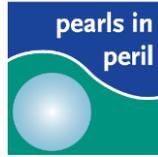


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Pearls in Peril LIFE+ GB

**Action A3: Conservation Actions
for the Freshwater Pearl Mussel
in the River Ehen, Cumbria**

September 2013-2016



ACKNOWLEDGEMENTS

Pearls in Peril is an interesting and exciting project that captures the imagination and I hope that the delivery of this management plan will significantly improve the conditions for the freshwater pearl mussels in the River Ehen. I wish to acknowledge and extend my thanks to the people who have taken a lot of time and effort to contributing to this document, ensuring that it is an effective one!

Special thanks to Ian Creighton at West Cumbria Rivers Trust; Jackie Webley, Scottish Natural Heritage; Charlie Poate, GIS Volunteer; Ian Killeen and Evelyn Moorkens, Macacological Services; colleagues at the Environment Agency - Mike Farrell, Steve Emery, Gail Butterill, Andy Gowans, Chris Addy, Jane Atkins and Helen Reid; Grace Martin and John Gorst from United Utilities; John Garner, Natural England; Rachel Oakley, Wild Ennerdale; Gareth Browning, Forestry Commission; and Sam Laird, Wath Brow Angling Association.

DOCUMENT CONTROL

Please note that part of the document has been redacted and the appendices are not included due to sensitive information

Version	Final (The Action Plan will remain a working document throughout the life of the project)
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EXECUTIVE SUMMARY

Freshwater pearl mussels (FWPM) are critically endangered internationally and are protected by International, European and national legislation.

The River Ehen in Cumbria supports the largest viable population of FWPM left in England. The population, however, is ageing and declining and urgent action is required to prevent their extinction.

Mussel populations have been affected by multiple issues, primarily habitat degradation and declining water quality, but also wildlife crime (pearl fishing). The River Ehen is one of 21 rivers in the four-year Project called, 'Pearls in Peril LIFE+'. This project has been funded and supported nationally by 14 organisations along with European funding to safeguard the future of FWPM. The Project is coordinated by Scottish Natural Heritage.

The project objectives are:

1. To RESTORE the habitat of FWPM and salmonids in selected river catchments within Great Britain.
2. To SECURE the long-term survival of existing FWPM populations and prevent their further degradation.
3. To COMMUNICATE with local, national and international audiences to raise awareness of FWPM conservation issues

This project will be used to implement a range of best practice conservation actions to investigate and address the issues known to be causing a decline in mussel populations. The project will facilitate the restoration of natural habitat and will include liaison with landowners and managers to implement land management regimes for the benefit of FWPM through agri-environment schemes, the stabilisation of riverbanks where appropriate, the planting of riparian woodlands, floodplain/wetland restoration and creation. In addition to habitat management, a programme to artificially encyst (attach) the resident wild salmon population with glochidia (mussel larvae) will be undertaken along with a programme of awareness raising, education and dissemination activities.

The aim of this document is to identify and plan the implementation of these actions to secure the future of the population of FWPM in the River Ehen with the support of other organisations.

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1. INTRODUCTION

1.1 Aim

The aim is to identify and plan the implementation of conservation actions to secure the future of the population of Freshwater Pearl Mussels (*Margaritifera margaritifera*) in the River Ehen and to work towards restoring favourable condition status of the Special Area of Conservation.

1.2 Objective

The objective is to provide a document that will inform the management of the River Ehen for the benefit of Freshwater Pearl Mussel and Atlantic salmon (*Salmo salar*). Primarily, the document will be used by the Pearls in Peril (PiP) Project Officer to deliver the actions of the PiP Project (Appendix A).

The document can also be used to inform the work programmes of other organisations with responsibilities in the catchment and support future funding applications for management.

1.3 Description

The freshwater pearl mussel (FWPM) is declining dramatically throughout its range and is under grave threat within Great Britain (GB). Research and habitat management work is underway across the species' range to help understand the reasons for observed declines and improve conditions for remaining populations. Mussel populations have been affected by multiple issues, primarily habitat degradation and declining water quality, but also wildlife crime (pearl fishing). A nationwide project, 'Pearls in Peril LIFE+' (PiP Project), has commenced to safeguard the future of priority FWPM populations by tackling these issues and implementing best practice conservation methods (Appendix B). The Project will be tackling issues at 21 rivers, all of which are NATURA 2000 sites and are designated as Special Areas of Conservation (SACs); 19 of the rivers are in Scotland, one in Wales and one in England.

1.4 Project Governance and Scope

Pearls in Peril LIFE+ is a four year project (2012-2016) co-funded by 14 organisations (Appendix C) and is also supported by the European Union's LIFE + NATURE programme¹. Scottish Natural Heritage is coordinating the project centrally and administering the total project budget of £3.4 million.

In England, £500,000 of the total project budget will be directed to address the issues on the River Ehen in Cumbria which supports the largest population of FWPMs in England, but has low levels of juvenile recruitment. The Environment Agency (EA), United Utilities (UU), Lake District National Park (LDNP) and West Cumbria Rivers Trust (WCRT) have contributed to the project.

¹ This is Europe's financial instrument to support environmental and conservation projects throughout the European Union. <http://ec.europa.eu/environment/life/index.htm>

WCRT will be delivering the project in England with support from partner and other organisations. The PiP Project is directed and supported by the River Ehen Steering Group which is informed by the River Ehen Technical Group. The overall governance of the PiP Project is through the PiP Steering Group, coordinated by Scottish Natural Heritage (SNH). All of the Groups meet quarterly.

The River Ehen is situated in Ennerdale, West Cumbria and flows from Ennerdale Water, discharging 27 km downstream into the Irish Sea at Sellafield. The project will focus on the SAC area, which is 13.5 km long, and stretches from the outlet of Ennerdale Water to the confluence of the River Keekle in Cleator Moor (Maps 1 and 2.). The FWPM and Atlantic salmon are the qualifying features of the River Ehen SAC designation.

The project objectives are:

1. To RESTORE the habitat of FWPM and salmonids in selected river catchments within Great Britain.
2. To SECURE the long-term survival of existing FWPM populations and prevent their further degradation.
3. To COMMUNICATE with local, national and international audiences to raise awareness of FWPM conservation issues.

2. BACKGROUND

2.1 Description of FWPM

The 'Ecology of the Freshwater Pearl Mussel' (Skinner, Young & Hastie, 2003)², provides a detailed description of the FWPM; the following paragraphs briefly summarises this information. The family of bivalve molluscs, Margaritiferidae, to which the FWPM belongs is very ancient, and has changed little in 65 million years³. The FWPM can be found on both sides of the Atlantic, from the Arctic and temperate regions of western Russia, through Europe to north-eastern North America.

The FWPM is a bivalve mollusc, which means that its body is almost completely enclosed between a pair of shells hinged together. The FWPM has a muscular 'foot'; this very large, white foot enables the mussel to move slowly and bury itself within the bottom substrate of its freshwater habitat. The outer shell is generally yellowish-brown in colour, darkening with age, and the inner surface, the mantle, is pearl white. The mantle protects the soft parts of the mussel from any parasites that get into the shell, by growing over them and covering them. As the layers build up a pearl may be formed.

FWPM has a long lifespan; they can live for over 100 years and can grow up to 155 mm in length. The adult mussel burrows to two-thirds of its shell depth into sandy/gravelly substrates, often between boulders and cobbles in fast-flowing oligotrophic (low nutrient) streams and rivers and is mostly sessile in nature. They are filter feeders, large quantities of water are pumped in through the animal's inhalant siphon, food-material is sifted out and passed to the mussel's mouth and then the water is expelled through the exhalant siphon. They require cool, clean and well-oxygenated water.

FWPM are typically dioecious (separate sexes), with males releasing sperm into the water column in June-July; the female inhales the sperm and fertilises the eggs. Between July and September the female releases one to four million tiny (approximately 0.6-0.7 mm) larvae, called glochidia, into the water column. Glochidia require a juvenile (fry) salmonid (Atlantic salmon or trout (*Salmo trutta*)) fish host for the next stage of their development. The preferred salmonid host in the River Ehen is Atlantic salmon. The tiny shells of the glochidia are held open until they are inhaled by the host, then snap shut on the host's gill filaments. Glochidia become encysted within the gill tissue and grow in this oxygen-rich environment until the following spring, when they drop off. These juvenile mussels must land and burrow into clean, sandy or gravelly substrates in order to settle and start to grow. This association does not appear to harm the fish, and facilitates mussel dispersal. Due to the essential role salmonid fish play in the life of the FWPM, the conservation of salmonids is also central to the survival of this endangered species.

Mussels reach sexual maturity between 10 and 15 years of age, when the shell length exceeds 6.5 cm. It is thought adult mussels do not have an upper age limit for reproductive activity and continue to reproduce until they die (Bauer, 1987).

²http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=SMURF_mussel.pdf

³http://freshwaterpearlmussel.com/?page_id=195

2.2 Legal status

The FWPM is afforded legal protection under, international, European and UK law. Table 1 summarises the various legislation, policy and plans that apply to FWPM and Atlantic salmon. The requirements and objectives set out in these documents have direct synergies and some shared objectives with the PiP Project and collaborative working with other organisations will be key to the delivery of the Project.

Table 1: Legislation and policy

Title/date	Description
International	
Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) 1982	FWPM and Atlantic salmon are internationally protected under Appendix III of the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention). The principal aim of the Convention is to ensure the conservation and protection of wild plant and animal species and their natural habitats by providing special protections through 'appropriate and necessary legislative and administrative measures of the listed will fauna species' in member countries.
IUCN⁴ Red Data List, 1994	FWPM is listed as Critically Endangered on the Red Data List. These are species that are in danger of extinction and whose survival is unlikely if the causal factors continue operating. http://www.iucnredlist.org/details/full/12799/1
The North Atlantic salmon Conservation Organization (NASCO) 1983	NASCO is an international council made up of Canada, the European Union, Iceland, Norway, the Russian Federation, and the United States, with its headquarters in Edinburgh. It was established in 1983 to help protect Atlantic salmon stocks, through the cooperation between nations. They work to restore habitat and promote conservation of the salmon.
European	
Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora (Habitats Directive) 1992	The Bern Convention was transposed into European legislation through the Habitats Directive. FWPM is listed under Annex II as an animal species of Community interest (i.e. endangered, vulnerable, rare or endemic) whose conservation requires the designation of Special Areas of Conservation (SAC). FWPM is also listed under Annex V, where the 'animal species of Community Interest whose taking in the wild and exploitation may be subject to management measures'. Atlantic salmon is listed under Annex I, protected species and Annex V. The main aim of the Habitats Directive is to promote the maintenance of biodiversity by requiring Member States to take measures to maintain or restore natural habitats and wild species listed on the Annexes at a favourable conservation status, introducing robust protection for those habitats and species of European importance.
Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy (Water Framework Directive) 2000.	The Water Framework Directive (WFD) is a European Union directive which commits European Union member states to achieve good qualitative and quantitative status of all water bodies (including marine waters up to one nautical mile from shore) by 2015 ⁵ . It is a framework in the sense that it prescribes steps to reach the common goal rather than adopting the more traditional limit value approach.

⁴ International Union for the Conservation of Nature

⁵ <http://jncc.defra.gov.uk/page-1375>

Title/date	Description
EC Freshwater Fish Directive (2006/44/EC) 2006	The Directive seeks to protect those fresh water bodies identified as waters suitable for sustaining fish populations. For those waters it sets physical and chemical water quality objectives for salmonid waters and cyprinid waters. The Directive will be repealed in 2013 by the EC Water Framework Directive.
UK	
The Conservation of Habitats and Species Regulations (The Habitats Regulations) 2010	The Conservation of Habitats and Species Regulations (The Habitats Regulations) transposes the Habitats Directive and Bern Convention into national legislation. The Regulations provide for the designation and protection of 'European sites', and species, and the adaptation of planning and other controls for the protection of European Sites (i.e. SACs). The River Ehen has been designated as a Special Area of Conservation (SAC) for FWPM predominantly but also the Atlantic salmon under these Regulations. Conservation objectives have been established for the River Ehen by Natural England (see Section 3.4).
Natural Environment and Rural Communities Act (NERC) 2006	FWPM is listed as a species of principal importance for the purpose of conserving biodiversity and therefore needs to be taken into consideration by a public body when performing any of its functions with a view to conserving biodiversity.
The Wildlife and Countryside Act (WCA) 1981	The River Ehen (Ennerdale Water to Keekle Confluence) was designated as a Special Site of Scientific Interest (SSSI) in 1997 for its FWPM population. The SSSI covers 13.5 km of the main river divided into 2 units: Upstream of Ennerdale Bridge (Unit 1) and downstream of Ennerdale Bridge (Unit 2). FWPM is listed in Schedule 5, 'Animals which are protected'. The Act makes it an offence to intentionally kill, injure or take any wild animal listed on Schedule 5, and prohibits interference with places used for shelter or protection, or intentionally disturbing animals occupying such places. Ennerdale Water is also designated as a SSSI (1965, 1984) for its nutrient poor status, macrophyte community and rare fish.
Salmon and Freshwater Fisheries Act (SAFFA) 1975	SAFFA is aimed at the protection of freshwater fish, with a particularly strong focus on salmon and trout. There are many activities that could constitute an offence under SAFFA including direct mortality, barriers to migration and degradation of habitats. Fish passage is also a major issue. In the future, it is likely that fish passage facilities will need to be designed to accommodate all fish species and life stages, with nature-like bypass channels being the most appropriate solution currently available.
Policy/Plans	
UK Biodiversity Action Plan (BAP), 1994.	FWPM is listed as a priority species for conservation action. However, please note: the ' UK Post-2010 Biodiversity Framework ' succeeds the UK BAP, but existing data on FWPM still applies and available on this link http://jncc.defra.gov.uk/speciespages/437.pdf .
North West River Basin Management Plan (WFD)	River Basin Management plans have been produced as a requirement of the Water Framework Directive. It outlines the pressures facing the water environment in this river basin district, and the actions that will address them. The overall status (in 2009) of the Upper Ehen is 'Moderate'. The waterbody is classified as a heavily modified water body on the basis of the abstraction from Ennerdale Water with the target of reaching good ecological potential by 2027. However the presence of the River Ehen SAC within the waterbody is given protected area status and favourable condition must be reached. The overall status of the Lower Ehen waterbody is 'Good' and should be maintained at that for 2015. http://www.environment-agency.gov.uk/research/planning/124837.aspx
Catchment Sensitive Farming – River Ehen and Keekle	The West Cumbrian Rivers, Ehen and Keekle have been included in the Catchment Sensitive Farming project (CSF), Phase 3 (2011-2014) one reason being to improve the failing SSSI status of the Upper Ehen, where nutrient input is detrimentally affecting the freshwater pearl mussel population. Objectives and delivery is provided in the, 'Natural England Catchment Summary for the Ehen Keekle Catchment in the North West River Basin District'. http://publications.naturalengland.org.uk/publication/11232289?category=7721026

2.3 Importance of FWPM

There are several reasons why FWPM is considered so important as to be afforded the level of legal protection detailed in the table above, some of which include the following:

- The FWPM is one of the longest-lived invertebrates known, the mollusc family have been in existence for the past 65 million years and FWPM individuals can live for well over 100 years. They are an iconic species.
- The designation of SAC/SSSI demonstrates the European and UK commitment to the protection of the FWPM.
- They are an indicator of excellent water quality as they require clean, well oxygenated water for their survival i.e. oligotrophic conditions⁶ (high status).
- The mussels themselves help to maintain good water quality as they filter several litres of water individually daily and also help maintain suitable environmental conditions for other species, such as, salmon and trout.
- Healthy, pristine rivers and lakes are essential for health, recreation and the local economy e.g. the lakes and rivers of Cumbria attract millions of tourists every year (recent surveys indicate 15.8 million!⁷).
- The FWPM is dependent on fish as part of their lifecycle; therefore, measures to protect mussels will also benefit fish populations.

Protecting the FWPM is dependent on the well-being of the whole river and catchment and the inherent value of nature and natural systems. By protecting the mussel, conditions of the river habitat will be improved and will secure a healthy freshwater ecosystem essential for our well-being.

2.4 Importance of River Ehen

The River Ehen supports the largest viable population of FWPM left in England, estimated at approximately 550,000 individuals (Killeen and Moorkens, 2013). It is the third largest population in GB. This led to the Ehen being designated as SAC and SSSI with FWPM as the qualifying feature.

Surveys indicate that juvenile mussels are present but they are rare and not enough are surviving to offset mortality. The population is therefore ageing and declining and urgent action is required to prevent extinction of this critically endangered population.

As GB contains a significant quantity of the known breeding populations of FWPM in Europe, the PiP Project has significant implications for the whole of the EU. Without this project, it is likely that FWPM populations in GB will continue to decline with possible extinction in many rivers. Given the importance of the British populations in a European and global context, loss of their loss would have a catastrophic impact on the overall survival of the FWPM in Europe.

⁶ Oligotrophic – lacking in nutrients and plant life and rich in dissolved oxygen

⁷ LDNP website

2.5 Reasons for Decline

As already mentioned, FWPM requires stable cobble and gravel substrates. Adult mussels are two-thirds buried and juveniles, up to five years old, are totally buried within the substrate. They require water that is high quality, clean, oligotrophic, fast-flowing, well oxygenated and without unnatural levels of silt, algae or plant life e.g. macrophytes. In addition, the presence of sufficient salmonid fish to carry the larval glochidial stage of the FWPM life cycle is essential.

It is thought that the decline in the population on the River Ehen has been occurring since the 1970's at least with a 40 year gap in sufficient levels of recruitment to offset the losses (G Butterill pers comm, 15 Aug 2013).

The possible issues affecting these requirements on the River Ehen include (using the WFD pressure groupings):

- Land use change within the catchment: afforestation followed by deforestation; intensification of agriculture; intensive sheep grazing; mining; quarries; road usage; extensive land drainage; and loss of floodplain and riparian/ghyll woodland, all of which will have contributed to changes in the hydrological regime as well as the water quality and habitat quality.
- Developments – Sellafield; housing; numerous mills with associated weirs; mining for coal (lower catchment downstream of SAC) and for limestone; water abstraction associated infrastructure; roads and bridges; and flood defences e.g. Cleator Moor.
- Point source pollution from sewage treatment works, private septic tanks, quarries, poor farm infrastructure (e.g. direct run-off from tracks, stock feeders), land drains and trade discharges.
- Diffuse pollution, namely sediment and nutrients from surrounding land (dominated by agriculture and, forestry). This affects water quality, turbidity, bed particle size and structure, interstitial/substrate dissolved oxygen concentrations and provide potential pathways for toxic contaminants to enter the watercourse such as sheep dips, oils and road drainage runoff.
- Direct damage to river habitat due to sediment introduction, stock trampling, weir construction, machine access and fallen trees (not all fallen trees are a problem and deadwood is essential in a well-functioning river where this is not having a direct impact on FWPM, see Appendix D for Environment Agency policy on deadwood). Eroding riverbanks, although a natural process can also be exacerbated by lack of vegetation cover and grazing by stock, in addition, direct access of grazing animals to the river can lead to further stock poaching and nutrient enrichment.

- Flow regime – the River Ehen has been subject to abstraction for public water supply from Ennerdale Lake since the late 1800's, resulting in a modified “unnatural” flow regime. Droughts and floods have led to mussels becoming stressed, dislodged from the riverbed and in extreme events like November 2009, washed up onto the banks in their hundreds; climate change scenarios suggest that in the future rainfall will become increasingly unpredictable and summer droughts may be more frequent and prolonged. Land use changes have also altered the catchments natural hydrological regime. Resilience to cope with future changes has been reduced with the loss of floodplain wetlands.
- In stream and bank engineering works impact on the natural flow regime and sediment transport of a river and can result in instability, erosion or scouring of the riverbeds and banks. There are several sections of historic bank protection on the River Ehen in varying condition.
- Gravel extraction can remove valuable habitat for the mussels, affect the natural flow of the river and release fine sediment downstream smothering mussels, their habitat and salmonid spawning habitat.
- Barriers to fish migration (e.g. Ennerdale Water weir and Egremont Mill dam (downstream of the SAC)) can affect the numbers and health of host salmon reaching the areas where the mussels are; the conditions for host salmon and their redds⁸ is also important in the conservation of the FWPM.
- Reduction of fish numbers due to a variety of possible reasons (e.g. mortality at sea, sea lice, commercial fishing at sea, predation and angling catch and release rates).
- Illegal fishing of both salmon and FWPM.
- Non-native invasive plants such as Himalayan Balsam and Japanese Knotweed overcrowd native species and when they die in winter leave exposed banks in the winter and resultant increase in bank erosion and sediment input, degrading the riverbed conditions (localised issue on the River Ehen).
- Physical works on the tributaries release silts/pollutants downstream into the River Ehen e.g. limestone quarrying, housing/farm developments.
- Climate change causing an increase in the frequency of large geomorphological floods, which has the potential to exacerbate bank erosion, slips, scour of substrate containing juvenile FWPM and salmon redds. In addition, low flow impacts, such as, extended periods of low flow reducing the width of the wetted channel (results in temporary habitat loss for FWPM) and introducing potential changes to the thermal regime.
- Recreation and ease of access to River Ehen creates additional direct damage from disturbance, bank erosion and trampling. Bleach Green car park lies adjacent to the Ehen on its south bank. During warm summer periods, the car park is popular with visitors wanting to access the river and lake for paddling, swimming and using canoes/inflatables.

⁸ a hollow in sand or gravel on a river bed, scooped out as a spawning place by salmon, trout, or other fish

Ennerdale Scout Camp owns the land on the north side of the Ehen (below the weir). The Scout Camp is working with various partners to support preventative measures to access this part of the river from their land.

This project will be used to implement a range of actions to investigate and address these issues, some of which are known and some are potential and requiring further investigation, with the aim to restore and secure the River Ehen FWPM population.

The project will facilitate the restoration of natural habitat and will include working with landowners and managers to implement land management regimes for the benefit of FWPM through agri-environment schemes, the stabilisation of riverbanks where appropriate, the planting of riparian woodlands, floodplain/wetland restoration and creation. In addition to habitat management, a programme to encyst⁹ the resident wild salmon population with glochidia will be undertaken along with a programme of awareness raising, education and dissemination activities (see Appendix A for detailed action plan).

Discussions will be held with all interested parties, i.e. landowners, Angling Associations, Statutory Bodies etc. before any physical works are undertaken to ensure everyone is in agreement and the necessary consents are in place.

In addition to the PiP Project, several other organisations continue to undertake environmental monitoring protection and enhancement projects to support the future of the FWPM and these are summarised in Section 3.6.

⁹ encystment already naturally occurs on the River Ehen, but juvenile mussel survival rates are low so once habitat is suitable for juvenile mussels, survival bankside encystment will be used to enhance the natural levels of encystment.

3. EHEN CATCHMENT

3.1 Overview

The River Ehen is situated in West Cumbria on the western edge of the Lake District National Park (Map 1). The upper catchment comprises the River Liza and Ennerdale Water; the lower catchment, the River Ehen itself as it flows westward to the Irish Sea. The total catchment area is 168 km² (Map 2).

The catchment is L-shaped with the River Ehen flowing through a narrow U-shaped glacial valley as it flows westward. The upper catchment is typical of Lakeland with steep valley sides used for forestry and agricultural purposes, mainly sheep grazing and rearing. At Cleator Moor, the catchment becomes more populated with industry centred on villages and towns such as Frizington, Cleator Moor and Egremont. The flood plains are restricted to the narrow valley bottoms where the principal land use remains agricultural¹⁰.

The upper catchment, is in the most rugged and mountainous part of the Lake District. The rocks of the Borrowdale Volcanics and the Skiddaw Slates have been sculpted and shaped by the last glaciation into a landscape of U shaped valleys, steep-sided mountains, corries and tarns. The area supports a rich variety of upland habitats both above and below the limit of tree growth.

The highest mountain summits support some of the only remnants of montane moss and lichen heaths found in England and are part of the Lake District High Fells SAC. Below these areas are cliffs, screes and rocky habitats; where these are inaccessible to grazing sheep they are some of the least modified habitats in the area. Springs and flushes emerge here and they support diverse arctic-alpine plant communities. Steep sided ghylls link the two zones above and below the tree line. The lower slopes of the open fell support heather moors, acidic grasslands with areas of bracken and blanket bogs. These vegetation communities have been strongly influenced by grazing stock. High altitude woodland is scarce but valley and slope plantation woodlands are a major feature in Ennerdale. (Natural England Natural Area profiles).

The lower catchment, as the river flows westwards is encroached by the Carboniferous Limestone series to the north eventually cutting into these strata on the coastal plain (Oliver & Killeen, 1997).

3.2 The River Ehen

The River Ehen headwaters flow from Great Gabel and Kirk Fell (elevation of 899 m) to form the River Liza which drains into Ennerdale Water. The River Ehen forms the outlet of the lake, flowing west through Ennerdale Bridge village where it is joined by Croasdale Beck (flowing from Banna Fell). The Ehen continues past Cleator Moor and Cleator, where it is joined by the River Keekle, before moving southwards through Egremont and eventually running parallel to the Irish Sea which it joins at Sellafield at the same point as the River Calder.

For much of its upper length the River Ehen is classed as an oligotrophic river flowing in a natural channel over bryophyte-dominated substrates of gravel, pebbles and cobbles.

¹⁰ River Ehen and Calder Sub Catchment Management Plan Consultation Report September 1993

Geology and soils

Above Ennerdale Bridge, the catchment is largely composed of acidic rocks of the Borrowdale Series and Skiddaw Slates. Downstream from Ennerdale Bridge the river is slightly enriched by streams flowing from Limestones and Millstone Grits of the Carboniferous Series.

The change from acidic to more alkaline conditions is considered to be the reason for the genetic variation identified in FWPM in the River Ehen. Those in the alkaline conditions tend to grow more quickly and have shorter lifespans than those in the more acidic environment (Killeen, 1996, 2006). There is genetic variation in north and south of England (Cauwelier, et al, 2009).

The majority of the Ehen SAC/SSSI catchment is underlain by slow permeable, seasonally wet, basic loams and clay soils with moderate fertility (<http://www.landis.org.uk/soilscapes/>).

Habitats description

Ennerdale boasts a wide variety of vegetation types which reflect the range in altitude, from 328 feet (100m) beside the lake to nearly 3000 feet (900m) on the mountain summits. Habitats range from the agricultural land and riparian zones of the valley bottom, through the coniferous and broadleaf woodland of the lower and middle slopes, to the heather moorland and rock of the upper slopes. The highest ridges and summits are characterised by a low growing montane heath. A number of designated sites exist in the valley, representing areas of value for nature conservation, geology and archaeology. These sites are designated for their regional, national or international importance (see Section 3.3 for further details) (Wild Ennerdale, Stewardship Plan, 2006)

Ennerdale Water (fed by the River Liza and numerous mountain becks) is a natural lake created as a result of glaciation; it is 4 km long by 1.6 km wide and 44 m at its deepest point. Surrounding the lake is pastoral farmland and buildings, together with a mix of conifer and broadleaf woodland (Wild Ennerdale, Stewardship Plan 2006). Ennerdale Water is designated as a SSSI as it is an important example of a nutrient-poor lake and in Cumbria it is second only to Wastwater SAC for its low productivity. It is relatively undisturbed and supports a characteristic freshwater flora and fauna which include examples of nationally rare and local species such as the rare arctic char *Salvelinus alpinus* (Natural England, SSSI citation).

Geomorphology

The geomorphic character of river channels is a product of the interaction of channel gradient, discharge and sediment supply. The River Ehen has been subject to a number of Fluvial Audits firstly by Malcolm Newsum in the 1980's then by Gibbons et al from Aberdeen University in 2006 and Atkins in 2012.

The planform of the Ehen is single channelled, with a moderate sinuosity, though a few tight bends are present. The gradient along the SAC (to the confluence with the Keekle) is fairly constant (Gibbons et al., 2006). This can be reflected in the low variation in geomorphic units observed throughout the reach. Gibbons et al. (2006) describe the river as mostly pool-riffle, with sections that are transitional between pool-riffle and the plane bed river type. Units include pools, riffles, glides and runs with lateral and point bars present. Mid-channel features such as bars and islands are present although relatively rare. The influence of weirs causing zones of ponding was also noted as a dominant feature.

Bed material is mostly within the gravel to cobble size range. Gibbons et al. (2006) sampled at six sites between Ennerdale Bridge and High Waterside, finding that the median particle size ranged from 26-67 mm, covering the range from coarse gravel to cobble. The highest mussel densities have been linked to the areas of cobble, where the bed is more static. Due to the low sediment supply and dampened flood regime from the lake, the bed of the river exhibits signs of stability.¹¹

Hydrology

There are several tributaries of the River Ehen, those which discharge within the SAC boundary include: Croasdale Beck; Rowland Beck; Banly Ghyll; Red Beck; Hole Beck; Mere Beck; and Roughton Beck.

Ennerdale Water exerts an important influence on the downstream hydrological character of the River Ehen. It is also the main drinking water supply for communities in West Cumbria (Whitehaven, Arlecdon, St Bees, Frizington, Salterbeck, Egremont, Cleator Moor, Beckermeth, Ravenglass and Bootle). The retained water level of this lake has been increased (by approximately 1 m) by the creation of a weir at the outlet, and United Utilities (UU) has a licence to abstract water from this source. Under the current abstraction licence and operating agreement, UU is able to abstract water from the lake down to 1.7 m below weir crest whilst providing a compensation flow to the River Ehen; to draw the lake down below 1.35 m requires a drought permit/order to be in place. Under the current agreement, the minimum compensation flow requirement is 80 Ml/d phased down to 60 Ml/d, depending on lake level. (Options for serving West Cumbria water supply in the long term is currently (2013) undergoing public consultation).

The influence of the abstraction from Ennerdale Water on the River Ehen is greatest at low flows; during flood conditions the weir and the abstraction have little impact on the flow and any geomorphic/ecological response. The lake naturally reduces peak flows and attenuates storm flows.

Since the 1970's, Ben Ghyll was diverted into the lake for abstraction. The UU Ben Ghyll abstraction licence will be revoked by March 2015, and the natural flow and sediment supply from Ben Ghyll will be restored back to the main River Ehen downstream of the lake outfall by UU in agreement with the EA, NE, LDNP and Cumbria County Council.

In addition to river flows being affected by the listed tributaries, precipitation, land drainage, loss of floodplain wetlands, artificial weirs, water abstractions and the compensation flow from Ennerdale Water also affect the hydrological regime of the River Ehen. Understanding the effects on the mussel population and their habitat is complex and is the subject of separate work by the EA and UU with NE (see Appendices E and F).

In addition, there are several consented discharges in the catchment (there are currently seven discharging into the River Ehen), see Map 7.

¹¹ This section was provided by the EA

3.3 Designations

There are numerous European and national designations in the Ehen catchment which are summarised here and shown on Map 2.

Special Areas of Conservation (SAC)

There are two SACs in the River Ehen catchment:

1. River Ehen SAC, designated for FWPM and Atlantic salmon - 24.39 ha.
Citation - <http://jncc.defra.gov.uk/protectedsites/sacselection/n2kforms/UK0030057.pdf>
2. Lake District High Fells SAC, designated for several vegetation types - 26999.36 ha
Citation - <http://jncc.defra.gov.uk/protectedsites/sacselection/n2kforms/UK0012960.pdf>

Sites of Special Scientific Interest (SSSIs)

River Ehen (Ennerdale Water to Keekle Confluence) SSSI, designated for FWPM – 23 ha

Citation - http://www.sssi.naturalengland.org.uk/citation/citation_photo/2000147.pdf

Operations Likely to Damage:

<http://www.sssi.naturalengland.org.uk/special/sssi/old/OLD2000147.pdf>

The SSSI has been divided into two units; Unit 1 is upstream of Ennerdale Bridge and Unit 2 is downstream of the Bridge.

The SSSI has been assessed by Natural England as being in unfavourable declining condition (date of last assessment June and August 2012). This has been attributed to an unfavourable flow regime, riverbed gravel sedimentation and agricultural and urban point and diffuse pollution (Natural England, Draft Diffuse Water Pollution Plan, 2013).

There are other SSSIs in the catchment, including:

- Pillar and Ennerdale Fells - 1498 ha
- Ennerdale SSSI - 425 ha
- Bowness Knott SSSI - 40 ha
- Yeathouse Quarry SSSI - 5.29 ha

National Park

The River Ehen SAC/SSSI is partially situated within the Lake District National Park and also within the Lake District Environmentally Sensitive Area (ESA)¹². The ESA scheme has now closed to new applicants and has been superseded by the Environmental Stewardship Scheme. Some existing agreements will continue until 2014.

<http://www.naturalengland.org.uk/ourwork/farming/funding/closedchemes/esa/lakedistrict.aspx>

¹² a type of designation for an agricultural area which needs special protection because of its landscape, wildlife or historical value

National Nature Reserve

High Leys, National Nature Reserve near Rowrah represents one of the best species rich Hay Meadow sites in Cumbria. The entire site covers a total of 8.83 hectares, with 3.9 hectares of this being referred to as a traditional hay meadow. The remaining areas of the site also offer a rare and floristically interesting experience in wetter grassland and mire communities. The Reserve is actually within the Derwent catchment but on the border with the Ehen catchment.

National Character Area

The River Ehen falls within the National Character Area – Cumbria High Fells (upstream of Ennerdale Bridge) and within the West Cumbria Coastal Plan (downstream of the Bridge)¹³. Character areas are defined by a unique combination of landscape, biodiversity, geodiversity and cultural and economic activity. They identify potential opportunities for positive environmental change and provide the best available information and evidence as a context for local decision making and action.

Cultural and Archaeology

The Wild Ennerdale website contains extensive information on the cultural and archaeological importance of Ennerdale (<http://www.wildennerdale.co.uk/archeology.html>).

Ennerdale contains a remarkable survival of settlement and industrial remains that extend back to at least the Bronze Age. In particular, its medieval remains are very well preserved and the valley as a whole is considered of exceptional importance (North West Upland Farming). Over five hundred individual archaeological sites have been recorded through survey work, many of which are of regional and national importance. Importantly, Ennerdale is home to the most impressive collection of valley bottom Bronze Age (2000 BC to 800 BC) and Non Monastic mediaeval (AD 410 to AD 1600) Archaeology in the Lake District, and one of the most important in England (Wild Ennerdale).

There are a collection of Scheduled Monuments and Listed Buildings in the area see Map 3. Both LDNP and Cumbria County Council will be consulted when any works are proposed on the riverbank.

Less Favoured Area

Much of Ehen catchment is classed as 'severely disadvantaged' and 'small area of disadvantaged' under the Uplands and Less Favoured Area Classification (Defra). Less Favoured Areas were established as a means for providing aid specifically to the socially and economically disadvantaged areas in the UK uplands. The River Ehen and River Keekle catchments are within the West Cumbrian Catchment Sensitive Farming Priority Catchments.

¹³ http://www.naturalengland.org.uk/publications/nca/west_cumbria_coastal_plain.aspx
<http://publications.naturalengland.org.uk/publication/2229157?category=587130>

Tree Preservation Orders

There are only two Tree Preservation Orders within the catchment boundary, but the only relevant one to consider when undertaking works is 104 which is a strip of woodland along Croasdale Beck by Ennerdale Bridge (Map 4).

Protected Habitats and Species

There are several habitats listed under UK Biodiversity Action Plan (UK BAP) for the Ennerdale area, including lowland dry acid grassland, lowland and upland heathland, blanket bog, fens, ancient woodland and deciduous woodland (Magic website). However, please note: the '[UK Post-2010 Biodiversity Framework](#)' succeeds the UK BAP and 'Conserving Biodiversity – the UK Approach', but existing data on FWPM still applies and is available on this link <http://jncc.defra.gov.uk/speciespages/437.pdf>.

The National Biodiversity Network (NBN) provides detailed information of all the species recorded on the River Ehen and within its catchment. Links are provided below, and include, in addition to FWPM and Atlantic salmon, red squirrels, bats, badgers, lamprey, slow worms, orchids and many other species.

- Species records at 10 km or better that fall within or overlap River Ehen (SAC) <http://data.nbn.org.uk/siteInfo/siteSpeciesGroups.jsp?useIntersects=1&engOrd=false&allDs=1&maxRes=1&siteKey=77009>
- Species records at 10 km or better that fall within or overlap River Ehen (Ennerdale Water To Keekle Confluence) (SSSI) <http://data.nbn.org.uk/siteInfo/siteSpeciesGroups.jsp>

3.4 River Ehen Conservation Objectives

Table 2 provides details of the SAC, SSSI, WFD and PiP conservation objectives and targets. These objectives will be supported in the delivery PiP conservation actions.

Table 2: Summary of River Ehen Conservation Objectives

Designation/ Project	Objectives/Targets
SAC	1. Avoid the deterioration of the qualifying species, and the significant disturbance of those qualifying species, ensuring the integrity of the site is maintained and the site makes a full contribution to achieving Favourable Conservation Status of each of the qualifying features.
	2. Subject to natural change, to maintain or restore: <ul style="list-style-type: none"> • The extent and distribution of the habitat of the qualifying species; • The structure and function (including typical species) of qualifying natural habitats and habitats of qualifying species; • The supporting processes on which qualifying natural habitats and habitats of qualifying species rely; • The populations of qualifying species; • The distribution of qualifying species within the site

Designation/ Project	Objectives/Targets
SSSI (NE Draft DWP 2013)	1. To maintain/restore the condition of the habitat / species for which a SSSI is designated, in this instance the FWPM.
	2. Phosphate - Favourable Condition Targets: Water quality – Orthophosphate Annual mean: ≤ 0.005 mg/l.
	3. Suspended solids - Favourable Condition Targets: Water quality – annual mean <10 mg/l. To have no unnaturally high loads of suspended solids in the watercourse. (Note: Suspended solids are routinely monitored by the EA but annual averages are misleading, spikes in suspended solids are more of a problem for the River Ehen as the natural background levels are so low.)
	4. Siltation - Favourable Condition Targets: Substrate – no excessive siltation. Channels should contain characteristic ranges of substrate types for unmodified rivers. Mean redox potential of <20% reduction at a depth of 5cm in the summer within mussel beds – for juvenile mussel survival.
	5. GQA Biology / Chemistry - Favourable Condition Targets: Water quality - <ul style="list-style-type: none"> • Chemical: • Dissolved oxygen (DO): >85% sat, 90%ile • Biochemical Oxygen Demand (BOD): <1.5 mgl-1 as an annual mean • Total ammonia: <0.25 mgl-1, 90%ile • Conductivity: <100µ/cm • PH: 6.85 – 8.5 • Un-ionised ammonia: <0.025 mgl-1 (as a 95-percentile NH3-N) • Biological (Environmental Quality Index (EQI) /Environmental Quality Ratios (EQRs)): <ul style="list-style-type: none"> • ASPT EQI/EQR score of 1.0 /0.97 • NTAXA EQI/EQR score of 1.0/0.97
	6. Macrophytes and Negative Indicators - Favourable Condition Targets: Filamentous algae: cover values >5% (over mussel beds) should be considered unfavourable, and should trigger further investigation. Filamentous algae, if present, should be wispy and ephemeral and never form mats over mussel beds.
	7. Flow regime - CSM/Favourable condition: Habitat functioning: water flow – as a general guide for SAC rivers, there are set levels of abstraction, however, these generic guidelines have been further refined for the River Ehen through the work carried out by the EA for the Review of Consents under the Habitats Regulations. This review of the public water supply abstraction regime at Ennerdale (including weir, lake storage and compensation flow) will implement licence changes from 2015 onwards and secure a flow regime for the river that does not damage site integrity and protects the specific needs and sensitivities of the FWPM populations.
	8. River morphology - Favourable Condition Targets: Maintain the characteristic physical features of the river channel, banks and riparian zone: clean, coarse sand is required in stable conditions. Presence of overhanging vegetation, and no decrease of current extent.
	9. Indicators of local distinctiveness - Favourable Condition Targets: Otter – ensure that populations are maintained or enhanced. Lamprey – ensure that populations are maintained or enhanced.

Designation/ Project	Objectives/Targets
WFD	<p>Under the WFD, the overall status of the Upper Ehen water body is 'Moderate' and should be at good ecological potential by 2027. The overall status of the Lower Ehen water body is 'Good' and should be maintained at that for 2015. The SAC designation requires that stringent conservation objectives are met to maintain a recruiting population of FWPM and that the WFD target should be 'High' rather than good. (Natural England Draft Diffuse Water Pollution Plan 2012).</p> <p>Refer to the North West River Basin Management plan that outlines the pressures facing the water environment in this river basin district, and the actions that will address them. http://www.environment-agency.gov.uk/research/planning/124837.aspx</p> <p>The attached link provides detail of current and target conditions: http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/genw0910bsri-e-e.pdf</p> <p>Mitigation measures that have defined Ecological Potential:</p> <ul style="list-style-type: none"> • Ensure that the thermal regime in waters downstream of the impounding works is consistent with good status conditions; • Ensure that good status of dissolved oxygen levels is being achieved downstream of the impounding works; • Provide flows to move sediment downstream; • Ensure there is an appropriate baseline flow regime downstream of the impoundment; • Maintain sediment management regime to avoid degradation of the natural habitat characteristics of the downstream river; • Re-engineering of the river where the flow regime cannot be modified
PiP Project	<ol style="list-style-type: none"> 1. To RESTORE the habitat of FWPM and salmonids in selected river catchments within Great Britain. 2. To SECURE the long-term survival of existing FWPM populations and prevent their further degradation. 3. To COMMUNICATE with local, national and international audiences to raise awareness of FWPM conservation issues.

3.5 Land use and ownership

There is evidence that historically, the Cumbrian Fells were mostly forested. In the post medieval period there was an increase of agricultural land use in the area in addition to mineral extraction and processing and limestone quarrying.

Currently, the land use within the catchment area includes commercial forestry (planting began in Ennerdale in 1925, and continued through the 20th Century (Wild Ennerdale, Stewardship Plan 2006)), a mix of upland and lowland agriculture, the provision of public water supply from Ennerdale Water since the late 1800's, and a range of villages and settlements.

As already mentioned, the upper catchment is predominantly used for rough sheep grazing whilst the lower catchment includes areas of more intensive sheep, cattle and horse grazing with localised arable fields and some industrial development including, limestone quarrying at Eskett Quarry near Frizington.

The SAC/SSSI catchment is approximately 90% rural with the dominant land use being rough sheep grazing.

Cleator Moor is the largest urban area with a population of approximately 7,000 with the only other notable area being Frizington which houses a population of around 3,500. There are also several small hamlets and isolated dwellings including farms, youth hostels and brewery. (Natural England, Draft Diffuse Water Pollution Plan, 2012).

There is a range of recreational activities within the catchment. There are very few Public Rights of Way along the River, the majority of which is privately owned. The Wild Ennerdale Partnership identifies the areas to experience a range of activities mostly in the upper catchment and includes: walking, biking, climbing, riding and canoeing¹⁴.

Wath Brow and Ennerdale Angling Association¹⁵ own/manage fishing on the upper half of the River Ehen for sea trout and salmon together with fishing for wild brown trout on Ennerdale Water and provide a range of fishing permits. There is currently no byelaw in place restricting the number of fish that anglers can take from the River Ehen¹⁶. Egremont Anglers Association manages the lower half of the Ehen from 1 km downstream of the River Keekle to the sea.

Ennerdale Scout Camp¹⁷ offers camping and accommodation and a range of activities, such as canoeing on certain parts of the Lake, orienteering, climbing etc.

The upper catchment (upstream of Ennerdale Bridge) is primarily owned by the Forestry Commission, National Trust, and United Utilities. The three organisations have formed a partnership, Wild Ennerdale, and operate within the Wild Ennerdale boundary of 4300 ha (Wild Ennerdale, Stewardship Plan, 2006). See attached link for Wild Ennerdale ownership map (<http://www.wildennerdale.co.uk/stplan/maps/c%20-%20ownership.jpg>)

3.6 Other Projects/Organisations

In addition to the PiP Project, several other organisations are undertaking environmental monitoring and projects to protect and restore the FWPM and general conservation in the catchment. These are briefly outlined here:

Environment Agency

The EA are working closely with WCRT in the delivery of the PiP Project but are also undertaking other environmental monitoring and projects some of which are in direct support of the conservation of the FWPM. Appendix E summarises this work.

¹⁴ www.wildennerdale.co.uk

¹⁵ <http://www.wbeaa.co.uk/>

¹⁶ Adjacent SACs (Eden, Derwent and Kent) have voluntary fish catch and release schemes

¹⁷ <http://ennerdale.cumbriascouts.org.uk>

United Utilities

UU has a licence to abstract water from Ennerdale Water. As already mentioned under Section 3.2, 'Hydrology', under the current abstraction licence and operating agreement, UU is able to abstract water from the lake down to 1.7 m below weir crest; to draw the lake down below this level requires a drought permit/order to be in place.

UU recognise the importance of their legal responsibility to protect the FWPM and as such they have established an extensive monitoring programme and have several projects underway, see Appendix F for a summary of these.

Lake District National Park

The River Ehen only partially falls within the LDNP boundary (see Map 1).

Much of the requirements of the LDNP are delivered through other organisations such as Natural England Environmental Stewardship Schemes, the Wild Ennerdale Partnership and now the PiP Project. LDNP offer direction and advice and the LDNP Volunteers undertake practical works in the catchment helping to deliver important conservation improvements.

Natural England

NE has produced the conservation objectives required to improve the status of the SAC/SSSI from unfavourable declining condition.

NE also provides a range of Environmental Stewardship Schemes and advice to aid local landowners to make changes to their land and management practices which also benefits the environment. These include, Higher Level and Entry Level Stewardship Schemes and Catchment Sensitive Farming. Map 6 outlines the areas that are under the various schemes. There are direct benefits and shared objectives of these schemes with the PiP Project and WCRT will be working with NE in the delivery of these objectives.

A Catchment Sensitive Farming Summary Sheet for the Ehen and Keekle Catchment has been prepared and available on this link:

<http://publications.naturalengland.org.uk/publication/11232289?category=7721026>

Forestry Commission

As part of the Wild Ennerdale Partnership, the FC has developed a management strategy for the area which is under review at time of writing available on this link:

<http://www.wildennerdale.co.uk/stplan/text/16.iii%20forestry.pdf>

As stated in the management strategy, the aim is to create more mixed woodland habitats through native broadleaf planting and thinning/clear felling of monoculture conifer forest. Visually detracting pockets of plantation forest do still exist and will be addressed as Wild Ennerdale evolves in the future.

A series of maps regarding woodland management have been produced in support of the strategy and are available on the Wild Ennerdale Website (links provided here) and are also provided in Appendix G and Map 5.

- Current woodland coverage
<http://www.wildennerdale.co.uk/stplan/maps/n%20-%20current%20woodland.jpg>
- Future clear felling
<http://www.wildennerdale.co.uk/stplan/maps/w%20-%20future%20felling.jpg>
- Future woodland development
<http://www.wildennerdale.co.uk/stplan/maps/x%20-%20future%20woodland.jpg>

Recent changes to forestry practice (e.g. Forest Guidelines for working near water¹⁸) have resulted in tighter controls on site runoff during felling and extraction operations. FC recognises that additional specific guidelines for works that may affect Atlantic salmon and FWPM may be necessary along with increased awareness of working in a sensitive SAC catchment and the need for Appropriate Assessment prior to works.

Wild Ennerdale Partnership

Wild Ennerdale is a partnership of people and organisations led by three main landowners: United Utilities, Forestry Commission and National Trust. Natural England is a fourth partner providing advisory and funding support. The landholding covers 4.300 ha of mountains, forest, open fell, rivers and lake.

The shared Wild Ennerdale vision is:” To allow the evolution of Ennerdale as a wild valley for the benefit of people, relying more on natural processes to shape its landscape and ecology”.
<http://www.wildennerdale.co.uk>

¹⁸ [http://www.forestry.gov.uk/pdf/FCGL007.pdf/\\$FILE/FCGL007.pdf](http://www.forestry.gov.uk/pdf/FCGL007.pdf/$FILE/FCGL007.pdf)

4. CURRENT FWPM STATUS

4.1 Baseline Data

FWPM

Several surveys and reports have been produced regarding FWPM population numbers, age structure, distribution, and encysted glochidia for the River Ehen. A summary is provided below which has been mostly extracted from the following paper, "Killeen, I.J., 2012. Conservation and restoration of a freshwater pearl mussel (*Margaritifera margaritifera*) population in Northern England".

Data has been collected on FWPM intermittently since 1995. FWPM specialists Ian Killeen and Evelyn Moorkens have been commissioned over the years by Environment Agency, English Nature (now Natural England), and United Utilities to undertake survey work for different projects and have acquired a detailed knowledge of the River Ehen FWPM population. Table 3 provides a basic summary of population numbers and age structure for the three overarching surveys undertaken in 1996, 2006 and 2012. Over the years a more rigorous methodology has been developed and therefore, the data in recent years is considered more accurate.

Table 3: Summary of FWPM monitoring

Parameter	1996/7	2006	2012
Population Estimate	300,000+	350,000-500,000	510,000
Age Structure	Evidence of juvenile recruitment	Predominantly an ageing adult population with mussels under 65 mm comprising less than 1.5% of the population and juveniles less than 10 mm long (approx. 4 years old) were rare and found in the most highly oxygenated riffles	The average percentage of juveniles in the populations is 1.035%, one twentieth of the required recruitment levels. (In high gradient riffles percentage of juveniles amounted to 20.7%)

The findings of the 1996/7 survey work led to the River Ehen being selected for SSSI/SAC designation for FWPM.

The findings of the 2006 surveys showed that the river was not in favourable condition as there was insufficient recruitment, resulting in an ageing population which would inevitably lead to extinction unless the trend was reversed.

The findings of 2012 showed that the shift to an ageing senescent population that has been evident since population studies commenced on the River Ehen continues. The vast majority of the habitat where the adult mussels originated can no longer support juvenile recruitment. Upstream of Ennerdale Bridge, the fragmented areas that support juvenile survival make up less than 5% of the overall habitat, downstream of Ennerdale Bridge the area is considerably less. In addition, the results of the monitoring transect mussel counts for 2012 showed a decline with respect to pearl

mussel numbers in the same transects in earlier years. It has been predicted that extinction of the population is still inevitable unless action is taken.

Killeen and Oliver (1997) produced growth curves for mussels at two locations in the river. There were differences in the age/size/growth rate structures between the mussel population upstream of Ennerdale Bridge and that further downstream at Hazel Holme (between Croasdale Beck and Wath Brow). Above Ennerdale Bridge the modal size was 90 mm with an age of 40-50 years but with an age maximum of 100 years. At Hazel Holme the modal size was 115 mm with an age of 30-40 years and a maximum age of only 45 years. This is believed to result from the higher calcium and nutrient levels at the downstream site.

In addition to the above survey work, there is ongoing monitoring at transects in the section above Bleach Green Bridge to support the reconnection of Ben Ghyll to the River Ehen, one of the projects being undertaken by UU and EA.

There is also an ongoing programme of stress testing of the mussels to determine the condition of mussel individuals and to document their recovery or continued decline following a low flow event in 2012. This monitoring is programmed to continue until 2014.

The distribution of the mussels in the River Ehen has been recorded by Ian Killeen and Evelyn Moorkens. This data is sensitive and has not been included with this plan.

FWPM - future monitoring

In addition to the monitoring already underway for FWPM, a monitoring programme will also be established as part of the PiP Project.

Salmonid encystment

The EA has undertaken targeted electrofishing at a number of sites since 2007 to establish host fish preference for FWPM's in the River Ehen, levels and extent of natural encystment (EA reports, 2007-2012). Electrofishing was undertaken by the EA in May 2013, at five sites to monitor juvenile salmonid encysted levels with the glochidia of FWPM. A total of 33 salmon were caught, 24 of which were encysted with glochidia. Two trout were caught but neither was encysted. FWPM in the River Ehen continue to encyst wild salmon as their principal host (Butterill, 2013).

Salmonid encystment - future monitoring

The EA will continue a programme of juvenile salmonid monitoring and encystment monitoring. There will also be additional monitoring undertaken by the PiP Project Officer as part of the PiP Project including redd counts and this data will be shared.

Water Quality

This section has been extracted from, "Killeen, I.J., 2012. Conservation and restoration of a freshwater pearl mussel (*Margaritifera margaritifera*) population in Northern England".

Water quality in the River Ehen is generally very high. There is a long dataset extending back over 15 years of monthly samples collected by the EA at a location within the core area of the mussel population (upstream of Ennerdale Bridge). The level of orthophosphate since 1995 has, on most

sampling dates, been less than 0.005 mg/l with a mean of 0.00195 mg/l. However, there have been a few occasions when the orthophosphate level has exceeded 0.02mg/l – above recommended levels of an annual mean of ≤ 0.005 mg/l. The total oxidised nitrogen levels since 1995 have been relatively stable with the majority of determinations being less than 0.5 mg/l and with a mean of 0.338 mg/l. There have been levels of over 2mg/l recorded but most high values were prior to mid-1998. Similarly levels of BOD and ammonia are all very low. All of the median levels of the critical determinants are in line with those given by Moorkens (2006, 2007) as being required for effectively recruiting populations. In spite of this apparent very high water quality, the river persistently experiences blooms of filamentous algae, particularly in the upper 2 km reaches. During high temperatures and sunlight, with continuous nitrate in the water, any introduction of available phosphorus to the system will be taken up immediately by organic growth. This was leading to continuous growth and decay and chronic filling of interstitial spaces within the gravel substrate. The water quality monitoring was not showing up phosphate elevations during times of filamentous algal growth and in spite of several lines of investigation, attempts to locate the source of the problem proved to very difficult.

In winter 2008/2009, auto-samplers were installed by the EA at two locations in an effort to pinpoint the source of the phosphorous to the river and demonstrate phosphorous levels in the river were elevated on a rising flood. Samples were taken on the rising flood rather than at or after the peak flood as both silt and phosphorus concentrations tend to peak at the start of a flood event. The auto-samplers were triggered by mobile phone when the hydrographs from a nearby gauging station indicated a forthcoming rising flood. Eight samples were then taken at hourly intervals. Results from these trials of the auto-samplers on three flood events showed a similar pattern. For example, at an upstream location the orthophosphate level rose gradually over the eight hour period from 0.003 to 0.006mg/l, whereas the level at a downstream location rose rapidly to 0.035mg/l within 2 hours, and then gradually fell back to 0.005mg/l over the ensuing six hours. This demonstrated that elevated levels of phosphorous enter the river on a rising flood then rapidly fall to low levels.

A total of two automatic turbidity loggers (sondes) from the EA were first installed in the upstream part of the river as part of the mitigation for forestry felling operations in 2007 and subsequently monitored by the FC. The loggers were set to take turbidity and temperature readings at 15 minute intervals. The data gathered showed that there was no significant increase in turbidity between the sondes and that the forestry mitigation measures were successful. The data also revealed that actual levels were very low and higher levels correlated with high rainfall. These turbidity loggers showed that field drains which were open to the river were one of the major sources of silt. They have also been used to identify which field drains (mainly agricultural in this case) were having the greatest silt input.

The EA sonde at Bleach Green has been added to with new sondes at the Oxbow and downstream of Croasdale Beck confluence. Appendix K provides further water quality information provided by the EA and will be used as baseline information to inform future monitoring.

Water quality - future monitoring

As part of the PiP Project a sonde will be installed and data gathered on temperature, conductivity pH, dissolved oxygen, turbidity and nitrate (these parameters and sonde location have yet to be confirmed). The data gathered will be shared and compared with the EA's monitoring of three existing sondes already in the river.

Fisheries data

In terms of fishing interest, the River Ehen is principally a migratory salmonid river, with relatively good catches of both salmon and sea trout in most years. Whilst there is some evidence of a decline in sea trout catches in recent years, salmon catches have tended to increase over the same period. There is also a small population of resident brown trout in the Ehen, while Ennerdale Water and its tributaries contain an important population of brown trout and the most significant extant population of river-spawning Arctic charr in England and Wales. Wath Brow and Ennerdale Angling Association own/manage fishing on the upper half of the river Ehen for sea trout and salmon and provide a range of fishing permits. Egremont Angling Association manages the lower half of the Ehen from 1 km downstream of the River Keekle to the sea.

The EA requires that all salmon and sea trout anglers return detailed records of their rod catches each year. Appendix H includes the rod catch data for both salmon and sea trout from the River Ehen for 2000-2012. This is provided in the context of rivers in the North West Region and for England and Wales. These rod catch data include all rod caught salmon and sea trout caught along with whether or not they were released back into the river.

These catch data indicate that the percentage catch and release of salmon for the River Ehen is relatively poor and quite some way behind the NW region as a whole and nationally. In terms of FWPM (and salmon stocks in general), this low salmon catch and release rate is very concerning and could become a significant factor in the future if salmon numbers start to fall and the numbers of fish released do not improve.

Current status of the salmon stock in the River Ehen

The Ehen Salmon population is currently considered to be “not at risk” now or in five years time, based on an assessment of estimated egg depositions over the last ten years (2003-2012)¹⁹. These data show that the stock as a whole has consistently performed above its Conservation Limit²⁰, and that egg depositions have shown an overall upward trend over this period, as per Figure 1 below.

It should be noted that for the Ehen (and other rivers) that much of this apparent trend is controlled by the comparatively low numbers in 2003 and that once this particular year drops off of this ten-year assessment, the overall trend may be less clear and could even be downwards depending on salmon runs over the next few years.

This method of stock assessment only assesses the salmon population for the catchment as a whole, because rod catch data only allows for this level of assessment. To further our understanding of salmon population health in greater detail, we also use juvenile electrofishing surveys to compare recorded densities of young salmon (and brown/sea trout) against expected densities and to compare areas or tributaries with one another. Although other factors such as

¹⁹ <http://www.cefas.defra.gov.uk/publications/salmon/salmonreport2012.pdf>

²⁰ Conservation Limit is the minimum level of egg deposition that is desirable in a catchment in order to maintain it at a sustainable population (catch) level. This limit is based on an assessment of the naturally available spawning habitat within the Ehen catchment including all relevant tributaries. Annual egg deposition estimates are then calculated from rod catch data each year and compared to this Conservation Limit to determine how healthy the overall population is.

electrofishing efficiency further complicate this work (electrofishing is relatively ineffective in low conductivity streams, and large rivers are notoriously difficult to assess for parr or older fish), these data show that while there are many areas of the catchment that do support healthy salmon stocks, other areas are relatively poor. Poor areas for salmon (and fish in general) include the upper reaches of the mainstem Ehen (downstream of Ennerdale Water) and much of the River Keekle which is in extremely poor condition (Figure 2).²¹

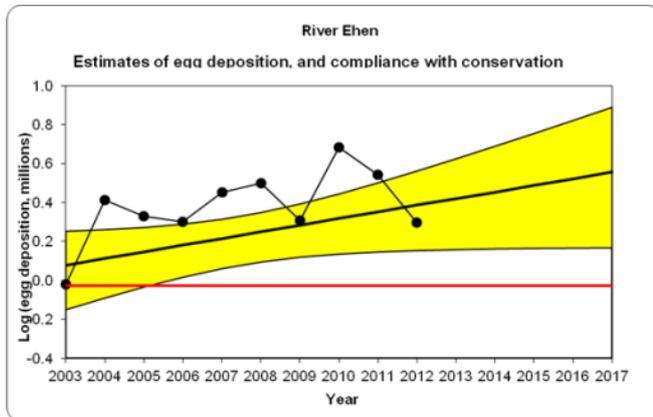


Figure 1: Salmon egg deposition estimates for the River Ehen from 2003 to 2012. The Conservation Limit is presented as a solid red line while the yellow bands represent the confidence levels around future predictions of stock status in relation to this Conservation Limit. Note that egg deposition estimates are presented on a log scale.

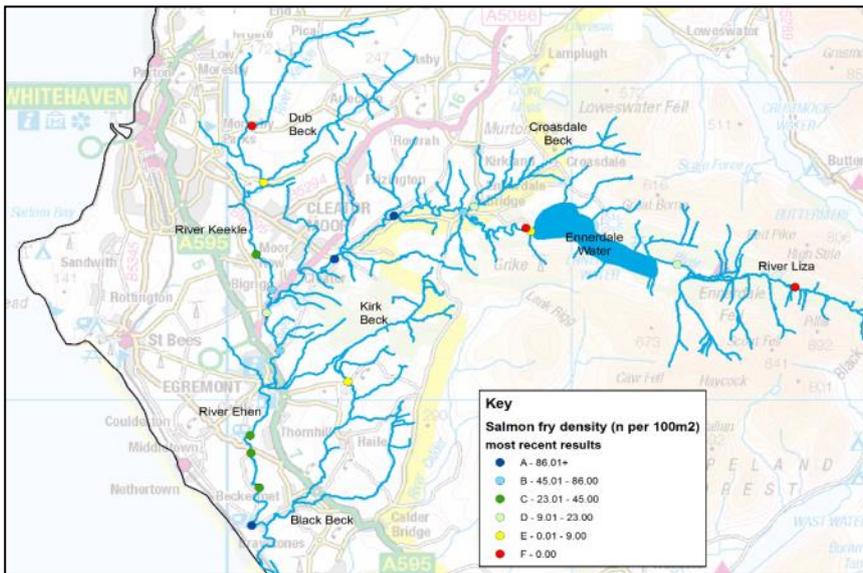


Figure 2: Salmon fry density estimates in the Ehen catchment, expressed as n per 100m². Data presented are for the most recent surveys carried out at each site. Map provided by the Environment Agency. © Crown Copyright and database right 2013. Ordnance Survey licence number 100024198.

To assist the passage of migratory fish over obstacles there are two fish passes in the catchment, one at Ennerdale Lake and one at Egremont Mill Dam. However, they are both not functioning properly and given that salmon are essential to the FWPM lifecycle, these issues should be addressed along with the habitat improvements already mentioned in this document. The actions that will be implemented as part of this project will benefit the salmonid populations and will be monitored as part of the project.

²¹ This section was prepared by the EA

4.2 Current Pressures

Introduction

Current pressures to the River Ehen have been identified by undertaking a desktop study, discussions with landowners and stakeholders, and a walkover of the river (the tributaries are being walked at time of writing) to identify the pressures and to map and prioritise actions. The walkover surveys are attached at Appendix I.

A detailed action plan is provided in Appendix A. A summary of the main pressures and proposals for mitigation are detailed in this section. In determining the actions as part of this management plan, it is recognised that rivers are natural systems and part of the hydrological cycle and where possible should be left to determine their own course therefore 'in river' hard engineering will not be undertaken, soft engineering will be considered at areas of accelerated bank erosion.

In the order followed within The Water Framework Directive (WFD), the pressures identified at the River Ehen are grouped as follows:

- a) point source pollution;
- b) diffuse pollution;
- c) pressures on the quantitative status of water (i.e. flow); and
- d) other impacts on the status of water²².

a) WFD Pressure: Point source pollution

Point source pollution enters a water body at a specific site and is generally readily identified. Potential point sources of pollution include effluent discharges from sewage treatment works, industrial sites, farms and septic tanks. Point source pollution is generally readily prevented since it is possible to identify where it is coming from and, having done so, those responsible for causing the pollution can take preventative measures through immediate remedial action or longer-term investment in treatment and control facilities.²³ The situation can be more complicated when the point discharge is intermittent. This can occur at Combined Sewer Overflows (CSOs) and on farms and may be dependent on the weather conditions and/or management practices.

Point source pollution²⁴ has been identified at various points along the River Ehen as part of the walkover exercise and is summarised in Table 5 and supported by maps (AppendixA1).

²²North West River Basin Management Plan- <http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/genw0910bsrn-e-e.pdf>

²³ <http://www.pik-potsdam.de/news/public-events/archiv/alter-net/former-ss/2007/03-09.2007/straskrbova/literature/Pollutionsourcs-WFD16-0.pdf>

²⁴ A report was prepared by Jacobs for UU regarding point source pollution and will be compared with those identified as part of walkover.

Table 5: Point source pollution at the River Ehen

Pressures/ Threats	Risk	Current status	Action Required
Septic tanks	Discharges from septic tanks affect water quality and biochemical oxygen demand ²⁵ and can result in sewage litter, filamentous algal growth which has negative impact on the FWPM habitat requirements.	There are many septic tanks across the catchment; however, there is currently no register of them. From the PiP walkover surveys, two polluting discharges at two points along the river were identified as being from malfunctioning septic tanks.	Further study is required to identify, assess and register all the septic tanks in the catchment (potential project with NE/EA). The two that have been identified as malfunctioning have been reported to the Environment Agency for action in July 2013. Results from walkover of tributaries will be added if further issues are identified.
Wastewater Treatment Works	Uncontrolled discharges from treatment works could have a negative impact on the FWPM habitat by degrading the water quality and riverbed substrate.	Cleator Wastewater Treatment Works discharges to the River Keekle, a main tributary of the River Ehen just downstream of the SAC boundary. There are also treatment works at Kirkland and Ennerdale Bridge.	UU is preparing for a £5 million upgrade at Cleator Wastewater Treatment Works, which will be fitted with new tanks, pipework, screens and filters.
Combined Sewer Overflow	A combined sewer overflow (CSO) is the discharge of wastewater and storm water from a combined sewer system directly into a river. Risk to FWPM habitat if operating frequently and introducing raw untreated waste and sewage litter.	There are a number of CSOs within the catchment that discharge directly to the River Ehen. Frequency of spill is currently unknown.	Further investigation/ campaign to monitor frequency of discharges of CSO's and sewage litter inputs to establish if there is a problem. (e.g. Bag it & Bin it campaign http://www.water.org.uk/home/resources-and-links/bagandbin)
Consented discharges	EA have reviewed all discharge consents within the SAC catchment, March 2010.	SIMCAT modelling of existing discharges indicate that existing discharges are within Conservation Objectives. All new permissions to be assessed in combination.	EA/NE to review all new discharges against conservation objectives alone and in-combination.
Eskett Limestone Quarry	Discharge from the quarry could affect the river e.g. increasing alkalinity which affects the growth of FWPM, elevated levels of suspended solids. FWPM grow more quickly and have shorter life span in alkaline conditions.	Workings at the quarry are currently on hold. Unknown status of settlement ponds.	Check settlement ponds are functioning properly to ensure no discharge into tributary before any work at quarry commences.

²⁵ Biochemical oxygen demand - The amount of oxygen required by aerobic microorganisms to decompose the organic matter in a sample of water, such as that polluted by sewage. It is used as a measure of the degree of water pollution.

Pressures/Threats	Risk	Current status	Action Required
Fly tipping and inappropriate bank protection	Degradation and loss of FWPM habitat.	There are a number of locations identified on the main River Ehen where fly tipping is occurring and inappropriate/unconsented bank protection measures have been installed Fly tipping is also evident on some tributaries and sites will be documented and reported as the plan develops.	Photograph and map locations and report to EA/NE to consider appropriate actions. Rubbish removal and tree planting options.

b) WFD Pressure: Diffuse water pollution

Diffuse water pollution arises where substances are widely used and dispersed over an area as a result of land-use activities such as urban development, amenity, farming and forestry. These activities may be recent or have been carried out in the past. It is often difficult to identify specific sources of such pollution and therefore take immediate action to prevent it, since prevention often requires major changes to land use and management practices.

Examples of diffuse pollution include the leaching to surface water and groundwater of contaminants from roads, manures, nutrients and pesticides used in agriculture and forestry, and atmospheric deposition of contaminants arising from industry and vehicles.

Natural England has prepared a draft Diffuse Water Pollution Plan (2012) which has been used to inform this section and has been integrated with the PiP Action Plan in Appendix A.

The main sources of diffuse water pollution identified as part of the walkover surveys are summarised in Table 6:

Table 6: Diffuse Pollution at the River Ehen

Pressures/Threats	Risk	Current status	Action Required
Agriculture – Silt	A major issue affecting FWPM habitat is silt entering the watercourse and covering the bed; silt can block the interstitial substrate and prevent the essential oxygen transfer affecting juvenile mussel survival, silt can smother salmon spawning habitat and can provide a suitable substrate for macrophytes to become established.	Land drainage ditches used to drain wet soils carry and deposit silt in the river. There are several land drainage ditches within the catchment.	Potential to grip block and/or plant with reeds/rushes to trap silt before entering the watercourse. In vulnerable areas (i.e. juvenile habitat, block or remove land drains and encourage less intensive land management/rewetting options/floodplain wetland/woodland creation Consider silt traps noting that that silt traps require a lot of maintenance to be continually effective and usually get forgotten about over time or need replacing and should be considered as a last resort and

Pressures/ Threats	Risk	Current status	Action Required
	FWPM need clean, well oxygenated gravel beds to survive; the silt and algae reduce the oxygen levels and covers the gravel.	Stock using the river as a source of drinking water track mud and silt into the water and also de-stabilise river banks causing erosion. There are several areas of stock poaching problems along the river. Farm tracks and stock feeders for overwintering livestock are also a source of silt.	<p>more sustainable sediment control measures would be considered first.</p> <p>Discussions will be required with landowners and Natural England to find an alternative solution to watering stock e.g. a water trough etc. Stocking levels and type and should also be considered along with farm track management.</p>
Agriculture – bank erosion	As above	<p>There is evidence of large eroded areas and landslips that have resulted from flooding, inappropriate land drains, overgrazing, blockages in the river such as fallen trees and lack of tree/vegetation cover. Note: Tributary erosion has been highlighted as an issue with potential Ghyll planting and fencing opportunities which will need further investigations and site visits.</p>	<p>Understanding the cause of the erosion and the potential impacts on the bed and banks downstream will underpin options/solutions at each location.</p> <p>Planting these areas with appropriate tree species. Tree roots bind soil and stabilise river banks, create nutrient soaks and help reduce the amount of pollutants and sediment reaching the water by trapping the particles. Trees cast shade, keeping rivers cool. This reduces the growth of weeds and algae, and also helps increase the amount of oxygen available for FWPM, fish and other wildlife (cooler water can hold more oxygen than warmer water).</p> <p>Fencing out stock will be required to ensure trees survival.</p> <p>Soft engineering can also be used to stabilise banks in conjunction with fencing and tree planting.</p> <p>Introducing wetland habitat will also be considered as part of this project which would help absorb energy from flood events and prevent flooding in more sensitive areas.</p>

Pressures/ Threats	Risk	Current status	Action Required
Agriculture - Nutrients/ chemicals	<p>Nutrient enrichment (e.g. fertiliser run-off, animal excrement at watering areas) increases the potential for algal growth and reduction of interstitial oxygen.</p> <p>Agricultural chemicals (e.g. pesticides, sheep dip, fertiliser application) can be toxic to many species particularly FWPM.</p>	<p>Many of the local landowners are in agri-environment schemes. Sources and pathways not fully understood.</p>	<p>WCRT and Natural England will work closely with landowners to review pesticide, fertilizer, muck spreading and sheep dip usage in the catchment and advise and where possible fund changes in land management activities to restore and protect pearl mussel and salmon habitat.</p> <p>Use the SCIMAP risk tool to identify high risk areas and implement effective buffer strips (10m+) where no direct pathways remain.</p> <p>Increase the uptake of “No input areas” in HLS agreements adjacent to juvenile mussel habitat.</p>
Forestry	<p>Forestry operations have the potential to result in siltation, nutrient enrichment and acidification of the watercourse if not managed in the appropriate way.</p>	<p>As part of the Wild Ennerdale Partnership, the conifer plantations at Ennerdale will be clear-felled and replanted with native woodland species over time.</p> <p>Forest Guidelines for working near water - (http://www.forestry.gov.uk/pdf/FCGL007.pdf/\$FILE/FCGL007.pdf)</p>	<p>This is a very positive action and WCRT will support the Wild Ennerdale Partnership as appropriate in its forestry operations and precaution protocol to assist in reducing any negative impacts to the river. Potential for developing FWPM/Salmon and forestry guidance note. Establish what other FC forest design plans occur within the Ehen SAC catchment and timings. See Appendix G for the clear felling and planting programme for Ennerdale.</p> <p>Investigate if there are any private blocks of forestry within the catchment and advise on best practice and legal requirements.</p>
Road Network	<p>Run-off into the river from the local road network will carry pollutants such as oils and fuels in addition to silt into the watercourse to the detriment of the river.</p>	<p>There is a specific issue at the bridge by Bleach Green Car park which UU have agreed to resolve.</p> <p>It has been observed that the public sometimes wash their cars at Wath Brow Bridge.</p> <p>Damaged road side verges have led to increased silt to the drainage network.</p>	<p>UU to undertake improvements to Bleach Green Bridge drainage system.</p> <p>Further work to determine run-off points /gully network is required and discussion with the Highways Authority on potential solutions including sediment control measures and protection of roadside verges to act as a filters.</p>

Pressures/Threats	Risk	Current status	Action Required
			<p>Discuss car washing with Copeland Borough Council.</p> <p>Consider adopting the EA 'Yellow Fish Scheme' in settlements to limit disposal of pollutants.</p> <p>http://www.environment-agency.gov.uk/homeandleisure/pollution/water/120363.aspx</p>

c) WFD Pressure: Pressures on the Quantitative status of water

WFD have identified abstraction and physical modification as pressures affecting the quantitative status of water. The River Ehen has both of these issues, details of which are provided in Table 7:

Table 7: Quantitative issues on the River Ehen

Pressures/Threats	Risk	Current status	Action Required
Abstraction	Abstraction affects natural the flow of a river system. It has been determined that flow regulation can have negative effects on FWPM. Prolonged low flows can cause stress due to temperature increase, oxygen depletion, concentrated pollutants and reduction of silt transport.	<p>There is ongoing discussion with the Environment Agency and United Utilities as to the appropriate level of abstraction from Ennerdale Lake and the compensation flow to the River Ehen. UU are also considering the future of Ennerdale Water as a drinking water resource and have issued a document regarding future water supply for public consultation at time of writing.</p> <p>Ben Ghyll abstraction licence will be revoked by March 2015 and the flow and sediment regime returned to the River Ehen.</p>	<p>This issue has not been included in the remit of the PiP Project.</p> <p>UU/EA are funding a PhD study to monitor Ben Ghyll restoration. PiP Project and Wild Ennerdale Partnership to be kept updated with progress by UU regarding construction and PhD project.</p>
Morphology – physical modification	The morphology of the river determines the rate of sediment transport through the channel, and erodability of the river bed and banks. All of which can affect the FWPM habitat.	The River Ehen has been artificially widened in the upper reach and has several weirs that affect the natural flow and sediment transfer regime of the river. There are areas of hard revetment to stabilise the river bank in various states. There are several problem trees along the river that have fallen in and are causing ponding, scouring,	<p>UU/EA/private landowners to consider options for weir and hard measures removal.</p> <p>Remove problem fallen trees.</p> <p>Education and awareness as part of the PiP Project.</p>

Pressures/Threats	Risk	Current status	Action Required
		obstruction and impacting the flow and sediment transport.	
Inappropriate tree management (too much and too little)	Loss of important tree cover/shade and in extreme cases bank erosion. Mature trees causing overshadowing and potential to fall in if not managed.	There are a number of locations where inappropriate (excessive and lack) tree management has been undertaken and in some cases whole scale tree removal has occurred resulting in bank erosion.	Identify problem locations; replant vulnerable slopes and riparian strips (wider than single tree lined reaches). Develop guidance for rotational tree management/coppicing where required with NE/FC

d) WFD Pressure: Other impacts on the status of water

The WFD lists numerous other impacts that affect the status of water the most relevant of which are summarised in Table 8:

Table 8: Other pressures on the River Ehen

Pressures/Threats	Risk	Current status	Action Required
Invasive non-native species	There is a threat to FWPM habitat from dense monocultures of plants such as Himalayan balsam and Japanese knotweed. When these species die down in winter, they leave the river banks bare, exposing them to increased soil erosion which affects FWPM habitat as well as potential to affect the oxygen levels in the river if they decay in the river.	There is evidence of non-native invasive species along the river bank.	Further survey is required to map locations of invasive plants. The plants need to be removed - potential to use volunteers in association with WCRT Invasive Species Officer and Wild Ennerdale Partnership.
Biological – Fish	Salmonids are essential to the lifecycle of FWPM. The health and number of host fish to support the lifecycle is essential. There are barriers to fish migration e.g. Ennerdale Water, Egremont Mill Dam, Hartley's Weir, Egremont.		EA/UU/private landowners to consider fish easement actions e.g. removal of fish barriers. (UU to replace Ennerdale Water fish pass by March 2015). Raise awareness of FWPM/SAC/SSSI with Angling Associations. Improve catch and release rates by voluntary agreements or consider requirement for Byelaws. Protect salmon spawning habitat. Juvenile salmonid and redd counts are monitoring requirements under PiP Project.

Pressures/ Threats	Risk	Current status	Action Required
Recreation	<p>Recreational activities such as canoeing and swimming in the river can directly damage FWPM and degrade their habitat.</p> <p>Angling presents a number of potential issues such as - catch and release rates, direct damage to mussel beds from trampling and damage to riverside trees.</p>	<p>There is a range of recreational activities within the catchment.</p> <p>There are some Public Rights of Way along the River which are considered to be an issue particularly at Bleach Green – leading to eroded riverbanks and increased activities in the river itself.</p> <p>Wath Brow and Ennerdale Angling Association own/manage fishing on the upper half of the river Ehen for sea trout and salmon and provide a range of fishing permits. Egremont Anglers Association manages the lower half of the River Ehen from 1 km downstream of the Keekle to the sea.</p> <p>Ennerdale Scout Camp offers camping and accommodation and a range of activities, such as canoeing on certain parts of the Lake, orienteering, climbing etc.</p> <p>Canoeists have been seen using the River Ehen – canoeing is only permitted on Ennerdale Water and not on the River.</p>	<p>The Wild Ennerdale Partnership identifies the areas to experience a range of activities mostly in the upper catchment and includes: walking, biking, climbing, riding and canoeing.</p> <p>Wild Ennerdale are also considering a project to direct people who park at Bleach Green away from the river and to use the track instead which will be of great benefit to the river.</p> <p>The Scout Camp has already been very supportive in changing the location of some activities to protect FWPM.</p> <p>Education and awareness raising is an objective of the PiP Project and there is budget available for signage and publicity. Awareness raising with Angling Assoc. to improve catch and release rates on a voluntary basis.</p> <p>UU are ensuring that their policy across the organisation is that canoeing is only permitted on Ennerdale Water.</p>
Climate Change	<p>There are many potential risks of climate change that will affect FWPM, for example, more extreme weather events, such as, flooding (e.g. flood events of 2005 and 2009), drought and changes in species dynamics as they adapt. Water temperature increases.</p>	<p>The project will deliver benefits for biodiversity and FWPM through improved habitat quality, sustainable flood management e.g. wetland creation where possible, and local scale buffering of climate change effects – further consideration as to where this can be achieved to best effect is required.</p>	<p>A number of actions within this project will assist with the process of adaptation to climate change. In particular, riparian and ghyll tree planting will help to buffer temperature rises and stabilise the riverbanks. The project will also help to improve the resilience of FWPM populations and their habitat by restoring natural processes e.g. sediment transport dynamics, creating floodplain wetlands and woodlands. By restoring natural processes the rivers and the wider catchment will be better able to respond to the extreme weather events that are predicted under several climate change scenarios.</p>

5. ACTION PLAN

5.1 Introduction

The action plan (Appendix A) has been compiled using the data gathered from desktop survey, discussions with landowners and stakeholders, and a walkover of the river undertaken by the PiP Project Officer and the Environment Agency in 2013 (Appendix I). It has been acknowledged that not all of the area has been surveyed at the time of writing and surveys will continue into the winter of 2013. The results of these surveys may influence the priorities currently identified in the action plan; this will need to be reviewed on a quarterly basis and updated as necessary to reflect any changes.

Over the years, a system of sectioning the River Ehen into 22 parts has been adopted, and as a recognised system it has been used in compiling the PiP action plan.

Where possible, each action has been given a priority class, action(s) with funding streams identified and supported by maps (Appendix A1). Some actions will require individual project specifications, particularly those requiring consents.

Two action plans have been produced:

1. An 'overall action plan', which lists all of the pressures/threats currently identified on the river including those that are the responsibility of other organisations e.g. United Utilities, Natural England²⁶.
2. A 'PiP shortlist action plan'. The LIFE Grant Agreement specifies twelve projects to be undertaken to reduce silt/nutrient input to the river. A selection of actions has been extracted from the main action plan for delivery by the PiP project and these will be under constant review during the life of the project.

In addition to the pressures/threats identified from the surveys, the action plans also includes:

- The actions from Natural England's draft Diffuse Water Pollution Plan (2012) - some have been integrated with the actions from the walkover surveys and where this is not the case have been listed separately; and
- The other PiP project actions, e.g. encystment, education and raising awareness – some of these are detailed on separate sheets within the action plan workbook.

Maps

A booklet of maps by section number (1-22) has been produced depicting action number and pressure for both the Overall Action Plan and the PiP Shortlist Action Plan (Appendices A1 and photos A2)

²⁶ PiP Project Officer to recommend prescriptions for riparian habitat improvement covering 10 km along the main River Ehen to Natural England.

5.2 Implementation

The 'overall action plan', has been compiled in an attempt to identify all of the issues including knowledge gaps of the River Ehen SAC. It is envisaged that whilst some of the actions will be delivered by the PiP project other actions will inform work programmes of other organisations, the future management of the river and will support future funding applications.

The focus for the PiP project will be the 'PiP shortlist action plan'. It is the responsibility of WCRT to deliver these actions with the support of other organisations where possible.

6. CONTACTS

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A list of relevant contacts is provided as confidential Appendix J for WCRT use.

7. APPENDICES

- A. Action Plan Workbook (including Overall Action Plan and PiP Action Shortlist)
 - A1. Unit Maps for Overall Action Plan
 - A2. Photos for PiP Action Shortlist
- B. PiP Detailed Project Actions
- C. Pearls in Peril Project Contributors
- D. Environment Agency Woody Debris Policy
- E. Summary of relevant Environment Agency Projects on River Ehen
- F. Summary of relevant United Utilities Projects on the River Ehen
- G. Forestry Clear Felling and Planting Programme
- H. Fisheries Data
- I. River Ehen Site Surveys and Photographs
- J. List of Contacts (confidential Appendix)
- K. Water Quality Data (Environment Agency)

8. MAPS

The following maps provide supporting information to this plan.

Map 1 - Site Location and Boundaries

- Location
- River Ehen Catchment Area
- Lake District National Park Boundary

Map 2 - Designated Sites

- SACs
- SSSIs
- NNRs

Map 3 - Scheduled Monuments and Listed Buildings

Map 4 - Tree Preservation Orders

Map 5 - Forestry

Map 6 - Environmental Stewardship Schemes

Map 7 - Consented Discharges

Map 8 - Obstructions/Weirs

9. GLOSSARY

BAP	Biodiversity Action Plan
CSF	Catchment Sensitive Farming
CSO	Combined Sewer Outflow
EA	Environment Agency
ESA	Environmentally Sensitive Area
FC	Forestry Commission
FWPM	Freshwater Pearl Mussel
LDNP	Lake District National Park
NBN	National Biodiversity Network
PiP	Pearls in Peril
SAC	Special Area of Conservation
SNH	Scottish Natural Heritage
SSSI	Site of Special Scientific Interest
UU	United Utilities
WCRT	West Cumbria Rivers Trust
WFD	Water Framework Directive

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There is a wealth of reference documents, research and reports available for the FWPM, the following list is not exhaustive and will be added to over time (most of this list has been compiled by Natural England).

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