JBA consulting

Blue Corridors: Summative Assessment

Final Report

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Prepared for:
North York Moors National Park Authority

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NORTH YORK MOORS NATIONAL PARK

NORTHERN POWERHOUSE

European Union
European Regional Development Fund

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This report describes work commissioned by the North York Moors National Park Authority, by an instruction dated 15 June 2022. The Client's representative for the contract was Briony Fox, the North York Moors National Park Authority's Director of Conservation and Climate Change. Jenny Broomby and Colette Bowen of JBA Consulting carried out this work.

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JBA would like to acknowledge everyone who took the time to share their insights into the development and delivery of the NYMNPA Blue Corridors project.

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Abbreviations

AONB .... Area of Outstanding Natural Beauty
BAP .... Biodiversity Action Plan
CIRIA....................... Company providing research and training in the construction industry
CIWEM.................... The Chartered Institution of Water & Environmental Management
CS .... Cross Section
DEFRA .... Department of the Environment, Food and Rural Affairs (formerly MAFF)
DS .... Downstream
EA .... Environment Agency
ERDF .... European Regional Development Fund

FRM .... Flood Risk Management
FWPM .... Fresh water pearl mussels
HIFI .... Hull International Fisheries Institute
INNS......................... Invasive Non-Native Species
ITTs.......................... Invitations to tender
LEP .... Local Enterprise Partnership
LPA .... Local Planning Authority
NLHF........................ National Lottery Heritage Fund
NPPF........................ National Planning Policy Framework
NYCC .... North York County Council
NYMNPA.................. North York Moors National Park Authority
SLT........................... Senior Leadership Team
SSSI .... Site of Special Scientific Interest
STW .... Sewage Treatment Works
uPBTs .... ubiquitous, persistent, bio-accumulative and toxic substances
US .... Upstream
WEG......................... Water Environment Grant
WFD .... Water Framework Directive
WTP .... Willingness to Pay
YNYER..................... York, North Yorkshire and East Riding
YW .... Yorkshire Water

Definitions

Riparian habitat: interface between land and a river or stream.

In-channel obstacles: in-stream obstacles are those that impact natural processes in terms of presenting potential barriers to fish migration, interrupting sediment continuity and degrading biodiversity linkages (NYMNPA).

1 Introduction

This document records the Summative Assessment of the North York Moors National Park Authority's (NYMNPA) Blue Corridors project, which was partially funded by the European Regional Development Fund (ERDF). JBA Consulting was commissioned to undertake this independent evaluation following the project's delivery, compliant with the ERDF requirements.

This Summative Assessment Report is intended to provide insights into project performance to enhance project implementation, reliable evidence of project efficiency, effectiveness, and value for money, as well as insights into what and why interventions work (or not), and lessons for the future.

This report provides project-level evidence which, combined with national evidence of progress and impact, will result in stronger evidence of the overall impact and effectiveness of the ERDF operational programme across England. Going forwards, the evidence can be used to support particular delivery approaches or project funding requests.

The structure of this Summative Assessment report includes:

- Section 1: Project Overview and Assessment Methodology
- Section 2: Project Context (at Design and Assessment stages)
- Section 3: Project Progress
- Section 4: Project Delivery and Management
- Section 5: Project Outcomes and Impacts
- Section 6: Project Value for Money
- Section 7: Conclusions and Lessons Learned.

1.1 Project Overview

The Blue Corridors project began on 23 March 2020 with works completed on 30 June 2023 and a financial completion date of 31 July 2023. Its overarching objectives focused on restoring ecological functions and processes within the two river catchments that fall within the blue/green rural infrastructure in the York, North Yorkshire and East Riding (YNYER) Local Enterprise Partnership (LEP) area. The operational catchments of the Esk and Rye rivers, and the planned blue corridors, are located within or nearby to the North York Moors National Park.

The project seeks to enhance the area's significant natural capital, reconnecting communities with nature and improving health and wellbeing. More specifically, the project aims to restore ecological functions and processes within the Rye and Esk catchments, improving biodiversity, soil health, and providing sustainable access.

These actions were designed to help address the recent ecological status failures of the Rye and Esk catchments, a goal which aligns with the ERDF's C23 output of increasing the surface area of habitats supported in order to attain better conservation status.

To deliver on these aims, the project was designed to ease the functional connectivity of watercourses, control Invasive Non-Native Species (INNS), and provide new and improved access routes throughout the area. Additional ecological monitoring and water quality data was collected, to assess the project's immediate impact and build an evidence base for any necessary future interventions.

The project's main delivery partners included the North York Moors National Park Authority (NYMNPA), North Yorkshire County Council (NYCC), and Yorkshire Water (YW). These partners also provided the funding matched by the ERDF to support the Blue Corridors project, the original budget is summarised in Table 1-1. A breakdown of the main delivery partner's public and private final match contributions is summarised in A.5.

Table 1-1 Summary of the Blue Corridors project funding

Funding source	Project funding (capital and revenue)
Private match	£ 341,220.00
Public match	£ 152,825.00
ERDF	£ 494,045.00
Total Blue Corridors project	**£988,090.00**

1.2 Research Design and Evaluation Methodology

The Blue Corridors project's assessment was based on a combination of quantitative and qualitative information from a range of sources. As this was one of the first projects of this scale delivered by the team leading the project, an emphasis was placed on identifying lessons learned, and tracking the reasons for any delivery complications and the reasoning behind project design decisions. This will help enhance the utility of the Summative Assessment report for the NYMNPA. An effort was made to isolate delivery issues that were amplified due to external factors beyond the project's control, and to highlight what mechanisms allowed the project to still deliver its intended outcomes.

1.2.1 Quantitative Assessments

Each of the project outputs outlined within the Blue Corridors project's logic model were first assessed in isolation, then their combined impact was used to gauge the project's outcomes and overall impact.

External reports were put together to assess the project's impact on improving water quality and Biodiversity Action Plan (BAP) priority species and habitats, based on monitoring and survey data gathered throughout the project's lifetime. The full list of species and habitats within the NYMNP's Blue Corridors is available in A.2. The insights from these reports are used to support this Summative Assessment.

1.2.1.1 Hectares of river processes restored

A counterfactual assessment methodology was used to predict the probable impact of easing 5 in-channel obstacles. As the impacts will not be seen instantaneously, looking at the impacts of similar projects provides a reasonably realistic assessment of the likely outcomes. This was combined with information obtained from the water quality assessment report. The analysis of the length (and therefore hectarage) of river processes restored was achieved by measuring the distance from the obstacle eased to the next upstream and downstream obstacles. Once this length had been ascertained, the average width of the river along the length improved was calculated. This figure was ascertained by measuring the channel width at approximately 500m intervals along the length of the watercourse, and then taking an average (mean) of all of the widths. It should be noted that the measurements were taken in google earth: as the resolution is low, these measurements are approximate and have been rounded to the 0.5m. The average width value was then multiplied by the length improved to calculate the m^2 improved, which was then converted to hectarage.

1.2.1.2 Hectares of riparian vegetation restored

The approach taken to quantify the hectares of riparian vegetation restored for the purposes of this Summative Assessment was based on isolating the measurable differences from before and after the Blue Corridors project's interventions. This geospatial analysis assumed an initial "before" neutral baseline, which was compared to the compiled three years of "after" INNS control mapping produced for the project.

The shapefiles provided allowed a spatial analysis in QGIS of the hectarage improved: they included information on the area controlled, but not which species. Where data was provided as a multi-polygon shapefile, a simple area calculation was run in the 'field calculator' in QGIS which adds a column to the attribute table of the layer which includes the total area of each multi-polygon in m2. A further column was created to show the area in hectares, achieved by dividing the values in the previous column by 10,000.

An alternative method was applied for the multi-line shapefile. This method is based on the assumption that the INNS controlled efforts expanded on either side of the linear figure by an average of 2.5m, covering an area of habitat improved averaging 5m wide. As such, a simple length calculation was run in the 'field calculator' in QGIS which adds a column to the attribute table of the layer which includes the total length of each multi-line in m. To calculate the area improved, the values in the length column were multiplied by five, again using the field calculator, which created another column with the area in m^2. A further column was then created to show the area in hectares, achieved by dividing the values in the previous column (area in m^2) by 10,000.

PDF maps were provided to show the area controlled for bracken. To calculate the area of land controlled for bracken, the maps were georeferenced in QGIS and then 'traced' the maps to create polygons to reflect the controlled areas. An area calculation was then run on the resulting shapefile, with the area in m^2 recorded in one column and the hectarage in another, as above.

1.2.1.3 Hectares of enhanced habitat

Similar to the approach outlined above in section 1.2.1.1, this approach is dependent on what type of shapefiles are provided outlining the five new riverside walks. The approach employed quantifies the change in habitat along the edges of the access tracks, calculating the area affected based on the new shapefiles/maps. A habitat improvement of 0.5m on either side of the new riverside walks was achieved. In order to calculate the hectarage improved, a buffer of 0.5m either side of the paths was applied to the line shapefiles in QGIS. An area calculation was run on the resulting buffered layer, giving a total area improved in m^2. This was then converted to hectarage.

1.2.2 Qualitative Assessments

To gather insight into the Blue Corridors project's implementation and delivery, the qualitative evaluation method selected was centred on interviews with key project and delivery partner stakeholders. This approach to the assessment was selected in an effort to understand the decision-making process throughout the project, to try to distinguish between normal project delivery complications and those amplified disproportionately by the global upheaval associated with the pandemic, war in Ukraine, and the unanticipated level of inflation. As there were no clearly identifiable direct project beneficiaries noted in the Blue Corridor's official Logic Model, no beneficiary stakeholders were directly solicited.

A list of the stakeholders to interview was compiled with Briony Fox, the Director of Conservation for the NYMNPA (see A.6), including a series of key project stakeholder interviews from Yorkshire Water, Envirocentre, NYCC, Blue Corridors, Ryevitalise, Pick Everard and the NYMNPA. The discussion points were aligned with the key questions in the ERDF Summative Assessment guidance documents. An interview flow guide was compiled to ensure that all the required topics were covered within the interview hour (see A.8).

At the start of each interview, stakeholders were informed that any insights provided would be anonymously integrated into this assessment. This supported congenial discussions with the common goal of identifying lessons learned, exploring the reasoning behind delivery challenges or implementation complications, and highlighting aspects and outcomes of the Blue Corridors project that were exemplary. These have been integrated throughout the Summative Assessment, and notably were used as the primary source of qualitative information pertaining to project delivery and management. Information gathered was cross-checked against the other interviews, and the quantified information available to build a wholistic picture.

2 Project Context (Section 1)

The Blue Corridors project was undertaken within the North York Moors National Park (NYMNP) and its surrounding area, focusing on addressing the recent ecological status failures of the Rye and Esk operational catchments. It was determined that through a programme of four concurrent activities, 112 ha of surface area of habitats could be supported to attain a better conservation status (C23). This encompassed:

- Enhancing and restoring 30ha of watercourse.
- Restoring 77ha of riparian vegetation.
- Enhancing 2ha of habitat.

The project aimed to enhance the area's natural capital by improving local biodiversity, soil health, and by providing sustainable access – reconnecting communities with nature, improving their health and wellbeing. More specifically, the Blue Corridors project was designed to accomplish the following goals:

- Enhance and restore watercourses.
- Increase biodiversity.
- Improve soil health.
- Provide sustainable access to visitors of the NYMNP.

The key landscape functions of the two main river corridors within the NYMNP underpin the economic, environmental and social value of the wider area. It is expected that the completion of the Blue Corridors project, which contributes to restoring these key landscape functions, will improve the following issues within the NYMNP:

- The previously degraded ecosystem services, particularly water quality.
- Biodiversity decline and habitat fragmentation.
- Climate resilience.
- Achieving sustainable flood risk management (FRM) targets.
- Appropriate access in the area, and its promotion.

2.1 Project Design

2.1.1 Economic and Policy Context

The Blue Corridors project was designed to align with the UK's key national policy priorities and environmental guidance. It aligns with the Government's 25 Year Environment Plan, which was working its way through Parliament at the time of the project's development to supersede the Natural Environment White Paper. The creation of Nature Recovery Networks was common to both documents, which was noted by the project's architects alongside the emphasis placed on National Parks having a critical role to play in restoring nature by successive DEFRA Ministers

(Michael Gove, Kew Gardens speech 16 July 2019; Theresa Villers, at The Oxford Farming Conference 8 January 2020).

Other considerations in the Blue Corridors project's design included the UK's National Planning Policy Framework (NPPF), and Natural England's Green Infrastructure Guidance. It was identified that paragraph 171 of the National Planning Policy Framework requires Local Planning Authorities (LPAs) to take a strategic approach to maintaining networks of habitats and green infrastructure. As the NYMNPA is an LPA, two possible actions were identified to implement this guidance:

- Protecting existing habitats and green infrastructure habitats, through restrictive policy.
- Encouraging the use and installation of green infrastructure in new development.

The first action, protection through restrictive policy, was noted to be covered through the NYMNPA's newest Local Plan, which sets out future planning policies. At project design, an updated Local Plan was being finalised that would remain relevant through to July 2029 (NYMPA, 2020). At the time of writing this Summative Assessment, it has been noted that the Local Plan is currently under review.

This Local Plan contains numerous relevant policies that helped build the framework for supporting the Blue Corridors project. At the time, the most noteworthy was considered to be Strategic Policy H, on Habitats and Biodiversity including a requirement for 'net gain' in ENV3: Remote Areas and Policy CO5, which encompasses land (including community spaces) designated as requiring protection. This is summarised on the Policies Map accessible here.

The Local Plan's second action, encouraging the use and installation of green infrastructure, was identified to align with the NYMNPA's 'placemaking' function by using masterplans and negotiations around developer contributions to deliver new green infrastructure. This supported the integration of the in-channel obstacles and access route works within the Blue Corridors project.

Natural England's Green Infrastructure Guidance aims to encourage planning for green infrastructure as part of 'placemaking', alongside other infrastructure. As only 29 new homes are anticipated to be built annually within the NYMNPA (with most of those beyond Helmsley's boundary being single dwellings), it was determined that there was little 'need' or scope for new green infrastructure to complement the project's new development, as it was deemed unlikely to lead to a loss of existing green assets. It was concluded that there was little scope for the delivery of green infrastructure through developer contributions as part of the Blue Corridors project, and therefore that most of Natural England's Green Infrastructure Guidance was not applicable. There were two exceptions in Section 106 agreements, which related to major developments in the NYMNP: the Woodsmith Mine Compensation and the Boulby Mine. These agreements offer compensation and mitigation from the impacts of the developments, and respectively allocate £211,222.00 and £62,000.00 to projects on the River Esk (Cripps, A. (2023) email to Colette Bowen, 20 March).

The NYMNPA has a statutory requirement to prepare and review a new Management Plan every five years, which sets out a long-term vision for the National Park: including goals, objectives, and key policies for the next 20 years. When finalising the scope of the Blue Corridors project, it was decided that the planning and management of green infrastructure would be executed through the NYMNPA's next Management Plan, as the existing Management Plan identified strategic habitat connections and the need for the Esk Freshwater Pearl Mussel and Salmon Recovery Project (NYMPA, 2022).

The Blue Corridors project was designed to align with multiple objectives from the existing NYMNPA's Management Plan (2012 - 2022):

- The connectivity and resilience of habitats will be improved both within and beyond the National Park, particularly in relation to river corridors (E12).
- The conditions for wildlife within streams, rivers and riparian habitats will be improved (E13).
- 'Good' status (under the Water Framework Directive) of all water bodies will be achieved, where feasible (E42).[1]
- Watercourses will be protected and restored for the benefit of wildlife (E43).

The creation of the Blue Corridors project coincided with the development of the NYMNPA's next Management Plan (2022-2027), which includes a framework for the delivery of environmental improvements - including Nature Recovery networks. As such, provisions were integrated into the project to ensure its alignment with any amendments to the objectives outlined above.

Combining a variety of ambitions to maximize local benefits

The Blue Corridors project was designed to the ERDF's sixth priority axis:

Priority Axis 6 (ERDF)

Preserving and protecting the environment and promoting resource efficiency.

As such, this offered the NYMNPA a rare opportunity to identify a suite of works for that would complement existing programmes in each catchment. The Blue Corridor's project plan was designed to combine funding from a wide range of sources for its different components, to reach the desired project scale appropriate to securing matched funding from the ERDF.

1 The European Water Framework Directive was enacted in the UK through the Water Environment (England and Wales) Regulations 2017.

The Blue Corridors project was designed to be complimentary to the two significant projects were already operating within the area: the Ryevitalise Landscape Partnership Scheme, and the Esk Water Environment Grant (WEG) Scheme. Crucially, the Blue Corridors project integrated activities that had been identified within the wider strategies of the existing schemes, that needed additional funding or that could not be funded within the aforementioned schemes or through wider agri-environmental schemes. This design methodology ensured that each Blue Corridors activity was complimentary to, yet distinct from, any ongoing works within the Rye and Esk catchments, and would support the common fundamental aim of enhancing and restoring habitat within the area.

Most of the total £3.4 million budget for the Ryevitalise Landscape Partnership scheme was secured through a National Lottery Heritage Fund (NLHF) grant at £1.8 million, with another £1.4 million sourced through partnership funding. When the Blue Corridors project was being developed, the remaining £200,000.00 required to complete the additional activities to deliver fish passage, access enhancements and monitoring in the Rye catchment had yet to be secured. As such, these outstanding activities were extracted from the Ryevitalise Landscape Partnership scheme, and included instead within the Blue Corridors project (ESIF-Form-2-028, Version 1, 2019).

The Blue Corridors project did not have any overlap with the £417,000.00 EA funded Esk WEG Scheme, as it had a narrow scope of reducing sources of diffuse pollution within the catchment, and water quality improvement measures in isolation are inadequate in addressing the wider biodiversity issues. The Blue Corridors project was also designed to avoid overlap with Natural England's Countryside Stewardship (CS) programme, and its four activities that together aimed to enhance 112 ha of habitat could not be delivered through the CS programme:

- Activity 1: In-channel obstacle easements to restore watercourse habitat.
  → Restore 33 ha of river processes.
- Activity 2: INNS control.
  → Restore 77 ha of riparian vegetation.
- Activity 3: Creation of five circular access routes.
  → Enhance 2 ha of habitat.
- Activity 4: Water quality and ecological monitoring.

To obtain the better conservation status targeted by the Blue Corridors project, it was determined that a catchment-based approach to INNS control was required. It should be clarified that while the CS programme contains an option for controlling invasive plant species, this is only offered as a supplement option to Higher Tier applicants in specific circumstances. As such, there are very few landowners within the boundaries of the Blue Corridors project who are eligible for or have received this CS supplement option, as the NYMNPA was careful to confirm that any INNS control undertaken through Activity 2 would not be carried out on land with the CS supplement in place

(ESIF-Form-2-028, Version 1, 2019). This lack of overlap was formally confirmed by Natural England.

2.1.2 Nature of the Market Failure and Project Objectives

The 'market failure' that the Blue Corridors project was developed to address was the recent ecological status failures of the Rye and Esk catchments. These failures were recorded by the statutory agency's survey work, and reinforced by further studies undertaken by project partners. The Blue Corridors project was one part of a suite of subsequent actions.

While the Esk catchment is encompassed within the NYMNP, the Rye catchment flows south beyond the National Park's boundary - into the Howardian Hills Area of Outstanding Natural Beauty (AONB), then on into the larger Derwent Catchment. While the Rye's Operational Catchment is part of the Derwent Humber Management Catchment, the River Rye flows on into the Upper Derwent Operational Catchment. The boundaries relevant to the Blue Corridors project are summarised below in Figure , which was published in the Blue Corridors Project Management Plan. Notably, several Sites of Special Scientific Interest (SSSI) fall within the Rye and Esk catchments, and their ecosystems are home to several protected species (A.2).

Under the Water Framework Directive (WFD), in 2019 all 36 waterbodies within the Rye catchment's ~854km^2 failed the WFD chemical status for surface waters, and only four had a good ecological status or potential (DEFRA, 2022). The most significant water management issue within the Rye catchment came from physical modifications; 25% of waterbodies in the Rye catchment were considered heavily modified in 2019 (Classifications data for Rye Operational Catchment, no date).

The Esk catchment encompasses 16 waterbodies within ~262km^2, nine of which had a good ecological status or potential in 2019. The most significant water management issues within the Esk catchment come from pollution, and in 2019 all 16 waterbodies failed the WFD chemical status (Classifications data for Esk Operational Catchment, no date).

It is worth mentioning that all the waterbodies had a chemical status of "fail" in 2019 due to changes in the EA's methodology and increased evidence base. This means that the 2019 chemical status assessments are not truly comparable to those performed in previous years. This significant change in chemical classification adds four groups of global pollutants into the equation.[2] If you were to omit the ubiquitous, Persistent, Bio-accumulative and Toxic substances (uPBTs) that were added to the newly expanded list of 52 chemicals listed as Priority Substances in the chemical

2 These uPBTs include: polybrominated diphenyl ethers (PBDEs), Mercury, certain Polycyclic aromatic hydrocarbons (PAHs) and Perfluorooctanoate sulfonate (PFOS), and a group of per-and polyfluoroalkyl substances (PFAS) (Classification | River Basin Management Plan: maps (arcgis.com)).

assessment, then there has been little underlying change in the chemical status for chemicals that are not uPBTs (River Basin Management Plan: maps, no date). Excluding the uPBTs, waterbodies in the Rye catchment, and most of the Esk catchment, would have obtained the surface water chemical status of "good" - yet the re-baselined approach offers a more realistic appraisal. This change in methodology highlighted a previously unnoticed ecological failure: the uPBTs.

The Blue Corridors project was implemented by the NYMNPA and its partners, Yorkshire Water (YW) and the North Yorkshire County Council (NYCC), who lacked the financial resources to support the practical works critical to enhancing the watercourse's ecological connectivity, and its connections to local communities. As detailed in Section 2.1.1 above, the Blue Corridors project was designed to complement the existing Ryevitalise Landscape Partnership and Esk Water Environment Grant (WEG) schemes. Significant time was devoted to ensuring the integrity of the matched-model funding summarised in Table 1-1, removing any inherent double counting and providing transparent accounting methodologies to the ERDF.

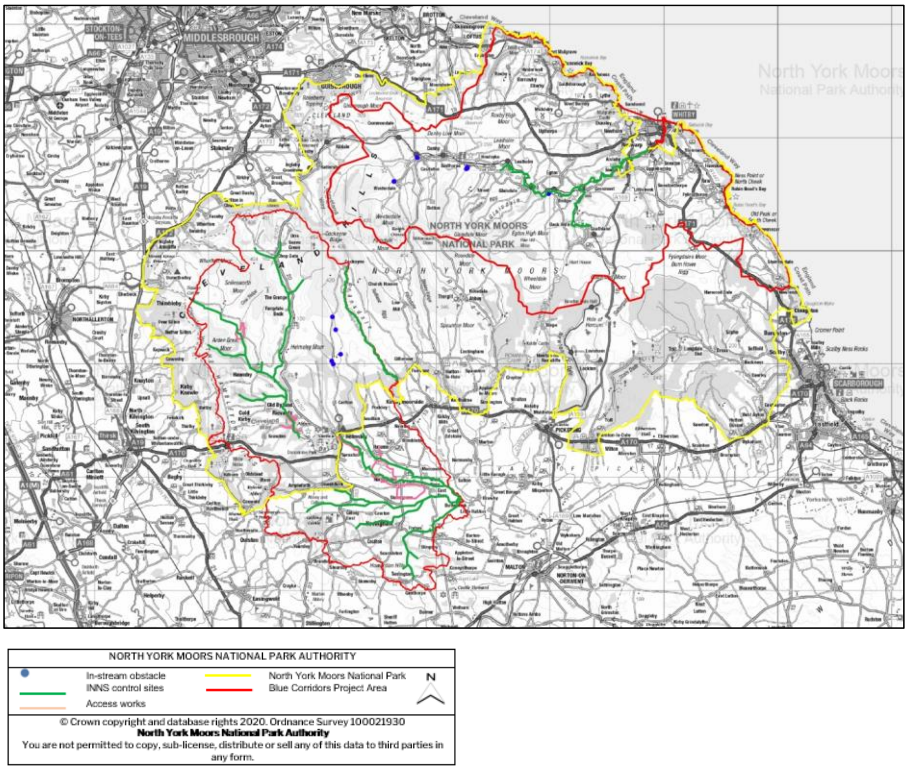

Figure 2-1 Boundaries and areas of work relevant to the Blue Corridors Project

To accomplish its goals, restoring and enhancing the identified failures in the ecological status of the Rye and Esk catchments, the Blue Corridors project was divided up to target four key activities:

- To enhance and restore 30ha of watercourse, the easement of 10 in-channel obstacles would be pursued (project locations are listed in A.1).
- To restore the ecological function of the riparian corridor and protect the aquatic environment, over 70 hectares of invasive non-native species (INNS) would be controlled (a full list of the targeted species has been provided in 0).
- To improve water quality, biodiversity, and local access to health and wellbeing by enhancing riverside access, five circular access routes would be created within the Rye catchment (details in A.4).
- To assess the impact of the three activities noted above, water quality and ecological monitoring would track in-channel changes, creating a baseline from Riverfly Monitoring (aquatic invertebrate) and electrofishing (juvenile fish monitoring) data.

The objectives of each of these key activities designed to restore and enhance the key landscape functions of the NYMNP's two main river corridors were projected in terms of short, medium, and long-term impacts. These have been summarised in the four tables below (Tables Table - Table).

Table 2-1 Enhancing and restoring 30ha of watercourse

Timeframe	Objectives / Anticipated Outcomes
Within the next 1-3 years	Easement of 10 in-channel obstacles → Opens access to over 30ha of additional fish spawning habitat → Improves the hydrological connectivity over 50km of watercourses
Over the next 5 years	Restoration of appropriate hydrological processes through 50km of linear watercourses → Provides over 30ha of new favourable spawning gravels for salmonids and other freshwater species
Over the next 10 years	Restoration of the naturally functioning river systems → Improves resilience to predicted climate change (e.g., high flow events, hotter and drier summers)

Table 2-2 Controlling over 70ha of INNS

Timeframe	Objectives / Anticipated Outcomes
Within the next 1-3 years	Control over 70ha of INNS in the Rye and Esk catchments, including Himalayan balsam, Skunk cabbage, and Japanese knotweed → Alleviates bankside erosion and resulting

Timeframe	Objectives / Anticipated Outcomes
	sedimentation
Over the next 5 years	Reduction of the seed bank of INNS in the Rye and Esk catchments → Restores native botanical diversity in the riparian corridors
Over the next 10 years	Restoration of 100ha of riparian corridor habitat in the Rye and Esk catchments, including the establishment of riparian trees → Consolidates river banks → Provides a buffer of native vegetation filtering surface water runoff, and slows the flow of water

Table 2-3 Creating five circular access routes in the Rye catchment

Timeframe	Objectives / Anticipated Outcomes
Within the next 1-3 years	Creation of five new circular access routes → Improves public access → Reduces habitat disturbance and alleviates riparian habitat degradation Installation of new infrastructure across ~18km of access routes → Provides access to the area for those with additional mobility needs (e.g., seasonal access for Tramper type mobility scooters)
Over the next 5 years	Improved awareness and usage of the ~18km of new circular routes → Associated health and well-being benefits for local users and visitors
Over the next 10 years	Promotion of a wider understanding of river environments, biodiversity and ecosystem services to circular routes access users, including appointing Lengths People to adopt sections of each route to ensure up-keep and provide long-term maintenance → Continues to reduce habitat disturbance in the surrounding areas

Table 2-4 Water quality and ecological monitoring

Timeframe	Objectives / Anticipated Outcomes
Within the next 1-3 years	Undertake the collection of water quality and ecological monitoring data → Allows baseline data to be collated → Allows the evaluation of the impact of the Blue Corridors project activities
Over the next 5 years	Established water quality and ecological monitoring sites across the Blue Corridors project areas → Regular monitoring and data collection
Over the next 10 years	Collate long-term water quality and ecological monitoring datasets → Provides valuable information for future projects to help focus sparse future funding where it can be the most effective to achieve positive environmental gains that will benefit the communities that rely on them

2.1.3 Rationale for the Delivery Approach

Focusing on the four key activities outlined above was designed to isolate the different components of the Blue Corridor project's objectives. This multipronged approach was designed to restore and enhance the key landscape functions of the NYMNP's two main river corridors, ultimately improving the ecological status of the Rye and Esk catchments.

This approach was designed to produce outcomes that would support the following wider benefits:

- Flood alleviation and water management.
- Pollution management / control / regulation (water and air).
- Economic growth and investment (new market opportunities).
- Health, well-being, recreation and leisure (linked to a growth benefit).
- Climate change adaptation and mitigation.

These links have been highlighted within the delivery plans of each key activity outlined in the sections below. All the activities should contribute to restoring functioning ecosystems within the Rye and Esk catchments, leading to an environment more resilient to climate change. Reducing the impacts of floods and droughts should encourage native species to flourish and provide a space for people to engage with the natural environment.

While the Blue Corridors project's Logic Model officially identified no direct beneficiaries, the project was designed to create benefits for a wide range of people and organisations. More information regarding project beneficiaries has been summarised below in Section 4.3.

2.1.3.1 Activity 1: Enhancing and restoring 30ha of watercourse

Of all four activities, Activity 1 has the largest capital outlay. It focuses on the easement of 10 in-channel structures, with the goal of improving aquatic habitats and hydrological connectivity and enhancing water level management by restoring naturally functioning river processes and ecosystem services.

This work is being delivered by the NYMNPA, who have a strong record of collaborating with local landowners to deliver conservation improvements. Legal agreements will be drawn up with landowners prior to works, either:

- Legally binding Blue Corridor Agreements agreed by the Authority and the Land Owner/Manager
- Equivalent S278 Agreements with NYCC for the sites related to NYCC Adopted Highways.

The physical removal or modification of the in-channel obstacles was planned to be undertaken by contractors during the summer seasons of 2021 and 2022, at the ten locations listed in A.1.

Many of the existing in-channel structures (e.g., artificial weirs and fords) within the Rye and Esk catchments have a significant impact on the healthy functioning of the river systems. Their existence contributes to habitat fragmentation, reduces hydrological connectivity and artificially changes water levels, all of which, in turn, has a negative impact on many aquatic, riparian and terrestrial species whose conservation is a concern. Removing several in-channel structures should restore hydrological processes, with the additional benefit of these upstream reconnections alleviating flood risks further downstream. By making more space for water to flow upstream, slowing the conveyance of floodwaters, the peak and severity of an event downstream is reduced. Additionally, increasing the local hydrological connectivity should open up new spawning grounds for both resident and migratory fish species.

However, these restoration efforts are acknowledged to have a potential polluting impact. Engineering works can lead to damaging changes in sediment inputs over the length of a river, resulting in an impact on the ecology throughout the catchment. Despite the potential sediment pollution created by the works required to remove or modify ten of the existing in-channel obstacles, it was determined that restoring natural processes will ultimately reduce sediment loads within the watercourses. In-channel structures create artificial areas of erosion and deposition, which can lead to aquatic invertebrate spawning gravels being smothered, having a negative impact on the species' conservation. Restoring natural processes should improve the habitat for key invertebrate, aquatic, and mammalian species.

This conclusion was reached through site-specific assessments of the amount of sediment the planned works may release, undertaken by the appointed consultants. These assessments confirmed that downstream areas would not be smothered by newly released sediment during the works. As a precaution, sediment capture techniques were also deployed throughout the works at each site.

Improving the ecological functions in watercourses increases the system's resilience to climate change and other environmental pressures (e.g., the threats of INNS), in turn increasing the resilience of their dependent communities. The 30ha of watercourses restored through the Blue Corridors project is anticipated to improve the habitat and species. Notably, the increased hydrological connectivity is expected to open up ~50km of river habitat for several aquatic species, including Atlantic salmon, brown/sea trout, and lamprey species. This is expected to result in ~33ha of habitat achieving a better conservation status.

2.1.3.2 Activity 2: Controlling over 70ha of INNS

With the aim of restoring the ecological function of the riparian corridor and protecting the aquatic environment, over 70 hectares of invasive non-native species (INNS) is planned to be controlled (a full list of the targeted species has been provided in A3).

This work will be delivered by the NYMNPA, and their good working relationships with local landowners/managers should facilitate the process of arranging access permissions for contractors to efficiently complete the INNS control works. Obtaining permissions for contractors will have the additional benefit of serving as an informal program for empowering and educating the local landowners/managers about the importance of INNS control for river restoration.

Due to the seasonal nature of INNS control works, the ability to operate within the necessary timeframes is critical to delivery. The NYMNPA have comprehensive maps of the INNS locations, which will facilitate a methodical and organised approach to the INNS control works. Once the appropriate permissions are secured, it is expected that contractors and NYMNPA volunteers will undertake the INNS control work during the early summer seasons of 2020, 2021, and 2022 - an overview of the anticipated works is provided below in Table . It is anticipated that arrangements to engage local communities on the importance of INNS control and biosecurity will be made through some 'super tasks' to control Himalayan balsam.

Table 2-5 Overview of the INNS Control Programme

INNS targeted	General location
Himalayan balsam	Throughout the Rye catchment and in the lower Esk catchment, at Sleights/Ruswarp
Skunk cabbage	At Hodge Beck, in the Rye catchment
Japanese knotweed	Throughout the Esk catchment

As highlighted by Table above, the main species focused on within the Rye and Esk catchments include Himalayan balsam, Skunk cabbage, and Japanese knotweed. As INNS can devastate aquatic and riparian habitats leading to the extinction of native plants and animals - habitats can be permanently altered as their biodiversity is destroyed. Removing these INNS from the catchments should contribute to restoring the ecological function of the riparian corridor and protect the associated aquatic environment.

Riverbanks dominated by seasonal INNS (principally Himalayan balsam) become seasonally bare, subjecting their soils to increased runoff into the watercourses which has a detrimental impact on the stream's habitats. Restoring native vegetation within riparian corridors reduces the erosion and collapse of riverbanks, which in turn also contributes to reducing the sediment loads within the watercourses. This should improve the area's conservation status by protecting the local native species, and strengthening the riverbanks also increases their resilience to future flood events. Riparian habitats with native trees and diverse groundcover create a filtration system, slowing the flow of water from land into watercourses which in turn reduces downstream flooding by helping to smooth peaks of high flow events upstream.

2.1.3.3 Activity 3: Creating five circular access routes in the Rye catchment

Enhancing riverside access in the Rye catchment through creating five new circular access routes is expected to improve water quality, biodiversity, and local access to health and wellbeing benefits by enhancing riverside access (details in A.4).

This work is expected to be delivered in partnership between the NYCC and the NYMNPA, with the Blue Corridors Project Officer. An overview of the delivery breakdown is summarised in Table . It is expected that the capital works will be undertaken by contractors, NYMNPA staff, and volunteers. Relevant landowners/managers have been notified to obtain any required permissions, supported by satisfactorily binding obligations in line with the 1980 Highways Act - which creates a legal obligation for the landowners/managers to maintain access infrastructure, and for the Highway Authority to maintain all bridges.

Table 2-6 Overview of the Circular Access Route delivery breakdown

Delivery partner	Actions to lead	Rationale
NYCC	Obtaining legal permissions for diversions of the public rights of way Coordinating the footbridge replacement on Nunnington - Harome route, including procurement of capital items and labour	The NYCC Definitive Map team are responsible for processing diversion orders The Nunnington - Harome route falls outside the NYMNP's boundary
NYMNPA	Delivering access improvements on the Hawnby and Rievaulx routes	The routes are within the NYMNP's boundary, so will be led by the local Ranger and apprentice teams who have good relationships with local landowners/managers
NYCC and Blue Corridors Project Officer	Procurement of various small lots of materials and contract management for the Helmsley, Nunnington Circular and Nunnington to Harome routes Blue Corridors project officer to coordinate the practical works with a team of volunteers	The sites are located outside the boundary of the NYMNP To bring additional capacity to the NYCC Rights of Way Team

An overview of the anticipated timeframes for the different access routes is summarised below in Table 2-7.

Table 2-7 Anticipated delivery timeframes for access route enhancements

Location	Expected delivery timeframe
Hawnby route	2020
Helmsley route	2021 - 2022
Rievaulx route	2021
Nunnington routes	2021 and 2022

A mixture of track re-surfacing and the installation of silt traps at vulnerable locations should help reduce the sediment load in runoff entering the watercourses. Re-surfacing works include the creation of small board walks to cross sensitive areas, like marshy grasslands. This should also reduce sediment pollution within the Rye catchment by preventing the erosion of bankside habitats, protecting the river gravel spawning habitats of salmonids and other aquatic species.

It is acknowledged that the route enhancement works, including the NYCC and NYMNPA removing barriers (e.g., stiles) and improving access above and beyond the minimum standard of maintenance, would not have been possible without the support of the Blue Corridors project. Alongside providing a more sustainable route for visitors, enhancing the riverside access by repairing existing infrastructure (e.g., bridges, boardwalks, gates and way-markers) should improve visitor experience and potentially increase learning opportunities by being closer to the ecosystem services that river catchments provide. Interpretation panels and artistic leaflets to highlight the Blue Corridors project's access routes improvements will provide additional information - although it should be noted that they will be delivered outside the scope of the Blue Corridors project budget.

Additionally, Activity 3 will increase access to a wider population by removing obstacles that prevent less able people from enjoying the access routes (e.g., replacing stiles with gates), and creating shorter circular walks should help encourage a broader audience to spend time outdoors. It is expected that this will have an economic benefit for associated hospitality services, potentially attracting new investment opportunities to cater to the needs of the wider market.

Increasing the accessibility of the routes for more of the year and promoting the new and improved access opportunities within the Blue Corridors' boundaries, is expected to encourage more people to explore the local area for recreation. The hope is that the increased awareness and opportunity to spend time in nature, walking through woods and alongside rivers will encourage health-promoting activities amongst visitors and the local population. These include physical exercise, mindfulness, and helping to deliver the socio-economic growth benefits linked to 'health, well-being, recreation and leisure'.

2.1.3.4 Activity 4: Water quality and ecological monitoring

The NYMNPA is committed to improving the ecological functions of the Rye and Esk river catchments, and prior work identified the key knowledge gaps and datasets required to continue to assess water quality and ecological health of the rivers. Gathering data to assess the outcomes of the Blue Corridors project presents an opportunity to begin to build many of these long-term datasets.

To track in-channel changes and assess the impact of Activities 1-3, water quality and ecological monitoring would allow the creation of a baseline from Riverfly Monitoring (aquatic invertebrate) and electrofishing (juvenile fish) data. A combination of three monitoring elements was identified to enable the project to continue to assess the conservation status of both the Esk and Rye catchments, and the impact of the Blue Corridors project now and in the future. These have been summarised in Table 2-8.

Table 2-8 Monitoring elements to assess the impact of the Blue Corridors project

Monitoring	Rationale
Water quality monitoring surveys	To assess sedimentation and nutrient loading
Aquatic invertebrate surveys (Riverfly monitoring)	To assess aquatic invertebrates sensitive to changes in water quality
Juvenile fish surveys (Electrofishing)	To assess fish distribution and abundance

The work is expected to be delivered in partnership between the NYMNPA and Yorkshire Water (YW), throughout the Rye and Esk catchments at specific pre-selected sites. The site-selection was designed to provide a samples representative of the watercourse health, often situated at the lower end of small tributaries feeding into the main river, or along the main rivers themselves. The sites have been distributed to help identify areas under pressure from the impacts of sedimentation or in-channel obstacles.

With the support of the Blue Corridors Project Officer, Riverfly monitoring, including water quality testing is expected to be carried out by NYMNPA volunteers across both the Rye and Esk catchments. They will bolster the existing Anglers Riverfly Monitoring Initiative scheme which has national recognition as an effective way to monitor watercourses, with direct support from the EA, and wider support from the UK's River Trusts and various conservation charities.

A combination of contractors, volunteers and project staff will undertake the monitoring work, while ensuring that volunteers are competent able to safely execute data collection. Under the Blue Corridors project, it is expected that data will be collected in autumn 2020, during the full spring/summer field seasons in 2021 and 2022, and concluding in the spring field season of 2023.

On the River Esk, the detailed aquatic invertebrate monitoring and water quality monitoring will be led by YW, procuring an ecological consultant who will contribute valuable expertise. As YW has several assets on the River Esk within the Blue Corridors project area, it is in their interest to obtain an understanding of the local water quality and contribute to ensuring conditions are over the 'good' threshold required to maintain a population of Fresh Water Pearl Mussels (FWPM).

2.1.4 Project Amendments: COVID-19 Pandemic

The Blue Corridors project officially began on 23 March 2020, on the first day of the first pandemic-induced UK Lockdown. The final full project application submitted to the ERDF included a series of programme adjustments as a result, outlined below:

Table 2-9 Anticipated COVID-19 Pandemic Programme Adjustments

Key activities	Anticipated Pandemic-Induced Adjustments
Enhancing and restoring 30ha of watercourse	No structures (in-channel obstacles) will be eased in 2020, as Lockdown halted work in the field → All work reprogrammed for 2021 and 2022
Controlling over 70ha of INNS	Movement restriction through the Lockdown reduced delivery of INNS control in 2020 → Only a limited amount of Himalayan Balsam control in the Rye could be completed
Creating five circular access routes in the Rye catchment	The three bridge structures in Hawnby proceeded as planned despite the disruption, as they would otherwise become a health and safety concern - this decision was influenced by a predicted increase in timber prices → Other routes were delayed
Water quality and ecological monitoring	Spring season monitoring in 2020 was made impossible due to the Lockdown and associated restrictions on field work. However, AECOM monitoring efforts continued.

2.1.5 Assessment: Appropriateness of the project delivery design, given its objectives

The following section outlines how the Blue Corridors project was appropriately designed to fit within the economic and policy context of the UK as outlined in section 2.1.1, prior to the COVID-19 pandemic.

The Blue Corridors project was developed as part of a suite of actions designed to address the recent ecological status failures of the Rye and Esk catchments. Prior technical surveys and community consultation organised through the pre-existing Ryevitalise project had identified the need for several actions within the Esk and Rye catchments, which created a strong rationale for the project's delivery.

The following local priorities were identified through consultations with local communities, river users, land managers, businesses and local organisations in the Rye catchment:

- To restore biodiversity and conserve species.
- To improve the landscape character.
- To establish better access routes.

Data on juvenile fish populations had been gathered by a team of volunteers and consultants working with the NYMNPA and the Yorkshire Esk Rivers Trust / Esk and Coastal Streams Catchment Partnership over the last 5 years before the project's inception, providing evidence that salmonids are prevented from reaching valuable spawning ground. Obstacles to fish passage had been identified as a key limiting factor to restoring the full ecological potential of the River Esk through the Yorkshire Esk Rivers Trust[3] fisheries management plan (2018 - 2022), which was written with Environment Agency consultation. This triggered a variety of feasibility studies and work began on the easement of several in-channel obstacles but was restricted by limited funding.

Reviewing these obstacles identified five within the Esk catchment that would not be eased without direct, additional intervention, which were incorporated into the Blue Corridors project. Previous feasibility and options appraisal of the Rye catchment's in-channel obstacles identified 10-15 for priority remediation, five of which were identified for easement through the Blue Corridors project and had design drawings produced.

Easing the 10 in-channel structures selected within the Rye and Esk catchments is expected to make a step change in improvements in the aquatic environment, improving biodiversity and habitat connectivity. To ensure delivery was practical, the willingness of relevant landowners/managers to work to improve the habitat was considered during the selection process.

Additional support for including the in-channel obstacle easement within the Blue Corridors project came from the NYMNPA, as the success of their recently secured Water Environment Grant (WEG) to reduce anthropogenic inputs into the aquatic system as part of a catchment restoration plan was dependent on in-channel obstacles being removed.

To restore biodiversity and conserve species, the need to control the Himalayan balsam INNS was highlighted by compiling a clear picture of the contaminated areas in the Rye catchment. This was done by aggregating previous Himalayan balsam INNS surveys with data gathered by the NYMNPA, Yorkshire Derwent Catchment Partnership, Howardian Hills Area of Outstanding Natural Beauty (AONB), Yorkshire

3 Since the Blue Corridors project's inception, the Yorkshire Esk Rivers Trust has folded into the Esk and Coastal Streams Catchment Partnership and the Esk Fisheries Association.

Invasive Species Forum, individual land managers and local angling clubs. Exploring the need for INNS control in the Rye catchment identified the expansion of Skunk cabbage, and once it was determined that a catchment-scale approach was appropriate, Japanese knotweed and Himalayan balsam expanding in the Esk catchment were also included in the project. It was confirmed with Natural England that none of the Blue Corridors project's planned INNS control overlaps with Natural England's Countryside Stewardship programme, avoiding any potential issues of double funding.

Activity 4, water quality and ecological monitoring, was designed to assess the impact of the Blue Corridors project. It also presented an opportunity to begin to build the long-term datasets required to fill previously identified knowledge gaps to continue to assess water quality and ecological health of the rivers.

These project goals, with targets outlining a four-pronged delivery model were realistic at the time of design, and it was reasonable to anticipate that they would be achievable within the projects proposed timeframes assuming there were no significant context changes. One notable weakness within the project model was the limited contingency budget, which was a decision made to encompass as many actions as possible - maximising outputs to provide perceived value for money.

The project was designed before the constraints and consequences of the COVID-19 pandemic were fully understood, while the supply-chain and shipping delays remained unforeseen, and the subsequent Russian invasion of Ukraine combined to create an unpredicted level of inflation. This is reflected by the relatively minor programme adjustments anticipated to result from the COVID-pandemic (section 2.1.4), which were included in the final full project application submitted to the ERDF.

2.2 Project Assessment

With the Blue Corridors project beginning on the first day of the UK's first national pandemic-induced Lockdown, the project's delivery has been marred by an unusually chaotic series of both local and global changes.

While the UK's policy context outlined in section 2.1.1 remains largely applicable, with the foresight to align the project to the now implemented Government's 25 Year Environment Plan, the economic landscape has shifted rather drastically.

The most significant implications of the COVID-19 pandemic and the significant geopolitical shifts were felt through the resulting inflationary pressures and supply chain complications impacting material costs. They also had significant implications for the practical delivery of the project that materialised in the restrictions to field work, the movement limitations impacting planned coordination with and numbers of volunteers, and the consequences of the enforced remote working on integrating new staff.

It has been acknowledged that the program budget had minimal contingency, and future works will include a greater 'risk' budget. However, no acceptable contingency budget could have covered the additional material costs that have resulted from the recent global events. As the originally allocated capital now falls short of covering the material costs required to undertake the planned engineering work, it is not unexpected that the project has been unable to deliver on the easement of all ten in-channel obstacles. The Blue Corridors project will complete 5 of the initial ten in-channel obstacles.

Neither is it realistic to have expected the project to budget for the program delays and gaps in data collection created by the previously unheard-of national Lockdowns and movement restrictions employed to counteract the pandemic's spread.

It is not realistic to expect the project to have completed all INNS control work planned for during the pandemic's years, due to the travel restrictions and distancing rules imposed across the UK. Neither is it realistic to expect the project to involve the significant number of planned volunteers, whose limited independence and generally older or aging demographic exacerbated their vulnerability to COVID-19, resulting in greater restrictions during the pandemic.

With the benefit of hindsight, a slight weakness in the project's model was the assumption that there would always be contractors available to pick up work that was put out to tender, when it was put out to tender. When the project was designed, in a growing economic environment, this was not an unreasonable assumption - although it may not have accounted for the reality of the limited supply of contractors based in Yorkshire. This slight weakness was likely amplified by the staffing shortages resulting from the changes to the labour market following the pandemic.

Some of the other challenges that the project encountered remain within the small mistakes associated with the learning curve of tackling a project of this scale. However, the impact of these miscommunications or slight programme hiccups was often exacerbated by the external situation.

Yet despite the changes to the UK's economic and wider political context since the project's inception, and the subsequent impacts on the practical delivery of the project, the identified local demand for the project remains unchanged. Arguably, through the UK's now more protectionist political lens, in times of global turmoil the need to secure a nation's natural capital only increases. On a more local scale, the sustained investment into the Rye and Esk catchments despite entering a period of recession provides an element of continuity.

3 Project Progress (Section 2)

3.1 Project Implementation

The Blue Corridors project has exceeded its intended outputs, although with a slightly different distribution between its key activities than initially anticipated. The following explicit output targets were outlined in the Blue Corridors project's logic model, with the ultimate goal of supporting 112ha of habitat in attaining a better conservation status (C23):

- Restore 33ha of river processes.
- Restore 77ha of riparian vegetation.
- Enhance 2ha of habitat.

The project balanced several concurrent activities to reach this goal of 112ha, and progress along the three workstreams whose contribution towards that 112ha target can be clearly quantified has been summarised below in Table 3-1. The different activities designed to restore river processes, riparian vegetation to enhance habitat are cumulatively taken to represent the Blue Corridors project's progress towards indicator C23 **Error! Reference source not found.**.

Table 3-1 Breakdown of project progress towards restoring and enhancing 112ha of habitat

Key Project Activity	Targets	Performance at Time of Evaluation		Achieved at Project closure		Overall
		No.	% of Target	No.	% of Target	
Hectares of river processes restored	33ha	2.3ha	7.3%	6.64ha	19.4%	
Hectares of riparian vegetation restored	77ha	114.67 ha	148.87%	114.67 ha	148.87%	
Hectares of enhanced habitat	2ha	3ha	150%	3ha	150%	

(C23) Total surface area of habitats supported in order to attain better conservation status	112ha	119.93 ha	107.08%	124.31 ha	111.28%	
Better water quality	N/A.	No direct contribution to the hectares of enhanced habitat.				
9 UK BAP priority species and habitats improved (C23)	9 priority species / habitats					

Key	
	less than 85%
	between 85% and 95%
	Greater than 95%

Delivering improved outputs under budget, despite the disruptions created by the COVID-19 pandemic, the war in Ukraine, and global inflation is a significant achievement. The Blue Corridors project has exceeded its target of 112ha by over 10%, - despite the number of in-channel obstacles eased to restore river processes being halved to keep the project within budget as material and construction costs soared due to external factors beyond the project team's control. Halving the number of in-channel obstacles decreased the outputs significantly creating a shortfall of 24ha of improved habitat through this activity (see section 3.2.1).

One additional hectare of enhanced habitat can be attributed to the initial mapping excluding access routes that fell beyond the NYMNP's boundary, as the enhanced access routes span 30km rather than the initially estimated 18 (see section 3.2.3). The unexpectedly high number of hectares of riparian vegetation restored through the INNS control activities, sufficient to fulfil the project's target of 112ha on its own, really comes down to the conservative methodology used when estimating the activity's potential during the project planning stages. While contractors were generally efficient and effective, the project team that designed the proposal was used to working along watercourses - and didn't account for the natural expansion of INNS control efforts moving more than 2.5m away from the watercourse on either bank. Contractor teams often worked throughout entire fields to ensure effective INNS control, and as such covered a much greater area than had initially been estimated (see section 3.2.2).

Significant monitoring efforts were made throughout the project, including water quality and the 9 UK BAP priority species and habitats. However, these efforts did not directly produce cleanly quantifiable outputs in hectares, and as noted in the project's Logic Model, have therefore been excluded from a quantitative performance evaluation in Table 3-1.. A more qualitative activity summary is available in section 3.2.4.

Table 3-1**Error! Reference source not found.**

As summarised in Table 1-1, the Blue Corridors project had a total budget of £988,090.00 available to achieve its goal of improving 112ha of habitat. This funding came from three streams: £341,220.00 private match, £152,825.00 public match, and the remaining £494,045.00 from the ERDF (A.5). This funding was split between the project's major components, and its evolution throughout the project's implementation has been summarised below in Table 3-2.

Table 3-2 Breakdown of spend between the main project components[4]

Funding	Activity	Project component	Initial	April 2023	Final	% Change (Final/Initial)
Capital	In-stream obstacles	Capital building and construction	£572,892.00	£168,830.00	£540340.49	↓ -5.7%
	INNS control	Other capital: INNS control	£91,000.00	£87,513.00	£87,247.88	↓ -4.13%
		Capital: Rootwave	£15,300.00	£15,300.00	£15,300.00	-
	Access route enhancement	Capital building and construction	£58,472.00	£62,275.00	£115665.67	↑ 97.8%
		Capital fees	£15,400.00	£8,177.00	£8,177.00	↓ -46.9%
Revenue	Monitoring	Other	£79,424.00	£76,171.00	£49,677.07	↓ 37.45%

4 The "initial" figures used below in Table 3-2 reflect the planned spend published in the Schedule 6: Project Specifications section of the 39R19P03950 The NY Moors National Park Blue Corridor Project Grant Funding Agreement. The project spend "to date" at the time of evaluation, along with the figures for the projected spend by project completion were provided by the Blue Corridors project team (Caldwell, J. (2023), email to Colette Bowen, 13 March).

Funding	Activity	Project component	Initial	April 2023	Final	% Change (Final/Initial)
		revenue				
	Other	Summative assessment	£12,000.00	£2,498.00	£11,988.	↓ -4.2%
		Recruitment / IT	£4,988.00	£470.51	£470.51	↓ -90.6%
		Salaries	£120,534.00	£61,309.00	£66,301.00	↓ -45.%
		Flat rate indirect costs (FRIC)	£18,080.00	£8,551.00	£9,945 00	↓ -45%

As noted earlier, the only reason that the final projected spend for the in-stream obstacle easements falls slightly short of the initially allocated budget is due to the number of interventions being reduced from ten to five (3.2.1). The scale of the impact of inflated material and construction costs is clearly captured in the almost doubling of the capital investment required for the building and construction components of the access route enhancement work (Table 3-2).

There were relatively significant decreases in projected expenditure related to capital fees and FRIC, some of which can be linked to the reduced number of in-channel obstacles easements. By far the most significant shortfall in expenditure came from the revenue earmarked for salaries - a decrease reflective of the Project Officer's unexpectedly short tenure in the role (see section 4.1).

There was a significant reduction in the expenditure on monitoring due to the financial evidence required from Yorkshire Water not being available. The monitoring was undertaken but cannot be claimed as expenditure for the project.

By the Blue Corridors project's completion date of 31 July 2023, the project has exceeded its goal of improving more than 112ha of habitat, and to has completed all of its key activities. It is expected that it's interventions will make a lasting impact on the quality of local habitats, supporting the attainment of a better conservation status.

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Indicator	Final figures at Project closure		Overall Assessment
	No.	% of Target	
Capital Expenditure (£m)	£766616.04	101.78%	
Revenue Expenditure (£m)	£138506.32	58.96%	
(C23) Surface area of habitats supported in order to attain better conservation status	124.31 ha	1**10.7**%	

Key	
	less than 85%
	between 85% and 95%
	Greater than 95%

3.2 Project Outcomes and Impacts

To deliver on the project outputs despite the programme shifting to adjust to unforeseen externalities, several project outcomes were adjusted. The intended project impacts, however, have remained consistent. While there have been significant project changes and reductions in goals, the area (in ha) of enhanced habitat has been achieved with a few program delays.

3.2.1 Activity 1: Enhancing and restoring 30ha of watercourse

Prior to the Blue Corridors project's inception, in-channel feasibility assessments in both the Esk and Rye catchments had been explored through the Ryevitalise Landscape Partnership Scheme and the Esk and Coastal Streams Catchment Partnership. This led to the identification of 10 in-channel obstacles whose easement would likely lead to significant habitat improvement (A.1). Early internal discussions with the NYMNPA's planning team helped facilitate the Planning Application process, which was streamline by submitting similar structures together.

Technical guidance was provided by EnviroCentre on the back of topographical surveys and site investigations, to understand the foundation requirements of each specific location. Aside from achieving compliance with civil regulations and road authority requirements, these designs needed the structural integrity to accommodate specific lorry sizes, as the primary users of these structures work with the Forestry

Commission. Back-up sites were identified during the project's design, to ensure project delivery in the unlikely event that any permits proved impossible to secure.

The general programme for Activity 1 is outlined below in

Table 3-3 and Table 3-4. The following months are encompassed in each quarter:

- Quarter 1 (Q1): Jan - March.
- Quarter 2 (Q2): April - June.
- Quarter 3 (Q3): July - Sep.
- Quarter 4 (Q4): Oct. - Dec.

Table 3-3 Programme overview: planned sites that were not taken forwards to delivery

Deliverable	2020				2021				2022				2023	
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2
Receive signed legal landowner agreements – Phase 1 → Esk 5, 11, 13 & Rye 17, 18														
Receive Planning Permission, Fish Pass Panel Approval and Works in Rivers consent → Esk 11														
Receive Planning Permission and Works in Rivers consent → Esk 13 & 5														
Receive Planning Permission and Land Drainage consent → Rye 17 & 18														
Procure In-channel Obstacle works → Esk 5 & Rye 18														
Deliver In-channel Obstacle works → Esk 5 & Rye 18														
Procure In-channel Obstacle works → Esk 11, 13 & Rye 17														
Deliver In-channel Obstacle works → Esk 11, 13 & Rye 17														

Legend:

= Planned delivery, but not taken forwards (removed)
= Planned
= Delayed delivery (complete)

The initially planned easement of 10 in-channel obstacles within the Rye and Esk catchment was reduced due to the impact of the unforeseeably high inflation on construction costs. This was agreed with the ERDF through a formal project change request.

Ultimately, the five sites selected for Activity 1 include three in the Rye catchment, and two in the Esk catchment. EnviroCentre Ltd. are the Principal Designer for all five sites that were taken forwards, whose location has been illustrated below in Figure 3-1.

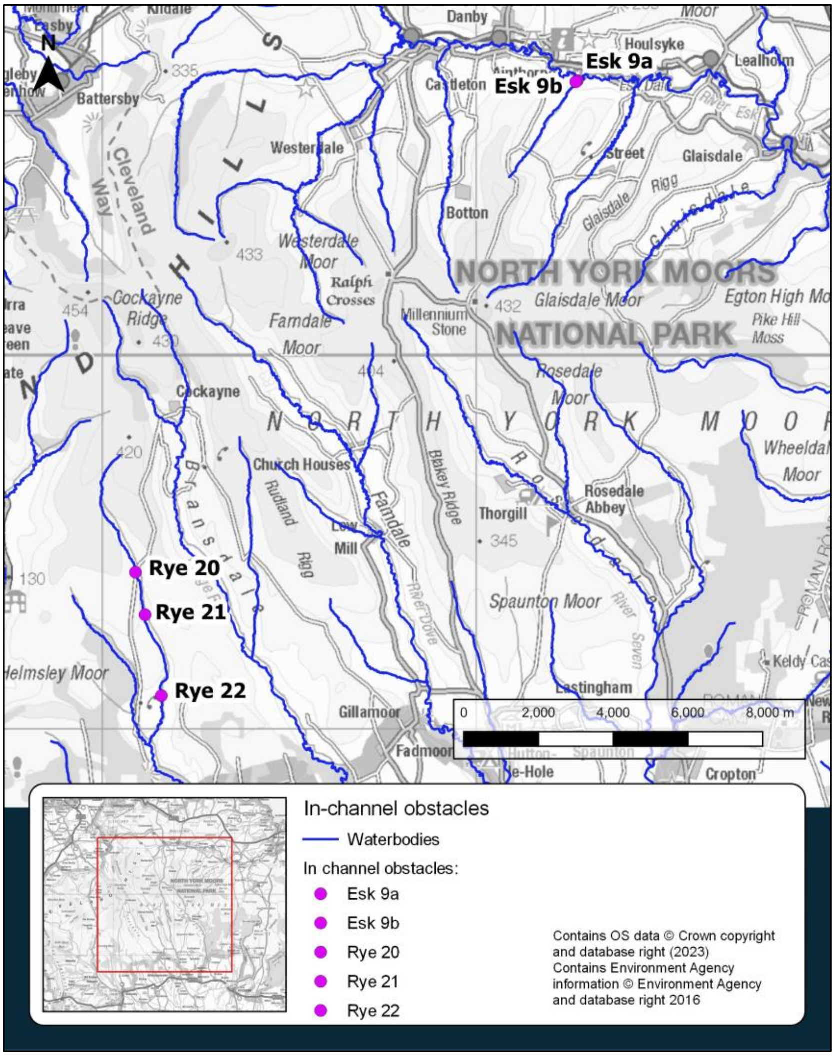

Figure 3-1 Location of the in-channel obstacles eased, in the Rye and Esk catchments

The general programme for these five sites that were taken forwards through Activity 1 is outlined below in Table 3-4.

Table 3-4 Programme overview: in-channel obstacle easement sites taken to delivery

Deliverable	2020				2021				2022				2023	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Receive signed legal landowner agreements – Phase 2 → Rye 22														
Receive signed legal landowner agreements – Phase 2 → Rye 20 & 21														
Receive Planning Permission and Works in Rivers consent → Rye 20, 21, 22														
Procure In-Channel Obstacle works → Rye 20, 21, 22														
Deliver In-Channel Obstacle works → Rye 20, 21, 22														
Receive signed legal landowner agreements – Phase 2 → Esk 9a & 9b														
Receive Planning Permission → Esk 9a & 9b														
Receive Works in Rivers consent → Esk 9a & 9b														
Procure In-Channel Obstacle works → Esk 9a & 9b														
Deliver In-Channel Obstacle works → Esk 9a & 9b														

Legend:

- = Delivered on schedule
- = Planned
- = Delayed delivery (complete)
- = Delayed delivery (in-progress April 2023)
- = Delayed delivery (complete)

In-channel obstacle easements at sites Rye 20, 21 and 22

Work on all of the planned in-channel obstacle easements in the Rye catchment have been completed. The interventions at sites Rye 20, Rye 21 and Rye 22 are summarised below.

Site Rye 20

The existing in-channel obstacle at site Rye 20 consistent of a 4m culvert-crossing road bridge, founded on three rectangular stone barrel culverts approximately 1m wide and 0.9m tall (see Figure 3-2).

The delivered in-channel obstacle easement involved the installation of two pre-weirs, at 5m and 9m downstream of the culvert. They were designed to increase the water depth by 0.2m downstream of the obstacle, increasing accessibility in a range of flow conditions.

Figure 3-2 Before (left) and after (right) intervention at Site Rye 20 (NYMNPA)

Site Rye 21

Site Rye 21 contained a concrete culvert with a 4.8m long pipe, with an 80cm diameter. The structure was covered in stone, with a track over the surface.

The entire structure was removed, and replaced with a multi-plate bottomless arch culvert that is 3m wide, 3m long, and 1m tall to maximise the water flow underneath. The concrete headwall was cast on-site, averaging 0.3m thick and inset into the structure's concrete foundations. The arched culvert is encased in concrete to increase its resistance to erosion, and the gill bed was reinstated beneath the culvert to restore a more natural watercourse (see Figure 3-3).

Figure 3-3 Before (left) and after (right) intervention at Site Rye 21 (NYMNPA)

Site Rye 22

The existing in-channel obstacle consisted of three 2.4m long concrete pipes, each with a diameter of 44cm and topped with concrete (see Figure 3-4 below).

Similar to the intervention at site Rye 21, the entire structure was removed, and replaced with a multi-plate bottomless arch culvert that is 3m long, 4m wide, and 1.26m tall to maximise the water flow underneath. The concrete headwall was cast on-site, averaging 0.3m thick and inset into the structure's concrete foundations. The arched culvert is encased in concrete to increase its resistance to erosion, and the gill bed was reinstated beneath the culvert to restore a more natural watercourse.

Figure 3-4 Before (left) and after (right) intervention at Site Rye 22 (NYMNPA)

Sites Rye 20, 21 and 22 are situated consecutively along the River Rye, so the interventions summarised above have enhanced the watercourse connectivity between the next in-channel obstacle upstream from Rye 20, and downstream from

Rye 22. This stretch of increased hydrological connectivity along the River Rye has been illustrated in Figure 3-5, **spanning a length of 9,002m**.

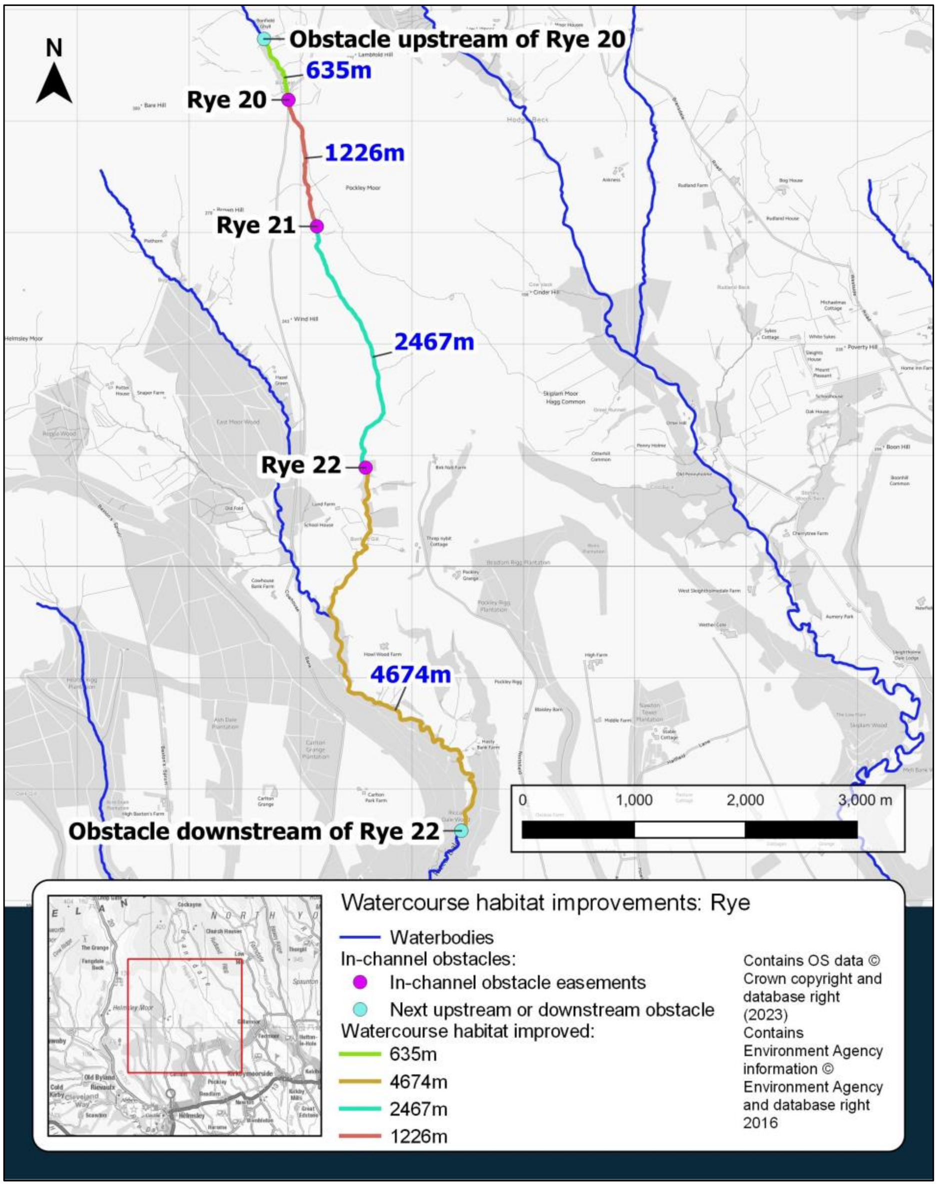

Figure 3-5 Stretch of the River Rye enhanced through the easement of the Rye 20, 21 and 22 in-channel obstacles

To calculate the hectares of watercourse that have been enhanced and restored through the Blue Corridors project through the easement of the in-channel obstacles at sites Rye 20, 21, and 22, the 9,002m stretch of river highlighted in Figure 3-5 was multiplied by an average river width along this section, of 2.5m. This figure was ascertained by measuring the channel width at approximately 500m intervals along the length of the watercourse, and then taking an average (mean) of all of the widths. It should be noted that the measurements were taken in google earth: as the resolution is low, these measurements are approximate and have been rounded to the 0.5m.

Table 3-5 Rye habitat improvement calculations

Site of easement	Next u/s obstacle	Next d/s obstacle	Total length improved (m)	Total area improved (length x 2.5m) (m^2)	Total area improved (ha)
Rye 20	460673, 494734	Rye 21	1,861	4652.5	0.5
Rye 21	Rye 20	Rye 22	-	-	-
Rye 22	Rye 21	462442, 487629	7,141	17852.5	1.8

Based on this methodology, the Blue Corridors project has enhanced **2.3ha** of habitat in the Rye catchment through the easement of the in-channel obstacles.

This method was based upon the assumption that easement of in-channel obstacles will increase river connectivity and therefore improve the riverine habitat. The Environment Agency has created a series of cost-benefit analysis tools designed to quantify the benefits associated with potential measures to improve the WFD status of waterbodies, by using the distance from the eased obstacle to the next upstream and downstream obstacles to get a measurement of the total length of watercourse improved.

As noted above, the Rye improvements consisted of installing two pre-weirs downstream of a culvert (Rye 20) and replacing concrete pipe culverts with two bottomless arch culverts (Rye 21 and 22). Barriers, like culverts, create hydromorphological pressures which have a large impact on fish populations though river fragmentation, as well as through water level and riverbed alterations. Therefore, removing or easing these barriers is key to achieving good ecological status (European Environment Agency 2018, 13-14, 27, 74). This is underscored by the fact that a 'favourable' river condition is defined as being an unfragmented one, free of barriers (Park et al. 2008; Jones et al. 2019; Atkinson et al. 2020).

In-channel obstacle easements at sites Esk 9a and 9b

Work within the Esk catchment included larger water courses and highway sites. This led to greater delivery challenges in the Esk catchment, which increased the importance of getting landowners and tenants on side - so efforts were made to accommodate their requests to facilitate delivery.

The pandemic created resourcing complications throughout the project's supply chain, and generally prolonged the delivery timescales. Seasonal restrictions on work within the river have also contributed to several delivery delays, and combined with planning permission complications detailed in 4.2.2.2, work planned at the two sites in the Esk catchment has yet to be completed. As summarised in Table 3-4, at the time of writing this Summative Assessment contractors to complete the works at sites Esk 9a and 9b are in the process of being procured. New invitations to tender (ITTs) were submitted for the sites in November 2022, and closed on 22 March 2023. Work at both sites is expected to be complete in Spring 2023 by 16 June, allowing sufficient time for invoicing before the hard Blue Corridors project deadline on July 31st, 2023 (Cripps, A. (2023), email to Colette Bowen, 02 March).

At the time of writing, the Works in Rivers consent for both sites has been submitted, and the Blue Corridors project team are awaiting the final response.

Site Esk 9a

The existing in-channel structure at Site Esk 9a, shown below in Figure 3-6, consists of a concrete bridge deck and apron covering an internal bridge spanning 11m, 4.6m wide.

Figure 3-6 Existing in-channel obstacle at site Esk 9a (NYMNPA)

3-6b New bridge and bridleway surfacing at Esk 9a

3-6b New River Profile at Esk 9a

The intervention for the site involved installing a prefabricated steel bridge on new abutments and foundations, placed immediately upstream of the existing bridge. Once installed, the existing in-channel obstacle, including the old abutments and foundations, was removed, and the bend and banks restored.

This work was completed in Q2 2023.

Site Esk 9b

The in-channel obstacle at site Esk 9b consisted of a culvert containing two 5.8m long concrete pipes, each 90cm in diameter (see Figure 3-7 below). It has degraded concrete headwalls and is covered by an unsurfaced farm track that allows access to the next field. The intervention replaced the existing in-channel obstacle with a multi-plate bottomless arch culvert similar to the ones installed at sites Rye 21 and Rye 22. It is 5m long, 4m wide and 1.16 tall to maximise the water flow underneath. The new concrete headwalls were cast on-site, averaging 0.3m thick and fixed into the structure's concrete foundations. The arched culvert was encased, above and to the side, with compacted class 6M aggregated, and topped with a compacted stone running surface.

Figure 3-7 Existing in-channel obstacle at site Esk 9b (NYMNPA)

3-7a Fryup Beck with new meandering river

3.2.1.1 Outcomes

Sites Esk 9a and 9b are situated consecutively along the River Esk, in close proximity at less than 50m apart. Notably, site Esk 9a sits on the nexus between the River Esk and one of its minor tributaries: Little Fryup Beck. Site 9b sits upstream of site 9a, on Little Fryup Beck itself. This means that the interventions summarised above have enhanced the watercourse connectivity between the next in-channel obstacles upstream and downstream from Esk 9a, as well as upstream of Esk 9b. Combined, this stretch of increased hydrological connectivity along the River Esk has been illustrated in Figure 3-8, spanning a length of 19,972m.

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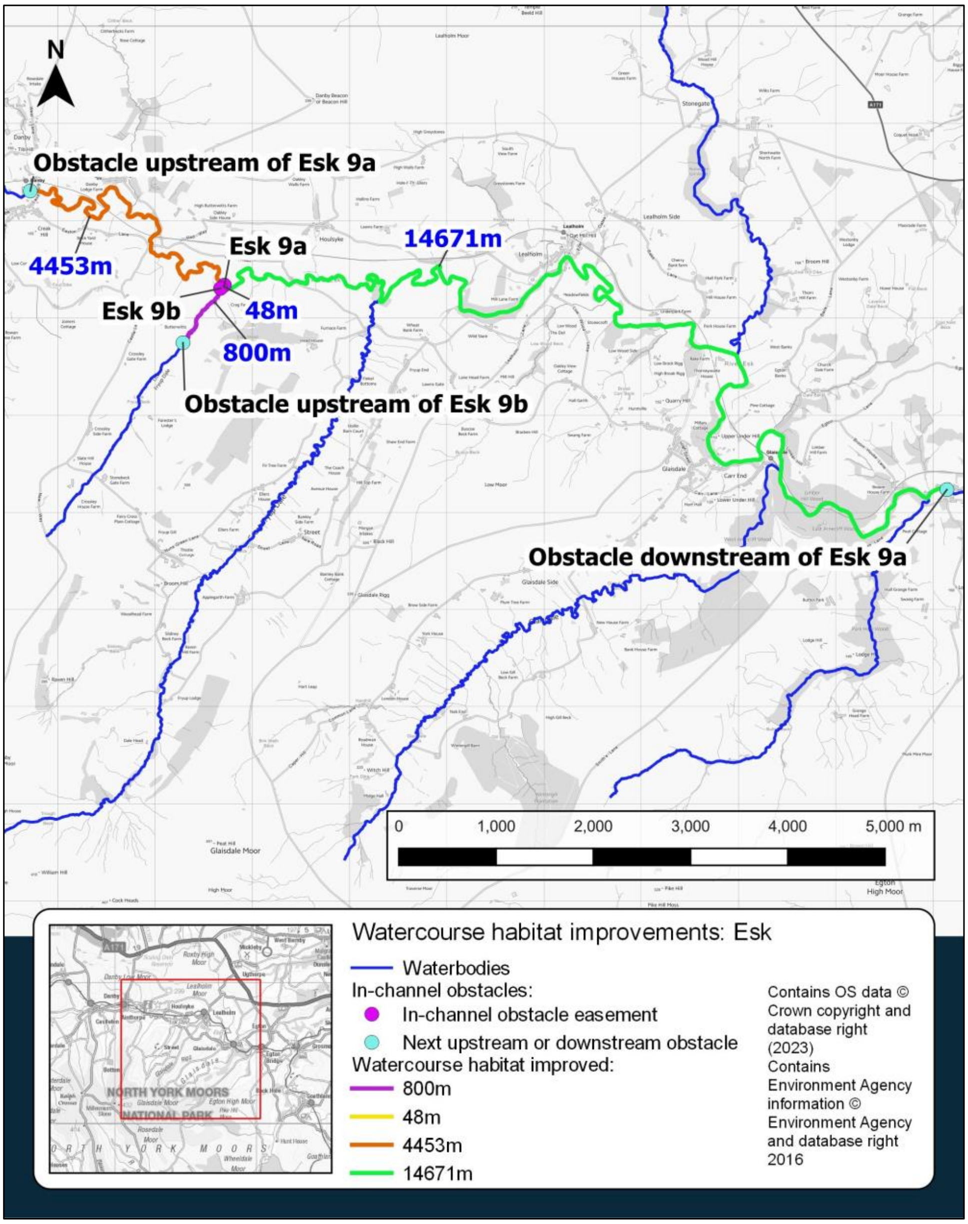

Figure 3-8 Stretch of the River Esk enhanced through the easement of the Esk 9a and 9b in-channel obstacles

Logically, the same methodology as detailed above for Sites Rye 20, 21 and 22 was used to calculate the hectares of watercourse that will be enhanced and restored through the Blue Corridors project through the easement of the in-channel obstacles at sites Esk 9a and 9b. As such, the 19,972m stretch of river highlighted in Figure 3.8 was multiplied by an average river width along this section of 11m. This figure was ascertained by measuring the channel width at approximately 500m intervals along the length of the watercourse, and then taking an average (mean) of all of the widths. The width of the tributary upstream of Esk 9b could not be ascertained, so was not included in this figure; 11m was applied to this portion of the watercourse. It should be noted that the measurements were taken in google earth: as the resolution is low, these measurements are approximate and have been rounded to the 0.5m.

Table 3-6. Original Esk habitat improvement calculations

Site of easement	Next u/s obstacle	Next d/s obstacle	Total length improved (m)	Total area improved (length x 11m) (m2)	Total area improved (ha)
Esk 9a	470717, 508306	480142, 505233	19,124	210364	21.0
Esk 9b	472287, 506744	Esk 9a	848	9328	0.9

Based on this methodology, the Blue Corridors project wouldenhance **21ha** of habitat in the Esk catchment through the easement of the in-channel obstacles.

Predicted outcomes based on all five in-channel obstacle easements

The Blue Corridors project will enhance a total of **21ha** of habitat across the Rye and Esk catchments through the easement of in-channel obstacles, by its completion date of 31 July 2023.

There are intrinsic benefits to the improved functioning of blue corridors and waterways. At the Blue Corridors project's inception, the short (1-3 years), medium (5 years), and long-term (10 years) impacts of enhancing and restoring 30ha of watercourse were identified, as summarised in Table 2-1. It is worth highlighting that these impacts were based on the anticipated easement of 10 in-channel obstacles. The final calculation of outputs was calculated by measuring the length of river opend up to the next obstacle rather than both up and down stream.

Project stakeholders suggested that it would likely take another few years of monitoring in order to reliably compare data from before and after the works, and determine the final physical impacts.

It has been shown that rivers as a habitat benefit from in-channel structure removal as connectivity is improved. This leads to a re-naturalisation of river processes, including sediment transport, nutrient transport, flows, and river morphology (Elbourne et al., 2013). Removing structures can aid in the restoration of floodplain connectivity and has the potential to increase floodplain storage capacity too (Elbourne et al., 2013). It can increase the diversity of habitats within the river, and, as a result, removal of in-channel structures has a direct positive effect on species diversity (Elbourne et al., 2013).

Fish species in particular benefit from improved river connectivity, as barriers to natural flows can prevent or delay migrations that are a part of natural lifecycles (Elbourne et al., 2013). Passing obstacles during migrations can result in direct mortality of species such as European eels (Anguilla anguilla) (Silva et al., 2017) and impact energy reserves of migratory species such as Atlantic salmon (Salmo salar) and sea trout (Salmo trutta) (Environment Agency, 2021). Removal of obstacles therefore allows migratory fish such as Atlantic salmon, sea trout, and European eel to access spawning grounds while reducing the risk of mortality (Wild Trout Trust, 2022; Environment Agency, 2021). The removal of barriers has been associated with improved diversity of fish species both upstream and downstream of the previous structure (Environment Agency, 2021).

In the short-term, it was anticipated that the easement of the in-channel obstacles would open access to over 30ha of additional fish spawning habitat and improve the hydrological connectivity over 50km.

Based on the works realised through Activity 1, greater hydrological connectivity will be achieved. While the number of sites eased was reduced to remain within project budget, and therefore the project will not reach the targeted creation of 30ha of fish spawning habitat, it has been shown an enhancement of 6.64ha of habitat across both catchments. The measures implemented have reconnected two stretches of the Rye and the Esk, easing passage for fish, as well as maximising water-flow in the areas of work, and re-naturalises the bank, bend, and gill bed of the rivers, therefore achieving greater river connectivity. Removing obstacles allows migratory fish such Atlantic salmon, sea trout, and European eel access to new spawning grounds and reduces mortality related to obstacle passage (Silva et al. 2017; Wild Trout Trust, 2022; Environment Agency, 2021). Project stakeholders see the removal of the in-channel obstacles as the backbone of other catchment-wide efforts to improve the fish populations, which could not have been achieved without the Blue Corridors project's funding due to the scale of the capital works required.

Over the next 5 years, it was anticipated that the project would restore appropriate hydrological processes through 50km of linear watercourses, providing over 30ha of new favourable spawning gravels for salmonids and other freshwater species. It is reasonable to expect that the benefits of greater hydrological connectivity detailed in the previous paragraph will continue to be delivered over the next five years. Removing obstacles re-naturalises the river processes, so over the next five years there will be greater sediment and gravel transport and improved river morphology

(Elbourne et al. 2013; European Centre for River Restoration n.d.): this will result in an increase in spawning gravels for salmonids.

Finally, over the next 10 years it was anticipated that the actions of the Blue Corridors project would contribute to the restoration of the naturally functioning river systems, improving their resilience to the anticipated climate change. Notably, this includes increasing their resilience to future high flow events, and hotter, drier summers. As noted above, removing the obstacles will encourage re-naturalisation of the watercourse, including the creation of a more natural bank profile, the creation of more varied habitat niches, and restoration of natural processes, including erosion and deposition (Elbourne et al. 2013; European Centre for River Restoration n.d.). Reinstating natural physical processes by renaturalising flow and sediment supply can reduce flood risk by slowing flows and reducing flood peaks (WWNP 2018, 16). More natural river processes increase a river's ability to accommodate changing sediment and flow regimes under climate change (Raven et al. 2009; WWNP 2018, 16). Culverts and bridges can restrict flow, increase downstream flood risk due to reduced response times and reduced flood water retention; with correct design and maintenance, removal/redesign of obstacles can reduce flood risk (CIWEM n.d.; Balkham et al. 2010). With climate change, these risks will be heightened due to more extreme rainfall events and wetter winters; obstacle removal has been identified as a potentially effective adaptation measure (CIWEM, n.d.).

In summary, while Activity 1 has achieved all its planned objectives and anticipated outcomes - it is on a smaller scale than initially anticipated (see table 3-8 below).

This change to the project delivery was previously agreed with the ERDF, and was necessary due to the soaring capital costs associated with materials and construction due to factors beyond the Blue Corridor project team's control. The project will, however, still meet all of the broader, long-term objectives outlined for this Activity.

Table 3-7 Enhancing and restoring 30ha of watercourse

Timeframe	Objectives / Anticipated Outcomes	Outcomes Achieved by Project Completion	RAG
Within the next 1-3 years	Easement of 10 in-channel obstacles → Opens access to over 30ha of additional fish spawning habitat → Improves the hydrological connectivity over 50km of watercourses	Easement of 5 in-channel obstacles → Opens access to 6.4ha of additional fish spawning habitat → Improves the hydrological connectivity over 29km of watercourses	

Timeframe	Objectives / Anticipated Outcomes	Outcomes Achieved by Project Completion	RAG
Over the next 5 years	Restoration of appropriate hydrological processes through 50km of linear watercourses → Provides over 30ha of new favourable spawning gravels for salmonids and other freshwater species	Restores appropriate hydrological processes through 29km, of linear watercourses (9km in the Rye, and 20km in the Esk). → Provides over 24.2ha of new favourable spawning gravels for salmonids and other freshwater species	
Over the next 10 years	Restoration of the naturally functioning river systems → Improves resilience to predicted climate change (e.g., high flow events, hotter and drier summers)	Expected to be achieved.	

3.2.2 Activity 2: Controlling over 70ha of INNS

The INNS control work officially started with the purchase of the root wave kit in March 2020, but works on the ground began in the summer season with a small, scaled-back INNS control program due to the restrictions created by the COVID-19 pandemic. This was carried out by a series of outdoor contractors in the Rye catchment, who had good working relationships with the local landowners which allowed for self-led work using detailed maps provided to the contractors. However, there were insufficient resources to also cover the Esk catchment, and acquiring landowner permissions during the pandemic presented significant complications. As such, due to the pandemic there were no INNS control activities undertaken in the Esk catchment in 2020.

Preliminary discussions with key landowners were held before the start of the Blue Corridors project, to establish the feasibility of the INNS control works. The INNS control strategy was to focus efforts on the headwaters as much as possible, to avoid downstream spread. Landowner permissions to deliver the INNS control works need to be renewed each year and are usually acquired over winter for the following seasons. Once landowners were successfully engaged, most were willing to get on board with the project - the Blue Corridors project was offering to do the INNS control work for them, for free.

Activity 2 was essentially an expanded repetition of previous work undertaken by the NYMNPA, now encompassed by the Blue Corridors project at a previously unfeasible scale. The general programme for Activity 2 has been outlined below in Table 3-8. Each quarter includes the following months:

- Quarter 1 (Q1): Jan - March.
- Quarter 2 (Q2): April - June.
- Quarter 3 (Q3): July - Sep.
- Quarter 4 (Q4): Oct. - Dec.

It is worth noting that initial trials of pirri-pirri burr using the Rootwave machine proved disappointing, and any significant control of this INNS was excluded from the Summative Assessment at the request of the Blue Corridors project team.

As summarised by Table 3-8 below, most of the INNS control work was delivered as planned, with the exception of the skunk cabbage and bracken control being limited to a single year of intervention in 2021. This is because skunk cabbage control was already being undertaken by the National Trust in 2022 (Cripps, A. (2023), email to Colette Bowen, 20 March). Bracken control efforts through the Blue Corridors project in 2021 using the Rootwave equipment evidenced that the effort required was prohibitive to the amount of control that could be achieved, and as such plans for bracken control in 2022 were scrapped. Instead, in 2022 bracken control efforts were undertaken by wider partners in the traditional manner, beyond the scope of the Blue Corridors project (Cripps, A. (2023), email to Colette Bowen, 20 March).

The program was also adjusted as required to reflect the state of the INNS spread. Less Himalayan balsam control was required in Bilsdale than initially anticipated, and although the area was still surveyed, this allowed more time to be spent controlling Himalayan balsam in the south of the Rye catchment.

As mentioned previously, there was a delayed start to the 2020 control season due to challenges in contracting landowners and the four appointed contractors during the COVID-19 pandemic. Yet all the works completed that year were successfully signed off and invoiced by September following spot checks by the project team (Activity Sheet 2, 2022). Increasing landowners permitting control also increased the extent of the work in following years. In 2021 there were eight appointed, and all work was checked and signed off by the end of October; and in 2022 there were six contractors, and all works were signed off by the end of September.

In 2020 and 2021, the INNS control outputs were mapped on Earthlight and signed off by the Ecologists before being submitted to the ERDF. At the time of compiling the Activity Sheet 2 - INNS Control document containing this Activity's output summary of hectares of habitat improved through the work, the Blue Corridors project team was still waiting for most all the data from 2022 to be mapped on Earthlight (Activity Sheet 2, 2022). However, the understanding was that control efforts hadn't targeted any new areas compared to the previous two years, and as such to avoid double counting the assumption was made that no additional hectarage of improved habitat could be claimed through works in 2022.

Table 3-8 Programme overview: Controlling over 70ha of INNS

Deliverable	2020				2021				2022				2023	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Procuring the Rootwave														
Update landowners and obtain access for annual INNS control season (Rye) → Himalayan balsam only (2020), predominantly (2021 & 2022)														
Procure contractors for annual INNS control season (Rye) → Himalayan balsam only (2020), predominantly (2021 & 2022)														
Carryout annual INNS control (Rye) → Himalayan balsam only (2020), predominantly (2021 & 2022)														
Update landowners and obtain access for annual INNS control season (Esk) → Himalayan balsam & Japanese knotweed														
Procure contractors for annual INNS control season (Esk) → Himalayan balsam & Japanese knotweed → Provide maps for 2022 season														
Carryout annual INNS control (Esk) → Himalayan balsam & Japanese knotweed														
Procure contractors for 2021 INNS control season (Esk) → Skunk cabbage and bracken → Provide maps for 2022 season														
Carryout 2021 INNS control (Esk) → Skunk cabbage and bracken														

Legend:

= Planned delivery, but not taken forwards (removed)

= Delivered on or ahead of schedule

= Planned

= Delayed delivery (complete)

Table 3-10 breaks down the INNS controlled areas by species, as submitted to the ERDF in October 2022 and claiming **an output of 108.17 ha** of surface area supported in order to attain a better conservation status. As summarised in Table 3-9, Activity 2 resulted in a total of 93.09 ha of improved habitat in the Rye catchment, and 15.08 ha of improved habitat in the Esk catchment.

The Blue Corridors project team was careful to avoid double counting when reporting their outputs. Notably, for the 79.10 ha of improved habitat claimed through works in 2021, several areas of the Esk catchment that were controlled for Japanese knotweed were excluded from calculations as efforts to control Himalayan balsam had already been noted in the same area (Activity Sheet 2, 2022).

No further INNS control work is planned under the Blue Corridors project in 2023.

Table 3-9 Summary of ha of habitat enhanced through INNS control (Activity 2)[5]

INNS	Rye Catchment - improved habitat (ha) (2020-2022)	Esk Catchment - improved habitat (ha) (2021-2022)	Total habitat improved (ha) across both catchments
	Controlled	Controlled	Controlled
Himalayan Balsam	92.09 ha	13.8 ha	105.89 ha
Japanese Knotweed	N/A.	0.98 ha	0.98 ha
Bracken	1 ha	0.3 ha	1.3 ha
Total habitat improved	93.09 ha	15.08 ha	108.17 ha

The Blue Corridors project team faced an unforeseen challenge in quantifying the hectarage of INNS controlled habitat simply due to the range of the data quality uploaded to Earthlight. The diverse contractors preferred slightly different recording mechanisms, which varied partially due to the naturally divergent sprawl of the different INNS species. Additionally, with various different officers working on the project over the last three years, and a new mapping system, the resulting shapefiles were over complicated. The result was a series of shapefiles containing a combination of lines, polygons and dots - significantly with some conflation between controlled and surveyed areas recorded by contractors. These shapefiles and the contractor maps have since been reviewed, and the outputs simplified, by the North York Moors National Park Authority. They have provided one single mapping layer for Himalayan balsam and Japanese knotweed, covering the Blue Corridor INNS areas to remove any possible duplication of locations across time or species. The resulting shapefiles

5 Information in Table 3-9 is extracted from the Output Summary of the Activity Sheet 2 - INNS Control document updated in October 2022, shared with the ERDF.

are one multi-line and one multi-polygon shapefile, showing areas controlled for both species.

Once the shapefiles from INNS control efforts in both catchments for all three years of work (including 2022) were untangled and clarified, the approach taken to quantify the hectares of riparian vegetation restored for the purposes of this Summative Assessment was based on isolating the measurable differences from before and after the Blue Corridors project's interventions. This geospatial analysis assumed an initial "before" neutral baseline, which was compared to the compiled three years of "after" INNS control mapping produced for the project.

The shapefiles provided allowed a spatial analysis in QGIS of the hectarage improved: they included information on the area controlled, but not which species. Where data was provided as a multi-polygon shapefile, a simple area calculation was run in the 'field calculator' in QGIS which adds a column to the attribute table of the layer which includes the total area of each multi-polygon in m2. A further column was created to show the area in hectares, achieved by dividing the values in the previous column by 10,000.

An alternative method was applied for the multi-line shapefile. This method is based on the assumption that the INNS controlled efforts expanded on either side of the linear figure by an average of 2.5m, covering an area of habitat improved averaging 5m wide. As such, a simple length calculation was run in the 'field calculator' in QGIS which adds a column to the attribute table of the layer which includes the total length of each multi-line in m. To calculate the area improved, the values in the length column were multiplied by five, again using the field calculator, which created another column with the area in m2. A further column was then created to show the area in hectares, achieved by dividing the values in the previous column (area in m2) by 10,000.

PDF maps were provided to show the area controlled for bracken. To calculate the area of land controlled for bracken, the maps were georeferenced in QGIS and then 'traced' the maps to create polygons to reflect the controlled areas. An area calculation was then run on the resulting shapefile, with the area in m2 recorded in one column and the hectarage in another, as above.

The areas controlled across the Rye and Esk catchments are illustrated below in Figure 3-9. At the request of the Blue Corridors project team, skunk cabbage control efforts in 2021 have been excluded from this report as no hectarage of improved habitat has been claimed against them. Most skunk cabbage plants were on Nation Trust land, and as such control measures were implemented by the National Trust, without the need for financing through the Blue Corridors project.

By applying the quantification methods outlined above to the shapefiles provided by the Blue Corridors project team for INNS control efforts in 2020, 2021, and 2022, a total of 114.67 ha of habitat was improved through the works undertaken in Activity 2.

This includes 20.97 ha of habitat improved through INNS control in the Esk catchment, and a total of 93.66 ha in the Rye catchment. Table 3-10 breaks down controlled areas.

Table 3-10 Summary of ha of habitat enhanced through the Blue Corridors project

INNS	Rye Catchment - improved habitat (ha) (2020-2022)	Esk Catchment - improved habitat (ha) (2021-2022)	Total habitat improved (ha) across both catchments
Himalayan Balsam and Japanese Knotweed	92.66	20.67	113.33
Bracken	1	0.34	1.34

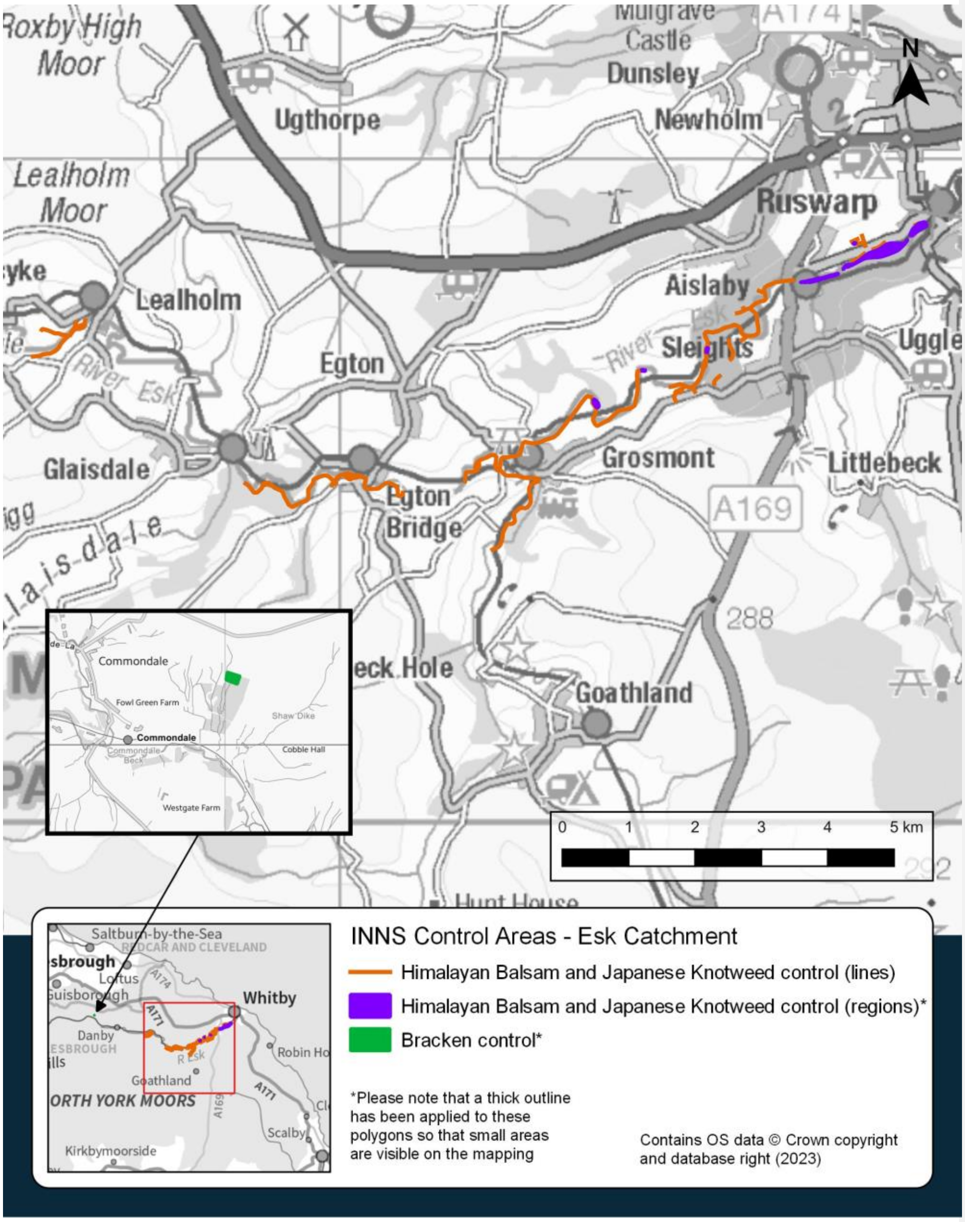

Figure 3-9 Controlled areas within the Esk catchment (2020 - 2022)

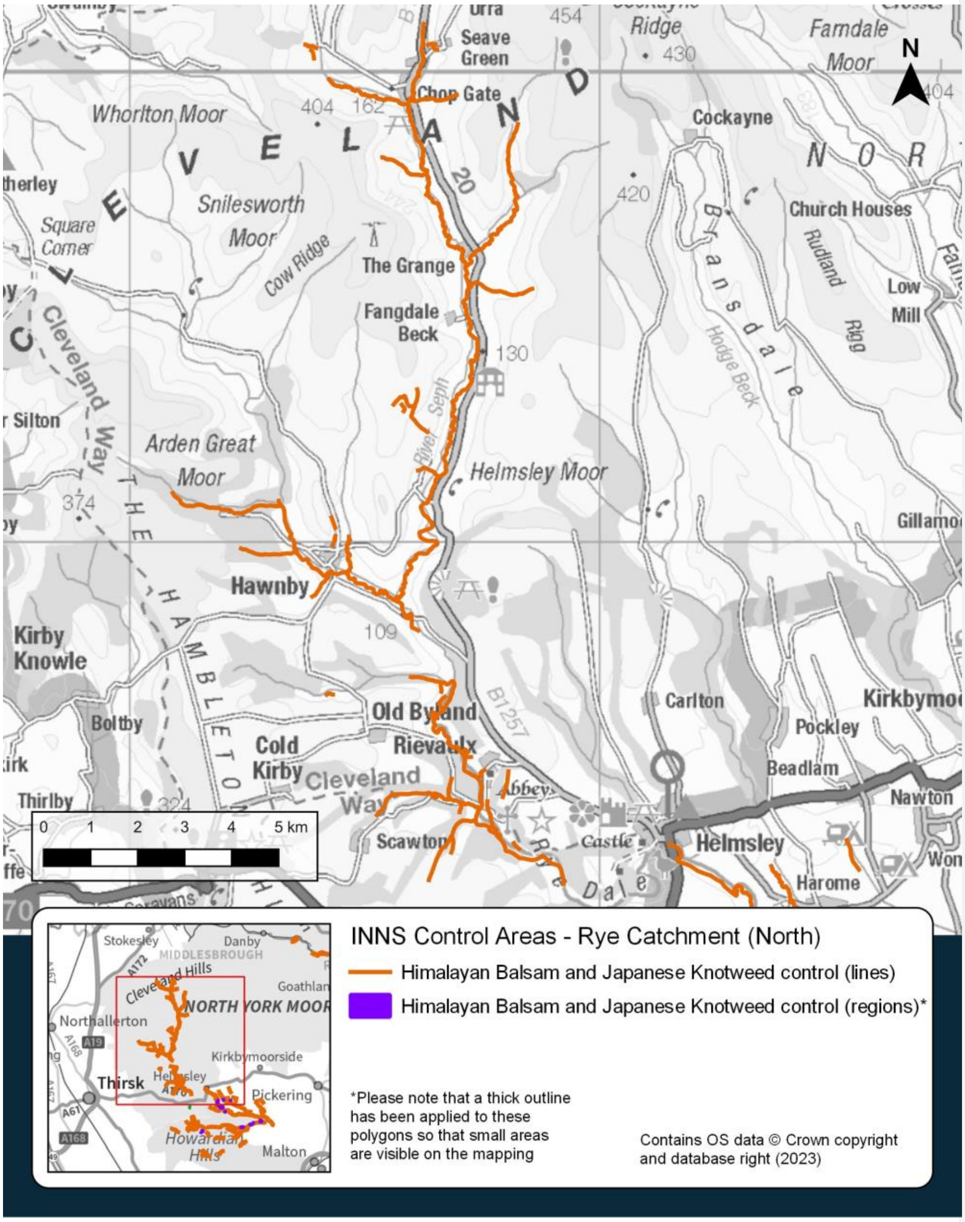

Figure 3-10 Controlled areas within the Rye catchment (north) (2020 - 2022)

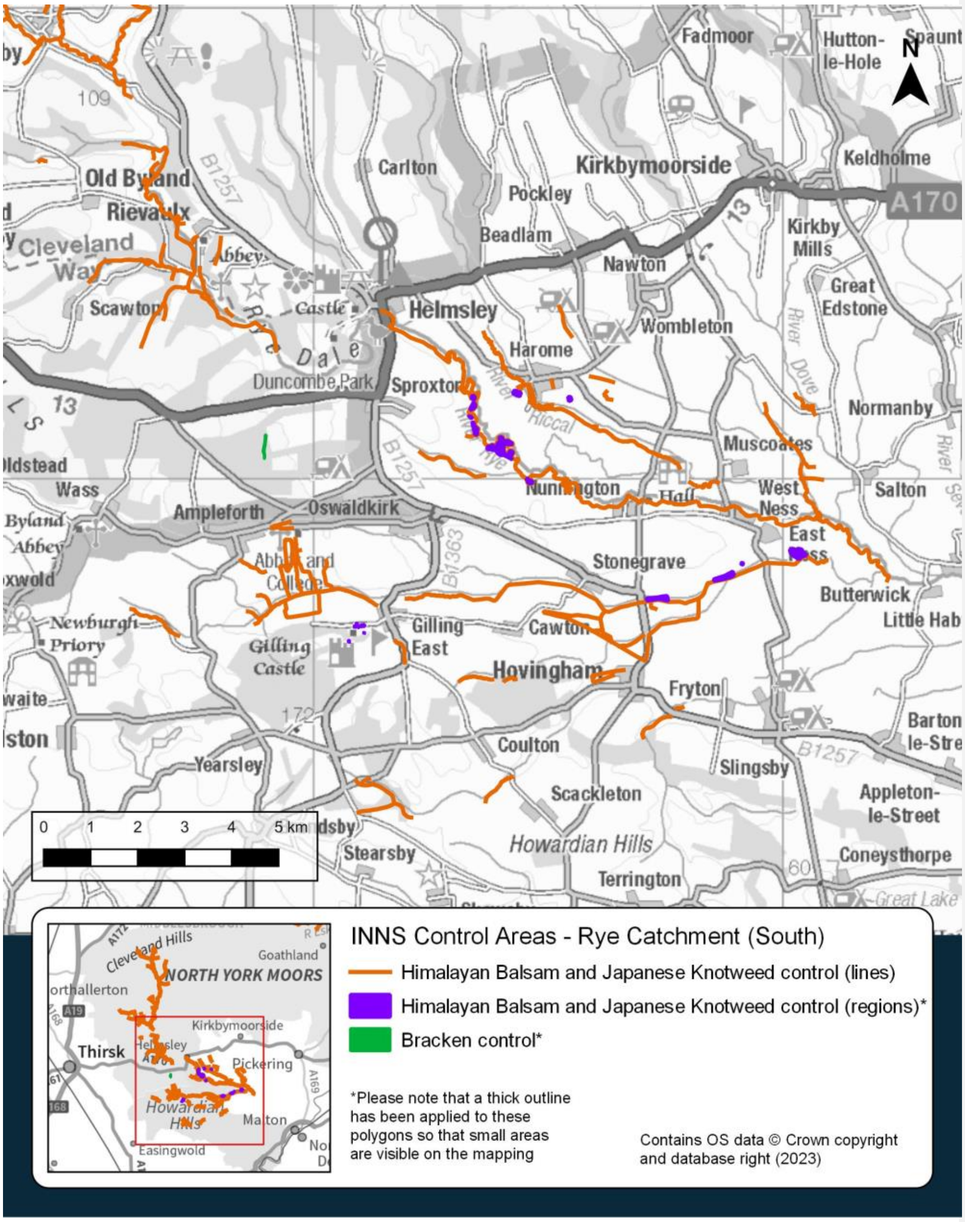

Figure 3-11 Controlled areas within the Rye catchment (south) (2020 - 2022)

Overall, the Blue Corridors project INNS control work has improved more habitat than initially anticipated, accounting for 114.67 ha. This is also greater than the output declared by the Blue Corridors project team through the Activity Sheet 2 - INNS Control document submitted to the ERDF in October 2022; a difference explained by the conservative assumption made at the time that no new areas were controlled in 2022 as the task of uploading the data mapped to Earthlight was still pending at that time.

This increase from the initially targeted 77ha is partially attributable to project design. There was an unexpected challenge in sourcing funding for the early control work, which was not covered by ERDF funding. Therefore, the more detailed maps produced in 2020 helped refine the project's areas of targeted INNS control - and the discovery of additional fields of Himalayan balsam in the Rye catchment led the Blue Corridors project to expand works beyond the national park boundary, which expands beyond the NYMNPA's administrative boundaries. Most of the contractors carrying out the work were also very thorough, and people would head back up ditches near feeder streams[6] where the Himalayan balsam thrived, further extending the INNS controlled areas. Project stakeholders noted that it can be particularly difficult to predict Himalayan balsam's spread, and with hindsight a rather conservative estimate of the area was submitted with the ERDF proposal. The estimate was based on river length of the area covered multiplied by 2.5m on either bank.

It was also noted that the Blue Corridors project members are used to gauging work based on river length, in kilometres, as opposed to visualising the impact in hectares. Project stakeholders believe that this contributed to the INNS control work covering a greater area than initially predicted, as contractors worked across entire fields - many of which were wider than anticipated. This suggests that if anything, the methodology applied to line shapefile data is likely to produce a conservative estimate of the area of habitat improved through Activity 2.

While the INNS control has managed to cover more hectares than initially anticipated, the downstream control ended up being approached as a patchwork of disconnected fields (illustrated in Figure 3-9, Figure 3-10, and Figure 3-11), as this was the first time that sufficient funding was available to extend the measures. However, the INNS control work through the Blue Corridors project allowed the NYMNPA to begin the process of building long-term contacts with the landowners in those areas, which should facilitate future collaboration efforts.

3.2.2.1 Predicted Outcomes

At the Blue Corridors project's inception, the short (1-3 years), medium (5 years), and long-term (10 years) impacts of controlling over 70ha of INNS were identified, as

6 Encompasses any stream that becomes managed as part of a drainage system.

summarised in Table 2-2. Removal of invasive non-native species (INNS) also benefits BAP species as it reduces the negative impacts caused by invasive plants.

In the short term, it was anticipated that over 70ha of INNS would be controlled across the Rye and Esk catchments, including Himalayan balsam, Skunk cabbage, and Japanese knotweed. This should alleviate bankside erosion and resulting sedimentation.

Assuming that control efforts are sustained across the 114.67 hectares of habitat improved through Activity 2 in both the Esk and Rye catchments, this short-term impact has been achieved and surpassed. It is reasonable to expect that future INNS control efforts will persist and grow over the next few years, as the Blue Corridors project has facilitated building relationships between local contractors and the NYMNPA that will outlast the project.

Himalayan balsam outcompetes other riparian vegetation, and its annual nature leaves little structure in place to hold the riverbanks together over the winter, leaving bare riverbanks vulnerable to erosion (Kimber, 2017). This can lead to issues with bank stability, which can impact species such as water vole as they burrow into riverbanks (The Wildlife Trusts, 2018), and otter (Lutra lutra), as nests are usually made in natural cavities which can include riverbanks (Woodland Trust, n.d. a).

This creates increased sedimentation and waterway pollution and creates a lack of riparian winter habitat for local wildlife. This may impact species such as water vole (Arvicola amphibius) as they prefer well vegetated banks (Mammal Society, n.d.). These erosion issues can lead to water quality issues due to huge sediment losses, which can impact otter and fish species such as Atlantic salmon and European eel (Pidd, 2017). Other species that may be impacted by sediment water quality issues include freshwater pearl mussels (Margaritifera margaritifera) (NatureScot, 2023) and white-clawed crayfish (Austropotamobius pallipes) (Norfolk Rivers Trust, n.d.).

The presence of Himalayan balsam in watercourses can also impede water flow due to the speed at which it can colonise riverbanks (Cooper, 2019), linking to further water quality and flow issues.

As such, INNS control measures have immediate impacts even in areas that are unable to move towards eradication. The removal of Himalayan balsam will reduce these negative impacts on species and allow more natural flora and fauna to re-establish along the banks of the Rye and Esk. Japanese knotweed crowds out native vegetation and causes structural damage, which has particular impacts for bank structure and can result in erosion (Canal and Rivers Trust, 2020). As such, the removal of Japanese knotweed will increase bank stability along the Rye and Esk, which benefitting water vole and otters, and improves water quality issues caused by sediment erosion, benefitting species vulnerable to pollution.

The removal of American skunk cabbage has also benefitted native habitats and species. Due to its ability to spread rapidly, it crowds out native species and cause extensive damage to native flora (Scottish Invasive Species Initiative, n.d.). It can block drainage channels which can impact water flow and water quality (Defra et al., 2019). This can have negative impacts on species that are sensitive to pollution and poor water quality, notably European eel, Atlantic salmon, white-clawed crayfish, and freshwater pearl mussels. Otter are often found in lower densities by polluted waters therefore these species will also benefit from American skunk cabbage removal (Woodland Trust, n.d. a).

Over the next 5 years, it was anticipated that the project would contribute to reducing the seed bank of INNS within the Rye and Esk catchments, restoring native botanical diversity in the riparian corridors.

The Blue Corridors project has made significant progress towards reducing the INNS seedbank within the Rye and Esk catchments. The INNS control measures implemented through Activity 2 have been noted to be particularly effective in the Rye's operational catchment, due to the large area covered through the Blue Corridors project (93.66ha) and the catchment's relatively small size. Project delivery partners anticipate that, if sustained, the INNS control efforts will shift from management to eradication, a transition that will have been triggered by the Blue Corridor's efforts.

Yet project stakeholders have expressed frustration that areas that fell within the patchwork control efforts are less likely to see sustained reductions in INNS populations, as a seed source remains. It was also highlighted that the outcomes of the INNS control efforts are reliant on continued, consistent funding and sustained efforts over the next several years. Project stakeholders noted that even missing one year can have devastating consequences for the local ecosystems, and that while the Blue Corridors project has contributed significantly to their management efforts, it is just one step in an ongoing process.

In the Esk catchment, the Himalayan balsam control expanded between 2021 and 2022, which enabled establishing better coverage and focusing efforts on areas where large stands of balsam are known to exist by getting neighbours involved in the works as well (Cripps, A., 2023). By expanding the number of local stakeholders actively participating in INNS control works, and targeting key patches rather than being forced to stop at the delineated edge of a particular field for permitting reasons, should create a far more comprehensive approach to INNS control work in future years.

The effectiveness of the Japanese knotweed control in the Esk catchment, with fewer plants observed and treated in consecutive years, led the same contractors to be used for Japanese knotweed and Himalayan balsam (Cripps, A., 2023). It was found that this approach enabled both plants to be surveyed simultaneously, helping to prioritise future works and reduce the risk of seed banks for Himalayan balsam remaining in areas targeted for Japanese knotweed, and vice versa.

With regards to restoring native botanical diversity in riparian corridors, despite its native status the bracken removal works undertaken through the Blue Corridors project will support these efforts, with knock-on effects on improving the local fauna as well. Bracken is a poor food source as it is poisonous to small mammals and dies back in winter, reducing habitat availability (The Wildlife Trusts, n.d.). Removal of bracken encourages primary habitats to re-establish on the river banks, which are of greater importance for wildlife as more space is available for birds such as spotted flycatcher (Muscicapa striata) (Baildon Parish Council et al. 2012). The reason for spotted flycatcher population decline is unclear, but it may be linked to a decline in flying insects which are their main food source (Woodland Trust, n.d. b). The removal of bracken and subsequent re-establishment of native flora and fauna can therefore benefit this species due to improved habitat and food availability.

Finally, over the next 10 years it was anticipated that the actions taken as part of Activity 2 will contribute to restoring 100ha of riparian corridor habitat in the Rye and Esk catchments, including the establishment of riparian trees. This would consolidate river banks, providing a buffer of native vegetation to filter surface water runoff, slowing the flow of surface water.

As works through Activity 2 have already enhanced 114.67 ha of habitat through INNS control, this target has technically already been achieved. The concept behind it, that continued works over the next decade will slowly expand from the areas covered within the Blue Corridors project remains sound, and it is reasonable to anticipate that additional habitat will be controlled assuming efforts remain consistent. For all the reasons discussed in the paragraphs above, the INNS targeted through the Blue Corridors project will help consolidate river banks and facilitate the restoration of native vegetation.

It is possible that the natural establishment of riparian trees could be supported through direct intervention, should funding permit it.

In summary, Activity 2 has met or surpassed most of its anticipated objectives and outcomes. While the realisation of the projected outcomes reiterated in Table 3-11 below remains contingent on control works being sustained over the next decade, the Blue Corridors project has laid the foundations the NYMNPA required to achieve these goals.

Table 3-11 Controlling over 70ha of INNS

Timeframe	Objectives / Anticipated Outcomes	Outcomes Achieved by Project Completion	RAG
Within the next 1-3 years	Control over 70ha of INNS in the Rye and Esk catchments, including Himalayan balsam, Skunk cabbage, and Japanese knotweed → Alleviates bankside erosion and resulting	Controlled **114.67 ha** of INNS in the Rye and Esk catchments, including Himalayan balsam, Skunk cabbage, and Japanese knotweed → Alleviates bankside erosion and resulting	

Timeframe	Objectives / Anticipated Outcomes	Outcomes Achieved by Project Completion	RAG
	sedimentation	sedimentation	
Over the next 5 years	Reduction of the seed bank of INNS in the Rye and Esk catchments → Restores native botanical diversity in the riparian corridors	Reduction of the seed bank of INNS in the Rye and Esk catchments → Restores native botanical diversity in the riparian corridors	
Over the next 10 years	Restoration of 100ha of riparian corridor habitat in the Rye and Esk catchments, including the establishment of riparian trees → Consolidates river banks → Provides a buffer of native vegetation filtering surface water runoff, and slows the flow of water	Restoration of **114.67 ha** of riparian corridor habitat in the Rye and Esk catchments, likely including the establishment of riparian trees → Consolidates river banks → Provides a buffer of native vegetation filtering surface water runoff, and slows the flow of water	

3.2.3 Activity 3: Creating five circular access routes in the Rye catchment

The focus of creating five circular access routes in the Rye catchment was to ultimately contribute to improving the local population's health and wellbeing, through improving habitat immediately adjacent to the enhanced access routes.

The access routes targeted through the Blue Corridors project had been identified as in need of enhancement through prior work involving comprehensive stakeholder consultation with all interested communities in the Ryevitalise project. This included an Access Improvement Feasibility Study that was carried out as part of the Ryevitalise Landscape Partnership Scheme, which encompassed a workshop to explore the relationship between local communities and the river. This yielded findings of a highlighted a sense of increased isolation and restricted access due to INNS or erosion. The organic, community-driven approach of previous grassroots consultations through the Ryevitalise project ranged from schools to community centres, to anyone with an interest in the river.

Towards the end of 2022, only a few tasks in Activity 3 remained under development, including several smaller gates and one large bridge - which were completed before end of June 2023. The bridge's delays were due to the increased material costs that have resulted from inflation combined with pandemic-induced supply chain disruptions (compounded by the war in Ukraine). The bridge kit initially specified increased exponentially in cost, but several potential alternatives were identified - including one product that is similar to the original design, but would not require a crane for installation, as it could instead be installed in segments.

Generally, the impacts of the COVID-19 pandemic on Activity 3's delivery were minor, and the more significant consequences have been incurred from inflation and supply-chain disruptions. Project stakeholders also noted that some of the costs that were estimated for this activity were conservative estimates, once you accounted for project management, design, installation, materials, Environment Agency consent applications, and tree removals. This challenge was amplified by inflation and the external global pressures - in one example, a quote for the same materials doubled from one year to the next.

The general programme for each access route enhanced through Activity 3 has been outlined below in Table 3-12 through Table 3-16. The following months are encompassed in each quarter:

- Quarter 1 (Q1): Jan - March.
- Quarter 2 (Q2): April - June.
- Quarter 3 (Q3): July - Sep.
- Quarter 4 (Q4): Oct. - Dec.

Stakeholders generally viewed the delivery of Activity 3 to be reasonably straight forward, with a good working relationship established by liaising directly with NYCC. The NYCC provided material delivery and collections and accompanied the Blue Corridors project staff on walkover surveys. The NYCC also supported the process of acquiring official landowner permissions - some of which took over 6 months to finalise due to lengthy response times.

As agreements with landowners were initially agreed in principle, project stakeholders also noted that there were a few smaller access points where landowner agreement had to be negotiated during the works. The programme therefore had a certain amount of flexibility built into it, dependent on final landowner agreement. Although well-managed, the time to acquire and align all the necessary components of legal diversions to allow temporary works required significant project resources. Notably, no complaints were made by local communities regarding the changes to the access routes - a fact that was highlighted by project stakeholders as a significant achievement.

Delivery timescales were compressed predominantly as a consequence of the COVID-19 pandemic's restrictions, but as noted in section 4.1, resourcing complications also impacted the programme's delivery. For Activity 3, these resourcing changes meant that the programme was compressed, leaving "hardly any time to do everything once we moved forwards." Stakeholders noted that once resourcing stabilised, the programme managed to get back under control.

The initial plans proposed for Activity 3 included volunteers. While one volunteer was involved, the compressed delivery timescale combined with the physical limitations of the average retired volunteer led to this plan being reviewed. Tasks either required reasonably physical manual handling, or were not deemed acceptable to be asked of a volunteer (e.g., hold the end of this pole while I….). Instead, it was decided that for tasks requiring only one or two people to support the lead officer, the focus should be on providing more hands-on experience for Blue Corridor project's graduate and trainee staff members. Stakeholders decided that involving volunteers for the sake of involving volunteers wouldn't achieve the right objectives, and that many would see through it. The increased efficiency of limiting the team members working on Activity 3 made it possible to ensure delivery within the project's compressed timescales.

Hawnby route

Enhancement works on the Hawnby route were complete by the end of 2021. As noted above, the delivery delays compared to the program outlined below in Table 3-12 were predominantly due to the movement restrictions implemented during the initial phases of the pandemic.

Table 3-12 Programme overview: Hawnby route

Deliverable	2020				2021				2022				2023	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Receive Planning Permission for Access Route → Hawnby route														
Procure timber outriggers for bridge top works → Hawnby route														
Procure access works materials → Hawnby route														
Deliver access improvement works → Hawnby route														
Procure contractors for sediment mitigation work, Blow Gill boardwalk, for brashing out and waymarking, and for the Cow Wath sleeper bridge repairs → Hawnby route														

Legend:

- = Delivered on or ahead of schedule
- = Planned
- = Delayed delivery (complete)

Helmsley route

The delivery program for the enhancement works on the Helmsley route is summarised below in Table 3-13. All the works on the Helmsley route were undertaken by Blue Corridors staff, and NYCC procured all the materials (Cripps, A. (2023), email to Colette Bowen, 20 March).

The river is very rapidly eroding the bank near the Helmsley route, to the extent that an additional several meters have been eroded by early 2023 since the Blue Corridors project began in 2020 (Cripps, A. (2023), email to Colette Bowen, 20 March). It was decided that the route of the proposed regarding was under threat of erosion, so the planned works to regards the slope and level path were scrapped as it was seen as pointless to proceed. NYCC are in discussions, seeking landowner agreement, to move the path and take forwards a ROW diversion - yet this remains under development as current forestry operations in the area need to be completed before the path works can begin (Cripps, A. (2023), email to Colette Bowen, 20 March). This will be resolved beyond the life

of the Blue Corridors project, and the area remains earmarked for future improvements.

Table 3-13 Programme overview: Helmsley route

Deliverable	2020				2021				2022				2023	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Procure contractors to regrade slope and level path → Helmsley route														
Procure access works materials → Helmsley route														
Receive Rights of Way diversion consents → Helmsley & Nunnington to Harome routes														
Deliver access improvement works → Helmsley route														

Legend:

- = Delivered on schedule
- = Planned
- = Delayed delivery (complete)
- = Delayed delivery (in-progress April 2023)
- = Delayed delivery (complete)

Nunnington to Harome route

Works on the Nunnington to Harome route have been summarised below

Deliverable	2020				2021				2022				2023	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Receive Rights of Way diversion consents → Helmsley & Nunnington to Harome routes														
Receive Works in Rivers consent for access works for Nunnington Bridge → Nunnington to Harome route														
Procure footbridge materials → Nunnington to Harome route														
Procure contractor to install bridge by crane → Nunnington to Harome route														
Deliver the bridge installation → Nunnington to Harome route														
Procure access works materials → Nunnington to Harome route														
Deliver access improvement works → Nunnington to Harome route														

NYCC led on its installation, with continual oversight from the NYMNPA (Cripps, A. (2023), email to Colette Bowen, 20 March). There were complications in procuring the footbridge materials and a contractor to install the bridge by crane, as the original materials quote was around £21,000.00. Following the supply chain disruptions created by the pandemic and war breaking out in Ukraine, the same contractor re-quoted for around £47,000.00 (Cripps, A. (2023), email to Colette Bowen, 20 March). This unforeseen rise in costs stalled project decisions for nearly a year as options were reassessed.

The bridge was installed at the end of May 2023.

Table 3-14 Programme overview: Nunnington to Harome route

Deliverable	2020				2021				2022				2023	
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2
Receive Rights of Way diversion consents → Helmsley & Nunnington to Harome routes														
Receive Works in Rivers consent for access works for Nunnington Bridge → Nunnington to Harome route														
Procure footbridge materials → Nunnington to Harome route														
Procure contractor to install bridge by crane → Nunnington to Harome route														
Deliver the bridge installation → Nunnington to Harome route														
Procure access works materials → Nunnington to Harome route														
Deliver access improvement works → Nunnington to Harome route														

Legend:

- = Delivered on schedule
- = Planned
- = Delayed delivery (complete)
- = Delayed delivery (in-progress April 2023)
- = Delayed delivery (complete)

Nunnington circular route

Works on the Nunnington circular route were complete by the end of 2022. An overview of the program is synthesized below in

Deliverable	2020				2021				2022				2023	
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2
Procure access works materials → Nunnington circular route														
Deliver access improvement works → Nunnington circular route														

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Table 3-15 Programme overview: Nunnington circular route

Deliverable	2020				2021				2022				2023	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Procure access works materials → Nunnington circular route														
Deliver access improvement works → Nunnington circular route														

Legend:

= Delivered on or ahead of schedule
= Planned
= Delayed delivery (complete)

Rievaulx route

Works on the Rievaulx route were completed by the end of Q3 in 2021, as summarised below in Table 3-16.

Table 3-16 Programme overview: Rievaulx route

Deliverable	2020				2021				2022				2023	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Procure access works materials → Rievaulx route														
Deliver access improvement works → Rievaulx route														
Procure contractor to resurface track → Rievaulx route														

Legend:

= Delivered on or ahead of schedule
= Planned
= Delayed delivery (complete)

Quantifying hectares of habitat improved

The hectares of habitat improvement associated with Activity 3 was quantified as a total improvement across all the sites, from a projected 0.5m on either side of the access route. This was based on the anticipated impact on habitat immediately adjacent to the enhanced access routes, through the implementation of boardwalks over sensitive areas, works to reduce sedimentation, etc.

When reviewed by the Blue Corridors project team, and separately for the Summative Assessment, the initial estimate of 2ha of enhanced habitat were amended to 3ha. This is based on an amendment to the length of the access routes to 30,048m, which includes an additional accessible section that was added to the project on the Rievaulx route (Cripps, A. (2023), email to Colette Bowen, 02 March). The final length of the access routes is highlighted below in Figure 3-12.

Based on the works realised through Activity 3, the activity has created a total of 30km of walking routes. Accounting for 0.5m of habitat improvements on either side of the path, this work has achieved **3 ha** of habitat improvements in the Rye catchment. This method does not take into account the width of the path itself, only measuring the extra 0.5m either side of each path.

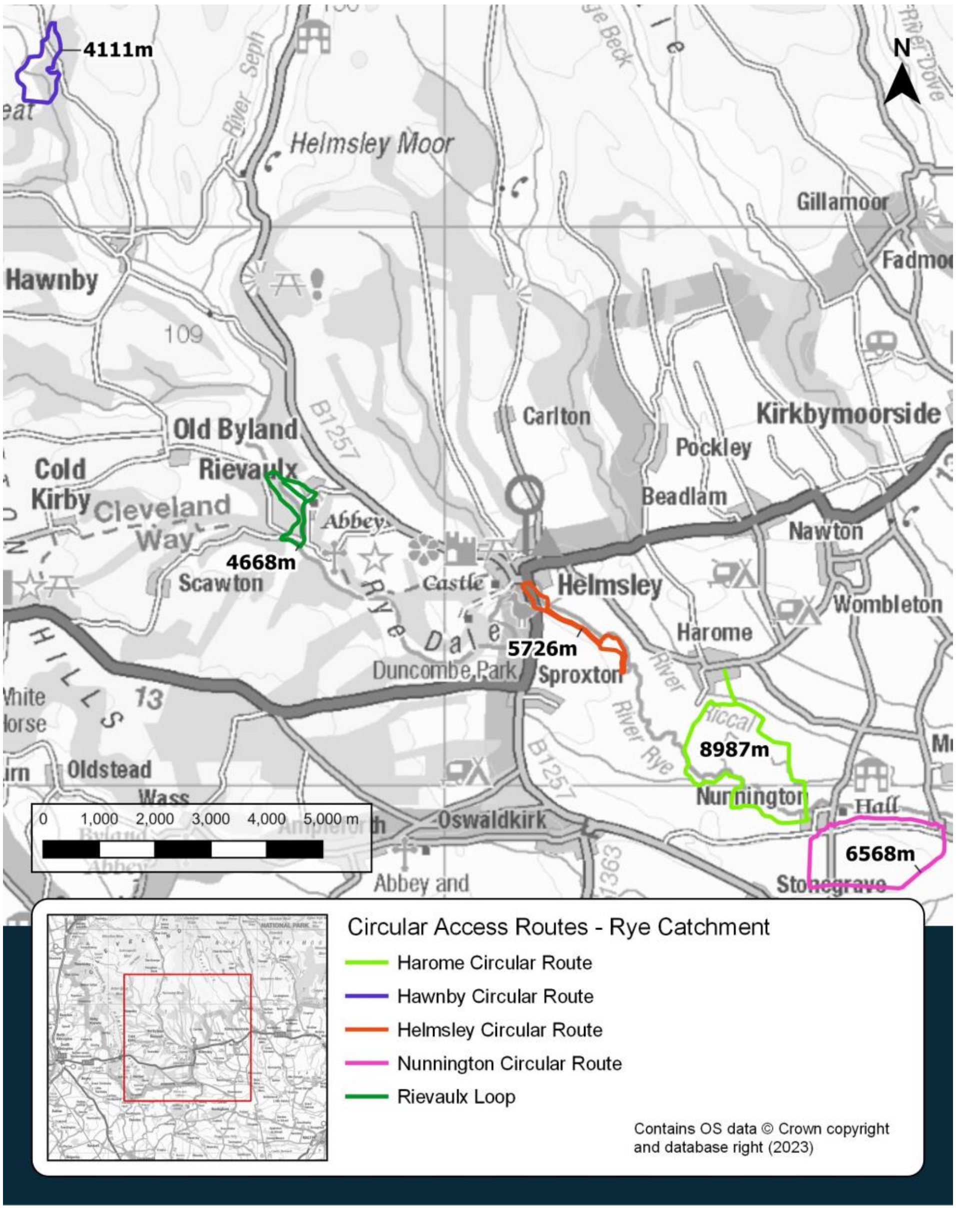

Figure 3-12 Circular access routes created and enhanced by Activity 3

3.2.3.1 Predicted Outcomes

At the Blue Corridors project's inception, the short (1-3 years), medium (5 years), and long-term (10 years) impacts of creating five circular access routes were identified, as summarised in

Table 3-18

In the short-term, it was anticipated that the project will improve public access while reducing habitat disturbance and alleviating riparian habitat degradation. This includes the installation of new infrastructure across ~18km of access routes, and providing access to the area for those with additional mobility needs (such as seasonal access for Tramper type mobility scooters).

The project has already enhanced ~30km across the five access routes outlined in the sections above - existing infrastructure was repaired, including bridges, boardwalks, gates and way-markers. It has been found that the enhanced provision of footpaths could mitigate recreational impacts on local conservation areas, and as such the access routes are expected to reduce habitat disturbance by helping keep traffic on the paths (Hornigold, K. et al.,2016). Previous efforts of track resurfacing within the Peak District National Park found that the number of walkers who strayed from the path dropped from 30% down to 3.8% after the enhancements (Pearce-Higgins, J. and Yalden, D., 1997).

For local riparian habitat directly adjacent to the enhanced access route, the works through Activity 3 should contribute to alleviating habitat degradation, through the implementation of boardwalks over sensitive areas, works to reduce sedimentation, etc. A mixture of track re-surfacing and the installation of silt traps at vulnerable locations should help reduce the sediment load in runoff entering the watercourses. Re-surfacing works include the creation of small board walks to cross sensitive areas, like marshy grasslands. This should also reduce sediment pollution within the Rye catchment by preventing the erosion of bankside habitats, protecting the river gravel spawning habitats of salmonids and other aquatic species.

The works in Activity 3 have increased access to the areas for those with additional mobility needs by removing barriers like stiles and improving access above and beyond the minimum standards of maintenance.

Over the next 5 years, it was anticipated that there will be improved awareness and usage of the ~18km of new circular routes, which can be associated with health and well-being benefits for local users and visitors.

While this increase cannot yet be quantified, it is reasonable to expect that the enhancements to the access routes in the Rye catchment will improve their usage, which will have knock-on health and well-being benefits for local users and visitors. Walking is considered Britain's "most popular outdoor pastime" (Fewster, J., 2004). Access routes and footpaths have been recognized to promote healthy green tourism in rural areas in the UK (Nomura, H. et al., 2015). This same study found that people placed the largest value on a track's length - with the preference of a health walk's profile being between 3 to 5 miles in length, which equates to approximately 4.8 to 8 km (Nomura, H. et al., 2015). As shown in Figure 3-12, the access routes in the Rye catchment through the Blue Corridors project vary between 4.1 to 9 km in length, with the Rievaulx, Helmsley and Nunnington circular routes falling within that bracket of preferred length, which should help to encourage their use and uptake by local users and visitors.

Literature reviews have noted that there is a "substantial body of evidence that shows green infrastructure is significantly beneficial for an individual's physical, mental and social health" (Bowen, K., et al., 2015). Increasing the accessibility of the routes for more of the year and promoting the new and improved access opportunities within the Blue Corridors' boundaries, is expected to encourage more people to explore the local area for recreation. The hope is that the increased awareness and opportunity to spend time in nature, walking through woods and alongside rivers will encourage health-promoting activities amongst visitors and the local population. That being said, research has suggested that simply having contact with nature has been shown to have mental health benefits, improving "psychological health by reducing stress, enhancing mood and replenishing mental fatigue" (Barton, J. et al., 2009).

The creation of shorter circular walks should also help encourage a broader population to spend time outdoors. It is expected that this will have an economic benefit for associated hospitality services, potentially attracting new investment opportunities to cater to the needs of the wider market.

Finally, it was anticipated that over the next 10 years the project would facilitate the promotion of a wider understanding of river environments, biodiversity and ecosystem services to circular route access users.

The access routes also increase learning opportunities for visitors by allowing them to be closer to the ecosystem services that the river catchments provide. Research has suggested that increased time outside, which one study qualified as "experiences of nature" or EoN, cannot be correlated directly with environmental knowledge or attitudes (Colléony, A. et al., 2019). To support building user's wider understanding of river environments and biodiversity, is expected that interpretation panels and artistic leaflets will be compiled to highlight the Blue Corridor project's access routes improvements will provide additional information to help promote the ecosystem services to circular access users. Notably, these are expected to be delivered outside the scope of the Blue Corridor project's budget.

Some project stakeholders expressed concerns that future maintenance funding remains slightly uncertain. It is anticipated that the Lengths People group may adopt sections of each route, ensuring up-keep and providing long-term maintenance, all of which will continue to reduce habitat disturbance in the surrounding areas. It is likely that the routes along the Rye may be adopted by a group of volunteers after the completion of the Blue Corridors project, potentially complemented by future training through the national park ranger team to develop guided walks along some of the routes.

Additionally, the good relationships that have been developed with local landowners through this project should facilitate at least the implementation of future repairs. While it falls beyond the scope of the Blue Corridors project, stakeholders have suggested that developing additional public communications about the enhanced access routes may help motivate the public to help maintain its legacy.

In summary, while Activity 3 is expected to exceed its most of its objectives and anticipated outcomes, as the total length of the access routes enhanced was amended, and all the planned works are expected to be complete by the end of May 2023. In the longer term, successfully achieving the anticipated outcomes and objectives over the next 10 years is likely to be reliant on some minor follow-on works following the completion of the Blue Corridors project - notably around increased promotion of the tracks, and seeking learning opportunities to engage the public. Responsibility for the maintenance and upkeep of each route may also benefit from being clarified.

Table 3-17 Creating five circular access routes in the Rye catchment

Timeframe	Objectives / Anticipated Outcomes	Outcomes Achieved by Project Completion	RAG
Within the next 1-3 years	Creation of five new circular access routes → Improves public access → Reduces habitat disturbance and alleviates riparian habitat degradation Installation of new infrastructure across ~18km of access routes → Provides access to the area for those with additional mobility needs	Created five new circular access routes → Improves public access → Reduces habitat disturbance and alleviates riparian habitat degradation Installed new infrastructure across ~30km of access routes → Provides access to the area for those with additional mobility needs	
Over the next 5 years	Improved awareness and usage of the ~18km of new circular routes	Improved awareness and usage of the ~30km of new circular routes (expected)	
Over the next 10 years	Promotion of a wider understanding of river environments, biodiversity and ecosystem services to circular routes access users, including appointing Lengths People to adopt sections of each route to ensure up-keep and provide long-term maintenance → Continues to reduce habitat	Expected to be achieved, contingent on some follow-up work following project completion.	

Timeframe	Objectives / Anticipated Outcomes	Outcomes Achieved by Project Completion	RAG
	disturbance in the surrounding areas		

3.2.4 Activity 4: Water quality and ecological monitoring

Activity 4 consisted of two main tasks: the first was to monitor a series of pre-selected sites across the catchment on an annual basis through electrofishing, using a combination of volunteers and Hull International Fisheries Institute (HIFI) consultants. The second was to annually survey a different set of pre-identified sites using Riverfly monitoring to build up an environmental baseline, and the foundation of a long-term dataset to provide insights into water quality and the ecological environment. While monitoring activities were stopped due to a lack of volunteers during the COVID-19 pandemic, as the restrictions eased it was one of the first Blue Corridors activities to resume due to its outdoor nature.

The pandemic had significant consequences for site access and monitoring efforts. There were reduced numbers of volunteers, with limited access to induction sessions, limited time, and complications in arranging safe site access. The induction sessions were part of an existing annual program that requires external funding to keep running it - which was provided by the Blue Corridors project for the duration of its lifespan. Yorkshire Water noted that the while the water quality sonde[7] remained in place throughout the pandemic gathering data, the Environment Agency staff was not allowed to go out and replace the filters or service the equipment - which raises data reliability questions.

All access permissions were secured in advance of any works, on an annual basis. The seasonal nature of the monitoring work increased the challenge of its delivery, but the general programme for Activity 4 has been outlined below Table 3-18. The following months are encompassed in each quarter:

- Quarter 1 (Q1): Jan - March.
- Quarter 2 (Q2): April - June.
- Quarter 3 (Q3): July - Sep.
- Quarter 4 (Q4): Oct. - Dec.

While the list of equipment purchased summarised in Table 3-19 has remained accurate throughout the Blue Corridors project's delivery, the number of each item acquired has often varied (Cripps, A. (2023), email to Colette Bowen, 20 March). This is predominantly due to supplier issues, and has had the most significant impact on

7 A sonde is an instrument probe that automatically transmits information about its surroundings from an inaccessible location - e.g., underground or underwater.

the procurement of unique kits - e.g., the Riverfly Monitoring kits, which are only available from one supplier.

Much of the kit required for the Blue Corridors monitoring work in the early phases of the project was borrowed, kit was purchased as part of the project to support the long term monitoring activity. (Cripps, A. (2023), email to Colette Bowen, 20 March).

To clarify the information summarised in Table 3-18, one full electrofishing kit was purchased for work in the Rye catchment, as the Esk already had one. However, additional anodes were purchased for both kits through the Blue Corridors project (Cripps, A. (2023), email to Colette Bowen, 20 March).

Table 3-18 Programme overview: water quality and ecological monitoring

Deliverable	2020				2021				2022				2023	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Procure (by Q4 2020) and deliver Aquatic Invertebrate monitoring, including report writing for the Esk (YW)														
Procure and deliver Crunkley Gill sonde analysis (reduced for 2020 due to pandemic), for 2020 - 2023														
Purchase:[8] → Riverfly Monitoring kits (x 28) → Water quality testing kits (x 28) → Waders (x 47) → Buoyancy aids (x 47) → Electrofishing kit, inc. extra anodes → Nets, buckets, measuring boards, etc. for electrofishing														
Secure landowner access for 2021 monitoring season (overlap with INNS ownership)														
Assign volunteers (already on a waiting list) to monitoring sites and tasks														
Procure consultant to provide an update in safe use of equipment and appropriate methods (2021, 2022, 2023) → for Esk water quality & Riverfly Monitoring volunteers														
Undertake Water quality and Riverfly Monitoring at Esk & Rye sites (2021, 2022, 2023)														
Procure electrofishing consultant for Esk & Rye, inc. data analysis for 2021 & 2022*														

8 Numbers of equipment purchased have often diverged from the initial plan, due to supplier issues and supply chain complications.

Procure consultant to provide safe and proficient use of electrofishing equipment for Rye electrofishing volunteers ahead of 2021 & 2022 seasons*														
Undertake electrofishing and data analysis at Esk & Rye monitoring sites (2021, 2022)														
Service electrofishing kits														
Project Officer to review Water quality and Riverfly Monitoring data														

Legend:

= Planned delivery, but not taken forwards (removed)
= Delivered on or ahead of schedule
= Delivered on schedule (anticipated)
= Planned
= Delayed delivery (complete)
= Planned delayed delivery (anticipated)
= Additional delivery (complete)
* = Programme reduced slightly due to the pandemic (excludes 2020)

The volunteer opportunities to support Activity 4 were advertised as needed through the NYMNP, using a range of mediums including websites and posters. Generally, once volunteers expressed interest, they were added to the project's monitoring lists, and allocated sites and tasks.

The Blue Corridors project has worked with 40 volunteers on the Rye catchment: 33 of those volunteers contributed to Riverfly monitoring, 7 worked on electrofishing surveys, and 5 people were involved in both monitoring activities. The Blue Corridors project also worked with an additional 28 volunteers on the Esk catchment: 20 of whom contributed to Riverfly monitoring, 8 worked on electrofishing surveys, and 5 people were involved in both monitoring activities (Cripps, A. (2023), email to Colette Bowen, 20 March).

The HIFI draft report on fish monitoring notes that the Esk catchment is dominated by brown trout (sea trout) and Atlantic Salmon, whose abundance has varied greatly over the last 140 years (Noble, R. et al., 2023). The run of salmon is currently low and has been generally declining since 2010 - which mirrors national patterns of decline in rivers across England, Scotland and Wales (Noble, R. et al., 2023). Until 2015, salmon were stocked within the River Esk, which complicates ascertaining the population of naturally reproducing salmon. Lower abundance upstream in the River

Esk is due to a "combination of physical barriers and low flow periods limiting progress upstream" (Noble, R. et al., 2023). By contrast, excellent densities of brown and sea trout were found throughout the Esk catchment, a divergence from the nationally declining trend that needs to be protected "by addressing man-made obstacles if possible" (Noble, R. et al., 2023).

The HIFI draft report on fish monitoring notes that the Rye catchment is dominated by brown trout, bullhead and Lampetra sp., with abundance of brown trout ranging between fair to excellent in the upper catchments (Noble, R. et al., 2023). Minnow and stoneloach as more common downstream, while grayling are important towards the middle reach of the River Rye (Noble, R. et al., 2023). Parts of the River Rye are noted to have dried out during the summer in recent years, and there are generally low numbers of Atlantic salmon using the lower River Rye for spawning - with the exception of the apparent recovery of the population in the Yorkshire Ouse system following operational changes at a barrage on the lower Derwent (Noble, R. et al., 2023). The presence of the bullhead, salmon and lamprey, which are protected and conservation species, underscore the importance of local hydrological connectivity efforts (Noble, R. et al., 2023).

Water quality reports drafted for Yorkshire Water by AECOM note a trend of degradation in water quality from upstream to downstream with regards to the requirements of freshwater pearl mussels (FPM) at the current FPM site in the River Esk (Garé, N., 2023). The report notes that, "all watercourses appear to support either salmon or trout in high enough densities to support FPM populations" in the River Esk (Garé, N., 2023). The FPM population in the River Esk is the last population in Yorkshire, and one of the last remaining populations in the UK, and as such monitoring and conservation efforts are critical (Garé, N., 2023).

Electrofishing Surveying

The electrofishing survey sites were selected specifically for the Blue Corridors project, through collaboration with the Hull International Fisheries Institute (HIFI) to determine the best catchment-coverage to complement existing Environment Agency survey sites. Some electrofishing sites had been earmarked through work for the Ryevitalise project, but these were amended and updated prior to the start of Activity 4 (Cripps, A. (2023), email to Colette Bowen, 20 March).

The monitoring work is inherently seasonal: the Environment Agency's license for electrofishing generally spans August through mid-October, although this varies between catchments and individual assessments. Limited kit contributed to limiting how many sites could be monitored during a season. Other complications for the monitoring efforts were created by heatwave in 2021 during the electrofishing season, as two of the rivers that were planned to be surveyed dried up, and there wasn't time to go back to the EA and amend the scope of the license acquired before the season ended.

The electrofishing surveys were carried out by a mix of volunteers and Blue Corridors project staff. A total of 18 volunteers were offered the opportunity to benefit from an update in the safe and proficient use of electrofishing equipment, although not all have remained active following the completion of the 2021 and 2022 electrofishing seasons.

The electrofishing efforts in the Rye catchment were supported by 10 Blue Corridors project staff across both catchments (8 Rye, 2 Esk), as well as by HIFI staff. Table 3-18 summarises the number of electrofishing sites monitored over the course of the Blue Corridors project.

Table 3-19 Electrofishing sites surveyed across the Rye & Esk catchments

Catchment	Number of sites monitored through the Blue Corridors Project			
	2021	2022		
	Volunteers and staff & HIFI Consultants	Volunteers and staff	HIFI Consultants	Total
Rye	11 sites	12 sites	5 sites	17 sites
Esk	6 sites	23 sites	7 sites	30 sites

No additional electrofishing surveys are planned through the Blue Corridors project, as the next season begins after the project's scheduled completion. However, work through the Blue Corridors project has ensured that there are 14 active volunteers (6 Rye, 8 Esk) who are ready to support future electrofishing surveys at the start of the 2023 season. There are 17 electrofishing sites in the Rye catchment, 12 of which will be surveyed by volunteers, and 5 of which are monitored by HIFI. There are an additional 23 electrofishing sites in the Esk catchment, 17 of which will be surveyed by volunteers, and the other 5 that are monitored by HIFI (Cripps, A. (2023), email to Colette Bowen, 20 March).

Water quality and Riverfly Monitoring

Several Riverfly monitoring sites had been earmarked across the Rye and Esk catchments through the Ryevitalise and the Esk & Coastal Streams Catchment Partnership projects. These sites were reviewed by Blue Corridors project staff working alongside the Riverfly Partnership and the Environment Agency Riverfly Co-ordinators, and all the selected sites were reviewed and signed off by the Environment Agency to ensure that their location would complement existing EA monitoring sites (Cripps, A. (2023), email to Colette Bowen, 20 March).

Volunteers had the annual opportunity to benefit from updates in the safe use of equipment and appropriate methods to gather water quality and Riverfly monitoring data between 2021 and 2023. Table 3-20 summarises the number of sites surveyed throughout the Blue Corridors project. Notably, additional water quality and Riverfly monitoring efforts are expected to continue under the Blue Corridors project in Q2 2023 (Table 3-18). For the 2023 surveying season, there are 40 (20 Rye, 20 Esk) active volunteers who are ready to engage with Riverfly monitoring efforts. Additionally, there are 9 new volunteers (4 Rye, 5 Esk) who will be engaged for the 2023 Riverfly monitoring season, and as such the Blue Corridors project expects to increase the number of active Riverfly sites across the catchments. Currently, there are 24 active sites in the Rye catchment, and 21 active sites in the Esk catchment - these are listed in A.6.

Table 3-20 Riverfly monitoring sites surveyed across the Rye & Esk catchments

Catchment	Number of active Volunteers	Number of sites monitored through the Blue Corridors Project			
		(2020)	2021	2022	2023 (anticipated)
Rye	20 volunteers	(10 sites)	13 sites	15 sites	> 24 sites
Esk	19 volunteers	(16 sites)	15 sites	21 sites	21 sites

All of the Riverfly data is automatically collated onto the Riverfly Partnership website once volunteers upload there results. The task of reviewing the water quality and Riverfly monitoring data noted in the programme in Table 3-19 was scrapped due to the Project Officer position being vacated earlier than anticipated. However, the task of reviewing the data was still completed, instead undertaken by the Esk and Rye National Park Officers (Cripps, A. (2023), email to Colette Bowen, 20 March).

The data collected has already had a significant impact, as the monitoring efforts led to the formation of the Esk Freshwater Pearl Mussel Steering Group - which in turn collected the evidence required to involve Natural England. This brought the EA into the project, who put in place a strategy to bring back the local pearl mussel populations - none of which would have happened without the data produced through the Blue Corridors project.

It was noted that many of the monitoring volunteers are recently retired, and their engagement with the Blue Corridors project had the unexpected consequence of leading them to volunteer for other projects - such as the Yorkshire Wildlife Trust.

3.2.4.1 Predicted Outcomes

At the Blue Corridors project's inception, the short (1-3 years), medium (5 years), and long-term (10 years) impacts of the water quality and ecological monitoring was identified, as summarised in Table 2-4.

In the short-term, it was anticipated that the project would facilitate undertaking the collection of water quality and ecological monitoring data, allowing baseline data to be collated, and supporting the evaluation of the impact of the Blue Corridors project activities.

As discussed in sections 3.2.1 and 3.2.2, the removal of in-channel structures and removal of INNS both help to improve water quality. Positive impacts on river habitats since project interventions have taken place can be shown by the presence of indicator Riverfly species in the area. Species of mayflies (Ephemeroptera), caddisflies (Trichoptera), and stoneflies (Plecoptera) have specific tolerances that make them good biotic indicators of water quality (The Riverfly Partnership, n.d.).

The data gathered is largely sufficient to inform an environmental baseline established before and during the works, against which the impact of the Blue Corridors project's activities will be able to be gauged over the next several years. Some data was gathered during the five years preceding the project, and while fewer sites were sampled each year that data clearly indicates a dramatically decreasing trend in the number of stoneflies in the Rye catchment between 2015 to 2019 (Data Explorer Riverflies-MASTER (Rye) document, 2023). Stoneflies are good indicator species because they are relatively intolerant of aquatic pollution and need highly oxygenated environments (Robinson and McAllister, 2022), therefore an increase shows that both water quality and flows have improved.

These indicator species provide an environmental baseline against which the Blue Corridors project was developed, and the data gathered during the project will inform the impact of the works on the catchment.

Over the next 5 years, it was anticipated that the water quality and ecological monitoring sites would become established across the Blue Corridors project areas, facilitating regular monitoring and data collection.

It is expected that delivery on both the Riverfly and electrofishing sites established in the Rye and Esk catchments through the Blue Corridors project will be sustained year on year. Many of the volunteers involved with gathering water quality and ecological monitoring data reported interest in continuing to gather data for the next several seasons. This will support the monitoring and data collection efforts to outlive the Blue Corridors project, assuming the National Parks buy and underwrite the annual servicing of equipment for future years. Going into the 2023 Riverfly monitoring season through the Blue Corridors project, there are 45 currently active sites and 49 volunteers across the Rye and Esk catchments (Cripps, A. (2023), email to Colette Bowen, 20 March). Yorkshire Water also has vested interests in supporting the development of the water quality monitoring reports put together by AECOM, particularly on the River Esk due to YW's focus on the populations of freshwater pearl mussels.

Work through the Blue Corridors project has ensured that 40 electrofishing sites are ready to be monitored in the 2023 season, with the help of 14 active volunteers across the Rye and Esk catchments. The citizen science only constitutes one part of the monitoring work, as expert staff and HIFI consultants will continue to support these efforts.

Finally, it was anticipated that over the next 10 years long-term water quality and ecological monitoring datasets could be collated. This is expected to provide valuable information for future projects to help focus sparse future funding where it can be most effective in achieving positive environmental gains that will benefit the communities that rely on them.

The Blue Corridors project has laid the foundation for establishing a long-term dataset to help target future river restoration efforts. By collating the Riverfly data directly onto the Riverfly Partnership website, a practice has been established that can be sustained past the end of the Blue Corridors project. With the early departure of the Blue Corridors Project Officer, the task of reviewing the data is already familiar to the Rye and Esk National Park Officers, which should support a smooth transition into continued collection over the next few years.

The value of establishing long-term water quality and ecological monitoring datasets is inherently intertwined with future funding allocations, as it provides the data required to identify issues and worrying trends. This allows the NYMNPA to target future projects and interventions appropriately, focusing tasks and funding to derive the best value for money outputs with the greatest impact on habitat improvement. Information is critical to good management, and the monitoring efforts that have been grown and matured through the Blue Corridors project will provide key, reliable insights to inform future decision-making processes. And as all the data gathered is made publicly available, these insights will be shared amongst all the stakeholders with a vested interest in future ecological and river restoration efforts in the Esk and Rye catchments, including Yorkshire Water, the Environment Agency, the Esk Freshwater Pearl Mussel Steering Group and Natural England, local community groups, etc.

In summary, while the works completed through Activity 4 do not contribute to quantifying the Blue Corridors project's impact today, they have established the environmental baseline required and have built the capacity required to be able to reliably measure the project's impact over the next several years. On the assumption that all of the electrofishing and Riverfly sampling monitoring activities will be sustained across both catchments throughout the next decade, it is reasonable to expect that the Blue Corridors project will achieve all the anticipated outcomes of

Activity 4. The outcomes achieved in Table 3-21 are therefore contingent on some follow-up work following project completion.

Table 3-21 Water quality and ecological monitoring

Timeframe	Objectives / Anticipated Outcomes	Outcomes Achieved by Project Completion	RAG
Within the next 1-3 years	Undertake the collection of water quality and ecological monitoring data → Allows baseline data to be collated → Allows the evaluation of the impact of the Blue Corridors project activities	Built and matured the capacity required to undertake the collection of water quality and ecological monitoring data → Baseline data has been collated → Will allow the evaluation of the Blue Corridors project activities in the future	
Over the next 5 years	Established water quality and ecological monitoring sites across the Blue Corridors project areas → Regular monitoring and data collection	Established 45 currently active Riverfly sites and 40 currently active electrofishing sites across the Rye and Esk catchments → Capacity has been developed to sustain regular monitoring and data collection at all these sites over the next few years	
Over the next 10 years	Collate long-term water quality and ecological monitoring datasets → Provides valuable information for future projects to help focus sparse future funding where it can be the most effective to achieve positive environmental gains that will benefit the communities that rely on them	The foundation has been laid to build long-term water quality and ecological monitoring datasets → These will provide valuable information for future projects to help focus spending to achieve the best value for money	

4 Project Delivery & Management (Section 3)

The information in the sections below is predominantly based on a qualitative analysis, with the context and information derived through a series of key project stakeholder interviews from Yorkshire Water, EnviroCentre, NYCC, Blue Corridors, Ryevitalise, Pick Everard and the NYMNPA. More information is available in A.7, following the structure outlined in A.8.

4.1 Project Governance and Management

The project was generally well-managed, with very logical management and governance structures set-up at the start of the project. Critically, the Blue Corridors project team proved adept at adapting and successfully restructuring in the face of unexpected resourcing changes.

The scale of this project was unusual for the NYMNPA, with regards to the size of its budget and in managing the significant capital works across multiple locations. Once the ERDF matched funding was acquired, it was freely acknowledged that there was significant learning on the job for the project team to ensure its delivery - particularly regarding its civil engineering and construction components.

In September 2020, a new role was created as delivery support for the Blue Corridors Project Officer (PO). Project stakeholders emphasised that in an ideal world, one of the officers who worked on compiling the ERDF application would have transitioned into the PO role, but the team involved through the NYMNPA simply did not have the resources to support this. As illustrated below in Figure 4-1, the PO role was designed to be the central nexus between the different components of the Blue Corridors project.

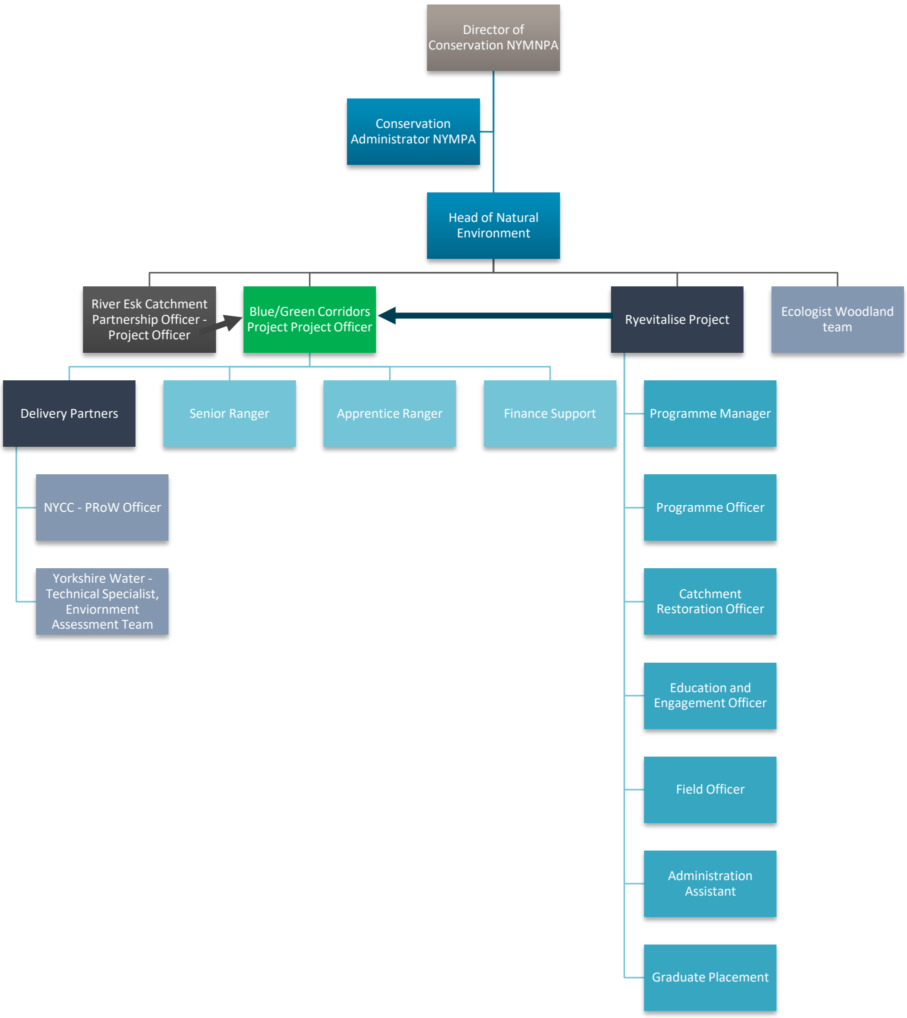

Figure 4-1 Blue Corridors project management structure organogram

Unfortunately, the person hired as the PO had to jump into the role working remotely due to the pervasive pandemic, and their onboarding into the project was left to the Head of Natural Environment. However, the Head of Natural Environment had not been the one spearheading the ERDF application - and the support the PO had transitioning into the role may have been lacking. Aside from the complications created by the COVID-19 pandemic, they had no foundation for a relationship with the contractors or volunteers.

Unfortunately, they left to pursue another career opportunity in December 2021. The PO's unexpected departure had several notable consequences on programme delivery:

- From the delivery partner's perspective, there was a lack clear coordination and communication with their Blue Corridors project counterparts - not helped by the perception that the appointed, "PO never really got started, and then left."
- In 2021, a reduced number of juvenile fish survey sites were monitored in the Rye catchment, and there were delays in raising the necessary awareness of best practice and key health and safety information to effectively utilise the available volunteers.
- Project stakeholders noted that the PO's departure also highlighted that tasks had not progressed as much as hoped, creating a missed opportunity to move forwards some of the behind-the-scenes work during the pandemic. This created a challenging delivery timeframe for 2022.

Given the now constrained delivery timeframe combined with the ~3 month on-boarding period it takes to get new staff up to speed, it was decided not to hire another PO. Instead, the remaining funding for the role was re-allocated to consultants, who coordinated the ITTs, planning applications, etc. Project stakeholders agree that given the information available at the time, this was the right decision - it has been noted, though, that awareness of the project's extension at this stage may have influenced the outcome.

The rest of the project team suffered less changeovers, and greater efforts were made to support staff moved onto the project after the PO's departure. Project stakeholders highlighted that the Director of Conservation, "excels at actively adapting to work around problems, and flexibly reassess an approach that proves ineffective".

Following the PO's departure, a single point of contact was established for INNS contractors, and those running to monitoring inductions, to help avoid confusion during the re-distribution of tasks.

The reporting structures within the NYMNPA were also amended part way through the Blue Corridors project, creating a Senior Leadership Team (SLT) to act a cross-cutting layer linking up the different departments to increase awareness of the different components of project delivery. This simplified internal communication channels, and the now regular "heads-of" project meetings allowed projects to be discussed earlier, increasing engagement and buy-in across the organisation. This improved on the structures in place for the Blue Corridors project creating additional opportunities for engagement, sharing lessons learned that can be fed back into the project. General consensus is that future NYMNPA projects will benefit from additional insights identified through this multi-facetted knowledge sharing approach - potentially starting from the project's design stages.

Collaboration with staff from the Ryevitalise project increased, and someone was brought in to support with the access route enhancements. Project stakeholders noted that this really helped re-start progress on Activity 4. More generally, several stakeholders highlighted that the project benefited greatly from the involvement of competent delivery partners.

4.1.1 Delivery Partners

Project stakeholders highlighted that the Blue Corridors project team was generally approachable, understanding of delivery complications and unexpected restrictions.

When delivery partners were approached about the match-funding opportunity presented by the Blue Corridors project, it was in YW's best interest to remove in-channel barriers to support their sewage works in three of the 12 tributaries along the catchment. YW was already committed to spending funds, and the Blue Corridors project offered an opportunity for habitat improvements that they could not achieve in isolation. It was in YW's interest to support the development of citizen science to monitor the health of the river in the other tributaries, acquiring additional information. The INNS control works was seen to have no known risks, the relatively small Rye catchment was reasonably well mapped, and the wider Derwent Humber catchment's health was being monitored by volunteers and Hull University.

As part of the agreement, YW arranged for consultants from AECOM to provide the Blue Corridors project volunteers with an information session covering best practice for Riverfly monitoring, highlighting what the data they gather would be used for.

4.1.2 Anticipated risks

Nothing was flagged as a significant hurdle during the project's design phase - although there are always difficulties when negotiating fish passes, unforeseen technical issues and environmental issues that can delay delivery. Foreseeable risks were compiled into a project risk register, and contingencies designed to mitigate potentially significant complications. At the start of the project, the most significant risk focused on the still largely uncertain impacts of COVID-19, but other significant risks highlighted in the risk register included are summarised in Table below. Residual risk scores are mitigated by the controls in place at the start of the project.

Table 4-1 Significant risks identified at the start of the project

Category	Risk	Initial Risk Score	Residual Risk Score
Regulatory and Compliance	Breach of ERDF procurement guidelines	12	4
Financial	Project overspend	10	3
Operational	Failure to secure all planning consents	10	3

Category	Risk	Initial Risk Score	Residual Risk Score
Operational	Failure to secure landowner permission for access for INNS control work	9	2
Regulatory and Compliance	Breach of ERDF data retention	9	3
External	Adverse environmental conditions/ weather	9	6
Partnership	Breach of Partnership Agreement	8	3

Stakeholders reflected that it would have been nice to have more time and funding available to refine the technical aspects of the project before submitting their application to the ERDF. While a noteworthy desire, its implementation remains restricted by a lack of readily available funding.

4.1.3 Procurement

In procurement, contractors were assessed on a quality (60%) vs. price (40%) split. For staff, an emphasis was placed on identifying skilled staff who could ask the appropriate questions and meet all procurement regulations. Site-visits were offered to any contractor applicants who were interested to allow them to develop a better understanding of the brief prior to drafting their bids.

Inflation and supply chain disruptions fed by unforeseeable externalities have created significant complications for material procurement scheduled towards the end of the project. Multiple stakeholders cited the extreme example of one quote expanding from £25,000 to ~£75,000; no project would have been expected to budget that level of contingency through a reasonable regular horizon scan.

Delivery partners held some responsibility for some material procurement, notably the NYCC's involvement with Activity 3 in procuring materials for the Helmsley, Harome, and Rievaulx routes. Similarly, Yorkshire Water procured several initial surveys, and both NYCC and YW have procured expert contractors. As such, both NYCC's and YW's procurement frameworks were submitted to the ERDF during the Blue Corridor's development. For materials procured directly through the Blue Corridors project, quote and quality were considered carefully.

One electrofishing back-pack purchased for the Rye catchment, and one for the Esk catchment, were procured early in the Blue Corridors project. This built a total of three electrofishing kits, whose utility will all outlive the Blue Corridors project.

4.2 Project Implementation and Delivery

4.2.1 Has the project delivered its intended activities to a high standard?

All of the project's intended activities have been impacted by the recent global pandemic, surging inflation and subsequent supply-chain complications amplified by the war in Ukraine to varying degrees. In light of this, several of the activities adjusted their approach and programmes - yet despite the necessary modifications to the intended activities, the Blue Corridor's project's intended outputs were still achieved. This, alongside the consensus from stakeholders that the project has provided a catalyst for future work, underscores that the activities have been delivered to a high standard.

Examples of this high standard from each of the project's four activities have been highlighted in the paragraphs below.

Enhancing and restoring 30ha of watercourse (Activity 1)

As inflation dramatically increased material costs, it was determined that the list of planned capital works needed to be reduced to avoid exceeding the project's budget. As such, the expected outcomes created by easing each of the ten in-channel obstacles was reviewed, and the sites whose impacts were limited to a few kilometres were removed from the list of works. The ERDF was informed and agreed to the scope change targeting fewer in-channel obstacles yielding the highest percentage of restored habitat - with no change to project funding.

The benefits of the restored watercourses are amplified by the uniqueness of the habitats that the Blue Corridors project is working in, most notably around the freshwater pearl mussels in the Esk catchment.

Stakeholders noted that comments from local communities were generally understanding regarding programme delays, as the interventions were perceived to offer significant improvements with obvious value. A receptive general public amongst the local communities facilitated programme delivery.

Controlling over 70ha of INNS (Activity 2)

The Blue Corridors project also built trust between the NYMNP and the landowners as the INNS control work was actually delivered, as opposed to just discussed. Several landowners have proactively volunteered their areas for future INNS control next year.

Creating five circular access routes in the Rye catchment (Activity 3)

Project stakeholders noted that one of the additional benefits of the Blue Corridors project was that the success of the access works in the Rye catchment allowed the NYMNPA to build strong working relationships with the Councils, which will have lasting impacts and should facilitate future collaboration.

Additionally, scoping out potential improvements for the Helmsley and Mornington access routes revealed that the river had eaten into the official line of the path, and that works would have to go through neighbouring fields. The project adjusted by officially altering the definitive on-site route, and the Local Authorities benefited from newly updated records.

The good relationships that have been developed with local landowners through this project should facilitate future repairs.

Water quality and ecological monitoring (Activity 4)

Collaborating with volunteers to perform the required surveys was effective, as once set-up it allowed staff project resources to be re-allocated to other areas without getting tied up into the data gathering processes.

4.2.2 Could the delivery of the project have been improved in any way?

Every project encounters complications. For the Blue Corridors project, which has achieved its intended project outputs, the lessons learned outlined in the sections below present an opportunity to improve future projects.

The reflections of various project stakeholders have been gathered into the following sections:

- Contingency planning.
- Obtaining permissions and approvals.
- Quality control.
- Procurement challenges.
- Maximising benefits from delivery partners.
- Public interactions and project promotion.
- Specifications of an ERDF project.
- Project scope.
- Compressed delivery timescales.

4.2.2.1 Contingency planning

It has been acknowledged that the project was designed with minimal contingency, and that even if the global context had not been turned upside down over the project's lifespan, the project would have benefited from more buffers: both financially, for contractor materials and costs, and built into the delivery timescales. Stakeholders have learned that large, multi-site projects require more contingency - although learning to gauge that acceptable level often requires trial and error. The project may have benefited from increased discussions with the ERDF around acceptable contingency prior to submitting its application. It was suggested that a minimum of 12% contingency should be applied to future capital works - a figure which could be increased to offset the lack of a detailed design.

4.2.2.2 Obtaining permissions and approvals

Enhancing and restoring 30ha of watercourse (Activity 1)

One significant challenge in project delivery was around the highways design and redesign for easing the in-channel obstacle at site ESK 5. The design was subcontracted by the Envirocentre to Pick Everard, whose brief included tight funding constraints. Following an iterative design process, the final proposed design included three connected arched, bottomless culverts, which would leave two points of structural contact on the riverbed. This would still provide a significant improvement to the existing in-channel obstacle, easing the waterway. Compliance with civil regulations and the roads authority rules underpinned the design. Unfortunately, the planning application wasn't presented to the NYCC highway's team by the Blue Corridors PO before it was submitted - a critical step as once built, the NYCC highway's team becomes responsible for all management and maintenance. This falls under section 228 of the Highways Act 1980, which allows the NYCC as Highway Authority to adopt a private road after the execution of street works, which makes its maintenance a public expense (Highways Act 1980).

When the planning application was submitted, NYCC noted they would prefer a single-span bridge due to reduce the risk of blockage - which Pick Everard regarded as a suggestion. This critical miscommunication, which was likely not helped by the head of the Envirocentre team being unable to attend the meeting to mediate between Pick Everard and NYCC, led to the planning application for ESK 5 to be rejected. Ultimately, the designs for ESK 5 have been scrapped, and Envirocentre and Pick Everard have stepped away from work at that site. The lack of pro-active redesign was considered to be unfortunate as other advice provided by Envirocentre has been critical in facilitating the delivery of the Blue Corridors project, and members still consider to have a good working relationship.

It has been acknowledged that engaging earlier with the roads authority may have streamlined the process, and that a start-up meeting to obtain a checklist of requirements before going through the iterative design process would have been useful. A new invitation to tender (ITT) for the work at site ESK 5 was sent out in November 2022, and the new contractor is affiliated with NYCC and has emphasised their familiarity with Section 228 of the Highways Act 1980. The plan is to design a single-span bridge to comply with the NYCC's preferences, and maximise the environmental benefits provided by the works. However, this does create an additional cost which has had to be covered by additional, external funding beyond the scope of the Blue Corridors project's budget.

Project stakeholders are cognisant that they had not fully accounted for the timeframes and challenges of working with and around highway sites. The project delivery highlighted that any capital developments that are crossed by highways have to meet highway specifications.

Controlling over 70ha of INNS (Activity 2)

One of the most significant challenges in delivering Activity 2 was in obtaining landowner permissions. Many areas lacked contact information, or the management/landownership details were unclear or not shared with the Blue Corridors project. In areas that were tenanted, it was often difficult to secure true commitment to the project's INNS control plans. This resulted in a patchwork of INNS controlled areas, and unmanaged areas. Project stakeholders have expressed frustration that areas with patchwork control efforts are less likely to see sustained reductions in INNS populations, as a seed source remains. Reflecting on the project, a suggestion to devote additional resources to landowner engagement was proposed, focusing on the areas around the headwaters to prevent seeds going downstream.

4.2.2.3 Quality control

Controlling over 70ha of INNS (Activity 2)

Working with contractors inevitably presents challenges. One challenge materialised initially through a quality-control spot-check of the INNS work, which revealed that one contractor had been using a strimmer to speed up the work. The INNS control tasks are very specific, as each plant needs to be cut at the base of its last node. It was revealed that there had been a miscommunication between the contractor and those in the field, and an agreement was reached concluding that the contractor would only be paid for a handful of the days worked. While no funds were wasted on the poor-quality work, this did create a bit of a gap in the INNS control area for that season, as the area couldn't be re-done within that season's timeframe. This only happened once, and collaboration has continued between the contractor and the Blue Corridor project - albeit with regular spot-checks and very explicit, prescribed contracts.

Creating five circular access routes in the Rye catchment (Activity 3)

Reflecting on the project's implementation, stakeholders noted that there was no clear methodology for monitoring the success of the access routes (e.g., by using counters to monitor increased footfall), although any increase in use would remain difficult to quantify without a pre-established baseline.

Enhancing and restoring 30ha of watercourse (Activity 1)

Additionally, stakeholders noted that the project's delivery challenges underscored the importance of consistency in project personnel, and of integrating good communication channels within delivery teams to track progress.

Water quality and ecological monitoring (Activity 4)

Stakeholders reflected that some of the newer volunteers have been a bit slow to upload the results of their river-fly monitoring, which complicated the task for the supervisor responsible for troubleshooting and quality control. This was highlighted as one aspect of future monitoring works that could potentially be improved.

4.2.2.4 Procurement challenges

Controlling over 70ha of INNS (Activity 2)

The delivery of the INNS control relied heavily on contractors, and the Blue Corridors project struggled to appoint enough mandates. While each INNS control area was ultimately successfully allocated to contractors, several were ultimately unable to deliver to their commitments. Some contractors missed their targeted days or up to their entire delivery windows, which led to the Himalayan balsam going to seed. This was due to competing work obligations, and project stakeholders suggested that this could potentially be mitigated in the future by timing earlier spot-checks, increasing communication or the number of spot-checks.

It has been acknowledged that the procurement challenges of finding enough people to carry out the expected works within the control season were unexpected, as the project was built on the assumption that work put out to tender would always attract quotes. Unfortunately, there is a finite number of contractors in the area, with finite availability. This issue extended beyond the INNS control work, and the firm ultimately contracted to deliver the in-channel obstacle easements, Envirocentre, is based in Glasgow. Project stakeholders underscored that overall, this worked out for the best as Envirocentre was great to work with, but they had a notable lack of connection with the local councils in North Yorkshire.

While inflation's most significant impact was not on the project's INNS control activities, the lack of available contractors to carry out the required work killed competition between the quotations received, driving up the costs. As this forced project stakeholders to break with their policy of accepting the most competitive quote, they were surprised to discover that the contractors who charged the most actually did the best job - the mirrored cost vs. quality provided interesting insights into value for money. Going forwards, references will be requested to help gauge quality of work alongside the monetary value of the quote provided.

Enhancing and restoring 30ha of watercourse (Activity 1)

Delivery partners highlighted that program delivery was also impacted by the number of proprietary systems brought into the construction projects, including precast concrete. Their supply, manufacture and delivery were noted to be key complications, and several suggestions were made to facilitate the delivery of future projects:

- Prioritising early supplier engagement.
- Early procurement of proprietary systems.
- Clear coordination with the contractor regarding timelines and the anticipated delivery of any pre-ordered units.

4.2.2.5 Maximising benefits from delivery partners

Water quality and ecological monitoring (Activity 4)

Some delivery partners had expected to be invited to a project steering group, or to be provided a similar opportunity to feed into the project as a whole, exchanging knowledge and expertise. It was suggested that the project may have benefited from a bi-monthly or quarterly steering group where the whole project is discussed, and delivery partners can provide input as well as formal progress updates. This exchange would reduce the sense of operating in isolation from the other project's components, and provide an opportunity to unofficially draw on their combined significant expertise to consult on any complex project problems. There is of course a cost-benefit balance between their time and potential contributions, but most noted that the project team missed an opportunity to gather additional insights by keeping delivery partners operating in silos. It was also highlighted that a better understanding of the project's wider goals may have facilitated delivery.

Enhancing and restoring 30ha of watercourse (Activity 1)

Several project stakeholders highlighted that the nature of the uncertainty designed into Activity 1 created a reliance of the core project team on their consultants to inform development. Where this created delivery complications, it was suggested that firmer timescales, and potentially a clearer contractual means of enforcing them, may be beneficial for future projects.

4.2.2.6 Public interactions and promotion

Water quality and ecological monitoring (Activity 4)

While the Hull International Fisheries Institute (HIFI) ran most of the induction sessions for the Riverfly and electrofishing volunteers (procured through direct award), Yorkshire Water (YW) jointly supported one of the early Riverfly monitoring sessions, where an AECOM specialist was invited to present. This session resulted in one of the YW speakers being cornered by attendees, berated about the water quality and told that YW is a bad company, which was not well received. Since then, all induction have been with the approved Riverfly partnership tutors (Cripps, A. (2023), meeting with Colette Bowen, 06 March).

Creating five circular access routes in the Rye catchment (Activity 3)

Some delivery partners also highlighted a lack of apparent public engagement or joint publicity.

It was also highlighted that some of the planned interpretation panels and artistic leaflets to highlight the Blue Corridors project's access routes improvements will be compiled following the project's completion. Several stakeholders referenced future plans that, while not directly part of the Blue Corridors project, will help promote the existence and accessibility of the new routes through various communication platforms, including newsletters.

However, other stakeholders noted that the routes have been promoted already through little maps and signs, which has generated several emails of un-prompted positive feedback and thanks from the local community. This would suggest that the improvements are both apparent and promoted to those who currently walk the routes, but that the Blue Corridors project's legacy may be secured through wider communications at some point in the future.

4.2.2.7 Specifications of an ERDF project

Several delivery partners also noted that they would have preferred to have been notified of the paperwork requirements associated with an ERDF project upfront, to have started the venture with a more comprehensive understanding of the paper trail they would need to compile.

The importance of working collaboratively with key project members who understood the unique challenges associated with ERDF funding mechanisms was also highlighted.

4.2.2.8 Project scope

Enhancing and restoring 30ha of watercourse (Activity 1)

Other stakeholders highlighted that the project's initial scope may was rather ambitious. Most notably, the number of in-channel obstacle easements suggested at the project onset may have been overly optimistic - prioritising fewer locations which optimal potential impact may have been a more realistic approach to start with.

4.2.2.9 Compressed delivery timescales

Delivery timescales were compressed predominantly as a consequence of the COVID-19 pandemic's restrictions, but as noted in section 4.1, resourcing complications also impacted the programme's delivery and created delays. Multiple stakeholders expressed that additional time to think, and a more granular programme would have eased the stress associated with the project implementation.

Creating five circular access routes in the Rye catchment (Activity 3)

Stakeholders noted that progressing tasks related to the bridge slightly sooner may have relieved pressure from programme delivery.

The project's very fixed ultimate deadline is creating anxiety around the delayed delivery of a bridge associated with the access routes. With several Environment Agency permissions still waiting to be confirmed towards the end of 2022, the increasingly variable weather, restricted material supplies and uncertain contractor availability there are concerns that it may not be installed in time for the end of the project. Without a clear back-up plan and no scope to extend the project, some stakeholders were concerned that the remaining funding may need to be hastily redirected towards the end of spring 2023.

Water quality and ecological monitoring (Activity 4)

The inherently seasonal nature of the monitoring works created significant timescale constraints for Activity 4. These were compounded by climate pressures, with site-access being weather dependent. The irony of a conservation and climate change project affected by climate change to the point that it complicates project delivery was not lost on stakeholders.

Controlling over 70ha of INNS (Activity 2)

Stakeholders also highlighted that the project design would have benefited from a longer development phase, to allow time to cement all the requirement agreements before launching into delivery, committing yourself to particular sites.

4.3 Project beneficiaries

Although no direct beneficiaries were identified through the Blue Corridors project logic model and original ERDF application, its delivery has highlighted several noteworthy beneficiaries. These include volunteers, local contractors, landowners, local communities in/near the Rye and Esk catchments, the NYMNPA, and arguably the general public.

4.3.1 Volunteers

These monitoring activities include the Riverfly monitoring volunteers, who were provided an induction covering best practice, health and safety awareness to allow them to safely deliver reliable monitoring outputs for aquatic invertebrates and water testing. Similarly, this encompasses the volunteers who were provided an induction to electrofishing surveys alongside the consultants.

The energy and enthusiasm that followed this knowledge-sharing proved to be a brilliant incentive to getting more people from the local communities invested in the river's health. The Blue Corridors project significantly increased local citizen science, upskilling volunteers and increasing public engagement and interest in the project. Several people actively sought-out additional volunteering opportunities after helping with the Blue Corridors project's data gathering initiatives, and several would bring their kids along to help engage younger generations.

4.3.2 Local contractors & landowners

Additional beneficiaries from the Blue Corridors project include local contractors, as the project has created sustained, reliable work. Building up local experience and capability means that the local contractors will provide better value for money to the NYMNPA in future projects.

Landowners, who have a legal obligation to control INNS on their land, have also benefited from the project's control work - and some have already volunteered their lands for future INNS control. Landowners around the enhanced access routes will have reduced maintenance obligations and costs over the next few years.

Farmers, more specifically, were also noted as unintended additional project beneficiaries from the project as their day-to-day logistics have improved through easier access tracks.

4.3.3 Local communities

Delivery partners have highlighted that local communities appear appreciative of the in-channel easements, recognising the benefits of improved local infrastructure and being generally congenial throughout the works. It was noted that several of the existing structures (fiords and bridges) flood on a semi-regular basis, and that easing the in-channel obstacles helps reduce future flood risk, enhancing transportation links and reducing risks of isolation.

There may also be potential economic benefits for local communities, should tourism increase as a result of the improved connectivity and enhanced natural environment.

Additionally, local communities will benefit directly from the Blue Corridors project through increased access to the river. The enhanced access routes should encourage people to get outside, which has a range of health improvements. These include a reduction in the risk of diseases associated with a lack of physical activity (e.g., heart disease), and as such assuming they are utilised the enhanced access routes represent an economic benefit - both to the individual's health, and as a cost-avoided to the public health service through reduce treatment costs. Through community consultation, the Ryevitalise Project had identified that people were feeling increasingly isolated from the river, with their access impeded by INNS or erosion. The Blue Corridors project's enhanced access routes in the Rye catchment should support reconnecting people and the environment.

Improvements to the Helmsley routes were highlighted by stakeholders, particularly for those with mobility issues.

4.3.3.1 Local angling communities

If successful in increasing the local fish stock, project stakeholders noted that the local Angling communities will benefit as well. This may also have a positive fiscal impact in the local area, as it was noted there's a lot of money in Angling communities. (Additionally, there are wider benefits for other angling communities of improving fish migration and enhanced function of key ecosystem services.)

Other special interest groups may benefit as well.

4.3.3.2 Project stakeholders

Several local project stakeholders noted that they regularly utilise the enhanced access routes.

4.3.4 The NYMNPA

Stakeholders have also noted that the NYMNPA has also benefited from the Blue Corridor's project, as the project team has gained significant experience in the design and management of large-scale capital projects. It has also highlighted a need for additional internal resource, and increased awareness of the impacts of large-scale engineering projects that will provide valuable insights into future projects.

4.3.5 General public

There are also a wide range of beneficiaries from the monitoring programme established by the Blue Corridors project. The data gathered is shared amongst the partner organisations, providing valuable insights into their projects - e.g., through the Esk & Coastal Streams Catchment Partnership. This contributes to the catchment-based approach supported through DEFRA, which includes the Blue Corridors project. There are a wide range of potential beneficiaries from the Riverfly monitoring data gathered through the project, as it is planned to also be submitted to the Riverfly public database.

5 Project Outcomes and Impacts (Section 4)

The Blue Corridors project's Logic Model identified very similar outputs, outcomes and intended impacts. As such, while this section focuses on outcomes and impacts, there is some overlap with the information summarised relating to the project's outputs in part 3 Project Progress (Section 2). Redundancy has been minimised by referencing previous sections where appropriate.

5.1 Project Progress

The Blue Corridors project's Logic Model identified project outcomes which are summarised in Table 5-1, along with the section of the report that details progress against each outcome. In summary, the project has exceeded its intended outcomes for Activities 2 and 3, partially due to underestimating the hectarage that would be impacted, yet still ultimately attributable to effective management and execution from the Blue Corridors project team (3.2.2, 3.2.3.1). Activity 2 has produced an output of 114.67 ha, and Activity 3 is expected to produce an output of 3 ha (3.2.2, 3.2.3.1). The number of in-channel obstacles that were earmarked for easement were reduced from 10 to 5, a change approved by the ERDF and proposed to keep the project within its budget despite external factors forcing material and construction costs to increase exponentially. These industry-wide cost increases were due to impacts of the pandemic and the war in Ukraine upon global supply chains, interlinked with soaring inflation. Yet despite halving the number of in-channel obstacles eased, it is expected that Activity 1 will yield a total output of 24.2 ha of improved habitat (3.2.1.1).

As the intended outcomes for Activities 1-3 are directly quantifiable in terms of associated outputs, as described in 3.2.1, 3.2.2, and 3.2.3, the Blue Corridors project can claim full credit for supporting a total of **124.31 ha** of habitats towards attaining better conservation status (C23, Table 3-1).

Table 5-1 Blue Corridors project's Logic Model Outcomes

Relevant Activity	Intended outcomes	How is it measured?	Associated output planned	Section(s) discussed
1	Obstacles eased; rivers restored	Hectares	33 ha	3.2.1.1
2	INNS Controlled	Hectares	77 ha	3.2.2.1
3	Enhanced habitat of 5 circular walks as per C23	Hectares	2 ha	3.2.3.1
4	Better water quality	Surveying and monitoring		3.2.4.1 (3.2.1.1, and

Relevant Activity	Intended outcomes	How is it measured?	Associated output planned	Section(s) discussed
				3.2.2.1)
4	(C23) 9 UK BAP priority species and habitats improvement	Surveying and monitoring		3.2.4.1 (3.2.1.1, and 3.2.2.1)

Activity 4 has allowed the establishment of an environmental baseline and has built the capacity required to be able to reliably measure the Blue Corridors project's impact over the next several years - assuming that the electrofishing and Riverfly sampling monitoring activities will be sustained across both catchments throughout the next decade (3.2.4.1). As such, the project has created the opportunity to confirm the achievement of its intended outcomes over the next several years.

The 9 UK BAP priority species and habitats improved referenced in Table 5-1

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- Rivers.
- European Eel.
- Water Vole.
- European Otter.
- Atlantic Salmon.
- Brown/sea trout.
- White-clawed crayfish (* only found within the Rye catchment).
- Freshwater pearl mussel (** only found within the Esk catchment).
- Spotted Flycatcher.

The impact of the Blue Corridors project on the water quality of the River Rye and River Esk has been intertwined all the project's Activities, and the eight UK BAP priority species have been discussed in section 3.2.4.1. This information was supported by a report on fish monitoring in the Rivers Rye and Esk which was compiled by HIFI, highlighting an abundance of brown/sea trout within the River Esk that needs to be protected, alongside a low population of juvenile Atlantic salmon (Noble, R. et al., 2023). The same report noted that the River Rye is dominated by brown trout, bullhead and Lampetra sp., with generally low numbers of juvenile Atlantic salmon (Noble, R. et al., 2023).

Water quality reports drafted for Yorkshire Water by AECOM note that the freshwater pearl mussels (FPM) population in the River Esk is the last population in Yorkshire, and one of the last remaining populations in the UK (Garé, N., 2023). With regards to water quality in the River Esk, the report found that "all watercourses appear to support either salmon or trout in high enough densities to support of freshwater pearl mussels (FPM) populations", with a trend of degradation in water quality from upstream to downstream with regards to the requirements of FPMs (Garé, N., 2023).

The intended impacts of the Blue Corridors project as laid out in its Logic Model are summarised below in

Relevant Activity	Intended impacts	Section(s) discussed
1	Restored river ecosystems contributing to: improved aquatic habitats, BAP species protected; improved natural river function inc. flood alleviation; reduced pollution pressures; improved water quality; enhanced ecosystem resilience in order for species and habitats to better adapt to climate change and be more resilient	3.2.1.1
2	Native vegetation restored and anthropogenic riverbank erosion mitigated: increased botanical diversity, reduced sediment inputs, improved water quality, protected and stabilised river banks, improved soil health, BAP species protected	3.2.2.1
3	18km of access routes enhanced (resulting in 30Km of catchment walks); improved health and well-being for local communities and visitors through greater connection and access to the outdoors	3.2.3.1
4	Improved understanding of the ecology of our rivers: water quality; aquatic invertebrates; juvenile fish populations	3.2.4.1 (3.2.1.1, and 3.2.2.1)
4	Surface area of habitats supported in order to attain a better conservation status: restoration, conservation and enhancement of aquatic and riparian habitats; BAP species protected leading to an increase in populations	3.2.4.1 (3.2.1.1, and 3.2.2.1)

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Table 5-2 Blue Corridors project's Logic Model Intended Impacts

Relevant Activity	Intended impacts	Section(s) discussed
1	Restored river ecosystems contributing to: improved aquatic habitats, BAP species protected; improved natural river function inc. flood alleviation; reduced pollution pressures; improved water quality; enhanced ecosystem resilience in order for species and habitats to better adapt to climate change and be more resilient	3.2.1.1
2	Native vegetation restored and anthropogenic riverbank	3.2.2.1

Relevant Activity	Intended impacts	Section(s) discussed
	erosion mitigated: increased botanical diversity, reduced sediment inputs, improved water quality, protected and stabilised river banks, improved soil health, BAP species protected	
3	18km of access routes enhanced (resulting in 30Km of catchment walks); improved health and well-being for local communities and visitors through greater connection and access to the outdoors	3.2.3.1
4	Improved understanding of the ecology of our rivers: water quality; aquatic invertebrates; juvenile fish populations	3.2.4.1 (3.2.1.1, and 3.2.2.1)
4	Surface area of habitats supported in order to attain a better conservation status: restoration, conservation and enhancement of aquatic and riparian habitats; BAP species protected leading to an increase in populations	3.2.4.1 (3.2.1.1, and 3.2.2.1)

The project's progress towards achieving its intended impacts has been woven through discussions in the sections noted in Table 5-2 above and is summarised by Activity in the paragraphs below.

In-channel obstacle easement (Activity 1)

As established in 3.2.13.2.1.1, the Blue Corridors project has enhanced watercourse connectivity between the in-channel obstacles upstream of site Rye 20 and downstream of site Rye 22, over a length of 9,002m in the River Rye. This enhances a total of 2.3ha of habitat in the Rye catchment.

Additionally, it is expected that the project will enhance hydrological connectivity between the in-channel obstacles upstream of site Esk 9b, which sits on a minor tributary of the River Esk known as the Little Fryup Beck, as well as up and downstream of site Esk 9a, covering a total length of 19,972m in the River Esk. This will enhance a total of 21.9ha of habitat in the Esk catchment (3.2.1.1).

The intended impacts of these restored river ecosystems, and progress made towards these impacts that can be attributed to the Blue Corridors project, has been summarised below in Table 5-3. Most of this progress has been highlighted previously in 3.2.1.1.

Table 5-3 Progress towards Blue Corridors project's intended impacts attributable to Activity 1

Intended Impacts	Progress or expected impacts directly to Activity 1
Improved aquatic	Removing in-channel structures has a direct positive effect on

Intended Impacts	Progress or expected impacts directly to Activity 1
habitats, and BAP species protected	species diversity as increased hydrological connectivity has been shown to increase the diversity of habitats within a river (Elbourne et al., 2013). Research suggests that even the partial restoration of natural river flow regimes has the potential for significant ecological recovery (Arthington, Á. et al, 2010). Fish species in particular benefit from improved river connectivity, as barriers to natural flows can prevent or delay migrations that are a part of natural lifecycles (Elbourne et al., 2013). Passing obstacles during migrations can result in direct mortality of species such as European eels (Silva et al., 2017), and impact energy reserves of migratory species such as Atlantic salmon and sea trout (Environment Agency, 2021). Removal of obstacles therefore allows migratory fish such as Atlantic salmon, sea trout, and European eel to access spawning grounds while reducing the risk of mortality (Wild Trout Trust, 2022; Environment Agency, 2021). The removal of barriers has been associated with improved diversity of fish species both upstream and downstream of the previous structure (Environment Agency, 2021). Additionally, removing obstacles re-naturalises the river processes, increasing sediment and gravel transport and improving river morphology (Elbourne et al. 2013; European Centre for River Restoration n.d.): which results in an increase in spawning gravels for salmonids.
Improved natural river function including flood alleviation	Improving river connectivity has been shown to lead to a re-naturalisation of river processes, including sediment transport, nutrient transport, flows, and river morphology (Elbourne et al., 2013). Removing structures can aid in the restoration of floodplain connectivity and has the potential to increase floodplain storage capacity too (Elbourne et al., 2013).
Reduced pollution pressures	Some studies have found that more natural areas of a river have a greater potential for pollutant removal (James, V. et al., 2017). Notably, the efficiency of removal of certain pollutants has been correlated to the level of habitat quality or modification - particularly for Fe, Ba, Sn, Mg, P and K (James, V. et al., 2017). In-channel obstacles can alter local channel gradients to result in upstream sedimentation that have the potential for accumulating elevated levels of contaminants throughout their lifespan (Howard, A. et al., 2017). A study modelling weir removal within the Derwent catchment noted that removing in-channel obstacles may allow these potentially contaminated legacy sediments to move away, yet with the danger of then dispersing throughout the wider riverine system (Howard, A. et al., 2017). The HIFI draft report on fish monitoring in the Rivers Rye and

Intended Impacts	Progress or expected impacts directly to Activity 1
	Esk notes that in-channel obstacle easement works will "assist in the protection and enhancement of flagship migratory species such as salmon, but also to protect the natural functioning of habitats and their connectivity, improving the resilience of fish species to pollution incidents and extreme events" (Noble, R. et al., 2023).
Improved water quality	It is understood that the degree of hydrological connectivity directly influences downstream water quality (Harvey, J. et al., 2019). However, research remains divided on the impact of removing in-channel obstacles on water quality (Whol, E. et al., 2015).
Enhanced ecosystem resilience in order for species and habitats to better adapt to climate change and be more resilient.	Removing obstacles encourages watercourse re-naturalisation, including the creation of a more natural bank profile and restoration of natural processes, including erosion and deposition (Elbourne et al. 2013; European Centre for River Restoration n.d.). Reinstating natural physical processes by re-naturalising flow and sediment supply can reduce flood risk by slowing flows and reducing flood peaks (WWNP 2018, 16). More natural river processes increase a river's ability to accommodate changing sediment and flow regimes under climate change (Raven et al. 2009; WWNP 2018, 16). Culverts and bridges can restrict flow, increase downstream flood risk due to reduced response times and reduced flood water retention; with correct design and maintenance, removal/redesign of obstacles can reduce flood risk (CIWEM n.d.; Balkham et al. 2010). With climate change, these risks will be heightened due to more extreme rainfall events and wetter winters; therefore, obstacle removal has been identified as a potentially effective adaptation measure (CIWEM, n.d.).

INNS control (Activity 2)

As established in 3.2.2, the Blue Corridors project has improved over 114.67 ha of habitat through INNS control of Himalayan Balsam, Japanese Knotweed, and bracken across the Esk and Rye catchments. This can be broken down between 93.66 ha of enhanced habitat in the Rye, and 20.97 ha of enhanced habitat in the Esk.

The intended impacts of restoring native vegetation and mitigating anthropogenic riverbank erosion, and the progress made towards these intended impacts through the Blue Corridors project's INNS control efforts, has been summarised below in Table 5-4. Most of this progress has been highlighted previously in 3.2.2.1.

Table 5-4 Progress towards Blue Corridors project's intended impacts attributable to Activity 2

Intended Impacts	Progress or expected impacts directly to Activity 2
Increased botanical diversity	Himalayan balsam outcompetes other riparian vegetation, while Japanese knotweed crowds out native vegetation; controlling these over 113.33 ha of habitat across the Esk and Rye catchments should increase botanical diversity (Kimber, 2017; Canal and Rivers Trust, 2020). American skunk cabbage also crowds out native species and cause extensive damage to native flora (Scottish Invasive Species Initiative, n.d.). Removal of bracken encourages primary habitats to re-establish on the river banks (Baildon Parish Council et al. 2012).
Reduced sediment inputs and improved water quality	As Himalayan balsam dies back in the winter, bare riverbanks are vulnerable to erosion (Kimber, 2017). This creates increased sedimentation and waterway pollution and creates a lack of riparian winter habitat for local wildlife. The presence of Himalayan balsam in watercourses can also impede water flow due to the speed at which it can colonise riverbanks (Cooper, 2019), linking to further water quality and flow issues. American skunk cabbage can block drainage channels which can impact water flow and water quality (Defra et al., 2019).
Protected and stabilised river banks	As Himalayan balsam dies back in the winter, bare riverbanks are vulnerable to erosion, which can lead to issues with bank stability (Kimber, 2017). Japanese knotweed causes structural damage, which has particular impacts for bank structure and can result in erosion (Canal and Rivers Trust, 2020).
Improved soil health	Invasive species have significant impacts on the nitrogen cycles in local soils, and have been shown to impact soil microbial communities, litter decomposition, and a soil's physiochemical properties (Wang, C. et al., 2015). Invasive species have both direct and indirect impacts on soil chemistry and ecosystem function. Over time, they can change soil nutrient pools, or event alter the nutrient cycles differently to native species (Weidenhamer, J. and Callaway, R., 2010). Research has suggested that invasive species can alter the soil biota to create a positive plant-soil feedback loop preferencing their own species over native flora (Huangfu, C. et al., 2019). As such, removing INNS and other invasive species like bracken can be a time sensitive task which will ultimately improve soil health by restoring it to the natural geochemical balances favourable to supporting native flora.
BAP species	Removing INNS benefits BAP species as it reduces the negative impacts caused by invasive plants. Bank stability

Intended Impacts	Progress or expected impacts directly to Activity 2
protected	issues caused by the bare winter banks of areas populated by Himalayan balsam can impact species such as water vole as they burrow into riverbanks (The Wildlife Trusts, 2018), and otter (Lutra lutra), as nests are usually made in natural cavities which can include riverbanks (Woodland Trust, n.d. a). Bare winter banks also creates a lack of riparian winter habitat for local wildlife, which can impact species such as water vole (Arvicola amphibius) as they prefer well vegetated banks (Mammal Society, n.d.). Erosion can create water quality issues due to huge sediment losses, which can impact otter and fish species such as Atlantic salmon and European eel (Pidd, 2017). Other BAP species that may be impacted by sediment water quality issues include freshwater pearl mussels (Margaritifera margaritifera) (NatureScot, 2023) and white-clawed crayfish (Austropotamobius pallipes) (Norfolk Rivers Trust, n.d.). The removal of Japanese knotweed will increase bank stability, benefitting water vole and otters. It will also improve water quality issues caused by sediment erosion, benefitting species vulnerable to pollution. Otter are often found in lower densities by polluted waters therefore these species will also benefit from American skunk cabbage removal (Woodland Trust, n.d. a). Finally, bracken is a poor food source as it is poisonous to small mammals and dies back in winter, reducing habitat availability (The Wildlife Trusts, n.d.). As bracken removal also encourages the re-establishment of primary habitats on the river banks, this supports wildlife as more space is available for birds such as spotted flycatcher (Muscicapa striata) (Baildon Parish Council et al. 2012). The reason for spotted flycatcher population decline is unclear, but it may be linked to a decline in flying insects which are their main food source (Woodland Trust, n.d. b). The removal of bracken and subsequent re-establishment of native flora and fauna can therefore benefit this species due to improved habitat and food availability.

Access route enhancement (Activity 3)

As established in 3.2.3, the Blue Corridors project has improved 3 ha of habitat through enhancing five circular access routes in the Rye catchment.

The intended impacts of enhancing 18km of access routes, and the progress made towards these intended impacts through the Blue Corridors project's INNS control efforts, has been summarised below in Table 5-5. It should be noted that the Blue

Corridors project enhanced the entire 30km of the five catchment walks, including the Hawnby route, the Helmsley route, the Nunnington to Harome route, the Nunnington circular route and the Rievaulx route. This progress has been highlighted previously in 3.2.3.1.

Table 5-5 Progress towards Blue Corridors project's intended impacts attributable to Activity 3

Intended Impacts	Progress or expected impacts directly to Activity 3
Improved health and well-being for local communities and visitors through greater connection and access to the outdoors	Walking is considered Britain's "most popular outdoor pastime" (Fewster, J., 2004). Access routes and footpaths have been recognized to promote healthy green tourism in rural areas in the UK (Nomura, H. et al., 2015). Literature reviews have noted that there is a "substantial body of evidence that shows green infrastructure is significantly beneficial for an individual's physical, mental and social health" (Bowen, K., et al., 2015). Contact with nature has been shown to have mental health benefits, improving "psychological health by reducing stress, enhancing mood and replenishing mental fatigue" (Barton, J. et al., 2009). Increasing the accessibility of the routes for more of the year and promoting the new and improved access opportunities within the Blue Corridors' boundaries, is expected to encourage more people to explore the local area for recreation. The creation of shorter circular walks should also help encourage a broader population to spend time outdoors. It has been suggested that in the UK, the preference of a health walk's profile is between 3 to 5 miles (4.8 to 8 km) long (Nomura, H. et al., 2015). As shown in Figure 3-12, the access routes in the Rye catchment through the Blue Corridors project vary between 4.1 to 9 km in length, with the Rievaulx, Helmsley and Nunnington circular routes falling within that bracket of preferred length, which should help to encourage their use and uptake by local users and visitors.

Monitoring and Surveying (Activity 4)

As established in 3.2.4, the Blue Corridors project has developed the environmental baseline and matured the capacity required to be able to reliably measure the project's impact over the next several years. There are now 45 currently active Riverfly sites, and 40 currently active electrofishing sites across the Esk and Rye catchments, with a total of 63 citizen science volunteers equipped to support the monitoring efforts of NYMNP staff and HIFI consultants.

The intended impacts of the improved understanding of the river's ecology, and the progress made towards these intended impacts through the Blue Corridors project's Riverfly and electrofishing surveys, has been summarised in Table 5-6 below.

Table 5-6 Progress towards Blue Corridors project's intended impacts attributable to Activity 3

Intended Impacts	Progress or expected impacts directly to Activity 3
Water quality	The data gathered through the Blue Corridors project was used to inform a draft water quality report compiled by AECOM for Yorkshire Water. Once publicly available, this should help improve the understanding of the water quality within the River Esk and River Rye for all interested parties - including the Esk Freshwater Pearl Mussel Steering Group. The draft report notes that "all watercourses appear to support either salmon or trout in high enough densities to support FPM populations" in the River Esk (Garé, N., 2023).
Aquatic invertebrates and juvenile fish populations	The data gathered for key indicator species provides a baseline against which to reliably measure the impact of the Blue Corridor's project's interventions over the next several years. It will also contribute to the long-term dataset compiled by the Riverfly Partnership, which is publicly available to any interested parties. Developing long-term datasets from the results gathered through Riverfly and electrofishing surveys, who now have a sufficient range of sites to provide statistically robust results, will support key parties in making decisions around future funding allocations. Gathering this information will facilitate targeted interventions and increase the ecological value gained per pound of investment in future projects.

The intended impacts of the Blue Corridors project ultimately meld to support the area in attaining a better conservations status (C23), through the restoration, conservation, and enhancement of aquatic and riparian habitats, and protecting BAP species with the intention of leading to an increase in their populations. This is expanded upon in the sections above, and the impact attributable to the Blue Corridors project on C23 is discussed below in 5.1.2.

5.1.1 Environmental, Social and Economic Impacts: Gross and Net

Evaluating outcomes related to enhanced biodiversity and other environmental indicators can be difficult to evidence due to the time lag between intervention and realisation of impact, as it will be several years before all the impacts fully materialise. As such, it is not possible to evaluate the true scale or value of many expected impacts directly.

Environmental

The environmental benefits of the Blue Corridors project's in-channel obstacle easement, INNS control, and access route enhancements have been discussed at length in the sections above. As quantified in 3.2, the net environmental benefit attributable to the Blue Corridors project lies in the 124.31 ha of improved habitat within the Esk and Rye catchments.

The forecast lifetime outturns are also expanded on in 3.2.1.1, 3.2.2.1, and 3.2.3.1. Notably, the forecast lifetime outturn of the INNS control work is contingent on sustained future INNS control efforts, and the area cleared is presumed to expand as persistent annual interventions move controlled locations closer to local eradication (3.2.2.1).

Social

While the Blue Corridors project had no direct beneficiaries noted in its Logic Model, it has produced several net societal benefits. These include several impacts from the water quality and ecological monitoring efforts, which invested in expanded the citizen science capacity within the local communities - efforts which led some to then seek other volunteering opportunities (4.3.1). The project invested in enhancing local environmental knowledge through the inductions held for its surveying events, and its engagement with local contractors and landowners across multiple activities. The access route promotion planned to follow the completion of the Blue Corridors project will promote a wider community engagement, and the physical and mental health benefits of the enhanced access routes for visitors and the local communities near the Rye catchment have been discussed in 3.2.3.1 and summarised in 5.1.

These benefits are forecast to increase over time; a review of the impact of resurfacing a stretch of the Pennine Way path in the Peak District National Park noted that resurfacing resulted in two-fold increase in the number of visitors using that part of the path (Pearce-Higgins, J. and Yalden, D., 1997).

One of the drivers behind the Blue Corridors project was that it had been identified previously through the Ryevitalise Project that people were feeling increasingly isolated from the river, with their access impeded by INNS or erosion - and the enhanced access routes in the Rye catchment should support reconnecting people and the environment. An assessment of local perception before and after the rehabilitation of the River Skerne in Darlington found through a series of surveys noted that it can take time "for people to build up a caring and emotional connection to their local riverscapes" after interventions (Åberg, E. and Tapsell, S., 2013). It was noted that this process could be supporting by enhancing features that provide "possibilities for recreation and access," as the Blue Corridors project has supported through its access route enhancement works (Åberg, E. and Tapsell, S., 2013). It also noted that providing "attractive greenery" supported the process of building an emotional connection to the area, and that aesthetic preferences are "strongly related to ecological quality" (Åberg, E. and Tapsell, S., 2013). As such, the significant INNS control efforts undertaken through the Blue Corridors project that will help make space for native flora to expand should help make the area more attractive to people exploring the Esk and Rye catchments.

Economic

While the Blue Corridors project is likely to result in a variety of economic benefits from reduced future spending to address damage caused by flooding, INNS, and poor health, at the time of compiling this Summative Assessment these cannot be quantified and attributed directly to the Blue Corridor's project using statistically robust methodologies.

Research emphasises the flood mitigation benefits associated with river re-naturalisation, balancing the cost of any interventions against potential damage from future flood events. It has been suggested that even the partial restoration of natural river flow regimes through, for example, the easement of in-channel obstacles, has the potential for significant ecological recovery (Arthington, Á. et al, 2010). There are an increasing number of re-naturalisation projects spurred by a review of water management systems to align with the increasingly common wet and dry extremes driven by climate change, including one with the goal of making the Regge water system in the Netherlands more dynamic and resilient (Groothuis, E., 2012). The economic valuation of re-naturalisation efforts at the scale of those undertaken within the Blue Corridors project remains an area of ongoing research.

While tentative arguments could be made around the increased citizen science capacity developed through the Blue Corridors project negating the need for paid staff, they would fall flat at this stage as the number of sites surveyed has increased, as opposed to reducing the number of project or HIFI staff involved in data collection.

There is an inherent value to the ecosystem services and existence of naturalised areas within the Rye and Esk catchments. A study through the University of Hull based on surveyed willingness to pay (WTP) demonstrated that participants ascribe an economic value to sites they don't use, and that local populations place a higher value on sites offering enhanced access footpaths open to disabled visitors (Bhatia, N., 2012). Prescribing an economic value to natural areas is always challenging, yet the UK's Office of National Statistics (ONS) quantifies the health benefits associated with outdoor recreation within the UK to have been between £6.2 and £8.4 billion in 2020 (ONS, 2022). In 2020, the ONS estimated the annual value of health benefits gained for outdoor exercise in England at £142.00 per person (ONS, 2022). Yet the ONS estimated that in 2020, approximately 21% of the UK's population gained health benefits from outdoor exercise, a trend which rising since the organisation started collating this data in 2009 (ONS, 2022).[9] As such, if focusing only on the percentage

9 While this increase has been driven by a rise of exercise in gardens and built-up

of the population that gained benefits from outdoor exercise, the estimated annual value of these health benefits in England in 2020 rise to £720.00 per person (ONS, 2022).

According to the 2011 Census, 23,380 people live within the NYMNP's boundary, and based on a STEAM report from 2019, approximately 8.28 million people visit the North York Moors every year (NYMNPA, 2023). However, as noted by project stakeholders no data is currently gathered regarding the number of people using the access routes in the Rye catchment that were enhanced through the Blue Corridors project - and there is no clear methodology for monitoring their increased uptake following the project's intervention (4.2.2.3). Without data to differentiate between the baseline use and the increased use following the Blue Corridor's enhancements works, there is not a statistically reliable way to quantify the economic health benefits associated directly with the works completed through Activity 3.

One can derive an estimate based on the use and welfare values estimated through the University of Exeter's Outdoor Recreation Valuation (ORVal) tool, by targeting the routes in the Rye catchment enhanced by the Blue Corridors project. This tool is designed to estimate the number of site visits, or "newly created" visits from new sites, which can in turn be used to approximate a proportion of visits that generate physical health benefits. Doing so generates the welfare values associated with each access route, although this method is unable to reliably isolate the impact of the Blue Corridors project's enhancement works.

Invasive species are estimated to cost the UK's economy at least £2.2 billion every year, through damage to crops, increased flooding and additional building construction and repair costs (Wildlife and Countryside Link, 2020). The study estimates an economic return of £23 per £1 spent on INNS control work over the next 20 years, which implies a rough cumulative financial benefit to the NYMNPA of around £2,364,699.00 by 2043, based on the £102,813.00 spent on INNS control efforts undertaken through the Blue Corridors project (Wildlife and Countryside Link, 2020; Caldwell, J. (2023), email to Colette Bowen, 13 March). However, this 23:1 valuation is based on the biosecurity threats created by a much broader range of invasive species and is predicated on eradicating 10 establishing invasive species across the UK by 2040 and preventing the establishment of 24 new ones ((Wildlife and Countryside Link, 2020). This is not representative of the scale of the works achievable within the Esk and Rye catchments over the next 20 years, and the valuation of the economic benefit of the Blue Corridors project's INNS control works is therefore about as statistically robust as any other back-of-the-envelope estimate.

areas, some data gathered following the pandemic suggests a change in the UK's relationship with nature, with an increased population seeking to visit more diverse areas (ONS, 2022).

The value of angling in the UK on each kilometre of river has been estimated at approximately £8,532.00 per month during the summer (Williams, F. et al., 2010). Previous research has suggested that several INNS water weeds and riparian species including Himalayan balsam and Japanese knotweed cause problems for anglers for two summer months each year, which brings the annual cost of riparian INNS to £17,064.00 per km of river, per year (Williams, F. et al., 2010). This presents an opportunity to estimate the value of the INNS control work through the Blue Corridors project through a proxy of its impact on the Angling communities, as suggested in 4.3.3.1. INNS control was undertaken along 135 km of the River Rye, at an estimated value of £2,303,640.00 per year to the Angling community. INNS control work was also undertaken along 19 km of the River Esk, at an estimated value of £324,216.00 per year to the Angling community. This method places a tentative value of £2,627,856.00 per year on the Blue Corridors project's INNS control works.

5.1.2 Contributions to the ERDF Programme Result Indicators

There is only one ERDF programme result indicator identified to be relevant to the project: C23 - total surface area of habitats supported in order to attain better conservation status. This supports the ERDF's sixth priority axis of preserving and protecting the environment and promoting resource efficiency.

As quantified in 3.2.1 through 3.2.3, the Blue Corridors project has resulted in a total of 124.31 ha of improved habitat (Table 3-1). These habitat improvements will support the areas in attaining a better conservation status, and as such the works from Activities 1 - 3 contribute to the achievement of ERDF programme result indicator C23.

Several Sites of Special Scientific Interest (SSSI) fall within the Rye and Esk catchments, and their ecosystems are home to several protected species (A.2). As discussed above, the work completed through the Blue Corridors project will support the 9 UK BAP habitats and species, whose improvements will in turn support those areas obtaining a better conservation status.

Only four waterbodies within the Rye catchment had a good ecological status or potential under the Water Framework Directive (WFD) in 2019 (DEFRA, 2022). The most significant water management issue within the Rye catchment came from physical modifications; 25% of waterbodies in the Rye catchment were considered heavily modified in 2019 (Classifications data for Rye Operational Catchment, no date). The work done through Blue Corridors project should contribute reducing the number of waterbodies in the Rye catchment that were considered heavily modified, through the in-channel obstacle easements at sites Rye 20, 21 and 22. While the most significant water management issues within the Esk catchment noted by the WFD came from pollution, the in-channel obstacle easements at sites Esk 9a and 9b also contribute to reducing the number of waterbodies in the Esk catchment that are considered heavily modified (Classifications data for Esk Operational Catchment, no date).

However, how much additional work will be required for riparian areas targeted through the Blue Corridors project to achieve an improved conservation status remains unclear, as the reason that all the waterbodies within the Rye and Esk catchments failed the WFD's chemical status in 2019 is due to changes in the EA's methodology and increased evidence base. As noted in 2.1.2, this means that the 2019 chemical status assessments are not truly comparable to those performed in previous years, as it involves a significant change in chemical classification, adding four groups of global pollutants into the equation[10].

If the ubiquitous, Persistent, Bio-accumulative and Toxic substances (uPBTs) that were added to the newly expanded list of 52 chemicals listed as Priority Substances in the chemical assessment were omitted, then there has been little underlying change in the chemical status for chemicals that are not uPBTs (River Basin Management Plan: maps, no date). Excluding the uPBTs, waterbodies in the Rye catchment, and most of the Esk catchment, would have obtained the surface water chemical status of "good" in 2019 - yet the re-baselined approach offers a more realistic appraisal.

This change in methodology captures a previously unnoticed ecological failure: the uPBTs. The actions taken through the Blue Corridors project do not reduce the uPBTs present within the catchment, and as such the additional work required to improve the area's chemical status assessment under the new methodologies remains unclear.

5.2 Impact Assessment

As has been repeatedly evidenced throughout this report, the Blue Corridors project has made a clear, direct, and quantifiable difference to the quality of 124.83 ha of habitat within the Rye and Esk catchments, approximately 0.08% of the NYMNP (NYMNPA, 2022)[11]. The average cost of improving each directly quantifiable hectare of habitat through the Blue Corridors project is £7262.47, based on the final spend of £905,122.36 (Table 3-1).

Sources of strategic value generated by the project include supporting progress towards controlling the spread of INNS within the NYMNP, significantly denting the populations of Himalayan balsam along riparian corridors (3.2.2). The project has also provided an opportunity to procure and test novel INNS control methodologies, through the procurement of the Routewave kit. While its utility failed to match

10 These uPBTs include: polybrominated diphenyl ethers (PBDEs), Mercury, certain Polycyclic aromatic hydrocarbons (PAHs) and Perfluorooctanoate sulfonate (PFOS), and a group of per-and polyfluoroalkyl substances (PFAS) (Classification | River Basin Management Plan: maps (arcgis.com)).

11 The NYMNP covers approximately 554 square miles, or 143,485.341 ha (NYMNPA, 2022).

stakeholder's expectations, the project provided strategic value for the NYMNPA as an opportunity to review their methodologies as opposed to simply assuming that their current approach was the best approach.

The project also offers strategic value through its access route enhancements, and particularly through the works to increase its accessibility to a wider range of local and visitor users. As noted previously, both physical and mental health benefits are expected to result from these works - although they cannot be directly quantified at this time as no visitor numbers were collated to reliably isolate the change from before and after the Blue Corridors project's interventions (5.1.1). Another strategic value is the expected impact of these works improving people's sense of connection to nature - although without surveying efforts before and (a year or two) after the project's interventions, this cannot be reliably quantified. Therefore, while the impacts existence and notable strategic value to the NYMNPA by bolstering a sensation that will likely make future public engagement easier, neither its direct value nor precise scale can be accurately pinned down.

The project offers significant strategic value through the water quality and monitoring efforts that were scaled up and matured through the Blue Corridors project - yet whose impact fails to be captured within the project's directly measurable outcomes of the hectares of habitat improved. The value of bolstering the capacity and engagement of local citizen science has yet to be determined and cannot be reasonably predicted. Its impact on expanding the number of Riverfly and electrofishing sites within the Esk and Rye catchments, with each location carefully selected to complement existing Environment Agency efforts, provides strategic value as a foundation for future monitoring efforts over the next decade. Additionally, while the completed water quality and monitoring efforts do not directly contribute to quantifying the Blue Corridors project's impact today, they establish the environmental baseline required to be able to reliably measure the project's impact over the next several years - assuming that sampling and monitoring activities are sustained. The value of the project's interventions on BAP habitats and species, on water quality, riverbank stabilisation, and decreased sedimentation will then be able to be reliably quantified. While some of this can currently be estimated through the proxy of the strategic value of the Blue Corridors project to local Angling communities at around £2,627,856.00 per year, but the data on indicator species gathered through sustained surveying efforts will be far more representative.

A significant part of the Blue Corridors project's strategic value for the NYMNPA, and other stakeholders, is interlinked with the expected increased knowledge gained through the publicly available datasets compiled from the Riverfly and electrofishing surveys. This should help focus sparse future funding where it can be most effective in achieving positive environmental gains that will benefit the communities that rely on them. This provides strategic value to all the stakeholders with a vested interest in future ecological and river restoration efforts in the Esk and Rye catchments, including

Yorkshire Water, the Environment Agency, the Esk Freshwater Pearl Mussel Steering Group and Natural England, local community groups, etc.

The Blue Corridors project also offers strategic value to the NYMNPA by slightly increasing the resilience of the River Rye and River Esk to climate change, as obstacle removal has been identified as a potentially effective adaptation measure (CIWEM, n.d.; Balkham et al. 2010). Reinstating natural physical processes can reduce flood risk by slowing flows and reducing flood peaks, increasing a river's ability to accommodate the changing sediment and flow regimes expected under climate change (WWNP 2018, 16; Raven et al. 2009; WWNP 2018, 16).

It is worth noting that there is also strategic value to the Blue Corridors project for the native riparian flora and fauna within the NYMNP, whose habitats run alongside the River Rye or River Esk. INNS outcompete plants; for Himalayan balsam, this is done through aggressive seed dispersal and high nectar production to attract pollinators (Denny, R., 2013). As noted above in 5.1, INNS can alter soil biota to create a plant-soil feedback loop preferencing their own species, so their removal will ultimately improve soil health by restoring it to the natural geochemical balances favourable to supporting native flora, increasing biodiversity (Huangfu, C. et al., 2019). The loss of winter vegetation in many INNS covered riparian corridors, and subsequent bank instability, can create habitat loss for native wildlife (The Wildlife Trusts, 2018; Woodland Trust, n.d. a). Reduced sedimentation from riparian corridors stabilised by native flora will provide value to species sensitive to water quality (Norfolk Rivers Trust, n.d.; Pidd, 2017). Removing in-channel structures has a direct positive effect on species diversity as increased hydrological connectivity has been shown to increase the diversity of habitats within a river (Elbourne et al., 2013).

Evaluating outcomes related to enhanced biodiversity and other environmental indicators can be difficult to evidence due to the time lag between intervention and realisation of impact, which complicates the evaluation. These timescales are one of the limitations to this assessment, as it will be several years before all the impacts fully materialise. As such, it is not possible to directly evaluate the true scale or value of many expected impacts.

For some impacts, notably regarding the expected future health benefits to both local populations and visitors derived from the access route enhancements, the lack of robust data precludes them from being robustly quantified, and/or monetised (as noted above in 5.1.1). Efforts have been made to qualitatively describe these expected impacts throughout the report, including some illustrative quantification, to ensure the full range of expected project impacts is captured (5.1.1).

Given the nature of the project's impacts, it is not possible to reliably extrapolate any FTE data to a standard that would allow the completion of the ERDF's table F-2 to accurately reflect the outcomes from this project. The valuation of environmental benefits derived from the type of activities undertaken by the Blue Corridors project remains a developing field. Without clear baseline data associated with the interventions, at this time there are very few methodologies that could be tenuously applied to calculate GVA. Proxies, as with the expected impact of the INNS control efforts on water quality and fish populations leading to a quantifiable financial impact on the local Angling communities, remain estimates couched on research reliant on generalisations and averages. GVA is only applicable to schemes that create or enhance jobs. Whilst the project will enhance the environment and amenity value of the sites of interest, there is little tangible evidence that local jobs and GVA will specifically be created or enhanced by the works. There is no direct evidence of specific local businesses benefitting from the works nor the potential uplift in GVA that could be derived. Per the advice of JBA Consulting's lead Economist, it was determined that a GVA table is not appropriate for the work undertaken through the Blue Corridors project, as any attempts to estimate figures would be inherently tenuous and likely to lead to misrepresenting the true value created through the habitat enhancement.

6 Project Value for Money (Section 5)

The works undertaken through the Blue Corridors project present good value for money. However, the project's nature precludes clear, directly attributable monetary valuation of all its impacts at this time - many of which will be measurable in the future through the water quality and ecological monitoring efforts matured through this project (5.2). At this time, the only truly quantifiable assessment relates to the cost per hectare of habitat directly improved through the Blue Corridors project, using the methodologies detailed in 1.2.1.

The average cost of improving each directly quantifiable hectare of habitat through the Blue Corridors project is £7281.17, based on a spend of £905,122.36, and project output of 124.31 ha (Table 3-1).

As summarised in Table 1-1, the Blue Corridors project had a total budget of £988,090.00 available to achieve its goal of improving 112ha of habitat - which it will exceed by an **additional 12.31 ha** of enhanced habitat. This funding came from three streams: £341,220.00 private match, £152,825.00 public match, and the remaining £494,045.00 from the ERDF (A.5). This funding was split between the project's major components, and its evolution throughout the project's implementation has been summarised below in Table 3-2. To facilitate an assessment aligned with the Activity-based breakdown of the project outputs, this information has been further summarised below in Table 6-1, as project spend per Activity.

Table 6-1 Overview of project spend per Blue Corridors project Activity

Activity	Initial	Final	% Change (Final/Initial)
1: In-stream obstacles	£572,892.00	£540,340.49	- 5.68%
2: INNS Control	£106,300.00	£123,842.67	+16.50%
3: Access route enhancements	£73,872.00	£102,547.88	+ 38.82%
4: Monitoring	£79,424.00	£49,677.07	-37.45%
(Other)	£155,602.00	£88,714.25	- 42.99%
Total	£988,090.00	£905,122.36	- 8.40%

The project was designed before the constraints and consequences of the COVID-19 pandemic were fully understood, while the supply-chain and shipping delays remained unforeseen, and the subsequent Russian invasion of Ukraine combined to create an unpredicted level of inflation. This resulted in several key programme adjustments, reflected above in Table 6-2. The 5.68% drop in spend for Activity 1 attributable to a combination of increased material costs and halving the number of sites with planned in-channel obstacle easements to keep the Blue Corridors project within budget.

The decreased costs associated with "Other" in Table 6-2 are primarily attributable to the short tenure of the Blue Corridors Project Officer, as reflected by the decrease in spend attributable to salaries in Table 3-2. The Blue Corridors project team's decision not to employ another Project Officer allowed the remaining budget to be re-allocated to Activity 3, enabling the delivery of all the planned access route enhancements despite the increased material costs due to the unforeseeable global complications. This allowed for the 63% increase in budget required to deliver Activity 3 as planned.

Multiple project stakeholders emphasised that combining the four Activities into one large Blue Corridors project allowed a far greater range of benefits to be delivered, compared to what could have been achieved through four separate projects.

Table 6-2 summarises the cost of each hectare of habitat improved through the different Blue Corridors project's four main activities: in-stream obstacle easements, INNS control works, access route enhancements, and water quality and ecological monitoring data collection.

Table 6-2 Value for money of each Activity: spend (final) per hectare of habitat improved

Activity	Final spend	Ha of habitat improved	Cost (£) per directly quantifiable ha of habitat improved
1: In-stream obstacles	£540,340.49	6.64 ha	£81,376.58
2: INNS Control	£102,547.88	114.67 ha	£894.29
3: Access route enhancements	£123,842.67	3 ha	£41,280.89
4: Monitoring	£81,542.00	0 ha	£0.00

In-channel obstacle easements (Activity 1)

There are few directly comparable figures against which to benchmark the Blue Corridors project's value for money, although a recent study ascertaining the average cost of river restoration in Europe estimated a figure of 310,000.00€/ha of river restored (Szałkiewicz, E. et al, 2018). At the time of writing this assessment, this equates to ~£272,769/ha of river restored.

When considering the breakdown presented in Table 6-2, it should be noted that stakeholders highlighted that a reasonable portion of the designs for the in-channel obstacle easements were paid for separately and were not covered by the Blue Corridors funding. This was done during the ERDF application stages to allow the Blue Corridors project to make informed decisions about how to best spend the money available. As such, it must be assumed that the actual cost of the habitat improved directly through Activity 1 is greater than £77,191.50/ha. However, this still places the Blue Corridors project's value for money per hectare of river restored at ~£**195,578**.00 lower than the European average (Szałkiewicz, E. et al, 2018).

This excellent value (£) per hectare of river habitat restored, compared to the European average, was generated despite the soaring material costs and supply-chain complications resulting from factors beyond the project team's control. This resulted in a reduced number of in-channel obstacle easements being attempted, agreed with the ERDF through a formal project change request to drop from 10 to 5 in-channel due to the impact of the unforeseeably high inflation on construction costs.

A small portion of the costs can be attributed to efficiencies generated through the in-channel feasibility assessments in both the Esk and Rye catchments which had been explored through the Ryevitalise Landscape Partnership Scheme and the Esk and Coastal Streams Catchment Partnership prior to the Blue Corridors inception.

It should also be noted that the in-channel obstacle works completed in the Rye catchment cost £78,070.00 (excluding VAT), which means that based on the predicted expenditure by project closure in Table 6-1, the in-channel obstacle easements in the Esk catchment will be a far more expensive investment (Caldwell, J. (2023), email to Colette Bowen, 28 February). Maintenance agreements for the structures have been agreed with landowners (Caldwell, J. (2023), email to Colette Bowen, 28 February).

INNS Control (Activity 2)

Invasive species are estimated to cost the UK's economy at least £2.2 billion every year, through damage to crops, increased flooding and additional building construction and repair costs (Wildlife and Countryside Link, 2020). It has been estimated that the annual cost to the UK's economy of Himalayan balsam is around £1,000,000.00, and around £165,609,000.00 for Japanese knotweed (Williams, F. et al., 2010).

As shown through Table 6-2, the INNS control works undertaken through Activity 2 present the best value for money in terms of cost per directly quantifiable hectare of habitat improved through the Blue Corridors project, at £894.60/ha. As a point of comparison, research in 2010 into the economic cost of INNS in Great Britain estimated the costs of controlling Japanese knotweed through spraying at £0.5533 per m^2 in riparian habitats, which equates to approximately £5,533.00 per ha (Williams, F. et al., 2010). While the Blue Corridors project predominantly targeted Himalayan balsam, the estimates support the argument that the INNS control works through the Blue Corridors project provide good value for money.

The estimate of £896.91/ha of habitat improved drops further to £763.44/ha if you exclude the one-off purchase of the Rootwave kit. The Rootwave kit[12] was purchased for £15,300.00 at the start of the project in March 2020 (Table 3-2). The Rootwave kit was seen to have the potential to enhance the INNS control process, and its effectiveness was initially trailed on pirri-pirri burr. Project stakeholders have admitted that it did not produce the anticipated results, and that the kit was not really fit for purpose as it remained far more effective to manually dig up the pirri-pirri burrs, flipping them to expose the roots to the cold winter weather to eliminate the plant - weather permitting.

Another consideration is that the hectarage cleared through the Blue Corridors project will have a compounding effect over time, facilitating future additional INNS control across more of the Rye and Esk catchments. Project stakeholders noted that their perceived value for money of the INNS control increased year-on-year, as the contractor's experience and understanding of the catchment increased.

Access Routes (Activity 3)

As shown through Table 6-2, the access route enhancements undertaken through Activity 3 present the least value for money in terms of cost per directly quantifiable hectare of habitat improved through the Blue Corridors project, at £41,280.89/ha. As noted in the sections above, this high cost per hectare of habitat is directly attributable to delivering all the planned works despite the rise in material costs that were beyond the influence of the project team. Based on the costs estimated at the project design, prior to the intertwined consequences of the pandemic, inflation, and war in Ukraine, placed the value of one hectare of habitat improved through Activity 3 at a planned £24,624.00/ha - which is far closer to the value for money derived through the works in Activity 1.

The Nunnington to Harome access is 8,987m long (Figure 3-12), and so based on the methodology detailed in 3.2.3, contributed almost 0.45 ha of improved habitat when completed by the end of May 2023. The enhancements planned for this access route suffered significantly from the supply chain disruptions created by the pandemic and compounded by the war in Ukraine, as the building costs more than doubled between when the works were initially planned and when they were delivered (3.2.3).

Gates and styles along access routes are generally the responsibility of the landowner, so their improvement is difficult to mandate without available funding. By completing these upgrades as part of the larger access routes enhancement works carried out through the Blue Corridors project, the labour remained in-house which reduced overall costs associated with the enhancements.

12 A device that electrocutes the roots of plants

Water quality and environmental monitoring (Activity 4)

As discussed previously, no hectares of habitat improved are directly attributable to the Blue Corridors project through the works undertaken through Activity 4. As discussed in 5.2, the water quality and monitoring efforts undertaken through the Blue Corridors project provide strategic value as a foundation for future monitoring efforts over the next decade. This builds a foundation of future value, establishing the environmental baseline required to be able to reliably measure the project's impact over the next several years (assuming that sampling and monitoring activities are sustained). Activity 4's inherent value is in its provision of high-quality data and an environmental baseline that will allow for future projects to target spend and resources more effectively.

Esk vs. Rye Catchments

Breaking down the Blue Corridors project across its main activities which generated directly attributable hectares of habitat improvement provides insight into the value for money generated by each of its workstreams. However, another equally interesting breakdown of interest to project stakeholders will be the breakdown between the costs (£) and benefits in terms of directly attributable hectares of habitat improved between the two catchments.

The quantifiable outputs of hectares of habitat improved are summarised below in Table 6-3 and Table 6-4, based on the cost (£) per hectare values presented in Table 6-2. These tables include an assumption that all monitoring and "other" revenue costs are split equally across both catchments.

Table 6-3 Cost per hectares of habitat improved in the Rye catchment

Activity	Hectares of habitat improved in the Rye	£/ha based on Activity (Table 6-2)	Cost (£) of works in the Rye catchment
1: In-stream obstacles	2.3 ha	£81376.58	£187,166.13
2: INNS Control	93.66 ha	£894.29	£83,759.20
3: Access route enhancements	3 ha	£41,280.89	£123,842.67
Half of: Monitoring (Activity 4) & "Other"	0 ha	N/a.	£69,195.66
Total	98.96 ha	N/a.	£463,963.66*

Table 6-4 Cost per hectares of habitat improved in the Esk catchment

Activity	Hectares of habitat improved in the Esk	£/ha based on Activity (Table 6-2)	Cost (£) of works in the Esk catchment
1: In-stream obstacles	4.34 ha	£81376.58	£353,174.36
2: INNS Control	21.01ha	£894.29	£18,789.03
3: Access route enhancements	0 ha	£41,280.89	£0.00
Half of: Monitoring (Activity 4) & "Other"	0 ha	N/a.	£69,195.66
Total	25.35ha	Na.	£441,159.05*

*slight discrepancy in totals due to rounding

Notably, the Blue Corridors project has improved over twice as much habitat in the Rye catchment as it has in the Esk catchment. As expected, based on the proportion of different Activities undertaken in each catchment, the cost (£)/ha of habitat improved through the Blue Corridors project differs between the catchments - with the cost of an average hectare of habitat in the Esk equating to just under four times the cost of an average hectare of habitat in the Rye.

The average cost of improving each directly quantifiable hectare of habitat through the Blue Corridors project is expected to be ~ **£4,688.12/ha in the Rye catchment**, and **~£17,402.72/ha in the Esk catchment** (Table 6-3; Table 6-4).

7 Conclusions & Lessons Learned (Section 6)

The NYMNP Blue Corridors project has exceeded its goal of enhancing 112 ha, reaching 124.31 ha (~120% output) of surface area supported towards attaining a better conservation status (C23).

The primary market failures addressed by the project were the recent WFD ecological status failures in the Rye and Esk catchments; with physical modifications noted to be the most significant management issue within the Rye catchment (Classifications data for Rye Operational Catchment, no date). The in-channel obstacle easements undertaken through this project will directly support the areas towards attaining a better WFD conservation status, while the INNS control and access route enhancements contribute to enhancing and restoring ecological functions and processes - including biodiversity, soil health, and providing sustainable access.

The inherent value of the monitoring and water quality works undertaken through the project lie in its provision of publicly available high-quality data establishing an environmental baseline that will allow for future projects to target spend and resources more effectively. This will also allow the impacts of the Blue Corridors project works to be quantified more reliably over the next decade. Evaluating outcomes related to enhanced biodiversity and other environmental indicators can be difficult to evidence due to the time lag between intervention and realisation of impact, as it will be several years before all the impacts fully materialise. As such, it is not possible to evaluate the true scale or value of many expected impacts directly.

While the Blue Corridors project had no direct beneficiaries noted in its Logic Model, there are local contractors, landowners, volunteers, communities, and Angling communities, the NYMNPA and the public who will benefit from its interventions. The Blue Corridors project has also produced several net societal benefits, including investing in and expanding local citizen science, and creating physical and mental health benefits for visitors and local communities using the enhanced access routes in the Rye catchment.

The project was carefully designed with several wider strategic goals in mind. While the scale of their impact cannot be reliably quantified at this stage, the Blue Corridors project offers strategic value through:

- Supporting progress towards controlling the spread of INNS within the NYMNP.
- Providing an opportunity to procure and test novel INNS control methodologies.
- Increasing access route accessibility to a wider range of local and visitor users.
- Improving people's sense of connection to nature, which should facilitate future public engagement with the NYMNPA.
- Bolstering the capacity and engagement of local citizen science.

- Supporting the Environment Agency's future monitoring efforts, through expanding the number of established Riverfly and electrofishing sites.
- Increasing the knowledge captured in publicly available datasets, establishing an environmental baseline to help all stakeholders focus sparse future funding where it can be most effective in achieving positive environmental gains.
- Increasing hydrological connectivity in the River Rye and River Esk, slightly increasing local resilience to climate change and future flooding.
- Increasing species diversity (flora and fauna) within riparian corridors.

The project's nature precludes clear, directly attributable monetary valuation of all its impacts at this time - many of which will be measurable in the future through the water quality and ecological monitoring efforts matured through this project (5.2). At this time, the only reliably quantifiable value for money assessments focus on the cost (£) per hectare of habitat directly improved through the Blue Corridors project, which averages to ~£7262.48/ha across the project (Section 6). Of the project's different activities, the most efficient output was achieved through the INNS control works (Activity 2) at ~894.29/ha. Activity 3 experienced a 44% increase in spend between design and delivery, the cost of which is directly attributable to delivering all the planned works despite the rise in material costs that were beyond the influence of the project team.

Also due to the impact of the unforeseeably high inflation on construction costs, the number of sites targeted for in-channel obstacle easement (Activity 1) were agreed to be reduced from 10 to 5 through a formal change request to the ERDF to keep the project in budget. By intervening at only 50% of their planned sites, only 21% of the planned output was achieved. On average across the two catchments, the in-channel obstacle easements came to ~£81,376.58/ha.

Delivering improved outputs under budget, despite the disruptions created by theCOVID-19 pandemic, the war in Ukraine, and global inflation is a significant achievement. While the shortfall in terms of hectares of enhanced through Activity 1 has been noted above, the additional outputs generated through Activity 3 can be attributed to the initial mapping excluding access routes that fell beyond the NYMNP's boundary, as the enhanced access routes span 30km rather than the initially estimated 18 (see section 3.2.3). The additional outputs delivered through Activity 2, at 114.67 ha rather than the planned 77 ha, can be attributed to the conservative methodology used when estimating the activity's potential during the project planning stages. While INNS contractors were generally efficient and effective, the project team that designed the proposal was used to working along watercourses - and didn't account for the natural expansion of INNS control efforts moving more than 2.5m away from the watercourse on either bank. Contractor teams often worked throughout entire fields to ensure effective INNS control, and as such covered a much greater area than had initially been estimated (see section 3.2.2).

The project's delivery has been marred by an unusually chaotic series of both local and global changes. The most significant implications of the COVID-19 pandemic and the significant geopolitical shifts were felt through the resulting inflationary pressures and supply chain complications impacting material costs. They also had significant implications for the practical delivery of the project that materialised in the restrictions to field work, the movement limitations impacting planned coordination with and numbers of volunteers, and the consequences of the enforced remote working on integrating new staff. It has been acknowledged that the program budget had minimal contingency, and future works will include a greater 'risk' budget. However, no acceptable contingency budget could have covered the additional material costs that have resulted from the recent global events.

There is a consensus among stakeholders that the project has provided a catalyst for future work, which underscores the high standard of delivery reflected in achieving an output of 124.31 ha of improved habitat. However, every project encounters complications, and several delivery components which could be improved in future projects include:

- Contingency planning - building in additional buffers, with a suggested minimum of 12% contingency applied to future capital works.
- Obtaining permissions and approvals - accounting for the timeframes and challenges of working with and around highway sites, pro-actively initiating pre-approval discussions as appropriate with the relevant authorities, and potentially devoting additional resources to acquiring landowner contact information and engagement.
- Quality control - allowing for regular quality-control spot-checks on contractor work, establishing clear methodologies for monitoring the success of future access route interventions (e.g., through counters to monitor increased footfall). Additionally, establish consistency and clear communication channels among all the project's personnel, and developing a more robust method for quality control of future monitoring works.
- Procurement challenges - consider the delivery capacity of sub-contractors during the initial project design stages and consider requesting references to help gauge quality of work alongside the monetary value provided in quotes. Additionally, consider prioritising early supplier engagement, early procurement of proprietary systems to avoid supply-chain delays, and clarifying the expected coordination with contractors between timelines and delivery of any pre-ordered units.
- Maximising benefits from delivery partners - exploring the potential (and cost-benefits) of a project delivery partner steering group, reducing silo work to facilitate delivery and utilise the combined expertise to consult on any complex project problems. Additionally, future projects reliant on consultants to inform

development may benefit from firmer timescales with clearer contractual enforcement mechanisms.

- Public interactions and promotion - identifying audience grievances when selecting speakers at public engagement or induction sessions and consider opportunities for joint publicity with other local projects or programmes.
- Specifications of an ERDF project - notifying delivery partners early of the paperwork and paper trail requirements of an ERDF project and sustaining collaboration with project members familiar with the mechanisms behind an ERDF project.
- Project scope - prioritise optimising potential impact with fewer intervention sites for future capital works.
- Compressed delivery timescales - develop a more granular project programme that buffers in thinking or problem-solving time, allow for a longer project development phase, and explore opportunities to build in a clear back-up plan and/or scope to extend the project in the event of significant unexpected complications.

A Appendices

A.1 Location of the original 10 in-channel easements

Table 7-1 and Table 7-2 below detail the original locations of the 10 in-channel easements proposed at the project design stage. It was anticipated that they would all be delivered by the NYMNPA.

Table 7-1 Original in-channel easement locations in the Esk Catchment

Esk catchment		
#	Location	Site
1	Butter Beck	ID5 NZ 79891 05073
2	River Esk	ID9a NZ 72711 07321
3	River Esk	ID11 NZ 66236 06156
4	River Esk	ID13 NZ 69290 06390
5	Little Fryup Beck	ID9b NZ 72673 07303

Table 7-2 Original in-channel easement locations in the Rye Catchment

Rye catchment		
#	Location	Site
6	Bogmire Gill	ID17 SE 60821 90288
7	Bogmire Gill	ID18 SE 60944 90002
8	Bonfield Gill	ID20 SE 60892 94187
9	Bonfield Gill	ID21 SE 61147 93052
10	Bonfield Gill	ID22 SE 61584 90887

A.2 Habitats and Species within the NYM National Park's Blue Corridors

Table 7-3 summarises the habitats and species within the Rye and Esk catchments that fall under a protected or priority status. The text bolded in the table below highlights the UK BAP priority habitats and species.

Table 7-3 Full list of the habitats and species in the NYMNP's Blue Corridors

Habitat /Species	UK BAP priority habitats	UK BAP priority species	NYM LBAP and Ryedale LBAP	EU Habitats Directive Annex II species	Wildlife & Countryside Act specially protected species
Rivers	✓		✓		
Kingfisher *(Alcedo atthis)*					✓
European Eel (Anguilla anguilla)		✓			
Water Vole (Arvicola amphibius)		✓	✓		✓
White-clawed crayfish (Rye only) (Austropotamobius pallipes)		✓	✓	✓	✓
Freshwater pearl mussel (Esk only) (Margaritifera margaritifera)		✓	✓	✓	✓
Bullhead *(Cottus gobio)*				✓	
Lamprey spp. (River lamprey and Brook lamprey) *(Lampetra fluviatilis and Lampetra planeri)*				✓	
Sea lamprey (Rye only) (*Petromyzon marinus)*				✓	
European Otter (UK special responsibility w/in EU) (Lutra lutra)		✓		✓	✓
Atlantic Salmon (UK special responsibility w/in EU) (Salmo salar)		✓		✓	
Brown/sea trout (Salmo trutta)		✓			
Aquatic invertebrates e.g., Scarce yellowstreak mayfly (Rye) *(Electrogena affinis)*			✓		

Habitat /Species	UK BAP priority habitats	UK BAP priority species	NYM LBAP and Ryedale LBAP	EU Habitats Directive Annex II species	Wildlife & Countryside Act specially protected species
Botanical interest e.g., Bluebell *(Hyacinthoides non-scripta)*					
Spotted Flycatcher *(Muscicapa striata)*		✓			

A.3 INNS targeted by the Blue Corridors project

Table 7-4 below records the complete list of the INNS that the project aimed to control across 70ha within the Rye and Esk catchments. These INNS were targeted to restore the ecological function of the riparian corridor and protect the aquatic environment.

Table 7-4 Full list of INNS targeted

#	Common name	Species name
1	Himalayan Balsam	Impatiens glandulifera
2	American Skunk Cabbage	Lysichiton americanus
3	Japanese Knotweed	Fallopia japonica
4	Pirri-pirri burr	Acaena novae-zelandiae
5	Bracken*	Pteridium aquilinum

*While bracken is a native invasive species, it was included in the INNS efforts of Activity 2.

A.4 Circular access route locations

The circular access routes were initially proposed in four locations: Helmsley, Hawnby, Rievaulx, and Nunnington. They were designed to include the installation of new infrastructure to improve tracks, and the installation of silt traps to reduce sediment runoff to improve water quality and biodiversity. These were planned to be delivered by the NYMNPA and NYCC.

A.5 Breakdown of the Blue Corridors Project Funding Sources

Table 7-5 Final Blue Corridors Project Matched Funding Contributions (Capital & Revenue)

Organisation	Funding Type	Total
NYCC	Public	£ 71,417.95
NYMNPA	Public	£ 49,536.01
NYMNPA	Private	£ 250,907.22

Organisation	Funding Type	Total
Yorkshire Water	Private	£ 80,700.00

A.6 Currently active Riverfly monitoring sites in the Esk and Rye catchments

Additional water quality and Riverfly monitoring efforts are expected to continue under the Blue Corridors project in Q2 2023 (Table 3-18). There are 24 active sites in the Rye catchment. These include the following sites:

- Ashberry Pastures - 7a
- Beck Meetings, River Rye - 1a
- Beck Meetings, Wheat Beck - 1b
- Bogmire Gill - 8
- Chop Gate Village Hall - Raisdale
- Fryton Village Site 1
- Fryton Village Site 2 - DS of Site 1
- Giling East DS of road junction
- Giling East US of footbridge
- Harome North - 19b
- Harome South - 19b
- Hawnby Village Hall
- Ness Hall - US of track
- Nettle Dale Spring Site 1 - Stocking House Farm
- Nunnington, near Plump Wood - 37a
- Riccal - Concrete Bridge
- Rye Nunnington
- Stockwell House, D/S - 1c
- Stockwell House, U/S - 1d
- Stonegrave - 12
- Throstle Nest - 41
- US of Hovingham ford
- US of Plantation track bridge
- US of sawmill

There are currently an additional 21 active sites in the Esk catchment. These include the following sites:

- The Woodlands, Sleights
- Little Beck, Throstle Nest Farm
- Iburndale Beck, Sleights Cricket Pitch
- Hunters Sty Bridge: Westerdale
- Great Fryup Beck, Furnace Farm

- Great Fryup Beck, Ellers Farm
- Glaisdale Beck PTC Esk
- Ewe-Crag Beck, Danby Village
- Esk, Egton Bridge stepping stones
- Esk, Danby Moors Centre
- Esk DS Beggars Bridge
- Eller Beck US Ellars Farm at Goathland
- East Row Beck, U/S road bridge
- D/S Rake Farm stepping stones
- D/S Lealholm stepping stones
- D/S Egton Bridge STW
- Cock Mill Beck US STW
- Cock Mill Beck DS STW
- Clither Beck U/S Lodge Farm, Danby
- Baysdale Beck U/S Hob Hole water splash.

A.7 People Interviewed to Compile the Summative Assessment

Several stakeholders were interviewed to help compile this Summative Assessment, as summarised below in Table 7-6.

Table 7-6 Stakeholder Interviews

Organisation	Interview Date
Project lead, NYMNPA	08/11/2022
Ecologist, Yorkshire Water	09/11/2022
INNS control, NYMNPA	25/11/2022
Delivery Officer, NYMNPA	08/22/2022
Technical delivery, Envirocentre	14/11/2022
Access liaison, NYCC	22/11/2022
Delivery Support, Blue Corridors	14/11/2022
Field Officer, Ryevitalise	15/11/2022
External Funding Officer, NYMNPA	21/11/2022
Engineer, Pick Everard	15/11/2022

A.8 Interview Structure: Copy of the Interview Flow Guide

Interview Guide

NYMNPA Blue Corridors Project Summative Assessment

Interview Flow

Stakeholder Information

- Project role: purpose and responsibilities
- What worked well? What did not?

Project Design

- Rationale behind the delivery approach - key influencers at the time
- Key objectives - known risks / potential barriers to achieving those objectives at the start of the project, and what mitigation actions were designed in?

Project Delivery Performance

- What worked well? What did not?
- What were the design changes throughout the project, and what were their key drivers?
- What were the key pressures on the project? What was the impact of these key pressures? At the time of change, what did you expect the impact to be? (Covid-19 pandemic, change in cost of materials/supplies, etc.)
- Has the project achieved its goals? How/ how not? Why/why not?

Project Delivery and Management

- Procurement - how smooth was the procurement process? How did this influence project delivery?
- Selection procedures - what selection criteria were given preference, and how did this influence project delivery?
- Governance - did the project have the right structures in place? What do you think the key stakeholders think of the project? What is your perception based on?
- Management - was the project managed well? Why / why not? Were the right structures in place? Did they work as expected? Why / why not?

Project Spend

- Do you think that the funds available were spent efficiently? Why/why not?
- To you, are the impacts delivered worth the funds spent to achieve them? Why / why not?

Lessons Learned
- What would you change or approach differently if you were to restart the project?
- What have you learned through the project?

Expected Lifetime Impacts
- Has the project made a difference?
- What do you expect the long-term impact of the project to be on the local area? What is your reasoning?

Beneficiaries
- Who / what benefits the most from this project? Why?
- Did the project engage with the right people? Did they identify the beneficiaries? Why/why not?
- Were the right processes in place to support engagement?
- What do the beneficiaries think of the quality of what the project has delivered?

Wider Benefits?
- What are the wider project benefits - social? economic? environmental? other?

Open-ended
- Is there anything that you think should be taken into account when assessing the project's delivery and impact, and its value for money?

References

Åberg, E.U. and Tapsell, S., 2013. Revisiting the River Skerne: The long-term social benefits of river rehabilitation. Landscape and Urban Planning, 113, pp.94-103.

Arthington, Á.H., Naiman, R.J., Mcclain, M.E. and Nilsson, C., 2010. Preserving the biodiversity and ecological services of rivers: new challenges and research opportunities. Freshwater biology, 55(1), pp.1-16.

Atkinson, S., Bruen, M., O'Sullivan, J. J., Turner, J. N., Ball, B., Carlsson, J., Bullock, C., Casserly, C. M., & Kelly-Quinn, M. (2020) An inspection-based assessment of obstacles to salmon, trout, eel and lamprey migration and river channel connectivity in Ireland. Sci. Total Environ. 719. https://doi.org/10.1016/j.scitotenv.2020.137215

Baildon Parish Council, Bradford Metropolitan District Council, and Friends of Baildon Moor (2012). Bracken Management: A long-term balanced plan [online]. Available at: http://baildonmoor.org/wordpress/information/bracken-management-a-long-term-balanced-plan/#:~:text=On%20balance%2C%20removing%20bracken%20encourages%20primary%20habitats%20to,provide%20more%20space%20for%20birds%20and%20other%20wildlife.

Balkham, M., Fosbeary, C., Kitchen, A., & Rickard, C. (2010) Culvert design and operation guide. CIRIA C689. London, UK.

Barton, J., Hine, R. and Pretty, J., 2009. The health benefits of walking in greenspaces of high natural and heritage value. Journal of integrative environmental sciences, 6(4), pp.261-278.

Bowen, K.J., Parry, M.A.R.I.S.S.A., Barrett, M.A., Miller, D., Frumkin, H., Peen, J., Schoevers, R.A., Beekman, A.T., Dekker, J. and Sandifer, P.A., 2015. The evidence base for linkages between green infrastructure, public health and economic benefit. project Assessing the Economic Value of Green Infrastructure.

Canal and Rivers Trust (2020). Japanese Knotweed [online]. Available at: https://canalrivertrust.org.uk/enjoy-the-waterways/canal-and-river-wildlife/the-rogues-gallery-of-invasive-species/japanese-knotweed

Challenges data for Rye Operational Catchment | Catchment Data Explorer (no date). Available at: https://environment.data.gov.uk/catchment-planning/OperationalCatchment/3387/rnags (Accessed: 17 February 2023).

CIWEM (2007) Policy Position Statement: De-culverting of watercourses. Available at: https://www.ciwem.org/assets/pdf/Policy/Policy%20Position%20Statement/Deculverting-of-water-courses.pdf Classification | River Basin Management Plan: maps (no date). Available at: https://experience.arcgis.com/experience/73ed24b6d30441648f24f043e75ebed2/page/Classification/ (Accessed: 17 February 2023).

Classifications data for Esk Operational Catchment | Catchment Data Explorer (no date). Available at: https://environment.data.gov.uk/catchment-planning/OperationalCatchment/3177/classifications (Accessed: 17 February 2023).

Classifications data for Rye Operational Catchment | Catchment Data Explorer (no date a). Available at: https://environment.data.gov.uk/catchment-planning/OperationalCatchment/3387/classifications (Accessed: 17 February 2023).

Classifications data for Rye Operational Catchment | Catchment Data Explorer (no date b). Available at: https://environment.data.gov.uk/catchment-planning/OperationalCatchment/3387/classifications (Accessed: 17 February 2023).

Colléony, A., White, R. and Shwartz, A., 2019. The influence of spending time outside on experience of nature and environmental attitudes. Landscape and Urban Planning, 187, pp.96-104.

Cooper, E. (2019). Invasive Species in Rivers: Check, Clean, Dry [online]. Available at: https://theriverstrust.org/about-us/news/invasive-river-species

Defra, Forestry England, Animal and Plant health Agency, and Lord Gardiner of Kimble (2019). Invasive Species Week: Ameircan skunk cabbage creates a stink [online]. Available at: https://www.gov.uk/government/news/invasive-species-week-american-skunk-cabbage-creates-a-stink

Denny, R., 2013. Himalayan Balsam and its control on the River Monnow in Herefordshire and Monmouthshire. International Pest Control, 55(4), p.214.

Elbourne, N., Hammond, D., and Mant, J. (2013). Weir removal, lowering and modification: A review of best practice Report: SC070024. Environment Agency and River Restoration Centre: Bristol.

Environment Agency (2021). Removal of Dovecliff weir restores river health [online]. Available at: https://www.gov.uk/government/news/removal-of-dovecliff-weir-restores-river-health

European Centre for River Restoration (n.d.) River Restoration: Remove Culverts. Available online: https://www.ecrr.org/River-Restoration/Flood-risk-management/Healthy-Catchments-managing-for-flood-risk-WFD/Environmental-improvements-case-studies/Remove-culverts

European Environment Agency (2018) European waters: Assessment of status and pressures. EEA Report No 7/2018. ISSN 1977-8449. Available at: https://www.eea.europa.eu/publications/state-of-water

Fewster, J., 2004, June. Walking—social, health and economic benefits, and the law. In Proceedings of the Institution of Civil Engineers-Municipal Engineer (Vol. 157, No. 2, pp. 111-115). Thomas Telford Ltd.

Groothuis, E., 2012. Valuing the benefits from nature: How renaturalization projects, like the Visschebelt-Koemaste project near Hellendoorn, may benefit the regional economy (Bachelor's thesis, University of Twente). Accessible at: http://essay.utwente.nl/62196/1/BSc_E_Groothuis.pdf (05 April 2023).

Harvey, J., Gomez-Velez, J., Schmadel, N., Scott, D., Boyer, E., Alexander, R., Eng, K., Golden, H., Kettner, A., Konrad, C. and Moore, R., 2019. How hydrologic connectivity regulates water quality in river corridors. JAWRA Journal of the American Water Resources Association, 55(2), pp.369-381.

Hornigold K, Lake I, Dolman P (2016) Recreational Use of the Countryside: No Evidence that High Nature Value Enhances a Key Ecosystem Service. PLoS ONE 11(11): e0165043. https://doi.org/10.1371/journal.pone.0165043

Howard, A.J., Coulthard, T.J. and Knight, D., 2017. The potential impact of green agendas on historic river landscapes: Numerical modelling of multiple weir removal in the Derwent Valley Mills world heritage site, UK. Geomorphology, 293, pp.37-52.

Huangfu, C., Hui, D., Qi, X. and Li, K., 2019. Plant interactions modulate root litter decomposition and negative plant-soil feedback with an invasive plant. Plant and Soil, 437, pp.179-194. Accessed at: https://link.springer.com/article/10.1007/s11104-019-03973-7 (05 April 2023).

Janes, V.J., Grabowski, R.C., Mant, J., Allen, D., Morse, J.L. and Haynes, H., 2017. The impacts of natural flood management approaches on in-channel sediment quality. River Research and Applications, 33(1), pp.89-101.

Jones, J., Börger, L., Tummers, J., Jones, P., Lucas, M., Kerr, J., Kemp, P., Bizzi, S., Consuegra, S., Marcello, L., Vowles, A., Belletti, B., Verspoor, E., Bund, de, Gough, P., Garcia de Leániz, C., 2019. A comprehensive assessment of stream fragmentation in Great Britain. Sci. Total Environ. 673, 756–762. https://doi.org/10.1016/j.scitotenv.2019.04.125

Kimber, E. (2017). Invasive non-native species (UK) - Himalayan balsam [online]. Available at: https://insideecology.com/2017/10/19/invasive-non-native-species-uk-himalayan-balsam/#:~:text=Due%20to%20an%20absence%20of%20natural%20predators%20in,in%20summer%20due%20to%20constricted%20water-flow.%20More%20items

Mammal Society (n.d.). Species - Water Vole [online]. Available at :https://www.mammal.org.uk/species-hub/full-species-hub/discover-mammals/species-water-vole/

NatureScot (2023). Freshwater pear mussel [online]. Available at: https://www.nature.scot/plants-animals-and-fungi/invertebrates/freshwater-invertebrates/freshwater-pearl-mussel

New Management Plan (no date). Available at: https://www.northyorkmoors.org.uk/looking-after/new-management-plan (Accessed: 17 February 2023).

Nomura, H., Yabe, M. and Sampa, M.B., 2015. Latent preferences and valuation of health walk on footpath in UK. In Fifth Congress of the East Asian Association of Environmental and Resource Economics.

Norfolk Rivers Trust (n.d.). The iconic white-clawed crayfish [online]. Available at: https://norfolkriverstrust.org/our-work/conservation-and-restoration/white-clawed-crayfish/#:~:text=The%20white-clawed%20crayfish%20is%20threatened%20by%3A%201%20Crayfish,predation%20and%20direct%20competition%20for%20food.%20More%20items

North York Moors National Park Authority Local Plan (July 2020). Available at: Local-Plan-FINAL-DRAFT.pdf (northyorkmoors.org.uk) (Accessed:17 February 2023).

North York Moors Management Plan 2022 (no date) North York Moors National Park. Available at: https://www.northyorkmoors.org.uk/looking-after/new-management-plan/north-york-moors-management-plan-2022 (Accessed: 17 February 2023).

NYMNPA, 2022. North York Moors Management Plan 2022. Available at: https://www.northyorkmoors.org.uk/looking-after/new-management-plan/north-york-moors-management-plan-2022 (06 April 2023).

NYMNPA, 2023. Facts and figures. Heritage Fund. Available at: https://www.northyorkmoors.org.uk/about-us/press-office/facts-and-figures (05 April 2023).

ONS, 2022. Health benefits from recreation, natural capital, UK: 2022. Available at: https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/healthbenefitsfromrecreationnaturalcapitaluk/2022 (05 April 2023).

Park, D., Sullivan, M., Bayne, E., Scrimgeour, G., 2008. Landscape-level stream fragmentation caused by hanging culverts along roads in Alberta's boreal forest. Can. J. For. Res. 38, 566–575. https://doi.org/10.1139/X07-179

Participation, E. (no date) Highways Act 1980. Statute Law Database. Available at: https://www.legislation.gov.uk/ukpga/1980/66/section/228 (Accessed: 17 February 2023).

Pearce-Higgins, J.W. and Yalden, D.W., 1997. The effect of resurfacing the Pennine Way on recreational use of blanket bog in the Peak District National Park, England. Biological Conservation, 82(3), pp.337-343. Accessed at: https://www.sciencedirect.com/science/article/abs/pii/S0006320797000347 (05 April 2023).

Pidd, H. (2017). Himalayan balsam: UK volunteers battle playboy of horticultural world [online]. Available at: https://www.theguardian.com/environment/2021/jun/07/himalayan-balsam-uk-volunteers-urged-to-help-to-battle-invasive-weed

Raven, E.K., Lane, S.N., Ferguson, R.I. AND Bracken, L.J., 2009. The spatial and temporal patterns of aggradation in a temperate, upland, gravel-bed river. Earth Surface Processes and Landforms, 34 (9), 1181-1197.

Robinson, H. W., McAllister, C.T. (2022). Stoneflies [online]. Available at: https://encyclopediaofarkansas.net/entries/stoneflies-13690/#:~:text=%20Stoneflies%20are%20called%20%E2%80%9Cindicator%20species%E2%80%9D%20because%20finding,Eleven%20Point%20%2C%20Spring%20%2C%20and%20White%20.

Szałkiewicz, E., Jusik, S. and Grygoruk, M., 2018. Status of and perspectives on river restoration in Europe: 310,000 Euros per hectare of restored river. Sustainability, 10(1), p.129.

Scottish Invasive Species Initiative (n.d.). American Skunk Cabbage [online]. Available at: https://www.invasivespecies.scot/american-skunk-cabbage

Silva et al. (2017). The future of fish passage science, engineering, and practice. Fish and Fisheries. Available online at: https://onlinelibrary.wiley.com/doi/full/10.1111/faf.12258

The Riverfly Partnership (n.d.). Riverflies Overview [online]. Available at: https://www.riverflies.org/riverflies-overview

The Wildlife Trusts (2018). New report points to 30% decline in water vole distribution [online]. Available at: https://www.wildlifetrusts.org/news/new-report-points-30-decline-water-vole-distribution

The Wildlife Trusts (n.d.). Bracken [online]. Available at: https://www.wildlifetrusts.org/wildlife-explorer/ferns-and-horsetails/bracken

Wang, C., Xiao, H., Liu, J., Wang, L. and Du, D., 2015. Insights into ecological effects of invasive plants on soil nitrogen cycles. American Journal of Plant Sciences, 6(01), p.34. Accessed at: https://www.scirp.org/html/5-2601872_52998.htm (05 April 2023).

Weidenhamer, J.D. and Callaway, R.M., 2010. Direct and indirect effects of invasive plants on soil chemistry and ecosystem function. Journal of chemical ecology, 36, pp.59-69. Accessed at: https://link.springer.com/article/10.1007/s10886-009-9735-0 (05 April 2023).

Wild Trout Trust (2022). WTT weir removal project on BBC Farming Today and Look North [online]. Available at: https://www.wildtrout.org/news/wtt-weir-removal-project-on-farming-today#:~:text=Removing%20the%20weir%20will%20open%20up%2018km%20of,is%20funded%20by%20the%20European%20Open%20Rivers%20Programme.

Wildlife and Countryside Link, 2020. Spend £6 million a year to save £2.7 billion on nature invater costs to the economy by 2040. Available at: https://www.wcl.org.uk/nature-invader-costs-to-economy-

2020.asp#:~:text=Invasive%20species%20cost%20the%20UK,building%20construction%20and%20repair%20costs. (05 April 2023).

Williams, F., Eschen, R., Harris, A., Djeddour, D., Pratt, C., Shaw, R.S., Varia, S., Lamontagne-Godwin, J., Thomas, S.E. and Murphy, S.T., 2010. The economic cost of invasive non-native species on Great Britain. CABI Proj No VM10066, 199. Available at: http://b3.net.nz/gerda/refs/429.pdf (05 April 2023).

Wohl, E., Lane, S.N. and Wilcox, A.C., 2015. The science and practice of river restoration. Water Resources Research, 51(8), pp.5974-5997. Accessed at: https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2014WR016874 (04 April 2023).

Woodland Trust (n.d. a). Otter [online]. Available at: https://www.woodlandtrust.org.uk/trees-woods-and-wildlife/animals/mammals/otter/

Woodland Trust (n.d. b). Spotted Flycatcher [online]. Available at: https://www.woodlandtrust.org.uk/trees-woods-and-wildlife/animals/birds/spotted-flycatcher/#:~:text=Threats%20and%20conservation%20The%20spotted%20flycatcher%20population%20is,there%20are%20many%20possible%20explanations%20for%20the%20decline.

Working With Natural Processes (2018) Burgess-Gamble, L., Ngai, R., Wilkinson, M., Nisbet, T., Pontee, N., Harvey, R., Kipling, K., Addy, S., Rose, S., Maslen, S., Hay, H., Nicholson, A., Page, T., Jonczyk, J., & Quinn, P. 2018. Working with Natural Processes – Evidence Directory. Environment Agency. SC150005. https://assets.publishing.service.gov.uk/media/6036c5468fa8f5480a5386e9/Working_with_natural_processes_evidence_directory.pdf

References (general)

Documents Provided by the Blue Corridors Project Team for the purpose of this Summative Assessment

- 201007 NY Moors FA V6.1 FINAL rounding corrected (ESIF-From-2-028). NYMNPA. E-claims Reference 39R19P03950.
- 201020 NY Moors Blue Corridor GFA Issued.pdf. NYMNPA.
- 2022-04_Blue Corridor INNS layer.zip. NYMNPA.
- 2022-10-25_Blue Corridor INNS outputs sign off.pdf. NYMNPA.
- 230124 Blue Corridors Programme_rev9_issue.xlsx. NYMNPA.
- Access Route, Harome - TLP.docx. NYMNPA.
- Access Route, Hawnby - TLP.docx. NYMNPA.
- Access Route, Helmsley - TLP.docx. NYMNPA.
- Access Route, Nunnington - TLP.docx. NYMNPA.
- Access Route, Rievaulx - TLP.doc. NYMNPA.
- Activity Sheet 2 INNS.pdf. NYMNPA.
- Blue Corridors_Gantt chart v3_delivered.xlsx. NYMNPA.
- Blue Corridors_Habitat and Species v2.docx. NYMNPA.
- Blue Corridors_Logic model Final v4.xlsx. NYMNPA.
- Blue Corridors Project Management Plan-Final.docx. NYMNPA.
- Complete dataset 2015-2022.xlsx. NYMNPA.
- Cripps, A. (2023). INNS Comments. Document shared with JBA Consulting for the purposes of the Summative Assessment.
- Data Explorer Riverflies-MASTER (Rye).xlsx. NYMNPA.
- EISF-Form-1-012 Summative Assessment Plan v5. NYMNPA.
- ESIF-Form-3-037 Annex A - PCR NYM Blue Corridors, version 2. NYMNPA.
- Electro-fishing 2021 report.pdf. NYMNPA.
- ERDF Summative Assessment Logic Model (ESIF-Form-011) - Blue Corridors Logic model Final v4 (version 3 April 2019). Blue Corridors Project.
- ERDF Blue Corridors Risk Register v0.1.xlsx. NYMNPA.
- Foul Green Farm Bracken 2021.JPG. NYMNPA.
- Foul Green Farm Bracken 2021.pdf. NYMNPA.
- Gantt chart_Blue Corridors.xlsx. NYMNPA.
- Garé, N. et al. (2020) Upper Risk Esk - Freshwater Pearl Mussel Monitoring - AECOM. Yorkshire Water Services Ltd. Project number: 60636174.
- Garé, N. et al. (2023) Upper Risk Esk - Freshwater Pearl Mussel Monitoring - 2021-2022. AECOM. Yorkshire Water Services Ltd. Project number: 60636174.
- Hawnby Route_Access Audit.pdf. NYMNPA.
- Helmsley final prog and map-NYCC.pdf. NYMNPA.
- INNS data fields.JPG. NYMNPA.

- Interviews with key Blue Corridors project stakeholders (November - December 2022).
- Noble, R. et al. (2023) North York Moors National Park - Rivers Rye and Esk Fish Monitoring 2021-2022. (Draft Report). University of Hull International Fisheries Institute.
- Nunnington original route final prog and map- NYCC.pdf. NYMNPA.
- Organogram A - Project Delivery Team December 2020.docx. NYMNPA.
- Pry Rigg Bracken 2021.JPG. NYMNPA.
- Pry Rigg Bracken 2021.pdf. NYMNPA.
- Rye+Esk monitoring sites.docx. NYMNPA.
- Ryevitalise Routes Along the Rye.zip. NYMNPA.

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