GeoSmart Information

Environmental Thinking

FloodSmart Plus

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Site coordinates	349568 443197
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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) (2019) and National Planning Practice Guidance (NPPG) (2014). 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	After Mitigation
River (fluvial) and Sea (coastal/tidal)	Whole Site	Variable: Negligible to High	Low
	Area proposed for development	Low to Medium	Low
Surface water (pluvial) flooding		Very Low	Very Low
Groundwater flooding		Negligible	Negligible
Other flood risk factors present		No	N/A
Is any other further work recommended?		Yes	Yes (see below)

N/A = mitigation not required

The Site is currently used within a residential capacity as a two storey residential dwelling with a garage and a landscaped garden area. Development proposals comprise the demolition of the garage and the construction of two two storey residential dwellings with associated driveways and garden areas.

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

- According to the Environment Agency's (EA) Flood Map for Planning Purposes, the Site is located within a fluvial Flood Zone 1 (Low Probability) and Flood Zone 2 (Medium Probability). Flood Zone 3 (High Probability) is located adjacent to the northern boundary of the Site. The area proposed for development is located within Flood Zone 2 (Medium Probability).

- The Site benefits from the presence of flood defences, 90 m away in good condition, designed to provide a 1 in 100 year event standard of protection.
- The Site is located 90 m from the main watercourse, the River Calder, and lies adjacent to the south of a surface water drainage ditch.
- 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 Variable Negligible to High risk of flooding from Rivers and the Sea where:
    - Medium risk is associated with the northern half of the Site, with High risk associated with the northwest corner; and
    - Low risk is associated with the southern half of the Site with Negligible risk associated with the existing development.
- The Site could potentially be at risk from flooding due to blockage or failure of a culvert located adjacent to the north of the Site.
- Modelled flood data obtained from the EA has been analysed in line with the most up to date guidance on climate change (EA, 2016), to confirm a maximum "design" flood level at the Site.

  During a 1 in 100 year plus 35 % climate change allowance event and a 1 in 100 year plus 70% climate change allowance event the flood level at the Site would be 13.41 mAOD and 13.99 mAOD respectively.

  During this event, flood depths in the area proposed for development could be up to 0.06 m during a 1 in 100 year plus 35% climate change allowance event and up to 0.64 m during a 1 in 100 year plus 70% climate change allowance event. Flood mitigation measures are included in the next section.
- According to the EA's Risk of Flooding from Surface Water (pluvial) flood mapping, the Site has a very low risk of pluvial flooding.
- Groundwater Flood Risk screening data indicates there is a Negligible risk of groundwater flooding at the surface in the vicinity of the Site during a 1 in 100 year event.
- 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 not at risk of reservoir flooding.
    - Ordnance Survey (OS) data confirms there are no canals near to the Site.
    - A sewer flooding history search was undertaken using the Strategic Flood Risk Assessment (Wyre Borough Council, 2016). This confirms no recorded incidences of sewer flooding at or within the vicinity of the Site

  The risk of flooding from artificial sources is considered to be negligible..
- The risk to the development has been assessed over its expected 100 year lifetime, including appropriate allowances for the impacts of climate change. More extreme weather events could increase the risk to the site from increases in river flooding and

or increased potential for surface water. Site specific assessment indicates risk to the site will not increase significantly and appropriate mitigation measures are proposed.

In accordance with paragraphs 157, 164 and footnote 51 of the NPPF (2019), as the development proposals are comprised of additional buildings within Flood Zone 2 and the Site has not been allocated within the Councils Local Plan, it is likely the Sequential Test will be required.

Recommendations / Next steps

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

In this instance, it is recommended to raise the finished floor levels 0.6 m above the 1 in 100 year plus 35% climate change to 14.01 mAOD. Where it is not possible to raise the finished floor levels additional mitigation measures should be considered including:

- Passive flood door systems;
- Temporary flood barriers;
- Air brick covers (manual or automatic closing);
- Non-return flap valves on sewer outfalls;
- Flood resilient materials and designs:
    - Use of low permeability building materials up to 0.3 m such as engineering bricks (Classes A and B) or facing bricks;
    - The use of internal lime plaster/render or where plasterboards are used these should be fitted horizontally instead of vertically and/or using moisture resistant plasterboard at lower levels;
    - Water, electricity and gas meters and electrical sockets should be located above the predicted flood level;
    - Communications wiring: wiring for telephone, TV, Internet and other services should be protected by suitable insulation in the distribution ducts to prevent damage.
- Ground floors designed to permit water passage at high flood depths;
- Hard flooring and flood resilient metal staircases; and
- Sump and pump.

Additional Measures

- The regular maintenance of any drains and culverts surrounding/on the Site should be undertaken to reduce the flood risk.
- A Sustainable Drainage Strategy (SuDS) should be developed for the Site, for effective management of surface water runoff from the proposed development.

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.

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 (2019) and the source(s) of any flood risk present. Finally, a preliminary assessment of the steps that can be taken to manage any flood risk to the development was undertaken.

This report has been prepared with reference to the NPPF (2019) and NPPG (2014).

"*The National Planning Policy Framework set out the Government's planning policies for England and how these are expected to be applied"* (NPPF, 2019).

The NPPF (2019) and NPPG (2014) 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.

"This general 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. The aim should be to keep development out of medium and high risk flood areas (Flood Zones 2 and 3) and other areas affected by other sources of flooding where possible" (NPPG, 2014).

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 2014 (Paragraph: 030 Reference ID: 7-030-20140306), a thorough review of a commercially available flood risk report 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 Wyre Borough Council Strategic Flood Risk Assessment (SFRA) (Wyre Borough Council, 2016) and the Lancashire and Blackpool Local Flood Risk Management Strategy (Lancashire County Council, 2013) are 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 (2019).

The existing and future flood risks 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 (Appendix B)	SFRA	Environment Agency (Appendix C)	OS Data
Historical	X	X	X	
Fluvial/tidal	X	X	X	
Surface water (pluvial)	X	X	X	
Groundwater	X	X		
Sewer		X		
Culvert/bridges		X		X
Reservoir		X	X	

*The SFRA and local guidance has been used to inform this report as referenced in Section 6.

3. Site analysis

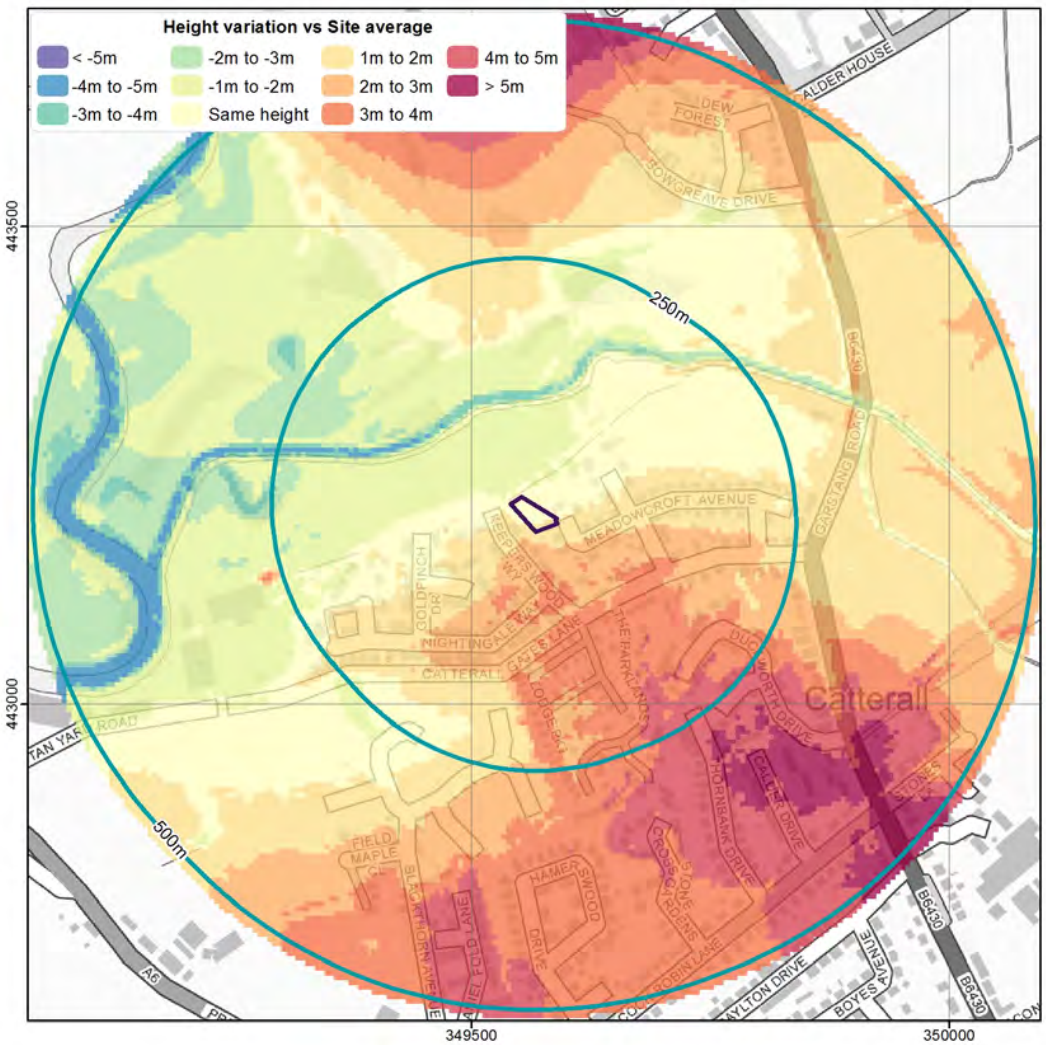
Site information

The Site is located in Catterall in a setting of residential land use at National Grid Reference SD 49568 43197. Site plans and drawings are provided in Appendix A.

According to OS data, using a 500 m buffer around the Site, the area is on a valley side (Figure 1). It is noted that to the north land rises to c. 21.34 m above Ordnance Datum (AOD). To the west land falls to 12.45 mAOD, to the east land rises to c. 15.76 mAOD and to the south rises to 16.98 mAOD.

The general ground levels on the Site are between 13.00 and 14.30 mAOD with the Site rising gradually in a southerly direction. This is based on EA elevation data obtained for the Site to a 1 m resolution with a vertical accuracy of ±150 mm (Appendix D).

Figure 1 Site Location and Relative Elevations



Development

The Site is currently used within a residential capacity as a two storey residential dwelling with a garage and a landscaped garden area.

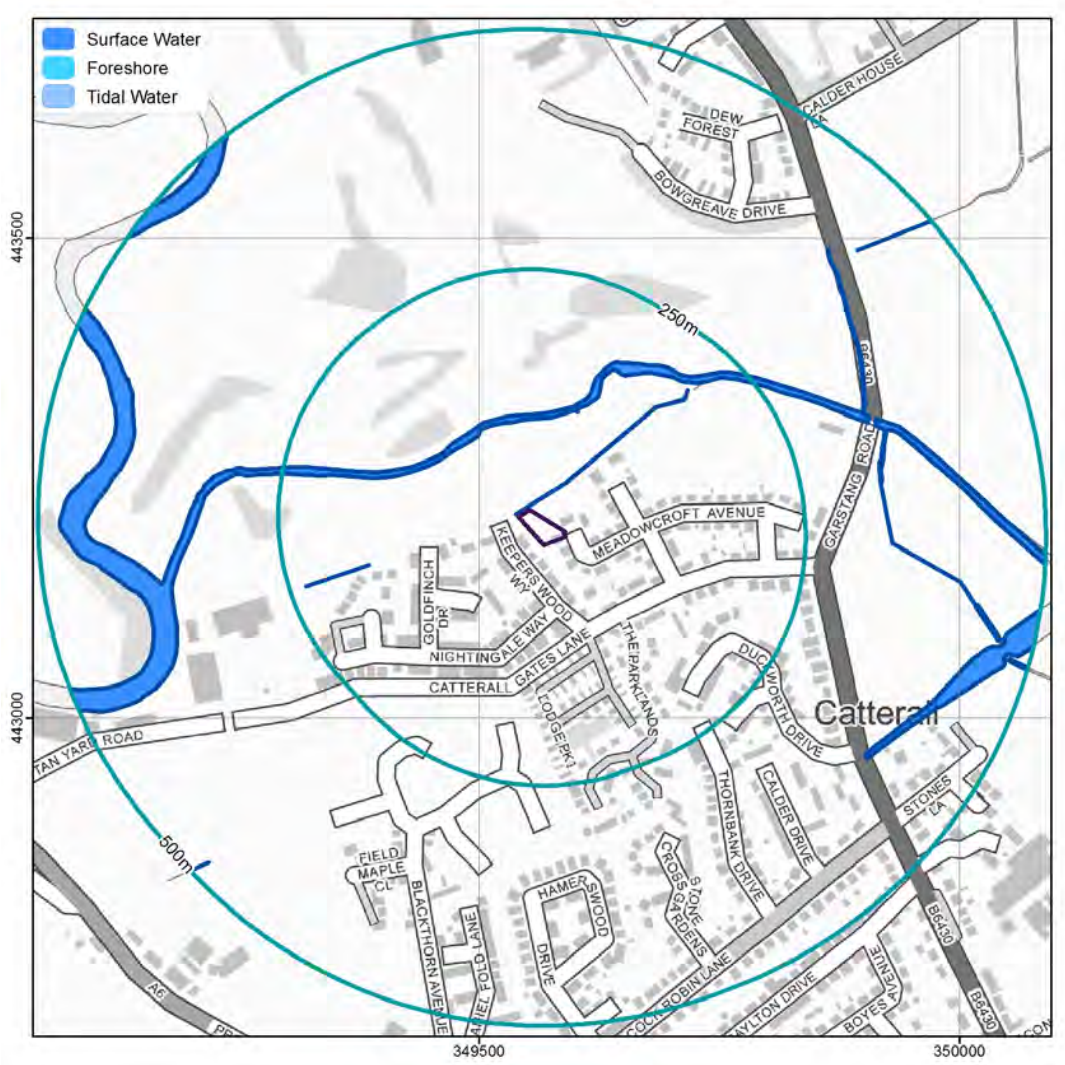
Development proposals comprise the demolition of the garage and the construction of two two storey residential dwellings with associated driveways and garden areas. Site plans are included within Appendix A.

The effect of the overall development will result in an increase in number of occupants and/or users of the Site but will not result in the change of use, nature or times of occupation. According to Table 2 of the NPPG (2014), the vulnerability classification of the existing development is More Vulnerable and proposed development is More Vulnerable. The estimated lifespan of the development is 100 years.

Hydrological features

There are numerous surface water features within 500 m of the Site (Figure 2), these are included in the mapping below:

Figure 2 Surface water features



The River Wyre is located 370 m west of the Site with its tributary, The River Calder located 95 m north of the Site flowing in an easterly direction.

A tributary to the River Calder is located adjacent to the north of the Site and appears to be a culverted drainage ditch as there is another surface watercourse located 190 m west of the Site.

Further tributaries to the River Calder are located 360 m and 370 m east of the Site, along Garstang Road.

There is a surface water course located 415 m southeast of the Site.

Proximity to relevant infrastructure:

Calder Bridge is located 360 m east of the Site.

The surface water course adjacent to the north of the Site appears to be a culverted drainage ditch.

The nearest flood defences are located on the River Calder and comprise of a fluvial high ground flood design designed to protect up to a 1 in 100 year event with a designed upstream and downstream crest levels of 14.95 mAOD and 12.80 mAOD correspondingly.

Hydrogeological features

British Geological Survey (BGS) mapping indicates the underlying superficial geology consists of Alluvium - Clay, Silt, Sand And Gravel (BGS, 2020) and is classified as a Secondary (A) Aquifer (EA, 2020).

BGS mapping indicates the underlying bedrock geology consists of the Sherwood Sandstone Group - Sandstone (BGS, 2020) and is classified as a Principal Aquifer (EA, 2020).

The Site lies within a total catchment groundwater Source Protection Zone (SPZ III) (EA, 2020).

A review of the BGS borehole database (BGS, 2020) indicates there are no relevant/relevant boreholes within the vicinity of the site.

The hydrogeological characteristics suggest there is unlikely to be a shallow groundwater table beneath the site.

4. Flood risk to the development

Historical flood events

According to the EA's historical flood map no historical flood events have been recorded at the Site (EA, 2020). 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.

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

The predominant risk at the Site is from flooding from rivers, termed as fluvial flooding. The Site is located in an inland location and the risk of flooding from coastal and tidal processes are therefore considered to be negligible.

River (fluvial) flooding occurs during times of heavy rainfall or snow melt when watercourses' capacity can be exceeded, over topping the banks and flood defences.

According to the EA's Flood Map for Planning Purposes (Figure 3), the Site is located within fluvial Flood Zone 1 and Flood Zone 2 and is therefore classified as having a Low and Medium probability of fluvial flooding from the River Calder. Flood Zone 3 lies adjacent to the north of the Site which is classified as having a High probability of fluvial flooding.

The area proposed for development is located within Flood Zone 2 which has a medium probability of fluvial flooding.

The nearest dry land outside Flood Zones 2 and 3 lies on Meadowcroft Avenue.

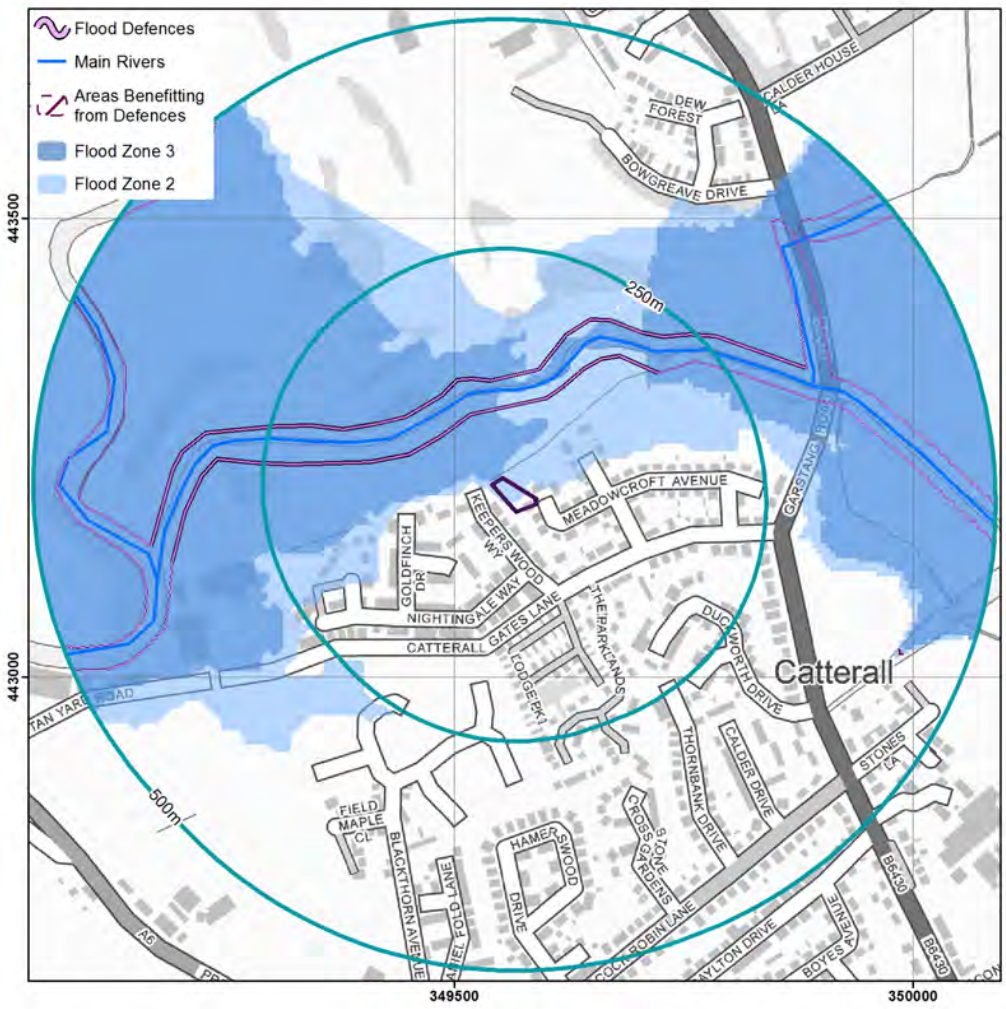
Guidance

As defined in the NPPF (2019):

Ignoring the presence of any defences, land located in a Flood Zone 2 is considered to have a Medium probability of flooding, with between a 1 in 100 and 1 in 1000 annual probability of fluvial flooding or between a 1 in 200 and 1 in 1000 annual probability of coastal flooding in any one year.

Development of "Water-Compatible" and "Less Vulnerable" land uses are suitable for this zone with "More Vulnerable" and "Essential Infrastructure" requiring an Exception test to be passed prior to development taking place. (see glossary for terminology).

Figure 3 EA Flood Map for Planning Purposes (EA, 2020)



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Flood defences

The nearest flood defences are located on the River Calder and comprise of a fluvial high ground flood design designed to protect up to a 1 in 100 year event with a designed upstream and downstream crest levels of 14.95 mAOD and 12.80 mAOD correspondingly.

Guidance

Sites that are located close to flood defences are likely to be zones where rapid inundation will occur in the event of the flood defences being overtopped or breached. A Site located close to flood defences (within 250 m) may require a more detailed FRA subject to local topography.

Model data

As the Site is located within the EA's fluvial floodplain, modelled flood elevation data was obtained from the EA and has been used to assess flood risk and to provide recommendations for mitigation for the proposed development.

Defended modelled flood data from the 2014 Wyre SFRM study has been taken from the node point located on Site and have been used to assess flood risk[1]. The data is provided in the table below and is included within Appendix C.

Table 2: EA modelled flood level data

Ground levels in the area proposed for development (mAOD)	Modelled Flood Levels (mAOD)		
	1 in 100 year	1 in 100 year plus 20% CC	1 in 1000 year
13.35 to 14.30	12.84	13.17	13.81
Flood depths	No flooding	No flooding	Up to 0.46

Climate Change factors

The EA's *Flood risk assessments: climate change allowances* guidance (2019) has been used to inform a suitable increase in peak river flows for the proposed development.

As the Site is located within the North West River Basin and the proposed development is classed as More Vulnerable, where the proposed lifespan is 100 years, the Higher Central (35%) and Upper End (70%) allowances have been used to determine a suitable climate change factor. The updated guidance confirms 'More Vulnerable' developments are required to undertake a Basic assessment approach.

A stage / discharge relationship has been calculated using the EA's modelled flood level data. The climate change allowances have been derived as a proportion of the 100 year peak flow to the 1 in 1000 year event, using the Flood Studies Report (1975) growth curves.

For the North West Region, the 1 in 1000 year event flow is approximately 60% greater than the 1 in 100 year flow, therefore the following flood levels apply.

Table 3: Flood levels plus climate change allowances

1 in 100 year plus 35% allowance for climate change flood level (mAOD)	1 in 100 year plus 70% allowance for climate change flood level (mAOD)
13.41	13.99

[1] The accuracy of the modelled flood levels are not known. These are dependent on the accuracy of input datasets such as LiDAR data, used to model the impacts of flooding within the 2D domain. Confirmation of the accuracy of the modelled flood data can be obtained separately from the Environment Agency.

Flood risk including the benefit of 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 the Sea (RoFRS) mapping (Figure 4), which considers the crest height, standard of protection and condition of defences, the flood risk from Rivers and the Sea is Variable: Negligible to High. High risk is associated with the northwest corner of the Site, Medium risk is associated with the northern half of the Site. Low risk is associated with the southern half of the Site where Negligible risk is associated where the existing development is located. The area proposed for development is at a Low to High fluvial flood risk from the River Calder.

Figure 4 Risk of Flooding from Rivers and Sea map (EA, 2020)

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.

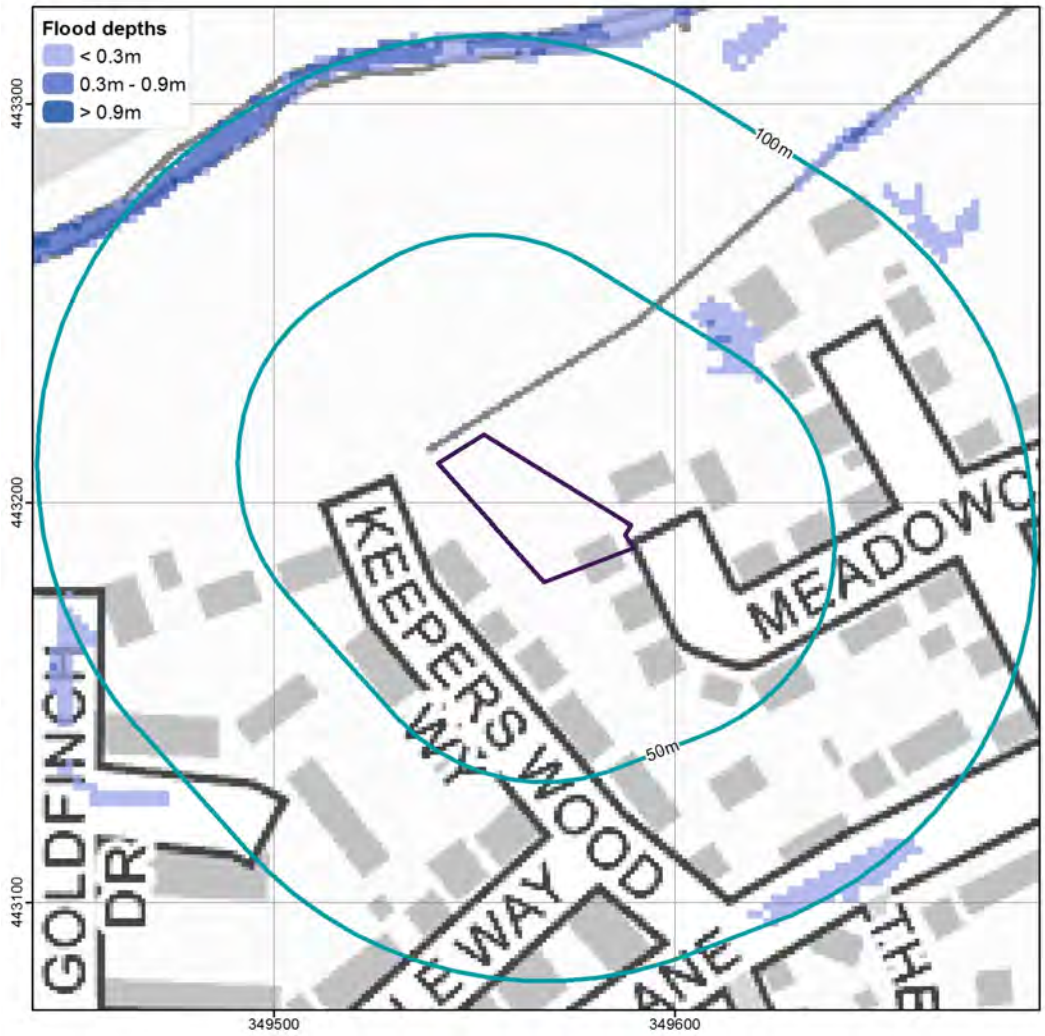
According to the EA's Risk of Flooding from Surface Water (pluvial) mapping, there is a Very Low risk of pluvial flooding at the Site.

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%).

Figure 5 EA Medium surface water flood risk map (EA, 2020)



Analysis of OS mapping, ground elevation data and the EA's pluvial flow route mapping in the 1 in 100 year event confirms the Site is not located on a potential overland flow route during a medium risk scenario.

Although the SFRA states that "the numbers of properties at risk from surface water flooding in Wyre is in excess of 1,300", the SFRA does not indicate reported incidents of historical surface water flooding within 100 m of the Site (Wyre Borough Council, 2016). The SFRA confirms the Site is not located within a Critical Drainage Area (CDA)[2] (Wyre Borough Council, 2016).

Climate change may lead to an increase in rainfall intensity which affects river levels, land and urban drainage systems. Rainfall intensity for small and urban catchments may increase from 5 to 20% (central estimate) or 10% to 40% (Upper estimate) over the period to 2115 (EA, 2020). The increase in surface water flood risk is best represented by the 1 in 1000 year pluvial flood extent but according to the mapping this is unlikely to impact the Site.

[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, 2019). 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 6) indicates there is a Negligible risk of groundwater flooding at surface in the vicinity from permeable bedrock and superficial during a 1 in 100 year event. Mapped classes 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.

Figure 6 GeoSmart GW5 Groundwater Flood Risk Map (GeoSmart, 2020)

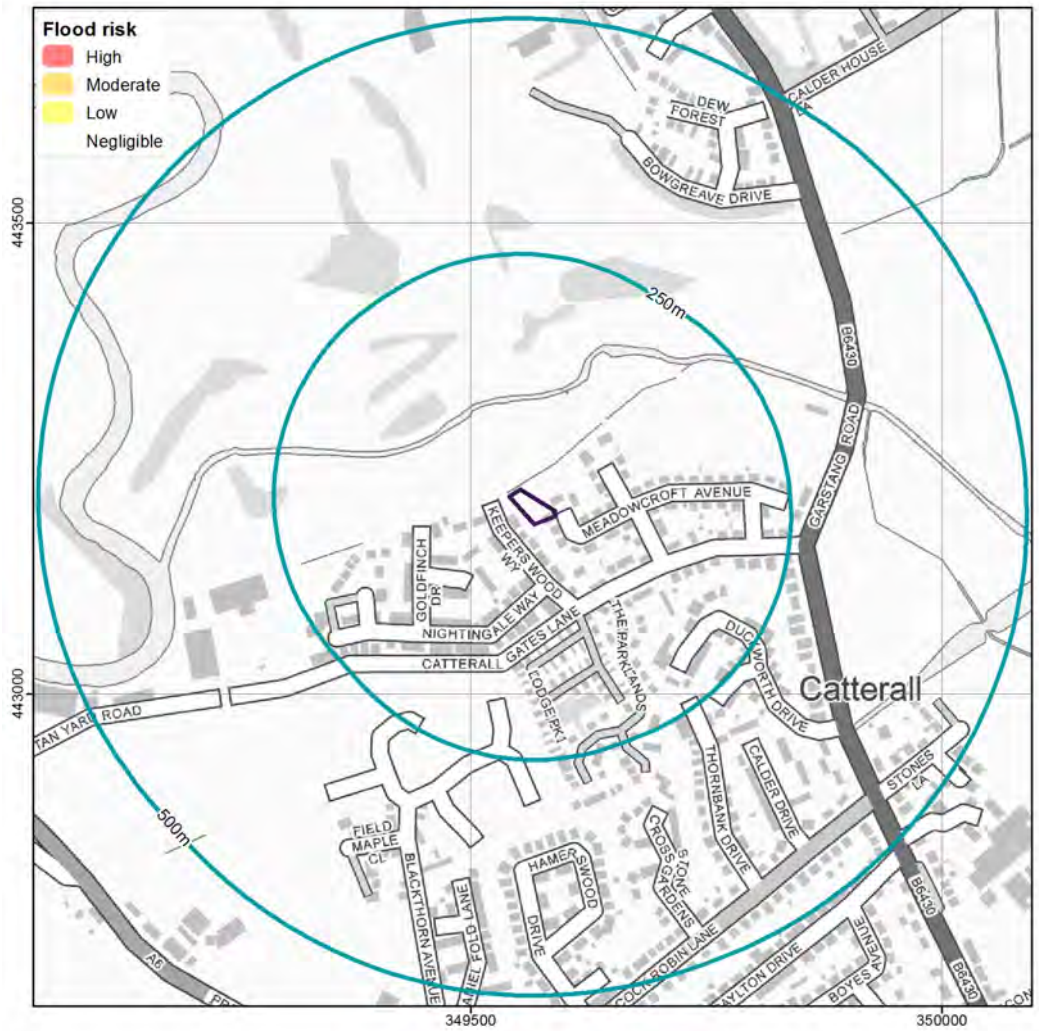


Figure 9.3 of the SFRA confirms the Site has a less than 25% risk of groundwater flooding and has not reported any incidents of historical ground water flooding within 20 m of the Site (Wyre Borough Council, 2016)

Site specific assessment suggests that groundwater levels are unlikely to reach the surface at the Site.

The presence of local drainage features are likely to intercept the groundwater.

The local topography is such that the development threshold is likely to be higher than the area where groundwater emerges in adjacent low points.

On the basis of the site-specific assessment the groundwater flood risk is considered to be negligible.

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

Guidance

Negligible 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 predicted risk in both peak river levels and sea levels and also the variation in rainfall recharge which is uncertain.

Based on the available evidence the resulting increase to groundwater flood risk is not considered significant.

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

Figure 9.4 of the SFRA illustrates 0 sewer related flood incidents within 100 m of the Site (Wyre Borough Council, 2016).

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.

Culverts and bridges have been identified within 500 m of the Site.

While the culvert at the rear of the Site on the northern boundary has a risk of blockage, Calder Bridge is 360 m east from the Site and is unlikely to represent a flood risk to the Site in the event of a blockage.

The SFRA has not identified any historical drainage issues within the Site area (Wyre Borough Council, 2016).

Reservoir flooding

According to the EA's Risk of Flooding from Reservoir mapping, the Site is not considered to be at risk of flooding from a breach in any nearby reservoirs.

Guidance

The risk of reservoir flooding is related to the failure of a large reservoir (holding over 25,000 m^3 of water) and is based on the worst-case scenario. Reservoir flooding is extremely unlikely to occur (EA, 2020).

5. Flood risk from the development

Floodplain storage

The development is located within a fluvial Flood Zone, it would be impacted by the 1 in 100 year plus 35% climate change event and involves an increase in building footprint, compensatory flood storage is therefore required for any loss in flood plain storage. 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 must 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. 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 35% allowance for climate change.

Drainage and run-off

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.

Using FEH 2013 rainfall data from the online Flood Estimation Handbook (FEH), developed by NERC (2009) and CEH (2016), the potential surface water run-off generated from the Site during a 1 in 100 year return period should be calculated. The NPPF (2019) recommends the effects of climate change are incorporated into FRA's and the recently updated climate change guidance (published in 2016 and updated in 2019) confirms the requirements for inclusion.

As the proposed development is residential, the lifespan of the development and requirements for climate change should allow up to the 2115 scenario.

Table 4: Climate change rainfall allowances

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Upper end	10%	20%	40%
Central	5%	10%	20%

A method of investigating the run-off due to the proposed development can be calculated by multiplying the run-off per square metre by the impermeable area within the proposed development plan.

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 5: 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.
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.

It is assumed that any changes to the existing drainage system will be undertaken in accordance with best practice and that care will be taken to ensure the new development does not overload/block any existing drainage or flow pathways to/from the Site. Based on the topography and low surface water flood risk in the vicinity interference with overland flow paths is considered unlikely.

GeoSmart could provide a separate outline drainage strategy as required, through our SuDSmart Pro report range. A separate proposal could be provided upon request.

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, 2019). 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 Table 6 overleaf (Table 3 of the NPPG (2014)).

As the area proposed for development on the Site is located within Flood Zone 2 and the proposed development is defined as More Vulnerable; the proposals would be acceptable subject to the Sequential Test.

Where the Sequential Test is required it must be demonstrated that there are no alternative reasonably available Sites at lower risk of flooding within Catterall. For a site to be considered to be reasonably available it must be 'deliverable' and 'developable' as defined by the NPPF (2019).

Table 6: Flood risk vulnerability and flood zone 'compatibility (taken from NPPG, 2014)

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

EA Flood Risk Standing Advice for vulnerable developments located in Flood Zones 2 or 3

For all relevant vulnerable developments (i.e. more vulnerable, less vulnerable and water compatible), advice on the points should be followed:

- Surface water management;
- Access and evacuation; and
- Floor levels.

Surface water management

Plans for the management of surface water need to meet the requirements set out in either the local authority's:

- Surface water management plan where available; OR
- Strategic flood risk assessment.

They also need to meet the requirements of the approved building regulations Part H: drainage and water disposal. Read section H3 rainwater drainage.

Planning permission is required to use a material that can't absorb water (e.g. impermeable concrete) in a front garden larger than 5 square metres.

Access and evacuation

Details of emergency escape plans should be provided for any parts of a building that are below the estimated flood level:

Plans should show:

- Single storey buildings or ground floors that don't have access to higher floors can access a space above the estimated flood level, e.g. higher ground nearby;
- Basement rooms have clear internal access to an upper level, e.g. a staircase;
- Occupants can leave the building if there's a flood and there's enough time for them to leave after flood warnings.

Floor levels

The following should be provided:

- Average ground level of the building; and
- Finished floor level of the lowest habitable room in the building.

Ground floor levels should be a minimum of whichever is higher of:

- 300 millimetres (mm) above the general ground level of the site; OR
- At least 600 mm above the estimated river or sea flood level[3].

If you cannot raise floor levels above the estimated flood level, you need to consider extra flood resistance and resilience measures.

Extra flood resistance and resilience measures

Follow the extra flood resistance and resilience requirements for developments in flood risk areas where ground floor levels are lower than the estimated flood level for the site.

Water depth up to 300 mm

The design of the building or development should keep water out as much as possible. You should use materials that have low permeability (materials that water cannot pass through, for example, impermeable concrete).

Water depth from 300 mm to 600 mm

The design of the building or development should keep water out (unless there are structural concerns) by:

- using materials with low permeability to at least 300mm
- using flood resilient materials (for example lime plaster) and design (for example raised electrical sockets)
- making sure there's access to all spaces to enable drying and cleaning

Water depth above 600 mm

The design of the building or development should allow water to pass through the property to avoid structural damage by:

- using materials with low permeability to at least 300 mm
- making it easy for water to drain away after flooding
- making sure there's access to all spaces to enable drying and cleaning

[3] This is 600 mm above the 1 in 100 year fluvial or 1 in 200 year tidal flood events. The 600 mm is split into a 300 mm freeboard allowance for climate change and 300mm allowance for the inaccuracies in the EA's flood modelling. Where the climate change flood level is known, a 300 mm allowance should be added to the climate change flood level to allow for the inaccuracies in the EA's flood modelling.

Local policy and guidance

For this report, several documents have been consulted for local policy and guidance and relevant information is outlined below:

Wyre Borough Council Strategic Flood Risk Assessment (Wyre Borough Council, 2016):

- *The principal watercourse flowing through the Borough is the River Wyre, with a number of smaller tributaries including the River Calder and the River Brock. The Lancaster Canal also runs through the Borough as well as a large number of smaller drains and watercourses.*
- *The basin at St. Michaels/Catterall involves the area between the River Wyre and the River Brock. The basin provides off-line storage of 1.7 million cubic metres (1.3 million required to accommodate the 50 year flood, the remainder acting as a margin of safety) over an area of 92 hectares.*
- *The core area is bound on the western and northern frontages by the Irish Sea and the eastern frontage is bounded by the tidal River Wyre. To the south lies the boundary with Blackpool.*
- *Over a quarter of the residents in the Wyre catchment are at some risk of either fluvial or tidal flooding.*

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, 2019).

Environment Agency pre-application response:

The EA (2020) was contacted as part of this FloodSmart report in order to obtain site-specific feedback on the proposed development. However, a response was not received within the timeframe of this report.

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 the sea, mitigation measures are not required.

Rivers (fluvial) flood mitigation measures

The Site is located within an area which is affected by flooding from rivers, the following table confirms the flood depths associated with the area proposed for development.

Table 7: Flood levels compared to ground levels in the area proposed for development

Ground levels in area proposed for development (mAOD)	Modelled Flood Levels (mAOD)		
	1 in 100 year plus 35% CC (mAOD)	1 in 100 year plus 70% CC (mAOD)	1 in 1000 year (mAOD)
13.35 to 14.30	13.41	13.99	13.81
Flood depths (m)	Up to 0.06	Up to 0.64	Up to 0.46

Raising minimum floor levels

The vulnerability classification of the site and the Flood Zone means proposals for the Site fall under the EA's Flood Risk Standing Advice (FRSA) for more vulnerable developments.

In this instance, in line with the EA's FRSA the recommended minimum Finished Floor Level (FFL) should be set at least 0.6 m above 1 in 100 year plus 35% allowance for climate change flood level of 13.41 mAOD.

Table 8: Recommended Minimum Finished Floor Level Required

Ground Level (mAOD)	Flood Level (mAOD)	Freeboard above Flood Level (m)	Recommended FFL (mAOD)
13.35 to 14.30	13.41	600mm	14.01

Additional Mitigation

Where it is not possible to raise the minimum finished floor levels to the recommended elevation, it may be appropriate to adopt a water exclusion strategy for flood depths up to 0.3 m in line with the EA's Standing Advice. A water exclusion strategy, using avoidance and

resistance measures, is appropriate where floods are expected to last for short durations. Potential water exclusion strategies include:

- Passive flood door systems;
- Temporary flood barriers;
- Air brick covers (manual or automatic closing);
- Non-return flap valves on sewer outfalls.

Avoidance and resistance measures are unlikely to completely prevent floodwater entering a property, particular during longer duration flood events. Therefore, it is recommended that the following flood resilience measures are also considered.

- Flood resilient materials and designs:
    - Use of low permeability building materials up to 0.3 m such as engineering bricks (Classes A and B) or facing bricks;
    - Hard flooring and flood resilient metal staircases;
    - The use of internal lime plaster/render or where plasterboards are used these should be fitted horizontally instead of vertically and/or using moisture resistant plasterboard at lower levels;
    - Water, electricity and gas meters and electrical sockets should be located above the predicted flood level;
    - Communications wiring: wiring for telephone, TV, Internet and other services should be protected by suitable insulation in the distribution ducts to prevent damage.

Where flood depths are expected to exceed 0.6 m at the Site, a water entry strategy should be adopted to preserve building integrity and to promote flood resilience rather than resistance (which is more difficult to achieve for significant flood depths). A structural engineer should be consulted to confirm this would be a suitable strategy for the proposed development, to ensure flood flows would not impact the structural integrity of the building. Potential strategies include:

- Ground floors designed to permit water passage at high flood depths;
- Hard flooring and flood resilient metal staircases.
- Heating systems, electrical sockets and utility meters should be raised above the predicted flood level where possible; and
- Sump and pump.

Where flood depths are expected to be between 0.3-0.6 m both water exclusion and water entry strategies should be adopted depending on a structural assessment of the building.

Surface water (pluvial) flood mitigation measures

As the Site is not identified as being at risk of pluvial flooding, mitigation measures are not required however, the regular maintenance of any drains and culverts surrounding/on the Site should be undertaken to reduce the flood risk.

A Sustainable Drainage Strategy (SuDS) should be developed for the Site, for effective management of surface water runoff from the proposed development.

Groundwater flood mitigation measures

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

Reservoir flood mitigation measures

The Site is not a risk of flooding from reservoirs; therefore, mitigation measures are not required.

Other flood risk mitigation measures

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

Emergency evacuation - safe access / egress and safe refuge

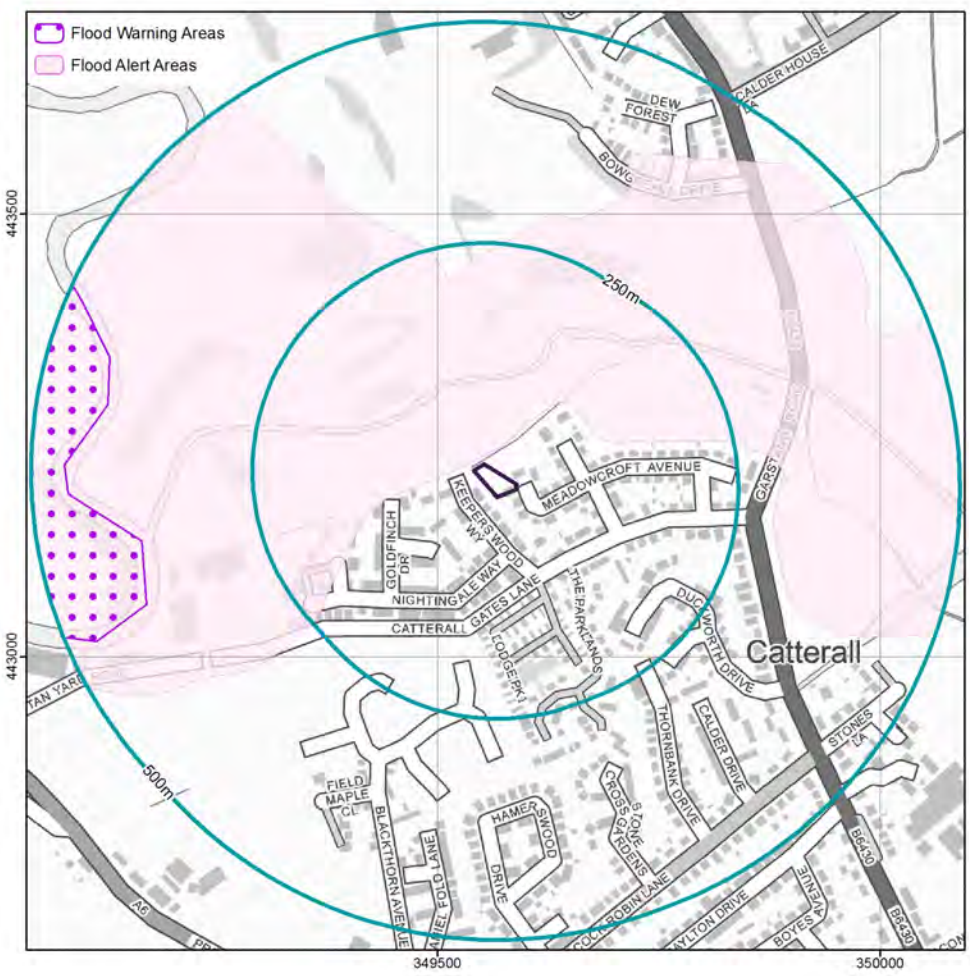
Emergency evacuation to land outside of the floodplain should be provided if feasible. Where this is not possible, 'more vulnerable' developments and, where possible, development in general (including basements), should have internal stair access to an area of safe refuge within the building to a level 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 so is unable to receive alerts and/or warnings (Figure 9).

Figure 9 EA Flood Warning Coverage for the local area.



Emergency Evacuation

Where possible, a safe access and egress route with a 'very low' hazard rating from areas within the floodplain to an area wholly outside the 1 in 100 year flood event including an allowance for climate change should be demonstrated.

Based on the EA's Flood Zone Map the closest dry evacuation area within Flood Zone 1 is along Meadowcroft Avenue. It is advised that evacuation from the premises would be the preferred option in a flood event if safe to do so. It is recommended that residents prepare to evacuate as soon as an EA Flood Warning is issued in order to completely avoid flood waters.

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 9: Risk ratings following implementation and subsequent maintenance of mitigation measures

Source of Flood Risk		Baseline	After Mitigation
River (fluvial) and Sea (coastal/tidal)	Whole Site	Variable: Negligible to High	Low
	Area proposed for development	Low to Medium	Low
Surface water (pluvial) flooding		Very Low	Very Low
Groundwater flooding		Negligible	Negligible
Other flood risk factors present		No	N/A

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.

Table 10: Summary of responses to key questions in the report

Key sources of flood risks identified	Fluvial (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?	
Recommendations for mitigation are provided below, based upon the proposed development and the flood risk identified at the Site: In this instance, it is recommended to raise the finished floor levels 0.6 m above the 1 in 100 year plus 35% climate change to 14.01 mAOD. Where it is not possible to raise the finished floor levels additional mitigation measures should be considered including: • Passive flood door systems; • Temporary flood barriers; • Air brick covers (manual or automatic closing);	

- Non-return flap valves on sewer outfalls;
- Flood resilient materials and designs:
    - Use of low permeability building materials up to 0.3 m such as engineering bricks (Classes A and B) or facing bricks;
    - The use of internal lime plaster/render or where plasterboards are used these should be fitted horizontally instead of vertically and/or using moisture resistant plasterboard at lower levels;
    - Water, electricity and gas meters and electrical sockets should be located above the predicted flood level;
    - Communications wiring: wiring for telephone, TV, Internet and other services should be protected by suitable insulation in the distribution ducts to prevent damage.
- Ground floors designed to permit water passage at high flood depths;
- Hard flooring and flood resilient metal staircases; and
- Sump and pump.

Additional Measures

- The regular maintenance of any drains and culverts surrounding/on the Site should be undertaken to reduce the flood risk.
- A Sustainable Drainage Strategy (SuDS) should be developed for the Site, for effective management of surface water runoff from the proposed development.

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.

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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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 200 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 ±0.25m 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 (2019) 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 2020 BlueSky copyright and database rights 2020
Flood Risk (Flood Zone/RoFRS/Historic Flooding/Pluvial/Surface Water Features/Reservoir/ Flood Alert & Warning)	Environment Agency copyright and database rights 2020 Ordnance Survey data © Crown copyright and database right 2020
Flood Risk (Groundwater)	GeoSmart, BGS & OS GW5 (v2.3) Map (GeoSmart, 2020) Contains British Geological Survey materials © NERC 2020 Ordnance Survey data © Crown copyright and database right 2020
Location Plan	Contains Ordnance Survey data © Crown copyright and database right 2020
Topographic Data	OS LiDAR/EA Contains Ordnance Survey data © Crown copyright and database right 2020 Environment Agency copyright and database rights 2020

Appendices

Appendix A

Site plans

Existing Site Layout 1:200

Proposed Site Layout 1:200

Location Plan 1:1250

North

HIGH PEAK **ARCHITECTS** LTD

2nd Floor, Wharf House, Wharf Road, Whaley Bridge, High Peak, Derbys SK23 7AD

Tel: 01663 719717 Website: highpeakarch.com Email: hpa@highpeakarch.com

Residential Development

53 Meadowcroft Avenue, Catterall

Location and Site Plans

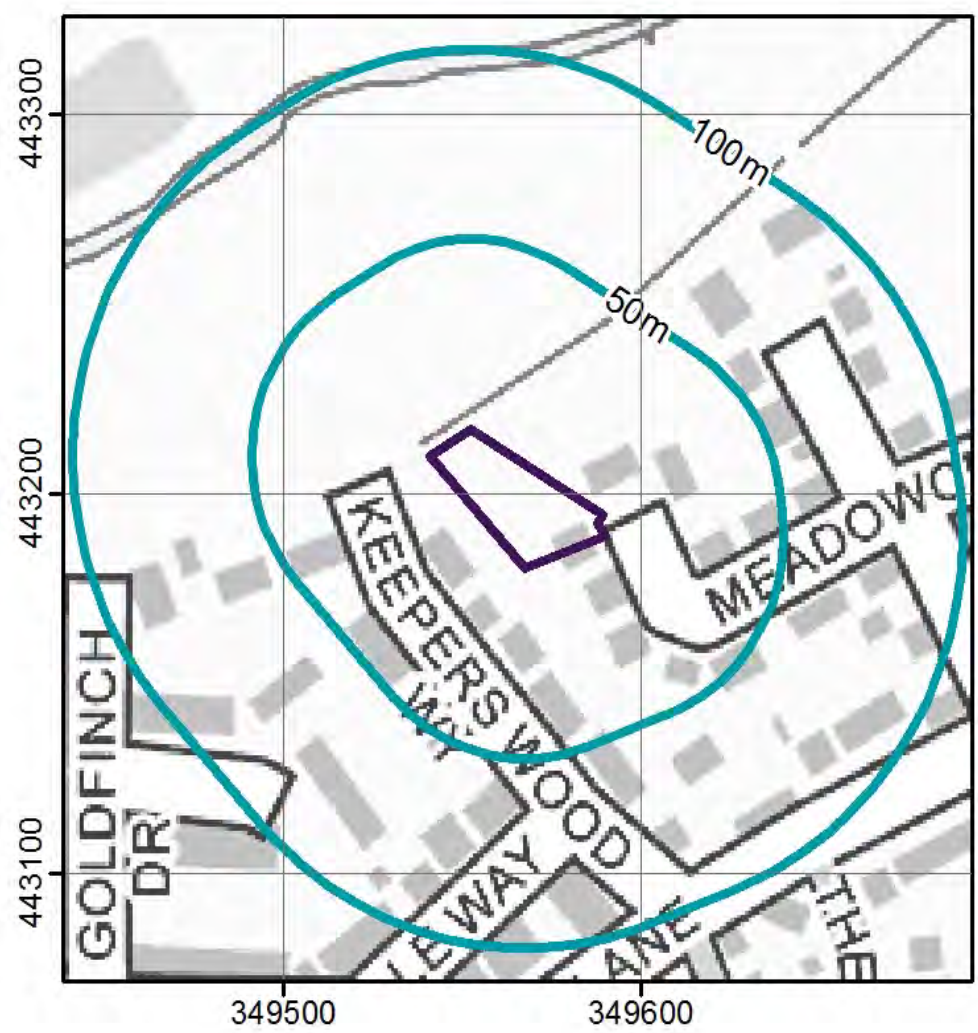
KB01.01

Scale: 1:200 & 1:1250 @ A1 Date: June 2019 DO NOT SCALE OFF THIS DRAWING Rev:

Appendix B

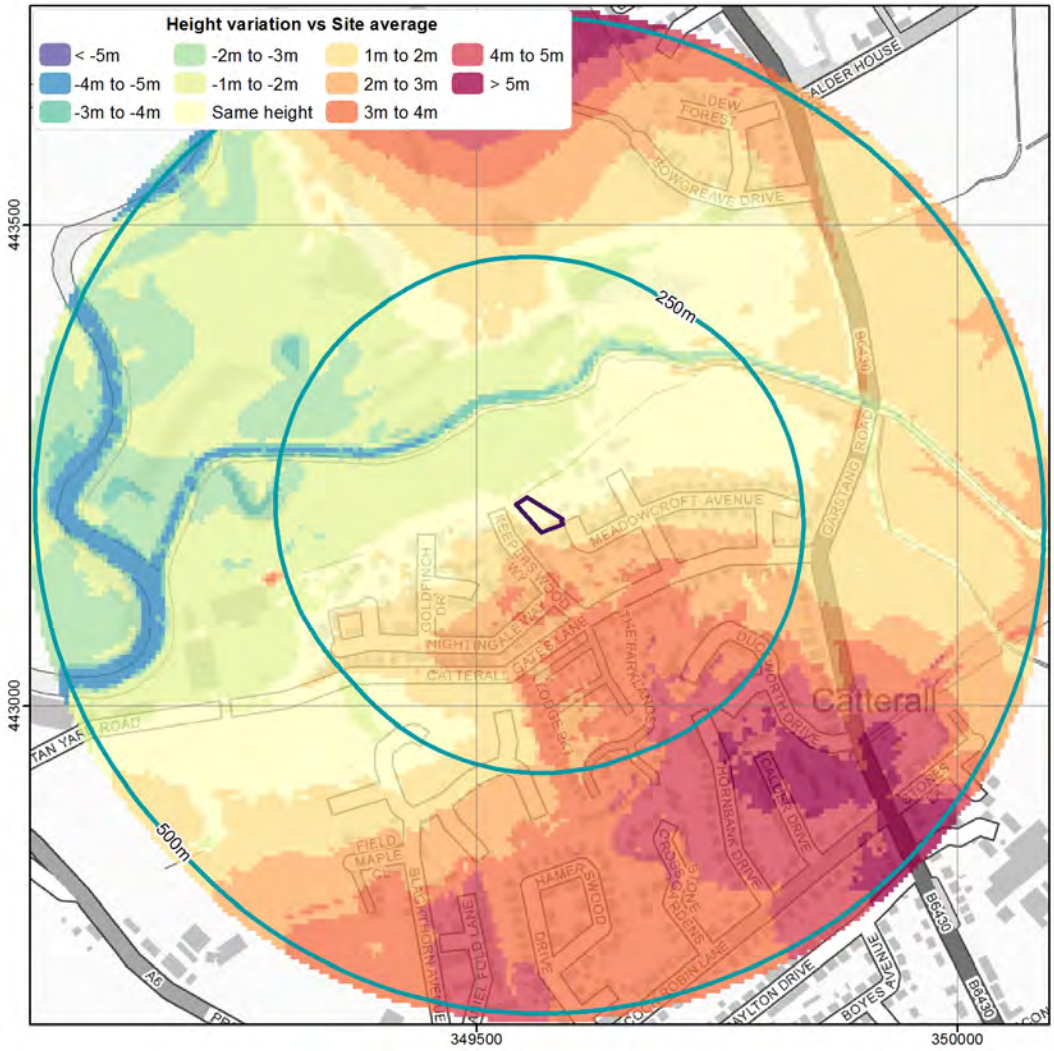
Commercial flood mapping

Site Location Plan (OS, 2020)

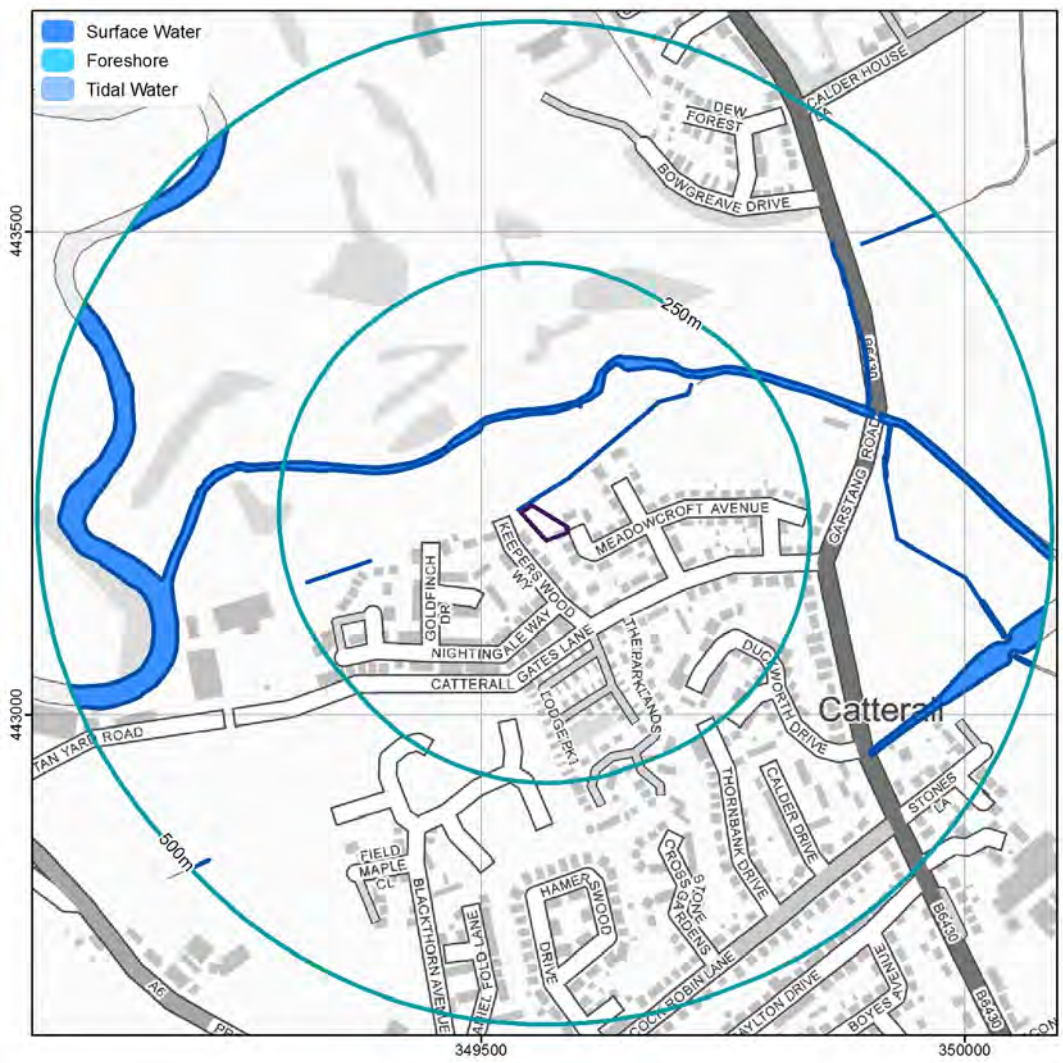


Aerial Photograph (BlueSky, 2020)

GeoSmart DTM5 (5m) map (EA, 2020)



Ordnance Survey Surface Water Feature Vector Map (OS, 2020)



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Environment Agency Historic Flood Map (EA, 2020)

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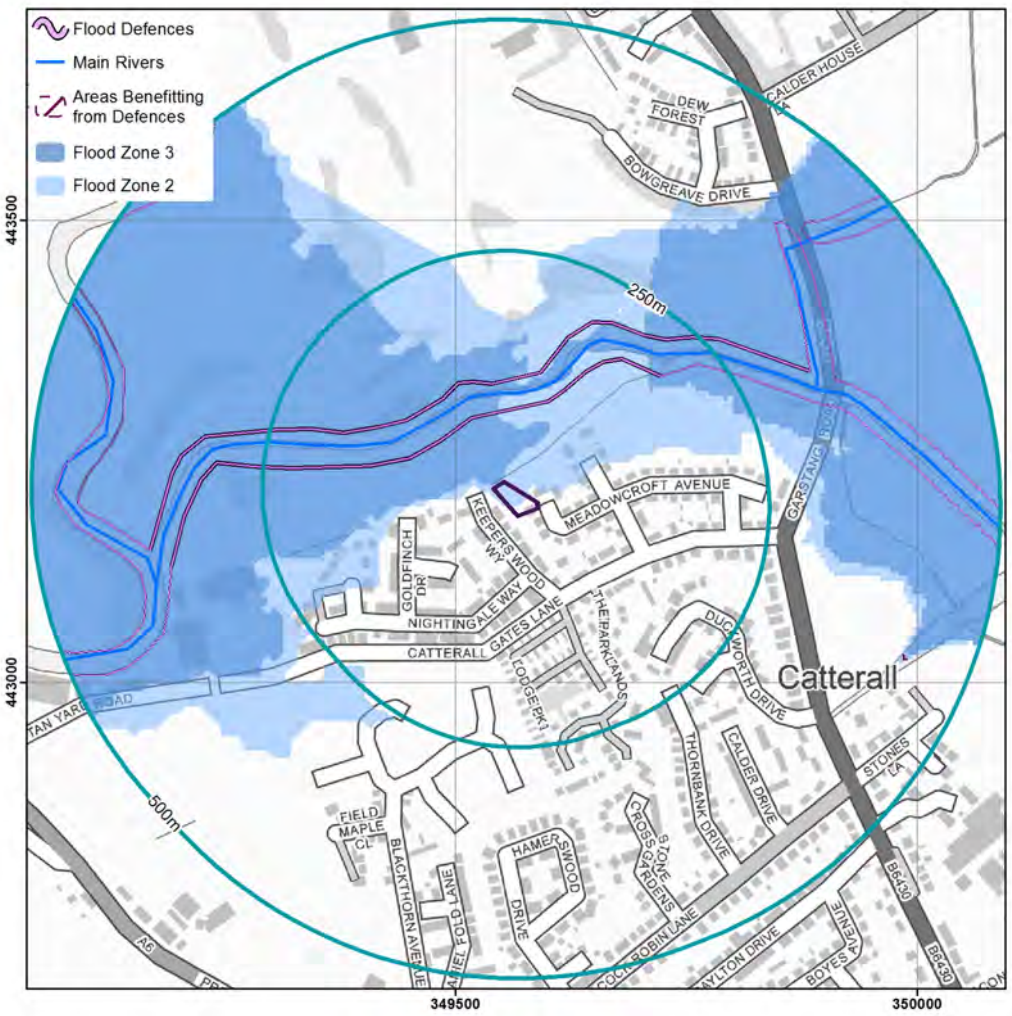
Environment Agency's Flood Map for Planning Purposes (EA, 2020)



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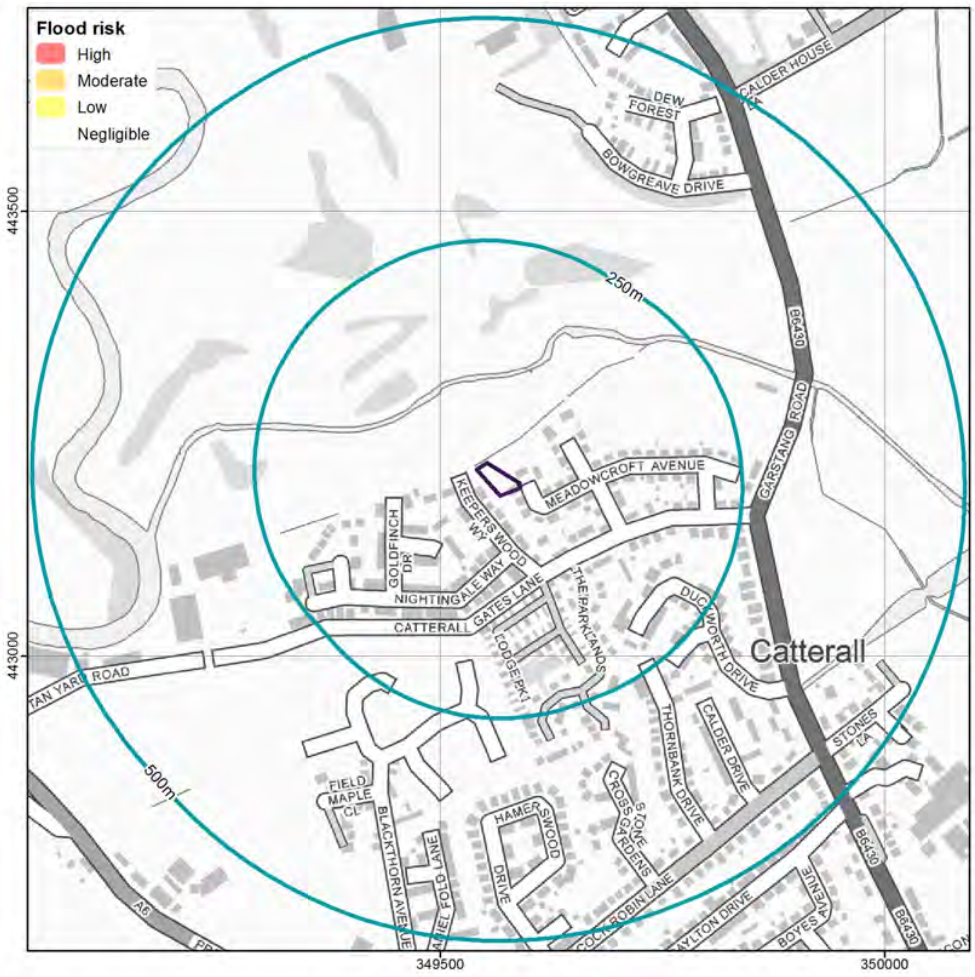
Environment Agency's Flood Risk from Rivers and Sea map (EA, 2020)

GeoSmart Groundwater Flood Risk (GW5, v2.3) Map (GeoSmart, 2020)



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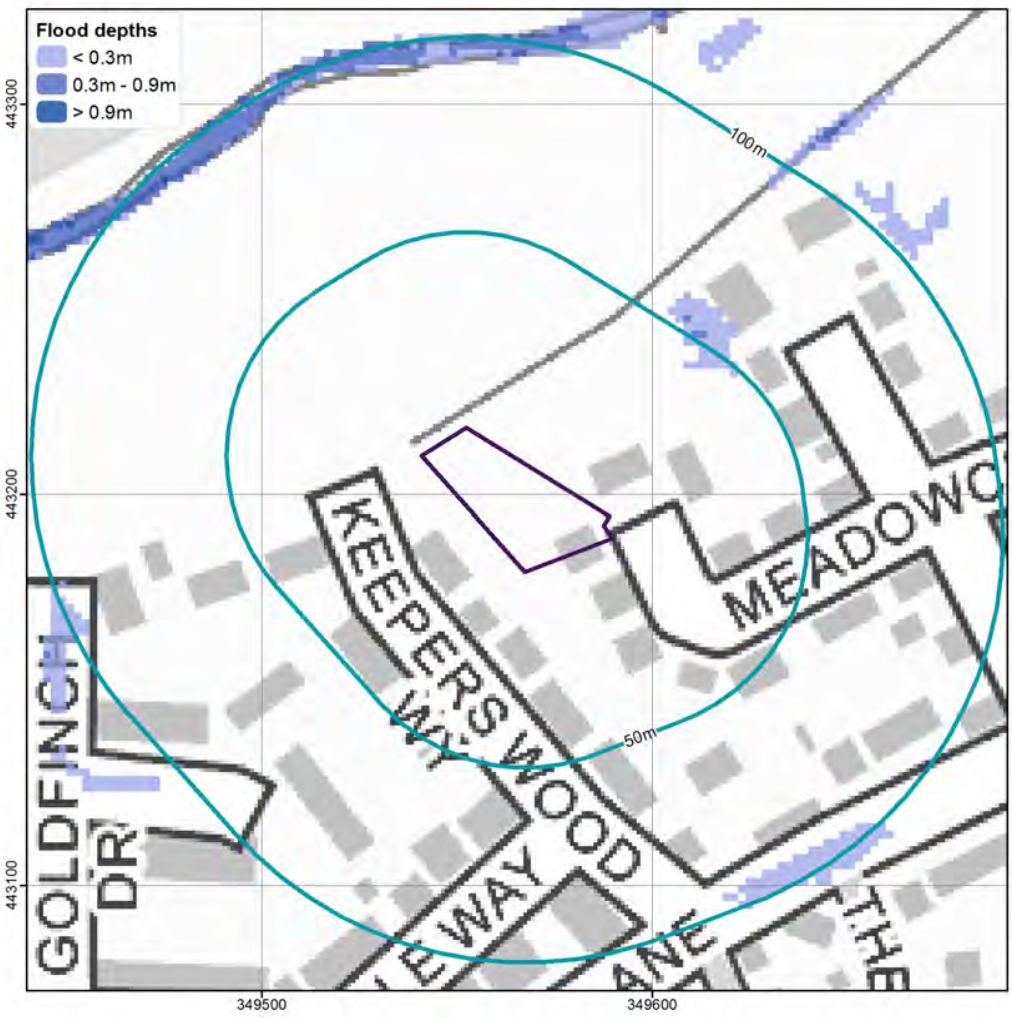
EA Risk of Flooding Surface Water (pluvial) Depth map 1 in 100 year (EA, 2020)

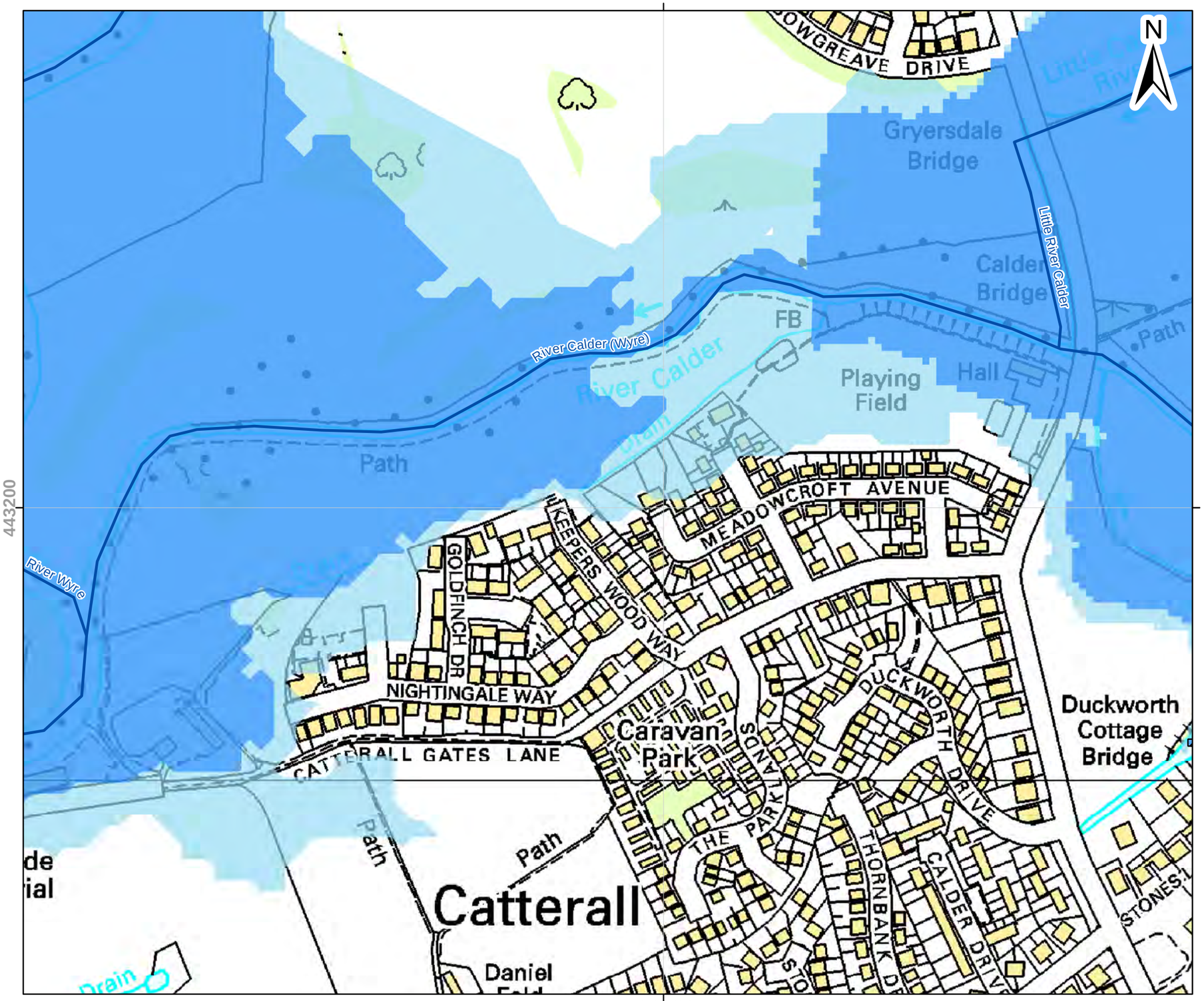


Appendix C

Environment Agency data

Flood Zones Map:
53 Meadowcroft Avenue, Catterall, Preston PR3

Produced: 30 June 2020
Our Ref: CL175134
NGR: SD 49559 43204



Key

- Main River
- Areas Benefitting from Defences
- Flood Zone 3
- Flood Zone 2

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
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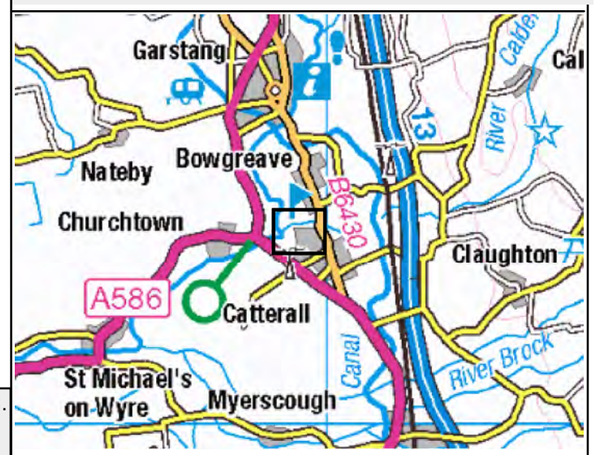
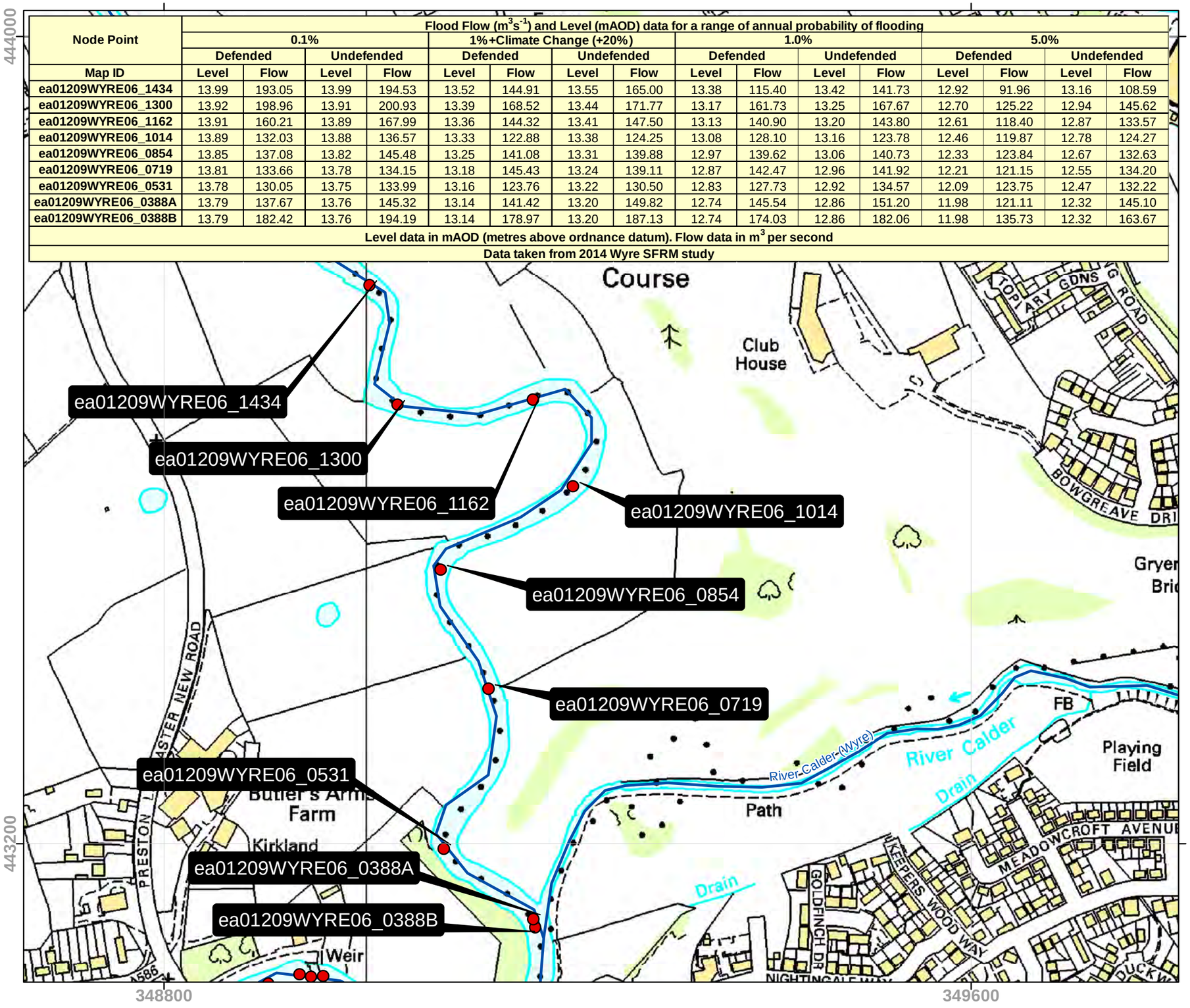


Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Node Point	Flood Flow (m^3s^{-1}) and Level (mAOD) data for a range of annual probability of flooding															
	0.1%				1%+Climate Change (+20%)				1.0%				5.0%			
	Defended		Undefended		Defended		Undefended		Defended		Undefended		Defended		Undefended	
Map ID	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow
ea01209WYRE06_1434	13.99	193.05	13.99	194.53	13.52	144.91	13.55	165.00	13.38	115.40	13.42	141.73	12.92	91.96	13.16	108.59
ea01209WYRE06_1300	13.92	198.96	13.91	200.93	13.39	168.52	13.44	171.77	13.17	161.73	13.25	167.67	12.70	125.22	12.94	145.62
ea01209WYRE06_1162	13.91	160.21	13.89	167.99	13.36	144.32	13.41	147.50	13.13	140.90	13.20	143.80	12.61	118.40	12.87	133.57
ea01209WYRE06_1014	13.89	132.03	13.88	136.57	13.33	122.88	13.38	124.25	13.08	128.10	13.16	123.78	12.46	119.87	12.78	124.27
ea01209WYRE06_0854	13.85	137.08	13.82	145.48	13.25	141.08	13.31	139.88	12.97	139.62	13.06	140.73	12.33	123.84	12.67	132.63
ea01209WYRE06_0719	13.81	133.66	13.78	134.15	13.18	145.43	13.24	139.11	12.87	142.47	12.96	141.92	12.21	121.15	12.55	134.20
ea01209WYRE06_0531	13.78	130.05	13.75	133.99	13.16	123.76	13.22	130.50	12.83	127.73	12.92	134.57	12.09	123.75	12.47	132.22
ea01209WYRE06_0388A	13.79	137.67	13.76	145.32	13.14	141.42	13.20	149.82	12.74	145.54	12.86	151.20	11.98	121.11	12.32	145.10
ea01209WYRE06_0388B	13.79	182.42	13.76	194.19	13.14	178.97	13.20	187.13	12.74	174.03	12.86	182.06	11.98	135.73	12.32	163.67

Level data in mAOD (metres above ordnance datum). Flow data in m^3 per second

Data taken from 2014 Wyre SFRM study



Environment Agency

Fluvial Levels Map: 53 Meadowcroft Avenue, Catterall, Preston PR3

Produced: 03 August 2020
Our Ref: CL175134
NGR: SD 49559 43204

Flood Zone 3 shows the area that could be affected by flooding:
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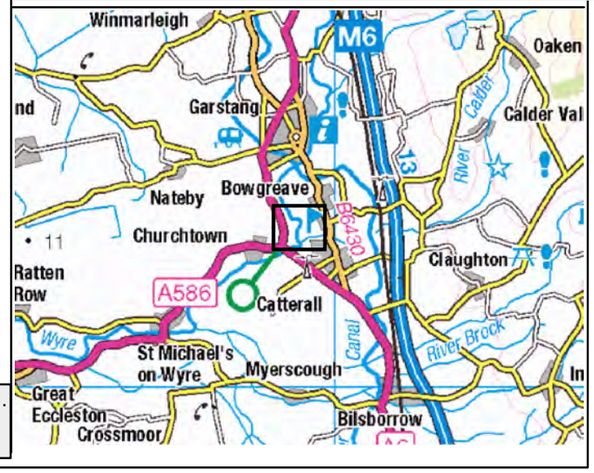

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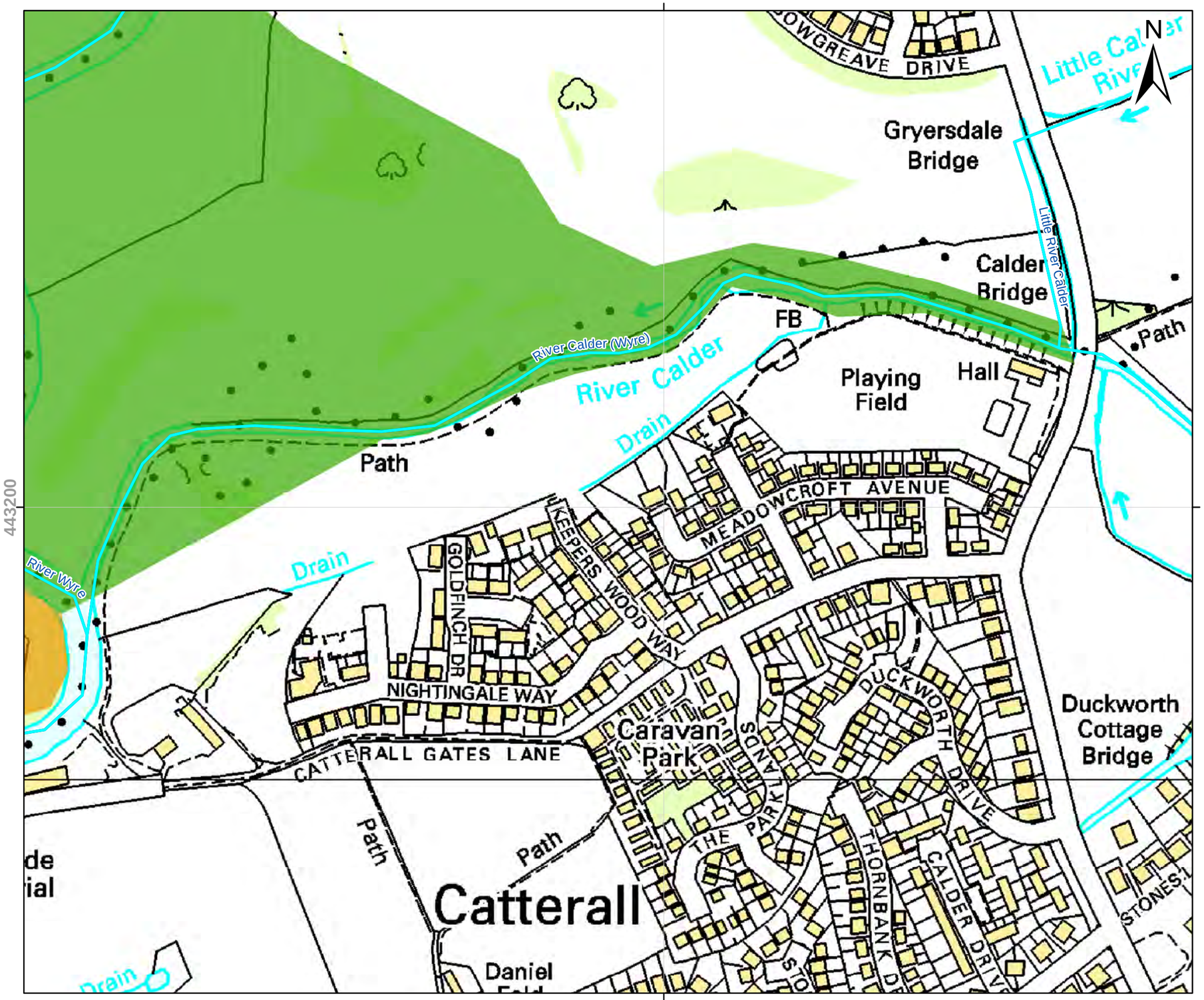

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Environment Agency

Historic Flood Map: 53 Meadowcroft Avenue, Catterall, Preston PR3

Produced: 30 June 2020
Our Ref: CL175134
NGR: SD 49559 43204

Key

Main River

November 1980

November 1980

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
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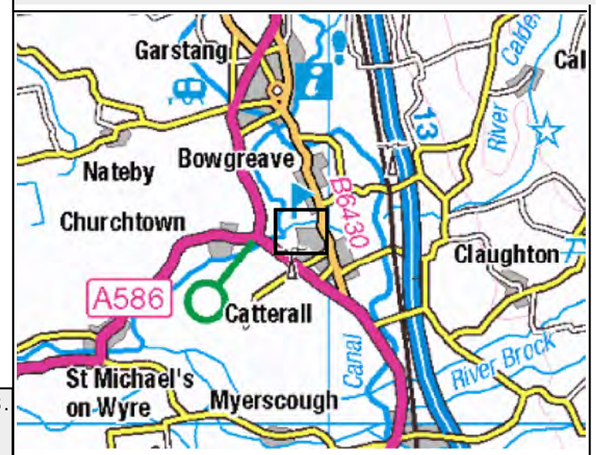

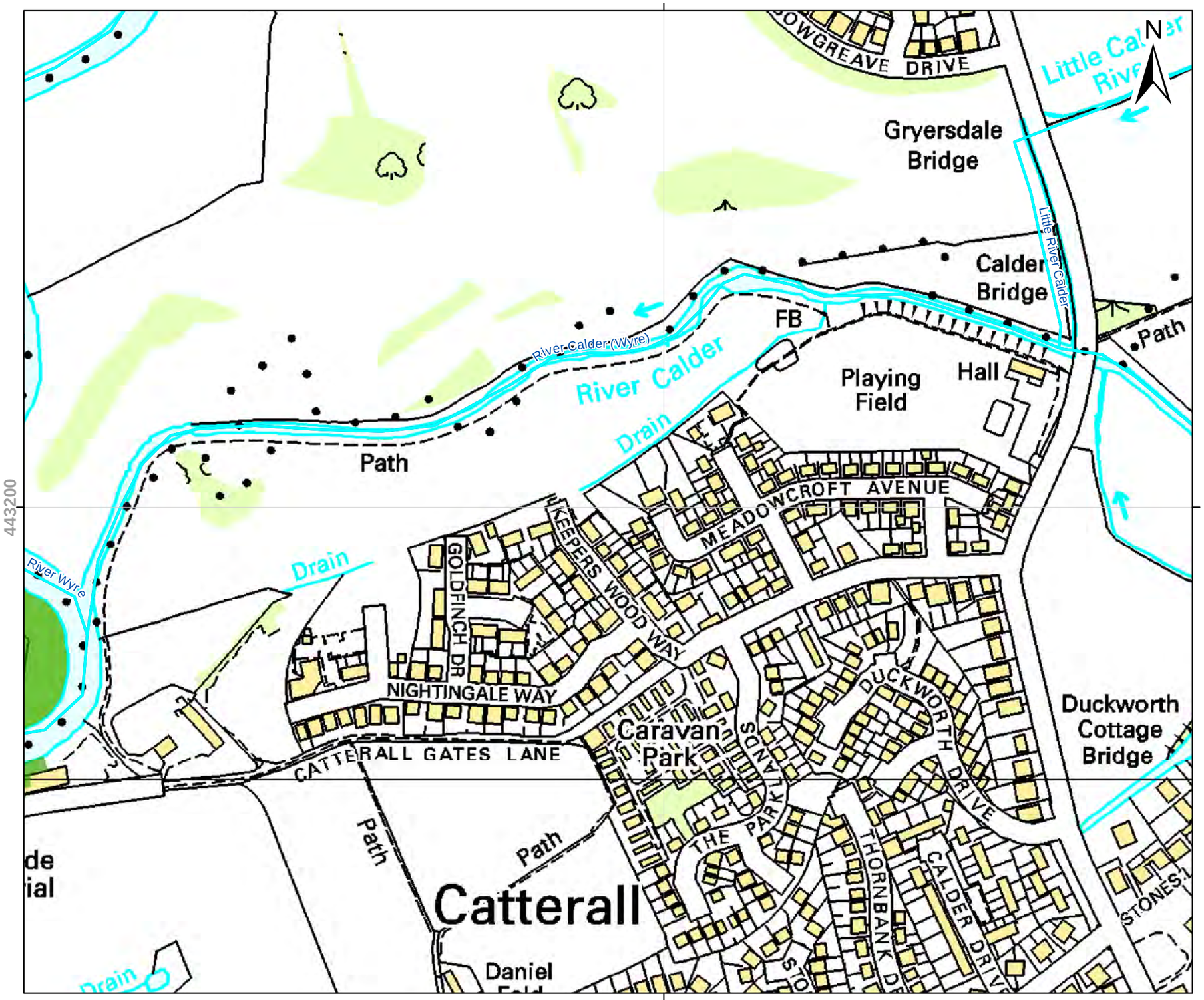

Environment Agency

Historic Flood Map:
53 Meadowcroft Avenue, Catterall, Preston PR3

Produced: 30 June 2020
Our Ref: CL175134
NGR: SD 49559 43204

Key

Main River

December 2015

Flood Zone 3 shows the area that could be affected by flooding:
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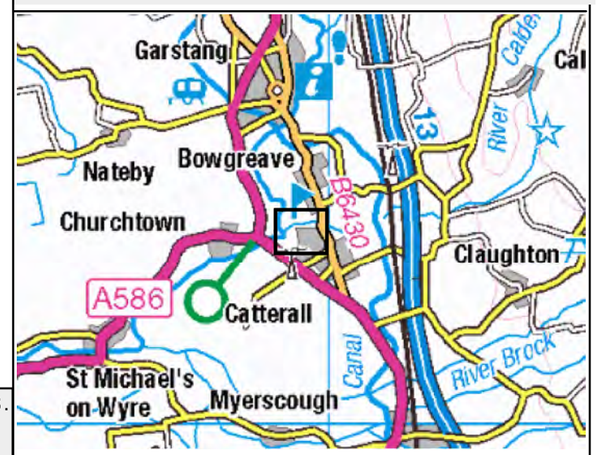

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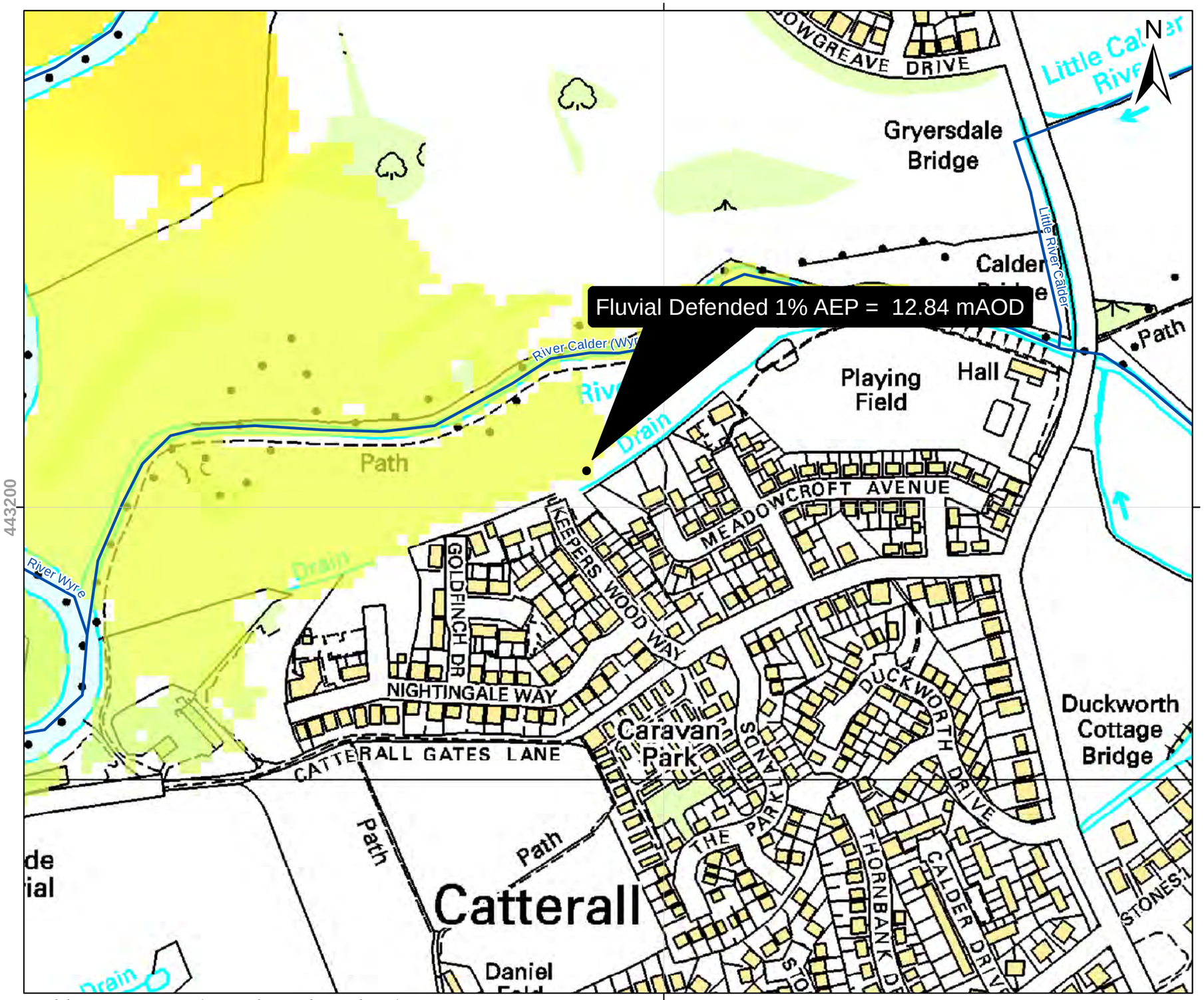

Level data given in mAOD (metres above ordnance datum)
AEP = Annual Exceedance Probability
Data taken from Wyre SFRM Study 2014

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Environment Agency

Fluvial Flood Levels Map: 53 Meadowcroft Avenue, Catterall, Preston PR3

Produced: 30 June 2020
Our Ref: CL175134
NGR: SD 49559 43204

Key

Main River

Fluvial Defended 1% annual probability of flooding scenario

mAOD

High : 14

Low : 11

Flood Zone 3 shows the area that could be affected by flooding:
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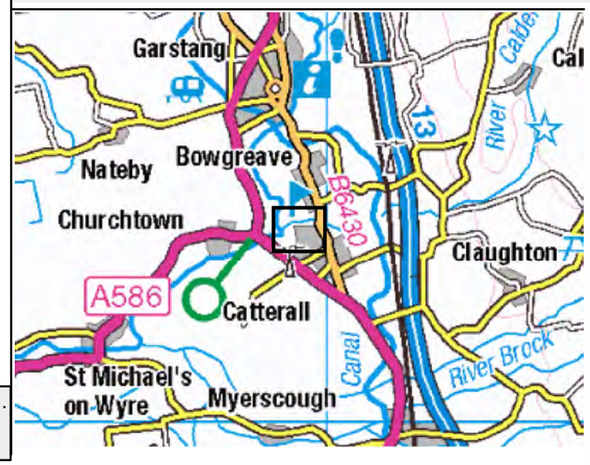
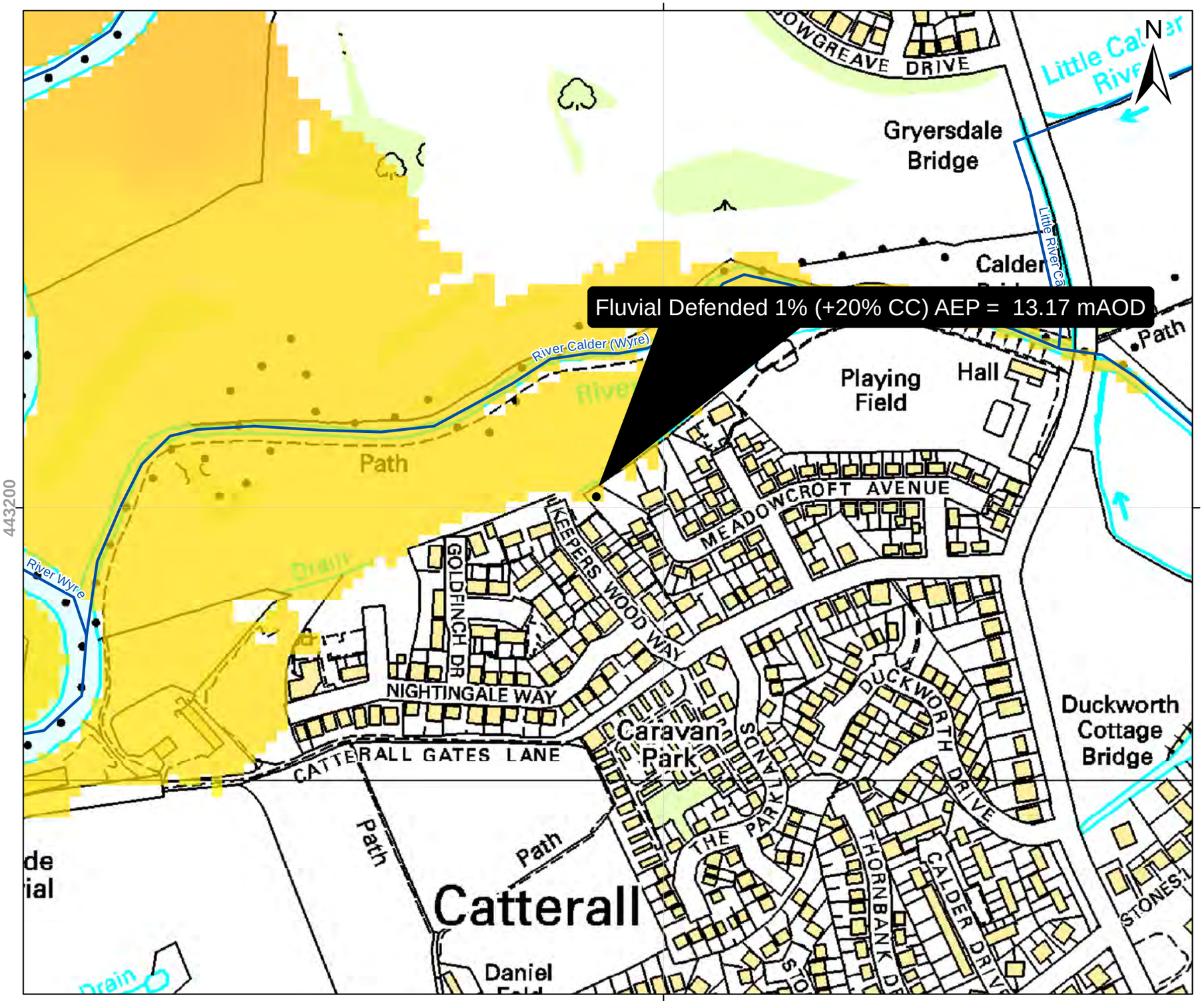


Fluvial Flood Levels Map: 53 Meadowcroft Avenue, Catterall, Preston PR3

Produced: 30 June 2020
Our Ref: CL175134
NGR: SD 49559 43204



Level data given in mAOD (metres above ordnance datum)
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Data taken from Wyre SFRM Study 2014

Key

Main River

Fluvial Defended 1% (+20% climate change) annual probability of flooding scenario

mAOD

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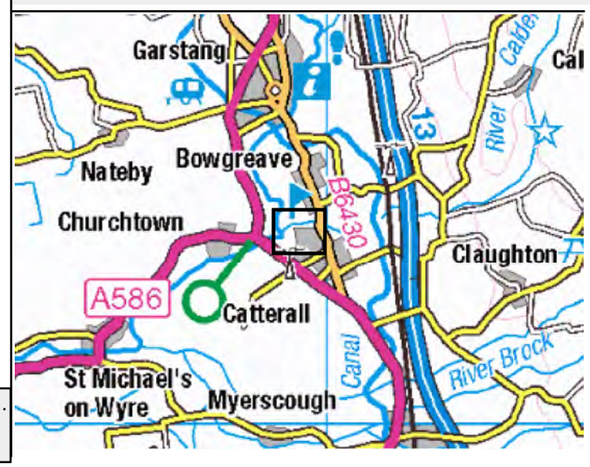

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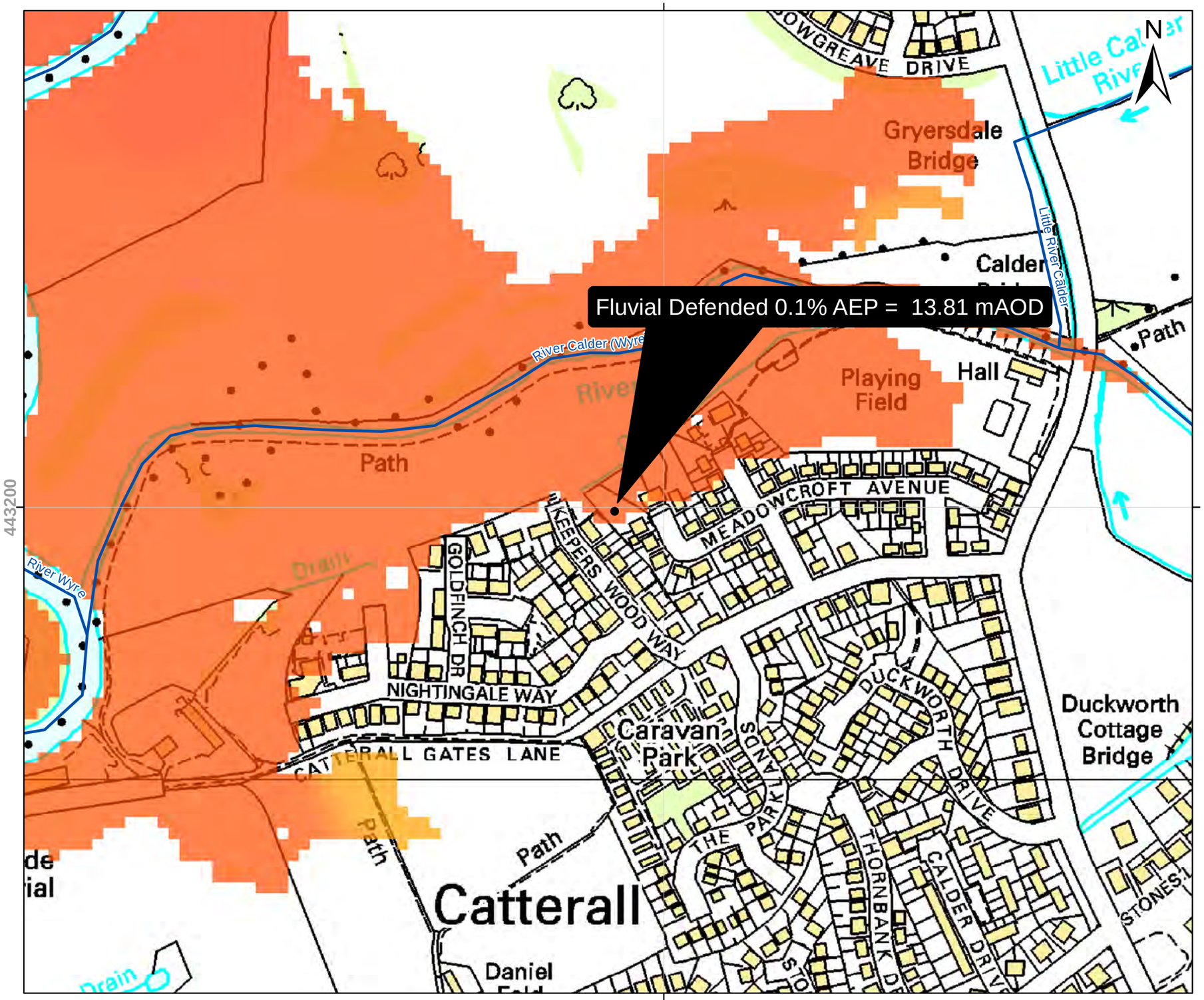

Level data given in mAOD (metres above ordnance datum)
AEP = Annual Exceedance Probability
Data taken from Wyre SFRM Study 2014

Key

Main River

Fluvial Defended 0.1% annual probability of flooding scenario

mAOD

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Low : 11

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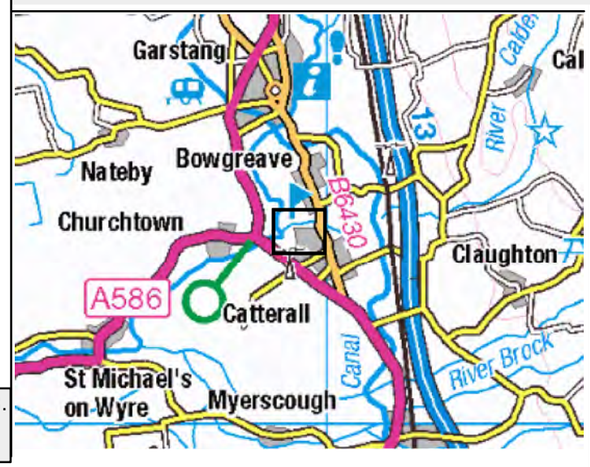

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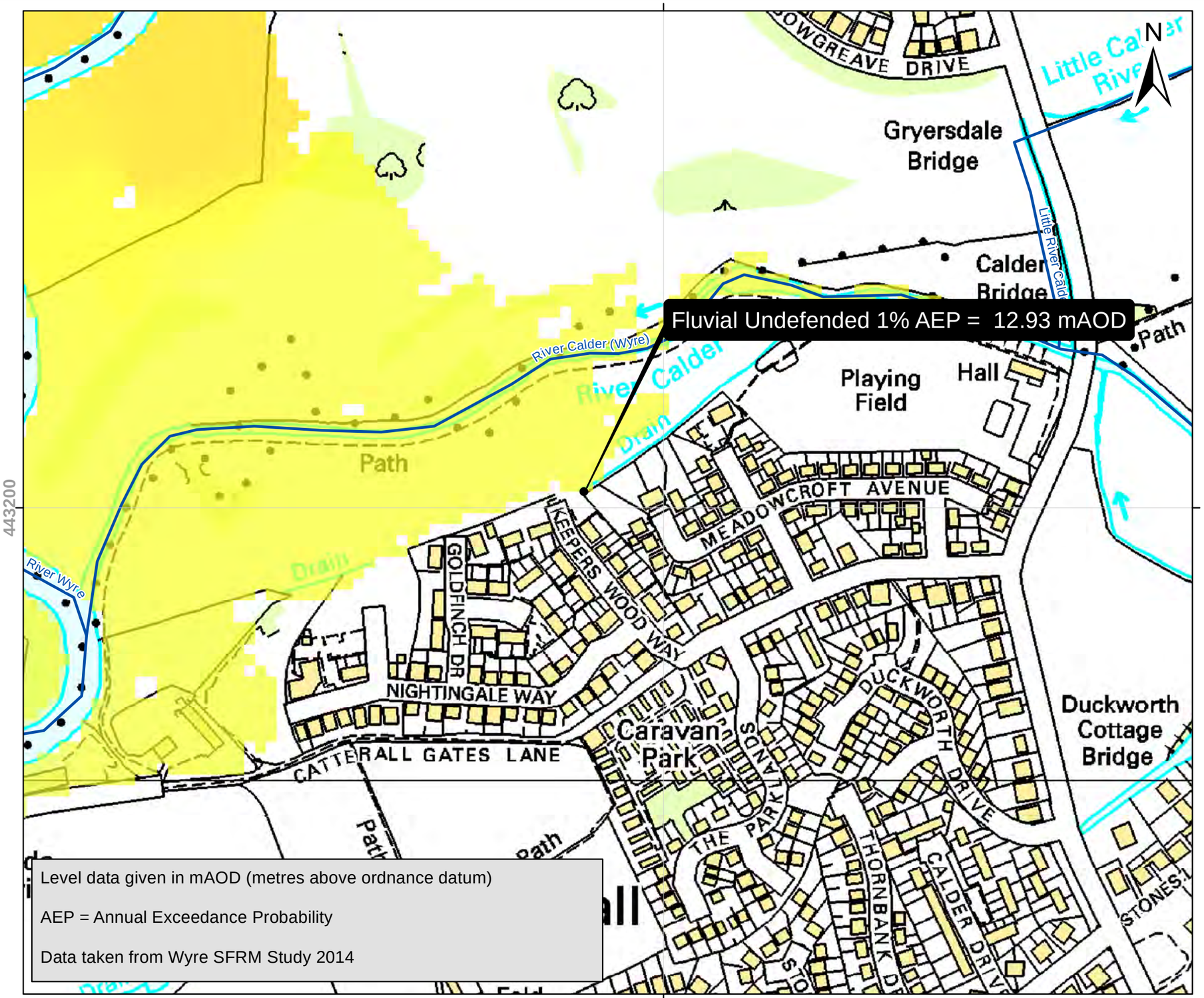

Key

Main River

Fluvial Undefended 1% annual probability of flooding scenario

mAOD

High : 14

Low : 11

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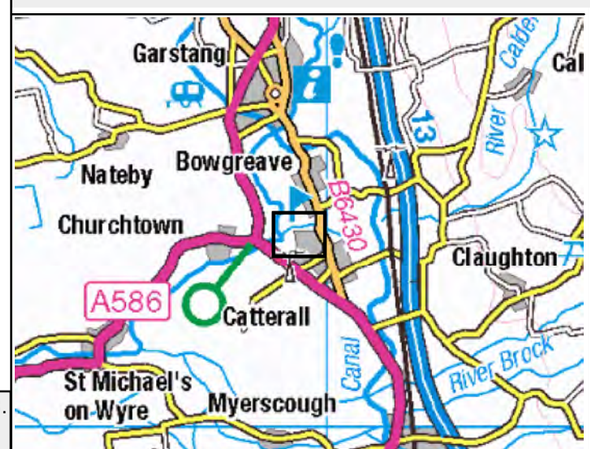

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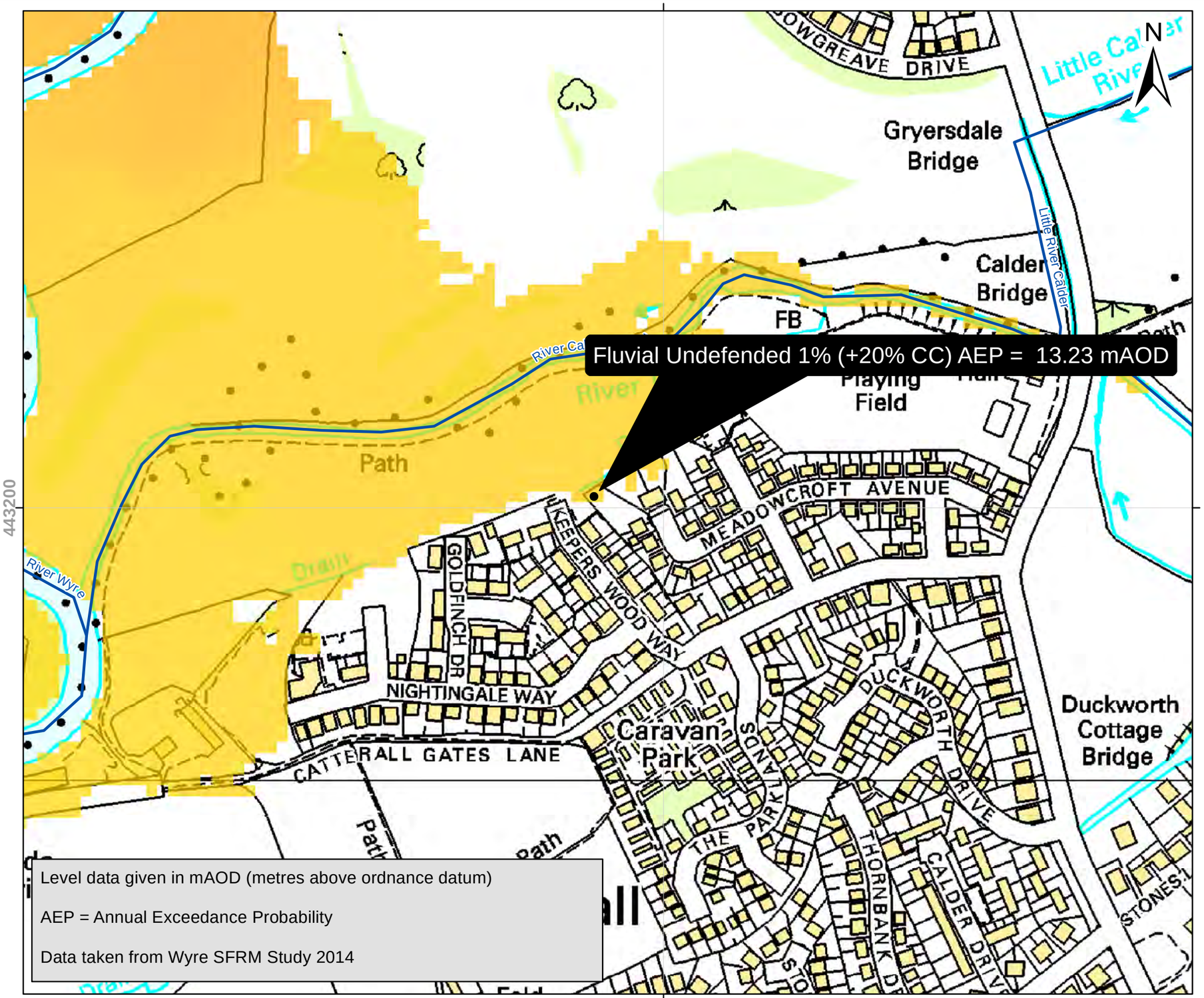

Level data given in mAOD (metres above ordnance datum)

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Data taken from Wyre SFRM Study 2014

Key

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Fluvial Undefended 1% (+20% climate change) annual probability of flooding scenario

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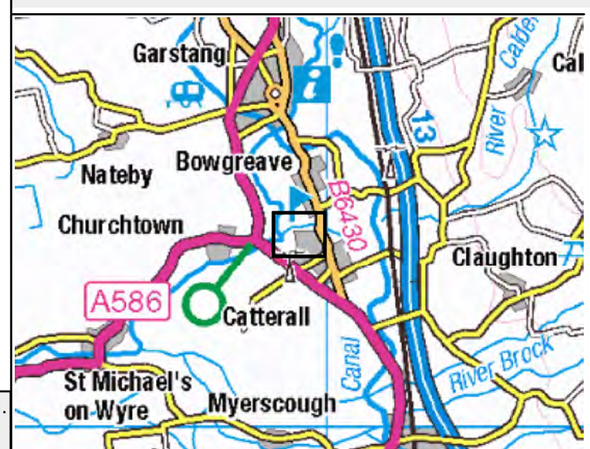

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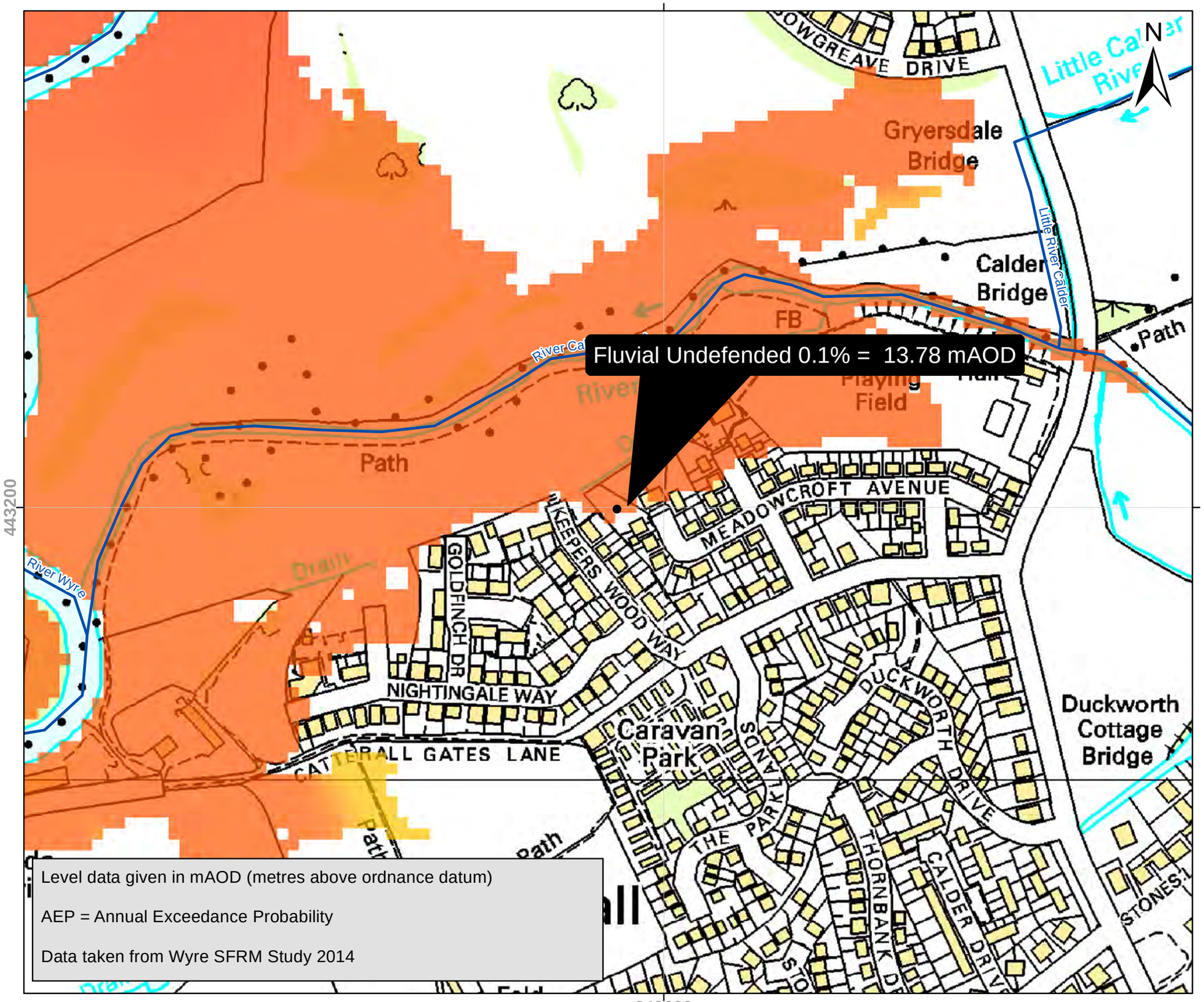

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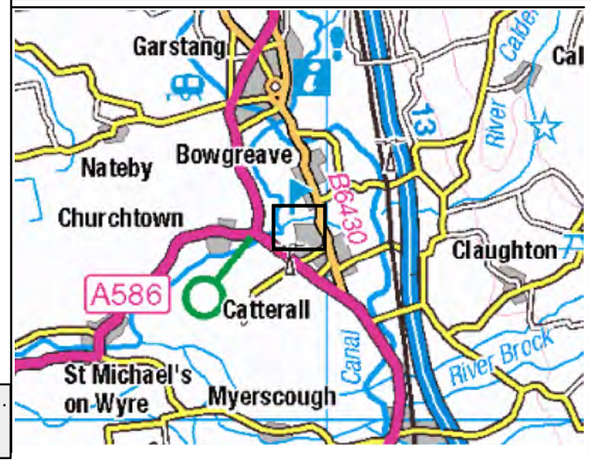

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Site Location	53 Meadowcroft Avenue, Catterall CL175134

Fluvial Defences

Asset ID	National Grid Reference	Asset Type	Protection Type	Location	Maintained By	Design Standard (Return Period)	Overall Condition Grade (Excellent 1- 5 Very Poor)	Effective Crest Level (m)		E.C.L Data Quality (Reliable 1-4 Unreliable)	Length (m)	Height (m)
								UCL (mAOD)	DCL (mAOD)			
68533	SD 48855 43026	High Ground	Fluvial	Kirkland Bridge to River Calder	Unknown	5	3	-	-	-	444.68	-
109285	SD 49181 43123	Embankment	Fluvial	River Wyre to Start of Playing Field	Private	100	4	14.95	12.8	4	656.84	7.6
156058	SD 49719 43342	Embankment	Fluvial	Start of Playing Field to Calder Bridge	Unknown	5	3	14.8	13.61	2	196.23	-
64540	SD 49905 43308	High Ground	Fluvial	Calder Bridge to Aqueduct	Unknown	5	3	-	-	-	272.52	-

The Environmental Permitting (England and Wales) Regulations 2016 require a permit to be obtained for any activities which will take place:

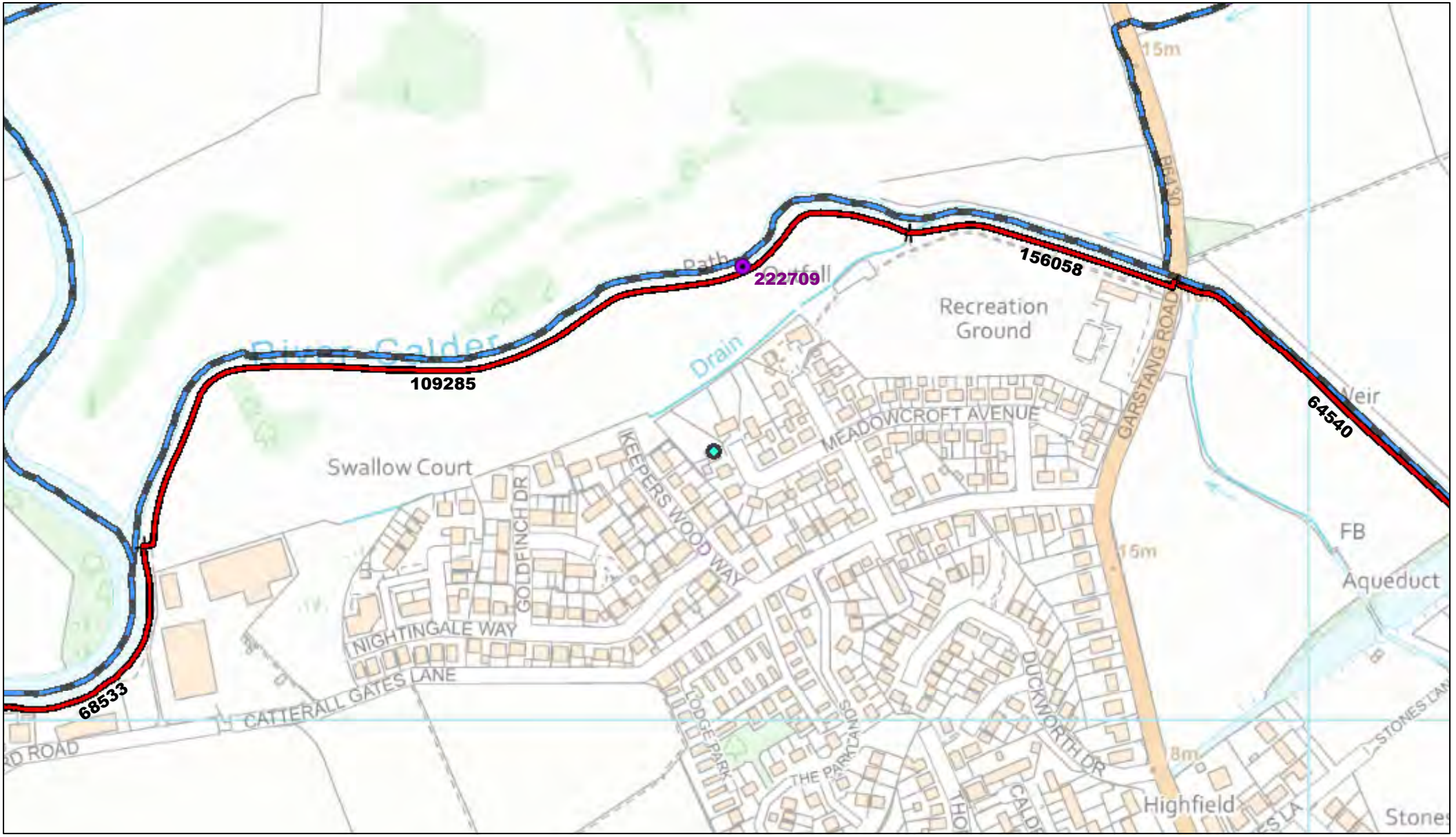
- **on or within 8 metres of a flood defence structure or culvert (16 metres if tidal)**
- **on or within 16 metres of a sea defence**

Site Location	53 Meadowcroft Avenue, Catterall CL175134

Fluvial Structures

Asset ID	National Grid Reference	Asset Type	Protection Type	Location	Maintained By	Design Standard (Return Period)	Overall Condition Grade (Excellent 1- 5 Very Poor)	Width (m)	Height (m)
222709	SD 49603 43319	Outfall	Fluvial	Downstream of Playing Field	Private	-	4	-	2

CL175134 53 Meadowcroft Avenue, Catterall



June 24, 2020

Structures

Defences

Channels

OS Traditional Maps

1:3,660

0 0.03 0.06 0.12 mi

0 0.05 0.1 0.2 km

Appendix D

Environment Agency LiDAR Ground Elevation Data

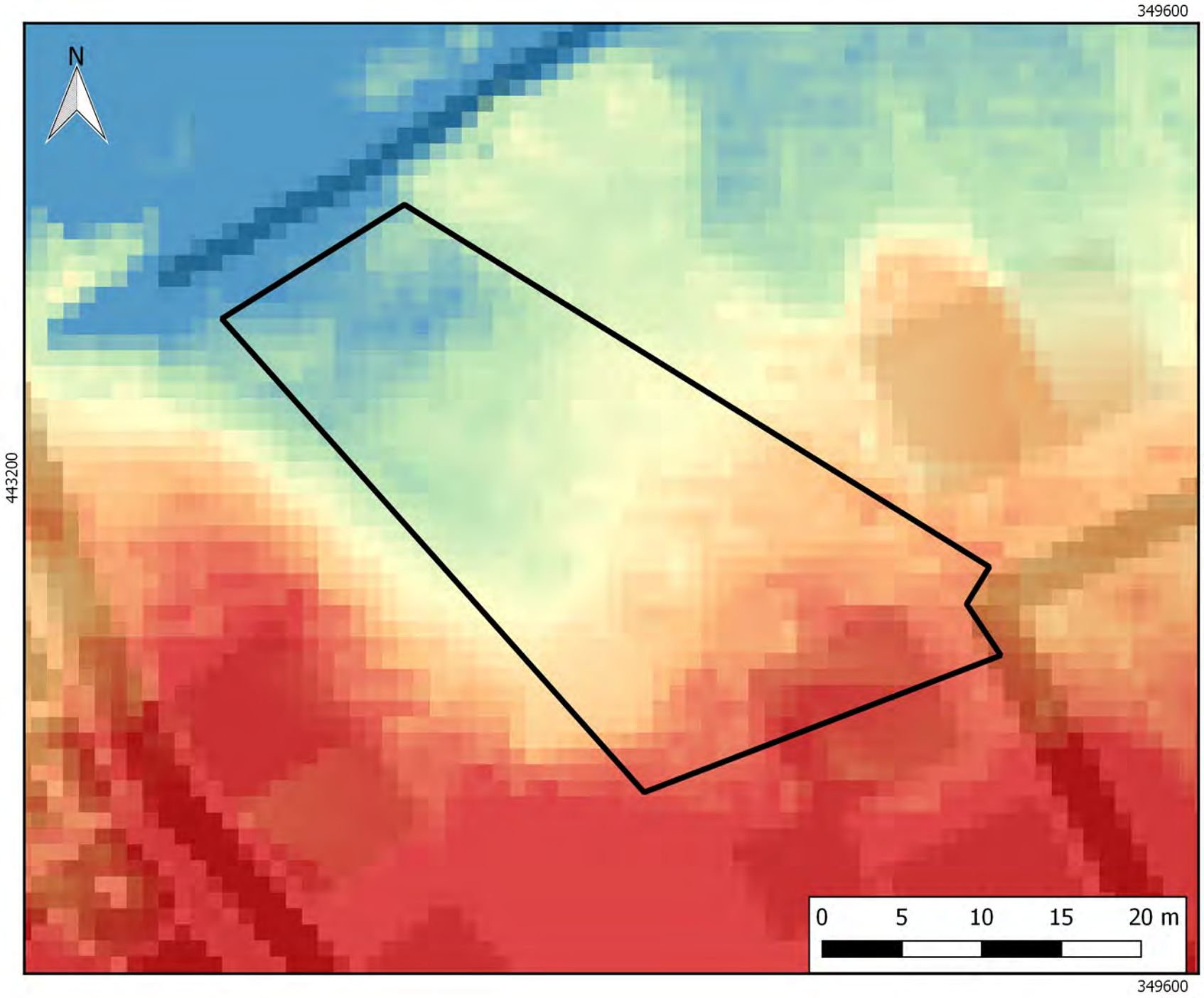


Figure D.1
Elevation on Site (LIDAR Data)

Legend

Site Boundary

Ground Levels (mAOD)

- 13
- 13.32
- 13.65
- 13.98
- 14.3

GeoSmart Information
Environmental Thinking

Date 17/07/2020	Drawn
Scale 1:338	Checked
Original	Revision
File Reference	

Disclaimer

This report has been prepared by GeoSmart in its professional capacity as soil, groundwater, flood risk and drainage specialists, with reasonable skill, care and diligence within the agreed scope and terms of contract and taking account of the manpower and resources devoted to it by agreement with its client and is provided by GeoSmart solely for the internal use of its client.

The advice and opinions in this report should be read and relied on only in the context of the report as a whole, taking account of the terms of reference agreed with the client. The findings are based on the information made available to GeoSmart at the date of the report (and will have been assumed to be correct) and on current UK standards, codes, technology and practices as at that time. They do not purport to include any manner of legal advice or opinion. New information or changes in conditions and regulatory requirements may occur in future, which will change the conclusions presented here.

This report is confidential to the client. The client may submit the report to regulatory bodies, where appropriate. Should the client wish to release this report to any other third party for that party's reliance, GeoSmart may, by prior written agreement, agree to such release, provided that it is acknowledged that GeoSmart accepts no responsibility of any nature to any third party to whom this report or any part thereof is made known. GeoSmart accepts no responsibility for any loss or damage incurred as a result, and the third party does not acquire any rights whatsoever, contractual or otherwise, against GeoSmart except as expressly agreed with GeoSmart in writing.

For full T&Cs see http://geosmartinfo.co.uk/terms-conditions

Important consumer protection information

This search has been produced by GeoSmart Information Limited, Suite 9-11, 1st Floor, Old Bank Buildings, Bellstone, Shrewsbury, SY1 1HU.

Tel: 01743 298 100

Email: info@geosmartinfo.co.uk

GeoSmart Information Limited is registered with the Property Codes Compliance Board (PCCB) as a subscriber to the Search Code. The PCCB independently monitors how registered search firms maintain compliance with the Code.

The Search Code:

- provides protection for homebuyers, sellers, estate agents, conveyancers and mortgage lenders who rely on the information included in property search reports undertaken by subscribers on residential and commercial property within the United Kingdom
- sets out minimum standards which firms compiling and selling search reports have to meet
- promotes the best practice and quality standards within the industry for the benefit of consumers and property professionals
- enables consumers and property professionals to have confidence in firms which subscribe to the code, their products and services.
- By giving you this information, the search firm is confirming that they keep to the principles of the Code. This provides important protection for you.

The Code's core principles

Firms which subscribe to the Search Code will:

- display the Search Code logo prominently on their search reports
- act with integrity and carry out work with due skill, care and diligence
- at all times maintain adequate and appropriate insurance to protect consumers
- conduct business in an honest, fair and professional manner
- handle complaints speedily and fairly
- ensure that products and services comply with industry registration rules and standards and relevant laws
- monitor their compliance with the Code

Complaints

If you have a query or complaint about your search, you should raise it directly with the search firm, and if appropriate ask for any complaint to be considered under their formal internal complaints procedure. If you remain dissatisfied with the firm's final response, after your complaint has been formally considered, or if the firm has exceeded the response timescales, you may refer your complaint for consideration under The Property Ombudsman scheme

(TPOs). The Ombudsman can award compensation of up to £5,000 to you if he finds that you have suffered actual loss as a result of your search provider failing to keep to the Code.

Please note that all queries or complaints regarding your search should be directed to your search provider in the first instance, not to TPOs or to the PCCB.

TPOs contact details:

The Property Ombudsman scheme

Milford House

43-55 Milford Street

Salisbury

Wiltshire SP1 2BP

Tel: 01722 333306

Fax: 01722 332296

Email: admin@tpos.co.uk

You can get more information about the PCCB from www.propertycodes.org.uk.

Please ask your search provider if you would like a copy of the search code.

Complaints procedure

GeoSmart Information Limited is registered with the Property Codes Compliance Board as a subscriber to the Search Code. A key commitment under the Code is that firms will handle any complaints both speedily and fairly. If you want to make a complaint, we will:

- Acknowledge it within 5 working days of receipt.
- Normally deal with it fully and provide a final response, in writing, within 20 working days of receipt.
- Keep you informed by letter, telephone or e-mail, as you prefer, if we need more time.
- Provide a final response, in writing, at the latest within 40 working days of receipt.
- Liaise, at your request, with anyone acting formally on your behalf.

If you are not satisfied with our final response, or if we exceed the response timescales, you may refer the complaint to The Property Ombudsman scheme (TPOs): Tel: 01722 333306, E-mail: admin@tpos.co.uk.

We will co-operate fully with the Ombudsman during an investigation and comply with his final decision. Complaints should be sent to:

Alan White
Operations Manager
GeoSmart Information Limited
Suite 9-11, 1st Floor,
Old Bank Buildings,
Bellstone, Shrewsbury, SY1 1HU
Tel: 01743 298 100
alanwhite@geosmartinfo.co.uk

Terms and conditions, CDM regulations and data limitations

Terms and conditions can be found on our website:

http://geosmartinfo.co.uk/terms-conditions/

CDM regulations can be found on our website:

http://geosmartinfo.co.uk/knowledge-hub/cdm-2015/

Data use and limitations can be found on our website:

http://geosmartinfo.co.uk/data-limitations/