Flood Risk Assessment with Surface Water and Foul Drainage Strategy

Glebe Farm, Northcroft, Weedon, Aylesbury HP22 4NR

Date	Prepared For	Reference
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Contract

GeoSon Limited were instructed by Craig Smith of Flint Architects, on behalf of Sally M Jones, by an email dated 9th September 2022 to undertake a Site Specific Flood Risk Assessment with Surface Water and Foul Drainage Strategy to support a proposed planning application for development at Glebe Farm, Northcroft, Weedon.

Project	Flood Risk Assessment with Surface Water and Foul Drainage Strategy for Planning
Prepared For	Sally M Jones
Location	Glebe Farm, Northcroft, Weedon, Aylesbury HP22 4NR
Application	Demolition of the existing barn and outbuildings followed by construction a new single storey dwelling within the same built footprint as the original barn
Our Reference	73011
Prepared By	Thomas Smith BSc (Hons) PIEMA

Document Issue Record

Issue Date	Version / Change	Issued To
14/12/2022	1.0	Sally M Jones and Craig Smith (Flint Architects)
17/02/2023	2.0 / Revised Plans	Craig Smith (Flint Architects)

Purpose

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Introduction

Context

GeoSon Limited have been instructed by Craig Smith of Flint Architects, on behalf of Sally M Jones, to undertake a Site Specific Flood Risk Assessment (FRA) with Surface Water and Foul Drainage Strategy to support a proposed planning application for development at Glebe Farm, Northcroft, Weedon.

This assessment has been undertaken in accordance with the revised National Planning Policy Framework (NPPF) July 2021, the associated Planning Practice Guidance (PPG) and the CIRIA SuDS Manual c753.

Study Objectives

In accordance with the National Planning Policy Framework (NPPF), a Flood Risk Assessment is required to accompany a planning application when a development site is:

- located within flood zones 2 or 3 (including minor development and change of use)
- more than 1 hectare (ha) in size
- less than 1 ha in flood zone 1 however includes a change of use in development type to a more vulnerable class (for example from commercial to residential) which could be affected by sources of flooding other than rivers and the sea
- located within an area which has been identified to have critical drainage problems by the Environment Agency

Although the development is located entirely within Flood Zone 1, part of the site has been modelled at risk of surface water flooding by EA. As such, a Flood Risk Assessment (FRA) has been undertaken to support the development proposals.

The FRA considers the proposed use of the site and assesses the potential flood risk posed to the intended development from multiple sources of flooding including rivers, sea, surface water, groundwater, reservoir failure, sewer surcharge and any other artificial sources. The risk posed from these potential sources of flooding is assessed to determine whether future site users and third party land will be safe now and for the expected lifetime of the development, taking climate change into account.

Additionally, given that the proposed development will alter the impermeable coverage at the site, thus will impact the existing runoff regime, details of the post development surface water drainage arrangements will be required to accompany the proposed planning application in line with current industry standards.

In accordance with the NPPF and CIRIA SuDS manual all surface water drainage strategies should follow the Drainage Hierarchy whereby discharge options are considered in the following order:

1. Stormwater reuse,
2. Discharge to ground,
3. Discharge to watercourse,
4. Discharge to surface water sewer,
5. Discharge to combined sewer.

This report details the preferred method for managing post development surface water runoff generated by newly introduced impermeable surfacing at the site. This includes how runoff can be managed now and for the lifetime of the development, so that future site users and third party land will not be at an increased risk of flooding as a result of the proposals.

Site Details

Site Description

The proposed development is located within the Glebe Farm estate and is situated approximately 130m north east of the main farmhouse. According to plans provided by the client the main area of the site (excluding the access road) is approximately 1860m^2 in size and is currently occupied by an agricultural barn, several outbuildings and a small pond in the north eastern corner.

The client has confirmed that the pond in the north eastern corner measures approximately 15m^2 x 0.55m deep. It is reported that the pond currently accepts runoff from the surrounding land and is lined with no formal discharge point. Considering this, it is assumed that water naturally disperses into the adjacent field.

Having reviewed the existing layout plan the site is already underlain by approximately 316m^2 of hardstanding comprising roof areas associated with the existing barn and outbuildings.

The site is accessed from the south western corner via a private road which branches off Northcroft approximately 330m south west of the proposed development.

Having reviewed aerial imagery the wider area, surrounding the development, is primarily characterised by agricultural land.

Site Address	Glebe Farm, Northcroft, Weedon, Aylesbury HP22 4NR
Current Use	Agricultural Use
Proposed Use	Residential Use
OS NGR	SP 81729 18558
County	Buckinghamshire
Local Planning Authority	Buckinghamshire Council - Aylesbury Vale Area
Lead Local Flood Authority	Buckinghamshire Council

Table 1: Site Details

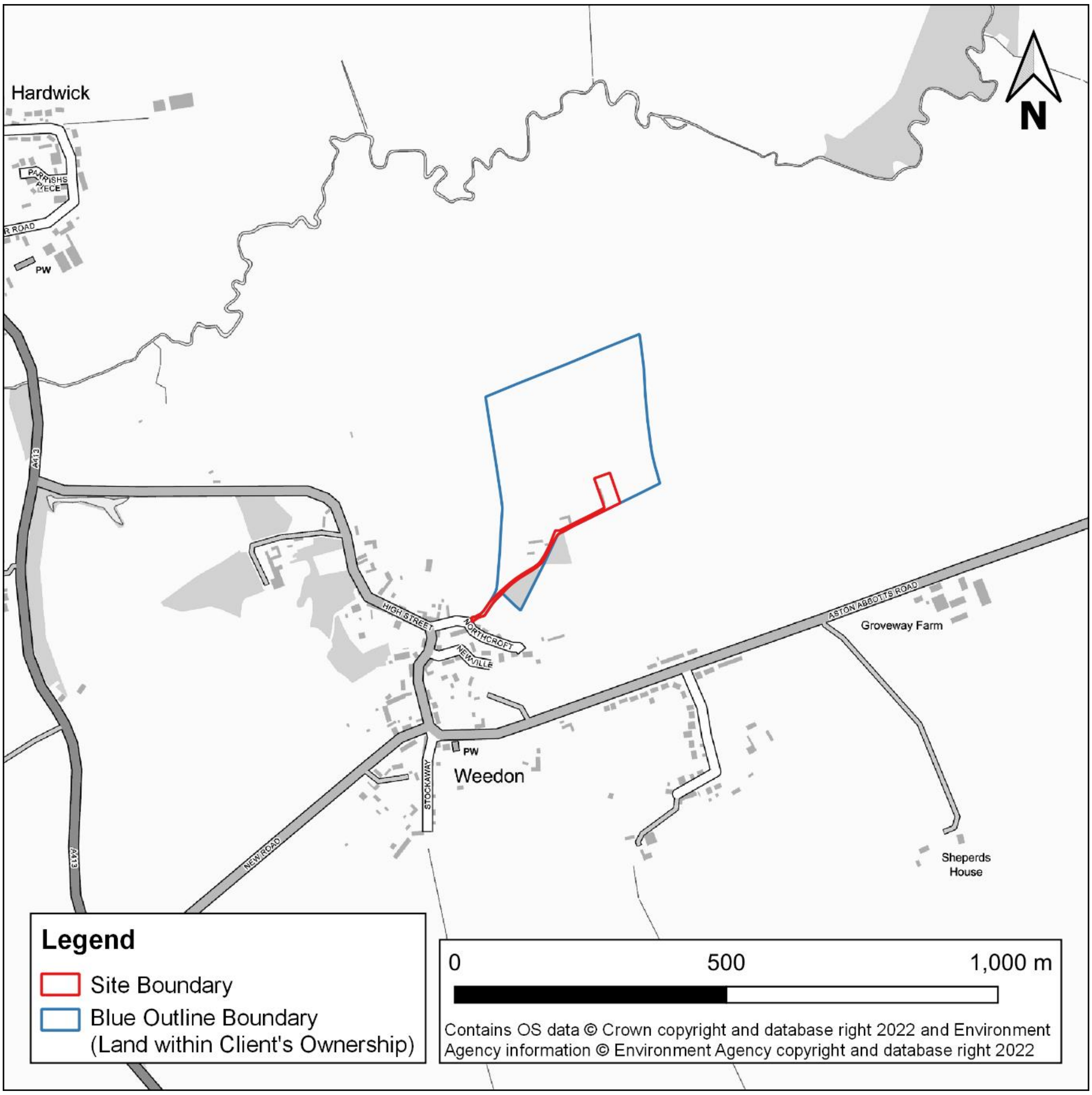


Figure 1: Site Location

Topography

A topographic survey was undertaken at the site by Target Surveys Limited in July 2020 and provided by the client for inclusion within this report. The topographical survey appears to have been undertaken to a local datum, and indicates that the site has a 2.73m gradient and slopes in a north easterly direction.

Considering that the topographic survey was undertaken to a local datum, 1.0m resolution LiDAR data has been obtained from the Environment Agency to assess the elevation of the site in metres Above Ordnance Datum (mAOD). According to EA LiDAR data ground levels at the site (excluding the access road) range between 92.80mAOD along the north eastern corner and 94.60mAOD in the south west, associated with the site access.

EA Topographic LIDAR data indicates that land to the south and west is elevated higher than the site. Having reviewed EA topographic data, the site appears to be located on the edge of plateau with land at the site and within the surrounding area sloping steeply in the north easterly direction towards Hardwick Brook. Figure 2 shows the elevation profile of the site and surrounding area. The topographic survey can be seen in Appendix A.

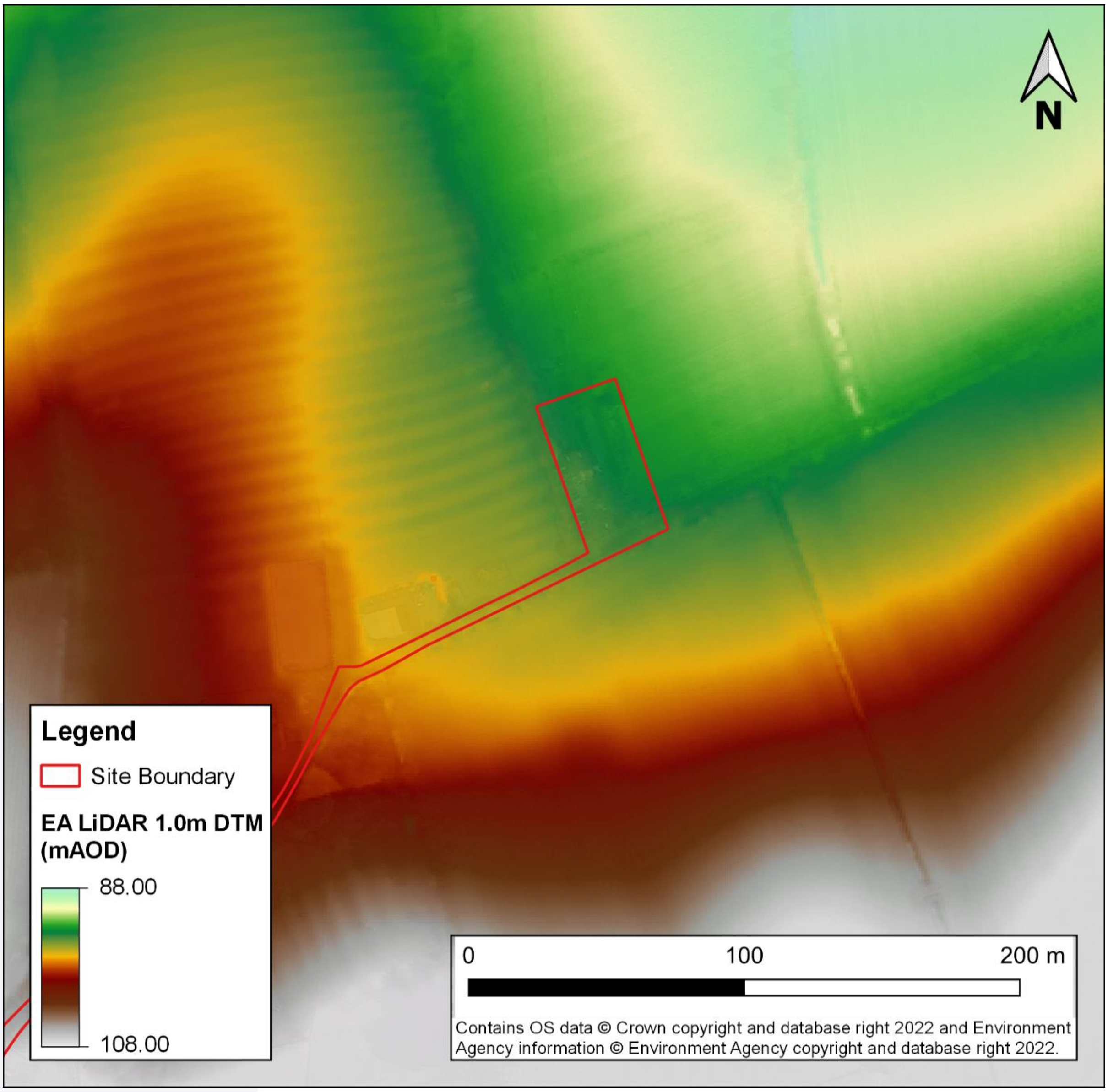


Figure 2: Topography of the Site and Surrounding Area

Geology and Hydrogeology

Review of online British Geological Survey (BGS) records indicates that the site is located directly upon Kimmeridge Clay Formation (Mudstone) bedrock. This geological strata was formed during the Kimmeridgian Age some 152.1 to 157.3 million years ago.

Records state that Kimmeridge Clay Formation is typically characterised by mudstones (calcareous or kerogen-rich or silty or sandy); thin siltstone and cementstone beds, and locally sands and silts.

Figure 3: Bedrock Geology Map (Source: British Geological Survey)

According to BGS data the site not underlain by superficial deposits.

Review of Landis Soilscapes online viewer suggests that the site is located in area where the soils are classified as ‘slowly permeable, seasonally wet, slightly acid but base-rich loamy and clayey soils’ with impeded drainage.

DEFRA ‘Magic Maps’ indicates that the site and surrounding area are not located within a groundwater Source Protection Zone.

Nearby Watercourses

The client has confirmed that several watercourses are located within proximity to the development including:

- A drainage ditch adjacent south of the site access road which runs in an easterly direction along the site boundary,
- A watercourse approximately 80m east of the red outline boundary which flows in a northerly direction, and;
- Hardwick Brook some 675m north of the development.

The watercourses nearest to the site are shown in (Figure 4 below).

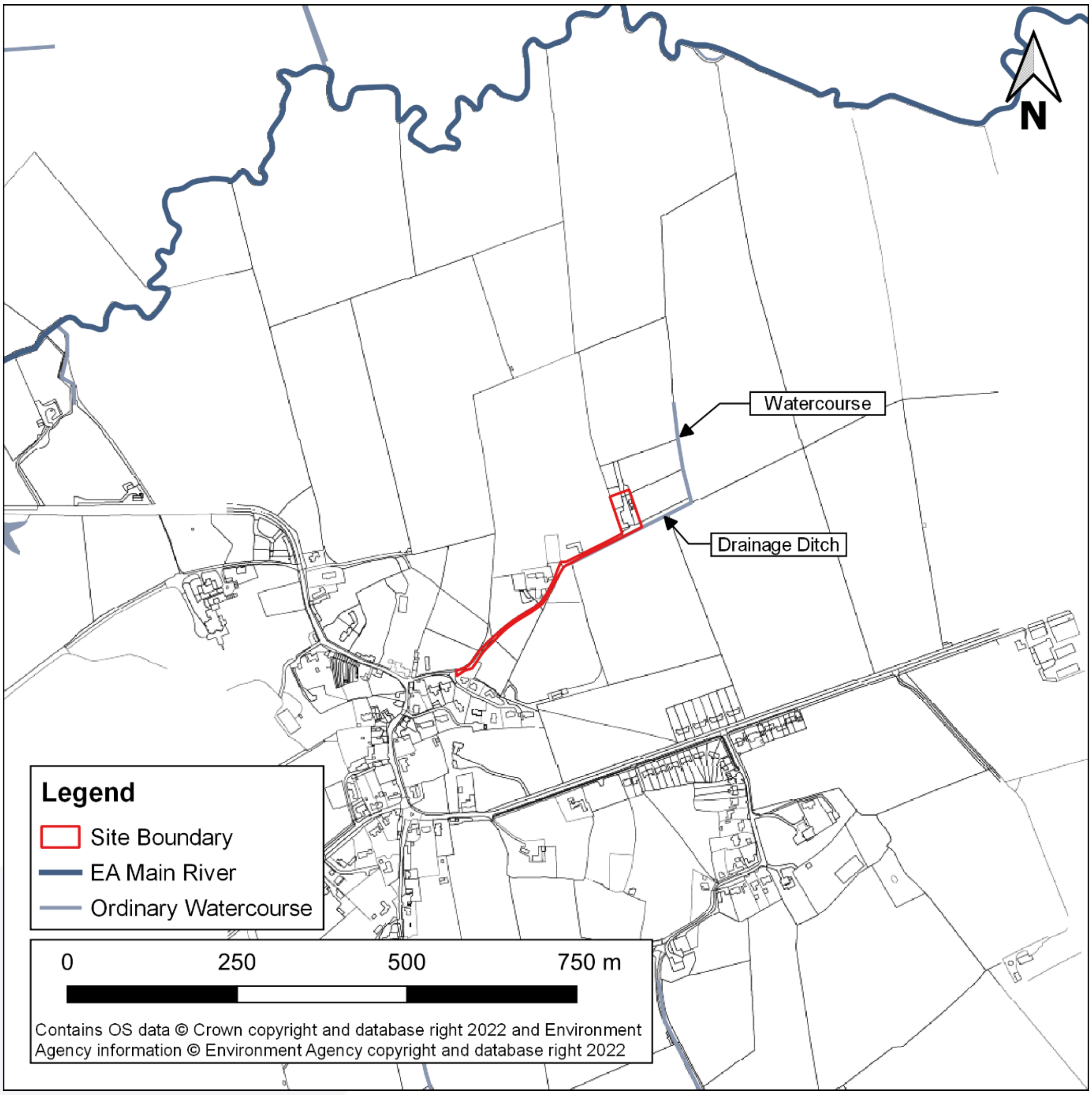


Figure 4: Watercourses Near the Site

According to the topographic survey provided by the client the drainage ditch located along the southern periphery is approximately 0.40m deep and has an invert level elevated higher than the majority of the site.

Whilst the second watercourse is located some 80m east of the red outline boundary the client has provided an ownership title which shows that the developer owns the land between the development and the watercourse. As such discharge across the agricultural land which separates the development and the watercourse can be achieved without the need to obtain third party land owner permission, if required.

Review of 1.0m LiDAR DTM data indicates that the top of bank of the section of watercourse 80m east has an elevation of approximately 90.30mAOD. The client has confirmed that the channel in this location has an approximate depth of 1.06m. Therefore, the section of watercourse 80m east of the site is considered to have an approximate bed level of 89.24mAOD.

Given the topographic profile of the site and surrounding area, it is considered that any surface water runoff generated by the existing site is directed towards the watercourse 80m east. It is assumed that any water within this watercourse is conveyed in a northerly direction and discharges into Hardwick Brook some 675m north of the development.

Hardwick Brook is classified as a 'Main River' and is managed by the Environment Agency. According to Aylesbury Vale District Council Level 1 Strategic Flood Risk Assessment (SFRA) Hardwick Brook rises approximately 1.10km south of Littlecote and is one of the principle tributaries of the River Thame. From its source, Hardwick Brook flows in a south-westerly direction and runs between the conurbations of Hardwick and Weedon before flowing along the eastern edge of Berryfield. Along its course several other watercourses discharge into Hardwick Brook (Littlecote, Creslow, Dunmill Brooks and the Weedon Ditch) before it converges with the River Thame north-west of Aylesbury.

Existing Drainage Infrastructure

Given the nature of the buildings at the site, and the development's rural setting, it considered that any surface water runoff generated by existing impermeable surfacing is currently drained via overland and subsurface flow onto adjacent land.

Additionally, it has been confirmed that there are no main sewer systems within the vicinity of Glebe Farm. The client has confirmed that surface water runoff generated by Glebe Farmhouse (145m metres south west) is currently conveyed to the drainage ditch which runs adjacent south of the site access road via private infrastructure and a private outfall.

Proposed Development

Development Proposals

The proposed planning application is for demolition of the existing barn and outbuildings followed by construction of a new single storey dwelling within the same built footprint as the original barn.

According to plans provided by the client, post development the total impermeable area at the site will amount to approximately 408m^2, comprising 271m^2 of roof area and 137m^2 of hardstanding associated with the paving areas and three parking spaces.

However, it is worth noting that the site is classified as brownfield land and is already underlain by approximately 316m^2 of hardstanding. Therefore, the true increase in impermeable area as a result of the development will amount to only 92m^2.

Despite this, attenuation sizing within the strategy will be based on a total impermeable area of 408m^2. As such, significant betterment will be provided post development when compared to the current situation.

A copy of the proposed site layout plan is provided below and is included within Appendix B.

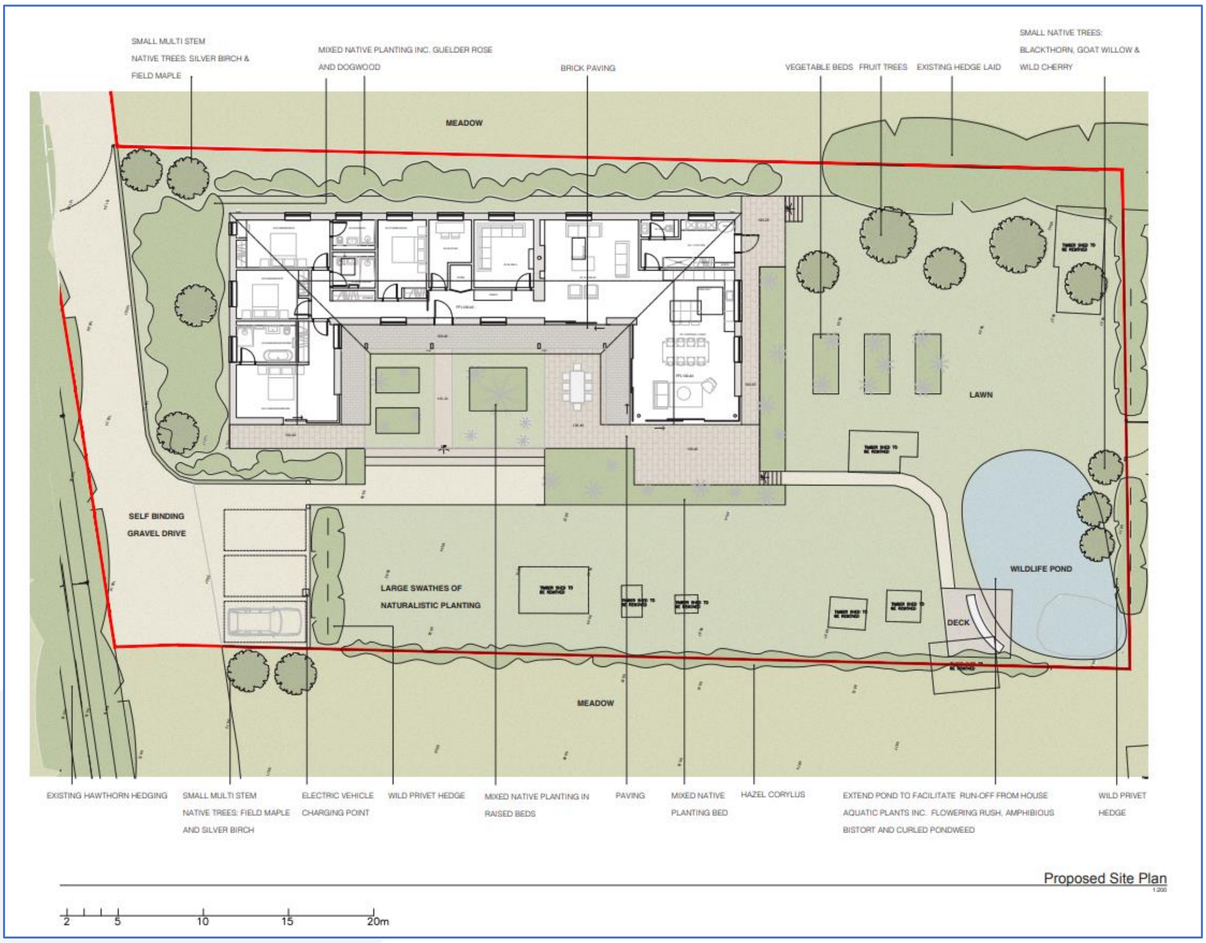


Figure 5: Proposed Layout Plan

Development Vulnerability Classification

The National Planning Policy Framework classifies land use type in terms of vulnerability to flooding. Annex 3 of the NPPF details the flood risk vulnerability classification for each land use type (refer below).

Essential infrastructure
• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including infrastructure for electricity supply including generation, storage and distribution systems; including electricity generating power stations, grid and primary substations storage; and water treatment works that need to remain operational in times of flood. • Wind turbines. • Solar farms.
Highly vulnerable
• Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure'.)
More vulnerable
• Hospitals • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • **Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.** • Non–residential uses for health services, nurseries and educational establishments. • Landfill* and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less vulnerable
• Police, ambulance and fire stations which are not required to be operational during flooding. • Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the 'more vulnerable' class; and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill* and hazardous waste facilities).

• Minerals working and processing (except for sand and gravel working). • Water treatment works which do not need to remain operational during times of flood. • Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place. • Car parks.
Water-compatible development
• Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel working. • Docks, marinas and wharves. • Navigation facilities. • Ministry of Defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

Table 2: Flood Risk Vulnerability Classification (Source: NPPF)

The site is currently occupied by an agricultural barn and several outbuildings. Therefore, in terms of flood risk vulnerability it is considered “less vulnerable”.

The proposals comprise demolition of the barn and outbuildings followed by construction of a single storey residential dwelling. As such, according to NPPF guidance the site as whole will become “more vulnerable” post development.

In light of this, it is considered that the vulnerability of the site as a whole will increase as a result of the development.

Sequential and Exception Test

In accordance with the National Planning Policy Framework, and associated Planning Practice Guidance, the Sequential and Exception Tests should be undertaken to determine the most appropriate location for a development and used to inform the proposed design layout.

The Sequential Test is designed to steer new development to areas with the lowest risk of flooding, taking all sources of flood risk and climate change into account.

The Exception Test is undertaken when development in a flood risk area cannot be avoided. The Exception Test comprises of two elements which need to be satisfied before a development can be permitted. It needs to be demonstrated that:

1. A development will provide wider sustainability benefits to the community that outweigh flood risk; and
2. A development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test Required	✓	✓	✓
Zone 3a	Exception Test Required	X	Exception Test Required	✓	✓
Zone 3b	Exception Test Required	X	X	X	✓

Table 3: Flood risk vulnerability and flood zone 'incompatibility' (Source: PPG)

Given the nature of the proposals the development is considered 'more vulnerable'.

According to Table 3 (above) 'more vulnerable' development is considered compatible within Flood Zone 1, 2 and 3a (subject to application of the Exception Test).

Assessment of Flood Risk

Flood risk is a combination of:

- the probability (likelihood or chance) of a flood event happening; and
- the potential consequences (impact) if an event were to occur.

In accordance with guidance set out in the Flood Risk and Coastal Change section of the PPG, areas at risk of flooding should be considered as those at risk of flooding from any source, now or in the future.

This study uses publicly available data (including EA flood maps and Local Authority documentation) to assess the potential flood risk posed to the intended development from multiple sources of flooding and the risk of flooding elsewhere, as a result of the proposals.

Where flood risks are identified this study outlines appropriate mitigation measures, compliant with NPPF and PPG, which would be suitable to incorporate within the proposed development to manage said flood risk(s).

Historical Flooding

Aylesbury Vale District Council Level 1 SFRA (May 2017) states that the region is prone to localised flooding, with the main source of flooding being from fluvial and surface water sources. According to the SFRA significant historical flood events occurred in Aylesbury Vale District in 1947, October 1987, April 1998, January 2003, July 2007 and December 2013 - February 2014.

Review of the Environment Agency's Recorded Flood Outline and Historic Flood Map datasets shows that a historical flood event was recorded some 600m north of the development (refer to Figure 6).

According to information held by the EA land adjacent to the Hardwick Brook flooded in October 1993 as a result of the channel exceeding capacity.

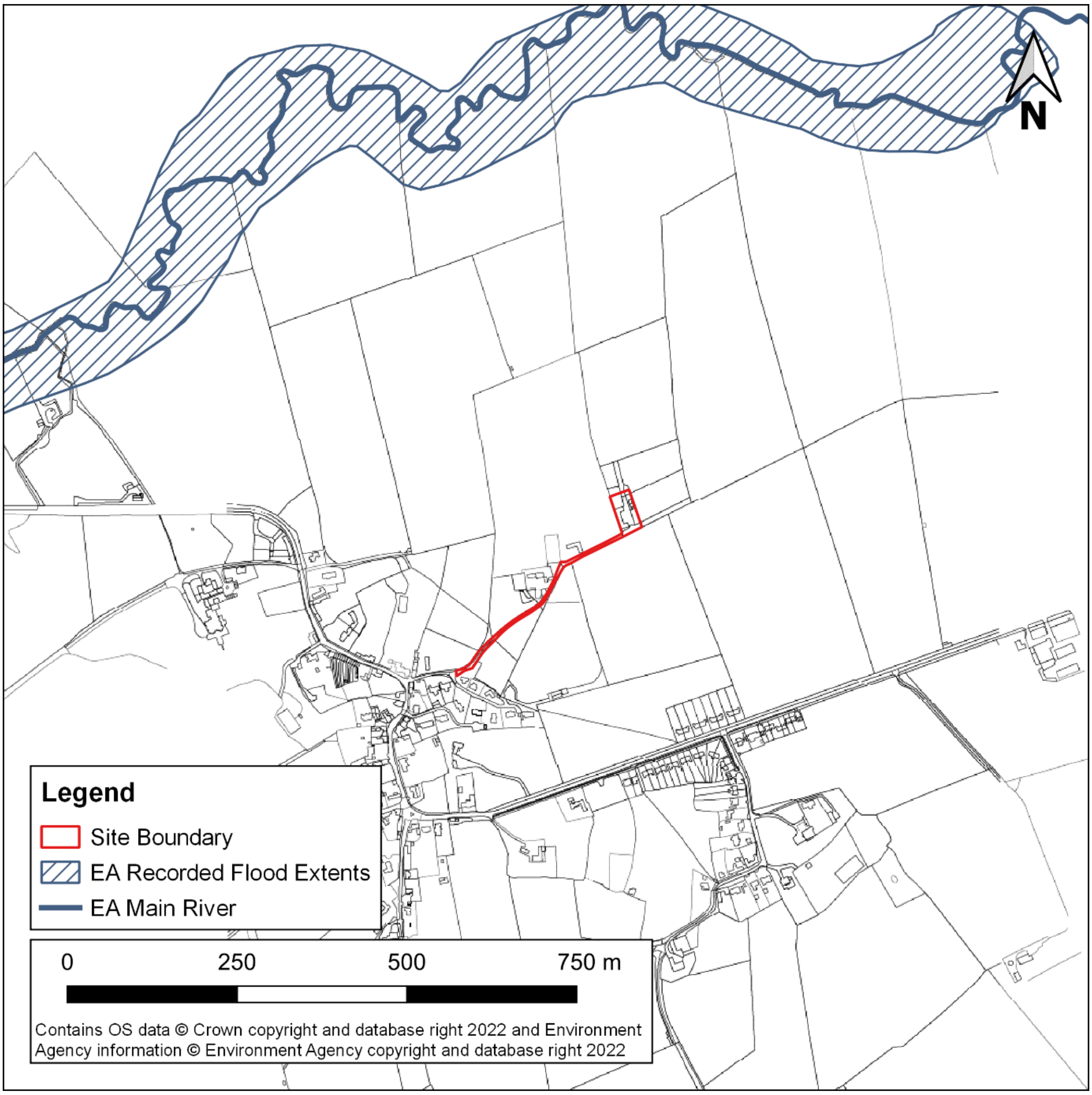


Figure 6: Environment Agency Recorded Flood Outlines

Despite several flood events being recorded in the Aylesbury Vale District there is no information to suggest that the site itself has ever flooded.

Flood Zones

The Environment Agency has created a set of Flood Zones which shows the risk of flooding from rivers and sea in England, for several return period events, ignoring the presence of defences. The Flood Zones are shown on the EA's Flood Map for Planning which forms the basis for assessing flood risk and development suitability under the National Planning Policy Framework.

Flood Zone	Definition
Zone 1 **Low Probability**	Land having a less than a 1 in 1000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map for Planning – all land outside Zones 2, 3a and 3b)
Zone 2 **Medium Probability**	Land having between a 1 in 100 and 1 in 1000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1000 annual probability of tidal 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 tidal flooding. (Land shown in dark blue on the Flood Map)
Zone 3b **Functional Floodplain**	This zone comprises land where water from rivers or the sea has to flow or be stored in times of flood. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. The functional floodplain will normally comprise: • land having a 1 in 30 or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or • land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 1 in 1000 annual probability of flooding). Areas of functional floodplain should be identified by local planning authorities within Strategic Flood Risk Assessments, in agreement with the Environment Agency. (Note, Zone 3b is not separately distinguished from Zone 3a on the Flood Map).

Table 4: Flood Zone Definitions (Source: Planning Practice Guidance)

Note: The Flood Zones shown on the Environment Agency's Flood Map for Planning (Rivers and Sea) do not take into account the possible impacts of climate change and consequent changes in the future probability of flooding.

Fluvial (River)

To the Site

According to the Environment Agency's Flood Map for Planning (refer to Figure 7) the site and surrounding area are located entirely within Flood Zone 1 (Low Probability), defined as land having less than a 1 in 1000 annual probability of fluvial flooding in any given year.

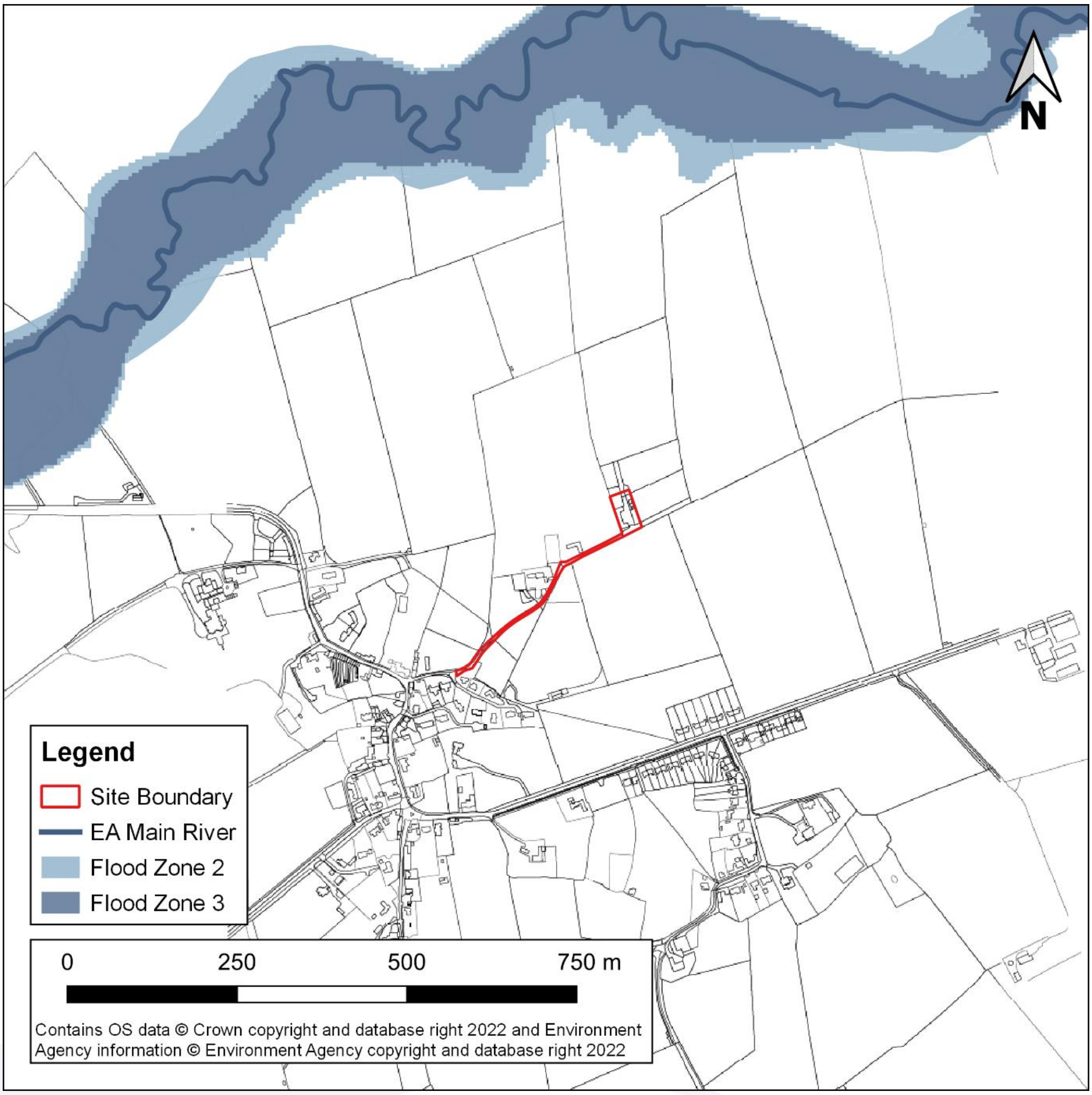


Figure 7: Environment Agency Flood Map for Planning

Having reviewed the fluvial flood risk in the wider area, the nearest Flood Zone 2 and 3 extents are located some 540m north of the development associated with agricultural land within close proximity to Hardwick Brook. In light of this, the risk posed to the site from fluvial flooding is considered to be very low.

Furthermore, based on the location of Hardwick Brook in relation to the site, and the elevation difference, any increase in water levels due to climate change are considered unlikely to affect the proposed development site.

From the Site

Given that the site is located entirely within Flood Zone 1, thus outside of any fluvial flood zone extent, the proposed development is not considered to have an impact on the existing floodplain functionality and will not increase the risk of fluvial flooding elsewhere.

Pluvial (Surface Water)

Pluvial (surface water) flooding occurs as a result of excess overland flow and stormwater ponding. Surface water flooding can happen when water does not have time to soak into the underlying ground or cannot infiltrate at all, for instance because the ground is already fully saturated.

This mechanism of flooding can also arise when the volume of precipitation exceeds the capacity of the drainage system meaning that water is unable to drain away through the sewer network and instead flows overland.

Overland flow will follow the local topography and can therefore pose a risk to both the development and surrounding third party land.

To the Site

The risk posed to the site from surface water flooding has been assessed using the Environment Agency's Risk of Flooding from Surface Water (RoFSW) dataset, refer to Figure 8.

The Risk of Flooding from Surface Water maps were produced in 2013 by the Environment Agency, working with Lead Local Flood Authorities. They are considered to represent a significant improvement on the previous surface water flood maps, both in terms of method and representation of the risk of flooding. Considerable improvements were made to the modelling techniques and data used, including the incorporation of locally produced mapping, where available, to represent features best modelled at a local scale.

The RoFSW information assesses flooding scenarios as a result of rainfall with the following chance of occurring in any given year:

- 1 in 30 (3.3%)
- 1 in 100 (1%)
- 1 in 1000 (0.1%)

The modelled return period outputs are then classified into four categories based on the level of surface water flood risk posed to an area. These categories are detailed below:

High	An area which has a 1 in 30 (3.3%) or greater annual probability of flooding
Medium	An area which has between a 1 in 100 (1%) and 1 in 30 (3.3%) annual probability of flooding
Low	An area which has between a 1 in 1000 (0.1%) and 1 in 100 (1%) annual probability of flooding
Very Low	An area which has less than a 1 in 1000 (0.1%) annual probability of flooding

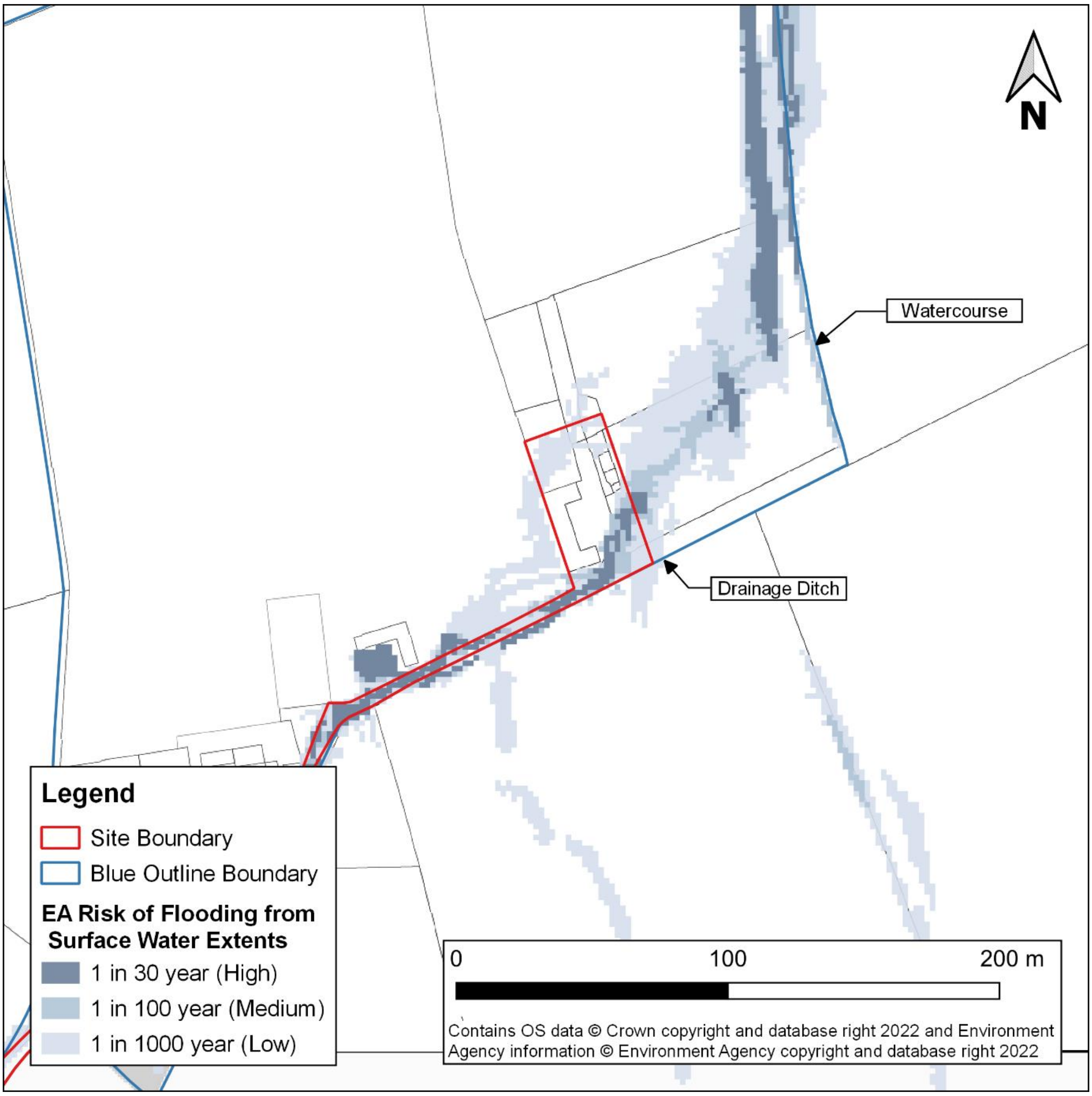


Figure 8: Environment Agency's Risk of Flooding from Surface Water Map

The EA's Risk of Flooding from Surface Water data (Figure 8) shows that the site is located within an area at "Very Low" to "High" risk of flooding from surface water. Whilst the land upon which the dwelling is proposed to be developed has been modelled at "Very Low" to "Low" risk of surface water flooding, a swathe of land 5-10m south of the proposed building appears to be at "Moderate" to "High" risk.

Given that surface water flood extents have been identified within close proximity to the proposed development footprint, further analysis of modelled surface water flood depths has been undertaken. The detailed flood mapping below (refer to Figure 9, Figure 10 and Figure 11) shows the modelled flood depths, taken from the Risk of Flooding from Surface Water dataset, across the site during the 1 in 30, 1 in 100, and 1 in 1000 year pluvial flood events, respectively.

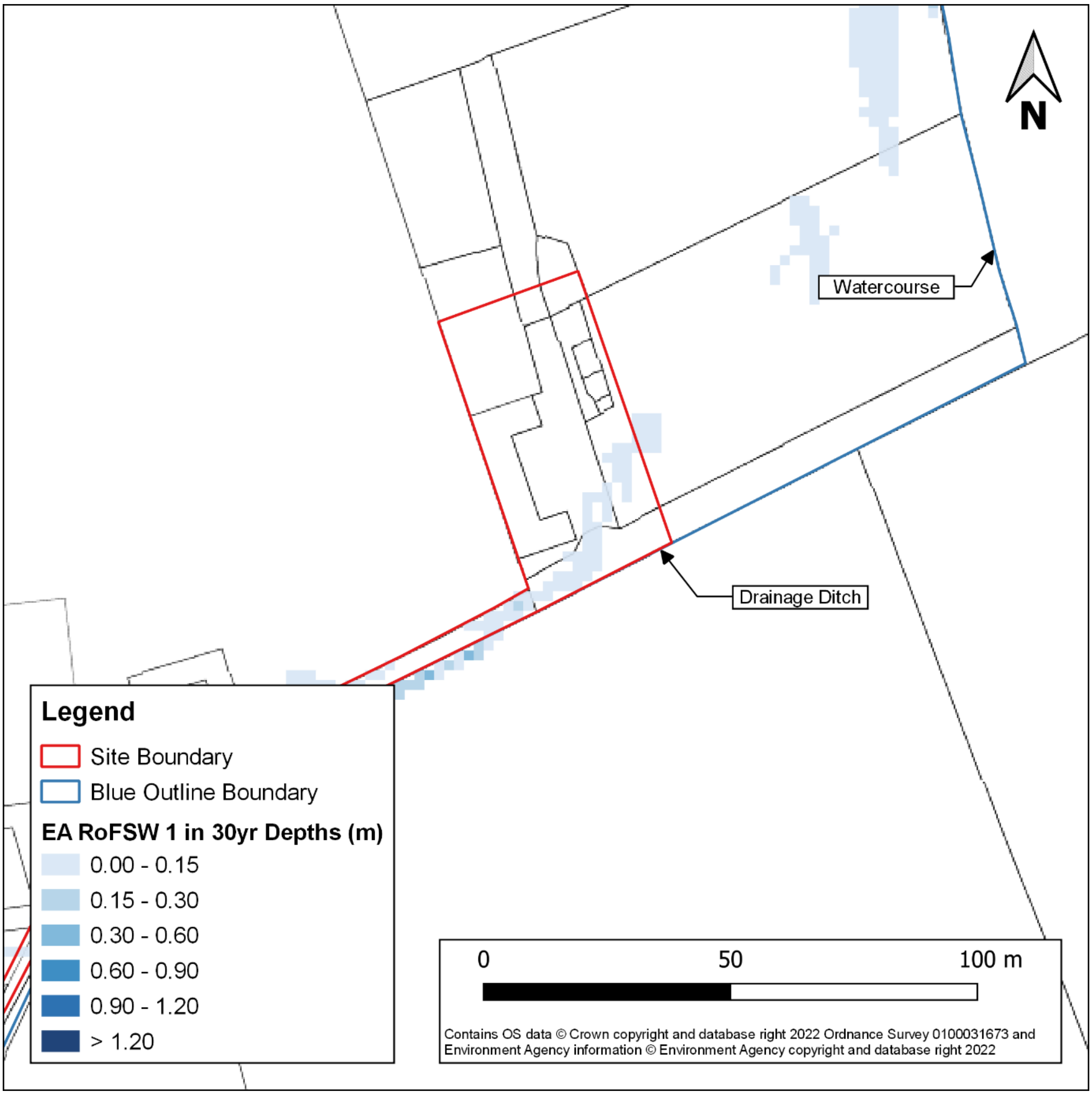


Figure 9: Risk of Flooding from Surface Water 1 in 30 year Depth Map

Figure 9 indicates that the majority of the site, including the barn built footprint, is flood free during the 1 in 30 year storm event.

However, a swathe of land 5m south and east of the barn footprint has been modelled at risk of flooding during this scenario. Flood depths of up to 150mm are anticipated in this area.

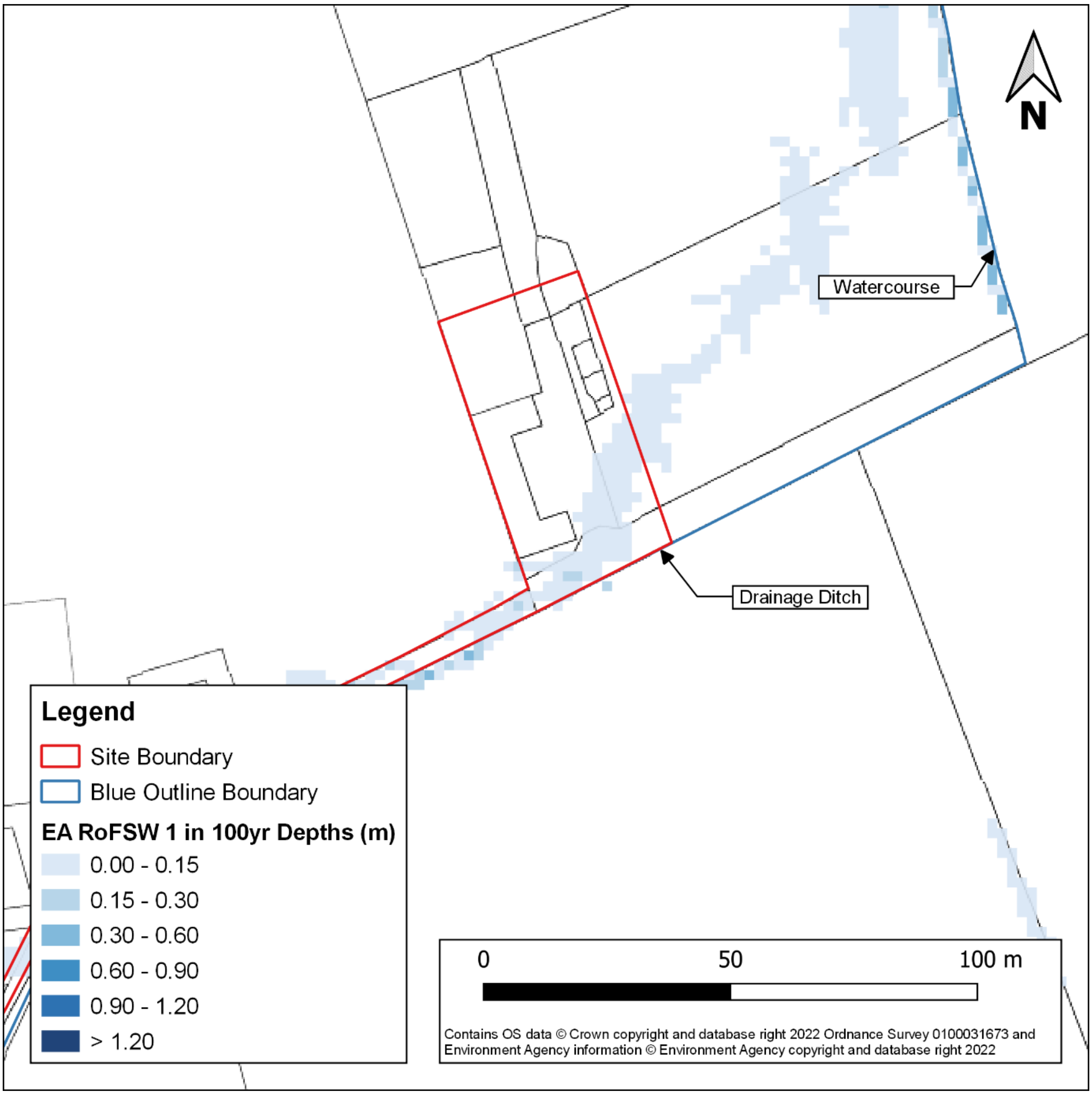


Figure 10: Risk of Flooding from Surface Water 1 in 100 year Depth Map

During the modelled 1 in 100 year surface water flood scenario (refer to Figure 10) a greater swathe of land is anticipated to be at risk of flooding with low levels, of up to 150mm deep, expected to accumulate upon land adjacent south of the barn footprint.

Water accumulation has also been modelled 80m east of the red outline boundary. Review of aerial imagery and information provided by the client indicates that the increased depths modelled in this location are associated with an existing watercourse and should therefore be considered as in-channel flows. Depths of up to 600mm are expected in the section of the watercourse 80m east of the development.

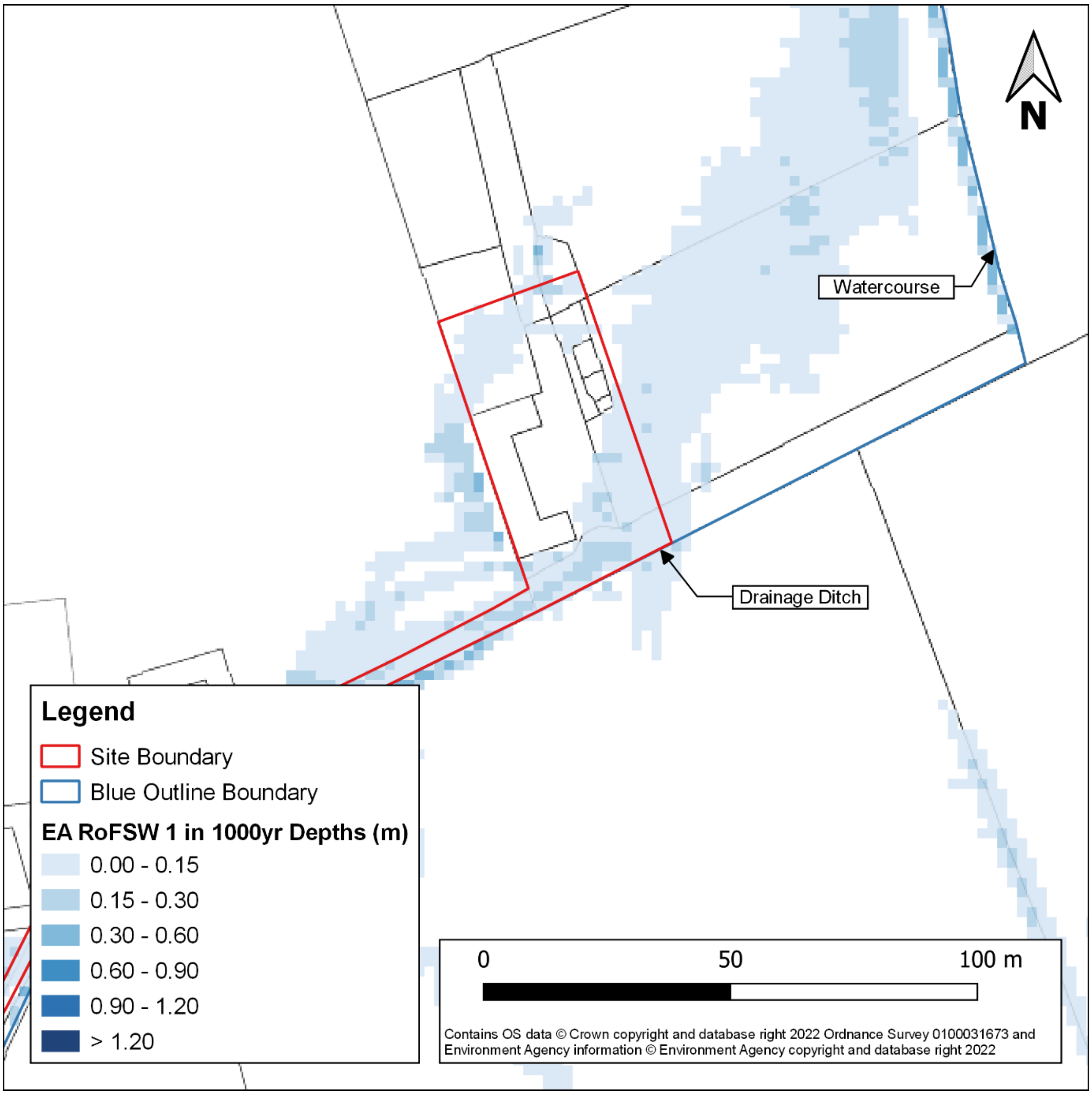


Figure 11: Risk of Flooding from Surface Water 1 in 1000 year Depth Map

Figure 11 indicates that a larger area of the wider site could be at risk of flooding during the 1 in 1000 year storm event. However, the area of land proposed to be developed upon is shown to remain flood free during this scenario.

RoFSW data shows that surface water flood extents could extend up to the proposed built footprint during the 1 in 1000 year storm event and reach depths of between 150-300mm along the southern and western peripheries. Greater depths of up to 600mm are anticipated 80m east, associated with the watercourse which flows along the eastern edge of the blue outline boundary.

Despite the modelled extents shown in the RoFSW dataset, no information has been provide to suggest that the site has historically flooded as a result of surface water flows.

From the Site

Increases in impermeable surfacing can alter the runoff regime at a site and can lead to increased surface water runoff rates and volumes when compared to the pre-developed situation.

Any additional surface water runoff can increase flood risk to third party land, create new flow paths and can lead to pollution of downstream waterways. Considering this, post development surface water runoff will need to be managed appropriately.

Refer to the Surface Water Drainage Strategy section for more information on how the surface water runoff will be managed at the development.

Groundwater

Groundwater flooding occurs when the water table rises up from the underlying rocks and emerges at the ground surface or within subsurface infrastructure (such as basements). Low lying areas that are underlain by permeable bedrock, superficial geology and aquifers are particularly susceptible to this form of flooding, especially during the winter months and after periods of heavy, sustained precipitation.

Unlike other mechanisms of flooding, groundwater flooding takes longer to dissipate as the water table needs to lower before any emerged flood water can soak back into the ground. As a result of this, whilst groundwater flooding does not pose a significant risk to life, flood waters can last for many months and can cause considerable damage to property.

According to Aylesbury Vale District Council Level 1 SFRA (May 2017), the district is generally at low risk from groundwater flooding with the main areas identified at risk of groundwater emergence underlain by superficial deposits.

The SFRA includes an extract from the Environment Agency's Areas Susceptible to Groundwater Flooding (AStGWf) map which shows the site to be located within an area classified as '<25% susceptible to groundwater flooding' (refer to Figure 12).

No further information has been provided to suggest that the site or surrounding area has historically been subject to groundwater flooding.

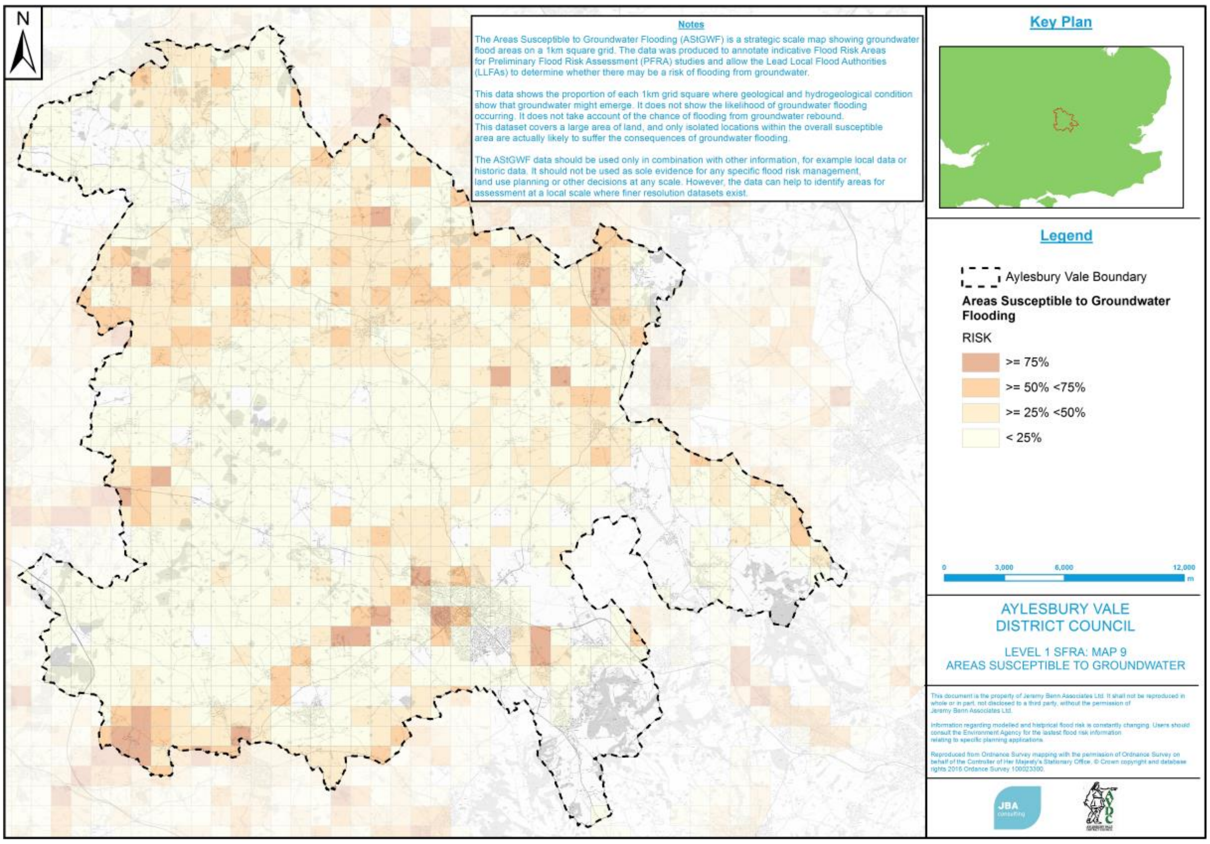


Figure 12: Areas Susceptible to Groundwater Flooding Map (Source: AVDC SFRA, 2017)

Sewer Surcharge

Sewer flooding occurs when the volume of water entering a drainage system is greater than the capacity of the sewer network. It is often experienced during periods of heavy rainfall, when a large amount of precipitation falls within a short period of time, and overloads the sewer system capacity causing a surcharge and localised short-term flooding.

Sewer flooding can also occur when the sewerage system is unable to discharge as intended. This is frequently caused by problems such as high water levels within the receiving watercourse, blockages, siltation and structural defects.

Historical incidents of sewer flooding are detailed by water companies in a DG5 register which records incidents of internal and external flooding relating to public foul, combined or surface water sewers and displays which properties suffered flooding. For confidentiality reasons, this data is generally supplied on a postcode basis from the Sewage Flooding History Database (SFHD). Aylesbury Vale District Council Level 1 SFRA includes details of the number of properties within a postcode region which have experienced sewer flood incidents, taken from the DG5 register. Details have been provided on a five digit postcode basis.

According to the Level 1 SFRA, 5-10 properties have reportedly experience sewer flooding in the postcode area which the development is located (HP22 4).

No further information has been provided to suggest that the site itself is susceptible to sewer surcharge flooding.

Reservoir

Reservoirs are artificially created lakes, typically formed by building a dam across an existing watercourse to hold water back. Whilst unlikely, flooding from reservoirs can occur as a result of water exceeding the reservoir capacity or structural failure of the dam or bank.

All large reservoirs are regulated under the Reservoirs Act 1975 and undergo regular maintenance to minimise the possibility of reservoir failure. This legislation is enforced by the Environment Agency and requires reservoirs to be routinely inspected and maintained to an appropriate standard. As an enforcement authority the Environment Agency is responsible for some 2,000 reservoirs in England and Wales.

The Environment Agency have produced a flood map which shows where water may go in the unlikely event of a dam or reservoir failure. Two flooding scenarios are shown on the reservoir flood maps:

- A 'dry-day' scenario which shows the predicted flood extents if a dam or reservoir failed when rivers are at normal levels
- A 'wet-day' scenario which shows how much greater the flood extent might be if a downstream river is already experiencing an extreme flood event

Review of the Environment Agency's Risk of Flooding from Reservoirs map indicates that the site is not located within the 'maximum extent of flooding from reservoirs'. As such, the development is not considered to be susceptible to reservoir failure.

Other Sources

No canals or other artificial infrastructure have been identified within the surrounding area which could pose a risk of flooding to the development.

Flood Risk Management

Finished Floor Levels and Surface Water Flood Risk Mitigation

Review of available data shows that the site is located entirely within Flood Zone 1. However, the EA's Risk of Flooding from Surface Water (RoFSW) dataset shows that land surrounding the development footprint could be at risk of surface water flooding.

RoFSW mapping indicates that flood depths of up to 150mm are anticipated to accumulate upon land adjacent south of the proposed built footprint during the 1 in 100 year scenario. Surface water depths of between 150-300mm have also been modelled along the southern and western peripheries of the proposed building slab during the 1 in 1000 year event.

To mitigate this potential risk, it is recommended that the Finished Floor Level of the proposed dwelling is set at least 300mm above the surrounding ground levels.

According to EA LiDAR information, ground levels adjacent to the proposed built footprint range between 93.50mAOD and 94.40mAOD. Therefore, it is recommended that the Finished Floor Level is set at least 94.70mAOD, 300mm above the surrounding ground levels.

Raising the Finished Floor Level 300mm above the surrounding ground levels will prevent water ingress from storm water flowing or ponding near doorways and other entry points such as low windows, vents and air bricks.

To further protect the development against the risk of surface water flooding, it is recommended that any external landscaping is designed to slope away from the proposed dwelling. This will help mitigate against overland flows being directed towards the dwelling during storm events and will reduce the risk of stormwater ponding at threshold entry points and stormwater ingress.

Furthermore, given that the proposed development will introduce impermeable surfacing at the site, the client has agreed to incorporate Sustainable Urban Drainage System (SuDS) techniques within the proposals to mitigate against increased flood risk to third party land and deterioration of the receiving water environment. Refer to the Surface Water Drainage Strategy section for more information on how post development surface water runoff will be managed.

Groundwater Flood Risk Mitigation

Whilst the site has been shown to be located in an area that is '<25% susceptible to groundwater flooding', it is recommended that the floor of the new dwelling is made of either solid construction materials or the ground beneath the suspended floor is sealed. This mitigation measure will protect against the unlikely occurrence of groundwater ingress should water table levels fluctuate in the future.

Flood Warnings and Alerts

The development site is not located within an EA Flood Warning or Alert area. However, future residents should be advised to monitor weather forecasts by signing up to the Met Office weather warnings.

Safe Access and Egress

The NPPF requires all new residential developments in areas at risk of flooding to demonstrate a route of safe escape for residents and site users which can be maintained for the lifetime of the development.

Whilst the proposed application is for construction of a new dwelling, the development is located entirely within Flood Zone 1. Therefore, in accordance to guidance a route of safe escape is not required.

Despite this, the following paragraphs detail how safe refuge and safe escape can be provided at the development.

Given that the Finished Floor Level of the proposed dwelling will be set at least 300mm above the nearest area of land modelled to be at risk of surface water flooding during the 1 in 100 year event, it is considered that safe refuge can be provided within the residential dwelling itself.

Safe access and egress to and from the development can be provided via the private access road which leads to Northcroft then onto High Street. Safe escape can be achieved to an area outside of the 1 in 100 year surface water flood extent approximately 130m south west of the development (refer to Figure 13).

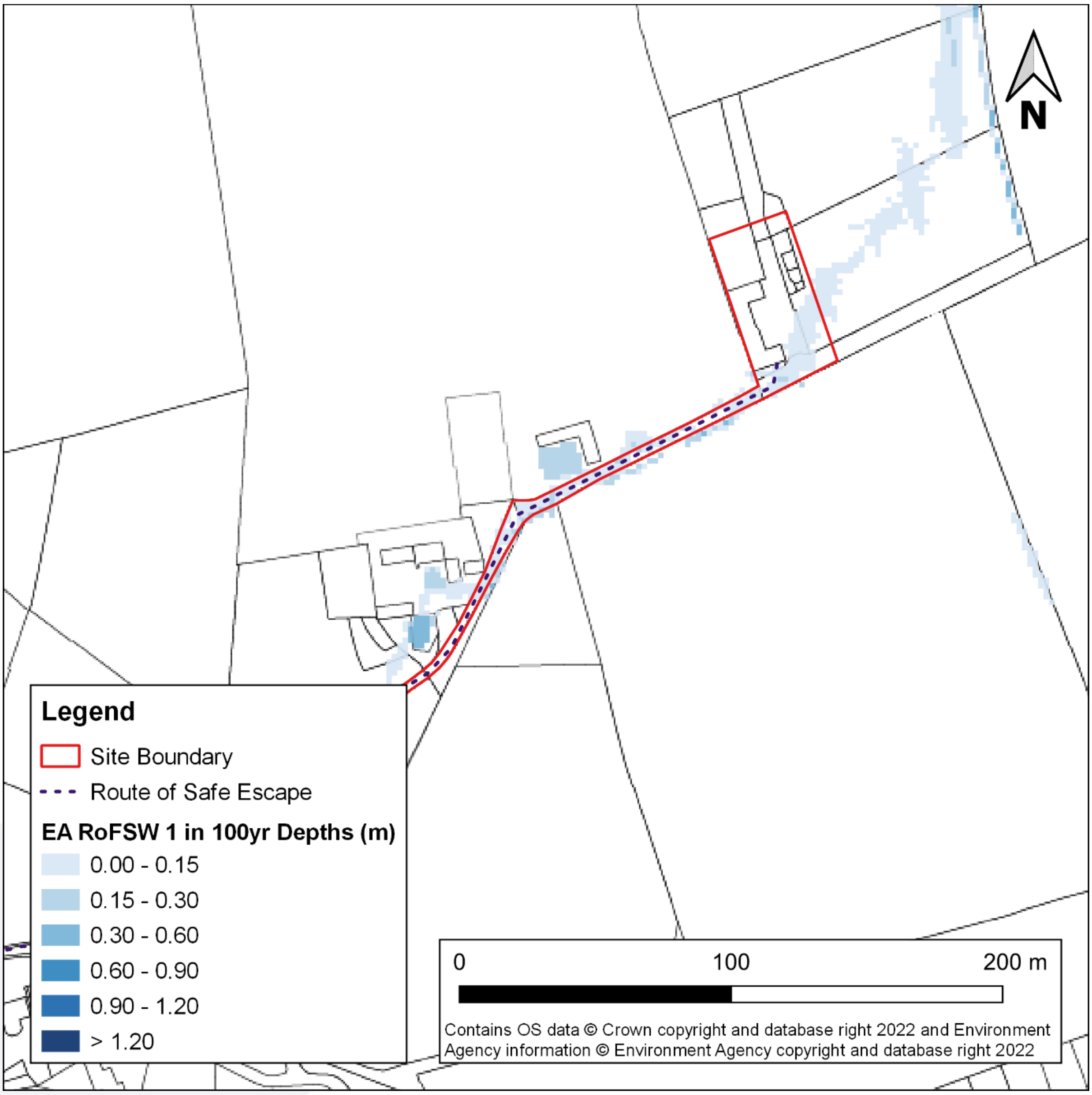


Figure 13: Route of Safe Access and Egress

Surface Water Drainage Strategy

Planning and Relevant Guidance

Given that the proposed development will alter the impermeable surfacing at the site and will impact the existing runoff regime, details of post development surface water management will be required to accompany the planning proposals.

The aim of this Surface Water Drainage Strategy is to assess how surface water runoff generated by the proposed development can be managed now and for the lifetime of the development so that future site users and third party land will not be at an increased risk of flooding as a result of the proposals.

This Surface Water Drainage Strategy has been designed in accordance with national and local guidance including:

- Buckinghamshire Council Minor Applications Sustainable Drainage Guidance (July 2020)
- Buckinghamshire Council's Vale of Aylesbury Local Plan (September 2021)
- National Planning Policy Framework
- Planning Practice Guidance on Flood Risk and Coastal Change (Updated August 2022)
- Sustainable Drainage Systems: Non-Statutory Technical Standards
- CIRIA SuDS Manual (c753)
- Sewerage Sector Guidance – Design and Construction Standards
- ICE SuDS Route Maps

Peak Rainfall Intensity Allowance

In May 2022 the Environment Agency issued revised peak rainfall intensity allowances for Management Catchments in England. The update introduced a regional variation in rainfall uplifts to account for Climate Change based on Management Catchment and development lifetime.

The Environment Agency published the Peak Rainfall Allowance Map which shows anticipated changes in peak rainfall intensity over time based on drainage catchment. According to the EA's Peak Rainfall Allowance Map the site is located within the Thames and South Chilterns Management Catchment. Peak rainfall allowances for this catchment are as follows:

3.3% Annual Exceedance Rainfall Event		
Epoch	**Central Allowance**	**Upper End Allowance**
2050s	20%	35%
2070s	25%	35%
1% Annual Exceedance Rainfall Event		
Epoch	**Central Allowance**	**Upper End Allowance**
2050s	20%	40%
2070s	25%	40%

Table 5: Thames and South Chilterns Management Catchment Peak Rainfall Allowances

The specific Climate Change allowance required to the be applied within the attenuation storage calculations to account for future change in peak rainfall intensity is dependent on the design lifetime of the proposed development.

In accordance with the development lifetime guidance, residential developments should be considered to have a minimum lifetime of 100 years. Developments with a lifetime beyond 2100 should use the Upper End Allowance for the 2070s epoch for both the 1% and 3.3% annual exceedance probability events.

As such, this drainage strategy has been designed to accommodate all surface water runoff during the 1% annual exceedance probability Upper End Allowance (40%) Climate Change event.

Urban Creep

Urban creep is the conversion of permeable surfaces to impermeable over time. Typical examples include paving of front gardens to provide parking or extensions to existing buildings.

An allowance for urban creep is required to be considered within the drainage design for residential developments only to account for the incremental change of use from permeable to impermeable surfacing over the lifetime of a development.

Where applicable, the following allowances must be applied to the impermeable area within the site curtilage to account for urban creep:

Residential Development Density (Dwellings per Hectare)	Urban Creep Allowance (%)
≤ 25	10
30	8
35	6
45	4
≥ 50	2
Flats and Apartments	0

Table 6: Urban Creep Allowances

Note: Where the inclusion of the urban creep allowance would increase the total impermeable area to greater than 100% of the site area, the drainage system should be sized to accommodate runoff generated by 100% of the site area.

Given the nature of the proposed development and the site's intended use, a 10% allowance for urban creep has been accounted for within the design calculations.

Proposed Surface Water Drainage Scheme

Drainage Hierarchy

In accordance with NPPF guidance and the CIRIA SuDS manual all surface water drainage strategies should follow the Drainage Hierarchy whereby discharge options are considered in the following order:

1. Stormwater reuse,
2. Discharge to ground,
3. Discharge to watercourse,
4. Discharge to surface water sewer,
5. Discharge to combined sewer.

The following sections detail how the drainage hierarchy has been followed and each of the discharge locations considered as part of this drainage strategy.

Water Re-Use (Optional)

Review of the design layout indicates that extensive planting and soft landscaping is proposed within the scheme. Therefore, it is considered likely that there will be a demand for non-potable water supply post development.

Rainwater butts offer a simple mechanism for water re-use. They typically take the form of an above ground storage tank which collects roof runoff from building downpipes. Any stored water within the rainwater butt can subsequently be drawn off at a later time for non-potable uses such as wash-down purposes or irrigation use. In accordance with CIRIA SuDS Manual water re-use SuDS provide an *'indirect amenity value by supporting the resilience of developments and their landscape to changes in climate and water resource availability'*.

Rainwater butts are simple to incorporate within residential developments and can easily be added onto building downpipes at any stage of a development, with the tank overflow connected to the site's wider drainage system.

In practise, water re-use SuDS provide little in the way of attenuation storage therefore are not accounted for within the formal attenuation storage calculations. However, they do increase the lag time for storm water to enter a drainage system.

In light of the above, it is considered that there would a benefit from incorporating rainwater butts into the scheme as a form of water re-use SuDS to reduce post development water demand.

Infiltration to Ground

Review of British Geological Survey (BGS) records indicates that the site is located directly upon Kimmeridge Clay Formation (Mudstone) bedrock.

Additionally, Landis Soilscapes suggests that the site is located in area where the soils are classified as 'slowly permeable, seasonally wet, slightly acid but base-rich loamy and clayey soils' with impeded drainage.

In light of the this, it is considered that a scheme based on infiltration to ground is not feasible at the site. As such infiltration to ground has not been considered further.

Discharge to Watercourse

The client has confirmed that a drainage ditch runs in an easterly direction, adjacent south of the site access road. In addition, a second watercourse is located approximately 80m east of the development and flows in a northerly direction.

Comparison of the elevation of both water features with the development indicates that the invert level of the drainage ditch to the south of the access road is elevated higher than the invert level of the proposed SuDS features. As such discharge to this location would require pumping, thus is not considered favourable and has not be explored further.

However, the top of bank of the watercourse 80m east of the site is elevated approximately 2.0m lower than ground levels within the development boundary. Therefore, it is considered that gravity connection could be achieved to this watercourse.

Whilst the stream is located some 80m east of the red outline boundary the client has confirmed that the land between the development and the watercourse is within their ownership. As such, discharge across this land can be achieved without the need to obtain third party land owner permission and the conveyance infrastructure proposed to be run across this land can be maintained by the owner-developer for the lifetime of the development.

Given the above, it is proposed to discharge all post development runoff at a controlled rate to the section of watercourse some 80m east of the development.

Discharge to Sewer

It is proposed to discharge post development runoff to watercourse therefore a connection to the main sewer network has not been explored within this drainage strategy.

Existing Runoff Rates

The Institute of Hydrology Report 124 Flood Estimation for Small Catchments (IH124) is appropriate for use where the site area is between 0 – 200 ha. Where the site is less than 50ha the analysis for determining the peak run-off-rate should use 50ha in the formula and scale it down using linear interpolation.

Considering that the site area is below 50ha the ICP SuDS method has been used to estimate the greenfield runoff rate for several return period events including QBAR.

Storm Event	Greenfield Runoff Rate (l/s)
QBAR	0.8
1 in 1 year	0.7
1 in 30 year	1.9
1 in 100 year	2.7

Table 7: Greenfield Runoff Rates

However, the site is currently occupied by brownfield land and underlain by approximately 316m^2 of hardstanding comprising the existing barn footprint (256m^2) and outbuilding roof areas (60m^2). Therefore, the greenfield rates detailed above are not considered to represent the current situation at the site.

Brownfield runoff rates for the 1-year, 30-year and 100-year 15-minute storm duration events have been calculated using the Modified Rational Method. Refer to Table 8 (below). The rates shown in Table 8 are based on the existing barn footprint only (256m^2).

Storm Event	Existing Runoff Rate (l/s)	Proposed Runoff Rate (l/s)	Pre/Post Development Change (%)
1 in 1 year	2.45	1.0	- 59
1 in 30 year	6.12	1.0	- 83
1 in 100 year	7.79	1.0	- 87
1 in 100 year + 40% CC	-	1.0	-

Table 8: Existing Runoff Rates from the Barn Footprint Only

Despite the calculated existing runoff rates, it is proposed that post development runoff from the site is limited to a maximum rate of 1.0 l/s. Restricting post development runoff to a maximum rate of 1.0 l/s will provide significant betterment for all return period scenarios when compared to the existing situation (as detailed in the final column of Table 8).

Restricting runoff to a maximum rate of 1.0l/s via hydro-brake equates to a 53mm diameter orifice with a 500mm head. In accordance with guidance a 50mm orifice diameter is considered the lowest practicable size to minimise the risk of blockage to the outflow control.

Attenuation Pond

It is proposed that all surface water runoff generated by post development impermeable surfacing at the site (408m^2) will be conveyed and stored within a new attenuation pond located in the north eastern corner of the site. The primary purpose of the pond will be to provide attenuation storage for all surface water runoff generated by new impermeable surfacing at the site. The use of above ground 'green' SuDS within the scheme will also offer biodiversity and amenity benefits for future residents.

Surface water runoff generated by the proposed dwelling roof (271m^2) and paved areas (88m^2), will be directed towards the pond via a combination of rills and subterranean pipework.

In order to collect and provide initial treatment for runoff generated by the three car parking spaces (49m^2) it is proposed to install a filter drain along the northern boundary of the car parking area. Any percolation which lands on the car parking area will follow the topographic profile of the ground and will be naturally directed towards the filter drain. The filter drain will be approximately 300-400mm wide and will have a perforated pipe at the base of the trench which will act as an underdrain. Once within the filter drain, any collected water will percolate through the graded gravel and be conveyed via subterranean surface water pipework towards the proposed pond.

From the pond any stored water will be gradually discharged to a section of the existing watercourse located 80m east of the red outline boundary at a restricted rate of 1.0l/s via hydro-brake control device or similar.

Given the nature of the development a 10% allowance for urban creep needs to be taken into account within the design calculations. As such, the proposed SuDS system has been designed based on a total impermeable contribution area of 449m^2.

All preliminary surface water drainage calculations have been undertaken using Innovyze InfoDrainage software. The InfoDrainage calculation sheets are included in Appendix C.

Preliminary calculations indicate that approximately 20m^3 of storage will be required to accommodate all runoff generated by 449m^2 of impermeable surfacing for all storms up to and including the 1 in 100 year plus (40%) climate change event, whilst limiting discharge to 1.0l/s.

Calculations show that a pond with a surface area of 102m^2 and an attenuation depth of 0.5m will provide sufficient storage to accommodate all runoff generated by 449m^2 of impermeable surfacing during the 1 in 100 year plus (40%) climate change event. This accounts for a 1:3 side slope and a 0.5m wide wet bench for safety.

The pond offers an opportunity to enhance biodiversity in the area and provides an amenity space for future residents. To maximise the SuDS feature's potential in delivering on both of these pillars the pond will retain a permanent water level at a depth of 0.5m. The attenuation volume required to store runoff generated by the development during the design storm event will be located above the permanent water level but below the required 0.3m freeboard. Provision of a 0.3m freeboard, above the maximum water level, has been incorporated within the pond design to mitigate against residual flood risk as a result of potential blockage or exceedance storm events.

The client would like to connect the SuDS pond with the existing pond in the north eastern corner of the site. However, for the purposes of this report the SuDS calculations have been based on provision of a separate SuDS pond feature to confirm that sufficient storage is provided within the scheme to accommodate all runoff generated by post development impermeable surfacing during the 1 in 100 year plus (40%) Climate Change event.

Raingardens (Optional Addition)

Raingardens (also referred to as bioretention schemes) can take the form of shallow landscaped depressions or raised planters and are used to reduce rainfall runoff whilst also mitigating the impact of pollution.

Raingardens are flexible, 'green' surface water drainage features which can be incorporated into most development schemes and provide a wide range of benefits including:

- Reducing rainfall runoff from a development,
- Improving water quality by removing sediment and other pollutants through the filtration process,
- Creating biodiverse habitats, and
- Enhancing amenity value for local residents and site users.

Having reviewed the proposed site layout, there is the opportunity to incorporate raingardens within the design proposals. According to plans provided by the client a planted area measuring approximately 45m^2 is proposed along the north and eastern boundary of the patio. This area could be utilised as a raingarden to provide additional attenuation storage upstream of the pond along with providing wider biodiversity and amenity benefits for future residents.

Roof runoff from the eastern and northern faces of the dwelling and runoff generated by the patio area could be directed into the raingarden area via downpipes and rills/linear drains. If incorporated within the design, it is recommended that stones and gravel are laid at the inlets within the raingarden(s) to dissipate the energy of entering water and prevent heavy flows from washing soils away.

Any water conveyed into the raingarden would percolate through the topsoil and be stored within a gravel sub-base. Given that the site is located on Kimmeridge Clay, and infiltration to ground is not considered feasible, a perforated under-drain would be required within the gravel sub-base of the raingarden(s) to direct any stored water towards the pond. The use of an under-drain would ensure that any water stored within the raingarden is drained effectively and prevents waterlogging.

Considering the cover and invert levels of the proposed pond SuDS system, should raingardens be utilised within the final design, the planted areas may need to be raised to allow gravity connection into the wider SuDS system.

Assuming that the raingarden area has a total depth of 0.8m (would require the planted area to be raised by approximately 400mm above the surrounding ground levels) a total additional attenuation storage volume of 13.05m^3 could be provided. Storage volume calculations have been undertaken in accordance with Designing Rain Gardens: A Practical Guide, by Urban Design London, and are detailed below.

Raingarden parameters:

- Area of raingarden - 45m^2
- Depth of freeboard - 0.2m
- Depth of topsoil (ratio 50% sand, 30% topsoil and 20% compost) - 0.3m
- Depth of sub-base - 0.3m
- Invert level of raingarden – approximately 93.10mAOD. This would allow gravity discharge from the raingarden(s) into the pond.

Depth of Storage (m)	=	Depth of Freeboard (m)	+	30% of Sub-base (m)
	=	0.2	+	30% of 0.3
	=	**0.29**		
Volume of Storage (m^3)	=	**Depth of Storage (m)**	x	**Area of Raingarden (m^2)**
	=	0.29	x	45
	=	**13.05**		

Note, the attenuation volume which could be provided by a raingarden have not been taken into account within the overall attenuation storage calculations provided for the site.

The proposed attenuation pond SuDS system alone provides sufficient storage to accommodate all runoff generated by the development during the 100 year plus (40%) Climate Change event. Therefore, should raingarden(s) be included within the final design proposals the overall SuDS scheme will provide an attenuation storage capacity greater than what is required by policy.

Design Exceedance

The proposed SuDS system has been designed to accommodate all surface water runoff generated by post development impermeable surfacing during the 1 in 100yr plus (40%) Climate Change event. As such, the SuDS system also has capacity to accommodate all runoff generated by the 1 in 30yr plus (35%) Climate Change rainfall event with no exceedance.

Despite this it is recommended that the profile of the site is designed to direct any exceedance surface water flows towards the formal drainage system.

In addition, it is advised that raised thresholds are put in place in line with building regulations, linear drains are installed at entrance points and all landscaping is designed to slope away from doorways. These measures will mitigate against water ingress.

Potential exceedance flow routes can be seen on the proposed SuDS layout plan in Appendix D.

Water Quality

In accordance with The Simple Index Approach, detailed in the CIRIA SuDS Manual, residential roof runoff is considered to have a 'very low' pollution hazard level (refer to Table 9). Nevertheless, it is recommended that debris / sediment traps are included on any new drainage.

Runoff from private driveways is considered to have a 'low' pollution hazard level.

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential Roofs	Very Low	0.2	0.2	0.05
Individual Property Driveways	Low	0.5	0.4	0.4

Table 9: Pollution Hazard Indices for Different Land Use Classifications

It is proposed to manage all surface water runoff via a combination of filter drain, attenuation pond and potentially raingardens (bioretention systems). Indicative SuDS mitigation indices for all proposed SuDS features are as follows:

Type of SuDS Component	Mitigation Indices		
	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Attenuation Pond	0.7	0.7	0.5
Filter Drain	0.4	0.4	0.4
Bioretention System	0.8	0.8	0.8

Table 10: Indicative SuDS Mitigation Indices for Discharges to Surface Waters

The proposed attenuation pond and filter drain will provide adequate treatment for surface water runoff and are shown to have a higher mitigation index than the pollution hazard index for the development. However, if the client decides to incorporate raingardens additional water quality benefits will be provided (as shown in Table 10).

Adoption and Maintenance

It is foreseen that all SuDS components will be maintained privately by the future site owner(s) / operators or an appropriate management company.

All SuDS components should be maintained in line with the guidance provided in The SuDS Manual (C753). The following operation and maintenance requirements are recommended for the SuDS elements proposed in this strategy.

Drainage Infrastructure	Required Action	Typical Frequency
Conveyance Pipes	Inspect and remove silt/debris. Jet where appropriate.	To be inspected annually and as required.
Chambers and Catchpits	Inspect and remove silt/debris. Jet where appropriate. Replace damaged covers.	To be inspected annually and following a large storm event.
Flow Control and Associated Chamber	Inspect for blockages and clear where required. Remediate any faults.	To be inspected annually and following a large storm event.

Table 11: Suggested Maintenance Requirements for Drainage Infrastructure

TABLE 23.1	Operation and maintenance requirements for ponds and wetlands	
Maintenance schedule	**Required action**	**Typical frequency**
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass – public areas	Monthly (during growing season)
	Cut the meadow grass	Half yearly (spring, before nesting season, and autumn)
	Inspect marginal and bankside vegetation and remove nuisance plants (for first 3 years)	Monthly (at start, then as required)
	Inspect inlets, outlets, banksides, structures, pipework etc for evidence of blockage and/or physical damage	Monthly
	Inspect water body for signs of poor water quality	Monthly (May – October)
	Inspect silt accumulation rates in any forebay and in main body of the pond and establish appropriate removal frequencies; undertake contamination testing once some build-up has occurred, to inform management and disposal options	Half yearly
	Check any mechanical devices, eg penstocks	Half yearly
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1 m above pond base; include max 25% of pond surface)	Annually
	Remove 25% of bank vegetation from water's edge to a minimum of 1 m above water level	Annually
	Tidy all dead growth (scrub clearance) before start of growing season (Note: tree maintenance is usually part of overall landscape management contract)	Annually
	Remove sediment from any forebay.	Every 1–5 years, or as required
	Remove sediment and planting from one quadrant of the main body of ponds without sediment forebays.	Every 5 years, or as required
Occasional maintenance	Remove sediment from the main body of big ponds when pool volume is reduced by 20%	With effective pre-treatment, this will only be required rarely, eg every 25–50 years
Remedial actions	Repair erosion or other damage	As required
	Replant, where necessary	As required
	Aerate pond when signs of eutrophication are detected	As required
	Realign rip-rap or repair other damage	As required
	Repair / rehabilitate inlets, outlets and overflows.	As required

Table 12: Maintenance Requirements for Ponds (Source: CIRIA SuDS Manual)

TABLE 16.1	Operation and maintenance requirements for filter drains	
Maintenance schedule	**Required action**	**Typical frequency**
Regular maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly (or as required)
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (eg NJUG, 2007 or BS 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

Table 13: Maintenance Requirements for Filter Drains (Source: CIRIA SuDS Manual)

TABLE 18.3	Operation and maintenance requirements for bioretention systems	
Maintenance schedule	**Required action**	**Typical frequency**
Regular inspections	Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary	Quarterly
	Check operation of underdrains by inspection of flows after rain	Annually
	Assess plants for disease infection, poor growth, invasive species etc and replace as necessary	Quarterly
	Inspect inlets and outlets for blockage	Quarterly
Regular maintenance	Remove litter and surface debris and weeds	Quarterly (or more frequently for tidiness or aesthetic reasons)
	Replace any plants, to maintain planting density	As required
	Remove sediment, litter and debris build-up from around inlets or from forebays	Quarterly to biannually
Occasional maintenance	Infill any holes or scour in the filter medium, improve erosion protection if required	As required
	Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch	As required
Remedial actions	Remove and replace filter medium and vegetation above	As required but likely to be > 20 years

Table 14: Maintenance Requirements for Rain Gardens (Source: CIRIA SuDS Manual)

Foul Drainage Strategy

Existing Foul Drainage

Considering the current use of the site it is assumed that there are no existing foul sewer connections.

Additionally, the client has confirmed that:

- there are no public sewer networks within vicinity to the site, and;
- foul sewerage from the wider Glebe Farm estate is managed via a private system.

Review of Foul Drainage Options

The most preferrable solution for managing foul effluent from new developments is to connect directly into a main foul sewer system managed by a local water authority.

However, in instances where there are no nearby mains foul drainage assets the General Binding Rules apply. These rules, published by the Environment Agency, outline the conditions that must be met for a septic tank or small sewage treatment plant to discharge waste water to ground or surface water.

Rule 15 of the General Binding Rules states that a development cannot meet the general binding rules if a public foul sewer is located within 30 metres of any boundary of the premises for which the proposed system is intended to serve.

Considering that the development is located 330m away from the nearest public road it can be confidently assumed that the development is not located within 30m of a public foul sewer. Additionally, the client has confirmed that there are no public foul sewers within proximity to the site and that Glebe Farmhouse relies on a private foul system.

Therefore, given the site's rural location, and the likely situation that any effluent would require pumping for some significant distance to reach a main foul asset, it is not considered appropriate or commercially viable to propose connection to a mains public sewer.

In light of this, it is anticipated that effluent generated by the proposed development will be managed via a suitably sized domestic sewage treatment plant located beneath soft landscaping adjacent to the dwelling.

Unlike traditional forms of private foul systems (septic tanks and cesspools), domestic sewage treatment plants 'clean' sewage waste so that waste water produced by a dwelling can be discharged without polluting or damaging the receiving environment. Treatment plants achieve this via three main treatment processes; sedimentation, aeration and settlement.

Sedimentation: the first phase of treatment, relies on gravity to separate the liquid and solid waste. Solid waste (known as sludge) is stored within the first chamber of the plant until disposed of by a professional service while the liquid waste is transferred to the plant's second 'aeration' chamber.

Aeration: compressed air is pumped into the second chamber to increase the oxygen content level within the liquid waste. Increased oxygen levels encourage the growth of aerobic bacteria which works to 'clean' the liquid waste before the treated effluent flows into the final chamber.

Settlement: in the final chamber is a calm area which allows the bacteria to settle at the bottom of the tank. The settled bacteria is moved into the first chamber for professional removal, while the cleaned waste water is ready for discharge to ground or watercourse.

Discharge Location

Review of BGS records indicates that the site is located upon Kimmeridge Clay therefore an infiltration field is unlikely to be a suitable mechanism for discharging treated water at the site.

Instead it is proposed to discharge treated waste water from the domestic sewage treatment plant to either the existing watercourse to the south of the access road or the watercourse to the east of the site. The final discharge location will be determined by the installation company.

In accordance with the government guidance (General Binding Rules: small sewage discharge to a surface water), discharge to watercourse is accepted by the Environment Agency, without the need for an environmental permit, if the installation meets all of the General Binding Rules for both existing and new discharges. More information can be found here: https://www.gov.uk/guidance/general-binding-rules-small-sewage-discharge-to-a-surface-water

Design Flows

In order to comply with the General Binding Rules, new discharges to surface water are required to be 5 cubic metres (5,000 litres) or less a day.

Given that the sewage treatment plant will be used to manage effluent generated by a single residential dwelling only, foul flows from the proposed development have been estimated using the governments daily discharge calculator.

Based on a single property with four bedrooms the treated sewage daily discharge rate is calculated to be 0.9 cubic metres per day. Therefore, it is considered that the daily discharge from a foul treatment system would comply with Rule 2 of the General Binding Rules.

Adoption and Maintenance

The domestic sewage treatment plant will be designed in accordance with BS EN 12566 standards.

The treatment plant will be privately owned and maintained.

The domestic sewage treatment plant and associated drainage infrastructure will be maintained in accordance with the manufacturer and supplier specifications.

Conclusions and Recommendations

GeoSon Limited have been instructed by Craig Smith of Flint Architects, on behalf of Sally M Jones, to undertake a Site Specific Flood Risk Assessment (FRA) with Surface Water and Foul Drainage Strategy to support a proposed planning application for development at Glebe Farm, Northcroft, Weedon.

The proposed development is located within the Glebe Farm estate and is situated approximately 130m north east of the main farmhouse. According to plans provided by the client the main area of the site (excluding the access road) is approximately 1860m^2 in size and is currently occupied by an agricultural barn, several outbuildings and a small pond in the north eastern corner.

The proposed planning application is for demolition of the existing barn and outbuildings followed by construction of a new single storey dwelling within the same built footprint as the original barn. According to plans provided by the client, post development the total impermeable area at the site will amount to approximately 408m^2, comprising 271m^2 of roof area and 137m^2 of hardstanding associated with the paving areas and three parking spaces.

However, it is worth noting that the site is classified as brownfield land and is already underlain by approximately 316m^2 of hardstanding. Therefore, the true increase in impermeable area as a result of the development will amount to only 92m^2.

Despite this, attenuation sizing within the drainage strategy has been based on a total impermeable area of 408m^2. As such, significant betterment will be provided post development when compared to the current situation.

Flood Risk Assessment Summary

According to the Environment Agency's Flood Map for Planning the site and surrounding area are located entirely within Flood Zone 1 (Low Probability), defined as land having less than a 1 in 1000 annual probability of fluvial flooding in any given year.

The EA's Risk of Flooding from Surface Water data shows that the site is located within an area at "Very Low" to "High" risk of flooding from surface water. Whilst the land upon which the dwelling is proposed to be developed has been modelled at "Very Low" to "Low" risk of surface water flooding, a swathe of land 5-10m south of the proposed building appears to be at "Moderate" to "High" risk.

Given that surface water flood extents have been identified within close proximity to the proposed development footprint, further analysis of modelled surface water flood depths has been undertaken (refer to Page 21).

According to Aylesbury Vale District Council Level 1 SFRA (May 2017) the development is located within an area classified as '<25% susceptible to groundwater flooding'. No further information has been provided to suggest that the site or surrounding area has historically been subject to groundwater flooding.

Aylesbury Vale District Council Level 1 SFRA also includes details of historical sewer flood incidents. According to the SFRA, 5-10 properties have reportedly experience sewer flooding in the postcode area which the development is located (HP22 4). Despite this, there is no information to suggest that the site itself is susceptible to sewer surcharge flooding.

The site is not considered to be susceptible to reservoir failure. No canals or other artificial infrastructure have been identified within the surrounding area which could pose a risk of flooding to the development.

The following flood risk mitigation measures are recommended:

- It is recommended that the Finished Floor Level of the proposed dwelling is set at least 300mm above the surrounding ground levels, at 94.70mAOD or higher. This will prevent water ingress from storm water flowing or ponding near doorways and other entry points such as low windows, vents and air bricks.
- Any external landscaping should be designed to slope away from the proposed dwelling, where possible.
- It is recommended that the floor of the new dwelling is made of either solid construction materials or the ground beneath the suspended floor is sealed. This mitigation measure will protect against the unlikely occurrence of groundwater ingress should water table levels fluctuate in the future.
- The development site is not located within an EA Flood Warning or Alert area. However, residents of the development should be advised to monitor weather forecasts by signing up to the Met Office weather warnings.
- Safe refuge can be provided within the residential dwelling itself. Safe access and egress to and from the development can be provided via the private access road which leads to Northcroft then onto High Street.

Surface Water and Foul Drainage Strategy Summary

It is proposed that post development discharge from the site will be restricted to a maximum rate of 1.0 l/s. Restricting post development runoff to a maximum rate of 1.0 l/s will provide significant betterment for all return period scenarios when compared to the existing situation (as detailed in the final column of Table 8).

It is proposed that all surface water runoff generated by post development impermeable surfacing at the site (408m^2) will be conveyed and stored within an attenuation pond located in the north eastern corner of the site via a combination of rills, filter drain and subterranean pipework. From the pond any stored water will be gradually discharged to a section of the existing watercourse located 80m east of the red outline boundary at a restricted rate of 1.0l/s via hydro-brake control device or similar.

Preliminary calculations indicate that approximately 20m^3 of storage will be required to accommodate all runoff generated by 449m^2 of impermeable surfacing for all storms up to and including the 1 in 100 year plus (40%) climate change event, whilst limiting discharge to 1.0l/s.

Calculations show that a pond with a surface area of 102m^2 and an attenuation depth of 0.5m will provide sufficient storage to accommodate all runoff generated by 449m^2 of impermeable surfacing during the 1 in 100 year plus (40%) climate change event. This accounts for a 1:3 side slope and a 0.5m wide wet bench for safety.

The SuDS system has been designed to accommodate all surface water runoff generated by post development impermeable surfacing during the 1 in 100yr plus (40%) Climate Change event. As such, the SuDS system has capacity to accommodate all runoff generated by the 1 in 30yr plus (35%) Climate Change rainfall event with no exceedance.

Provision of a pond offers an opportunity to enhance biodiversity in the area and provides an amenity space for future residents. To maximise the SuDS feature's potential in delivering on both of these pillars the pond will retain a permanent water level at a depth of 0.5m. The attenuation volume required to store runoff generated by the development during the design storm event will be located above the permanent water level but below the required 0.3m freeboard. Provision of a 0.3m freeboard, above the maximum water level, has been incorporated within the pond design to mitigate against residual flood risk as a result of potential blockage or exceedance storm events.

In addition to a pond, there is the potential to incorporate a rainwater butt and raingardens within the proposals (considered an optional addition in this strategy). Should raingardens be included within the final design proposals the overall SuDS schemes will provide an attenuation storage capacity greater than what is required by policy.

The proposed attenuation pond and filter drain will provide adequate treatment for surface water runoff and are shown to have a higher mitigation index than the pollution hazard index for the development.

It is anticipated that effluent generated by the proposed development will be managed via a suitably sized domestic sewage treatment plant located beneath soft landscaping adjacent to the dwelling. It is proposed to discharge treated waste water from the domestic sewage treatment plant to either the existing watercourse to the south of the access road or the watercourse to the east of the site. The final discharge location will be determined by the installation company.

In accordance with the government guidance (General Binding Rules: small sewage discharge to a surface water), discharge to watercourse is accepted by the Environment Agency, without the need for an environmental permit, if the installation meets all of the General Binding Rules for both existing and new discharges.

Appendix

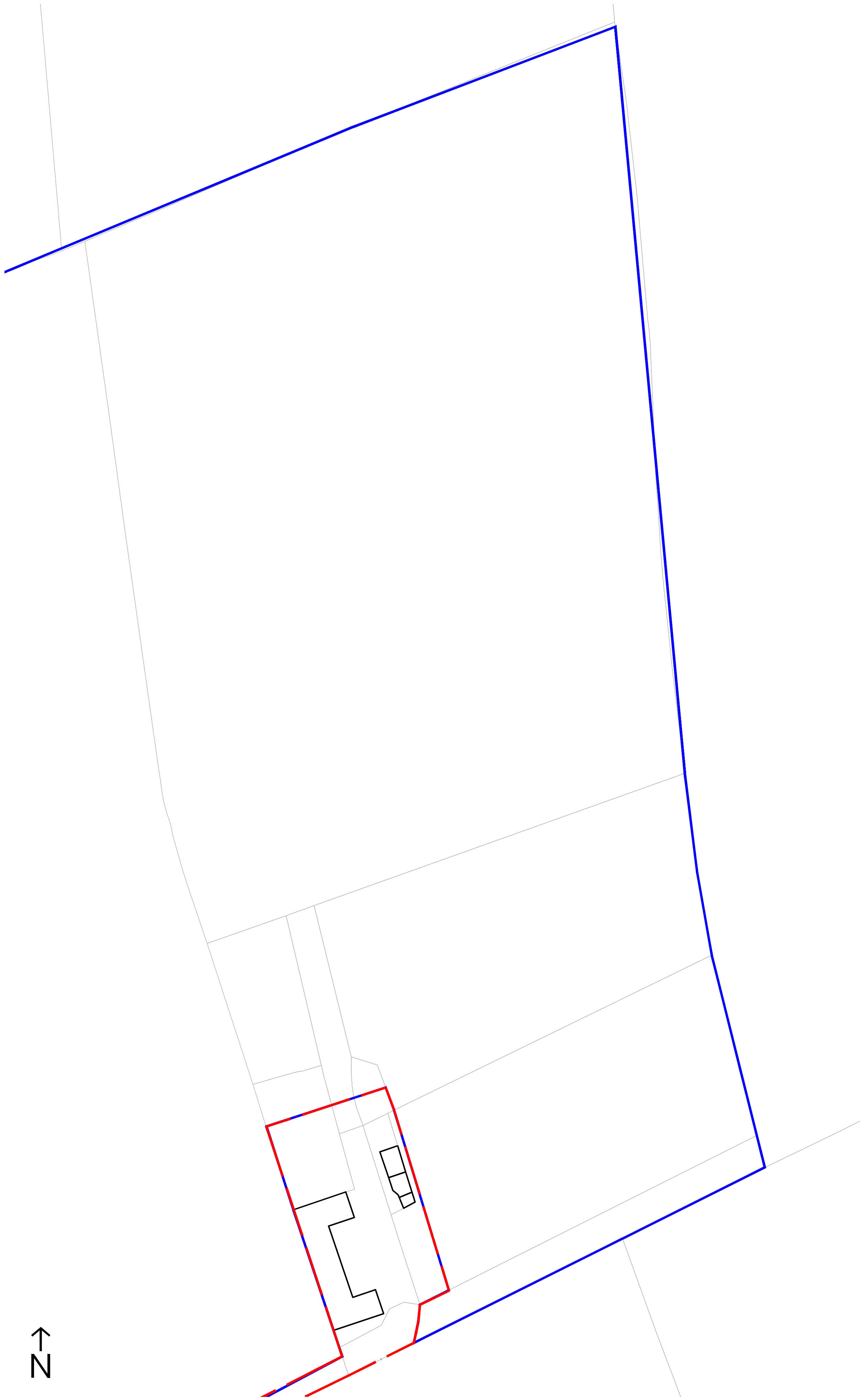
A. Existing Plans / Topographic Survey

B. Development Proposals

C. Calculation Sheets
- ICP SUDS Greenfield Runoff Calculations
- Modified Rational Method Brownfield Runoff Calculations
- Innovyze InfoDrainage Pond Sizing Calculations

D. Proposed SuDS Layout Plan

Appendix A

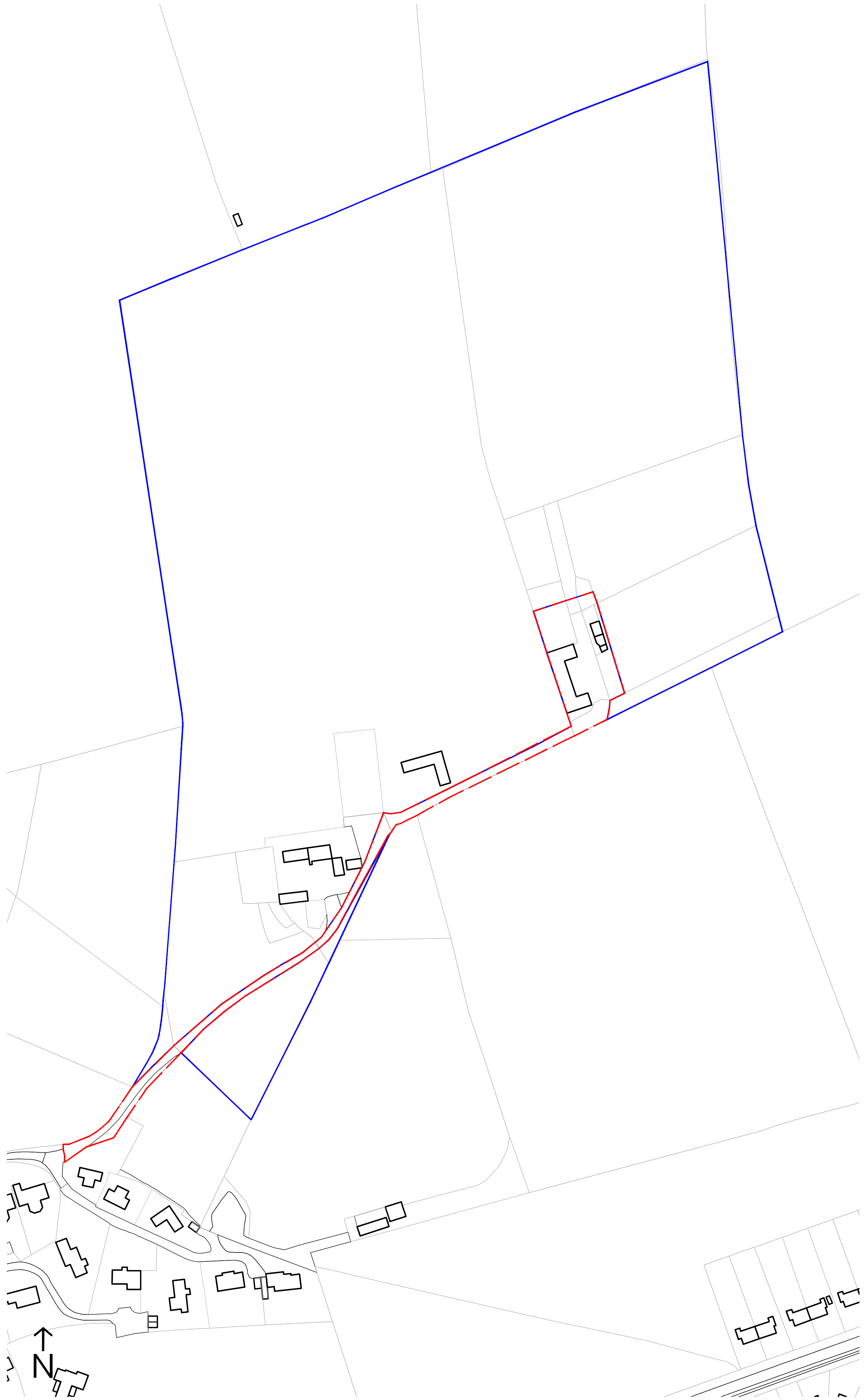


LOCATION PLAN

1:1250 @A3

1: 1250

0 5 10 20 50 100m



LOCATION PLAN

1:2500 @A3

1: 2500

0 20 40 60 80 100 200m

NOTES

KEY:

LAND OWNERSHIP

SITE BOUNDARY

EXISTING

PROPOSED

For planning purposes only

All dimensions to be checked on site prior to commencement of any works, and/or preparation of any shop drawings.

Existing dimensions from survey information by Target Surveys

All marked dimensions are indicative.

All temporary works to be responsibility of the contractor.

This drawing to be read in conjunction with all relevant Architect's drawings, specifications and other Consultant's information.

REV	DATE	DESCRIPTION	DRAWN

CLIENT
JONES

PROJECT
GLEBE FARM BARN
WEEDON

DRAWING TITLE
LOCATION PLAN

STATUS
PLANNING

PROJECT No	DWG TYPE	DWG No	REV
FA018	PL	010	00

SCALE	DATE	DRAWN	CHECKED
1:1250@A3	SEP '20	CS	

CONTRACTOR TO CHECK SITE DIMENSIONS AND REPORT ANY VARIATIONS OR OMISSIONS. NOT FOR CONSTRUCTION. FOR PLANNING ONLY. DO NOT SCALE FROM THESE DRAWINGS

NOTES

KEY:

LAND OWNERSHIP

SITE BOUNDARY

EXISTING

PROPOSED

For planning purposes only

All dimensions to be checked on site prior to commencement of any works, and/or preparation of any shop drawings.

Existing dimensions from survey information by Target Surveys

All marked dimensions are indicative.

All temporary works to be responsibility of the contractor.

This drawing to be read in conjunction with all relevant Architect's drawings, specifications and other Consultant's information.

REV	DATE	DESCRIPTION	DRAWN

CLIENT
JONES

PROJECT
GLEBE FARM BARN
WEEDON

DRAWING TITLE
EXISTING SITE PLAN

STATUS
PLANNING

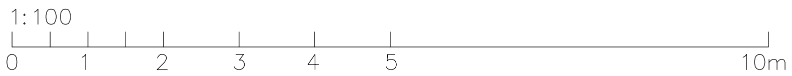
PROJECT No	DWG TYPE	DWG No	REV
FA018	PL	011	00

SCALE	DATE	DRAWN	CHECKED
1:200@A3	SEP'20	CS	

CONTRACTOR TO CHECK SITE DIMENSIONS AND REPORT ANY VARIATIONS OR OMISSIONS. NOT FOR CONSTRUCTION. FOR PLANNING ONLY. DO NOT SCALE FROM THESE DRAWINGS

Existing Ground Floor Plan

1:100



NOTES

KEY:

- LAND OWNERSHIP
- SITE BOUNDARY
- EXISTING
- PROPOSED

For planning purposes only

All dimensions to be checked on site prior to commencement of any works, and/or preparation of any shop drawings.

Existing dimensions from survey information by Target Surveys

All marked dimensions are indicative.

All temporary works to be responsibility of the contractor.

This drawing to be read in conjunction with all relevant Architect's drawings, specifications and other Consultant's information.

REV	DATE	DESCRIPTION	DRAWN

CLIENT
JONES

PROJECT
GLEBE FARM BARN
WEEDON

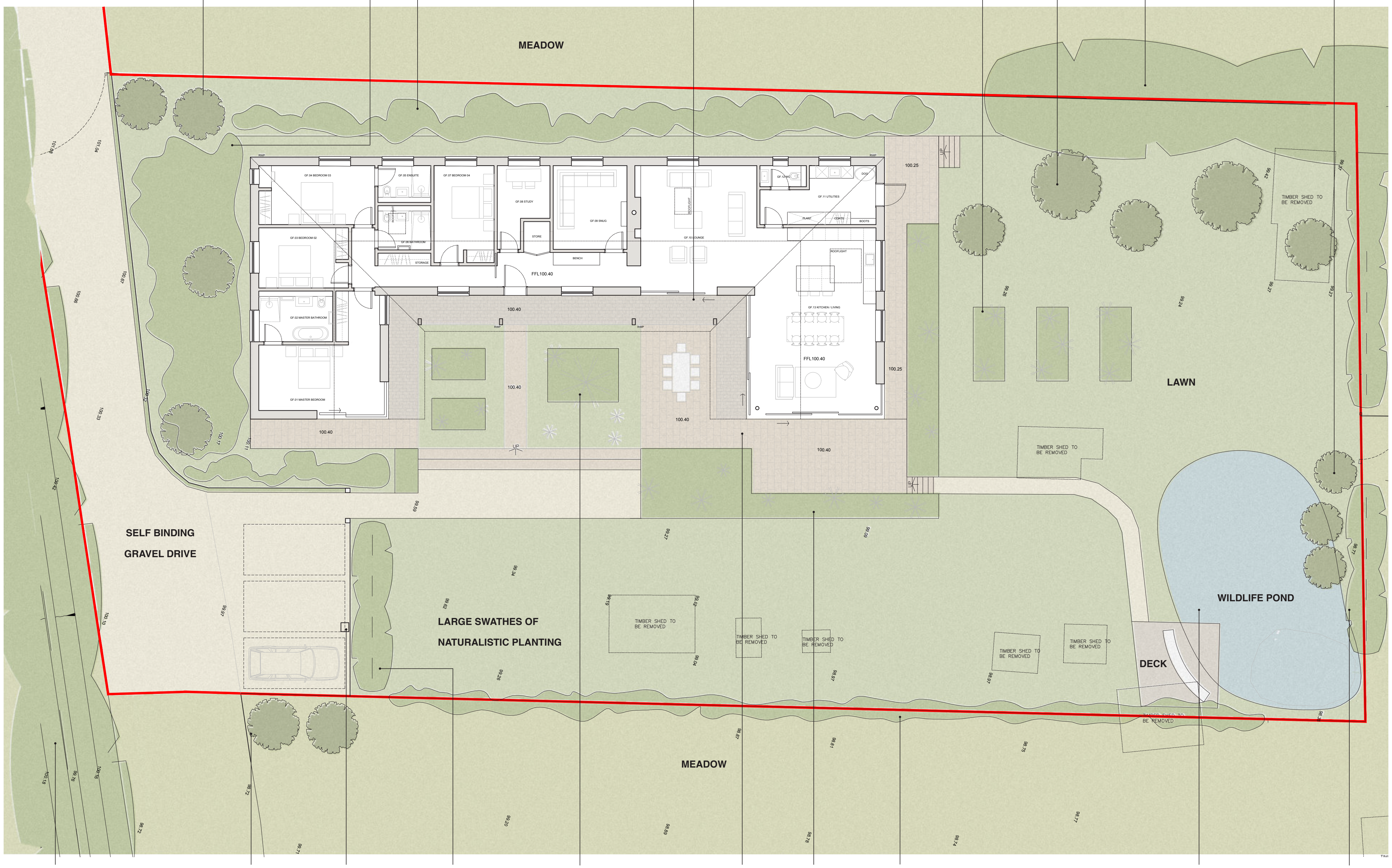
DRAWING TITLE
EXISTING GROUND FLOOR PLAN

STATUS
PLANNING

PROJECT No	DWG TYPE	DWG No	REV
FA018	PL	020	00

SCALE	DATE	DRAWN	CHECKED
1:100@A3	SEP '20	CS	

Appendix B



Proposed Site Plan
1:200

2 5 10 15 20m

NOTES

1. For planning purposes only.
2. Proposed works are based upon survey information provided by Target Surveys.
3. The Architect is not responsible for discrepancies in survey information.
4. Do not scale
5. All dimensions to be checked on site prior to commencement of any works, and/or preparation of any shop drawings.
6. All co-ordinates, levels, dimensions and discrepancies are to be reported to the Architect.
7. All temporary works to be responsibility of the contractor.
8. This drawing to be read in conjunction with all relevant Architect's drawings, specifications and other Consultant's information.

KEY

Site Boundary

Proposed

REV	DATE	DESCRIPTION	DRAWN

CLIENT
JONES

PROJECT
GLEBE FARM
WEEDON

DRAWING TITLE
PROPOSED SITE PLAN

STATUS
PLANNING

PROJECT No	DWG TYPE	DWG No	REV
FA018	PL	200	03

SCALE	DATE	DRAWN	CHECKED
1:200	FEB '23	CS	

FLINT ARCHITECTS

CHANDOS HOUSE
BACK STREET
WENDOVER
HP22 6EB

info@flintarchitects.co.uk
www.flintarchitects.co.uk

Appendix C

Project: Greenfield Runoff Rates	Date: 29/11/2022		
	Designed by: TS	Checked by:	Approved By:
Report Title: UK and Ireland Rural Runoff Calculator	Company Address: GeoSon Limited		

ICP SUDS / IH 124

Details

Method	ICP SUDS
Area (ha)	0.186
SAAR (mm)	658.0
Soil	0.47
Region	Region 6
Urban	0
Return Period (years)	0

Results

Region	QBAR Rural (L/s)	QBAR Urban (L/s)	Q 1 (years) (L/s)	Q 30 (years) (L/s)	Q 100 (years) (L/s)
Region 6	0.8	0.8	0.7	1.9	2.7

Modified Rational Method Calculation Sheet

Qp = CiA/0.36

	T (Return Period)		
	1 in 1 year	**1 in 30 year**	**1 in 100 year**
Qp (l/s)	**2.45**	**6.12**	**7.79**
C	1.17	1.17	1.17
ARF x i (mm/hr)	29.46	73.58	93.60
A (ha)	0.0256	0.0256	0.0256

Modified Rational Method Workings for the 15-Minute Storm Duration:

	1 in 1 year	1 in 30 year	1 in 100 year
	Determination of C		
Cv	0.9	0.9	0.9
Cr	1.3	1.3	1.3
C	1.17	1.17	1.17
	Determination of i		
M5-60min (mm)	20	20	20
r	0.412	0.412	0.412
D (mins)	15	15	15
T (yrs)	1	30	100
	Determination of M5-D		
Z1	0.637	0.637	0.637
M5-D (mm)	12.74	12.74	12.74
	Determination of MT-D		
Z2	0.615	1.536	1.954
MT-D (mm)	7.84	19.57	24.89

	Determination of point rainfall intensities		
i (mm/hr)	31.34	78.27	99.58
	Application of areal reduction factor		
ARF	0.94	0.94	0.94
i (mm/hr)	29.46	73.58	93.60

Catchment Area

Type : Catchment Area

Area (ha)	0.045

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	100

Project: Attenuation Pond Sizing 1 in 30yr plus (35%) Climate Change Event	Date: 12/12/2022		
	Designed by: TS	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Storm Phase: Phase	Company Address: GeoSon Limited		

Pond

Type : Pond

Dimensions

Exceedance Level (m)	93.300
Depth (m)	0.800
Base Level (m)	92.500
Freeboard (mm)	300
Initial Depth (m)	0.000
Porosity (%)	100
Average Slope (1:X)	3.596
Total Volume (m³)	20.401

Depth (m)	Area (m²)	Volume (m³)
0.000	25.00	0.000
0.500	59.00	20.401
0.501	73.00	20.467
0.800	102.00	46.509

Inlets

Inlet

Inlet Type	Point Inflow
Incoming Item(s)	Catchment Area
Bypass Destination	(None)
Capacity Type	No Restriction

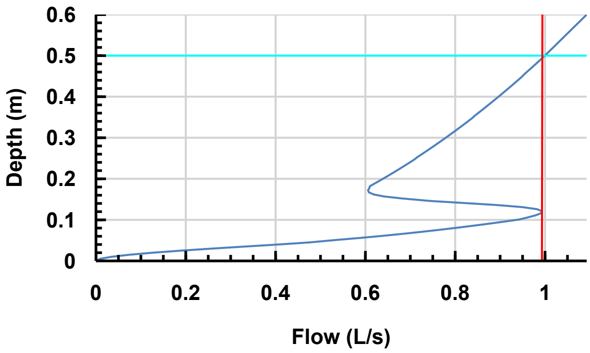
Outlets

Outlet

Outgoing Connection	(None)
Outlet Type	Hydro-Brake®

Invert Level (m)	92.500
Design Depth (m)	0.500
Design Flow (L/s)	1.0
Objective	Minimise Upstream Storage Requirements
Application	Surface Water Only
Sump Available	☐

Unit Reference	CHE-0053-1000-0500-1000



Advanced

Perimeter	Circular
Length (m)	13.000
Friction Scheme	Manning's n
n	0.035

Project: Attenuation Pond Sizing 1 in 30yr plus (35%) Climate Change Event	Date: 12/12/2022		
	Designed by: TS	Checked by:	Approved By:
Report Title: Rainfall Analysis Criteria	Company Address: GeoSon Limited		

Runoff Type	Dynamic
Output Interval (mins)	5
Time Step	Default
Urban Creep	Apply Global Value
Urban Creep Global Value (%)	0
Junction Flood Risk Margin (mm)	300
Perform No Discharge Analysis	☐

Rainfall

FSR

Type: FSR

Region	England And Wales
M5-60 (mm)	20.0
Ratio R	0.412
Summer	☑
Winter	☑

Return Period

Return Period (years)	Increase Rainfall (%)
30.0	35.000

Storm Durations

Duration (mins)	Run Time (mins)
15	30
30	60
60	120
120	240
180	360
240	480
360	720
480	960
600	1200
720	1440
960	1920
1440	2880
2160	4320
2880	5760
4320	8640
5760	11520
7200	14400
8640	17280
10080	20160

Project: Attenuation Pond Sizing 1 in 30yr plus (35%) Climate Change Event	Date: 12/12/2022		
	Designed by: TS	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Company Address: GeoSon Limited		

Summary Results for Pond: Rank By: Max. Avg. Depth

Storm Event	Max. US Level (m)	Max. DS Level (m)	Max. US Depth (m)	Max. DS Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Total Lost Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Half Drain Down Time (mins)	Percentage Available (%)	Status
FSR: 30 years: +35 %: 15 mins: Summer	92.750	92.750	0.250	0.250	20.0	8.079	0.000	0.000	0.9	1.029	79	60.399	OK
FSR: 30 years: +35 %: 15 mins: Winter	92.775	92.775	0.275	0.275	21.0	9.097	0.000	0.000	0.7	1.084	107	55.411	OK
FSR: 30 years: +35 %: 30 mins: Summer	92.799	92.799	0.299	0.299	13.1	10.117	0.000	0.000	1.0	2.311	114	50.411	OK
FSR: 30 years: +35 %: 30 mins: Winter	92.828	92.828	0.328	0.328	13.8	11.422	0.000	0.000	0.9	2.428	137	44.011	OK
FSR: 30 years: +35 %: 60 mins: Summer	92.834	92.834	0.334	0.334	11.2	11.681	0.000	0.000	0.9	4.947	157	42.743	OK
FSR: 30 years: +35 %: 60 mins: Winter	92.868	92.868	0.368	0.368	10.1	13.295	0.000	0.000	1.0	5.195	162	34.832	OK
FSR: 30 years: +35 %: 120 mins: Summer	92.846	92.846	0.346	0.346	8.0	12.247	0.000	0.000	0.9	9.954	143	39.970	OK
FSR: 30 years: +35 %: 120 mins: Winter	92.885	92.885	0.385	0.385	6.5	14.159	0.000	0.000	0.9	10.507	153	30.599	OK
FSR: 30 years: +35 %: 180 mins: Summer	92.842	92.842	0.342	0.342	6.2	12.051	0.000	0.000	1.0	14.433	126	40.932	OK
FSR: 30 years: +35 %: 180 mins: Winter	92.880	92.880	0.380	0.380	4.8	13.863	0.000	0.000	1.0	15.229	166	32.048	OK
FSR: 30 years: +35 %: 240 mins: Summer	92.834	92.835	0.334	0.335	5.1	11.714	0.000	0.000	1.0	19.028	144	42.580	OK
FSR: 30 years: +35 %: 240 mins: Winter	92.871	92.870	0.371	0.371	3.9	13.438	0.000	0.000	1.0	20.269	151	34.130	OK
FSR: 30 years: +35 %: 360 mins: Summer	92.818	92.818	0.318	0.318	3.8	10.952	0.000	0.000	1.0	21.532	128	46.319	OK
FSR: 30 years: +35 %: 360 mins: Winter	92.848	92.848	0.348	0.348	2.8	12.359	0.000	0.000	1.0	24.082	131	39.421	OK

FSR: 30 years: +35 %: 480 mins: Summer	92.800	92.800	0.300	0.300	3.1	10.166	0.000	0.000	1.0	23.003	113	50.171	OK
FSR: 30 years: +35 %: 480 mins: Winter	92.823	92.823	0.323	0.323	2.3	11.206	0.000	0.000	1.0	25.775	118	45.071	OK
FSR: 30 years: +35 %: 600 mins: Summer	92.783	92.783	0.283	0.283	2.6	9.418	0.000	0.000	1.0	24.182	100	53.836	OK
FSR: 30 years: +35 %: 600 mins: Winter	92.798	92.797	0.298	0.297	1.9	10.064	0.000	0.000	1.0	27.111	106	50.671	OK
FSR: 30 years: +35 %: 720 mins: Summer	92.766	92.766	0.266	0.266	2.3	8.720	0.000	0.000	1.0	25.179	85	57.258	OK
FSR: 30 years: +35 %: 720 mins: Winter	92.772	92.772	0.272	0.272	1.6	8.946	0.000	0.000	1.0	28.201	90	56.149	OK
FSR: 30 years: +35 %: 960 mins: Summer	92.732	92.732	0.232	0.232	1.8	7.355	0.000	0.000	1.0	26.742	64	63.946	OK
FSR: 30 years: +35 %: 960 mins: Winter	92.713	92.713	0.213	0.213	1.3	6.627	0.000	0.000	1.0	29.996	56	67.516	OK
FSR: 30 years: +35 %: 1440 mins: Summer	92.627	92.627	0.127	0.127	1.3	3.616	0.000	0.000	1.0	29.114	37	82.275	OK
FSR: 30 years: +35 %: 1440 mins: Winter	92.595	92.594	0.095	0.094	1.0	2.596	0.000	0.000	0.9	32.665	30	87.273	OK
FSR: 30 years: +35 %: 2160 mins: Summer	92.589	92.589	0.089	0.089	1.0	2.420	0.000	0.000	0.9	31.738	30	88.136	OK
FSR: 30 years: +35 %: 2160 mins: Winter	92.567	92.566	0.067	0.066	0.7	1.753	0.000	0.000	0.7	35.472	29	91.410	OK
FSR: 30 years: +35 %: 2880 mins: Summer	92.570	92.570	0.070	0.070	0.8	1.885	0.000	0.000	0.7	33.579	29	90.758	OK
FSR: 30 years: +35 %: 2880 mins: Winter	92.553	92.552	0.053	0.052	0.5	1.383	0.000	0.000	0.5	37.711	30	93.223	OK
FSR: 30 years: +35 %: 4320 mins: Summer	92.552	92.552	0.052	0.052	0.5	1.370	0.000	0.000	0.5	36.404	30	93.286	OK
FSR: 30 years: +35 %: 4320 mins: Winter	92.540	92.540	0.040	0.040	0.4	1.027	0.000	0.000	0.4	40.892	32	94.967	OK
FSR: 30 years: +35 %: 5760 mins: Summer	92.543	92.543	0.043	0.043	0.4	1.108	0.000	0.000	0.4	38.624	31	94.569	OK

FSR: 30 years: +35 %: 5760 mins: Winter	92.535	92.535	0.035	0.035	0.3	0.889	0.000	0.000	0.3	43.527	34	95.642	OK
FSR: 30 years: +35 %: 7200 mins: Summer	92.538	92.538	0.038	0.038	0.4	0.976	0.000	0.000	0.4	40.187	32	95.216	OK
FSR: 30 years: +35 %: 7200 mins: Winter	92.530	92.530	0.030	0.030	0.3	0.775	0.000	0.000	0.3	45.672	38	96.200	OK
FSR: 30 years: +35 %: 8640 mins: Summer	92.535	92.535	0.035	0.035	0.3	0.889	0.000	0.000	0.3	41.886	35	95.641	OK
FSR: 30 years: +35 %: 8640 mins: Winter	92.528	92.528	0.028	0.028	0.2	0.718	0.000	0.000	0.2	46.847	40	96.480	OK
FSR: 30 years: +35 %: 10080 mins: Summer	92.532	92.532	0.032	0.032	0.3	0.813	0.000	0.000	0.3	43.069	37	96.014	OK
FSR: 30 years: +35 %: 10080 mins: Winter	92.526	92.526	0.026	0.026	0.2	0.661	0.000	0.000	0.2	49.079	43	96.758	OK

Project: Attenuation Pond Sizing	Date: 07/12/2022		
	Designed by: TS	Checked by:	Approved By:
Report Details: Type: Inflows Storm Phase: Phase	Company Address: GeoSon Limited		

Catchment Area

Type : Catchment Area

Area (ha)	0.045

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	100

Project: Attenuation Pond Sizing	Date: 07/12/2022		
	Designed by: TS	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Storm Phase: Phase	Company Address: GeoSon Limited		

Pond

Type : Pond

Dimensions

Exceedance Level (m)	93.300
Depth (m)	0.800
Base Level (m)	92.500
Freeboard (mm)	300
Initial Depth (m)	0.000
Porosity (%)	100
Average Slope (1:X)	3.596
Total Volume (m³)	20.401

Depth (m)	Area (m²)	Volume (m³)
0.000	25.00	0.000
0.500	59.00	20.401
0.501	73.00	20.467
0.800	102.00	46.509

Inlets

Inlet

Inlet Type	Point Inflow
Incoming Item(s)	Catchment Area
Bypass Destination	(None)
Capacity Type	No Restriction

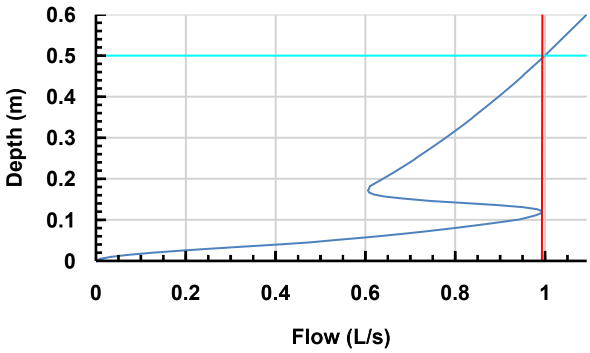
Outlets

Outlet

Outgoing Connection	(None)
Outlet Type	Hydro-Brake®

Invert Level (m)	92.500
Design Depth (m)	0.500
Design Flow (L/s)	1.0
Objective	Minimise Upstream Storage Requirements
Application	Surface Water Only
Sump Available	☐

Unit Reference	CHE-0053-1000-0500-1000



Advanced

Perimeter	Circular
Length (m)	13.000
Friction Scheme	Manning's n
n	0.035

Project: Attenuation Pond Sizing	Date: 07/12/2022		
	Designed by: TS	Checked by:	Approved By:
Report Title: Rainfall Analysis Criteria	Company Address: GeoSon Limited		

Runoff Type	Dynamic
Output Interval (mins)	5
Time Step	Default
Urban Creep	Apply Global Value
Urban Creep Global Value (%)	0
Junction Flood Risk Margin (mm)	300
Perform No Discharge Analysis	☐

Rainfall

FSR

Type: FSR

Region	England And Wales
M5-60 (mm)	20.0
Ratio R	0.412
Summer	☑
Winter	☑

Return Period

Return Period (years)	Increase Rainfall (%)
100.0	40.000

Storm Durations

Duration (mins)	Run Time (mins)
15	30
30	60
60	120
120	240
180	360
240	480
360	720
480	960
600	1200
720	1440
960	1920
1440	2880
2160	4320
2880	5760
4320	8640
5760	11520
7200	14400
8640	17280
10080	20160

Project: Attenuation Pond Sizing	Date: 07/12/2022		
	Designed by: TS	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Company Address: GeoSon Limited		

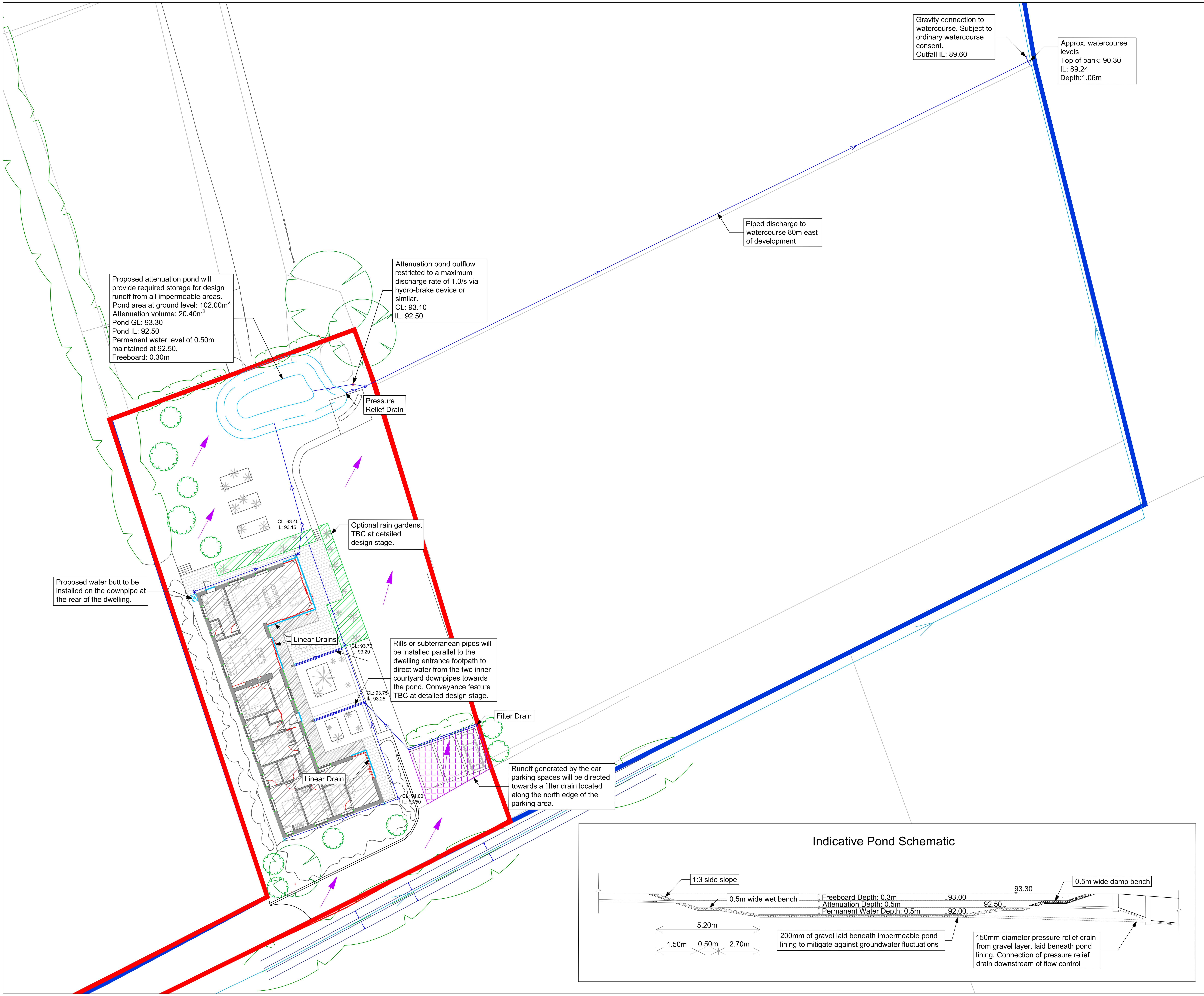
Summary Results for Pond: Rank By: Max. Avg. Depth

Storm Event	Max. US Level (m)	Max. DS Level (m)	Max. US Depth (m)	Max. DS Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Total Lost Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Half Drain Down Time (mins)	Percentage Available (%)	Status
FSR: 100 years: +40 %: 15 mins: Summer	92.818	92.818	0.318	0.318	26.8	10.975	0.000	0.000	0.8	1.151	130	46.202	OK
FSR: 100 years: +40 %: 15 mins: Winter	92.848	92.848	0.348	0.348	28.2	12.335	0.000	0.000	0.8	1.210	139	39.535	OK
FSR: 100 years: +40 %: 30 mins: Summer	92.881	92.881	0.381	0.381	17.7	13.943	0.000	0.000	0.9	2.602	203	31.654	OK
FSR: 100 years: +40 %: 30 mins: Winter	92.916	92.916	0.416	0.416	18.6	15.719	0.000	0.000	0.9	2.726	227	22.950	OK
FSR: 100 years: +40 %: 60 mins: Summer	92.928	92.927	0.428	0.427	15.2	16.336	0.000	0.000	1.0	5.636	204	19.924	OK
FSR: 100 years: +40 %: 60 mins: Winter	92.968	92.968	0.468	0.468	13.7	18.571	0.000	0.000	1.0	5.862	218	8.968	OK
FSR: 100 years: +40 %: 120 mins: Summer	92.951	92.950	0.451	0.450	10.9	17.581	0.000	0.000	1.0	11.513	194	13.823	OK
FSR: 100 years: +40 %: 120 mins: Winter	92.998	92.997	0.498	0.497	8.8	20.251	0.000	0.000	1.0	12.028	203	0.735	OK
FSR: 100 years: +40 %: 180 mins: Summer	92.947	92.947	0.447	0.447	8.4	17.391	0.000	0.000	1.0	16.858	177	14.754	OK
FSR: 100 years: +40 %: 180 mins: Winter	92.997	92.996	0.497	0.496	6.5	20.201	0.000	0.000	1.0	17.742	227	0.981	OK
FSR: 100 years: +40 %: 240 mins: Summer	92.939	92.939	0.439	0.439	6.9	16.953	0.000	0.000	1.0	21.482	203	16.901	OK
FSR: 100 years: +40 %: 240 mins: Winter	92.987	92.987	0.487	0.487	5.2	19.625	0.000	0.000	1.0	22.837	205	3.802	OK
FSR: 100 years: +40 %: 360 mins: Summer	92.922	92.921	0.422	0.421	5.1	16.016	0.000	0.000	1.0	28.693	178	21.493	OK
FSR: 100 years: +40 %: 360 mins: Winter	92.966	92.965	0.466	0.465	3.8	18.417	0.000	0.000	1.0	31.846	180	9.723	OK

FSR: 100 years: +40 %: 480 mins: Summer	92.904	92.904	0.404	0.404	4.2	15.105	0.000	0.000	1.0	30.693	162	25.958	OK
FSR: 100 years: +40 %: 480 mins: Winter	92.942	92.942	0.442	0.442	3.0	17.099	0.000	0.000	1.0	34.346	177	16.187	OK
FSR: 100 years: +40 %: 600 mins: Summer	92.887	92.887	0.387	0.387	3.5	14.236	0.000	0.000	1.0	32.181	149	30.218	OK
FSR: 100 years: +40 %: 600 mins: Winter	92.918	92.918	0.418	0.418	2.5	15.817	0.000	0.000	1.0	36.050	160	22.469	OK
FSR: 100 years: +40 %: 720 mins: Summer	92.869	92.869	0.369	0.369	3.0	13.378	0.000	0.000	1.0	33.404	138	34.426	OK
FSR: 100 years: +40 %: 720 mins: Winter	92.893	92.893	0.393	0.393	2.2	14.566	0.000	0.000	1.0	37.426	146	28.602	OK
FSR: 100 years: +40 %: 960 mins: Summer	92.836	92.836	0.336	0.336	2.4	11.803	0.000	0.000	1.0	35.345	123	42.145	OK
FSR: 100 years: +40 %: 960 mins: Winter	92.845	92.845	0.345	0.345	1.7	12.195	0.000	0.000	1.0	39.633	126	40.221	OK
FSR: 100 years: +40 %: 1440 mins: Summer	92.774	92.774	0.274	0.274	1.7	9.075	0.000	0.000	1.0	38.247	92	55.515	OK
FSR: 100 years: +40 %: 1440 mins: Winter	92.746	92.745	0.246	0.245	1.2	7.888	0.000	0.000	1.0	42.779	69	61.336	OK
FSR: 100 years: +40 %: 2160 mins: Summer	92.637	92.636	0.137	0.136	1.2	3.930	0.000	0.000	1.0	41.302	38	80.734	OK
FSR: 100 years: +40 %: 2160 mins: Winter	92.591	92.590	0.091	0.090	0.9	2.474	0.000	0.000	0.9	46.248	30	87.874	OK
FSR: 100 years: +40 %: 2880 mins: Summer	92.595	92.595	0.095	0.095	1.0	2.630	0.000	0.000	0.9	43.564	31	87.107	OK
FSR: 100 years: +40 %: 2880 mins: Winter	92.569	92.568	0.069	0.068	0.7	1.830	0.000	0.000	0.7	48.789	29	91.028	OK
FSR: 100 years: +40 %: 4320 mins: Summer	92.567	92.567	0.067	0.067	0.7	1.801	0.000	0.000	0.7	46.922	29	91.170	OK
FSR: 100 years: +40 %: 4320 mins: Winter	92.549	92.549	0.049	0.049	0.5	1.291	0.000	0.000	0.5	52.574	30	93.671	OK
FSR: 100 years: +40 %: 5760 mins: Summer	92.554	92.553	0.054	0.053	0.6	1.408	0.000	0.000	0.6	49.405	30	93.098	OK

FSR: 100 years: +40 %: 5760 mins: Winter	92.540	92.540	0.040	0.040	0.4	1.028	0.000	0.000	0.4	55.213	32	94.960	OK
FSR: 100 years: +40 %: 7200 mins: Summer	92.545	92.545	0.045	0.045	0.5	1.180	0.000	0.000	0.5	51.479	30	94.215	OK
FSR: 100 years: +40 %: 7200 mins: Winter	92.536	92.536	0.036	0.036	0.3	0.926	0.000	0.000	0.3	57.853	34	95.462	OK
FSR: 100 years: +40 %: 8640 mins: Summer	92.540	92.540	0.040	0.040	0.4	1.027	0.000	0.000	0.4	53.163	31	94.966	OK
FSR: 100 years: +40 %: 8640 mins: Winter	92.533	92.532	0.033	0.032	0.3	0.832	0.000	0.000	0.3	59.489	36	95.920	OK
FSR: 100 years: +40 %: 10080 mins: Summer	92.537	92.536	0.037	0.036	0.3	0.943	0.000	0.000	0.4	54.399	34	95.379	OK
FSR: 100 years: +40 %: 10080 mins: Winter	92.530	92.530	0.030	0.030	0.3	0.775	0.000	0.000	0.3	60.825	38	96.201	OK

Appendix D



GeoSon FLOOD RISK SOLUTIONS

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Key

- Site Boundary
- Blue Outline Boundary
- Proposed Roof Area
- Proposed Paving
- Proposed Parking Area
- Proposed Pond
- Proposed Linear Drain
- Proposed Filter Drain
- Assumed Downpipe Locations
- Proposed Surface Water Pipework
- Proposed Surface Water Manhole
- Proposed Flow Control
- Ordinary Watercourse
- Proposed Outfall
- Potential Overland Flow Route
- Optional Rain Gardens
- Optional Rainwater Butts

Notes

1. All dimensions in this drawing are in millimetres unless stated otherwise.
2. All levels are in metres Above Ordnance Datum (mAOD).
3. The proposed drainage layout is based on drawing reference Glebe Farm_PL provided by Flint Architects.
4. Environment Agency LiDAR data has been used to approximate ground levels at the site. Final levels should be confirmed by a topographic survey undertaken to mAOD prior to construction.
5. It is proposed to manage post development surface water runoff via attenuation pond.
6. Preliminary calculations indicate that a pond with a ground area of 102m² and attenuation depth of 0.5m will be sufficient to accommodate all runoff generated by the development during the 1 in 100yr + CC event whilst discharging at a controlled rate of 1.0l/s.
7. A combination of Rills, Filter Drain and Linear Drains will be used to collect surface water runoff from proposed impermeable areas and direct water towards the pond.
8. No deep rooted vegetation should be planted within proximity of the proposed below ground drainage components.
9. It is currently unknown whether there are any utilities beneath the site. A survey of the existing service infrastructure should be undertaken to determine the location of any utilities prior to detailed design.
10. At this stage, detailed modelling of the drainage system has not been undertaken therefore the proposed SuDS scheme should be taken as indicative.
11. This drawing is for planning purposes only. Not for construction.
12. Do not scale from this drawing.

Client

Sally M Jones

Title

Drainage Layout Plan

Location

Glebe Farm, Northcroft, Weedon

Drawing Number: 73011-01		Revision: v.1.0
Date: 12/12/2022		Scale: 1:200
Designed By: TS	Checked By: JN	Approved By: TS

Disclaimer

The drawing(s) provided are for planning purposes only. Not for construction.