SCIENCE MUSEUM GROUP

Building ONE | The Science Museum Group at Wroughton | December 2017

FRA

Building ONE, The Science Museum Group at Wroughton

Level 1 Flood Risk Assessment

Science Museum Group

5161116-ATK-ZZ-XX-RP-C-108

15 December 2017

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Document history

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Glossary of terms

Term	Description
ABD	Areas Benefitting from Defences
bgl	below ground level
BGS	British Geological Survey
CFMP	Catchment Flood Management Plan
FRA	Flood Risk Assessment
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
mAOD	metres Above Ordnance Datum
NGR	National Grid Reference
NPPF	National Planning Policy Framework
PFRA	Preliminary Flood Risk Assessment
RAF	Royal Air Force
RoFSW	Risk of Flooding from Surface Water
SBC	Swindon Borough Council
SFRA	Strategic Flood Risk Assessment
SMGW	Science Museum Group at Wroughton
SPZ	Source Protection Zone
SuDS	Sustainable Drainage Systems

Executive summary

Site Name and Address	Science Museum Group, Wroughton, SN4 9NU Swindon.		
Grid Ref	SU 138789	Size	27,000m^2
Current Use	Greenfield Managed grassland area between the old runways.	Proposed use	Other Building ONE is a new building to store the Science Museum Group's collection at Wroughton
Flood Zone	Flood Zone 1		
Vulnerability class	Less Vulnerable		
Is it compatible?	Yes		
Application of the Sequential test.	Open Data on the Environment Agency website shows that the site has a less than 1 in 1000 annual probability of river flooding. The proposed scheme is therefore in Flood Zone 1 and passes the Sequential Test.		
Exception test?	Not Required		

1. Introduction

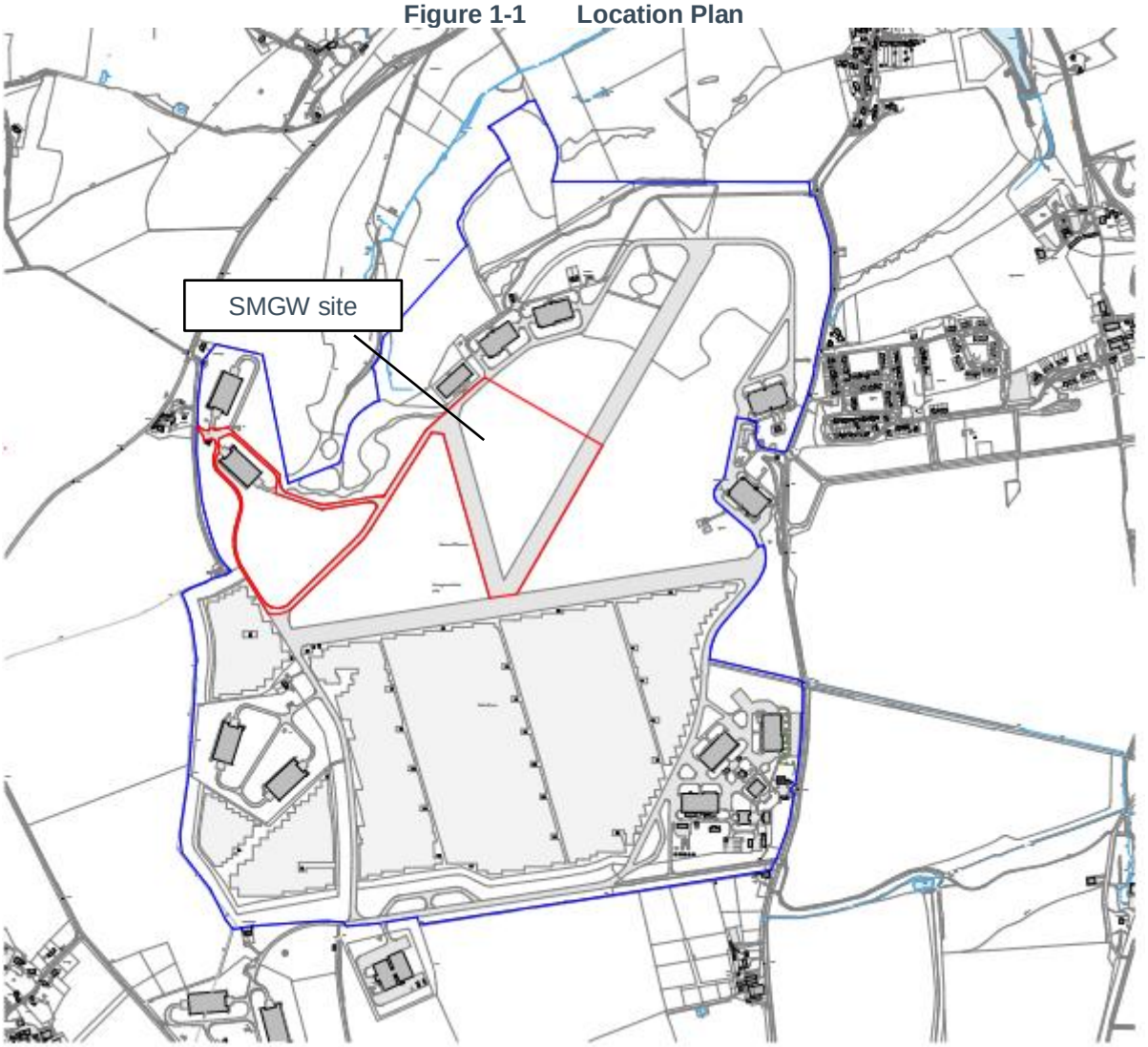
1.1. Background

Atkins has been commissioned by Science Museum Group (SMG) to undertake a Flood Risk Assessment (FRA) to support the design of a proposed warehouse building at the Science Museum Group at Wroughton (SMGW).

1.2. Site Location and Existing Conditions

The proposed development lies within an old RAF airfield which was acquired by SMG in 2000. The entire area, herein defined as the site, is located approximately 1km south of the village of Wroughton and 5km south of Swindon (NGR 413982, 179154). The site is around 220ha, predominately flat grassland, with disused concrete runways. The concrete runways stretch to the edges of the plot and are connected by smaller perimeter roadways. A recent development of 73ha of solar panels now covers the western and southern parts of the site. The northern part of the site is surrounded by recently planted trees. The location plan is shown in Figure 1-1.

Figure 1-1 Location Plan



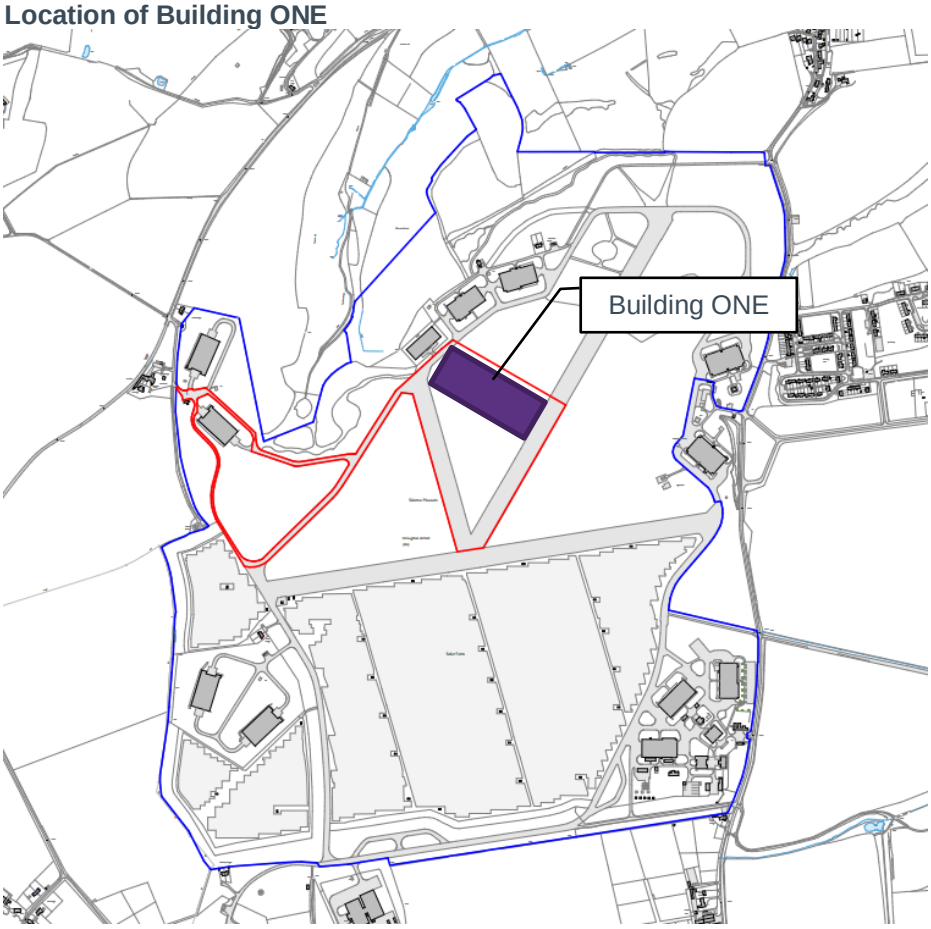
1.3. Development Proposals

SMGW uses the former RAF Wroughton airfield site for storing objects in their collection. The SMGW will expand their storage capacity through building a large new collections management facility, known as Building ONE of footprint 27,000m^2. This will be built on a managed grassland area of the development site.

The building will be provided with permeable surfaces to three elevations extending approximately 10m from the face of the building. It is proposed that surface water drainage will be by means of soakaway drainage and that foul water drainage will be by means of Biodigester tank and associated effluent drainage field.

Figure 1-2 is extracted from the Science Museum Group One Collection Design & Access Statement.

Figure 1-2 Location of Building ONE



1.4. Report Scope

This Level 1 FRA is a screening study which determines whether there is any flood risk or surface water management issues related to the development that may warrant further assessment. The report has been completed in line with the National Planning Policy Framework (NPPF) and makes use of readily available information from the following sources:

- Environment Agency Open Data (Environment Agency, 2017);
- SMG One Collection Facility, Phase 1 Geotechnical and Geoenvironmental Desk Study (Atkins, 2017);
- SMG Building One, Wroughton Drainage Strategy (Atkins, 2017);
- Swindon Borough Council Preliminary Flood Risk Assessment (Halcrow, 2011);
- Swindon Borough Council Level 1 SFRA – Final Report (Halcrow, 2008);
- Wiltshire County and Swindon Borough Council SFRA Level 1 (Scott Wilson, 2008).

2. Planning Policy

2.1. Overview

The National Planning Policy Framework (NPPF) (Department for communities and local government, 2014) is the overarching document in relation to development and flood risk and sets out the Government's policy on development relating to flood risk. The aim of the NPPF is to ensure that a new development is not at an unacceptable risk of flooding by steering development to areas at lowest risk. Where development is unavoidable in areas at risk from flooding the NPPF ensures that the development is safe without increasing flood risk elsewhere and where possible reducing flood risk overall.

In accordance with the NPPF, proposed development sites greater than one hectare, or those which fall within either Flood Zone 2 or 3, require an FRA to be undertaken to support the planning and consents process. The Lead Local Flood Authority in the study area is Swindon Borough Council.

2.2. Flood Zone Definition

The Environment Agency's Flood Map is divided into three separate Flood Zones. These Flood Zones are used by NPPF in determining the appropriateness of proposed developments when considering flood risk through the application of the Sequential Test. They represent the probability of flooding without flood defences in place.

The Flood Zones are defined as:

- Flood Zone 1 – Areas with a 'Low Probability' of flooding: the annual chance of flooding is lower than 0.1% for either fluvial or sea flooding;
- Flood Zone 2 – Areas with a 'Medium Probability' of flooding: the annual chance of flooding is between 0.1 and 1.0% for fluvial flooding or between 0.5 and 0.1% for flooding from the sea; and
- Flood Zone 3 – Areas with a 'High Probability' of flooding: the annual chance of flooding is 1.0% or greater for fluvial flooding or 0.5% or greater for sea flooding. Flood Zone 3 is sub divided into two further classification:
  - Flood Zone 3a - High Probability
  - Flood Zone 3b - Functional floodplain where water has to flow or be stored in times of flood.

The Environment Agency's Flood Map also defines Areas Benefitting from Defences (ABDs) within Flood Zone 3; however, this category is not expressly determined within NPPF or the Sequential Test process. NPPF provides guidance on assessing the vulnerability of land uses in relation to flood risk and classifies new developments into one of five categories:

- Essential Infrastructure;
- Water Compatible;
- Less Vulnerable;
- More Vulnerable;
- Highly Vulnerable.

This scheme is a storage facility and therefore would be classed as 'Less Vulnerable' based on the Flood Risk Vulnerability Classification table (NPPF, 2014) which can be found in Appendix B.

2.3. Development and flood risk compatibility

The NPPF flood risk vulnerability and flood zone 'compatibility' table indicates that development is appropriate for the site. This is based on the site being located within Environment Agency Flood Zone 1 and the proposed development considered to be classified as 'Less Vulnerable'.

Table 2-1 Flood risk vulnerability and flood zone 'compatibility'

Flood Risk Vulnerability classification		Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	1	✓	✓	✓	✓	✓
	2	✓	✓	Exception test required	✓	✓
	3a	Exception test required	✓	×	Exception test required	✓
	3b	Exception test required	✓	×	×	×
Key: ✓ ×		Development is appropriate Development should not be permitted				

2.4. Sequential Test

NPPF states that the 'Sequential Test' should be carried out when allocating land for development to demonstrate that there are no alternative sites available for development in areas that are at a lower risk of flooding. As outlined within the NPPF, for the purpose of the Sequential Test, the Strategic Flood Risk Assessments (SFRA) flood maps should be used in preference to the Environment Agency flood mapping where available.

When an area is at risk from either fluvial or coastal flooding, then development should be allocated outside Flood Zones 2 and 3 where possible. However, if there are no reasonable sites available for development within Flood Zone 1, and depending upon flood vulnerability, some developments can be permitted in Flood Zones 2 or 3 if they are designed to be safe without increasing flood risk elsewhere and remain operational in the event of flooding.

As discussed further in Section 3.3, the proposed scheme is entirely within Flood Zone 1 and therefore passesthe Sequential Test.

2.5. Local Planning Policy

2.5.1. Swindon Borough Council / Local Plan Policy

The Swindon Borough Local Plan 2026 was formally adopted by Swindon Borough Council on 26 March 2015. It is the principal planning policy document for Swindon Borough Council, providing the development strategy to deliver sustainable growth to the year 2026. It includes a set of more detailed development management policies used to assess planning applications in the Borough.

As reported within the Local Plan Policy, the Local Authority, together with the Environment Agency (EA) and other partners such as Thames Water, play a key role in the management of local flood risk. Whilst the EA has overall responsibility for managing flood risk, including flood risk associated with main rivers (fluvial), Swindon Borough Council has the requirement as Lead Local Flood Risk Authority to consider local flood risk, including surface water flooding, which has been identified as a major flood risk issue within Swindon Borough. Together with the requirements of the Flood Risk Regulations 2009, Flood and Water Management Act 2010 and national strategy, local authorities should ensure that local strategy and policy reduce the risk and impact of flooding and that appropriate mitigation measures are implemented.

The Sustainable Drainage Systems (SuDS) Policy, which came into force on the 6 April 2015, requires the use of sustainable drainage systems to manage runoff on all applications relating to major development (10 dwellings and above or equivalent development). This is also a requirement of Policy EN6 of the Swindon Local Plan.

The Swindon Borough Local Plan Policy in relation to flood risk and sustainable drainage management (Policy EN6: Flood Risk) is as follow:

*"**a**. The risk and impact of flooding will be minimised through:*

- *Directing development to areas with the lowest probability of flooding;*
- *Ensuring that all development addresses the effective management of all sources of flood risk;*
- *Ensuring that development does not increase the risk of flooding elsewhere including on adjoining and surrounding land; and*
- *Ensuring wider environmental benefits of development in relation to flood risk.*

***b**. The suitability of development proposed in flood zones will be assessed using the Sequential Test, and, where necessary, the Exceptions Test. A sequential approach should be used at site level.*

***c**. A site specific flood risk assessment will be required for development proposals of one hectare or greater in Flood Zone 1 and for all proposals for development (including minor development and change of use) in Flood Zones 2 and 3 and Critical Drainage Areas, and also where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding. Appropriate mitigation and management measures must be implemented.*

***d**. All development proposals must be assessed against the Local Flood Risk Management Strategy to address locally significant flooding including that affecting neighbouring authorities. Appropriate mitigation and management measures must be implemented.*

***e**. All development shall be required to provide a drainage strategy. Developments will be expected to incorporate sustainable drainage systems and ensure that run-off rates are attenuated to greenfield run-off rates. Higher rates would need to be justified and the risks quantified.*

***f.** Sustainable drainage systems should seek to enhance water quality and biodiversity in line with The Water Framework Directive."*

In order for the LLFA to carry out a full consultation, a Surface Water Management Strategy is required which must provide the following information:

- Existing Greenfield Runoff rates for the site. This can be calculated using HR Wallingford's Greenfield Runoff Estimation for Sites tool on their UK Sustainable Drainage Guidance and Tools website;
- A detailed plan showing the existing drainage features on the site and how the proposed drainage strategy will be implemented;
- A detailed topographical Survey that clearly identifies the existing drainage features on the site as well as level contours to show how the site falls;
- Soakage tests in accordance with BRE 365, if infiltration is proposed;
- Calculations to demonstrate the attenuation requirements for the 1 in 100 year plus climate change event to support the proposed strategy;
- Consent for any outfalls from the proposed drainage systems into a public sewer or other drainage system not owned by the applicant.

3. Flood Risk

3.1. Overview

It is outlined within the NPPF that flood risk from all sources must be addressed within the FRA to ensure that potential flood risks are considered during the design development and proposed works. This section outlines all the potential sources of flood risk to the site and the implications these risks have on the development.

3.2. Historical Flood Events

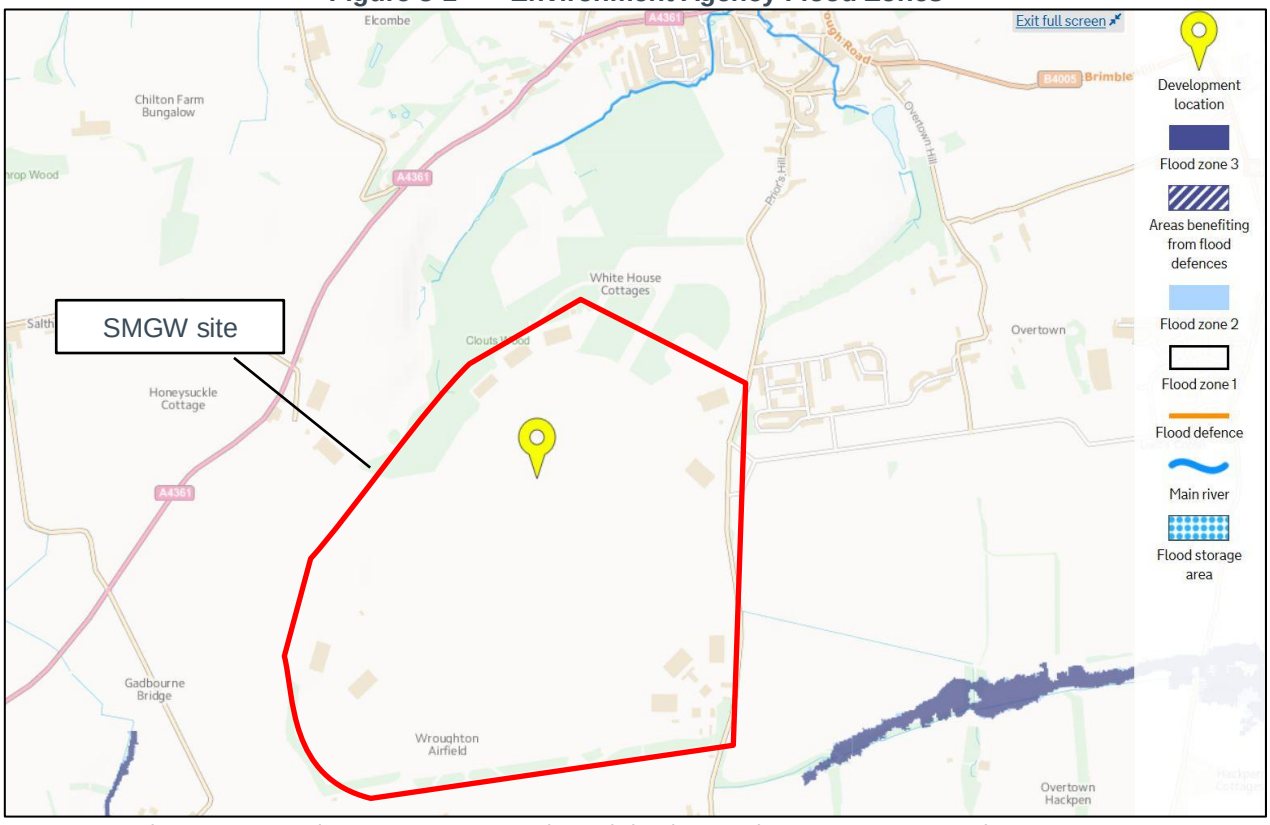
Records or anecdotal information associated with historical flooding can be used to identify locations that may be vulnerable to flooding in the future. Publicly available sources such as FRAs and Environment Agency datasets have been used to provide an insight into past flooding. There are no reported issues of past flooding at the study area.

3.3. Fluvial Flood Risk

Fluvial flooding occurs when the capacity of a watercourse is exceeded such that water overtops the channel. To determine fluvial flood risk to the study area, the Environment Agency Flood Maps were utilised. The flood zones provided on the Environment Agency's website indicate that the proposed development is flood free at the 1000-year event and is therefore within Flood Zone 1, as shown in Figure 3-1.

The proposed development is in Flood Zone 1 and is approximately 1.1km away from Flood Zone 2 and 3.

Figure 3-1 Environment Agency Flood Zones



3.4. Coastal Risk

Tidal flooding occurs when rising sea levels overtop the height of coastal land and sea defences. The extent of tidal flooding is influenced greatly by tidal range, coastal elevation and tide locked rivers in the local area.

The proposed development site is remote from the coast and is not therefore at tidal or coastal flood risk.

3.5. Surface Water Flood Risk

Surface water flooding occurs when rainfall intensities exceed the infiltration capacity such that water collects on the ground surface. Developed land, specifically with large areas of impermeable surfacing, can be vulnerable to surface water flooding where an adequate drainage system is not present.

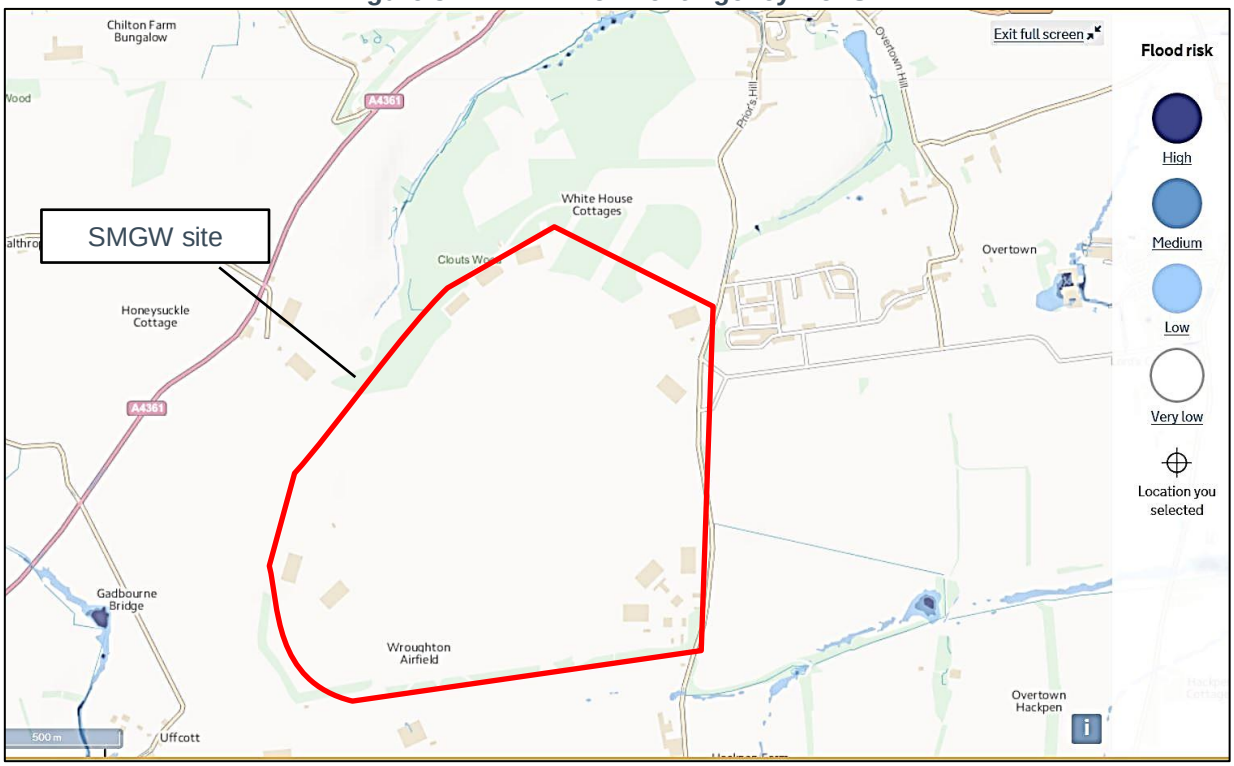
The Environment Agency has published the Risk of Flooding from Surface Water (RoFSW) Maps. These maps show the modelled flood extents potentially caused by surface water flooding during a 1 in 30 (3.3%), 1 in 100 (1.0%) and 1 in 1000 (0.1%) annual probability rainfall event. They do not consider combined impacts from multiple sources.

The RoFSW provided on the Environment Agency's website indicates that the proposed development is flood free from surface water at the 1000-year event, as shown in Figure 3-2. The RoFSW indicate that there are no areas on the site or in proximity of the site that are at risk of surface water flooding.

The RoFSW map shows a watercourse approximately 100m north to the site and 750m north of the proposed development. This watercourse flows north-east through the River Ray to the north of Wroughton.

The RoFSW is based on a simplistic surface water runoff model which make broad assumptions on infiltration rates, flow paths and surface water sewers. Therefore, the extents and depths predicted by the model are unsuitable for use in a detailed design and provide indicative values only.

Figure 3-2 Environment Agency RoFSW



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3.6. Groundwater Flood Risk

Groundwater flooding normally occurs where the water table meets the ground surface in low lying areas which are underlain by permeable rock known as aquifers. This tends to follow long periods of sustained rainfall, but can also be caused as a result of local obstructions to groundwater flow (e.g. following the placement of engineering structures or buildings with foundations) or by the rebound of groundwater levels after a decrease in abstraction or dewatering.

It is important to recognise that the risk of groundwater flooding is typically highly variable and heavily dependent on local geological, topographical and weather conditions. Groundwater flooding is hard to predict and challenging to mitigate.

The *SMG One Collection Facility Geotechnical and Geoenvironmental Desk Study* reports that the British Geological Survey (BGS) has a record of historical boreholes located near the site. The borehole data suggests a thin layer (0.15m) of topsoil across the site, with some made ground expected near the runways. This is underlain by the Zig Zag Chalk Formation to a depth of up to 55m bgl. The BGS describes the Zig Zag Chalk Formation as mostly firm, pale grey to off-white blocky chalk with a lower part characterised by rhythmic alternations of marls and marly chalks with firm white chalk.

Standing groundwater has been historically found between 39 and 43m bgl, although as the records are very old this will need to be confirmed through ground investigation.

Information from the Environment Agency indicates that the Bedrock Formation of Zig Zag Chalk that underlies the site is classified as a Principal Aquifer. This is defined by the EA as "*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.*"

The EA indicates that the site lies within a Groundwater Source Protection 'Zone 3' (total catchment), defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source.

The site lies within a 'Major Aquifer High' Groundwater Vulnerability Zone.

Due to the low groundwater level found from the historical boreholes and the high permeability of the chalk, the risk that the water table might have an impact on the site is considered to be very low.

3.7. Other Sources of Flooding

3.7.1. Sewers

Flooding from sewers (open or culverted) is caused by exceedance of sewer capacity and/or a blockage in the sewer network. In areas with a combined sewer network system there is a risk that land and infrastructure could be flooded with contaminated water. In cases where a separate sewer network is in place, sites are not sensitive to flooding from the foul sewer system.

The drainage strategy reports that enquiries with the statutory undertakers have been undertaken and indicate that there are currently no surface or foul drainage systems within the area of the proposed development. Therefore, flooding from sewers is not thought to be an issue.

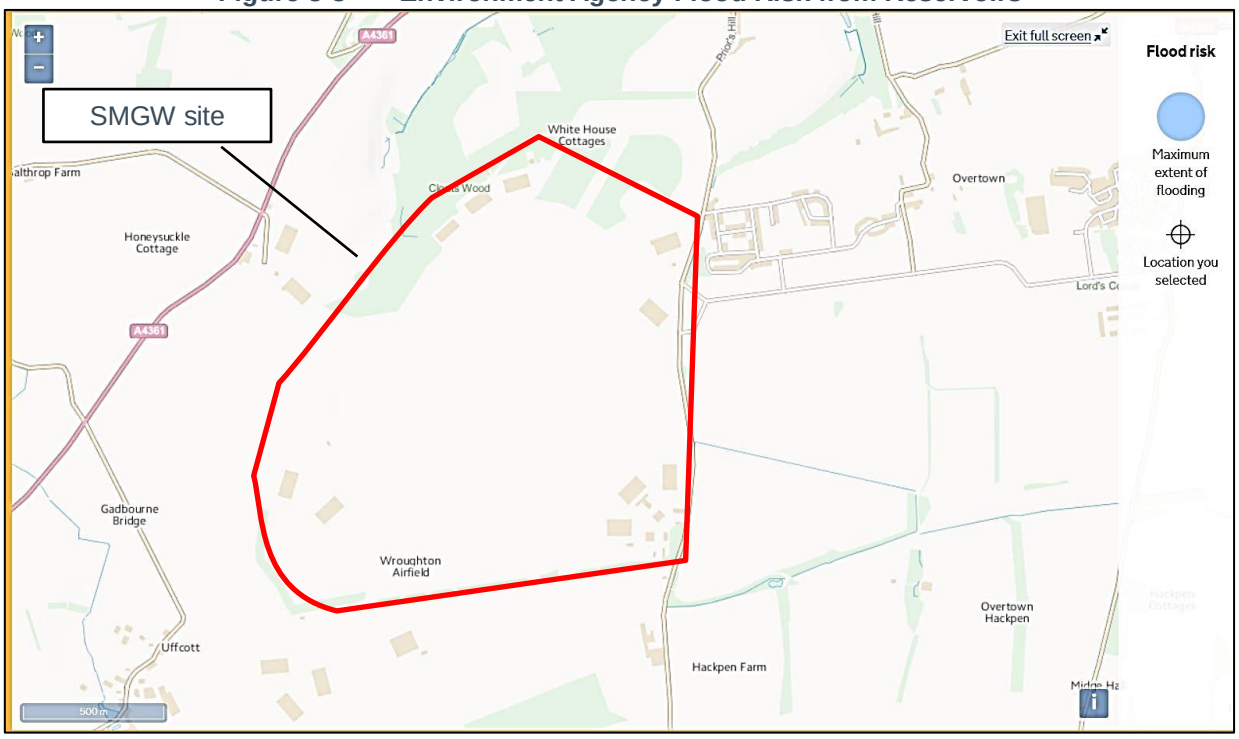
3.7.2. Canals

There are no canals within or in proximity to the site which could impact flood risk.

3.7.3. Reservoirs

Where reservoirs are present in proximity to the development, there is a residual flood risk associated with them in the event of a breach. As shown in the Environment Agency long term flood risk maps (Figure 3-3), there is no risk of flooding from reservoirs at the proposed development site.

Figure 3-3 Environment Agency Flood Risk from Reservoirs



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3.8. Climate Change

Flood risk throughout the study area will increase as a result of climate change. The site lies within the Thames basin. Table 3-1 shows the predicted changes in peak rainfall intensity, peak river flow and sea level rise of the Thames basin, as outlined within the latest guidance from the Environment Agency (Environment Agency, 2016).

The 2016 climate change guidelines take a probabilistic approach, providing a range of estimates with higher increases predicted for less likely but plausible scenarios. The climate change date range applied should be in line with the design life of the proposed scheme. As this is not currently known, the highest range bracket has been applied (2070 to 2115).

As the proposed scheme is classed as Less Vulnerable and lies in Flood Zone 1, the Central allowance for peak river flow increases (i.e. 25%) should be considered in any detailed assessment and drainage design. The Environment Agency recommends assessing both the Central and Upper end allowances for peak rainfall intensity (i.e. 20% and 40%), in order to understand the range of impact.

Table 3-1 Climate change predictions for the Thames river basin district

Allowance category	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)
Peak river flows			
Upper end	25%	35%	70%
Higher central	15%	25%	35%
Central	10%	15%	25%
Rainfall intensity			
Upper end	10%	20%	40%

Allowance category	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)
Peak river flows			
Central	5%	10%	20%

Although the proposed site is not currently at risk of flooding from any sources, and is approximately 1.1km from Flood Zone 2 and 3, this could potentially change with increasing river levels. As the existing flood models have not been run under these climate change scenarios, it is not possible to precisely determine the change in risk. However, given the distance from watercourses, the increase in risk is likely to be low from fluvial flooding.

Future increases in rainfall intensities are more likely to impact the development. These will increase the frequency and extent of surface water flooding within the site. It is important to ensure that the development is sufficiently resilient to future changes so it remains operational throughout its design life.

Swindon Borough requirement for new applications is to design the drainage features for a peak rainfall event of 100-year plus climate change. The drainage strategy needs to demonstrate that for the 1 in 100 year plus climate change event there is no increasing in flood risk on site and elsewhere for the drainage features lifetime.

3.9. Summary

The flood risk from all sources has been addressed in this section. The assessment concludes that:

- The site is remote from any watercourses and lies in Environment Agency Flood Zone 1. Therefore, it is not considered to be at risk from fluvial flooding;
- The proposed development site is remote from the coast and is not therefore at tidal or coastal flood risk;
- The Environment Agency's RoFSW maps suggest that there are no areas of the site that are at any risk of surface water flooding;
- Information from BGS record of historical boreholes suggests that the risk of groundwater flooding is low;
- The Drainage Strategy states that there is no drainage provision near the proposed development and therefore flood risk from sewers is considered very low; and
- The scheme is approximately 1.1km outside from fluvial Flood Zones, thus the increases in peak river levels due to climate change allowances do not require detailed consideration.

4. Impact of the scheme

4.1. Sustainable Drainage Systems (SuDS) Overview

The proposed development will increase the impermeable area of the site as it will be built on the existing greenfield land. The development will have a 27,000m^2 footprint.

As the impermeable area is going to change, mitigation measures are required and mitigation using SuDS is recommended. SuDS techniques aim to reduce the peak flows, storm volumes and improve water quality. SuDS are physical structures and fall into three broad groups:

- Source Control Techniques: such as soakaways and infiltration trenches. These offer scope for a reduction in storm runoff. They require relatively permeable underlying strata and the groundwater table to be well below the ground surface;
- Permeable Conveyance Systems: such as filter drains, French drains or swales. These offer permeable conveyance drainage and create temporary surface attenuation; and
- Passive Treatment Systems: such as basins, ponds, and wetlands, which provide a means of attenuating surface water flows and allow storm water to be released in a controlled manner.

4.2. Proposed Drainage Strategy

A proposed Drainage Strategy has been produced by Atkins (report 5161116-ATK-ZZ-XX-RP-C-110), based on the available information. The main points of the drainage strategy are summarised below.

4.2.1. Surface Water Drainage Strategy

The proposal of the surface water drainage strategy is to use soakaways. Based on information available, indeed, the site geology comprises a thin layer of topsoil (0.15mm) directly overlying chalk material. The permeability of the chalk material is likely to be suitable for soakaway drainage. An intrusive ground investigation to determine ground parameters, however, has not yet been undertaken and it is therefore recommended.

The drainage calculation has been undertaken with MicroDrainage and thefollowing parameters have been used:

- Impermeable area: 2.5 ha;
- Infiltration coefficient: 0.0767 m/hr. This value has been taken from another site with similar ground properties. The drainage strategy states that it is considered conservative, considering the chalk material of the site;
- Rainfall event: 1 in 100-year plus 30% of climate change (winter event); and
- Finished floor level of the building: 195.500 m AOD.

Different options have been considered for the soakaways location, as shown in Figure 4-1.

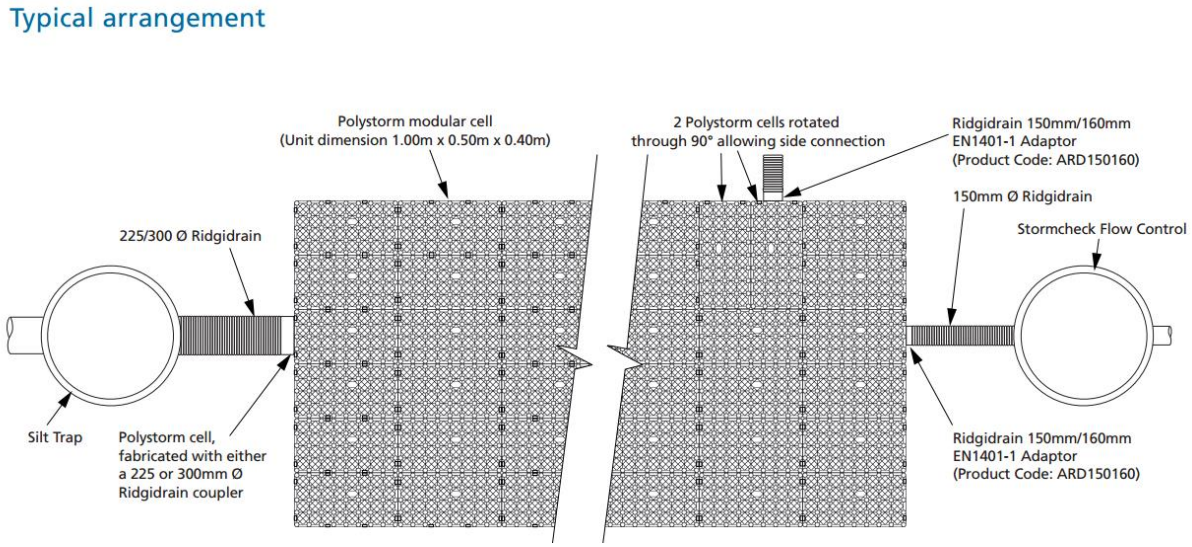
Figure 4-1 Proposed soakaways locations

The strategy has considered three alternatives to the single soakaway tank option, as follows:

- *Alternative 1*: Splitting the soakaway in two tanks – providing one tank to each side of the building (Option 3 and 1 in the figure);
- *Alternative 2*: A longer linear feature for the tank either side of the building (Option 4); and
- *Alternative 3*: similar to alternative 2, but using swales instead of tanks. Key to this consideration will be the relative fall from the building to the swale.

The preferred alternative is *Alternative 2*, i.e. using infiltration trench soakaways. A typical arrangement for prefabricated cell soakaway is shown in Figure 4-2. The trench depth, width and length have been determined using MicroDrainage.

Figure 4-2 Typical Geocellular cells



MicroDrainage results show that there is no flooding for a day storm winter event, 100 return year + 30% climate change. The parameters which define the trench soakaways design are defined below:

- Length trench soakaway: 250 m (each side of the building), with a total length of 500 m.
- Depth: 1.6 m (with 0.5 meters cover)
- Width: 3.0 m

4.2.2. Foul Water Drainage Strategy

There is no foul drainage provision in the area of the airfield where the building is proposed. Due to the relatively low population of the building, a septic tank would be suitable. Based on a staff population of 20 people, plus a visiting group of 30 people, a biodigester tank of size 4.0x2.5x2.5m is likely to be suitable.

The tank would also need an associated drainage field to offer soakaway drainage from the tank.

5. Summary and Recommendations

5.1. Summary

- All sources of flood risk have been considered and no potential flood risk has been identified for the site;
- The proposed building is considered to be “Less Vulnerable”, and the site is located in Flood Zone 1. Therefore, the development is appropriate for the proposed use in line with the NPPF; and
- The drainage strategy proposes the use of soakaways.

5.2. Recommendations

This FRA has the following recommendations:

- Soakaway tests of appropriate size for site are required. Soakage tests must be in accordance with BRE 365 to demonstrate infiltration is feasible;
- Details should be provided of how the proposed and drainage features on the site will be maintained and managed after completion with confirmation from the relevant authority that they will adopt any systems that are being offered for adoption;
- Details of how the drainage scheme has incorporated SuDS techniques to manage water quantity and maintain water quality in accordance with best practice guidance including the latest SuDS Manual C753; and
- Information regarding the exceedance routes should be provided.

6. References

Atkins. (2017). *SMG One Collection Facility, Wroughton Phase 1 Geotechnical and Geoenvironmental Desk Study Science Museum Group*.

British Geological Survey. (2006). *Guide to Permeability Indices - CR/06/160N.*

Department for communities and local government. (2014). *National Planning Policy Framework, Planning Practice Guidance.* United Kingdom.

Environment Agency. (2016a, 07 04). *Environmental Spatial Data Catalogue*. Retrieved from gov.uk: http://environment.data.gov.uk/ds/catalogue/index.jsp#/catalogue

Environment Agency. (2016b, 02 19). *Flood risk assessments: climate change allowances.* Retrieved from Gov.co.uk: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#what-climate-change-allowances-are

Halcrow. (2008). *Swindon Borough Council Level 1 SFRA – Final Report (Volume I).*

Halcrow. (2011). *Swindon Borough Council Preliminary Flood Risk Assessment.*

NPPF. (2014, 03 06). *Flood Zone and Flood Risk Tables - Paragraph: 066 Reference ID: 7-066-20140306*. Retrieved from Planning Practive Guidance: http://planningguidance.communities.gov.uk/blog/guidance/flood-risk-and-coastal-change/flood-zone-and-flood-risk-tables/table-2-flood-risk-vulnerability-classification

Scott Wilson. (2008). *Wiltshire County and Swindon Borough Council Level 1 SFRA.*

Appendices

Appendix A. Proposed scheme

Appendix B. Flood risk classification

B.1. Flood Risk Vulnerability Classification

Land Use Vulnerability	Type of 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 Stations, Ambulance Stations and Fire stations, Command Centres and 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.
More Vulnerable	Hospitals. Residential institutions such as 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 specific warning and evacuation plans.
Less Vulnerable	Police Stations, Ambulance Stations and Fire stations which are not required to be operational during flooding. Buildings used for: shops, financial, professional and other services; restaurants and cafes, hot food takeaways; offices; general industry; storage and distribution; non-residential institutions not included in 'more vulnerable'; and assembly and leisure. Land and buildings used for agriculture and forestry. Waste treatment (except for landfill and hazardous waste facilities). Minerals working and processing (except for sand and gravel working). Water treatment plants which do not need to remain operational during times of flood. Sewage treatment plants (if adequate pollution control measures in place).
Water Compatible Development	Flood control infrastructure. Water transmission infrastructure and pumping stations. Sewage transmission infrastructure and pumping stations. Sand and Gravel workings. Docks, Marinas and Wharves. Navigation facilities. MOD installations. Shipbuilding, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. Water based recreation (excluding sleeping accommodation). Lifeguard and coastguard operations.

	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 specific warning and evacuation plans.

B.2. Flood Risk Vulnerability and Flood Zone Compatibility

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.

Notes to table:

•This table does not show the application of the Sequential Test which should be applied first to guide development to Flood Zone 1, then Zone 2, and then Zone 3; nor does it reflect the need to avoid flood risk from sources other than rivers and the sea;
•The Sequential and Exception Tests do not need to be applied to minor developments and changes of use, except for a change of use to a caravan, camping or chalet site, or to a mobile home or park home site;
•Some developments may contain different elements of vulnerability and the highest vulnerability category should be used, unless the development is considered in its component parts.
† In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood.
* In Flood Zone 3b (functional floodplain) essential infrastructure that has to be there and has passed the Exception Test, and water-compatible uses, should be designed and constructed to:
•remain operational and safe for users in times of flood;
•result in no net loss of floodplain storage;
•not impede water flows and not increase flood risk elsewhere.

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