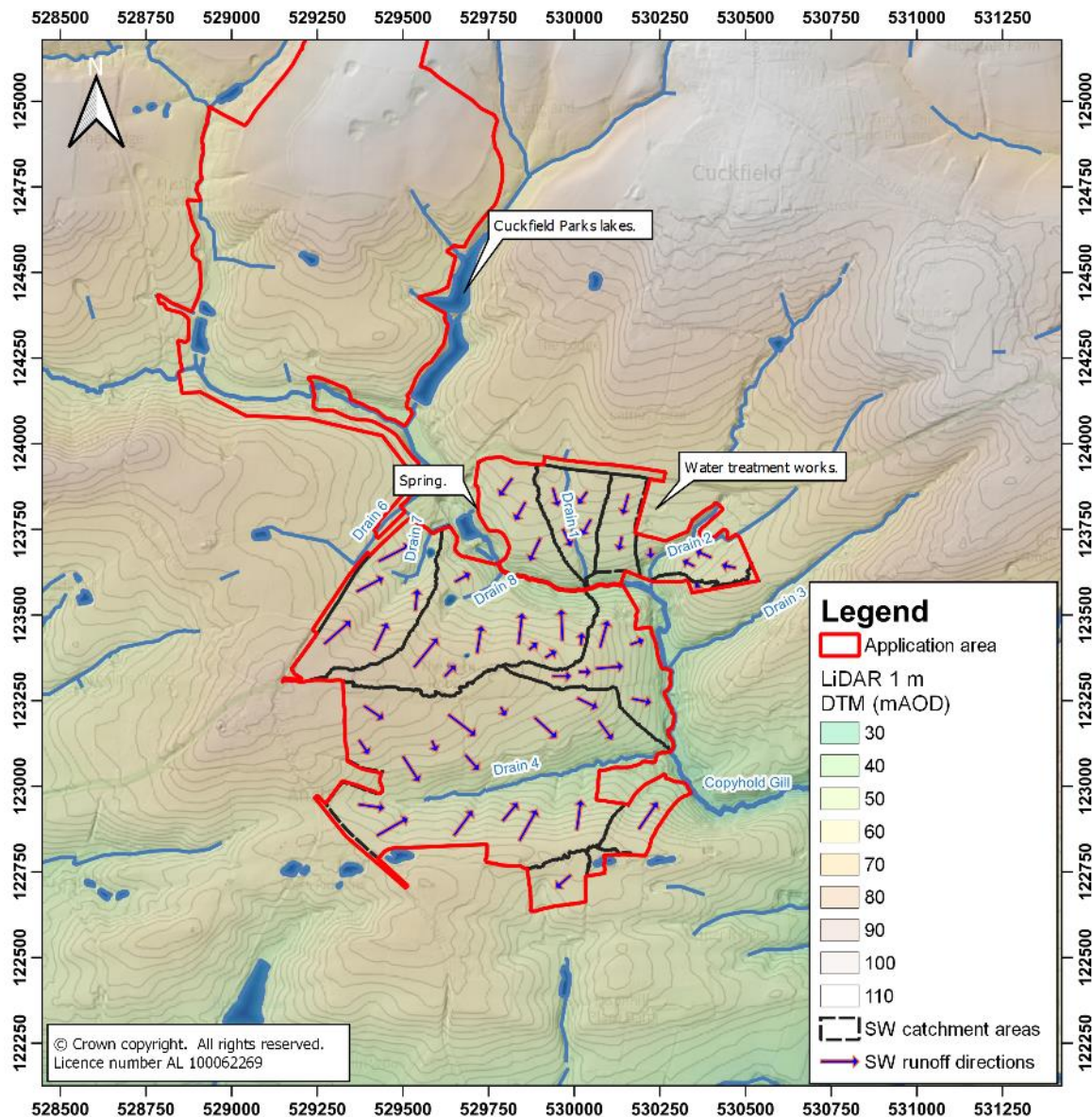


Figure 3 Site topography and current runoff regime in development area

2.3 SITE VISIT AND DATA COLLECTION

Site visits were undertaken by Yellow Sub in January and May 2023. The weather was dry and partly sunny on the day although in January the ground conditions remained very wet and soft following a period of prolonged rainfall. The purpose was to undertake a site walkover and gain an understanding of the general Site conditions and potential development constraints and/or opportunities.

2.4 GEOLOGY AND HYDROGEOLOGY AND SOILS

2.4.1 Published geology and soils

The following information has been compiled Soilsapes and British Geological Survey (BGS) 1:50,000 scale mapping. The geological sequence underlying the Site is as follows (see Figure 4 for spatial distribution of referenced formations/ features).



2.4.1.1 Soil

Soilscape provides high level information on natural soil characteristics across the UK. Soilscape classifies the soil type at the Site as: 'Slightly acid loamy and clayey soils with impeded drainage' (Cranfield Soil and AgriFood Institute, 2023).

2.4.1.2 Superficial deposits

Superficial deposits are largely absent over the Site area, with the exception of a small area of Head Deposits (silt, sand and gravel) on the western boundary.

2.4.1.3 Solid geology

Much of the Site is underlain by the Upper Tunbridge Wells Sand (interbedded sandstone and siltstone). The northern and southern parts of the Site are also underlain by the Lower Tunbridge Wells Sand (sandstone, siltstone and mudstone), the Lower Grinstead Clay (mudstone) and the Cuckfield Stone Bed (calcareous sandstone).

2.4.2 Published BGS borehole records

Several BGS boreholes are noted in the area (see Figure 4). Borehole TQ32SW22 is located at Copyhold Farm, just to the east of the Site, which describes the geology as being a series of clays down to 16m below ground level (m bgl). No groundwater is noted in this log.

BGS borehole TQ22SE25 is located along the northern Site boundary. This log notes clay to a depth of 3.80m bgl over mudstone. Water was encountered at 3.8m bgl, which rose to 1.9m bgl after 15 minutes. This suggests that the groundwater may be confined with the upward migration of groundwater being inhibited by the cohesive overlying material.

BGS borehole TQ22SE14 is located 670m to the southwest of the Site, located on the Upper Tunbridge Wells Sands. This log notes the Weald Clay Formation to a depth of 12m bgl, overlying the Tunbridge Wells Sands (thickness of 33m at this location) and then further Weald Clay Formation below this. Groundwater strikes are not noted in this log owing to the drilling method utilised.

2.4.3 Hydrogeology

The Upper Tunbridge Wells Sand which underlies much of the Site is classified by the EA as a Secondary A aquifer. These are described by the EA as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

The Upper Tunbridge Wells Sand at the Site is classed as being at high vulnerability. The Site is not located within a groundwater source protection zone (SPZ).

2.4.4 Soakaway test results

On-Site infiltration testing was undertaken in June 2023. The proposed soakaway test locations were chosen to coincide with the proposed attenuation basins supporting the proposed development. Trial pits were typically excavated to a depth of 3m with infiltration testing between 1m and 3m bgl in accordance with methodology set out in BRE365. Full details of the site work undertaken including engineering logs and the and results are included in Appendix D. All soakaway locations failed and therefore infiltration will not be taken forward as a means of surface water disposal for the proposed development.

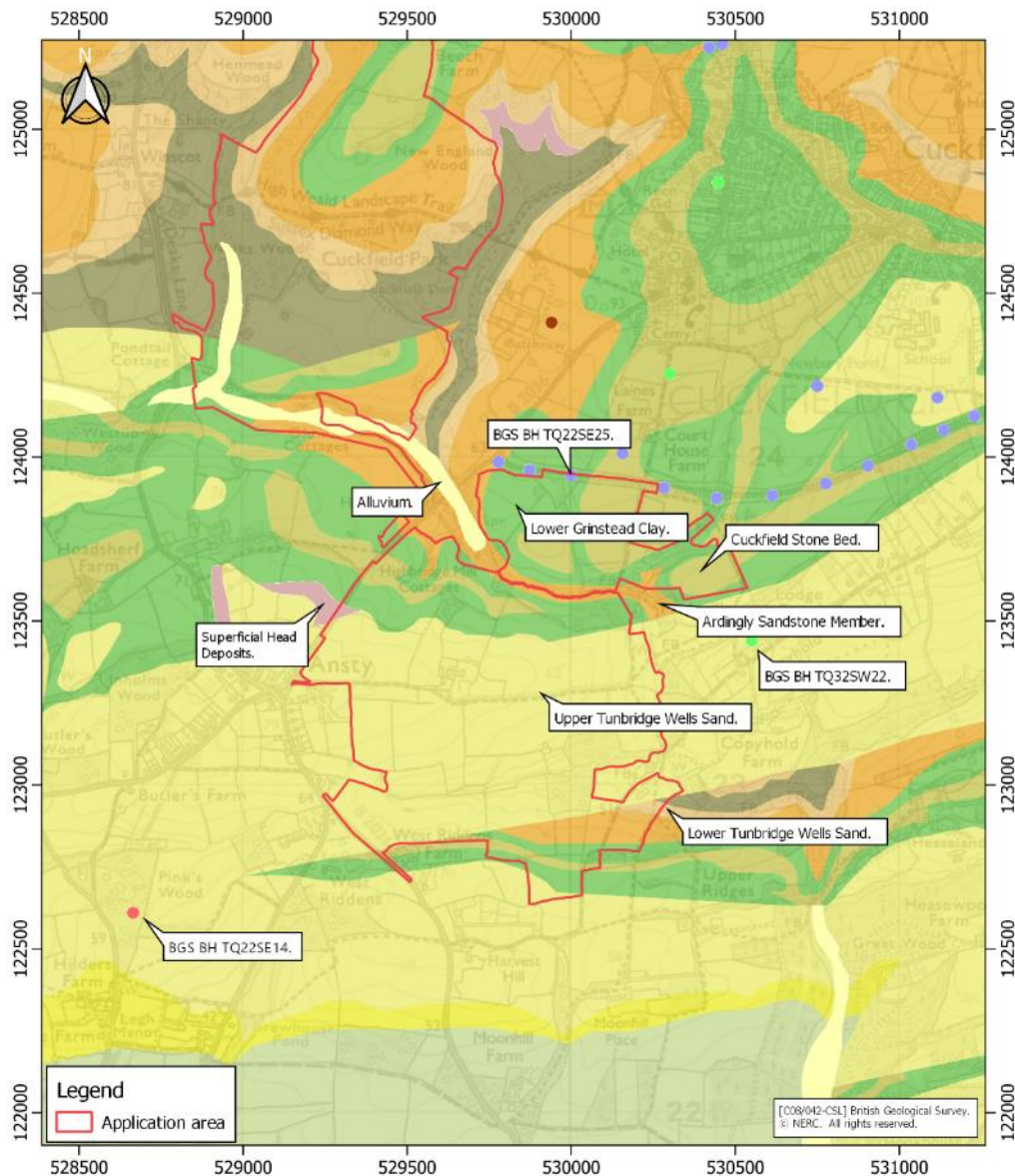


Figure 4 Bedrock and superficial geology

2.5 HYDROLOGY

The valley of Copyhold Gill separates the northern and southern parts of the Site and is also present in the south of Beechy Bottom Parkland Reserve. Copyhold Gill is a relatively minor watercourse with a catchment area of around 8.7km² at this location – it is designated as an Ordinary Watercourse.

The Site area includes several small unnamed surface watercourses/ drains and overland flow paths, which drain to Copyhold Gill. Where these features do not have a name, they have been ascribed a numerical ID (see Figure 3) for the purposes of this assessment, to avoid confusion.

The Copyhold Gill (see photos in Figure 5) is constrained in a steep-sided valley at this location, as is also evident from the fluvial flood risk data presented later.





Figure 5 Site photos collected March 2023. Clockwise from top left: Ground cover in centre of the Site, surface water ponding on-site, on-site pond; Copyhold Gill

2.6 CLIMATE

The Standard Average Annual Rainfall (SAAR) for the Site area is 813mm per annum (mm/a).

2.7 CURRENT DRAINAGE ARRANGEMENTS

The Site is not currently served by a formal drainage system and rainfall runoff primarily drains to Copyhold Gill (either directly or via one of the smaller tributaries). Figure 3 presents the runoff directions and surface water catchment areas for the Site under current conditions. The majority of the southern part of the Site drains to an unnamed drain/ stream (named "Drain 4" in this assessment) which flows through Ridden's Wood to the confluence with Copyhold Gill. The extreme southern end of the Site drains in a southerly direction to an area of farmland. Public sewer asset plans for the Site and surrounding local area have been sourced from Southern Water and are presented in Appendix D. There is a foul sewer flowing south into the existing sewage treatment works along the northern boundary, as well as foul sewer assets serving the dwellings in Ansty to the west of the Site. There are no surface water or combined sewers in the vicinity. The dwellings within the centre of the Site (The Barn House, The Grainloft and Old Place) are assumed to be served by private drainage. This likely drains surface water runoff to the adjacent surface water bodies and foul sewerage to closed/ septic systems.

Some photos are included below of the on-Site drains and surface water flowpaths. These are incorporated into the Outline SuDS scheme presented in Section 8 which aims to preserve the pre-existing flowpaths and surface water features.





Figure 6 (Left) Drain 1 in the north (right) Drain 8

Given the cohesive soils noted during the site visits, the waterlogged conditions and failed soakaway tests, it appears that the majority of rainfall in this area runs off to Copyhold Gill.



3 Proposed development

3.1 THE SITE

The illustrative masterplan for the Site is provided in Appendix C. The Proposed Development will create a new Garden Community and separate Beechy Bottom Parkland Reserve, comprising of the erection of up to 1,450 homes (including 30% affordable), up to 90 residential care (C2 units), a primary school, new special educational needs and disabilities (SEND) school, sports facilities including all weather hockey pitches and tennis centre, allotments, retail, community and employment uses together with ancillary and associated development including new and enhanced pedestrian/cycle routes, open spaces, and landscaping

To support the outline planning application, development zones/ parameters have been identified, rather than defined individual plots, gardens and buildings.

The Site will be accessed via three points, one in the south (B2036), the west (the A272 near Ansty) and the north (the A272). The principle internal access road will be surfaced with impermeable hardstanding, with minor access roads and driveways surfaced with permeable material.

Areas of mature vegetation and overland flow routes (such as the Ridden's Wood valley) will be retained/ enhanced. Additional surface water features will be installed downgradient of the development areas to manage surface water runoff from the various sub-catchments of the developed Site as close to the source as possible.

3.2 BEECHY BOTTOM PARKLAND RESERVE

Beechy Bottom Parkland Reserve occupies approximately 103Ha of land to the north-west of the Site, to the west of Cuckfield and north of Ansty. It comprises approximately 96Ha of farmland and woodland and 7Ha of private recreation grassland. The proposed development will comprise change of use of farmland and woodland to parkland reserve to include public access and instigation of long-term management and rewilding regime, including establishment of pedestrian and cycle tracks, with new pedestrian and cycle access points off Cuckfield Road to the south and Staplefield Road to the north. Proposals to include the addition of two wooden viewing platforms. Sports pitches at Beech Farm Field to remain in sports use.



4 Flood risk to the proposed development

4.1 FLUVIAL AND TIDAL

The Environment Agency (EA) Flood Map for Planning for the Site area is presented in Figure 7. The definitions of each flood zone are presented within Table 1.

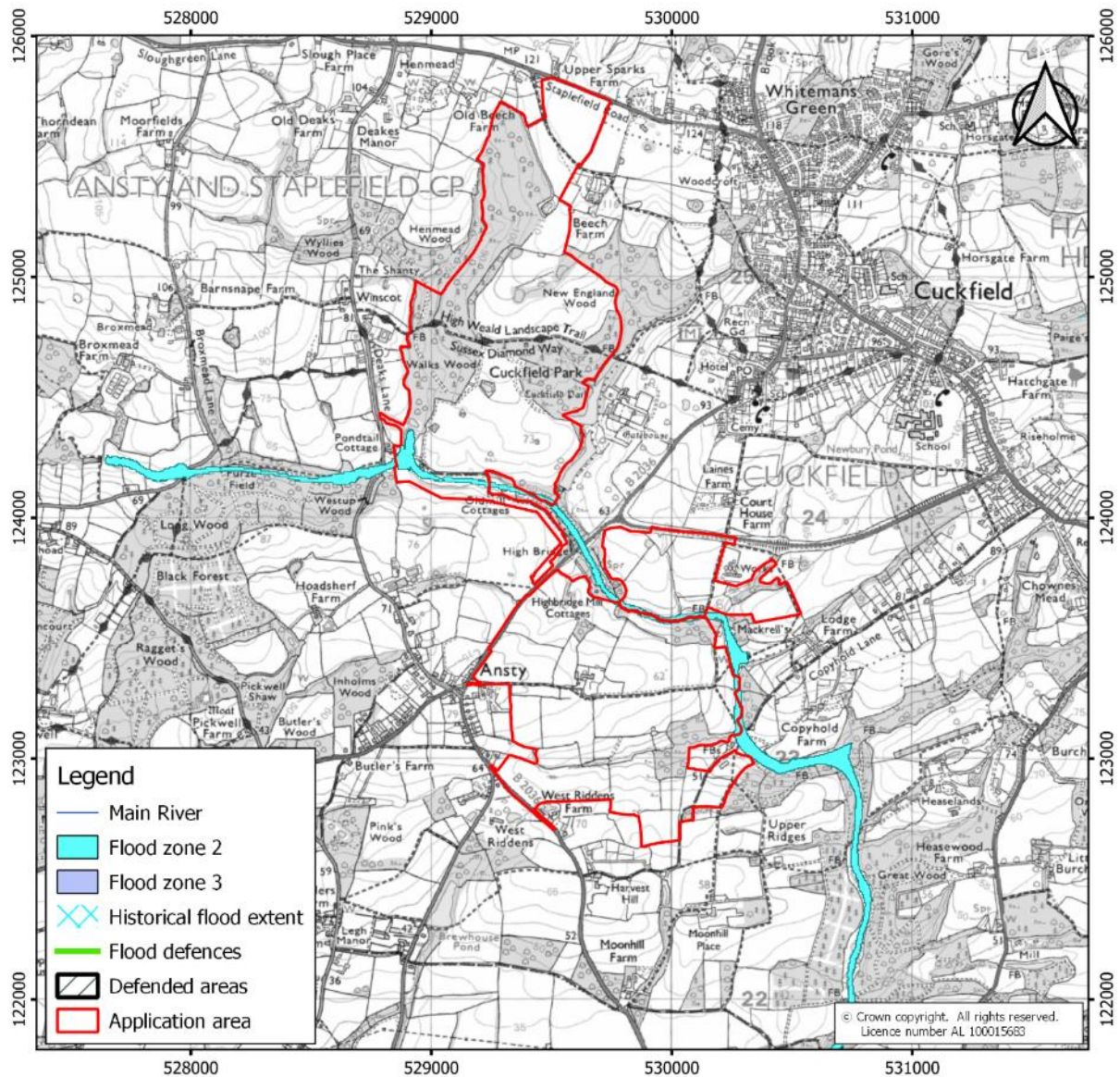


Figure 7 EA fluvial flood risk data

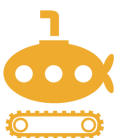


Table 1 EA Flood Zone definitions

Flood zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

The Site is principally located within Flood Zone 1. Part of the Site, along the boundary adjacent to Copyhold Gill, is classed as Flood Zone 2; this does not include any of the proposed development areas.

The EA were contacted to request fluvial flood model data. None currently exists for Copyhold Gill.

4.2 FLOOD DEFENCES

The Site is not protected by formal flood defences according to EA data and Site observations. The watercourse is constrained in a well-defined valley at this location.

4.3 SURFACE WATER (PLUVIAL)

Surface water (pluvial) flooding is usually associated with extreme rainfall events but may also occur when rain falls on land that is already saturated or has a low permeability. Rainfall that is unable to infiltrate into the ground generates overland flow which can lead to flooding or 'ponding' in localised topographical depressions before the runoff is able to enter local drainage systems and watercourses.

A map of surface water flood risk is shown in Figure 8 and Figure 9. The majority of the Site is at negligible risk of surface water flooding, owing to its elevated position relative to the local watercourses. Linear areas of elevated risk (low to high probability) are present along the bottom of the valleys of Copyhold Gill and its tributaries. A larger area of low risk is also noted in the northwest of the Site (illustrated in Figure 8); the low risk zones indicate areas which may flood under a very extreme flood scenario (1 in 100 TO 1 in 1,000 year event). An overland flow path drains the area northwest of Ansty (i.e. part of the Site area) to this accretion area - this area may be expected to experience relatively waterlogged conditions at times (less so following the installation of the drainage assets post-development).

Most of Beechy Bottom Parkland Reserve area is at a very low risk of surface water flooding, given its elevated landform. Some overland flowpaths are noted near the eastern and western boundaries, which drain small catchment areas to the valleys around the site boundary.

There are no identified critical drainage areas (CDA) within proximity of the Site according to the SFRA (Mid Sussex District Council, 2015).

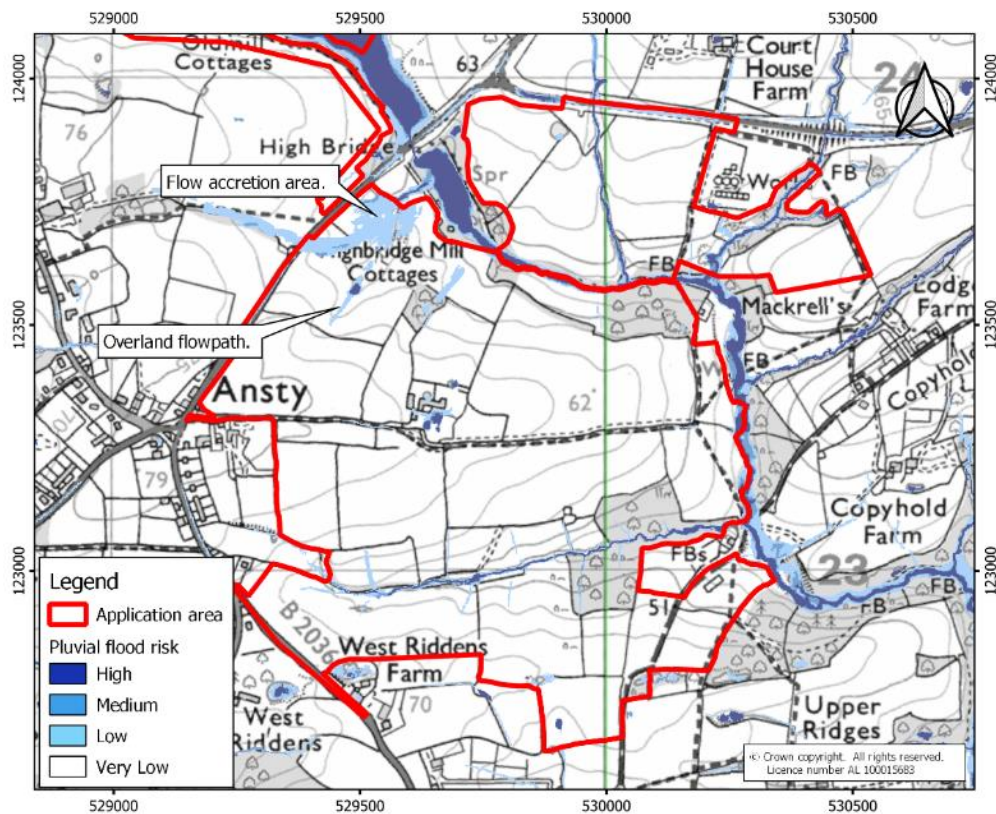


Figure 8 EA pluvial flood risk data – Site area

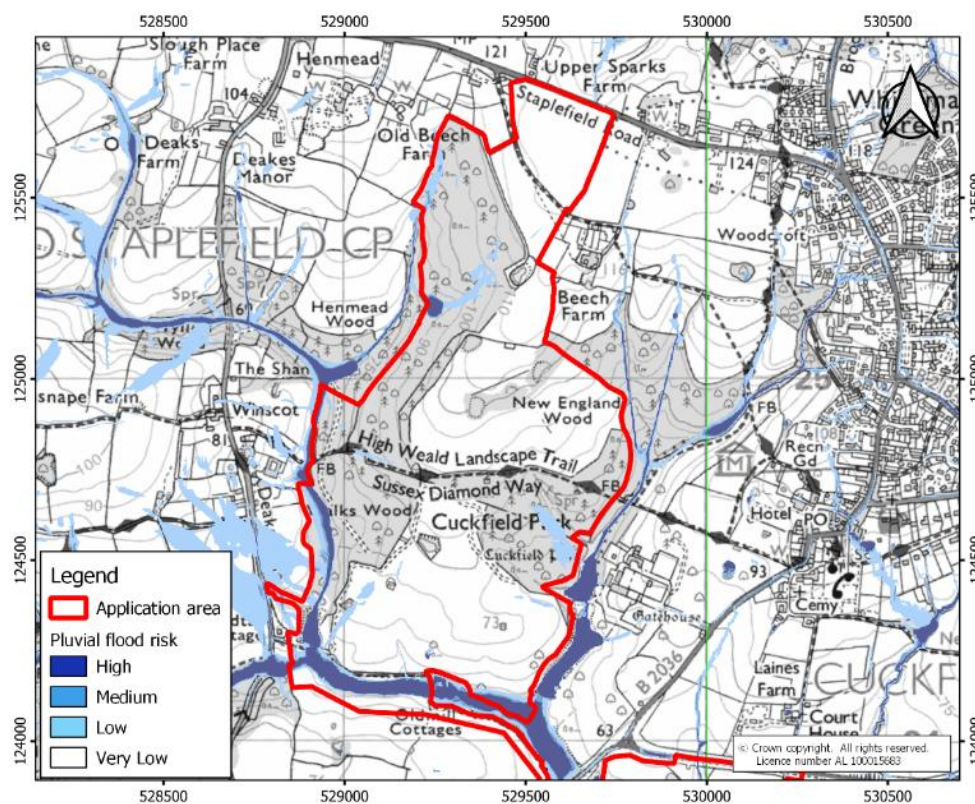
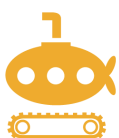


Figure 9 EA pluvial flood risk data - Beechy Bottom Parkland Reserve



4.4 GROUNDWATER

Groundwater flooding occurs when the water table rises above the surface elevation (or the floor of sub-surface structures).

Commercial groundwater flood risk data has been purchased for this assessment and is presented below. This illustrates that the majority of the Site is classified as being at negligible risk of groundwater flooding (Class 1). Some areas of elevated groundwater flood risk (Low and Medium risk) are noted in the valley bottom of Copyhold Gill and Drain 2, where there will likely be some emergence of groundwater into the watercourses. The areas of elevated groundwater flood risk do not overlap with any of the proposed development zones.

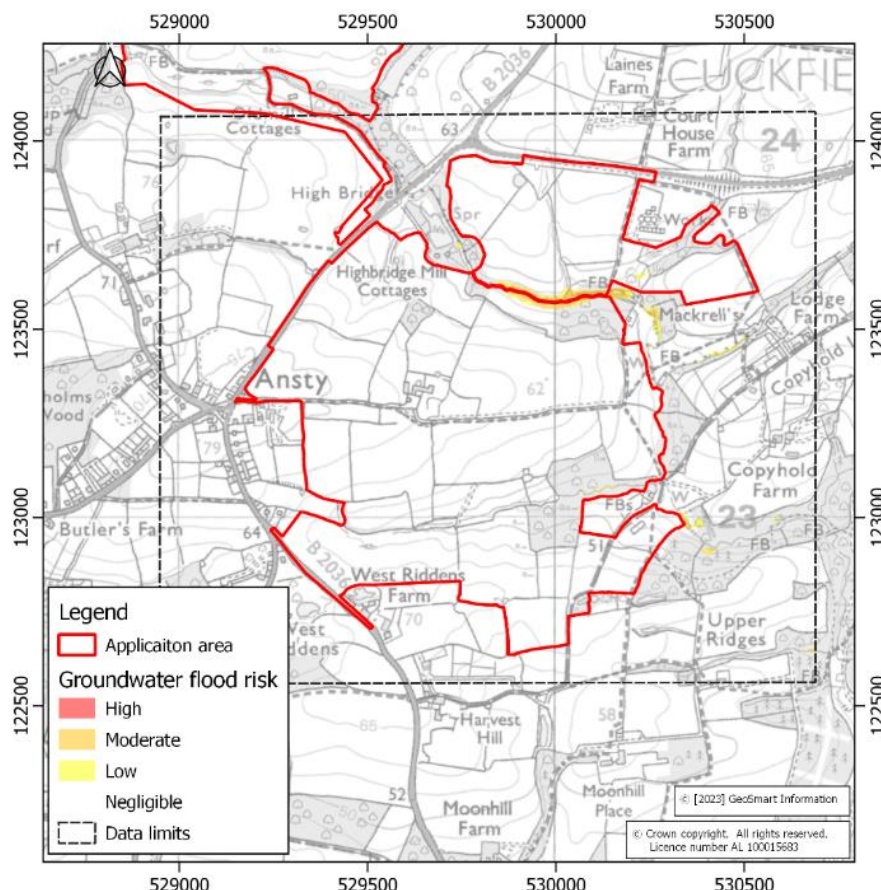
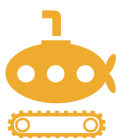


Figure 10 Groundwater flood risk (Geosmart Information, 2023)

Table 2 Groundwater flood risk zone descriptions (Geosmart Information, 2023)

Risk level	Description
1	There is a negligible risk of groundwater flooding in this area and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
2	There is a low risk of groundwater flooding in this area with a chance of greater than 1% annual probability of occurrence.
3	There is a moderate risk of groundwater flooding in this area with a chance of greater than 1% annual probability of occurrence.
4	There is a low risk of groundwater flooding in this area with a chance of greater than 1% annual probability of occurrence.



4.5 SEWER FLOODING

Sewer flooding can occur during periods of intense rainfall and/ or if a sewer becomes blocked with debris. The Site is not currently served by a sewer system but is adjacent to some residential streets which would be.

The Mid-Sussex SFRA does not identify the Ansty area as having issues with sewer flooding, although Burgess Hill is noted as having previously experienced regular sewer flooding (Mid Sussex District Council, 2015).

4.6 CATASTROPHIC FAILURES

This section considers catastrophic failures of water bearing infrastructure in the area of interest.

The risk of reservoir flooding is related to the failure of a large water storage reservoir. The maximum expected extent of flooding from reservoir failures does not encroach on the Site area according to EA data.

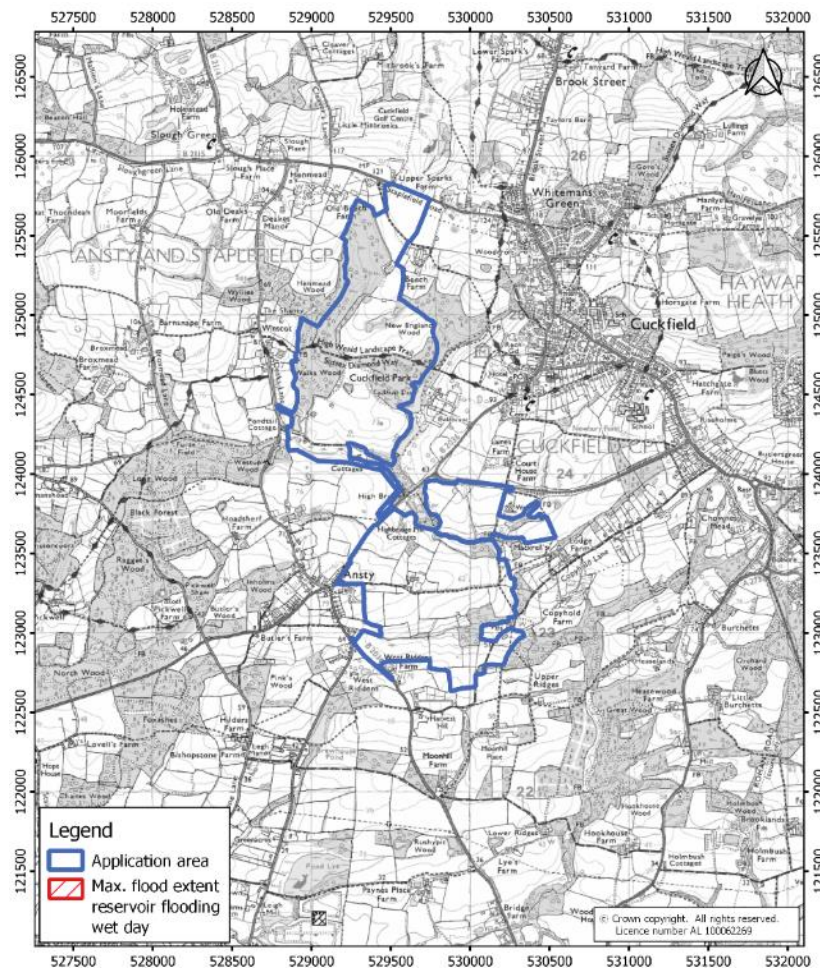


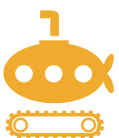
Figure 11 Reservoir flood risk zones

4.7 HISTORIC FLOODING

The EA database of historical flooding contains no evidence of flooding having occurred in this area. The Mid Sussex SFRA contains no references of historical flooding occurring at the Site area. Water levels in Copyhold Gill and its tributaries will have reached extreme, flood levels in the past, during storm conditions. Given the steep sided valleys and the relatively



large range of ground elevations across the Site, this is unlikely to have caused flooding of the wider Site area – as illustrated in the Flood Zone 2 and surface water flood risk extents.



5 Suitability of the proposed development

The Sequential Test, outlined in the PPG for Flood Risk and Coastal Change, identifies that developments should be directed to areas with the lowest probability of flooding. The Site is located primarily within Flood Zone 1 (see Figure 7). with some small areas close to Copyhold Gill also within Flood Zone 2.

All types of development are considered appropriate within Flood Zone 1. More Vulnerable developments are allowable in Flood Zone 2 (see Table 3). For the Site, the development areas are all located in Flood Zone 1.

Table 3 Flood risk vulnerability and Flood Zone compatibility (PPG for Flood Risk and Coastal Change)

Flood risk vulnerability classification	Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception Test required	✓	✓
Zone 3a	Exception Test required	✓	✗	Exception Test required	✓
Zone 3b (functional floodplain)	Exception Test required	✓	✗	✗	✗

Beechy Bottom Parkland Reserve would be classified as “Water Compatible” with regards to flood risk and would therefore be allowable in this area.

5.1 SEQUENTIAL DEVELOPMENT

Where flood risk is present to varying degrees across a Site, layouts should be tailored to ensure the most sensitive parts of a development are located in parts of the Site least at risk of flooding.

As stated above, all development areas will be located in Flood Zone 1.

6 Flood Risk from the Proposed Development

The National Planning Policy Framework (NPPF) stipulates that all new developments must be “safe, without increasing flood risk elsewhere”. As such the following stipulations are provided in the EA guidance for managing rainfall runoff (Environment Agency, 2013):

- Stormwater runoff rates and volumes discharged from urban developments should approximate to the Site greenfield response over a range of storm frequencies of occurrence (return periods).
- Runoff for extreme events should be managed on-site. This requires:
 - the peak rate of stormwater runoff to be limited;
 - the volume of runoff to be limited;
 - the pollution load to receiving waters from stormwater runoff to be minimised; and,
 - the assessment of overland flows and temporary flood storage across the Site.

The Sustainable Drainage Strategy for the Site (see Section 8) has been designed in such a way as to prevent any increase in runoff from the Site under a range of design storm scenarios. This includes suitable allowances for future increases in rainfall intensity caused by climate change.



7 Flood risk mitigation measures

7.1 KEY CONSIDERATIONS

To meet the PPG requirements, the proposed development will be considered appropriate in this location provided the following conditions are met:

- Remains safe in times of flooding whilst taking climate change into account;
- Does not result in a net loss of floodplain storage;
- Does not impede existing water flow pathways; and,
- Does not increase the volume and rate of surface water runoff leaving a site over its intended design lifetime.

Each of these requirements is discussed in relation to the proposed development in Sections 7.2 to 7.5 below.

7.2 REMAIN SAFE IN TIMES OF FLOODING

The development areas are in Flood Zone 1 and will be at negligible risk of flooding from rivers (and the sea), surface water and groundwater. The proposed development zones are illustrated in Figure 12 along with peak surface water and fluvial flood extents under the extreme (1 in 100 to 1 in 1,000 year storm events).

A crossing is proposed over Copyhold Gill. This will need to be designed to ensure a safe crossing during times of flooding (a sufficient elevation above the flood water level and sufficient capacity for watercourse flows beneath).

7.3 NO NET LOSS OF FLOODPLAIN STORAGE

There is no development proposed within a floodplain. A crossing of Copyhold Gill is proposed to connect the areas to the north and south of the watercourse. This will be designed to minimise potential losses in floodplain storage and to provide sufficient flow capacity for extreme storm flows to pass underneath.

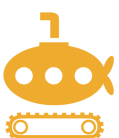
7.4 NO IMPEDIMENTS TO FLOOD WATER FLOWS

An overland flowpath is noted in the north-western part of the Site. This drains an area to the west of the Site to a wetland feature. This will be retained post-development. The smaller flowpath to the north of this is derived from Site runoff and will be managed by the drainage infrastructure post-development.

Several crossings are proposed over Drain 4 and one over Copyhold Gill. A suitable design will be required to ensure that these do not impede storm flows such that local flood risk is increased.

7.5 NO INCREASE IN THE VOLUME AND RATE OF SURFACE WATER RUNOFF

The Sustainable Drainage Strategy discussed in Section 8 would ensure that runoff rates and volumes are not increased as a result of the proposed development.





8 Outline Sustainable Drainage (SuDS) Drainage

8.1 INTRODUCTION

The following sections describe the outline SuDS Strategy for the proposed development with due regard to DEFRA's Non-Statutory Technical Standards for SuDS (DEFRA, 2015) and the policy for surface water drainage on major developments in West Sussex (West Sussex County Council, 2018), which recommends the following hierarchy for the disposal of surface water from new developments:

- 1 Discharge to ground via infiltration techniques (most preferred)¹;
- 2 Discharge to a surface water body;
- 3 Discharge to a surface water sewer; local highway drain or another drainage system; and,
- 4 Discharge to a combined sewer (least preferred).

The WSCC Policy for the Management of Surface Water provides individual SuDS policies by which planning applications are determined against. These policies are summarised in Table 4

Table 4 Individual SuDS policies included in the WSCC's 2018 Policy for the Management of Surface Water

Policy	Summary
SuDS Policy 1	Follow the drainage hierarchy
SuDS Policy 2	Manage Flood Risk Through Design
SuDS Policy 3	Mimic Natural Flows and Drainage Flow Paths
SuDS Policy 4	Seek to Reduce Existing Flood Risk
SuDS Policy 5	Maximise Resilience
SuDS Policy 6	Design to be Maintainable
SuDS Policy 7	Safeguard Water Quality
SuDS Policy 8	Design for Amenity and Multi-Functionality
SuDS Policy 9	Enhance Biodiversity
SuDS Policy 10	Link to Wider Landscape Objectives

The policies presented within WSCC's Policy for the Management of Surface Water are broadly consistent with the National Planning Policy Framework (NPPF), National Planning Practice Guidance and Defra Non-Technical Standards for Sustainable Drainage.

The proposed residential development will be located on previously undeveloped, 'greenfield' land. A significant proportion of the Site would comprise impermeable areas following its development (for example, roofs and some of the main access roads). Without appropriate management, this would result in a significant increase in both the volume and rate of surface runoff generated by the proposed development, which could lead to an increase in surface

¹ On-site water reuse is now also considered to be a preferred method for surface water disposal.



water flood risk elsewhere (i.e. downstream). Surface runoff from the developed Site will, however, be sustainably managed using SuDS, as described in the following sections.

SuDS aim to mimic the natural drainage characteristics of a site prior to its development by controlling surface water runoff as close to where the rain falls as possible e.g. through interception and re-use, evaporation and infiltration into the ground. Furthermore, SuDS provide opportunities to remove pollutants from runoff and also provide amenity and biodiversity benefits.

No SuDS are proposed in the Beechy Bottom Parkland Reserve area, given that no development is planned in this area. Therefore this Section focuses on the proposed housing development area (The Site).

8.2 GREENFIELD RUNOFF AND PERMISSIBLE DISCHARGE RATES

The Institute of Hydrology Report 124 (IH124) method in the 'Rural Runoff' calculator within the industry standard software Causeway Flow+ was utilised to estimate the greenfield runoff rates for the existing Site as a whole (see Appendix F). It would seem appropriate to consider the bulk runoff rates at this point given that the whole Site is thought to ultimately discharge to the Copyhold Gill, either directly or via the smaller on-Site tributaries. This total value has been scaled down for each of the post-development sub-catchment areas in the following Outline Drainage Strategy, to define suitable flow control rates in each location.

The 'QBAR' (i.e. 1 in 2.3 year return period) greenfield runoff rate for the existing Site was determined along with runoff rates for other relevant return period storms using the regional growth curve (see Table 5). The greenfield runoff volumes were calculated using the 'Rural Runoff' calculator (with an SPR value of 47%) and are also included in Table 5.

Table 5 Greenfield runoff

Storm return period(yrs.)	Peak greenfield runoff rate(l/s)	Total greenfield runoff volume
1	460.0	11,000 (extrapolated)
2.3 (Qbar)	541.2	14,200
30	1055.3	27,148
100	1342.2	34,900

The greenfield QBAR runoff rate or 2 l/s/ha (whichever is greater) is generally set as the 'permissible discharge rate' for new developments. However, the WSCC's Policy for the Management of Surface Water states that:

"Discharge to a watercourse or surface water sewer must be restricted to the estimated mean greenfield runoff rate (Q1) by means of a controlled outflow..."

Q1 is defined as the greenfield 1 in 1 year flow rate; in this case the Q1 rate would be 460.0 l/s for the Site as a whole (but has been scaled down for the various sub-catchments of the Site as discussed below).

8.3 CLIMATE CHANGE

The potential increase in rainfall intensity needs to be considered when designing drainage strategies. The recommended allowances for rainfall intensity in the Adur and Ouse Management Catchment are included in Table 6.

Table 6 Climate change allowances for rainfall in the Adur and Ouse Management Catchment

Epoch	Central allowance	Upper end allowance
1 in 30 year (3.3%)		
2050s	20%	35%
2070s	20%	40%
1 in 100 (1%)		
2050s	20%	45%
2070s	25%	45%

The EA guidance for climate change allowances in flood risk assessments (Environment Agency, 2022) recommends designing development so that, with the upper end allowances for the 1 in 100 year event:

- *“there is no increase in flood risk elsewhere; and*
- *your development will be safe from surface water flooding”.*

A design lifespan of 100 years has been assumed and the upper end allowances are applicable in runoff/ drainage calculations for the proposed development.

8.4 RUNOFF DESTINATION AND PROPOSED SUDS DESIGN

On-site infiltration testing has demonstrated that infiltration based SuDS are not viable in this location (Section 2.4.4).

Southern Water asset location plans (Appendix E) demonstrate that there are no surface water or combined sewers in the vicinity of the Site.

Discharges to surface watercourses (Copyhold Gill and associated tributaries) with suitable attenuation in surface blue/green infrastructure is considered to be feasible in this instance, given the extensive size and undeveloped nature of the Site. An Outline Sustainable Drainage Strategy has been drafted primarily based on this method of water disposal. This includes swales and ponds within each sub-catchment to provide the attenuation required prior to off-site discharge at a controlled rate (<Q1). As the layout plans for the Site progress, the required attenuation will be distributed over a greater number of features which will comprise a “SuDS train” within each sub-catchment, but the level of detail currently provided is considered to be consummate with the current stage of the design and planning process.

Rainwater harvesting (i.e. the use of water butts or more sophisticated tank systems) could be implemented at the Site. These systems collect water from clean surfaces (such as rooftops) for (generally non-potable) use on-site. Rainwater harvesting is particularly useful at sites with a low infiltration potential and limited space for attenuation features. It also has wider sustainability benefits with regards to lowering the water supply demand.

GIS software was used to calculate the total area within the sub-catchments draining to each SuDS feature (see Figure 13). The impermeable surface area within each catchment has been estimated based on the housing density in each development zone (see Table 7). The final impermeable areas used in the calculations are included in Table 8 below – no urban creep

has been included in these calculations as the impermeable surface areas utilised are already considered to be conservatively high; this can be added to the calculations at the detailed design phase, once the actual impermeable surface area is known.

The permissible discharge rates for each catchment have been included for each of the sub-catchments. This has been scaled down from the total 1 in 1 year peak flow rate for the whole Site (see Table 5 for the respective catchment areas. This value was used to set the flow control limits from the principle SuDS features.

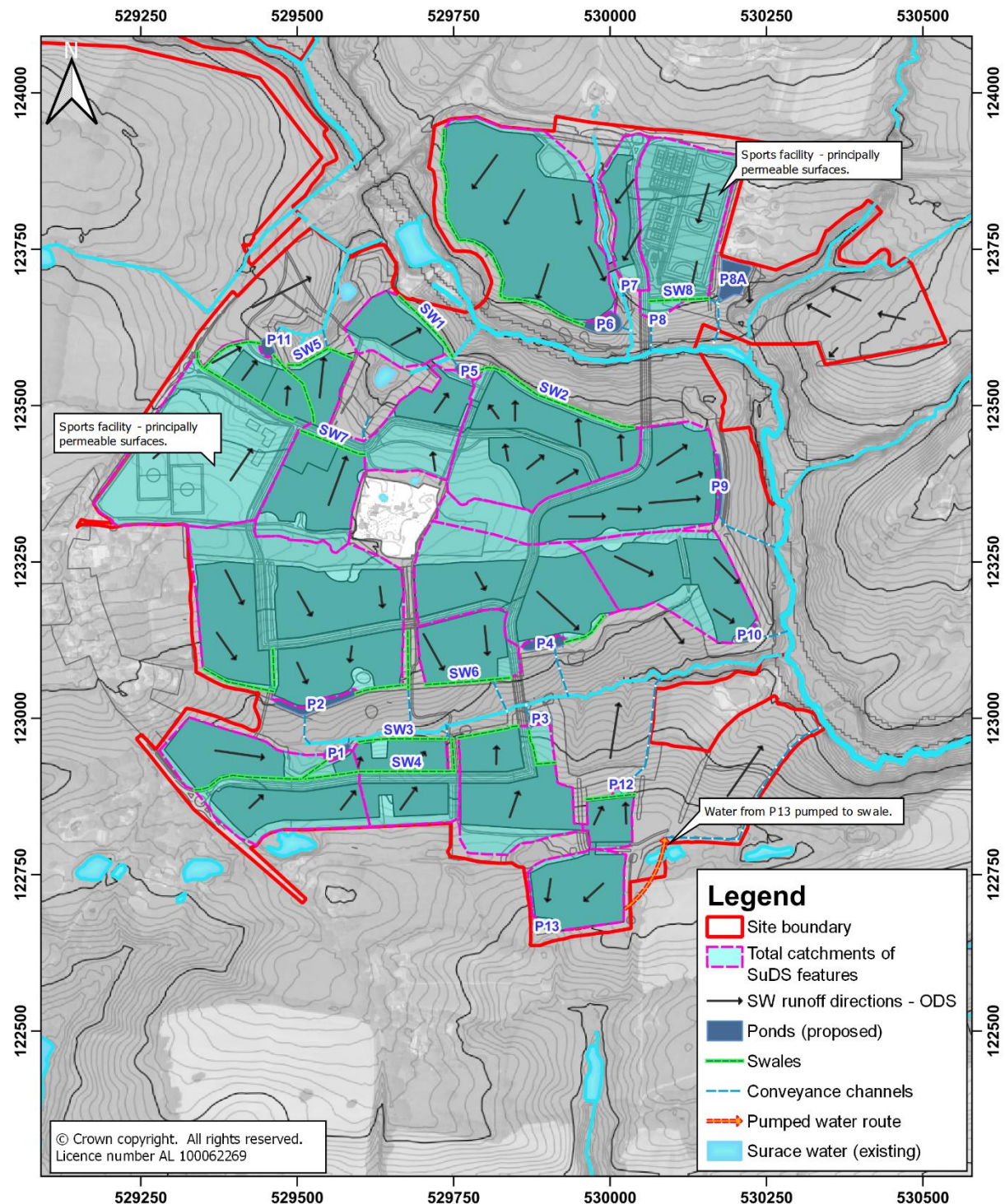


Figure 13 Catchment areas and proposed SuDS features

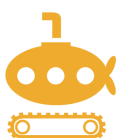
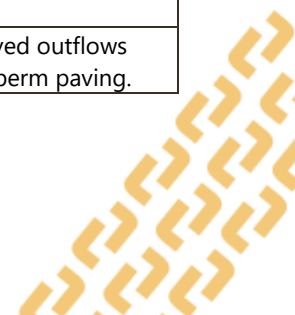
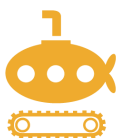


Table 7 Impermeable areas assumed for development areas

Housing density (DPH)	% Impermeable
30	50%
32.5	53%
35	55%
40	57%
45	65%
50	70%
80	75%

Table 8 Impermeable areas and greenfield rates of post-development SuDS catchments

SuDS feature	Total catchment area (ha.)	Development area (ha.)	Mean density (DPH)	% impermeable	Imp. area (ha.)	Peak T1 flow rate (l/s)	Notes
P1	3.978	3.187	32.5	53%	1.689	17.65	
P2	7.955	5.255	45	65%	3.416	35.29	
P3	3.119	2.512	40	57%	1.432	13.84	
P4	4.262	2.671	45	65%	1.736	18.91	
P5	2.014	1.668	32.5	53%	0.884	8.94	
P6	6.072	5.454	35	55%	3.000	26.94	
P7	1.114	0.619	35	55%	0.340	4.94	
P8A	0	0	n/a	n/a	1.000	0.00	No catchment within development. Nominal imp. area added for now to represent inflows. May be used in future as part of sewage works wetland project
P8	0	n/a	Permeable	25%	0.000	0.00	Receives outflow from SW8 (and upstream catchment).
P9	3.000	3.763	32.5	53%	1.994	13.31	
P10	3.168	2.304	32.5	53%	1.221	14.05	
P11	6.487	0.867	45	65%	0.564	28.78	
P12	0.629	0.49	32.5	53%	0.260	2.79	
P13	1.683	1.539	35	55%	0.846	7.47	
SW1	1.208	0.855	32.5	53%	0.453	5.36	
SW2	4.362	0.742	35	55%	0.408	19.35	Drains onwards to P5.
SW3	0.756	0.648	45	65%	0.421	3.35	
SW4	1.286	0.632	30	50%	0.316	5.71	
SW5	0.745	0.634	50	70%	0.444	3.31	
SW6	1.558	1.355	45	65%	0.881	6.91	
SW7	0.000	0.000	50	70%	0.000	0.00	Received outflows from perm paving.



SuDS feature	Total catchment area (ha.)	Development area (ha.)	Mean density (DPH)	% impermeable	Imp. area (ha.)	Peak T1 flow rate (l/s)	Notes
SW8	3.39	n/a	Permeable	25%	0.848	15.04	Coverings largely permeable. Nominal imp. area value of 25% used for calculations. Drains to P8.
Perm paving	2.221	3.488	50	70%	2.442	9.85	Drains to SW7.

The Outline SuDS layout is included in Appendix G along with the relevant dimensions of each SuDS feature and other supporting information/ details. Additional details will be added as the design of the site layout progresses. Ponds are included with a large freeboard depth at present (which will likely be revised down in future as the scheme is developed). These would have a shallow permanent waterbody at the base for ecological benefit.

The Site is not expected to require land raising/ lowering to accommodate a gravity driven drainage system; there is a suitable gradient over most of the Site to allow for a gravity driven drainage network.

8.5 PERFORMANCE CALCULATIONS

The initial design of the principal attenuation SuDS features has been undertaken using the Causeway "Flow+" v 10.4 industry standard software. Simulations were run for the 1 in 30 year + 40% and the 1 in 100 year + 45% events (allowances given for climate change as defined above). Hydrological descriptors for the Site were obtained from the Flood Estimation Handbook (FEH) website (UK Centre for Ecology & Hydrology, 2023). These are shown in Table 9 below.

Table 9 FEH Hydrological Descriptors

Catchment Descriptor	Abbreviation	Value
Base Flow Index associated with each HOST soil class	BFIHOST19	0.459
Proportion of time when soil moisture deficit was equal to, or below, 6mm during 1961-90	PROPWET	0.36 (i.e. 36% of the time)
Average Annual Rainfall (1961 – 1990)	SAAR	813 mm

The main attenuation features (ponds and swales) within each catchment have been included as storage features within the model. The attenuation capacity provided by other grassed conveyance swales and source control features were added as a generalised capacity within the network, rather than at discrete locations (considered appropriate for this stage of the design). The capacity of the main SuDS features included in the model may be reduced in due course as more SuDS features are included across the Site.

Note that the Site has a fairly steep gradient in places and therefore, some check dams within the swales will be required – perhaps a cascade sequence of smaller features where appropriate). This will maximise the storage capacity available, increase residency time within the features and reduce scour risk. This fine tuning of the scheme can be achieved during the detailed design phase and for now, the swales have been modelled as single features with a single invert/ bank levels to demonstrate the broad general feasibility of the scheme (i.e. that there is sufficient space to provide the required attenuation prior to discharging to a watercourse at the greenfield Q1 rate).

The infiltration rate for all features was set to zero, based on the results of the on-Site test results (Section 2.4.4).

Hydro-brake® flow control features have been included to limit the outflow from the various SuDS features. These may be substituted for alternative features at the detailed design phase if appropriate.

Appendix G contains the output from the drainage simulations. This confirms that, based on the parameters described above, the proposed drainage scheme will be able to attenuate and discharge all runoff generated during the 1 in 30 year storm event with a 40% allowance for climate change. Flooding of many of the features is expected under the extreme 1 in 100 year +45% scenario. Details of exceedance flows is provided in Section 8.6. Suitable overflow features will be installed within the banks of the features to control overflows under such an extreme event.

As the detailed layout plan evolves, it will be possible to include further SuDS techniques within the development layout in order to enhance the 'SuDS Management Train'. Techniques such as rainwater capture and re-use and bio-retention areas will be considered during the development of the detailed layout to maximise water efficiency, water quality, biodiversity, health and wellbeing, and amenity benefits.

It is important to note that the calculated sum total of the outflow and overflow discharge over the storm event for the 1 in 100 year event with CC allowance (11,898 m³) is below the QBar greenfield discharge volume (14,200 m³). This should result in considerable betterment to downstream flood risk receptors under the more extreme storm events (e.g. T30 – T100).

8.6 EXCEEDANCE ROUTES

Flooding of some features is expected under the extreme 1 in 100 year +45% scenario (as shown in Appendix H). Under these extreme events, exceedance flows from the SuDS features will be designed to follow the existing preferential surface water flow pathways towards Copyhold Gill and its tributaries (or to the south in the instance of Pond 13). This is illustrated in Figure 14. A more detailed analysis of exceedance flows can be undertaken once the drainage network has been finalised and modelled.

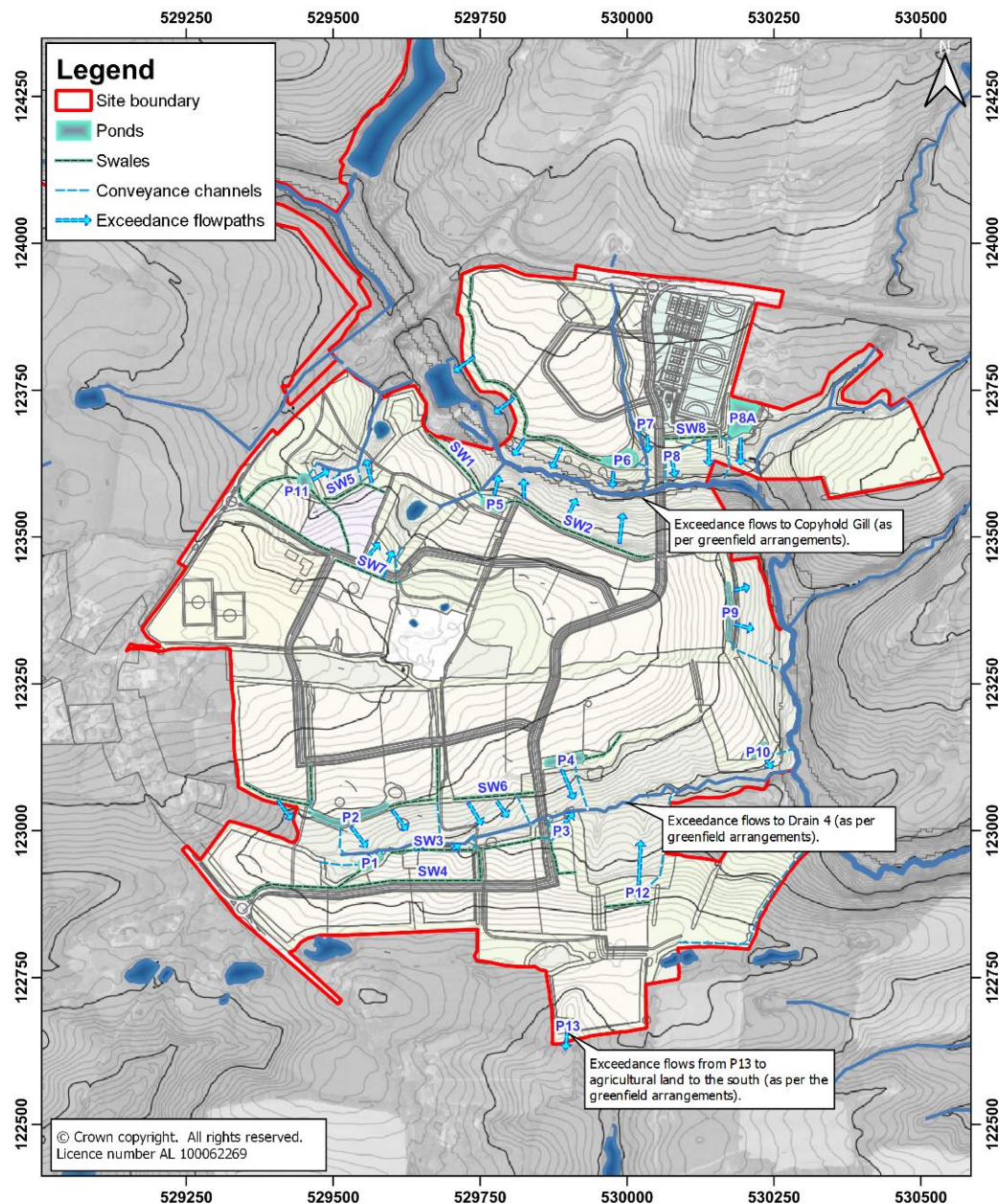


Figure 14 Exceedance flow routes from SuDS features

8.7 WATER QUALITY

SuDS techniques can be used to effectively manage the quality of surface water flowing across a site. Different methods can be used to intercept pollutants and allow them to degrade or be stored in-situ without impacting the quality of water further downstream. Frequent and short duration rainfall events are those that are most loaded with potential contaminants (silts, fines, heavy metals and various organic and inorganic contaminants). Therefore, the first 5mm to 10 mm of rainfall (i.e. the 'first flush') should be adequately treated using SuDS.

The proposed development will include residential dwellings, low traffic roads and driveways. The CIRIA SuDS manual categorises runoff from residential dwellings as presenting a very low water quality hazard and runoff from low usage roads and residential driveways as presenting a low hazard rating (see Table 10).

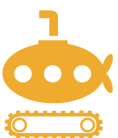


Table 10 Water quality hazard ratings (CIRIA, 2015)

Land use	Hazard level
Residential Roof drainage	Very Low
Residential, amenity uses including low usage car parking spaces and roads, other roof drainage.	Low
Commercial uses including car parking spaces and roads (excluding low usage roads, trunk roads and motorways).	Medium
Sites with heavy pollution (e.g. haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemical and fuels (other than domestic fuel oil) are delivered, handled, stored used or manufactured, industrial sites.	High
Trunk roads and motorways	High

The CIRIA SuDS manual (CIRIA, 2015) advocates a qualitative approach to designing a SuDS scheme for a site with a low hazard rating. This should provide adequate controls on pollutants contained in runoff water.

As the proposed development is residential in nature with a low hazard rating, hazard indices of 0.5 for Total Suspended Solids (TSS), 0.4 for Metals and 0.4 for Hydrocarbons are considered applicable.

The following measures in Table 11, are examples which are suitable for inclusion in a drainage strategy for a residential development to mitigate a potential increase in pollutant load within on-site and off-site runoff – note text in bold are measures included in this SuDS Strategy. Removal indices are included for each feature type relative to the specific pollutant.

Table 11 Mitigation indices for SuDS components

Component Type	TSS	Metals	Hydrocarbons
Filter drain	0.4	0.4	0.4
Swale	0.5	0.6	0.6
Permeable paving	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5

The inclusion of swales and ponds within the SuDS Strategy for the post-development catchments will provide adequate treatment to mitigate the low hazard associated with runoff from the development.

Additional SuDS measures (such as source control features) will be included in the layout as the design progresses. These features will add to a SuDS train for the management of runoff from each development area catchment.

Sediment traps (i.e. sumps within the inspection chambers of the final manhole upstream of each feature) will be used to facilitate the maintenance of these SuDS features and reduce the build-up of potentially polluted material.

All runoff from roads will pass through at least one water treatment feature prior to discharging to a watercourse (to be included at the detailed design phase).

8.8 SUDS MAINTENANCE

Inspection and long-term maintenance of SuDS components ensures efficient operation and prevents failure. Surface SuDS components can be managed using landscape maintenance techniques. Table 12 describes the management and maintenance requirements for the SuDS features included. These requirements will be implemented following the completion of the proposed development, and will be undertaken either by the Lead Local Flood Authority, a private management company or by the local water company, subject to discussions regarding this responsibility.

Table 12 Management and maintenance requirements for SuDS features

SuDS Device	Maintenance requirements	Maintenance frequency
Swales	• Litter/trash removal • Cut grass • Inlet/outlet cleaning • Sediment monitoring and silt removal.	• Monthly • Monthly in summer • Quarterly • Annually or every three years
Ponds	• Litter/trash removal • Inlet/outlet cleaning • Vegetation management • Sediment monitoring and silt removal.	• Monthly • Quarterly • Quarterly • Annually or every 3 yrs.

8.9 FURTHER SUDS CONSIDERATIONS

As the layout plan evolves, it will be possible to include further SuDS techniques within the development layout in order to improve the 'SuDS Management Train'. Techniques such as rainwater capture and re-use, and bio-retention areas will be considered during the development of the detailed layout plan to maximise water efficiency, water quality, biodiversity, health and wellbeing, and amenity benefits.

8.10 BIODIVERSITY AND AMENITY

SuDS schemes present opportunities to enhance habitat for wildlife on-site and this often improves the biodiversity of the surrounding areas. Ponds, constructed wetlands and other surface water features are landscape assets that have amenity value and improve the aesthetics of a site more than conventional drainage systems. The use of grassed swales and ponds (with mature vegetation around the banks) will enhance the biodiversity and amenity value of the Site post-development. Ecological diversity should be enhanced by the use of native planting within each feature.

Surface water flowpaths will be preserved along with areas of open green space to provide naturalised zones within the Site boundary which will provide amenity and ecology benefits.



9 Conclusions

The Site is primarily within Flood Zone 1, with a linear area of Zone 2 present along Copyhold Gill. The proposed development areas are all within Flood Zone 1. As noted in Section 4, there is a low risk of flooding from fluvial, surface water, groundwater, sewer and catastrophic sources to the proposed development areas.

The proposed development will be residential in nature, with a vulnerability classification of 'More Vulnerable' with regards to flood risk. All types of development are permissible within Flood Zone 1.

Given the apparent low flood risk present at the Site, no specific mitigation measures are proposed other than the implementation of a Sustainable Drainage Strategy to mitigate any potential increases in off-site flood risk and the suitable design of infrastructure which intersects water features and surface water flowpaths.

This report provides an Outline SuDS Strategy for the Site. The principal components of the scheme are ponds and large grassed swales located downgradient of the development areas. The details of the drainage network will evolve along with the layout plans, but the key findings of the present strategy and calculations are that there is a suitable means for water disposal in the area and there is ample space for the required attenuation and treatment of runoff prior to its disposal.

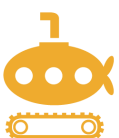
A preliminary assessment of the performance of the initial SuDS system under the 1 in 30 year + 40% climate change storm was undertaken and shows that the proposed SuDS are capable of accommodating the required stormwater runoff volumes.

Appropriate management and maintenance arrangements for the proposed SuDS scheme will be in place throughout the lifetime of the proposed development.

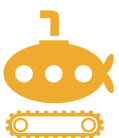


References

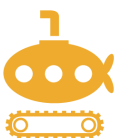
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Appendices



Appendix A: Report Conditions



Report Conditions

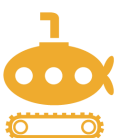
This report has been prepared by Yellow Sub Geo Ltd. (Yellow Sub Geo) in its professional capacity as soil and groundwater specialists, with reasonable skill, care and diligence within the agreed scope and terms of contract and taking account of the manpower and resources devoted to it by agreement with its client, and is provided by Yellow Sub Geo solely for the internal use of its client.

The advice and opinions in this report should be read and relied on only in the context of the report as a whole, taking account of the terms of reference agreed with the client. The findings are based on the information made available to Yellow Sub Geo at the date of the report (and will have been assumed to be correct) and on current UK standards, codes, technology and practices as at that time. They do not purport to include any manner of legal advice or opinion. New information or changes in conditions and regulatory requirements may occur in future, which will change the conclusions presented here.

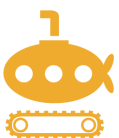
Where necessary and appropriate, the report represents and relies on published information from third party, publicly and commercially available sources which is used in good faith of its accuracy and efficacy. Yellow Sub Geo cannot accept responsibility for the work of others.

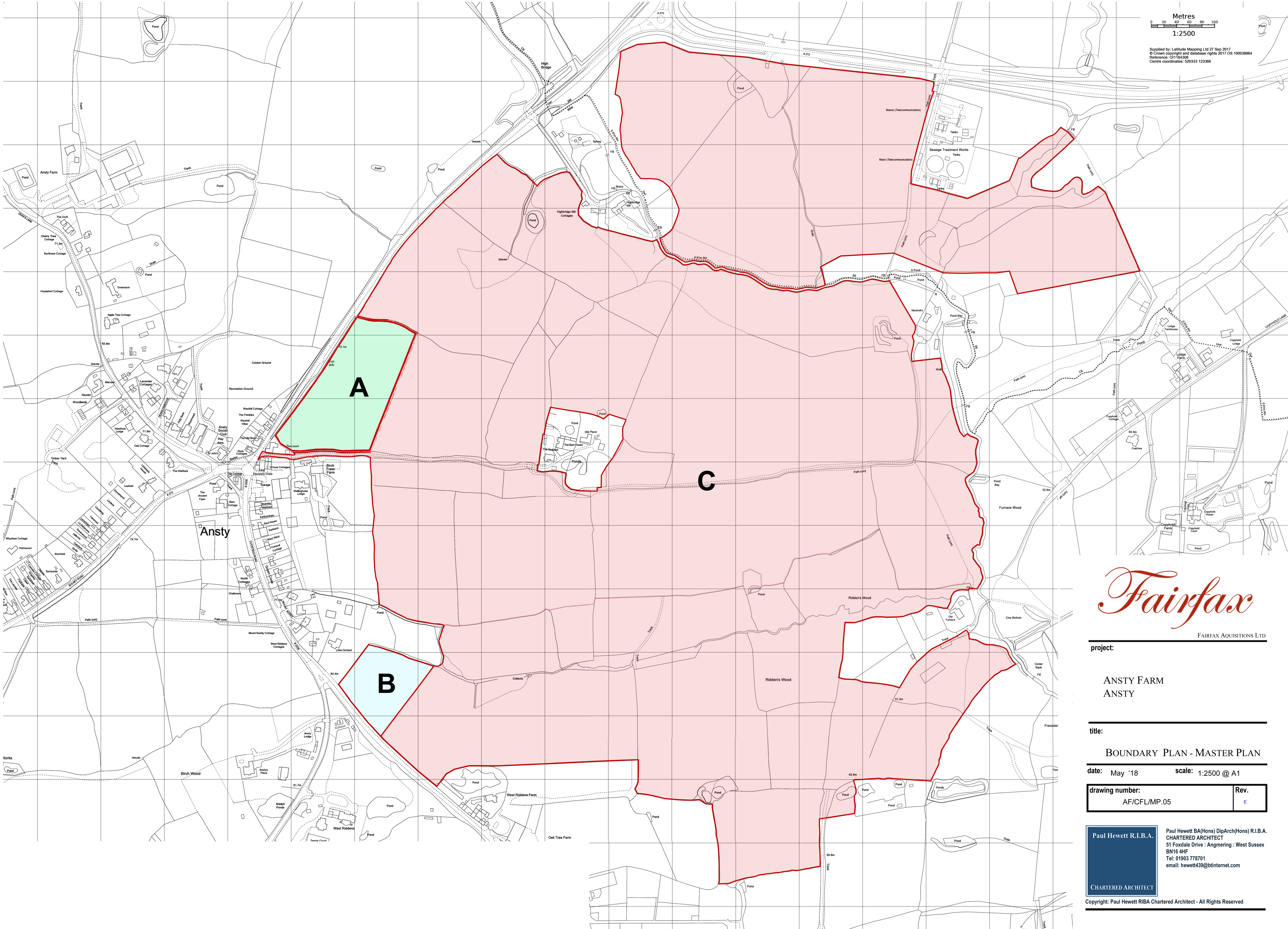
Site investigation results necessarily rely on tests and observations within exploratory holes only. The inherent variation in ground conditions mean that the results may not be representative of ground conditions between exploratory holes. Yellow Sub Geo take no responsibility for variation in ground conditions between exploratory positions.

This report is confidential to the client. The client may submit the report to regulatory bodies, where appropriate. Should the client wish to release this report to any other third party for that party's reliance, Yellow Sub Geo may, by prior written agreement, agree to such release, provided that it is acknowledged that Yellow Sub Geo accepts no responsibility of any nature to any third party to whom this report or any part thereof is made known. Yellow Sub Geo accepts no responsibility for any loss or damage incurred as a result, and the third party does not acquire any rights whatsoever, contractual or otherwise, against Yellow Sub Geo except as expressly agreed with Yellow Sub Geo in writing. Yellow Sub Geo reserves the right to withhold and/ or negotiate the transference of reliance on this report, subject to legal and commercial review.



Appendix B: Topographical Site survey





Fairfax

FAIRFAX AQISITIONS LTD

project:

ANSTY FARM
ANSTY

title:

BOUNDARY PLAN - MASTER PLAN

date: May '18

scale: 1:2500 @ A1

drawing number:
AF/CFL/MP.05

Rev.
E

Paul Hewett R.I.B.A.

CHARTERED ARCHITECT

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Appendix C: Site development plans

