

FLOOD RISK ASSESSMENT & OUTLINE SUSTAINABLE DRAINAGE STRATEGY

**Solar PV Panels &
Car Park Extension
Ford Halewood**

**Ford Motor
Company
March 2023**

DOCUMENT ISSUE RECORD

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Author



Roy Loble
07847 482244
Roy.Loble@outlook.com
<http://www.roylobleyconsulting.com/>

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EXECUTIVE SUMMARY

This Flood Risk Assessment is compliant with the requirements set out in the National Planning Policy Framework, and the associated online Planning Practice Guidance. It has been produced on behalf of Ford Motor Company. This report demonstrates that the proposed development is not at significant flood risk, and will not increase flood risk to others, subject to the recommended flood mitigation strategies being implemented.

Policy

Development Type	Flood Zone	Vulnerability	Sequential Test
Solar Farms	1	Essential Infrastructure	Not Required

Climate Change Allowance

Peak Rainfall Intensity

Epoch	Percentage Increase
50s	25

Flood Risk and Mitigation

Flood Risk Source	Level of Risk Without Mitigation	Proposed Mitigation
Pluvial	Medium	Panels raised above ground level and flow routes maintained.
Fluvial Groundwater Sewers	Low	
Tidal Reservoir Canal/Artificial	None	
Development Surface Water	To wider catchment	New car park restricted run off to 5 l/sec to existing sewer.

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1.0 INTRODUCTION

- 1.1 This Flood Risk Assessment, (FRA), is compliant with the requirements set out in the National Planning Policy Framework, (NPPF), and the associated online Planning Practice Guidance.
- 1.2 The FRA has been produced on behalf of Ford Motor Company in respect of a planning application for the installation of solar PV panels and an extension to existing car park at Ford Halewood.

Data Used

- 1.3 This FRA is based on the following information:
- Proposed Plans
 - British Geological Survey Drift & Geology Maps
 - Environment Agency Consultation
 - Environment Agency Data
 - British Geological Survey Hydrogeology Data

Existing Site

- 1.4 The site is located at grid reference SJ4521984083 as shown in **Figure 1.1** below.

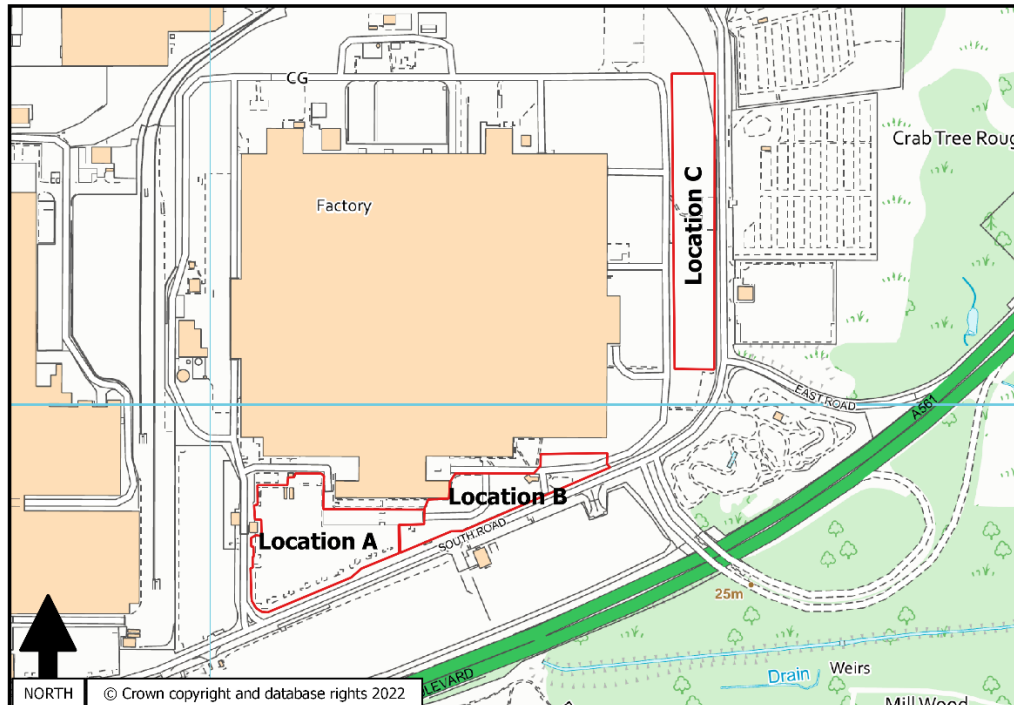
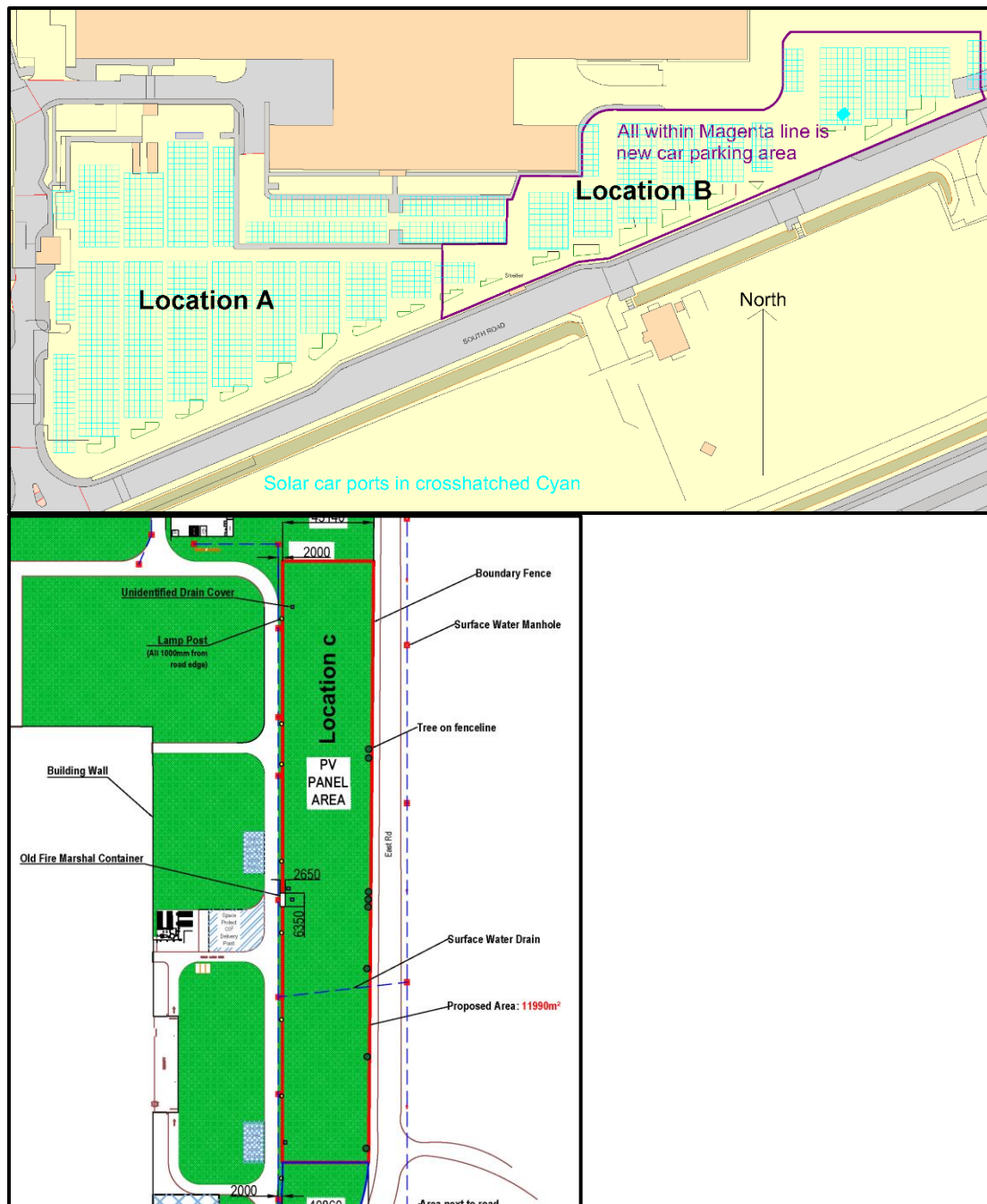


Figure 1.1 Site Location

- 1.5 The online British Geological Survey maps indicates that the site is located on superficial deposits of Till over a bedrock of sandstone.

Proposed Development

- 1.6 The proposed development consists of the installation of solar PV panels and an extension to existing car park as shown on the extract of the proposed plans below in **Figure 1.2**



Location A – Solar PV panels over existing car park.
Location B – Solar PV panels over new car park.
Location C – Solar PV panels over existing grass verge
Figure 1.2 Proposed Plans

2.0 FLOOD RISK PLANNING POLICY

National Planning Policy Framework

- 2.1 The NPPF sets out the Government's national policies on different aspects of land use planning in England in relation to flood risk. A supporting web-based Planning Practice Guidance is also available.
- 2.2 The guidance uses four Flood Zones to characterise flood risk which refer to the probability of river and sea flooding, ignoring the presence of defences.

Sequential Test

- 2.3 The NPPF requires the application of a Sequential Test to ensure that new development is in areas with the lowest probability of flooding and the Flood Zones provide the basis for applying the Test.

Flood Zone Definition

Flood Zone 1	Low probability (1 in 1000 annual probability of river or sea flooding (<0.1%)).
Flood Zone 2	Medium probability (between 1 in 100 and 1 in 1000 annual probability of river flooding (1.0%-.0.1%) or between 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5%-.0.1%) in any given year).
Flood Zone 3a	High probability (1 in 100 or greater annual probability of river flooding (>1.0%) or 1 in 200 or greater annual probability of sea flooding (>0.5%) in any given year).
Flood Zone 3b	This zone comprises land where water must flow or be stored in times of flood. Land which would flood with an annual probability of 1 in 20 (5.0%), or is designed to flood in an extreme flood (0.1%) should provide a starting point for discussions to identify functional floodplain.

- 2.4 The Flood Zones do not consider the projected effects of climate change and may not represent potential flooding from smaller watercourses.
- 2.5 The aim is to steer new development to Flood Zone 1 and where there are no reasonably available sites in Flood Zone 1, local planning authorities in their decision making should consider the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2, applying the Exception Test if required.
- 2.6 Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 be considered, considering the flood risk vulnerability of land uses and applying the Exception Test if required.
- 2.7 The guidance also sets out the vulnerability to flooding of different land uses and some of these are detailed below.

Flood Risk Vulnerability Classification

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

- 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

Appropriate Development

- 2.8 Based on the vulnerability of a development the guidance states what Flood Zone(s) the development is appropriate within. The flood risk compatibility is summarised below.

Flood Zone 1	Appropriate Development – All.
Flood Zone 2	Exception Test - Highly vulnerable. Appropriate Development - Essential Infrastructure; More vulnerable; Less vulnerable and Water Compatible.
Flood Zone 3a	Should not be permitted – Highly vulnerable. Exception Test – Essential Infrastructure, More vulnerable. Appropriate Development – Less vulnerable; Water compatible.
Flood Zone 3b	Should not be permitted – Highly vulnerable; More vulnerable; Less vulnerable. Exception Test – Essential Infrastructure. Appropriate Development –Water compatible.

- 2.9 The Planning Practice Guidance also states that all sources of flooding should be considered when preparing a FRA.

Exception Test

- 2.10 The Exception Test is a method to demonstrate and help ensure that flood risk to people and property will be managed satisfactorily, while allowing necessary development to go ahead in situations where suitable sites at lower risk of flooding are not available.
- 2.11 The first part of the Exception Test is to show that the proposed development will provide wider sustainability benefits to the community that outweigh flood risk. The second part is the requirement for a FRA to demonstrate that it will be safe for its lifetime, without increasing flood risk elsewhere and where possible reduce flood risk overall.

Development Proposals

- 2.12 The proposed development consists of a Solar farm.

Flood Zones

- 2.13 The Flood Zones are shown on **Figure 2.1** below which shows the site to be in Flood Zone 1.

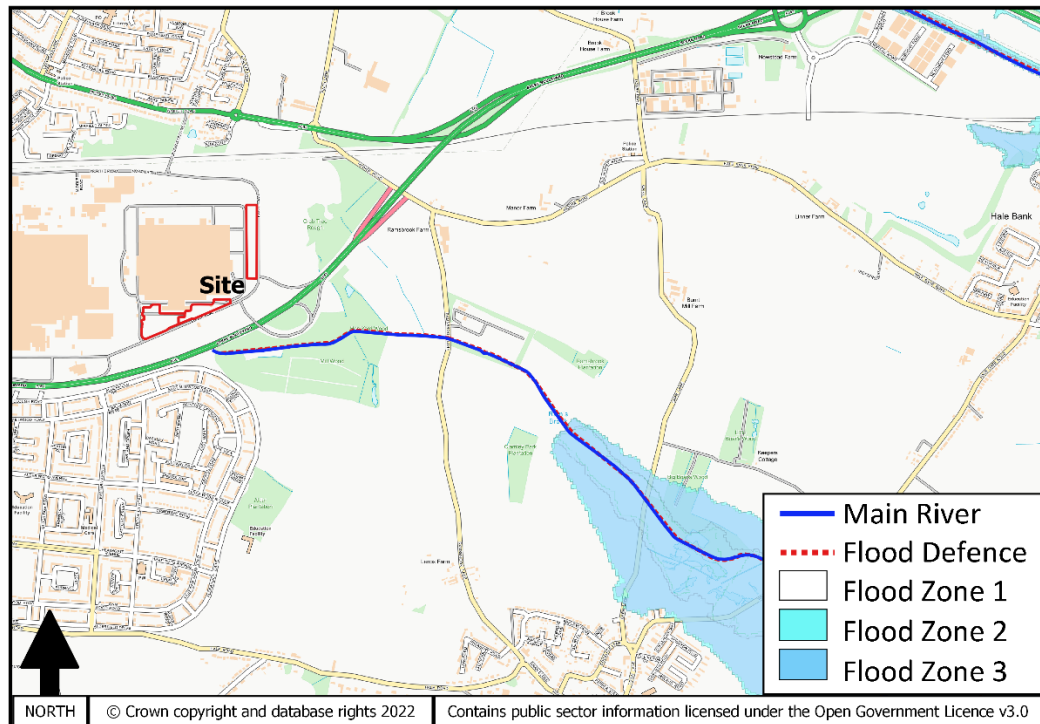


Figure 2.1 Flood Zones

Development Vulnerability

- 2.14 Solar Farms are Essential Infrastructure and therefore appropriate in Flood Zone.

Exception Test

- 2.15 Whilst the development is considered appropriate a FRA is required to ensure the development will remain safe over its lifetime from all sources of flooding and not increase flood risk elsewhere.

3.0 CLIMATE CHANGE

- 3.1 The NPPF sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change.
- 3.2 As the Government's expert on flood risk on 19th February 2016 the Environment Agency, (EA), published revised climate change allowances to support the NPPF. The sea level rise allowances were revised on the 17th December 2019, the peak river flows revised on the 20th July 2021 and the peak rainfall allowances were revised on 10th May 2022.
- 3.3 The climate change allowances are based on projections and different scenarios of carbon dioxide (CO₂) emissions to the atmosphere and provide predictions of anticipated change for:
- peak river flow and peak rainfall intensity by river Management Catchment;
 - sea level rise;
 - offshore wind speed and extreme wave height.

Peak River Flow Allowances

- 3.4 The peak river flow allowances show the anticipated changes to peak flow by Management Catchment with three allowances; central; higher central and upper end. This proposed development is in the Lower Mersey Management Catchment.
- 3.5 However, this proposed development is in Flood Zone 1 and therefore peak river flow allowances do not apply.

Peak Rainfall Intensity Allowance

- 3.6 Increased rainfall affects river levels and land and urban drainage and should be applied to surface water drainage systems. These allowances are also based on the Management Catchment with two allowances; central; and upper end and change over two periods of time, (epoch), over the next century and the appropriate allowance should be chosen based on the expected lifetime of the development.
- 3.7 This development has a lifetime of up to 2060, (2050s epoch), and therefore the Central allowance for climate change in peak rainfall intensity is used.

Epoch	Percentage Increase
50s	25

Table 3.1 Climate Change Allowances for Peak Rainfall Intensity

Sea Level Allowances

- 3.8 There is a range of allowances for each region and epoch or time frame for sea level rise. However, this site is not affected from tidal sources, see section 4.

4.0 FLOOD RISK SOURCES

- 4.1 The following flood risk sources have been identified and where mitigation is required to reduce the flood risk this is discussed in **Section 5**.

Fluvial

Main River

- 4.2 The site is not at risk of flooding from Main Rivers.

Ordinary Watercourses

- 4.3 The site does not lie within any Internal Drainage Board District.
- 4.4 The risk of flooding from fluvial sources is low.

Pluvial

- 4.5 The EA have produced maps showing flooding when rainwater lies or flows over the ground. The surface water flooding extents are shown below in **Figure 4.1**. Unlike the fluvial mapping, which is based on a detailed hydraulic model, this mapping is based purely on applying rainfall to a digital terrain model. As such this mapping serves to represent a worst-case scenario which may well overstate the actual probability of flooding in this area.
- 4.6 There is a caveat, as to the use of these maps and that they are not to be used to identify that an individual property will flood. Because of the way they have been produced and the fact that they are indicative these maps are not appropriate to act as the sole evidence for any specific planning or regulatory decision or assessment of risk in relation to flooding at any scale without further supporting studies or evidence.

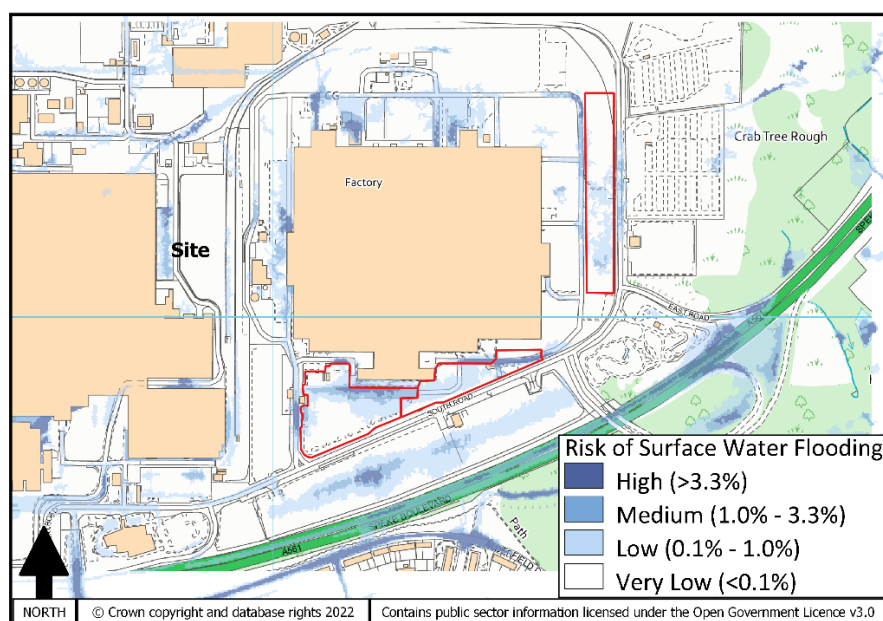


Figure 4.1 Surface Water Flooding Extents

- 4.7 The risk of flooding from pluvial sources is medium.

Groundwater

- 4.8 The site is located on a highly productive aquifer and there are no known instances of groundwater flooding in the area.
- 4.9 The risk of flooding from groundwater is low.

Sewers

- 4.10 Public maintained sewers are unlikely to pose a significant flood risk as they are well maintained.
- 4.11 The risk of flooding from existing sewers is low.

Reservoirs

- 4.12 The EA has prepared reservoir failure flood risk mapping to show the largest area that might be flooded if a reservoir were to fail and release the water it holds.
- 4.13 The site is not at risk of flooding from reservoirs.

Canals and Artificial Water Bodies

- 4.14 The site is not at risk of flooding from canals.

Development Surface Water

- 4.15 The proposed development will require the disposal of surface water which could impact on existing systems and developments.

5.0 MITIGATION

- 5.1 Section 4.0 has identified the sources of flooding which could potentially pose a risk to the site and the proposed development. This section of the FRA sets out the mitigation measures which are to be incorporated within the proposed development to address and reduce the risk of flooding to within acceptable levels.

Site Layout

- 5.2 The proposed development is only at a medium risk of flooding from surface water.
- 5.3 The solar PV panels will be on frames lifted above the ground level and the existing surface water flow paths will be maintained.

Development Surface Water Drainage

- 5.4 The following **Section 6** identifies the proposed mitigation for the developments surface water disposal.

6.0 OUTLINE SUSTAINABLE DRAINAGE STRATEGY

Surface Water

- 6.1 When rain falls on a natural landscape it soaks into the ground, evaporates, is taken up by plants and some of it eventually finds its way into streams and rivers.
- 6.2 These stages of the water cycle can be impeded when land is developed and there tends to be less permeable ground available for infiltration and less vegetation for evapotranspiration. When rain falls on impermeable surfaces much more of it turns to surface water runoff, which can cause flooding, pollution and erosion problems.
- 6.3 Sustainable drainage systems, (SuDS), are designed to maximise the opportunities and benefits that can be secured from surface water management.

Hierarchy of Surface Water Drainage

- 6.4 The recommended surface water drainage hierarchy is to utilise soakaway, or infiltration as the preferred option, followed by discharging to an appropriate watercourse or if this is not available the final option is to an existing public sewer.
- 6.5 The online British Geological Survey maps indicates that the site is located on superficial deposits of Till over a bedrock of sandstone, which is unlikely to support the use of infiltration.
- 6.6 There are no watercourses adjacent to the site and the site has an existing surface water infrastructure which will be used for the disposal of any additional surface water.

Surface Water Discharge to Existing Sewer

Location A

- 6.7 The solar PV panels will be on a canopy above the existing car park and the rainwater will shed onto the car park which drains to the existing sewer.
- 6.8 There will be no increase in the impermeable area and the surface water run off from this location.

Location B

- 6.9 The solar panels will be on a canopy above an extension to the car park and the rainwater will shed onto the new car park. This will increase the surface water run off to the existing sewer system.
- 6.10 Surface water runoff and storage calculations have been undertaken using a software tool developed by HR Wallingford and a summary is included below with the full results included in **Appendix 1**.

Existing Site Runoff

- 6.11 SOIL types (1 to 5) are defined in the Flood Studies Report and broadly describes the maximum runoff potential.
- 6.12 SOIL type 1 is sandy highly permeable material with permeability reducing as the SOIL value increases. SOIL type 4 is heavy clay and 5 (which is rarely applied) is exposed rock.
- 6.13 The existing site is greenfield, with a SOIL type 4.

6.14 The proposed impermeable area 0.7 ha.

Surface Water Storage

6.15 Two volume control approaches are available as follows;

- Flow control is limited to the greater rate of Q_{bar} or 2 l/s/ha. A minimum discharge of 5 l/sec applies to any site.
- Long Term Storage allows the site discharge rate to be based on the greenfield 100-year value. Runoff rates are higher as part of the runoff is retained for a significant period or infiltrated on the site.

6.16 For this site the flow control has been limited the minimum rate of 5 l/sec to utilise lower discharge rates, as the available capacity in the receiving system is not known.

6.17 The storage volume has been calculated for the 25% climate change allowances in peak rainfall intensity and is 448m³.

On-Site Requirements

6.18 The proposed car park will be drained to the existing sewer at a restricted rate of 5 l/sec and the 448m³ of required storage can be provided over the car park area of 4,000m² to a maximum depth of 64mm.

6.19 The above storage requirements are indicative only for the purposes of this strategy and will be confirmed at detailed design stage.

Location C

6.20 The solar PV panels will be on a frame and sit above the existing grass verge and the rainwater will shed onto the grass verge. The run off from the panels onto the grass will mimic the existing green field drainage.

7.0 CONCLUSIONS

- 7.1 This FRA is compliant with the requirements set out in the NPPF and the associated online Planning Practice Guidance.
- 7.2 The FRA has been produced on behalf of Ford Motor Company.
- 7.3 This report demonstrates that the proposed development is not at significant flood risk, and will not increase flood risk to others, subject to the recommended flood mitigation strategies being implemented.
- 7.4 The identified risks and mitigation measures are summarised below;

Flood Risk Source	Level of Risk Without Mitigation	Proposed Mitigation
Pluvial	Medium	Panels raised above ground level and flow routes maintained.
Fluvial Groundwater Sewers	Low	
Tidal Reservoir Canal/Artificial	None	
Development Surface Water	To wider catchment	New car park restricted run off to 5 l/sec to existing sewer.

Table 7.1 Summary of Risk and Mitigation

Appendix 1

Surface Water Calculations

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Surface water storage requirements for sites

www.uksuds.com | Storage estimation tool

Calculated by:	Roy Lobley
Site name:	RLC-1199
Site location:	Halewood

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the design of the drainage scheme.

Site Details

Latitude:	53.34924° N
Longitude:	2.82331° W
Reference:	3539474446
Date:	Mar 02 2023 07:19

Site characteristics

Total site area (ha):	.7
Significant public open space (ha):	0
Area positively drained (ha):	0.7
Impermeable area (ha):	0.7
Percentage of drained area that is impermeable (%):	100
Impervious area drained via infiltration (ha):	0
Return period for infiltration system design (year):	10
Impervious area drained to rainwater harvesting (ha):	0
Return period for rainwater harvesting system (year):	10
Compliance factor for rainwater harvesting system (%):	66
Net site area for storage volume design (ha):	0.7
Net impermeable area for storage volume design (ha):	0.7
Pervious area contribution to runoff (%):	0

* where rainwater harvesting or infiltration has been used for managing surface water runoff such that the effective impermeable area is less than 50% of the 'area positively drained', the 'net site area' and the estimates of Q_{BAR} and other flow rates will have been reduced accordingly.

Design criteria

Climate change allowance factor:	1.25
Urban creep allowance factor:	1
Volume control approach	Flow control to max of 2 l/s/ha
Interception rainfall depth (mm):	5 or Qbar
Minimum flow rate (l/s):	5

Methodology

esti	IH124	
Q_{BAR} estimation method:	Calculate from SPR and SAAR	
SPR estimation method:	Calculate from SOIL type	
Soil characteristics	Default	Edited
SOIL type:	4	4
SPR:	0.47	0.47
Hydrological characteristics	Default	Edited
Rainfall 100 yrs 6 hrs:	--	63
Rainfall 100 yrs 12 hrs:	--	81.62
FEH / FSR conversion factor:	1.06	1.06
SAAR (mm):	769	769
M5-60 Rainfall Depth (mm):	20	20
'r' Ratio M5-60/M5-2 day:	0.4	0.4
Hydrological region:	10	10
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 10 year:	1.38	1.38
Growth curve factor 30 year:	1.7	1.7
Growth curve factor 100 years:	2.08	2.08
Q_{BAR} for total site area (l/s):	3.77	3.77
Q_{BAR} for net site area (l/s):	3.77	3.77

Site discharge rates	Default	Edited	Estimated storage volumes	Default	Edited
1 in 1 year (l/s):	5	5	Attenuation storage 1/100 years (m³):	448	448
1 in 30 years (l/s):	5	5	Long term storage 1/100 years (m³):	0	0
1 in 100 year (l/s):	5	5	Total storage 1/100 years (m³):	448	448

This report was produced using the storage estimation tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at <http://uksuds.com/terms-and-conditions.htm>. The outputs from this tool have been used to estimate storage volume requirements. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

ROY LOBLEY CONSULTING

Roy.Lobley@outlook.com

07847482244

www.roylobleyconsulting.com