considine
civil + structural engineers

PROPOSED RESIDENTIAL DEVELOPMENT

AT BARHAM COURT FARM, THE STREET

BARHAM

KENT, CT4 6PB

FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

FOR

RCG HOMES LTD

20th September 2022

Report No.: 4613 FRA

P03

Contents Amendment Record

Revision	Date	Author	Checker	Approver
P01	12/11/2021	Amy Pledge	Jack Moss	Jack Moss
P02	17/11/2021	Amy Pledge	Jack Moss	Jack Moss
P03	20/09/2022	Jack Moss	Mike Frazer	Jack Moss

Original Author: Amy Pledge HNC EngTech MICE

Original Checker: Jack Moss MEng (Hons) CEng MICE MCIWEM

Original Approver: Jack Moss MEng (Hons) CEng MICE MCIWEM

Project Number: 4613 **Current Revision:** P03 **Date:** 20/09/2022

Considine Limited
25 Hollingworth Court
Turkey Mill, Ashford Road
Maidstone
Kent ME14 5PP

Contents

List of Appendices

1. Introduction and Brief

This report has been prepared for RCG Homes Ltd to assess Flood Risk and to provide guidance on the method of foul and surface water disposal for the proposed residential development at Barham Court Farm, The Street, Barham, CT4 6PB. The proposal is to construct 22 dwellings with associated driveways, access roads and landscaping.

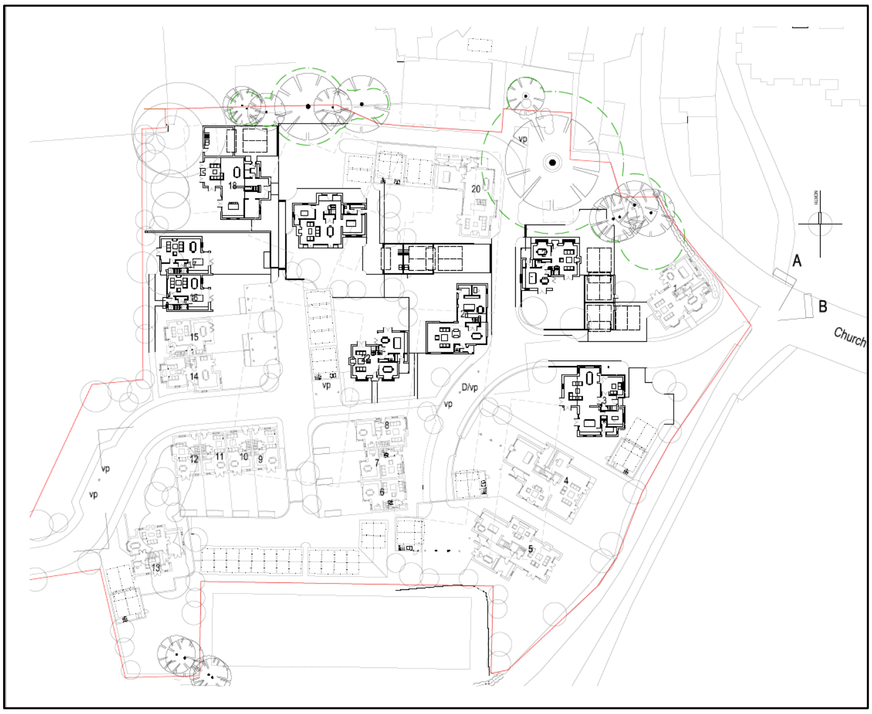

Figure 1.1 – Development Proposals – full drawings within Appendix 1

This document has been produced in accordance with current best practice and recommendations and guidance set out in the National Planning Policy Framework (NPPF).

Considine has no responsibility to any other parties to whom this report may be circulated, in part or in full, and any such parties rely on the contents of this report solely at their own risk.

All copyright and other intellectual rights in and over this report and its contents shall remain vested in Considine. The client and any other person authorised by them is granted irrevocable royalty free licence to use and reproduce this report for all purposes relating to the property, but Considine shall not be liable for any use of the report for any purpose other than that for which it was originally prepared.

2. Existing Site Conditions

2.1 Location

The development site is located at Barham Court Farm, The Street, Barham, CT4 6PB. The British National Grid Reference is: E: 620879, N: 149976. The figures below show the site in the wider area, more locally and then an aerial image to show the site in its current context.

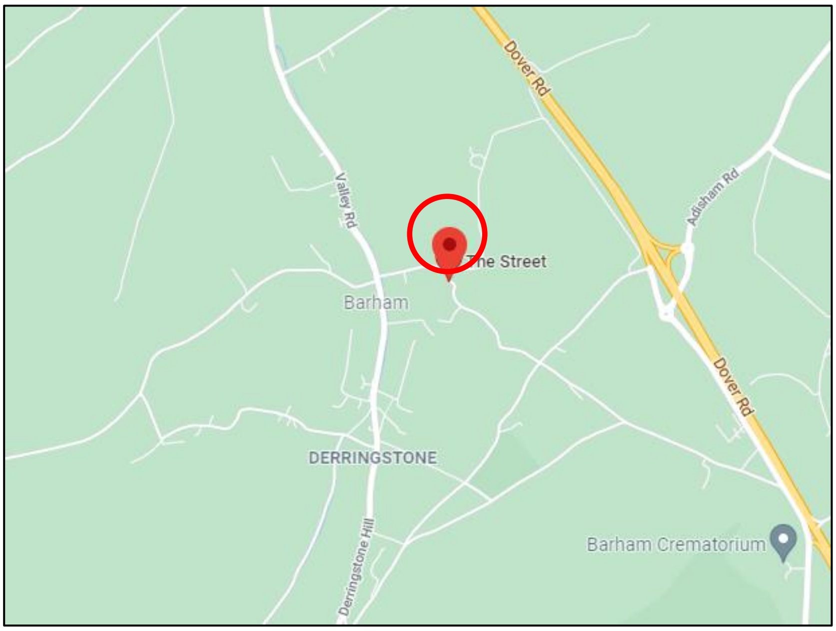

Figure 2.1 – Site location general area. Location shown by red circle. © Google Maps

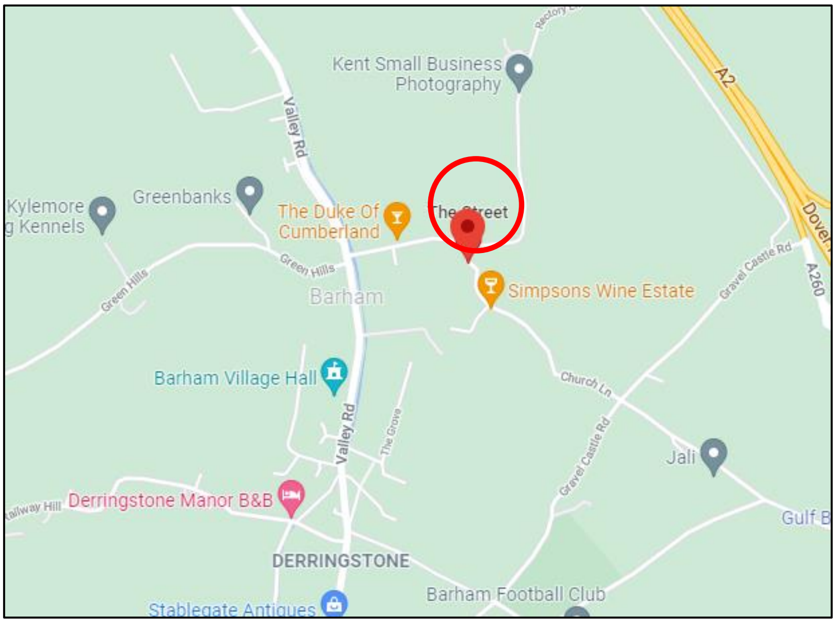

Figure 2.2 – Site Location shown by red circle.

The following aerial image provides additional information about the context of the site and surrounding areas.

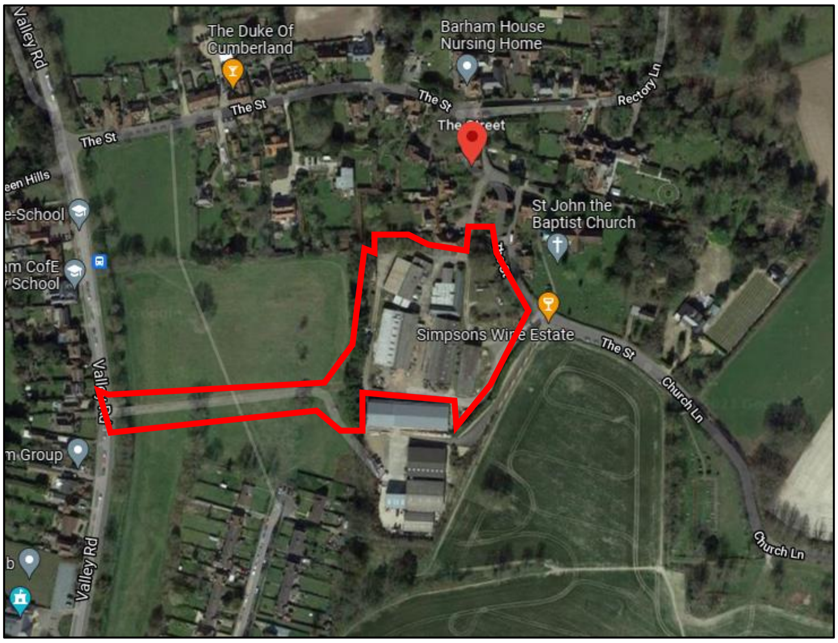

Figure 2.3 – Aerial image of site © Google Maps. Approximate site boundary shown in red.

The site is currently partially developed and comprises farm buildings, livestock shelters and associated landscaping, access tracks and hardstanding. It is bounded by residential properties and The Street to the north, St John the Baptist Church to the east, fields, and residential properties to the south and Valley Road and the River Nailbourne to the west.

The existing impermeable areas are shown in the figure below and are summarised as follows:

	Area (m^2)
Total Site Area:	13,599
Existing Roof Area:	3,212
Existing Impermeable Hardstandings:	2,538
Total Existing Impermeable Area:	5,750

Figure 2.4 – Drained Areas Analysis Extract (Pre-Development)

2.2 Site Topography

A review of the topographical survey indicates that the site generally falls from the east to the west. Overall, there is a fall of approximately 17.7m.

2.3 Site Geology

A review of the BGS online bedrock mapping tool has identified that the development site is likely underlain by Lewes Nodular Chalk Formation (Chalk). This formation is described by BGS as 'composed of hard to very hard nodular chalks and hardgrounds (which resist scratching by finger-nail) with interbedded soft to medium hard chalks (some grainy) and marls; some griotte chalks. The softer chalks become more abundant towards the top. Nodular chalks are typically lumpy and iron-stained (usually marking sponges). Brash is rough or rubbly and tends to be dirty. First regular seams of nodular flint, some large, commence near the base and continue throughout'.

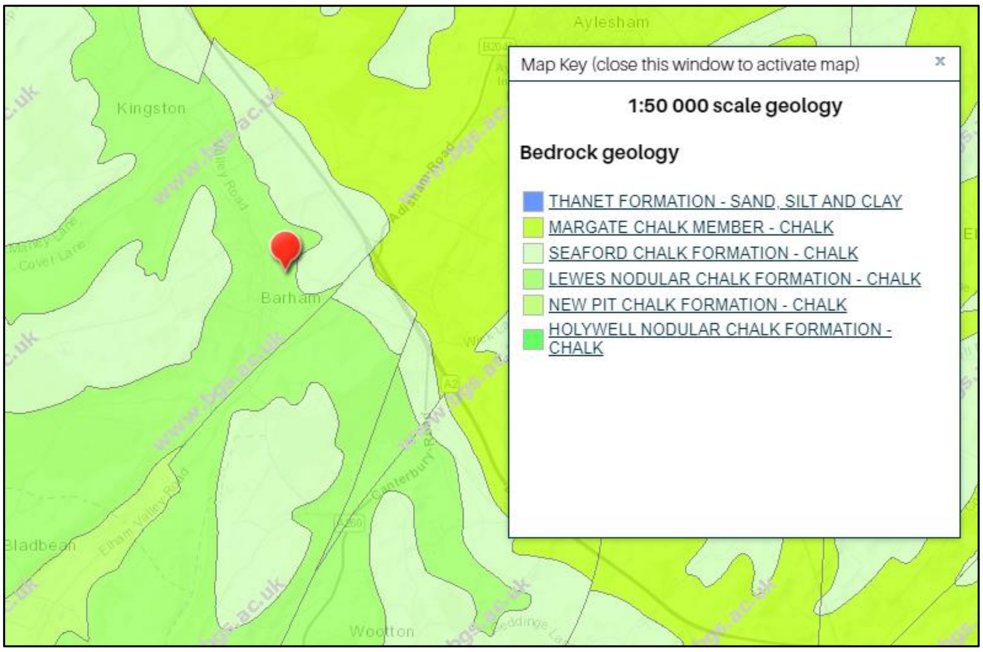

Figure 2.5 – BGS Extracts: Bedrock Geology © BGS

A review of the BGS online superficial deposits mapping tool has identified that the development site is not likely underlain by any superficial deposits.

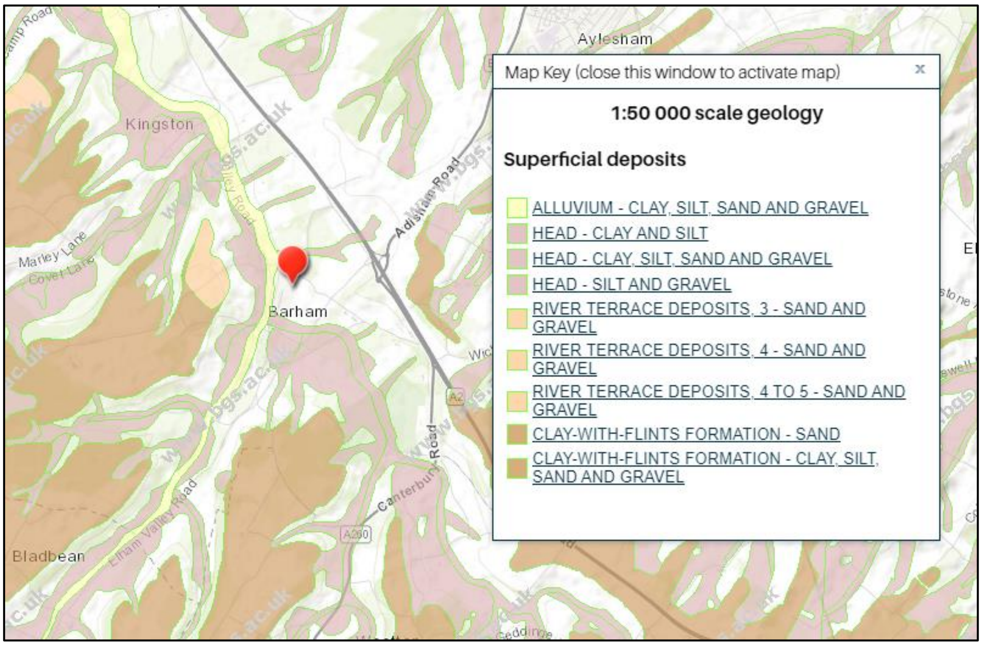

Figure 2.6 – BGS Extracts: Superficial Geology © BGS

Since the previous revision of this report, on site BRE365 infiltration testing has been undertaken. The worst result achieved was 2.08 x 10^{-4} m/s.

2.4 Hydrogeology and Hydrology

The Environment Agency provide information about the groundwater and aquifers. Review of that information confirms that part of the site is within Groundwater Source Protection Zone 3. It is also located over a Principal Aquifer in terms of the Bedrock, and it is also located within a Groundwater Vulnerability Zone. The following EA Extracts identify the zoning for the site.

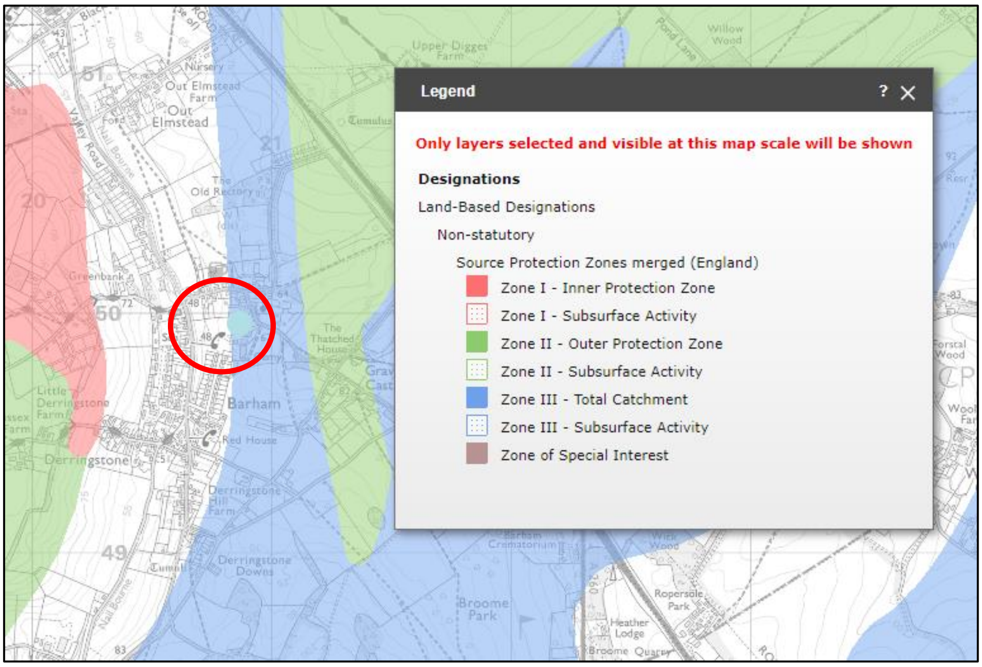

Figure 2.7 – Groundwater Source Protection Zone © Environment Agency

As defined within the figure above, most of the site is within Groundwater Source Protection Zone 3. This zone is the area around a source within which all groundwater recharge is presumed to be discharged at the source.

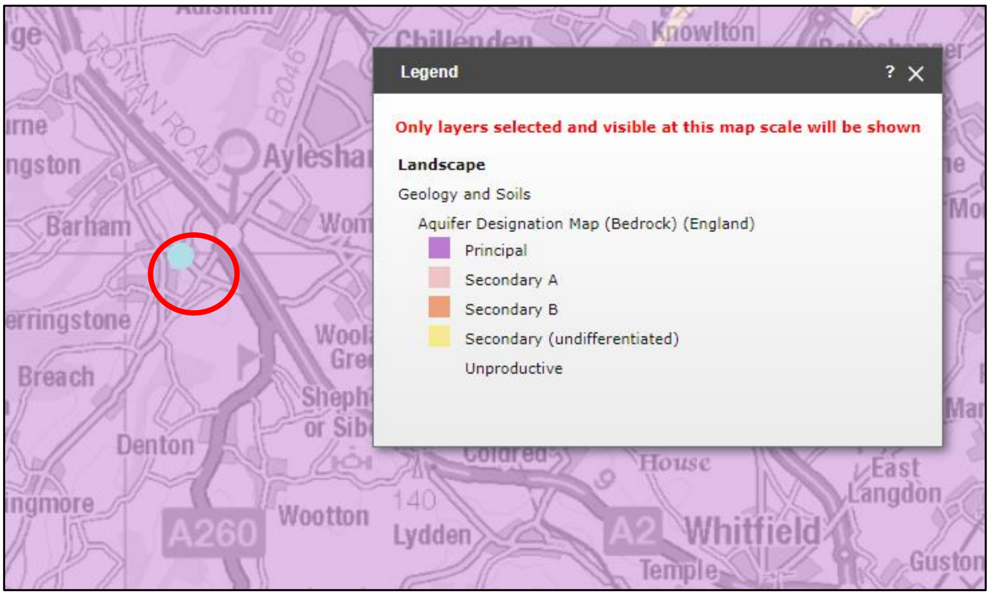

Figure 2.8 – Aquifer Designations Map (Bedrock) © Environment Agency

As noted within the figure above, the site is above a Principal Aquifer. These are layers of rock or drift deposits that have high intergranular and/or fracture permeability – meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as a major aquifer.

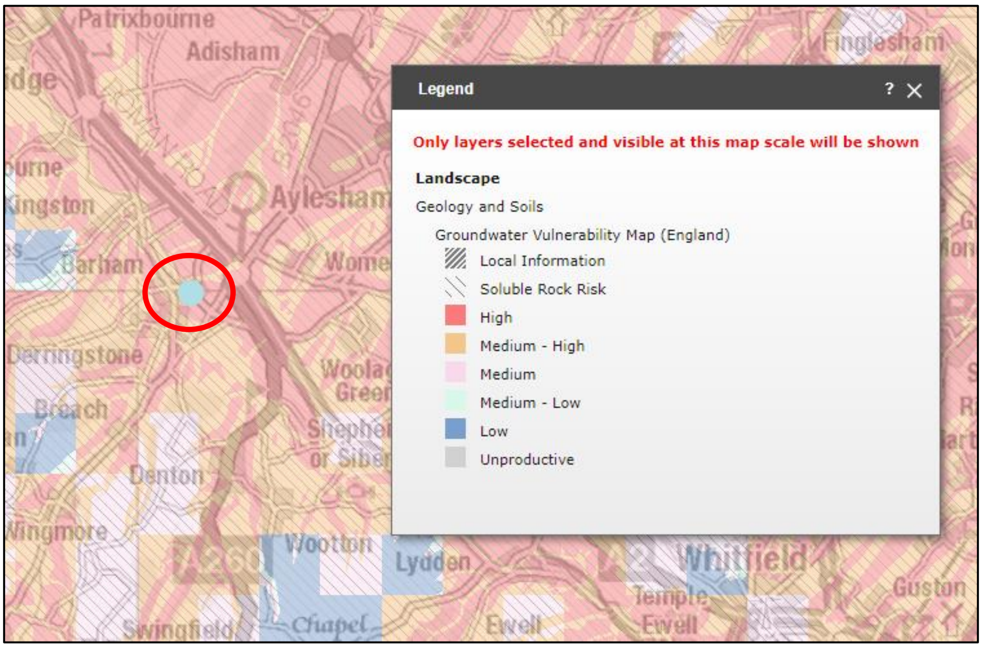

Figure 2.9 – Groundwater Vulnerability Zone Map © Environment Agency

As noted within the above figure, the site is also within the Major Groundwater Vulnerability Zone. The Environment Agency indicates that these areas are offer some groundwater protection.

It is important though to understand that pollution risks are an issue for the underlying geology. As such the risk of Pollution can be assessed using the Source, Pathway, Receptor model as follows.

Source – there are two sources of potential contamination on the site. Firstly, contamination as a result of current and previous site activities and secondly from the proposed site activities. The existing site is partially developed with low-medium contamination risk. The proposed development is for residential purposes. Therefore, the risk is considered low.

Pathway – the pathway is the vertical movement of water through the subsoils and the bedrock. This can be by direct surface down soakage or from drainage features such as soakaways or other infiltration systems. The infiltration potential at ground level is high at the site, and therefore the opportunities for ingress of contaminants is also high.

Receptor – the receptor is the actual uses of groundwater that receives flow from the vicinity of the discharge, such as groundwater, watercourses etc. where infiltration is proposed, a suitable unsaturated zone should be applied.

Water Quality and Surface Water runoff is addressed later in this report.

3. Proposed Development

The proposal is to construct 22 dwellings with associated driveways, access roads and landscaping. The figure below shows the Architect's current proposals.

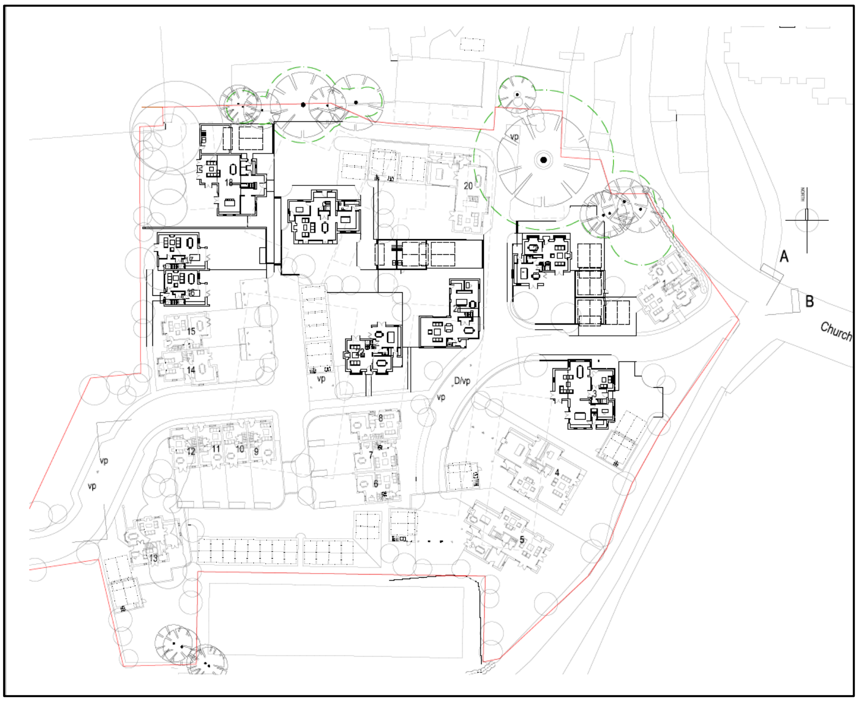

Figure 3.1 – Proposed Site Plan – full drawing within Appendix 1.

The proposed development impermeable areas are shown in the figure below and are summarised as follows:

	Area (m^2)
Total Site Area:	13,599
Proposed Roof Area:	3,063
Proposed Permeable Hardstandings:	3,903
Proposed Impermeable Hardstandings:	0
Total Proposed Drained Area:	3,063

Figure 3.2 – Drained Areas Analysis Extract (Post-Development)

It is evident that the proposals decrease the impermeable areas by 2,687m^2.

In accordance with KCC's Drainage and Planning Policy Statement, an allowance of 10% should be included for urban creep. Therefore, an impermeable area of 3,369m^2 needs to be considered for positive surface water design.

4. Flood Risk

This Flood Risk Assessment (FRA) is based on the guidance provided within section 10 of the NPPF and accompanying Planning Practice Guidance (PPG).

4.1 Criteria

As according to the PPG, a site typically requires a specific detailed FRA where the total site area is greater than 1ha or the site is found to be at risk of flooding.

The site is greater than 1ha and, therefore, an FRA is required, regardless of whether the site is within a Flood Risk Zone.

Therefore, the site has been assessed for Flood Risk using the following hierarchy:

- Level 1 can be described as a screening study to identify whether any flood issues should be considered. The purpose of a Level 1 FRA is to determine:
    - the potential flooding hazards which may pose a risk to the development, or which the development may affect so as to increase flood risk elsewhere.
    - whether the proposed development may obstruct access to watercourses or flood defences or affect the integrity of a flood defence; and
    - whether the development may lead to an increase in runoff.

- Level 2 can be described as a scoping study to follow on from a Level 1 assessment. The study should include the following:
    - an assessment of the availability and adequacy of existing information.
    - a qualitative assessment of the flood risk to the site,
    - the impact of the site on flood risk elsewhere.
    - and an assessment of the possible scope for appropriate development design and to scope additional work required.

- Level 3 can be described as a detailed study to follow on from a Level 2 assessment and should include a quantitative assessment of the potential flood risk to the development; a quantitative assessment of the potential impact of the development site on flood risk elsewhere; and a quantitative demonstration of the effectiveness of any proposed mitigation measures.

Flooding can occur from a range of individual and or a combination of sources that include fluvial (main river), tidal (sea), land, groundwater, sewers, infrastructure, reservoirs, and other artificial sources.

Therefore, each potential source of flooding on the site has been considered in further detail below.

4.2 Flood Risk Zones

The PPG defines a number of flood zones based on the probability of flooding and provides guidance on the most appropriate form of development within each zone. The flood risk is summarised below:

Table 4.1 – Flood Zone Definitions

Flood Zone	Definition
Zone 1 – Low Probability	Land having a less than 1 in 1000 annual probability of river or sea flooding.
Zone 2 – Medium Probability	Land having between 1 in 100 and 1 in 1000 annual probability of river flooding, or land having between 1 in 200 and 1 in 1000 annual probability of sea flooding.
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.
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 Assessment (SFRA) areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency.

4.1 Tidal and Fluvial Flooding

A review of the Environment Agency's online mapping tool has also identified that most the development site is within Flood Zone 1, an area with a low probability of flooding from Rivers and Sea. A small portion of the development site is within Flood Zone 2 and 3. Flood Zone 2 is an area with a medium probability of flooding from Rivers and Sea and Flood Zone 3 is an area with a high probability of flooding from Rivers and Sea.

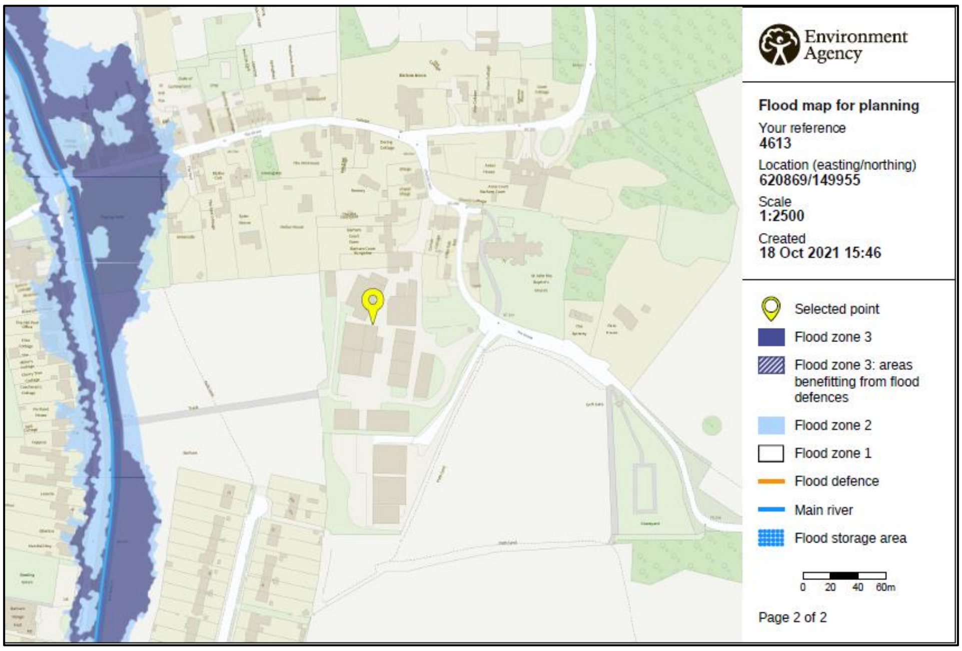

Figure 4.2 – Extract of Environment Agency's Flood Map for Planning

Flood Zone 1 comprises land assessed as having a <0.1% (1 in 1000) AEP of flooding from rivers or sea. Flood Zone 2 comprises land assessed as having between a 1 in 100 and a 1 in 1,000 annual probability of river flooding, or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. Flood Zone 3 comprises land assessed as having a 1 in 100 or greater annual probability of river flooding, or a 1 in 200 or greater annual probability of sea flooding.

The majority of the development site is located within Flood Zone 1 with only a small portion of the entrance to the site which is also the lowest part of the site being located within Flood Zone 2 and 3. The residential development is not proposed within this area, therefore, the risk of flooding from Fluvial or Tidal Sources is considered to be low.

4.2 The Sequential Test

The NPPF (paragraph 100), requires that a risk based Sequential Test should be applied at all stages of planning with the aim of steering new development to areas at the lowest probability of flooding (Zone 1).

The majority of the proposed development is located within Flood Zone 1 with only a small portion of the entrance to the site which is also the lowest part of the site being located within Flood Zone 2 and 3 and as such it is considered to satisfy the Sequential Test.

4.3 Vulnerability Classification

Table 2 of the NPPF indicates that buildings used for dwellings are classified as “more vulnerable”.

Table 3 of the NPPF includes a list of appropriate land uses in each flood zone dependant on vulnerability to flooding. In applying the Sequential Test, reference is made to Table 3 of the NPPF below.

Table 4.2 – Flood Risk Vulnerability and Flood Zone ‘Compatibility’

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone1	Development is appropriate	Development is appropriate	Development is appropriate	Development is appropriate	Development is appropriate
	Zone 2	Development is appropriate	Development is appropriate	Exception Test Required	Development is appropriate	Development is appropriate
	Zone 3a	Exception Test Required	Development is appropriate	Development should not be permitted	Exception Test Required	Development is appropriate
	Zone 3b Functional Floodplain	Exception Test Required	Development is appropriate	Development should not be permitted	Development should not be permitted	Development should not be permitted

4.4 Kent County Council Flood Risk to Communities Canterbury

Flood Risk to Communities Canterbury has been produced by Kent County Council in June 2017. This document has been reviewed, and information has been used to support this FRA.

A summary of observations can be found below:

- The Nailbourne and Little Stour are designated main rivers and are predominantly groundwater fed. The Nailbourne is an ephemeral stream, which anecdotally flows for a period of around six months every seven years. The occurrences of flow in the Nailbourne have been more frequent in recent years, with events being recorded in 2000/1, 2003, 2010, 2012/13, 2013/14, 2014/15 and 2015/16. A number of improvements have recently been made to these watercourses in the Barham, Bishopsbourne, Bridge, Patrixbourne and Littlebourne areas to reduce the likelihood and impact of severe flooding.
- The number of dwellings at medium-high risk (up to 1% AEP) of tidal/fluvial flood risk in Barham are 90.
- The number of dwellings at overall risk (up to 0.1% AEP) of tidal/fluvial flood risk in Barham are 109.
- The number of dwellings at medium-high risk (up to 1% AEP) of fluvial/tidal flooding in Barham Downs are 98.
- The number of dwellings at overall risk (up to 0.1% AEP) of fluvial/tidal flooding in Barham Downs are 117.

4.5 Kent County Council Surface Water Management Plan

A Surface Water Management Plan (SWMP) has been produced by Jacobs for Kent County Council in April 2012. This SWMP has been reviewed, and information has been used to support this FRA.

A summary of observations can be found below:

- Villages along the Nailbourne/Little Stour have been flooded from the watercourse, from rising groundwater, emergence of springs, surface runoff and as a result surcharging and backing up of the sewers. An estimated 60 properties and a number of roads in Barham were flooded in the winter of 2000/1.
- The development site is highlighted as a potential development site on Canterbury SWMP Preliminary Risk Assessment Map Appendix A-Nailbourne/Little Stour.
- The following flooding events on Valley Road are listed on Canterbury SWMP Preliminary Risk Assessment Map Appendix A Nailbourne/Little Stour:
  - Flooding inside a house on 08/02/1995.
  - Flooding in a bungalow on 20/06/1996.
  - Flooding inside a property on 12/08/1996 and flooding to a boiler room on 08/02/2001.
  - 8” of flooding in a house on 09/02/2001.
  - Flooding on 08/02/2001.
  - Flooding affecting electrics on 08/02/2001.
  - Flooding in a property on 10/02/2001.
  - Flooding in premise on 08/02/2001 and flooding on 08/02/2001.

considine
civil + structural engineers

4.6 Flooding from the Land

Intense rainfall, often short duration, that is unable to soak into the ground or enter a drainage system can quickly run off the land and result in localised flooding. Local topography and buildings can influence the direction and depth of flow. It is inevitable that as a result of extreme rainfall, the capacities of existing sewers, surface water attenuation features and other drainage systems will be exceeded on occasion.

The Environment Agency website now provides surface water flood risk information based on information provided by the lead local flood authority. This highlights areas at risk from surface water flooding from overland flows.

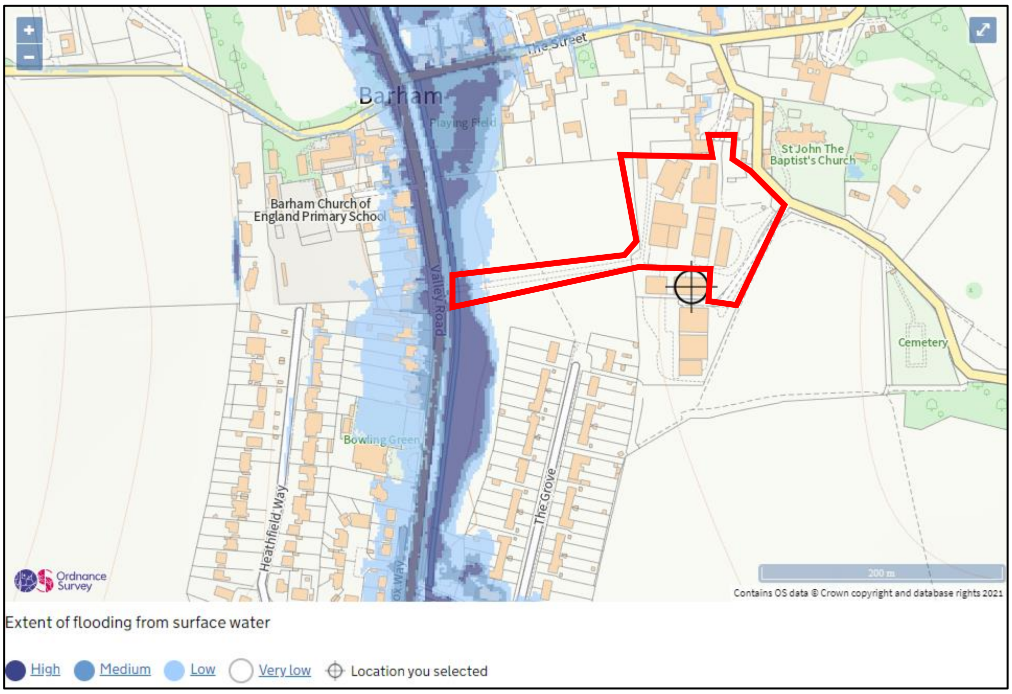

Figure 4.3 – Extract of Environment Agency Surface Water Flood Map (Extents of Flooding)

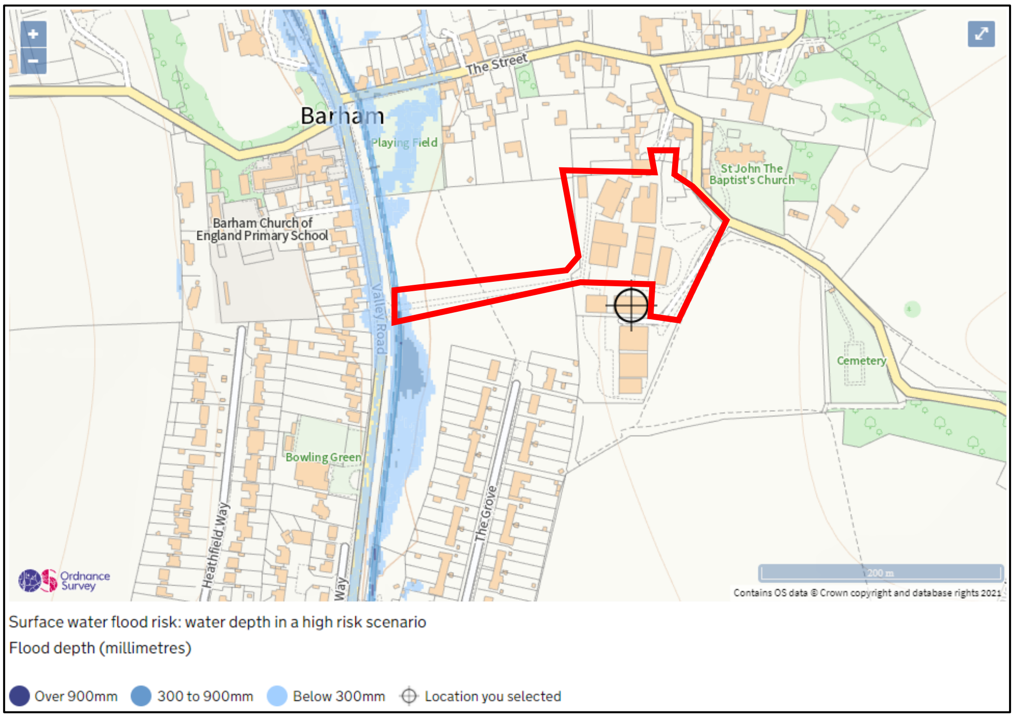

Figure 4.4 – Extract of Environment Agency Surface Water Flood Map (High Risk Depths)

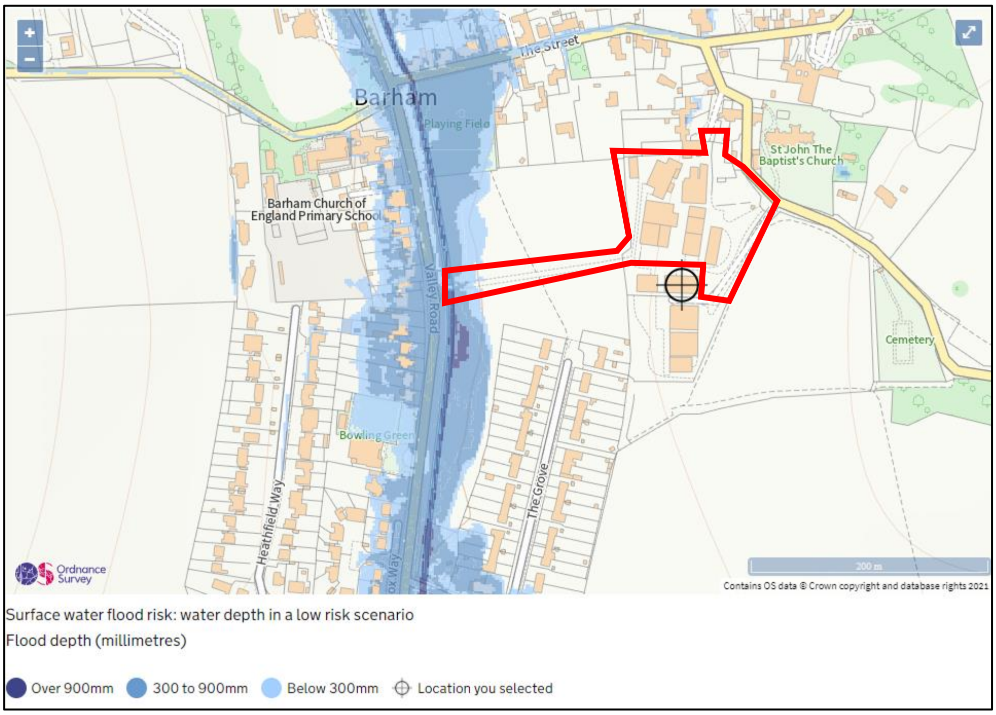

Figure 4.5 – Extract of Environment Agency Surface Water Flood Map (Low Risk Depths)

It is evident from the previous extracts that the development is at high risk of flooding from surface water. High risk is defined as a probability of flooding of greater than 3.3%.

The surface water flood maps indicate that for the high-risk scenario, it is anticipated that flood depths would be below 300mm above ground level. Residential dwellings are not proposed in these areas, therefore, the risk of flooding from overland flows is considered to be low at the site.

4.7 Flooding from Groundwater

Groundwater flooding occurs when water levels in the ground rise above surface levels. It is most likely to occur in low lying areas underlain by aquifers. These may be extensive regional aquifers, such as chalk, or may be localised sands or gravels.

Water levels below the ground rise during wet winter months and fall again in the summer as water flows out towards rivers. In very wet winters, water level rise may lead to flooding of normally dry land. Groundwater flooding can sometimes take weeks or months to dissipate because groundwater flows are much slower than surface flow.

The Flood Risk to Communities Canterbury indicates that there was flooding to villages along Nailbourne from the watercourse, rising groundwater, emergence of springs, surface runoff and as a result surcharging and backing up of the sewers. A small portion of the entrance to the site which is also the lowest part of the site is located within Flood Zone 2 and 3. The residential development is not proposed within this area, therefore, the risk of flooding from this source is considered to be low.

4.8 Flooding from Sewers, Highways and Private Drains

Public Sewers

It is evident from Southern Water sewer asset records that there are existing 150mm diameter foul water sewers located within The Street and running through the northern area of the site and 300mm diameter foul water sewers located within Valley Road. A review of the Flood Risk to Communities Canterbury indicates that there was surcharging and backing up of the sewers as a result of flooding from the watercourse, rising groundwater, emergence of springs and surface runoff to the villages along the Nailbourne River which runs along Valley Road. The Flood risk to Communities Canterbury indicates that there are no known instances of flooding from public sewers within the vicinity of The Street.

Highways drainage

A review of the site area revealed that there are no known public highway gullies or drains within the site. a review of the Flood Risk to Communities Canterbury indicates that there are no known instances of flooding from highways drainage within the vicinity of the site.

Private Drainage

A review of the topographical survey indicates that there is private drainage on site, therefore, it is assumed that there is an existing drainage network. A review of the Flood Risk to Communities Canterbury indicates that there are no known instances of flooding from private drainage within the vicinity of the site.

The design of the surface water drainage system, discussed in further detail in Chapter 6, serving the new development will also show that flood risk is not increased.

Therefore, the risk of flooding from Sewers, highway drainage and private drains is considered to be very low

4.9 Flooding from Reservoirs and other Artificial Sources

Non-natural or artificial sources of flooding can include reservoirs, canals, and lakes, where water is retained above natural ground level. Reservoir or canal flooding can occur as a result of the facility being overwhelmed and or as a result of dam or bank failure. The latter can happen suddenly resulting in rapidly flowing, deep water that can cause significant threat to life and major property damage.

There are no canals or reservoirs in close proximity to the site. Additionally, the Environment Agency's Flood Risk from Reservoirs map has been reviewed, indicating that the site is not within a flood zone. Therefore, the risk of flooding from reservoirs and other artificial sources is considered very low.

4.10 Flood Risk Summary

This site has been assessed in accordance with the guidance provided within section 10 of the NPPF, accompanying Planning Practice Guidance (PPG) and Flood Risk to Communities Canterbury Kent County Council's SWMP has also been reviewed.

Accordingly, the potential flood risk to the proposed development site has been summarised below:

Fluvial flood risk	Low Risk
Tidal flood risk	Low Risk
Flooding from the land	Low Risk
Flooding from groundwater	Low Risk
Flooding from sewers	Low Risk
Flooding from drainage	Low Risk
Flooding from artificial sources	Low Risk

Having considered the potential sources of flooding, most have been identified as having a low risk to the development site.

The design of the surface water drainage system serving the new development should ensure that flood risk is not increased.

5. Proposed Foul Water Strategy

5.1 Existing Development Foul Water System

It is evident from Southern Water sewer asset records that there are existing 150mm diameter foul water sewers located within The Street and running through the northern area of the site and 300mm diameter foul water sewers located within Valley Road.

There is some development within the site currently, and therefore, it is assumed that there is an existing foul water system.

5.2 Capacity Check

Since the OFWAT Regulation changes of April 2018 it is no longer a requisite to check available capacity. The new requirement is for the sewer authority to accept all discharge from new development sites into their nearest available sewer. In exchange they receive an enhanced connection payment per dwelling in order to fund network improvements. If the local network does not have available capacity and the improvement programme is not going to be completed until sometime after the development is complete, then the sewer authority (Southern Water Services) can work with the developers to agree temporary solutions to the capacity issue – these measures can include on site storage or timed pumping.

The proposal is to construct 22 dwellings with associated driveways, access roads and landscaping.

5.2.1 Existing Occupancy

The Foul Water expected to be generated by the existing site has a peak flow of approximately 0.1927 litres per second with an average flow of 0.0321 litres per second. This is calculated using DCG as follows:

0.3212(ha) x 0.6 = 0.1927 l/s (peak flow) / 6 = 0.0321 l/s (average flow).

5.2.2 Proposed Occupancy

The Foul Water expected to be generated by the site has a peak flow of approximately 0.984 litres per second with an average flow of 0.164 litres per second. This is calculated as follows:-

Residential Load

2 bed units – 4 x 4P = 16P
3 bed units – 6 x 5P = 30P
4 bed units – 12 x 6P = 72P
Total residential population (P) = 118

Adjusted population (P) = 118 x 0.8 = 94.4

Total occupancy of 95 persons @150 litres per day (Flows and Loads) = 14,250 l/day.

14,250 / (24x60x60) = 14,250 / 86,400 = 0.164 l/s average which is 0.984 l/s peak flow.

This is an increase in peak flow by approximately 0.792 l/s. It is a requirement that the local drainage authority is consulted to approve the means and mode of connecting the new development to the public sewer network under a formal Section 106 connection agreement.

5.3 Foul Water Strategy

On the basis of the above, it is proposed that the foul network is connected to the existing public foul sewer within Valley Road. This is proposed due to the level of certainty that a gravity connection could be achieved.

However, detailed site investigation shall be required prior to detailed design, to ascertain the opportunities and constraints of a gravity connection elsewhere and more locally. This includes investigations to understand whether a gravity connection could be achieved at chamber 8903 / 8902 as defined on Southern Water's sewer records. This would be a more sustainable solution if achievable through detailed design.

A formal Section 106 connection approval will be required from the sewer authority.

6. Proposed Surface Water Strategy

6.1 Existing Surface Water Strategy

A review of the BGS online bedrock mapping tool has identified that the development site is likely underlain by Lewes Nodular Chalk Formation (Chalk). This formation is described by BGS as 'composed of hard to very hard nodular chalks and hardgrounds (which resist scratching by finger-nail) with interbedded soft to medium hard chalks (some grainy) and marls; some griotte chalks. The softer chalks become more abundant towards the top. Nodular chalks are typically lumpy and iron-stained (usually marking sponges). Brash is rough or rubbly and tends to be dirty. First regular seams of nodular flint, some large, commence near the base and continue throughout'.

It is evident from Southern Water sewer asset records that there are no surface water sewers within the vicinity of the site. A review of the topographical survey indicates that there is private drainage on site, therefore, it is assumed that there is an existing drainage network.

BRE365 infiltration testing suggests that the site has good infiltration potential. Further investigation of the existing run off rates have been explored below.

6.2 Existing Run Off Rates

The existing site comprises farm buildings, livestock shelters and associated landscaping, access tracks and hardstanding.

The underlying geology from review of BGS data indicates that the site is likely permeable in terms of infiltration. Accordingly, the existing runoff rates have been calculated using Innovyze: MicroDrainage using the IH124 methodology.

The Interim Code of Practice recommends that the IH124 method is applied with 50ha, and the resulting discharge is linearly interpolated for the required area. MicroDrainage ICP SUDS Mean Annual Flood tool allows for the aforementioned requirement and has been used accordingly. The table below outlines the Greenfield Runoff rates for the existing site.

Table 6.1 - Summary of Greenfield Runoff Rates obtained from MicroDrainage.

Greenfield Runoff Rates		
	Greenfield Site (1.360 ha)	Greenfield Runoff for Proposed Impermeable Area (0.306ha)
Qbar	0.6	0.1
1 in 1 year (l/s)	0.5	0.1
1 in 30 years (l/s)	1.5	0.3
1 in 100 years (l/s)	2.1	0.5

It is proposed for surface water that the site infiltrates via soakaways, however, this should be confirmed through detailed site investigations prior to construction.

Methods for managing surface water are discussed in the following sections.

6.3 Managing Surface Water

The management of surface water has been assessed in accordance with the guidance set out in CIRIA report C753 'The SuDS Manual 2015'.

To mimic the natural catchment processes as closely as possible, a "management train" is required. This concept is fundamental to successful management of surface water and employs drainage techniques in series to incrementally reduce pollution, flow rates and volumes.

The hierarchy of techniques and processes that should be considered in developing the management train are as follows:

- Prevention. The use of good site design and housekeeping measures to prevent run off transporting pollutants to the drainage system.

- Source Control. Control of run off at or very near to its source. This includes disposal methods that comprise green roofs, permeable pavements, rainwater harvesting or other permeable surfaces.

- Site Control. Management of surface water locally within a development site. This includes disposal techniques that comprise infiltration structures and detention basins.

- Regional Control. Management of run off from a site, or series of sites, typically in a balancing pond or wetland. However, for this development regional controls do not apply.

6.4 Managing Surface Water – Scheme Proposals

Wherever possible, surface water should be managed in small cost-effective landscaped features located within small sub catchments rather than being conveyed to and managed in large systems at the bottom of the drained area. The techniques that are higher in the hierarchy are preferred to those further down so that prevention and control of water at source should always be considered before site or regional controls. However, where upstream opportunities are restricted, a number of lower hierarchy options should be used in series and water should only be conveyed elsewhere if it cannot be dealt with on site.

6.4.1 Prevention

Internal roads, footpaths and driveways are to be of Type A Permeable Paving construction in order to trap the majority of silt within the top 30mm of the jointing material between the blocks, the biodegradation of organic pollutants such as petrol and diesel within the pavement construction, adsorption of pollutants and retention of solids. It is also proposed that catchpits and silt traps will be utilised.

6.4.2 Water Quality

There are a number of factors that contribute to pollution incidents and water quality issues such as sediments, oil, fertilisers, pesticides, animal waste and litter, but improvements can be made by managing surface water and stormwater particularly during extreme weather events.

Sustainable drainage systems mimic natural drainage and help to improve water quality by reducing sediment and contaminants from runoff leading to a number of benefits such as aesthetic, health, and opportunities for wildlife and biodiversity.

It is proposed to utilise Type A permeable paving and catchpits to maximise pollution control at the site.

A CIRIA C573 Pollution Indices table has been produced and can be found in Appendix 6. It is evident that using the aforementioned features shall not increase the risk of polluting downstream waters.

6.4.3 Source Control

As already noted, source control features include permeable pavements and other infiltration structures which are explored further as follows.

Permeable Pavements (Type A & B)

As infiltration is likely viable, Type A permeable pavements have been proposed for the internal roads, footpaths, and driveways for this development.

Green Roofs

The roof lines do not naturally lend themselves to utilising green roofs. Therefore, green roofs have been discounted from this development.

Rainwater Harvesting

Rainwater harvesting has not been proposed for this development, however, water butts could be utilised.

6.4.4 Site Control

As previously mentioned, site control includes disposal techniques that comprise infiltration structures and detention basins. The opportunities of utilising these have been explored below.

Soakaways

The site is likely suitable for concentrated infiltration techniques such as soakaways, therefore, an array of soakaways have been proposed for this development.

Attenuation Tanks

As infiltration is likely viable and soakaways have been proposed, attenuation tanks have been discounted from this development.

Ponds

The site use does not naturally lend itself to the use of ponds. Therefore, ponds have been discounted from this development.

Detention Basins

The site use does not naturally lend itself to the use of detention basins. Therefore, detention basins have been discounted from this development.

Permeable Pavements (Type C)

Type A permeable pavements have been proposed for this development. Therefore, Type C permeable pavements have been discounted from this development.

Swales

The site use does not naturally lend itself to the use of swales. Therefore, swales have been discounted from this development.

6.4.5 Strategy Proposals & Preliminary Sizing Estimations

An element of site control must include provision for Climate Change. The Technical Guidance to the National Planning Policy Framework States that:

"In making an assessment of the impacts of climate change on flooding from land, rivers and the sea as part of a flood risk assessment, the sensitivity ranges in table 5 may provide an appropriate precautionary response to the uncertainty about climate change impacts on rainfall intensities, river flow, wave height and wind speed"

Table 5: Recommended national precautionary sensitivity ranges for peak rainfall intensities, peak river flows, offshore wind speeds and wave heights

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	+5%	+10%	+20%	+30%
Peak river flow	+10%	+20%		
Offshore wind speed	+5%		+10%	
Extreme wave height	+5%		+10%	

Figure 6.1 – NPPF Technical Guidance, Table 5

KCC have adopted a government policy which calls for an increase in allowance for climate change to 40%. Therefore, the surface water drainage strategy will include a 40% allowance from increased rainfall intensities as a direct result of climate change.

As previously calculated, the greenfield runoff from all of the post-development areas is anticipated to be 0.5l/s for the 1:100-year event. It is proposed that the site infiltrates via soakaways, however, this should be confirmed through detailed site investigations prior to construction.

The individual elements have been explored further below:

Soakaways

As can be seen by the appended MicroDrainage calculations and drainage strategy layouts, an array of soakaways have been proposed to fully accommodate the 1:100-year event with a 40% climate change allowance.

The soakaways have been designed to a rate of 2.08×10^{-4} m/s which is the poorest infiltration rate achieved during preliminary on site BRE365 infiltration testing. The infiltration rate should be confirmed prior to detailed design with a BRE365 infiltration test or equivalent, located at the proposed soakaway locations. Chalk density will also need to be confirmed prior to detailed design, to confirm the viability of infiltration structures within proximity to buildings.

Permeable Paving

Permeable paving provides a pavement suitable for pedestrian and vehicular traffic, while allowing rainwater to infiltrate through the surface and into the underlying layers. The water is temporarily stored before infiltrating into the ground below or discharging to piped outfall. They are traditionally 'shallow' structures with a depth formation of around 350mm, depending on the traffic conditions and recorded soakage rate/discharge rate.

Permeable pavements also offer an extra stage of pollution control as a direct result of their construction. The permeable sub-bases and block work laying course can remove between 60% and 95% of total suspended solids and 70% to 90% of hydrocarbons. When subjected to low level oil drips, such as in car parks, the pavements can continue to biodegrade the hydrocarbons indefinitely. 'Pollution Prevention Guideline' PPG 3 (Environment Agency, 2006) identified the beneficial performance of permeable pavements in removing pollution from runoff.

It stated that: "*Techniques that control pollution close to the source, such as permeable surfaces or infiltration trenches, can offer a suitable means of treatment for runoff from low-risk areas such as roofs, car parks, and non-operational areas*". Permeable pavements are more effective at removing a wider range of pollutants from runoff than oil separators (CIRIA, 2004).

Internal roads, footpaths and driveways are to be of Type A permeable construction, with full infiltration. The appended drained areas analysis sketches outline the proposals.

As can be seen from the appended MicroDrainage calculations (modelled as an infiltration blanket), the required sub-base depth is anticipated to be in the region of 30mm thick for the infiltration rate of 2.08×10^{-4} m/s. The infiltration rate should be confirmed prior to detailed design with a BRE365 infiltration test or equivalent, located at a few locations throughout the proposed permeable pavement area.

6.5 Exceedance and Surface Water Conveyance

Exceedance routes shall be provided by appropriate external levels design during the detailed design stage. The exceedance routes shall need to accommodate system failure and events greater than the 1:100-year event inclusive of a 40% climate change allowance.

6.6 SuDS Hierarchy

The SuDS Hierarchy has been considered and the results are found within Appendix 5.

6.7 Surface Water Strategy Summary

The existing site comprises farm buildings, livestock shelters and associated landscaping, access tracks and hardstanding. It is bounded by residential properties and The Street to the north, St John the Baptist Church to the east, fields, and residential properties to the south and Valley Road and the River Nailbourne to the west. It is anticipated the site's strata would have good infiltration potential.

The proposal is to utilise an array of geocellular soakaways, Type A permeable paving and catchpits at the site to adequately accommodate and discharge surface water to the ground. An infiltration rate of 2.08 x 10^{-4} m/s has been obtained at this site and utilised for the purposes of this preliminary design. The infiltration rate should be confirmed prior to detailed design with a BRE365 infiltration test or equivalent, located at a few locations throughout the proposed permeable pavement area and at soakaway locations.

Accordingly, all storm events up to and including the critical 100-year event with a 40% allowance for climate change will be assessed when considering the volume for the infiltration structures.

The surface water network will be sized to accommodate a 1 in 100-year storm event with a 40% allowance for future climate change. This is in accordance with KCC's Drainage and Planning Policy Statement (June 2017).

It is anticipated that a condition will be imposed on a planning permission requiring further details of the surface water drainage system to be submitted for approval.

It is evident from the aforementioned that a suitable surface water network can be provided that accords with National and Local Planning Policy Guidance in addition to KCC's Drainage and Planning Policy Statement (June 2017).

7. Conclusions

This document has been produced in accordance with current best practice and recommendations and guidance set out in the National Planning Policy Framework (NPPF) and as required by Kent County Council's Drainage and Planning Policy Statement (2017).

The report concludes:

- The site is currently partially developed and comprises farm buildings, livestock shelters and associated landscaping, access tracks and hardstanding. It is bounded by residential properties and The Street to the north, St John the Baptist Church to the east, fields, and residential properties to the south and Valley Road and the River Nailbourne to the west.

- A review of the BGS online superficial deposits mapping tool has identified that the development site is not likely underlain by any superficial deposits.

- A review of the BGS online bedrock mapping tool has identified that the development site is likely underlain by the Lewes Nodular Chalk Formation (Chalk).

- Since the previous revision of this report, on site BRE365 infiltration testing has been undertaken. The worst result achieved was 2.08 x 10^{-4} m/s. The infiltration rate should be confirmed prior to detailed design with a BRE365 infiltration test or equivalent, located at a few locations throughout the proposed permeable pavement area and at soakaway locations.

- A review of the Environment Agency's online mapping tool has also identified that the majority of the development site is within Flood Zone 1, an area with a low probability of flooding from Rivers and Sea.

- It is evident from the previous extracts that a portion of the development is at high risk of flooding from surface water. High risk is defined as a probability of flooding of greater than 3.3%. However, the majority of the site, and where dwellings are proposed, is at low risk of flooding.

- The proposal is to construct 22 dwellings with associated driveways, access roads and landscaping.

- An assessment of peak foul water flow has been carried out in accordance with 'British Water Flows and Loads'. It is anticipated that there shall be an increase in peak flow by approximately 0.792 l/s.

- It is proposed that the foul network is connected to the existing public foul sewer within Valley Road. A connection is subject to a formal Section 106 connection agreement with Southern Water.

- The proposal for surface water is to utilise an array of geocellular soakaways, permeable pavements, and catchpits.

- The surface water drainage strategy will include a 40% allowance from increased rainfall intensities as a direct result of climate change.

- It is evident that the site can be drained satisfactorily in accordance with Local and National Planning Policy Guidance. The details of the drainage systems should be the subject of suitably worded Planning Conditions which would require the schemes to be submitted to the local authority for approval prior to construction work commencing.