Understanding your river

This factsheet provides a short summary of understanding your river within its catchment and why this is important to consider before undertaking restoration:

1. **Why understanding your river is important**
2. **Natural controls**
3. **Natural processes**
4. **Identifying modifications to your river**
5. **How to find out about your river**

1. Why understanding your river is important

Rivers are diverse so **restoration projects require tailored approaches** and varying techniques dependent on their specific environmental settings. To effectively restore a river to a more naturally functioning system, you need to understand what controls a river system and determine **what your river needs to be able to act more naturally**.

Once you **understand the natural controls and processes** acting upon your river, it is easier to identify issues. You can design an effective river restoration project that works with these processes and deals with the cause of the issue rather than solely the symptom. This approach will likely be the most **cost-effective and sustainable** way of addressing the issue.

Without a basic understanding of how rivers work there is a risk of restoration aims not being met, as a river may react differently to how you expect. Negative impacts may also occur upstream or downstream of the restored reach if the river is not considered within its catchment setting. Rivers are naturally complex and dynamic so it **takes time to be well practised in understanding** how they behave.

2. Natural controls

You need to consider what controls your river at different scales.

Catchment scale

⇒ **Climate** - a river's discharge and sediment regime are controlled by rainfall and temperature

⇒ **Geology** - river types across a catchment are controlled by changing underlying geologies (Figure 1)

⇒ **Topography** - run-off rates, flow velocity and the sediment regime are controlled by channel steepness

⇒ **Hydrology** - catchment hydrology influences a river's discharge and response to rainfall

⇒ **Land use** - water quality, sediment supply and a catchment's flood response are controlled by land use

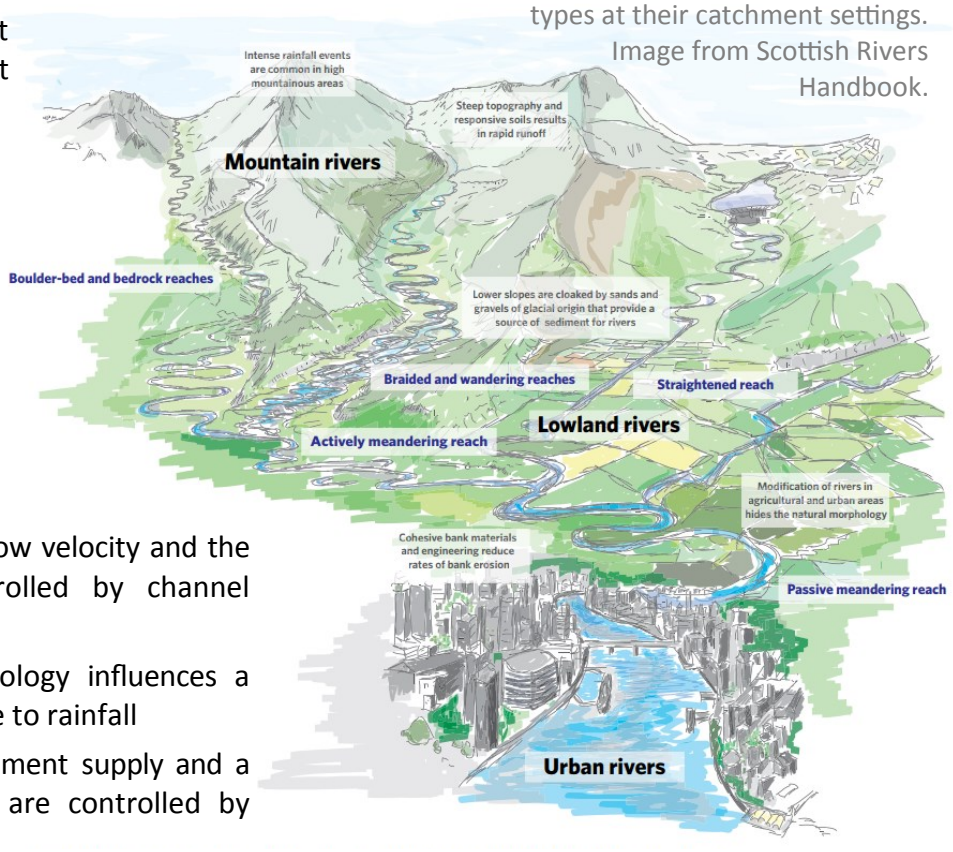

Figure 1. Diagram illustrating river types at their catchment settings. Image from Scottish Rivers Handbook.









Reach scale

At reach scale, < 10km, you need to understand:

⇒ **Channel morphology** - the current cross-section/planform and historical form of the river

⇒ **Flow regime** - the discharge of your river and its response to rainfall events

⇒ **Sediment regime** - the source of sediment and how it moves through your river

⇒ **Location** - the catchment setting of your river. Is it in the upper, middle or lower catchment?

⇒ **Ecology** - the fauna, flora and habitats plus any protected species/habitats or invasive species

⇒ **Modifications** - how your river has been altered by humans. This is covered further in Section 4

Local scale

At the most local scale where an issue is found or work is planned, you need to understand:

⇒ **Upstream and downstream impacts** - many techniques, especially weir removal, channel narrowing, re-meandering or floodplain reconnection, will impact surrounding reaches

⇒ **Land ownership** - do you know all land owners and can you get permissions?

⇒ **Time planning** - consider weather, budget and time restrictions e.g. nesting or spawning seasons

3. Natural processes

To implement effective and sustainable river restoration, an understanding of natural processes in a river catchment, and their connections with the landforms we see, is important. A restoration technique should aim to **recreate or emulate these processes** to produce a more naturally functioning channel.

Figure 2 Understanding natural processes in a river is essential to understanding why the river is shaped the way it is. Image of the River Ogwen, North Wales, from RRC.

Hydromorphology

The main natural function of a river is to **convey water and sediment** which, in doing so, shapes valleys and floodplains, creating valuable habitats for aquatic and terrestrial species (including humans!). Hydromorphology is the study of these processes, considering both water and sediment, and their interrelationship with vegetation and fauna. **Hydromorphological processes** are important to understand in terms of river restoration as they control the shape and form of rivers (Figure 2).

The most obvious river processes are **longitudinal** so act along the long profile of a river and involve the erosion, transportation and deposition of sediment. **Lateral processes,** such as the migration of the channel and the connection between the channel and its floodplain, are also important as without this connection water quality and natural habitats are put at risk. Barriers preventing flooding inhibit the relationship between sediment, nutrients and biota.

The presence of plants and animals inhabiting river environments can have a direct influence on river form - they can **'bioengineer'** habitats. In-channel vegetation can slow the flow causing deposition and trapping of sediment while burrowing organisms can increase oxygenation within the river bed and disturb sediment. On a larger scale, beavers are **'ecosystem engineers'** as they can modify a river's form and create a diversity of habitats, which benefits them and many other species.

4. Identifying modifications to your river

Once you understand how your river should function naturally you can identify the issues. Modifications are usually there for a reason, so find out if they can realistically be removed or modified to restore some natural processes. Table 1 outlines common modifications to rivers to look out for, and Table 2 details wider scale global issues not necessarily recognisable at the river bank.

Modification		Impact
Channelisation and dredging/gravel extraction Rivers have been straightened, diverted and deepened to aid navigation, drain farmland and reduce local flooding		• Uniform cross-section reduces flow variability which reduces habitat diversity • Channel-floodplain disconnected • Accelerated flow can increase flooding downstream • Habitat damage from heavy machinery • Dredging can increase erosion rates, destabilise banks and cause silt build-up downstream
Removal of in-stream wood Fallen trees are removed from rivers to improve navigation and it was thought to reduce flood risk, aid fish migration and assist drainage		• Lack of flow diversity - wider and straighter channels • Reduces habitat for fish refuge and invertebrates • Lack of roughness can increase flow velocities increasing flood-risk downstream
Artificial obstructions Weirs, locks and dams impound water used for mills, river navigation and to produce power		• Prevents longitudinal movement of fish species • Alters natural water and sediment transport • River features submerged in deep water impounded behind obstruction • Can trap sediments and deflect flow altering natural erosion and deposition patterns
Bank reinforcement Rock, timber or concrete to reduce bank erosion and prevent channel movement, protecting adjacent land		• Restricts river movement in response to floods, which can increase local flood risk • Riverbank habitats for water vole, kingfisher and juvenile fish removed • Channel-floodplain connection lost
Flood protection/ embankments Flood banks built to prevent rivers flooding floodplains, now used for farming or urban development		• Flood water confined which increases river bed erosion and flow velocities, increasing downstream flood risk and reducing warning time • Degradation or complete removal of floodplain habitat important for wetland species, flood water storage, nutrient exchange and carbon storage
Vegetation management Riparian vegetation is often removed for access when developing for farms or infrastructure		• Reduction in river corridor biodiversity • Increased bank erosion as removal of bankside vegetation removes ability of roots to bind soil • Tree removal reduces shading important as refuge for animals and removes in-channel wood resource

Table 1 Common modifications to rivers and their impact on the river environment. All photos from RRC.

5. How to find out about your river

Desk study

A good place to start is to search for any data already available and read up on information about your catchment. **River Basin Management Plans** set out the current state of water environments in each catchment and what future management plans are. **Previous monitoring data** may be available through statutory organisations and will give you a good idea of what has been done before. **Historical maps** can be useful to see how your river has been modified in the past.

Modification	Impact
Floodplain development Land management impacts catchment hydrology and controls water, sediment and pollutant inputs	• Clearance of trees and creation of impervious surfaces reduce infiltration rates and increase surface run-off and peak flood flows • Water quality degraded by pollutants and sediment from farmland, roads (diffuse pollution), sewage works and factories (point-source pollution)
Invasive non-native species (INNS) INNS have been accidentally (or historically deliberately) introduced	• Some INNS outcompete, predate or spread disease to native species (e.g. Signal crayfish, mink, Killer shrimp) or damage the physical environment (e.g. Japanese knotweed, Himalayan balsam, Chinese mitten crab)
Climate change Rivers are sensitive to temperature/rainfall pattern changes so are vulnerable to predicted climate changes. UK predictions include warmer air temperatures and increased frequency and intensity of rainfall events	Potential impacts: • More frequent extreme flood and low flows, degrading physical habitat and water quality and reducing biodiversity • Increased water temperature which can be lethal to some species, including Brown trout and salmon

Table 2 Wider scale issues and their impact on the river environment.

Walk/survey your river

Walking your river (Figure 3) can give you a **general overview of its health**. Make notes and pose questions - are natural processes occurring, and if not, why not? Are there any obvious modifications? Are there any features or outfalls that look in disrepair? Further information on more advanced surveys are below.

Figure 3 Walkover training run by the Bedford Rural Communities Charity and Essex Wildlife Trust on the River Ivel. Image from RRC.

Seek local and technical expertise

Local expertise, from landowners, catchment partnership organisations, angling groups, canoeing/kayaking groups as well as agencies and the RRC, can be crucial to understanding the **current issues within your river**. Find your **local rivers trust or catchment partnership** to find out what work they are doing and talk about ways you can get involved.

Links to further information

The following table is a non-exhaustive list of online resources with hyperlinks to help you find out more about how rivers function and specific information about your local river:

Plans and survey methods	Handbooks and other resources
England and Wales River Basin Management Plans	The Channel Management Handbook
Scotland River Basin Management Plans	Nigel Holmes & Paul Raven's book 'Rivers'
North Ireland River Basin Management Plans	River Restoration and Biodiversity publication
Interactive map of England WFD data	Wild Trout Trust
Interactive maps of Scotland WFD data	Catchment Based Approach
Interactive maps of Wales WFD data	IUCN Water Programme
The Scottish Rivers Handbook	GB non-native species secretariat
River Habitat Survey	RRC Manual of Techniques
Urban River Survey	RRC useful links
Modular River Survey (MoRPh)	RRC Publication Library