TC/L9880/2021/01

FLOOD RISK ASSESSMENT & DRAINAGE STRATEGY

AT

Huntley-Jacob's House
Sanderson Lane
Heskin
Chorley
PR7 5PX

FOR

Bennett's Associates

OFFICES AT SHREWSBURY, CHORLEY, LANCASTER

Huntley-Jacob's House, Sanderson Lane, Chorley. PR7 5PX

REPORT VERIFICATION

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1 INTRODUCTION

1.1 Project Scope / Client Brief

Thomas Consulting has been commissioned by Bennett's Associates to carry out a site-specific flood risk assessment and drainage strategy report in accordance with the National Planning Policy Framework (NPPF) to support a planning application that fulfils the requirements of the Local Planning Authority, Lead Local Flood Authority and the Sewerage Undertaker.

1.2 Site Location & Topography

The site is located to the West side of Huntley-Jacob's House, Sanderson Lane, Chorley, PR7 5PX and this report is for proposed works which include demolition and clearance of the existing building on site to be replaced by a new residential building and redesigned landscaping. A layout plan of the proposed development is provided in Appendix A of this report. The approximate Ordnance Survey (OS) grid reference for the site is 351380, 413515 and the location of the site is shown on Figure 1.

Figure 1: Site location plan (Source: OS Maps, 2021)

The site covers a total area of approximately 2.25ha and currently comprises an open grassed field to the north with two residential properties, a greenhouse, wooden sheds and a stable in the south; a narrow strip of woodland forms the eastern boundary (see Figure 1). A disused helipad (constructed from compacted gravel and concrete flags) is located near the centre of the site to the east of the driveway.

A topographical survey has been made available and can be found in Appendix B of this report. As can be seen within the survey the site generally slopes moderately downwards from south to north. The land to the south appears to have been artificially raised to facilitate the construction of the buildings and the pond. The level of the southern site boundary is around 103m AOD with the northern boundary of the site at a level of around 85m AOD.

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1.3 Development Class in terms of Planning

The NPPF and its Planning Practice Guidance (PPG) states any development other than the following outlined below is classed as a major development.

- Minor non-residential extensions: industrial/commercial/leisure etc extensions with a footprint less than 250 square meters.
- Alterations: development that does not increase the size of buildings such as alterations to external appearance.
- Householder development: For example, sheds, garages, games rooms etc within the curtilage of the existing dwelling, in addition to physical extensions to the existing dwelling itself. This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling such as subdivision of houses into flats.

1.4 Planning Policy

The NPPF and its PPG follows on to state a site-specific flood risk assessment is required for the following site proposals.

- A site proposed in Flood Zone 2 or 3 including minor development and change of use in development type to a more vulnerable class.
- More than 1 hectare (ha) in Flood Zone 1
- Less than 1 ha in Flood Zone 1, including a change of use in development type to a more vulnerable class (for example from commercial to residential), where they could be affected by sources of flooding other than rivers and the sea (for example surface water drains, reservoirs)
- In an area within Flood Zone 1 which has critical drainage problems as notified by the Environment Agency

1.5 Environment Agency Flood Map for Planning

National Planning Policy Framework (NPPF) Flood Zones comprise Flood Zone 1, Flood Zone 2 and Flood Zone 3. The Environment Agency's Indicative Flood Map for Planning (Figure 2) shows that the site is located within the NPPF defined Flood Zone 1.

Flood Zones are based on an areas Annual Exceedance Probability (AEP) of River or Sea Flooding. For example, Flood Zone 1 has a 'Low Probability' of flooding as it has an AEP of <0.1% (Less than 1 in 1000 year) of occurring in any one year. Flood Zone 2 has a 'Medium Probability' having an AEP of 0.1-1.0% (1 in 1000 – 1 in 100 year) chance of river flooding, or 0.1-0.5% (1 in 1000 – 1 in 200 year) chance of tidal/sea flooding.

Flood Zones 3 is split between 'a' and 'b' classifications. Flood Zone 3a has a 'High Probability' of flooding as it has an AEP of >1.0% (More than 1 in 100 year) chance of river flooding, or >0.5% (More than 1 in 200 year) chance of sea/tidal flooding. Flood Zone 3b (The Functional Floodplain) comprises land where water must flow or be stored in times of flooding. Local planning authorities should identity in the Strategic Flood Risk Assessments areas of function floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map for Planning).

The extent of the flood zones does not consider the presence of any formal flood defences or other features which also act as informal flood defences.

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The NPPF is accompanied by the Planning Practice Guidance (PPG) documents which classifies each development into a vulnerability class, depending on the type of development, which are outlined in Figure 3. According to the PPG a residential dwelling would fall under the "More Vulnerable" class. "More Vulnerable" developments are acceptable in Flood Zone 1 as shown in Figure 4.

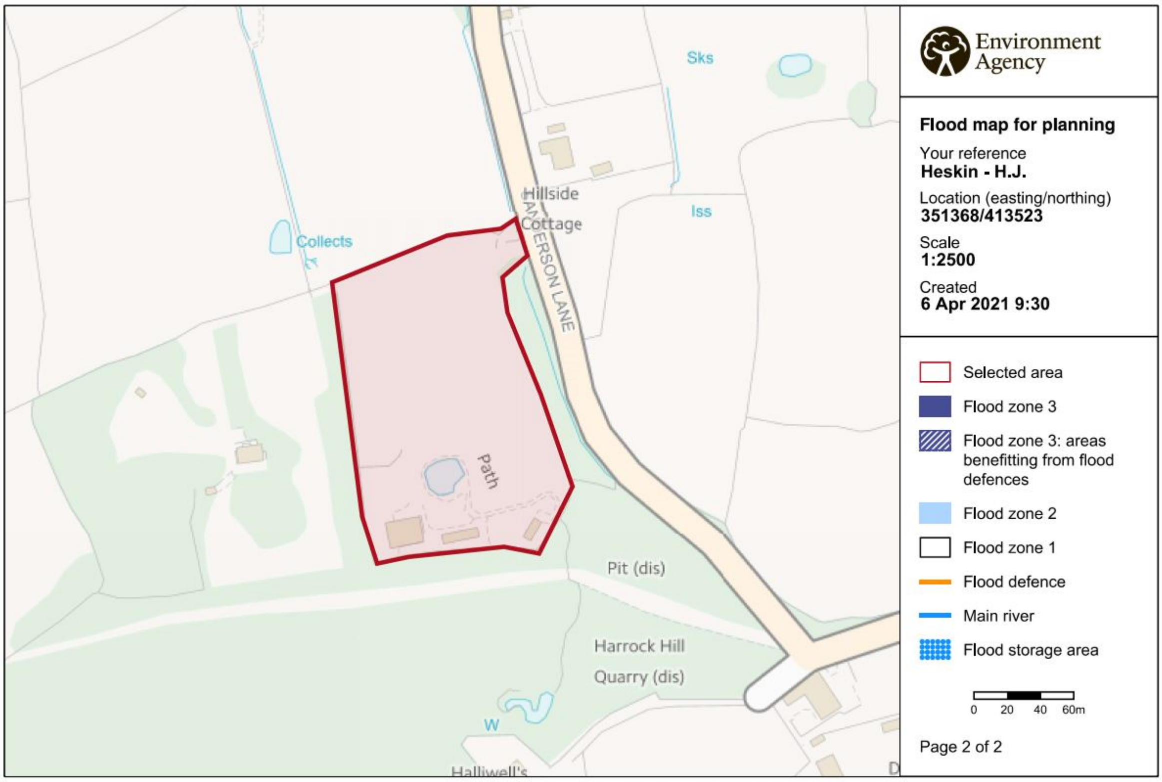

Figure 2: Environment Agency Flood Zone Map (Source: Environment Agency, 2021, GOV.UK)

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Vulnerability Classification	Development
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 electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood • Wind turbines
Highly Vulnerable	• Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operation during flooding. • Emergency dispersal points • Basement dwellings • Caravans, mobile homes and park homes intended for permanent residential use • Installations requiring hazardous substances consent
More Vulnerable	• Hospitals • Residential institutions such as residential care homes, children's 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 education 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 distributions; non-residential institutions not included in the 'more vulnerable' class; and assemble and leisure. • Land and buildings used for agriculture and forestry • Waste treatment (except landfill & hazardous waste facilities) • Minerals working & processing (except for sand & 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.
Water-Compatible Development	• Flood control infrastructure • Water transmission infrastructure & pumping stations • Sewage transmission infrastructure & pumping stations • Sand & gravel working • Docks, marinas and wharves • Navigation facilities • Ministry of Defence installations • Ship building, repairing & dismantling, dockside fish processing & refrigeration & compatible activities requiring a waterside location • Water based recreation (excluding sleeping accommodation) • Lifeguard and coastguard stations • Amenity open space, nature conservation & 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 & evacuation plan.

Figure 3: NPPF Flood Risk Vulnerability Classification (Source: National Planning Practice Guidance, 2014)

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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 †	✗	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	✗	✗	✗	✓ *

Key:

✓ Development is appropriate

✗ Development should not be permitted.

Figure 4: NPPF Flood Risk Vulnerability Classification (Source: National Planning Practice Guidance, 2014)

1.6 Proposed Development in context of Planning

The proposed development area is approximately 22,500m² (2.25 hectares), of which approximately 300m² will comprise the building footprint. The site is located within Flood Zone 1 but is classed as a Major Development due to being over 1ha in size, in accordance with the Town and Country Planning Order 2015. As this is the case a brief flood risk assessment is required with greater emphasis based on the drainage strategy.

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2 SITE CHARACTERISTICS

2.1 Site Geology & Hydrogeology

British Geological Survey (BGS) and Land Information Systems (LandIS) mapping indicates the site is underlain by the geology sequences outlined in Table 1. The EA Groundwater Vulnerability Map indicates the site is not situated in Groundwater Source Protection or Groundwater Abstraction Zone. The development site is situated within a "Unproductive" groundwater vulnerability zone.

Principal Aquifers - These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.

Secondary A Aquifers - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

Secondary B Aquifers - predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.

Secondary (Undifferentiated) Aquifers - has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

Geological Layer	Classification	Description	Aquifer Class
Soil	(N:) Soilscape 18	Seasonally wet slightly acid but base-rich loamy and clayey soils	Slowly permeable
	(S:) Soilscape 8	Slightly acid loamy and clayey soils	Impeded drainage
Superficial (Drift)	Till	Devensian – Diamicton	Secondary (Undifferentiated)
Bedrock (Solid)	(N:) Pennine Lower Coal Measures Formation	Mudstone, Siltstone & Sandstone	Secondary A
	(S:) Upper Haslingden Flags	Sandstone	Secondary A

Table 1: Site Geological Summary

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2.2 Existing Watercourses

The closest significant watercourse is the River Douglas, 3.2km west of the site. However, an Enviro-GeoInsight Report (dated 17/03/21 – Appendix B) shows a small number of minor unnamed watercourses nearby, the closest of which runs parallel to the site's eastern boundary approximately 1m from the site. This channel appears to drain surface water run-off from the hillside on which the site is located, down to the wetland to the North, which is then picked up and drained by another unnamed watercourse running North.

2.3 Existing Sewers

Local sewer maps suggests that no sewers directly cross the site boundary.

2.4 Ground Conditions

There has been no Phase 2 Site Investigation carried out to date, or if so, it had not been made available to us at the time of writing this report. A Phase 1 Investigation has advised drilling a series of boreholes and trail pits to prove the nature and thickness of any made ground present and characterise the natural strata.

Information in the Enviro-GeoInsight Report and from the Coal Authority interactive map confirm that the site is located within a coal mining consultation area. The Enviro-GeoInsight Report shows that the northern half of the site lies within an area where 'Sporadic underground mining of restricted extent may have occurred'. The report summarizes that the 'potential for difficult ground conditions are unlikely and localised and are at a level where they need not be considered'.

However, the site is located with a Coal Authority defined 'Development High Risk Area' and there are possibly 2no. mine entries located on the site, with several others nearby. It is therefore our recommendation that a detailed Coal Mining Risk Assessment is prepared for the site.

Although BGS information suggests that infiltration is unlikely to be achievable on site, in order to satisfy the SuDS Hierarchy it is necessary to determine whether this is the case or not. It is our recommendation that falling head tests are carried out on site, and if these prove infiltration to be a viable option then further testing will be carried out to BRE365 in order to more accurately determine infiltration rates.

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3 ASSESSMENT OF FLOOD RISK

3.1 Flood Risk Terminology

Flood risk considers both the probability and consequence of flooding. Flood events are often described in terms of their probability of recurrence or probability of occurring in any one year. The threshold between a medium flood and a large flood is often regarded as the 1 in 100-year event. This is an event which statistical analysis suggests will occur on average once every hundred years. However, this does not mean that such an event will not occur more than once every hundred years. Table 2 shows the event return periods expressed in years and annual expectance probabilities as a fraction and a percentage. For example, a 1 in 100-year event has a 1% probability of occurring in any one year, i.e., a 1 in 100 probability. A 1000-year event has a 0.1% probability of occurring in any one year, i.e., a 1 in 1000 probability.

Return Period (Years)	Annual Exceedance Probability (AEP)	
	Fraction	Percentage
2	0.5	50%
10	0.1	10%
25	0.04	4%
50	0.02	2%
100	0.01	1%
200	0.005	0.5%
500	0.002	0.2%
1000	0.001	0.1%

Table 2: Flood return periods and exceedance probabilities

3.2 Fluvial Flood Risk

The site is not located in proximity to a main river. The nearest watercourse is a small unnamed channel and located parallel to the site's eastern boundary, approximately 1m from site. This possesses no flood risk to the site due to its channel depth and gradient. The Flood Zone 1 outline in Figure 2 and the Fluvial Flood Map in Figure 5 indicates the site is not at risk of fluvial flooding.

The fluvial flood map in Figure 5 shows Very Low risk of fluvial flooding from rivers or the sea. High risk is a >3.3% Annual Exceedance Probability (AEP) event, meaning this area has a chance of flooding of greater than 1 in 30 years (dark blue). This considers the effect of any flood defences in the area. However, these defences reduce but do not completely stop the chance of flooding as they can be overtopped or fail. Medium risk is an AEP event of between 3.3-1% (1 in 30 - 1 in 100 - year, blue) chance of flooding.

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Low risk is an AEP event of between 1-0.1% (1 in 100 – 1 in 1000-year, light blue) chance of flooding. Very Low risk is an AEP event of <0.1% (Less than 1 in 1000 year, white) chance of flooding.

The Flood Map shows the current best information on the extent of the extreme flood from rivers or the sea that would occur without the presence of flood defences. The potential impact of climate change is not considered by the mapping.

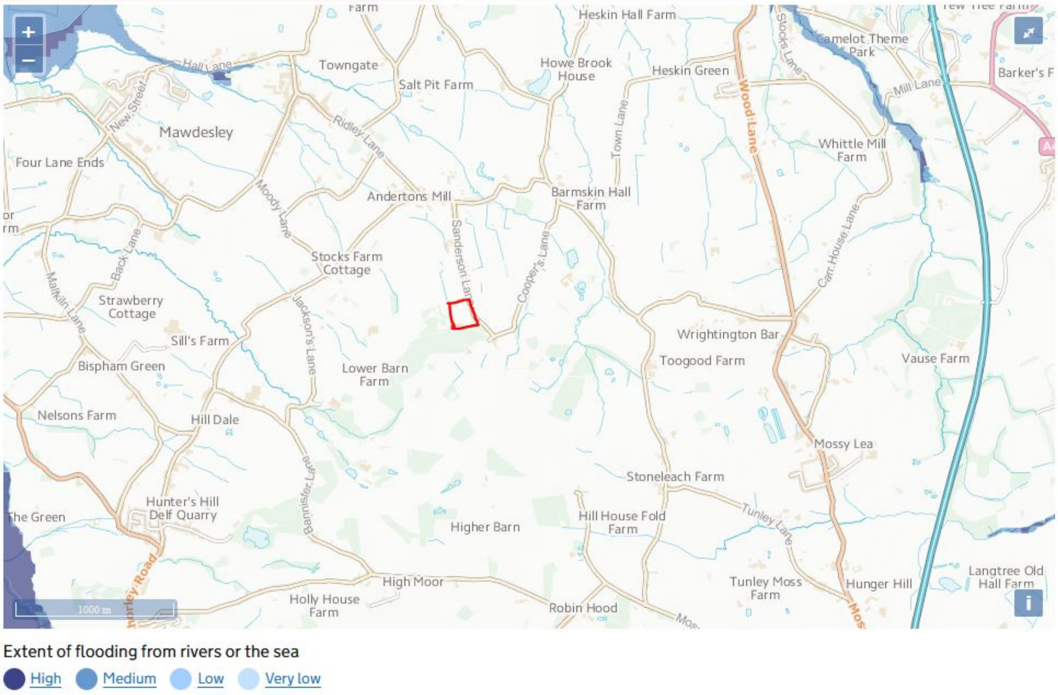

Figure 5: Environment Agency Fluvial Flood Map (Source: Environment Agency, 2021, GOV.UK)

3.3 Surface Water Flood Risk

The EA have mapped areas prone to surface water flooding based on historic flooding information received from the lead local flood authorities and modelling based on a LiDAR/IfSAR digital terrain model, Ordnance Survey information on urban areas and a direct rainfall approach using Flood Estimation Handbook (FEH) methodology. The critical (worst case) of the 1,3 and 6-hour storm durations have been mapped with no areal reduction factor applied. No allowance is made for climate change, the mapping therefore indicates the current predicted flood risk.

The maps work in the same colour coding as described above for the fluvial maps where High-Risk AEP events are displayed in Dark Blue, Medium Risk in Blue, Low Risk in Light Blue and Very Low Risk in White. The maps do not account for culverts/underground drainage and due to digital terrain model resolutions may also underestimate or omit small drainage channels/ditches. Figure 5 below shows the resulting predicted flood risk from surface water, which is indicated as Very Low risk.

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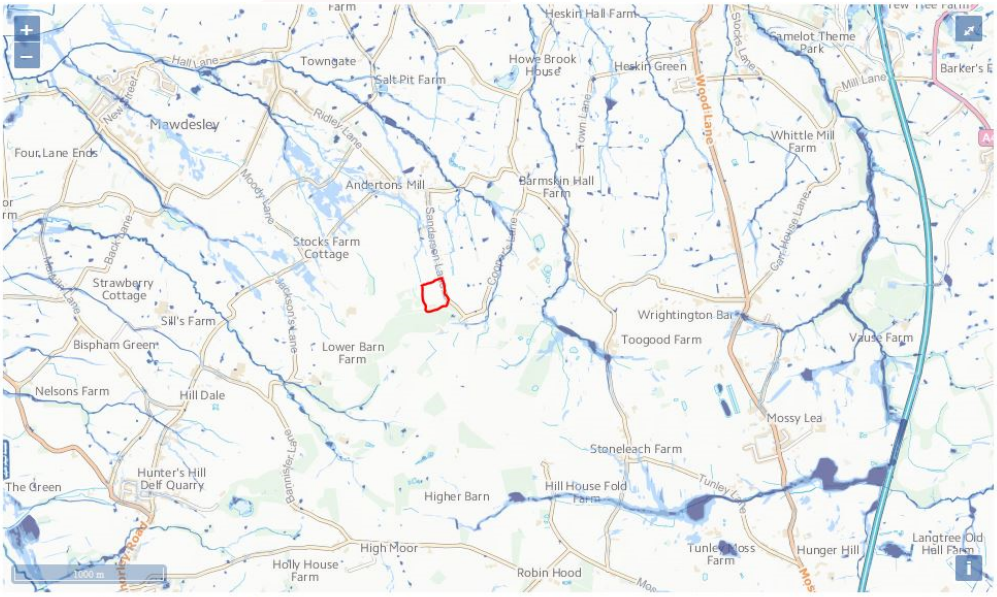

Figure 6: Environment Agency Extent of SW Flood Map (Source: Environment Agency, 2021, GOV.UK)

3.4 Flooding from Artificial Sources

The Reservoir Flood Map which can be seen in Figure 1, indicates the maximum extend of flooding from reservoirs highlighted in light blue. As can be seen the site is not at risk of flooding from reservoirs and has no other canals or artificial sources nearby that pose any risk of flooding.

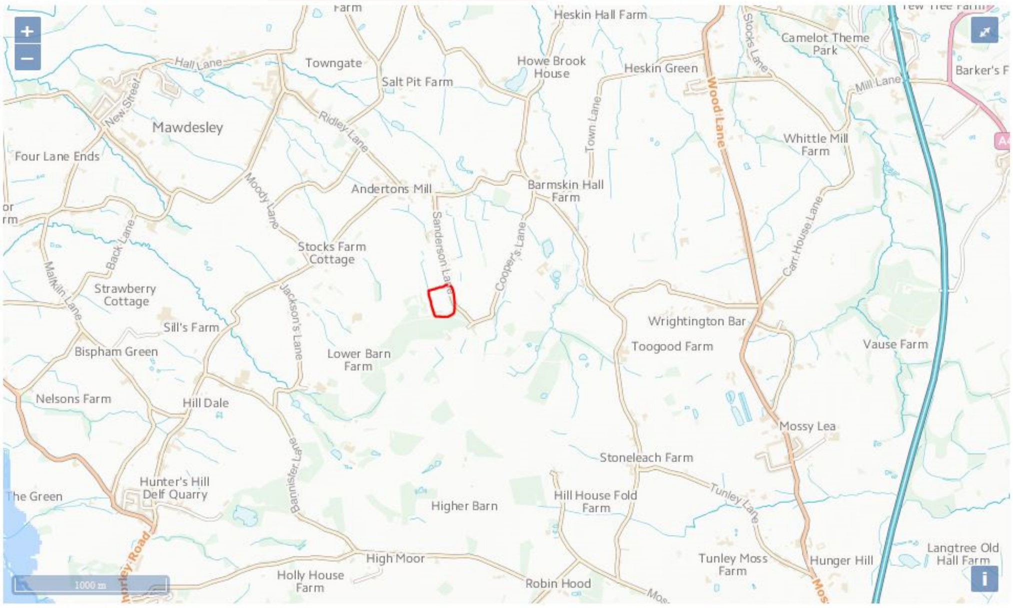

Figure 7: Environment Agency Reservoir Flood Map (Source: Environment Agency, 2020, GOV.UK)

3.5 Flooding from Sewers

UU do not provide information on flood risk from their assets. As discussed in Section 2.3, sewer records indicate that there are no sewers presently crossing the site.

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4 FLOOD MITIGATION

4.1 Summary of Flood Risk

The risks of flooding from fluvial sources, surface water, sewers, artificial sources and reservoirs are considered very low and therefore it is recommended that mitigation measures are not necessary in this respect for the proposed development.

Source of Flood Risk	Predicted Flood Risk (AEP, %)	Interpreted Risk Classification	Justification
Fluvial	<0.1%	Very Low	As predicted by EA
Tidal	<0.1%	Very Low	As predicted by EA
Surface Water	<0.1%	Very Low	As predicted by EA
Groundwater	N/A	N/A	Pending Ground Investigation
Artificial Sources	N/A	Very Low	As predicted by EA and engineering observation of sources on OS Maps
Sewer	<0.1%	Very Low	Based on Sewer Records

Table 3: Summary of Flood Risk

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5 SURFACE WATER DRAINAGE STRATEGY

5.1 Site Areas

The total site area is 2.25ha (22500m²). To support the exploration of options for site drainage, the spatial extent of different types of proposed land cover on the site have been assessed. Table 4 shows the estimated existing land cover areas.

Table 5 shows the estimated proposed land cover areas, indicating roads cover 3% of the total site area, housing roof areas cover 1.5% and parking/paved areas cover 2.5%. The remainder of the site is covered by gardens and soft landscaped areas (93%).

Table 6 shows potentially permeable and impermeable areas post-development would be 93% and 7% respectively, indicating that the proposed development provides a 5% betterment in the reduction of impermeable areas.

Table 4: Estimated Existing Land Cover Areas

Land Cover	Area		Percentage of total site area
	m²	ha	
Total impermeable area	2590.0	0.259	12%
Remaining permeable area	19910.0	1.991	88%

Table 5: Potential Proposed Land Cover Areas

Land Cover	Area		Percentage of total site area
	m²	ha	
Total housing roof area + 10%	330.0	0.033	1%
Total parking and paved area	550.0	0.055	2%
Total road area	700.0	0.070	3%
Garden & landscaped areas	20920.0	2.092	93%

Table 6: Proposed Permeable and Impermeable Areas Post-Development

Land Cover	Area		Percentage of total site area
	m²	ha	
Total impermeable area	1580.0	0.158	7%
Remaining permeable area	20920.0	2.092	93%

5.2 Urban Creep

BS 8582:2013 outlines best practice regarding Urban Creep. Although not a statutory requirement, future increase in impermeable area due to extensions and introduction of impervious positively drained areas has been considered. An uplift of 10% on impermeable areas associated with roof areas only (excluding roads) has been applied to the contributing areas as detailed above.

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5.3 Rate of Runoff Assessment

Full details of the calculations and the methodology for deriving the Peak Rate of Runoff are in included in Appendix C. A summary of the results is included in Table 7 below and shows a reduction in peak runoff post-development which has been achieved through a reduction of the impermeable areas on site. As post-development runoff rates will subsequently reduce, no increase in flood risk will occur due to the development. Therefore, no further restriction is required.

Table 7: Surface Water Rate of Runoff Results – Entire Development

Rate of Run-Off (l/s)			
Event	**Greenfield**	**Pre-Development Brownfield**	**Post-Development Brownfield**
Q1	14.0	19.0	11.6
QBAR	16.1	27.8	16.9
Q10	22.2	37.9	23.1
Q30	27.4	46.3	28.3
Q100	33.5	59.4	36.2
Q100 + 40% CC	43.5	77.2	47.1

5.4 Surface Water Disposal

Surface water disposal has been considered in line with the hierarchy outlined in the SuDS manual. The approach considers infiltration drainage in preference to disposal to watercourse, in preference to discharge to sewer.

5.5 Surface Water Drainage Design Parameters

The surface water drainage system will be designed based on the modified rational method and a generated rainfall profile.

5.5.1 Climate Change

Projections of future climate change indicate that more frequent short-duration, high intensity rainfall and more frequent periods of long-duration rainfall are likely to occur over the next few decades in the UK. These future changes will have implications for river flooding and for local flash flooding. These factors will lead to increased and new risks of flooding within the lifetime of planned developments.

In February 2016, new climate change guidance issued by the Environment Agency came into effect outlining the anticipated changes in extreme rainfall intensity.

Table 8 shows anticipated changes in extreme rainfall intensity in small and urban catchments. Guidance states that for site-specific flood risk assessments and strategic flood risk assessments, both the central and upper end allowances should be assessed to understand the range of impacts. A climate change allowance of 40% has been selected for the purpose of drainage design based on the 100-year anticipated design life of the proposed development. This figure has been selected for conservative design. No properties are located immediately downstream of the site and therefore the site poses low risk to neighbouring property, although access to an adjacent property is via a track at the north of the site – this is to be considered when positioning the pond / wetland so that any flooding would not impact the neighbouring access.

Table 8: Peak Rainfall Intensity Allowance in Small and Urban Catchments

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

5.5.2 Percentage Impermeability (PIMP)

The percentage impermeability (PIMP) for all impermeable areas will be modelled as 100%. The entirety of the impermeable areas is therefore assumed to be positively drained.

5.5.3 Volumetric Runoff Coefficient (Cv)

The volumetric runoff coefficient describes the volume of surface water which runs off an impermeable surface following losses due to infiltration, depression storage, initial wetting and evaporation. The coefficient is dimensionless. Default industry standard volumetric runoff coefficients are 0.75 for summer and 0.84 for winter.

5.5.4 Rainfall Model

The calculations are to use the REFH2 unit hydrograph methodology in line with best practice as outlined in the Suds manual. The calculations will use the most up to date available catchment descriptors (2013) provided by the Centre for Ecology and Hydrology Flood Estimation Handbook web service. Calculations for detailed design will use the FEH statistical method.

5.6 Consideration of SuDS Components

A full range of SuDS components and techniques have been considered for the development of the site and their applicability to the site is discussed below.

- **Green roofs** - Limited volume of water retention. Not suitable for conventional houses due to roof pitch.

- **Water butts** – these are suitable for the site, but their effectiveness would depend on them being empty prior to a period of significant rainfall. This could occur during the summer when occupiers are likely to use the water but unlikely during the autumn and winter.

- **Permeable paving** – Underlying ground conditions have not yet been proven suitable for infiltration-based SuDS and therefore permeable paving would not be deemed effective at this stage due to the existing site not showing signs of existing soakaway usage. Should falling head tests suggest that infiltration is viable then this will be reconsidered for the access road.

- **Open channel drains / swales** – The site possesses gradients at which drainage channels will operate effectively and as such the proposal includes the construction of two new channels which will be incorporated into the landscaping and direct excess runoff into a pond / wetland constructed to the north of the site. The proposed location and arrangement of the channels is shown in Appendix D.

- **Filter drains** – Underlying ground conditions have not yet been proven suitable for infiltration-based SuDS and therefore filter drains would not be deemed effective at this stage. Should falling head testing suggest that infiltration is viable then this will be reconsidered as an option. Filter drains may also be incorporated into the wider SuDS scheme to serve an irrigation system.

- **Ponds / wetland** – Considered the best form of SuDS due to the topography of the land and the nature of the landscaping proposals. An existing pond on site is to be relocated and integrated as part of the proposed SuDS which will accommodate excess rainwater directed into it from the two channel drains mentioned above. The pond will be assessed ecologically and will be designed to balance in extreme rainfall events not to overburden the downstream watercourses.

- **Detention basin –** Ponds possess greater ecological benefits and are more in keeping with the proposed landscaping arrangements. There is already an existing pond on site, which is to be redesigned back into the site at a lower lever and will be more aesthetically pleasing than a detention basin.

- **Rainwater Harvesting** – Rainwater harvesting tanks will collect and store rainwater for reuse and irrigation purposes. This will also subsequently reduce the amount of runoff existing the site naturally.

- **Hydro-Generation** – The development will also consider the use/implementation of hydro-power to generate energy using micro hydro-power technology incorporated into the drainage channels leading to the pond. This will also contribute to the reduction in natural runoff by slowing the rate at which runoff leaves the site and enters the watercourse.

- **Geocellular Storage Tanks** – Not considered as part of the proposed development. More aesthetic SuDS have been proposed which boost ecological benefit and provide a less intrusive method of installation. Geocellular units do not provide adequate treatment and require significant maintenance.

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5.7 Surface Water Drainage Proposals

Based on the above assessment the following SuDS techniques are proposed:

- Rainwater Harvesting - For reuse within the property and wider landscape proposals for potential irrigation system.

- Open Surface Water Channels – Beyond the capacity of the harvesting system open surface water channels will direct flows away from the property feeding potential irrigation systems and hydro-power generators and subsequently into a new pond / wetland.

- Feature Pond and/or Wetland – The pond will be fed by surface water channels to capture excess surface water runoff from the development. The pond will be designed to balance during periods of extreme rainfall and will have multiple outlets which could feed a wider wetland area reducing and slowing the rate at which runoff exits the site to the nearby watercourse.

The SuDS will be sized to contain a future 1% AEP event of critical duration with future climate change (40%) and urban creep (10% to housing area only) accounted for so that flood risk will not be increased on-site or elsewhere downstream. A conceptual proposal for surface water drainage, has been developed by Exterior Architecture and is included in Appendix D of this report.

It is proposed the entirety roof and paved areas will be drained via rainwater downpipes, channel drains and gullies into a rainwater harvesting system located adjacent to the property for storage prior to reuse on site. During periods of heavy or extended rainfall, excess water beyond the volume of the harvesting system will be directed into channel drains which will flow down open channel drains potentially feed an irrigation system and/or mini hydro-power generators. The channels will also subsequently feed into a proposed pond/wetland located towards the north of the site.

The pond will be designed to naturally balance and will incorporate numerous outfalls to accommodate numerous storm durations and return periods. During more extreme or prolonged events the ponds level will rise and feed a wider wetland area to reduce the rate of runoff and slow runoff feeding times to the nearby watercourse. The reduction in impermeable areas and the design of the new SuDS features will reduce flood risk resulting from the site and reduce strain on the existing watercourse.

There is an existing access road serving a neighbouring property on the northern boundary of the site. It is important that this is considered when designing the new SuDS features - the high-water level at which the pond will begin to release water will be at a level lower than that of the access road so that if the capacity of the pond were to be overwhelmed, it would not adversely affect the adjacent property and maintain safe access / egress for its inhabitants.

5.8 Designing for Local Drainage System Failure

In accordance with the general principles discussed in CIRIA Report C635 – Designing for Exceedance in Urban Drainage, the proposed surface water drainage, where practical, should be designed to ensure there is no increased risk of flooding to the buildings on the site or elsewhere as a result of extreme rainfall, lack of maintenance, blockages or other causes.

5.9 Blockage & Exceedance

The site drainage will be designed to store a 100-year design storm including a 40% allowance for climate change. The drainage systems will also provide capacity for lower probability (greater design storm events) which are not critical duration. Exceedance flows shall be retained on site within the drainage system as far as practical however for storms of a greater return period it may be necessary to pass forward more flow or spill flows. In this unlikely event, exceedance flows from the rainwater harvesting system and permeable paved areas would be routed down newly constructed irrigation channels towards the wetlands north of the site.

5.10 Treatment Processes

Treatment of surface water run-off from the main dwelling will be via filtration through rainwater harvesting system and micro-hydropower facility, before being released to the pond. Permeable paving can also act as a general treatment to control and diffuse pollution, which either remains at the surface or becomes trapped within the sub-grade to become filtered or degrade over time. Permeable paving will be assessed following any falling head tests that are subsequently completed.

6 FOUL WATER DRAINAGE STRATEGY

At the time of writing this report no CCTV drainage survey has been made available. There is evidence of existing manholes on the site as can be seen on the topographical survey however, what these manholes serve is unknown at present.

Under Section 106 of The Water Industry Act 1991, 'the owner / occupier of any premises shall be entitled to have his drain or sewer communicate with the public sewer of any sewerage undertaker and thereby to discharge foul water and surface water from those premises or that private sewer.' Unless 'the making of the communication would be prejudicial to the undertaker's sewerage system'.

As this is the case the existing foul water drainage needs to be investigation and further consideration needs to be made on whether the existing method of disposal can be reused, adopted or whether it needs replacing entirely. Any new foul drainage system shall be constructed to standards outlined in Part H of the Building Regulations and will remain private.

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7 CONCLUSIONS

- The site is located within Flood Zone 1.
- The proposed development is classed as a major development and according to the NPPF's PPG as a residential dwelling the site is classed as more vulnerable to flood risk. More vulnerable developments are deemed acceptable in Flood Zone 1.
- The site is at very low risk of flooding from all sources.
- In order to determine whether infiltration would be viable it is our recommendation that falling head tests are carried out on site, and if these prove infiltration to be a viable option then further testing will be carried out to BRE365 in order to more accurately determine infiltration rates.
- It is also recommended that a CCTV Drainage Survey is carried out on the existing manholes serving the site. The existing foul water disposal methods needs to be determined to understand whether any changes need to be made for foul water disposal or whether the existing system can be reused.
- Surface water shall be directed in the first instance into a rainwater harvesting system for reuse on site. It is proposed that further SuDS features will be utilised including open channel drains which will direct excess surface water from the harvesting system into further SuDS features and a newly constructed pond/wetland located on site.
- The pond will be designed to accommodate floodwater and will create an area rich in biodiversity, whilst reducing pressure on the local water network during periods of heavy rainfall. In the most extreme circumstances, should the pond overtop, excess water will be directed towards the existing surface water channel in the north eastern corner of the site.
- The development proposals, levels and drainage system will be designed to ensure no negative impact will be felt downstream with regards to flood risk. Overflow from the rainwater harvesting system will be carefully managed and directed to the pond located away from the adjacent property and its access. The property to be constructed on site, as well as the neighbouring property, are both located at high points on the land and are therefore at no risk of flooding from the proposed development.
- The site layout and drainage systems will be designed to ensure that there is no increased risk of flooding on or off site as a result of extreme rainfall, lack of maintenance, blockages or other causes. The measure that will be implemented comprise additional flows allowed for adding 10% urban creep to the roof catchment areas as well as 40% addition for climate change allowance. The production of an Operation and Maintenance Plan is recommended at the detailed designed stage.

8 REFERENCES

[1] Ministry of Housing, Communities and Local Government, *National Planning Policy Framework*, July 2018.

[2] Ministry of Housing, Communities and Local Government, *Planning Practice Guidance to the National Planning Policy Framework*, October 2019. (Some parts of the guidance backdate)

[3] GOV.UK, DEFRA/Environment Agency Portal.

[4] British Geological Survey (BGS), Superficial Deposits and Bedrock Geology Viewer.

[5] Land Information System (LANDIS), Soilscapes Viewer

[6] Environment Agency Groundwater Vulnerability Maps, DEFRA Magic Map.

[7] Environment Agency, Main River Map Viewer.

[8] United Utilities Sewer Records.

[9] Marshall & Bayliss, *Flood Estimation for Small Catchments*, *Report No. 124 (IoH 124)*, Institute of Hydrology, June 1994.

[10] D.B Boorman, J.M. Hollis & A. Lilly, 1995. *Hydrology of soil types, Report No. 126. (IoH126) Institute of Hydrology*, November 1995.

[11] UK SuDS Online Tool in accordance with Environment Agency report SC030419*, Rainfall Runoff Management for Developments*, October 2013

[12] CIRIA, *The SUDS Manual Version 6, Report C753*, 2015.

[13] CIRIA, *Designing for Exceedance in Urban Drainage – Good Practice*, *Report C635*, 2006.

[14] DEFRA, *Sustainable Drainage Systems – Non-statutory technical standards for sustainable drainage systems,* March 2015.

[15] LASOO, *Non-statutory SUDS technical standards guidance,* 2016

[16] Enviro GeoInsight Report, *Huntley-Jacob's House Groundsure Report.* March 2021.

APPENDIX A

SITE LAYOUT

Proposed Site Plan

1:500 @A1 / 1:1000 @A3

N

APPENDIX B

TOPOGRAPHICAL SURVEY

Huntley-Jacob's House, Sanderson Lane, Chorley. PR7 5PX

APPENDIX C

CALCULATIONS

Calculation Brief

This spreadsheet has been produced to calculate the peak rate of run-off for surface water. The calculation helps determine changes in peak flow resulting from the development of a greenfield or brownfield site.

Baseline Information & References

For greenfield sites this calculation is to be used when the site area is less than 50ha and subsequently follows methodology outlined in IoH Report 124 to derive QBar. Using regional growth curves origionally published in FSSR 14 this calculation then interpolates runoff rates for greater storm return periods.

For Brownfield sites this calculation follows methodology outlined in The Wallingford Procedure Volume 4 and uses the Modified Rational Method. Using this method the pre-development brownfield and post-development brownfield runoff rates are calculated and a post-development restriction documented.

The below references have been used in the preparation of these calculations:

- Marshall & Bayliss, IoH Report No. 124, Flood Estimation for Small Catchments, 1994.
- D.B. Boorman et al, Institute of Hydrology, Report No. 126, Hydrology of Soil Types, 1995.
- DEFRA/EA Report No. SC030219, Rainfall Runoff Management for Developments, 2013.
- The Walling Procedure, Design and Analysis of Urban Storm Drainage, V4, The Modified Rational Method, 1983.
- IoH, Flood Estimation Handbook (FEH)
- IoH, Flood Studies Report (FSR)
- CIRIA, Report C753, The SuDS Manual Version 6, 2015.
- The UK SuDS Online Tool.
- NERC, FSSR 2, The Estimation of Low Return Period Flows, IoH, 1977.
- NERC, FSSR 14, Review of Regional Growth Curves, IoH, 1983.

Proposed Land Use Changes

Changes to the existing site are as follows: Brownfield Site to Brownfield Site

Results Summary

Rate of Run-Off (l/s)				
Event	**Greenfield**	**Pre-Development Brownfield**	**Un-Restricted Post-Development Browfield**	**Proposed Restricted Post-Development Brownfield**
Q1	14.0	23.4	14.2	14.2
QBAR	16.1	34.4	21.0	21.0
Q10	22.2	46.7	28.5	28.5
Q30	27.4	57.3	35.0	35.0
Q100	33.5	74.2	45.3	45.3
Q100 + 30% CC	43.5	96.5	58.9	58.9

SITE AREAS

Existing Impermeable & Permeable Land Cover

Total Site Area: **2.25** **ha** **22500** **m²**

Existing Impermeable & Permeable Land Cover

Land Cover	Area		Percentage of total site area
	m²	ha	
Total impermeable area	2590.0	0.259	12%
Remaining permeable area	19910.0	1.991	88%

Proposed Land Cover Areas

Land Cover	Area		Percentage of total site area
	m²	ha	
Total housing roof area + 10%	330.0	0.033	1%
Total parking and paved area	550.0	0.055	2%
Total road area	700.0	0.070	3%
Garden & landscaped areas	20920.0	2.092	93%

Proposed Impermeable & Permeable Land Cover

Land Cover	Area		Percentage of total site area
	m²	ha	
Total impermeable area	1580.0	0.158	7%
Remaining permeable area	20920.0	2.092	93%

ESTIMATION OF QBAR (GREENFIELD RUNOFF RATE)

IoH Report No. 124 is based on the research of small catchments < 25 km2

Their methodology is based on regression analysis of response times
using catchments from 0.9 to 22.9 km^2

QBAR is mean annual flood on rural catchment
QBAR depends on SOIL, SAAR and AREA most significantly

QBAR = $0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$

For SOIL refer to IoH Report No. 126

Contributing watershed area

Area, A	=	500000	m^2	insert 50 ha for EA
	=	0.500	km^2	small catchment method
	=	50.000	ha	
SAAR	=	**980**	mm	From UKSuds website (point data)

Soil index based on soil type, SOIL = $\frac{(0.1S1+0.3S2+0.37S3+0.47S4+0.53S5)}{(S1+S2+S3+S4+S5)}$

Where:	S1	=		%
	S2	=		%
	S3	=		%
	S4	=	**100**	%
	S5	=		%
			100	%
So,	SOIL	=	**0.47**	

UK Suds website provides a value of 4.

Note: for very small catchments it is far better to rely on local site investigation information.

$QBAR_{rural}$	=	0.358	m^3/s
	=	357.8	l/s

Small rural catchments less than 50 ha

The Environment Agency recommends that this method should be used for development sizes from
0 to 50 ha and should linearly interpolate the formula to 50 ha.

So, catchment size	=	**22500**	m^2
	=	0.023	km^2
	=	2.250	ha
$QBAR_{rural\ site}$	=	0.01610	m^3/s
	=	**16.10**	l/s

Excluding significant open space which would remain disconnected from the positive drainage system during flood events.

GREENFIELD RETURN PERIODS

QBAR can be factored by the UK FSR regional growth curves for return periods <2 years and for all other return periods to obtain peak flow estimates for required return periods.

These regional growth curves are constant throughout a region, whatever the catchment type and size.

See Figure A.1.2 of the DEFRA/EA 2013 guide for UK growth curves from FSSR 14

Region = **10**

Use Figure A1.1 of the DEFRA/EA 2013 guide to determine region

GREENFIELD RETURN PERIOD FLOW RATES

Return Period	Ordinate	Q (l/s)
1	0.87	14.01
2	0.93	14.98
5	1.19	19.16
10	1.38	22.22
25	1.64	26.41
30	1.7	27.38
50	1.85	29.79
100	2.08	33.49
200	2.32	37.36
500	2.73	43.96
1000	3.04	48.95

Interpolation taken from Figure 24.2 (Page 515) SuDS Manual with derives the FSSR14 ordinates

ESTIMATE OF BROWNFIELD RETURN PERIODS

Total site impermeable area, A = **2590** m^2

M5-60 rainfall depth **20** mm
Ratio M5-60/M5-2Day, r **0.40**

Data obtained via the UK SuDS Website or MicroDrainage using the FSR database.

Storm Duration 15 mins

Anticipated critical duration for the site = 15 minutes

Duration factor, Z1 0.63

Data obtained from The Wallingford Procedure 1983 document Figure A.3b, Page 17

M5-15 rainfall depth = 12.7 mm

Return period ratio, Z2

M1-15	0.62
M10-15	1.23
M30-15	1.51
M100-15	1.96

Data obtained from The Wallingford Procedure 1983 document Table 1A, Page 9.

Rainfall

	Depth (mm)	**Intensity, i (mm/hr)**
M1-15	7.8	31
M10-15	15.6	62
M30-15	19.2	77
M100-15	24.8	99

Peak discharge, Qp = Cv Cr i A

Where:

Cv = Volumetric Runoff Coefficient
Cr = Routing Coefficient
i = Rainfall intensity (mm/hour)

Cv = 0.8
Cr = 1.3

Data obtained from the Wallingford Procedure 1983 document, Chapter 4, Page 5

Peak Runoff

	l/s
Q1	23.4
Q10	46.7
Q30	57.3
Q100	74.2

ESTIMATION OF QBAR (BROWNFIELD RUNOFF RATE)

See Figure A.1.2 of the DEFRA/EA 2013 guide for
UK growth curves from FSSR 14

Region = **10**

Use Figure A1.1 of the DEFRA/EA 2013 guide to determine region

Return Period	Ordinate
1	0.87
2	0.93
5	1.19
10	1.38
25	1.64
30	1.70
50	1.85
100	2.08
200	2.32
500	2.73
1000	3.04

Interpolation taken from Figure 24.2 (Page 515) SuDS Manual with derives the FSSR14 ordinates

Qbar

Ordinate used	l/s
10 year	33.8
30 year	33.7
100 year	35.7

Proposed Brownfield Runoff, Qbar = **34.42** l/s

Using the average Qbar derived from three ordinates.

THOMAS CONSULTING STRUCTURAL & CIVIL DESIGN ENGINEERS	Job	Huntley-Jacob's House	Job No.	L9880	Initial	FT
		Sanderson Lane	Date	Apr-21	Checked	JP
		PR7 5PX	Page	7 of 8	Revision	Origional
	Title	Peak Rate of Run-Off Calculation				

ESTIMATE OF BROWNFIELD RETURN PERIODS

Total site impermeable area, A = **1580** m^2

M5-60 rainfall depth **20** mm
Ratio M5-60/M5-2Day, r **0.40**

Data obtained via the UK SuDS Website or MicroDrainage using the FSR database.

Storm Duration 15 mins

Anticipated critical duration for the site = 15 minutes

Duration factor, Z1 0.63

Data obtained from The Wallingford Procedure 1983 document Figure A.3b, Page 17

M5-15 rainfall depth = 12.7 mm

Return period ratio, Z2

M1-15	0.62
M10-15	1.23
M30-15	1.51
M100-15	1.96

Data obtained from The Wallingford Procedure 1983 document Table 1A, Page 9.

Rainfall

	Depth (mm)	**Intensity, i (mm/hr)**
M1-15	7.8	31
M10-15	15.6	62
M30-15	19.2	77
M100-15	24.8	99

Peak discharge, Qp = Cv Cr i A

Where:

Cv = Volumetric Runoff Coefficient
Cr = Routing Coefficient
i = Rainfall intensity (mm/hour)

Cv = 0.8
Cr = 1.3

Data obtained from the Wallingford Procedure 1983 document, Chapter 4, Page 5

Peak Runoff

	l/s
Q1	14.2
Q10	28.5
Q30	35.0
Q100	45.3

THOMAS CONSULTING STRUCTURAL & CIVIL DESIGN ENGINEERS	Job	Huntley-Jacob's House	Job No.	L9880	Initial	FT
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ESTIMATION OF QBAR (BROWNFIELD RUNOFF RATE)

See Figure A.1.2 of the DEFRA/EA 2013 guide for UK growth curves from FSSR 14

Region = **10**

Use Figure A1.1 of the DEFRA/EA 2013 guide to determine region

Return Period	Ordinate
1	0.87
2	0.93
5	1.19
10	1.38
25	1.64
30	1.70
50	1.85
100	2.08
200	2.32
500	2.73
1000	3.04

Interpolation taken from Figure 24.2 (Page 515) SuDS Manual with derives the FSSR14

Qbar

Ordinate used	l/s
10 year	20.6
30 year	20.6
100 year	21.8

Proposed Brownfield Runoff, Qbar = **21.00** l/s

APPENDIX D

LANDSCAPE ARCHITECT PROPOSALS

BLUE INFRASTRUCTURE

- Enhance and celebrate the existing water channels as part of the story of the landscape
- Maximise sustainability through rain-water havesting and the possibility of micro-hydro
- Improve biodiversity through wetland creation and enhancement of existing water channels
- Reduce pressure on local watercourses by slowing run-off during rainfall events