Integrated Catchment Management Toolkit

For secondary schools

A resource pack for assessing and mapping your local water catchment!

BURREN AND CLIFFS OF MOHER GEOPARK
PEOPLE. PLACE. LEARNING. LIVELIHOOD.

GeoparkLIFE:
Tourism for Conservation

Toolkit Contents

Part One:
Overview

1.1 Welcome

to the Burren & Cliffs of Moher UNESCO Geopark Catchment Mapping Toolkit! The toolkit is designed for use by transition year groups but can easily be adapted for community groups or anyone with an interest in better understanding and assessing our local landscapes, rivers, streams, lakes and aquifers. A list of the resources needed for this programme is given below.

Teachers You will need to identify someone within the school or community willing to spend time familiarising themselves with the programme. Science or geography teachers would be ideal as the programme sits well within those curriculums.

Time A catchment mapping project like this will need at least 1.5 hours a week over 12 weeks.

QGIS This is a free open source software that can be downloaded easily from www.qgis.org! It will need to be installed on all the school/community group computers!

Data There is a wealth of freely available environmental data online in GIS format for most countries in Europe. It is advisable to have some data ready for students, but it is great for them to explore and download it themselves.

River A local stretch of river that is safe and within walking distance of the school is ideal for surveying

Equipment Sweep nets for kick sampling, wellies, tray containers and identification guides
for macro-invertebrates, metre sticks or tape measures for measuring river depth and width etc., cameras for recording the project .

Guest Speakers To offer different perspectives on the catchment, local experts, geopark geologists, staff from local universities, local authority officers, water officers, local stakeholders such as farmers, anglers etc.

Online Resources There are a number of online MapViewers from various agency websites that students can use in researching their catchment. Ensure school computers have access to these websites.

1.2 Introduction

We all live in catchments, whether we live in a city, a country town or by the sea. When we are talking about a water catchment we simply mean the area of land around a river (river catchment), lake (lake catchment) or even groundwater (groundwater catchment). Appreciating this connected flow of water in a landscape is important for the management and conservation of natural habitats and in understanding how we can impact on the environment.

Thinking of our local area as a catchment and promoting the importance of our common water resource can provide lots of benefits to the community also such as high-quality drinking water, better agriculture and a thriving tourism industry. This resource guide will show you how to investigate your local catchment and understand the processes at play. This will allow us to share the knowledge so we can better manage our catchments!

Compiled by Grainne Barron,
Dr Tiernan Henry & Dr Gesche Kindermann.
Edited by Dr Tiernan Henry

Earth & Ocean Sciences
School of Natural Sciences
NUI Galway
OÉ Gaillimh

1.3 Water Framework Directive

The first line of the Water Framework Directive (WFD) says…

'Water is not a commercial product like any other but, rather, a heritage which must be protected, defended and treated as such'

The WFD was adopted by the European Union in 2000 to establish a framework in all the European member states for the protection and improvement of all our natural water bodies which include; rivers, lakes, estuaries, coastal waters and groundwater. This essentially means every European country must make a big effort to stop and reverse water pollution.

Under Irish law, the WFD is regulated by the Department for Housing, Planning, Community and Local Government, which in turn oversees the Environmental Protection Agency (EPA) and also by Local Authorities. The protection and improvement is to be achieved through catchment management.

We are now into the second cycle of those plans from 2016–2021.

For more info on the WFD check out the new EPA Catchments website @ https://www.catchments.ie/

1.4 Water Resources

WHERE is water on, in, and above the Earth?

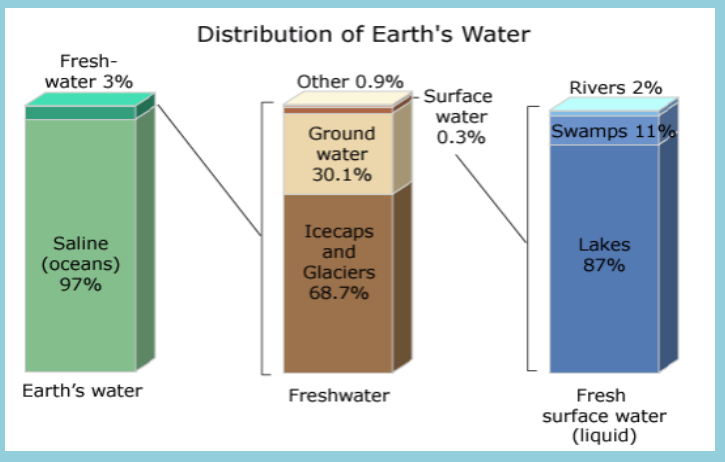
Currently, **71%** of the surface of the planet is covered in water. **96.5 %** of the Earth's water is found in the oceans. **1%** is saline and locked up deep beneath the surface. Just **2.5%** of the Earth's water is freshwater!!

So, the 2.5% of all water is freshwater?

Right now, **68.7%** of the Earth's fresh water is stored in glaciers and icecaps! **30.1 %** of the water is groundwater, and just **1.2%** of our freshwater is found on the surface.

Right, so we're at 1.2% of 2.5% of water?

Yes, but of that **69%** is ground ice and permafrost! **3.8%** is soil moisture, **2.6%** is held in swamps and marshy ground, **3%** is in the atmosphere, **0.26%** is in living things. **20%** is lakes and just **.49%** is flowing in our rivers. Not a lot really, considering all the jobs it must do! So…. water is scarce!



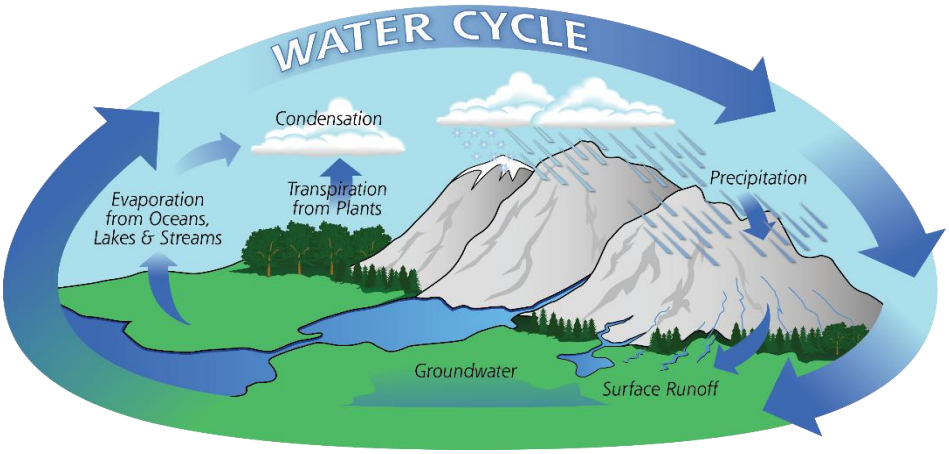
water.usgs.gov/edu/pdf/earthwherewater.pdf

For more info check out this YouTube link
https://www.youtube.com/watch?v=S2hLnw6B5I8

1.5 Water Cycle

The water cycle describes how water moves continuously on, in and above the Earth. The total amount of water on Earth is largely unchanged through time, but where we find it changes: as ice, liquid water or water vapor.

The water or hydrological cycle keeps water moving around the planet. Water evaporates and becomes water vapour. It falls as snow or rain. Some of this can evaporate, some is transpired by plants. Some gets stored in glaciers and ice, some in the ground and in lakes. Some of the water ends up in rivers and returns to the sea.



For more info check out this YouTube link
https://www.youtube.com/watch?v=ts19O41kwDA

1.6 Catchments Explained

What is a catchment?

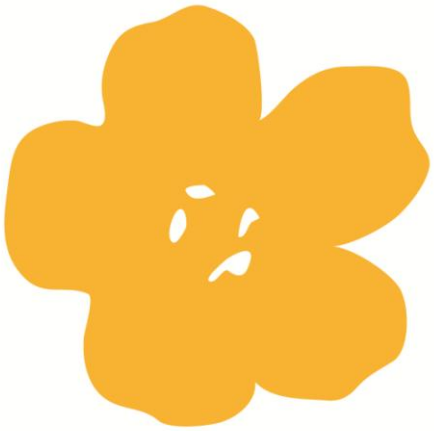
A catchment is best defined as the geographic area contributing water to a river and its tributaries.

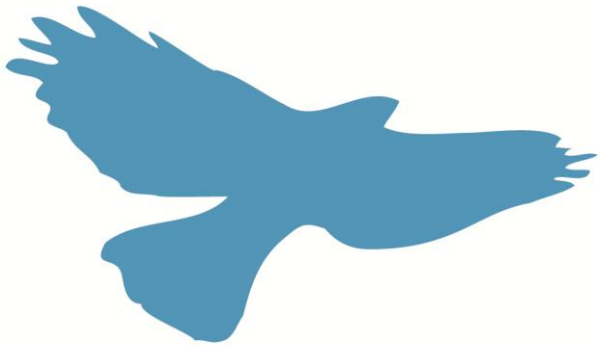
A catchment is often also referred to as a drainage basin or a watershed that collects all precipitation that falls within the boundaries. In this way topography defines our catchments big and small! All surface water from rain *etc.* will flow and eventually find its way to the nearest lake or river or even go underground before it finds a river

Imagine you are standing on the highest point of a hill or small mountain. When rain falls it will either flow one way down the hill or the other towards the nearest lake or stream. This topographical high point would be the dividing line or boundary of two separate catchments!

As water moves throughout the catchment from high points to low points, a number of processes of the water cycle are at play! We all live in catchments, so it is in our best interest to know where the water is and how it is moving and what is impacting on it.

For more info check out this YouTube link
https://www.youtube.com/watch?v=v-b1nM0RbOs





Part two:

Catchments and ?

2.1 Geology

The bedrock underneath our feet is the most significant factor in controlling and forming catchments. The shape of the landscape - the topography – and the lay of the land reflects the bedrock underneath. Geology influences where the water goes, it influences what we find in the water and it influences where we find water (in the ground or on the ground).

There are 3 types of rocks: igneous, sedimentary and metamorphic

Igneous rock forms from molten magma. When magma cools slowly beneath the ground intrusive igneous rocks like granite are formed (the Galway or Wicklow granites are good examples). When magma reaches the Earth's surface, as lava, it cools quickly, forming extrusive igneous rock like basalt (the Giant's Causeway).

Metamorphic rocks are formed from existing rocks that have been squeezed, heated up or both. A new rock is formed from the changed (metamorphosed) parent rock. So, limestone becomes marble, and shale becomes slate with an increase in temperature and pressure. Metamorphism can occur when tectonic plates collide. There are abundant metamorphic rocks throughout Connemara, for example, the best known being Connemara marble.

Sedimentary rocks forms when sediments accumulate (usually in or near water) and are compressed and get cemented together over time. Sediments are made from rocks. They are eroded, transported by rivers, glaciers or the wind. and are deposited into layers before being buried and lithified (when loose sediment becomes solid rock). **Limestone** makes up almost half of Ireland's bedrock and is made from Calcium Carbonate precipitate from sea water or collected in shells and skeletons.

For more info check out this YouTube link
https://www.youtube.com/watch?v=WYtF-ZdTr7s

2.2 Hydrogeology

Why is the **geology** one of the most important factors at play in a catchment or watershed? A catchment includes not only to the water which occurs **on** the Earth's surface in streams, rivers and lakes but also the groundwater **beneath** the surface. Some of the rain (and occasional snow) that falls on the ground works its way down through the ground; it fills pore spaces between sand and gravel deposits and the cracks and fractures in crystalline bedrock such as granite or limestone. This process is known as **groundwater recharge.** Water can get stored and transported in the rock and these water-bearing rocks are called a **aquifers**. All rocks in Ireland have water in them (some more, some less) so all rocks in Ireland are aquifers.

The term **hydrogeology** is used to describe the science of understanding these how water gets into the ground, how it moves in the ground and how it interacts with the ground.

It is not always easy to work out what the rocks in an area are made of because they are often covered by soil and vegetation, but below the surface in every landscape there are rocks. But, some simple clues can give us lots of information about the relationship between water and the rock: if there are lots of rivers, lakes and streams it is likely that the rock underneath is tough and resistant, and is not a good aquifer. If there are few or no rivers, it's likely that the bulk of the water is to be found *in* the rock. Other good clues are in place names and in local features. In Ireland, most of our townland names stretch back through the centuries and frequently they reflect some local feature: a woodland, a hill or a bridge for example. They can also tell us about water: if Turlough is part of name then it indicates that water collects on the surface occasionally; Owenbristy – or Abhainn Briste – indicates that water goes underground; springs and holy wells can also be good indicators of how rocks and water interact.

For more info check out this YouTube link:
https://www.youtube.com/watch?v=oNWAerr_xEE

2.3 Heritage

There are more than 3,000 holy wells in Ireland where water flows out of the ground. In Irish myth, wells and **springs** are thought to bring water from the **otherworld** to the well, spring or even as the source of a river. Often associated with goddesses – for example ***Bóann*** and ***Sionann*** were thought to be flowing from the other world to gush forth as rivers such as the **Boyne** and **Shannon**. They are often thought to have the power to cure illness and are associated with rituals, early Christian saints, or pagan Gods. These wells have always been important to Irish people as places of healing and **legends** and **myths** about them are evident in pre Christian folklore. With the arrival of Christianity, these wells, were re-named to fit with Christian beliefs as were the folklore and legends surrounding them. Stone churches and places of worship sprung up close to these ancient places. The surviving names of many wells are a direct translation into English and the names of many townlands, fields, and houses were a homage to these wells.

Over the course of recorded history in Ireland Irish place names became **anglicized** for tax and ownership purposes. This often resulted in the original Irish names becoming slightly distorted versions as English spellings were forced on Irish language place names. Common words used in place names were **Bally/Balli meaning t**own from the irish word "***Baile***". "***Kil/Kill***" can mean either wood "***coill***" or church "***cill***". A little local knowledge of some investigation of local historic maps can often shed light on these mysteries. Place names with "Drum" or "***Drom***" comes from the Irish word "***Droim***" meaning ridge and often refer to an area that has a geological outcrop or ravine visible on the landscape. The presence of ring-forts or enclosures can be deduced through place names including "***lis***." The town Lisdoonvarna is known in Irish as Lios Dúin Bhearna, meaning an enclosed fort "*lios dúin*" of the gap "***bhearna***".

YouTube For more info check out This link:
https://www.youtube.com/watch?v=m_OaT0pC47I

2.4 Ecology

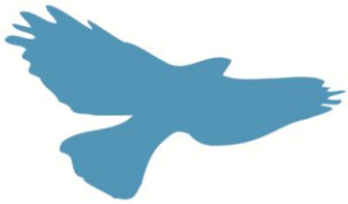
Nature is an essential component of the catchment; the biodiversity in our gardens, in hedgerows, parks, on farms interact and impact upon all of the life and ecological processes that surround us. **Biodiversity** refers to the interdependent web of living things (eco-systems), from bacteria, algae, to plants, trees, fish, birds and mammals and humans! By studying **ecology** we get a better sense of how living things are connected and interdependent in a finely balanced system. Any change in this can affect the survival needs of all the individual species. We can often assess the health of a catchment with the health of the habitats contained within it.

Identifying habitats is often difficult in practice as they often mix and merge with one another. In Ireland we use a standard guide for habitat identification which covers natural, semi-natural and artificial habitats of land, freshwater and marine environments

Habitats may be entirely natural but can be changed by drainage, over use of fertilisers, or over grazing. Humans can significantly alter habitat quality and species. Depending on the condition of the habitat, its importance for **conservation** and biodiversity may vary. Habitats provide a healthy foundation for the health of rivers, streams and the groundwater in a catchment. **Mapping habitats** can help provide key insights into the ecological processes at play. A useful way to do this is through **Geographical Information Systems (GIS)**).

Habitats are defined by three significant factors: weather, soil conditions and humans!. These variables provide for the needs of the **species** that live in each type of habitat. **Soils** develop from rock, so the properties of the soil can reflect those of the rock, and this controls what **plants** that can grow there, as does the **weather** (rainfall, sunlight, wind, etc.). We have shaped **the** land by clearing forests and fields, planting hedgerows, trees and scrub, and building cities. Ireland now has a mixed landscape of natural, semi-natural and urban habitats.

2.5 Habitats



Habitats often have their own distinctive flora. The **Burren** in County Clare is famous for the wildflowers found on its **limestone pavements**. Many wildflowers are found growing along **riverbanks** and wet habitats in Ireland. Botanists often use a simple key to identify plant and wildflower species, before **recording its abundance** using quadrat surveys.

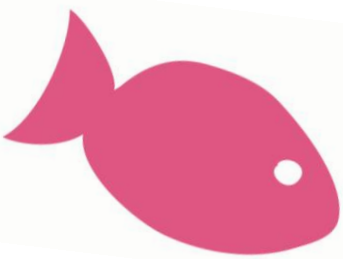
At least 65% of all species on the planet are **invertebrates**.Areas of flower rich **grassland** often contain rare plants, aswell as more common species such as thistles, hogweed, Bird's foot trefoil, clovers and vetches. These plants provide pollen sources for many insects such as Bees and wasps (*Hymenoptera*), beetles (*Coleoptera*), grasshoppers (*Orthoptera*), moths and butterflies (*Lepidoptera*), flies (*Diptera*). Ponds and wet areas including streams, rivers, wet woodland, coastal habitats and seasonal lakes (**turloughs**) also have high numbers of aquatic invertebrates such as dragonflies and damselflies (*Odonata*), water beetles (*Coleoptera*), flies (*Diptera*) and moths (*Lepidoptera*).

Ireland has over 60 species of **mammals** however only 26 species are **native** to Ireland. Foxes, hedgehogs, stoats, otters, pygmy shrew, and badger are common. The Irish hare, red deer, and pine marten are considered rare. Some introduced species have become thoroughly naturalised, e.g. the European rabbit, grey squirrel, bank vole and brown rat. In addition, ten species of bat are found in Ireland.

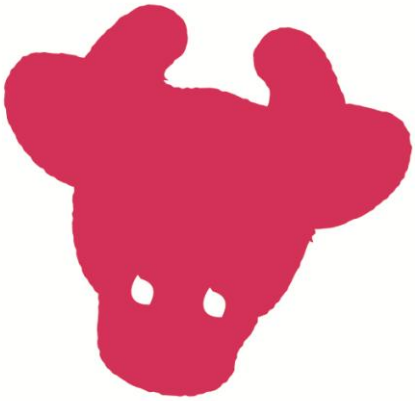
About 400 **bird species** have been recorded in Ireland, many of which are **migratory** which come in the winter or the summer to breed. Ireland has fewer breeding species than the UK and Europe because there are fewer habitat types and fewer **deciduous woodlands** but we do have some populations species which are in decline elsewhere such as Storm petrels, roseate tern, chough, and corncrake.

2.6 Tourism

Ireland's **waterways** are a big part of the heritage and natural beauty of our country. We have a wealth of river systems and canals that offer exceptional **recreational** boating, angling and other **leisure** opportunities. For tourists these landscapes offer **picturesque** settings and a link with the environmental and natural world. Healthy, vibrant waterways and surrounding habitats are an important **economic** resource. The responsible management of catchments can result in a payback to the local community that isn't only economic; the community may also enjoy the strong sense of **heritage** and **place**, as well as the amenity benefits from environmental awareness actions. **Eco-tourism** potential within a catchment to promote both environmental conservation and **socio-economic** development benefits everyone. By taking a **responsible** and **sustainable** approach to tourism that conserves the environment and improves the livelihoods of local business people we can ensure an ecologically and economically viable and thriving tourism industry in the local catchment.



The rich **natural diversity**, cultural heritage and unique lifestyle can be appreciated and valued by the entire community. **Awareness events** and community led conservation efforts will encourage awareness and pride of place among the local community.



Part Three

Landuse and Pollution

3.1 Threats to Biodiversity

Biodiversity is the life support system of the country. All of our food production depends on biodiversity, as do our freshwater and marine fishing industries. **Ecosystems** are designed to breakdown and recycle nutrients, filter water, buffer against flooding and maintain **soil fertility**.

There are a range of **human activities** that can lead to the alteration, degradation or destruction of various habitat types. For example, any **Landuse** or development that increases the level of plant **nutrients in watercourses** is likely to impact negatively on aquatic or wetland habitats.

For more info check out this YouTube link
https://www.youtube.com/watch?v=kdDSRRCKMiI

3.2 Agriculture

Agriculture in Ireland is economically, socially and culturally important. Two thirds of Irelands land are in agricultural use. Historically farmers have been and continue to be the **caretakers** of the land and farming practices have shaped the landscape for thousands of years. However the demands placed on farmers can have **environmental impacts**. EU Directives and legislation have been introduced to address these impacts, but more importantly farmers themselves are working across catchments have put in place measures to better manage water quality.

Nutrient runoff from the land can lead to accelerated growth of algae and plants, and lead to **eutrophication** in rivers, lakes and coastal waters. This results in oxygen depletion of the water body and can lead to algal blooms (massive increase in **phytoplankton**).

In the past, the **land spreading** of slurry in rainy weather or close to water bodies, the over-application of **inorganic nitrate** or phosphate-containing fertilisers on grasslands, and poor management of farmyard wastes impacted on water quality, but farmers are addressing these issues and the positive impacts are now clear.

Farmers must be supported so they can maintain their stewardship of the land, and they should be supported so that they can continue to farm in **economically sustainable** ways that protects our shared water resources.

For more info check out this YouTube link
https://www.youtube.com/watch?v=V5WiD8ZPSNk

3.3 Forestry

Forestry covers about 10% of Ireland. Most, about 80%, are **commercial coniferous plantations** of non-native species like Sitka spruce. These commercial operations can have impacts on the aquatic environment particularly when they are located on marginal land, typically on **upland** and **peatland** areas where the soils are naturally **acidic**. Conifer pine needles falling on the forest floor can change the acidity of the water logged soils which can **run-off** to nearby streams and watercourses. The **change in the water pH** can have impacts on the habitats sustained by the streams. **Forestry management** practices can reduce sediment loading to rivers and can reduce the loading of nutrients to streams too. Both can have major impacts on species living in rivers and streams. Minimising these are among the goals of good forestry practice.

Freshwater Pearl Mussels (FPM) are a protected species, and their presence is indicative of excellent water quality. They can live up to 150 years but they require clean, fast-flowing rivers, and occasionally lakes. They are very sensitive to nutrient & silt pollution.

Measures such as reducing fertiliser use, creating deciduous forestry buffer zones around water bodies and phased clear felling at any one time can help reduce the impacts.

3.4 Invasive Species

Invasive species are species that have been introduced outside their natural environment and whose establishment can threaten **native ecosystems** They can frequently out-compete **native species** because of lack of competition or predation. The rate of new invasive species to Ireland is accelerating because of increased international travel and trade. Invasive plant and animal species are the second biggest **threat to biodiversity** worldwide after **habitat destruction** They can drastically transform habitats and **threaten** whole **ecosystems** causing serious problems to the environment and the economy. In addition to their biological effects, invasive species can adversely impact the recreational and amenity use of **infested watercourses** by restricting angling, boating, swimming and other water-based leisure pursuits. They clog engines, turbines and water intake pipes.

An example of this is the **Zebra mussel** a small **filter feeder** that feeds on the plankton that young fish depend on while often resulting in toxic algal blooms.
Plants such as **Himalayan balsam** colonise river banks and other areas of damp ground. When the seed pods are mature they will explode scattering the seeds which spread downstream in rivers and streams. **Japanese knotweed** spreads via the movement of soil material contaminated with the rhizomes **Giant rhubarb** is a large plant resembling the common rhubarb that also dies back at the end of the growing season. Native species that function to maintain bankside stability along rivers disappear and in the winter the banks being left bare and vulnerable to erosion and bank collapse, and **increased sediment** deposit into the waterway affecting fish spawning and the river ecosystem.

For more info check out this YouTube link
https://www.youtube.com/watch?v=xc0hXWSrrmI

3.5 Domestic Waste Water

Domestic waste water includes grey water from sinks and washing machines and sewage from domestic dwellings. Where houses are not connected to the main municipal waste water treatment plant (WWTP), waste water is collected in septic tanks or other treatment systems before being discharged to the ground.

When building new houses the best type of system to used is determined by examining the soil type and thickness, the type of bedrock and the location of wells, streams and other houses. Effective system include a double chamber tank and a percolation area. The solids are partially digested by bacteria in tank and the effluent water flows through a percolation area where the water slowly seeps down through the ground.

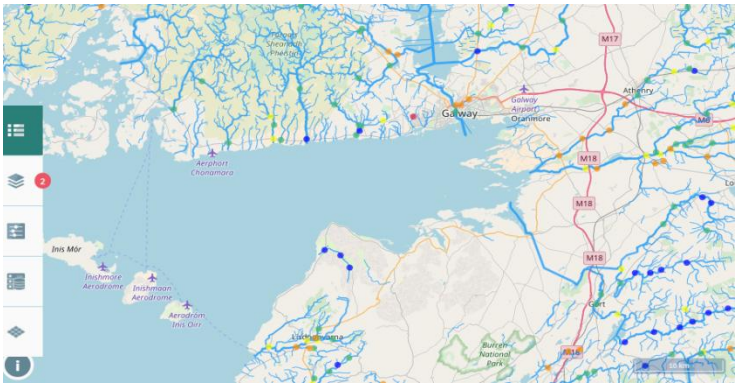
Septic tanks should be de-sludged every three or four years. If there is a smell of sewage from the general area of the percolation area, slowly draining toilets, or drains backing up or visible ponding of sewage on the percolation area, the septic tank is likely to need emptying. Well-maintained septic tanks can have a major positive impact on ensuring good quality ground water.

For more info check out this YouTube link
https://www.youtube.com/watch?v=uu0Ruwb4cfs

Part Four:
CITIZEN SCIENCE

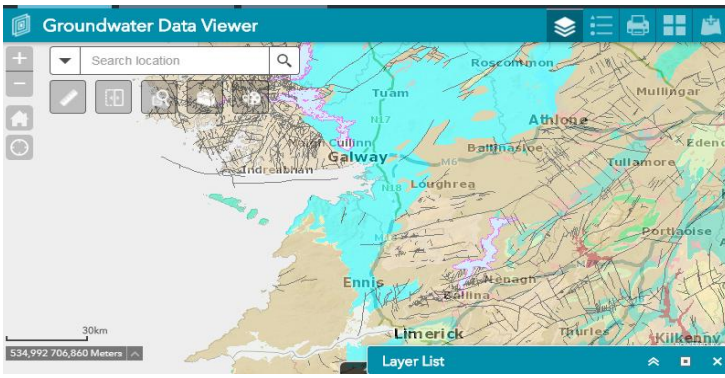
4.1 Desk Study

Prior to going out into the field and conducting an assessment of any area, it is always useful to first complete a **desk study**. This is done by compiling and reviewing any available information from a variety of sources.



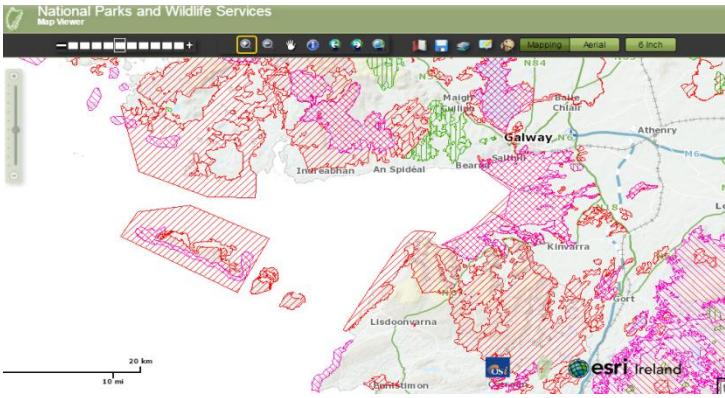
River Quality Map – Source: https://gis.epa.ie/EPAMaps/

Examine **topographic maps** and **aerial photos** to identify key landmarks such as the location of the school, and the location of a waterway relative to the school. Try to identify the broad catchment boundaries and the route of the waterway from the headwaters to the sea.



Aquifer map – Source: https://www.gsi.ie/en-ie/data-and-maps/Pages/default.aspx

There are a number of **free online mapping viewers** developed to enable people to access information on the environment. (See next page!).



Conservation Sites Map – Source: http://webgis.npws.ie/npwsviewer/

4.2 Resource List

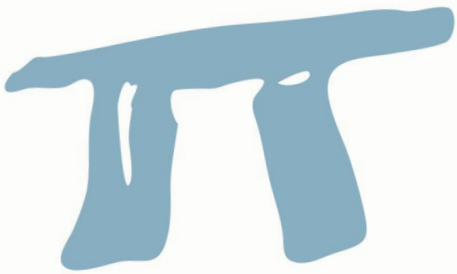
Environmental Protection Agency (EPA)

The EPA provides information on waterways, bathing waters, air quality, IPPC licenses, historic mines waste and waste water treatment licences, land cover information, soil and subsoil datasets, WFD Protected Areas and River Basin Districts, hydrometric stations. The main map viewer operated by the EPA, known as ENvision, is accessible here: https://gis.epa.ie/EPAMaps/

National Parks and Wildlife Services (NPWS)

The NPWS online map viewer provides data on species records, indicative habitat maps, biological records and designated sites such as SPAs, SACs, NHAs and pNHAs. Maps can be viewed online here:

http://webgis.npws.ie/npwsviewer/



Soils

National Soils Database - http://erc.epa.ie/nsdb/index.jsp

Peatland Maps - http://www.ucd.ie/eacollege/biosystems/staff/research/johnconnolly/publicatios/

Marine

Marine Institute - http://www.marine.ie/home/publicationsdata/

Marine Irish Digital Atlas http://mida.ucc.ie/contents.htm

Biodiversity

National Biodiversity Data Centre http://www.biodiversityireland.ie/

Biodiversity Maps - http://maps.biodiversityireland.ie/#

4.2 Resource List

Geological Survey Ireland (GSI)

The GSI produces many datasets from bedrock, quaternary, groundwater, marine, geological heritage, to geotechnical, minerals, geophysics, geochemistry and geohazards. They can be viewed in online viewers accessible here:

https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228

Irish Cave Database - http://www.ubss.org.uk/irishcaves/irishcaves.php

Catchments.ie Website (EPA)

The flow of water both above and below ground, possible sources of pollution, including urban waste water treatment plants, septic tanks, and runoff from farming, forestry and landfills, Information about our 46 catchments, 583 subcatchments and 4829 waterbodies, trend charts in key biological and chemical indicators, They can be viewed in online viewers accessible here: https://www.catchments.ie/maps/

Heritage

National Monuments Service - http://www.archaeology.ie/

National Inventory of Architectural Heritage - http://www.buildingsofireland.ie/

Heritage Council - http://www.heritagecouncil.ie/

Place names - https://www.logainm.ie/ga/inf/proj-about

4.3 Geographical Information System

Geographical Information System (**GIS**) software is a useful tool for storing, checking, analysing, manipulation, integrating and critically the displaying of **spatial data**. It can show georeferenced information in a colourful and accurate manner.

The Geological Survey Ireland GSI produces many downloadable datasets from bedrock, quaternary, groundwater, marine, geological heritage, to geotechnical, minerals, geophysics, geochemistry and geohazards. The dataset is available here: https://www.gsi.ie/en-ie/data-and-maps/Pages/default.aspx.

The Environmental Protection Agency (EPA) also has including **Corine**, **Soils** and **Subsoils** data. Datasets available to download here: https://gis.epa.ie/GetData/Download.

They can be downloaded as zipped ESRI **Shapefiles** for use with a number of GIS software packages.

All files are projected to Irish National Grid / ING prior 2016 and in Irish Transverse Mercator / ITM from 2016 onwards. The Marine files are in WGS84.

A practical guide to QGIS, a free and open source Geographic Information System is available to accompany this toolkit and contains instructions on the downloading and displaying of this data

4.4 Risk Assessment

This programme involves a **Citizen Science** survey of your local streams and rivers so remember to be safe and aware of any potential risk at all times. Riverbanks and lakes are often dangerous due to deep waters, fast currents, muddy and steep banks, hazardous waste or sharp objects that may have been dumped, fast currents. Always work in groups near water and make sure that you have the correct clothing, boots and waterproofs.

Name:	
Title of Fieldwork Activity:	
Location(s) of Work:	
Duration (incl. dates From / To) :	
Brief Description of Fieldwork:	

Hazard (s)	Risk L/M/H/VH	Likelihood	Consequence	Control Measures	Resultant Risk
Physical Hazards (e.g. extreme weather conditions, cliffs, caves, mountains, marshes, quicksand, fresh / seawater, mines, quarries, tides)					
Biological Hazards (e.g. poisonous plants, venomous / aggressive animals, soil or water microorganisms, insects)					
Chemical Hazards (e.g. pesticides, dusts, contaminated soils, chemicals on site)					
Man-made hazards (e.g. machinery, electrical equipment, vehicles, insecure buildings, slurry pits, power and pipelines)					
Personal Safety (e.g. lone working, attack on person or property, first aid)					
Environmental impact (e.g. refuse, pollution, disturbance of eco-systems)					
Other hazards (e.g. procedural, manual handling) Please specify.					

4.4 Risk Assessment Contd.

Emergency Procedures: Specify arrangements for first aid, special emergency procedures, survival aids, communication, etc.)				
Additional Information: Identify any additional information relevant to the fieldwork activity, including supervision, training requirements, information, specialist equipment or clothing, inoculations, etc.				
SCHOOL	Name:	Tel. Contact:		
S. ON-SITE	Name:	Tel. Contact:		
Address of residential base:				
Has necessary training and information been given?		Yes ☐	No ☐	N/A ☐
Is there adequate provision for those with health problems or disabilities?		Yes ☐	No ☐	N/A ☐
Are there adequate First Aiders available?		Yes ☐	No ☐	N/A ☐
Is there suitable supervision (i.e. Staff to Student ratio)?		Yes ☐	No ☐	N/A ☐
Is permission required to work on site?		Yes ☐	No ☐	N/A ☐
Are there suitable transl arrangements and licensed drivers?		Yes ☐	No ☐	N/A ☐
Is adequate insurance cover in place? *(Contact Finance Office for advice, 091-8134)*		Yes ☐	No ☐	N/A ☐
Have all participants submitted next of kin information to NUI, Galway?		Yes ☐	No ☐	N/A ☐
Have route notification schedules been provided to the Garda Síochána or Coastguard?		Yes ☐	No ☐	N/A ☐
Assessment carried out by: Name:		Date:		
Signature:		Review Date:		
Title (e.g. Group Leader, Lecturer, Research Student, etc):				
Assessment Authorised by Name:		Date:		
Signature:				

4.5 Bank Survey Sheet

Site Details:	
Site Location:	Survey Completed By:
Co-Ords:	Date:
Flow Direction:	Water Feature Type:
Weather Conditions:	Rainfall in last 24hs:
Field Measurements:	
Channel Width:	Bank Structure:
Bank Depth:	Riparian Vegetation:
Channel Depth Cross Sectionally:	
Substrate:	Temp:
Calculate Flow Discharge:	pH:
Canopy over stream/river:	Conductivity (mS/cm):
Visible Signs of Pollution:	Dissolved Oxygen (mg/l):
Sample Taken:	Turbidity:
Other Comments:	Photo Taken:

4.6 Kick Sampling

Freshwater macroinvertebrates are water insects that live in all types of rivers. They include insects in their **larval** or **nymph** stage, **crayfish**, clams, snails, and worms. Many of the adults take on a winged terrestrial form and live the later parts of their lives out of the water. They good **indicators** of water quality because they are impacted directly by the physical, chemical, and **biological** conditions of the stream including habitat loss. Some are very **intolerant of pollution**. In fact they can be classified by their intolerance to pollution. They are **relatively** easy to sample and identify. The EPA carry out biological water testing assessments in rivers in Ireland. They use biotic indices **("Q Values")** to reflect average water quality. A **high status** is indicated by a **Q4-Q5** value while a poor status is given by a Q value of 2-3 or even Q 1.

To find out the quality of our river, we will collect, sort, and identify the macroinvertebrates living in the river.

1. First we choose a part of the river we can wade into or tat we can reach with the net.
2. Take note of any visual pollution issues.
3.Note the conditions of the area. Record weather conditions, water appearance (clear, milky, oily etc.) and any water odour (sulphur, sewage, etc.).
4. Wade into the stream and place the net so it is facing the flow of water.

b. kick the substrate of the riverbed to disturb invertebrates, catching any creatures with your net as the swim downstream.

6. Fill a collection tray about halfway with clean steam water. Empty the contents of the net into the tray.
7.Observe, identify, and record the presence of any macroinvertebrates using an identification key and the survey sheet provide.

4.6 Kick Sampling

(Use this freely available to download macroinvertebrate identification guide!
https://stroudcenter.org/wp-content/uploads/MacroKey_Complete.pdf)

Blood worms are very tolerant of pollution and so give a low Q rating of Q2-3

Different types of **macroinvertebrates** tolerate different levels of pollution. Depending on the types of macroinvertebrates found in a stream, predictions about water quality can be made.

For example, **mayflies**, **caddisflies**, and **stoneflies** can not live in polluted water. They therefore have a water quality rating of between **Q4** and **Q5**.

For more info check out this YouTube ık
https://www.youtube.com/watch?v=ftJuAi9Pj7U

4.7 Macroinvertebrate Survey

Site Details:	
Site Location:	Survey Completed By:
Co-Ords:	Date:
Flow Direction:	Water Feature Type:
Weather Conditions:	Rainfall in last 24hs:

Biological Indicators:				
Indicators of Good Water Quality: (Q4 – Q5):	Abundant	Some	Rare	None
Mayfly/Larvae:				
Cased Cassis fly/ Larvae:				
Stonefly/ Larvae;				
Other				
Indicators of Moderate Quality: (Q3):	Abundant	Some	Rare	None
Beetles:				
Uncased caddis:				
Freshwater shrimp:				
Other				
Indicators of Poor Water Quality: (Q1– Q2):	Abundant	Some	Rare	None
Water louse:				
Worms particularly blood worms:				
Fly larvae:				
Snails:				
Other				
Other				

4.8 Estimating Discharge

River discharge (Q) or flow refers to the volume of water moving through time in a channel. It is measured in units of volume through time, typically cubic metres per second (m^3/s). The discharge of a river is directly related to the velocity of the water and the cross sectional area of the river channel (Q = VA).

- Pick a spot in the stream/river. This is your **cross section point**, choose a point that is not bending and where the channel is free flowing. If there is a bridge you can do this on the bridge (watch out for traffic!).
- If it is safe to do so, measure the **depth** of the stream at one bank and see if the depth changes much across to the other bank. If the water is deeper than your shin, moving too quickly or if it's too cloudy to safely see what the bed is like then don't go in the water. Take an estimate of the depth!
- Measure, or estimate, the width of the stream from where you're working. Multiply this width (m) by the depth (m) to give you the **cross sectional area** of flow (**A**) in m^2.
- Measure or pace out a length along the river bank (pick an easy number: 10m, 5m, 1m). Mark the distance with two stones or bags. Get some twigs or small branches and throw them into the stream upstream of your first mark. Use your phone to time how long it takes the twig to cover the distance;
- **Repeat the process two more times (3 in total!) and work out the average time taken for the twig to travel the 10m (or however long a stretch you have chosen to measure);**
- **Divide the distance (*e.g.* 10m) by the average time. This gives you a good estimation of the average velocity (V) of the stream, in units of metres per second (m/s);**

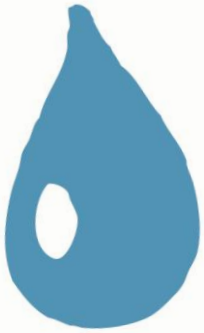
4.8 Estimating Discharge

- This velocity represents how fast the surface flow is, but the water will flow slower near the bed and edges of the river (because of friction). So, multiply the average velocity by 0.8 to get a value that probably best represents the real velocity of the stream from surface to bed;
- Finally, to get the stream discharge (Q) multiply the cross-sectional area (A) by the average velocity (V): Q=VA The answer will be the discharge in cubic metres per second $(m/s)^3$.

4.9 Catchment Walk

There are many ways to explore your **catchment** but by far the most enjoyable way is to follow the river from source to mouth. This will really allow you to discover first hand the **abundance** of nature and **ecosystems** living in, on, above and around your river.

If possible, arrange for a local expert to come on the catchment to share their knowledge with the class. A local **geologist, environmental scientist, farmer, angler, college lecturer, archaeologist, historian** will all have fascinating and valuable insights into different facets of your catchment.



A catchment walk will allow you to appreciate the scale of the catchment **processes**, the impact of various land uses and the extent and cause of possible pollution issues. Try to observe any local landmarks, historical features or interesting place names. Have a think about the meaning or cultural **significance** of these sites of interest. Where did the town develop? Has it moved? Are there any reasons for this? Are there any **conflicts** of interest in the current management of the catchment? What is the landscape like? Is it dynamic, steep, flat? You will be better placed to develop a large-scale catchment map, based on your **observations**.

Plan for a whole afternoon or morning walking in the local area. If you live in a large catchment, a catchment bus tour is another alternative.

4.10 Habitat Mapping

According to the Guide to habitats, there are 11 broad groups and 117 separate individual habitats all given a separate code. The guide can be accessed here in PDF format: https://www.npws.ie/sites/default/files/publications/pdf/A%20Guide%20to%20Habitats%20in%20Ireland%20-%20Fossitt.pdf. :

1. When preparing a habitat map, first print off a map or google image of the area and define the boundaries

2. In the field, working as a group walk the whole area. On the map/aerial photo, delineate different habitats as you see them.

3. Using a species identification key, identify the vegetation if possible. Record the dominant species present in each habitat.

4. Add symbols to your map and prepare accompanying target notes for each habitat area.

5. Use these target notes and Fossit's 'Guide to Habitats' to identify and code the habitats.

6. Construct a full colour habitat map of the area either by hand or using GIS software including the habitat codes with target symbols and accompanying

Irish Habitat Categories

FRESHWATER HABITATS
Lakes and ponds, Watercourses
Springs, Swamps

GRASSLAND AND MARSH
Improved grassland , Semi-natural grassland, Freshwater marsh

HEATH AND DENSE BRACKEN
Heath, Dense bracken

PEATLANDS
Bogs, Fens and flushes

WOODLAND AND SCRUB
Semi-natural woodland
Highly modified/non-native woodland
Scrub/transitional woodland
Linear woodland/scrub

EXPOSED ROCK AND DISTURBED GROUND
Exposed rock, Underground rock and caves, Disturbed ground

CULTIVATED AND BUILT LAND
Cultivated land, Built land

COASTLAND
Sea cliffs and islets, Brackish waters, Salt marshes, Shingle and gravel banks
Sand dune systems
Coastal constructions

MARINE LITTORAL (INTERTIDAL)
Littoral rock, Littoral sediment

MARINE SUBLITTORAL (SUBTIDAL)
Sublittoral rock, Sublittoral sediment

MARINE WATER BODY

Part Five:
Communication

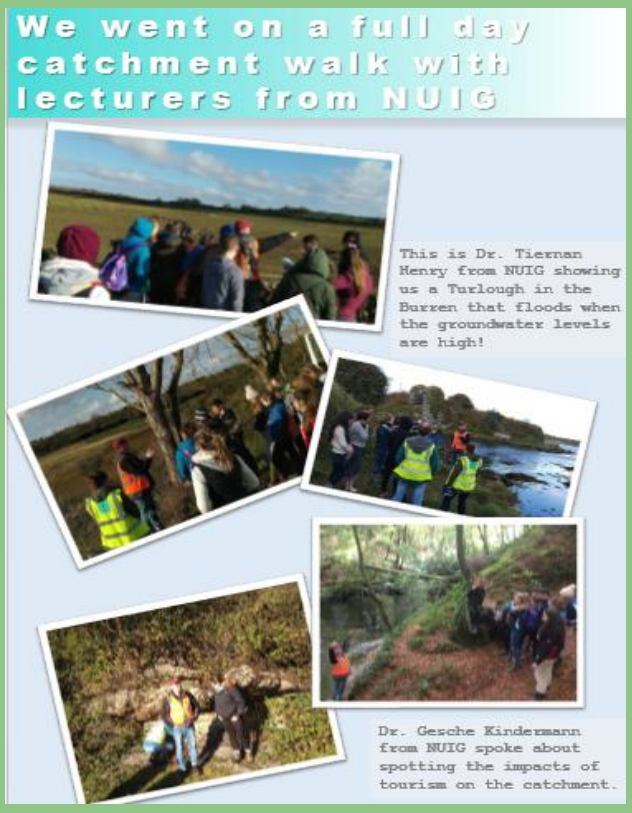
5.1 Poster Presentation

Once you have made your maps in **QGis** and exported them as jpegs or in PDf format, it is a great idea to make a **poster** to show case them and explain them! This can be done easily in **PowerPoint**, software that is easy to use and everyone is familiar with!

A good size of poster is **A0 (84.1 cm x 118.9 cm).** To change the size and orientation of your PowerPoint slide, click the **Design** tab on the ribbon, click **Page Setup** and select '**Custom**'. Type 84.1 in the width box and 118.9 in the height box for an A0 Portrait poster. N.ow you are ready to add **information.** Chose a colour scheme that you like, embed the **images** from QGis. Add **photos** and **descriptions** of **fieldwork** or local **landmarks**. Write up the results from the discharge calculation exercise and from the **macroinvertebrate survey**. You can add information about the **local heritage** of your town, that you gained while doing the desk study and exploring your catchment like the Uisce Aille project poster below. Remember to make it eye catching and colourful!

5.2 MAKE A PHOTO JOURNAL

Another excellent way to let people know about the project and the catchment is to make a **photo journal**. This can be simply just lots of pictures of you and your classmates doing **fieldwork** and working together on the project or it could be a series of pictures of the **catchment, landmarks**, **land** uses, **wildlife** etc.! A photo journal can be made in **PowerPoint** also. Follow the steps for the poster except choose **A4 size**. PDF it when you re done and then you can either print it or upload it on a website as a PDF document!



5.3 Spread the word!!

Put together a talk outlining all the things you have learned about your catchment (You can make it in PowerPoint again if you like). Try to keep it interesting. Tell your audience about the boundaries defining the catchment, its history, the geology and soils present. Tell your audience about the water quality of the local river and about any possible pollution issues. Remind them why your place is special and the reasons why it is important to water that flow through it healthy and vibrant!

We all live in a catchments, and we all are affected when the rivers and land in our area are under threat from pollution. Having studied your catchment, you now know some of the reasons that pollution happens but you also now how we can do things a little better. Use this knowledge to spread the word amongst your family members, school friends and the local community. A good place to start is to give a short presentation to your friends at school.