



# Mapping the potential for Working with Natural Processes – user guide

SC150005

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This report is the result of research commissioned by the Environment Agency's FCRM Directorate and funded by the joint Flood and Coastal Erosion Risk Management Research and Development Programme.

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This report is the result of research commissioned by the Environment Agency's FCRM Directorate and funded by the Joint Flood and Coastal Erosion Risk Management Research and Development Programme. The programme is a joint collaboration between the Environment Agency, Defra, Natural Resources Wales and the Welsh Government. It conducts, manages and promotes flood and coastal erosion risk management research and development.

You can find out more about our current science programmes at <https://www.gov.uk/government/organisations/environment-agency/about/research>.

If you have any comments or questions about this report or the Environment Agency's other scientific work, please contact [research@environment-agency.gov.uk](mailto:research@environment-agency.gov.uk).

Professor Doug Wilson  
**Director, Research, Analysis and Evaluation**

# Executive summary

This user guide provides an interpretation of an updated set of strategic maps to identify potential for Working with Natural Processes (WWNP) across England. The maps are indicative, and signpost a range of areas for managing flood risk by protecting, restoring and emulating the natural regulating function of catchments and rivers.

This guide explains what the maps show and how to use them; more technical details of their derivation are provided in the accompanying technical report. The maps, user guide and technical report form part of a wider WWNP evidence base project ([SC150005](#)), where users can find further evidence on the effectiveness of the different WWNP measures as well as information on wider environmental, social and cultural benefits.

The updated maps are based entirely open data, and have been made into a suite of interactive and georeferenced PDFs, allowing for wide accessibility. They highlight potential for WWNP derived from national datasets such as the Environment Agency maps showing the risk of flooding from rivers, sea and surface water. They have been used to target areas where rivers have been disconnected from their floodplain, or areas of high flow accumulations where it would be effective to temporarily store and hold back water to reduce flood peaks further downstream. The maps introduce new science on characterising slowly permeable soils, based on geological datasets, where tree planting could increase hydrological losses and reduce surface run-off. Geographical information system (GIS) shapefiles of the new data layers created as part of this project are also available.

The maps do not cover a comprehensive list of WWNP measures and they are not prescriptive as to how these measures could be designed. Wider environmental and societal benefits are not included in the maps, but need to be considered in addition to flood risk mitigation. Care should be taken to seek out experts to help understanding of catchment processes and to select the appropriate solution as a result.

The maps identify potential areas for:

- floodplain reconnection
- run-off attenuation features and gully blocking
- woodland planting covering floodplain planting, riparian planting and wider catchment woodland

A new constraints dataset based on open data aims to help users further refine potential areas. This dataset includes roads and rail, urban areas, existing woodland, peat and water bodies, which may restrict potential for some interventions.

The user guide includes sections on:

- what the maps show
- how to use the maps, based on 2 detailed case studies
- the underlying data

The maps are intended to be used for reference during and after landowner engagement on natural flood management (NFM). They do not oblige landowners and occupiers to become involved in NFM schemes. Practical or farm business reasons may exist which prevent NFM implementation being possible in locations highlighted on the maps.

# Acknowledgements

Many thanks are given to Andrew Fielding of JBA for generating the thousands of interactive maps.

We are grateful for the suggestions and advice from the multi-agency project steering group, our user testers and to Mike Waters for his advice on making the maps free of intellectual property constraints. We are also very grateful for the inputs and proactive data sharing by the British Geological Survey, and especially the advice and guidance from Holger Kessler and Russell Lawley. Finally, thanks to Sim Reaney, our external peer reviewer for his helpful comments and suggestions.

This [evidence base](#) is dedicated to the memory of our friend and colleague Duncan Huggett, whose pioneering work and dedication to the field of Natural Flood Management has had a significant impact on the development of the policy, science and practice which underpins this report.



**Duncan Huggett addressing the Flood and Coast Conference 2017 (Source: Flood and Coast Conference 2017)**

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# 1 Introduction

## 1.1 Purpose and scope of project

Working with Natural Processes (WWNP) aims to protect, restore and emulate the natural functions of catchments, floodplains, rivers and the coast. It takes many different forms and can be applied in urban and rural areas, and on rivers, estuaries and coasts. Globally, many different terms are used to refer to this form of flood and coastal risk management (FCRM). In the UK context, WWNP and natural flood management (NFM) are the most commonly used; these 2 terms are used interchangeably throughout this report.

A suite of interactive maps called the National Strategic NFM Opportunity Maps were developed for the Environment Agency in 2016 to help understand the extent of potential areas throughout England for NFM. Two versions were made:

1. For internal use only within the Environment Agency due to intellectual property right restrictions on some of the datasets
2. An external version containing only open data

The maps were produced pragmatically and in time to include the 2016 flood and coastal erosion risk management (FCERM) schemes, the location of which were included on the maps.

The Woodlands for Water layer, originally on the internal maps, is included in the table in Appendix 3 listing ‘additional datasets’, along with conditions for their use. Further details on the differences between the original and updated maps can be found in Section 3.2.1 and the project technical report.

The purpose of this project has been to update the first generation of maps so that they contain a wider range of WWNP interventions, and can also be shared as open data, to ensure the widest possible audience.

Note that the maps remain strategic in nature. They aim to signpost areas for WWNP that are considered more likely to be effective at reducing flood hazards. It is anticipated that the maps will be improved further through time, especially as more evidence gaps are filled and as the quality of open data improves.

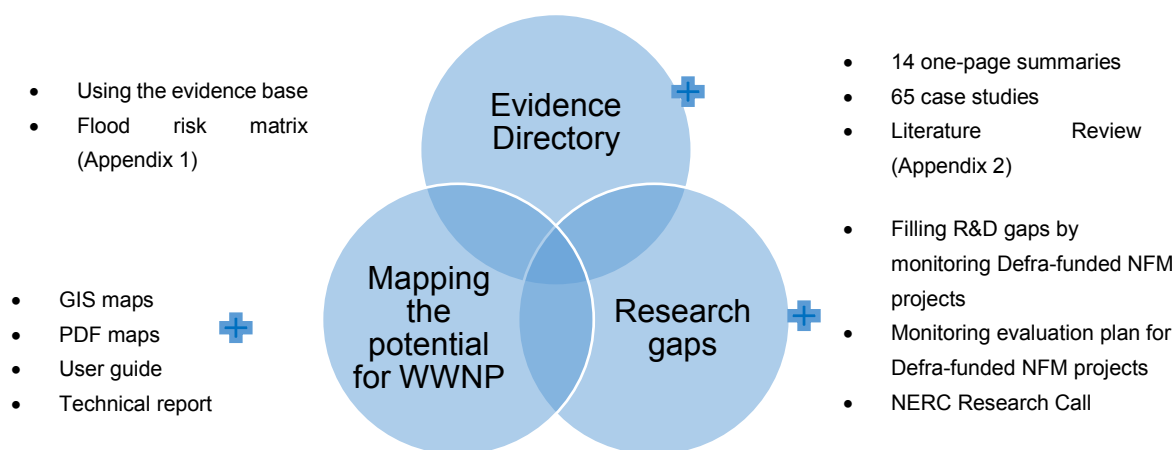
This project has 4 outputs:

- a suite of interactive georeferenced PDF maps (geoPDFs) that visualise and tabulate the extent of the different WWNP interventions
- this user guide to the WWNP maps
- a technical report to provide more detail on methodology and data
- the geographical information system (GIS) data behind the maps

## 1.2 WWNP evidence base projects

These maps are one part of 3 interlinked projects (Figure 1.1), which together form an [evidence base for WWNP](#).





**Figure 1.1 Three interconnected projects making up the WWNP evidence base**

### 1.2.1 Evidence Directory

The [Evidence Directory](#) summarises what we know about the effectiveness of different measures from a flood risk and ecosystem services perspective. It is underpinned by a detailed [Literature Review](#) and links to real world examples through 65 standalone case studies ([River and floodplain case studies](#); [Woodland case studies](#); [Runoff from hills case studies](#); and [Coast and estuary case studies](#)). In addition, [14 one-page summaries](#) of the different types of WWNP measures – have been produced.

The Evidence Directory is an invaluable resource intended to help you think about which FCRM measures may potentially work best in your catchment. We have written a guide which sits alongside the Evidence Directory and the Maps, and explains how you can use this evidence base to help [make the case for WWNP](#). It also includes guidance on implementing these sorts of measures in areas at risk of groundwater flooding.

### 1.2.2 Mapping the potential for WWNP

The maps are intended to be used alongside the [Evidence Directory](#) to help you think about the types of measure which may work in your catchment, and potentially the best place to locate them. They are a useful tool to help start conversations with key partners. The maps are provided in GIS and PDF form, and they are supported by this user guide and detailed technical report.

### 1.2.3 Research gaps

Research gaps that need to be addressed to move this form of FCRM into the mainstream are listed at the end of each chapter in the [Evidence Directory](#). The Environment Agency has worked with the Natural Environment Research Council (NERC) to develop a Research Call to help address some of these gaps and with many of the Principal Investigators to inform their proposals. The funded projects will be announced in autumn 2017 and the Environment Agency will work in partnership with them to continue to address priority areas of research.

The list of research gaps has also been shared with Defra-funded NFM projects, so that these can address research gaps through long-term monitoring. As part of this project, an evaluation plan is being developed to capture the outcomes of this monitoring, so that the outcomes of this research can be shared across the WWNP community.

## 1.3 WWNP measures included on the maps

The maps cover those WWNP measures that have been prioritised – based on the need for mapping – in consultations with Environment Agency staff and external partners. They include:

- floodplain reconnection
- run-off attenuation features
- gully blocking as a subset of run-off attenuation features on steeper ground
- tree planting covering 3 categories:
  - floodplain
  - riparian
  - wider catchment woodland

Further information on the WWNP interventions excluded from this project is given in Section 3. More details on methodology are provided in the Mapping the potential for WWNP technical report.

In addition to identifying potential areas to adopt WWNP, an open data constraints layer has been developed. This brings together different spatial data for locations where certain options are not likely to be feasible, such as avoiding targeting tree planting where there is already woodland (the layer includes the latest Forestry Commission National Forest Inventory). This includes roads and rail, urban areas, existing woodland, peat and water bodies, which may limit potential for some interventions (in particular woodland planting). For urban areas it may be more appropriate to target green infrastructure such as sustainable urban drainage systems (SUDS) for which there are, for example, British Geological Survey (BGS) layers (see Appendix 3).

### 1.3.1 Points to bear in mind

- The maps do not cover all aspects of WWNP. They should be used alongside all other sources of relevant information (where available) to focus more detailed investigations.
- Advice should be sought when interpreting the maps to ensure that measures are:
  - in the most appropriate location for the most effective flood attenuation benefits
  - will help to achieve the potential wider environmental and societal benefits of WWNP. Further guidance on the ecosystem services provided by WWNP can be found in the [Evidence Directory](#), and tools also exist to map and model these<sup>1</sup>.
- Efforts should be made to look for connectivity within a catchment to:
  - understand processes
  - identify appropriate interventions

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<sup>1</sup> For example: InVEST <https://www.naturalcapitalproject.org/invest/> and LUCI <http://lucitools.org/>

- assess whether no active intervention or assisted recovery is the best option
- Landowner considerations are paramount. Effective engagement and an understanding of local knowledge should be established before considering any indicative potential presented by the maps.

## 1.4 Interactive WWNP maps

An important output of this project is the new suite of nationally consistent WWNP maps, which can be used as a screening tool to support the identification and development of better ways to work with natural processes.

The maps are in the form of interlinking, indexed, interactive PDFs. They have been updated to include new types of interventions and to be dependent only on open data.

There are 4,224 maps showing water body catchments within England with an average area of 32km<sup>2</sup>, ranging from between 0.1km<sup>2</sup> for some small transitional zones to 615km<sup>2</sup> for the largest water body Catchment. In addition to spatial data, the maps include information on the extent of the potential for the WWNP measure in question.

The maps are available at 4 different scales (see Figure 4.1):

- national River Basin Districts
- River Basin Districts showing Management Catchments
- Management Catchments showing Water body Catchments
- Water body Catchments

The last 2 maps in the list show potential for WWNP interventions, providing a range of information at different levels.

## 1.5 How to use this guide

Chapter 2 provides a brief description of the methodology used to create the mapping layers for each type of WWNP intervention. The datasets used in the maps are also listed. A more detailed description of methodology and data can be found in the technical report.

Chapter 3 describes the general principles that should be applied when using the maps, including important guidance on exclusions, user considerations and additional sources of information.

Chapter 4 offers an overview of the 4 different mapping levels. It shows how each level can be used to display different features and drill down into more detail.

Chapter 5 provides 2 walkthrough examples in the Bristol Avon and the Don and Rother catchments. These examples are intended to provide guidance on how the maps can be used to identify potential for WWNP.

Chapter 6 lists the system requirements to access the interactive PDF maps and GIS shapefiles.

Appendix 1 lists the parameters used for different WWNP measures for the colour scales ('limited' to 'very high') used in the Management Catchment maps (Tier 3).

Appendix 2 provides information on landowner and occupier considerations in relation to WWNP and offers advice on engagement when considering potential locations for interventions.

Appendix 3 provides details of additional datasets that could be used to supplement and enhance the information provided by the WWNP maps.

## 2 Data and methodology

### 2.1 Methodology

The first generation of strategic opportunity maps have been broadened to include more types of WWNP measures, including floodplain reconnection and gully blocking. This is in addition to 3 types of woodland planting and the targeting of run-off attenuation features in areas of high flow accumulation.

A brief description of how areas of potential for each intervention were derived is provided below. The technical report presents a more detailed description of the methodology.

#### 2.1.1 Floodplain reconnection

Potential for floodplain reconnection is based on the premise that areas of low risk – using the Risk of Flooding from Rivers and Sea maps – which are in close proximity to a watercourse are likely to be poorly connected. This may be due to the natural river features or landscape modifications (for example, historic embankments).

#### 2.1.2 Run-off attenuation features

Run-off attenuation features are based on the premise that areas of high flow accumulation in the Risk of Flooding from Surface Water maps are areas where the run-off hydrograph may be influenced by temporary storage (if designed correctly).

#### 2.1.3 Gully blocking

Gully blocking potential is based on run-off attenuation features on steeper ground with a gradient >6%, where leaky barriers may be more beneficial than a deepened pond, raised bund or grip blocking.

#### 2.1.4 Tree planting

There are 3 types of woodland potential:

- Riparian woodland – a 50m buffer of riparian land on smaller river networks
- Floodplain woodland – Flood Zone 2 (0.1% annual exceedance probability, AEP)
- Wider catchment woodland – slowly permeable soils where woodland could break up naturally impermeable soils and reduce surface run-off

### 2.2 Data

The updated maps are based entirely on open data and data available under Open Government Licence (OGL). Although at times the datasets may be inferior to data available under a conditional licence, they are still fit for purpose. Efforts have been made to use the best available open data and to negotiate the use of new open data

(for example, a new 100m gridded dataset based on the BGS 1:50,000 geology maps). Summaries of the main types of data are provided below. The technical report and its appendices provide complete details of the data that have been used.

### 2.2.1 Background mapping

The following Ordnance Survey (OS) open data background mapping has been used:

- OS MiniScale™ (1:1,000,000)
- OS 1:250,000
- OS VectorMap® District (Raster)
- OS Open Map – Local (Vector)

### 2.2.2 Catchment boundary

The OGL Water Framework Directive datasets used are:

- River Basin Districts (Cycle 2)
- Surface Water Management Catchments (Cycle 2)
- River Water body Catchments (Cycle 2)

### 2.2.3 Water features

The following OS open data are used for display purposes. Some conditional licensed data (the Detailed River Network) were used in the derivation of some of the layers but they are not displayed (see technical report).

- OS Open Map – Local: Surface Water Line
- OS Open Map – Local: Surface Water Area
- OS Open Rivers

### 2.2.4 Land cover, land use, designations

The following open data have been used for display and constraint purposes:

- CORINE Land Cover
- Agricultural Land Classification
- protected habitats data

### 2.2.5 Flood risk data

The following datasets are included, which still come under conditional licence:

- Flood Zones from Flood Map for Planning
- Risk of Flooding from Rivers and Sea maps
- Spatial Defence Data

A notable omission is of the Risk of Flooding from Surface Water maps.

## 2.2.6 Constraints data

A new layer of all open data constraints was developed, which was used to mask the tree planting potential. A smaller selection of constraints data was used to mask floodplain reconnection, run-off attenuation features and gully blocking potential (see technical report for further details).

The constraints layer is included in the maps as it contains useful land use data to consider alongside the potential areas for WWNP. It combines the following open data:

- OS Open Map – Local: Railway
- OS Open Roads
- Forestry Commission National Forest Inventory woodland maps
- OS Open Map – Local: Woodland
- OS Open Map – Local: Surface Water Line
- OS Open Map – Local: Surface Water Area
- OS Open Rivers
- CORINE Land Cover: Urban Areas (excludes green spaces)
- CORINE Land Cover: peat layer

## 2.2.7 WWNP potential

The areas of potential for WWNP shown on the maps and the data used in their derivation are listed in Table 2.1 (see the technical report for further details). The different features are all polygons, and have been compiled into a single geodatabase and provided as open data.

**Table 2.1 WWNP interventions and the data sources used to derive them**

WWNP intervention	Data sources
<b>Floodplain reconnection</b>	<ul style="list-style-type: none"><li>• Risk of Flooding from Rivers and Seas</li><li>• Detailed River Network (to be superseded by OS Water Network but not available for the project in time)</li><li>• Constraints data (residential properties and key services)</li></ul>
<b>Run-off attenuation features</b>	<ul style="list-style-type: none"><li>• Risk of Flooding from Surface Water<sup>1</sup></li><li>• Constraints data (urban areas, roads and rail)</li></ul>
<b>Gully blocking<sup>1</sup></b>	<ul style="list-style-type: none"><li>• OS Terrain open data (50m) to classify each run-off attenuation feature based on median slope</li></ul>
<b>Tree planting</b>	Floodplain woodland <ul style="list-style-type: none"><li>• Flood Zone 2 and new constraints layer</li></ul> Riparian woodland <ul style="list-style-type: none"><li>• 50m buffer of OS water features, with new constraints layer</li></ul> Wider catchment woodland (slowly permeable soils)



WWNP intervention	Data sources
	<ul style="list-style-type: none"> <li>• BGS 50,000 Superficial and Bedrock layers. Used with new science to derive new 100m gridded open data. New constraints layer added to this.</li> <li>• To the north of the line of Anglian glaciation, the presence of Till-Diamicton is shown in the technical report to be a strong predictor of slowly permeable soils.</li> <li>• To the south of this line, particular bedrock geologies detailed in the technical report have been shown to have a similarly strong spatial relationship to the presence of slowly permeable soils.</li> <li>• Users can often use freely available online web mapping datasets from BGS<sup>2</sup> or others to check conditions in more detail (see Appendix 3).</li> </ul>

Notes: <sup>1</sup> Data provided by East Riding of Yorkshire and Hull Local Authorities in the Risk of Flooding from Surface Water was removed from the dataset, due to additional licensing restrictions  
<sup>2</sup> A subset of run-off attenuation features on steeper ground  
<sup>3</sup> See BGS Geology of Britain viewer (<http://mapapps.bgs.ac.uk/geologyofbritain/home.html>)

## 2.3 Licensing

The licensing for all datasets on the maps is open or OGL, as recorded in Appendix 1 of the technical report. The correct licence is shown for the datasets displayed on each layer selected in the interactive maps.

## 3 How to apply the maps

### 3.1 Introduction

Because the maps are strategic and indicative in nature, they should be used as a **screening tool** to signpost areas for more detailed, local field or modelling investigations. The maps can also be used in discussions with catchment stakeholders in combination with local knowledge. Further details on how the maps should and should not be used are given below.

The maps can be used at different levels, but it is envisaged that Tier 3, Management Catchment maps will enable a user to compare the potential for the different types of WWNP measures between water body Catchments. Tier 4 can then be used to drill down to the individual areas of potential in more detail, as demonstrated in the 2 walkthrough examples presented in Sections 5 and 6.

### 3.2 General principles

The following general principles should be applied when using the updated WWNP maps. These principles emphasise the requirement to exercise expert judgement in the application of the maps.

#### 3.2.1 Content

- The original maps have been broadened to include more types of WWNP measures. These were prioritised in consultations with Environment Agency staff and external partners based on the need for mapping. The maps include new layers on floodplain reconnection and gully blocking in addition to 3 types of woodland planting and the targeting of run-off attenuation features in areas of high flow accumulation.
- The wider catchment woodland layer in this study uses different data and methodology from Woodlands for Water. There is some overlap between the areas identified for potential tree planting from both methods, but there are also material differences.

Woodlands for Water is based on standard percentage runoff (SPR) and Hydrology of Soil Types (HOST) data, both derived from National Soil Resources Institute maps. It estimates areas of land which contribute the most to the fast component of flood response of a river. The new layer by contrast is created from BGS geological mapping data showing surface conditions likely to be associated with the formation of slowly permeable soils. It identifies some areas missed by Woodlands for Water, where planting trees to break up slowly permeable soils could have local benefits. Woodlands for Water adds other areas where the conceptual models show a contribution to the rapid response part of the flood hydrograph, but without slowly permeable soils indicators present at the surface.

Both datasets are scientifically robust, although use of either should be accompanied with considerations for the nature of the catchment in question and cost, time and quality requirements of your work. Woodlands

for Water is currently available for a fee, under a conditional license; whereas Mapping the Potential for Working with Natural Processes data is open access and free to use.

### 3.2.2 Exclusions

- The maps provide a starting point for identifying potential measures that work with natural processes to achieve flood risk management benefits. They should not be considered as a comprehensive guide.
- The maps should be used with the [Evidence Directory](#), which documents the latest science on the effectiveness of WWNP measures and provides a detailed description of each intervention.
- The WWNP interventions highlighted on the maps are those that were considered high priority by the project consultation groups, both in terms of their potential flood risk benefit and the requirement for open data mapping. Interventions ranked as medium priority (moorland grip blocking and in-channel leaky dams) and low priority (land and soil management, wetlands and washlands, and river restoration) were not included in this project. The best way to incorporate these additional layers into an open product in the future is being considered. Coastal interventions were not included as consultations with coastal experts suggested that maps were not currently needed. Further information on these additional interventions is provided in the [Evidence Directory](#).
- The maps primarily concentrate on identifying WWNP potential with possible flood risk benefits. It is also important to consider the wider environmental, social and cultural benefits (and any potential dis-benefits) that are an integral part of delivering flood risk benefits through WWNP. Multiple benefits assessments of different WWNP interventions can be found in the [Evidence Directory](#).

### 3.2.3 User considerations

- WWNP typically requires widespread implementation across a catchment to have a significant benefit. There are strong benefits of co-ordinating effort across interested groups to ensure there are a range of community benefits.
- The maps should be considered 'indicative' only as there will be other considerations and constraints, not least landowner agreements and permissions. The maps should be used in conjunction with early and full landowner and occupier engagement. Wider landowner considerations, such as eligibility for payment schemes, funding availability, liability risks, impacts on riparian rights and responsibilities, farm tenancy agreements and longer term viability should be taken into account. Local knowledge should be sought from landowners and occupiers, who may be able to suggest more optimum locations for WWNP interventions. General advice on landowner engagement is provided by Natural England, the Environment Agency and agricultural organisations. Further advice on landowner/occupier considerations and engagement can be found in Appendix 2.
- Care needs to be taken to ensure that any active intervention does not degrade or replace an existing valued habitat.

- Implementing floodplain reconnection can lead to putting areas at greater erosion risk back in contact with flow. Consideration should therefore be given to this, with reference to other mapped information on erosion (see Appendix 3).

### 3.2.4 Modelling tips

- We have written a guide which sits alongside the [Evidence Directory](#) and the Maps, and explains how you can use this evidence base to help make the case for WWNP. It also includes guidance on implementing these sorts of measures in areas at risk of groundwater flooding.
- The maps could be used to inform future modelling studies by including some scenarios to test the outputs of the mapping (and other information) in the model study.
- The identified run-off attenuation features are in areas already predicted to flood. Benefits can be estimated through modelling, for instance, the addition of 1m storage at these locations. In the earlier maps, regression relationships were used based on a library of modelling to relate potential benefits with extent of potential. In the new maps, however, these have been excluded, deferring instead to catchment-specific modelling.
- For tree planting potential, the benefits can be computed by increasing the roughness and representation of changes to hydrological losses, such as infiltration, evaporation and interception. Because increased roughness can have a negative impact on upstream property due to backwater effects within the floodplain, it is essential to take these effects into account. Targeting areas in headwaters, upstream of settlements is a sensible first step, and thereafter allowing for the backwater length where planting is proposed downstream of communities.
- For projects attempting to slow the flow, it is important to consider the synchronisation issues discussed in the [Evidence Directory](#) modelling chapter. Where there are tributaries with similar response times, it is vital to avoid causing synchronisation such that flood peaks arrive at the same time, and conversely it may be useful to desynchronise flood peaks.

### 3.2.5 Additional sources of information

- Where other WWNP potential information is available, such as locally produced mapping, it should be used in tandem with these strategic maps. There may be locations for which the benefits of WWNP have been modelled to provide more detailed information.
- Where users are interested in tree planting interventions, they should consult the Forestry Commission to check whether the land falls within the Countryside Stewardship maps' priority measures for funding support. Users should also consult Woodlands for Water where possible, although this information is subject to licensing restrictions.<sup>2</sup>
- Other relevant datasets are signposted in Appendix 3. Such datasets can be overlaid with the GIS datasets supplied by this project in ArcGIS, if required, by suitably skilled users. Local communities at risk data (held by the Environment Agency) should also be used alongside the maps to target

<sup>2</sup> <https://www.forestry.gov.uk/fr/infid-97xgxx>

risk reduction strategies. The maps show background mapping so it is possible to establish, at the very least, if there are urban centres at risk downstream.

- The maps should not be used in isolation. Guidance and support can be gained from local expertise, including from Environment Agency FCRM teams, Water Quality teams familiar with diffuse pollution mitigation, Area Fisheries, Biodiversity and Geomorphology staff, groundwater experts in Groundwater and Contaminated land teams, and National Environmental Assessment Service teams. Staff from these teams can assist with the interpretation of the maps, and with the identification of the most effective and sustainable intervention in the most appropriate location to achieve the required result at both local and strategic scales.
- Local knowledge of the geomorphological and ecological characteristics of the catchments, as well as their flood characteristics, is essential in enabling the development of a healthy, functioning system from source to sea that provides FCRM with cost-effective and sustainable solutions. No active intervention is also a valid choice for WWNP.
- Expertise may also be sought from external organisations. There are no longer any licensing restrictions, so the maps can be shared outside the Environment Agency, although maps should be annotated with the correct copyright and licensing as shown on the PDFs.
- Examples of real world NFM assessments and schemes can be used to help identify potential areas. The interactive map<sup>3</sup> that forms the entrance to the JBA Trust's online catalogue of nature-based flood risk management projects in the UK provides a useful starting point.

## ***Guidance on design and maintenance requirements for WWNP interventions***

### **Floodplain reconnection**

- [Ecoflood guidelines: how to use floodplains for flood risk reduction](#)
- [Manual of River Restoration Techniques](#)
- [Flood planner – a manual for the natural management of river floods](#)

### **Run-off attenuation features**

- [Rural sustainable drainage systems](#)
- [Run-off attenuation features: A guide for all those working in catchment management](#)
- [Flood storage and attenuation on farms](#)
- [Potential use of run-off attenuation features in small rural catchments for flood mitigation](#)

### **Woodlands**

- [The UK Forestry Standard](#)

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<sup>3</sup> <http://naturalprocesses.jbahosting.com/#6/54.188/-1.945>

- [Restoring floodplain woodland for flood alleviation](#)
- [Restoring and managing riparian woodlands](#)

See the Bibliography for full details of these sources. All links were accessed on 13 September 2017.

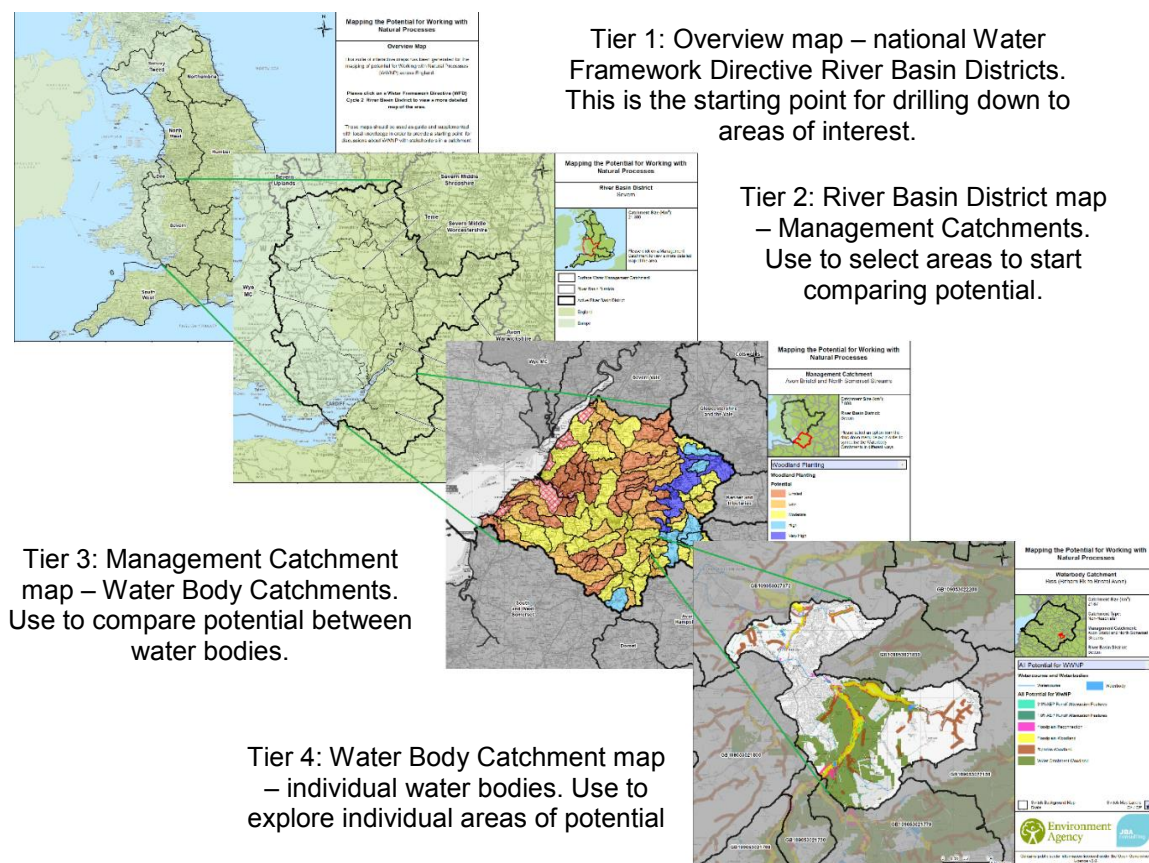
# 4 Overview of the maps

## 4.1 Introduction

The new suite of interactive maps has 4 tiers of maps (Figure 4.1). These maps are:

- national overview showing the Water Framework Directive River Basin Districts
- River Basin Districts showing the Management Catchments present
- Management Catchments showing the Water body Catchments present
- Water body Catchments

These different layers allow users to zoom in on their areas of interest.



**Figure 4.1 New suite of WWNP maps**

Section 5 and 6 present 2 walkthrough examples based on the Bristol Avon and North Somerset Streams, and the Don and Rother respectively. These Management Catchments were used for the first generation of maps, and represent 2 different climatic regions in England (northern Pennines and southern levels) with very different geologies. For instance, the slowly permeable soils are identified based on different geological characteristics. The examples are intended only to show how the information in the maps could be interpreted and used generically.



## 4.2 Overview map (Tier 1)

The overview map (Figure 4.2) is the top level of the hierarchy and provides the locations of the Water Framework Directive River Basin Districts. It is the normal starting point for users of the maps. Clicking on a River Basin District on the overview map opens the intermediate detail map for that Management Catchment from the second tier of the hierarchy.

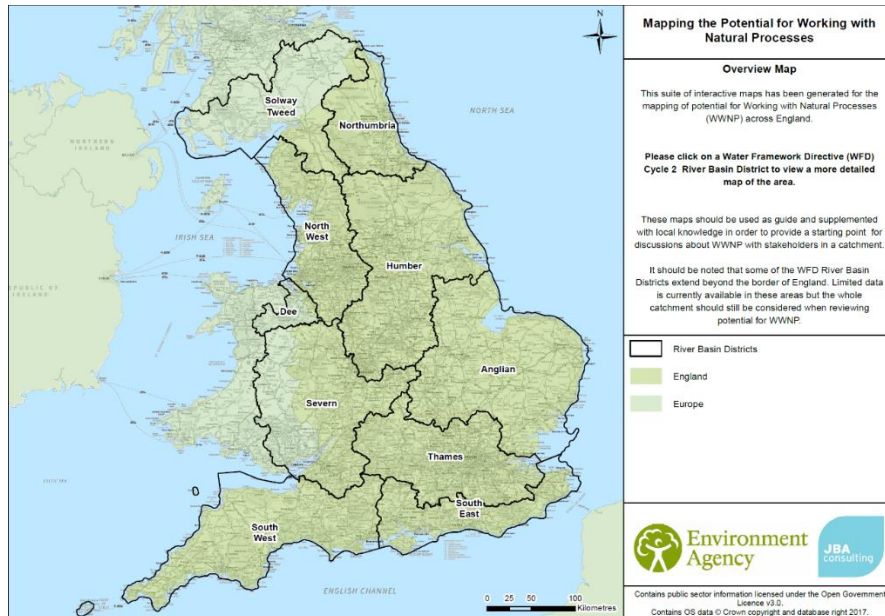


Figure 4.2 National overview map

## 4.3 River Basin District maps (Tier 2)

The River Basin District maps (Figure 4.3) show the water Management Catchments. Users can click on these to navigate to a finer scale of map and start visualising the different levels of potential for WWNP.

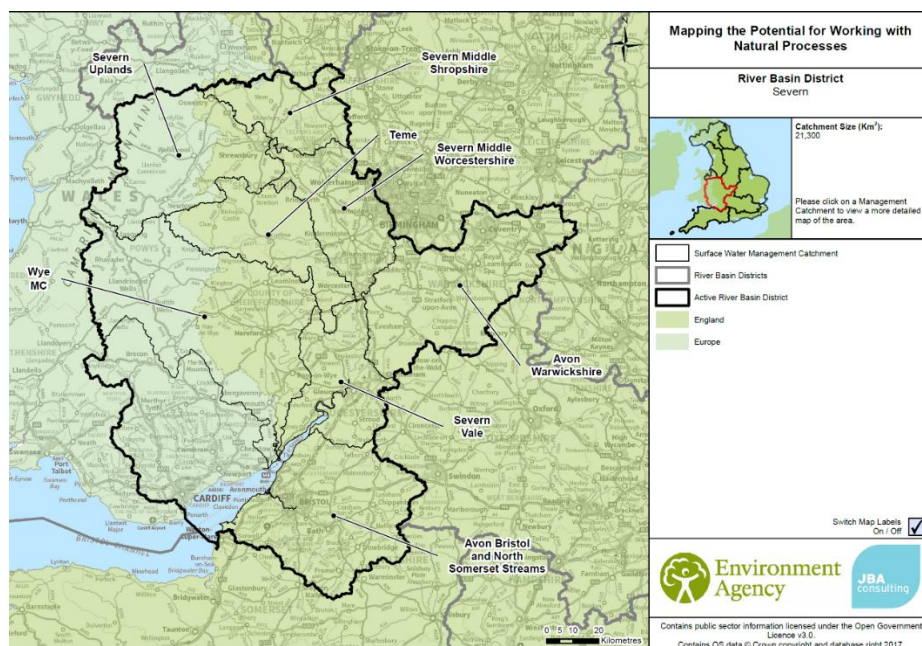


Figure 4.3 Example of River Basin District map showing its Management Catchments

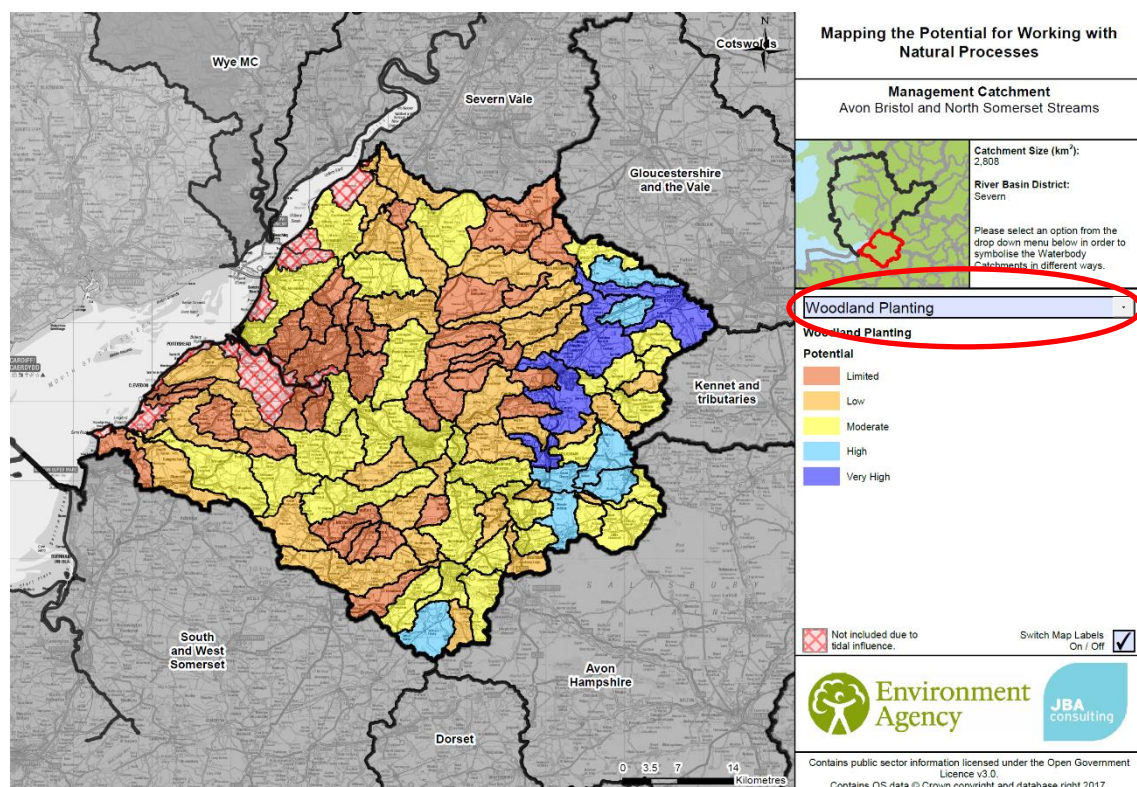
## 4.4 Management Catchment maps (Tier 3)

The Management Catchment maps (Figure 4.4) allow users to quickly identify Water Framework Directive Water body Catchments within the Management Catchment that have greater potential for WWNP for a selected type of measure; the example in Figure 4.4 shows floodplain reconnection potential.

The colour scales used in the maps are based on a national range of potential per catchment (see Appendix 1), ranging from 'limited' to 'very high' potential areas.

Users can use the dropdown menu in the right hand panel of the map to toggle between the visualisation of different themes in the Water body Catchments within the Management Catchment (see Figure 4.4). The available themes are:

- woodland planting
- floodplain reconnection
- run-off attenuation feature capacity (based on 3.3% and 1% AEP maps)
- catchment type (headwater or non-headwater)



**Figure 4.4 Management Catchment map – example visualisation based on area of floodplain reconnection potential for each Water body Catchment**

Notes: The red circle highlights the dropdown menu that is used to switch between themes on the maps.

The Management Catchment maps also show transitional zones (that is, areas that are 'not part of a water body'). These are areas drained predominantly by tidally influenced rivers. The different flooding mechanisms operating in these areas were not investigated and were consequently not mapped for the second tier of the mapping hierarchy. They cannot therefore be clicked on in the overview map (Tier 1) to drill down to the next tier. The transitional zones are, however, mapped in the fourth and

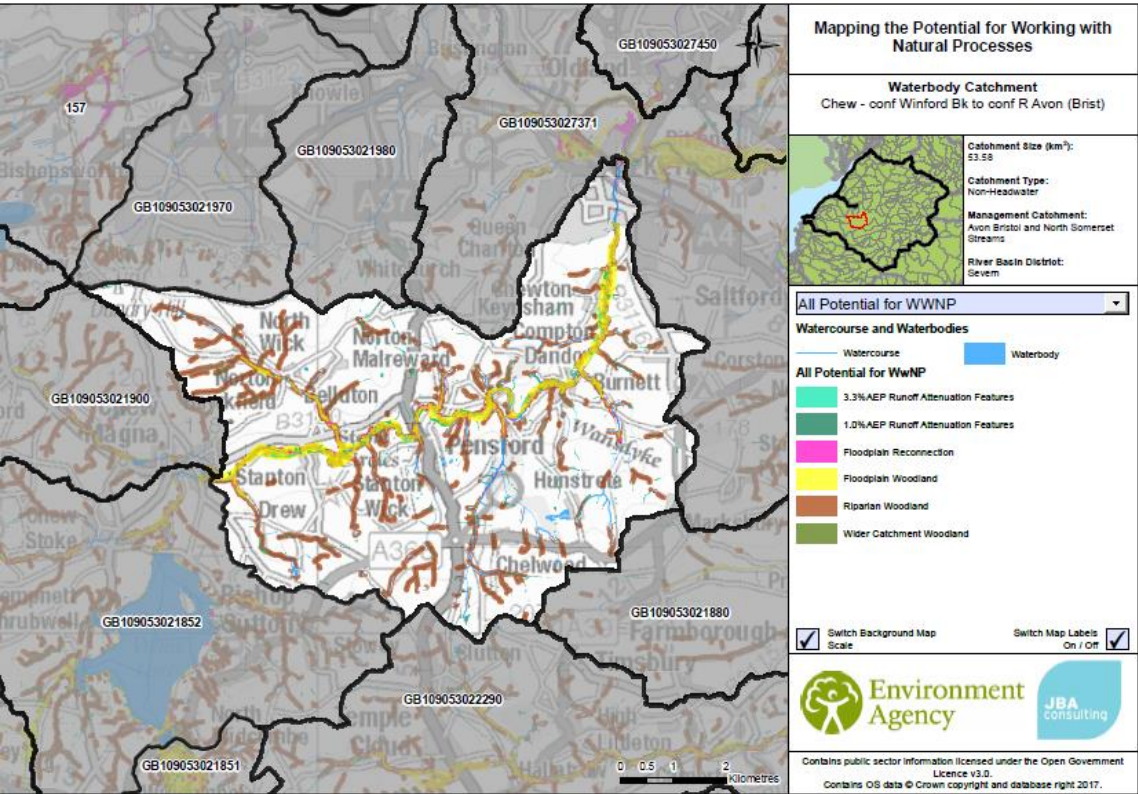


lowest tier of the hierarchy, providing some information to inform potential use of WWNP in these areas.

The Water Framework Directive Management Catchment level of mapping shows the potential to implement the WWNP measure being scrutinised in a given layer. Clicking on an individual water body on a Management Catchment map opens the lowest tier map for that Water body Catchment, allowing the user to drill down to the detail. Similarly, clicking on a transitional zone shown on the Management Catchment map opens the corresponding fourth tier map.

A more detailed exploration of the layers is given in the walkthrough examples in Sections 5 and 6.

## 4.5 Water body Catchment maps (Tier 4)



**Figure 4.5 Example Water body Catchment map showing all potential for WWNP**

The Water body Catchment level of mapping (Figure 4.5) shows the specific locations in which the WWNP measures could be implemented within the catchment. There are 11 different layers available with different levels of background mapping for the Tier 4 Water body Catchment maps (Table 4.1).

**Table 4.1 Layers available in Tier 4 Water body Catchment maps**

Layer	Description
<b>All potential for WWNP</b>	This layer combines the new data created to map potential for WWNP. It includes the following measures: <ul style="list-style-type: none"><li>• 3.3% AEP Run-off attenuation features</li><li>• 1% AEP Run-off attenuation features</li></ul>

Layer	Description
	<ul style="list-style-type: none"> <li>• Floodplain reconnection</li> <li>• Floodplain woodland</li> <li>• Riparian woodland</li> <li>• Wider catchment woodland</li> </ul>
<b>Constraint areas</b>	This contains the different open data listed in Section 2.2.6, which was applied to the 3 types of woodland potential.
<b>Floodplain reconnection</b>	New data generated by this project signposting areas of low connectivity between river and floodplain.
<b>Tree planting</b>	New data targeting tree planting in 3 different categories: riparian, floodplain and wider catchment woodland.
<b>Run-off attenuation features</b>	<p>New data generated by this project targeting enhanced storage in areas of high overland flow accumulation. If on steep ground classified as gully blocking.</p> <p>Classified by 3.3% AEP (or 1 in 30 year return period) and 1% AEP (or 1 in 100 year return period) based on Risk of Flooding from Surface Water (RoFSW) data.</p>
<b>Flood Zones</b>	Nationally consistent flood extents based on broad-scale mapping techniques in the Flood Map for Planning leading to Flood Zone 3 (1% AEP) and Flood Zone 2 (0.1 % AEP).
<b>Flood defences</b>	Dataset shows flood defences protecting against river floods with a 1% (1 in 100) chance of happening each year, or sea floods with a 0.5% (1 in 200) chance of happening each year, together with some, but not all, defences that protect against smaller floods.
<b>Risk of Flooding from Rivers and Sea (RoFRS)</b>	Dataset shows the chance of flooding from rivers and/or the sea, based on cells of 50m. Each cell is allocated one of 4 flood risk categories, taking into account flood defences and their condition.
<b>Protected habitats</b>	<p>This layer includes:</p> <ul style="list-style-type: none"> <li>• Special Protection Areas (SPAs) – land classified under Directive 79/409 on the Conservation of Wild Birds</li> <li>• Sites of Special Scientific Interest (SSSIs) – land notified as an SSSI under the Wildlife and Countryside Act (1981); they support many characteristic, rare and endangered species, habitats and natural features</li> <li>• Special Areas of Conservation (SACs) – land designated under Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora <ul style="list-style-type: none"> <li>• Ramsar sites – land listed as a wetland of international importance under the Convention on Wetlands of International Importance Especially as Waterfowl Habitat 1973 (the Ramsar Convention)</li> </ul> </li> </ul>
<b>Agricultural Land Classification</b>	Agricultural land is classified into 5 grades from best quality (Grade 1) to poorest quality (Grade 5). A number of consistent criteria are used for assessment including climate (temperature, rainfall, aspect, exposure, frost risk), site

Layer	Description
	(gradient, micro-relief, flood risk) and soil (depth, structure, texture, chemicals, stoniness) for England only.
<b>Land cover (CORINE)</b>	This was initiated in 1985 (reference year 1990), with updates in 2000, 2006 and 2012. It consists of an inventory of land cover in 44 classes. It uses a minimum mapping unit of 25ha for areal phenomena and a minimum width of 100m for linear phenomena.

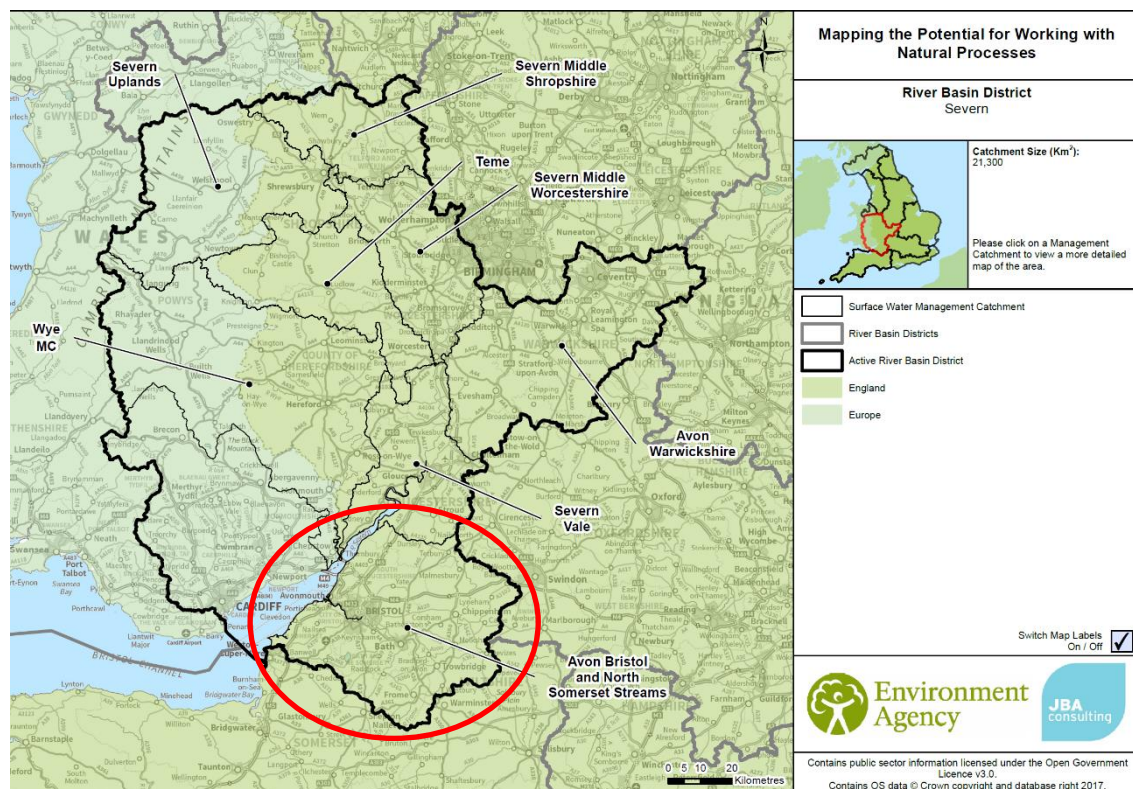
# 5 Bristol Avon walkthrough

This example demonstrates the full range of interactive maps, and the different layers and features within them for a Management Catchment. It demonstrates how to:

- compare potential at different scales
- drill down into the detailed Tier 4 maps which signpost potential areas where WWNP might make a greater difference

The Bristol Avon and North Somerset Streams Management Catchment is accessed via the Severn River Basin District map (Figure 5.1). It was selected in part because the tree planting potential on slowly permeable soils are based on the bedrock types, as opposed to those based on surface drift in the north described in Section 6.

## 5.1 Step-by-step guide

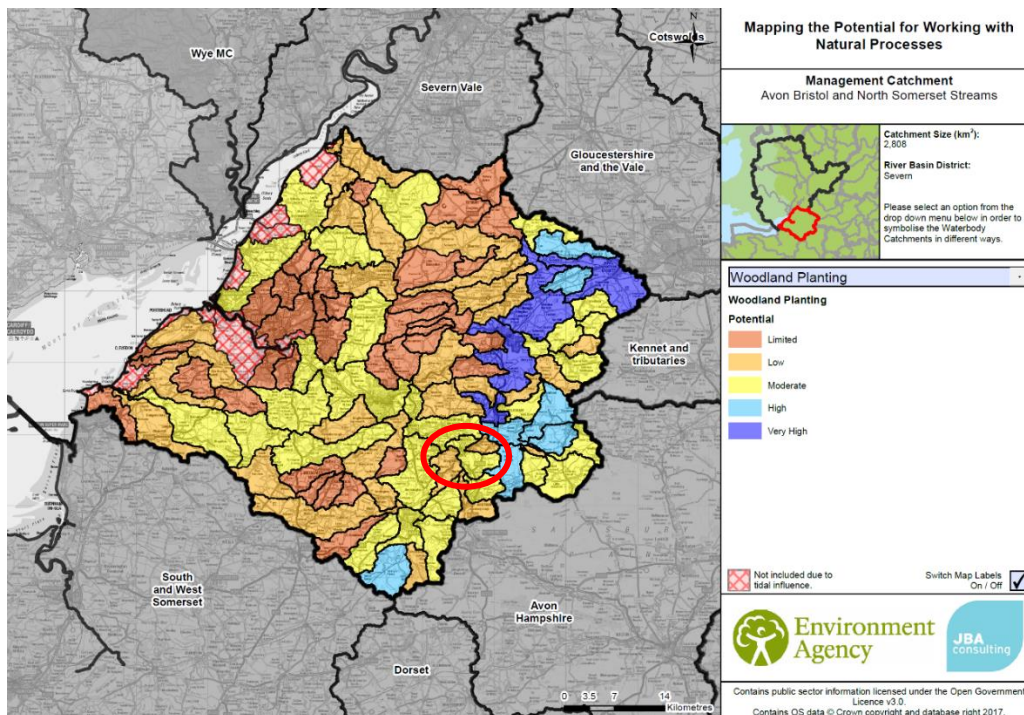


**Figure 5.1 Avon Bristol and North Somerset Streams located in the Severn River Basin District**

Notes: Red circle marks the location of the Avon Bristol and North Somerset Streams Management Catchment.

Clicking on Avon Bristol on this map opens the Tier 3 map of the Management Catchment (Figure 5.2). This is initially colour themed by the extent of woodland potential, based on the combined total of riparian, floodplain and wider catchment tree planting potential (excluding overlaps). The red circle in Figure 5.2 highlights the Water body Catchment (Biss) on which this example focuses.

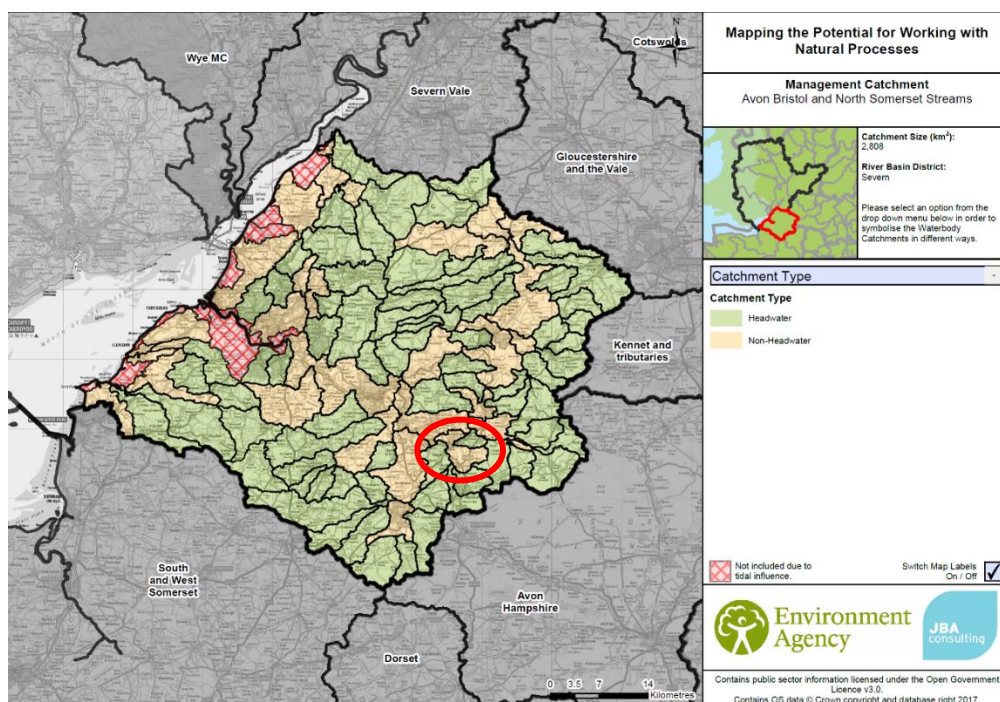




**Figure 5.2 Woodland planting potential in the Bristol Avon and North Somerset Streams Management Catchment**

Notes: The red circle highlights the Water body Catchment (Biss) of interest in these examples.

The next step is to toggle the dropdown to the type of catchment (headwater or non-headwater) shown in Figure 5.3. This shows that the highlighted Water body Catchment is a non-headwater catchment, with some headwater, meaning it would be affected by upstream changes in other catchments. Potential for WWNP in non-headwater catchments should be considered in the context of the wider upstream catchment.

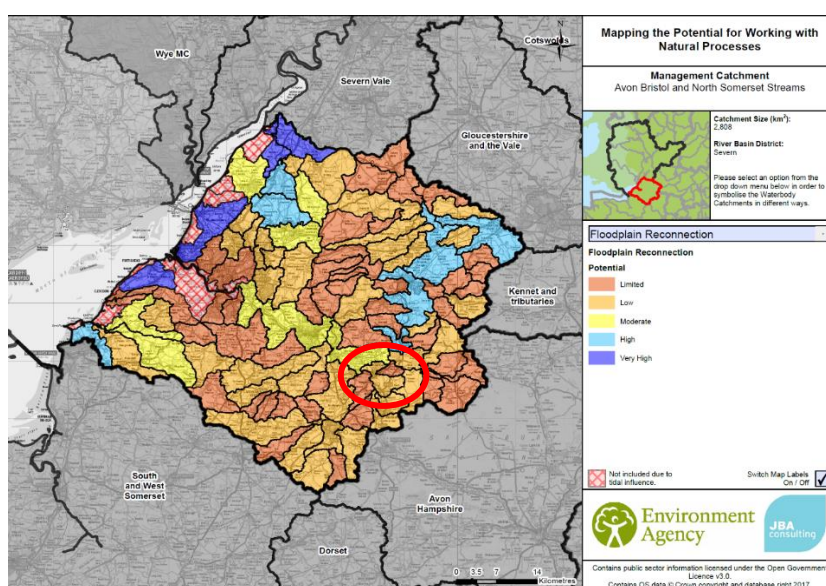


**Figure 5.3 Type of catchment (headwater/non-headwater)**

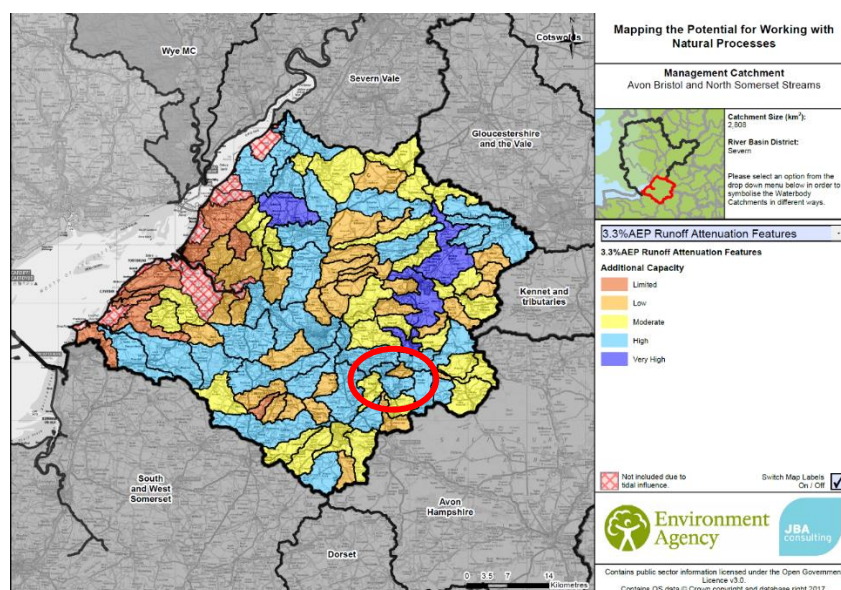


Users can then choose a range of different WWNP interventions from the dropdown menu, and evaluate the relative level of potential:

- Woodland planting (across all 3 types) (Figure 5.2). There is moderate potential in the Biss Water body Catchment. Potential is highest in Water body Catchments to the east of the Management Catchment.
- Floodplain reconnection (Figure 5.4). There is low potential in the Biss Water body Catchment. Potential is highest in Water body Catchments to north and west of the Management Catchment, with some areas of high potential in the north-east.
- Run-off attenuation storage (Figure 5.5). There is high potential in the Biss Water body Catchment. There are areas of high potential spread across the Management Catchment, with very high potential areas the north-east.

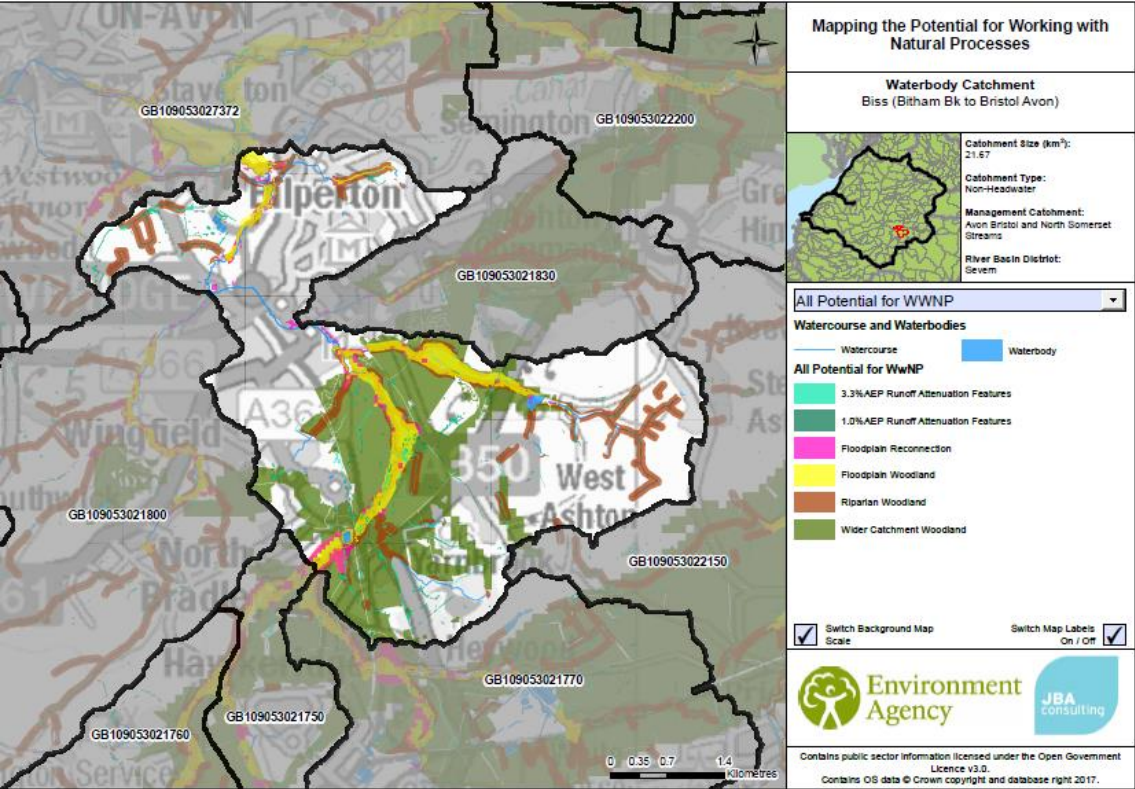


**Figure 5.4 Floodplain reconnection potential in the Bristol Avon and North Somerset Streams Management Catchment**

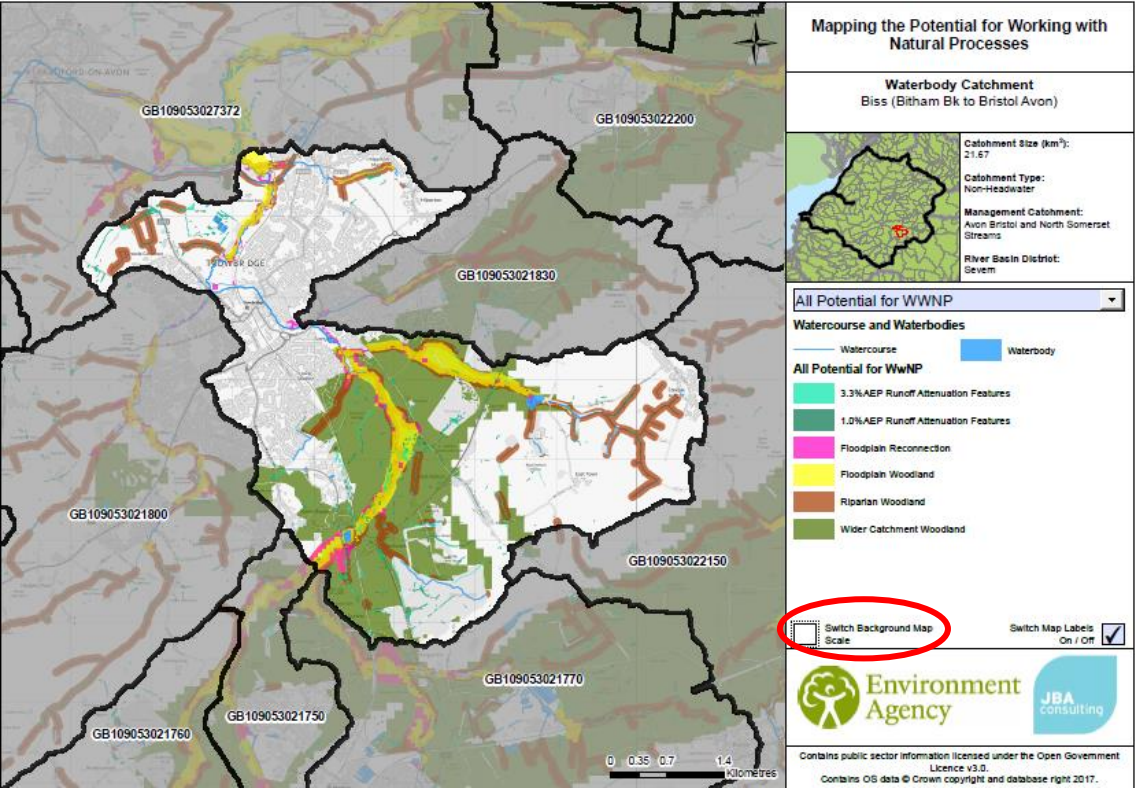


**Figure 5.5 Run-off attenuation features (based on 3.3% AEP data) in the Bristol Avon and North Somerset Streams Management Catchment**

Users should now click on the Biss Water body Catchment highlighted and open a detailed map (Figure 5.6). This initially opens with a coarse background, but can be made more detailed by unchecking the tick box highlighted in Figure 5.7



**Figure 5.6 All potential for WWNP with coarse-scale background mapping for the Biss Water body Catchment**



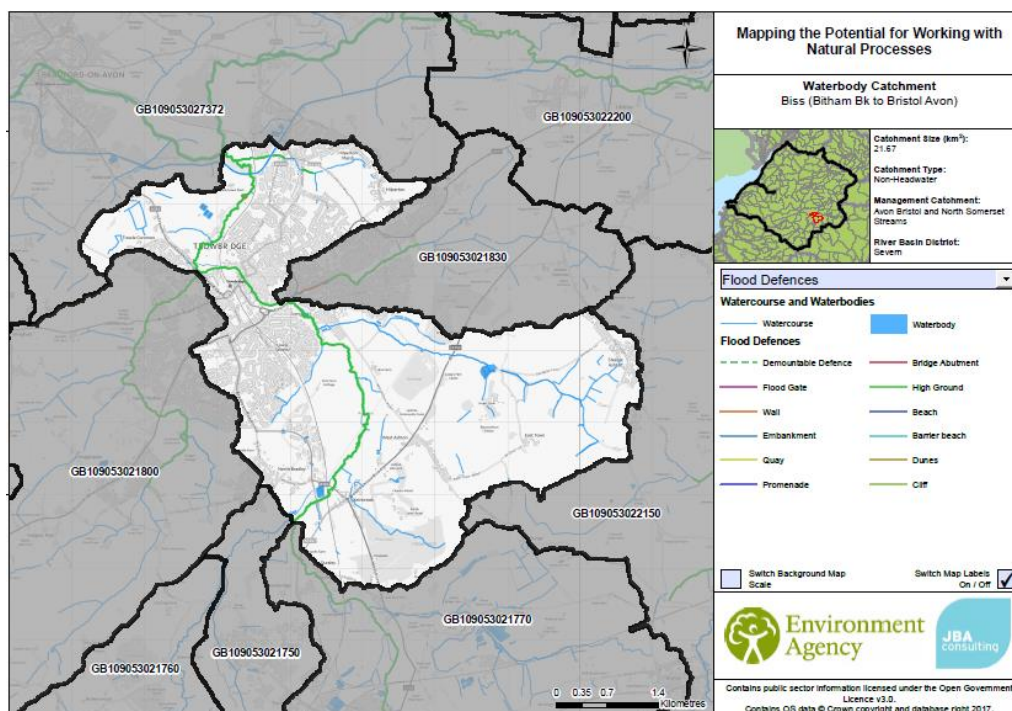
**Figure 5.7 All potential for WWNP with fine-scale background mapping for the Biss Water body Catchment**



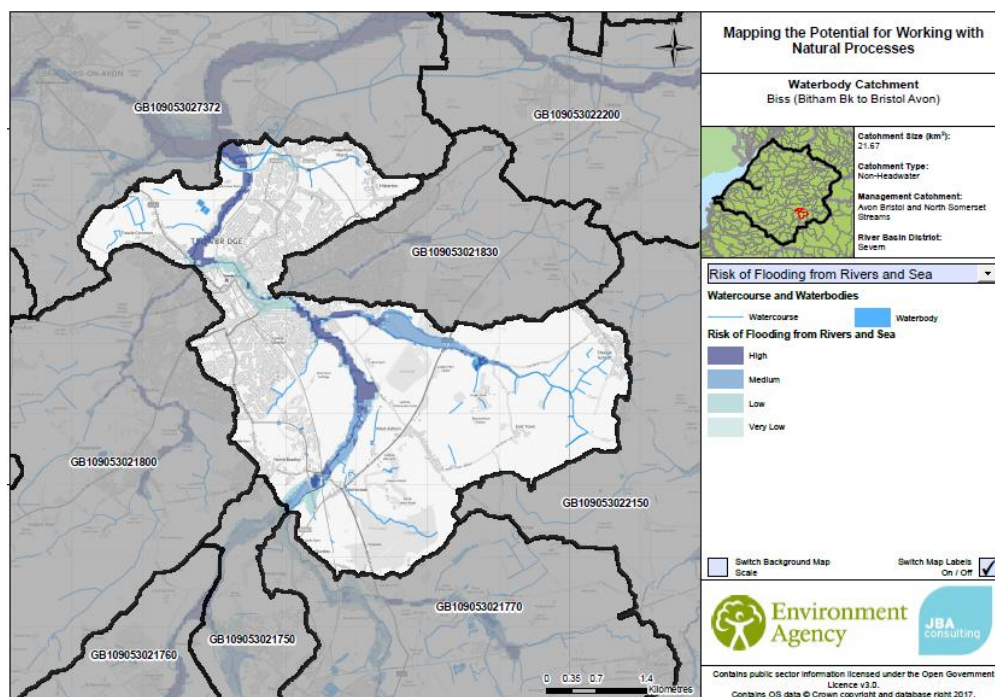
Users can now explore some of the background layers, for example:

- Flood defence data (Figure 5.8)
- Risk of Flooding from Rivers and Sea data (Figure 5.9)

Comparison of Figures 5.8 and 5.9 suggests the 'high ground' indicated does not fully explain flood risk outcomes, since much of the town of Trowbridge shows a 'low' or 'very low' probability of flooding. This could be due to channelisation, but the maps show residual low risk of property flooding which it would be good to reduce further.



**Figure 5.8** Open spatial flood defences data for the Biss river network



**Figure 5.9** Risk of Flooding from Rivers and Sea for the river network

The CORINE land cover data shows that the Water body Catchment is predominantly agricultural above Trowbridge (Figure 5.10). Much of the land is Grade 2–3 with a belt of Grade 4 (Figure 5.11). The presence of high quality agricultural land may restrict wider uptake of WWNP measures in places.

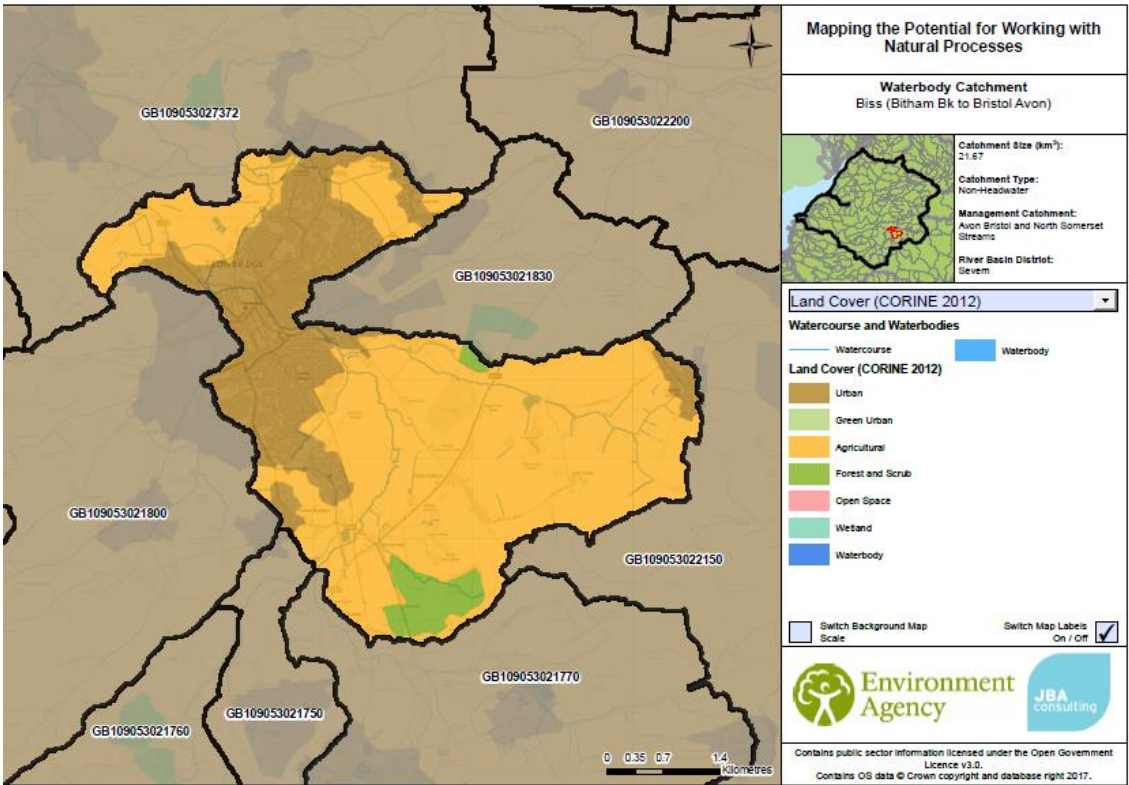


Figure 5.10 Land cover (CORINE) for the Biss Water body Catchment

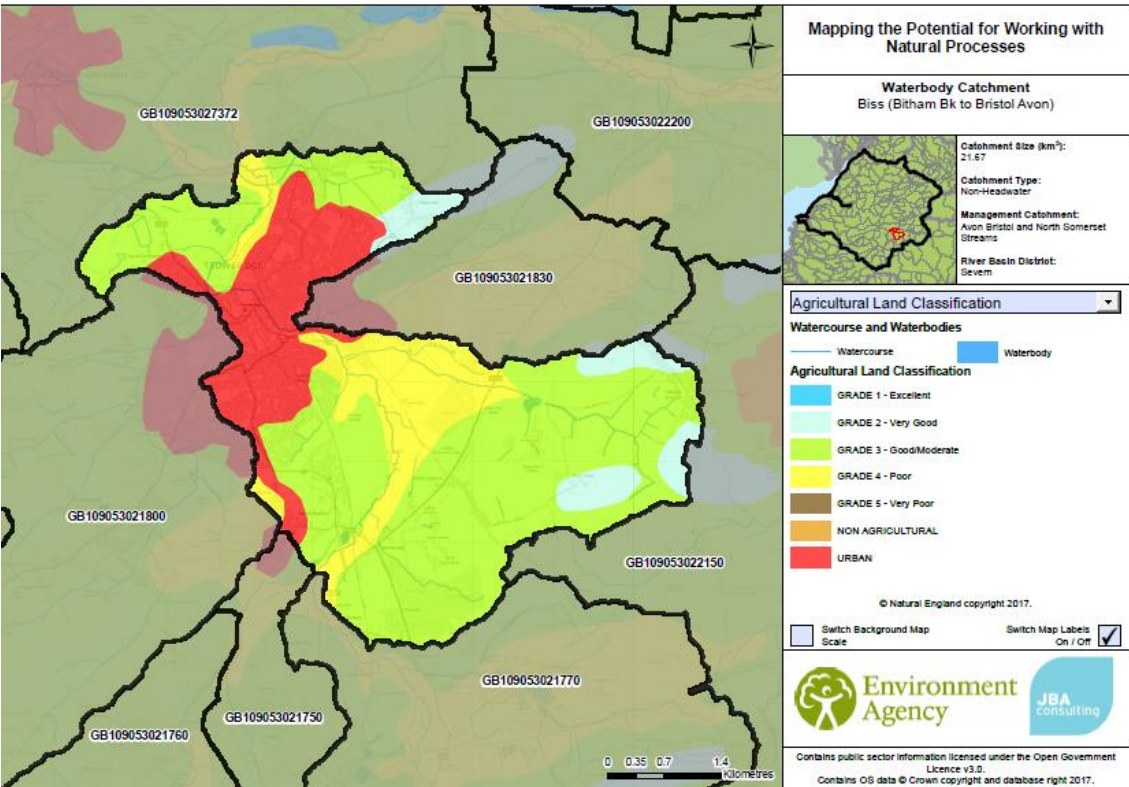
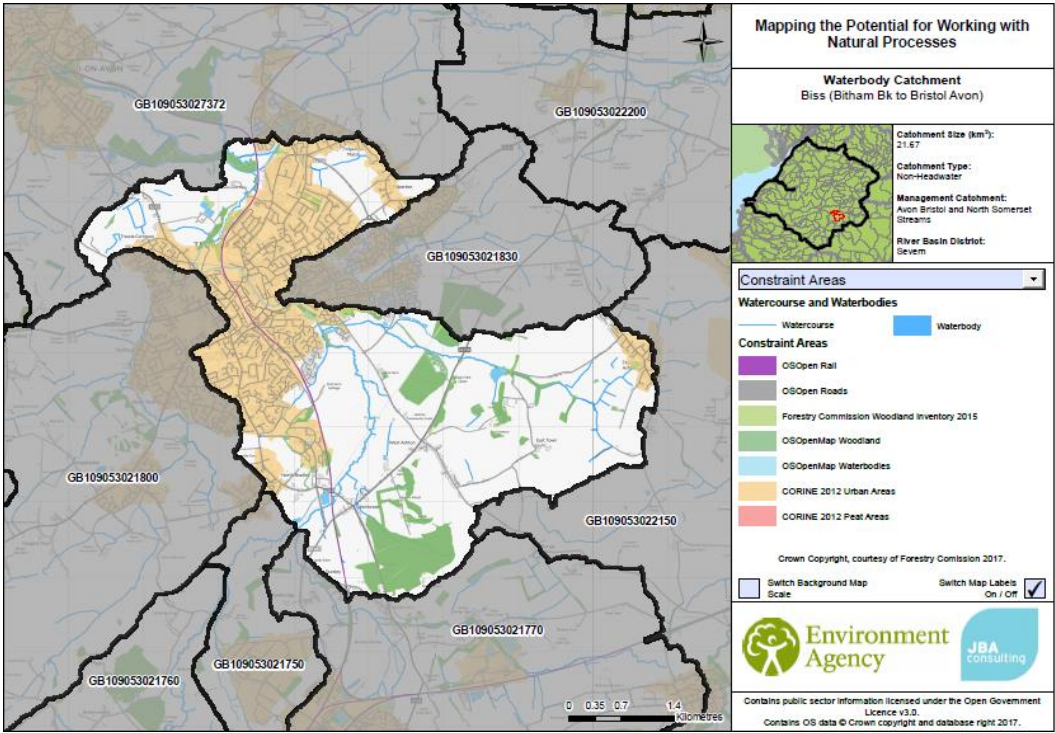


Figure 5.11 Agricultural Land Classification for the Biss Water body Catchment

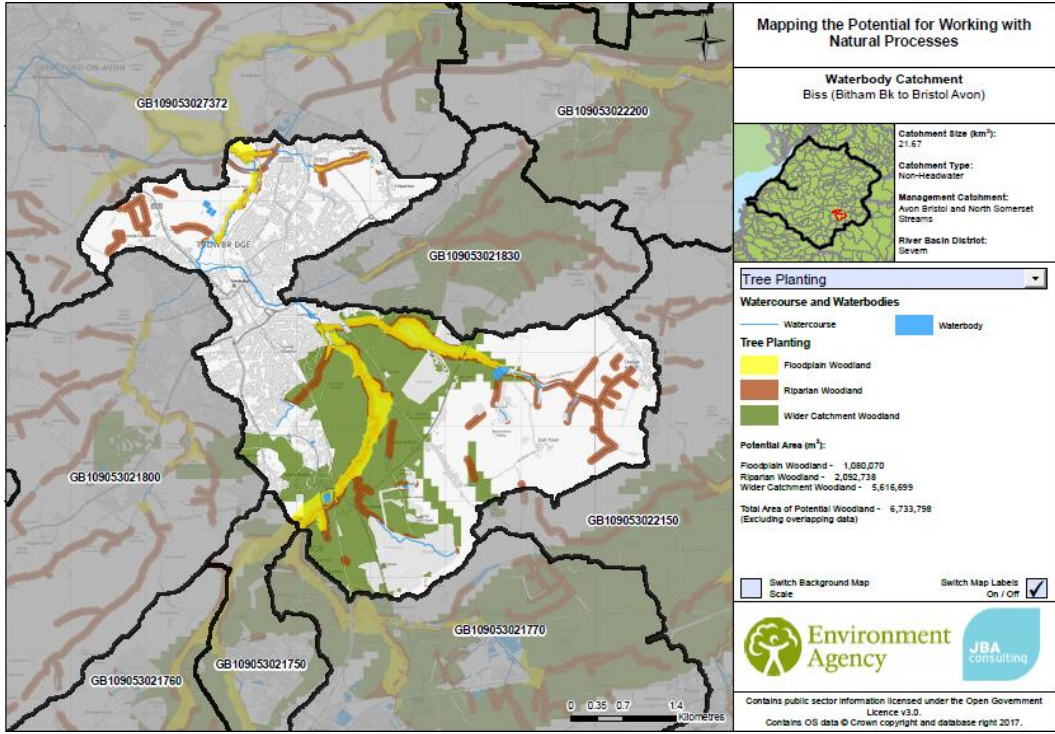


Before looking at the potential for WWNP, it is worth flicking to the last layer in the dropdown – the open data constraints layer (Figure 5.12).



**Figure 5.12 Constraint areas for Biss Water body Catchment**

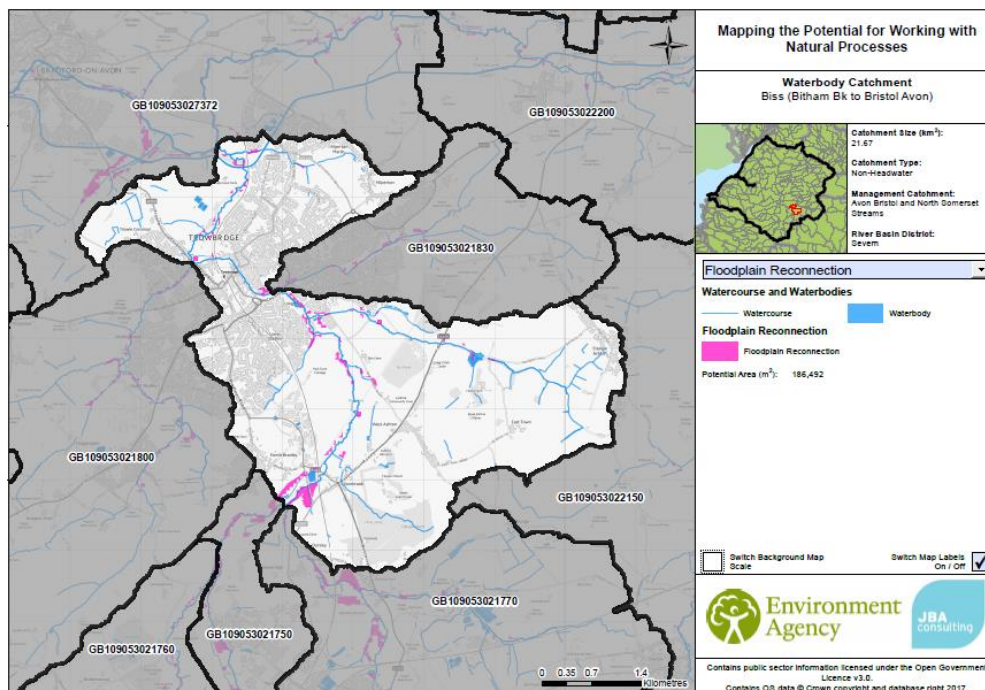
Figure 5.13 shows 3 types of tree planting having taken into account the constraints data in Figure 5.12. The green data are based on the new slowly permeable soils dataset, demonstrating potential for wider catchment woodland. The yellow data shows potential for floodplain tree planting and, while the brown data identifies riparian tree planting potential.



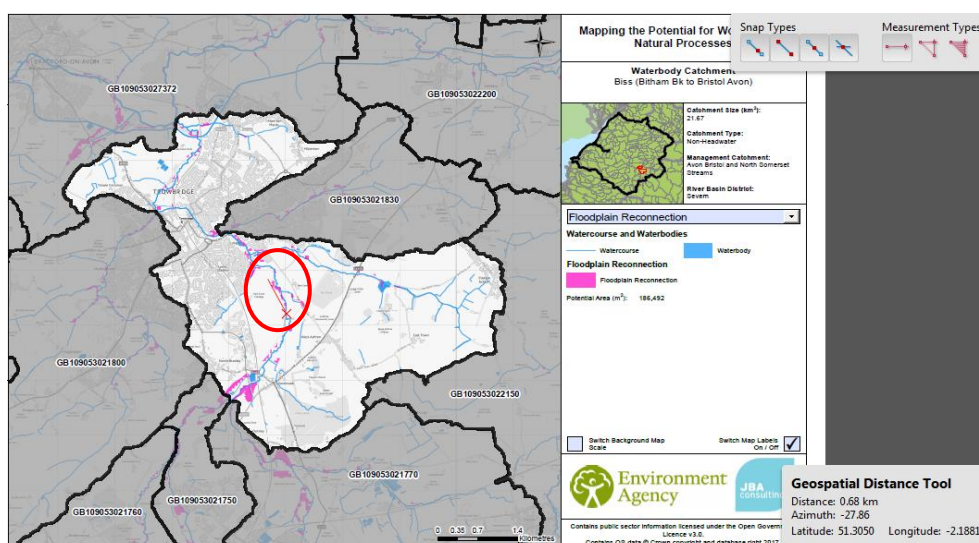
**Figure 5.13 Three types of tree planting potential for the Biss Water body Catchment**

It can be seen how the existing woodland in the south of the Water body Catchment (Figure 5.12) is masked from the potential woodland shown in Figure 5.13. This is because this woodland is also a SSSI based on the protected habitats layer (not shown here). SSSIs can act as an opportunity or a constraint depending on the intervention proposed and the type of protection applied to the site (Natural England can provide further guidance).

Figure 5.14 displays potential areas for floodplain reconnection; it may be useful to measure the size of these. Since the interactive maps are georeferenced PDFs (or geoPDFs), this can be done using the measuring tool (edit > analysis > measuring tool). For an example, see Figure 5.15 where the user has drawn a red line in the black circle, and the panel on the right of the PDF tells us that the floodplain reconnection potential area being measured is 0.31km long.



**Figure 5.14 Floodplain reconnection potential (shown in pink)**



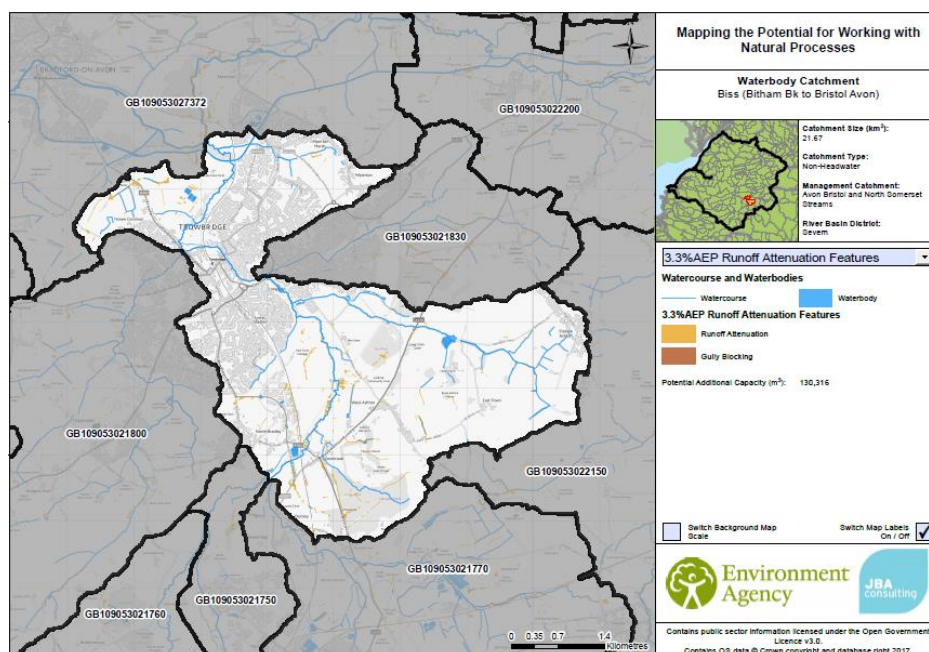
**Figure 5.15 Example of measuring floodplain reconnection potential on a geoPDF**

Notes: The length in question is marked by a red line drawn by the user in the black circle.

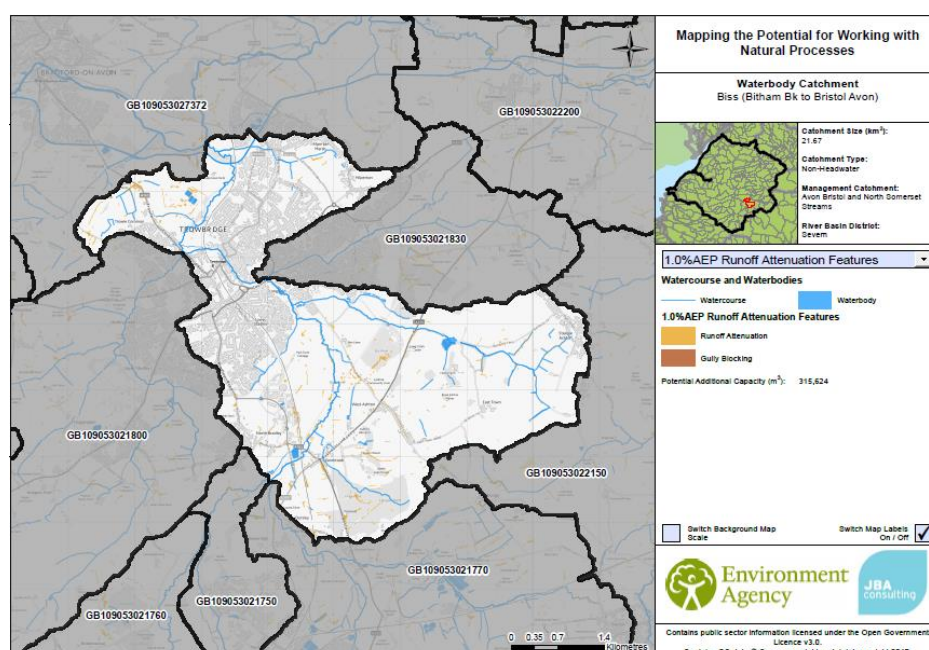


Finally, Figures 5.16 and 5.17 highlight the run-off attenuation features based on the 3.3% AEP and 1% AEP of Flooding from Surface Water (RoFSW) maps, respectively. The run-off attenuation features are shown in orange on the maps – brown if they occur on steep ground (labelled as gully blocking). They represent areas of high flow accumulation, such as ponded water or water that has backed up in a small channel, and are restricted between 100m<sup>2</sup> and 5,000m<sup>2</sup>.

The [Evidence Directory](#) and supporting guide provide examples of how such areas might be targeted and modelled to assess effectiveness. This user guide does not provide information on the design of such enhancements, which may include bunds that can drain down between events, and may need long-term maintenance such as sediment removal.



**Figure 5.16 Run-off attenuation features based on 3.3% AEP mapping**



**Figure 5.17 Run-off attenuation features based on 1% AEP mapping**



## 5.2 Summary

The example of the Biss Water body Catchment in the Bristol Avon and North Somerset Streams Management Catchment shows some strong potential for WWNP to help reduce flood risk across a range of measures. There are some broad floodplains in agricultural land, upstream of Trowbridge, some of which have with low river to floodplain connectivity where it may be possible to look for potential to reconnect and to plant floodplain woodlands. Some of the agricultural land is high quality, but is also crossed by belt of slowly permeable soils, where tree planting may be effective at reducing run-off. Part of this belt overlaps with low productivity Grade 4 agricultural land, and so this may be a good place to focus further investigations on the woodland or run-off attenuation features that have also been identified. When considering which interventions to prioritise, users should take into account a range of factors including:

- the need for flood mitigation within and upstream of a Water body Catchment
- the sizes of individual areas of potential
- clusters of potential areas within subcatchments

These assumptions take into account a range of constraints, including not planting where there are existing trees or urban space, and other priority habitats. The new open data constraints layer includes useful woodland layers that are more detailed than CORINE land cover data.

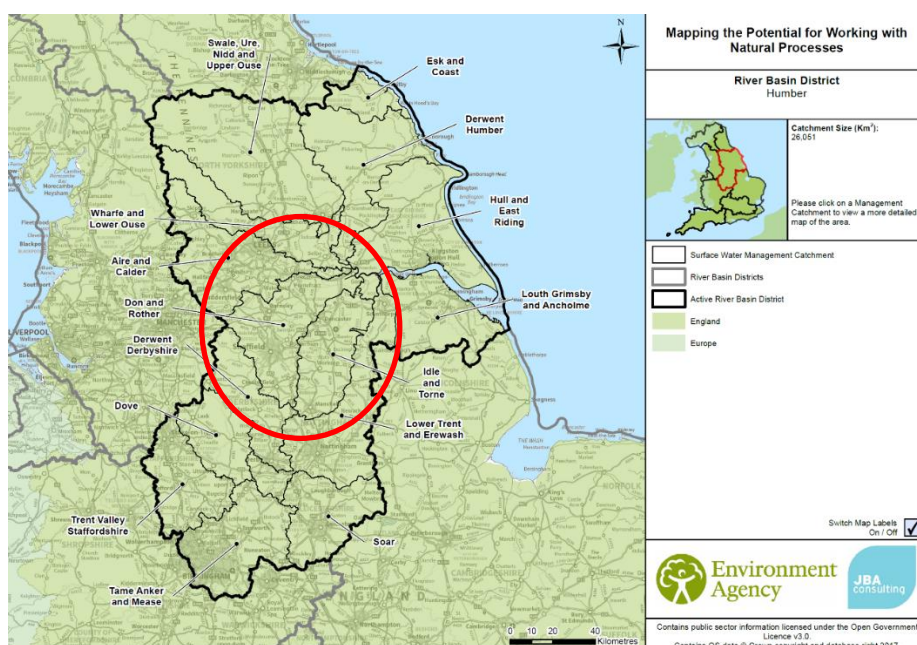
The next step would be to gather further knowledge and expertise, consulting with the Environment Agency on whether this catchment requires flood risk mitigation, and cross-checking the identified potential areas against more detailed mapping, additional data sources, land ownership considerations and local knowledge.

## 6 Don and Rother walkthrough

This example in the north of England demonstrates the full range of interactive maps, and the different layers and features within them. It shows how to compare potential for interventions at different scales, and to drill down into the detailed Tier 4 maps which signpost potential areas where WWNP might make the most difference.

### 6.1 Step-by-step guide

The first step in using the WWNP maps is to identify which Management Catchment you are interested in. This example focuses on the Don and Rother Management Catchment, so open the national overview map (Tier 1), locate the Humber River Basin District (Tier 2), and click on the Don and Rother Management Catchment (circled in red in Figure 6.1).



**Figure 6.1 Don and Rother Management Catchment on the Humber River Basin District map**

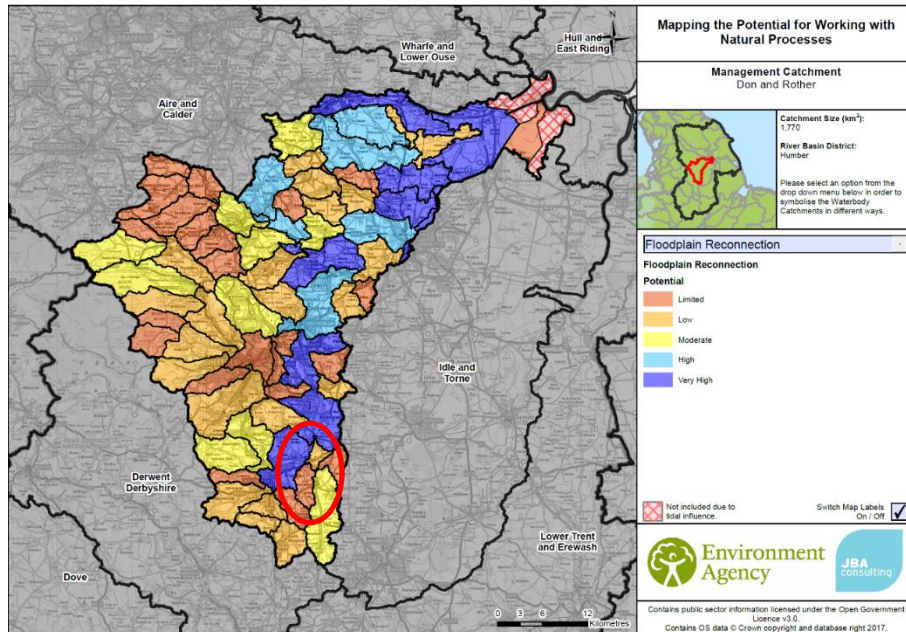
Notes: Red circle marks the location of the Don and Rother Management Catchment.

This will open the Tier 3 map for the Don and Rother Management Catchment (Figure 6.2). Circled in red in this example is a Water body Catchment (Pools Brook), which a user wishes to explore to help with a study that seeks to make better use of natural capital to achieve multiple benefits in addition to mitigating flood risk. This catchment does not show high levels of potential for WWNP. By toggling the dropdown menu, the user obtains the following information from the maps:

- Floodplain reconnection (Figure 6.2). There is some limited potential (compared with a national average) in the Pools Brook Water body Catchment. Potential is higher in Water body Catchments further north.
- Run-off attenuation features (Figure 6.3). There is moderate potential for run-off attenuation features storage in the Pools Brook Water body

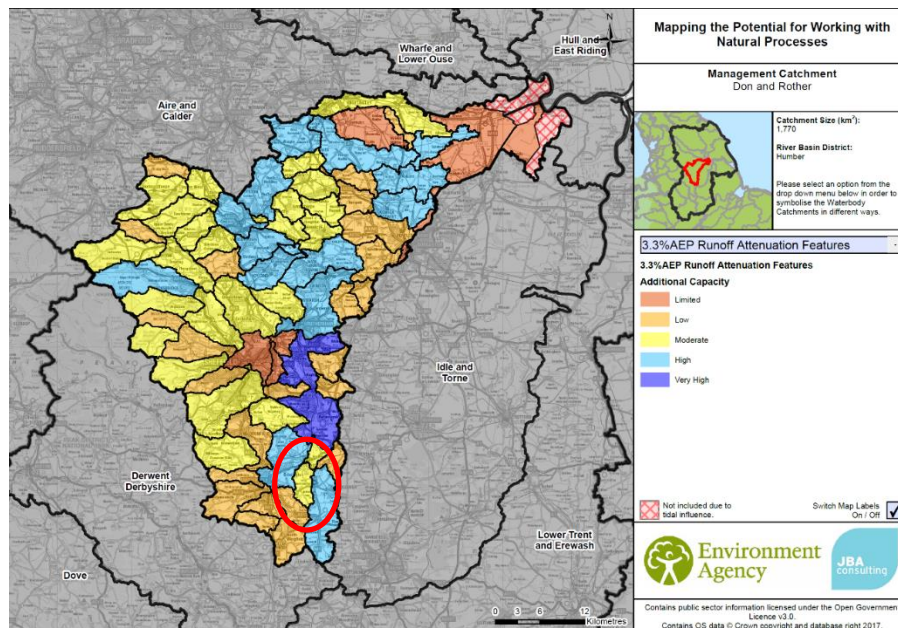
Catchment. This includes gully blocking if present on the Tier 4 maps. Potential is higher in Water body Catchments directly north of Pools Brook.

- Woodland planting (Figure 6.4). There is some limited potential for woodland in the Pools Brook Water body Catchment. This is the case across much of the Don and Rother Management Catchment, although there are a few Water body Catchments in the north east with high or very high potential for tree planting.



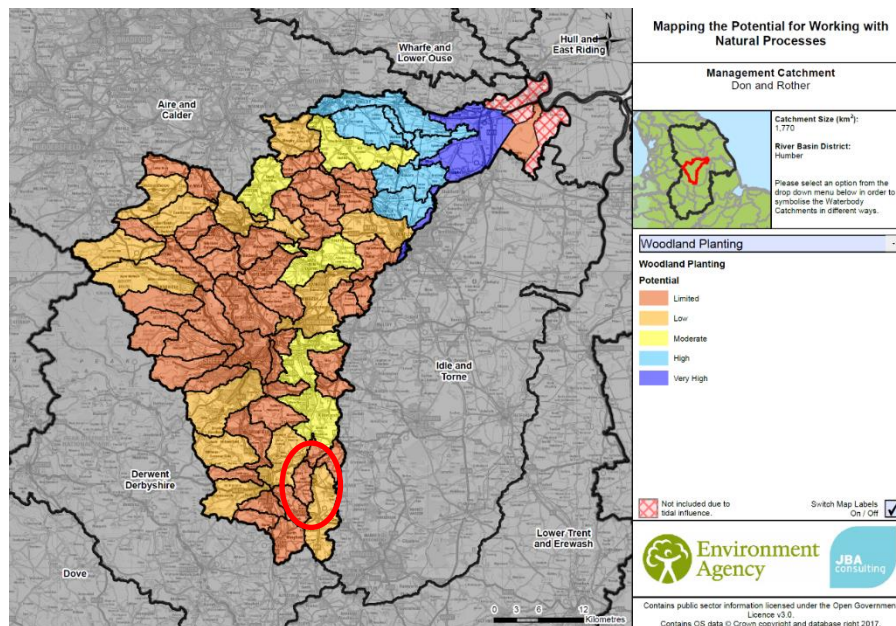
**Figure 6.2 Don and Rother Management Catchment with Water body Catchments themed by potential for floodplain reconnection**

Notes: The red circle marks the location of the Water body Catchment (Pools Brook) of interest in these examples.



**Figure 6.3 Don and Rother Management Catchment with Water body Catchments themed by potential for run-off attenuation features**

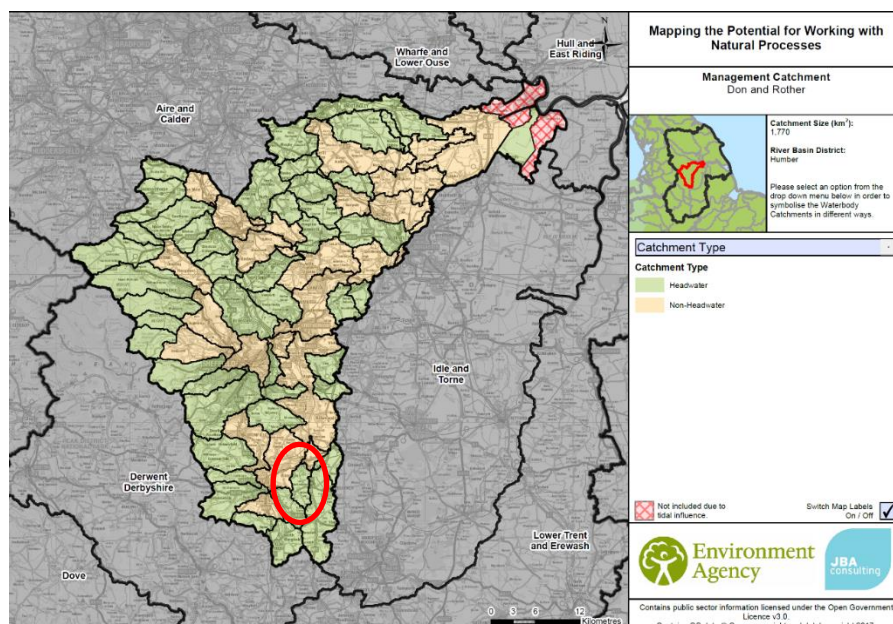




**Figure 6.4 Don and Rother Management Catchment with Water body Catchments themed by woodland planting potential**

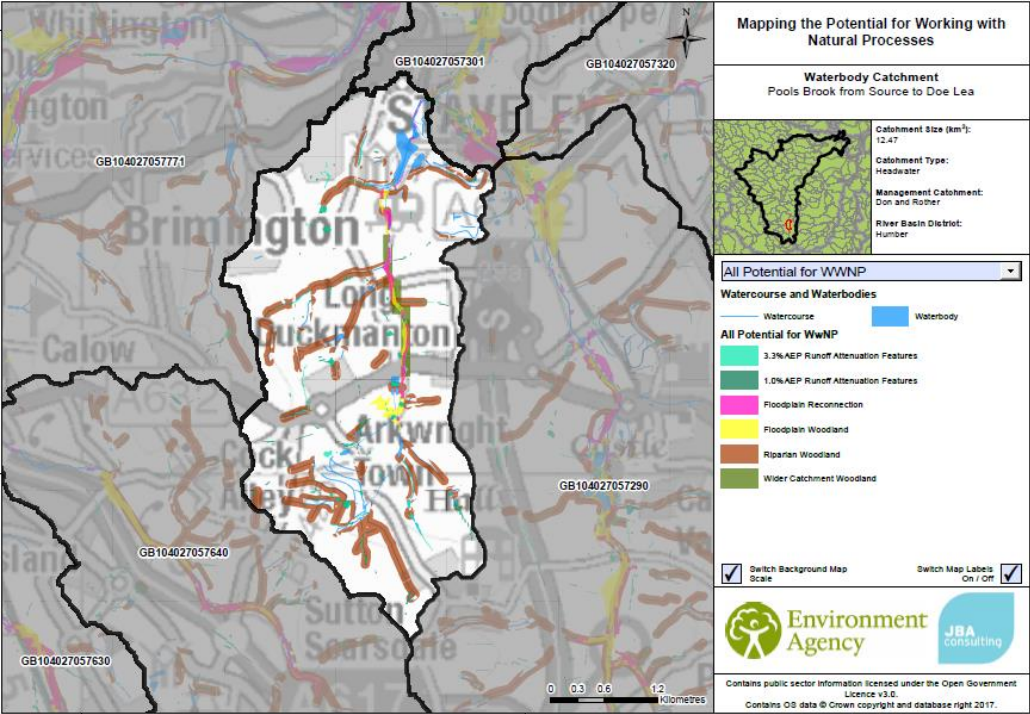
The user can also toggle to 'catchment type' (Figure 6.5) to see if the Water body Catchment in question is a headwater or a non-headwater catchment. The encircled Water body Catchment is a headwater catchment, and so the impact of interventions on flood events in upstream catchments is not of concern. Most of the risk in this Water body Catchment appears to be downstream.

The user is constrained to this Water body Catchment and wishes to supplement a proposed FCRM scheme, but at the same time use WWNP interventions to deliver additional environmental benefits (see Appendix 3 for additional data sources). It may also be the case that particular landowners wish to use WWNP, and the relatively low potential on a national scale does not mean it should be ruled out.

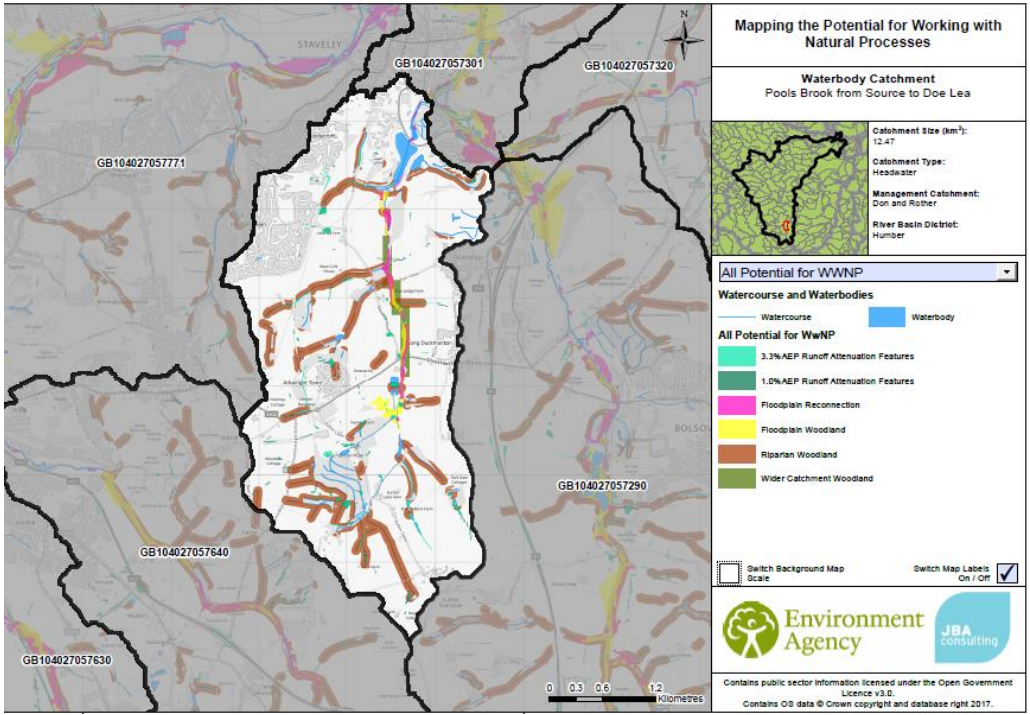


**Figure 6.5 Don and Rother Management Catchment with Water body Catchments themed by catchment type (headwater or non-headwater)**

The next stage of the screening involves looking in more detail at the Water body Catchment. Clicking on the highlighted Water body Catchment on the Management Catchment map opens the detailed map of the specific Water body Catchment. In this example, it opens the map for Pools Brook. This initially opens with a coarse background (Figure 6.6), but it can be made more detailed by unchecking the tick box marked 'Switch Background Map Scale' (Figure 6.7).



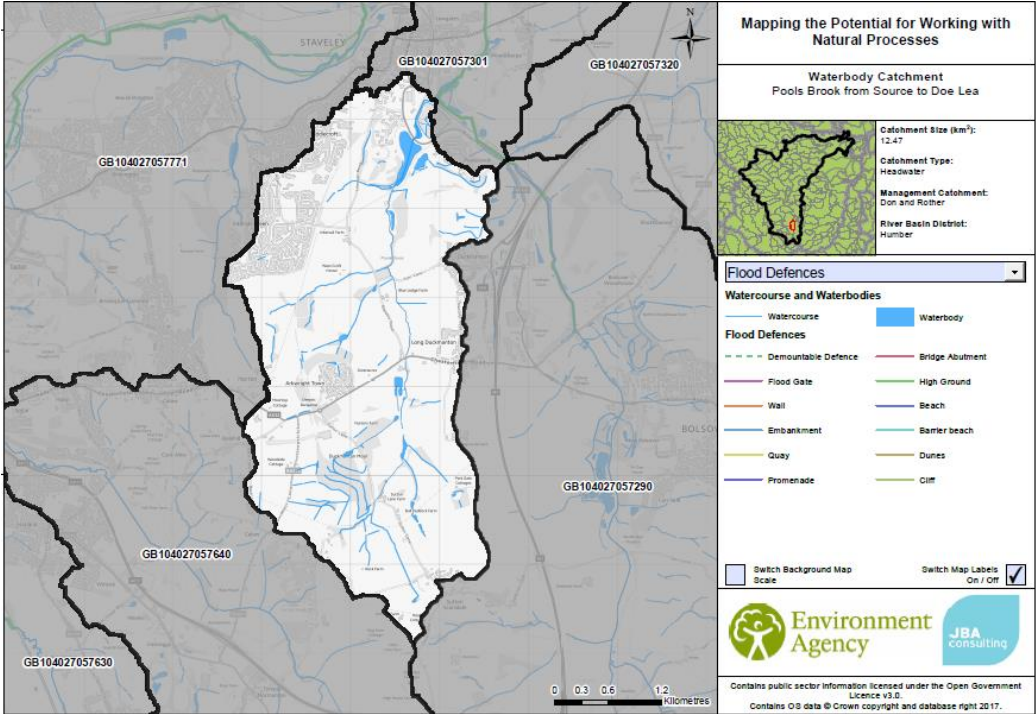
**Figure 6.6** All potential for WWNP with coarse-scale background mapping for Pools Brook



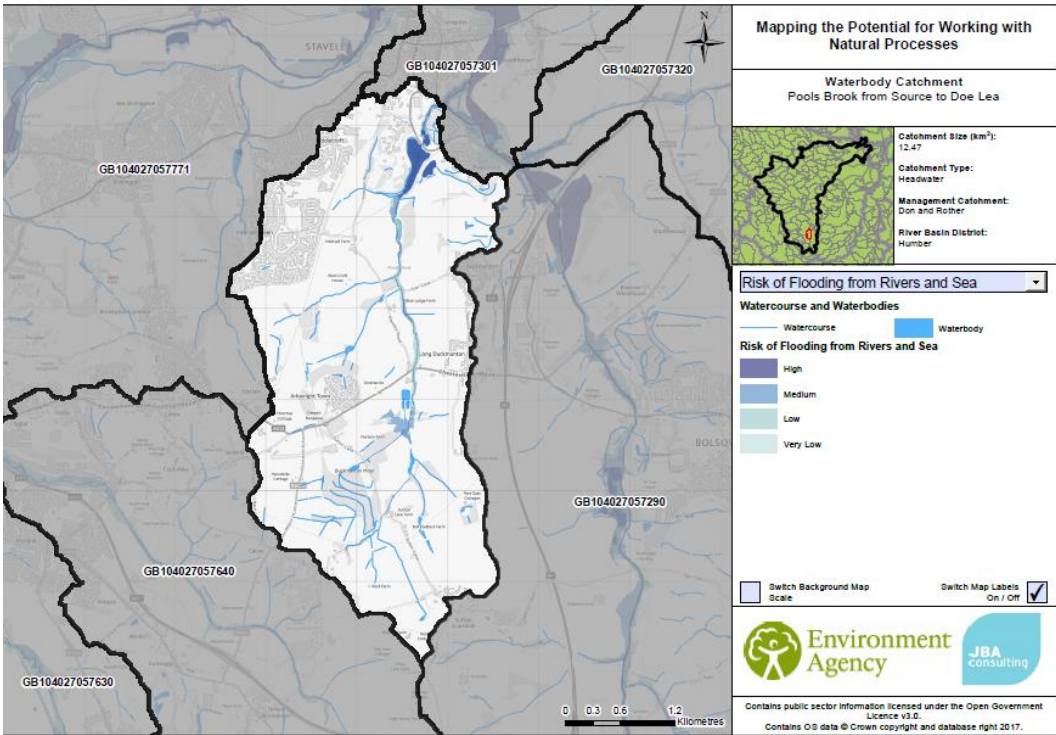
**Figure 6.7** All potential for WWNP with fine-scale background mapping for Pools Brook



Figure 6.8 shows that while there are no documented defences within this small Water body Catchment, some defence features are visible in the neighbouring catchments. However, based on the Risk of Flooding from Rivers and Sea map (Figure 6.9), the areas of high risk are away from urban areas and the floodplain on the main stem of the river is a low risk.

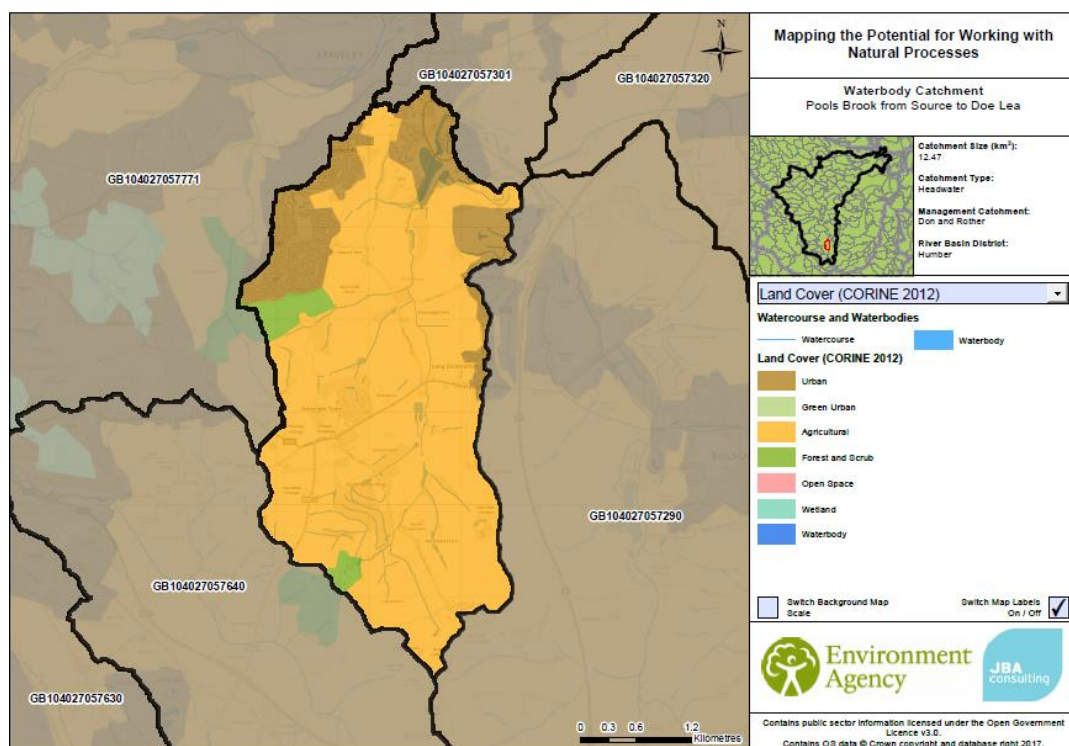


**Figure 6.8 Flood defences layer shows there are none for Pools Brook**

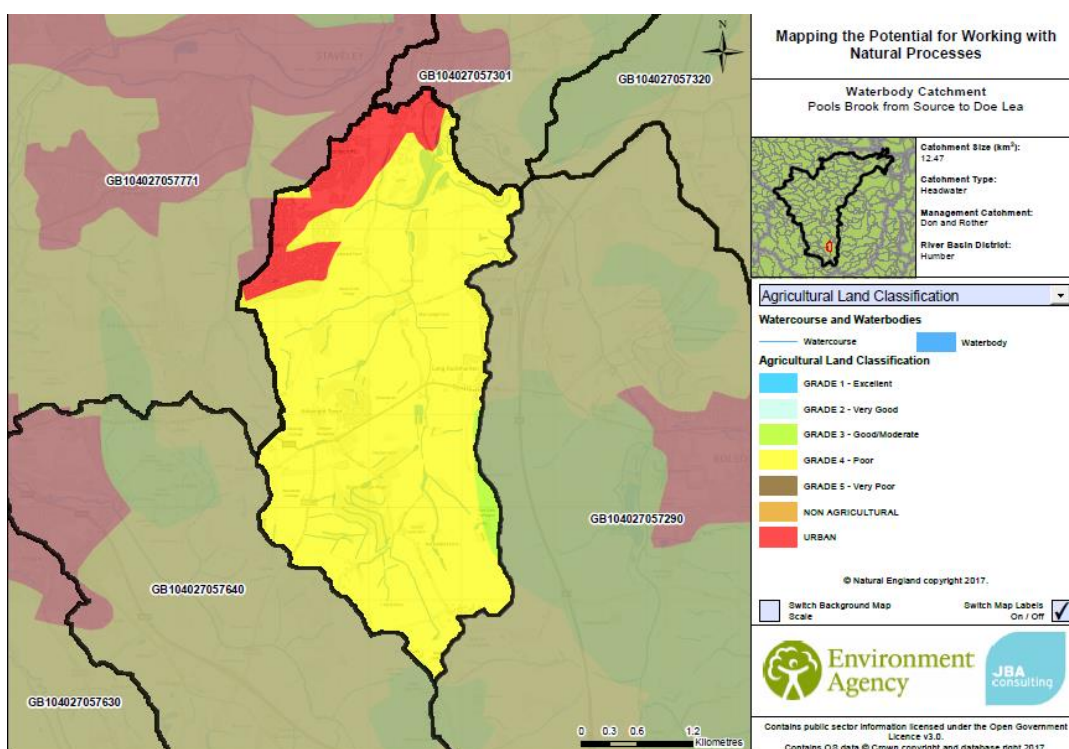


**Figure 6.9 Risk of Flooding from Rivers and Sea for Pools Brook**

Before examining the actual WWNP potential, it is worth assessing the land cover (Figure 6.10) and grade of agricultural land (Figure 6.11); much of which appears to be relatively low grade and therefore potentially more available for flood storage.



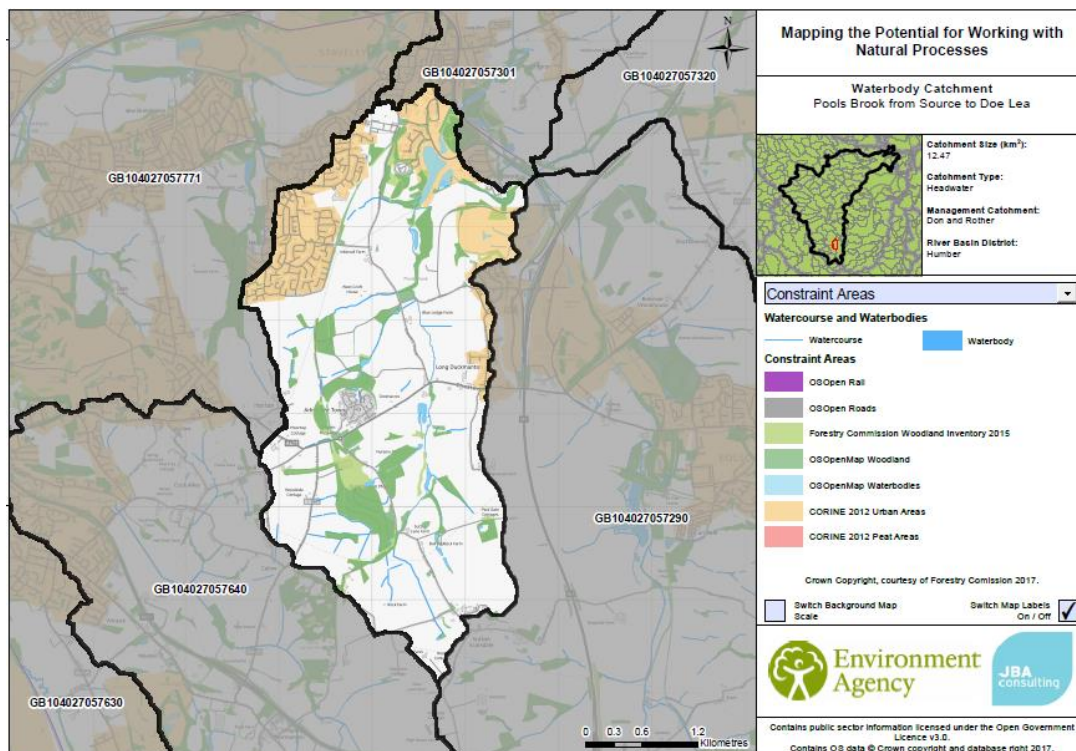
**Figure 6.10 Land cover (CORINE) for Pools Brook**



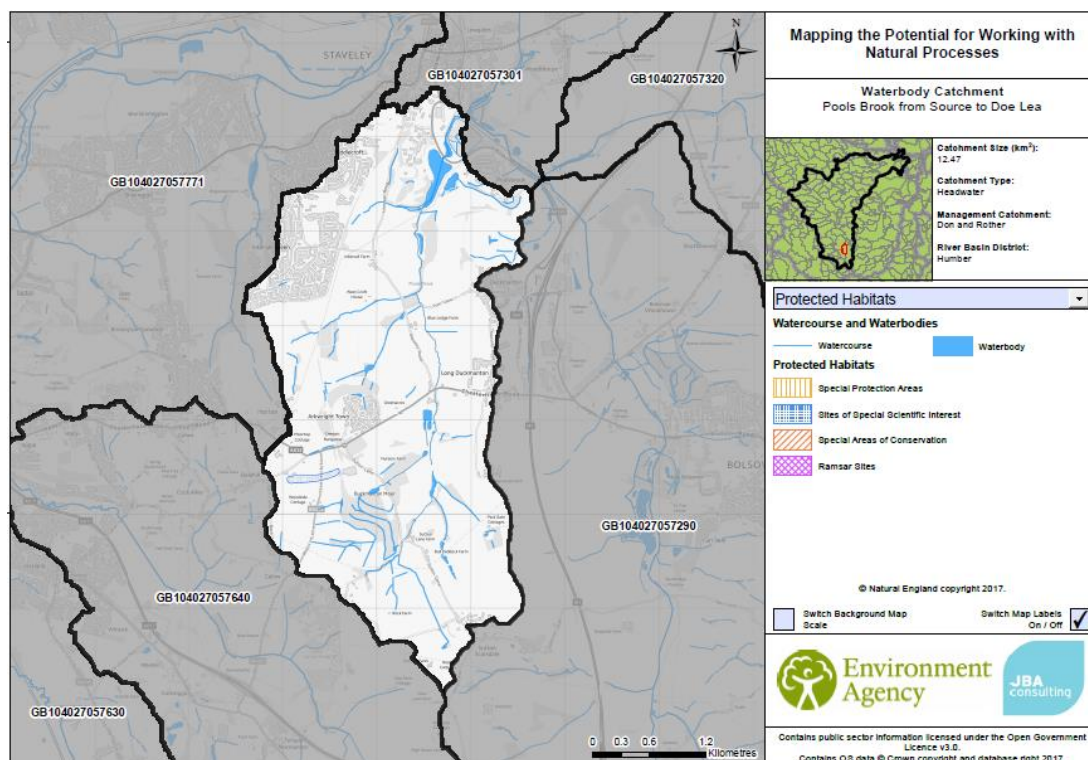
**Figure 6.11 Agricultural Land Classification for Pools Brook**

Figure 6.12 shows the constraints data applied to the woodland potential encompassing the range of land cover in the key. Although this reduces the available area, it is also important to check the protected habitats layer (Figure 6.13), which in this case only indicates a small strip of SSSI to the west (shown in blue shading).



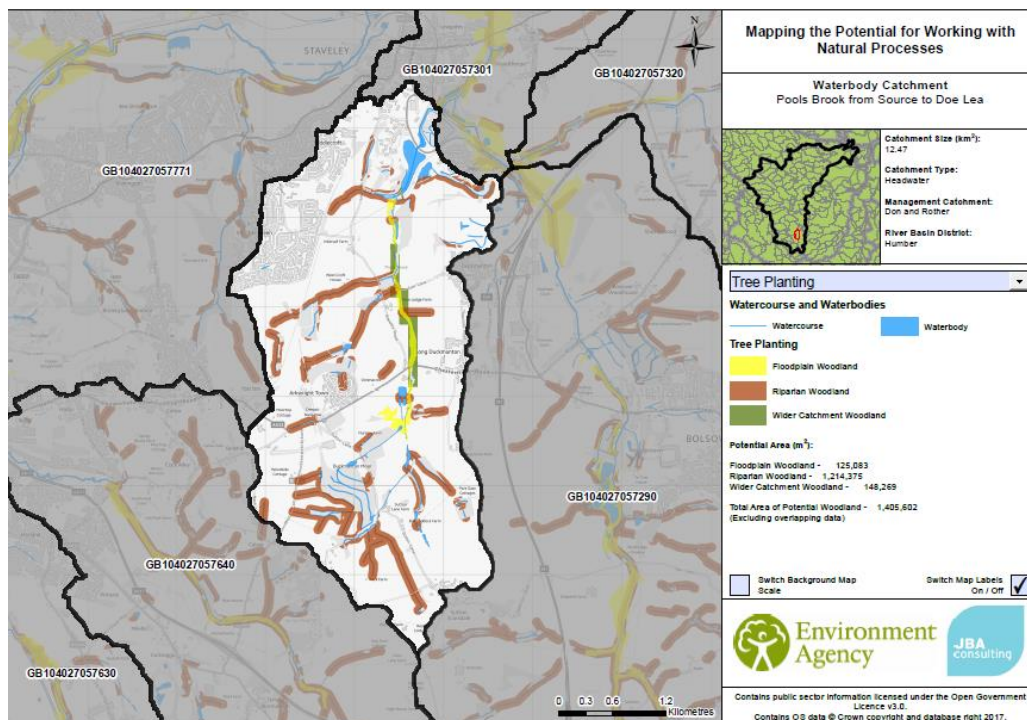


**Figure 6.12 Constraints data for Pools Brook**



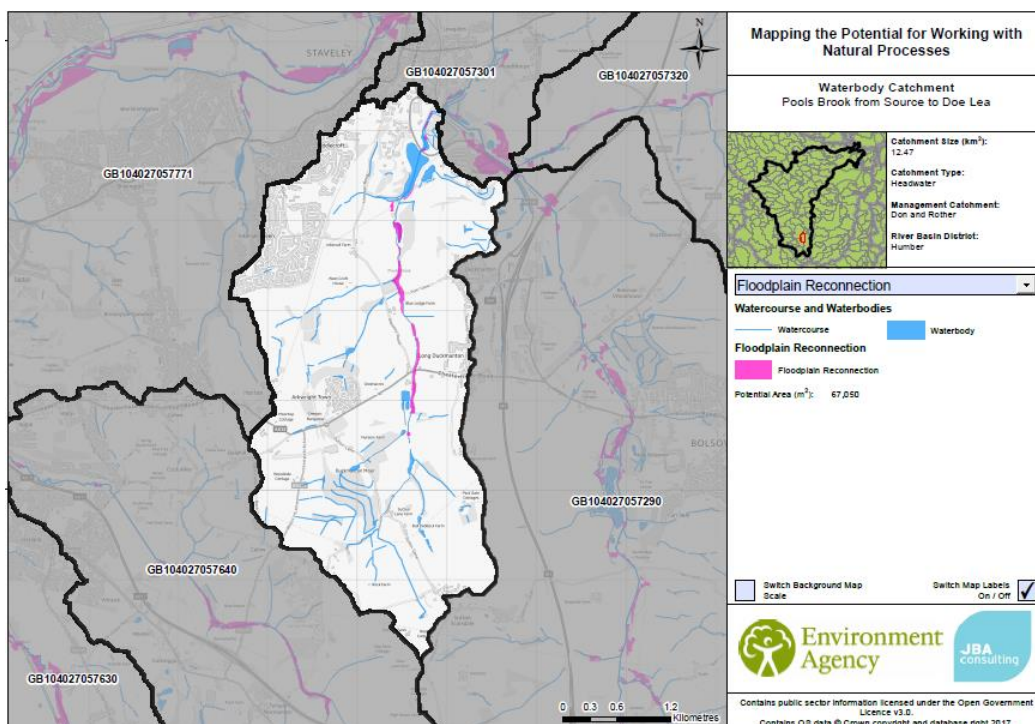
**Figure 6.13 Protected habitats data for Pools Brook**

Figure 6.14 shows the potential available for woodland, considering the constraints data (Figure 6.12). The 3 types of tree planting overlap in places, though this is helpful since it indicates whether an area of floodplain is also an area of slowly permeable soil.



**Figure 6.14 Three types of tree planting potential for Pools Brook**

Figure 6.15 indicates that the main watercourse has a low likelihood of floodplain inundation. This may provide potential to enhance connectivity and, in addition, to plant trees along a strip of slowly permeable soils (shown as dark green in Figure 6.15).

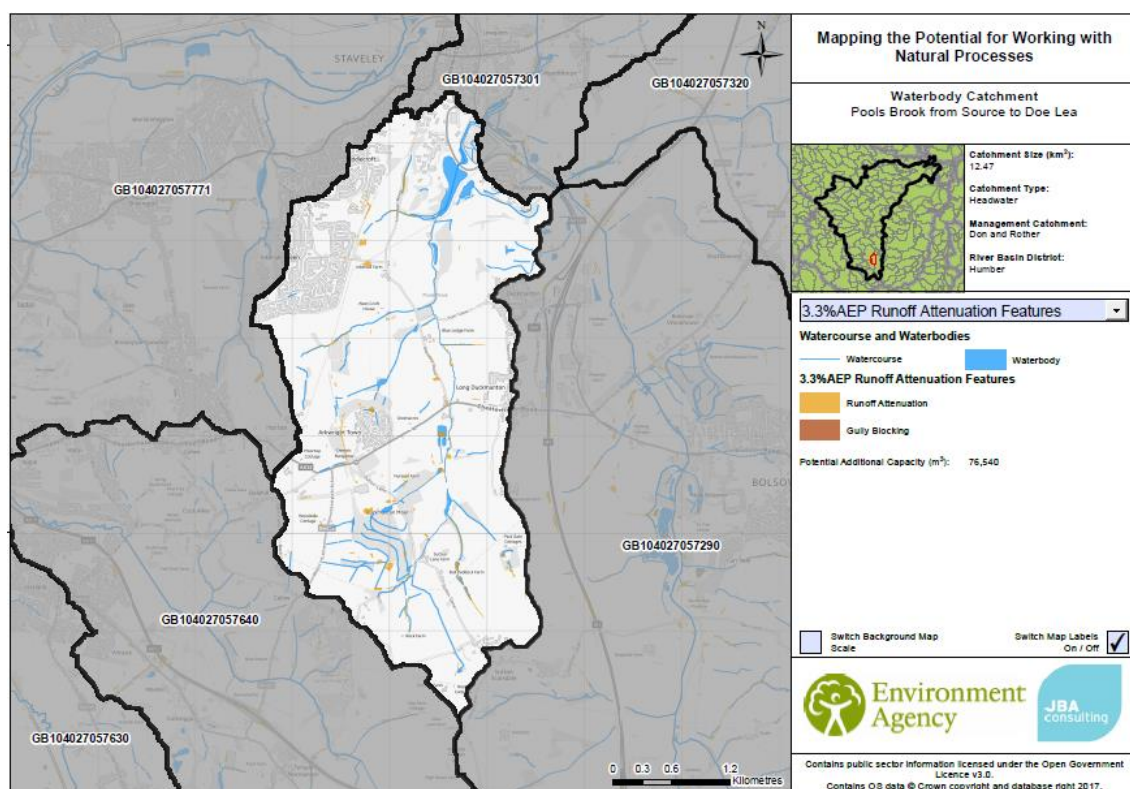


**Figure 6.15 Floodplain reconnection potential for Pools Brook**

It is also useful to use the dropdown menu to consider the other different layers and constraints to identify where there may be protected habitats or existing woodland. The run-off attenuation features could be designed to store water at higher flows, perhaps working together with the reconnected floodplains in the vicinity of the main channel.



The terrain in the chosen example has relatively shallow gradients and so there is no gully blocking potential identified (shown in brown in Figure 6.16).



**Figure 6.16 Run-off attenuation features (3.3% AEP) for Pools Brook**

## 6.2 Summary

This walkthrough presents the full set of maps and layers available to build up a picture for an example Water body Catchment. Although there is not a high level of potential for WWNP in this Water body Catchment based on a national standard, a user may find they are constrained to focus on a particular catchment.

The different layers tell a story of relatively low grade agricultural land upstream of some communities, where the main watercourse is poorly connected to the floodplain, which also has a strip of slowly permeable soils. Reconnection of the floodplain such that the floodplain floods more frequently and slowing that flood water using trees on a slowly permeable floodplain may help to attenuate flooding, lessen the flood risks and potentially deliver wider environmental benefits. Run-off attenuation features could be enhanced and connect at higher flows with the improved floodplain system. When considering which measures to prioritise, users should take into account a range of factors, including:

- the need for flood mitigation within and upstream of a catchment
- the sizes of individual areas of potential
- clusters of potential areas within subcatchments

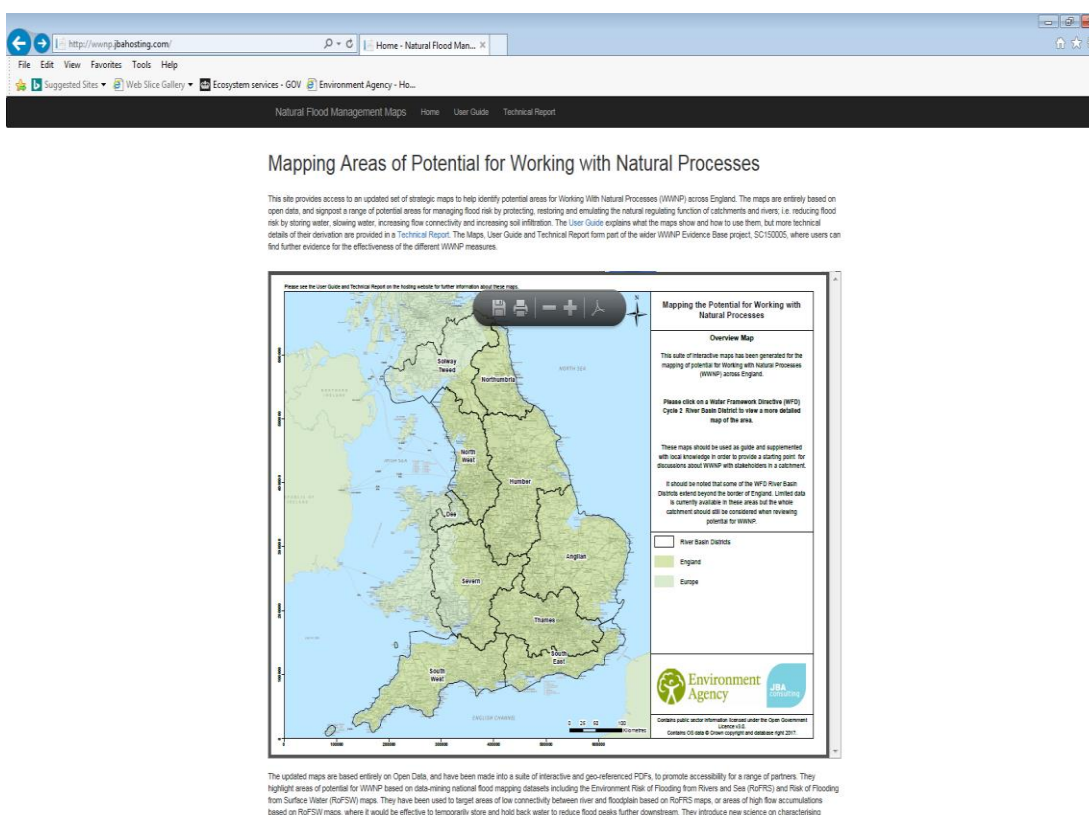
It should be noted that this is just an example. The next step would be to gather further knowledge and expertise, consulting with the Environment Agency on whether this catchment requires flood risk mitigation, and cross-checking the identified potential against more detailed mapping, additional data sources, land ownership considerations and local knowledge.

# 7 Software requirements

## 7.1 How to access the maps

The interactive geoPDF maps can be accessed online.

Using Internet Explorer (other browsers are not supported),<sup>4</sup> the maps are fully interactive at <http://wwnp.jbahosting.com>. A screenshot of the landing page is shown in Figure 7.1. The user can click on the PDFs interactively as long as the default PDF software is set to Adobe Reader v9.0 or higher, and can save individual PDFs onto their own hard drive, permissions allowing. Use the symbol on the far left of the black bar shown in Figure 7.1 to save a copy.



**Figure 7.1** Accessing the interactive maps (<http://wwnp.jbahosting.com>)

Notes: Screenshot when opened in Internet Explorer. The black bar appears when the cursor is hovered over the map.

<sup>4</sup> Internet Explorer is still available in Windows 10 through the Window Accessories dropdown menu. You can either open it each time via this route or install it on your computer.

## 7.2 GIS data

The new open data WWNP interventions and constraints layers are available in a single file geodatabase, accessed through the [Spatial Data Catalogue](#).

The metadata for each dataset is available at [data.gov.uk](http://data.gov.uk):

- [WWNP Floodplain Reconnection Potential](#)
- [WWNP Floodplain Woodland Potential](#)
- [WWNP Riparian Woodland Potential](#)
- [WWNP Runoff Attenuation Features 1% AEP](#)
- [WWNP Runoff Attenuation Features 3.3% AEP](#)
- [WWNP Wider Catchment Woodland Potential](#)
- [WWNP Woodland Constraints](#)

## 7.3 Online maps

ArcGIS Online is an online web GIS that allows users to view and access the WWNP maps and layers produced in this project. All the new open data layers have been uploaded, as well as some predefined web maps. These [maps and layers](#) will be available shortly after the project has launched.

ArcGIS Online can be accessed through a web browser (modern and up-to-date browsers recommended), mobile devices (apps or browser), or through desktop installations of ArcGIS. The project has aimed to make all the WWNP related content available without the need for an account with ESRI (the ArcGIS Online developers); although technical limitations may require users to register with ESRI.com before viewing the maps and data. Public accounts are available for free for non-commercial use. Further details on ArcGIS online can be found by conducting an internet search for “ArcGIS Online”.

Depending on the type of output and how you access it, there are various options for viewing, manipulating and downloading the data. These options are outlined in Table 7.1. A full list of layers and their functionality is provided in Table 7.2.

**Table 7.1 ArcGIS Online map documents**

Document Name	Description & usage cases	User functionality ( <i>some may require commercial AGOL subscription</i> )
Mapping Potential for WWNP (reduced functionality – easy-to-use map)	<p>This map has the simplest interface of all the maps. It is designed to simply view all the layers, as well as limited support layers (Environment Agency Flood Zones, Flood Defences and Main Rivers).</p> <p>The layers in this document have been pre-rendered to improve draw performance over a range of display scales.</p> <p>It is optimised for viewing at scales between UK-wide national maps and local watercourses (approximately 1:10,000).</p>	<p>Users can:</p> <ul style="list-style-type: none"> <li>Turn individual layers on and off</li> <li>Pan and zoom</li> <li>Search for locations</li> <li>Optionally track device location</li> <li>Rapidly zoom from national to local scales</li> </ul> <p>Users cannot:</p> <ul style="list-style-type: none"> <li>Add additional layers</li> </ul>
Mapping Potential for WWNP – Quick-load map – best for broadscale or national views (full functionality)	<p>This map is a full ArcGIS Online web map, preloaded with the same layers as the above simplified web map.</p> <p>It has the full set of ArcGIS Online web map functions available on your user account.</p>	<p>Everything available in the easy-to-use map.</p> <p>Users can:</p> <ul style="list-style-type: none"> <li>Add/remove and search for other layers</li> <li>Add custom web map layers and services</li> </ul>
	<p>It is optimised for viewing at scales between UK-wide national maps and local watercourses (approximately 1:10,000).</p>	<p>Save a copy of the document for their own editing</p> <p>Undertake geoprocessing tasks</p> <p>Users cannot:</p> <ul style="list-style-type: none"> <li>Query the attribute tables of the layers</li> <li>Change the legend or colour schemes of WWNP layers</li> </ul>
Mapping Potential for WWNP – Online Maps (full functionality)	<p>This map is a full ArcGIS Online web map, preloaded with the full potential for WWNP feature layers.</p> <p>It has the full set of ArcGIS Online web map functions available on your user account.</p> <p>It is optimised for viewing at scales between city-wide maps to field scale (approximately 1:5,000).</p>	<p>Everything available in the quick-load map.</p> <p>Users can:</p> <ul style="list-style-type: none"> <li>Inspect the attribute tables of the WWNP layers</li> <li>Change the colour scheme/rendering options of the WWNP layers</li> </ul>

**Table 7.2 ArcGIS Online map layers**

Layer Name	Hosted Layer Type	Functionality				
		View the layer	View the attributes	Edit (the live data)	Download 1: data 2: in-app caching	Change colour scheme
WWNP - WFD - River Basin Districts	Feature Layer	Yes	Yes	No	Yes	Yes
					Yes	
WWNP – WFD - Management Catchments	Feature Layer	Yes	Yes	No	Yes	Yes
					Yes	
WWNP - WFD - Water body Catchments	Feature Layer	Yes	Yes	No	Yes	Yes
					Yes	
WWNP Woodland Constraints	Feature Layer	Yes	Yes	No	Yes	Yes
					Yes	
WWNP Riparian Woodland Potential	Feature Layer	Yes	Yes	No	Yes	Yes
					Yes	
WWNP Floodplain Woodland Potential	Feature Layer	Yes	Yes	No	Yes	Yes
					Yes	
WWNP Wider Catchment Woodland Potential	Feature Layer	Yes	Yes	No	Yes	Yes
					Yes	
WWNP Runoff Attenuation Features 1in30 AEP	Feature Layer	Yes	Yes	No	Yes	Yes
					Yes	
WWNP Runoff Attenuation Features 1in100 AEP	Feature Layer	Yes	Yes	No	Yes	Yes
					Yes	
WWNP Floodplain Reconnection Potential	Feature Layer	Yes	Yes	No	Yes	Yes
					Yes	
WWNP Combined Woodland Potential (Cached Tiles)	Cached Tile Layer	Yes	No	No	No	No
					Yes	
WWNP Runoff Attenuation Features 1in100 AEP (Cached Tiles)	Cached Tile Layer	Yes	No	No	No	No
					Yes	
WWNP Woodland Constraints (Cached Tiles)	Cached Tile Layer	Yes	No	No	No	No
					Yes	
WWNP Floodplain Reconnection Potential (Cached Tiles)	Cached Tile Layer	Yes	No	No	No	No
					Yes	
WWNP Runoff Attenuation Features 1in30 AEP (Cached Tiles)	Cached Tile Layer	Yes	No	No	No	No
					Yes	



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## Floodplain reconnection

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## Run-off attenuation features

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QUINN, P., O'DONNELL, G., NICHOLSON, A., WILKINSON, M., OWEN, G., JONCZYK, J., BARBER, N., HARDWICK N. AND DAVIES, G., 2013. *Potential use of runoff attenuation features in small rural catchments for flood mitigation: evidence from Belford, Powburn and Hepscott*. Joint Newcastle University, Royal Haskoning and Environment Agency report.

## Woodlands

FORESTRY COMMISSION, 2011. *The UK Forestry Standard*. Edinburgh: Forestry Commission.

NISBET, T.R. AND THOMAS, H., 2008. *Restoring floodplain woodland for flood alleviation*. Final report for Defra, Project SLD2316. London: Department for Environment, Food and Rural Affairs.

PARROTT, J. AND MACKENZIE, N., 2000. *Restoring and managing riparian woodlands*. Aberfeldy, Perthshire: Scottish Native Woods.

# List of abbreviations

AEP	annual exceedance probability
BGS	British Geological Survey
FCERM	flood and coastal erosion risk management
FCRM	flood and coastal risk management
GIS	geographical information system
LiDAR	light detection and ranging
NFM	natural flood management
OGL	Open Government Licence
OS	Ordnance Survey
SSSI	Special Site of Scientific Interest
SUDS	sustainable urban drainage system
WWNP	Working with Natural Processes

# Glossary of terms

<b>Annual exceedance probability (AEP)</b>	This is a term for expressing flood frequency. The 100-year return period flood can be expressed as the 1% AEP flood, which has a 1% chance of being exceeded in any year. A 20% AEP event has a 20% chance of being exceeded in any one year, and is equivalent to the 5-year return period flood. The return period of a flood is the average period of time expected to elapse between the occurrence of a flood event of a certain size at a given site. The actual number of years between consecutive floods varies considerably because of the naturally changing climate. A 100-year event is an extreme flood event of such size that, over a long period of time, the average time between flood events of equal or greater magnitude is 100 years.
<b>Floodplain restoration</b>	Floodplain restoration aims to restore the hydrological connection between rivers and floodplains, so that flood waters inundate the floodplains and store water during times of high flows. This can involve removing flood embankments and other barriers to floodplain connectivity.
<b>Floodplain woodland</b>	Floodplain woodland refers to all woodland lying within the fluvial floodplain that is subject to intermittent, regular planned or natural flooding regime. It typically comprises broadleaved woodland, and can range from productive woodland on drier, intermittently flooded, areas to unmanaged, native wet woodland in wetter areas. The degree of benefit provided by this range of types can vary depending on the woodland.
<b>GIS (geographical information system)</b>	A geographical information system is a system designed to capture, store, manipulate, analyse, manage and present spatial or geographic data.
<b>Gully blocking</b>	Gullies are naturally occurring features of peatlands, where blanket peats spread to the heads of valleys; they also form where artificial drainage features become eroded. They can be blocked using a variety of materials including wood, plastic, stone and heather. They can create temporary flood storage space.
<b>Management Catchment</b>	The unit of geography for which action plans are drafted in implementing the Water Framework Directive.
<b>Measures and interventions</b>	The terms 'measures' and 'interventions' of Working with Natural Processes have been used interchangeably throughout this report. Measures and interventions are the change to a landscape or management regime with an intention to reduce flood risk. Examples include a change in a land management practice, construction of a run-off attenuation feature, planting of a new woodland and managed realignment on the coast.
<b>Riparian woodland</b>	Riparian woodland is woodland located within the riparian zone, defined here as the land immediately adjoining a watercourse or standing water and influenced by it. The

	<p>riparian zone is usually relatively narrow. It typically comprises native broadleaved woodland and is often unmanaged. The main role of riparian woodland from a natural flood management perspective is to slow down and hold back flood flows within watercourses, as well as to reduce sediment delivery and bankside erosion.</p>
<b>River Basin District</b>	<p>The Water Framework Directive defines River Basin Districts as “the area of land and sea, made up of one or more neighbouring river basins together with their associated groundwaters and coastal waters”.</p>
<b>Run-off</b>	<p>Total run-off or discharge, comprising of both surface run-off and throughflow.</p>
<b>Run-off attenuation features</b>	<p>These are intended to mimic natural hydrological regimes to minimise the impact of human activity on surface water drainage discharge, reducing flooding and pollution of waterways and groundwater. They include measures such as swales, ponds and sediment traps.</p>
<b>Slowly permeable soils</b>	<p>These are soils through which water passes slowly. These types of soils are more likely to generate infiltration-excess overland flow. Planting woodland on these naturally impermeable soils could break up them up, enabling greater infiltration and reducing surface run-off.</p>
<b>Till-diamicton</b>	<p>Till describes a group of sediments laid down by the direct action of glacial ice. These are usually sandy, silty clay (potentially chalky in southeast England) with pebbles, but can contain gravel-rich, or laminated sand layers. Diamicton refers to poorly sorted sediment with a wide size range and undefined composition.</p>
<b>Water body Catchment</b>	<p>The Water Framework Directive defines River Water body Catchments as “an area of land from which all surface run-off flows through a series of streams, rivers and, possibly, lakes to a particular point in the water course such as a river confluence”.</p>
<b>Wider catchment woodland</b>	<p>Wider catchment woodland is defined as the total area of all woodland within a catchment. The term ‘woodland’ is used to describe land predominantly covered in trees (with a canopy cover of at least 20%), whether in large tracts (generally called forests) or smaller areas known by a variety of terms, including woods, copses, spinneys or shelterbelts. Catchment woodland is likely to affect:</p> <ul style="list-style-type: none"> <li>• the generation and conveyance of flood flows by the water use by trees</li> <li>• the related effects on snow accumulation and melting</li> <li>• soil infiltration beneath woodland</li> <li>• the hydraulic roughness exerted by woodland</li> <li>• the impact of woodland on soil erosion and sediment delivery</li> </ul>

**Working with Natural Processes (WWNP)**

Working with Natural Processes is taking action to manage fluvial and coastal flood and coastal erosion risk by protecting, restoring and emulating the natural regulating function of catchments, rivers, floodplains and coasts.



# Appendix 1: Colour scales

## Woodland planting potential

Limited	<2,500,000m <sup>2</sup>
Low	2,500,000 m <sup>2</sup> – 5,000,000m <sup>2</sup>
Moderate	5,000,000m <sup>2</sup> – 10,000,000m <sup>2</sup>
High	10,000,000m <sup>2</sup> – 25,000,000m <sup>2</sup>
Very High	>25,000,000m <sup>2</sup>

## Floodplain reconnection potential

Limited	<100,000m <sup>2</sup>
Low	100,000m <sup>2</sup> – 250,000m <sup>2</sup>
Moderate	250,000m <sup>2</sup> – 500,000m <sup>2</sup>
High	500,000m <sup>2</sup> – 1,000,000m <sup>2</sup>
Very High	>1,000,000m <sup>2</sup>

## 3.3% AEP run-off attenuation features

Limited	<10,000m <sup>3</sup>
Low	10,000m <sup>3</sup> – 50,000m <sup>3</sup>
Moderate	50,000m <sup>3</sup> – 100,000m <sup>3</sup>
High	100,000m <sup>3</sup> – 250,000m <sup>3</sup>
Very High	>250,000m <sup>3</sup>

## 1% AEP run-off attenuation features

Limited	<10,000m <sup>3</sup>
Low	10,000m <sup>3</sup> – 50,000m <sup>3</sup>
Moderate	50,000m <sup>3</sup> – 100,000m <sup>3</sup>
High	100,000m <sup>3</sup> – 250,000m <sup>3</sup>
Very High	>250,000m <sup>3</sup>

# Appendix 2: WWNP and landowner considerations

The WWNP potential maps should be used in conjunction with early and full landowner and occupier engagement. It is also essential that wider farm business issues are taken into account. This appendix provides further guidance on landowner/occupier considerations and principles for engagement on NFM.

It is important to note that the mapping findings do not oblige landowners and occupiers to get involved in WWNP schemes. Practical, regulatory and permitting, or farm business reasons may exist which prevent NFM implementation being possible in locations highlighted on the maps.

## Landowner/occupier considerations

Landowners and occupiers have a range of considerations to take into account in relation to NFM. These include, but are not limited to:

- Terms of farm tenancy agreements
  - The landowner/tenant relationship is a crucial part of decision making in farm businesses.
  - Both parties will need to be consulted in relation to any proposed NFM schemes.
  - *Tenancy agreements* may contain terms regarding the use of the land or the condition it must be retained in. *Common land* is a piece of land in private ownership, where other people have certain traditional rights to use it in specified ways, such as being allowed to graze their livestock. Care must be taken to ensure NFM activities do not breach the conditions within agricultural tenancy or commons agreements.
- Eligibility for payment schemes
  - Involvement in measures such as planting trees and storing water could affect eligibility for the Basic Payment Scheme (under the Common Agricultural Policy), Countryside Stewardship and other environmental agreements.
- Availability of funding
  - Landowners/occupiers will need to obtain capital funding to cover the costs of implementing the scheme and whilst there may be funding available, it may not always be accessible.
  - They may also be a need for ongoing revenue funding to cover maintenance costs, or the costs to repair or reinstate land after an inundation event.
- Riparian rights and responsibilities
  - Riparian responsibilities include allowing water to flow in its natural state, keeping the watercourse free of debris and obstructions and maintaining banks and beds.
  - Measures such as woody material in the watercourse and tree planting may impact on these responsibilities.
- Consents

- Permission from relevant organisations is necessary to implement WWNP in or near main rivers and ordinary watercourses.
- Permits, licenses or consents may be required from different government agencies, with differing associated costs and processing times.
- Liability
  - If measures fail and cause flood damage on someone else's land or property, landowners may have liability in respect of the damage.
- Long-term considerations
  - Schemes often provide funding for a specific period of time, whereas NFM schemes are likely to be designed to increase downstream resilience in perpetuity.
  - After a scheme finishes, government authorities may designate a structure, meaning that consent would be needed to alter or remove it.

## Engagement principles

- ✓ Engage from an early stage
  - Initial awareness raising is an important first step.
  - Engagement with landowners and tenants in the catchment is key. However there are likely to be other organisations – including agronomists, land agents, supply chain, the National Farmers Union, the Country Land and Business Association, and the Tenant Farmers Association – which it may be necessary or beneficial to consult with.
  - Tying in with other local initiatives – such as Catchment Based Approach, Catchment Sensitive Farming, Rivers Trusts, and industry-led campaigns – can help to familiarise landowners/occupiers with WWNP schemes.
  - Talk to advisors the farmer trusts, they may be able to help you deliver your message more effectively
- ✓ Assess local situation first
  - This could involve a survey of local views, as was carried out in the River Ray case study (further details below).
  - Consulting local stakeholders may help to build understanding of local circumstances and provide a route into engaging with landowners/occupiers.
  - Do pre-site research before visiting individual farms. This could include looking at farm size, tenancy and payment schemes.
  - There is no 'one size fits all' approach. Know your sector and have a strategy.
- ✓ Start with a broader conversation
  - Work with existing trusted advisors to ask farmers about their farm business and system and try to understand how things work for them.
  - Leave discussions around the mapping or other sources of evidence until a later stage.
  - Invest time in building a relationship of trust.
- ✓ Listen to landowner/occupier knowledge
  - Landowners and occupiers have good long-term knowledge of the catchment, and how river levels respond to rainfall events.

- Landowner engagement should involve asking about the accuracy of the WWNP maps, and whether they believe there are more optimum areas for NFM implementation.
- ✓ Provide robust evidence and communicate this clearly
  - Be clear about intended outcomes. Is the project solely aimed at increasing flood resilience, or is it also intended to deliver biodiversity, water quality, carbon sequestration or other benefits?
  - Additional evidence, including data, modelling studies, local mapping and knowledge from relevant organisations should be used to supplement the findings of this project.
  - Evidence presented should be localised, visual, risk-based, demonstrate impacts and draw on other examples wherever possible.
  - Be open and realistic regarding any potential increase in flood risk to parcels of agricultural land.
- ✓ Invite farmers to say what they think the solutions might be
  - Listen before providing any advice.
- ✓ Take into account landowner concerns
  - Does implementing WWNP fit with their farm business?
  - What barriers are there to becoming involved in WWNP schemes? Can these be resolved? Are there compromise solutions?
- ✓ Look for win-win
  - Focus on situations which will benefit the farm business, in addition to flood risk management.
  - Consider multiple benefits – economic, social, environmental and regulation and compliance.

#### Case study: River Ray Rural Flooding - Oxfordshire

**Project Stage:** Consultation phase (2014/2015)

**WWNP Measures:** Likely to include changes in land management, soil improvements and runoff attenuation

**Cost:** £33.5k (mainly for modelling and mapping)

**Summary:** A survey on the attitudes of farmers in the River Ray catchment towards conventional and novel approaches for flood risk management was carried out. A hydrological modelling study considered the relative impacts of various land use and land management scenarios on the severity of flooding events. The modelling scenarios predicted that low cost catchment interventions could create significant reductions in flood damage.

The modelling survey generated a number of 'stakeholder engagement maps', which were used in discussions with catchment stakeholders. These show areas with the greatest sensitivity to flooding intervention measures and potential locations for runoff attenuation features. The aim is for this evidence base to be used to continue working with stakeholders to develop a works programme for delivering community-based flood attenuation.

The project's approach of 'engaging through research' enabled all stakeholders to approach the issues with an open mind, understanding that there was no right or wrong answer. More broadly, it demonstrated that stakeholder engagement and building consensus are crucial factors in delivering measurable outcomes at a catchment scale. Lessons learnt included recognising the high degree of time, effort, consistency and funding required to build consensus.



# Appendix 3: Additional datasets

The WWNP maps are intended to be used alongside other relevant datasets and sources of information. This can help users to refine their investigations and further target areas of interest. The datasets were selected on the basis of feedback from the project steering group and user testers. The table below does not provide an exhaustive list, and may be supplemented with additional data and local knowledge.

The datasets set out in the table below include information on topics such as agriculture, pollution, sediment, land cover, habitats, groundwater, geohazards, soils, geology, flood risk management and abstraction. These topics might be used to:

- highlight areas where WWNP could provide multiple benefits
- exclude areas where it may have detrimental impacts
- provide greater detail on the location of interventions and their potential flood risk benefit

The additional data provided in the table are categorised in terms of their access (licensing restrictions), coverage and resolution.

- **Green** shading in the table indicates that the data are as good, or better, than the maps produced in this project.
- **Yellow** shading suggests that users will need to check this limitation will be compatible with their analysis.
- **Red** shading highlights that some further input is likely to be required to allow these data to be included or useful in further analysis.

Information is also provided on the ownership of the data and the formats in which they are available.

Following the links<sup>6</sup> provided will allow you to find out more about the datasets.

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<sup>6</sup> All the links were accessed on 14 September 2017.

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
BGS Aquifer Designations	<p>The aquifer designation dataset was created by the Environment Agency/Natural Resources Wales and BGS, and identifies the different English and Welsh aquifers. Since April 2010, groundwater protection policy in England and Wales has used aquifer designations consistent with the Water Framework Directive. These designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply) but also their role in supporting surface water flows and wetland ecosystems.</p> <p>The maps are split into 2 different types of aquifer designation:</p> <ul style="list-style-type: none"> <li>• Superficial (drift) — permeable unconsolidated (loose) deposits (for example, sands and gravels)</li> <li>• Bedrock — solid permeable formations (for example, sandstone, chalk and limestone)</li> </ul> <p>The maps display the following aquifer designations:</p> <ul style="list-style-type: none"> <li>• Principal aquifers</li> <li>• Secondary aquifers (further subdivided into Secondary A, Secondary B and Secondary Undifferentiated)</li> <li>• Unproductive strata</li> </ul>	BGS	Conditional licence to use data; free to view	England and Wales	1:50,000	GIS vector data Online viewer WMS	<p>Data:  <a href="http://www.bgs.ac.uk/products/hydrogeology/aquiferDesignation.html">http://www.bgs.ac.uk/products/hydrogeology/aquiferDesignation.html</a></p> <p>Viewer:  <a href="http://apps.environment-agency.gov.uk/wiyby/151302.aspx">http://apps.environment-agency.gov.uk/wiyby/151302.aspx</a></p>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
BGS depth to groundwater	This dataset is a gridded interpolation of depth to groundwater. It is a raster grid, with 50m × 50m pixels holding values that represent the probable maximum depth, in metres, to the phreatic water table. This represents the likely lowest water level, under natural conditions, in an open well or borehole drilled into the uppermost parts of a rock unit. The dataset was modelled from topography and hydrology, assuming that surface water and groundwater are hydraulically connected. It does not use observations of groundwater level in wells or boreholes directly, though these have been used to validate its performance.	BGS	Conditional licence	Great Britain	1:50,000	GIS vector data	<a href="http://www.bgs.ac.uk/products/hydrogeology/depthToGroundwater.html">http://www.bgs.ac.uk/products/hydrogeology/depthToGroundwater.html</a>
BGS geological maps	Generalised digital geological map data Geological areas attributed with name and composition Arranged in 4 themes: <ul style="list-style-type: none"> <li>• bedrock geology</li> <li>• superficial deposits</li> <li>• mass movement</li> <li>• artificial ground</li> </ul> Faults and other linear features are available in a separate theme.	BGS	Conditional licence A free WMS service is available for 1:50,000	Variable depending on product	1:10,000 (partial coverage) 1:25,000 (various coverage) 1:50,000 (most of the UK) to 1:250,000 (100% national coverage)	GIS vector data Some available via WMS	<a href="http://www.bgs.ac.uk/products/digitalmaps/">http://www.bgs.ac.uk/products/digitalmaps/</a>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
BGS GeoSure (geohazards)	<p>These datasets identify areas of potential hazard and thus potential natural ground movement in Great Britain. These data, produced by BGS geologists and geotechnical specialists, are presented as 6 GIS data layers relating to the cause of the geohazard. Consists of 4 products:</p> <ul style="list-style-type: none"> <li>• BGS GeoSure: 1:50 000 high resolution dataset, providing information about 6 natural ground subsidence hazards in Great Britain</li> <li>• BGS GeoSure Shrink Swell 3D London: 1:50,000 regional hazard susceptibility map that identifies areas of potential shrink–swell hazard, in 3D space, at intervals down to 20m in London and the Thames Valley</li> <li>• BGS GeoSure debris flow: 1:50,000 national hazard susceptibility map, identifying areas of potential debris flow hazard for Great Britain</li> <li>• BGS GeoSure 5km hex grid: GIS model of interlocking hexagon cells (side length 5km) summarising information about 6 natural ground subsidence hazards in Great Britain</li> </ul>	BGS	Conditional licence or OGL (attributable) (depending on product)	Great Britain (3D London only)	1:50,000 5km resolution hex grid	GIS vector data GIS raster data PDF maps	<a href="http://www.bgs.ac.uk/products/geosure/home.html">http://www.bgs.ac.uk/products/geosure/home.html</a>



Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
BGS hydrogeology 625k	<p>The hydrogeological map indicates aquifer potential in generalised terms using a threefold division of geological formations:</p> <ul style="list-style-type: none"> <li>• those in which intergranular flow in the saturated zone is dominant</li> <li>• those in which flow is controlled by fissures or discontinuities</li> <li>• less permeable formations including aquifers concealed at depth beneath covering layers</li> </ul> <p>Highly productive aquifers are distinguished from those that are only of local importance or have no significant groundwater. Within each of these classes, the strata are grouped together according to age or lithology.</p> <p>The 1:625,000 scale data may be used as a guide to the aquifers at a regional or national level, but should not be relied on for local information.</p>	BGS	OGL (attributable)	UK	1:625,000	<p>GIS vector data</p> <p>Online viewer</p> <p>WMS</p>	<a href="http://www.bgs.ac.uk/products/hydrogeology/maps.html">http://www.bgs.ac.uk/products/hydrogeology/maps.html</a>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
BGS Infiltration SUDS map	<p>The dataset gives a preliminary indication of the suitability of the ground for infiltration SUDS (drainage systems that allow surface water to infiltrate to the ground such as soakaways, infiltration basins, infiltration trenches and permeable pavements). The selection and design of an appropriate system depends on the properties of the ground and in particular:</p> <ul style="list-style-type: none"> <li>• presence of severe constraints that must be considered prior to planning infiltration</li> <li>• drainage potential of the ground</li> <li>• potential for ground instability when water is infiltrated</li> <li>• protection of groundwater quality</li> </ul> <p>The map is based on 15 nationally derived subsurface property datasets, some of which are a result of direct observations, while others rely on modelled data. The dataset is structured using the factors listed above, and allows consideration of:</p> <ul style="list-style-type: none"> <li>• subsurface permeability</li> <li>• depth to groundwater</li> <li>• presence of geological floodplain deposits</li> <li>• presence of artificial ground, ground stability (soluble rocks, collapsible ground, compressible ground, running sand, shallow mining, landslide and shrink–swell clays)</li> <li>• potential for pollutant attenuation</li> <li>• Environment Agency's source protection zones</li> </ul>	BGS	Conditional licence or subscription service (depending on product)	Great Britain	1:50,000	GIS vector data Online viewer	<a href="http://www.bgs.ac.uk/products/hydrogeology/infiltrationSuds.html">http://www.bgs.ac.uk/products/hydrogeology/infiltrationSuds.html</a>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
BGS mining hazard (not including coal)	<p>The voids resulting from past underground mining activity pose a possible hazard. These datasets draw together a diverse range of material derived from geology, which constrains distribution, supplemented by literature searches for historic locations and expert knowledge to assemble, interpret and organise this information. The data provide an assessment of the likelihood that past underground mining may have occurred in the area.</p> <p>Mining of coal is specifically excluded from this dataset and enquiries on past coal mining should be directed to The Coal Authority.</p>	BGS	Conditional licence or OGL (attributable) (depending on product)	Great Britain	1:50,000 1km resolution hex grid	GIS vector data	<a href="http://www.bgs.ac.uk/products/geohazards/miningHazard/home.html">http://www.bgs.ac.uk/products/geohazards/miningHazard/home.html</a>

BGS National Landslide Database	<p>This database is the most extensive source of information on landslides in Great Britain. Each data point is regarded as a reference of a reported landslide event. The database currently holds over 17,000 records, which are continually being updated. New records are added as landslide information is made available. These data come from a variety of sources including social media, published BGS geological maps and active surveys. Other sources include commissioned and research studies, information from the public, and a number of regional databases inherited or compiled by the BGS since the 1970s, including the Department of the Environment's National Landslide Database constructed in the 1990s. Each landslide event is documented as fully as is possible, with information on:</p> <ul style="list-style-type: none"> <li>• location</li> <li>• name</li> <li>• size/dimensions</li> <li>• type</li> <li>• trigger</li> <li>• damage caused</li> <li>• movement date</li> <li>• age</li> </ul> <p>There is also a full bibliographic reference. The level of detail is determined by the source of the original reference. Where the record has been through the quality assurance process, the original reference has been checked for the reported location information and the point location has been amended as appropriate.</p>	BGS	Index GIS layer is free to access; specific reports are chargeable	Great Britain	N/A	PDF reports Index available as WMS	<a href="http://www.bgs.ac.uk/landslides/NLD.html">http://www.bgs.ac.uk/landslides/NLD.html</a>
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Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
BGS permeability	<p>Permeability data are often used in studies of groundwater and in particular during investigations of pollution or aquifer contamination. The BGS permeability information is based on the 1:50,000 Digital Geological Map of Great Britain (BGS Geology). The permeability indices are based on geological considerations and are as follows:</p> <ul style="list-style-type: none"> <li>• predominant flow mechanism, either intergranular flow, fracture flow, or a mixture of intergranular and fracture flow</li> <li>• a maximum permeability index</li> <li>• a minimum permeability index</li> </ul> <p>The permeability indices indicate the range of permeability likely to be encountered for each BGS Geology unit. The maximum and minimum permeability indices are divided into 5 classes:</p> <ul style="list-style-type: none"> <li>• very high permeability</li> <li>• high permeability</li> <li>• moderate permeability</li> <li>• low permeability</li> <li>• very low permeability</li> </ul>	BGS	Conditional licence	Great Britain	1:50,000	GIS vector data	<a href="http://www.bgs.ac.uk/products/hydrogeology/permeability.html">http://www.bgs.ac.uk/products/hydrogeology/permeability.html</a>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
BGS Soil Parent Material Model	<p>A parent material is a soil science name for a weathered rock or deposit from, and within which a soil has formed. In the UK, parent materials provide the basic foundations and building blocks of the soil, influencing their texture, structure, drainage and chemistry. Soils are the result of weathering processes that occur on the Earth's surface where the atmosphere meets the geosphere and hydrosphere. The Soil Parent Material Model details the distribution of physiochemical properties of the weathered and unweathered parent materials of the UK. The aim is to:</p> <ul style="list-style-type: none"> <li>• facilitate spatial mapping of UK soil properties</li> <li>• identify soils and landscapes sensitive to erosion</li> <li>• provide a national overview of our soil resource</li> <li>• develop a better understanding of weathering properties and processes</li> </ul>	BGS	Conditional licence or OGL (attributable) (depending on product)	Great Britain	1:50,000 1km resolution hex grid	GIS vector data PDF maps	<a href="http://www.bgs.ac.uk/products/onshore/soilPMM.html">http://www.bgs.ac.uk/products/onshore/soilPMM.html</a>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
BGS Geology: Superficial deposits thickness models	<p>Superficial deposits are the youngest of the geological formations (&lt;2 million years old). They are largely unconsolidated and cover much of the bedrock of Britain. They generally include sediments deposited during the Pleistocene (Quaternary) glacial episodes, and subsequent Holocene rivers and coastal systems. Superficial deposits also include modern manmade deposits such as mining spoil and road embankments.</p> <p>These models show the depth of the bedrock surface, information critical in a number of areas of work such as civil engineering, the evaluation of groundwater resources and possible water pollution, and in the prediction of surface hazards such as landslides and the collapse of underlying rocks.</p> <p>The model has been created using digital mathematical interpolation techniques. It is produced by analysing information from ~600,000 borehole logs held in the BGS archives. It also uses the extent of superficial deposits from the 1:50,000 scale digital geological map of Britain.</p>	BGS	Conditional licence or OGL (attributable) (depending on product)	Great Britain	1:50,000 1km resolution hex grid	GIS vector data	<a href="http://www.bgs.ac.uk/products/onshore/superficialThickness.html">http://www.bgs.ac.uk/products/onshore/superficialThickness.html</a>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
BGS Susceptibility to groundwater flooding	In response to the need for more information on groundwater flooding, BGS produced the first national dataset on the susceptibility of groundwater flooding covering England, Wales and Scotland. Based on geological and hydrogeological information, the digital data can be used to identify areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface.	BGS	Conditional licence	Great Britain	1:50,000	GIS vector data	<a href="http://www.bgs.ac.uk/products/hydrogeology/groundwaterFlooding.html">http://www.bgs.ac.uk/products/hydrogeology/groundwaterFlooding.html</a>
CEH Land Cover Map 2015 (LCM2015)	LCM2015 is derived from satellite images and digital cartography, and provides land cover information for the entire UK. Land cover is based on UK Biodiversity Action Plan Broad Habitats classes. It is used by government departments and agencies, county councils, charities and commissions, as well as environmental management bodies, consultancies and researchers. It has wide application in many sectors and is available in different formats to suit the requirements of users.	CEH	Conditional licence	Great Britain	Smallest mapped area is 0.5ha. Anything smaller is included with adjacent land parcels. Available as vector, 25m raster and various 1km rasters	GIS vector data GIS raster data	<a href="https://www.ceh.ac.uk/services/land-cover-map-2015">https://www.ceh.ac.uk/services/land-cover-map-2015</a>



Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
CEH Land Cover® plus: Crops	<p>This is the first detailed, interactive map of UK cropping and is based on satellite data. The map is based on the Land Cover Map parcel framework. Every parcel &gt;2ha categorised as arable/horticultural or improved grassland parcels is coded with crop type information. Where parcels contain 2 or more crops, preliminary processing subdivides parcels into separate cropping units. Cropping data for 2015 and 2016 were available at the time of writing.</p> <p>The crop classes for 2015 are winter wheat (including oats), winter barley, spring barley, oilseed rape, field beans, potatoes, sugar beet, maize and improved grass. Those in 2016 are winter wheat (including oats), spring wheat, winter barley, spring barley, oilseed rape, field beans, potatoes, sugar beet, maize and improved grass.</p> <p>Other cereals, peas, early potatoes, early maize, and vegetables are grouped in a class called 'other', together with a small number of parcels that could not be classified.</p>	CEH	Conditional licence	UK	Minimum mapping unit is 2ha (which would equate to a square ~140m × 140m)	GIS vector data	<a href="https://www.ceh.ac.uk/crops2015">https://www.ceh.ac.uk/crops2015</a>
CEH SAAR	Flood Estimation Handbook data: standard average annual rainfall (SAAR) gives information on the average climatic conditions.	CEH	Conditional licence	England and Wales	1:250,000	GIS vector data (proprietary format)	<a href="https://www.ceh.ac.uk/services/flood-estimation-handbook">https://www.ceh.ac.uk/services/flood-estimation-handbook</a>
CEH SPRHOST	Flood Estimation Handbook Data: standard percentage run-off (SPR) (%) associated with each Hydrology of Soil Types (HOST) soil class. This can be used to derive SPRHOST over a catchment.	CSAFI/ CEH	Conditional licence	England and Wales	1:250,000 or 1km grid	Data tables or GIS raster files	<a href="http://www.landis.org.uk/data/nmhost.cfm">http://www.landis.org.uk/data/nmhost.cfm</a>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
CSAFI Soil Series maps for England and Wales, and NATMAP Vector	<p>'Soil series' are the taxonomic names given to the various types of soil recognised by CSAFI within England and Wales. Each soil series has a set of field and laboratory measurements for a range of characteristics (physical, chemical, bio-indicative). When combined with the National Soil Map, complex thematic maps and modelled outputs can be created to give a national 3D map of representative soil characteristics across England and Wales. The following products are available:</p> <ul style="list-style-type: none"> <li>• SOILSERIES Info</li> <li>• SOILSERIES Pesticides</li> <li>• SOILSERIES Hydrology</li> <li>• SOILSERIES Leacs</li> <li>• HORIZON Fundamentals</li> <li>• HORIZON Hydraulics</li> </ul> <p>NATMAP Vector is a 1:250,000 scale map of England and Wales, showing the locations of the 297 distinct soil associations wherever they occur. Within each of the soil associations are multiple soil series. This hierarchical data structure allows for easy integration with the series-based, non-spatial SOILSERIES data.</p>	CSAFI/ OS	Conditional licence	England and Wales	Various: 1:50,000 to 1:250,000 depending on element	Data tables GIS vector data	<p>SOILSERIES:  <a href="http://www.landis.org.uk/data/series.cfm">http://www.landis.org.uk/data/series.cfm</a></p> <p>NATMAP Vector:  <a href="http://www.landis.org.uk/data/nmvector.cfm">http://www.landis.org.uk/data/nmvector.cfm</a></p>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
Environment Agency: Catchment Abstraction Management Strategies (CAMS)	CAMS set out how the Environment Agency plans to manage the water resources of a catchment and contribute to implementing the Water Framework Directive. A licence is needed from the Environment Agency to abstract >20m <sup>3</sup> of water per day from a river or stream, reservoir, lake or pond, canal, spring or an underground source. Whether a licence is granted depends on the amount of water available after the needs of the environment and existing abstractors are met, and whether the justification for the abstraction is reasonable.	Environment Agency	OGL	England	Not applicable	PDF reports: split into 16 map areas, each containing a number of catchments	<a href="https://www.gov.uk/government/collections/water-abstraction-licensing-strategies-cams-process">https://www.gov.uk/government/collections/water-abstraction-licensing-strategies-cams-process</a>
Environment Agency: Catchment Flood Management Plans (CFMPs)	CFMPs consider all types of inland flooding from rivers, groundwater, surface water and tidal flooding. Shoreline Management Plans (SMPs) consider flooding from the sea. CFMPs also include: <ul style="list-style-type: none"> <li>the likely impacts of climate change</li> <li>the effects of how we use and manage the land</li> <li>how areas could be developed to meet our present day needs without compromising the ability of future generations to meet their own needs</li> </ul> CFMPs help the Environment Agency and its partners to plan and agree the most effective way to manage flood risk in the future. The CFMPs are grouped by river basin district.	Environment Agency	Various: reports are in the public domain	England	Catchment scale	PDF reports Further supporting data available on a catchment basis. Please search on data.gov.uk for more details.	<a href="https://www.gov.uk/government/collections/catchment-flood-management-plans">https://www.gov.uk/government/collections/catchment-flood-management-plans</a>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
Environment Agency: Detailed River Network (DRN)	The DRN is the only large-scale, accurate and fully attributed digital river centreline covering England and Wales. It is captured from the water features theme of the OS MasterMap® topographic layer and built into a network using automated rules. Other input datasets and extensive local Environment Agency staff knowledge have been used to augment the core geometry to incorporate critical spatial detail and attribution, such as flow direction and path, not available from the OS mapping and to verify the accuracy of the centreline itself. The dataset has full feature network geometry cross-referenced with OS MasterMap following Digital National Framework principles.	Environment Agency	Conditional licence; may be limited use	England	1:10,000	GIS vector data	<a href="https://data.gov.uk/dataset/detail/ed-river-network--offline-drainage-afa036">https://data.gov.uk/dataset/detail/ed-river-network--offline-drainage-afa036</a>



Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
Environment Agency: Flood Map for Planning (Rivers and Sea)	<p>The Flood Map shows the areas across England and Wales that could be affected by flooding from rivers or the sea. It also shows flood defences and the areas that benefit from them. The Flood Map includes the following layers of information:</p> <ul style="list-style-type: none"> <li>Flood Zone 3 – shows the Environment Agency's best estimate of the areas of land with a 1 in 100 (or greater) chance of flooding each year from rivers, or with a 1 in 200 chance (or greater) of flooding each year from the sea</li> <li>Flood Zone 2 – shows the Environment Agency's best estimate of the areas of land between Zone 3 and the extent of the flood from rivers or the sea with a 1 in 1,000 chance of flooding in any year (includes those areas defined in flood zone 3)</li> <li>Spatial flood defences (without standardised attributes) – shows those defences constructed during last 5 years with a standard of protection <math>\geq 1\%</math> for rivers and 0.5% from the sea</li> <li>Areas benefiting from flood defences – shows those areas that would benefit from the presence of defences in a 1% fluvial/ 0.5% tidal flood event</li> <li>Flood storage areas – shows those areas that act as a balancing reservoir</li> </ul>	Environment Agency	OGL	England	Variable: nominally 1:10,000	GIS vector data	<p>Flood Zone 3:  <a href="https://data.gov.uk/dataset/flood-map-for-planning-rivers-and-sea-flood-zone-3">https://data.gov.uk/dataset/flood-map-for-planning-rivers-and-sea-flood-zone-3</a></p> <p>Flood Zone 2:  <a href="https://data.gov.uk/dataset/flood-map-for-planning-rivers-and-sea-flood-zone-2">https://data.gov.uk/dataset/flood-map-for-planning-rivers-and-sea-flood-zone-2</a></p> <p>Spatial flood defences:  <a href="https://data.gov.uk/dataset/flood-map-for-planning-rivers-and-sea-spatial-flood-defences-without-standardised-attributes">https://data.gov.uk/dataset/flood-map-for-planning-rivers-and-sea-spatial-flood-defences-without-standardised-attributes</a></p> <p>Areas benefiting from defences:  <a href="https://data.gov.uk/dataset/flood-map-for-planning-rivers-and-sea-areas-benefiting-from-defences">https://data.gov.uk/dataset/flood-map-for-planning-rivers-and-sea-areas-benefiting-from-defences</a></p> <p>Flood storage areas:  <a href="https://data.gov.uk/dataset/flood-map-for-planning-rivers-and-sea-flood-storage-areas">https://data.gov.uk/dataset/flood-map-for-planning-rivers-and-sea-flood-storage-areas</a></p>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
Environment Agency: Historic Flood Map	<p>This GIS layer shows the maximum extent of all individual Recorded Flood Outlines from river, the sea and groundwater springs, and shows areas of land previously subject to flooding in England. Records began in 1946, though limited details about earlier flooding incidents may be available.</p> <p>This dataset differs from the Recorded Flood Outline dataset (see below) in that it contains only those flood outlines that are 'considered and accepted' if certain criteria are met (see link for details).</p> <p>The absence of coverage in the Historic Flood Map for an area does not mean that the area has never flooded, only that there are currently no records of flooding in this area. It is also possible that the pattern of flooding in this area has changed and that this area would now flood under different circumstances.</p> <p>The Historic Flood Map takes into account the presence of defences, structures and other infrastructure that existed at the time of flooding. It includes flood extents that may have been affected by overtopping, breaches or blockages. Flooding shown to the land does not necessarily indicate that properties were flooded internally.</p> <p>The Historic Flood Map consists of spatial data only.</p>	Environment Agency	OGL	England (only where records exist)	Variable: nominally 1:10,000	GIS vector data	<a href="https://data.gov.uk/dataset/historic-flood-map1">https://data.gov.uk/dataset/historic-flood-map1</a>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
Environment Agency: LiDAR/DTM	<p>The Environment Agency's LiDAR data archive contains digital elevation data derived from surveys carried out by the Environment Agency's specialist remote sensing team. Accurate elevation data are available for over 70% of England.</p> <p>The dataset can be supplied as a Digital Surface Model (DSM) produced from the signal returned to the LiDAR equipment (including heights of objects such as vehicles, buildings and vegetation, as well as the terrain surface) or as a Digital Terrain Model (DTM) produced by removing objects from the Digital Surface Model. These data can be processed by the user to show slope, aspect, catchment watersheds and so on.</p>	Environment Agency	OGL	About 70% of England; focused primarily on floodplains	Various:- 2.0, 1.0, 0.5, 0.25m grids available	GIS raster ASCII raster JPEG images	<a href="https://data.gov.uk/data/search?q=%22LiDAR%22&amp;publisher=environment-agency">https://data.gov.uk/data/search?q=%22LiDAR%22&amp;publisher=environment-agency</a>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
Environment Agency local detailed flood models	<p>Local, detailed flood models are used by the Environment Agency, its partners, customers and a wide range of other users for a variety of reasons. Generally, flood models produce the following information, much of which is generated in a spatial format and can be added to maps:</p> <ul style="list-style-type: none"> <li>• flow and water level conditions in rivers, tidal rivers, estuaries and at the coastline</li> <li>• boundary wave conditions for tidal flood risk assessments</li> <li>• flood extent, depth, velocity, hazard, timing, duration and flow paths over the fluvial or tidal floodplain</li> <li>• loadings on defences</li> </ul> <p>Pre-existing flood models can be very useful when planning and assessing WWNP intervention measures at a detailed scale.</p>	Environment Agency	Conditional licence: from freely available to limited use	England only (where records exist)	Variable from ultra-detailed single site 2D models to 1:100,000 strategic catchment models	Variable from bespoke model input files to PDF maps	<p>Contact your local Environment Agency team, or make contact via the Environment Agency's national customer contact centre:</p> <p><a href="https://www.gov.uk/government/organisations/environment-agency/about/access-and-opening">https://www.gov.uk/government/organisations/environment-agency/about/access-and-opening</a></p>



Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
Environment Agency: National Receptors Dataset (NRD) 2014	<p>The NRD is a collection of risk receptors primarily intended for use in FCERM. It is a spatial dataset which contains a number of GIS layers categorised into themes of information including:</p> <ul style="list-style-type: none"> <li>• buildings</li> <li>• environment</li> <li>• heritage</li> <li>• transport</li> <li>• utilities</li> </ul> <p>The NRD includes property points that are Copy Derived from OS MasterMap AddressLayer2 with information on property type, floor area and the Flood Hazard Research Centre's Multi-Coloured Manual codes attributed. It was designed to meet the needs of Preliminary Flood Risk Assessments and the Environment Agency's National Flood Risk Assessment, although it can be used for other purposes.</p>	Environment Agency	<p>External version: conditional licence; may be limited use.</p> <p>Version internal to the Environment Agency: only available for projects where the Environment Agency is the main lead.</p>	England	1:1,250 (same as underlying OS MasterMap data)	GIS vector data	<a href="https://data.gov.uk/dataset/national-receptor-dataset-afa171">https://data.gov.uk/dataset/national-receptor-dataset-afa171</a>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
Environment Agency: Recorded Flood Outlines	<p>Recorded Flood Outlines is a GIS layer that shows all the Environment Agency's records of historic flooding from rivers, the sea, groundwater and surface water. Each individual recorded flood outline contains a consistent list of information about the recorded flood. Records began in 1946, though limited details about earlier flooding incidents may be available.</p> <p>The absence of coverage by Recorded Flood Outlines for an area does not mean that the area has never flooded, only that the Environment Agency does not currently have records of flooding in this area. It is also possible that the pattern of flooding in this area has changed and that this area would now flood or not flood under different circumstances.</p> <p>The Recorded Flood Outlines take into account the presence of defences, structures and other infrastructure where they existed at the time of flooding. It includes flood extents that may have been affected by overtopping, breaches or blockages. Any flood extents shown do not necessarily indicate that properties were flooded internally.</p> <p>The Historic Flood Map contains a subset of Recorded Flood Outlines that satisfy certain criteria.</p>	Environment Agency	OGL	England: only where records exist	Variable: nominally 1:10,000	GIS vector data	<a href="https://data.gov.uk/dataset/recorded-flood-outlines1">https://data.gov.uk/dataset/recorded-flood-outlines1</a>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
Environment Agency: riparian shading	<p>Insolation is a measure of solar radiation energy received on a given surface area in a given time. The Environment Agency has maps of insolation from both LiDAR DSM and DTM. The insolation maps have been produced using the ArcGIS function 'Area Solar Radiation', with the date parameters set to May, June, July, August and September, with hourly intervals (every 14 days). The product from the function is a raster of incoming solar radiation in Watt Hours per square metre (WH/m<sup>2</sup>) for both DTM and DSM.</p> <p>The Relative Shade map is created from the surface objects and is a product of the difference between the DSM and DTM. The Solar Insolation maps, with units in WH/m<sup>2</sup>, have then been clipped using OS MasterMap water feature polygons that have themselves been clipped and dissolved using a 25m × 25m or 100m × 100m grid.</p>	Environment Agency	Conditional licence or OGL (attributable) (depending on product)	National dataset, but the analysis has only been made where riparian LiDAR is available	Unknown	GIS raster data PDF maps	<p>Contact your local Environment Agency team, or make contact via the Environment Agency's national customer contact centre:</p> <p><a href="https://www.gov.uk/government/organisations/environment-agency/about/access-and-opening">https://www.gov.uk/government/organisations/environment-agency/about/access-and-opening</a></p>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
Environment Agency Risk of Flooding from Surface Water (RoFSW) (multiple datasets)	<p>These maps indicate the broad areas likely to be at risk of surface water flooding. The maps pick out natural drainage channels, rivers, low areas in floodplains, and flow paths between buildings. They do not indicate flooding caused by local rainfall, or show flooding that occurs from overflowing watercourses, drainage systems or public sewers caused by catchment-wide rainfall events or river flow. A national model (2m<sup>2</sup> grid) was run for 1 in 30, 1 in 100 and 1 in 1,000 year rainfall events. Layers available show data for 3 probabilities (1 in 30, 1 in 100 and 1 in 1,000) and include:</p> <ul style="list-style-type: none"> <li>• Extents – 3 layers showing extent of flooding</li> <li>• Depths – 3 banded layers showing depth of flooding</li> <li>• Velocity – 3 banded layers showing flooding velocity</li> <li>• Flow direction (2m) – 3 banded layers showing flood flow direction (at maximum velocity) (created from original 2m raster grid)</li> <li>• Flow direction (25m) – 3 banded layers showing flood flow direction (at maximum velocity) (created from resampled 25m raster grid)</li> <li>• Suitability – one layer showing basic confidence information</li> <li>• Model details – one layer showing the source of the final outputs and basic information about the model methodology and parameters used.</li> </ul>	Environment Agency	Conditional licence; may be limited use	England	1:10,000	GIS vector data	<a href="https://data.gov.uk/data/search?q=%22risk+of+flooding+from+surface+water%22&amp;publisher=environment-agency&amp;page=1">https://data.gov.uk/data/search?q=%22risk+of+flooding+from+surface+water%22&amp;publisher=environment-agency&amp;page=1</a>



Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
Environment Agency: Water Framework Directive River Basin Management Plans 2 (RBMP2) Risk Assessments – Rivers	This dataset contains risk assessments produced to support the cycle 2 RBMPs. It contains river water bodies that are assessed to be at risk of failing Water Framework Directive objectives or at risk of deteriorating for a number of different environmental pressures. It contains Water body data for all English river basin districts and the Severn. It contains Welsh water bodies in the Severn River Basin District in spreadsheet format.	Environment Agency	OGD	All English river basin districts and the Severn	Unknown	Excel spreadsheet	<a href="https://data.gov.uk/dataset/wfd-rbmp2-risk-assessments-rivers">https://data.gov.uk/dataset/wfd-rbmp2-risk-assessments-rivers</a>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
Environment Agency: Woodlands for Water opportunity mapping	<p>Forest Research was commissioned to provide GIS spatial datasets and maps that identify opportunities for woodland creation to reduce diffuse pollution and flood risk across England and Wales. The maps can be applied across a range of scales, from assessing opportunities for planting at a strategic national or regional level down to the practical catchment or farm scale.</p> <p>The national opportunity maps identify priority areas where woodland planting could deliver positive outcomes for water quality and/or flood risk management in England and Wales. The maps identify:</p> <ul style="list-style-type: none"> <li>• priority areas (at a scale of 1km<sup>2</sup>) in catchments of river water bodies at risk of failing good status due to diffuse pollutant loads (nitrate, phosphate, sediment, pesticides and faecal indicator organisms)</li> <li>• areas at risk from flooding from rivers and surface water</li> <li>• priority areas where run-off from soils is rapid</li> </ul> <p>They also include information on constraints to woodland planting.</p>	Environment Agency	Conditional license (need chargeable)	England and Wales	1:10,000	GIS vector data PDF maps	<a href="https://www.forestry.gov.uk/fr/opportunitymapping">https://www.forestry.gov.uk/fr/opportunitymapping</a>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
European Soil Data Centre: European Soil Database v2.0	<p>The European Soil Database is an important source of data from which many other data and services are derived. For instance, the European Soil Database v2 Raster Library contains raster (grid) data files with cell sizes of both 1km × 1km and 10km × 10km for a large number of soil related parameters.</p> <p>The 10km × 10km rasters are in the public domain and allow expert users to use the data, for instance, to run soil, water and air related models. The 1km × 1km rasters are available after prior registration.</p> <p>The grids fit with ideas from INSPIRE to develop 'nested' systems for reporting and updating European (soil) data at different scales, according to a hierarchy of grids with a common point of origin and standardised location and size of grid cells.</p>	European Soil Data Centre	<p>Free for public use (registration needed)</p> <p>May need conditional licence for commercial use.</p>	Eurasia	1:1,000,000	GIS vector data	<a href="http://esdac.jrc.ec.europa.eu/content/european-soil-database-v20-vector-and-attribute-data#tabs-0-description=1">http://esdac.jrc.ec.europa.eu/content/european-soil-database-v20-vector-and-attribute-data#tabs-0-description=1</a>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
ESI / Ambiental Groundwater Flood Risk (GeoSmart's Groundwater Flood Risk Map, GW5)	<p>GEOSMART GW5 at a glance</p> <ul style="list-style-type: none"> <li>Covers all of properties in England and Wales.</li> <li>5m resolution allows for risk assessment at property level.</li> <li>Classifies risk as negligible, low, medium or high (1.5% of properties categorised as high risk).</li> <li>Identifies areas within a property that may be at risk.</li> <li>Considers all aquifer types and permeable superficial deposits from rivers and high tides.</li> <li>Focuses on risk rather than susceptibility to provide a less conservative overview.</li> </ul>	ESI Consulting	Conditional licence	Great Britain	5m grid	<p>GIS vector data</p> <p>GIS raster data</p> <p>PDF maps</p>	<a href="http://www.ambiental.co.uk/products/groundwater_flood_risk/">http://www.ambiental.co.uk/products/groundwater_flood_risk/</a>
Forestry Commission: Countryside Stewardship Scoring Woodland Priority Habitat Network England 2016 to 2017	<p>This dataset was used to score Higher Tier Countryside Stewardship applications for woodland creation in England for 2016 to 2017 where points were available for biodiversity objectives.</p> <p>Countryside Stewardship, launched in 2015, is a Rural Development Programme for England grant scheme. It aims to contribute ~£900 million over 6 years to help farmers and woodland managers look after the environment.</p> <p>Countryside Stewardship grants are open to those who propose to make the best environmental improvements within their local area. Although the scheme is open to everyone who is eligible to apply, it is competitive and targeted.</p>	Forestry Commission	OGL	England	Unknown	GIS vector data	<a href="https://data.gov.uk/dataset/countryside-stewardship-scoring-woodland-priority-habitat-network-england-2016-2017">https://data.gov.uk/dataset/countryside-stewardship-scoring-woodland-priority-habitat-network-england-2016-2017</a>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
Forestry Commission: National Forest Inventory (NFI) 2015 (other years are available)	<p>The NFI is a rolling programme designed to provide accurate information about the size, distribution, composition and condition of Great Britain's forests and woodlands, and the changes taking place in the woodlands through time. It is essential for developing and monitoring the policies and guidance that support the sustainable management of woodland.</p> <p>The Forestry Commission has carried out woodland surveys and compiled forest inventories at 10–15 year intervals since 1924. The NFI, which started in 2009, is the latest of these periodic surveys to gather information and keep it current across Great Britain.</p> <p>The NFI covers any forest or woodland in Great Britain of at least 0.5ha in area with a minimum width of 20m, and which has at least 20% tree canopy cover (or the potential to achieve this). This ensures that the NFI outputs are compatible with outputs from other European forest inventories.</p> <p>The Forestry Commission is also interested in smaller areas of woodland, including smaller woods (0.1–0.5ha), trees in linear features (hedges), trees in groups and single trees. Data for these 'small woods' are based on sample field survey and/or newly emerging high resolution remote sensing data.</p>	Forestry Commission	OGL (registration needed)	Great Britain	Unknown	GIS vector data	<a href="https://www.forestry.gov.uk/inventory">https://www.forestry.gov.uk/inventory</a>



Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
General administrative boundaries	<p>A range of administrative boundaries are available to search and download on the internet. Please consider your needs and search. Examples include:</p> <ul style="list-style-type: none"> <li>• Environment Agency Operational Areas</li> <li>• local government boundaries</li> <li>• Internal Drainage Board district boundaries</li> <li>• National Parks</li> </ul>	Various	Various: mostly OGL	Various (Great Britain)	Various: local to national  Usually apply to an appropriate scale	Various	Search on <a href="http://data.gov.uk">http://data.gov.uk</a> Or a general internet search engine

<p>HM Land Registry: Land Ownership 'National Polygon Service'</p>	<p>The National Polygon Service contains 3 licensed, chargeable datasets (not available separately).</p> <ul style="list-style-type: none"> <li>• National Polygon dataset – shows indicative shape and position of each boundary of a registered title for land and/or property in England and Wales. Every title (freehold or leasehold) has at least one index polygon. Dataset contains &gt;24 million titles and includes 28 million polygons. HM Land Registry index polygons are mapped against OS MasterMap.</li> <li>• Title Descriptor dataset – describes legal interest(s) recorded against freehold and leasehold estates (property and/or land) registered in England and Wales.</li> <li>• Title Number and UPRN Look Up dataset –contains title numbers and associated Unique Property Reference Numbers (UPRNs) for freehold and leasehold property/land registered in England and Wales.</li> </ul> <p>UPRNs are unique 12 digit numbers assigned to every addressable location in the UK. The information is created by GeoPlace, a joint venture between OS and local authorities, which name and number every street and property. OS AddressBase links both property and land information to a map whenever possible. Title numbers and UPRNs can only be linked where a relationship between the title number and AddressBase address has been identified.</p>	<p>HM Land Registry</p>	<p>Conditional licence</p>	<p>England and Wales</p>	<p>1:1,250, 1:2,500 and 1:10,000</p>	<p>GIS vector data, and linked databases (will require linking by user)</p>	<p><a href="https://www.gov.uk/guidance/national-polygon-service">https://www.gov.uk/guidance/national-polygon-service</a></p>
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Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
	UPRNs provide a comprehensive, complete and consistent identifier throughout a property's life. Cross-referenced with title numbers they enable files to be matched and merged with datasets from different sources to create valuable insight.						
JBA Groundwater Flood Maps	<p>JBA's modelling approach calculates the maximum position of the groundwater table during flood conditions. This takes into account spatial variations in aquifer storage properties (bedrock and superficial deposits), groundwater recharge volumes and topography, as well as the groundwater level in typical winter conditions. The modelled groundwater levels are calibrated against observed levels from a range of boreholes across the country. All the modelling is undertaken at 5m resolution and uses highly detailed geological data.</p> <p>JBA is able to vary the severity of the flood event modelled by loading the groundwater system with different amounts of rainfall. For instance, its 1% annual probability groundwater flood map assumes recharge derives from the 1% annual probability winter rainfall event. Its robust rainfall estimates are based on statistical analysis of reliable long-term rainfall records and vary spatially to reflect regional and local variations in rainfall.</p>	JBA Consulting	Conditional licence	National	5m grid	GIS vector data PDF maps	<a href="https://www.jbaconsulting.com">https://www.jbaconsulting.com</a>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
LANDIS SoilScapes	<p>SoilScapes is a 1:250,000 scale, simplified soils dataset covering England and Wales. It was created from the far more detailed National Soil Map (NATMAP Vector – see above) held by CSAFI to communicate a general understanding of the variations which occur between soil types, and how soils affect the environment and landscape of the 2 countries.</p> <p>SoilScapes is intended to enable informed decision-making by non-soil scientists who need to understand soil and how it affects broad landscapes. Using the SoilScapes viewer, it is easy to build up a good understand of many fundamental soil–landscape processes for any region across England and Wales.</p> <p>The SoilScapes dataset is also available separately to lease as one of the National Soil Resources Institute's soil data products.</p>	LANDIS/ CSAFI	Free to view the maps Parent dataset (NATMAP vector) is available under conditional licence	England and Wales	1:250,000	Online Viewer	<a href="http://www.landis.org.uk/services/soilscapes.cfm">http://www.landis.org.uk/services/soilscapes.cfm</a>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
Natural England: Moorland Deep Peat AP Status	The Peat Layer was produced by Natural England during June to October 2008, with the aim of identifying the extent of 3 classes of peaty soils for the purposes of the Partnership Project to Protect and Enhance Peat Soils ('The Peat Project'). The project was a joint initiative between Defra, Natural England, the Environment Agency, Forestry Commission, the Welsh Government, the Countryside Council for Wales, the Northern Ireland Environment Agency, Cadw and the then Department for Energy and Climate Change. It sought to improve co-ordination between the partners in their efforts to understand, manage and restore peaty soils.	Natural England	Conditional licence	England	Unknown	Unknown	<a href="https://data.gov.uk/dataset/moorland-deep-peat-ap-status">https://data.gov.uk/dataset/moorland-deep-peat-ap-status</a>



<p>Natural England: Priority Habitats Inventory (PHI)</p>	<p>This inventory replaces Natural England's previous separate Biodiversity Action Plan (BAP) habitat inventories. The PHI project began in April 2012 and combines the existing individual BAP habitat inventories into one national polygon layer. Its objectives were to:</p> <ul style="list-style-type: none"> <li>• address overlaps between the existing inventories by identifying one main habitat per polygon</li> <li>• improve the consistency with other data sources</li> <li>• produce a layer that could more easily be updated.</li> </ul> <p>The PHI was interpreted based on:</p> <ul style="list-style-type: none"> <li>• OS MasterMap polygons used to capture the habitat boundaries</li> <li>• 25 individual priority habitat inventories</li> <li>• ENSIS (Natural England's SSSI database) and SSSI management units (information for each unit included main habitat, description, features and National Vegetation Classification codes)</li> <li>• Farm Environment Plan (FEP), Rural Land Registry (RLR) and Higher Level Stewardship (HLS) (FEP features and corresponding HLS management options were attributed against individual RLR parcels; FEP paper maps were not used)</li> <li>• contextual data including coniferous woodland, moorland line and OS MasterMap</li> <li>• aerial photography</li> </ul>	<p>Natural England</p>	<p>OGL</p>	<p>England</p>	<p>10–100m (better than 1:10,000)</p>	<p>GIS vector data</p>	<p><a href="http://environment.data.gov.uk/ds/catalogue/#/catalogue">http://environment.data.gov.uk/ds/catalogue/#/catalogue</a></p>
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Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
Nitrate Vulnerable Zones (NVZs) Designated Areas	<p>NVZs are areas that contain surface water or groundwater that is susceptible to nitrate pollution from agricultural activities. They are designated in accordance with the requirements of the Nitrates Directive (91/676/EEC), which aims to protect water quality across Europe by:</p> <ul style="list-style-type: none"> <li>preventing nitrates from agricultural sources polluting ground and surface waters</li> <li>promoting the use of good farming practices</li> </ul>	Various (Environment Agency, Natural Resources Wales and Scottish Government)	OGL	Great Britain	Unknown	GIS vector data	<p>England:  <a href="https://data.gov.uk/data/search?publisher=environment-agency&amp;license_id-is-ogl=true&amp;q=nitrate+vulnerable+zones">https://data.gov.uk/data/search?publisher=environment-agency&amp;license_id-is-ogl=true&amp;q=nitrate+vulnerable+zones</a></p> <p>Scotland:  <a href="https://data.gov.uk/dataset/nitrate-vulnerable-zones/resource/31b19fe8-91e2-47aa-88fb-bf03c8b36ce4">https://data.gov.uk/dataset/nitrate-vulnerable-zones/resource/31b19fe8-91e2-47aa-88fb-bf03c8b36ce4</a></p> <p>Wales:  <a href="https://data.gov.uk/dataset/nitrate-vulnerable-zones-nvz">https://data.gov.uk/dataset/nitrate-vulnerable-zones-nvz</a></p>
OS MasterMap® vector	<p>OS MasterMap is a database that records every fixed feature of Great Britain larger than a few metres in one continuous digital map. Every feature is given a unique TOID (TOpographical IDentifier). Typically each TOID is associated with a polygon. OS MasterMap is offered in themed 'layers', for example a road layer and a building layer, each linked to a number of TOIDs.</p> <p>OS MasterMap can be used to generate maps for a vast array of purposes. Although the scale on a digital map is much more flexible than a paper map, it is possible to print out maps from OS MasterMap data with detail equivalent to a traditional 1:1,250 paper map.</p>	OS	Conditional licence	Great Britain	1:1,250	GIS vector data	<a href="https://www.ordnancesurvey.co.uk/business-and-government/products/mastermap-products.html">https://www.ordnancesurvey.co.uk/business-and-government/products/mastermap-products.html</a>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
OS OpenData	<p>OS Open data includes various mapping data, useable for context and further analysis (see the OS website for further details). Examples include:</p> <ul style="list-style-type: none"> <li>• OS Open Greenspace</li> <li>• OS Open Map – local</li> <li>• OS 1:250,000 raster</li> <li>• OS Open Rivers</li> <li>• OS Boundary Line</li> <li>• OS Code-Point Open</li> </ul>	OS	OGL	Great Britain	Various National to local (1:10,000)	<p>Depends on product:</p> <p>GIS vector data</p> <p>GIS raster data</p> <p>TIF images</p>	<a href="https://www.ordnancesurvey.co.uk/business-and-government/products/opensdata-products.html">https://www.ordnancesurvey.co.uk/business-and-government/products/opensdata-products.html</a>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
RSPB wetland vision project	<p>This project sets out a 50-year vision for England's freshwater wetlands. It will show where new wetlands could be created and current wetlands restored. The RSPB's vision is about describing the location, nature and extent of the wetland landscape that will be needed in the future, illustrating this at a national scale through maps.</p> <p>Project outputs include a series of maps, using GIS to describe the potential locations of freshwater wetlands in 50 years' time. RSPB wishes to share as much of this information as possible with those involved in the conservation and management of wetlands.</p> <p>Various datasets have been collated from partners to help describe the current fragmented state of wetlands, and where they may exist in the future, as well as where they once existed in the past. With this information, maps have been generated for individual types. These are areas thought likely to be particularly suitable for the restoration and creation of different types of wetland to bolster and defend our existing resource.</p> <p>As well as sharing as much project information as possible (depending on data ownership), the project will provide guidance on accessing and using local data sources. These are often of more relevance to local projects and can help to refine the maps.</p>	RSPB	<p>Free to view the maps</p> <p>Data may be available on a conditional licence</p>	England	Broadscale, national	<p>PDF maps</p> <p>GIS vector data may be available</p>	<a href="http://www.wetlandvision.org.uk/dyndisplay.aspx?d=downloads">http://www.wetlandvision.org.uk/dyndisplay.aspx?d=downloads</a>

Title	What does it show?	Owner	Access	Coverage	Resolution	Format	Link
Satellite mapping/ national aerial photography	A number of free and commercial satellite and aerial photography providers can supply data that would complement these opportunity maps. Some products are supplied ready-to-view, with natural colours. Some use more complex colour schemes, designed to highlight specific features (for example, vegetation cover). These 'multispectral' images are best used in a GIS or advanced image processing software.	Various	Various: commercial to conditional licence to OGL	Variable depending on product	Variable:- <1m to 50+m	GIS raster data	Search on <a href="http://data.gov.uk">http://data.gov.uk</a> Or a general internet search engine Other possible sources include Nasa, Nasa's Jet Propulsion Laboratory and the European Space Agency

Notes:

- Green shading: indicates data are as good, or better, than the strategic opportunity maps produced in this project.
- Yellow shading: users will need to check this limitation will be compatible with their analysis.
- Red shading: some further input is more than likely required to allow these data to be included or useful in further analysis.

CEH = Centre for Ecology and Hydrology; CSAFI = Cranfield Soil and Agricultural Institute; LiDAR = light detection and ranging; SAR = synthetic aperture radar; WMS = Web Map Service