

FloodSmart



Flood Risk Assessment

Site Address

Halifax Road
Littleborough
OL16 2SQ

Grid Reference

SD 92079 15663

Report Prepared for

Malcolm McClean

Date

2023-10-30

Report Status

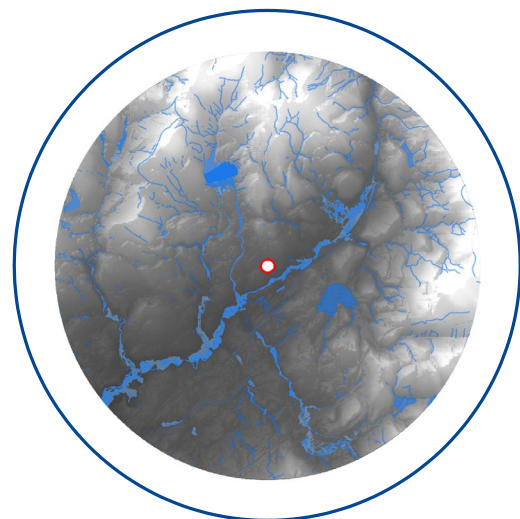
FINAL

Site Area

0.17 ha

Report Reference

80754R1



RISK - Low

The Site is located in Flood Zone 1, and is at Very Low risk of flooding from rivers and the sea. Surface water (pluvial) flood risks are Low. Groundwater flood risks are low and flooding risks from artificial sources (i.e. canals, reservoirs and sewers) are Low. Mitigation measures are recommended in this report to reduce the risks to an acceptable level over the lifetime of the development.

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1. Executive summary



A review has been undertaken of national environmental data sets to assess the flood risk to the Site from all sources of flooding in accordance with the National Planning Policy Framework (NPPF) (2023) and National Planning Practice Guidance (NPPG) (Published in 2014 and updated in August 2022). A site-specific flood risk assessment, to assess the flood risk to and from the development Site, is provided within this concise interpretative report written by an experienced GeoSmart consultant. Baseline flood risk and residual risks that remain after the flood risk management and mitigation measures are implemented are summarised in the table below.

Site analysis

Source of Flood Risk	Baseline*	Final **
River (fluvial) flooding	Very Low	N/A
Sea (coastal/tidal) flooding	Very Low	N/A
Surface water (pluvial) flooding	Low to Medium	Very Low
Groundwater flooding	Negligible	Negligible
Other flood risk factors present	Yes	Yes
Is any other further work recommended?	Yes	Yes (see below)

*BASELINE risks have been calculated for the whole Site, using national risk maps, including the benefit of EA flood defences. **FINAL RISK RATING Includes a detailed analyses of flooding risks over the lifetime of the proposed development, including allowances for climate change AND assumes recommended mitigation measures are implemented. N/A indicates where mitigation is not required.

Summary of existing and proposed development

The Site is currently a brownfield site with an area of hard standing in the west of the Site and grassed area in the east.

Development proposals comprise the construction of a 17 unit residential development to provide housing for vulnerable adults. This will include the formation of new associated landscaping and retention of existing access and the development of a new car park. Site plans are included within Appendix A.

Summary of flood risks

The flood risks from all sources have been assessed as part of this report and are as follows:

River (fluvial)

According to the Environment Agency's (EA) Flood Map for Planning Purposes, the Site is located within a fluvial Flood Zone 1 (Low Probability).

According to the EA's Risk of Flooding from Rivers and Sea (RoFRS) map, which considers the type, condition and crest height of flood defences, the Site has a Very Low risk of flooding.

Surface water (pluvial) flooding

According to the EA's Risk of Flooding from Surface Water (pluvial) flood mapping, the Site has a risk of pluvial flooding ranging from Very Low to Medium.

- Flood depths in the area proposed for development could be up to 0.15 m in the 1 in 100 year present day scenario event.
- Flood depths in the area proposed for development could be up to 0.30 m in the 1 in 100 year plus climate change event, which equates to a 'design' flood level of 155.8m AOD in the area proposed for development.

As there is an increase in the built footprint at the Site and the area proposed for development is affected by the design flood level, this may displace flood water and floodplain compensation may be required. This is discussed further in Section 5 of this report.

A SuDS strategy has been prepared separately (ref: 80754.01) to ensure surface water runoff from the Site is managed over the lifetime of the proposed development.

Baseline mapping indicates a Very Low to Medium. risk, however a review of the flood model and borehole data indicates the risk is likely to be lower. The proposed development does not obstruct any overland flows as they are modelled to occur across non-essential areas of the site.

Groundwater flooding

Groundwater Flood Risk screening data indicates there is a Negligible potential risk of groundwater flooding at the surface in the vicinity of the Site during a 1 in 100 year event.

Baseline mapping indicates a Negligible risk, however a review of the flood borehole data indicates the risk is likely to be Low.

Artificial sources of flooding

The risk of flooding from artificial (man-made) sources such as reservoirs, sewers and canals has been assessed:

- The EA's Risk of Flooding from Reservoir map confirms the Site is at risk of reservoir flooding. The potential for a breach of a reservoir to occur and flooding affecting the Site is Low.

- Ordnance Survey (OS) data confirms there are no canals near to the Site.
- The Strategic Flood Risk Assessment (SFRA) (JBA Consulting, 2019) confirms no recorded instances of sewer flooding at or within the vicinity of the Site.

The risk of flooding from artificial sources is considered to be Negligible.

Recommendations

Recommendations for flood mitigation are provided below, based upon the proposed development and the flood risk identified at the Site.

- As there is a risk of flooding from surface water sources, where flood depths could be up to 0.30 m in depth in the area proposed for development, Finished Floor Levels (FFL) of the proposed development should be set to 156.1 mAOD¹. Standard flood resilient design measures should be incorporated.
- Where raising of FFL's is constrained the FFL should be set as high as possible and standard flood resistance and resilient design measures included (see Section 7). In addition, where sleeping accommodation is proposed at ground level and would be affected by flooding, this should be moved to a higher level of the building.
- The ongoing management and maintenance of existing and any proposed drainage networks, under the riparian ownership of the developer, should be undertaken in perpetuity with the development.
- An assessment of floodplain storage should be considered to ensure the proposed development does not displace flooding, particularly where ground level or finished floor level raising is proposed.

GeoSmart recommend the mitigation measures discussed within this report are considered as part of the proposed development where possible and evidence of this is provided to the Local Planning Authority as part of the planning application.

¹ 0.30m above the 1 in 100 year plus climate change flood level of 155.8 mAOD.

2. Introduction



Background and purpose

A site-specific flood risk assessment has been undertaken, to assess the flood risk to and from the development Site. This assessment has been undertaken by firstly compiling information concerning the Site and the surrounding area. The information gathered was then used to construct a 'conceptual site model', including an understanding of the appropriateness of the development as defined in the NPPF (2023) and the source(s) of any flood risk present, guided by the NPPG (Published in 2014 and updated in August 2022). Finally, a preliminary assessment of the steps that can be taken to manage flood risk to the development was undertaken.

This report has been prepared with reference to the NPPF (2023) and NPPG (2022).

"The National Planning Policy Framework set out the Government's planning policies for England and how these are expected to be applied" (NPPF, 2023).

The NPPF (2023) and NPPG (2022) promote a sequential, risk based approach to the location of development. This also applies to locating a development within a Site which has a variable risk of flooding.

"The approach is designed to ensure that areas at little or no risk of flooding from any source are developed in preference to areas at higher risk. This means avoiding, so far as possible, development in current and future medium and high flood risk areas considering all sources of flooding including areas at risk of surface water flooding" (Paragraph: 023. NPPG, 2022).

The purpose of this report is to provide clear and pragmatic advice regarding the nature and potential significance of flood hazards which may be present at the Site.

Report scope

In accordance with the requirements set out within NPPG 2022 (Paragraph: 021 Reference ID: 7-021-20220825), a thorough review of publicly and commercially available flood risk data and EA supplied data indicating potential sources of flood risk to the Site from rivers and coastal sources, surface run-off (pluvial), groundwater and reservoirs, including historical flood information and modelled flood extent. Appropriate measures are recommended to manage and mitigate the flood risk to the property.

Information obtained from the EA and a review of the Greater Manchester Strategic Flood Risk Assessment (SFRA) (JBA Consulting, 2019) is used to ascertain local flooding issues and, where appropriate, identify information to support a Sequential and/or Exception test required as part of the NPPF (2023).

The existing and future flood risk to and from the Site from all flood sources is assessed in line with current best practice using the best available data. The risk to the development has been assessed over its expected lifetime, including appropriate allowances for the impacts of climate change. Residual risks that remain after the flood risk management and mitigation

measures are implemented, are considered with an explanation of how these risks can be managed to keep the users of the development safe over its lifetime.

An indication of whether the Site will potentially increase flood risk elsewhere is provided, including where the proposed development increases the building footprint at the Site. A drainage strategy to control runoff can be commissioned separately if identified as a requirement within this report.

Report limitations

It is noted that the findings presented in this report are based on a desk study of information supplied by third parties. Whilst we assume that all information is representative of past and present conditions, we can offer no guarantee as to its validity and a proportionate programme of site investigations would be required to fully verify these findings.

The basemap used is the OS Street View 1:10,000 scale, however the Site boundary has been drawn using BlueSky aerial imagery to ensure the correct extent and proportion of the Site is analysed.

This report excludes consideration of potential hazards arising from any activities at the Site other than normal use and occupancy for the intended land uses. Hazards associated with any other activities have not been assessed and must be subject to a specific risk assessment by the parties responsible for those activities.

Datasets

The following table shows the sources of information that have been consulted as part of this report:

Table 1. Datasets consulted to obtain confirmation of sources of flooding and risk

Source of flooding	Datasets consulted				
	Commercial Flood Maps	Local Policy & Guidance Documents*	Environment Agency	Utility provider	OS Data
Historical	X	X	X		
River (fluvial) / Sea (tidal/coastal)	X	X	X		

Source of flooding	Datasets consulted				
	Commercial Flood Maps	Local Policy & Guidance Documents*	Environment Agency	Utility provider	OS Data
Surface water (pluvial)	X	X	X		
Groundwater	X	X			
Sewer		X			
Culvert/bridges		X			X
Reservoir		X	X		

*Local guidance and policy, referenced in Section 6, has been consulted to determine local flood conditions and requirements for flood mitigation measures.

Local policy and guidance

Rochdale Borough's Strategy for Flood Risk Management 2014-2024 (Rochdale Borough Council, 2013):

- Rochdale borough and the wider Pennine uplands encircling much of Greater Manchester contains extensive water gathering grounds and a large number of reservoirs providing drinking water and water for recreation and abstraction for a variety of uses. Whilst water within reservoirs can be regulated, flood risk can arise and the most significant risk is from failure of a reservoir dam for example through a breach in the dam wall.
- United Utilities maintain records of properties at risk of flooding from sewerage systems and of reported incidents of flooding both internal to properties and where gardens, highways and public open spaces have flooded. For illustration, between September 2012 – September 2013 United Utilities have reacted to 19 reported hydraulic flooding incidents.

Greater Manchester Strategic Flood Risk Assessment (JBA Consulting, 2019):

- There is a risk of localised flooding associated with the drainage infrastructure of the urban areas due, in part, to undersized existing drainage capacity and sewer

systems and also possible blockages of the network. UU is responsible for the management of the adopted sewerage system, including surface water and foul sewerage.

- Littleborough in Rochdale also has a large RFO area due to flooding from the River Roch and also surface water in December 2015.

Guidance

Strategic Flood Risk Assessments are carried out by local authorities, in consultation with the Environment Agency, to assess the flood risk to the area from all sources both now and in the future due to climate change. They are used to inform planning decisions to ensure inappropriate development is avoided (NPPF, 2023).

3. Site analysis



Site information

The Site is located in North East Rochdale in a setting of commercial and residential land use at National Grid Reference SD 92079 15663.

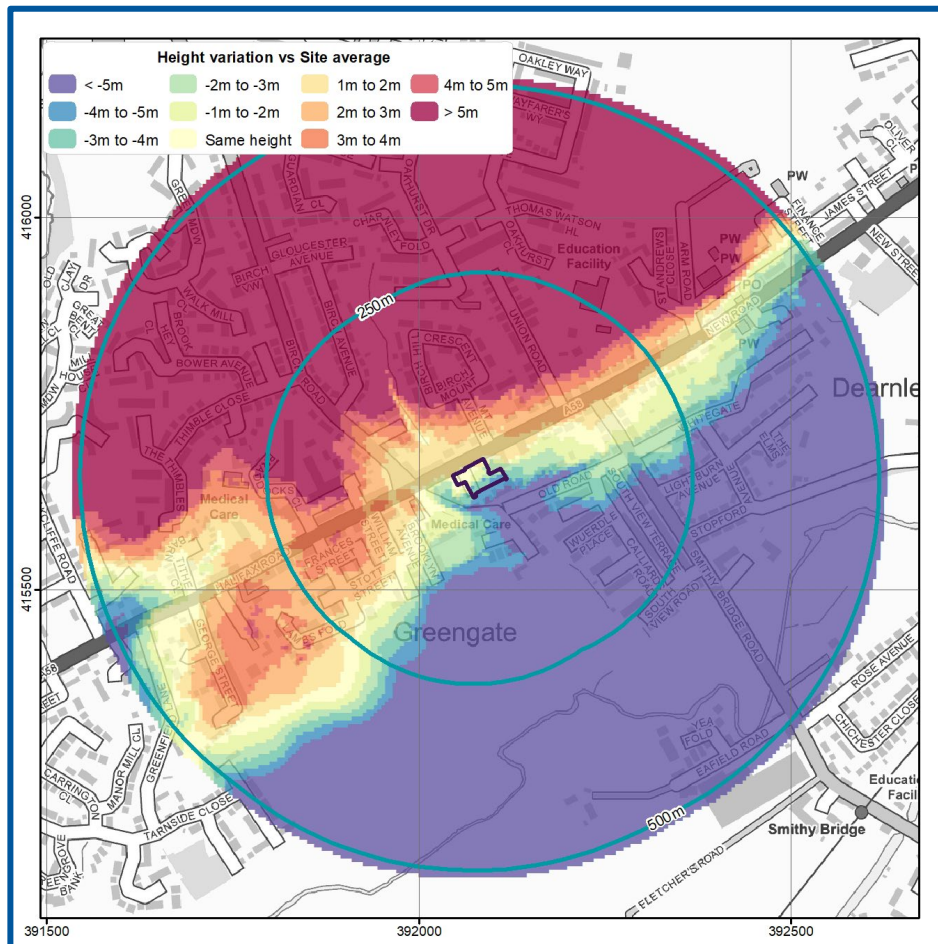
Figure 1. Aerial imagery of the Site (Bluesky, 2023)



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Figure 2 overleaf indicates ground levels within 500m of the Site fall in an easterly direction. The general ground levels on the Site are between 152.5 and 155.5 mAOD with the Site falling gradually in an easterly direction. This is based on EA elevation data obtained for the Site to a 1 m resolution with a vertical accuracy of ± 0.15 m (Appendix B).

Figure 2. Site Location and Relative Elevations (GeoSmart, 2023)



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Development

The Site is currently a brownfield site with an area of hardstanding in the west of the Site and grassed area in the east.

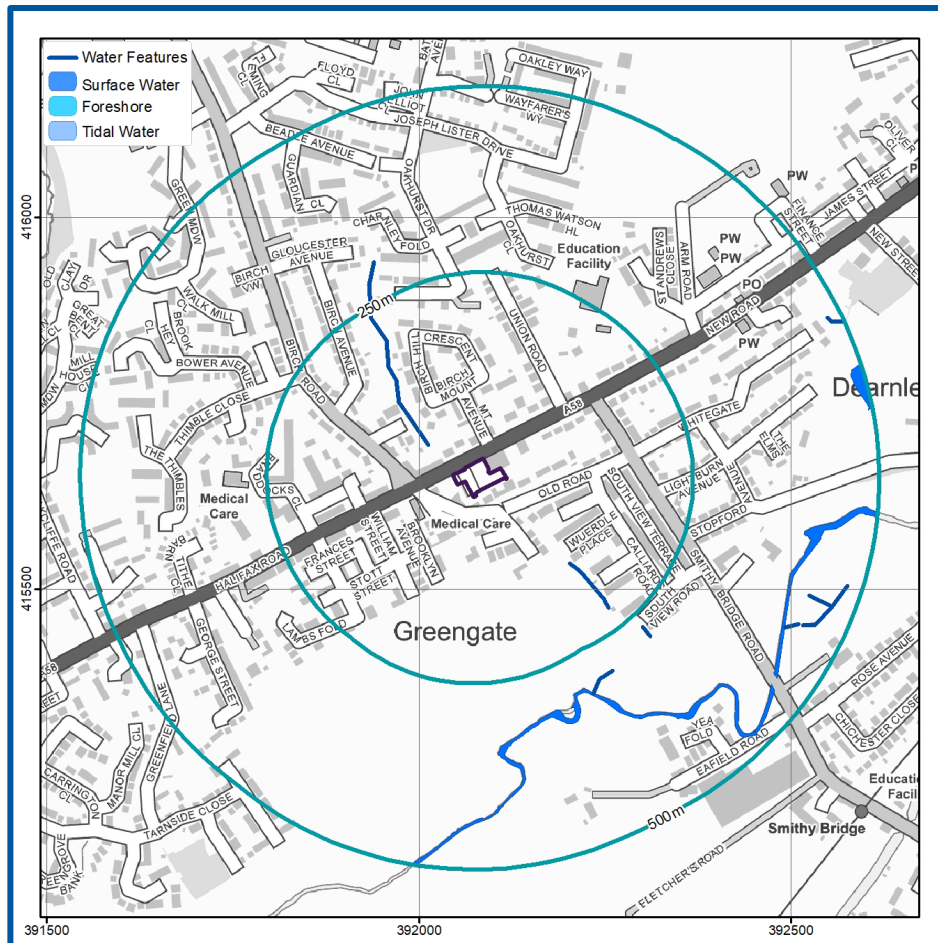
Development proposals comprise the construction of a 17 unit residential development to provide housing for vulnerable adults. This will include the formation of new associated landscaping and retention of existing access and the development of a new car park. Site plans are included within Appendix A.

The effect of the overall development will result in an increase in number of occupants and/or users of the Site and will result in the change of use, nature or times of occupation. According to Annex 3 of the NPPG (2022), the vulnerability classification of the existing development is Less Vulnerable and proposed development is More Vulnerable. The estimated lifespan of the development is 100 years.

Hydrological features

According to Ordnance Survey (OS) mapping included in the following figure, there are numerous surface water features within 500 m of the Site. 300m to the south of the Site the River Roch flows from east to west at an estimated 30m lower elevation. There is a further water feature situated at 50m to the north of the Site flowing to the south at an estimated 1m higher elevation.

Figure 3. Surface water features (EA, 2023)



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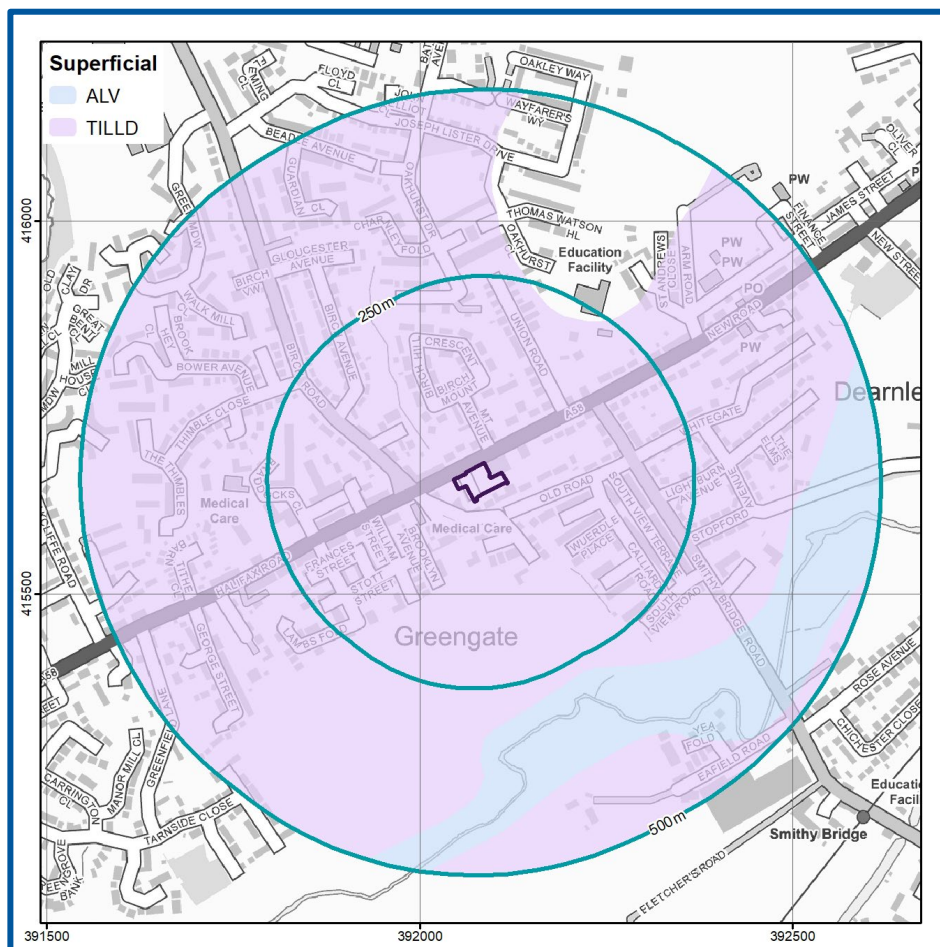
Proximity to relevant infrastructure

The water feature located to the north of the site is potentially culverted to allow for a connection to the river Roch to the south of the site via the located culvert to the south east running adjacent to the housing estate.

Hydrogeological features

British Geological Survey (BGS) mapping indicates the underlying superficial geology (Figure 4 below) consists of Devensian Till (TILLD) (BGS, 2023) and is classified as a Secondary Undifferentiated Aquifer (EA, 2023).

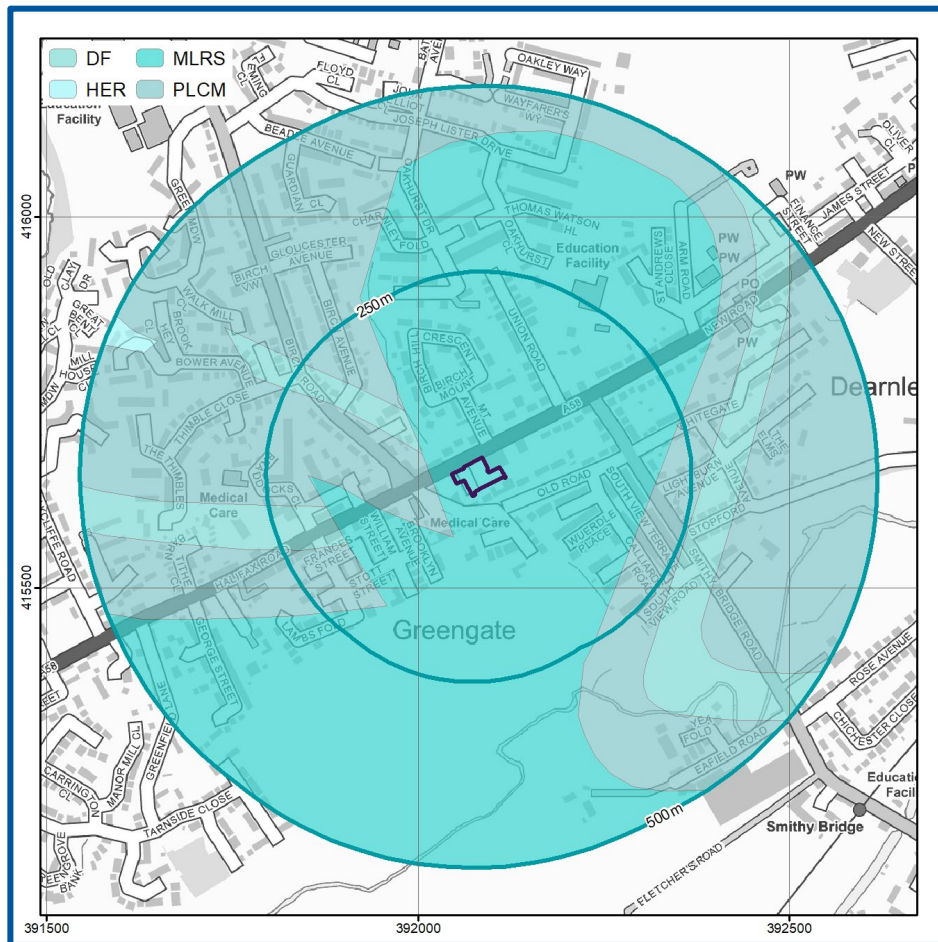
Figure 4. Superficial Geology (BGS, 2023)



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BGS mapping indicates the underlying bedrock geology (Figure 5 below) consists of the Milnrow Sandstone (MLRS) (BGS, 2023) and is classified as a Secondary (A) Aquifer (EA, 2023).

Figure 5. Bedrock Geology (BGS, 2023)



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Geological conditions

A review of the BGS borehole database (BGS, 2023) indicates the nearest borehole (ref: SD91NW3) is to the south east of the site. However, the geological logs are illegible.

Groundwater

At borehole SD91NW3 ground water levels are at 1.83 m below ground level (bgl) with a ground level of 151.31m AOD, thus Groundwater levels are estimated to be approximately 149.57 mAOD compared with ground levels on the Site of 152.5 and 155.5m AOD, with an approximate ground water depth of 2.93m bgl at the site.

4. Flood risk to the development

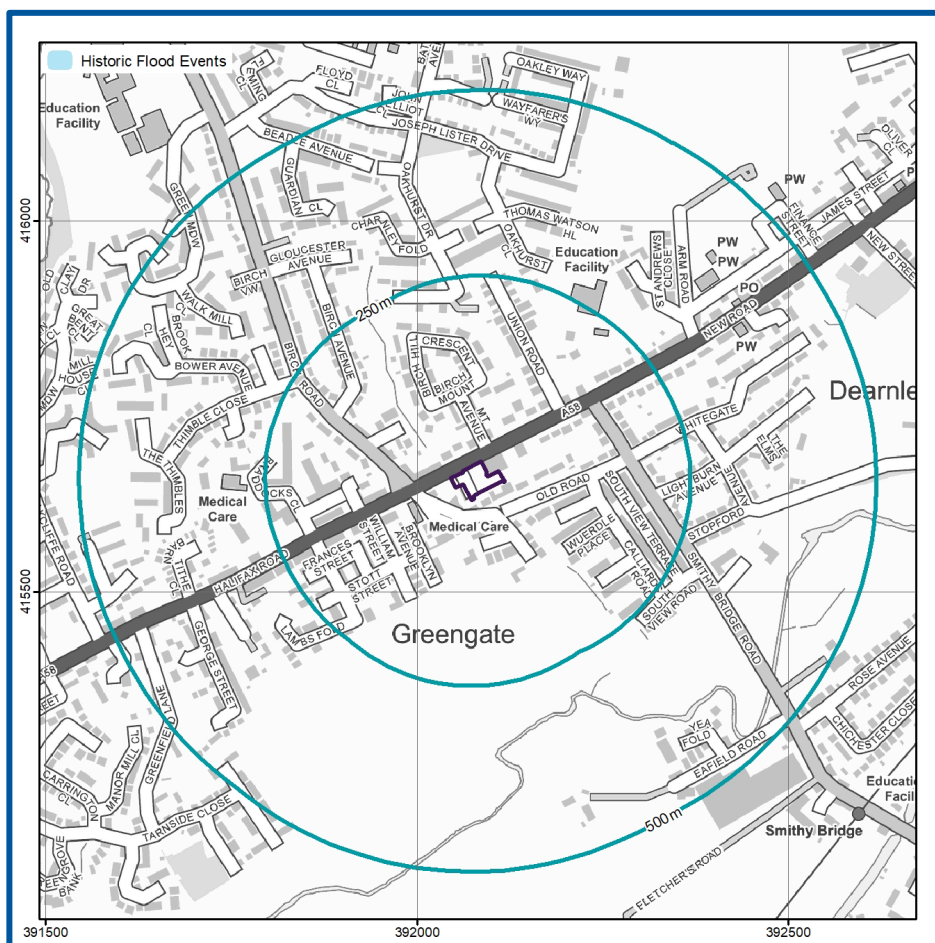


Historical flood events

According to the EA's Historical Flood Map (Figure 6 below) there has been no flooding events affecting the Site

The purpose of historical flood data is to provide information on where and why flooding may have occurred in the past. The absence of any recorded events does not mean flooding has never occurred on-Site or that flooding will never occur at the Site.

Figure 6. EA Historic Flood Map (EA, 2023)

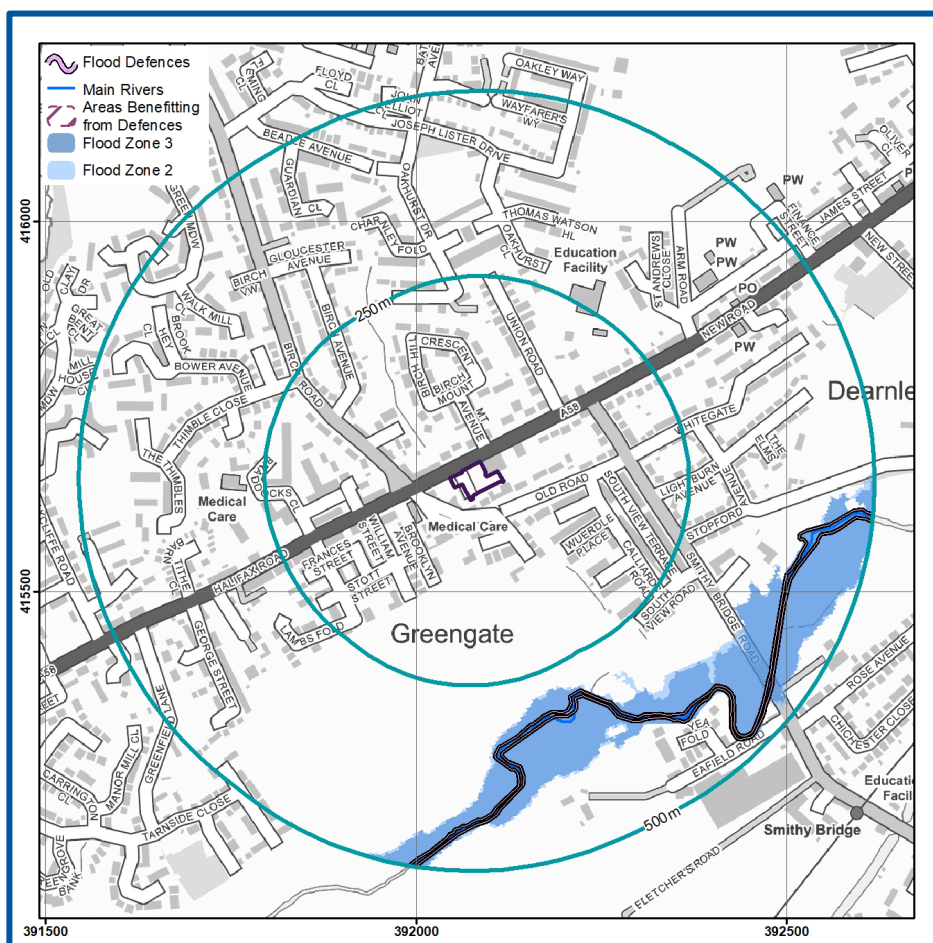


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Rivers (fluvial) / Sea (coastal) / Estuarine (tidal) flooding

According to the EA's Flood Map for Planning Purposes (Figure 7), the Site is located within fluvial Flood Zone 1 and is therefore classified as having a Low probability of fluvial flooding from nearby watercourses.

Figure 7. EA Flood Map for Planning Purposes (EA, 2023)



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Guidance

As defined in the NPPF (2023):

Ignoring the presence of any defences, land located in a Flood Zone 1 is considered to have a Low probability of flooding, with less than a 1 in 1000 annual probability of fluvial or coastal flooding in any one year.

Development of all uses of land is appropriate in this zone (see glossary for terminology).

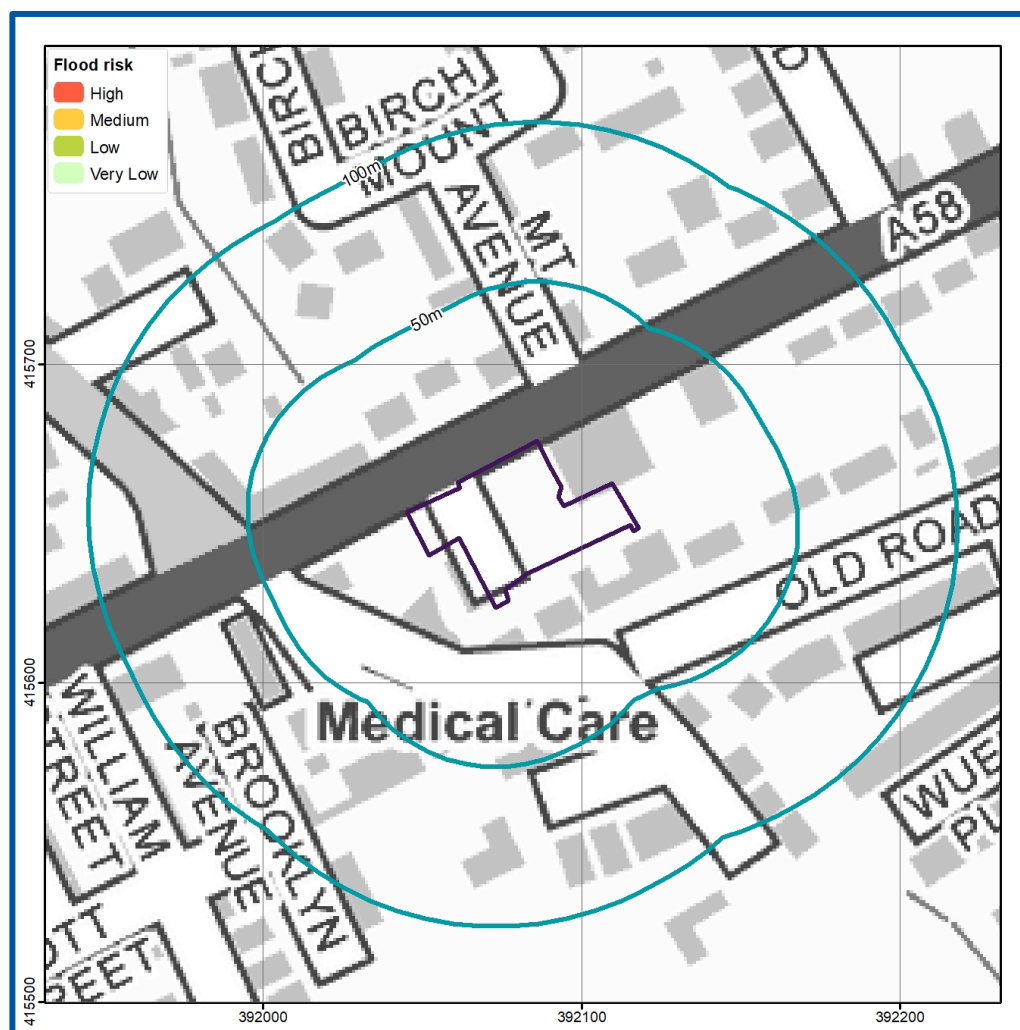
Flood risk including the benefit of defences

The Site is not located in an area benefiting from flood defences.

The type and condition of existing flood defences influence the 'actual' risk of fluvial flooding to the Site, albeit the long-term residual risk of flooding (ignoring the defences) should be considered when proposing new development.

According to the EA's Risk of Flooding from Rivers and Sea (RoFRS) map (Figure 8), which considers the type, condition and crest height of flood defences, the Site has a Very Low risk of flooding from the nearby watercourse.

Figure 8. Risk of Flooding from Rivers and Sea map (EA, 2023)



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Surface water (pluvial) flooding

Surface water flooding occurs when intense rainfall exceeds the infiltration capacity of the ground and overwhelms the drainage systems. It can occur in most locations even at higher elevations and at significant distances from river and coastal floodplains.

According to the EA's Risk of Flooding from Surface Water (pluvial) flood mapping (Figure 9), the Site is at a variable risk of pluvial flooding ranging from Very Low to Medium.

- high risk running along the adjacent Halifax Road to the north.
- medium risk at the northwest of the Site, where the proposed site entrance will be,
- Low risk to the south and south east of the site,
- Very low risk located in the north of the site.

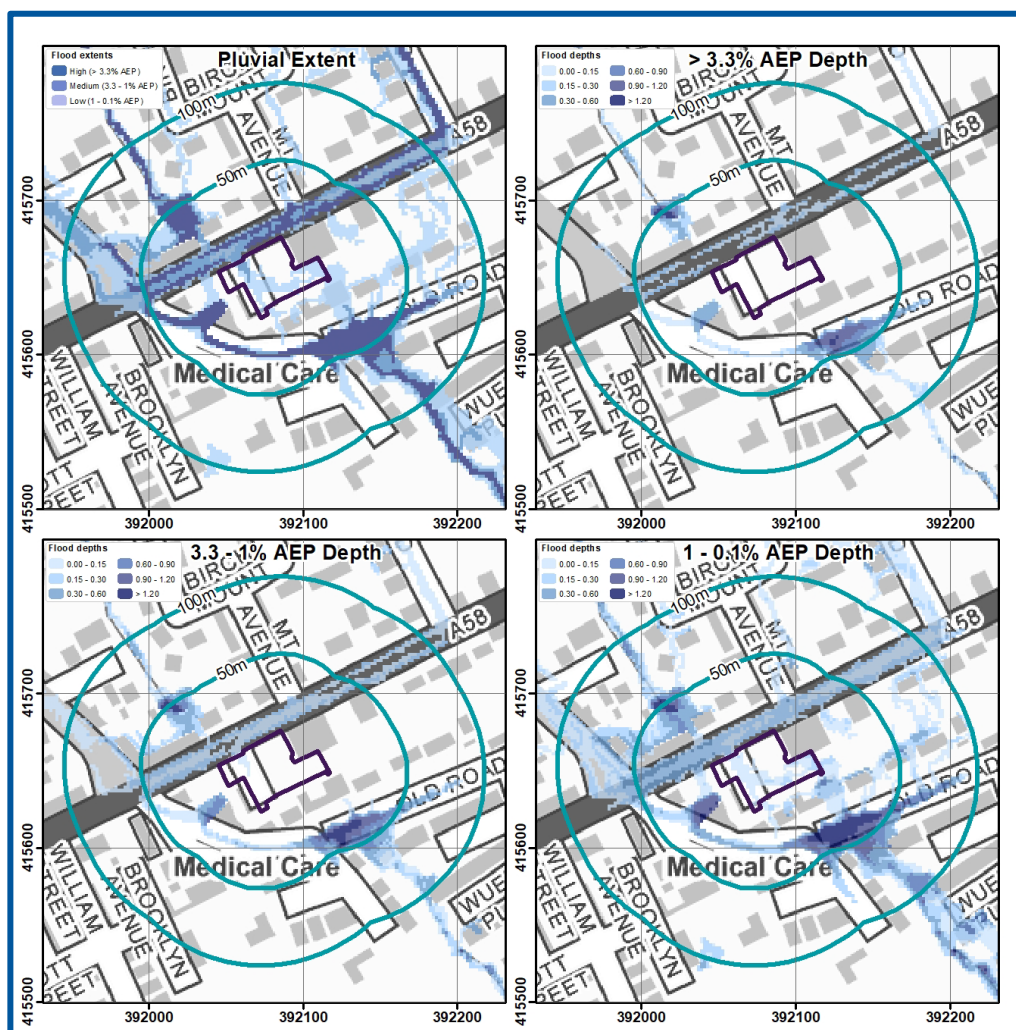
The Figure below confirms the extent and depth of flooding in multiple modelled flood scenarios.

- Flooding depths of up to 0.15 m would impact the area proposed for development in the 3.3 - 1% AEP (Medium) risk event.
- Flooding depths of up to 0.30 m would impact the access routes to and from the Site in the 1 - 0.1% AEP (Low) risk event.

This results in the need for finished floor levels of the proposed development to be set at least 300mm above the 1 in 100 year plus climate change event flood to 156.1mAOD.

Due to the building only being effected by the low risk event the overall range can be lowered to a Low risk.

Figure 9. EA surface water flood extent and depth map (EA, 2023)



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Guidance

According to EA's surface water flood risk map the Site is at:

- Very Low risk - chance of flooding of less than 1 in 1000 (0.1%).
- Low risk - chance of flooding of between a 1 in 1000 & 1 in 100 (0.1% and 1%).
- Medium risk - chance of flooding of between a 1 in 100 and 1 in 30 (1% and 3.3%).

The SFRA does indicate reported incidents of historical surface water flooding within Littleborough to the east of the Site and confirms the Site is located within a Critical Drainage Area (CDA)² (JBA Consulting, 2019).

Guidance

According to EA's surface water flood risk map the following advisory guidance applies to the Site:

Flood Depth

- 0.15 to 0.3 m - Flooding would: typically exceed kerb height, likely exceed the level of a damp-proof course, cause property flooding in some areas

Climate change factors

Paragraph 002 of the National Planning Practice Guidance (August, 2022) requires consideration of the 1% AP (1 in 100 year) event, including an appropriate allowance for climate change.

As the Site is located within the Irwell Management Catchment and the proposed development is classed as More Vulnerable, where the proposed lifespan is approximately 100 years, the Upper End (45%) allowance is required to determine a suitable climate change factor to apply to rainfall data.

The 0.1% AP (1 in 1000 year) surface water flooding event has been used as a proxy in this instance for the 1% AP (1 in 100 year) plus climate change event.

Surface water flooding flow routes

The 1 in 1000 year (low probability) event indicates the extent of flooding in a worst-case future 100 year with climate change scenario, where a flood flow route does develop within the Site. However, the overland flow is identified to be flowing on the area proposed for the new parking with permeable paving pays.

During a 1 in 100 year event some of flow velocities are greater than 0.25 m/s. The flows could potentially affect the buildings and/or access routes to the Site.

A review of the Site plans, topography and the EA's Risk of Flooding from Surface Water Direction mapping indicates any overland flows on the Site would not be obstructed by the proposed development and occur across non-essential areas of the Site. The proposed development seems to take into account the overland flow route and will result in a reduced impact on the planned buildings.

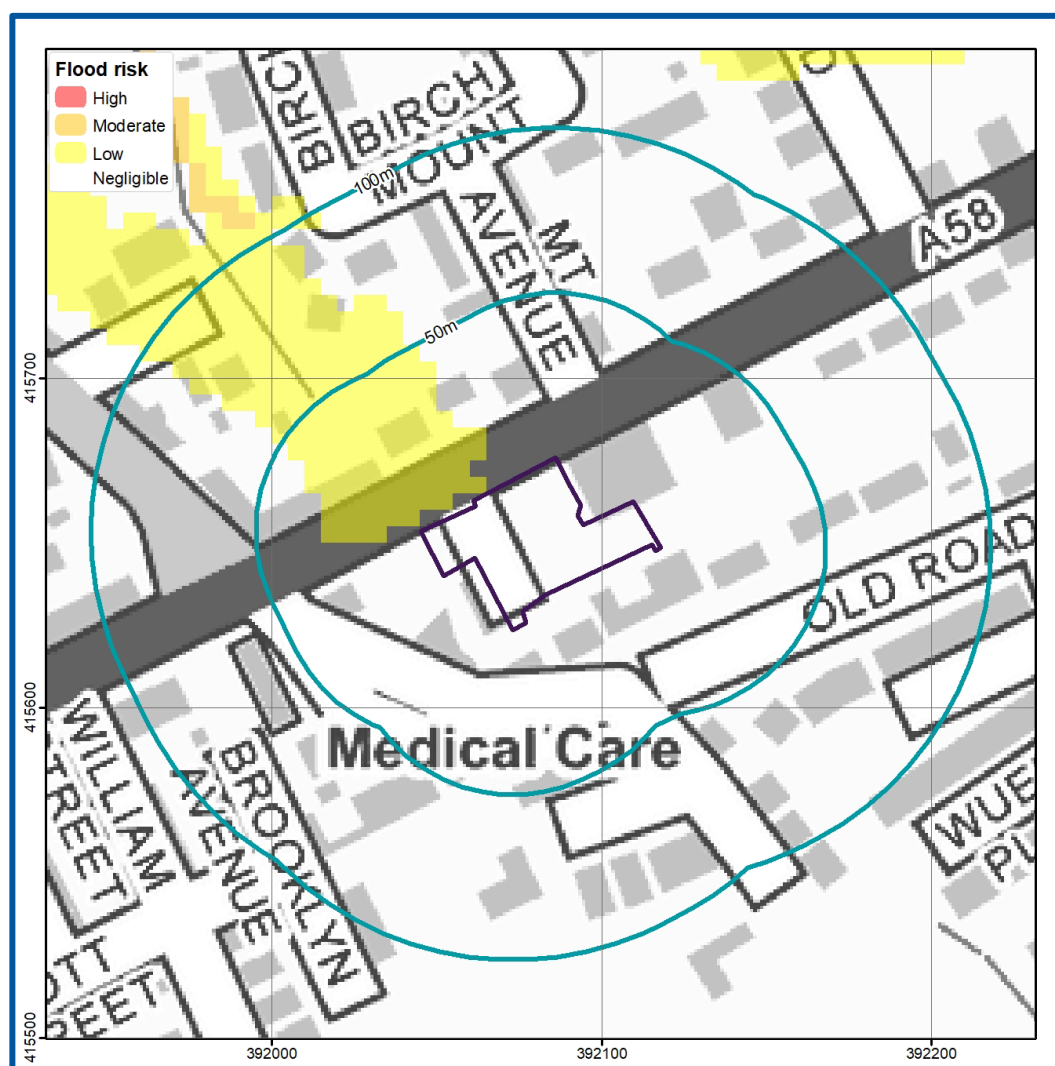
² A Critical Drainage Area (CDA) is an area that has critical drainage problems and which has been notified to the local planning authority as such by the Environment Agency in line with the National Planning Policy Framework (NPPF, 2021). CDA's are specific to Flood Zone 1, defined as areas where runoff can and may have historically contributed to flooding downstream, although they are not necessarily areas where flooding problems may occur. Where a Site is located in Flood Zone 1 and within a CDA, a Flood Risk Assessment (FRA) is required and the Council may also request Sustainable Drainage Scheme (SuDS) features to be included within the proposed development.

Groundwater flooding

Groundwater flooding occurs when sub-surface water emerges from the ground at the surface or into Made Ground and structures. This may be as a result of persistent rainfall that recharges aquifers until they are full; or may be as a result of high river levels, or tides, driving water through near-surface deposits. Flooding may last a long time compared to surface water flooding, from weeks to months. Hence the amount of damage that is caused to property may be substantially higher.

Groundwater Flood Risk screening data (Figure 10 overleaf) indicates there is a Negligible risk of groundwater flooding at surface in the vicinity of the site from permeable bedrock and superficial deposits during a 1 in 100 year event.

Figure 10. GeoSmart GW5 Groundwater Flood Risk Map (GeoSmart, 2023)



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Mapped classes within the screening map combine likelihood, possible severity and the uncertainty associated with predicting the subsurface system. The map is a national scale screening tool to prompt site-specific assessment where the impact of groundwater flooding

would have significant adverse consequences. Mapping limitations and a number of local factors may reduce groundwater flood risk to land and property even where it lies within mapped groundwater flood risk zones, which do not mean that groundwater floods will occur across the whole of the risk area.

A site-specific assessment has been undertaken to refine the groundwater risk screening information on the basis of site-specific datasets (see Section 3) including BGS borehole data, and the EA's fluvial and tidal floodplain data (where available) to develop a conceptual groundwater model. The risk rating is refined further using the vulnerability of receptors including occupants and the existing and proposed Site layout, including the presence of basements and buried infrastructure. The presence of any nearby or on-Site surface water features such as drainage ditches, which could intercept groundwater have also been considered.

It is understood there are no existing basements and a basement is not proposed as part of the development.

The risks are higher for basements, buried infrastructure and soakaway systems which may be affected by high groundwater levels.

According to a review of the hydrogeology (Section 3), the Site is underlain by permeable superficial deposits above permeable bedrock. Groundwater levels may rise in the bedrock and superficial aquifers in a seasonal response to prolonged rainfall recharge which may cause an unusually high peak in groundwater levels during some years.

The design of the property should consider the groundwater pathway through permeable formations.

Despite the presence of an aquifer the Site would only be at risk of groundwater flooding if the water table reaches the base of the Site development or the ground surface when groundwater seepage could lead to overland flow and ponding.

According to a review of the hydrogeology (Section 3), the nearby boreholes (ref: SD91NW3) encountered groundwater at a depth of 1.83m bgl within the permeable superficial geology. Groundwater levels are estimated to be approximately 149.57 mAOD compared with ground levels on the Site of 152.5 and 155.5m AOD, with an approximate ground water depth of 2.93m bgl at the lowest point of the site.

Spring lines have not been identified in close proximity to the Site.

The hydrogeological characteristics suggest there is potential for a groundwater table beneath the Site.

The baseline groundwater flood risk rating is Negligible, but on the basis of the site-specific assessment the groundwater flood risk is considered to be Low.

Guidance

Low Risk - There will be a remote possibility that incidence of groundwater flooding could lead to damage to property or harm to other sensitive receptors at, or near, this location.

Climate change predictions suggest an increase in the frequency and intensity of extremes in groundwater levels. Rainfall recharge patterns will vary regionally resulting in changes to average groundwater levels. A rise in peak river levels will lead to a response of increased groundwater levels in adjacent aquifers subject to the predicted climate change increases in peak river level for the local catchment. Sea level rises of between 0.4m and 1m are predicted by 2100, leading to a rise in average groundwater levels in the adjacent coastal aquifer systems, and potential increases in water levels in the associated drainage systems. The 'backing up' of groundwater levels from both coast and tidal estuary locations may extend a significant distance inland and affect infrastructure previously constructed above average groundwater levels.

The impact of climate change on groundwater levels beneath the Site is linked to the variation in rainfall recharge which is uncertain.

Flooding from artificial sources

Artificial sources of flood risk include waterbodies or watercourses that have been amended by means of human intervention rather than natural processes. Examples include reservoirs (and associated water supply infrastructure), docks, sewers and canals. The flooding mechanism associated with flood risk from artificial sources is primarily related to breach or failure of structures (reservoir, lake, sewer, canal, flood storage areas, etc.)

Sewer flooding

The SFRA does not include any information regarding flooding events from sewers (SFRA JBA consulting, 2019) of the Site.

Guidance

Properties classified as “at risk” are those that have suffered, or are likely to suffer, internal flooding from public foul, combined or surface water sewers due to overloading of the sewerage system either once or twice in the ten year reference period. Records held by the sewage utility company provide information relating to reported incidents, the absence of any records does not mean that the Site is not at risk of flooding.

Canal failure

According to Ordnance Survey (OS) mapping, there are no canals within 500 m of the Site.

Water supply infrastructure

Water supply infrastructure is comprised of a piped network to distribute water to private houses or industrial, commercial or institution establishments and other usage points. In urban areas, this represents a particular risk of flooding due to the large amount of water supply infrastructure, its condition and the density of buildings. The risks of flooding to properties from burst water mains cannot be readily assessed.

If more information regarding the condition and history of the water supply infrastructure within the vicinity of the Site is required, then it is advisable to contact the local water supplier (United Utilities).

Culverts and bridges

The blockage of watercourses or structures by debris (that is, any material moved by a flowing stream including vegetation, sediment and man-made materials or refuse) reduces flow capacity and raises water levels, potentially increasing the risk of flooding. High water levels can cause saturation, seepage and percolation leading to failure of earth embankments or other structures. Debris accumulations can change flow patterns, leading to scour, sedimentation or structural failure.

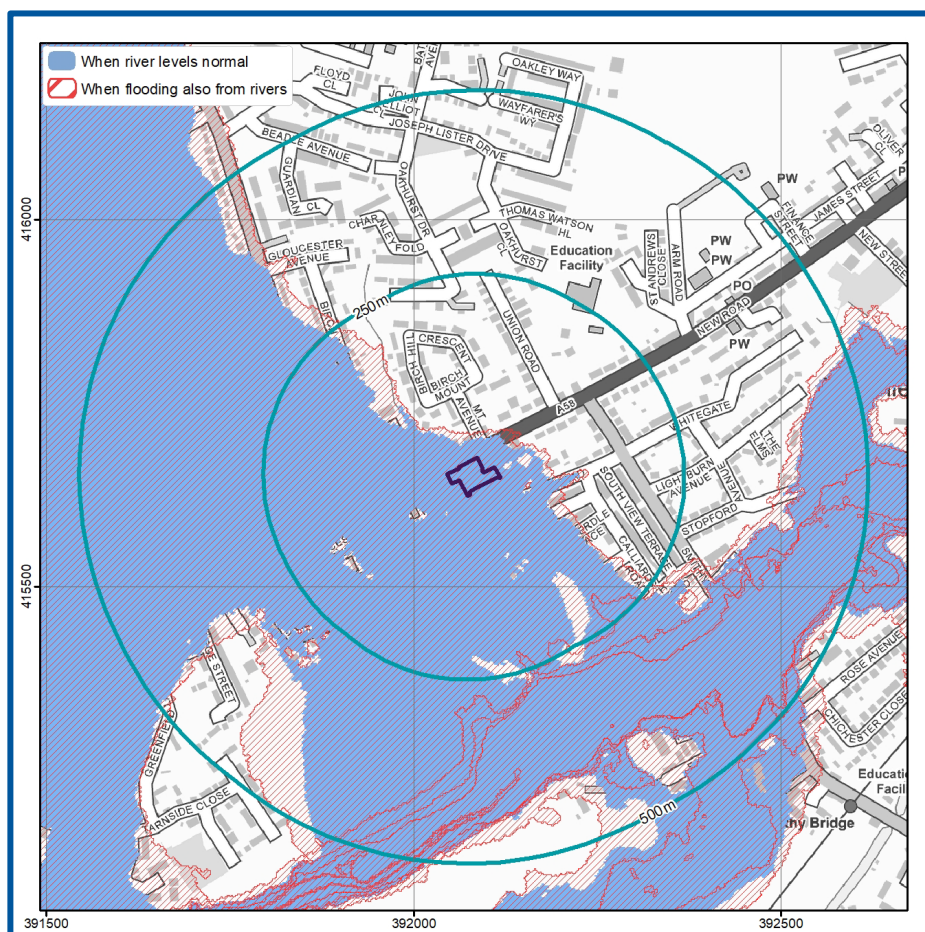
A culvert has been identified within 100 m of the Site to the south east running adjacent to the housing estate.

Reservoir flooding

According to the EA's Risk of Flooding from Reservoir mapping the Site is at risk of flooding from reservoirs (Figure 11) (EA, 2023).

The Site is considered to be at risk of flooding from the Watergrove Reservoir, located 2.3 km northwest of the Site.

Figure 11. EA Risk of Reservoir Flooding (EA, 2023)



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Guidance

The risk of reservoir flooding is related to the failure of a large reservoir (holding over 25,000 m³ of water) and is based on the worst-case scenario. Reservoir flooding is extremely unlikely to occur (EA, 2023).

5. Flood risk from the development



Floodplain storage

Where flood storage from any source of flooding is to be lost as a result of development, on-Site level-for-level compensatory storage, accounting for the predicted impacts of climate change over the lifetime of the development, should be provided. Where it is not possible to provide compensatory storage on-Site, it may be acceptable to provide it off-Site if it is hydraulically and hydrologically linked.

The loss of floodplain storage is less likely to be a concern in areas benefitting from appropriate flood risk management infrastructure or where the source of flood risk is solely tidal.

Surface water flood depths in the area proposed for development could be up to 0.15m in the 1 in 100 year plus climate change event, this will affect areas of development as well as an area of the Site that is being used as an access road and car park so will not affect the proposed structures. As there is an increase in the built footprint at the Site and the area proposed for development is affected by the design flood level, this may displace flood water and floodplain compensation may be required. Any losses in floodplain storage are likely to displace flooding and could potentially alter flood flow routes, increasing flood risk elsewhere.

Compensation for any reduction in floodplain storage and displacement of flood water (up to the 1 in 100 year event with allowance made for climate change) should be provided. Compensatory flood storage should be provided through a level for level, volume for volume approach and may require an area at the edge of the floodplain to provide storage.

Where this is not possible, the EA and Lead Local Flood Authority (LLFA) may accept voids, stilts or undercroft parking as options for flood plain storage compensation.

Whilst the use of stilts and voids below buildings may be an appropriate approach to mitigating flood risk to the buildings themselves, such techniques should not normally be relied upon for compensating for any loss of floodplain storage. This is because voids do not allow water to freely flow through them, trash screens get blocked, voids get silted up, they have limited capacity, and it is difficult to stop them being used for storing belongings or other materials.

These solutions should be discussed at an early stage and may require a management and maintenance plan, as they can become blocked over time leading to a gradual reduction in storage. More information is provided in the EA's *"Framework and Guidance for Assessing and Managing Flood Risk for New Development"* FD2320/TR2 publication (EA, 2005).

Scoping estimates of the storage requirements can be made by multiplying the increase in building footprint by the average flood depth at the development, during the 1 in 100 year flood event with a 45% allowance for climate change.

Drainage and run-off

Based on the topography and surface water flood risk in the vicinity, interference or interaction with overland flow paths and inflows from off-Site is considered possible. It is recommended that steps are taken to manage these potential inflows within the Site drainage system.

The proposed development involves an increase of impermeable surfaces at the Site. An estimation of run-off is therefore required to permit effective Site water management and prevent any increase in flood risk to off-Site receptors from the Site.

A Sustainable Drainage Strategy has been prepared separately by GeoSmart (ref: 80754.01) to manage the increase in runoff from the Site.

Sustainable Drainage System (SuDS)

It is recommended that attenuation of run-off is undertaken on-Site to compensate for proposed increases in impermeable surface areas. Attenuation may comprise the provision of storage within a Sustainable Drainage System (SuDS). SuDS can deliver benefits from improving the management of water quantity, water quality, biodiversity and amenity. Potential SuDS options are presented in the table below, subject to further investigation:

Table 2. SuDS features which may be feasible for the Site

Option	Description
Rainwater harvesting	Rainwater harvesting can collect run-off from the roofs for use in non-potable situations, using water butts for example.
Green roof	Having part/all of the roof as a green roof covered in vegetation can intercept and store a proportion of the rainfall to result in an overall reduction in the amount of surface water run-off generated from a building structure. They comprise a substrate (growth medium) layer which can be seeded with specially selected plants suitable for the local climatic conditions. Beneath the growth medium is a geotextile filter layer which filters out the substrate from entering the aggregate/geo-composite drainage layer below. At the very bottom of the green roofing, a waterproof membrane protects the roof structure below.
Permeable paving	Permeable pavements can be used for driveways, footpaths and parking areas to increase the amount of permeable land cover. Suitable aggregate materials (angular gravels with suitable grading as per CIRIA, 2007) will improve water quality due to their filtration capacity. Plastic geocellular systems beneath these surfaces can increase the void space and therefore storage but do not allow filtration unless they are combined with aggregate material and/or permeable geotextiles.

Option	Description
Swales	Shallow, wide and vegetated channels that can store excess run-off whilst removing any pollutants.
Soakaways	An excavation filled with gravel within the Site. Surface water run-off is piped to the soakaway.
Attenuation basins/pond	Dry basin or a permanent pond that is designed to hold excess water during a rainfall event.

6. Suitability of the proposed development



The information below outlines the suitability of proposed development in relation to national and local planning policy.

National policy and guidance

The aims of the national planning policies are achieved through application of the Sequential Test and in some cases the Exception Test.

Guidance

Sequential test: The aim of this test is to steer new development towards areas with the lowest risk of flooding (NPPF, 2023). Reasonably available sites located in Flood Zone 1 should be considered before those in Flood Zone 2 and only when there are no reasonably available sites in Flood Zones 1 and 2 should development in Flood Zone 3 be considered.

Exception test: In some cases, this may need to be applied once the Sequential Test has been considered. For the exception test to be passed it must be demonstrated that the development would provide wider sustainability benefits to the community that outweigh flood risk and a site-specific FRA must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

Suitability of the proposed development, and whether the Sequential and Exception Tests are required, is based on the Flood Zone the Site is located within and the flood risk vulnerability classification of the existing and proposed development. 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.

This report has been produced to assess all development types, prior to any development. The vulnerability classification and Flood Zones are compared within the table overleaf (Table 2 of the NPPG (2022)).

As the Site is located within Flood Zone 1, all types of development listed within the Table overleaf are acceptable according to National Policy.

Table 3. Flood risk vulnerability and flood zone 'incompatibility' (taken from NPPG, 2022)

Flood risk vulnerability classification		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood Zone	Zone 1 – low probability	✓	✓	✓	✓	✓
	Zone 2 – medium probability	✓	✓	Exception test required	✓	✓
	Zone 3a - high probability	Exception test required	✓	X	Exception test required	✓
	Zone 3b – functional flood plain	Exception test required	✓	X	X	X

7. Resilience and mitigation



Based on the flood risk identified at the Site, the national and local policies and guidance and proposed development, the mitigation measures outlined within this section of the report are likely to help protect the development from flooding.

Sea (coastal/tidal) flood mitigation measures

As the Site is not identified as being at risk of flooding from sea (coastal/tidal) sources, mitigation measures are not required.

Rivers (fluvial) flood mitigation measures

As the Site is not identified as being at risk of flooding from fluvial sources, mitigation measures are not required.

Surface water (pluvial) flood mitigation measures

A Very Low to Low surface water (pluvial) flooding risk has been identified at the Site. In order to ensure the development includes sufficient flood mitigation measures to reduce the risk of pluvial flooding over its lifetime, the flood depths, levels and appropriate mitigation measures have been assessed.

Finished floor levels of the proposed development should be set at least 300mm above the maximum 1 in 100 year plus climate change event flood level of 0.3m to 156.1 mAOD.

Where Finished floor levels cannot be set at the recommended elevation, the floor levels should be set as high as possible and flood resilience measures included:

In addition, the regular maintenance of any drains and culverts surrounding/on the Site under the riparian ownership of the developer should be undertaken to reduce the flood risk.

A surface water drainage (SuDS) strategy has been prepared separately (ref: 80754.01) to ensure surface water runoff can be managed effectively over the lifetime of the proposed development.

If these mitigation measures are implemented this would reduce the flood risk to the development from Medium to Very Low.

Groundwater flood mitigation measures

It is likely the flood mitigation measures recommended for surface water (pluvial) risk will reduce the groundwater flood risk at the development. However specific additional groundwater measures that may also be considered for the Low risk identified include:

- Waterproof tanking of the ground floor and basement;
- Interceptor drains;
- Automatic sump to extract flood water; and

- Non-return flap valves on the proposed foul and surface water sewer lines.

If these mitigation measures are implemented this could reduce the flood risk to the development from Low to Negligible.

Reservoir flood mitigation measures

According to EA data, the nearest reservoir is situated approximately 2.3 km to the northwest of the Site.

There would be a relatively high rate and onset of flooding associated with a reservoir breach, it is therefore unlikely that safe access could be achieved unless a long warning period was provided. Therefore, occupants should get to the highest level of the building as possible and contact the emergency services.

Other flood risk mitigation measures

As the Site is not identified as at risk from other sources, mitigation measures are not required.

Residual flood risk mitigation measures

The risk to the Site has been assessed from all sources of flooding and appropriate mitigation and management measures proposed to keep the users of the development safe over its lifetime. There is however a residual risk of flooding associated with the potential for failure of mitigation measures if regular maintenance and upkeep isn't undertaken. If mitigation measures are not implemented or maintained, the risk to the development will remain as the baseline risk.

Further flood mitigation information

More information on flood resistance, resilience and water entry can be found here: http://www.planningportal.gov.uk/uploads/br/flood_performance.pdf

www.knowyourfloodrisk.co.uk

Emergency evacuation - safe access / egress and safe refuge

Emergency evacuation to land outside of the floodplain should be provided if feasible. Where this is not possible, 'more vulnerable' developments and, where possible, development in general (including basements), should have internal stair access to an area of safe refuge within the building to a level higher than the maximum likely water level. An area of safe refuge should be sufficient in size for all potential users and be reasonably accessible to the emergency services.

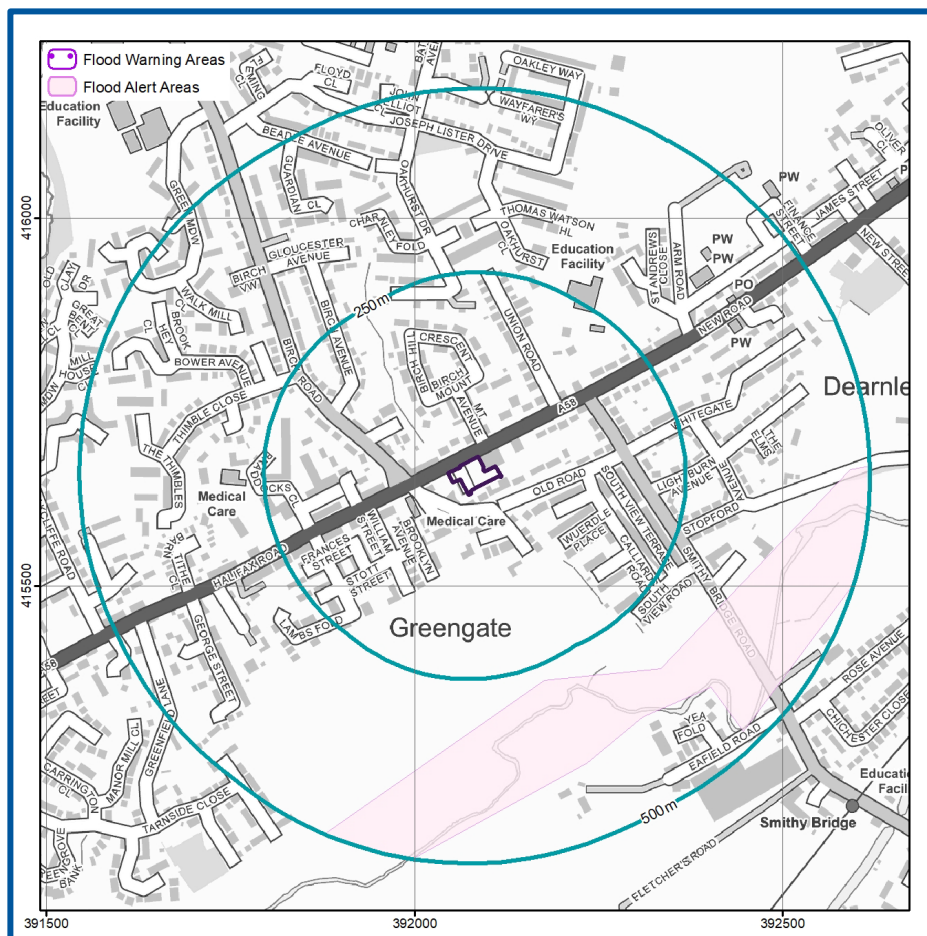
Emergency evacuation from the development and the Site should only be undertaken in strict accordance with any evacuation plans produced for the Site, with an understanding of the

flood risks at the Site including available mitigation, the vulnerability of occupants and preferred evacuation routes.

Flood warnings

The EA operates a flood warning service in all areas at risk of flooding; this is available on their website: <https://www.gov.uk/check-flood-risk>. The Site is not located within an EA Flood Alerts/Warning coverage area (Figure 12).

Figure 12. EA Flood Warning Coverage for the local area (EA, 2023).



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On-Site refuge

Evacuation should be the primary action in preference, however safe refuge could be sought at first floor level in a worst-case scenario as the residential areas of the development are situated on the first and second floor.

8. Conclusions and recommendations



Table 4. Risk ratings following Site analysis

Source of Flood Risk	Baseline ¹	After analysis ²	After Mitigation ³
River (fluvial) flooding	Very Low	Very Low	N/A
Sea (coastal/tidal) flooding	Very Low	Very Low	N/A
Surface water (pluvial) flooding	Low to Medium	Low	Very Low
Groundwater flooding	Negligible	Low	Negligible
Other flood risk factors present	Yes	Yes	Yes
Is any other further work recommended?	Yes	Yes	Yes (see below)

1 BASELINE risks assigned for the whole Site, using national risk maps, including the benefit of EA flood defences.

2 AFTER ANALYSIS modification of risk assessment based on detailed site specific analysis including some or all of the following: flood model data, high resolution mapping, building location, access routes, topographic and CCTV surveys. Reasons for the change in classification are provided in the text.

3 AFTER MITIGATION risks include risks to proposed development / asset and occupants if mitigation measures recommended in this report are implemented, including the impacts of climate change.

*N/A indicates where mitigation is not required.

The table below provides a summary of where the responses to key questions are discussed in this report. Providing the recommended mitigation measures are put in place it is likely that flood risk to this Site will be reduced to an acceptable level.

More vulnerable developments in a Flood Zone 1 are acceptable according to the NPPF and providing the recommended mitigation measures are put in place (see previous sections) it is likely that flood risk to this Site will be reduced to an acceptable level.

Table 5. Summary of responses to key questions in the report

Key sources of flood risks identified	Pluvial and groundwater (see Section 4).
Are standard mitigation measures likely to provide protection from flooding to/from the Site?	Yes (see Section 7).
Is any further work recommended?	Yes (See exec summary and section 7)

9. Further information



The following table includes a list of additional products by GeoSmart:

Additional GeoSmart Products			
✓	Additional assessment: SuDSmart Report		The SuDSmart Report range assesses which drainage options are available for a Site. They build on technical detail starting from simple infiltration screening and work up to more complex SuDS Assessments detailing alternative options and designs. Please contact info@geosmartinfo.co.uk for further information.
✓	Additional assessment: EnviroSmart Report		Provides a robust desk-based assessment of potential contaminated land issues, taking into account the regulatory perspective. Our EnviroSmart reports are designed to be the most cost effective solution for planning conditions. Each report is individually prepared by a highly experienced consultant conversant with Local Authority requirements. Ideal for pre-planning or for addressing planning conditions for small developments. Can also be used for land transactions. Please contact info@geosmartinfo.co.uk for further information.

10. References and glossary



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- Ministry of Housing, Communities & Local Government (2022).** Planning Practice Guidance (NPPG). Flood Risk and Coastal Change. Accessed from <https://www.gov.uk/guidance/flood-risk-and-coastal-change> on 26/10/2023.
- Ordnance Survey Mapping (2023).** © Crown copyright. All rights reserved. Licence number AL 100054687. For full terms and conditions visit: www.ordnancesurvey.co.uk
- LiDAR Survey Open Data (2023).** Accessed from: <https://environment.data.gov.uk/DefraDataDownload/?Mode=survey> on 26/10/2023.

Glossary

General terms

BGS	British Geological Survey
EA	Environment Agency
GeoSmart groundwater flood risk model	GeoSmart's national groundwater flood risk model takes advantage of all the available data and provides a preliminary indication of groundwater flood risk on a 50m grid covering England and Wales. The model indicates the risk of the water table coming within 1 m of the ground surface for an indicative 1 in 100 year return period scenario.
Dry-Island	An area considered at low risk of flooding (e.g. In a Flood Zone 1) that is entirely surrounded by areas at higher risk of flooding (e.g. Flood Zone 2 and 3)
Flood resilience	Flood resilience or wet-proofing accepts that water will enter the building, but through careful design will minimise damage and allow the re-occupancy of the building quickly. Mitigation measures that reduce the damage to a property caused by flooding can include water entry strategies, raising electrical sockets off the floor, hard flooring.
Flood resistance	Flood resistance, or dry-proofing, stops water entering a building. Mitigation measures that prevent or reduce the likelihood of water entering a property can include raising flood levels or installation of sandbags.
Flood Zone 1	This zone has less than a 0.1% annual probability of river flooding
Flood Zone 2	This zone has between 0.1 and 1% annual probability of river flooding and between 0.1% and 0.5 % annual probability sea flooding
Flood Zone 3	This zone has more than a 1% annual probability of river flooding and 0.5% annual probability of sea flooding
Functional Flood Plain	An area of land where water has to flow or be stored in times of flood.
Hydrologic model	A computer model that simulates surface run-off or fluvial flow. The typical accuracy of hydrologic models such as this is $\pm 0.25\text{m}$ for estimating flood levels at particular locations.
OS	Ordnance Survey
Residual Flood Risk	The flood risk remaining after taking mitigating actions.
SFRA	Strategic Flood Risk Assessment. This is a brief flood risk assessment provided by the local council

SuDS

A Sustainable drainage system (SuDS) is designed to replicate, as closely as possible, the natural drainage from the Site (before development) to ensure that the flood risk downstream of the Site does not increase as a result of the land being developed. SuDS also significantly improve the quality of water leaving the Site and can also improve the amenity and biodiversity that a Site has to offer. There are a range of SuDS options available to provide effective surface water management that intercept and store excess run-off. Sites over 1 Ha will usually require a sustainable drainage assessment if planning permission is required. The current proposal is that from April 2014 for more than a single dwelling the drainage system will require approval from the SuDS Approval Board (SABs).

Aquifer Types

Principal aquifer

These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

Secondary A aquifer

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.

Secondary B aquifer

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.

Secondary undifferentiated

Has been assigned in cases where it has not been possible to attribute either category A or B to a rock type due to the variable characteristics of the rock type.

Unproductive Strata

These are rock layers or drift deposits with low permeability that has negligible significance for water supply or river base flow.

NPPF (2023) terms

Exception test

Applied once the sequential test has been passed. For the exception test to be passed it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk and a site-specific FRA must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

Sequential test

Aims to steer new development to areas with the lowest probability of flooding.

Essential infrastructure

Essential infrastructure includes essential transport infrastructure, essential utility infrastructure and wind turbines.

Water compatible	Water compatible land uses include flood control infrastructure, water-based recreation and lifeguard/coastal stations.
Less vulnerable	Less vulnerable land uses include police/ambulance/fire stations which are not required to be operational during flooding and buildings used for shops/financial/professional/other services.
More vulnerable	More vulnerable land uses include hospitals, residential institutions, buildings used for dwelling houses/student halls/drinking establishments/hotels and sites used for holiday or short-let caravans and camping.
Highly vulnerable	Highly vulnerable land uses include police/ambulance/fire stations which are required to be operational during flooding, basement dwellings and caravans/mobile homes/park homes intended for permanent residential use.

Data Sources

Aerial Photography	Contains Ordnance Survey data © Crown copyright and database right 2023 BlueSky copyright and database rights 2023
Bedrock & Superficial Geology	Contains British Geological Survey materials © NERC 2023 Ordnance Survey data © Crown copyright and database right 2023
Flood Risk (Flood Zone/RoFRS/Historic Flooding/Pluvial/Surface Water Features/Reservoir/ Flood Alert & Warning)	Environment Agency copyright and database rights 2023 Ordnance Survey data © Crown copyright and database right 2023
Flood Risk (Groundwater)	GeoSmart, BGS & OS GW5 (v2.4) Map (GeoSmart, 2023) Contains British Geological Survey materials © NERC 2023 Ordnance Survey data © Crown copyright and database right 2023
Location Plan	Contains Ordnance Survey data © Crown copyright and database right 2023
Topographic Data	OS LiDAR/EA Contains Ordnance Survey data © Crown copyright and database right 2023 Environment Agency copyright and database rights 2023

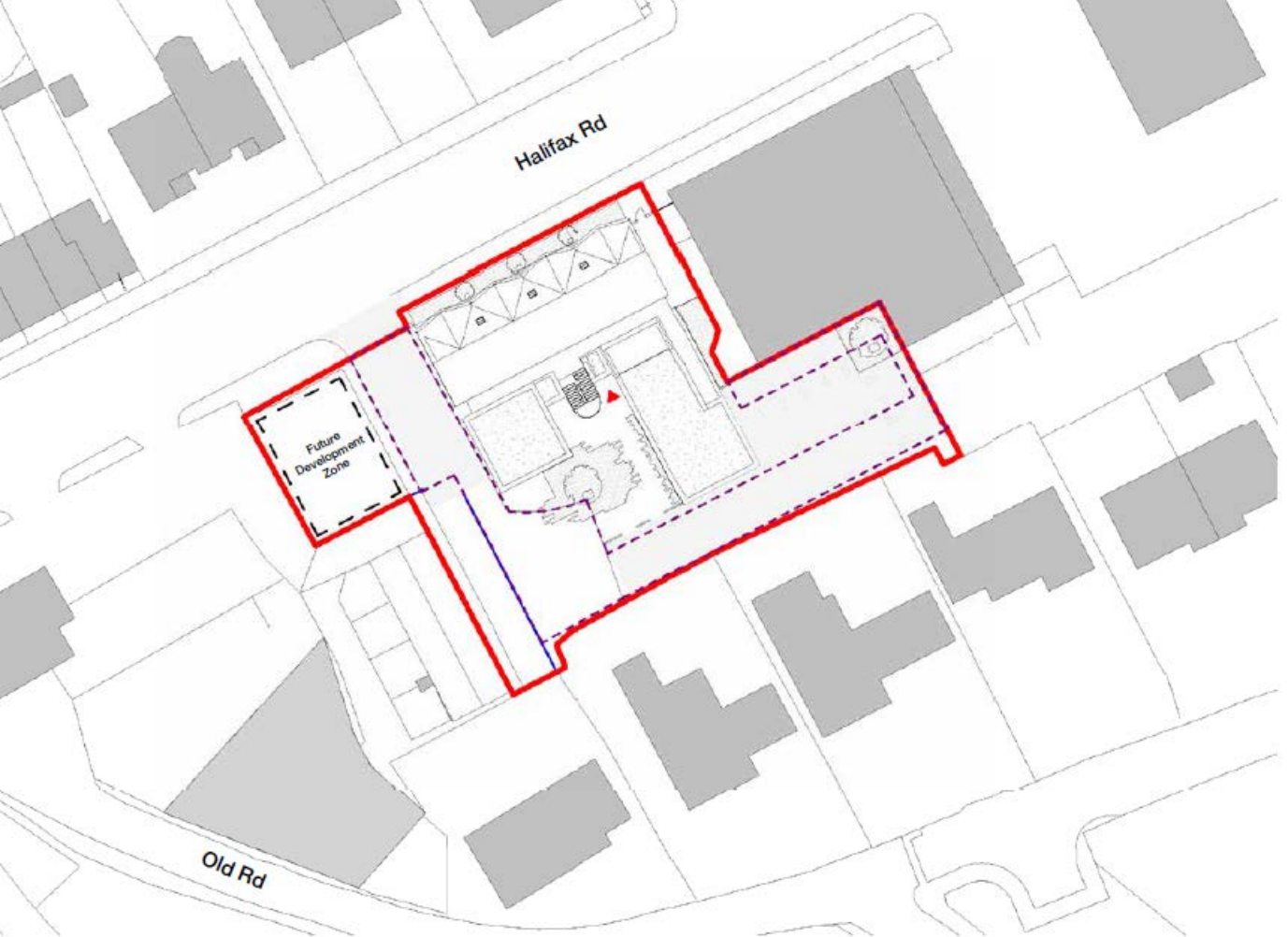
11. Appendices



Appendix A



Site plans



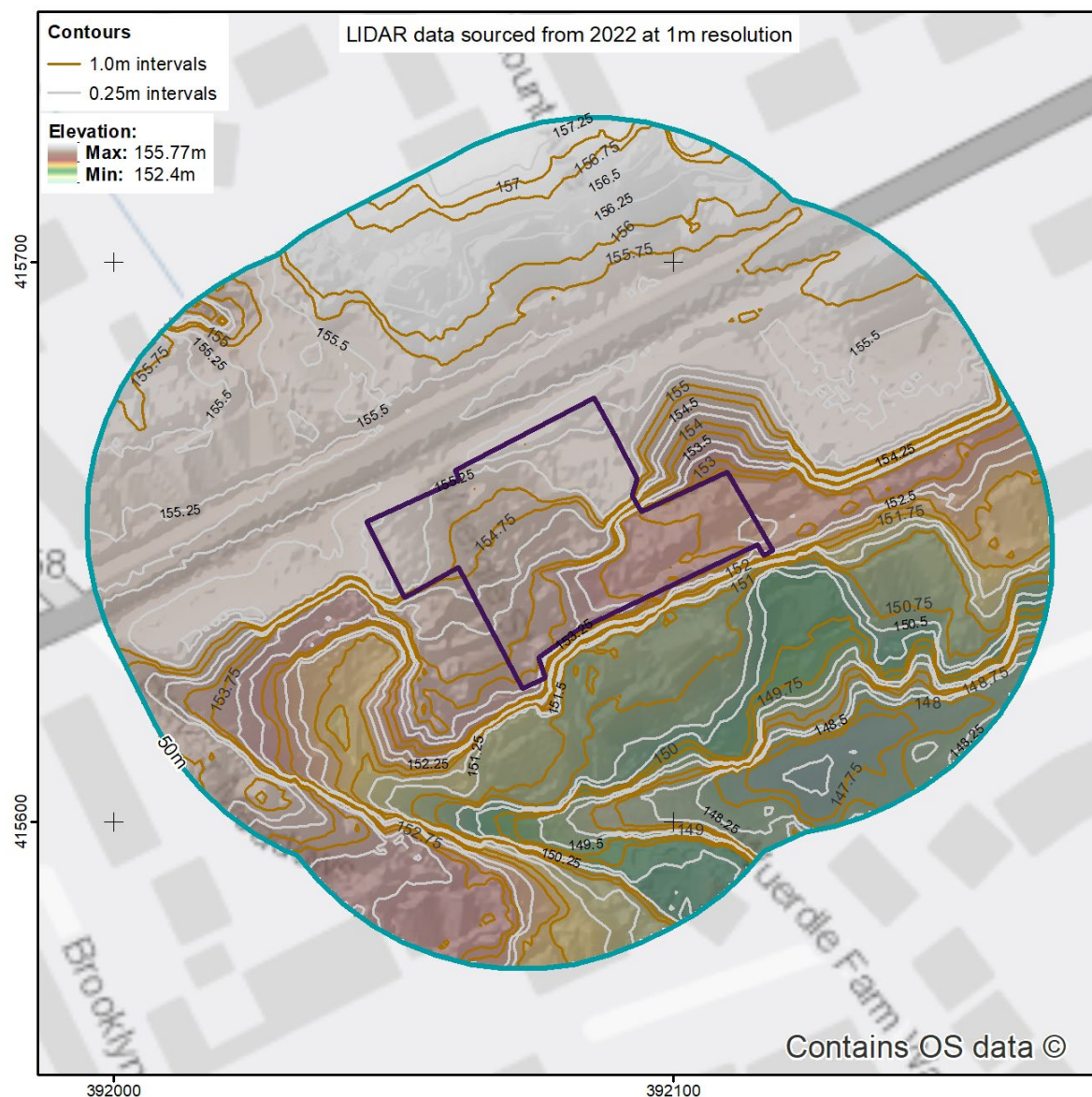
Halifax Rd

Future
Development
Zone

Old Rd



Environment Agency LiDAR ground elevation data



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