URS

Hertfordshire Water Framework Directive Guidance

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EXECUTIVE SUMMARY

Water management and environmental conservation are increasingly high profile subjects. New responsibilities are being placed on governments, local authorities and developers to promote environmental improvements as part of sustainable development.

In 2000, the European Union adopted Directive 2000/60/EU "establishing a framework for Community action in the field of water policy". Commonly known as the Water Framework Directive (WFD), it was transposed into UK law in 2003. Member States must aim for all inland and coastal waters to reach 'good status' (defined mainly in terms of water quality and ecology) by 2015, although certain limited exceptions are permitted, including deferment of meeting objectives until 2021 or 2027.

The WFD sets out a legislative framework for the analysis, planning and management of water resources and the protection of aquatic ecosystems. The overarching aims of the WFD are to:

- Enhance the status and prevent further deterioration of aquatic ecosystems and associated wetlands which depend on the aquatic ecosystems,
- Promote the sustainable use of water,
- Reduce pollution of water, especially by 'priority' and 'priority hazardous' substances,
- Ensure progressive reduction of groundwater pollution.

To achieve these aims, the Environment Agency, which is responsible for implementation of the WFD in England, has developed River Basin Management Plans (RBMPs). RBMPs define the current status of waterbodies and outline environmental objectives and are to be updated every six years. They include details on how 'good' status for a waterbody can be met, and information on whether 'good' status is realistically achievable by 2015.

With respect to flood management duties, the Environment Agency are responsible for main rivers, but as a Lead Local Flood Authority (LLFA), Hertfordshire County Council (HCC) is responsible for ordinary watercourses in its administrative area. Main rivers are predominantly large watercourses such as the River Colne, River Lee and River Ver. An ordinary watercourse is any watercourse which does not form part of a main river, including rivers, streams, canals, ditches, drains, cuts, culverts, dikes, sluices, sewers and passages through which water flows, but may not hold water all the time.

Whilst HCC are not responsible for monitoring, classifying or developing objectives for ordinary watercourses under the WFD, as a co-deliverer of the WFD, HCC has a duty to support the Environment Agency and to consider objectives defined in RBMPs when undertaking its statutory flood risk management duties in relation to ordinary watercourses, as well as downstream impacts on main rivers. HCC's minimum statutory role is to ensure that in administrating its functions as a flood risk management authority, it does not prevent the objectives of other legislation being met. This means that HCC must consider environmental objectives as well as flood management objectives when consenting applications for developments that could affect ordinary watercourses.

HCC intend to achieve this by working closely with developers, in order to discuss ways in which development ambitions can be achieved in a sustainable way, in line with WFD objectives, and wherever possible without requiring the development consenting phase.

A lot of activities associated with works on and development in the vicinity of ordinary watercourses will not require WFD Assessment, and HCC should be contacted at the earliest possible opportunity to help streamline the development process.

This guidance has been developed as an introduction to the WFD, in order to:

- Discuss why the WFD is important,
- Explain key concepts and terminology,
- Describe who is responsible for the WFD,
- Inform when WFD Assessments are required,
- Describe where to find relevant information,
- Inform when WFD Assessments are required,
- Provide a methodology and pro-forma/template for WFD Assessments where they are necessary in order to assist applicants for ordinary watercourse consent in undertaking any WFD Assessments that HCC may require of them.

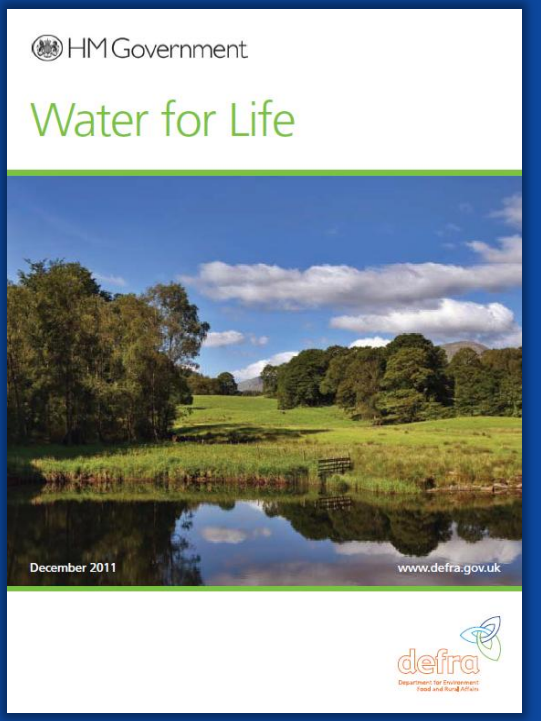
The importance of the WFD is highlighted throughout the Government's White Paper for Water: Water for Life (December 2011), as summarised in the box below.

"Our water bodies are already under stress in some parts of the country. Because of pollution and over-abstraction only a quarter of our rivers and lakes are fully functioning ecosystems. In the coming years the combined effects of climate change and a growing population are likely to put increasing pressure on our rivers. If we do not act the security of our water supplies could be compromised."

"A healthy natural environment is the essential foundation if we are to enjoy sustained economic growth, prospering communities and personal wellbeing."

"Water is not only essential for life; it is critical to the Government's commitment to drive economic growth. We must manage our water resources in a way that supports growth and the wider needs of society. Pressure on water resources would threaten growth."

"We must halt and reverse the damage we have done to water ecosystems and ensure that they can continue to provide essential services to us and the natural environment."

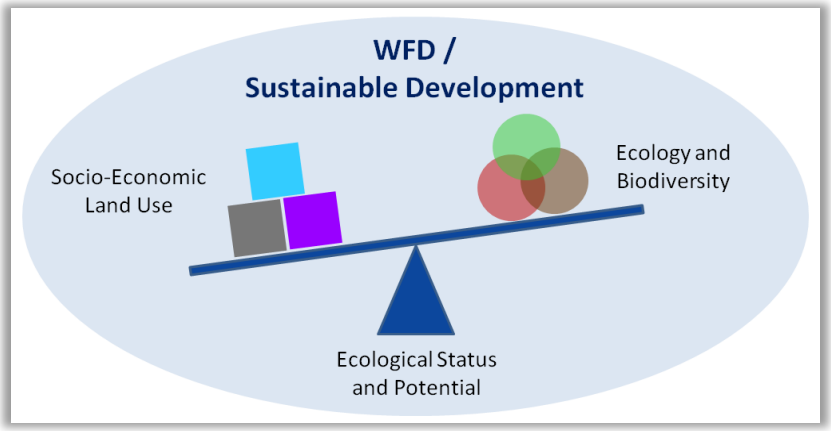


1. INTRODUCTION

1.1 Introduction

Conservation and enhancement of the natural environment are increasingly high profile issues and an important part of planning and consenting any new developments. Increasing responsibilities are being placed on regulators, local authorities and developers to protect and manage watercourse environments and flooding through legislation such as the Water Framework Directive 2000 (WFD).

The WFD is a wide ranging and complex legislation, designed to establish a framework for a Europe-wide approach to action in the field of water policy. The WFD embraces all inland and near shore waterbodies including groundwater. Its aim is to ensure the planning and delivery of a better water environment, focussing on ecology. Any proposed activity or development that could be detrimental to the water environment, or that could prohibit future conservation or improvements to aquatic ecology, is unlikely to be permissible, or will need to be planned with mitigation measures for preventing deterioration and to improve the status and potential of aquatic habitats.



The WFD is not intended to be restrictive to development, but aims to legislate sustainable development for both human and ecological requirements.

The primary sources of WFD information for waterbodies and catchments are River Basin Management Plans (RBMPs). RBMPs contain the most detailed information available on the current status and objectives of waterbodies across Europe. They include mitigation measures that could be implemented to preserve and improve the aquatic environment.

HCC and other local authorities have a range of duties and powers associated with the legal requirements of the WFD.

The Environment Agency is the “competent authority” that has overall responsibility for delivering the objectives of the WFD. HCC and other local authorities have a duty to “have regard to” the RBMPs, and to assist the Environment Agency in the delivery of WFD objectives. The Environment Agency are a statutory consultee on the WFD, and can mandate that WFD Assessments are undertaken for any development activities that could potentially affect waterbodies, which HCC and other local authorities would consent. In turn, HCC and other local authorities would need developers to undertake WFD Assessments as part of planning applications, in the same way as flood risk assessments and other statutory planning documents. This guidance forms part of the advisory service that HCC provide.

Ultimately, it is up to the company, public body, individual, or group of individuals that is proposing development activities that could affect waterbodies to undertake the appropriate type of assessment and mitigation of activities in line with the WFD.

HCC is responsible for consenting activities associated with works on and development in the vicinity of “ordinary watercourses” in Hertfordshire. An ordinary watercourse is defined as a watercourse which does not form part of a “main river”. A main river is a watercourse shown on a main river map, for example the Environment Agency flood map[1]. Ordinary watercourses include rivers, streams, canals, ditches, drains, cuts, culverts, dikes, sluices, sewers and other passages through which water flow but may not hold water all the time. Developers proposing activities that could affect ordinary watercourses in Hertfordshire therefore need to contact HCC for advice as early in their planning process as possible.

The Environment Agency is responsible for consenting activities that could affect main rivers, which are predominantly large watercourses such as the River Colne, River Lee and River Ver, but can also be relatively small watercourses. Developers proposing activities that could affect main rivers or groundwater therefore need to contact the Environment Agency for advice as early in their planning process as possible.

HCC takes a pro-active approach to flood and environmental management, and commissioned URS Infrastructure & Environment UK Ltd (URS) to provide consultancy support to develop this WFD guidance in conjunction with an ordinary watercourses risk assessment tool for flooding and environmental issues within the administrative area of Hertfordshire. The tool is a good source of information for flood and environmental risks, including the WFD and is summarised in Chapter 2.

Every watercourse is unique and will have a specific set of environmental requirements, so this guidance has been designed to set out the responsibilities and types of information involved in enabling works on and development in the vicinity of ordinary watercourses.

1.2 The Importance of the Water Environment for Local Communities and Economies

A high quality water environment is an integral part of quality of life benefits for local people, animals and plants. For water-based ecosystems, these include:

- Drinking water supply,
- Water for agriculture, food production, fish, industry, recreation, tourism and transport,
- Water to transfer, dilute and treat sewage effluent,
- Water for wildlife,
- Water for environmental setting, aesthetic values and community benefits,
- Flood risk reduction,
- Climate adaptation.

The Government’s White Paper for Water: Water for Life (December 2011) highlights throughout that water resources and a high quality water environment underpin economic development by providing water for households, industries, agriculture, recreation and tourism, and reducing the need for expenditure on water treatment and health care. It is widely accepted that local investment in environmental improvements can help to attract wider economic investments.

A high quality water environment provides local amenity, recreation and aesthetic benefits for living and working, and related physical and mental health benefits, and can provide immeasurable values as a focus for local communities and society.

[1] http://www.environment-agency.gov.uk/homeandleisure/floods/default.aspx

2. HERTFORDSHIRE ORDINARY WATERCOURSES RISK ASSESSMENT TOOL

The Hertfordshire Ordinary Watercourses Risk Assessment Tool has been developed to assist HCC consenting officers prioritise suitable assessment of ordinary watercourses. “The Tool” can be applied at strategic level to assess the spatial distribution of risks across the county, and also at local level to support assessments of WFD objectives and ordinary watercourse consent applications.

The Tool can be used to support assessments of flood and environmental risks associated with works on and development in the vicinity of ordinary watercourses. Development could include any proposed use of land or any activities that could affect the flow or storage of water, or affect the environment or WFD objectives.

The Tool is a Geographical Information System (GIS) in which a map of ordinary watercourses is integrated with maps of other spatial data representing potential flood and environment risks.

The result is an interactive risk assessment map of ordinary watercourses in Hertfordshire. Detailed information can be displayed for selected ordinary watercourses or sections of ordinary watercourses. Selecting a particular area or an ordinary watercourse will display environmental information including WFD status and objective, other environmental information such as whether the selected area lies within a Site of Special Scientific Interest (SSSI) or other designations, as well as information about flood risks.

It is recommended that the Hertfordshire Ordinary Watercourses Risk Assessment Tool is used as an early means of collecting relevant WFD waterbody information for proposed developments in Hertfordshire. It should be noted though that it is a tool, and it is not intended to provide definitive analysis of WFD objectives or other flood or environmental risks.

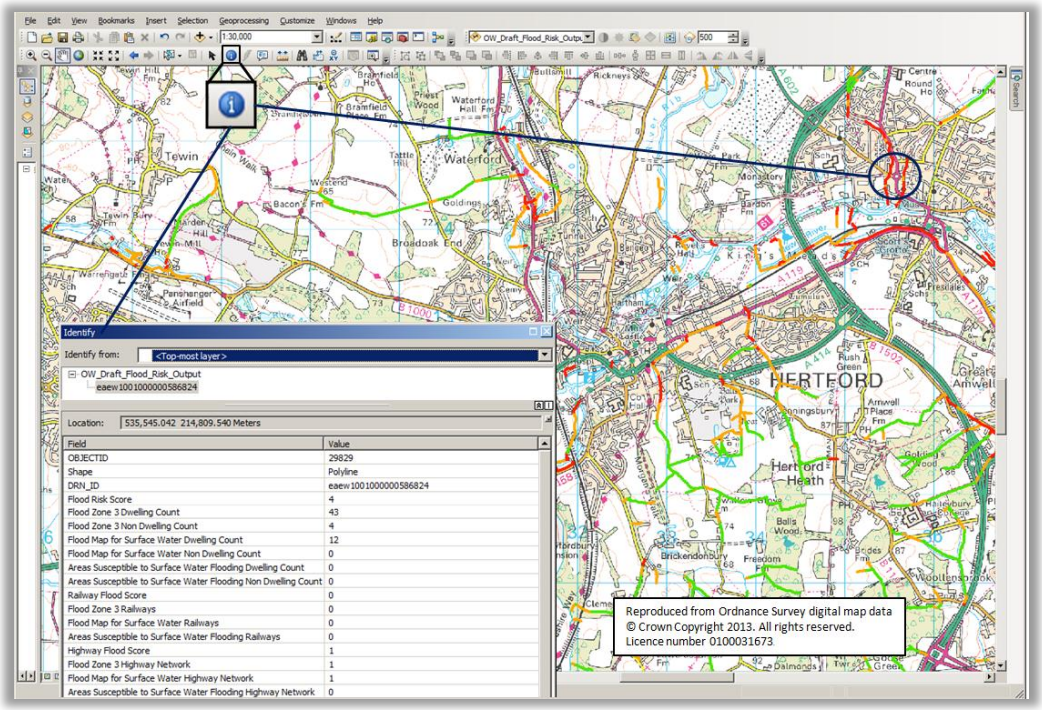


Figure 2-1: Screenshot of the Hertfordshire Ordinary Watercourses Risk Assessment Tool

3. THE WATER FRAMEWORK DIRECTIVE

3.1 What is the Water Framework Directive?

The WFD is a European Union (EU) Directive[2] that commits EU Member States to protect and enhance the water environment. Its overarching aim is to provide consistent legislation that is designed to improve and integrate the way waterbodies are managed throughout Europe. The WFD sets out a legislative framework for the analysis, planning and management of water resources and the protection of aquatic ecosystems.

In 2000, the European Union adopted Directive 2000/60/EU "establishing a framework for Community action in the field of water policy". Commonly known as the WFD, it was transposed into UK law in 2003 by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003.

The overarching aims of the WFD are to:

- Enhance the status and prevent further deterioration of aquatic ecosystems and associated wetlands which depend on the aquatic ecosystems,
- Promote the sustainable use of water,
- Reduce pollution of water,
- Ensure progressive reduction of groundwater pollution.

Member States must aim for all inland and coastal waters to reach "good status" by 2015, which is defined in terms of biological, chemical and physical conditions. Certain limited exceptions are permitted to defer achievement of 'good' status until 2021 or 2027, if meeting objectives by 2015 is proven to be disproportionately expensive or technically infeasible.

The Environment Agency is responsible for the delivery of WFD objectives in England and Wales. LLFAs are co-deliverers of the WFD and have a duty to have regard to its objectives and to support the Environment Agency in its delivery.

3.2 Community Benefits

At the heart of the WFD is the philosophy to "make waterbodies better", not just in terms of aquatic habitats but also for human benefits, through sustainable development (both natural and human).

The European and River Corridor Improvement Plans (ERCIP) project[3] summarises the community benefits of river corridors improvements, especially in urban areas, as shown below. These principles apply to the protection and improvement of all waterbodies.

Enhance and maintain the unique image and identity of waterbodies

- Strengthen the image and identity of local communities along waterbodies by stimulating development that enhances the landscape and urban characteristics of the waterbody,
- Generate value and a sense of local ownership by providing high quality public spaces as well as stimulating public and community facilities along or nearby the river corridor,
- Stimulate community facilities, as well as commercial and residential development along waterbodies to acknowledge the river positively.

[2] Available for download in English language pdf format at:
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF
[3] See http://www.ercip.eu/ and http://www.ercip.eu/Resources/downloads

Reduce and manage flood risk and deal with a changing climate

- Raise awareness of the expected increased risk of flooding and extreme weather conditions and encourage appropriate adaptation and mitigation measures,
- Maximise opportunities from regeneration to reconsider the location, layout and design of riverside sites to help reduce and manage flood risk both to the waterbody development sites and the wider community.

Ensure an attractive, safe and secure environment for people and wildlife

- Use environmentally sensitive designs to enhance the waterbody for wildlife, providing better conditions for habitats to flourish and adapt to climate change,
- Provide high quality public open space along the waterbody, encouraging opportunities to access, leisure, cultural and sport facilities,
- Encourage safe and legible cycling and pedestrian routes along and across the waterbody taking into consideration any negative impact onto wildlife and private property,
- Use environmentally sensitive designs.

3.3 WFD Timeline

A timeline of the WFD is summarised in Table 3-1, where the current phase of activities is shown in the dashed outline. The Environment Agency and Defra have been developing strategies and data resources in line with the WFD since 2003. It has taken considerable time to build an evidence base to describe all of the waterbodies in England and Wales and to determine how best to plan and manage future improvements to the water environment.

By 2012 the Environment Agency had collected sufficient information at national level to be able to make operational programmes of measures for enforcing WFD objectives in planning schemes in different waterbodies. This forms an important part of meeting environmental objectives by 2015.

The Environment Agency is enforcing the WFD by promoting its objectives through their advisory and regulatory activities on waterbodies and, if necessary, by formally objecting to planning proposals where WFD objectives are not proven to be met by site specific WFD Assessments. This means that even schemes that have been in the pipeline for several years before 2012 may require a WFD Assessment to gain planning permission without formal objection from the Environment Agency.

TABLE 3-1: WFD TIMELINE AND CURRENT PHASE		
Year	**Issue**	**Reference**
2000	Directive entered into force	Article 25
2003	Transposition in national legislation Identification of River Basin Districts and Authorities	Article 23 Article 3
2004	Characterisation of river basin: pressures, impacts and economic analysis	Article 5
2006	Establishment of monitoring network Start public consultation (at the latest)	Article 8 Article 14
2008	Present draft river basin management plan	Article 13
2009	Finalise river basin management plan including programme of measures	Article 13 & 11
2010	Introduce pricing policies	Article 9
2012	Make operational programmes of measures	Article 11
2015	Meet environmental objectives First management cycle ends Second river basin management plan & first flood risk management plan	Article 4
2021	Second management cycle ends	Article 4 & 13
2027	Third management cycle ends, final deadline for meeting objectives	Article 4 & 13

3.4 WFD Assessment

The current phase of WFD implementation means that since 2012 a new type of technical assessment – Water Framework Directive Assessment – has become enforced as a legal requirement to support planning applications.

In line with the European Directive, consented schemes that do not uphold the objectives of the WFD can be reported to the EU. Local Planning Authorities (LPAs) can ultimately be fined for issuing consents for schemes which cause waterbodies to deteriorate or prevent the objectives of the WFD from being met.

To ensure that the principles of the WFD are upheld, the EA and LPAs require WFD Assessments to form part of planning applications in the same way that they require flood risk assessments and other standard planning support documents. The EA may formally object to proposed schemes affecting waterbodies until appropriate WFD Assessments are undertaken. This is the case even if WFD Assessments have not previously been mandated for schemes that have already been in the pipeline for several years.

Some types of activities on watercourses are exempt from WFD Assessment, but in principle there are very few types of developments that would be able to proceed without appropriate WFD Assessment and mitigation measures. It may be appropriate that WFD Assessments are only very brief.

To comply with the obligations of the WFD, evidence should be provided as a WFD Assessment that planned developments in and around the water environment do not:

1. Cause deterioration in ecological status or potential of the waterbody,
2. Prevent the waterbody from meeting its objective of ‘good’ ecological status or potential,
3. Prevent or compromise WFD objectives being met in other waterbodies,

4. Cause failure to meet 'good' groundwater status, or result in a deterioration of groundwater status,
5. Prevent the implementation of mitigation measures which define the hydromorphological designation of heavily modified waterbodies.

The level of detail of WFD Assessments should be proportional to the level of impact that a scheme would invoke, and certain types of activities in or near waterbodies are exempt from WFD Assessment. A phased methodology for undertaking WFD Assessments is described in Chapter 9, which explains that there are **three levels of WFD Assessment**:

- A **screening phase** is used to consider all possible WFD-related impacts of proposed activities in order to determine whether WFD Assessment is required,
- A **preliminary assessment**, if required, is used to identify the waterbodies that could be affected, gather WFD-related information about those waterbodies and determine which elements of WFD status or potential could be affected,
- A **further assessment** (which was previously referred to as a detailed assessment), if required, is used to analyse how activities that cannot be screened out as not having an impact on WFD objectives would affect waterbodies, appraise alternative designs and options that could uphold the WFD objectives, and if necessary, assess mitigation measures to compensate for impacts of the proposed activities.

A WFD Assessment needs to adequately demonstrate that all obligations of the WFD will be met for any proposed scheme that could affect the water environment. Specialist information and experienced judgement may be required to undertake a WFD Assessment comprehensively and to provide timely support to planning applications.

Where personal or in-house expertise do not include assessments of waterbody biological, chemical and physical conditions, it may be necessary to consult ecologists, water quality specialists and hydromorphologists / geomorphologists who are qualified to provide guidance, undertake surveys, and advise on design options and mitigation measures that could compensate for any potential negative impacts on the water environment associated with proposed developments.

In view of the above, this guidance focuses on the early stages of WFD Assessment, particularly on decision making as to whether WFD Assessment is required, and how to gather baseline WFD information for a site. The nature of further assessments is inevitably broad ranging and highly site-specific, so if necessary, appropriate further guidance would need to be sought from specialists on a site-by-site basis.

3.5 WFD Objectives and Compliance

The overarching aims of the WFD are stated in Section 3.1, and there are a number of different environmental objectives for all surface waterbodies and groundwater bodies.

The environmental objectives for surface water are to:

- Prevent deterioration in status for waterbodies,
- Aim to achieve 'good' ecological and 'good' surface water chemical status in waterbodies by 2015,
- For water bodies that are designated as artificial or heavily modified, aim to achieve 'good' ecological potential by 2015,

- Comply with objectives and standards for protected areas where relevant,
- Reduce pollution from priority substances and cease discharges, emissions and losses of priority hazardous substances.

The environmental objectives for groundwater are:

- Prevent deterioration in the status of groundwater bodies,
- Aim to achieve 'good' quantitative and 'good' groundwater chemical status by 2015 in all those bodies currently at 'poor' status,
- Implement actions to reverse any significant and sustained upward trends in pollutant concentrations in groundwater,
- Comply with the objectives and standards for protected areas where relevant,
- Prevent or limit the input of pollutants into groundwater,
- Specific environmental objectives have been devised for River Basin Districts (RBD) within England and Wales.

3.6 Ecological Status or Potential

Waters must sustain or achieve 'good' ecological and chemical status, in order to protect human health, water supply, natural ecosystems and biodiversity. The status and objectives of waters are defined according to inter-linked biological, chemical and physical (morphological) parameters. Waterbodies should generally be protected or improved to **Good Ecological Status** or better.

Ecological status is defined by the biological condition or health of a watercourse, in combination with the water quality and physical habitat conditions that underpin biological communities. The classification of ecological status considers the abundance of aquatic flora and fauna, physical habitat availability (hydromorphology), and water quality factors such as pollution or the availability of nutrients.

Artificial Waterbodies (AWBs) and Heavily Modified Waterbodies (HMWBs) are waterbodies that have been defined as unable to achieve natural conditions due to the legacy and continuation of socio-economic uses. Therefore AWBs and HMWBs have a target to achieve **Good Ecological Potential**, which recognises the continuing need for waterbody uses, whilst making sure that ecological benefits are implemented as far as possible.

3.7 Heavily Modified and Artificial Waterbodies

HMWBs and AWBs are unable to achieve natural conditions due to anthropogenic and socio-economic uses, so AWBs and HMWBs have a target to achieve 'good' ecological potential, which recognises their important uses, whilst making sure ecology is protected as far as possible. The waterbody can only reach 'good' ecological potential once all mitigation measures that have defined ecological potential are in place.

Heavily Modified Water Bodies

HMWBs are bodies of water which as a result of physical alterations by human activity are substantially changed in character and cannot therefore meet 'good' ecological status. In this context physical alterations mean changes to, for example, the size, slope, discharge, form, shape and boundary substrates of a river or waterbody.

Artificial Water Bodies

AWBs are surface waterbodies which have been created in locations where no waterbodies existed previously and which have not been created by the direct physical alteration, movement or realignment of existing waterbodies.

Possible morphological pressures are:

- Flood protection,
- In-channel structures,
- Inland navigation,
- Land drainage,
- Recreation,
- Urbanisation,
- Water storage and supply.

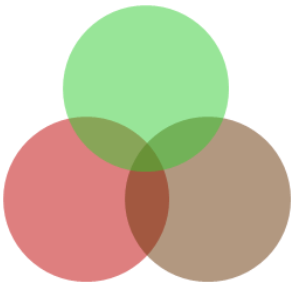
and:

- Other sustainable human use (such as heritage value, for example mill races for historic watermills),
- Wider environment (for example former gravel pits forming AWBs that have been colonised and provide valuable habitats).

3.8 Biological, Chemical, Physico-Chemical and Hydromorphological Quality Elements

Stream ecology and biodiversity are dependent on the physical and chemical qualities of host aquatic habitats, riparian zones and the wider catchment. Ecological status is defined in the WFD according to:

- Biological elements
- Elements supporting the biological elements, i.e. hydromorphological elements and physico-chemical elements.

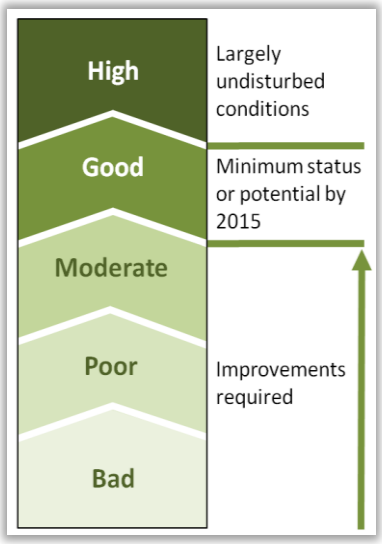


Biological, hydromorphological, physico-chemical and chemical quality elements are inter-related, so any changes within one group of elements, whether detrimental or beneficial, would have concurrent affects in the other groups. All groups of elements, and how they interact, must be considered throughout WFD assessments.

Each of the three types of elements are described according to several constituent groups, which are shown in Appendix A. It should be noted that the specific waterbody elements shown in Appendix A apply to rivers (as opposed to lakes, transitional or coastal watesr, or groundwater), since the vast majority of consent applications in Hertfordshire will relate to rivers For example the hydromorphology of a waterbody is described according to hydrology, morphology and river continuity. In turn, each element group is described according to several different classifications. For example, morphological conditions are classified according to waterbody depth and width variation, the structure and substrate of the bed, and the structure of the riparian zones. All of the elements must be assessed in order to determine the impacts of a proposed development on the water environment.

3.9 Surface Water Classification

Overall Ecological Status



The WFD classification scheme for a surface waterbody's overall ecological status includes five categories: 'high', 'good', 'moderate', 'poor' and 'bad'. 'High' status means no or very low anthropogenic pressures. 'Good' status means a slight deviation from natural conditions. 'Moderate' status means moderate deviations from natural conditions that allow for human use of waterbodies, and so on. Overall status mainly depends on biological and chemical elements, and is influenced by the supporting physico-chemical and hydromorphological elements.

The overall ecological status or potential of a waterbody is based firstly on a 'one out, all out' principle for biological elements, so the worst single biological status determines the overall status. For example, if one biological element is 'poor', but all other biological elements are 'good', then the overall status would be classified as 'poor'.

Biological status is based on surveys of plant and animal populations and assessment of the biological community that exists within a waterbody in comparison to the community that would be expected for pristine waterbodies.

For a waterbody to be in overall 'good' ecological status both biological and chemical status must be at least 'good'.

Chemical status is based on monitoring of water chemistry for priority substances. Priority substances are regulated chemical pollutants of high concern across the EU, which are listed in Appendix B. Chemical status is assigned on a scale of 'good' or 'fail' (i.e. fails to meet 'good' status). If the chemical status of a waterbody is 'fail', the overall ecological status is limited to 'moderate'.

Supporting Elements

The status of individual physico-chemical elements is based on monitoring of water chemistry for a range of key pollutants, and is classified according to environmental standards (concentrations) on a scale of 'bad' through to 'high'. The supporting physico-chemical elements can only influence the overall ecological status from 'moderate' through to 'high', so even if a physico-chemical element is classified as 'bad' status, if all biological elements are 'good' or 'high', the overall ecological status would be set to 'moderate'.

Hydromorphological status is based on whether waterbodies have been modified from natural conditions for anthropogenic uses, for example navigation, ports, or flood protection, to the degree that the waterbody is substantially changed in character. Hydromorphological status is firstly assigned on a scale of HMWB / AWB or not designated HMWB / AWB. For a predominantly natural non-HMWB / AWB, supporting element status is assigned on a scale of 'high', 'supports good', or 'does not support good' overall ecological status. The supporting hydromorphological status can only influence whether the overall ecological status is 'good' or 'high'. If the hydromorphological status of a waterbody is not 'high', the overall ecological status is limited to 'good'. If the hydromorphological status 'does not support good' but all

biological elements are 'good' or 'high', the overall ecological status would be still be 'good'.

3.10 Groundwater Classification

Groundwater body status is classified on the basis of quantitative and chemical status. Groundwater bodies are separated into Groundwater Management Units (GWMU) and Water Resource Management Units (WRMU). GWMU are sub-divisions of groundwater bodies to aid the resource assessment process. WRMU are sub-divisions according to the water resource availability and the management of water

Status is mainly influenced by large scale effects such as significant abstraction or widespread / diffuse pollution. The worst case classification is assigned as the overall groundwater body status, in a 'one-out all-out' system.

Quantitative Status

Quantitative status is defined by the quantity of groundwater available as base flow to watercourses and water-dependent ecosystems and as 'resource' available for use as drinking water and other consumptive purposes. It is assigned on a scale of 'good' or 'poor', and on the basis of four classification elements or 'tests' as follows:

- The **saline or other intrusions** test is designed to identify groundwater bodies where the intrusion of poor quality water, such as saline water or water of different chemical composition, as a result of groundwater abstraction is leading to sustained upward trends in pollutant concentrations or significant impact on one or more groundwater abstractions.
- The **surface water** test is designed to identify groundwater bodies where groundwater abstraction is leading to a significant diminution of the ecological status of associated surface water bodies.
- The **Groundwater Dependent Terrestrial Ecosystems (GWDTE)** test is designed to identify groundwater bodies where groundwater abstraction is leading to significant damage to associated GWDTE.
- The **water balance** test is designed to identify groundwater bodies where groundwater abstraction exceeds the 'available groundwater resource', defined as the rate of overall recharge to the groundwater body itself less the rate of flow required to meet the ecological needs of associated surface water bodies and GWDTE.

Chemical status

Chemical status is defined by the concentrations of a range of key pollutants, the quality of groundwater feeding into watercourses and water-dependent ecosystems, and the quality of groundwater available for drinking water purposes. This is assigned on a scale of 'good' or 'poor', and on the basis of five classification elements or 'tests', as follows:

- The **saline or other intrusions** test is designed to identify groundwater bodies where the intrusion of poor quality water, such as saline water or water of different chemical composition, as a result of groundwater abstraction is leading to sustained upward trends in pollutant concentrations or significant impact on one or more groundwater abstractions.
- The **surface water** test is designed to identify groundwater bodies where groundwater is leading to a significant diminution of the chemical status of associated surface water bodies.
- The **GWDTE** test is designed to identify groundwater bodies where groundwater is leading to significant damage to associated GWDTE.

- The **Drinking Water Protected Areas (DrWPA)** test is designed to identify groundwater bodies failing to meet the DrWPA objectives defined in Article 7 of the WFD or at risk of failing in the future. The aim is no deterioration in quality of waters for human consumption.
- The **general quality assessment** test is designed to identify groundwater bodies where widespread deterioration in quality has or will compromise the strategic use of groundwater. The aim is no significant impairment of human use of groundwater and no significant environmental risk from pollutants across a groundwater body.

4. WATER FRAMEWORK DIRECTIVE INFORMATION AND DATA

The main sources of information on the WFD are RBMPs, which are described in Section 4.1; however, this will only provide information on waterbodies that have been assessed by the Environment Agency, and hence given a defined WFD 'status' (or potential). Some ordinary watercourses will not have been monitored or assessed by the Environment Agency and will not be detailed in the RBMPs.

The Hertfordshire Ordinary Watercourses Risk Assessment Tool is also a useful data source. It contains interactive maps of ordinary watercourses in Hertfordshire, so that selecting a particular area or ordinary watercourse(s) will display environmental information including WFD status and objective, whether the area lies within a Site of Special Scientific interest etc, as well as information about flood risks. It is recommended that the Hertfordshire Ordinary Watercourses Risk Assessment Tool is used as an early means of collecting relevant WFD waterbody information for proposed developments in Hertfordshire.

As well as the Hertfordshire Ordinary Watercourses Risk Assessment Tool and the RBMPs, baseline information at national scale is available online for ecological status and some of the biological and supporting elements. Among other sources, information can be found at:

- The Environment Agency's "What's in your backyard?" interactive maps, which include River Basin Districts and WFD Management Catchments, current and predicted ecological and chemical water quality, and monitoring points,
- The Government's public data website, which includes monitoring data,
- Natural England's interactive nature maps, which include information about National and Local Nature Reserves, areas under agri-environment schemes, protected sites such as Sites of Special Scientific Interest, and Biodiversity Action Plan habitats.

It is likely for most locations that there will be no hydromorphological monitoring or surveys, or very little other hydromorphological information. This means that the Environment Agency may require specialist hydromorphological assessments including site surveys to inform baseline conditions and appropriate mitigation measures, although the requirement for this and the level of detail would vary on a case-by-case basis. Some reports such as flood risk assessments and scour analysis reports for bridges and other structures may contain useful information, but may well not contain the level of detail required for a WFD Assessment. Likewise, River Habitat Surveys may contain relevant information on water and substrate habitats, but by definition they are not hydromorphological surveys.

The WFD is a broad ranging legislation, so there are a wide range of sources of information not mentioned above that could be relevant for WFD Assessments. For all schemes, local knowledge is highly important.

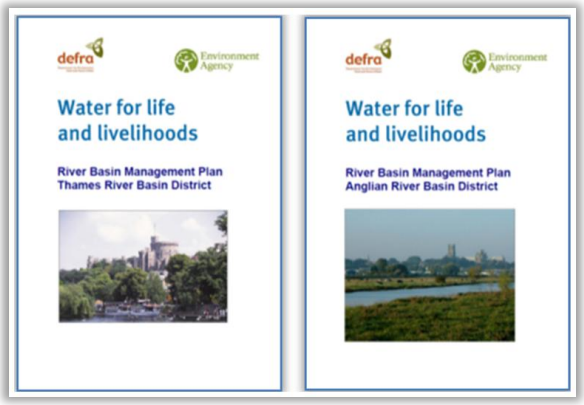
For large schemes that are already in planning, existing Environmental Impact Assessments, Environmental Statements, ecology surveys, etc, are likely to contain a lot of relevant information that can be re-worked into a WFD Assessment. Alternatively, appropriate commentary on the WFD could be added into existing reports.

For small schemes, there may well be no site-specific data, in which case cost-proportionate assessments could be undertaken using information in the RBMPs and the resources described above. It would not usually be necessary to undertake detailed sampling or in situ logging of data for WFD elements unless they are directly impacted by the proposals.

4.1 River Basin Management Plans

River Basin Management Plans (RBMPs) are the vehicle by which the WFD is being delivered across Europe. As such they are the principal information resource for the WFD. They include details of the status and objectives of waterbodies and recommended mitigation measures for waterbodies where existing status is less than 'good'.

RBMPs in England and Wales are produced for each of the 11 River Basin Districts (RBDs). A RBD map is available on the Environment Agency's website. The RBDs are sub-divided into river catchments within the RBMPs, and further into individual (but connected) waterbodies at a more manageable sub-catchment scale. Two RBDs and RBMPs cover Hertfordshire; those for the Thames and Anglian River Basin Districts. The RBMP's are also available on the Environment Agency's website.



River Basin Management is a continuous process of planning and delivery of RBMPs. The WFD introduces a formal series of six year cycles. RBMPs have been developed by Defra and the Environment Agency since the WFD was first made a legal requirement in England and Wales in 2003, and were first published in 2009. They will be revised for each river basin district every six years, so the first cycle will end in 2015 when the RBMPs will be formally updated. 2015 at the latest is therefore the first target date for improvement of the aquatic environment. The latest available information is the 2012 progress update to the 2009 RBMPs, which is available on the Government's public data website.

The RBMPs describe the RBD and the pressures that the regional water environment faces. They define the current state of the water environment, and what actions need to be taken to address the pressures. Each RBMP presents specific environmental objectives for all waterbodies within the RBD. They set out what improvements are possible by 2015 and how the specified actions will make a difference to the water environment, i.e. the catchments, estuaries, the coast and groundwater.

Each RBMP is supported by 14 annexes which contain supporting information for that RBD, and the national and European approaches to the WFD. Annex B of each RBMP contains information on the status and objectives of each waterbody in the relevant RBD.

A WFD Assessment should describe the impacts of proposed activities in terms of the catchment objectives that are set out within the relevant RBMP.

A step-by-step guide on how to find information in RBMPs is provided as Appendix C.

4.2 Mitigation Measures for Preventing Water Body Deterioration and Improving Status and Potential

It is acknowledged in the WFD that historic development has affected the present day water environment, and that sustainable development needs to continue in the future. This does not mean that development cannot be allowed because of the WFD. However, all practicable steps must be taken to implement mitigation measures for historic and future impacts on the water environment.

Mitigation measures need to be tailored to specific schemes, so detailed guidance on how to identify and implement specific measures cannot be provided here. Specialist advice may be needed from an early stage of planning to ensure that the impacts of proposed activities can be prohibited or minimised through design and options appraisal, or failing that, by provision of compensatory measures within affected waterbodies, so that proposed schemes will ensure that the overall status of waterbodies does not deteriorate, or are not prohibited from reaching 'good' ecological potential.

It is emphasised that mitigation is less preferable than prevention of impacts. Scheme designs should be appraised as to whether any more environmentally sensitive solutions are practicable, if any potential detrimental effects are identified. If scheme designs cannot be altered, a wide range of mitigation or compensation options should be assessed. Opportunities to implement cost effective measures to enhance the local environment should be encouraged for all developments in the vicinity of waterbodies. This would greatly enhance development proposals and the likely success of planning applications.

A wide range of guidance is available from many different sources, but a good starting point for planning mitigation measures is the Environment Agency's online Mitigation Measures Manual. The manual is intended to:

- Introduce mitigation measures for a wide range of flood risk management and land drainage activities,
- Give detailed information on the different measures,
- Explain how to apply mitigation measures in practical solutions.

The Mitigation Measures Manual covers a comprehensive range of activities. An example is shown in Table 4-1. The manual is interactive, so each of potential hydromorphological changes and mitigation measures can be selected to display detailed information.

It should be noted that the manual makes statements about hydromorphological changes, but the WFD emphasises the need to assess the biological and chemical / physico-chemical impacts as well.

TABLE 4-1: IMPACTS OF CULVERTS AND APPROPRIATE MITIGATION MEASURES REPRODUCED FROM THE ENVIRONMENT AGENCY MITIGATION MEASURES MANUAL

Activity	Function	Potential Hydromorphological Change	Mitigation Measures
Culverts*	To enable conveyance of water across other functions, e.g. transport infrastructure	Change in flow dynamics	Modify or Enhance Structures
			Improve Fish Passage
		Loss of morphological diversity (rivers)	Good Practice Vegetation Management
			Remove Obsolete Structures
		Loss of structure and condition of the riparian zone	Manage and Restore Aquatic and Riparian Habitats

4.3 Waterbody Connectivity and the Catchment Based Approach

River catchments and channels and other waterbodies are the mechanisms by which rainfall is transferred to the sea in the water cycle. This also means that hydrology, geomorphology, watercourses and other waterbodies control landscape processes such as valley and floodplain formation, soil erosion from catchment surfaces, and the erosion, transport and fate of sediment and associated nutrients and contaminants. Waterbodies and their catchments, and therefore aquatic ecosystems, are inter-connected at landscape scale between watersheds (lines of high ground that determine drainage directions) and the sea.

The Catchment Based Approach is an initiative by Defra to develop a framework for integrated management of land and water in a co-ordinated and sustainable way, to balance environmental, economic and social demands at a catchment scale. It is intended to develop into an holistic approach that recognises the many different pressures facing ecosystems and align funding and actions within catchments. As such is it is integral to effective delivery of the WFD.

On 3rd June 2013 Defra launched a Policy Framework to aid wider adoption of the Catchment Based Approach. The policy sets out the high level objectives for the approach, to establish catchment partnerships in every catchment in England where there is an interest in doing so, to:

- Deliver positive and sustained outcomes for the water environment by promoting a better understanding of the environment at a local level,
- Encourage a more transparent form of decision making, in support of local collaboration or partnership working, for both planning and delivery.

More information about the Policy Framework and an accompanying funding initiative for the financial year 2013-14 to recruit and train catchment partnership hosts. More details are available on the Environment Agency's website.

In the context of local projects in Hertfordshire, it should be recognised that site specific modifications to a waterbody can disrupt the continuity of natural hydrological and sediment regimes at catchment scale, meaning that a point or short-area impact that is detrimental to natural hydrological or geomorphological processes or ecosystems (for example via migrating species) could sever the habitat availability of the entire waterbody network up-catchment of the modification. Equally, site specific impacts caused by waterbody modifications could cascade down through the landscape drainage network to impact the form and function of downstream waterbodies, sensitive habitats and ecosystems that are dependent on upstream catchment processes.

Development proposals and mitigation measures must therefore take into account not just the local waterbodies that proposed activities lie within (as defined in the RBMPs), but potential wider impacts to the connecting waterbody network and catchment areas. Specialist advice may be needed to determine these effects and to identify appropriate mitigation measures that are needed to implement local schemes.

5. RELATED POLICY AND GUIDANCE

The WFD is 'all-encompassing' in terms of water environments and has parallels with a large number of other policies, directives and regulations. The principles described in the WFD are not necessarily new, and other established legislation and best practice also describe the principles of protecting and improving the environment, while recognising that development needs to take place and should be sustainable. The main directives that relate to development affecting the water environment are listed below, but others may also be relevant for many locations. Further information is available at the Environment Agency's Water Legislation website.

5.1 Key European Legislation

Priority Substances Directive 2008

The Priority Substances Directive (2008/105/EC) is a Daughter Directive of the Water Framework Directive. It is aimed at protecting human health and the environment by limiting the concentration of Priority Substances (harmful substances). A European 'priority list' of substances posing a threat to or via the aquatic environment has been established (see Appendix B), with the aim of reducing (or eliminating) pollution of surface water (rivers, lakes, estuaries and coastal waters) by the pollutants on the list. The Directive requires the progressive reduction or phasing out of these substances.

Groundwater Daughter Directive 2006

The Groundwater Daughter Directive (2006/118/EC) is a Daughter Directive of the WFD. Under Article 22 of the Water Framework Directive the 1980 Groundwater Directive (80/68/EEC) is due to be repealed in December 2013. The Water Framework Directive sets objectives for groundwater quality, including an objective to meet "good chemical status" by 2015, an objective on pollution trends, and an objective to prevent or limit the input of pollutants to groundwater. A groundwater directive was proposed by the European Commission in September 2003. It focused on the objectives mentioned above but required further development to ensure that it was practical, effective, risk-based and proportionate.

Strategic Environmental Assessment Directive 2001

The SEA Directive is designed to ensure that the environmental outcomes of particular plans, programmes and policies are identified and assessed during their preparation and before their adoption. For example, where there is a risk of flooding, the SEA Directive should ensure that the environmental impacts of all possible options for addressing that problem are taken into consideration before a preferred solution is decided. The Directive has been transposed into UK law since 2004.

Natura 2000 Network

Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) together form a European ecological network of protected sites known as Natura 2000. The Habitats Directive states that it must be demonstrated that any activity carried out at a Natura 2000 designated site will not affect the integrity of that site. It also requires the prevention of any impact on site integrity through the employment of measures to mitigate and compensate for the effects of the activity. For example, in terms of river management, a development could result in the release of fine sediment which could adversely affect bullhead, shad, salmon, freshwater pearl mussel and floating water-plantain (example species for which an SAC can be designated). Any activity that could potentially affect a SAC or a SPA requires an assessment of whether it is likely to have a significant impact on the integrity of the site with reference to the features for which it was designated and its conservation objectives.

Habitats Directive 1992

Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (otherwise known as the Habitats Directive) is intended to help maintain biodiversity by defining a common framework for the conservation of wild plants, animals and habitats through the designation of Special Areas of Conservation (SACs). These areas are designated based on the presence of particular habitats or species that are either rare or declining in the EU.

Any development that is likely to have an impact on a SAC or another type of European protected site (for example, Special Protection Areas – see below) requires the completion of an 'appropriate assessment' to determine the potential impacts of the proposal on a site's conservation objectives. The Directive also requires consideration of issues such as 'imperative reasons of overriding public interest' (IROPI) when assessing proposals that may have an impact on European protected sites.

Environmental Impact Assessment Directive 1985 (amended in 1997 and 2003)

The environmental impact assessment (EIA) process is well established, but does not fully or specifically account for WFD objectives. The main aim of EIA is to allow specialists to identify and assess the potential impacts of an individual plan or project. This is followed by the identification of appropriate mitigation or compensation measures for any impacts expected to have a significant environmental effect in order to reduce any residual environmental change to an acceptable level.

5.2 Key National Legislation

National Planning Policy Framework 2012

The National Planning Policy Framework (NPPF) was published in March 2012 together with accompanying Technical Guidance and revoked most of the previous Planning Policy Statements (PPS) and Planning Policy Guidance. The NPPF places a lot of emphasis on sustainable development and climate change, spatial planning, increased neighbourhood involvement and quality outcomes.

The Flood and Water Management Act 2010

The Flood and Water Management Act (FWMA) places duties on upper tier Councils such as HCC, by designating them as LLFAs for the coordination of local flood risk management in their respective administrative areas. The principal aim of the FWMA is to ensure that LLFAs identify and manage flood risks from surface runoff, groundwater and ordinary watercourses, through locally agreed work programmes. New duties placed on LLFAs include forging partnerships and coordinating local flood risk management, investigating flooding incidents, establishing asset registers, and acting as Sustainable Drainage Systems (SuDS) Approval Bodies (SABs), amongst others.

The Habitat Regulations – The Conservation of Habitat and Species Regulations 2010

Development plans have a legal duty under the Conservation of Habitat and Species Regulations to be mindful of any works that may impact upon protected species. Appropriate assessment will be required by a competent authority if any proposed works are likely to affect Natura (European) Sites (Special Protection Areas / Special Areas of Conservation).

The Eel Regulations 2009

The Eel Regulations afford new powers to the Environment Agency to implement measures for the recovery of European eel stocks and have important implications for operators of abstractions and discharges. The regulations came into force on 15th January 2010, and are to be enacted by 1st January 2015. The requirements of the regulations are: to notify the Environment Agency of any activities involving structures that likely to affect the passage of eels, construct and operate an eel pass to allow the free passage of eels, removal of any obstruction, if deemed necessary, and the use of eel screens to exclude eels from water abstraction and discharge points.

Natural Environment and Rural Communities Act 2006

The Natural Environment and Rural Communities Act (NERC) created Natural England as a new integrated agency to promote the natural environment and established a Commission for Rural Communities, which operates as a national rural adviser. The Act is designed to help achieve a rich and diverse natural environment and thriving rural communities by facilitating the implementation of environmental government policy.

Water Resources Act 1991

The Water Resources Act (WRA) sets out Environment Agency responsibilities in terms of water resource management and issues including flood defence and water pollution. Under the Act there is strict regulation of discharges to rivers, lakes, estuaries and groundwaters. It also aims to ensure polluters cover the costs associated with pollution incidents.

The Wildlife and Countryside Act 1981

The Wildlife and Countryside Act allows for the designation of Sites of Special Scientific Interest (SSSIs) due to features of conservation interest related to flora, fauna, physiography or geology. The Act makes it an offence to kill, injure, take, possess or trade in many wild animal species and to pick, uproot, possess or trade in a number of wild plants. Measures are outlined to prevent the establishment of non-native species that could adversely affect native wildlife.

5.3 Key Local Policy

Local Flood Risk Management Strategy for Hertfordshire Strategic Environmental Assessment (2012)

HCC, as an LLFA, is required by the FWMA to produce a Local Flood Risk Management Strategy (LFRMS) which must be maintained, applied and monitored. The requirement for a Strategic Environmental Assessment (SEA) emanates from a high level national and international commitment to sustainable development. The most commonly used definition of sustainable development is that drawn up by the World Trade Commission on Environment and Development in 1987 which states that sustainable development is:

> *'development that meets the needs of the present without compromising the ability of future generations to meet their own needs.'*

The European Directive 2001/42/EC "on the assessment of the effects of certain plans and programmes on the environment" (the 'SEA Directive') was adopted in June 2001 with a view to increase the level of protection for the environment, integrate environmental considerations into the preparation.

HCC published its LFRMS for Hertfordshire SEA in June 2012.

6. RESPONSIBILITIES

6.1 European Union

The EU's principal responsibilities are setting and enforcing the legislation. The EU Directive requires Member States to establish River Basin Districts and for each of these a River Basin Management Plan. The WFD sets a cyclical process where river basin management plans are prepared, implemented and reviewed every six years. Within the cycle, the EU has defined four distinct elements to river basin planning: characterisation and assessment of impacts on river basin districts; environmental monitoring; the setting of environmental objectives; and the design and implementation of the programme of measures needed to achieve them.

The EU enforces the WFD by, for example, reviewing River Basin Management Plans, and through having powers to fine Member States if WFD objectives are not met at national scale or for local projects. The EU also sets environmental quality standards for priority substances, which are assessed under the chemical status part of the overall ecological status.

6.2 United Kingdom

The UK and the other Member States have powers to make decisions about how river basin planning and management is delivered. For example Member States define the boundaries of River Basin Districts, and set environmental quality standards for biological, hydromorphological and physico-chemical elements and the specific pollutants making up ecological status.

The legal responsibility for implementing the Water Framework Directive in England and Wales is split between two distinct authorities, these are:

1) **Competent Authority** – In England, the Environment Agency is the 'Competent Authority'. The main roles of the Competent Authority are:

   - Characterise River Basin Districts (RBD),
   - Prepare River Basin Management Plans (RBMP) for each RBD,
   - Establish monitoring programmes,
   - Produce Environment Objectives for each waterbody in each RBD,
   - Produce a Programme of Measures where objectives are unlikely to be met without specific actions.

2) **Appropriate Authority** – In England, the Secretary of State for Environment, Food and Rural Affairs (*de facto* Defra) is the 'Appropriate Authority'. The Appropriate Authority has the overall responsibility for:

   - Transposing the Directive into National Law,
   - Approving RBMPs prepared by the Competent Authority,
   - Approving Programmes of Measures produced by the Competent Authority.

Within the UK, transposition of the Directive into national law occurred through 'The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (Statutory Instrument 2003 No. 3242)' for England and Wales.

6.3 Environment Agency Responsibilities

The Environment Agency is the 'Competent Authority' for delivery of the WFD in England. As part of their responsibilities, the Environment Agency have undertaken a series of actions (refer to Table 3.1) including characterisation of RBDs, preparation of RBMPs, established monitoring programmes, produced environmental objectives and set up a programme of measures where specific actions are required to achieve environmental objectives.

These actions have allowed:

- The removal of uncertainties about waterbodies and modifications,
- The identification of waterbodies under Environment Agency control, e.g. main rivers,
- The identification of non-main rivers where the Environment Agency have sufficient knowledge and are working closely with a partner public body who has the required powers to undertake measures to achieve the required environmental objectives,
- The provision of guidance to authorities to enable them to decide whether measures are cost effective,
- Influencing of third parties to provide environmental outcomes related to the WFD.

The Environment Agency has limited powers over other authorities although it can require other authorities to provide information where considered necessary.

6.4 Local Authority Responsibilities

Local authorities do not have any specific duties to complete WFD investigations or implement measure but have a duty to provide the Environment Agency with information and assist the Environment Agency in exercise of Environment Agency functions.

In addition, they have a duty to regard RBMPs when exercising their functions, this includes:

- LLFAs - when consenting works in or adjacent to an ordinary watercourse have a duty of care to advise developers and riparian landowners of their responsibilities. As with other relevant legislation requirements, they must ensure they do not consent works that could lead to an impact on WFD objectives,

- LPAs - must consider the requirements of the WFD when determining planning applications for development. As a statutory consultee in the planning process, the Environment Agency as the Competent Authority will raise objections if they feel that the objectives of the WFD have the potential to be compromised by development proposals; however, the LPA has overall responsibility to ensure that permission is not granted to development which could compromise the WFD objectives,

- LPAs, County Councils and Unitary Authorities must consider the WFD when undertaking their statutory growth plan making and policy development. Proposals and policies within Local Plans, and other statutory plans such as Waste and Minerals Plans must not prevent WFD objectives from being met. Water Cycle Studies (WCS) are a recent, non-statutory evidence based studies which have been used by several local authorities to demonstrate that strategic growth plans do not impact on WFD objectives.

6.5 Developers and Riparian Owners Responsibilities

Developers and riparian owners have a duty to have regard to RBMPs and the WFD when undertaking works within or adjacent to a watercourse or waterbody. This is to ensure that any works do not cause detriment and result in deterioration in ecological status or potential. When considering works, they should contact the relevant organisation (Environment Agency, Local Authority, LLFA) to gain advice on the whether works require consent and if required, the information that needs to be provided to determine whether further assessment is required under the WFD.

6.6 Linkages with other Legislation, Policy and Guidance

The Environment Agency, Local Authorities, Developers and riparian owners all have a duty to regard relevant legislation, policy and guidance when considering works within or adjacent to a watercourse or where a waterbody (including groundwater) may be affected. The WFD is inherently linked with these and it is recommended that any person considering works within or adjacent to a watercourse or where a waterbody may be affected should contact the Environment Agency (and HCC for ordinary watercourses) to gain further information on legislation, policy and guidance that should be considered.

6.7 Summary

Ultimately, the Environment Agency is responsible for delivery of the WFD in England, so developers and LLFAs should seek Environment Agency guidance on the level of WFD assessment that is required for consent applications, much like Local Planning Authorities do through planning process. This guidance aims to provide HCC with the knowledge it needs to advise consent applicants, but ultimately, both HCC and the applicant will need to consult with the Environment Agency on a case by case basis. HCC will not be able to make decisions on whether WFD assessments are sufficient, and in all cases this is the Environment Agency's role. This is similar to the Habitats Directive and judgement of whether consent proposals have potential to impact on a Special Area of Conservation (SAC) or a Special Protection Area (SPA): it would be up to Natural England to make formal decisions, even if HCC can advise on whether a Habitats Regulations Assessment (HRA) is required.

7. POTENTIAL IMPACTS OF DEVELOPMENT ON THE AQUATIC ENVIRONMENT

7.1 Emphasis on Culverts

The focus of this guidance is in accordance with the majority of ordinary watercourse consent applications to HCC, which are predominantly for culverts. It is not possible to provide comprehensive guidance on all types of development impacts on WFD objectives within one document, but general comments on the causes of detrimental impacts to the ecological status of waterbodies are provided below. As emphasised above, it is HCC's role to advise ordinary watercourse consent applicants and to support the Environment Agency in the delivery of WFD objectives, but ultimately it is the responsibility of the Environment Agency to regulate the assessment and mitigation of culverts and other developments.

7.2 Causes of Impacts on the Ecological Status of Waterbodies

A wide variety of pressures on the water environment have historically caused the deterioration of present day waterbodies to less than 'good' status. These types of impacts should be considered when planning any new developments that could affect waterbodies, both in terms of preventing deterioration of existing conditions and by using development opportunities to help improve water environments that have been degraded by historic activities. The pressures can be broadly grouped into the following categories:

- Water pollution,
- Over-abstraction,
- Physical alterations,
- Historic legacies (which may include some or all of the above).

With population growth, development needs and climate change, the pressures on the water environment will inevitably increase, and a concerted approach is needed to improve waterbodies to meet the standards required by the WFD.

The pressures are not necessarily directly on biological elements of the WFD, but can also be more on the elements supporting biology, i.e. physical and chemical habitat qualities that define habitat availability and populating biodiversity.

It is important to emphasise that biological, hydromorphological, physico-chemical and chemical quality elements are all inter-related, so any changes within one group of elements, whether detrimental or beneficial, would have the potential to have concurrent affects in the other groups. All groups of elements, and how they interact, must be considered throughout WFD assessments, for surface waters and groundwater.

Urbanisation increases runoff rates (and therefore the capacity to transport pollutants) and the majority of surface water runoff receives no treatment before entering receiving waters. Runoff from urban surfaces can carry pollutants such as sediments, highways grits, salts and de-icers, toxic heavy metals, pesticides and hydrocarbons. These tend to accumulate during dry weather periods and can be suddenly mobilised in high concentrations during intermittent storm events, a phenomenon known as the 'first flush'. Urban watercourses are often engineered box-like channels with little hydromorphological diversity, which reduces turbulence and flow mixing and in turn reduces the mixing of oxygen (and carbon dioxide to a lesser extent) through the water column and into bed habitats.

Culverting causes direct loss of riparian and bank habitats, and often bed habitats unless the culvert does not have a base. Culverts also sever the continuity of the channel with the riparian, floodplain and groundwater zones, and alter flow dynamics

and sediment transport. The loss of riparian / wetlands habitats and vegetation prevents the input of organic detritus into the channel, and limits the nitrification capacity of the ecosystem to produce nitrates available for uptake by plants. Culverts cause excessive shading (see below), and can also hide outfalls and misconnections, and prevent access for maintenance and clean-up.

Structures can often impede the movement of migratory and other species, and interrupt the continuity of the natural hydraulic and sediment regimes. Obsolete structures can become poorly maintained and present health and safety hazards and environmental risks resulting from sudden failure.

Excessive shading (for example by invasive plant species or culverts) reduces light intensity, photosynthesis, metabolic activity and biochemical cycling, e.g. nitrification. Shading also reduces water temperatures and alters diurnal temperature regimes, thereby limiting habitat colonisation by some species, and causes the reduction in dissolved oxygen concentration (which is directly dependent on temperature).

Point source water pollution such as discharges of industrial effluent, and discharges from combined sewer overflows, wastewater treatment plants or mines. Environmental regulations and permits and discharge consents have served to greatly improve pollution control from point sources in recent decades.

Diffuse pollution can arise from current and past land use in agricultural and urban environments and from contaminated land. Its sources can be difficult to trace and control, and while pollution sources may be minor individually, their cumulative impact can be severe. Urbanisation, agricultural practices and septic tanks for rural dwellings are often associated with diffuse pollution.

Sediment runoff from land is a natural process, but fine sediment in water habitats can quickly become excessive due to increased soil erosion or particulate supply from agricultural land, deforested areas, land under construction, or land already urbanised. Fine sediment is a physical pollutant because it can reduce light penetration through the water, fill or blanket habitat spaces in substrate habitats, and damage organisms by abrasion. It is also a vector for pollutants and (excess) nutrients, and thereby has an important role in linking catchment land use with aquatic habitat quality.

Agriculture, deforestation and mining can significantly increase rural diffuse pollution. As well as sediment and contaminant runoff such as agricultural fertilisers or heavy metals derived from mining spoil heaps, biological hazards such as Cryptosporidium or E. coli are associated with livestock and slurry or silage.

Abstraction and low flows water impoundment and abstraction from rivers, reservoirs or groundwater can reduce hydraulic habitat availability, effectively increase concentrations of contaminants and excess nutrients, and limits the capacity of the watercourse to entrain and transport sediment, or deposit sediment outside of the river channel.

Invasive Plant Species can result in the dominance of one species that can ‘choke’ waterways and native species and reduce the biodiversity native plant species and other organisms.

Drainage misconnections of foul wastewater (e.g. from toilets and washing machines) into surface water drainage systems can result in discharge of pollutants to waterbodies. Proper connections to foul water sewers would result in discharge to wastewater treatment facilities. The Environment Agency is using its Yellow Fish scheme to raise awareness about the sources and effects of water pollution including misconnections.

Other pollutant sources include spillages, poor storage or handling of potentially polluting materials which can enter surface water drains and then flow into watercourses, deliberate disposal of pollutants into surface water drains, fly tipping and littering and general poor maintenance or abandonment of watercourses.

Flooding especially surface water flooding in urban areas, can result in the mobilisation and discharge of pollutants from combined sewer overflows into water habitats, or mobilise pollutants such as pesticides from land adjacent to watercourses.

Flood protection such as channel impoundments or raised embankments can limit the natural deposition of sediment (and associated nutrients and contaminants) out of the channel and onto floodplains, thus exacerbating excess sediment problems in waterbodies. They can also serve to concentrate flow energy and thus increase the erosion of channel substrate habitats and undermine near-channel assets.

Other modifications to watercourses such as straightening and culverting can result in direct loss of substrate, bank or riparian habitats, and disruption of the natural regimes of flow and sediment erosion, transport and deposition. All these effects can result in the loss of substrates that plants, invertebrates and animals inhabit, and cause depletion of primary productivity and the food chain. Waterbody modifications can have severe effects on the discontinuity of watercourse habitats and migration routes, which can cause the disconnection of catchments and watercourse habitat networks upstream of modifications, and cause negative effects to cascade downstream with flow routes to other habitats.

Habitat degradation including anthropogenic impacts and the effects of invasive non-native species, such as Himalayan Balsam, Japanese Knotweed, giant hogweed, American mink or signal crayfish, can overwhelm indigenous species, resulting in the damage of habitats and indigenous ecosystems.

It is unreasonable to expect urbanised or otherwise developed landscapes to be fully restored to pre-impacted conditions. But water environments can be rehabilitated or enhanced from the legacies of pollution or physical change, and the effects of future development can be mitigated by sustainable planning.

7.3 Ordinary Watercourse Consentable Activities / Activities that are Unlikely to be Consentable

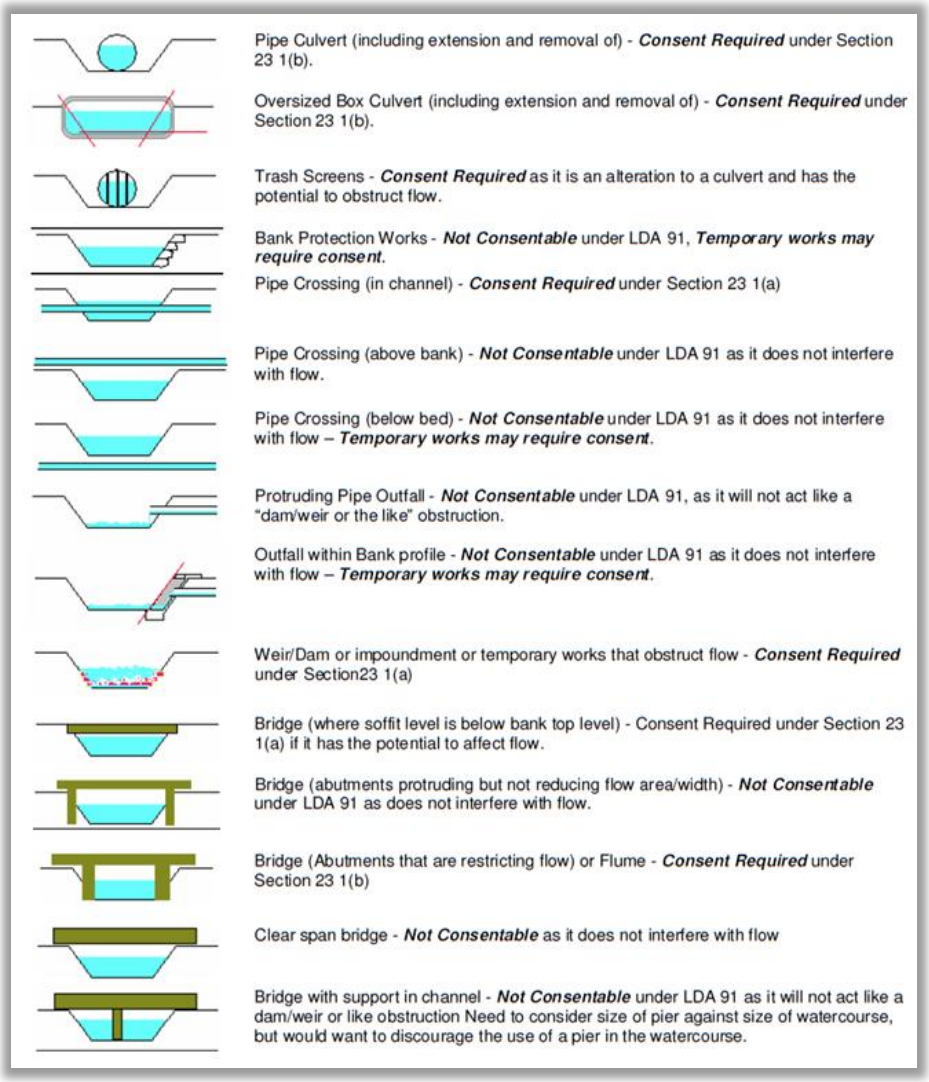


Figure 7-1: Ordinary Watercourse Consentable Activities[4]

In Figure 7-1, 'LDA 91' refers to the Land Drainage Act and 'Section 23' refers to Schedule 2 of the Flood and Water Management Act, which amends Section 23 of the Land Drainage Act.

The same principles that are presented in Figure 7-1 apply to the WFD, in that activities such as open span bridges and above-bank pipe crossings that would not affect water flow do not require WFD assessment. Wherever an ordinary watercourse consent is required for accordance with the LDA and the FWMA, it is likely that a WFD assessment will also be required.

More detailed guidance on how to screen activities out of WFD assessments are presented in the methodology for WFD assessments in Chapter 9, including a WFD exemptions list (Section 9.2). Guidance is also provided on how to undertake WFD assessments, if they are required.

[4] Excerpt from the Appendix to the Advice Note for Lead Local Flood Authorities on regulation of activities on ordinary watercourses. Available to download from http://www.environment-agency.gov.uk/research/planning/136423.aspx

7.4 Impacts of Culverts

Culverts can often be detrimental to watercourse and aquatic habitat quality in a range of ways, so culverts generally require a further assessment for compliance with WFD objectives. However, the assessment should still be proportional to the scale of impact, for example it is logical that a small pipe for a drainage ditch under a footpath is unlikely to cause a significant impacts.

Additionally to these notes, it would be important to assess any impacts related to culvert construction, including construction activities and the need for channel realignment or cuttings. The cost of constructing a culvert or cutting usually depends on length, so the least expensive option is usually perpendicular to the waterbody crossing, which may require extensive realignments / river training upstream and downstream. This could mean lengthening or shortening the waterbody and changing channel gradients, with direct changes to physical habitat areas, and consequent changes to hydraulic / substrate habitats in terms of changes to flow velocities and substrate erosion transport or deposition.

The number of culverts upstream and downstream of a proposed new culvert may affect the viability of a proposed new culvert. Impacts on a waterbody, however small, can have significant cumulative effects so any new impacts are likely to need mitigation. If the waterbody is already heavily modified, for example due to urbanisation including culverts or other watercourse encroachments, the impact of new schemes is not likely to be lessened, even if it appears that the new scheme would not have a proportionally significant impact on the condition of the waterbody. This would probably make deculverting and waterbody mitigation and improvement more important.

With reference to Appendix A, the impacts of culverts on the WFD elements underpinning ecological status and potential could include those listed below.

7.4.1 *Biological Elements*

Phytoplankton

River plankton abundance may be affected by hydrological (discharge, water residence time), chemical (nutrient concentrations), physical (light conditions) and biotic (grazing, competition) conditions. Phytoplankton biomass tends to be proportional to river discharge and can be strongly regulated by nutrient concentrations.

Culverts can therefore be detrimental to phytoplankton abundance and the primary productivity of a stream by reducing photosynthetic activity due to shading. The nature of plankton means that these impacts would be carried downstream with the river flow.

Macrophytes and Phytoplankton

Shading will reduce photosynthetic activity in macrophyte communities leading to reduced biomass, and potentially a change in community composition within the shaded area. Land-take will lead to direct loss of macrophytes, energy inputs to the ecosystem through loss of organic detritus and nitrification, while channel re-profiling will reduce the availability of macrophyte habitats within the area directly affected by land-take. Changes to channel hydraulics may result in localised and downstream changes in flow velocity. Increased velocity may cause wash out of macrophyte communities, while reduction in velocity may increase accretion leading to establishment of species more tolerant of sluggish flow conditions.

Benthic and Invertebrate Fauna

Benthic and invertebrate fauna may be affected by the loss of primary productivity. Shading will usually be a localised impact with no anticipated effects on the wider

waterbody. Land-take would lead to direct loss of macroinvertebrates while channel re-profiling would reduce the availability of habitats available for colonisation within the area directly affected by land-take. Changes to channel hydraulics may result localised and downstream changes in flow velocity. Increased velocity may cause wash out of macroinvertebrate communities. Reduction in velocity may increase accretion leading to blocking of interstitial spaces and loss of high dissolved oxygen- dependent macroinvertebrate communities

Fish Fauna

Extensive culverts are likely to be severe impediments to migrating fish species, which could effective cut-off the availability of up-stream habitats. Land-take is unlikely to result in direct mortality of fish but channel straightening and re-profiling will reduce the availability of habitats used by fish for feeding and spawning, and as refuges in the directly affected area. Shading would usually be a localised impact with no anticipated effects on the wider waterbody. Change to channel hydraulics may result localised and downstream changes in flow velocity. Increased velocity may cause localised scour within sensitive fish habitats. Reductions in velocity may increase accretion leading to blocking of interstitial spaces resulting in degradation of on fish spawning habitats.

During construction, noise and vibration may cause mortality or injury at high levels and behavioural responses at low levels. Fish status is not directly sensitive to noise and vibration impacts although changes in fish abundance and composition could occur. Direct impacts would be limited to the vicinity of the noise source, although noise may act as a barrier to upstream migration.

7.4.2 *Hydromorphological Elements*

Hydrological Regime

Floodplain flow and storage and possible groundwater interactions would be disconnected at the culvert. Channel form and boundary conditions and therefore channel flow patterns are likely to be homogenised. Channel straightening can result in increased gradient and flow velocity, and likely reductions to channel boundary roughness for hydraulic efficiency can also increase flow velocity. The net effects of altering the natural channel to a hydraulic conduit could be to increase flow velocities and scour potential to local areas downstream. Headward erosion may also occur due to changes in bed gradients related to straightening the channel. Check weirs can be installed to stop headward erosion by introducing a controlled step, but these may in turn cause other erosion, bed substrate transport or habitat continuity issues. If the culvert capacity is exceeded, the culvert could cause flows to back-up and increase flood risks upstream.

River Continuity

Culverts would disconnect floodplains and out-of-bank flows, and result in direct loss of bank and riparian habitat. Bed substrates are likely to be lost if culvert bases are not set well below bed level, and even with this design there is likely to be loss of pool-riffle sequences or other substrate features; homogenising the channel could result in uniformity in bed composition.

Morphological Conditions

Culverts would cause the direct loss of bank and riparian habitats, and disconnection of floodplains and out-of-bank flows could prohibit sediment deposition outside the channel and potentially increase sediment load in the channel. Bed substrates would be lost if the culvert base is not set well below bed level, and there is likely to be loss or interruption of pool-riffle sequences through the culvert and downstream.

Homogenising the channel would probably result in uniformity in the bed composition. Scour upstream / downstream of rigid structures could create steps in channel that would further interrupt natural sediment conveyance. Bank protection to control realignments could be discontinuous to natural banks, and could prevent natural sediment inputs to the channel. Channel straightening can result in increased gradient, flow velocity and substrate scour. Channel training (realignment, with control measures such as bank reinforcement) to align streams upstream, through and downstream of culverts can significantly affect the natural regime of channel erosion, sediment transport and deposition, with detrimental impacts on substrate habitats. Natural channel planform migration (meandering) can also be affected, which could have severe impacts on channel sustainability.

7.4.3 *Chemical and Physico-Chemical Elements*

Chemical and physico-chemical impacts on waterbodies tend to relate to point and diffuse pollution, but culverts can also have significant direct and indirect impacts. Enclosure of waterbodies limits access for maintenance or monitoring purposes, and historically, culverting and sewer misconnections have resulted in influxes of pollutants and have made tracing and management of pollutant sources difficult. Disconnection of riparian and wetland vegetation can also affect biochemical processes and nutrient cycles, so impacts would occur at reach or waterbody scale, and not just within the area of the culvert.

Thermal Conditions

Extensive culverts, or culverts on waterbodies where there is slow flow can significantly reduce water temperatures and affect diurnal thermal variance due to extensive shading, which consequent impacts on ecosystem functioning.

Oxygenation Conditions

Oxygenation conditions could change if, for example, the waterbody is extensively shaded to the degree that photosynthesis or other nutrient and biochemical processes are affected. Legacy sewer misconnections, or enclosure of the waterbody preventing of maintenance access, could result in excess nitrates or phosphates and oxygen consumption by microbial decomposition of organic matter. The waterbody could also be disconnected from oxygen delivery by groundwater upwelling, or the culvert design could result in fine sediment deposition to the degree that it blankets the bed and thereby limits hyporheic zone mixing and oxygen delivery from the water column into bed substrates.

Salinity

Salinity problems would not typically be expected in Hertfordshire.

Acidification Status

Culverts are unlikely to directly affect acidification unless they are constructed directly in contaminated ground. If waters are acidic then it is possible that sulphate resistant concrete could be required for construction.

Nutrient Conditions

The loss of riparian / wetlands habitats and vegetation prevents the input of organic detritus (mainly Particulate Organic Matter (POM) and Particulate Organic Carbon (POC)) into the channel, which tend to comprise the dominant energy source in aquatic systems. Disconnection of riparian and wetlands habitats limits the nitrification capacity of the ecosystem to produce nitrates available for uptake by plants. Shading and the

loss of detritus can cause die-off and increased grazing of primary producers in some circumstances.

Specific Pollutants

Culverts are unlikely to affect specific pollutants unless they are constructed directly in contaminated ground.

7.5 Benefits of De-culverting

"Daylighting" of culverts is generally accepted to provide for a multitude of benefits for waterbodies and opportunities for de-culverting are strongly encouraged by the Environment Agency and other organisations such as the Chartered Institution of Water and Environmental Management (CIWEM). This also reflects the detrimental impacts that can be caused by the construction of culverts.

The benefits of de-culverting are briefly summarised in Table 7-1.

TABLE 7-1: BENEFITS OF DE-CULVERTING

Environmental	Maintenance/Operational	Socio-economic
Improve fish passage	Reduce maintenance costs	Improve aesthetic appearance
Increase habitat	Easier to trace pollutants in open channels	Improve amenity
Improve morphology	Reduce flood risk from blockages or collapse	Improve social environment
Improve biodiversity	Decrease health and safety risks	Potential economic benefits for householders
Improve water quality	Decrease operational risk of flood events	Potential increased revenue for local businesses
Reduce habitat fragmentation		Engagement of local residents and stakeholders
		Opportunities for partnership working

7.6 Activities other than Culverting

It is emphasised again that this guidance is focussed on culverts, since culverts constitute the majority of ordinary watercourse consent applications to HCC. The notes provided above, particularly the discussion of general impacts on aquatic habitat quality and WFD objectives in Section 7.2 should provide useful guidance for assessing whether or how proposed activities could be detrimental to WFD objectives.

The nature of the aquatic environment, and therefore the sustainable planning, design and mitigation of any activities associated with works on or development in the vicinity of waterbodies, is highly site specific.

Specialist information and experienced judgement may be required to undertake a WFD assessment comprehensively and to provide timely support to a planning application, so where personal or in-house expertise do not include assessments of certain WFD elements, it may be necessary to consult suitably qualified expertise.

8. MITIGATION MEASURES

The principal resource for identifying appropriate mitigation measures is the Environment Agency's online Mitigation Measures Manual. It should be noted that the manual emphasises impacts and mitigation measures for hydromorphology, but the WFD emphasises the need to give equal weighting to biological, chemical / physico-chemical and hydromorphological elements.

TABLE 7-1: IMPACTS OF CULVERTS AND APPROPRIATE MITIGATION MEASURES *

Activity	Function	Potential Hydromorphological Change	Mitigation Measures
Culverts	To enable conveyance of water across other functions, e.g. transport infrastructure	Change in flow dynamics Loss of morphological diversity (rivers) Loss of structure and condition of the riparian zone	Modify or Enhance Structures Improve Fish Passage Good Practice Vegetation Management Remove Obsolete Structures Manage and Restore Aquatic and Riparian Habitats

*Functions, changes and measures reproduced from the Environment Agency Mitigation Measures Manual

A lot of the discussions presented in Sections 8.3 to 8.6 follow the guidance published in the Environment Agency Mitigation Measures Manual.

8.1 Culverts

Culverts should be as short as possible. If culverts are perpendicular to crossings, then they are likely to be less expensive to construct and to have less impact on ecology. Channel re-alignments may be required to ensure that the culvert orientation ties in with the natural watercourse as far as possible, but this could also provide opportunities to implement local mitigation measures.

The culvert design should maintain the natural bed profile within the channel, both in terms of channel gradients and substrates, the latter being achieved by setting culvert bases well below bed level, or constructing the culvert without a base if possible. Altered channel forms and severe shading can prohibit the migration of fish and other species, so culvert beds could be designed such that the hydraulics serve to guide fish through them. Provision of natural light, for example by incorporation of slots or transparent panels, would also help to mitigate the barrier effect of long culverts.

Natural flow depths, widths and velocities (including natural variance and diversity) should be maintained at the culvert inlet and outlet and through the culvert, in order to provide habitat diversity and resting areas for migrating species. Installation of baffles in the culvert can improve conditions for fish by slowing the flow and locally increasing depth. Conversely, this could compromise flood conveyance capacity, or trap debris and increase the risk of blockage. More details are provided in discussion of fish passage below.

8.2 Improvements for Riparian Mammals

Drainage culverts are well known to provide ecological corridors and crossing points for a wide range of terrestrial mammals as well as for aquatic species such as otters. Culverts should be designed with a ledge above the baseflow water level to provide terrestrial species with a dry path through the structure. The ledge would need to tie in with levels of the surrounding terrain.

Scottish Natural Heritage[5] has reported that culverts in excess of 200 m have been installed and subsequently used by otters when designed appropriately, as detailed in the following paragraph (although much shorter culverts are obviously far preferably for ecology).

"Without dry ledges, otters often find it impossible to move upstream through culverts due to currents. A ledge 45 – 60 cm wide, 15 cm above the design flood level and providing minimum headroom of 60 cm will enable otters to avoid the water and traverse culverts successfully. The ledge must be provided with split ramps at each end such that the ledge is accessible both from the water and the bank. Ideally, the surface of these ramps should also be roughened to enhance grip. Culverts are more likely to be successful ecological corridors if they are oversized and square or rectangular in cross section. Large pipe culverts are not recommended as there may not be sufficient air space during high flows. Free air flow is vital, if scent is to be easily carried through the structure and encourage otters to use it."[5]

8.3 Improve Fish Passage

The free passage of migratory fish is a key requirement of the WFD. The presence of migratory fish is used by the Environment Agency as a simple and effective indicator of whether water bodies are meeting Good Ecological Potential or Status. Culvert designs should incorporate fish passage (and other species) requirements as well as specifications for conveyance capacity and flood risk management. To ensure that culverts are sympathetic to fish passage, consideration should be given within the design to access (downstream, through and upstream,), and flow conditions (depth, turbulence and velocity). Details of these elements are discussed further below.

Access (Downstream, Through and Upstream)

Downstream of a culvert, there should be a pool of sufficient depth to allow the fish to rest without any difficulty, before 'bursting' through the culvert. Scour pools can often develop downstream of structures due to high flows being constrained through the structure, but these can also result in 'steps' forming between rigid structures and the erosive channel bed (also known as 'perching'), which can impede the migration of (smaller) species. This can be controlled with a weir or pre-barrage immediately downstream, which can also help to control water depths in the culvert. Low weirs can be constructed of stone or other materials, with notches to allow fish passage. It may also be necessary to provide resting pools for fish immediately downstream of the culvert.

Through the culvert, the culvert base should be set below the channel bed to ensure continuity of substrates.

The upstream exit should be in an area with low flow velocities to provide rest areas and so that the fish will not be washed back into the culvert. These should not be dead zones with recirculation, which can result in reduced dissolved oxygen. The culvert

[5] http://www.snh.org.uk/publications/on-line/wildlife/otters/mitigation.asp

base should be below the substrate bed, so that the structure does not impound downstream substrate conveyance.

TABLE 8-1: CULVERT DESIGN GUIDANCE FOR IMPROVING FISH PASSAGE*

Parameter		Coarse fish (< 25cm) Roach, Dace, Chub, etc.	Brown trout (15 cm) Coarse fish (25 to 50 cm)	Sea trout and Brown Trout (25 to 50 cm) Large Coarse Fish (>25 cm)	Salmon (> 50 cm)
Maximum acceptable mean flow velocity through culvert and any screen fitted (ms^{-1})	Culvert length < 20m	1.25	1.25	1.6	2.5
	Culvert length 20 to 30m	0.8	1.0	1.5	2.0
	Culvert length >30m	0.5	0.8	1.25	1.75
Minimum depth of water in culvert (mm)		100	100	150	300
Maximum water level drop at either inlet or outlet (mm)		100	200	300	300
Minimum gap between trash screen bars (mm)		100	100 (trout) 150 (coarse fish)	150	200
Turbulence (Wm^{-3})		100-150			< 200

** Reproduced from the Environment Agency's online Mitigation Measures Manual. Adapted by the Environment Agency from River Crossings and Migratory Fish: Design Guidance - a consultation paper, April 2000, Scottish Executive. NB The velocities for the shorter culverts are approximate to the burst speed achievable by salmonids at 5°C, and the velocities for culverts >30m approximate to the cruising speed. For coarse fish they equate to mean burst speed and the median cruising speed achievable at 10°C. Turbulence ranges are quoted elsewhere in Environment Agency Mitigation Measures Manual as sourced from Mallen-Cooper, 1993.*

- Armstrong G.S., Aprahamian M.W., Fewings G.A., Gough P.J., Reader N.A., & Varallo P.V. (2004) *Environment Agency Fish Pass Manual: Guidance notes on the Legislation, Selection and Approval of Fish Passes in England and Wales. Version 1.1*.
- Scottish Executive Development Department (2000) *River Crossings and Migratory Fish: Design Guidance*.
- Mallen-Cooper, M. (1993) Fishways in Australia; Past Problems, Present Success and Future. Opportunities" Ancold Bulletin. No. 93

Flow Conditions (Depth, Turbulence and Velocity)

The culvert should be designed according to the flow tolerances summarised in Table 8-1. Flow ranges should be designed according to existing or target species in the local waterbody and connecting waterbodies. Flow depths must be sustained during low flow conditions.

8.4 Remove Obsolete Structure

Structures that no longer serve their original uses for flood control, navigation, scour protection, etc, often deteriorate in condition and can present health and safety risks or increasing maintenance costs. Removal of structures can remove barriers to the migration of fish and other species, and help to re-establish natural continuity in

habitats, substrate conveyance and other hydromorphological processes, and temperature, oxygen balance, pH and salinity.

Removal of structures can also help to restore a waterbody's natural self-regulating processes, but there can be risks associated with local changes in scour regimes (particularly relevant to near-channel assets) or the release of large amounts of (potentially contaminated) sediment into downstream habitats.

8.5 Good Practice Vegetation Management

Improvements to the management of bankside (riparian) and in channel vegetation can increase the morphological diversity of the channel as well as improving biodiversity value, and therefore offers potential as compensation for impacts associated with waterbody crossings

Riparian Vegetation

Sensitive management of riparian vegetation can be beneficial for bank protection or flood control, for example by controlling blocking of the channel (especially at culverts) by overhanging vegetation or falling large woody debris (LWD).

Near-channel vegetation and LWD also serve useful functions for variance in channel morphology, habitats and biodiversity, and provide a substantial amount of an ecosystems energy resource and nutrition in the form of organic detritus. Denitrifying microorganisms existing in riparian and wetland habitats also have a crucial role in the synthesis of nitrates that are available for uptake by plants.

Bank stability can be increased by orders of magnitude by vegetation root binding strength. Marginal vegetation can encourage the deposition of sediments and the formation of side bars which can help to restore the natural functioning of the channel (provided excessive sedimentation is not an issue). Such processes increase channel and flow diversity, giving rise to greater habitat and species diversity.

Riparian vegetation management can also enhance the ecological value of the riparian zone by providing habitats for a range of species and by preventing loss of biodiversity due to the dominance of any particular species.

At culverts, riparian vegetation management can help to improve water quality by providing buffer strips between the land and channel (e.g. for controlling the influx of excess phosphorus from the catchment surface to the channel), provide fish and invertebrates with shelter and spawning habitats,

There is a typical need to widen the inlets and outlets of culverts for wingwall construction, so ideally a riparian shelf should be established at these features above baseflow level and stabilised with native shrubs and grasses.

In-Channel Vegetation

In-channel vegetation is often cleared for the purposes of increasing channel capacity and providing flood risk mitigation, but good practice can also have benefits for ecology and hydromorphology, by:

- Allowing light to reach the channel (i.e. through selective tree thinning), improving macrophyte growth and providing quality habitat for invertebrates and fish spawning,
- Ensuring marginal vegetation is retained during silt removal, providing good macrophyte habitat suitable for invertebrates and fish spawning,

- Preventing de-oxygenation during die-back which can lead to fish and invertebrate mortality. Control also prevents dominance of single species and increases macrophyte diversity leading in turn to increased invertebrate diversity.

The colonisation and stabilisation of substrates by in-channel vegetation can provide morphological and habitat diversity, and help to re-naturalise streams by narrowing over-wide channels and restoring a self-regulating, sustainable baseflow properties.

Invasive Plant Species

Appropriate control of invasive plant species can help to reduce the dominance of non-native plant species that can 'choke' waterways and native species. Common invasive species are shown in Table 8-2. Control of invasive species can serve to:

- Allow the sustainable diversity of native macrophytes,
- Reduce shading and allowing light penetration, which benefits native macrophytes, phytoplankton and phytobenthos,
- Provide more suitable habitat for native invertebrates,
- Reduce coverage of bed substrates and fluctuations in oxygen concentration that can be caused by dense mats of invasive in-channel plants, thereby producing better conditions for fish species,
- Remove biomass from the aquatic environment which can assist with nutrient control, improvements to water quality and reduction in sedimentation,
- Controlling erosion by allowing the growth of vegetation understorey.

TABLE 8-2: COMMON INVASIVE SPECIES

Channel Location	Species Name
In-channel or wet margins	Australian swamp stonecrop (*Crassula helmsii*) Canadian pondweed (*Elodea canadensis*) Floating pennywort (*Hydrocotyle ranunculoides*) Parrot's feather (*Myriophyllum aquaticum*) Water fern (*Azolla filiculoides*)
Bankside	Giant hogweed (*Heracleum mantegazzianum*) Japanese knotweed (*Fallopia japonica*) Himalayan balsam (*Impatiens glandulifera*)

8.6 Manage and Restore Aquatic and Riparian Habitats

Management and restoration of aquatic and riparian habitats offers the broadest group of options for mitigating the impacts of culverts and viaduct footings, with the range of measures available being almost too numerous to list.

Measures should focus on restoring or sustaining hydraulic and sediment regimes to their pre-impacted conditions, improving waterbody continuity both downstream and laterally to riparian zones and floodplains, and improving water quality (especially of in-flowing drainage). Ideally, site surveys should be used to characterise existing ecological conditions and interpret how they have been modified from pre-impacted

conditions. If the waterbody is already modified, then site visits should be used to identify proxy sites that are un-impacted or otherwise provide suitable template conditions that mitigation measures should seek to restore to.

The Environment Agency Mitigation Measures Manual lists the following groups of options for management and restoration of aquatic and riparian habitats:

- Create and restore backwater habitats,
- Management and use of large wood,
- Re-meandering straightened rivers,
- Rehabilitation of banks and riparian zone,
- Managing bank instability and erosion.

Some more specific measures are listed in Table 8-3. Most of these are intended to promote morphological and habitat diversity, which are the key requisites for biodiversity. In general, mitigation can best be achieved by allowing the river space to naturally restore its processes in order to achieve a self-regulating and sustainable environment.

TABLE 8-3: HYDROMORPHOLOGICAL MITIGATION MEASURES

Nature of Measure	Specific Measure
Working with Physical Form and Function	• Removal of hard engineering structures (e.g. naturalisation), • Replacement of hard engineering with soft / green engineering, • Managed realignment of flood defences, • Re-profile banks, • Recreate a sinuous river channel (re-meandering), • Narrow over-wide channels, • Create low flow channels in over-widened/over-deepened channels, • Reconnect and restore historic aquatic habitats, • Recreation of gravel bars and riffles using permanent and/or temporary bed structures (increase morphological diversity), • Regrade stream beds (raising or lowering), • Replenishment of mobile sediments, • Adopt strategic options and policies promoting natural recovery, • Use of engineering techniques to assist natural recovery.

9. METHODOLOGY FOR WFD ASSESSMENTS

9.1 Overview

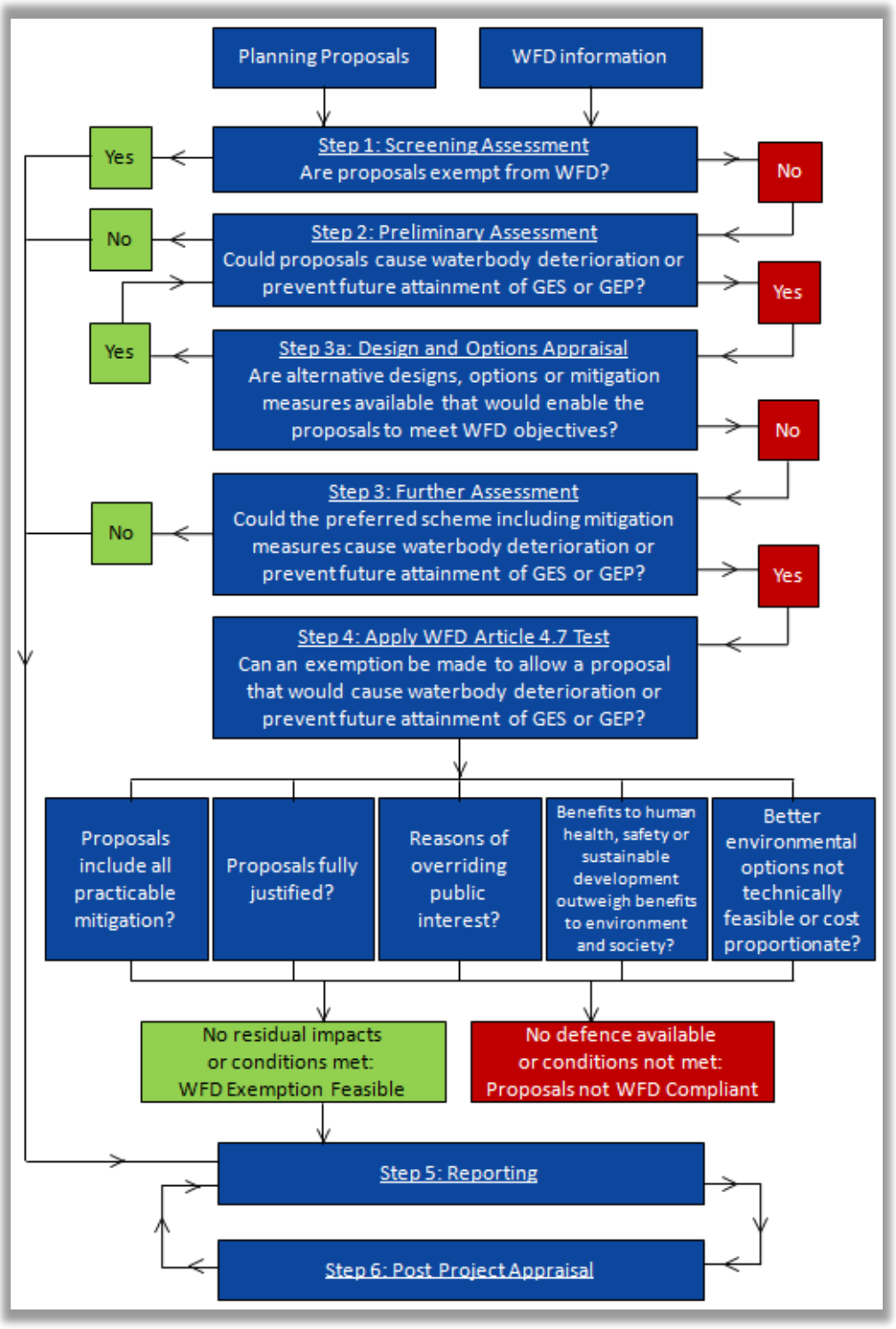


Figure 9-1: WFD Assessment Process

The WFD assessment process is summarised in Figure 9-1. It is broadly divided into **three sequential stages**, plus reporting and post project appraisal. Optioneering and

exemption cases may also be part of a WFD assessment if necessary, but early planning for WFD principles should mean these steps are not necessary. The three stages comprise:

- A **screening phase** is used to consider all possible WFD-related impacts of all proposed activities in order to determine whether WFD assessment is required,
- A **preliminary assessment**, if required, is used to determine the waterbodies that could be affected, gather WFD-related information about the waterbodies and determine which supporting elements of WFD status or potential could be affected,
- A **further assessment** (which had previously been referred to as a detailed assessment), if required, is used to analyse how project elements that cannot be screened out as not having an impact on WFD objectives would affect waterbodies, appraise other designs and options that could uphold the objectives of the WFD, and if necessary, analyse mitigation measures to compensate for impacts of the proposed activities.

To comply with the obligations of the WFD, evidence should be provided as a WFD assessment that planned developments in and around the water environment do not:

1. Cause a deterioration in ecological status/potential of the waterbody (e.g. from 'poor' to 'bad'),
2. Prevent the waterbody from meeting its objective of 'good' ecological status/potential,
3. Prevent or compromise WFD objectives being met in other waterbodies,
4. Cause failure to meet 'good' groundwater status, or result in a deterioration of groundwater status,
5. Prevent the implementation of mitigation measures which define the hydromorphological designation of heavily modified waterbodies.

The level of detail of WFD assessments should be proportional to the level of impact that a scheme would invoke. Certain types of activities in or near waterbodies are exempt from WFD assessment, and some may only need very brief assessment.

9.2 Step 1: Is WFD Assessment Required?

- This stage should be undertaken by the applicant, but the screening decision should be agreed with HCC or the EA,
- Applicants are strongly encouraged to contact HCC to hold early discussions about the proposed activities and for high level guidance on the possible impacts of the scheme and the planning application documents that are likely to be required,
- HCC may be able to discuss ways in which activities and developments can be implemented without the need for a consenting phase or further assessment,
- The outcome of this stage would be to confirm with HCC or the EA that assessment for WFD is not required, or to specify the scope of a WFD Preliminary Assessment

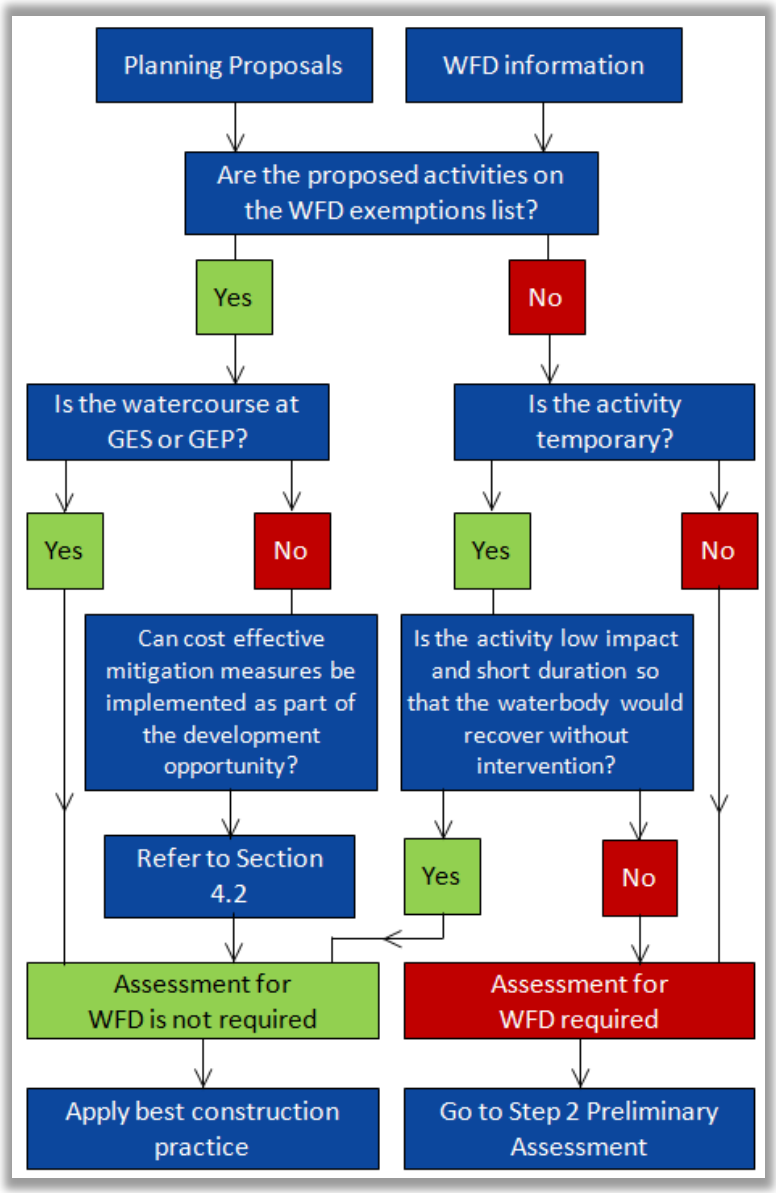


Figure 9-2: Is WFD Assessment Required?

Preparation for WFD assessments, if necessary, should start with the collection of scheme data and WFD data on the waterbody/waterbodies in which the development is proposed, as summarised in Tables 9-1 and 9-2. This will allow for early consideration of the possible impacts of development plans on WFD objectives, and vice versa. Data collection should be desk based, and should only use information that is readily available (mainly from RBMPs).

A summary of how to find waterbody WFD data is provided in Appendix C. The Hertfordshire Ordinary Watercourses Risk Assessment Tool is also a good source of information.

At this stage, scheme information need only be in the form of short descriptions. Simple bullet points or half a written side of A4 of the proposed activities supported by photographs or an annotated drawing should be sufficient detail. The Environment Agency will often provide a pro forma to be completed for this part of a WFD assessment.

Applicants are strongly encouraged to contact HCC early on for guidance on the WFD and other planning requirements. HCC can advise on how to smooth the planning process and may be able to discuss ways in which activities and developments can be implemented without the need for a consenting phase or further assessment.

TABLE 9-1: WFD BASELINE DATA REQUIREMENTS
Data Available in River Basin Management Plans
• The waterbody ID number(s),
• Current status and overall and individual quality elements,
• Water body objective and date to achieve objective,
• Hydromorphological designation (is it a HMWB) and reason for designation (water body use) if it is a HMWB,
• Information on ecological potential classification and mitigation measures in place and not in place, if the waterbody is a HMWB,
• Reasons for waterbody failure (less than 'good' status) if relevant,
• Length or area of waterbody.
Other Environmental Data
• If there is a nationally or internationally protected site (for example, SSSI, SAC, SPA, Ramsar or Drinking Water protected areas upstream or downstream that could be impacted.
Other Information
• Any other relevant information that is readily available.

It is recommended that the Hertfordshire Ordinary Watercourses Risk Assessment Tool is used as a source for the data specified in Table 9-1. The screening process to determine the need for a WFD assessment is summarised in Figure 9-2.

TABLE 9-2: PROPOSED SCHEME BASELINE INFORMATION REQUIREMENTS
Site-Specific Information
• Geographical location: 10-figure National grid reference for centre point of the scheme, or start and end points,
• Site setting and the high-level characteristics of the watercourse, e.g. is it a heavily urbanised or non-developed area; a valley or a floodplain, etc?
• Size, for example, culvert diameter and length, length of river modified dimension, or dimensions of an impoundment,
• Nature of the engineering activities, and construction materials,
• Likely footprint or extent of impact; how much of a waterbody will the scheme impact? For example a culvert may be proposed for a short distance, but may required channel realignments, bank reinforcements and cuttings. A weir may only occupy a short channel length, but the impounding effects may extend to a much larger proportion of the waterbody,
• Proportion of the waterbody that would be affected by the scheme,
• Timing of the works: start and end date or seasonality,
• Working method statement,
• Any environmental impact mitigation or compensation measures incorporated in the scheme design.
Other Information
• Any other relevant information that is readily available.

The WFD Exemptions List is shown in Table 9-3. If the proposed activities are on the Exemptions List, or involve temporary works that are sufficiently low impact and short duration that the waterbody would naturally recover from any minor effects without intervention, then WFD assessment would not be required.

TABLE 9-3: WFD EXEMPTIONS LIST	
Activity	**Type of modification**
Low impact maintenance activities (encourage removal of obstructions to fish/eel passage)	• Re-pointing (block work structures),
	• Void filling ('solid' structures),
	• Re-positioning (rock or rubble or block work structures),
	• Replacing elements (not whole structure),
	• Re-facing,
	• Skimming/covering/grit blasting,
	• Cleaning and/or painting of a structure.
Temporary works	• Temporary scaffolding to enable bridge re-pointing,
	• Temporary clear span bridge with abutments set-back from bank top,
	• Temporary coffer dam (if eel/fish passage not impeded),
	• Temporary flow diversion (if fish/eel passage not impeded) such as flumes and porta-dams,
	• Repair works to bridge or culvert which do not extend the structure, reduce the cross-section of the river or affect the banks or bed of the river, or reduce conveyance,
	• Excavation of trial pits of boreholes in byelaw margin,
	• Structural investigation works of a bridge/culvert/flood defence such as intrusive tests, non-intrusive surveys.
Bridges	• Permanent clear span bridge, with abutments set-back from bank top,
	• Bridge deck/parapet replacement/repair works,
	• Replacing road surface on a bridge,
Service crossing	• Service crossing below the river bed, installed by directional drilling or micro tunnelling if more than 1.5m below the natural bed line of the river,
	• Service crossing over a river. This includes those attached to the parapets of a bridge or encapsulated within the bridge's footpath or road,
	• Replacement, installation or dismantling of service crossing/high voltage cable over a river.
Other structures	• Fishing platforms / Fish/eel pass on existing structure (where <2% water body length is impacted),
	• Cattle drinks,
	• Mink rafts,
	• Fencing (if open panel/chicken wire) in byelaw margin,
	• Outfall to a river ≤ 300mm diameter.

If WFD assessment is not required and the current status or potential of the watercourse is less than 'good', then the development opportunity should be utilised to implement cost effective measures to enhance the local water environment. This would greatly enhance development proposals and the likely success of planning applications. Best construction practice should be applied whether WFD assessment is required or not.

To facilitate interpretation of whether sufficient data have been collected to decide whether a WFD assessment is needed, some key 'gateway' questions for Step 1 are summarised in the box below.

Step 1 Key Questions

- Is HCC aware of the proposed scheme?
- What is the nature of the proposals?
- What is the nature of the affected waterbody?
- Has a pro forma been completed to inform decision making?
- Is the proposed scheme on the WFD exemptions list?
- Is the proposed scheme low impact and temporary?
- Can WFD assessment be ruled out with confidence?
- Has the screening decision been agreed with HCC or the EA?
- Could the development opportunity be used to implement environmental improvements?

9.3 Step 2: Preliminary WFD Assessment

- This stage requires technical knowledge of the WFD and the science that underpins the policy, so specialist consultation may be required,
- It is recommended that the relevant EA office is contacted for their local knowledge, additional data, and guidance on likely impacts and mitigation measures,
- Surveys may be required if baseline information on any WFD elements is not sufficient to make judgements of impacts, e.g. for hydromorphology,
- Experienced judgement is needed to demonstrate whether WFD objectives will by met,
- The outcome of this stage is a WFD Preliminary Assessment report to justify whether the proposed activities would affect WFD objectives, and if necessary, specifications for the scope of a WFD Further Assessment.

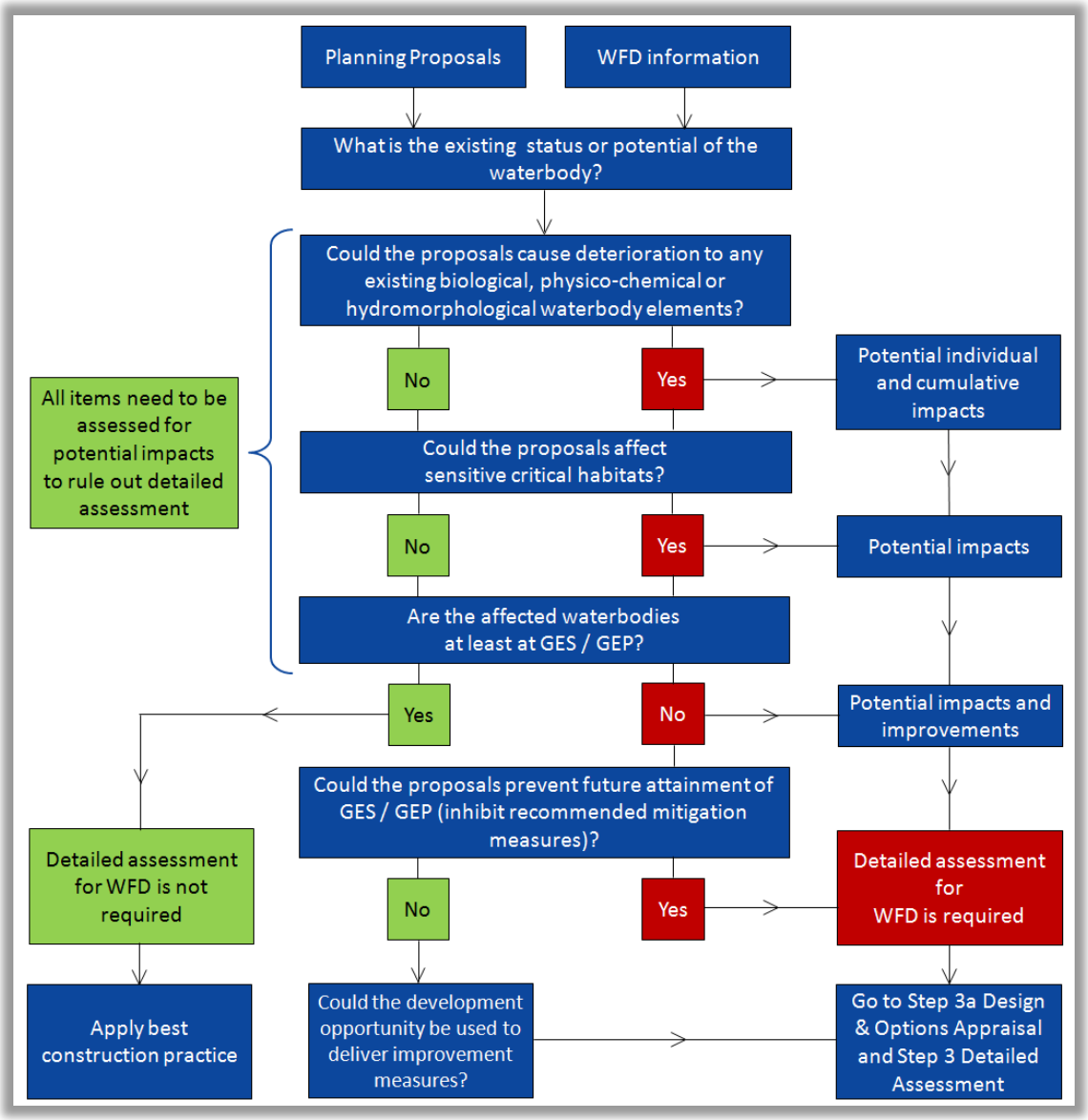


Figure 9-3: WFD Preliminary Assessment

Focus and Outcomes

The focus of a preliminary assessment is to identify whether a proposed scheme *could* affect WFD objectives. If it can be justified at this stage that the proposals would not be detrimental to existing ecological status and would not prevent future ecological mitigation measures, then a further WFD assessment will not be required. If there is a risk that WFD objectives could be compromised, then a further assessment will be necessary.

A preliminary assessment may only need to be brief. All WFD elements should be considered, i.e. biological, chemical and hydromorphological, for surface waters and groundwater. These can be concisely presented in a preliminary assessment matrix, with additional supporting text, following the WFD assessment pro forma that can be provided by the Environment Agency.

The outcome of a preliminary assessment is likely to hinge on the scale of scheme proposals relative to the waterbody. If the ecological risk of the scheme is that only a very small proportion of the waterbody could be affected, and it is possible to briefly justify that the proposals will not significantly affect important local ecology at the site, within the rest of the waterbody, or in connecting waterbodies, the preliminary assessment should be sufficient to demonstrate that WFD objectives have been met. The Environment Agency's guidance on the level of WFD assessment that will be required relative to possible proposal impacts is summarised in Appendix D.

For culverts, the Environment Agency's guidance states that generally all culverts will require a further assessment. However, common sense should be applied; for example a small pipe culvert under a footpath is unlikely to cause a significant ecological risk, in which case, a preliminary assessment could be enough to justify that WFD objectives are not significantly affected. A culvert for a highway or railway crossing is likely to be ecologically significant simply because of its length, and would therefore require further assessment. A short culvert within a town centre area may be significant because of its setting. There may be few 'ecological islands' within the densely urbanised area, so a new culvert could have significant impacts at local scale, making it important to ensure that the remaining local habitats are protected, and necessitating a further assessment.

It is often useful to include a summary (e.g. a table / sketch map) of measurements of the total extent (length / area) of the waterbody(s) that would be affected by proposals relative to the total waterbody extents, and the extents of existing and proposed waterbody modifications. This would help to identify the individual and the cumulative effects of the proposals, and contextualise the extent to which the scheme has significance at local and waterbody scales, in terms of:

- The direct impacts of the proposals,
- The immediate environs of the scheme, i.e. up and downstream linkages and influences,
- The wider waterbody and connecting waterbodies.

Each of the above should be assessed in terms of the immediate, medium and long-term timescales of impact, for example whether there will be a loss of any future opportunities to carry out improvements.

Additional Data Collection

The WFD Preliminary Assessment builds on baseline information collected during the screening assessment. HCC should be contacted to discuss the scheme if they have not already been made aware at the screening stage. It is recommended that the relevant Environment Agency office is contacted to ensure that they are aware of

proposals that could have WFD implications early in the planning process. The Environment Agency may be able to provide useful local knowledge and additional data for the site, and for guidance on likely WFD impacts and mitigation measures that would need to be addressed in WFD assessments.

Surveys may be required if look-up information on any WFD elements are not available to a level of detail that would enable robust judgement of WFD impacts to be made. Without sufficient data there may be no adequate baseline against which to judge if the proposals could cause deterioration.

The Environment Agency hold data on water quality and biodiversity surveys for waterbodies in England, but some judgement may be required on the proximity of the sampling points to proposal locations, and whether the sample points provide relevant information.

For the majority of waterbodies, hydromorphological surveys are not available. The Environment Agency's newly established (since 2012) national hydromorphology team is keen to promote the importance of hydromorphology and ensure that it becomes firmly embedded with WFD assessments and any other activities that could affect waterbodies. Surveys to document and interpret the physical processes of waterbodies have not previously been collected by the Environment Agency in the same way as its routine sampling programmes for water quality or biodiversity.

River Habitat Surveys (RHSs) may be available, which provide useful 'snap-shot' information on physical habitats, but by definition these are not WFD hydromorphology assessments. RHS includes data on physical habitats such as channel dimensions and in-channel forms, and because it is a standardised methodology – and therefore spatially and temporally comparable – it is ideally suited to monitoring change, for example pre and post-development. However, RHS has limitations in determining hydromorphological functions, i.e. the reach and catchment scale processes that control site-specific habitat structure. It was not designed for and is not suitable to appraise the potential impacts of engineered alterations to waterbodies[6].

Other relevant information may be available from documents that have been routinely included in planning applications prior to WFD assessments being enforced through legislation in 2012. Environmental Impact Assessments, ecology surveys, Flood Risk Assessments and a range of other documents could inform WFD assessments if they do not directly assess WFD objectives.

Protected Species

Biodiversity Action Plan (BAP) or other designated priority habitats and species should be considered in preliminary and further WFD assessments if necessary (see Figure 9-3), even though they do not directly contribute to WFD status. If these species or habitats are present in areas that could be affected by scheme proposals, they may well reflect the biological sensitivity of the impacted reach, and should be considered integral to the ecosystem that the WFD assessment is designed to address. These species should be included in the WFD assessment, but their jurisdiction under different European legislation should be stated (see Chapter 5) with reference to separate ecological reports in which they would need to be assessed in more detail.

[6] Haycock Associates (2005). *Review of Impact Assessment Tools and Post Project Monitoring Guidance*. Report to the Scottish Environmental Protection Agency authored by Dr Kevin Skinner Prof Colin Thorne.

Cumulative Impacts

The possible cumulative impacts of different schemes must be considered within a WFD assessment. A waterbody and its ecosystem can 'absorb' or tolerate a certain amount of modification, but multiple, small scale effects can still aggregate to a significant cumulative impact. In principle, if the impacts of an individual scheme are properly mitigated, then there will be no residual effects and no cumulative impacts from multiple schemes.

It is the responsibility of the owner of a proposed activity to investigate WFD impacts at waterbody scale, how their individual scheme could affect cumulative impacts, and how they should be mitigated and this is likely to require expert judgement. Part of the WFD assessment process would be to consult with HCC and the Environment Agency, who would be able to provide information on other schemes in planning pipeline that could also contribute to cumulative impacts.

There are certain circumstances where a proposed scheme cannot take place because a waterbody has already been affected by development to the extent that it cannot 'absorb' any more impacts, no matter how small the impacts for the newly proposed scheme might be. Forthcoming developments that are advanced enough to be funded and already appear in development programmes and strategies should also be considered, on the assumption that they will take place and contribute to cumulative impacts.

New development may only be feasible in principle if ecological mitigation measures are implemented before the development takes place, and the extent of measures required to enable development may be prohibitively expensive to the proposals. It would not be the case that a waterbody is already detrimentally affected by developments so much that additional impacts do not matter.

HCC and the Environment Agency should be consulted for details of other schemes and how this might influence cumulative ecological impacts. Expert judgement will need to be applied to assessing whether cumulative impacts will occur, so it may be necessary to seek consultant support.

To facilitate interpretation of whether sufficient data have been collected to decide whether sufficient preliminary WFD assessment has been undertaken, or whether further assessment is needed, some key 'gateway' questions for Step 2 are summarised in the box below.

Step 2 Key Questions

- Could the proposals cause a deterioration in the ecological status or potential of the waterbody?
- Could the proposals cause a deterioration in the ecological status or potential of connecting waterbodies?
- Could the proposals prevent the waterbody from reaching its objective future status or potential being met in connecting waterbodies?
- Could the proposals affect groundwater and/or surface water?
- Could the proposals prevent the implementation of mitigation measures which define the hydromorphological designation of HMWBs?
- Could the proposals affect sensitive critical habitats?
- Could cumulative impacts on the waterbody result from several schemes (existing or proposed)
- What mitigation measures could be put in place so that the proposals have no net effect on waterbody ecology or there is a net improvement?
- Could the development opportunity be used to implement environmental improvements?
- Has the outcome of the Preliminary Assessment been agreed with HCC and the EA?

9.4 Step 3: Further WFD Assessment

This stage has previously been referred to as 'Detailed Assessment', but the term has been made redundant by the Environment Agency because it suggested a focus on engineering detailed design, whereas the function of a WFD assessment is only to steer detailed designs by identifying the types of environmental measures that should be included in scheme planning.

It is difficult to provide guidance on the scope of further assessments since water environments are unique and WFD assessments must be tailored to site-specific requirements. Further assessments should usually be undertaken by technical specialists, who should:

- Work closely with developers and regulators,
- Provide guidance to developers on WFD objectives,
- Identify the exact scope of WFD and other requirements for the subject scheme,
- Undertake the assessments to the extent that developers require them to do so (i.e. to supplement in-house skills and resources as required),
- Advise on scheme alternatives or mitigation measures.

Practicable scheme alternatives should be identified prior to mitigation measures, in order to preclude environmental impacts wherever possible. If this is not possible and mitigation measures are required, the measures will need to be specific and achievable, so that assurances are included within planning proposals that development and the water environment are managed in line with WFD objectives. The Environment Agency has powers to object to schemes or place planning conditions on proposals to ensure that mitigation measure are implemented as part of the development.

WFD impacts and design option appraisals can only be identified for specific sites and development proposals, so no additional guidance to the main text of this document can realistically be provided. Some further guidance on mitigation measures is provided below, but it is re-emphasised that these must be tailored to specific development proposals.

Identifying Appropriate Mitigation Measures

There are a wide range of options for mitigating the effects of culverts and any other types of waterbody activity. The rationale of mitigating environmental impacts in line with WFD objectives is to apply measures that are technically feasible, cost proportionate and are not detrimental to the function of the existing or required waterbody modification.

The best practice approach to the selection of mitigation measures is to firstly consider a comprehensive list of all possible options regardless of cost, and then begin to strike out options that can be justified as not being practicable. Measures should be reviewed on the basis of whether they are technically feasible and cost proportionate, with viable mitigation measures identified as part of WFD assessments and carried forward into detailed scheme designs.

Mitigation measures should ideally be implemented adjacent to the location of the impact or elsewhere in the waterbody, to control impacts at local level, maintain ecological continuity, and make sure measures are logistically feasible, i.e. within the same land ownership. However, in accordance with WFD policy, impacts are measured at waterbody scale, so mitigation measures could be located several kilometres away, as long as they are within the same waterbody.

Mitigation measures located away from an impact site may need to be regulated as Grampian conditions, so assurance and ownership of these measures is a formalised part of the development plans. There are risks associated with planning measures that are implemented 'off-site' because there tends to be increased reliance on third party land ownership, which can complicate project planning and costs.

Mitigation does not need to be limited to like-for-like measures, so the possibilities of restoring towards to a more naturalised waterbody by any means available should be explored. Expert judgement may be required to justify that non-like-for-like mitigation measures are of the equivalent or greater scale than the development impacts.

All modifications to watercourses should be implemented with careful planning, design, construction method statements, construction best practice, and post-project maintenance plans, appraisal and monitoring.

Justification that Mitigation Measures Balance or Outweigh Development Impacts

It is impossible to quantify many of the complex and inter-linked elements of river systems and ecology. For example, re-naturalising river banks by removal of hard engineering may permit natural bank erosion and therefore the influx of substrates into bed habitats, thus increasing morphological diversity and allowing the channel to restore a more natural profile in a self-regulating manner. This, in turn, would provide for improved sustainable habitat and support ecological diversity.

The effects of modifications to waterbodies can cascade for long distances downstream of the modification, in terms of hydromorphology, chemical and physico-chemical qualities, and ecology. In some cases, modifications such as culverts can effectively cut-off stream connectivity and sever the habitat availability of the entire upstream watercourse network, if migratory species are unable to pass the modification.

A simple means of beginning to demonstrate that mitigation measures are of equivalent scale and ecological value to WFD impacts is to measure the direct extents (distances along a channel or areas) of impacts and mitigation. Expert judgement may be required to assess the indirect extents of impacts, which can occur at a variety of spatial and temporal scales, and can be tangible and non-tangible.

9.5 Step 4: Application of Article 4.7 for Priority Development

Article 4.7 provides legislation for exemption conditions that could allow implementation of schemes that cause deterioration in ecological status, for example for reasons of overriding public interest. Article 4.7 of the WFD should not be considered until further assessments of scheme impacts, design appraisal and environmental options, and mitigation measures have been completed. However, the further assessments would provide most of the information necessary to inform an Article 4.7 case, which are as follows:

- All practicable mitigation measures are taken,
- There are no significantly better environmental options,
- There are reasons of overriding public interest and/or the benefits to human health, safety or sustainable development outweigh the benefits in achieving the WFD objective,
- Reasons for the waterbody modifications are fully explained,
- Impacts on other waterbodies are considered and compliance with other legislation is ensured.

As with further assessments, each planning case will have unique virtues and disadvantages, so it is difficult to provide meaningful guidance. However, of the considerations listed above, only 'overriding interests' would not be routinely evaluated within a WFD assessment. It should be possible to draw information on scheme interests from other planning documents that describe the philosophy of the proposals, and from there develop a reasoned basis for understanding of the benefits and problems associated with the plans.

9.6 Stage 5: Reporting

There is no fixed format for a WFD assessment, but the pro-forma provided by the Environment Agency summarises the Environment Agency's systematic approach to assessments, and it is strongly recommended that this is used or requested for all assessments. If the pro-forma is not made available, it is recommended that the section headings shown below would facilitate coverage and structure of surface water and groundwater, and biological, chemical / physico-chemical and hydromorphological elements for a further assessment.

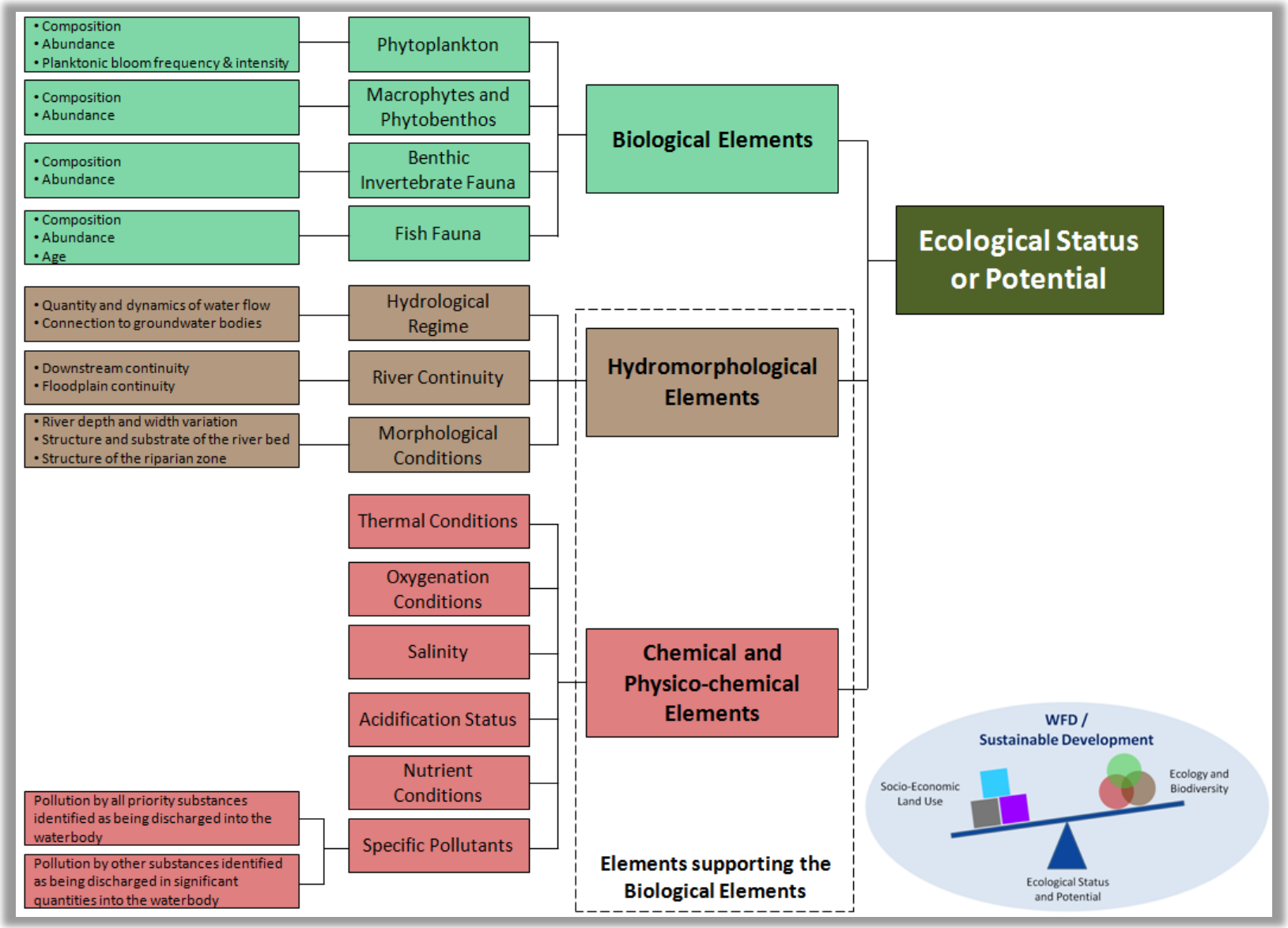
1	**INTRODUCTION**
1.1	Summary of the Proposals
2	**METHODOLOGY**
2.1	WFD Classification Process
2.2	WFD Assessment Process
2.2.1	Surface Waterbodies
2.2.2	Groundwater Bodies
3	**BASELINE DATA**
3.1	Data sources
3.2	Relevant waterbodies and RBMP Data
3.3	Ecological status and objectives
3.4	Critical habitats
3.5	Biological Elements
3.6	Physico-Chemical Elements
3.7	Hydromorphological Elements
4	**SCREENING ASSESSMENT**
4.1	WFD Exemptions
4.1.1	Surface Waterbodies
4.1.2	Groundwater Bodies
5	**PRELIMINARY ASSESSMENT**
5.1	Impacts
5.2	Cumulative Impacts
5.3	Critical Habitats
5.4	Impacts on Existing Ecological Status
5.5	Impacts on Future Ecological Status (Objectives)
6	**FURTHER ASSESSMENT**
6.1	Options Appraisal
6.2	Mitigation Measures
6.2.1	Local Mitigation Measures
6.2.2	Waterbody Mitigation Measures
7	**POST PROJECT APPRAISAL**
8	**CONCLUSIONS**
	REFERENCES
	APPENDICES
	(For example scheme drawings, measurements of the extents of the impacts of the scheme compared with the extents of mitigation measures, proportion of the waterbody that is affected by the scheme, etc)

9.7 Stage 6: Post Project Appraisal and Maintenance Work

A monitoring strategy should be outlined to formalise a methodology for assessing the short and longer term impacts of waterbody interventions. The strategy should include means by which to identify any deteriorations that could be attributable to the development, and also to validate the selection and implementation of mitigation measures, in terms of there being no detrimental effect or there being improvements to ecology.

Post-project appraisals should be specific to sites and development. They would often be based on site visits by experienced personnel, and would be documented with photographs and brief notes on any relevant issues. For larger schemes, site visits could take place seasonally twice a year for the first two years, and also after at least two significant storm events, with the need for future monitoring to be reviewed after two years. Post-scheme monitoring for WFD appraisal of culverts should ideally be co-ordinated with flood risk specialists, and/or structural engineers. If surveys such as River Habitat Surveys, River Reconnaissance Surveys and other standardised techniques have been undertaken during scheme planning, these would provide an ideal means of comparing pre- and post-scheme impacts. If these are not available, the strategy would need to include appropriate methods for monitoring and logging change.

APPENDIX A – WATER FRAMEWORK DIRECTIVE ELEMENTS FOR RIVERS


• Composition
• Abundance
• Planktonic bloom frequency & intensity
Phytoplankton
• Composition
• Abundance
Macrophytes and Phytobenthos
• Composition
• Abundance
Benthic Invertebrate Fauna
• Composition
• Abundance
• Age
Fish Fauna
Biological Elements
• Quantity and dynamics of water flow
• Connection to groundwater bodies
Hydrological Regime
• Downstream continuity
• Floodplain continuity
River Continuity
• River depth and width variation
• Structure and substrate of the river bed
• Structure of the riparian zone
Morphological Conditions
Hydromorphological Elements
Thermal Conditions
Oxygenation Conditions
Salinity
Acidification Status
Nutrient Conditions
Pollution by all priority substances identified as being discharged into the waterbody
Pollution by other substances identified as being discharged in significant quantities into the waterbody
Specific Pollutants
Chemical and Physico-chemical Elements
Elements supporting the Biological Elements
Ecological Status or Potential
WFD / Sustainable Development
Socio-Economic Land Use
Ecology and Biodiversity
Ecological Status and Potential

APPENDIX B – LISTED SUBSTANCES

Article 16 of the WFD sets out "Strategies against pollution of water", and includes 33 new and eight previously regulated chemical pollutants of high concern across the EU in the field of water policy. These are often collectively referred to 'Annex X' substances.

The 33 substances or groups of substances (listed on the next page) were defined in the Directive on Environmental Quality Standards (Directive 2008/105/EC) (EQSD), also known as the Priority Substances Directive. These priority substances include chemicals, plant protection products, biocides, metals and other groups like Polyaromatic Hydrocarbons (PAH) that are mainly incineration by-products, and Polybrominated Biphenylethers (PBDE) that are used as flame retardants.

The eight other pollutants (listed below) are not in the priority substances list, but environmental quality standards for these substances are included in the EQSD.

LIST OF POLLUTANTS NOT IN PRIORITY SUBSTANCES LIST		
Number	**CAS number**	**Name of other pollutant**
6a	56-23-5	Carbon-tetrachloride[1]
9b	Not applicable	DDT total[1,2]
	50-29-3	para-para-DDT[1]
9a		Cyclodiene pesticides
	309-00-2	Aldrin[1]
	60-57-1	Dieldrin[1]
	72-20-8	Endrin[1]
	465-73-6	Isodrin[1]
29a	127-18-4	Tetrachloro-ethylene[1]
29b	79-01-6	Trichloro-ethylene[1]

1. This substance is not a priority substance but one of the other pollutants for which the EQS are identical to those laid down in the legislation that applied prior to 13 January 2009
2. DDT total comprises the sum of the isomers 1,1,1-trichloro-2,2 bis p-chlorophenyl) ethane CAS number 50-29-3; EU number 200-024-3); 1,1,1-trichloro-2 o-chlorophenyl)-2-p-chlorophenyl) ethane CAS number 789-02-6; EU Number 212-332-5); 1,1-dichloro-2,2 bis p-chlorophenyl) ethylene CAS number 72-55-9; EU Number 200-784-6); and 1,1-dichloro-2,2 bis p-chlorophenyl) ethane CAS number 72-54-8; EU Number 200-783-0).

LIST OF PRIORITY SUBSTANCES				
Number	**CAS number[i]**	**EU number[ii]**	**Name of priority substance[iii]**	**Priority hazardous substance**
1	15972-60-8	240-110-8	Alachlor	
2	120-12-7	204-371-1	Anthracene	✓
3	1912-24-9	217-617-8	Atrazine	
4	71-43-2	200-753-7	Benzene	
5	Not applicable	Not applicable	Brominated diphenylether[iv]	✓
	32534-81-9	Not applicable	Pentabromodiphenylether congener numbers 28, 47, 99, 100, 153 and 154) [v]	
6	7440-43-9	231-152-8	Cadmium and its compounds	✓
7	85535-84-8	287-476-5	Chloroalkanes, C10-13[iv]	✓
8	470-90-6	207-432-0	Chlorfenvinphos	
9	2921-88-2	220-864-4	Chlorpyrifos Chlorpyrifos-ethyl)	
10	107-06-2	203-458-1	1,2-Dichloroethane	
11	75-09-2	200-838-9	Dichloromethane	
12	117-81-7	204-211-0	Di2-ethylhexyl)phthalate DEHP)	
13	330-54-1	206-354-4	Diuron	
14	115-29-7	204-079-4	Endosulfan	✓
15	206-44-0	205-912-4	Fluoranthenevi	
16	118-74-1	204-273-9	Hexachlorobenzene	✓
17	87-68-3	201-765-5	Hexachlorobutadiene	✓
18	608-73-1	210-158-9	Hexachlorocyclohexane	✓
19	34123-59-6	251-835-4	Isoproturon	
20	7439-92-1	231-100-4	Lead and its compounds	
21	7439-97-6	231-106-7	Mercury and its compounds	✓
22	91-20-3	202-049-5	Naphthalene	
23	7440-02-0	231-111-4	Nickel and its compounds	
24	25154-52-3	246-672-0	Nonylphenols	✓
	104-40-5	203-199-4	4-nonylphenol)	✓
25	1806-26-4	217-302-5	Octylphenols	
	140-66-9	Not applicable	4-1,1',3,3'-tetramethylbutyl)-phenol)	
26	608-93-5	210-172-5	Pentachlorobenzene	✓
27	87-86-5	201-778-6	Pentachlorophenol	
28	Not applicable	Not applicable	Polyaromatic hydrocarbons	✓
	50-32-8	200-028-5	Benzoa)pyrene)	✓
	205-99-2	205-911-9	Benzob)fluoranthene)	✓
	191-24-2	205-883-8	Benzog,h,i)perylene)	✓
	207-08-9	205-916-6	Benzok)fluoranthene)	✓
	193-39-5	205-893-2	Indeno1,2,3-cd)pyrene)	✓
29	122-34-9	204-535-2	Simazine	
30	Not applicable	Not applicable	Tributyltin compounds	✓
	36643-28-4	Not applicable	Tributyltin-cation)	✓
31	12002-48-1	234-413-4	Trichlorobenzenes	
32	67-66-3	200-663-8	Trichloromethane chloroform)	
33	1582-09-8	216-428-8	Trifluralin	

i. CAS: Chemical Abstracts Service.
ii. EU number: European Inventory of Existing Commercial Substances EINECS) or European List of Notified Chemical Substances ELINCS).
iii. Where groups of substances have been selected, typical individual representatives are listed as indicative parameters in brackets and without number). For these groups of substances, the indicative parameter must be defined through the analytical method.
iv. These groups of substances normally include a considerable number of individual compounds. At present, appropriate indicative parameters cannot be given.
v. Only Pentabromodiphenylether CAS number 32534-81-9).
vi. Fluoranthene is on the list as an indicator of other, more dangerous PAHs.

APPENDIX C – BASELINE WATER FRAMEWORK DIRECTIVE INFORMATION (RIVER BASIN MANAGEMENT PLANS)

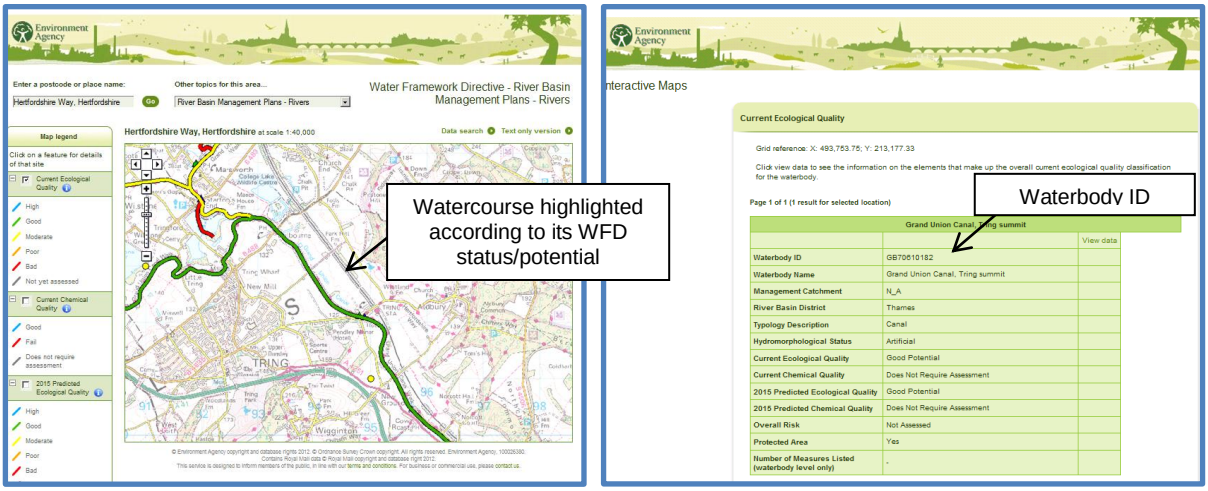
The Environment Agency has produced River Basin Management Plans (RBMP), which contain information about WFD status/potential and objectives for waterbodies in England and Wales. A brief guide on how to find this data for a local waterbody is summarised below.

C1: Locating Summary Waterbody Information

The easiest way to identify summary baseline WFD information for a waterbody is to locate the site on the Environment Agency's 'What's in your backyard' web page. From this page go straight to the interactive maps and then select the relevant topic (e.g. 'River Basin Management Plans – Rivers, Lakes or Groundwater'); and enter a location.

If the waterbody of interest has been attributed a WFD status/potential then it will be highlighted on the map, and selecting (clicking on) the waterbody will display relevant WFD information including a Watercourse ID. The Watercourse ID can be used to gain further information within the RBMP. If WFD details are available, proceed to **C2**.

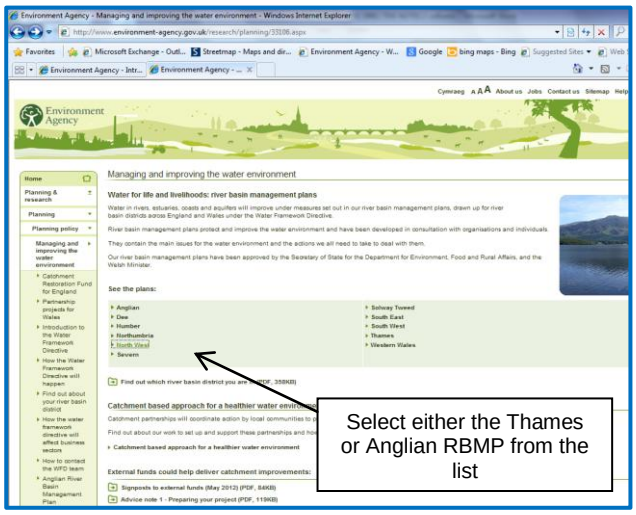
Some smaller watercourses and tributaries have not yet been attributed a WFD status/potential and therefore there will be no additional information relating to that watercourse within the RBMP. If this is the case proceed to **C4.**



C2: Find the relevant River Basin Management Plan

Additional baseline data on waterbodies can be found in the relevant RBMP. RBMPs are organised by River Basin Districts (RBD), so the relevant RBMP can be found from the RBD map on the Environment Agency's website. Hertfordshire is covered by the Thames and Anglian RBMPs, which can also be found on the Environment Agency's website.

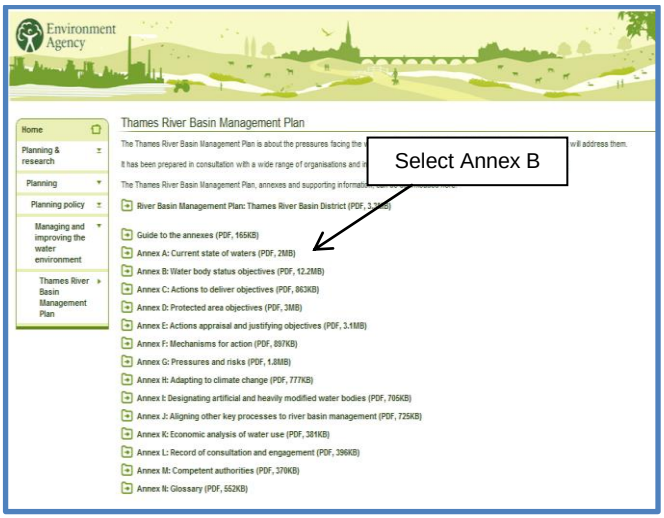
Now proceed to **C3.**

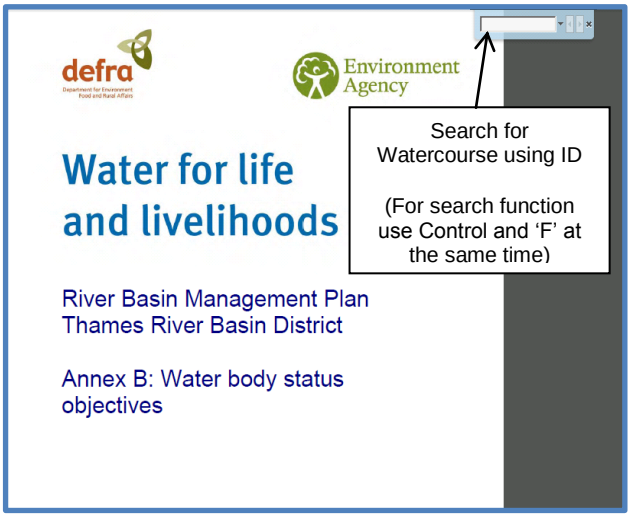


C3: Find local waterbody information within the River Basin Management Plan?

WFD information for each waterbody is contained in Annex B of the RBMPs. These are large files and probably need to be downloaded from the website to make searching easier.

In Annex B, search for the name or Watercourse ID identified in **C1**.





More recent or detailed WFD data can also be found at www.data.gov.uk, where surface water classification status and objectives can be downloaded in spreadsheet format, and specific waterbodies can be looked using the waterbody ID number as above.

C4: What to do if the waterbody is not shown on the Environment Agency website and is not found within a River Basin Management Plan

The majority of the waterbody network in England has been mapped and attributed identification codes. However, the sale and complexity of the task means that inevitably some smaller tributaries, watercourses or drains are not specifically mapped in the RBMPs.

It is re-emphasised that the WFD applies to ALL inland waters, so even if a waterbody does not appear to be included within a RBMP it is NOT exempt from the WFD.

If a stretch of water is not specifically mapped, under the WFD waterbody approach it would be identified as part of the waterbody that it connects to. Connectivity can be traced on maps, and baseline data looked up as per steps C1 to C3.

APPENDIX D – ENVIRONMENT AGENCY GUIDANCE ON POTENTIAL HYDROMORPHOLOGICAL IMPACTS

Type of modification		Guidance on level of WFD assessment required Click on the relevant hyperlinks for more explanation and definitions of the terms used below.		
		Further impact assessment unlikely - follow best practice guidance	**Furtherimpact assessment unlikely - follow best practice and record in the RBMP data solution**	**Further impact assessment may be required - use thresholds of concern as guidance. River water body length is provided in the River Basin Characterisation data set in the RBMP data solution. If no further assessment is undertaken follow best practice and record in the RBMP data solution**
Channel / Watercourse alteration	Watercourse alteration including - resectioning, straightening, realignment, channelisation			Calculate the length of river water body impacted. Further assessment should be undertaken where >2% of the river water body length is impacted.
	Channel diversions			All channel diversions will need further assessment.
	By pass channel/flood relief channel			Calculate the river water body length to be by passed. Further assessment should be undertaken where >3% of the river water body length is bypassed.
	Bank protection	Green/soft bank reinforcement or re-profiling ≤10m or ≤ one channel width in length (whichever is greater).	Green/soft bank reinforcement or re-profiling ≤50m in length.	Calculate the total length of bank protection, remembering to include the length of protection on both banks. For green/soft engineering further assessment should be undertaken where total length of bank protection is >5% of the river water body length. For grey/hard engineering further assessment should be undertaken where total length of bank protection is >3% of the river water body length.
	Bed protection		Bed reinforcement ≤10m in length downstream of closed culverts to prevent scour immediately downstream.	Calculate the length of the water body impacted. Further assessment should be undertaken where >1% of the water body is impacted.
Defence (linear flood defence)	Embankment / flood banks			Calculate the **total** length of the embankment/flood bank, remembering to include the length for both banks. Further assessment should be undertaken where total length of embankment/flood bank is >3% of the water body length.
	Set-back embankment / flood banks			Calculate the total length of the set-back embankment/flood bank, remembering to include the length for both banks. Further assessment should be undertaken where total length of set-back embankment/flood bank is >5% of the water body length.
	Revetment			Calculate the total length of revetment remembering to include the length for both banks. Further assessment should be undertaken where the total length of revetment >3% of water body length.
	Wall			Calculate the **total** length of the wall, remembering to include the length for both banks. Further assessment should be undertaken where total length of wall is >3% of the water body length.
	Set back wall			Calculate the total length of the set-back wall, remembering to include the length for both banks. Further assessment should be undertaken where total length of set-back wall is >5% of the water body length.
Channel / Watercourse structures	Infrastructure surrounding a outfall/intake, sluice, pipe, inlet, outlet, off-take, pumping stations			Calculate the total length of bank/bed impacted. Further assessment should be undertaken where >3% of the bank or bed is impacted.
	Structures such as small boat slipways, piers, jetties and platforms			Calculate the total length of bank/bed impacted. Further assessment should be undertaken where >5% of the bank or bed is impacted.
	In stream structures such as croys, groynes, boulder placement and other flow deflectors	Boulder placement in a river occupying <10% of channel width.		Calculate the length of river over which the in stream structures will be placed. Further assessment should be undertaken when >2% of water body length is impacted. A threshold approach does not work particularly well for this type of structure. Consideration should be made as to whether they are the appropriate solution to the problem and advice should be sought from a geomorphologist.
	Lock			All locks require further assessment
	Culvert			All culverts will generally require a further assessment. Use a common sense approach, for example a small pipe culvert used under a footpath is unlikely to cause a significant morphological risk
Impoundment structures (including changes to existing structures)	Barrage / dam (including components & installations)			All barrages and dams will need further assessment
	Weir / sluice- raising height of existing weir, changing capacity of impoundment or operational changes to existing structures			Calculate the length of the **additional** impounded water. Further assessment should be undertaken where the additional impounded water >1% water body length.
	Weir / sluice - removal			All weir or sluice removals will need further assessment
	Weir / sluice - new structure			All new weir or sluice structures will need further assessment.

Type of modification		Guidance on level of WFD assessment required Click on the relevant hyperlinks for more explanation and definitions of the terms used below.		
Power generation	Hydroelectric power scheme - changing height of existing weir, changing capacity of the impoundment or operational changes to existing structures			Calculate the length of the **additional** impounded water. Further assessment should be undertaken where the additional impounded water >1% water body length.
	Hydroelectric power scheme - new weir structure			All new weir / barrage / barrier structures will need further assessment.
	Hydroelectric power scheme			Calculate the length of the depleted reach. Further assessment should be undertaken where the depleted reach is >1% water body length.
Fish passage	Installation of a fish pass			Consideration should first be made as to whether the impoundment could be removed or modified. Where a fish pass is the appropriate option then calculate the length of the structure. Further assessment should be undertaken where > 2% of the water body length is impacted.
Flood storage area	Flood storage area			All flood storage areas require further assessment
Capital dredge	Capital dredge			All capital dredges will require a further assessment
Maintenance activities	Sediment management			Calculate the length of river over which sediment is to be removed, moved or manipulated. Further assessment should be undertaken where >2% of the water body is impacted.
	Management of woody debris			Thresholds for further assessment are not appropriate for the management of woody debris. Further assessment may be required depending on circumstances and scale of activity and expert judgement should be applied. Good practice guidance can be found in the mitigation measure manual at http://evidence.environment-agency.gov.uk/FCERM/en/SC060065/MeasuresList/M5/M5T3.aspx
Vegetation management	Removal/management of riparian vegetation			Further assessment is required where the asset is being managed to target condition 2 and/or if undertaking grass control at M1 or M2; weed control at W1 or W2, WB1 or WB2 and tree control at TB1 or TB2 under the "Delivering consistent standards for sustainable asset management guidelines" (http://ams.ea.gov/ams_root/2009/301_350/301_09_SD05.pdf). If the vegetation management activity is not covered by the ASM standards then calculate the length of water body that vegetation is being removed from or managed. Further assessment in required where >5% of water body length is being impacted
	Removal/management of in stream vegetation			
Bridges and other types of crossing structure	Bridges	Minor bridges with no construction on bed or banks Temporary bridges in rivers <5m wide	Bridges with no construction on bed (e.g. no piers or in-channel supports) and ≤20m of total bank affected.	All bridges with > 20m bank affected or an in channel support require further assessment
	Fords			Refer to thresholds for bed and bank protection as appropriate
Removal of natural barriers	Removal of natural barriers (removal of waterfalls and other in-stream natural barriers, usually to permit upstream fish migration)			All cases of natural barrier removal need further assessment