Promoting Adaptation to Changing Coasts

A Practical Guide

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Content

Foreword

The Promoting Adaptation to Changing Coasts (PACCo) project is a cross-border initiative which is financially supported by the INTERREG VA France (Channel) England project co-financed by the European Regional Development Fund.

The broad aim of PACCo is to demonstrate that it is possible to work with stakeholders in estuarine regions to deliver a range of benefits for people and the environment by adapting pre-emptively to climate change. It has a total value of €27.2m, with €18.8m coming from the European Regional Development Fund (ERDF).

The project focuses on two pilot sites: the Lower Otter Valley, East Devon, England and the Saâne Valley in Normandy, France.

For more information see: [Promoting Adaptation to Changing Coasts (pacco-interreg.com)]

Acknowledgements

We would like to thank all our PACCo project partners:

Environment Agency

East Devon Pebblebed Heaths Conservation Trust (EDPHCT)

Conservatoire du littoral (Cdl)

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Agence de l'eau Seine-Normandie

Région Normandie

Executive Summary

Introduction

The Promoting Adaptation to Changing Coasts (PACCo) project is an EU funded project which is piloting pre-emptive climate change adaptation in two estuaries - the Lower Otter Valley (East Devon, England) and the Saâne Valley (Normandy, France).

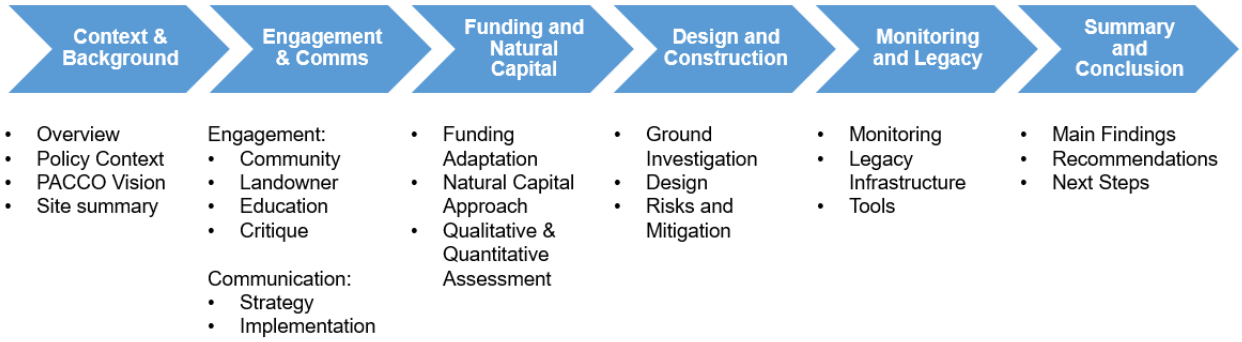
The PACCo project involved delivering a wide range of different activities which formed part of the climate change adaptation strategies for both estuaries. This included:

- Communicating about climate change and raising awareness
- Protecting and restoring lost intertidal habitats
- Relocating businesses and amenities to areas at lower risk of flooding
- Developing resilient design for new infrastructure

PACCo part-funded a blend of research-based activities, studies and construction work, which are summarised in this guide.

Report Structure

This guide is structured into six parts:



Each part of the report is made up of a series of chapters which provide an overview of the approach taken in both estuaries, sharing what we did, the outcomes of our actions, including any lessons learnt or future recommendations.

Outputs

Throughout this report, we provide a summary of both the construction works and research delivered as part of this project. Hyperlinks to additional resources and more detailed reports are available on the PACCo webpage.

In chapter 11 we summarise our project's main achievements (using infographics) and describe our lessons learnt.

Top tips

The project's lessons learnt have been summarised into the following top tips:

- Identify suitable funders, landowners, stakeholders and partners at an early stage.
- Understand your funders, landowners and partners requirements.
- Ensure you know what the key constraints are.
- Know your site's history to shape its future design.
- Take a natural capital approach to articulate options and benefits, whilst recognising that there are other benefits of early adaptation, such as to the local economy.
- Nurture your partnership throughout as it is the foundation for project success.
- Involve local communities from the earliest stage, engage effectively and be receptive to local views.
- Bring your community with you through effective engagement.
- Communicate constantly and effectively using a wide range of approaches.
- Be realistic about project phasing, especially if there are multiple dependencies between different project parts.
- Do not under-estimate the degree to which habitat and protected species constraints may impact on project delivery (time and cost).
- Do not under-estimate the difficulty of gaining landowner agreement for a scheme and the length of time and cost of ensuring that all necessary legal agreements are in place to deliver it.
- Use the project as an opportunity to engage the next generation.
- Conduct a detailed site wide ground investigation and surveys of species present on site.
- Show foresight and accommodate future engineering projects.
- Be vigilant to continually changing climatic and ground conditions during construction. Working in flood plains can be very challenging.
- Maintain and improve visitor infrastructure during and post-construction.
- Anticipate problems and resolve them collectively.
- Plan monitoring of project outcomes in advance and secure budget for it.
- Think about the project's legacy when developing signage and infrastructure.

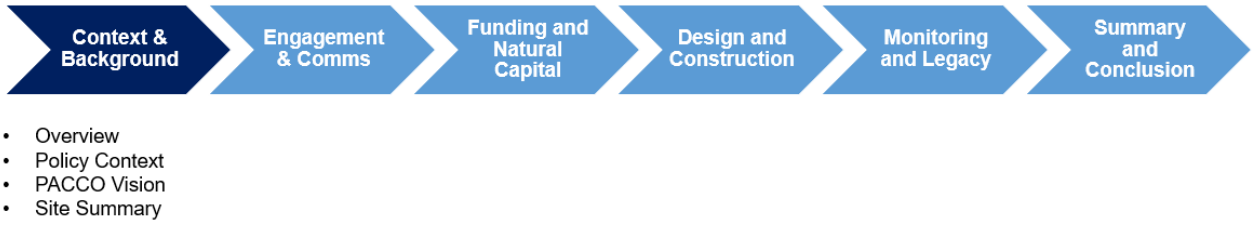
Next steps

We believe that this report is the first of its kind – providing an overview of what climate change adaptation entails. By sharing the specific details about how PACCo was delivered we hope that our lessons learnt can be used across many other estuaries.

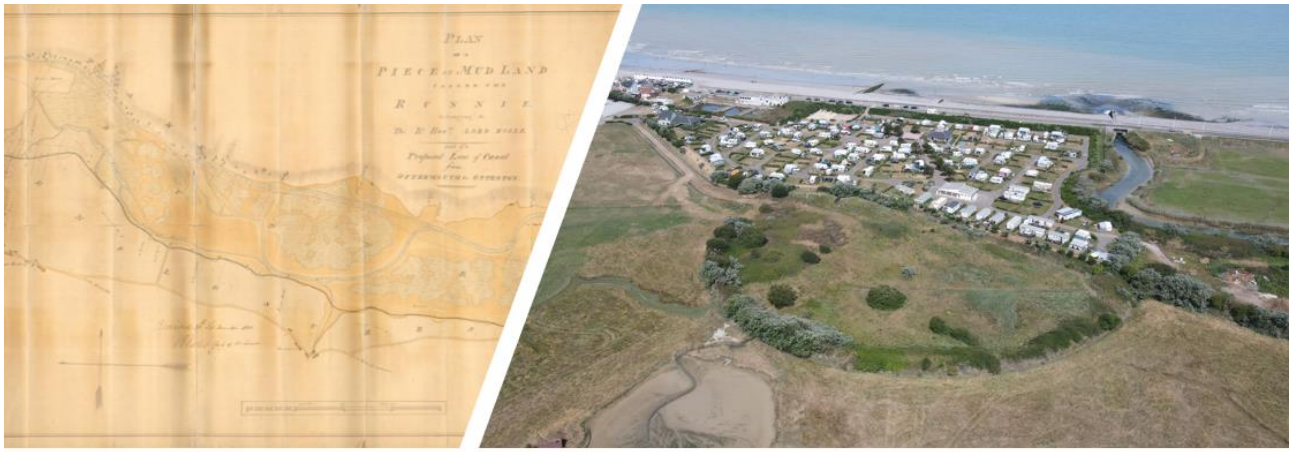
Part A. Background Context

This report is subdivided into six main parts describing the different components of two coastal climate change adaptation projects.

The first two chapters introduce the project, describe its vision and provide a description of the two estuaries included in the study.



- Overview
- Policy Context
- PACCO Vision
- Site Summary



Chapter 1. Introduction

Authors: Lydia Burgess-Gamble, Edward McIntyre and Benjamin Fouqué.

Affiliated authors (listed alphabetically): Camille Simon, Delphine Jacono, Megan Rimmer, Mike Williams & Thomas Drouet.

This chapter provides background context to the report, setting out the policy landscape and explaining the origins of the Promoting Adaptation to Changing Coasts (PACCo) project.

1.1 Overview

Global warming has led to massive ice melting and the expansion and warming of the oceans (IPCC, 2019). At the same time, we have seen global sea level rise (SLR) 15cm over the 20th century. This could reach up to 110cm by 2100 (IPCC, 2021). The impacts of global warming and SLR pose an existential threat to low lying coastal areas (IPCC, 2022).

The Paris climate agreement (United Nations, 2015) sets out to limit global warming to below 2°C, preferably to 1.5°C compared to pre-industrial levels, with the aim of achieving a climate neutral world by mid-century.

However, the impacts of climate change twinned with unprecedented loss of biodiversity are being felt now. Globally we find ourselves in a climate and biodiversity crisis (CIEEM, 2019). We need to act immediately if we are to address this. The following chapter summarises the impacts of the climate and biodiversity crises. It provides the Franco-English policy context and explains why both countries are working in partnership on a coastal climate change adaptation project.

This chapter helps to set the context for the rest of the report, which is focussed on describing specifically how climate change adaptation measures were put into place in the Lower Otter Valley (East Devon, England) and Saâne Valley (Normandy, France) as part of the Promoting Adaptation to Changing Coasts (PACCo) project (PACCo, 2022).

1.2 Climate Change and Biodiversity Crisis

1.2.1 The Climate Crisis

The International Panel on Climate Change (IPCC) has demonstrated that climate change is both inevitable and irreversible. The IPPC's most recent report states that 'Global warming of 1.5°C and 2°C will be exceeded during the 21st century unless deep reductions in carbon dioxide (CO_2) and other greenhouse gas emissions occur in the coming decades'

(IPCC, 2021). As the climate changes, average and peak temperatures have risen. Annual average rainfall is now greater, and wettest days are now even wetter. These trends are set to continue. Global climate models predict global mean sea level rise to be in the range of 0.63-1.02m for a very high emissions scenario (European Environment Agency, 2021).

Across Europe the impacts of climate change are becoming more and more noticeable, with a greater number and frequency of natural disasters ranging from flooding and coastal erosion, through to drought and wildfire.

1.2.2 The Biodiversity Crisis

Over the last 300 years, human activity along our estuaries and coasts has led to habitat loss, resulting in over 65% of seagrass/wetland habitats being destroyed and over 90% of formerly important species being depleted (Lotze, et al., 2006). Ongoing saltmarsh loss is estimated at 100ha/yr-1 in the UK (Pye & French, 1993)) and globally less than half the world's original wetlands remain (Barbier, et al., 2011).

Inter-tidal habitats provide a wide range of ecosystem services (Hudson, Kenworthy, & Best, 2021) (Burgess-Gamble, et al., 2017). These include acting as carbon sinks and helping coasts and estuaries become more resilient to the impacts of climate change. This means the loss or degradation of salt marshes affects both people and wildlife. Protecting, preserving and restoring salt marsh is vitally important in combatting the twin biodiversity and climate crises.

1.2.3 Challenges

The climate is changing now, and its impacts worsen year by year (Global Commission on Adaptation, 2019). The Flood and Coastal Erosion Risk Management Strategy for England (Environment Agency, 2020) says we are already seeing the impacts of climate change including:

- more extreme coastal erosion
- more frequent and more extreme droughts
- water shortages and wildfires
- potentially permanent damage to habitats, plants, wildlife and cultural heritage.

Climate change is exacerbating the biodiversity crisis. Rising temperatures and unpredictable weather conditions affect species distribution. For ecosystems to be resilient and to adapt to climate change they need space. However, as habitats are lost or become disconnected there is less room for those species dependent on these habitats to move to escape from flood or drought conditions.

1.2.4 Solutions

In recognition that climate change is already happening a two-pronged response is usually recommended (NASA, 2022). This includes mitigation and adaptation which involves:

- Reducing emissions and stabilizing the levels of greenhouse gases (mitigation).
- Adapting to the climate change which is already under way (adaptation).

This report focusses on adaptation, though some of the measures we discuss also draw out carbon dioxide from the atmosphere so help to mitigate climate change impacts too.

Adaptation enables us to 'prepare for and adjust to current and future climate change impacts' (European Commission, 2021). In the context of flooding and coastal erosion adaptation can include a wide portfolio of different approaches.

A report by the Conservatoire du littoral makes it clear that: 'Adaptation to climate change is one of the greatest challenges of our time, especially in coastal areas. These impacts involve retreating coastlines linked to sea level rise, accelerated erosion in some areas and an increase in the frequency and severity of storms and coastal flooding, salt water intrusion making rivers and aquifers brackish as well as the degradation of marine and coastal ecosystems' (Conservatoire du littoral, 2022)**.**

Whilst there is no single solution to the twin crises, nature-based solutions (NBS) can play an important role in 'limiting the impact of climate change, while improving biodiversity and providing a range of other social and economic benefits (Environment Agency, 2022).' The role of NBSs is recognised internationally (see Table 1.1) with guidance on their implementation being provided by the World Bank (World Bank, 2019)**.** Adopting a nature-based approach to climate change adaptation on the coast benefits not only the climate and biodiversity crises but also achieves some of the United Nation's sustainable development goals (UN General Assembly, 2015)**.**

Unlike hard-engineered solutions, NBSs are more easily able to adapt to the impacts of climate change in coastal areas (McKenna, Kruger, & Hinzmann, 2016), having a buffering effect that reduces wave energy and the impacts caused by storms and sea level rise (Timmerman, et al., 2013).

Table 1.1 Key global policy documents

Global policy documents
Implementing Nature-based Flood Protection (World Bank, 2019)
This document sets out 6 key principles for using nature-based solutions in flood protection: • **Plan** - Defining the desired goals and objectives, evaluating alternative actions and selecting a preferred strategy with recognition of sources of uncertainty • **Design** - Identifying/designing a flexible management action to address a challenge • **Implement** - Implementing the selected action according to its design • **Monitor** - Monitoring the results or outcomes of the management action • **Evaluate** - Evaluating the system response in relation to goals/objectives

Global policy documents
• **Adapt** - Adapting the action if necessary to achieve the stated goals/objectives
United Nations Sustainable Development Goals (UN General Assembly, 2015)
There are 17 UN sustainable development goals, these ones relate to the coast and climate change: • Ensure availability and sustainable management of water and sanitation for all (Goal 6 Clean water and sanitation) • Make cities and human settlements inclusive, safe, resilient and sustainable (Goal 11 Sustainable cities and communities) • Take urgent action to combat climate change and its impacts (Goal 13 Climate action) • Conserve and sustainably use the oceans, seas and marine resources for sustainable development (Goal 14 Life below water)

1.3 The Policy Context

1.3.1 European Policy Drivers

In Europe, over 100,000 citizens are at risk of coastal flooding each year. If no adaptation measures are put in place this figure could reach up to 3.9 million by the end of the century (Vousdoukas, et al., 2020).

Recognising the existential threat posed by climate change, the European Commission has put in place a green deal (European Commission, 2019) which commits the EU to becoming climate neutral by 2050.

The green deal is complemented by a biodiversity strategy (European Commission, 2021) which aims to put Europe's biodiversity on the path to recovery by 2030 for the benefit of people, climate and the planet.

Individual EU member states have taken these policies and developed their own strategies to be applied nationally, regionally and locally.

1.3.2 English Policy Drivers

In England, 247,000 homes and business are at high risk of coastal flooding and by 2030 over 700 properties could be lost to coastal erosion (Environment Agency, 2015).

Although no longer a member of the EU, English national strategies and policies (Table 1.2) describe the need to adapt to and become more resilient to the impacts of climate change (see Defra, 2018, Defra 2020 and Environment Agency, 2020).

For coastal areas in England, Shoreline Management Plans (SMP) (Environment Agency, 2022) are developed by the Coastal Groups identifying the most sustainable approaches to managing flood and coastal erosion risks across 20-, 50- and 100-year time periods. SMPs, are important in identifying solutions that help address the impacts of the climate and biodiversity crises because they help define management options for different stretches of coasts such as: hold the line, advance the line, no active intervention, and managed realignment.

Managed realignment/retreat is a strategic flood and coastal erosion policy option. It involves breaching or moving sea defences landward, which 'creates sustainable, environmentally beneficial intertidal habitat in the form of mud flats and salt marshes' and 'helps to dissipate wave energy and protect against erosion' (The Flood Hub, 2018). In England managed realignment is often used to provide compensatory habitats in line with the Habitats Regulations.

Table 1.2 Key English policy documents

English policy documents
The 25 year Environment Plan (Defra, 2018)
This plan aims to take all possible action to mitigate climate change, while adapting to reduce its impact.
Flood and Coastal Erosion Risk Management Policy Statement (Defra, 2020)
Summary: • Upgrading and expanding our national flood defences and infrastructure • Managing the flow of water more effectively • Harnessing the power of nature to reduce flood and coastal erosion risk and achieve multiple benefits • Better preparing our communities • Enabling more resilient places through a catchment-based approach.
National Flood and Coastal Erosion Risk Management Strategy for England (Environment Agency, 2020)
This long-term strategy includes specific ambitions related to climate change. Such as: • Working with partners to bolster resilience to flooding and coastal change across the nation, both now and in the face of climate change • Making the right investment and planning decisions to secure sustainable growth and environmental improvements, as well as infrastructure resilient to flooding and coastal change • Ensuring local people understand their risk to flooding and coastal change, and know their responsibilities and how to act.

1.3.3 French Policy Drivers

In France a quarter of the developed coastline is at risk of erosion, 270km of which is retreating more than 50cm per annum (DGALN, 2021) with over 850,000 jobs at risk of coastal flooding (Bafoil, 2022).

French national strategies and policies (Table 1.3) help protect the coast of France from development (Loi littoral, 1986) and set out a list of priority locations where towns and communities need to be protected especially against coastal erosion (Decret no 2022-750, 2022). These policies have helped to identify coastal areas which are vulnerable to the impacts of climate change. A recent climate resilience law has put in place new measures to consider coastal retreat as part of the land use planning process (LOI n° 2021-1104, 2021).

Like other EU countries, policy drivers have tended to promote flood protection by use of dykes over and above NBSs (Article R.562-13, 2019[1]). However, the national coastal strategy,[2] much like the English flood risk strategy is showing a move towards working with nature and includes the development of coastal zone strategies.

Managed realignment is proactively promoted by the Conservatoire du littoral, which integrates climate change adaptation into their strategies and management guidelines. Recently the French Ministry of Ecological Transitions supported the implementation of nine projects to restore and preserve coastal ecosystems (Ministère de la Transition écologique, 2021).

Table 1.3 Key French policy documents

French policy documents
L'aménagement, la protection et la mise en valeur du littoral (Loi littoral, 1986)
Coastal law has defined a 100m coastal strip that cannot be built on.
Décret établissant la liste des communes dont l'action en matière d'urbanisme et la politique d'aménagement doivent être adaptées aux phénomènes hydrosédimentaires entraînant l'érosion du littoral (Decret no 2022-750, 2022)
This document published a list of 126 municipalities which must take measures to combat erosion, prohibiting new construction in exposed areas within 30 years.
Code de l'environnement (Article R.562-13, 2019)[3]
The current legal frameworks across the EU do not recognise Nature-based Solutions as a protection system. In France, protection of an area exposed to the risk of flooding or marine submersion can only be achieved by a dyking system.
Stratégie nationale de gestion intégrée du trait de côte[4]
The national strategy for integrated coastline management promotes "living with the sea", which is applied at a local scale through coastal zone management strategies to effectively reduce the vulnerability of people, property and activities to coastal erosion.
Le Conservatoire du littoral face au changement climatique (Conservatoire du littoral, 2013)
The Conservatoire du littoral promotes the dynamic management of ecosystems on the coast, such as moving dykes landwards away from the sea.
Strategy for climate change adaptation for the Seine Normandy (2016)
It sets out 3 principles: • Prioritised NBS • Seek multifunctional solutions • Avoid maladaptation.

[1] Article R562-13 - Code de l'environnement - Légifrance (legifrance.gouv.fr)

[2] Stratégie nationale de gestion intégrée du trait de côte | GéoLittoral (developpement-durable.gouv.fr)

[3] Article R562-13 - Code de l'environnement - Légifrance (legifrance.gouv.fr)

[4] Stratégie nationale de gestion intégrée du trait de côte | GéoLittoral (developpement-durable.gouv.fr)

French policy documents
A specific chapter is devoted to sea level rise. Two strategic responses to this issue are offered: • Develop integrated management approach for the coastline • Move, adapt or enhance water management infrastructure facing sea level rise.
Two regulatory planning documents: the SDAGE Seine et côtiers normands 2021-2027 and the Document Stratégique de Façade
Developed conjointly, these documents describe the European regulations and set objectives such as a rate of ground artificialization of the foreshore to be less than 0.9% by 2026. The part 5 of the SDAGE (Schémas directeurs d'aménagement et de gestion des eaux - Water development and management master plans) is specifically dedicated to the coast. In terms of adaptation to climate change, it describes 4 approaches to regulation: • Integrate climate benchmarks from the planning stage • Assess the risk of saline intrusion and take it into account in development projects • Develop shoreline management planning considering biodiversity issues and the risks of flooding and marine submersion • Adopt an approach to the risk of submersion by avoiding the use of structures.

1.4 The Franco-English Context – Working Together

The scientific and policy drivers behind climate change adaptation have been described in this chapter. Section 1.3 has described the different policy drivers across the EU, which shape how we address the impacts of the climate and biodiversity crises.

In addition to these policy drivers there have been practical solutions (section 1.4.1) implemented in England and France which have acted as a precursor to the PACCo project. The LiCCo project helped identify the need and opportunity for pre-emptive climate change adaptation on the Lower Otter and in the Saâne Valley.

In addition to this project there are additional coastal adaptation projects in France (1.4.2) and England (1.4.3). These have been initiated separately to PACCo but learning between these projects should be shared.

1.4.1 Living with a Changing Coast (LiCCo) – England and France

The EU INTERREG funded LiCCo (LiCCo, 2014) project ran from 2011 to 2014 and brought together partners from across Devon, Dorset and Normandy who were united by similar coastal climate change challenges.

The purpose of LiCCo was to help coastal communities better understand, prepare for and adapt to the impacts of climate change, sea level rise and erosion on the natural and human environment.

LiCCo developed best practice for engaging coastal communities, enabling them to understand the predicted impacts of climate change. PACCo partners used the engagement techniques developed through LiCCo to work with stakeholders and develop the PACCo project.

In France, the Saâne Valley (Normandy) was a LiCCo pilot site. Initial work in this catchment through LiCCo then led to it being taken forward as part of the PACCo project where climate change adaptation measures are now being implemented.

In Devon the River Exe was a LiCCo pilot site. However, this estuary was not taken forward for inclusion in the PACCo project because the Exe Estuary Flood and Coastal Erosion Risk Management Strategy (Environment Agency, 2014) and follow-up work demonstrated that compensatory habitat creation was not possible in the estuary. Instead, the Otter Estuary was identified as a potential site to create the compensatory habitat as the Environment Agency needed to do flood defence works in the Exe Estuary. Working with Clinton Devon Estates (CDE) the landowner, the 55ha Lower Otter Restoration Project site was secured, receiving partnership funding from PACCo.

LiCCo was a pre-cursor to PACCo and helped cement the Anglo-French partnership whilst also identifying two catchments on either side of the channel with similar problems and challenges.

1.4.2 LIFE Adapto – France

Initiated by the Conservatoire du littoral (Cdl) the EU LIFE funded 'Adapto' project (Adapto, 2022) ran from 2017 to 2022. It explored scenarios and solutions to the impacts of climate change on the coast, such as sea level rise and the increasing frequency of extreme weather events.

On 10 pilot sites owned by Cdl, the Adapto programme demonstrated the ecological and economic benefit of improving the resilience of coastal areas creating more space for nature along the coastline.

The Adapto project developed transferable tools and methods which can be applied to other coastal locations. As part of PACCo these tools are being used by partners in the Saâne Valley to inform the development of an approach to adaptive estuary management. The outputs of PACCo will in turn feed into the Adapto project and also the Interreg MANABAS COAST project which started in 2023 and aims to implement nature-based climate change adaptation solutions.

1.4.3 Flood and Coastal Resilience Innovation Fund - England

In England there are a range of initiatives funding projects to test out different approaches to climate change adaptation on rivers and the coast (Environment Agency, 2022) including:

- **Adaptation Pathways Programme (APP) –** This aims to develop adaptation pathways in four key locations of national significance, to test and share guidance, resources and tools to better integrate adaptation to future flooding and coastal change into projects, investments and strategic plans.

- **Coastal Transitions Accelerator Programme (CTAP) -** The CTAP will explore how we can adapt to the effects of climate change on the coast. Two local authorities have received funding to work with communities on the coast that cannot sustainably be defended from coastal erosion.
- **Flood and Coastal Resilience and Innovation Programme (FCRIP) -** As part of the FCRIP programme, 25 projects will demonstrate how practical innovative actions can improve resilience to flooding and coastal erosion.

Although PACCo is being funded and delivered separately, we will share our learning with this programme.

1.5 Report Focus

There is no one single climate change adaptation strategy. Each strategy will be unique and tailored to the estuary where it's developed, appropriate to the specific environmental, social, economic and political context. Hybrid approaches, which include a mix of infrastructure-based and nature-based solutions, have been used on the PACCo project. The approach is advocated as a 'more flexible and integrated protection of coasts, enabling a better adaptation in the face of uncertainty' (Conservatoire du littoral, 2022)**.**

The report describes the PACCo project. In particular, it describes the different components of the project's climate change adaptation strategies which can be broadly split into 4 categories:

- Awareness raising
- Protecting and restoring nature
- Relocating businesses and amenities
- Resilient design.

Awareness raising - An important part of climate change adaptation is developing a common understanding across a community of what adaptation means. This in turn can be used to shape the development of co-designed adaptation strategies. In the report we cover communications and engagement.

Protecting and restoring nature - We can help our coasts and estuaries pre-emptively adapt to the impacts of climate change through protecting and restoring habitats. By capturing greenhouse gas emissions, salt marshes and mudflats act as a carbon sinks, drawing emissions from the atmosphere and storing them in sediments and plants. Restoring salt marshes also creates a buffer along our estuaries and coasts providing more space, 'slowing down and reducing the energy of the water, ultimately attenuating inland progression of floodwaters and waves before they meet the upland shoreline' (Piercy, Pontee, Narayan, Davis, & Meckley, 2021). In this report we describe two sites where lost intertidal habitats are restored enabling climate change mitigation and adaptation.

Relocating businesses and amenities - In some locations, restoring nature alone will not enable communities to adapt to the impacts of climate change. In the report we describe measures that were put in place to relocate businesses and amenities to areas at lower risk of flooding or erosion. Doing this pre-emptively saves future costs – acting early to reduce economic damages and to influence stakeholder to create resilient areas.

Resilient design - In locations where infrastructure cannot be relocated it is important that it is designed to withstand adverse climatic conditions. In the report we provide examples of infrastructure which has been raised above flood levels or afforded extra engineered protection to prevent erosion. We also provide an example of the development of a new state of the art sewage treatment plant which accommodates a growing population and helps improve water quality within the catchment area and the beach.

1.6 Report Purpose and Structure

The need to share learning from coastal adaptation projects at an international scale is vital to ensure that good practice is adopted, we learn from mistakes and can start to transition from pilot projects to wider application (Conservatoire du littoral, 2022).

Purpose

The aim of the guide is to share our learning from the PACCo project to show that pre-emptive adaptation is possible and to enthuse practitioners working in other estuaries so they can take away tips and apply them to their sites.

Its purpose is to:

- Summarise the different elements of the PACCo project
- Set out the findings of the project
- Capture our lessons learnt - both good and bad
- Share our recommendations for future projects
- Highlight policy level challenges associated with adaptation
- Signpost to more detailed reports.

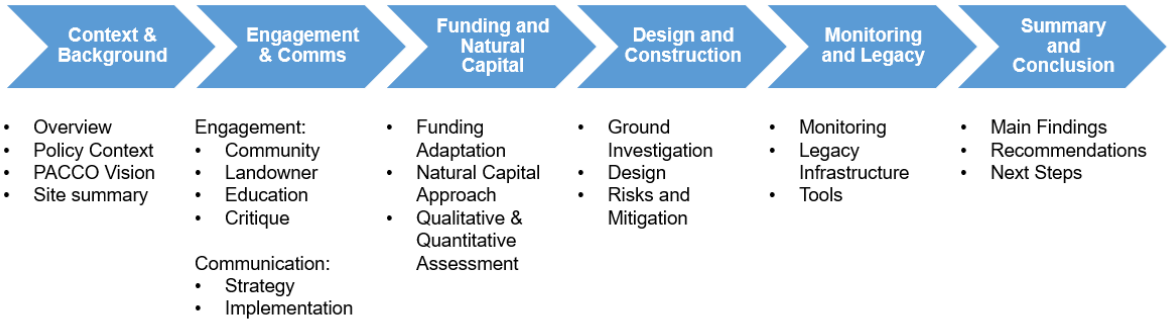
This guide is structured into the following 6 parts:

Each part of the report is made up of a series of chapters which provide an overview of the approach taken in both estuaries, sharing what we did, the outcomes of our actions, including any lessons learnt or future recommendations. It doesn't need to be read cover to cover, each chapter is standalone and can be read separately.

This guide is written with a technical audience in mind. It will be of most interest to individuals and organisations developing their own climate change adaptation projects, in particular:

- Environmental non-governmental organisations
- Consultants and contractors in the environment and construction sectors
- Communications and engagement specialists
- Landowners and land managers
- Policy makers and practitioners in the public sector and civil services
- Researchers and academics

Structure



1.7 Further Reading

This report is available in full and in summary version here:

Promoting Adaptation to Changing Coasts – a practical guide (Burgess-Gamble et al., 2023a)

Promoting Adaptation to Changing Coasts – a practical guide summary document (Burgess-Gamble et al., 2023b)

Chapter 2. The PACCo Vision

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The chapter describes the vision for the PACCo project, providing a high-level overview and an introduction to the two estuaries focussed on as part of this project.

2.1 Introduction

2.1.1 What is PACCo?

The Promoting Adaptation to Changing Coasts (PACCo) project (PACCo, 2022) is a cross-border project that is delivering climate change adaptation projects in two estuaries – The Lower Otter Valley (East Devon, England) and Saâne Valley (Normandy, France) see Map 2.1. The vision for PACCo is to show how stakeholders can work together across two estuaries to deliver a range of benefits for people and the environment by adapting infrastructure to enhance biodiversity, improve wellbeing and provide local socio-economic benefits.

Map 2.1 The two pilot sites (Source: Clinton Devon Estates)

2.1.2 Why is adaptation needed?

Historically both estuaries have been physically modified, resulting in both rivers being disconnected from their floodplains. On the River Otter, an embankment was built during the early 19th century to turn a large area of the floodplain into agricultural land. In the Saâne valley, dykes/embankments were created during the 18th century to drain the land for agricultural use and the river now enters the sea through a culverted pipe under an embankment disconnecting the valley from the sea.

These historical modifications have affected both rivers from an ecological standpoint leading to a loss of intertidal habitat. Climate change and sea level rise are already affecting both valleys, flooding businesses and infrastructure. Adaptation to the impacts of climate change is needed in both locations to help protect communities, livelihoods and wildlife in the future.

More information on the historical modifications across both sites can be found in the 'PACCo Socio-economic Framework' report (East Devon Pebblebed Heaths Conservation Trust, 2022).

2.1.3 Why are we working in partnership?

Both estuaries face common environmental challenges. The project is the first time that pre-emptive proactive climate change adaptation has been demonstrated on a landscape scale across two sites in different countries. Working together to share knowledge, expertise and problems across international boundaries enables solutions and tools to be developed that can be used in both England and France (photo 2.1).

Photo 2.1 The PACCo project team (Source: Karen Baxter)

By working together, the PACCo project will recreate around 100ha of intertidal and wetland habitat by reconnecting the sea to its floodplain, enhance biodiversity and bring socio-economic benefits to the two sites. As part of the project, we have developed the guide to summarise how we pre-emptively adapted our twin estuaries to sustainably cope with the impacts of climate change.

2.1.4 Why is PACCo important?

PACCo is important because we anticipate that in both estuaries it will:

- Minimise costs associated with the repair / replacement / maintenance of flood risk management infrastructure
- Provide increased socio-economic benefits resulting from increased tourism
- Provide public health cost savings
- Increase natural capital value because of the restored wetland habitat.

Nationally (England and France) and at a global level we also hope that these pilot sites will demonstrate to other estuaries that:

- Climate change, including sea level rise, threatens coastal areas
- Adaptation will be necessary for many communities
- Adaptation of coastal regions is possible and should be seen as an opportunity to bring long-term social, environmental and economic benefits
- Early adaptation to climate change will be more cost-effective and provide better value for money for society than late or no action
- Late adaptation to climate change results in a greater burden on future generations who must then pay the costs of inaction as well as the cost of adapting late.

2.1.5 Who is delivering PACCO?

The Lower Otter Restoration Project (LORP) (LORP, 2022) is being delivered by the Environment Agency in partnership with the landowner, Clinton Devon Estates (CDE) and is part-funded by PACCo. In England, PACCo is being led by the Environment Agency with three English partners: the Department for Environment, Food and Rural Affairs (Defra), the East Devon Pebblebed Heaths Conservation Trust (EDPHCT) and Clinton Devon Estates (CDE).

In France PACCo is being delivered by the Conservatoire du littoral (Cdl) who are working with partners from the town council of Quiberville and the Communauté de Communes Terroir de Caux (TDC) to deliver the climate change adaptation works. The Syndicat Mixte des Bassins Versants Saâne Vienne Scie is responsible for the reconnection of the Saane valley to the sea. This part of the project is not included in the PACCo project.

2.2 The Lower Otter

2.2.1 Overview

The Lower Otter Estuary drains into the English Channel at Budleigh Salterton, a small town to the east of Exmouth in East Devon in England (see Map 2.2). The estuary contains a range of intertidal habitats including saltmarsh and tidal creeks and is nationally important from a biodiversity perspective and designated as a Site of Special Scientific Interest (SSSI). The shingle bar at the mouth of the estuary is part of the Dorset and East Devon Coast World Heritage Site (WHS).

Map 2.2 Location of Budleigh Salterton (Source: (C) Google)

Photo 2.2 The Lower Otter Valley (Source: EDPHCT)

2.2.2 History

The River Otter and its estuary have been physically modified by humans for centuries. In the early 19th century, an embankment was built to reclaim land for agricultural use. These works straightened and disconnected the river from its floodplain turning a range of intertidal habitats into agricultural land. Later, the Budleigh Brook, which drains into the Otter, was diverted into an aqueduct and a railway arrived in 1897. In 1928 an area of land alongside the river started to be used as a municipal refuse tip, and in the 1930s a cricket club was established. These physical changes to the landscape have disrupted natural processes and the river is no longer able to adapt and move naturally across the floodplain, nor can it cope effectively with flooding events. The natural environment is also poorer, resulting in reduced biodiversity and lower-quality habitats.

Photo 2.3 Photo of 1809 map of the Lower Otter estuary with the river connected to the floodplain (Source: Clinton Devon Estates)

2.2.3 Challenges

The Lower Otter's is subject to river and tidal flooding and its embankments have been affected by erosion. The historical modification of the estuary has exacerbated the effects of flooding and coastal erosion. The river channel which is constrained within embankments is unable to carry flood flows and water backs up until it overtops the embankments across the floodplain filling the area behind the banks. Annually we now see prolonged deep flooding of adjacent fields. In 2018 the embankments were almost breached, requiring a costly temporary repair. Without intervention there is a high likelihood that a large flood event or storm would lead to a catastrophic failure of the embankments. Retaining the status quo is now becoming more difficult, costly and environmentally unsustainable.

Photo 2.4 Lower Otter embankment being repaired after extensive erosion in 2018 (Source: Environment Agency)

2.2.4 Solutions

To enable the valley to adapt to the impacts of climate change a range of different solutions are being put in place (see Map 2.3). The adaptation strategy employed across PACCo focusses on delivering measures to (discussed in detail below):

- Raise awareness
- Protect and restore nature
- Relocate businesses and amenities
- Use a resilient design.

Awareness raising - An important part of the Lower Otter project has involved working with partners and stakeholders through a liaison group to inform the development and implementation of the Lower Otter Restoration Project. Working with local schools we have also raised awareness of the risks associated with climate change and explained how the project is helping the Otter estuary adapt pre-emptively to these impacts. On this site a series of ‘hubs’ are being built to provide signage and interpretation boards to encourage visitors to the area, providing amenity and local economy benefits.

Photo 2.5 School children finding out more about the Lower Otter's restoration (Source: Clinton Devon Estates)

Photo 2.6 The Lower Otter floodplain (left) and estuary (foreground) (Source: KOR)

Protecting and restoring nature - A key part of the Lower Otter project involves restoring 55 hectares of lost intertidal habitats by reconnecting the river to its floodplain. Restoring lost coastal wetlands will create more space for water during times of flood and provide ecological benefits throughout the estuary. In addition to connecting the river to the sea, we have also restored part of the Budleigh Brook, removing it from its aqueduct and re-connecting it to the new tidal creek in the northern part of the site.

Relocating businesses and amenities - The former cricket pitch and pavilion tended to flood annually where flood waters have reached the eaves of the pavilion (Photo 2.7). As part of PACCo the cricket club has been relocated to higher ground to the east of Budleigh Salterton (Photo 2.16). This ensures the building and facilities are resilient in the future. Moving these facilities also provides space for more habitat restoration.

Photo 2.7 The former cricket club pavilion (Source: Clinton Devon Estates)

Resilient design - An important part of the Lower Otter project involves making infrastructure resilient to the impacts of climate change.

A major part of this involves ensuring that we preserve and enhance public access. South Farm Road will be raised so that it is passable at high tide and a road bridge will span the new tidal creek. A new footbridge at the location of the breach at the southern end of the site will preserve access along the South West Coastal Path. Public footpaths on the western edge of the floodplain are being raised and the surfacing improved.

The former landfill site is better capped and protected against erosion. The final element of the resilient design involves replacing the ageing and vulnerable combined sewer overflow (CSO) pipe from the rear of the shingle bar with a new pipe below the estuary, extending its useful working life well into the future.

Photo 2.8 New cricket pitches constructed on higher ground - centre left of photo (Source: KOR Communications)

Photo 2.9 The new South Farm Road being built (Source: KOR Communications)

Map 2.3 The Lower Otter (Devon) showing the habitat restoration project (Source: Clinton Devon Estates)

2.3 The Saâne Valley

2.3.1 Overview

The project is located 13 km west of Dieppe, in the Saâne valley. It extends from the town of Sainte-Marguerite-sur-Mer and Quiberville to Longueil covering approximately 180 hectares.

The Saâne is a coastal river that drains into the English Channel at Quiberville, a small town to the west of Dieppe in Normandy in France (see Map 2.4). The river is 34km long and drains into the sea through an unflapped culverted pipe going through an embankment and preventing fish migration. The main road connects Pays de Caux and Dieppe is part of a sea defence with walls and an embankment, disconnecting the estuary from the sea (Photo 2.10).

Map 2.4 Location of Quiberville (Source: IGN, 2019)

Photo 2.10 The Saâne Valley (Source: Thomas DROUET/CdI, 2022)

2.3.2 History

Up until the 16th century, the Saâne river flowed naturally into the English Channel. From the 16th century onwards, the estuary was modified (especially its lower part) with dykes being constructed for military purposes and a road embankment was installed to prevent marine intrusion.

The Saâne's outlet to the sea was culverted in 1863, which was then further modified and protected by groynes during the 19th century. Over the past 20 years, the towns located within the Saâne valley have suffered three fluvial floods (January 1995, December 1999 and May 2000) which were elongated by the culvert's small capacity. The culvert's size limits flow capacity, meaning that water is not able to drain away quickly enough. This in turn aggravates flooding in the valley.

Between 1963 and 1973, the Quiberville campsite was built landward of the road embankment.

The Saâne valley is also at risk of tidal flooding. In the winter of 1977 to 1978, tidal flooding affected the valley and rip rap protection was damaged.

Aside from flooding, the culvert acts as a barrier to the migration of fish species (sea trout, eels, river and sea lampreys).

Photo 2.11 Historical view of Quiberville - Saâne Valley in background (Source: Henry DANIEL records)

2.3.3 Challenges

The lower Saâne valley is subject to coastal erosion, river flooding and tidal flooding (Photo 2.12). The historical modification of the estuary has exacerbated the effects of flooding and coastal erosion, increasing erosion and runoff of rainwater laden with mud and silt. In recent history (1977, 1995, 1999, 2000 and 2018) river and coastal floods damaged properties, the campsite and surrounding land. These events have led to the local community developing new solutions to minimise the area's vulnerability to flooding and coastal erosion.

Since 2012, the Conservatoire du littoral has been piloting a territorial project across the entire lower Saâne valley. The objectives of the project are to provide solutions to local stakeholders facing the risk of fluvial flooding and to limit the risk of marine intrusion. It also aims to allow the restoration of the ecological continuity of the Saâne, to improve the natural environments of the entire lower valley (habitats, landscapes, biodiversity), the interaction between the land and the sea and to set climate change adaptation objectives for the area to enable pre-emptive adaptation.

The Basse Saâne 2050 project was adopted by local stakeholders (town councils) in 2015 and initial steps to reconnect the Saâne to the sea began in 2018. The project encompasses:

- Land management and ownership
- Relocation of activities
- Restoration of ecological continuity
- Restoration of wetlands
- Adaptation to climate change and tidal floods
- Development and awareness raising of environmental issues.

Photo 2.12 Quiberville town during the 1999 fluvial flood (Source: Henry DANIEL records)

2.3.4 Solutions

To enable the valley to adapt to the impacts of climate change a range of different solutions are being put in place (see Map 2.3). The adaptation strategy employed across PACCo focusses on delivering measures to:

- Raise awareness
- Protect and restore nature
- Relocate businesses and amenities
- Use a resilient design.

Awareness raising - To address the challenges facing the valley the PACCo project's French partners worked with the different stakeholders in the Saâne Valley to develop a long-term solution to help the community adapt pre-emptively to the impacts of climate change. Public meetings and awareness raising (photo 2.13) have helped involve the local community (local residents, associations, local businesses) in the project ensuring the project is embraced by stakeholders and citizens. The aim was to maintain the area's socio-economic attractiveness whilst restoring wetlands and the biodiversity.

Photo 2.13 Inauguration of the summer exposition in 2021 in à Sainte Marguerite-sur-Mer (Source: Cdl, 2021)

Protecting and restoring nature - A key part of the Saâne Valley project involves restoring 50 hectares of lost intertidal habitats by reconnecting the river to its floodplain and to the sea (photo 2.14). This is being undertaken as part of the project 'Basse Saâne 2050' project (Basse Saane, 2022). Restoring lost coastal wetlands will create more space for water during times of flood (fluvial and tidal) and provide ecological benefits throughout the valley. The culvert which currently drains the Saâne to the sea will be replaced by a bridge, better reconnecting the river to the sea.

Relocating businesses and amenities - A key component of the climate change strategy for the valley involves moving the municipal campsite located behind the embankment inland and to higher ground (see Map 2.5) to minimise future flood damage and to enable the habitat restoration works (wetlands and aquatic habitats) (photo 2.15). Relocating the campsite also allows the local council to develop a new campsite which is designed more

sustainably increasing the attractiveness of the area, enhancing the local economy.

PACCo has provided an opportunity to develop amenities which are more suited to the current tourism demand, with more diversified services and quality rental offer and infrastructures that fit into the landscape (Photo 2.16).

Resilient design - As part of the PACCo project, new sewage treatment facilities are being developed to benefit the communities within the Saâne Valley. This will also provide water quality benefits in the valley and on the beaches, and ensure the sewerage network is resilient in the future (Photo 2.17).

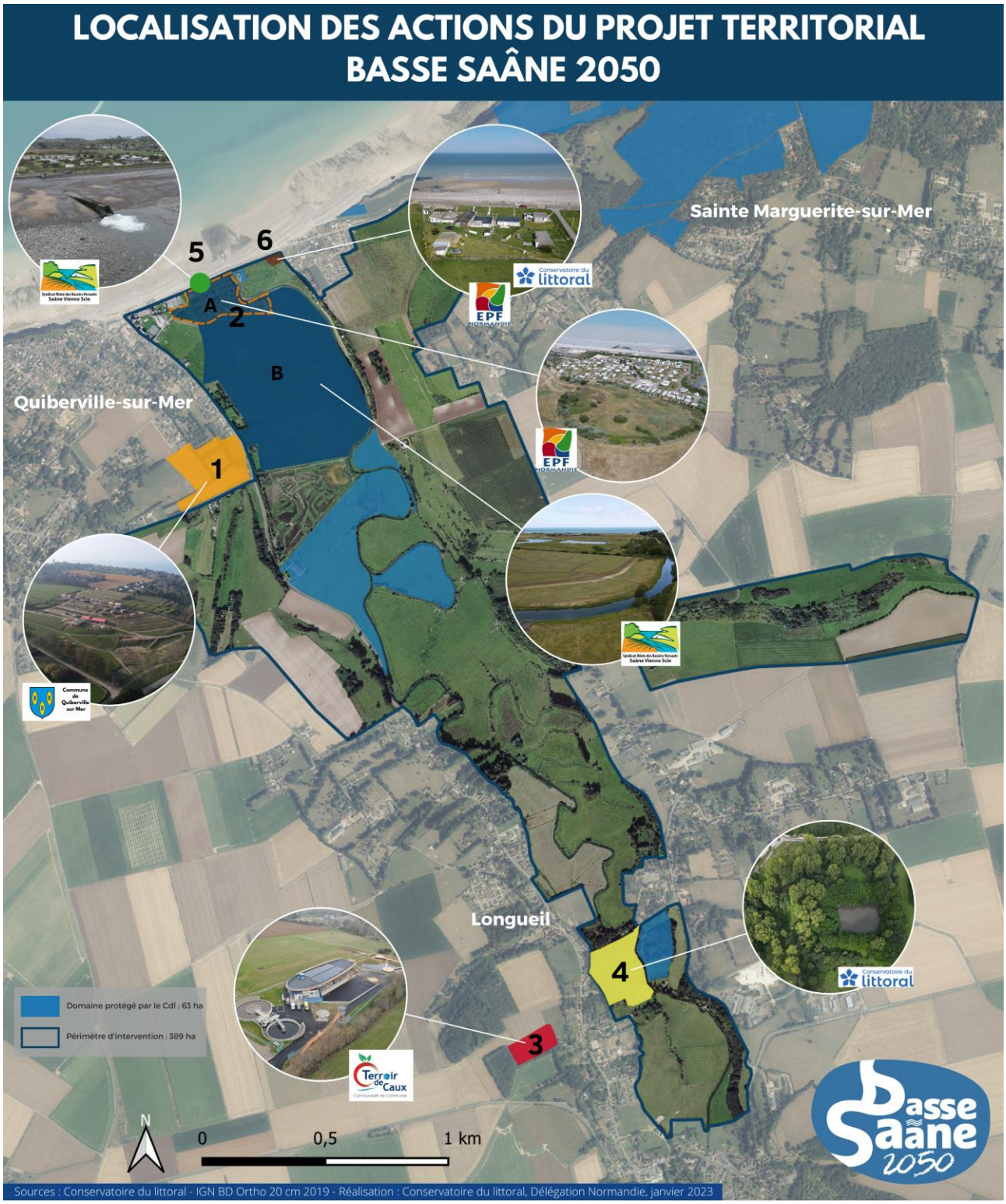
Photo 2.14 The Saâne Valley (Source: Thomas DROUET/Cdl, 2022)

Photo 2.15 Quiberville campsite "La Plage" next to the sea before being relocated (Source: Thomas DROUET/Cdl, 2022)

Photo 2.16 Quiberville new campsite under construction (Source: Thomas Drouet/Cdl, 2023))

Photo 2.17 The sewage treatment plant under construction (Source: Thomas Drouet/Cdl 2023)

Map 2.5 Location of the different part of the Basse Saâne 2050 project (Source: Cdl,2023)



FINANCEUR PRINCIPAL

ACTIONS DU PROJET TERRITORIAL

1	Relocalisation de l'équipement touristique de Quiberville
2 / 2	**A**-Renaturation de l'actuel camping de Quiberville **B**-Renaturation du lit majeur et création de nouveaux méandres
3	Construction d'une nouvelle station d'épuration à Longueil
4	Renaturation de la peupleraie de Longueil
5	Réalisation du pont cadre pour le nouveau débouché de la Saâne
6	Relocalisation des bungalows à Sainte-Marguerite-sur-Mer

PRINCIPAUX PARTENAIRES DU PROJET

2.4 Delivering the PACCo Vision

To achieve the objectives of PACCo the project was split into five work packages that were led by different partners (Table 2.1). Each work package involved delivering a range of different activities, which in turn resulted in the achievement of a range of different deliverables. 'Deliverables' included anything from construction work, through to the publishing a report or a presentation at a conference. The report provides a high-level summary of the project's main activities, summarising the deliverables and hyper-linking to more detailed reports where these are available.

Table 2.1 Summary of the PACCo work packages

Work package name	Lead	Main deliverables	Summarised in which part of report
Management	EA	Project management oversight and leadership across project's delivery and partnership. Includes technical project management meetings and use of project management tools (programme, risks and finances).	Throughout
T1. Managing risk & improving ecosystem quality by adapting to climate change	Cdl	Delivery of construction projects in both estuaries. Development of a risks and solutions register. Development of tools related to monitoring, and the assessment of historical threats.	Design and Construction Monitoring and Legacy
T2. A new transferrable method for enhanced and sustainable socio-economic use of estuaries	EDPHCT	Development and implementation of a socio-economic protocol and framework in both estuaries. Development of a methodology model for local engagement. Delivery of a programme of educational outreach activities. Development of visitor infrastructure and interpretation.	Funding and Appraisal
T3. Establishing / promoting the new transferable PACCo Model for adaptive management	EA	Writing the guide to share learning from both estuaries. Implementing cross-border exchanges to share learning, including promoting the project at conferences.	Throughout

Work package name	Lead	Main deliverables	Summarised in which part of report
Communication	EDPHCT and Defra	Developing information packs, leaflets etc. including partner and stakeholder publications, press releases and articles Delivering a final conference and attending and presenting at regional and national conferences / events and workshops. Implementing promotional tools such as a website, blogs and videos.	Comms and Engagement

2.5 How can I find out more?

As part of the PACCo project we have published a report which describes both estuaries and their uses in more detail covering:

- Transport and trade
- Agriculture and food production
- Leisure and living.

The report uses the two PACCo sites as case studies. It documents how socio-economic benefits can be realised by creating new rare intertidal habitat, improving ecosystem services, managing threats to the environment and human health, and adapting existing public facilities and infrastructure to the impacts of climate change.

In this report we look at the two project sites in their historical context. By examining the case studies and stories that have emerged over the course of the project it compares the challenges of delivering adaptation at each site and draws out lessons for consideration at other sites. In subsequent chapters, we explain how we addressed the challenges described here, providing a description of the climate change adaptation solutions used.

2.6 Further Reading

Disused tip case study – Lower Otter (Fouqué, B., 2022)

Methodology for evaluating and managing man made historical threats (Drouet, T., 2022)

The history of both estuaries - Lower Otter and Saâne Valley (East Devon Pebblebed Heaths Conservation Trust and Drouet, T., 2022)

See bibliography for further details.

Lessons Learnt & Recommendations - Part A

Part A of this report has provided a high-level overview of the PACCo project. Table 2.2 lists some of the key recommendations and lessons learnt.

Table 2.2 Key recommendations and lessons learnt

Key recommendations and lessons learnt
Identify stakeholders and build partnerships early
• Build partnerships early - finding landowners and partners to work with, agreeing a project vision and design and securing any legal agreements related to land release / occupation and legacy management can take many years to complete. Where multiple landowners are involved, this can be especially difficult. • Securing funding to deliver a project can also take time • Engage with local communities early and understand the issues from their perspective.
Manage the project on the ground
Being on site with local stakeholders allows you to: • Identify all questions as they arise and do not forget issues • Reassure stakeholders that their concerns have been considered, inform them regularly about the progress of the project • Avoid rumours and false information.
Understand the scientific and policy context of your project
This will help you: • Identify suitable funding sources • Identify potential project partners • Develop an adaptation solution which is in line with current scientific and political needs.
Understand the historical context of your site
This will help you: • Place the site in its historical context • Understand the reasons why your site was modified in the past • Develop a suitable restoration plan to address these modifications • Explain to stakeholders why change is needed now.

The remainder of the report describes in much more detail the different elements of the adaptation strategies for both valleys.

Part B. Engagement and Communication

The next two chapters describe the project's approach to engagement and communication.

Context & Background | **Engagement & Comms** | Funding and Natural Capital | Design and Construction | Monitoring and Legacy | Summary and Conclusion

Engagement:
- Community
- Landowner
- Education
- Critique

Communication:
- Strategy
- Implementation

Chapter 3. Engagement

Authors: Bridget Beer, Lydia Burgess-Gamble **&** Camille Simon**.**

Affiliated authors (listed alphabetically): Carolyn Petersen, Delphine Jacono, Jasmine Van der Eijk, Kendal Archer, Megan Rimmer, Mike Williams, Régis Leymarie, Sam Bridgewater & Thomas Drouet.

This chapter looks in detail at the different approaches to engagement across both estuaries, covering:

- Community engagement
- Landowner engagement
- Educational engagement

3.1 Introduction

Engagement is the blend of activities we use to connect with people, understand their perspectives on problems with a view to arriving at solutions which have societal approval. It helps to keep them involved and informed and demonstrates that their input and feedback is valued.

Engagement also helps gain a common understanding between project partners and the local community of project aims, challenges and opportunities. It facilitates creative thinking and addresses or minimises concerns and challenges that could be critical to successful delivery. Engagement, therefore, helps gain approval and support for projects.

We need to let anyone that is, or could be, affected by our planned projects know what we are doing, why we are doing it, how it will affect them, where and when they can be involved and what they can influence. We try to put ourselves in the stakeholders' shoes and understand their perspectives – what would we want to know if this was happening in our community?

Engagement comprises a dynamic mix of communication, consultation, listening, understanding, relationship building, influencing and negotiation, tailored to identified audiences and their needs. Early and ongoing engagement planning is an integral element of effective project management as stakeholders' perceptions and reactions can influence the design, planning and success of our projects.

Identifying our stakeholders, their interests, objections, expectations and feelings about us and our work offers valuable insights for project risk management, specialist resources allocation and cost projections. Stakeholder and situational analysis can pick up difficult issues early on, providing useful context for planning strategic engagement and how project delivery will deal with them.

Ultimately good stakeholder engagement relies on building relationships and trust with people from the start to ensure we deliver our project smoothly, to time and budget. It was fundamental to the successful delivery of our two PACCo pilot sites in East Devon, England and Normandy, France.

The broad aim of PACCo is to show that it is possible to work with stakeholders in estuarine areas, to deliver benefits to people and the environment, by pre-emptive adaption to climate change. Within that broad aim the project has several long-term outcomes that rely on effective engagement to:

- Help society better understand climate change risks
- Enable coastal communities to be more prepared for climate change
- Deliver greater understanding of the socio-economic benefits of adaptation
- Improve engagement and funding from politicians locally, nationally and at European level.

For both sites we identified three main audiences:

- Local community (Section 3.2)
- Landowners (Section 3.3) and
- Education sector (Section 3.4).

Each site used similar engagement approaches with some variations tailored to differing audiences and cultures. How we engaged with these three audiences is described below.

3.2 Community Engagement

3.2.1 Overview

Community engagement covers the activities with all those impacted by or interested in the PACCo project. This includes members of the public and businesses, as well as representatives from local government, non-governmental organisations, national organisations, and charities.

Why was engagement needed?

The French and English sites have both been prone to flooding in the past (Photo 3.1), which has been exacerbated by historical human intervention (East Devon Pebblebed Heaths Conservation Trust, 2022). Ongoing climate change impacts combined with sea level rise are increasing the level of flood and coastal erosion risk. During planning, and prior to the launch of the project, the individual project teams held extensive public meetings, workshops and exhibitions over several years, examining the socio-economic and environmental problems of their location. Local communities and other interested parties were invited to give their input, comments and suggestions in order to fully consider potential future options.

Photo 3.1 Left hand photo - Budleigh Salterton cricket club flooded in 1950s (Source: Clinton Devon Estates). Right hand photo - Quiberville Town flooded 1990s (Source: Henry Daniel records)

Once the preferred option had been chosen it was necessary to secure funding needed to deliver them. During this period, the teams kept the public up to date on progress with their funding bids, sharing the process and decisions with the community through updates, meetings and local media coverage.

Once the Interreg application was approved in January 2020, the necessary funding package was complete enabling the two PACCo sites - Lower Otter Restoration Project and the Saâne Valley project - to be delivered. Together the initiative would recreate 100 hectares of intertidal and wetland habitat, enhance ecosystems, and bring socio-economic benefits.

3.2.2 Strategy and Delivery

Specialist communications and engagement staff joined both project teams to plan, support and deliver strategic engagement and communications. This built on the significant stakeholder analysis and relationship development work already carried out by LORP and the Saâne Valley teams prior to securing PACCo funding.

Aims and Objectives of Engagement

There were now clear aims and objectives for engagement and communication for the PACCo climate change adaptation projects to:

- Demonstrate it is possible to work with stakeholders to deliver a range of benefits for people and the environment by adapting pre-emptively to climate change and
- Promote the PACCo guide to an extensive stakeholder network to influence policy makers at national and EU level to enable climate change adaptation at more sites.

The PACCo Education and Communications Strategy and Plan (Aug 2020 – June 2023) set out target audiences (external and internal), governance, structure, advocacy, work packages and a list of required communication outputs.

To engage by reaching, connecting, and involving as many people as possible each of the projects used a blend of:

- Consultation
- Information sharing (via different platforms such as websites, exhibitions, Newletters)
- Stakeholder meetings (group and individual)
- Involvement in the formal processes (planning and permitting)
- Site visits and presentations
- News and social media commentary

PACCo engagement activity was timetabled around key project milestones to receive, listen and act on inputs from the community and other stakeholders to develop a genuine dialogue about climate change adaptation. The intention was for everyone impacted by the projects to feel able to:

- Openly express their views on the locations' past, present and future management,
- Freely communicate their opinions on the PACCo initiative, and
- Feel they were heard, their views captured, and their opinions helped to shape delivery of the projects.

Another important benefit of the PACCo engagement and communications strategy was that it clearly assigned specific actions for the partner organisations and individuals to deliver specific actions. This helped to ensure consistency and efficiency as it reduced opportunities for duplication and confusion.

Developing and Nurturing Confidence and Trust

Confidence and trust developed among project colleagues as they worked together and got to know each other. This is essential when bringing together teams from different organisations with varying cultures and ways of working.

Due to the coronavirus lockdowns in the UK and France between March 2020 and December 2021 many of the engagement and communications activities had to be carried out remotely rather than in person. During this time, meetings were held either online or on the telephone, and communication became even more important.

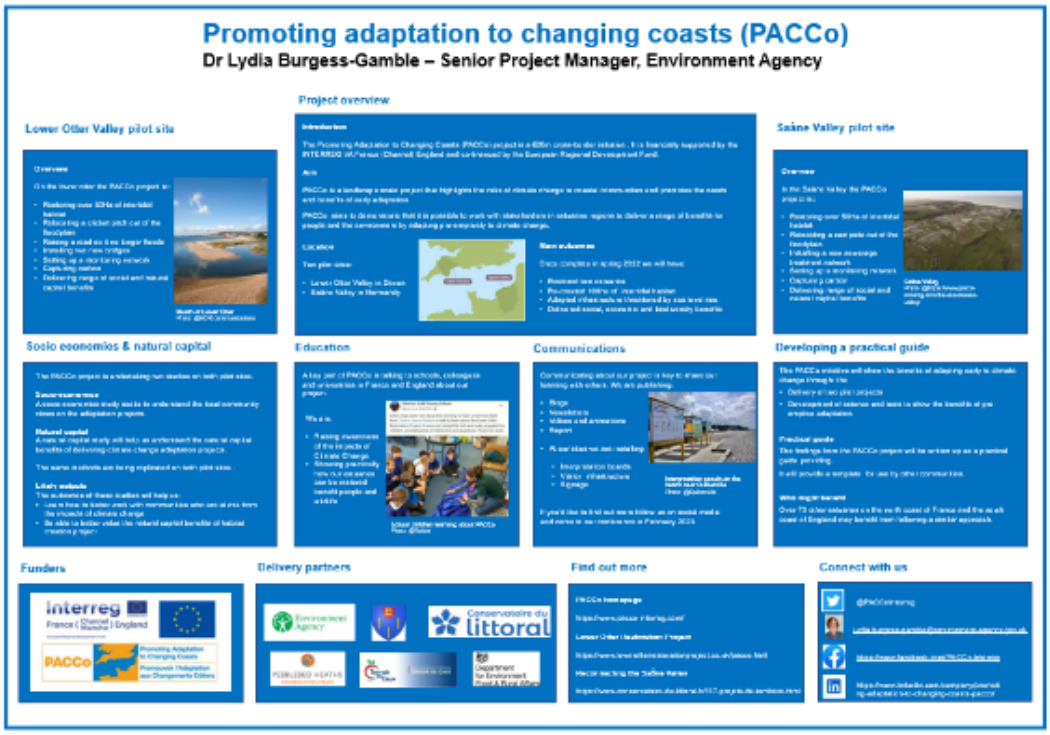
Some members of the public expressed their dissatisfaction with the local PACCo project continuing during this period. However, the project teams made good use of remote working to maintain public dialogue throughout this challenging time. Pausing PACCo was not an option due to funding and time constraints. Section 3.5 summarises independent surveys and analysis which has reviewed the engagement approaches used in both

estuaries as well as providing a model for engagement that other schemes might wish to follow.

The PACCo website[5] provided a useful overview of the cross-border initiative showcasing the project and sites with strong images, news releases, blogs and videos in both French and English. It also linked through to the LORP[6] and Basse Saâne[7] websites ensuring visitors could access all they needed via the connected resources. These communication activities are summarised in Chapter 4.

As well as community engagement, PACCo sought to connect with others working in related organisations and industries to promote the programme as an exemplar of coastal community adaptation to climate change. Professional conferences were an important mechanism to influence policy makers and funders for future schemes. Senior PACCo team members used summary posters (see Figure 3.1), banners and videos as discussion points for peer-to-peer learning, collaboration, and networking.

Figure 3.1 Example of a PACCo conference poster (Source: Lydia Burgess-Gamble)



[5] Available at: https://www.pacco-interreg.com/ [Accessed: 29/092022]

[6] Available at: https://www.lowerotterrestorationproject.co.uk/ [Accessed: 05/10/2022]

[7] Available at: https://basse-saane-2050.com/ [Accessed: 05/102022]

3.2.3 Lower Otter

The Lower Otter Restoration Project (LORP) was formally established in 2014 to address the challenges of climate change and failing flood defences in the lower River Otter.

However, five years earlier, the landowner Clinton Devon Estates (referred to also here as 'The Estate'), commissioned a hydrological review of the issues facing the area (Haycock, 2009). The findings of this report helped inform early discussions with government, environment and civic organisations about the issues affecting the estuary. The Estate / East Devon Pebblebed Heaths Conservation Trust also sought guidance and advice from the Environment Agency on the many technical, social, environmental and financial constraints facing the conceptual managed realignment scheme.

Early recognition of the significant social interests prompted the formation of the LORP Stakeholder Group in 2013. Representatives from identified audience groups were invited to join the early discussions. The group formed the basis of a dynamic stakeholder list, which was analysed using an influence and impact matrix to establish who to inform, and with whom to develop two-way dialogue with (inform, receive, and collaborate). This list was then reviewed and updated as the project progressed.[8] This included increasing representation during the development phase. However, some groups still felt excluded and the background to this is explored further in a commissioned report associated with the engagement model (see also Section 3.5.1)

The LORP Stakeholder Group was set up specifically to connect the project team with the community and other interested parties while a range of options was explored. It was important to provide structured opportunities for people to shape the broad form of the project right from the start. The stakeholder group was co-ordinated by the Environment Agency and Clinton Devon Estates / the East Devon Pebblebed Heaths Conservation Trust (EDPHCT) with an independent chair. It helped to:

- Maintain two-way dialogues
- Develop relationships
- Highlight issues
- Understand stakeholder and public perceptions
- Share knowledge and information
- Assess reactions to outline proposals and options.

Members of the group included residents, tenants, businesses and councils plus project partners, site contractor, wildlife charities statutory consultee organisations such as Natural England. A technical steering group ran separately to deal in depth with specialist

[8] Available at: https://www.lowerotterrestorationproject.co.uk/resources.html [Accessed: 05/10/2022]

considerations such as biodiversity licensing and highway legislation. There was some membership overlap on the two groups with meeting decisions and actions shared. All minutes from these meetings were made available on the LORP project website.

In 2014, the Environment Agency became the lead partner for the Lower Otter Restoration Project to deliver over 55 hectares of mudflat and saltmarsh, creating a new wildlife reserve of international conservation value as compensation for lost habitat in the neighbouring Exe Estuary. Other key benefits included:

- Maintaining and improving public access with a raised road and enhanced footpaths
- Reducing pollution risk by securing of a redundant municipal refuse tip
- Relocating the local cricket club to a new site outside of the floodplain.

Clinton Devon Estates / EDPHCT retained the support of its public relations agency KOR Communications with their association starting at the beginning of the Lower Otter Restoration Project. KOR created a suite of publicity materials, including the project website, and supported the stakeholder group. This early professional input set a firm foundation for the LORP stakeholder engagement and communications activities.

An important point to note is that during the early years developing LORP the project team was small, comprising just a few technical staff. Between them, these officers from Clinton Devon Estates / EDPHCT and the Environment Agency forged a strong network of stakeholder relationships and engaged with the community and other organisations at the same time as devising early versions of the technical, environmental and engineering options. However, the project would perhaps have benefitted from specialist engagement advice and input, this is also explored further in Section 3.5.1. However, such early engagement input can be constrained in the initial stages of a project if it is in its early conceptual phase with no significant resourcing.

When the Environment Agency became the LORP delivery lead, and funding became available, its specialist stakeholder engagement staff started to provide additional guidance and support to the project team. The catalyst for the provision of dedicated engagement and communications resources from Clinton Devon Estates / EDPHCT and the Environment Agency to boost the capability and capacity of the project team was the successful Interreg funding application for PACCo in January 2020. This expanded the capability and capacity of the project team. PACCo subsequently set up five work packages, including one specifically for communications (see Chapter 2, Section 2.4).

Key Messages

Specific LORP key messages were produced to provide the main narrative of the engagement and communications content. These were:

- LORP is delivering a natural solution to help the Lower Otter Valley adapt to climate change in a planned and funded way.

- Currently the valley is not secure or sustainable in the face of climate change after centuries of human modifications. The sea will take the valley back at some point.
- Waiting for an inevitable catastrophic breach will make repairs to local roads and footpaths difficult and costly, with no guarantee of funding.
- Now is the right time to make essential changes in a funded and managed way so future generations do not pay the price for our lack of action.
- LORP is working with local people and partner organisations to adapt and improve the Lower Otter Valley for future generations.

Other key messages included the benefits of the project, the need to relocate the cricket club, construction timing and impacts, post-delivery arrangements, funding and timing of that funding, explanation of the roles of the LORP partners and how we were undertaking public engagement.

The primary LORP stakeholder engagement methods used were:

- Public exhibitions
- Stakeholder groups
- Websites
- Stakeholder updates/newsletters
- Site visits
- Direct stakeholder correspondence
- Small group and individual engagement.

These methods are now summarised below.

Public Exhibitions

Public exhibitions (see Figure 3.2) were held in central community venues in 2014 (LORP, 2014) and 2017. They used visual displays, presentations and discussions to guide people through the Lower Otter's challenges and the suggested options.

In 2014, input from stakeholders, tenants, residents and visitors was used by the project team to shape the proposal and secure most of the necessary funding from the Environment Agency capital programme. In 2017, the public were shown four options and asked to identify the one they felt was the right fit for the area and its community. Analysis of the feedback gathered enabled the team to draw up a specific plan based on the most popular choice, which also coincided with the best option on technical, environmental and economic grounds.

Ordinarily, a further public exhibition would have been held in 2020 to support the planning application prior to submission. However, public gatherings were prohibited under the coronavirus restrictions. To combat this, extra efforts were made to promote the planning authority's online planning consultation to get as many people involved as possible.

Figure 3.2 Poster inviting community members to a public exhibition in 2017 (Source: LORP)

Stakeholder Groups

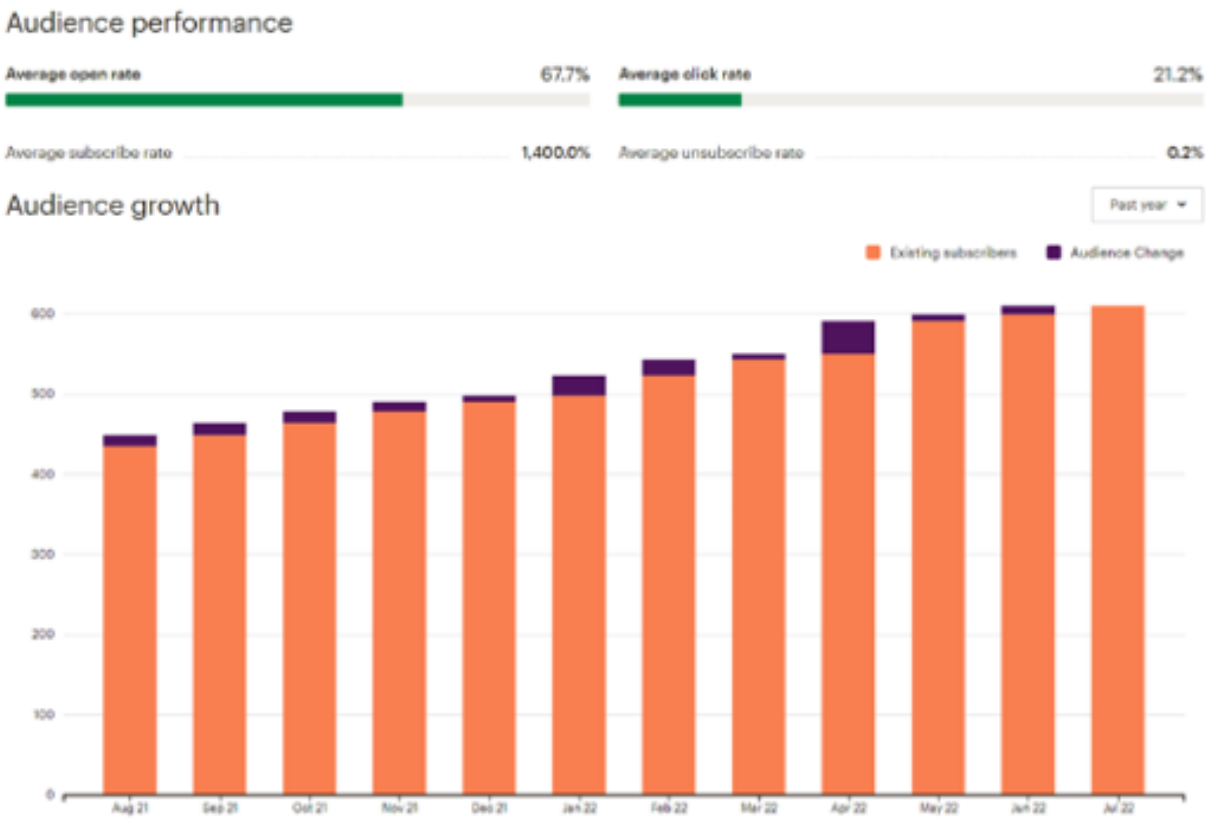
There have been three formal interactions with the stakeholder group during the development of LORP. The original one formed in 2013 and there was also a technical steering group of involved organisations. This evolved and expanded once the Environment Agency took the lead in the project in 2014.

Once planning permission was approved, the main role of the stakeholder group was achieved. A new LORP Liaison Group was formed to continue the effective two-way links between the project team, local community, specialist groups and the wider public for the construction and delivery phase. This group met remotely initially to agree their chair and terms of reference (LORP, 2021), with the secretariat provided by the partners and contractor.

Websites

Launched by Clinton Devon Estates in 2016 the LORP webpage[9] is a public facing central resource. It has become the primary vehicle for sharing information with the local community including proposals, storing stakeholder meeting minutes, factsheets, Frequently Asked Question (FAQs) document, timelines and all planning materials. Those interested were able to sign up to the project mailing list via the site. As can be seen in Figure 3.3, the number of people engaging with the webpage has increased over the lifetime of the project.

Figure 3.3 Audience performance on the LORP website



There was a steady growth over time as shown in the analytics above, as well as a high level of engagement which was demonstrated by the 67% opening rate of the newsletters. The website also invited individuals to make direct email contact with the most common requests being for further information, talks and site visits. There was very little negativity

[9] Available at: https://www.lowerotterrestorationproject.co.uk/ [Accessed: 05/10/2022]

in the direct emails. In addition to this website, LORP's site contractor Kier also set up their own webpage.[10]

Stakeholder Updates/newsletters

It was agreed between the project team and stakeholder groups that updates and newsletters would only be sent out when there was something to share, rather than simply to a fixed frequency. This approach gave the LORP team the ability to pace the dialogue with more timely and focused news and communications actions, adding real value to audience interactions as well as a high level of engagement.

Updates and newsletters were also sent direct by email and displayed on local noticeboards supporting the online publication. The content was then re-used by Clinton Devon Estates / EDPHCT in their regular pieces in several parish council newsletters and websites, briefing notes for councillors and in relevant organisations' company newsletters such as the Otter Valley Association. This helped to reinforce and maintain key messages.

As part of its considerate constructor ethos, Kier (the primary delivery contractor) had its own dedicated community Stakeholder Manager throughout the construction phase to deal with queries, requests and complaints from the public. In addition, it published its own newsletter sharing site progress, staff profiles, working times and contact details (see Figure 3.4), and assisted with local enquiries and site tour arranging. Kier also demonstrated its social values by donating wood from felled trees to a nearby home heating project, installing sponsored flower beds, joining litter picks, and making efforts to be a good neighbour. A popular initiative was the bird spotting board, which showed the public what species the contractor team saw while working on site.

Kier also added QR codes (see Figure 3.4) to gates along the footpaths for people to use with their mobile phones to ask questions about the LORP works. In addition to this, the opportunity arose to work with 'Hello Lamp Post' - an organisation that creates interactive site signage. On the Lower Otter, visitors to a site can interact virtually with the project by scanning a QR code and responding to questions posed (see Photo 3.2). Although this is a trial, it could be a useful tool for collecting views from the public over time. Both initiatives provided an innovative and interactive way for the public to have a two-way conversation with their surroundings, to find out more and have greater input into local decision-making. Insights from conversations can help organisations be better informed about stakeholders' perceptions, opinions and ideas.

[10] Available from: https://www.kier.co.uk/projects/lower-otter-restoration-project/ [Accessed: 05/10/2022]

Figure 3.4 Example of Kier's Lower Otter newsletter and engagement using QR codes (Source: Kier)

KIER

September 2022

Lower Otter Restoration Project

An update on the project we are delivering for your local community

Welcome to the quarterly newsletter, aiming to provide information surrounding work progress, key programme and community engagement on behalf of Kier, The Environment Agency and landowner, Clinton Devon Estates.

Key benefits to this project include;

● New footbridge on the SW footpath ● Raising and surfacing of some existing footpaths ● New embankment to carry South Farm Road ● Re-naturalisation of Budleigh Brook ●Relocation of Budleigh Salterton Cricket Club ● Breach to enable valley to become intertidal

Construction update:

The road embankment has now been constructed and the settlement period is now complete. Works to remove the additional soil back to finished height has now begun.

The Western footpath improvements (Little Bank) are now underway with temporary diversions in place until the end of October.

The Budleigh Salterton Cricket Club will be relocated to a purpose-built pitch in a more sustainable location above the floodplain, preparing the way for the connection of the historic flood plain with the Otter estuary via a breach in the earth embankment

South Farm Road overnight closures: Monday 5th – Friday 9th September between 8pm - 5am
All heavy works will finish no later than 11pm. It is unlikely to generate an noise beyond the sound of regular traffic and all emergency services will have full access throughout the duration.

Key Construction Dates:

Autumn 2022: Raising footpath (south of South Farm Road) and temporary diversion at Whitebridge

Early spring 2023: New South Farm Road to become operational

Spring 2023: Kersbrook Culvert connection to new creek system at the new South Farm Road bridge

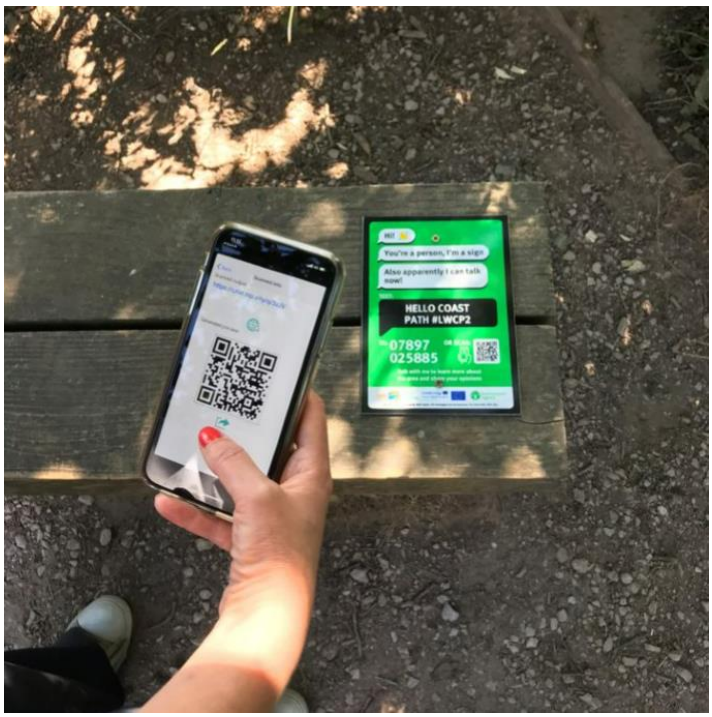
Late spring 2023: Breach existing bank north of Lime Kiln car park. Project will then become intertidal

www.kier.co.uk @kiergroup Kier Group

Community Engagement

To keep everyone posted on construction activities and any updates such as changes to public access Kier have set up a Facebook page https://www.facebook.com/KIER-at-Lower-Otter-109330674991760/

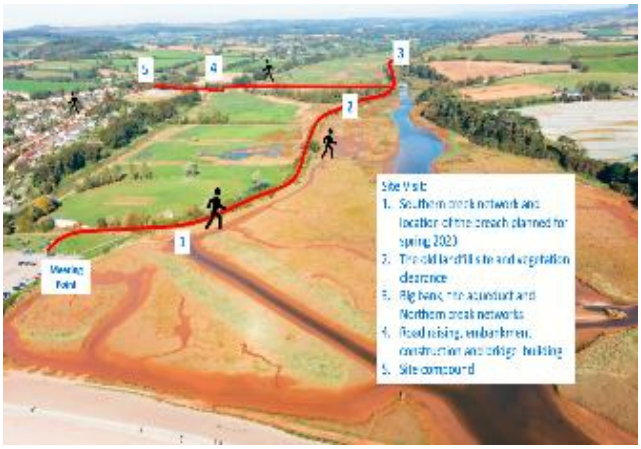
Photo 3.2 Hello Lamp Post sign on a bench on the Lower Otter (Source: Carla Whitaker)



Site Visits

Although physical site visits were initially restricted due to the coronavirus pandemic, once visits they were able to go ahead, they were very popular. Between April 2021 and March 2023 there were over 50 site visits to LORP by organisations, schools and local groups (see Photo 3.3). A similar approach was also implemented in the Saâne Valley.

Photo 3.3 A typical site tour on the Lower Otter with associated map showing the route (Source: Lydia Burgess-Gamble)



Site visits were all excellent opportunities to connect with people, explain what was happening and why, to educate, inform, to influence and reassure. Seeing the complexities, challenges, and progress and early benefits for themselves with informative commentary from the project team, helped improve understanding. Many visitors, including some sceptics, became advocates for LORP after a guided walk and talk along the riverbank.

A virtual tour using drone footage was also run to enable large groups from further afield to learn about and benefit from LORP and PACCo (and virtual tours have been ongoing throughout the PACCo project - once a month). This was particularly useful when engaging with wider audiences at conferences and events, and through digital and social media channels.

Direct Stakeholder Correspondence

Many people wanted direct responses to specific questions or points of view. These enquiries could be made either via the LORP website or direct to the partner organisations. Both Clinton Devon Estates / EDPHCT and the Environment Agency had established systems for receiving and responding to enquiries from stakeholders.

There was a regular flow of correspondence from individuals with detailed queries or concerns about impacts on their property, on wildlife, pollution, flooding, parking problems and timing of works.

A strong tool in the LORP partnership was the depth of each organisation's existing networks and connections. The team used this knowledge to positively inform how and who responded to stakeholders' enquiries and how to continually cross-check with colleagues. A single stakeholder enquiry system accessible to all partners would make this work more efficient.

Although much of the direct email correspondence focussed on concerns occasionally there was some positive (and welcome) feedback:

> 'Thank you for getting back to me so quickly! I'm very reassured by what you've said and appreciate the dilemma it presents! It's making the best of a bad job I suppose. The whole restoration project will be amazing for nature.'

Kier's participation in the construction industry's 'Considerate Constructors Scheme' scored them top marks in all three categories:

- Respect for the community
- Care for the environment
- Value their workforce.

The moderators noted lots of good practice and stated:

> 'Extensive goodwill opportunities and site meetings and webinars with schools and colleges have been key activities in recent months.'

This recognition of professional commitment to stakeholder engagement was a great boost and motivation to the whole project team.

Small Group and Individual Engagement

As LORP and PACCo progressed there were frequent opportunities for direct discussions with specific groups (e.g. the local farm business community, parish paths partnership, portfolio councillors, resident groups) and affected individuals. These discussions were tailored to their interests and although less structured and more personal interactions, were hugely important to those involved.

The most frequent issues raised included typical construction site concerns such as about noise levels, dust, working hours, and worries about emergency vehicle access due to inconsiderate public car parking. Each of these was treated with respect - the team even got the local fire service to drive an appliance through to give reassurance that access was possible in case of an emergency.

Volunteer groups were used to safeguard some rare plant species helping dig up, move and replant them out of the site area. They also monitored and surveyed the wildlife providing the team with excellent on-the-ground knowledge and images before, during and after construction (see Photo 3.4).

Presentations were given to specific community groups (e.g. Budleigh Salterton Town Council, Otter Valley Association, Parish Councils) plus facilitated workshops with local councillors to build understanding and advocacy.

The whole team worked together to distribute this stakeholder engagement according to aptitude, experience and skills.

Photo 3.4 Volunteers assisting with fish monitoring on the Lower Otter (Source: Kendal Archer)

3.2.4 Saâne Valley

The Basse Saâne 2050 project started in 2012. A steering committee was created, to bring together representatives of user groups (hunters, fishermen, farmers, associations of local residents), local authorities, public services, site and/or structure managers, the contracting authorities of the operations, the technical funding partners. This group includes approximately 30 organizations. Several technical committees have been set up: one for the overall project, and one for each operation of the project. This made it possible to discuss technical questions in a small committee before presenting them to the general technical committee and validating them in the steering committee.

After an initial phase where preliminary studies of the area took place, it was possible to create different scenarios and to hold consultation workshops with the general public between 2014 and 2016. In 2016, the steering committee agreed on the project objectives and expectations for the medium and long term. After this phase which made it possible to identify the contracting authorities of each of the operations, came the phase of seeking

funding. The PACCo funding accelerated the process and enable the project to start the operational phase.

A communication strategy was created by the contracting authorities and funders, and a graphic design selected for the project Basse Saâne 2050.

Stakeholder Identification

The first step was to set out the target audience for both engagement activities and for receiving communications messages. The audience was defined at a local level (inhabitants, tourists and users) and more widely at a national and regional level.

Existing Communication Routes

The next step in the development of a communications and engagement strategy involved defining existing communications routes which could be tapped into and used throughout the project. This included links to the PACCo Education and Communications Strategy and Plan. It also involved identifying other organisations and their specific communication routes (see Figure 3.5):

- Agence de l'eau Seine Normandie – French Water Agency
- Syndicat bassin versant Saâne Vienne et Scie – qualified in Aquatic environment management and flood prevention (GEMAPI in French) on the Scie and the Saâne lower valley
- Conservatoire du littoral – Organisation with similarities to both National Trust and Natural England
- Quiberville – The local Town/Parish
- Communauté de communes Terroir de Caux – Qualified in wastewater management and tourism
- Other local partners such as Longueil and Sainte-Marguerite sur Mer towns, the Seine Maritime département, the Normandie région

The objective was not to duplicate these tools and to be able to use them to relay the project information.

Figure 3.5 Targeted audience identified in the communication strategy for the lower Saâne project (Source: L'Agence Nature)

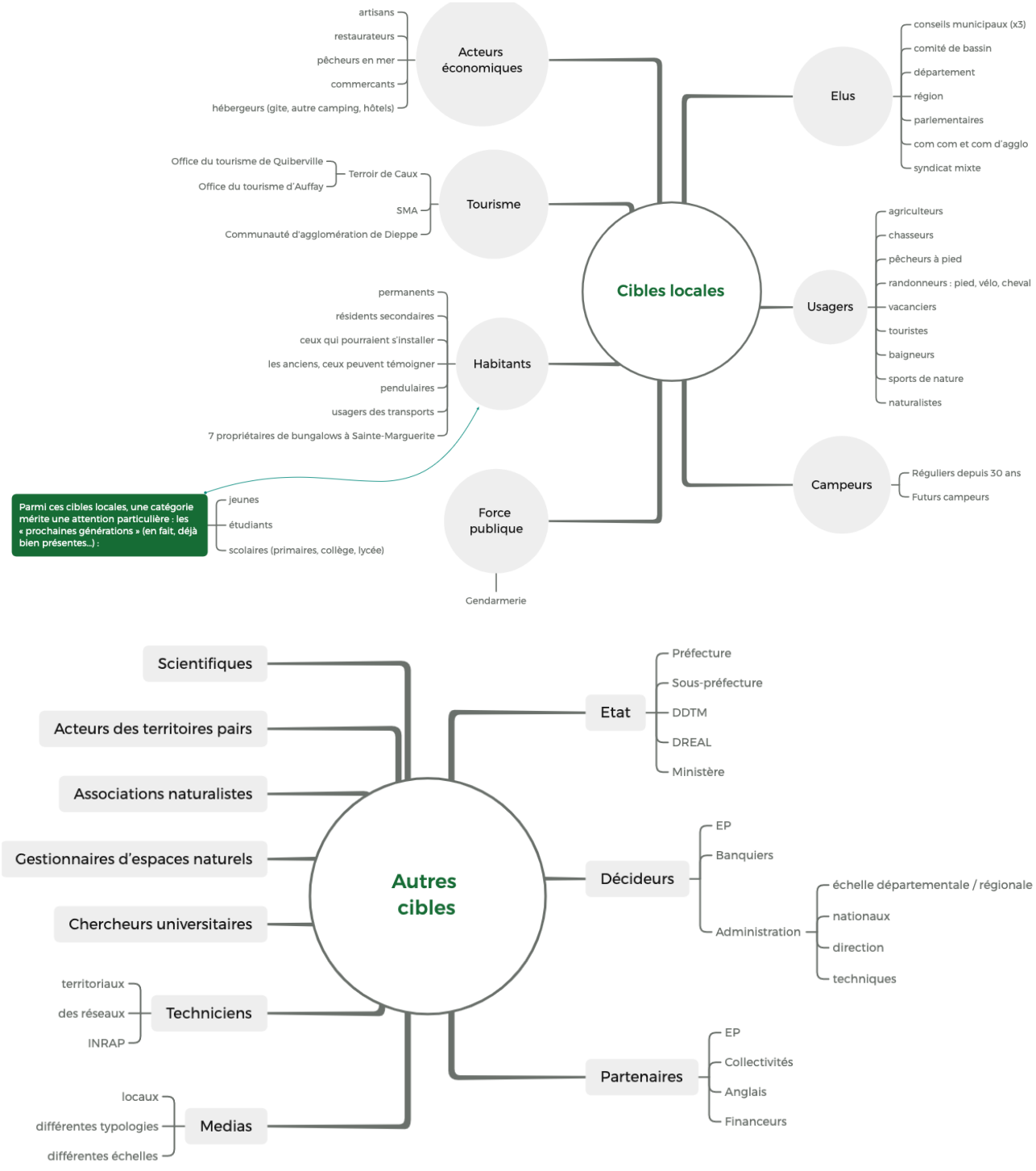
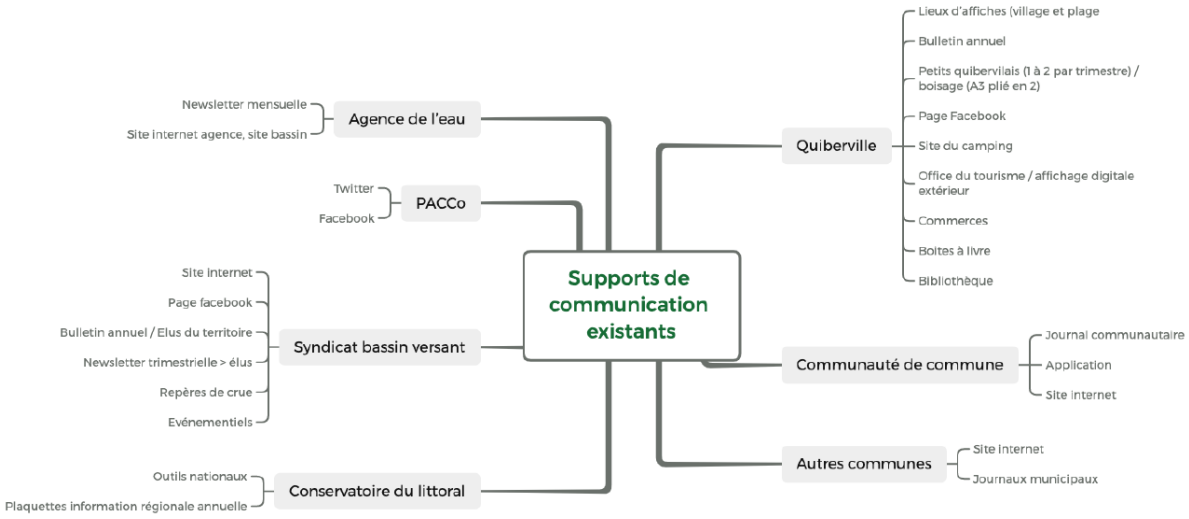


Figure 3.5 (Continued) Mapping out existing communications routes (Source: L'Agence Nature)



Developing a Timeline

A timeline was developed to set out the different stages of the PACCo project and its connection with the Basse Saâne projects. This enabled to develop a communications and engagement calendar aligned to key dates and events in the project's delivery calendar.

Commitment to Transparency

Transparency was deemed an essential element of successful communication and engagement – to ensure that the recipients are convinced that everything is being told to them, and that they can find the answers to their questions. To achieve this, a commitment to regular communication must be made and kept overtime.

A quarterly communication event would be undertaken throughout the project. A "project diary" was selected as one of the main modes of communication. This involved keeping outdoors exhibition panels located in three towns affected by the project up to date. A four-page paper version, called the Saâne letter, is also distributed in the mailboxes of all inhabitants of the lower Saâne valley and available at the Quiberville tourist information centre and in the three town halls of the lower valley. The digital version is also available on the website of the Conservatoire du littoral and distributed to project partners and residents who wish to receive it.

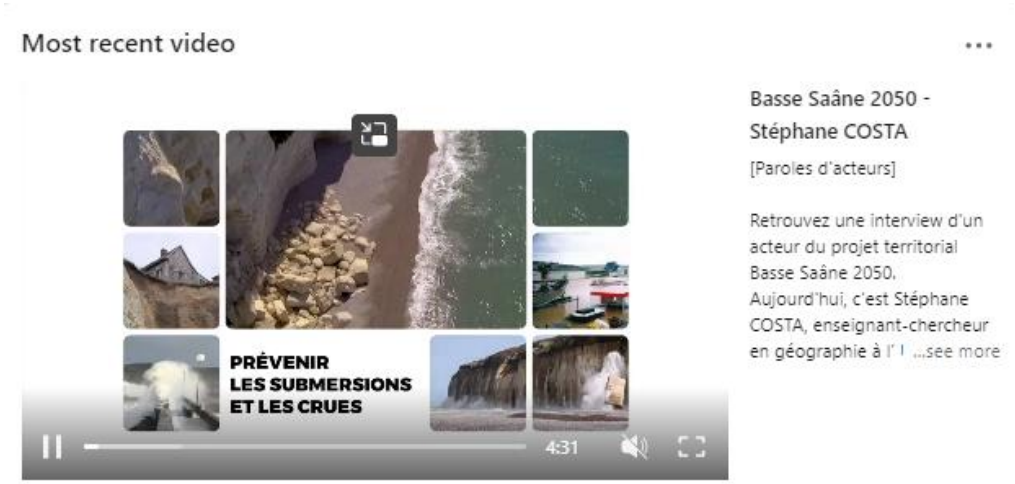
The purpose of the diary and the letter was to inform and engage residents and tourists on the progress of the project and the construction work. It was also used to communicate on the upcoming phases and prevent misconception and objection from public due to misunderstanding of the progress of the project.

Dynamic Press Kit

A dynamic press kit available on the Internet.[11] It was developed to allow the media and members of the public to access all the information on the project (see Figure 3.6).

Figure 3.6 Basse Saâne dynamic press kit

Figure 3.7 Video testimonials from those involved in Basse Saâne 2050



[11] https://basse-saane-2050.com/

The dynamic press kit provides access to short video clips which includes testimonies of local partners. These videos are used on social media and during other events to promote the project. The videos are also available on the Conservatoire du littoral YouTube channel, where you can also find videos showing construction site progress.

Summer Exhibition

Each year, a summer exhibition was implemented in the three towns of the lower valley. It included 12 panels located in popular places (seafront in Quiberville and Sainte Marguerite and opposite the school in Longueil). Each year the exhibitions covered a different theme.

In 2021, the summer exhibition introduced the territorial projects of the Saâne and Otter valley, as well as the PACCo project. In 2022, it showcased the habitats and protected species of the Saâne valley. In 2023, the exhibition shared the views of the inhabitants and local users of the area.

Site Visits

Although physical site visits were initially restricted due to coronavirus restrictions, once they were able to go ahead, they were very popular. Much like the Lower Otter, in the Basse Saâne site visits were delivered to local communities, local and coastal stakeholders, organisations, schools and local groups which showed interest in the project (see Photo 3.5).

Photo 3.5 Site tour brochure used in the Saâne Valley (Source: Cdl)

3.2.5 Visitor Surveys

To measure the success of the PACCo projects, an assessment was undertaken: visitor surveys were carried out to understand their views of the projects and their knowledge of the natural risks that the valleys are threaten by. The findings from the visitor surveys are summarised in Appendix 1.

The visitor surveys were carried out in person and online during the spring and summer of 2021 and 2022 by ABPmer and EDPHCT staff in England, and the Conservatoire du littoral in France. The findings can be used in future climate change adaptation projects, to improve the engagement strategy. They provided valuable comparisons and insights into stakeholders' demographics, as well as their attitudes and to both sites before and during development and delivery.

One of the PACCo project objectives is to enhance the socio-economic value of the Lower Otter and Basse Saâne Valley sites. Although socio-economic outcomes can be partially determined using a natural capital assessment approach, the project also sought to capture less measurable but no less important aspects of what visitors / local people value (and dislike) about the sites, how they perceive them, and what activities they do there. The socio-economic surveys were therefore carried out locally to find out perceptions of the site (before and during the construction of the scheme). The French survey also included attitudes to climate change that for reasons of brevity were excluded from the English survey.

The surveys were designed to provide baseline socio-economic data which can be used to monitor change over time. They were also intended to capture people's changing views across the different stages of project delivery, which included periods that presented challenges to visitors and local people (e.g., construction works, noise, path closures, vegetation clearance etc). The methods and full results are available in the Lower Otter and Saâne Valley survey reports.

Surveys before, during and after can assist with understanding less tangible aspects of the value that visitors and local people place on the site, people's perceptions of the site and scheme, and the socio-economic benefits and disbenefits, and how these change over time. Such surveys may also shed light on instances when local people experience challenges during the different stages of the scheme and / or a sense of loss as a familiar landscape and particular features are altered.

3.3 Landowner Engagement

3.3.1 Overview

A priority in all proposals should be proactive engagement with the owners of the identified land at the earliest possible stage. There is a clear need to work with landowners to co-

create the planned project and understand and overcome any concerns, and closer to project delivery, secure the necessary permissions to proceed.

Agreements in respect of rights related to archaeological finds, access arrangements, correspondence with tenants and land users must be established to avoid any later complications.

Another option can consist of buying land during the project set up. This is the strategy used by Conservatoire du littoral. The area that the Conservatoire du littoral is authorised to buy land cover the Saâne valley and it is through landowner negotiation. It depends mainly on the landowner and if they are willing to sale. As of February, the 1st 2023, the Conservatoire du littoral owns 63 hectares of land near Quiberville, Sainte Marguerite and Longueil. Only the land owns by Conservatoire du littoral will be used to restore habitats.

In the Otter Valley the situation was simpler as the restoration project site was owned by a single landowner Clinton Devon Estates (CDE). The non-profit conservation arm of Clinton Devon Estates, the East Devon Pebblebed Heaths Conservation Trust (EDPHCT), became a PACCo project partner. CDE / EDPHCT had already started exploring potential solutions to managing the area differently. However, although all land was owned, they did not have land occupation with significant proportions of land being tenanted. Any change in land use therefore had to be carefully negotiated and legally documented.

The approaches to engaging with landowners and land users differ across the two projects due to distinct cultural ways of working, political contexts and expectations.

3.3.2 Lower Otter

As a small site with one landowner, LORP benefitted from the extensive local connections of Clinton Devon Estates, who took the lead on interactions with their tenants (domestic and businesses).

Local Connections

The insight and knowledge of their tenants helped define the stakeholder engagement approaches so those most affected by the project were involved, informed and knew who to contact. Most of the tenant/landowner relationships were longstanding so the parties knew each other.

As part of the LORP, project the local cricket club was relocated to higher ground, meaning a key element of this project involved negotiating with the tenant of this land. As several of LORP's project team members were also members of the local cricket club, there was the potential for there to be a conflict of interest, especially at the early stages of the project when initial discussions were challenging – this was mitigated by changes in the representation on the committee.

It was important to be aware of the potential for dilemma and personal impacts on those living, playing and working in their local community, and to provide support to anyone affected during periods of uncertainty and challenge.

The Estate established contact points received questions and concerns about LORP. An effective triage of stakeholder enquiries was agreed with the appropriate partner contributing their input and providing a single LORP response. This complemented similar systems in used by the Environment Agency, Kier and via the LORP website.

Public Access

Thousands of people enjoy walking along the popular River Otter which has several designated public access routes including the well-used South West Coast Path. Therefore, an important socio-economic benefit of LORP was to improve and/or safeguard public access where it was possible to do so.

Every effort was made to keep the public footpaths open as long as possible during the project. However, some paths criss-crossed the construction site necessitating diversions and closures so work could proceed without risk to the public and construction staff.

Managing public expectation of access to footpaths was complex as there were various remits held by different authorities. At the Lower Otter site some members of the public assumed that the Estate, as the landowner, was responsible for the maintenance of all nearby footpaths, which was not the case. The Estate liaised closely with the relevant district and county highway authorities and the site contractor using statutory notices, information posters and local media to give walkers as much notice as possible of diversions and closures.

Archaeological investigations in the Lower Otter area identified interesting finds relating to early prehistoric occupation of the river estuary. Working with local volunteers, the team found remains of flint tools such as arrowheads from the end of the last Ice Age (see Photo 3.6). These items were exhibited locally and at the Royal Albert Museum, Exeter. A blog with more information on the finds is on the PACCo website.

Photo 3.6 Arrow head (Left) and blade core (Right) found on the Lower Otter (Source: Greg Chuter)

3.3.3 Saâne Valley

In the Saâne valley, the Conservatoire du littoral has established partnerships with the Etablissement Public Foncier de Normandie (EPFN) and the Société d'aménagement foncier et d'établissement rural de la Seine-Maritime (SAFER - Seine-Maritime Land Development and Rural Establishment Company). These agreements made it possible to acquire lands located within the scope of the project and to carry out initial restoration work.

The EPFN also carried out the land management of the plots of the new tourist facilities in Quiberville. They acquired the land on behalf of the town in advance of the campsite's relocation.

For the reconnection of the Saâne to the sea and the habitat creation, the EPFN will purchase from Quiberville town the land where the old campsite used to be located. They will demolish buildings and infrastructures after carrying out the necessary studies (soils, buildings, etc.). The Conservatoire du littoral (Cdl) will be the final owner of the land and will delegate the project management of the habitat creation and restoration works to the Syndicat Mixte des Bassins Versants Saâne Vienne Scie.

Due to the recent purchase of a new plot of land in the lower valley in 2023 the modelling of the Saâne Valley's restoration/breach is being re-evaluated. The original designs need to be modified, and the flood models will need to be re-run.

The breach and restoration works will impact farmers, some have temporary agreements for agricultural use with Cdl. All farmers in the valley are in contact with the Conservatoire du littoral who keeps them informed about changes within the valley. The way in which these farmers manage their land will have to evolve to adapt to the changes in the valley.

3.4 Educational Engagement

3.4.1 Overview

PACCo's engagement approach had a strong commitment to encourage learning and participation in the delivery of the project to develop a sense of social awareness, cultural responsibility and awareness of climate change adaptation (see Photo 3.7).

A specific work package focussed on education set out the ambition to work with different schools. Different approach were use either side of the Channel. In England, CDE worked with six schools across all age groups, with three visits (to school and to site) per year during 2021 and 2022. In France, 36 presentations were given by Conservatoire du littoral to reach as many students as possible.

Partners from either side of the channel also visited a school in France or England to deliver a bilingual lesson. The purpose of this was to show that we face many similar

climate change challenges no matter where we live, and that often the solutions are the same.

Photo 3.7 Kate Ponting from CDE delivering a lesson about PACCo and climate change to a local school (Source: EDPHCT)

Another key deliverable to support the programme of school visits was the production of a bilingual education pack to help embed understanding of the principles of PACCo into future generations. The interactive pack linked to school curriculums with lessons plans, videos, citizen science data collection materials and historical maps, for visits and in the interpretation hubs (see Part 5 of this guide for summary of the hubs).

The PACCo Education and Communications Strategy and Plan also included communications and engagement activities planned with schools. A bilingual educational pack was used to deliver all PACCo educational talks and site visits.

3.4.2 Lower Otter

Before PACCo was established, the EDPHCT team already had a dedicated education officer delivering a busy programme of education events, volunteer days and visits to engage with local schools and colleges.

The Lower Otter Restoration Project provided a rich and accessible resource for students to understand the motivations and challenges of coastal adaptation including, the benefits to people, wildlife, carbon capture and local people. The children were also handed postcards to give feedback and details on where to get more information.

Educational engagement enabled us to:

- Undertake over 60 school visits engaging over 2,000 students in England and France
- Deliver a virtual talk to 40,000 school children via Learn Live
- Attend a Geography conference sharing the materials developed.

Additionally, a local museum described LORP as 'the most significant event in the River Otter estuary for over 200 years' as it launched a two-year long exhibition for school groups, visitors and local people. This opportunity, just a short walk from the site, was welcomed and supported by the Environment Agency, Clinton Devon Estates / EDPHCT and the East Devon Area of Outstanding Natural Beauty. At this exhibition, information panels and a video explained the history, flooding, wildlife and archaeology of the Otter estuary, as well as the aims of the project, its funding, climate change and community engagement, providing a social history record for future generations.

3.4.3 Saâne Valley

The Saâne Valley did not have its own education officer, the PACCo project partners led events with local school. This included doing talks, presenting the project and participating in environmental events such as tree planting.

Additionally, the Communauté de communes Terroir de Caux and the Communauté d'agglomération Dieppe Maritime delivered lessons with local schools to raise awareness of climate change and to deliver key messages of both PACCo and Basse Saâne 2050.

Educational environmental lessons already existed in local schools, and this gave the PACCo project team the opportunity piggyback on to these, for examples describing the PACCo project during a water lesson funded by agence de l'eau. The Syndicat Mixte des Bassins Versants Saâne Vienne Scie worked with the local schools in Longueil and Luneray to talk about climate change and habitat restoration in the Saâne valley.

3.5 Independent Evaluation of our Engagement

A critical review of LORP engagement was carried out by specialist researchers at the University of Exeter and the Lisode Consultancy as part of Work Package 2. The aim was to develop a methodology for the engagement of end users and key stakeholders in other coastal climate adaptation projects, learning from the experiences of both the Lower Otter Restoration Project and the Saâne Territorial Project. This methodology was developed into a final model for engagement for others to use.

Their research involved:

- A documentary study covering all reports, media coverage, communication tools, public meetings of territorial projects
- Workshops with community residents and
- Interviews with project partners and stakeholders.

The first report from this package provided a detailed and evidenced account of the engagement activities that were undertaken during the development of the Lower Otter Restoration Project and Saâne Territorial Project. The second report gave a voice to stakeholder representatives and local communities to share their knowledge and perceptions. It then concluded with presentation of the final Model and its component parts. These include five theoretical principles to achieve in the optimal approach to engagement, and an appreciation of elements that relate to engagement as a process through time. There are also challenges and limitations identified that will constrain the ability to achieve the optimal approach to engagement. Links to the detailed reports are provided at the end of this chapter.

Rather than summarising these two reports here we have instead focussed on summarising the model for engagement which the researchers have developed for use on future climate change adaptation projects.

3.5.1 A Model for Engagement

There are four aspects to the engagement model, which together are visualised as a wheel (Figure 3.8):

- **Theoretical Principles -** These are the five philosophical principles of engagement within this model, represented by the segments in the central part of the wheel.
- **Sequential Process -** These are the elements of the model (circular arrow) that relate to the engagement process as it progresses through time.
- **Challenges and Limitations -** These are the external factors (represented as arrows) that will have an influence on the engagement process, including what is principally or technically feasible.
- **Optimal approach -** Represented at the centre of the wheel.

These 4 aspects are summarised below.

Figure 3.8 Visualisation of the model for engagement in coastal adaptation and landscape change (Source: Auster et al, 2022).

3.5.2 Theoretical principles

The model includes the followings five principles of engagement.

Empowerment - Climate change adaptation projects affect multiple stakeholder interests and social groups, particularly in sites with significant public access. The engagement process should seek to empower stakeholders and communities in the development process, particularly those who are most likely to be affected or are living in the vicinity. It is important to recognise and understand the different types of knowledge and the opinions that these groups may be able to contribute. Empowerment in the process will require an openness to feedback where, if it is necessary, input could lead to changed ways of thinking or changes in design. It is necessary to precisely identify the expectations and the objectives pursued at the key decision-making stages, and to keep the records of the debates and mediations.

Representation - Climate change adaptation projects will interact with multiple interest groups. Engagement should enable them to feel their interests have been represented in project development. Representation will likely need to include political or statutory bodies, landowners, landscape users, and local communities. An effectively managed stakeholder or steering group can be a good forum for an ongoing, two-way exchange of feedback and knowledge throughout the development of a project. This group should consider including residents within the vicinity of the project. Public engagement events should also be undertaken so that those not included in these groups can contribute.

Working with uncertainties - Adaptation to climate change involves actions taken to address future circumstances. Whilst awareness and acceptance of climate change itself may be growing, there can be disagreement about its impacts and levels of local risk. This can result in disagreement about whether proposals may be the “right” course of action to

take. Opening with discussion and information about local (or global) environmental risk, prior to introducing ideas for the solution, may reduce levels of uncertainty and instil confidence in the actions proposed.

Trust - Climate change adaptation projects intersect with many interests and community groups and will involve an acceptance of changes in a landscape. To gain acceptance of these changes there is a need for trust between groups. When stakeholders and communities feel empowered and represented, they can access clear information, and feel their concerns have been recognised and understood. To enhance trust, it is necessary to be engaged in a way that is transparent, honest, and open. Partners should ensure they work with communities in an inclusive way and that they listen to and empathise with community voices and opinions. Clear and accessible information should be available and outline the reasons for actions, describing the assessments undertaken and setting out any remaining uncertainties.

Clarity & Accessibility - Climate change adaptation projects address multiple objectives simultaneously, have multi-faceted designs and intersect with many different interest groups. This level of complexity can make it hard to communicate project motivations, decisions, or actions. This, in turn, can make it difficult for different groups of people to visualise. It is therefore important to consider how best to make the information accessible to different audiences and help them understand the project. Projects should seek to share information through multiple methods to increase the likelihood of reaching as many different groups as possible.

3.5.3 Sequential Process

We recommend undertaking the following phases of the engagement to ensure that all engagement is empowering, representative, trusted, accessible, and responds to uncertainty. Phases of engagement:

- **Preparation -** Prior to the initial outreach, it is advisable to reflect on the local social context and targeted audience. Consider using an independent engagement facilitator, to enable two-way sharing of knowledge and feedback. Any additional expense is likely to be repaid later.
- **Early engagement -** Early engagement with both stakeholders and community groups is likely to be received more favourably. The tone will need to be sensitive to their respective positions as landscape change is an emotive subject, with differing opinions on potential gains and losses. At this stage, projects should recognise the knowledge and perspectives that the different groups can contribute. Where possible, provide opportunities for knowledge transfer about the issue, before introducing ideas for the solution.
- **Sustained engagement -** Engagement will need to be an ongoing process throughout the various stages of a project's development. Communications will need to be kept up to date, and regular engagement meetings or events held. Avoid

long gaps between engagement events, even if progress is slow. There will need to be a continued openness to include different voices.

- **Engagement into the future -** There will likely be continued interest in the future of the project once complete. Give thought to the future and the potential approaches towards continued engagement and empowerment following project implementation.

3.5.4 Constraints and Limitations

The optimal engagement approach will be challenged by the push and pull of external factors such as:

- Organisational capacity, including changing personnel
- Financial resources
- Funder requirements
- Technical limitations
- Legal and regulatory requirements
- The lack of engagement (for example within the local community)
- Apathy (e.g., within local communities) towards a project and / or
- Unforeseen events (e.g., COVID 19)

These factors can limit what engagement activities are possible or what feedback is feasible to incorporate into project designs. For example, during Covid it was not possible to undertake face to face meetings, which impacted our ability to engage fully. It can be a challenge to navigate these factors and they affect the optimal engagement approach. As a result, special attention must be paid to the involvement of partners and stakeholders and regular reviews are needed. Engagement will require ever more commitment to work through challenges, and project partners will need to be open with engaged parties when such factors apply.

3.5.5 Conclusion

Coastal climate change adaptation projects result in significant change to the local landscape with multiple impacts for local people. Consequently, effective and continuous engagement with people is key to the success of adaptation schemes, and so we have developed an engagement model which is based on the learning from the PACCo project. The model describes an engagement process in which the full range of diverse stakeholders and communities are represented and empowered, where there is trust between groups, where information is accessible, and uncertainties are worked through. The optimal approach to engagement sits at the intersect between these values and is one that enables the voices of local communities and stakeholders to be heard on an equal footing, in a democratised decision-making process.

3.6 Further reading

Educational resources Lower Otter

Educational resources Saâne Valley

PACCo educational pack

PACCo educational resources

Socio-economic engagement (Executive Summary) – Lower Otter and Saâne Valleys (Auster, R.E., Gentle, M., Woodley, E., Brazier, R.E., Rougier, J-E., & Barr, S., 2022a)

Socio-economic engagement (Documentary evaluation) – Lower Otter and Saâne Valleys (Auster, R.E., Gentle, M., Woodley, E., Brazier, R.E., Rougier, J-E., & Barr, S., 2022b)

Socio-economic engagement (Stakeholder interviews) – Lower Otter and Saâne Valleys (Auster, R.E., Gentle, M., Woodley, E., Brazier, R.E., Rougier, J-E., & Barr, S., 2022c)

Summary of visitor surveys – Lower Otter and Saâne Valleys (Petersen, C., 2023)

Visitor Survey – Full Report Lower Otter (ABPmer, 2023a)

Visitor Survey – Full Report Saâne Valley (SMLN, 2022)

See bibliography for further details.

Chapter 4. Communication

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This chapter provides an overview of the approach to communication used on the PACCo project covering topics such as:

- Strategy
- Branding
- Translation and interpretation
- Printed media
- Face to face events
- Online media and
- Local or national media (Newspapers, television and radio).

4.1 Introduction

Communications (or comms) is frequently used as a catchword for all public relations, stakeholder engagement and communications activities. However, it is important to understand that engagement and communications are different disciplines that need to work together to be successful.

Engagement - Enables the dialogue with people, developing relationships to inform, involve, promote, include, correct (e.g. misapprehensions / misunderstandings), discuss, make decisions, or solve problems.

Communication - Provides the means to connect people with useful information which:

- Reflects the audience, message and timing
- Creates understanding or prompts action.

Communication is essential for effective engagement. Effective communications use a variety of channels and methods to reach specified target audiences. These are identified during the communications planning stage, which researches the most effective and relevant communications channels – for example, an article in a village newsletter and posters on notice boards will reach members of the local community, while a news release for specialist trade press will promote innovative engineering techniques among future funders.

In this chapter, we provide an overview of the approach to communication on the PACCo project, then delve into more detail and describe some of the communications activities across both estuaries, before a final individual focus on the Lower Otter and Basse Saâne.

4.2 Overview

4.2.1 Goal, Objectives, Strategy and Tools

Communications Goals

PACCo's communication goals are to:

- Demonstrate that it is possible to work with stakeholders in estuarine and coastal zones to deliver a range of benefits for people and the environment by adapting pre-emptively to climate change.
- Promote the PACCo guide to an extensive stakeholder network to influence policy makers at a national and EU level and enable climate change adaptation at more sites.

Communications Objective

The main communication objective of PACCo was to raise awareness of the impact of climate change on coastal communities and to promote cross-border ways of working for pre-emptive adaptation. Promotion of the PACCo model would demonstrate that adaptation to climate change is possible and desirable, enabling others to make progress.

Strategy

The PACCo Communication and Engagement Strategy set out the key messages to be conveyed in the various tools and channels (see Table 4.1).

Table 4.1 PACCo key comms messages

#	Key message
1	Climate change threatens coastal areas and adaptation will be necessary for many communities.
2	Pre-emptive adaptation of coastal regions is possible and presents an opportunity to bring long-term social, environmental and economic benefits.
3	Early adaptation to climate change will be more cost-effective and provide better value for money for society than late or inaction when considered over the medium and long term.
4	Late adaptation to climate change results in a greater burden on future generations who must then pay the costs of inaction as well as the cost of adapting late.

#	Key message
5	The PACCo model can be used to ascertain whether adaptation is right for a coastal area, and if so, provides guidance on how to proceed.
6	Intertidal habitat is threatened, of high conservation value, and supports a broad range of wildlife including wading birds.
7	Intertidal habitat supports many ecosystem services including carbon sequestration, feeding ground for protected species and recreation.

It also stated the project's principles of communication were to:

- Listen first
- Respect all views
- Be honest, open and transparent
- Strive to remove communication barriers
- Clarify audiences
- Be clear on how and when to communicate
- Be clear what can be influenced and what is decided
- Be clear how people can get involved.

Using agreed communication pathways for external and internal audiences the PACCo team set out a timetable to promote the project and deliver stakeholder engagement. For example, the existing project board and/or steering committee members were used as active ambassadors to promote and disseminate key messages and outcomes, with support from communications staff.

Tools

The main communication tools used were delivered though a specific PACCo communications work package. A communications log (Figure 4.1) was used to record how the partners were involved, when and what communication was taking place, and by whom was it delivered.

4.2.2 Branding

One of the funding requirements of PACCo was the need to develop consistent branding to be used by all partners in all our comms and project materials (see Figure 4.2).

Figure 4.1 Extract from the PACCo communications log / Journal des communications

Use this sheet to detail any communication and engagement that has been completed by any area of the project.

Utilisez cette feuille pour détailler toute communication et engagement qui ont été réalisés par n'importe quel domaine du projet.

Date of communication	Communication type	Key Message / Headline	Author / Presenter / Auteur / présentateur	Additional notes / Notes complémentaires	Audience / Le public	Reach	Engaged - oui/non

We also developed banners (Photo 4.1), which were used at conferences, meetings and all partner events to help describe and promote the project.

The same branding was used in the on-site signage and interpretation boards installed at our PACCo site hubs (described in Part E of this guide). The hubs, at both the French and UK sites, explain and promotes the benefits of adaptive coastal change generally and specifically at the two locations. Using before and after images and data, the hubs demonstrated the PACCo outcomes of improved ecosystems and socio-economic fabric. They also look forward by 20 and 40 years to compare the sites and explain how the benefits delivered at the Lower Otter in Devon and the Saâne Valley in Normandy can be transferred to approximately 70 other coastal sites in the UK and France (Appendix 2).

Photo 4.1 Example of PACCo branding and Banners in use at an all-partner event (**L'Agence Nature/Conservatoire du littoral, Septembre 2022)**

4.2.3 Translation and Interpretation

Even though many team members could converse in both French and English at various levels, we bought in professional language and translation service to ensure comprehensive understanding across both languages and ease the transfer of documents.

Using the same translators throughout the project established a good rapport and they were welcomed as team members. They became knowledgeable about the projects and familiar with the technical jargon. This helped them learn new phrases to provide accurate translations both verbally and in written correspondence. Securing the right translators was a strong pillar of PACCo communications.

4.2.4 Transnational Working Groups

Each of the five PACCo work packages had support through a transnational working group. Every group comprised a membership of cross-border specialists from the partners and co-financiers with an identified partner lead. They provided guidance and input as needed using the skills and experience of the individual members.

The Communications work package was led by the East Devon Pebblebed Heaths Conservation Trust. Communication was the golden thread connecting the work packages with management groups, territorial project groups and technical meetings.

PACCo multi-partner events were planned with and run by a team of external facilitators. The involvement of a professional facilitator, proficient in Anglo-French working, made sure all participants could fully participate in and benefit from the activities.

4.3 Communications across both Estuaries

As a cross-border initiative, an essential element of PACCo was to deliver communications in French and English across both estuaries, including:

- Articles in different media (e.g., newsletters, information packs, social media)
- Face-to-face events (e.g., conferences, meetings, site visits)
- Electronic and digital media (e.g., videos and animations).

The key messages in the PACCo Communication and Engagement Strategy were specifically written to apply to the Lower Otter Restoration Project and the Saâne Valley, providing a consistent communication framework in both languages. PACCo also developed an Education and Communication Strategy and Plan.

4.3.1 Printed Media

An integral part of the PACCo project involved communicating about its progress and events – providing written materials to describe the project or to make announcements to

celebrate key milestones or raise awareness of a specific issue. We used a range of different approaches to appeal to different groups of people and to help gain a following (e.g., on social media). These written materials took many different forms e.g.:

- Information packs
- Newsletters aimed at public and stakeholders
- Banners for public events
- Posters for conferences displaying key elements of PACCo and its projects
- Leaflets online and hard copy summarising PACCo (aims, calendar, project partners, key messages).

Information Packs and Leaflets

Developing a PACCo information pack and leaflet (Figure 4.3) was a useful activity as it enabled project partners to distribute summary information to stakeholders at conferences and to direct them to more detailed information (websites for example).

Figure 4.3 The PACCo leaflet 1 which provides a short summary of the project

Newsletters

Bi-annual newsletters were also developed and acted as a good means of sharing progress and stories from both estuaries with those interested in the project (Figure 4.4).

Articles and Blogs

News stories in the form of press releases and articles in regional, trade and national media (print and digital) also helped to share the outcomes of the PACCo project with a range of different audiences in a tailored, and targeted way (Figure 4.5). We wrote bespoke items in publications with knowledgeable and influential readership (e.g., newsletters for Jurassic Coast, South West Coast Path, Exe Press and the Area of

Outstanding Natural Beauty). We also wrote features in specialist journals including British Wildlife, Conservation Land Management, Hydromag, Reporterre and GoodPlanetMag.

As part of the project, we produced regular blogs on different topics written by a range of partners and available online on the PACCo website (see Figure 4.6).

Figure 4.4 An example of the PACCo newsletter

Figure 4.5 Two examples of articles written about PACCo for English and French media (Source: CIWEM and La Croix)

Figure 4.6 Examples of two blogs produced for PACCo project covering monitoring on the Lower Otter and the Construction sites in the Saâne Valley

4.3.2 Face-to-face Events

Conferences and Workshops

Throughout the duration of the initiative the PACCo, the team presented the project at virtual and face-to-face conferences and workshops – using presentation materials such as branded PowerPoint slides and posters. Conferences provided the project team with opportunities to disseminate the PACCo techniques and solutions directly to interested audiences across France, UK and wider Europe. Presentations and posters at the events were effective at raising awareness of problems relating to transitional and coastal waters, climate change adaptation and relevant policies. These events enabled the project to reach a large technical and policy audience in both countries and even further away (see Photo 4.2).

Photo 4.2 Régis Leymarie of Conservatoire du littoral talking about PACCo at a coastal climate change adaptation conference in Marseille, Summer 2022 (Source: Cdl)

Final Conference

PACCo held a final conference which was run collaboratively and in partnerships with the Environment Agency's annual Coastal Practitioners Conference.

Over 210 people attended from 5 different countries. Over 50 different organisations attended. The conference reached organisations who work on coasts and estuaries around the whole of the English and Welsh coast, the coast of Northern France and the Netherlands.

The agendas included a mixture of:

- Plenary sessions
- Breakout sessions
- Networking
- Exhibitions / demonstrations
- Site visit

During the conference we heard 34 number of presentations on a range of different coastal topics. The PACCo project presented, ran breakout sessions and exhibited their material in the exhibition space. This was a great opportunity to expand the reach of the project.

Photo 4.3 Highlights from the PACCo conference (Source: Jasmine van der Eijk)

Exhibitions

LORP was invited to form part of an exhibition in a local museum. This ad hoc opportunity enabled us to share information about the project and to reach a wider audience. Key project partners alongside local stakeholders described the project through a short video recording. Finding different ways like this to present project information can be a great way to diversify audience demographics and increase engagement.

In the Saâne valley, annual summer exhibitions and quarterly wall newspapers have been used to keep the community updated and show the project's progress in the three municipalities (see Chapter 10).

Site Visits and Educational Events

In addition to the face-to-face events described above, site tours and educational events were also delivered. The site visits were invaluable in helping show the site to members of the public and other stakeholders such as the funding organisations and the technical partners. We found that guiding people around the site really aided understanding and was a great way to alleviate concerns and answer questions. The educational events gave us the opportunity to talk to younger community members about climate change in general and to show them that there are positive solutions that can enable climate change adaptation.

In the Saâne valley, site visits provided an opportunity to show coastal communities, potential funders and technicians from coastal areas, the Saâne valley and the PACCo project. These have been useful in promoting pre-emptive climate change adaptation projects and motivating others to deliver similar projects.

4.3.3 Online Media (electronic and digital)

Webpage and Social Media

PACCo developed a digital presence through a bilingual website and active frequent use of Facebook, Linkedin and Twitter accounts.

A website, created specifically for PACCo, held up to date information and showcased project achievements. It also linked with both local projects and hosted blogs written by project team members giving greater detail on their work.

Social media (LinkedIn, Facebook and Twitter) was proactively used to reach wider public and industry contacts by the PACCo team and partner organisations, sharing strong news and images at key project stages.

PACCo also worked closely with the comms leads for Basse Saâne 2050 and LORP initiatives, actively sharing each other's posts to expand the project's comms reach.

Animations, Drones and Videos

PACCo created a series of videos and animations to help describe the project but also to raise awareness of the impacts of climate change on the coast and how adaptation can be achieved. On both sides of the channel drone footage and fixed-point drone photos were also helpful in showing change within both estuaries, to help explain visually what climate change adaptation looks like.

A set of four bilingual videos are hosted on the PACCo website and YouTube. These were created to raise awareness of the coastal adaptation programme and foster understanding of its impacts and results. Each video covered different topics:

- Introduction to PACCo, sets the scene and explains the rationale
- Explains the science and technical elements for general audiences
- Explains the science and technical elements for policy/technical audiences
- A showcase of PACCo's achievements.

There is also an animated presentation of the projects to provide a slightly different and extremely accessible way of improving, understanding and sharing the benefits.

4.3.4 Traditional Media: Newspapers, Television and Radio

Press Releases

As both estuaries involved large scale construction works to deliver landscape scale habitat restoration, it was important to provide regular press releases to keep the local public aware of progress on-site or to flag up issues for their awareness. Examples of press releases include:

- News releases for project start, construction milestones, stakeholder workshops and final conference plus additional media releases from project partners throughout project delivery.
- Articles in relevant media outlets for project aims, objectives, early benefits and policies seeking to inform and influence change.

Radio and Television

PACCo seized the opportunity to promote the project on local radio and national television in England and France, which enabled the project to inform and educate the public about climate change adaptation. A few examples are highlighted below.

France

- **Le Monde de Jamy** – Edition on rising water levels: how to save our coasts (Le Monde de Jamy, 2022).

- **France 24** – Edition on rising waters in Quiberville (Normandy), the challenge of letting the sea in (see Photo 4.4) (France 24, 2021).

Photo 4.4 Jean-François Bloc the Mayor of Quiberville being filmed as part of France 24 edition on Quiberville, November 2021 (Source: France 24).

England

- **Countryfile -** Edition on the Clinton Devon Estates featuring LORP and PACCo (see Photo 4.5) (Estates, Countryfile heads to Clinton Devon Estates).
- **Radio 4 Farming today –** Sam Bridgewater spoke about the Lower Otter restoration project and PACCo.

Photo 4.5 Lydia Burgess-Gamble of the Environment Agency being filmed as part of a Countryfile edition focused on Clinton Devon Estates, January 2022 (Source: Karen Baxter)

4.3.5 Lower Otter

Alongside the delivery of communications activities specifically related to PACCo, the Lower Otter Restoration Project also delivered its own messages.

Clinton Devon Estates / EDPHCT involved its retained public relations agency KOR Communications from the outset of the Lower Otter Restoration Project. KOR produced a suite of communication and marketing materials and the project website, as well as supporting and advising the stakeholder group. The main tactic was to encourage stakeholders to use their communications networks to distribute LORP materials and demonstrate their support for the initiative. Target audiences were prioritised by influence and interest. This early professional input provided an excellent foundation.

As LORP progressed, engagement and communications increased with a specific group set-up to plan, co-ordinate and deliver these important elements. This group was led by the Environment Agency as lead partner, assisted by EDPHCT as the Comms work package lead. The LORP engagement and communications team used a mix of direct and indirect channels to reach its audiences. Indirect communication channels were via the local media (press, TV and radio) social media (Facebook community groups) supported with notices, posters and schematics, while direct communication used the engagement activities of updates, direct dialogue, liaison group and site tours.

Images were a strong element throughout both engagement and communications as the team sought to enable as many people as possible to visualise the finished project using planning drawings, sketches, photographs and video, including overhead drone footage. Photos and video were particularly useful to show the changes taking place as work progressed (LORP, 2022).

4.3.6 Saâne Valley

Overview

Alongside the delivery of communications activities specifically related to PACCo, the Basse Saâne 2050 project developed its own comms strategy and plan, which are summarised below. This complemented and linked to the PACCo comms strategy.

In the Saâne Valley, communications have been led by a specialised company: l'Agence Nature. Early in the project stakeholders were brought together to:

- Specify their shared values
- Identify the communication targets
- Outline a strategic communications plan.

This resulted in developing a Saâne-specific communications strategy and plan. At this event, the following four key words were identified:

- Ambition
- Risks

- Scales and
- Need to reconcile.

These words have been used to develop communications messages.

The principles of Basse Saâne 2050 communication strategy included:

- Developing a collective signature that unites all partners
- Commitment and transparency at each key stage of the project
- Local communication in the form of wall newspapers at 3 locations in the valley
- A project endorsed by elected officials and technicians in the form of video testimonials.

A letter from the Saâne has also been mailed to residents and is also available in town halls, the tourist information centre and the website of the Conservatoire du littoral.

4.4 Further Reading

Communications strategy

Communications and engagement strategy

Conference report

PACCo Final Conference Report (Environment Agency, 2023)

Blogs, Newsletters, leaflets

Leaflets and information packs

Newsletters

PACCo blogs posts

Social media

PACCo Facebook page

PACCO Linkedin account

PACCo Twitter account

Videos, animations, drones

Cross-border exchange – Natural capital and socio-economic

Cross-border exchange - Virtual tour of the Lower Otter

Lower Otter drone Flyover

PACCo videos and animation

PACCo YouTube channel

Webpages

Basse Saâne 2050 webpage

Lower Otter webpage

PACCo webpage

See bibliography for further details.

Lessons Learnt & Recommendations - Part B

Engagement

PACCo brought together different countries, languages and cultures to deliver important local projects delivering adaptation to coastal climate change.

We were keen to highlight areas where we can improve our engagement activities so that we, and others, could learn from our PACCo experiences (see Table 4.2). Our recommendations cut across the following themes:

- Working together
- Stakeholder engagement
- Learning from others.

Table 4.2 Key recommendations and lessons learnt about engagement

Key recommendations
Team working
Working remotely saves time and travel. However, it has its limitations, and it is important to know when you should make the effort to work together in person. COVID-19 restrictions meant the PACCo project teams were unable to meet face-to-face for a prolonged period of the project. As a result, team building sessions did not happen as frequently as desired or originally planned. Although meetings were held remotely, opportunities to meet in-person, chat with each other over a coffee, pick up on shared interests and benefit from the subliminal cues that help build relationships was not possible. Accepting that the COVID19 restrictions were outside of PACCo's control, the team felt the absence of this early team development. External stakeholder engagement quickly and necessarily became the focus, whilst internal team engagement was not initially established. We recommend facilitated team building events are held as early as possible to enable staff to meet each other, start to build relationships, understand each other's roles, and agree how to work with each other and deal with challenges. This must be in-person for all team members and include as many people as possible (technicians, engineers, funders, mayor). Then keep it going – schedule regular meetings and activities to get to know each other better, understand how team members work, their strengths and weaknesses. These sessions are an investment in efficient and effective working. They also help to introduce and support new project team members should there be staffing changes during the lifecycle of the project. Recognising that delivery of the project is the main objective, this becomes easier to meet if the team foundations are strong, this in turn enables truly collaborative working. Partnership working is an even bigger challenge as the organisations brought together operate differently from each other. For example, a variety of chain of command and sign-off procedures can mean slower decision-making, potentially causing tensions (e.g., when making key announcements). Understanding

Key recommendations
each partner organisation's culture and ways of working from the outset can help to manage expectations to deliver harmonious and effective partnerships. When taking on international projects it is also important to take time to get to know each other, to understand ways of working that might be different between different countries and cultures. It is recommended to run a facilitated event at the start of a project to agree ways of working between partners. The findings from such an event can be re-visited and it can also be a means of setting out different approaches for addressing any problems or conflicts, through documents that include the working methods agreed between the partners.
Team members
It is important to be aware that individual team member roles can change as projects progress, particularly when resources for specialist input may not be available right from the start. Some PACCo project team members were involved for many years and were responsible for a wide range of aspects initially. In the early days of both the Lower Otter and Saâne Valley projects whilst project concepts were being developed and no funding was available stakeholder engagement was delivered with little dedicated resources or expertise – this came when the projects were more established. Due to the length of time spent on the PACCo projects, many staff members developed a strong bond and pride in their work. This emotional connection can cause a degree of defensiveness and **frustration** when the projects are misunderstood or challenged by the public or by specialist team members. A key element of team working is for everyone to be aware of the potential for individuals to be emotionally compromised and to work together to support each other to minimise risks to relationships (internally and externally). Persistent stakeholders can use a lot of project manager resource. This work should by shared out across team members, identifying leads for topics to reduce the risk of individuals being overloaded. For example, good use was made of LORP Project Board members to lead responses to in-depth and frequent enquiries from members of the public.
Contractors
As soon as contractors are agreed they should join the project team to develop that essential close working relationship. LORP benefitted from the contractor recognising the importance of public relations and employing a dedicated public liaison officer as the main public point of contact during site working. The contractor, Kier, formed a strong engagement and communications triumvirate with the Environment Agency and Clinton Devon Estates / EDPHCT to deliver a joined-up stakeholder engagement service.
Shared systems
Bringing different organisations together on a single project also means working with several different IT systems. Efforts to use a single system accessible to all the project team members were limited due to IT firewalls, individual capacity (time and inclination) and the need to meet fixed project delivery deadlines. However, if planned early enough, a single online project portal is recommended to deliver efficiency, cost-effectiveness, accessibility, and robustness as it is not reliant on sole user expertise and compliance

Key recommendations
with data protection regulations. It would enable the swift transfer of larger files and images without the increased cost of and reliance on third party systems.
Sensitive issues
Team meetings provide essential opportunities to identify and agree in advance how to handle sensitive issues so that everyone is prepared. The project risk register is a useful framework for putting hard to deal with topics on the agenda. Adequate time must be allowed for the team to discuss the situation and put themselves in the stakeholders' shoes to look from a different point of view. Stakeholder engagement specialists can facilitate these conversations to guide and support the team in their next steps. PACCo confirmed that the public and other stakeholders quickly fill any information gaps with rumour and criticism, increasingly via social media. However, by being pro-active and working closely with engagement and communications colleagues, the project team can manage the timing, facts, and milestones of a particular situation to encourage a more accurate narrative and provide authority to communicate fact-based messages and responses to internal and external stakeholders. It can be easy for technical drawings, which are complex to understand, to be misinterpreted. It is important to build enough time into a project to describe key elements of the project and check that stakeholders have a common understanding. This can save time in the long-run and reduce stress to the community. When something does go wrong a quick, open and honest response will help to manage the situation and dampen critics. Tactical advocacy is also a good investment so that, at times of challenge, the project is supported by knowledgeable ambassadors willing to provide perspective and balance.
Keep engaging
Never stop engaging with the local community and stakeholders on your project. There is always an appetite for information and opportunities to get involved before, during and after. Opinions and interests change as different phases of the work affect new locations and individuals. Remember, people get their information from a variety of sources, not all of them accurate or supportive so the best way to keep stakeholders (old and new) up to date is to keep engaging with them. The PACCo engagement and communications strategy was a dynamic document managed by the engagement and communications team who kept it up to date on project progress. Activities and timings were adapted as necessary, and stakeholder insight was applied to make the best use of feedback. Capturing stakeholder feedback is an essential activity to check how they feel, what they understand and to identify knowledge gaps or concerns. The most important part of stakeholder feedback is acting on it and showing people through your actions that you have done so, or explaining why it is not possible.
Contact management
One of the biggest benefits of working in partnership is the wealth of stakeholder contacts that each organisation brings to the project. For engagement activities, it is recommended to use a single list, ideally held and updated centrally. This will reduce the risk of duplication and omissions, both of which can make

Key recommendations
the recipient feel negative towards your team and project. A key element in contact list management is making sure it is accessible to all users and meets data protection regulations.
Other sites
At the beginning of a new project, it is difficult for members of the public to visualise what their community will look like once the work is complete. Particularly when, as with both PACCo sites, the locations are well-loved, with users emotionally connected and concerned about change. Planning drawings and illustrations help, although sharing real examples of similar completed projects (including offering visits if feasible) is a stronger tool to assist stakeholders see the outcome for their site, making it easier for them to understand the environmental and social benefits the changes will bring. PACCo project team members welcomed hundreds of visitors to site. Many staff had worked on similar projects, so used their experience to demonstrate the benefits by bringing them to life. They also liaised closely with other sites sharing best practice with each other, for example, Steart Marshes in Somerset, UK.. In France, the team have discussed with other project representant such as Adapto, Life ARTISAN and the ask from the Ministry for ”Natural based solution for resilient area”. Engagement specialists also visited other sites and organisations. This helped them to update their skills, seek new ideas for visuals and learn from others. This extra effort ensured PACCo stakeholder engagement was kept relevant, appropriate and active.
Procurement
There were clear economies of scale to be made in PACCo right across the project, including in the field of engagement and communications. However, each partner organisation continued to use its own procurement systems rather than sharing existing contracts to enable efficient, cost-effective and environmentally assessed buying. Any new contracts that are negotiated for partnership projects should be available to the whole project to use. This will avoid delays and duplication resulting from individual organisations using various existing contracts, but also ensure consistency and quality control, for example. The whole project must benefit from sharing the buying power and knowledge of partners. This is particularly important with public relations materials, which must have a consistent project look and feel.

Communication

PACCo brought together different countries, languages and cultures to deliver important local projects, delivering adaptation to coastal climate change. It educated and informed communities and stakeholders in Devon, Normandy and further afield.

We are keen to share with others how we can improve the communication of similar projects by reviewing PACCo activities and sharing our recommendations. Our five main recommendations are found in Table 4.3.

Table 4.3 Key recommendations about communication

Key recommendations and lessons learnt
Right audience, right channel
Every piece of communication must consider the audience and timing, as well as the project key messages, specific information and action. Then the channels of communication must be decided to reach the targets in time, providing a balance of material between both countries and both languages. Research into how and where stakeholders get their news provides valuable insight as to which channels will help your messages reach them. Material written for one route can be adapted for multiple channels as over-reliance on a single communications channel will miss target audiences. For instance, social media is good for short items with strong images and is best used to complement other channels such as newspapers, TV, radio, newsletters, posters, flyers etc… The creation of a common branding (logos, name of the project) has been an important tool to ensure consistency of communications across the project.
Plan your communications
Each partner organisation and contractor had their own corporate communications strategy and style in addition to the specific requirements of the PACCo, LORP and Basse Saâne 2050 projects. Project communication can become a very busy place as partners seek to promote their involvement and profile. It is therefore essential to plan and map these communications activities across the project. This communications map will highlight gaps and overlaps enabling the team to streamline all the input into regular proactive communications across the project partners. Within the LORP engagement and communications group a forward look section flagged stories, key dates, spokespeople, media training needs, great images, specialist and trade media opportunities etc. For Basse Saâne 2050, a timeline set out the key stages of the project's delivery, communication was timed and coordinated around key dates in this timeline, providing the right information to the local community at then right time. An additional tool was a flow chart showing the agreed sign-off process for news releases to keep each organisation informed and satisfied with content before it was issued. It also identified the differing timescales for sign off for partner organisations.
Keep communicating
As with most projects, audiences' interest ebbed and flowed through the life cycle of PACCo with individuals being more engaged at stages of the project as they became impacted or interested, or when other aspects of their lives took priority. Energy and capacity to engage may vary, but interest usually remains, so continue to communicate with all your identified audiences through your mix of communications channels whether they are active or not. This is an ideal time to put yourself in the stakeholders' shoes and consider how you would feel about your project if you lived there, and then use this fresh insight to refine your communications activities.

Key recommendations and lessons learnt

Branding

Interreg projects must meet specific branding objectives as part of the funding agreement. For PACCo there were detailed logo sizing requirements and guidance, which had to be used when producing promotional signage and other communications.

Both LORP and the Saâne Valley projects were already in existence prior to the funding through PACCo being obtained, and both projects already had their own branding. To comply with INTERREG guidance, we needed to develop new branding. The importance of branding as a condition of funding must be emphasised along with clear, easy-to-use guidance for positive application by the project team.

The use of branding has helped make it easy to identify the work undertaken under as part of the PACCo project.

Part C. Funding and Natural Capital

The next chapter describes the project's approach to funding and natural capital.

Context & Background | Engagement & Comms | **Funding and Natural Capital** | Design and Construction | Monitoring and Legacy | Summary and Conclusion

- Funding Adaptation
- Natural Capital Approach
- Qualitative & Quantitative Assessment

Chapter 5. Funding Adaptation

Authors: Lydia Burgess-Gamble & Delphine Jacono.

Affiliated authors (listed alphabetically): Camille Simon, Carolyn Petersen, Régis Leymarie, Sam Bridgewater & Thomas Drouet.

This chapter provides a high-level introduction to the complexities related to funding climate change adaptation projects.

It then describes what natural capital assessments are, providing a summary from the literature to demonstrate some of the co-benefits associated with the restoration of intertidal habitat.

This chapter also summarises the findings from high level and detailed natural capital assessments undertaken for PACCo and provides the reader with two different approaches to natural capital assessment which they could apply elsewhere.

5.1 Funding Adaptation

The Costs of Flooding and Coastal Erosion

Flooding and coastal erosion impacts communities globally causing loss of life and extensive economic damages. Recent research estimates that climate-related flooding and drought is likely to cost the world's major cities as much as $194bn (£158bn) per annum by 2050 (The Actuary, 2022). In Europe, the current cost of flooding is estimated to be €1.4bn. Without further investment in flood risk management infrastructure, it is expected to rise to €210bn by 2100 (Vousdoukas, et al., 2020). In England, the cost of flooding is expected to increase to £5bn by 2050 under current emissions scenarios (Insurance Business UK , 2022).

The Benefits of Nature-Based Solutions

A recent report into the flood risk management benefits of nature-based solutions (Van Zanten, et al., 2021) demonstrates that without nature-based solutions, annual economic losses will increase dramatically. Even if nature-based solutions cannot be applied everywhere they have been found to still provide considerable economic benefits (CDC, 2019) and are in some cases they are cheaper than hard-engineered infrastructure (CEPRI, 2016) see Table 5.1. Preserving mangroves (Menéndez, P; Losada, I J; Torres-Ortega, S; Narayan, S; Beck, M W, 2022) and coral reefs (Beck, et al., 2018) was found to enable significant cost savings in terms of their flood reduction benefits.

In addition, NBS can provide a large range of co-benefits, and contribute to making territories more resilient to the impact of climate change in the long term.

Table 5.1 Cost estimates for engineered and nature-based solutions

Engineered solutions	Nature-based solutions	Reference
Rock filled dyke: €1800 per metre	**Creation of dune belt:** from €320 to €400 per linear metre	CEPRI, 2016
Groins: €2,500 per linear metre	**Restoration of a dune belt:** €75 per linear metre	CEPRI, 2016
Breakwaters: from €4,000/ml to €6,200 per linear metre	**Beach nourishment:** from €7 to €45m³	CEPRI, 2016
	Mangrove preservation: USD$65 billion of annual avoided flood damages	Menéndez et al. 2020
	Coral reef preservation: USD$4 billion of annual avoided flood damages	Beck et al. 2018

Funding Climate Change Adaptation

Despite the clear benefits of implementing a nature-based approach to flooding and coastal change, in France the majority of public expenses has been focussed in improving sea defences (Rapport Interministériel, 2019). The case is also similar in England whereby flood schemes must demonstrate they reduce the risk of flooding to people and property. It is typically easier to demonstrate (through flood modelling) the flood risk reduction benefits of engineered infrastructure compared to nature-based solutions. This indirectly results in fewer nature-based schemes being delivered.

Across the European Union and in England there is currently no specific funding source available to fund nature-based climate change adaptation. In France, however, public funding can be obtained to enable climate change adaptation, the restoration of floodplains and the protection and restoration of habitats. In France, nature-based solutions have been favoured and prioritised by those developing projects. In addition, l'Agency de l'eau Seine-Normandy has developed its 11th intervention program called the "Water and Climate program".

Table 5.2 shows the wide range of different funding mechanisms used in England, France and Europe. In England, Environment Agency flood risk management funding can be used to help address the impact of climate change adaptation but only if it reduces the risk of flooding to people and property as well. In both France and in England, European Union funding (e.g. LIFE+, ERDF, Interreg, Horizon 2020, BONUS fund and EU Cohesion Fund) has historically been instrumental in funding past climate

change adaptation project enabling both countries to implement the sorts of projects which would have been harder to fund through domestic funding sources (Conservatoire du littoral, 2022).

Table 5.2 Summary of funding sources available in England, France and Europe

England	France	Europe
• Ad-hoc government grants or pilot schemes • Biodiversity net gain • Carbon trading/credits • Charitable funding • Flood defence grant in aid (FDGiA) • Green finance • Landfill community fund • Partnership funding from local authorities and country councils • Research Council funding	• Landowners • Water Agencies • Government departments • Parish funding • Local authority funding • County council funding • Regional funding • State funding	• Horizon • INTERREG • LIFE • ERDF

Some countries such as the United States and France have legal provision that enable them to remove constructions located in areas exposed to natural risks. It is a useful tool, but it has not been sized to deal with the multiple impacts of climate change. Implemented in 1995 in France, the Barnier Fund covers major natural risks impacts. To date, it has enabled "the acquisition of more than 1,150 homes located in flood zones for a total amount of nearly 300 million euros" (Conservatoire du littoral, 2022).

The “Climate and Resilience” law adopted in France in August 2021 is a new step in the management of coastal risks. The Decree No. 2022-750 published on the 29th of April 2022 establishes a list of towns whose action in terms of town planning and development policy must be adopted to address the ‘hydro-sedimentary phenomena’ that lead to coastal erosion. 122 towns are now affected by this new approach, including Quiberville and Sainte-Marguerite. These towns benefit from new regulation and legal obligations which help them to manage the erosion of the coastline with greater consideration of the impacts of climate change. For example, this includes:

- The towns most exposed to coastal erosion by 2050 are granted a specific right of pre-emption as well as a tools to buy land.
- For landlords, a new long-term lease is initiated (new real lease for adaptation to climate change).
- Under certain conditions, coastal towns can derogate from the historic law (Loi Littoral), which requires building in continuity with existing urbanization, to carry out relocations.
- A new method for calculating the value of real estate subject to erosion is adopted.
- A mandatory modification of the planning permission and urbanisation process is recorded to take erosion into account.

This is an important step for considering the impacts of climate change on coastal areas, particularly in terms of planning, but the question of financing future relocations remains unresolved.

In England, the national flood risk management strategy focusses on helping communities become resilient and adapt to the impacts of flooding rather than relocating them (Environment Agency, 2020)

In recent years there has been increased interest in funding nature-based solutions to achieve carbon or biodiversity offsets. This is leading to an interest in developing offsetting markets for 'blue carbon'[12] which could in the future help to finance nature-based climate change adaptation projects. A natural capital approach can be used to help value the wider benefits of a project and this can in turn help generate investment into the project from other sources.

5.2 Natural Capital Approach

What is the Natural Capital Approach?

The natural capital approach is a way of placing a value on the services provided by nature. It is defined as:

> "The elements of nature that directly or indirectly produce value to people, including ecosystems, species, freshwater, land, minerals, the air and oceans, as well as natural processes and functions" (NCC, 2014)

Natural capital is the air we breathe, the water we drink, the food we eat, and the environment we enjoy. The world's natural assets underpin our society and sustain our lives. Valuing natural capital assets enables us to make the case for protecting and restoring valuable habitats, providing an economic value for the services they provide.

Natural Capital is the stock of natural assets, for example, habitats, soils, water and biodiversity which produces a wide range of ecosystem services that provide benefits to people. Ecosystem services can be placed into three different categories based on the types of services they provide (See Figure 5.1).

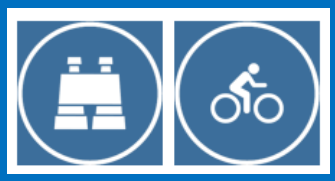
[12] Blue Carbon refers to organic carbon that is captured and stored by the world's oceanic and coastal ecosystems, mostly by algae, seagrasses, macroalgae, mangroves, salt marshes and other plants in coastal wetlands (Source: Wikipedia).

Natural Capital Policy Drivers

The natural capital approach is recognised internationally and forms part of the UN's sustainable development goals, which is a framework that helps to account for nature's contribution to the economy (United Nations, 2017). It is also embedded in European policy through the European Green Deal (European Commission, 2020).

In England the natural capital approach forms part of government decision-making processes with the Enabling a Natural Capital Approach (ENCA) resources, data, guidance and tools readily available for use on projects (Defra, 2021).

Figure 5.1 The different ecosystem service categories (Source: Rouquette, 2022)

Provisioning	Regulating	Cultural
		
Products obtained from ecosystems e.g. food, timber, water	Benefits obtained from environmental processes that regulate the environment e.g. air quality, climate regulation, pollination	Non-material benefits people obtain from ecosystems e.g. recreation, aesthetic experiences, health and wellbeing

In France, the French assessment of ecosystems and ecosystem services, known as EFESE[13], is similar to a platform between science, decision-making and society. Its objective is to enhance their consideration in public policies and private decisions. EFESE defines ecosystem goods and services as socio-economic benefits. This approach recognizes the multiplicity of benefits provided by ecosystems and their biodiversity. It does not aim to calculate a "total economic value" of an ecosystem, but to identify and describe its uses, legacy and ecological values provided by ecosystems (Ministère de l'environnement, et l'énergie et de la mer, 2016).

Natural Capital Practical Drivers

To help fund future projects, there is a need to be able to articulate the multiple benefits that can be achieved through the preservation, restoration or creation of habitats such as salt marshes and mudflats. Being able to value the range of natural capital benefits

[13] Translated to the French evaluation of ecosystems and ecosystem service.

provided by such habitats can help to attract future funding sources from government and the private sector.

Natural capital assessments are a tool that enable us to assess different natural capital options / scenarios for a site to help select an optimum approach to restoration or to make the case for funding. The Environment Agency has developed appraisal guidance[14] which can be used when developing a business case for a project to help assess the benefits associated with flood and coastal erosion risk management projects. In France, public policies will favour multi-functional solutions (for example: reconnection of a river to its floodplain and restoration of wetland biodiversity)

In a presentation to the PACCo project team, Jim Rouquette (pers comm, 2022) also explained that a natural capital approach is beneficial because it enables:

- A more strategic and holistic approach to the management of land and water
- Moving away from thinking in silos
- An understanding of the multiple benefits that the natural environment provides
- The delivery of environmental outcomes more effectively and with better value for money and
- A wider set of values to be incorporated into decision-making.

A natural capital assessment is usefully undertaken at the different stages of developing a business case for a project. It can help you assess different options and provide an economic value for different benefits. This in turn can help to attract other sources of funding.

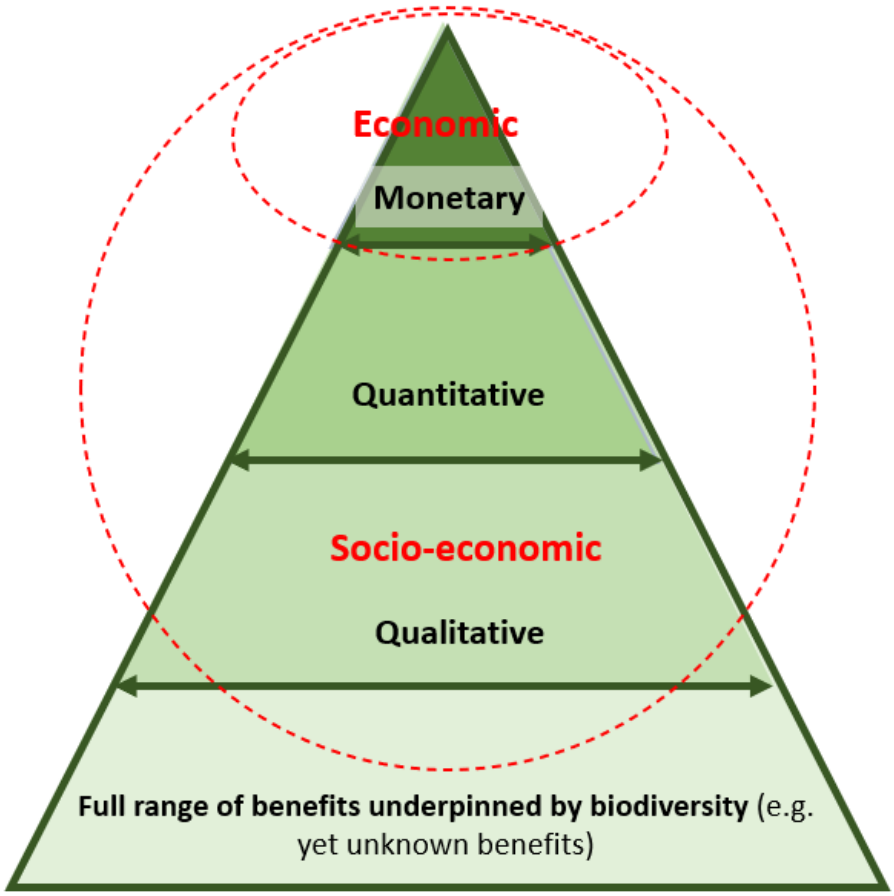
Taking a Natural Capital Approach as part of PACCo

Natural capital assessments are quite flexible and can be undertaken with different levels of detail (see Figure 5.2). A monetary assessment is an extensive study which results in economic figures which can then be used to write business cases. However, it can only put a financial value on a few services. A quantitative assessment provides marginally less detail than a monetary assessment but tries to place numbers or values on different ecosystem services, often based on existing literature. A qualitative assessment is more descriptive seeking to describe the entire range of benefits for people and wildlife even if some of these are unable to be quantified.

[14] Environment Agency appraisal guidance can be accessed here, it provides useful guidance on appraising, environment, carbon and mental health impacts: https://www.gov.uk/government/collections/fcerm-projects-appraisal-supplementary-guidance [Accessed: 11/11/22]

The different tiers of assessment all have value with the level of detail selected dependent upon your budget and your reasons for undertaking the assessment. As part of the PACCo project we decided to undertake two different types of natural capital assessment - a rapid qualitative assessment and a detailed quantitative / monetary assessment. The qualitative assessment was undertaken for both estuaries to enable a comparison of ecosystem service provision across a range of options. A quantitative assessment was undertaken solely for the Lower Otter to drill down into more detail and to try and value numerically and financially as far as possible the benefits of the site's restoration compared to other options.

Figure 5.2 A tiered approach to assessment (Source: Rouquette, 2022. Based on 'The economics of ecosystems and biodiversity' TEEB, 2011)



The Conservatoire du littoral has also noted that: 'There is a lack of an efficient economic valuation of the coastal protection services provided by coastal ecosystems and habitats' (Conservatoire du littoral, 2022). Scoping studies are available, but they remain theoretical and not practical for projects for adaptation to climate change which are being implemented. Therefore, it is important to undertake natural capital assessments on large pilot projects such as PACCo to enhance this evidence base to help show the economic value of ecosystem restoration.

5.3 Qualitative Natural Capital Assessment

5.3.1 Introduction

In France, most ecological restoration projects use multi-criteria analyses which, without studying the natural capital in detail, allow it to be considered in the decision-making process in the same way as risk management or implementation costs. This approach was implemented on the Saâne in 2019 as part of the preliminary design stage which looked at reconnecting the Saâne to the sea. This study helped inform the size of the breach of the road embankment.

Qualitative natural capital assessments are useful in that they can be implemented quickly and at a low cost to enable stakeholders on a project to assess different options. This approach can help understand how different options compare and which ones deliver the largest number of co-benefits.

Qualitative assessments are also referred to as 'expert-led' assessments. This is because they are usually facilitated by someone with a knowledge of the natural capital approach. The assessment is undertaken by the facilitator describing different ecosystem services and asking stakeholders to place a value on ecosystem service provision on a scale of 0 to 3 (see Table 5.3). This process can be repeated for a range of different options, and the findings can help inform the selection of a preferred option.

Table 5.3 Example of an expert-led natural capital assessment (Source: Rouquette, 2022) [15]

Ecosystem service category	Ecosystem service	Score
Provisioning	Food: crop and livestock production	1
	Fibre and fuel	0.5
	Water	0.5
Regulating	Carbon sequestration and storage	1
	Local climate regulation	2
	Air quality regulation	1

[15] **Scoring system:** 0 = no delivery. 0.5 = some delivery but not significant. 1 = delivery. 2 = significant delivery. 3 = very significant delivery

Ecosystem service category	Ecosystem service	Score
	Water quality regulation and erosion control	2
	Water flow regulation	3
	Pollination	2
	Pest and disease control	2
	Noise attenuation	2
	Soil quality regulation	2
	Habitat and population maintenance (biodiversity)	3
Cultural	Aesthetic experiences	2
	Education, training and scientific investigation	3
	Recreation and tourism	2
	Health and well-being	2
	Characteristics and features of biodiversity that are valued (existence, option, bequest)	2
	Spiritual and cultural experiences	2

A qualitative assessment was undertaken for both estuaries assessing and comparing the likely ecosystem service provision for 3 different options:

- **Baseline** – Describing the baseline for each estuary, setting out the different ecosystem services provided pre-project before any interventions are in place.
- **Do nothing** – Describing the changes to the baseline ecosystem services which would occur if adaptation measures were not put in place and both estuaries suffered the impacts of climate change.
- **PACCo** – Describing the ecosystem service achieved as a result of the restoration of both estuaries including implementation of other adaptation measures such as moving infrastructures.

5.3.3 The Lower Otter

Potential ecosystem service delivery was scored for the Lower Otter for the three different options (Baseline, Do nothing and Restoration). The findings from this assessment are fully described in ‘Expert-led natural capital assessment of the Lower Otter and Saâne Valley restoration projects’ (Rouquette, 2022).

The findings from this report are summarised in Figure 5.3 which broadly shows that if nothing was undertaken and a catastrophic breach occurred that there would be a decline in ecosystem services compared to the baseline (pre-restoration scenario). The restoration scenario broadly depicts an increased delivery of ecosystem services compared to the baseline and do nothing scenario.

Figure 5.4 shows the change in ecosystem services. This figure shows a comparison between the do nothing and restoration scenarios, showing that:

- **Baseline scenario (thick black line) -** The baseline is shown as the thick black line, with lines to the outside indicating an increase in ecosystem service provision and lines to the inside indicating a decrease in provision. The baseline scenario
- **Do nothing scenario (blue line) -** The blue line appears on both sides of the black line indicting a mixed response compared to the baseline, although the largest changes are declines in food production, aesthetic experiences, recreation and tourism, and health and wellbeing.
- **Restoration scenario (red line) –** The red line is almost entirely to the outside of the black line, indicting increases compared to the baseline, with the exception of food production, which declines. The largest increases are for carbon storage and sequestration, pest and disease control, education, training and scientific investigation.

Overall, eight ecosystem services achieve maximum scores under the restoration scenario, indicating very significant delivery, compared to two under the baseline and one under the do-nothing scenario. Some services, such as recreation and tourism, health and wellbeing, and biodiversity are very high, but the increase in score is less, as they already score quite well under the baseline.

Figure 5.3 Estimated ecosystem service provision scores for the Lower Otter for a) the Baseline (top panel), b) the Do Nothing scenario (middle), and c) the Restoration scenario (bottom)

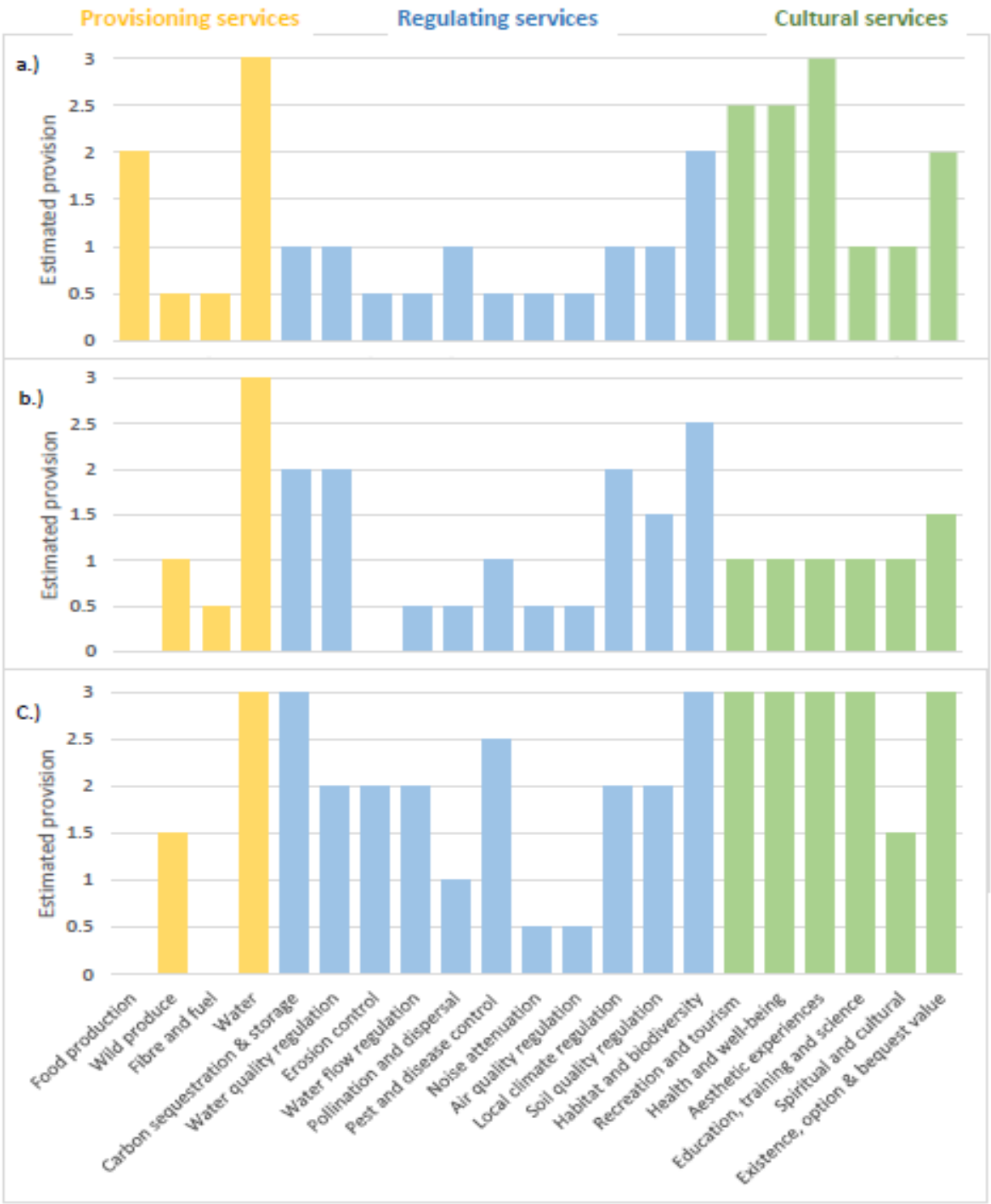
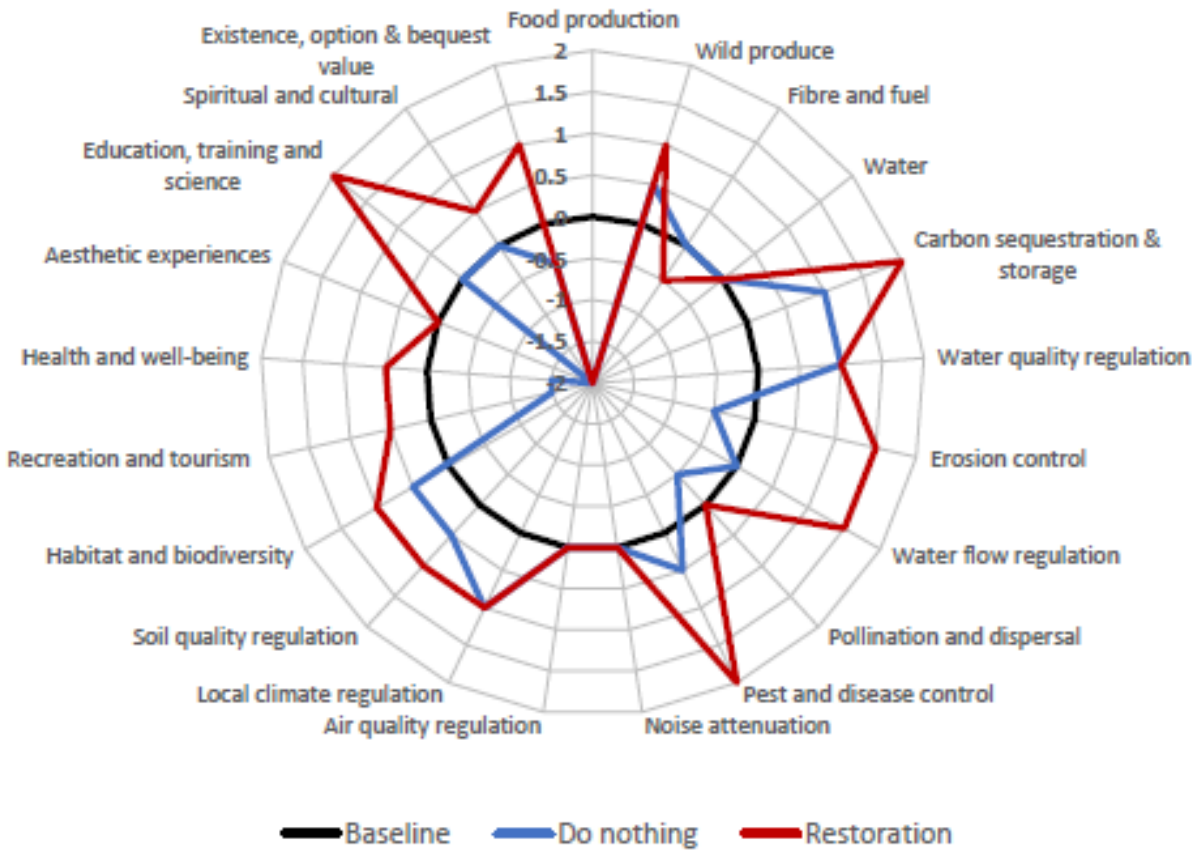


Figure 5.4 Change in ecosystem service provision compared to the baseline for the do nothing and restoration scenarios in the Lower Otter



5.3.2 The Saâne Valley

Potential ecosystem service delivery was scored for the Saâne Valley for the three different options (Baseline, Do nothing and Restoration). The findings from this assessment are fully described in 'Expert-led natural capital assessment of the Lower Otter and Saâne Valley restoration projects' (Rouquette, 2022).

The findings from this report are summarised in Figure 5.5 which broadly shows that if nothing was undertaken and a catastrophic breach occurred that there would be a decline in ecosystem services compared to the baseline (pre-restoration scenario). The restoration scenario broadly depicts an increased delivery of ecosystem services compared to the baseline and do-nothing scenario.

Figure 5.6 shows the change in ecosystem services. In this figure, better outcomes are indicated by lines closer to the outside, and the baseline is shown as the thick black line. Lines to the outside of the thick black line indicate an increase in ecosystem service provision, whereas lines to the inside indicate a decrease in provision. It is clear that the restoration scenario (red line in Figure 5.4) enhances most ecosystem services, with the exception of food production which suffers a small decline. On the other hand, under the do-nothing scenario (blue line), a number of services stay the same, but there are significant declines for recreation and tourism, health and wellbeing, aesthetic

experiences, and habitat for biodiversity. This scenario is, however, not really an option. The Saâne valley's culvert acts as a barrier to fish passage, from a policy perspective, barriers to fish passage must be addressed restoring ecological continuity as a priority.

Figure 5.5 Estimated ecosystem service provision scores for the Saâne Valley for a) the Baseline, b) the Do Nothing scenario, and c) the Restoration scenario

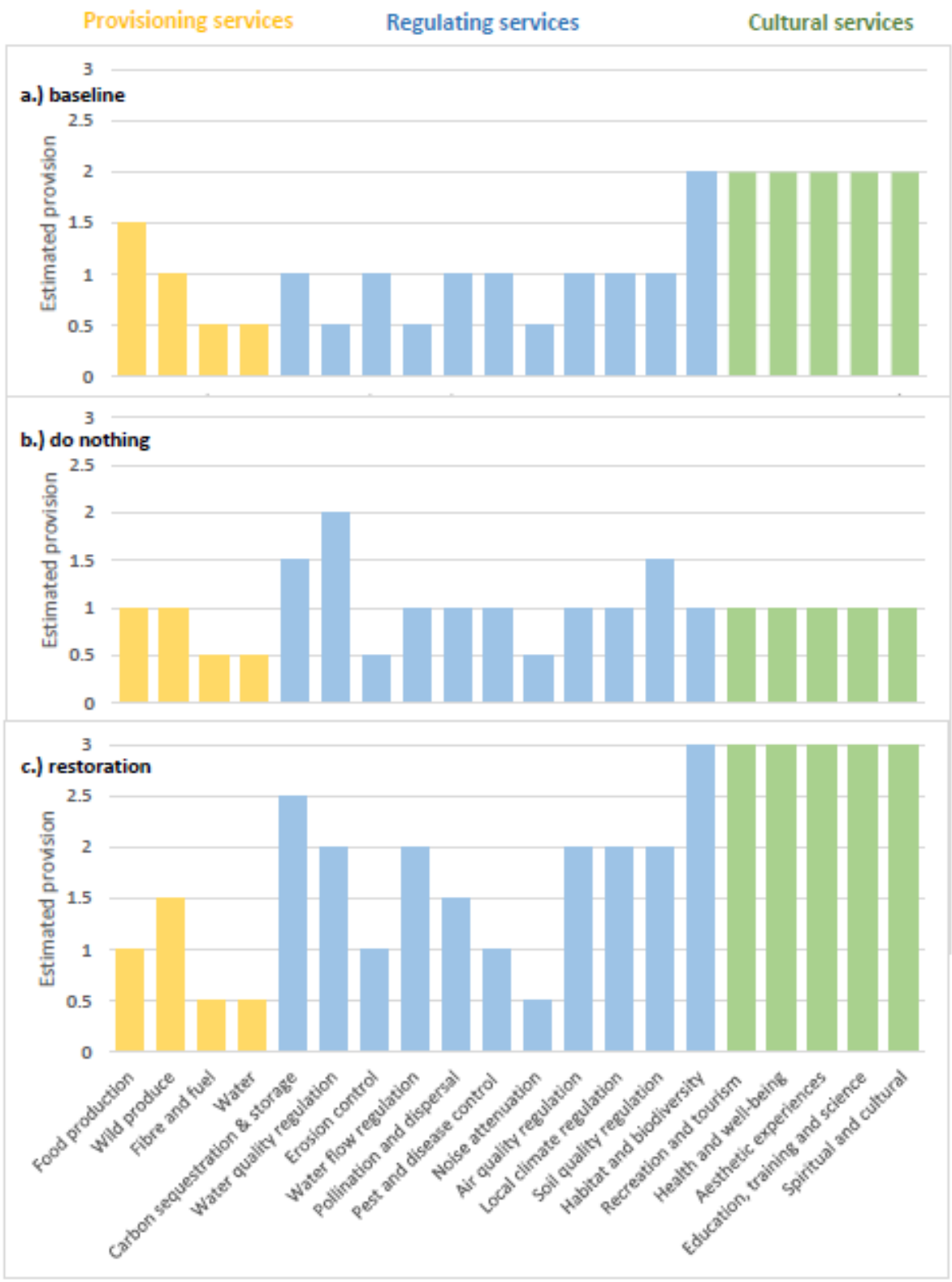
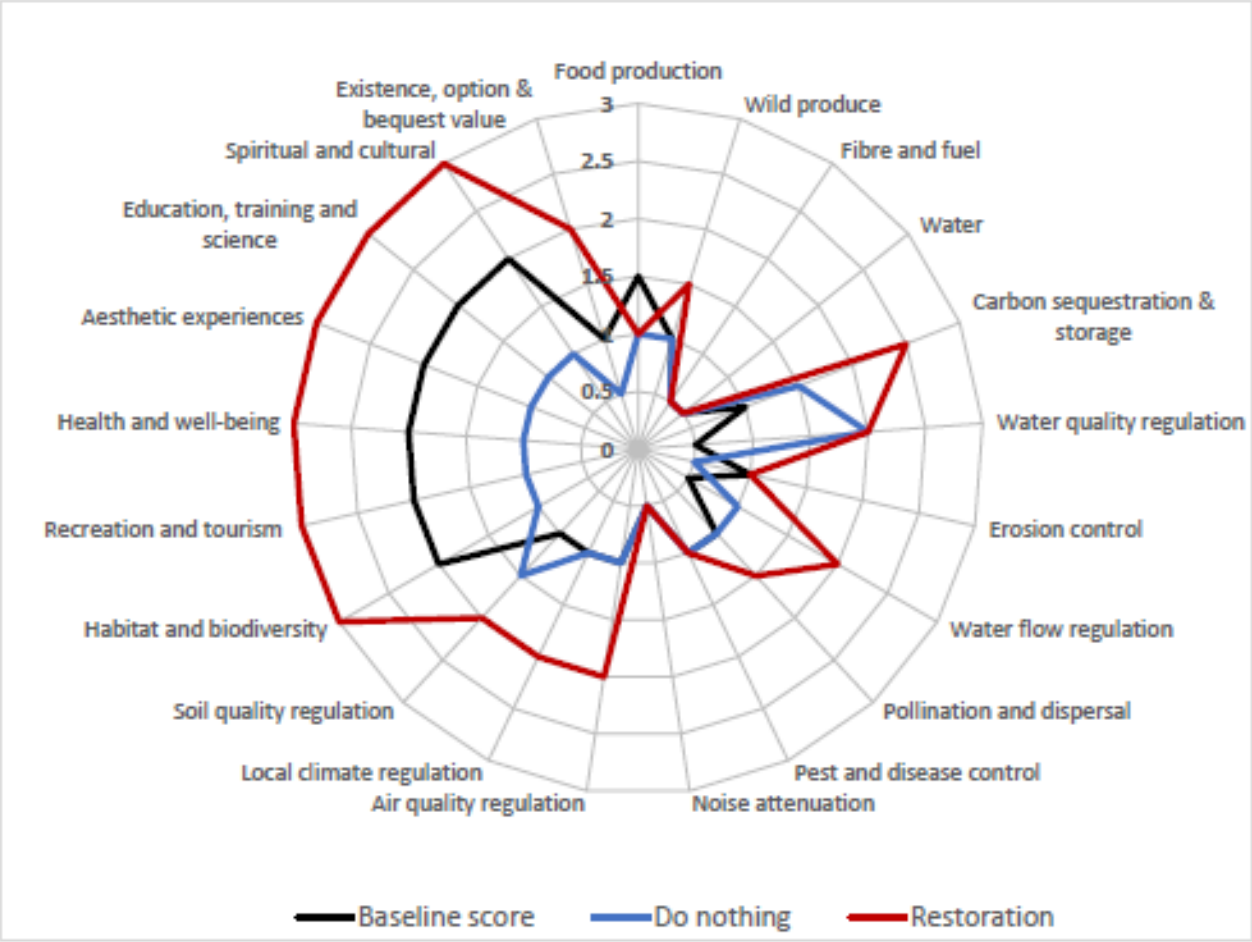


Figure 5.6 Change in ecosystem service provision compared to the baseline for the Do Nothing and Restoration scenarios in the Saâne Valley



5.4 Quantitative Natural Capital Assessment - Lower Otter

5.4.1 Introduction

A quantitative natural capital assessment was undertaken for the Lower Otter, enabling the PACCo project to expand on the findings of the qualitative assessment to provide a detailed quantification of the project's ecosystem service benefits.

To develop the natural capital assessment a suite of preceding studies was undertaken:

- Methods Review
- Standardised Protocol
- Baseline Report

These reports provided background on the Lower Otter and Saâne Valley projects, described the Natural Capital Accounting (NCA) approach and assessed the baseline scenario for the Lower Otter. The restoration scenario accounting has now been combined

with the baseline report to create an overall socio-economic evaluation report for the Lower Otter Restoration Project which is summarised here.

This overall socio-economic evaluation summarises the results for two scenarios:

- **Baseline scenario -** The baseline scenario describes a situation whereby the Lower Otter restoration project is not delivered and within 15-years an unmanaged breach occurs.
- **Restoration scenario** - The restoration scenario includes the full restoration of the Lower Otter.

In order to assess these different scenarios, the natural capital assets for the study area have been described and forecast and the different ecosystem services assessed and valued. Not all benefits/services which are expected to arise could be valued or monetised, and thus, this NCA represents a partial assessment. This is typical for NCAs, as not all gaps can be filled. Neither do all the possible benefits tend to get valued due to data gaps or some benefits being hard to value. As part of this study a 60-year accounting period has been applied, and costs and benefits discounted over time in line with HM Treasury guidance.

5.4.2 Context

When reviewing the findings from this report it is important to understand the background context for this project. On the Lower Otter, one (of many) driver for the creation of intertidal habitats is to compensate for habitats impacted by flood risk management activities on the Exe estuary. The Habitats regulations requires that habitat impacted by 'coastal squeeze' be compensated for through the creation of new habitat elsewhere.

Within the Exe estuary the flood risk management activities delivered by the Environment Agency enabled measures to be put into place to reduce the risk of flooding to thousands of properties. The net benefit of these activities has previously been estimated at over £350 million, which is a substantial additional off-site benefit resulting from the Lower Otter's restoration.

These benefits are not included in the NCA because the NCA is solely focussed on the Lower Otter, but it is important to bear this context in mind when reviewing the NCA.

5.4.3 Main Findings

This report concludes that, over 60 years, the gross natural capital present value (PV) of the 'baseline' scenario is £23.6 million. The LORP / restoration scenario has a higher gross natural capital PV60 of almost £35 million. The natural capital benefits associated with the Lower Otter restoration scenario are therefore substantially higher (50%) than those calculated for the baseline scenario. Of the benefits which could be monetised, the benefits related to the welfare value of recreational visits were valued most highly, followed by physical health benefits, water quality and carbon sequestration related benefits.

The Lower Otter's total net asset value PV60 (derived by summing natural capital values with income flows and deducting scheme costs) has been calculated as being lower than that of the 'baseline' scenario. There are several reasons for this, not all of which are

related to natural capital. For example, substantial proportions of the Lower Otter's costs relate to infrastructure construction which is not directly linked to natural capital uplift (e.g., road and bridge works).

Also, comparing the 'restoration scenario' with the 'baseline scenario' that results in an unmanaged breach which assumes a similar degree of restorative work, means that the resulting natural capital (habitats) and associated benefits are fairly similar to the restoration scenario. In reality, due to resource and practical constraints exacerbated by flooding (see below), it is unlikely that after a catastrophic breach remedial work to repair damage would be fully undertaken by those responsible for upkeep.

Managed realignment is a way of working with nature in a controlled fashion to enhance benefits and reduce risks. This is clearly demonstrated in the total natural asset value improvement (when compared to the baseline) of approximately £11.2 million.

In addition, the NCA's benefit estimates are broadly conservative, whereas the scheme costs will include contingencies and optimism bias. Also, it is likely that the impacts of unmanaged breaching would be much more costly than has been assumed for this NCA i.e., the reality is that undertaking any reactive adaptation within a tidal area from a catastrophic breach will be more difficult and costly than undertaking the work reactively and prior to a breach.

The results of this partial NCA thus underestimate the full value of the Lower Otter Restoration Project and its value relative to an unmanaged breach scenario. Nevertheless, the NCA is helpful in identifying the multiple and significant benefits of such projects, and the methodology developed in this study can be used and built upon as our knowledge of benefits improves.

The PACCo project has therefore enabled us to show-case two different approaches to natural capital valuation, one qualitative and one quantitative.

5.5 Further Reading

Qualitative Natural Capital Assessments - Lower Otter and Saâne Valley (Rouquette, J., 2023)

Quantitative Natural Capital Assessment – Lower Otter (ABPmer and eftec, 2023)

Summary of natural capital assessment (Lower Otter) and surveys (Lower Otter and Saâne Valleys) (ABPmer, 2023b)

Summary of visitor surveys – Lower Otter and Saâne Valleys (Petersen, C., 2023)

Visitor Survey – Full Report Lower Otter (ABPmer, 2023a)

Visitor Survey – Full Report Saâne Valley (SMLN, 2022)

See bibliography for further details.

Lessons Learnt & Recommendations - Part C

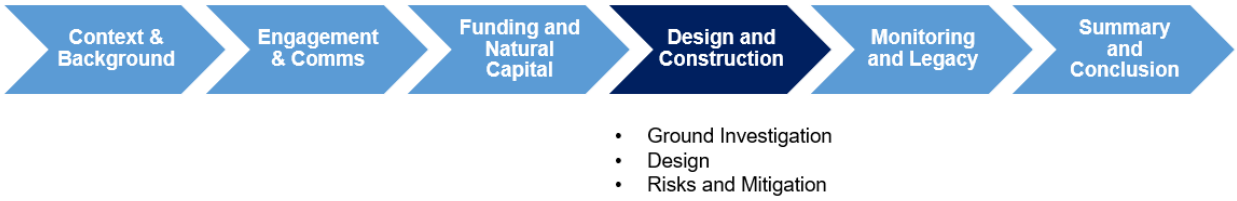
Financing landscape scale adaptation projects is not straightforward as there is no one funding pot. Natural capital assessments are useful in that they help partners and stakeholders to value and communicate the benefits delivered by different options. In England, they can also be used to put a financial value on the various benefits that habitat restoration project can provide, this in turn can help attract alternative funding sources. Key findings and recommendations can be found in Table 5.4 below.

Table 5.4 Key recommendations and lessons learnt

Key recommendations and lessons learnt
Funding
• Funding adaptation projects is not straightforward. There is no one funding source available and achieving funding can take many years. • A blended approach to financing is recommended, bringing together multiple sources of funding. • Taking a natural capital approach is recommended because by defining the wide range of benefits that a project can deliver can help attract a wider range of partners and different funding pots.
Qualitative natural capital assessments
• Qualitative natural capital assessments can be a cheap and fast way of assessing different options to help identify which one has the potential to deliver the largest number of benefits. • Qualitative assessments are usefully undertaken at an early stage of a project when developing an outline business case. • Undertaking a qualitative assessment with partners at the project's development stage can help engage partners in the project's shaping and development. • Qualitative assessments can help rule out options that will have negative impacts or be unacceptable to partners. • Qualitative assessments can be overly simplistic. However, their outputs are quite visual and can help to explain different options to a range of audiences.
Quantitative natural capital assessments (only applicable to the Lower Otter)
• Quantitative natural capital assessments are more time consuming and costly than qualitative assessments, but they are more accurate and can place financing value on the environmental benefits that a project may deliver. • Quantitative assessments are useful in drawing in other partners and funders because they enable a more accurate financial value to be placed on environmental benefits. • Quantitative assessments are useful at a full business case stage because they provide better insights and information that can assist a cost:benefit analysis. • Quantitative assessments can help communicate the wider benefits of a project and help demonstrate what the project will achieve in the long-term.

Part D. Design and Construction

The next three chapters describes the project's approach to design and construction. This is then followed by a description of the tools developed to identify risks, problems and solutions.



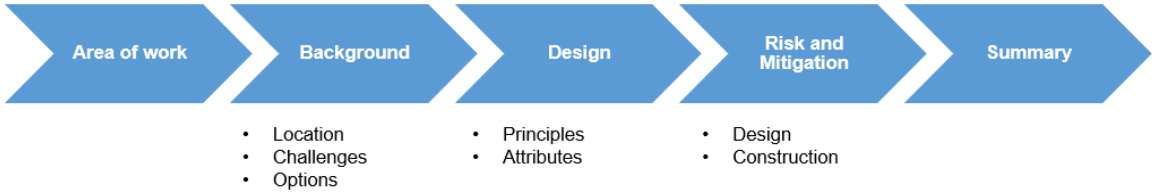
- Ground Investigation
- Design
- Risks and Mitigation

The following part of the report covers the design and construction stage of both projects (Chapters 6 and 7) and risks and solutions (Chapter 8).

This part of the report covers the implementation process that follows on from the funding and appraisal stage. It focuses on transferring desk-based studies into physical, functioning structures.

An introduction to both sites will summarise the site extent, construction phasing, Ground Investigation (GI) and Environmental Impact Assessment (EIA). Each area of construction will be summarised, flowing chronologically from the background challenges and options, through to design principles and attributes. To showcase the problem solving, a section on risks and their mitigation in design and construction will draw on consideration of the full life cycle of the asset, collaborative working, quality management and ethical practise (Figure 6.1).

Figure 6.1 Structure for summarising works on the LORP and Basse Saâne Valley



Chapter 6. Design and Construction: LORP

6.1 Introduction

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6.1.1 Site Extent, Brief History and Challenges to the Estuary

Figure 6.2 displays the 55ha site extent, subdivided into three areas working from south to north: Big Marsh South, Big Marsh North and Little Marsh. South Farm Road (SFR) runs across the floodplain from west to east, separating Big Marsh South and Big Marsh North. Little Bank and Big Bank separate agricultural fields south of the village of Otterton and to the north Little Marsh, and Little Marsh and Big Marsh respectively. The River Otter is separated from the floodplain by the eastern embankment. Budleigh Salterton Cricket Club (BSCC) and Lime Kiln Car Park lie southwards where the River Otter outfalls around a shingle bar at Otterton Point. The South West Coast Path (SWCP) runs along the eastern embankment as far north as SFR, attracting circa 250,000 visitors per year.

Figure 6.2 Site extent with key areas labelled. Source: Jacobs

The natural environment of the estuary has been heavily modified since the 19th century. Embankments were built to create agricultural land, in the process straightening the River Otter and disconnecting it from its floodplain. To the north of the project area, the landscape is less modified but the construction of a now disused railway through the floodplain affected how water moves. The main outlet from the reclaimed estuary to the sea caters only for normal drainage from the area. Further modifications include the construction of Budleigh Brook aqueduct across Little Marsh in the late 1920s, a municipal tip adjacent to SFR that was operational between 1928 and 1978 and use of the southernmost site for BSCC in the 1930's.

Heavy and prolonged rainfall events overwhelm drainage outlets. Consequently, water spills over embankments resulting in regular and prolonged flooding of fields, BSCC, footpaths and SFR, and partial flooding of the refuse tip (figure 6.3). Climate change only threatens to exacerbate these issues, resulting in more extensive damage to embankments, footpaths, SFR, BSCC and existing outfalls.

Figure 6.3 Prolonged flooding of fields. Source: KOR Communications

6.1.2 Options Appraisal and Implementing the Preferred Option

Four options were taken forward to address the current issues. These were: Full scale restoration, assisted natural recovery, Big and Little Marsh flood plain restoration, and Big Marsh South floodplain restoration.

Big and Little Marsh floodplain restoration was the preferred option, selected by the project team and through public consultations over the other options as it restores 55ha of

intertidal habitat, maintains the SWCP, reduces the risk of flooding on SFR and reduces erosion to the landfill area. It met all the project objectives, was the most cost-effective option per hectare of habitat created and introduced fewer risks than the other options.

To reconnect the floodplain to the river and the estuary, without removing the functionality of the SWCP, SFR and BSCC, various assets needed to be upgraded, removed or relocated.

To reconnect the floodplain the following works were required:

- 70m breach in southern estuary embankment to allow ingress and egress of fluvial and tidal water
- Construction of a tidal creek network connecting Big Marsh and Little Marsh
- Lowering of 170m of Big Bank to connect Big Marsh and Little Marsh
- Removal of 200m of Little Bank to reconnect the River Otter to the floodplain
- Removal of raised concrete aqueduct to reconnect Budleigh Brook to the floodplain and the River Otter

To retain the functionality of the assets the following works were required:

- Raise SFR above the floodplain to retain access to properties and businesses
- Construction of a new road bridge to allow the tidal creek network to flow under the new raised SFR
- Footbridge across southern breach to retain SWCP
- Relocation of BSCC out of the floodplain
- Provision of a new car park to replace informal parking previously available along SFR
- Protection of former municipal waste site to prevent potential contaminant leaching
- Reinforcement of existing embankment in certain places

Asset owners were engaged early to establish partnership funding and discussions at a senior level were required to reach a resolution.

6.1.3 Ground Investigation

The ground investigation (GI) comprised detailed desk studies, sampling and testing of soils and water, factual reports and risk registers. From the desk studies, British Geological Survey data showed Helsby Sandstone as the predominant bedrock, overlain with superficial saltmarsh deposits, comprising of clay and silt. Helsby Sandstone is a principal aquifer, with high permeability and levels of water storage. The superficial deposits are a secondary aquifer with permeable strata that support local water supplies and are an important baseflow for rivers. Soil classifications displayed loamy and clayey floodplain soils with naturally high groundwater. Sampling and testing of soils determined their characteristics. Soils, groundwater and surface water were analysed for likely contaminants such as metals, oils, poly-aromatic hydrocarbons, cyanide, poly-chlorinated bi-phenyls, herbicides, pesticides and asbestos.

6.1.4 Environmental Impact Assessment

The Environmental Impact Assessment (EIA) formed a large part of the design stage of LORP. There are five broad stages to the process, which are:

- Screening – the local authority determines whether a statutory EIA (production of an Environmental Statement (ES)) is needed
- Scoping—the applicant seeks advice on the scope of the ES from the local authority, which in turn consults statutory bodies
- Preparing—the ES must be prepared by competent experts and submitted to the Local Planning Authority with the planning application
- Planning application and consultation—the planning application and associated documents, including the ES, are publicised, allowing statutory consultees and the public to make known their views on the development and the ES
- Decision making—the Local Planning Authority decides whether to grant consent for the works

The EIA detailed: alternative options considered, scope of the works, initial construction phasing, site logistics, likely environmental effects of the project (both positive and negative) and ways to avoid or reduce any negative environmental effects. Details of the design are needed to assess the likely impacts, so an iterative approach to the ES and the detailed design is often needed.

The main sections with effects and mitigation are: Population and human health; Noise and vibration; Biodiversity, Marine ecology and fish; Geology, Soils and Contamination; Water, Geomorphology and Hydromorphology; Landscape and visual; Historic Environment; Traffic and Transport; and Cumulative Effects.

6.2 Cricket Pitch Relocation

6.2.1 Background

The current Budleigh Salterton Cricket Club (BSCC) lies at the southernmost extent of the site bounded by Lime Kiln Car Park and the SWCP to the southeast (figure 6.4). The main trunk drain that drains Big Marsh and Little Marsh bounds the site to the west. The new ground is located out of the floodplain just north of South Farm cottages.

During fluvial flooding water cannot discharge through the existing outfall, backing up behind the estuary embankment and Lime Kiln Car Park causing flooding. The existing clubhouse is regularly flooded up to the eaves (figure 6.5), placing financial burden on the club in repairing silt and water damage. The existing site of the cricket club is not

sustainable in the face of climate change, so moving it to a flood-free location secures the long-term future of the club. If the cricket club had not been moved it would have become subject to daily tidal inundation, either through the 70m breach as part of LORP or through natural embankment failure in a no-LORP scenario.

Figure 6.4 BSCC Site Location Plan. Source: Environment Agency

Figure 6.5 BSCC flooded up to its eaves in 2018 floods. Source: Clinton Devon Estates

Relocating the ground out of the floodplain was the only viable option to both improve the natural functionality of the floodplain and secure the future of the cricket club. Two other field locations were considered: to the west of the floodplain south of South Farm Road and to the east of the floodplain. Land requirements and a lack of community access meant these options were dismissed. The location selected allowed both senior and junior

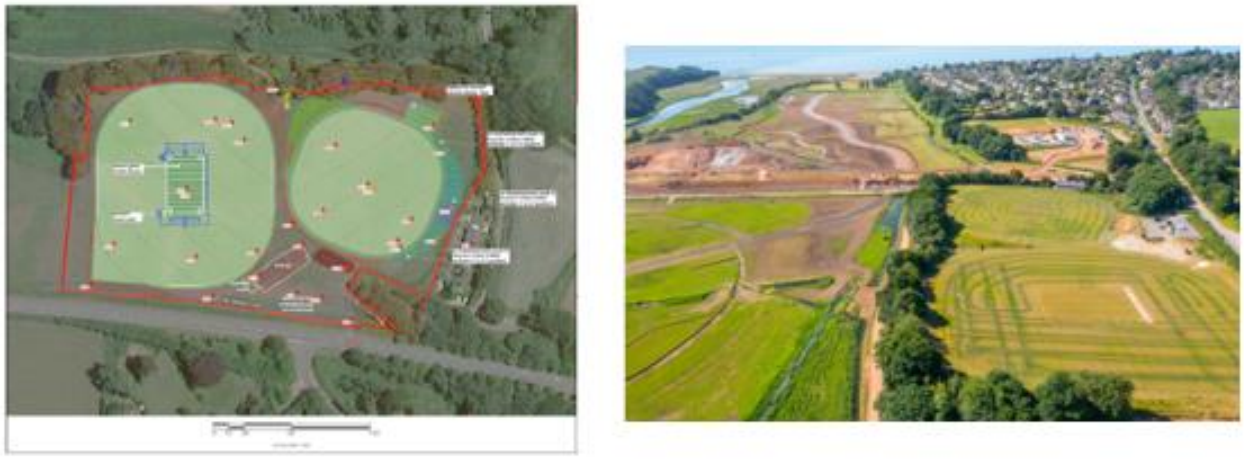
pitches to be built near local bus routes and with good cycling and walking links back to the town.

6.2.2 Design Principles and Attributes

The England and Wales Cricket Board (ECB) stipulate technical guidance for the design of new cricket grounds, considering features such as pitch orientation, pavilion location and sun and wind directions. New clubhouses must also accommodate disabled access and flexible changing spaces that allow for senior, junior and female players.

The ground has an improved adult pitch, new junior pitch (figure 6.6) and a new multifunctional two storey clubhouse. As a publicly funded project LORP could only pay for like-for-like replacement of the existing facilities, albeit with an allowance for building the new facilities to modern standards. BSCC has sought additional funding to allow them to construct an enhanced clubhouse that will meet their needs in the future.

Figure 6.6 New cricket ground layout (left) and aerial photography of the new pitches (right). Source: STRI (left) and KOR Communications (right).



The new pavilion is orientated away from the prevailing south-westerly wind direction and the grounds' north-south orientation maximises sun exposure. Three new AstroTurf practise strips are located on a raised platform using material cut from the pitch construction.

Soakage tests displayed very slow infiltration rates with topsoil consisting of loose sand and gravels to a depth of 0.6m. Positive drainage has therefore been needed. The natural topography of the area slopes into the floodplain, so underground drainage has been designed to follow these routes. An attenuation pond is positioned to capture surface runoff.

The site is surrounded by trees, some existing and others newly planted. These will provide shade for spectators, reduce visual impact and improve bank stability. The car park is positioned behind the clubhouse to prevent glare from vehicle windows and protect vehicles from stray balls.

6.2.3 Risk and Mitigation

Table 6.1 Design and construction risks and mitigation

Risk	Mitigation
Slow infiltration rates.	Opted for large retention pond over soakaways.
Differential settlement.	Lightweight structure with raft foundation to spread the loading as opposed to piles. Wide foundations mean extensions can be built on the same foundations.
Planning permission delays pitch development pushing breach date back.	Specialist contractors on standby to ensure establishment (not required).
Decommissioning of BSCC pavilion and contact with utilities causing injury.	PAS128 surveys and Ground Penetrating Radar (GPR) to locate electricity and consulted landowner and tenant for local advice.
Tree removal creates unstable banks.	Trees coppiced to base with root systems remaining in place.

6.2.4 Summary

Regular flooding of the existing BSCC placed financial burden on the club and the preferred option for LORP would inundate the site tidally on a regular basis. The club was therefore relocated out of the floodplain, increasing the functionality and securing its future. The site selected provides good transport links and has the required topography for pitch drainage.

ECB guidelines were followed throughout, ensuring all visitor infrastructure was considered. Detailed GI found slow infiltration rates, so the drainage design opted for an attenuation pond and positive drainage to avoid using soakaways.

6.3 Footpaths, Footbridge and Viewing Platforms

6.3.1 Background

The four main footpaths are:

- The SWCP, running from Lime Kiln Car Park up the Otter embankment to White Bridge, where it turns across the river and continues on the opposite bank.
- The Otterton Footpath, a continuation of the river footpath north of White Bridge on the eastern side of the floodplain.
- The Western Footpath, running up the western flank of the floodplain both south and north of SFR, and along Big Bank to meet the Otterton Footpath.

- The East Budleigh footpath, running from the eastern end of Big Bank along Little Bank towards East Budleigh.

An interactive map of the public rights of way can be found here.

Safeguarding Public Rights of Way (PRoW) was a legal obligation and viewed as essential from the local perspective. The project has sought to maintain and improve the Public Rights of Way (PRoW).

The new footbridge lies at the southernmost extent of the site (figure 6.7), just north of where the SWCP meets Lime Kiln Car Park.

Figure 6.7 Footbridge Site Location Plan

A footbridge has been installed across the 70m breach in the estuary embankment to retain continuity of access along the SWCP whilst allowing the floodplain to be reconnected to the estuary. Diverting the SWCP to a route at the back of the floodplain was rejected due to the popularity of the estuary path and the potential to deter people from coming to the area, which could impact local tourism.

Seven new visitor viewing platforms have been installed at:

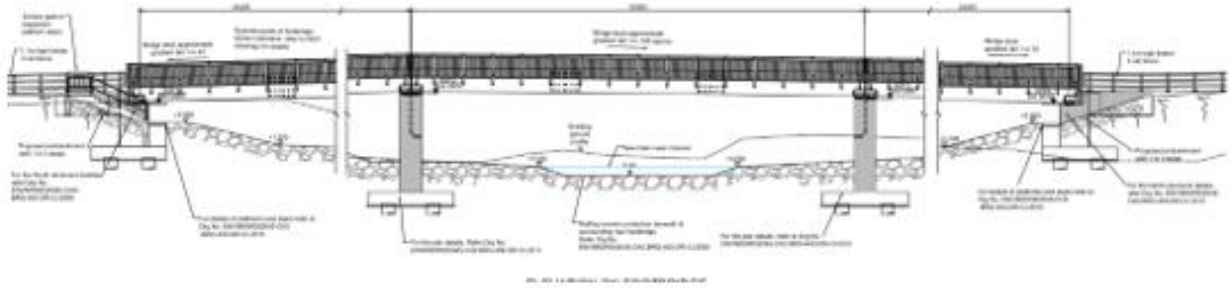
- Southern breach location
- Two, approximately 300m north of the breach, along the SWCP
- Southern corner of the landfill area
- Two towards the east of Big Bank
- New car park west of SFR.

6.3.2 Design Principles and Attributes

Footbridge

The footbridge is 75m long, with three spans of 25m supported by concrete piles and pile caps (figure 6.8). A Fibre Reinforced Polymer (FRP) solution was chosen for the superstructure due to its light weight, durability in estuarine environments and minimal maintenance requirements. Slip resistant resin and gently sloping ramps accommodate disabled access and all pedestrians, including those with pushchairs.

Figure 6.8 Footbridge general design arrangement. Source: Jacobs



Steel or concrete superstructure options were dismissed due to significant ongoing maintenance requirements, carbon footprint and heavy craneage needed for installation.

Soffit levels provide significant clearance above the water level that has a 1 in 100 chance of happening in any given year, including sea level rise as a result of climate change. British Standards, Eurocodes and CIRIA guidance defined the superstructure design life of 120 years, the permanent loadings acting on the bridge and acceptable differential settlement.

Ground conditions at the breach location were saturated, informing the substructure design for the footbridge. Concrete has been chosen for the piles, pile caps, abutments and mid-channel piers. The grade of concrete specified had to be suitable for a marine environment, and a moulded form-liner was used on the inside of the shuttering during concrete placement to introduce texture to the visible areas, improving the aesthetics of the structure.

Footpaths

Frequency of footpath use, exposure to wave action and overtopping velocities informed public safety risk assessments, and in turn decisions around where footpaths should be raised or lowered, the need for refuge areas and where erosion protection were needed. The footpaths across Big Bank and Little Bank have been lowered to flood plain level. Links to tide tables have been provided, along with gauge boards that allow footpath users to see accurately the depth of any flooding.

Western Footpath

The southern section of the western footpath has its low spot in the middle of its 800m length, so that users will always be able to see any flooding ahead of them and retreat to

higher ground as necessary. The northern section has two refuge areas, one of which has emergency egress through the new cricket pitch location.

The western footpath has been widened and raised using a combination of site won and imported material, with rip rap protection and gently graded slopes to dissipate wave action. Estuarine seed mix was planted on slopes for stability and drainage provided between the landward and seaward sides of the path prevent ponding of surface water and minimise head difference across the raised structure. A crushed aggregate sub-base with a self-binding gravel surface was chosen, to both provide robust surfacing and reduce the carbon footprint over an all-concrete solution. Western Power Distribution (WPD) high voltage power cables have been diverted underground to reduce visual impact, eliminate maintenance of poles in a saline environment and mitigate the risk of birds flying into overhead cables.

The western footpath was widened over what might otherwise have been necessary to accommodate the potential FAB Link project. This is a project that will bring power from France via Alderney to Britain (hence FAB), with the preferred route running from Lime Kiln Car Park along the western footpath as far as SFR then beneath the new cricket pitch. Whilst accommodating their project was a legal requirement, doing so will also minimise disruption to newly established habitat when the FAB Link project is constructed.

Viewing Platforms

Viewing platforms were strategically located to screen people and dogs from the environment, encouraging wildlife to settle, and designed ergonomically considering all end users through consultation with local wildlife enthusiasts. The timber platforms are 3m by 5m and include aesthetically pleasing timber screening, viewing slots, portholes, steps and arm rests at appropriate heights for children, adults and wheelchair users.

Detachable billboards will ensure that up to date information can be shared with the public on an ongoing basis.

6.3.3 Risk and Mitigation

Table 6.2 Summary of risks and mitigation for design and construction of footpaths, viewing platforms and footbridge

Risk	Mitigation
Unknown timescale of FAB Link[16] Project.	Accommodating FAB Link requirements within the LORP design.

[16] The “FAB” project (France–Alderney–Britain) involves building an electrical interconnector underwater and underground between France and Great Britain via the island of Alderney – see https://www.fablink.net/

Risk	Mitigation
Bank failure due to demolition of EA outfall.	Structural inspections and contractor notified of hazards. Weather and tide conditions monitored.
Collisions between pedestrians and construction traffic.	Appropriate works phasing, temporary diversions and banksmen employed.
Damage to neighbouring trees during site clearance and spread of invasive species.	Clearly mark trees to be retained. Where trees are to be cleared, remove stumps or apply herbicide, chip wood for reuse and adhere to biosecurity protocols for equipment.
Damage to Otter Estuary SSSI.	Works in the SSSI minimised, clearance avoided bird nesting season and vegetation retained on upper slopes where possible.

6.3.4 Summary

PRoW across the site have been retained through upgrading footpaths and construction of a new footbridge. The 1 in 120-year design life of the superstructure reduces future maintenance requirements and the use of FRP increases durability and aesthetics. Sections of footpaths have been lowered and reinforced across Big and Little Bank and the Western Footpath widened to accommodate the potential FAB Link project. Seven new viewing platform across the site improve visitor infrastructure and consultation with local wildlife enthusiasts ensure its suitability for the end users.

6.4 Creek Network and Breach, Embankments and Utilities

6.4.1 Background

The new creek network extends 2.2km from Little Bank in the north to the breach location near Lime Kiln Car Park in the south through the former cricket ground, agricultural land and Big and Little Bank. The Budleigh Brook Aqueduct has been removed and the brook diverted into the new creek. Multiple agricultural drainage ditches run west to east across the floodplain, with the River Otter confined by the eastern embankment to the eastern edge of the floodplain.

Human activity in the early 19th century enclosed large proportions of the floodplain for agricultural land. The River Otter was straightened and disconnected from the floodplain via embankments, and drained via a drainage network and trunk drain discharging into the sea beneath the beach. The disconnected system results in water becoming trapped in the floodplain in fluvial flood events and overtopping and eroding embankments. Current and future maintenance of assets are increasingly costly with climate change. LORP had the potential to address many of these issues, but also had to be careful not to exacerbate problems for existing assets that will remain in place.

New outfalls to improve drainage were not considered as a viable option due to all parties' desire to create a sustainable system with minimal maintenance. New spillways across the embankments to reduce erosion would not have reconnected the river with its floodplain. Dredging existing channels to increase capacity would have had a detrimental impact on riverbed ecosystems and would not have been a sustainable option.

6.4.2 Design Principles and Attributes

The design has evolved over the course of the project in response to constraints and opportunities, not all of which were known at the outset.

Creek Network, Embankments and Breach

The design of the creek system within the site considered the following aspects:

- Hydrodynamic connections with:
    - the breach at the south to allow tidal water to enter the site
    - lowered cross banks in the northern part of the site to allow fluvial flood water to enter the site with culverts scaled to creek dimensions
    - an existing freshwater stream–Budleigh Brook which previously crossed the floodplain in an aqueduct
    - an existing freshwater trunk drain (main land drain) to the west of the site, previously passing under SFR through a culverted crossing
    - an existing freshwater stream–Kersbrook
    - existing areas of low land elevation within the scheme
- Reuse of portions of existing drains and overlap with low lying areas to minimise cut
- The blockage of existing field drains to avoid a rectilinear drainage network
- Using fill from other areas of construction to minimise material import
- Avoiding significant disturbance to the historic landfill at SFR
- Avoiding the existing sewer main running through Big Marsh South.

The design of the breach was developed by considering:

- The position of an existing flood relief culvert and channel through the fronting saltmarshes at the southern end of the site
- Stable breach dimensions based on a regime relationship (Townend, 2008)
- The results of a hydrodynamic flow model, which provided maximum velocity through the breach and inundation extent
- The requirement for the continuity of the SWCP
- Cost effectiveness, for example one breach versus multiple.

The main elements of the resulting scheme are summarised in figures 6.9, 6.10 and 6.11.

The floodplain is reconnected to the River Otter at the northern end by breaches in Little and Big Banks assisted by a new culvert. The floodplain is reconnected to the estuary at the south via a breach at BSCC, which included decommissioning an existing outfall. The decommissioning of Budleigh Brook aqueduct enabled historic channels in the floodplain to be utilised, encouraging fish passage from the estuary through the creek network into Budleigh Brook.

The network comprises of a main channel, with secondary and tertiary creeks feeding in and agricultural drains blocked to improve drainage. The overall effect of the new layout

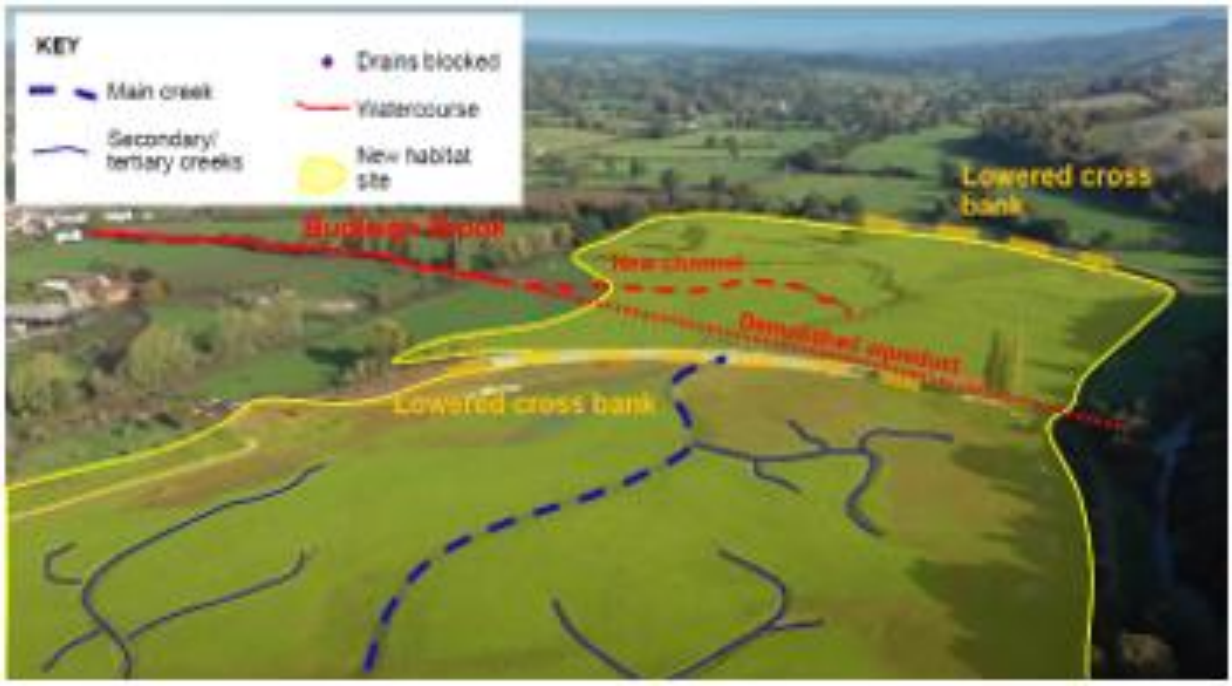
decreases overtopping and erosion of the Otter Embankment and encourage controlled tidal flooding and drainage.

Lowered footpath sections have been reinforced with concrete, rip rap and natural seeding, with warning signs for public safety. Two raised bird islands have been built using material cut from the creek network excavations.

Figure 6.9 Creek network system at Big Marsh South. Source Jacobs

Figure 6.10 Creek network system at Big Marsh North. Source Jacobs.

Figure 6.11 Creek network at Big Marsh North and Little Marsh. Source Jacobs.



Utilities

A Groundwater Risk Assessment confirmed Helsby Sandstone bedrock acts as a regionally important groundwater resource with three SWW abstraction points and source protection zones within the LORP site. Currently, abstraction points are unaffected by saline intrusion, although SWW are already concerned about saline intrusion to their boreholes from the coast and is monitoring the effects. The project had to carry out significant studies and implement an extensive groundwater monitoring network to ensure that any progression of saline water towards the drinking water abstraction boreholes is picked up well in advance of saline ingress. The implementation of the network was not expected and created programme delays.

A SWW Combined Sewer Overflow (CSO) pipe from the SWW sewage pumping station in Lime Kiln Car Park runs along the back of the shingle bar. The increased volume of water passing into the estuary through the new breach could have increased erosion to the CSO. The solution to prevent damage was to directionally drill a new route for the CSO under the estuary mouth, burying it and removing it from erosive pressures. This option provides a resilient and future proof CSO pipe.

A SWW pumped sewer runs south to north beneath the floodplain of Big Marsh South. No protection works to this sewer were required because the above ground velocities in this area do not produce significant erosion. Outfalls discharging into the trunk drain were cleared, with new flap valves installed where necessary.

SFR has been relocated south onto an earth embankment, enabling the creek network to pass under it via a highway bridge. See Appendix 3 for Jacobs' creek network design philosophies.

6.4.3 Risk and Mitigation

The variety of biodiversity required extensive environmental mitigation during construction of the project, not just the creek networks, most notably through derogation licenses. Licenses can only be applied for post planning stage and subsequent turnaround times and restrictions impacted the construction schedule.

Table 6.3 Risks and mitigation for design and construction of creek networks, breaches, culverts and utilities

Risk	Mitigation
Saline intrusion of principal aquifer.	Highly conservative groundwater modelling and monitoring strategy adopted.
Tidal and fluvial flooding during construction.	Phasing ensured high risk earthworks were done in summer and making the breach the final activity isolated the working area from the tide.
Major fast flowing flood water.	Compounds and storage areas on high ground, monitoring of weather forecasts and EA flood warning notifications. Removal of machinery out of the floodplain at the end of each day.
Striking of pumped sewer under the floodplain.	PAS128 and GPR surveys located utilities and no permitted excavation within 10m of sewer.
Soft and wet floodplain conditions overturning plant machinery.	Channels and structures designed away from deep areas and limited spans and weights to utilise smaller rigs.

6.4.4 Summary

Enclosing of agricultural land and straightening of the River Otter has disconnected the river from the floodplain. Resultingly, more frequent rainfall events cause fluvial flooding, increasing current and future maintenance costs.

A new creek network system increases hydrodynamic connections of watercourses and the sea through lowering, reinforcing and breaching sections of embankments. A series of secondary and tertiary channels feed into a main creek, utilising low lying areas to reduce cut and blocking of other agricultural drains to avoid a rectilinear network. Significant groundwater monitoring ensures any impact of saline intrusion into drinking water abstraction boreholes will be picked up well in advance. Directional drilling for a new CSO under the estuary buries and protects it from erosion. Appropriate phasing of works ensuring the breach was the final activity isolated the working area from the tide.

6.5 Historical Landfill Site

6.5.1 Background

The former landfill site covers a roughly triangular area extending almost the full length of SFR and abutting the SWCP to the east. The northwest tip of the landfill area adjoins the trunk drain at the site of the highway bridge (figure 6.12).

The tip was active from 1928 to 1978. It gradually expanded over time and its contents are poorly documented, although it is listed as mainly receiving inert and household waste and small amounts of industrial and commercial waste. It is understood not to have been lined before use, and little capping material was applied when the site closed in the 1970s. Flooding in 1968 resulted in rubbish being carried into adjacent farmland, and the uncertainty of the tips contents and proximity to water abstraction boreholes meant that it was an area of concern for LORP. Breaching of the estuary embankments will lead to regular tidal inundation around the tip, compared with relatively infrequent fluvial flooding. The team therefore needed to better understand the contents of the disused landfill site and any potential for contaminants to leach into the environment. Remediation of the whole landfill site area was considered as part of the full restoration option, which would have seen all the tipped material removed off site. However, excavating and removing the tip was prohibitively expensive, could potentially involve health risks to the specialist contractors involved and could have mobilised the tip contents. These reasons contributed to the full restoration option being discounted.

Figure 6.12 Former historic landfill site.

6.5.2 Design Principles and Attributes

Many trial pits were excavated across the landfill site as part of the ground investigation carried out in 2017. Boreholes directly through the site were avoided, to minimise the risk of piercing any sealing layer at the base of the tip that may have built up over time. Instead, boreholes were drilled close to the tip, to monitor groundwater and any leaching of contaminants.

Laboratory analysis on landfill materials, groundwater, and surface water in and around the landfill determined that most of the samples did not exceed guideline values. Some exceedance of the guideline values for a public park were recorded due to the presence of near surface salt waters. A report was produced to inform design of any potential

contaminant risk. Risk was considered moderate to low, with the highest risk of exposure during the construction phase.

Design aimed to minimise the risk of contamination during construction and maintenance, so that the area would be safe as a public space. This was achieved by:

- Reducing the occurrence of fluvial and tidal flooding over the landfill area
- Limiting ground disturbance despite construction works on SFR
- Designing appropriate erosion protection for the perimeter of the tip.

This was particularly challenging around the new highway bridge where it overlapped with the landfill site. Bridge abutments and piers create high velocity and unusual flow patterns resulting in increased scouring and erosion, potentially exposing contaminants. 1500m^3 of soil in this area (the northwest of the site) was removed and disposed of offsite to accommodate the highway bridge. Sheet piles around the eastern abutment of the bridge safely retain and cover exposed landfill sections, preventing groundwater seepages and creating safe working spaces. Rip rap protection around the bridge abutments form a revetment, limiting erosion of the tip from the creek network and dissipating energy. Where material has been removed, a capping layer is provided via SFR.

The new SFR lies on an embankment across the northern side of the landfill area. This in itself provides a capping layer for the landfill material beneath, and also makes use of the additional height above the flood plain created by the tipped material. Clean soil was used to cap the remaining landfill area, raising it by between 0.3m—0.8m. To prevent any leaching, temporary impermeable barriers were installed between the surface water bodies and the landfill area. Shallow slopes dissipate water energy, reducing the risk of erosion of the landfill. An orange geotextile layer notifies future subcontractors to not disturb the area. Existing trees and shrubs were removed to facilitate construction, but their stumps were generally left in place to reduce the risk of workers to potential contaminants. Native planting and seeding post capping encourages naturalisation and acts as a visual screen.

6.5.3 Risk and Mitigation

Table 6.4 Construction and design risks and mitigation for the historic landfill site

Risk	Mitigation
Embankment surcharging forcing contaminants into groundwater.	Continual monitoring and contingency plans to intercept groundwater if necessary.
Contamination of surface waters in new creek network.	Capping, raising and protecting landfill and erosion protection on bridge.
Exposure of inert material–eye sore.	Native planting and seeding, and raising level above the floodplain.
Excavation of landfill material.	Excavated material surrounded by impermeable geo-environmental sheet piling.
Mobilisation of asbestos.	Control of Asbestos Regulations (CAR) 2012 procedures followed, decontamination units, dust suppression system and specialist contractors using protective equipment were employed.

6.5.4 Summary

Tip expansion over the years is poorly documented. Though primarily used to dispose of inert and household waste small amounts of commercial and industrial waste were deposited here. Proximity to drinking water extraction points and erosive floodwaters created concerns for LORP.

Detailed ground investigations and laboratory analysis determined some exceedances of guideline values for a public park. Consequently, the design reduced the occurrence of flooding, minimised ground disturbance and incorporated erosion protection. Sheet piles preventing leaching at the site of the new highway bridge, and the remainder of the site was capped with clean soil to a depth of 0.3—0.8m. Native planting and seeding on the slopes acts as a visual screen. An orange geotextile layer informs future contractors of the presence of the tip, and Control of Asbestos Regulations (CAR) 2012 procedures were followed throughout.

6.6 South Farm Road Area: Embankment, Car Park and Highway Bridge

6.6.1 Background

SFR bisects Big Marsh, acting as a vital transport link connecting the properties and businesses in South Farm and South Farm Court to the B3178 (East Budleigh Road). Park Lane, running north from Otter Rise to Otterton, is permanently closed due to subsidence. The creek network crosses SFR to the west at the site of the new highway bridge (figure 6.13).

South Farm Road acts as the sole access for properties and residents east of the River Otter. The existing road is flooded approximately annually, isolating properties and businesses as there is no viable detour. Without further action, tidal inundation caused by breaching of the estuary embankments (either unplanned or through LORP) would have flooded the road daily. Previously, visitors chose to park cars in passing places or on the verges of SFR, causing inconvenience to agricultural operations and posing a flood, environmental and safety risk.

Maintaining access was always an objective of the scheme. Early discussions with emergency services showed that a tidal road would not be acceptable. Access for HGVs and farm vehicles was required, ruling out any option to re-open the narrow Park Lane. A bridge crossing the full width of the floodplain was dismissed as too costly.

Figure 6.13 SFR and Car Park Site Location Plan (left) and New Highway Bridge location (right)

6.6.2 Design Principles and Attributes

To retain vehicular access, SFR was elevated out of the floodplain onto an earth embankment. Tidal and fluvial connectivity between Big Marsh North and Big Marsh South was maintained by a 30m span highway bridge built to a 120-year design life. All concrete was poured in situ due to restricted access preventing the delivery of precast units to site. Transitional concrete slabs between the bridge and embankment reduced the differential settlement between the two structures. The new embankment and bridge were built slightly south of SFR, allowing the existing road to remain operational throughout construction and making use of the additional height of the tip above the floodplain. Kersbrook culvert was decommissioned as part of the works and replaced with a twin pipe on a slightly different alignment. To the west, out of the floodplain, a new 46 (43 plus 3 disabled) space car park has been built.

Various GI techniques were used in the area, depending on access limitations and what information needed to be gathered. Boreholes, trial pits, window samples and cone penetration tests were all used. The ground is characterised as superficial saltmarsh deposits atop beach deposits and weathered Helsby Sandstone bedrock.

The embankment for SFR is founded directly on the deposits below, rather than having a piled foundation, so structural integrity of the strata needed to be maintained and minimise differential settlement. A cut and fill balance were applied throughout, using site won material from the excavation of the creek network to construct the embankment. Large volumes of material were stockpiled and dried out which were carefully considered in the construction schedule. To assess the soils behaviour, an observational approach was adopted to monitor the rate of settlement during construction. Monitoring equipment was installed beneath the embankment prior to construction, which was extended through it as the embankment built up. The embankment was initially built higher than the finished road level, by about 2m, to surcharge the structure and ground below and increase the rate of consolidation. It was then left to settle prior to the road construction being installed along it. Monitoring took place to determine when the ground and embankment had consolidated sufficiently for the surcharge material to be removed and road construction to continue. The design stipulates a maximum settlement in use of 1mm/year over a 20-year period.

6.6.3 Risk and Mitigation

Table 6.5 Design and construction risks and mitigation for SFR embankment, highway bridge and car park

Risk	Mitigation
Differential settlement rate due to surcharging.	Flexible plans should thresholds be exceeded.
Use of site won and imported materials for embankment construction.	Observational approach to monitor settlement.
Construction traffic causing collisions.	Night closures, diversions avoiding peak times, and appropriate signage.
Collapsing of bored pile holes.	Shallow pile design and designs flexible to incorporate steel casing if required.
Differential settlement between embankment and bridge.	Transitional concrete slopes and intrinsically linked sub and superstructure of the bridge.
Erosion of bridge piers and abutments due to high velocity water.	Rip rap protection and variety of concrete classes used.
Delivery of large pre-cast units via narrow lanes.	All concrete poured in situ.
Channelling of BT and high voltage power cables under the embankment.	PAS128 surveys and liaison with utility suppliers to isolate supply.
Embankment stability.	Mitigated through design and Manual of Contract Documents for Highways Works (MCHW) – Series 600 followed.
Flooding of pile construction workspace.	Temporary cofferdams to pump water out, safe access and egress routes identified and monitoring of weather forecasts.
Disturbing protected species.	European Protected Species (EPS) derogation licences obtained and works halted on discovery with buffer zone radii applied.

See technical appendix 4 for general site risks and mitigation.

6.6.4 Summary

The existing SFR is flooded regularly isolating dwellings, farms and businesses east of the floodplain. A tidal road was unacceptable for emergency services therefore the road was raised above the floodplain. Tidal and fluvial connectivity remained through a 30m highway bridge. The bridge sub and super structure was poured in situ and transitional concrete slabs reduced the differential settlement between the bridge and embankment. A new 46 space car park reduces the occurrence and inconvenience of visitors parking along SFR and improves visitor access. An observational approach was adopted to monitor the rate of embankment settlement.

6.7 Conclusion

The Lower Otter floodplain has been heavily modified for agricultural purposes since the 19th century. Human intervention has seen the area used for agriculture, access across the floodplain, waste disposal, and a playing cricket club. Regular fluvial flooding has

placed a strain on the existing infrastructure and climate change impacts increase the likelihood of asset failure.

To reconnect the floodplain to the river and the estuary and restore 55ha of habitat, without removing functionality of the SWCP, SFR and BSCC, multiple assets needed to be upgraded, removed, or relocated. In summary, this involved:

- Relocating BSCC out of the floodplain to prevent regular deep flooding
- Constructing a new FRP footbridge across the southern breach, seven new viewing platforms and upgrading of footpaths to maintain and improve visitor access
- Development of a new creek network improving hydrodynamic connections
- Detailed Ground Water Risk Assessment and continual borehole monitoring
- Extensive Ground Investigation informing capping of former landfill site
- Directional drilling under the shingle bar for a new CSO
- Raising SFR onto an earth embankment and monitoring of settlement rates
- Construction of new 46 space car park.

LORP has shown the large volumes of materials involved in large scale adaptation projects. A cut and fill balance strategy was adopted as far as possible. The drying out and stockpiling of site won material for footpath and road raising takes time. As such the timing of construction activities should be carefully considered.

The variety of biodiversity required extensive environmental mitigation, most notably through derogation licenses. Licenses can only be applied for post planning stage and subsequent turnaround times and restrictions impact the construction schedule.

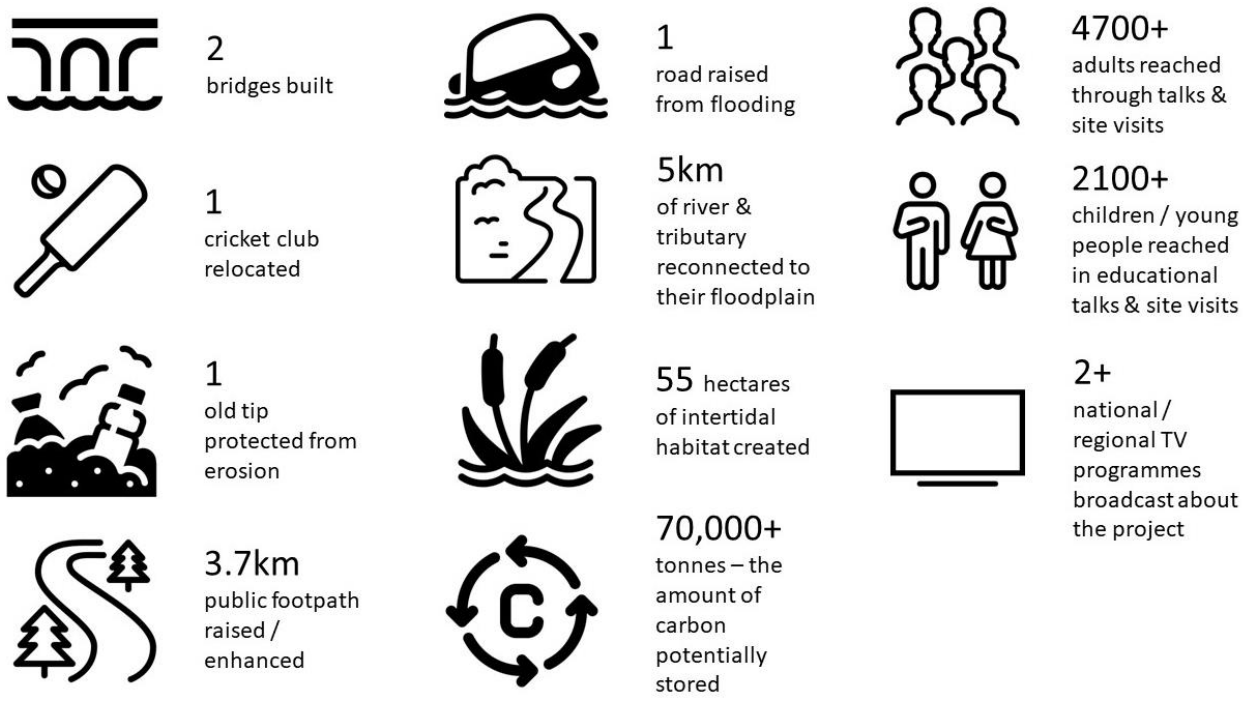
The scale of groundwater risk assessment and monitoring network was necessary. However, this was unexpected and caused programme delays during design and cost increases during construction. The impact of saline intrusion should be accounted for early in the project phasing.

Partnership funding and equitable sharing of costs is critical for adaptation projects. Asset owners should be engaged as early as possible, preferably before timescales for a project have been set. Responsibility of asset owners should be clearly defined and translate into financial support for the project. It is likely senior discussions between organisations will be needed for a resolution to be reached.

Overall, the scheme has improved the ecological functioning of the lower Otter valley, enhanced the value of its biodiversity and habitats, has safeguarded access and recreational facilities and pre-adapts the valley to the future effects of climate change.

Figure 6.14 summarises some of our main achievements on the Lower Otter.

Figure 6.14 Achievements within the Lower Otter (Source: EDPHCT)



6.8 Further Reading

Disused tip case study – Lower Otter (Fouqué, B., 2022)

See bibliography for further details.

Chapter 7. Design and Construction: Basse Saâne Valley

Authors: Delphine Jacono, Camille Simon, Thomas Drouet & Edward McIntyre**.**

Affiliated authors (listed alphabetically): Amélie Boutillier & Régis Leymarie.

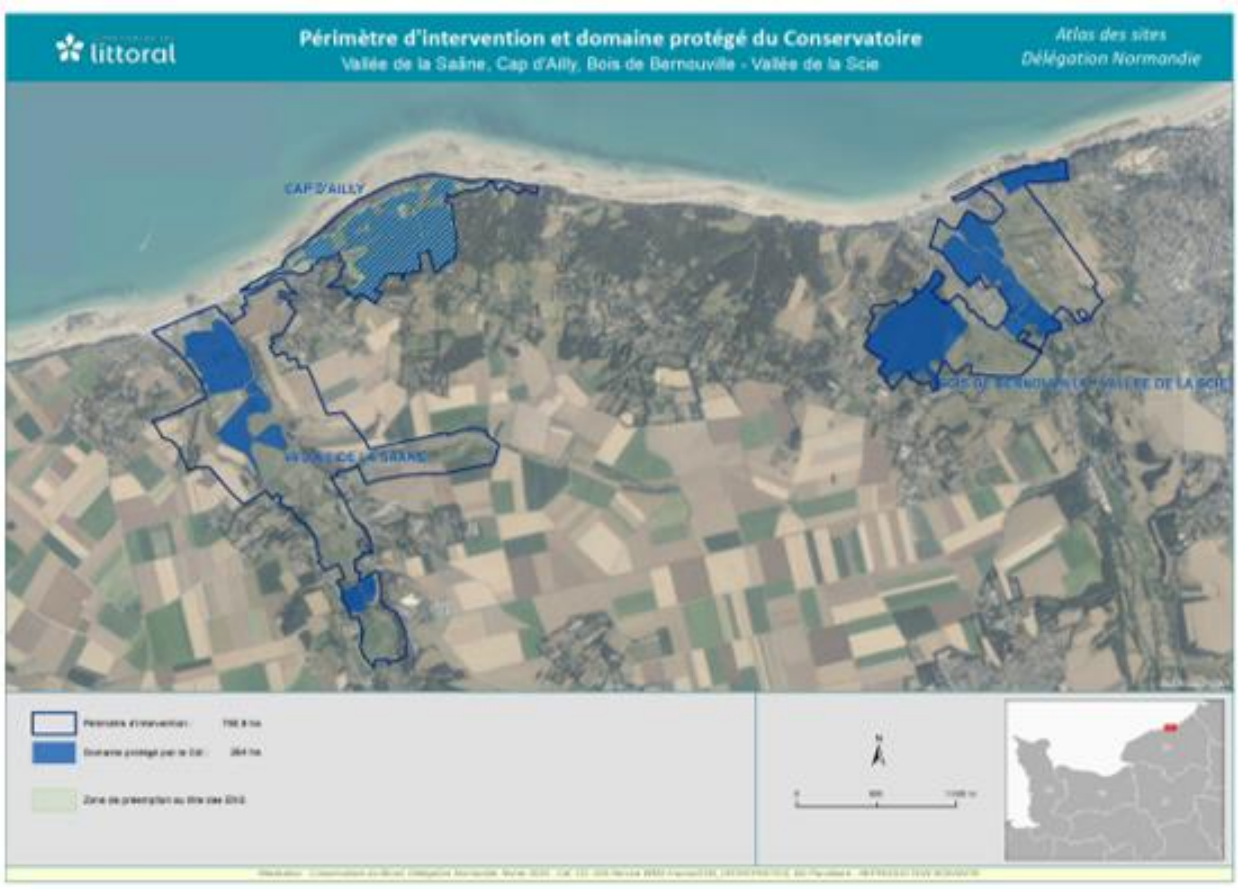
7.1 Introduction

The PACCo project has made it possible to implement two major operations of the Basse Saâne 2050 project: the relocation of the Quiberville campsite and the creation of a new wastewater treatment plant and sewerage networks.

The works to reconnect the Saâne and its valley to the sea will take place in 2025, and are therefore not the focus of the guide, however, it is part of the Basse Saâne 2050 project and will be referred to.

7.1.1 Site Extent, Brief History and Challenges to the Estuary

Figure 7.1 Lower Saâne Valley location. Source: Conservatoire du littoral



Site Extent

The Saâne Valley site extends 3.5km inland southeast from the coast (figure 7.1). The River Saâne is enclosed between two limestones plateaus and flows into the English Channel, east of Quiberville-sur-Mer and west of Sainte Marguerite-sur-Mer. The area is located approximatively 20km west from Dieppe (North of the Seine-Maritime region). The main road, the departemental road RD75, connects small towns and villages along the coast as well as Pays de Caux and Dieppe, with the town of Longueil lying to the south (figure 7.2). Secondary roads run parallel to the valley (the RD127 to the west, the RD27 and the Chemin de la Saâne to the east) where the topography rises sharply towards the agricultural plateaus.

The departmental road RD75 lies on a concrete sea wall built to prevent seawater intrusion into the lower valley. South of the road is Camping de la Plage, the town campsite of Quiberville-sur-Mer, which is surrounded by a high earthen dyke to protect it from flooding. Eight bungalows in Sainte-Marguerite-sur-Mer, on the northern edge of the valley, lie within the flood zone. The area is lower than surrounding land and bordered by a secondary road, the Fond chemin of the Saâne. The lower valley has been modified by human activities shaping the landscape. Towards the coast, ponds and hunting gabions are linked together by paths and agricultural plots are dedicated to extensive livestock farming. Longueil marsh to the south is a small wetland known for its flora and fauna.

Figure 7.2 Aerial photography looking northwards showing the relative locations of Sainte Marguerite-sur-Mer, Longueil and Quiberville-sur-Mer. Source: Thomas Drouet

Brief History

In the 16th century the land naturally comprised brackish marsh and wetland. Towards the end of the century humans modified the estuary, installing a raised dyke to deter foreign

invasion from the sea. A first culvert was installed at the mouth of the estuary in 1864, mainly to protect the area from coastal flood but also to drain the area. Following urbanisation of Sainte-Marguerite-sur-Mer and the construction of Quiberville's campsite in 1960, new temporary dwellings were built within the flood zone.

The culvert and surrounding groynes, as it is today, were built in the 1950s with the latest groynes built in the 1990s. These structures, made of wood or concrete (concrete groynes in The Saâne Valley) were installed to limit sediment movement on the beach reducing its erosion.

Figure 7.3 Effects of the 1999 flooding on the campsite (left) and properties of Sainte Marguerite-sur-Mer. Source: Henry DANIEL

Severe flooding occurred in 1977, 1995, 1999, 2000 and 2018. This was from the coast, fluvial flooding and surface water run-off from the agricultural higher ground, or a combination of them all. Most notably in 1999, water became trapped behind earth dykes flooding the lower valley, bungalows of Sainte Marguerite-sur-mer, Quiberville and the campsite for twelve days (figure 7.3).

Challenges

The existing narrow culvert is the only way the valley and river can drain into the sea and is tidally locked when fluvial flood waters meet the high tide, prolonging flood events. Climate change is likely to exacerbate these issues.

Within the catchment area, intense farming has resulted in increased erosion of topsoil with the deposition of mud and silt in channels. This has contributed to poor water quality impacting bathing water status and hence tourism.

Water quality is also deteriorating due to the poor sewerage systems in place which discharge insufficiently treated wastewater into the watercourse. Six obsolete wastewater treatment plants along the Saâne malfunctioned and were deemed non-compliant with three lying in flood prone wetlands. In particular, the Ouville la Rivière station has a strong impact due to sludge discharges. Further studies carried out in Longueil in 2015 identified direct discharging of wastewater not connected to a treatment plant. The classification has subsequently been reduced to 'average' in the Diatom Index due to the occasional release of macropollutants having a harmful impact on biodiversity.

7.1.2 Options Appraisal and Implementing the Preferred Option

The overarching aims of design and construction are to:

- Reconnect the Saâne River to the floodplain (funding of the studies and work is by Agence de l'eau Seine-Normandie, this is outside the PACCo project and will be implemented after)
- Decrease the risk of flooding and submersion of Quiberville campsite
- Increase water quality of the Saâne river and bathing waters

Figure 7.4 Site of the project of Basse Saâne 2050 (Source: Cdl)

To achieve these aims the following assets needed to be designed and constructed (figure 7.4):

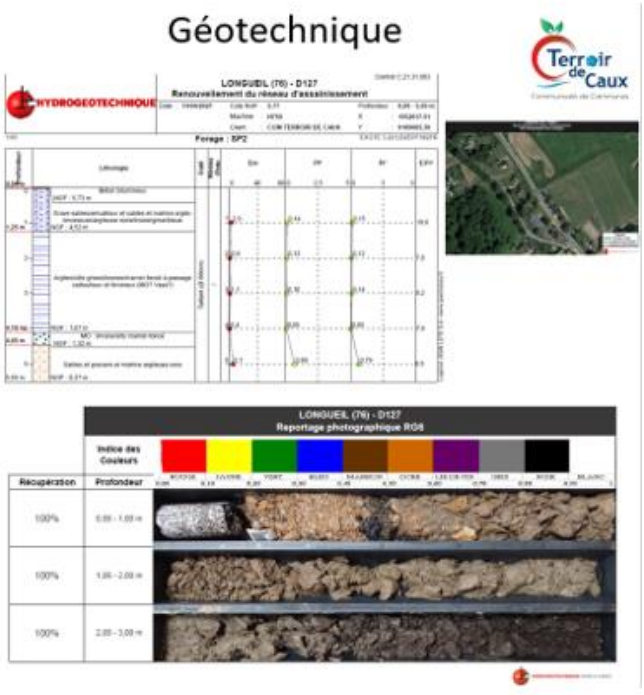
- Relocate Camping de la Plage campsite (Quiberville are the client) out of the floodplain
- Decommissioning and replacing the old sewerage network system, moving sewage treatment works out of the floodplain and connecting the houses of Longueil to eliminate pollution discharge (the Communauté de communes Terroir de Caux are the client)

7.1.3 Ground Investigation Scope

The Ground Investigation was carried out by Hydrogeotechnique. Studies were completed to inform the installation of the new sewerage treatment network and the location of the wastewater treatment plant. Coring samples were taken down to a depth of 5.5m to determine groundwater level and soil type, displaying the following conditions (figure 7.5):

- 0.0m—0.04m—impermeable surface
- 0.04m—1.25m—Sandy gravel, stones and sand and silty-clay, in a clay matrix
- 1.25m—4.10m—clay with some gravelly and silty sections
- 4.10m—4.45m—dark brown clay
- 4.45m—5.50m—sands and gravels in a clay matrix.

Figure 7.5 Coring samples and depths for the ground investigation on the Basse Saane. Source: Terroir de Caux.



For the relocation of the Quiberville campsite, soil studies were also undertaken and combined with topographical survey data, flood zone maps and the flood risk prevention plan. This impacted design by determining the most suitable locations for campsite buildings such as toilets and reception, and on-site utilities.

7.1.4 Environment Assessment

The environmental assessment covered the project and was carried out by the Syndicat Mixte des Bassins Versants Saâne Vienne Scie, involving all project partners.

The aim of the environmental assessment process is to integrate the environment from project inception and into the decision-making process. The process enables the public to respond to the regulatory bodies and holds clients accountable for individual aspects of work. Environmental impacts are considered and monitored through the handover and operation phases of the project. The process ends once all regulatory paperwork and public enquiries are complete.

The environmental assessment compiled the results of the studies carried out for the relocation of the campsite and the creation of the wastewater treatment plant and networks. The project fell within the threshold for a case-by-case examination to determine its impact on the environment, assessed against a list of criteria relating to project characteristics, location, and the potential impact.

The decision whether or not to submit the project to environmental assessment is therefore based on the analysis of the application form in which the developer specifies the main characteristics of the project. [17]

The environmental assessment concerns the entire territorial project, and not just the reconnection to the sea. It is carried out by the Syndicat Mixte des Bassins Versants Saâne Vienne Scie and involves all the project partners in the preparation of the file.

7.2 Wastewater Treatment Works

7.2.1 Background

The Communauté de communes Terroir de Caux (Community of Terroir de Caux municipalities) covers 38,000 inhabitants in 79 towns, including one coastal town,

[17] https://www.ecologie.gouv.fr/levaluation-environnementale-et-demande-dexamen-au-cas-cas

Quiberville. The Communauté de communes Terroir de Caux is the client of the new wastewater treatment plant construction and its network.

Studies carried out by Agence de l'eau Seine Normandie (AESN- Seine-Normandy Water Agency) showed water quality of the Saâne requires improvement to meet European Water Framework Directive and French standards (SDAGE du bassin Seine et côtiers normands). The primary cause of poor water quality are septic tanks and public wastewater treatment plants with inconsistent treatment levels and non-compliance and accidental discharging of sewage during flood events.

Upgrading the existing system was dismissed as it would not alleviate issues with individual treatment.

Feasibility studies proposed creating a new efficient public wastewater treatment plant, replacing the six small failing treatment sites. Eight towns are connected to the sewerage network and to the new wastewater treatment plant. Only the connections in the commune of Longueil are included in the PACCo project. The rest of the connections will be finalised by 2024 and are part of the Basse Saâne 2050 territorial project. The new wastewater treatment works are located on higher ground in Longueil (label 3 on figure 7.4).

7.2.2 Design Principles and Attributes

The new collective system connects 4,300 inhabitants exceeding existing demand and allowing for development over the next 20-30 years. The system consists of 28,500m of pipes, 20 pumping stations, and 1500 connections, including 750 new connections. In addition to Longueil, it will allow another 7 towns located upstream of the valley to be connected to the new wastewater treatment plant. Existing defective connections will be upgraded, with the old obsolete system removed.

The main advantages to replacing several small wastewater treatment facilities with a single medium-sized wastewater treatment plant (activated sludge) are: reduced vulnerability to occasional pollution and stabilised operation; higher purification performance on carbon, nitrogen and phosphorus parameters; a sludge process capable of treating sludge external to this wastewater system.

The new wastewater treatment plant has been designed to be "water and climate" compatible with the following principles:

- It considers the drop in flow of the Saâne and therefore its purification capacities (QMNA5 -10%)
- Built outside wetlands and flood-prone areas
- Energy efficient equipment and operation
- Reuses and allows rainwater to infiltrate
- Integrates a terrestrial and aquatic biodiversity component within the site itself
- An educational trail for visitors with permanent free access is part of the construction

- The new wastewater treatment centre is located out of the floodplain to reduce the risk of flooding (figure 7.6). The water is fed via pumps to the plant and when treated, gravity discharges the water. Sewage passes through the aeration and clarification tanks, with continual monitoring of water quality before discharging into the Saâne at the site of the previous poplar grove plantation in Longueil. Sludge is removed from the aeration tank, pressed and stored before being re-used as fertiliser. Photovoltaic panels partially cover the energy requirements for facility operation. A new educational centre, retention pond for surface runoff and raised viewing tower improves visitor infrastructure, facilitating tours around the site.

Figure 7.6 New wastewater treatment facility at Longueil. Source: Thomas DROUET/Cdl, 2023

7.2.3 Risk and Mitigation

Table 7.1 Risks and mitigation for construction of new sewage treatment system.

Risk	Mitigation
Flooding of the site during construction.	Temporary over pumping on standby with straw filters.
Cutting the wastewater flows during the installation process of the new network.	Effective management of the different phases of the installation. Implementation of temporary network to divert the flow. Regular communication with the inhabitants.

Risk	Mitigation
Significant impact on traffic in the valley for users and tourists.	Duration of works minimised and avoided the tourist season. Several teams were working at the same time, adhering to tight work scheduling. Traffic plan implemented by the CCTC (Communauté de communes Terroir de Caux), to reduce impact particularly during school pick up and drop off. Traffic plan regularly updated if necessary and communicated to persons effected.
Poor understanding and support from residents directly impacted by the work and cost.	Public meetings in the effected towns to present the project, objectives, schedule and funding. Documents were mailed to the inhabitants of the 8 towns to inform them of the public meetings. Implementation of an agreement with the voluntary private owners of the 8 towns, wishing to benefit from the technical skills of the CCTC for the connection of their homes to the public sewerage network. The agreement, via the CCTC, also made it possible to source funding from the Seine-Normandy water agency.

7.2.4 Summary

Insufficient treatment of wastewater due to old sites, leaking networks, direct discharges into the river and accidental spills during floods deteriorated the water quality of the Saâne and bathing waters on the beaches of Quiberville and Sainte Marguerite-sur-Mer. A new collective wastewater system (network and treatment), accounts for urban development expected over the next 20 to 30 years and reduces the impacts of wastewater on the watercourse and the coast. The new wastewater treatment plant is located outside the flood zones, providing an open-access educational space. Complete and detailed design studies, precise phasing of the site and monitoring of its implementation made it possible to meet project deadlines.

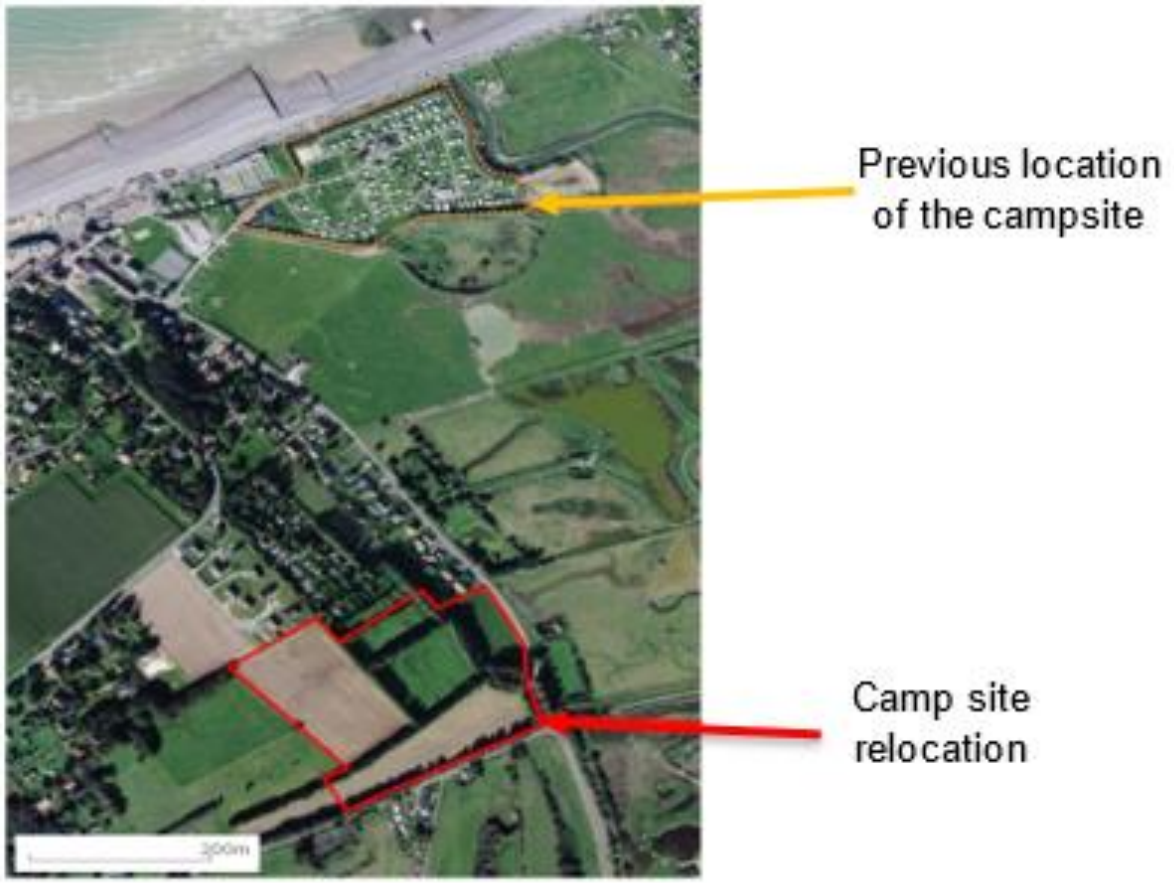
7.3 Campsite Relocation

7.3.1 Background

Camping de la Plage is located in the floodplain, east of Quiberville where the Saâne meets the sea. A raised earth embankment encompasses the north of the site, separating it from the D75 (figure 7.7). Historically, the area has been subjected to fluvial flooding, with the dyke preventing the discharge of water, damaging campsite infrastructure. Future sea level rise could see the dyke overtopped. The campsite is a vital socioeconomic activity, generating 40% of the income for the municipality with direct and indirect

employment; closure of the campsite is therefore not an option. Following the 1999 flood, the campsite was threatened with administrative closure if no relocation solution was found.

Figure 7.7 Former campsite location (dashed orange outline) and new campsite location (solid red outline). Source: Cdl



7.3.2 Design Principles and Attributes

To relocate the campsite out the floodplain it had to remain on municipality-owned land, limiting potential sites to the plateau or hillside. The site selected is within walking distance of the coast and Quiberville (around 600m), with easy access to the road network. It aims to improve the tourism service and integrate into the surrounding landscape better than the existing campsite.

Design decisions made by the Quiberville town council were based on a feasibility study carried out in 2019 to better understand user requirements. The project partners, Seine-Maritime Attractivité and the Communauté de communes Terroir de Caux, used the conclusion of the studies and requests made to the tourist office to alter design attributes.

The relocation of the Quiberville campsite will allow the town to maintain an economic asset. To remain attractive to existing and new customers, the municipality (the client) has upgraded it with the aim of opening a four-star campsite. To integrate it into the landscape,

all the reception and sanitary buildings are made of wood and significant work has been carried out on the revegetation of the site.

Modelling of surface runoff informed the location of ditches and swales, redirecting water into retention and filtration ponds at the base (southeast) of the campsite. Permeable vehicle pitches and parking spaces enable rainwater infiltration, reducing surface runoff across the site and into the floodplain. Planting of native shrubs and trees stabilise the soils reducing the transport of sediment into watercourses and increase rainwater infiltration. An additional series of swales next to the access road intercept water, reduce the risk of flooding on the road linking Quiberville and Longueil, and improve water quality. Water collected in ditches and swales coming from the town and the agricultural plateau, are directed to retention basins before being discharged into the valley under the road.

Figure 7.8 Landscape sketch of the new campsite (left) and site plan (right) (Source : Quiberville, 2022 et 2023)

7.3.3 Risk and Mitigation

Table 1.2 Risk and mitigations for design and construction of the campsite.

Risk	Mitigation
The development of the hillside plot increases runoff and aggravates the flooding of the road linking Quiberville to Longueil during heavy rain events.	Stabilisation of topsoil with native planting and intercepting drains and swales. Reduced the area of impermeable surfaces through drainage systems on the motorhomes and caravans pitches. Maintain as many existing hedges as possible. Installation of ditches and retention basins within the campsite.
Flooding of lower part of the site.	Use of the temporary flood risk prevention plan aiding the location of campsite infrastructure.
Integration into landscape impacting the environments aesthetics.	Choice of construction materials (wood). Buildings do not exceed one storey. New cabins follow the topography of the site instead of carrying out major earthworks. Planting of native shrubs and trees.

7.3.4 Summary

The existing campsite in the floodplain is exposed to fluvial flooding and future tidal flooding. Closure is not an option due to the economic value it provides for the municipality. It has been relocated onto the hillside within walking distance of the beach. Modelling of surface runoff informed the location of infiltration and retention ponds, channelled via swales and ditches. Permeable vehicle pitches further reduce runoff with native shrubs stabilising soils and reducing sediment mobilisation. Swales along the access road intercept agricultural runoff and water runoff from the campsite. Trees have been planted over the 6ha campsite ground to integrate the site into the landscape.

7.4 Floodplain Restoration

The studies and work to reconnect the Saâne to the sea and to restore the habitats are financed by the agence de l'eau Seine-Normandie (Seine-Normandy) water agency and are not integrated into the PACCo project. The contracting authority is the Syndicat Mixte des Bassins Versants Saâne Vienne et Scie, which is competent in the management of aquatic environments and flood prevention (GEMAPI- Gestion des milieux aquatiques et de prévention des inondations).

7.4.1 Background

The River Saâne meanders across the floodplain 3.5km inland before discharging into the English Channel between the settlements of Quiberville-sur-Mer and Sainte Marguerite-sur-Mer.

The road embankment and culvert slow the flow of the Saâne, especially at high tide. In flood events, the lower valley remains inundated due to an under-capacity outfall, impacting property and people (departmental road, campsite, bungalows) and land usage (agriculture). This also poses a risk of marine submersion accentuated by future sea level rise. The embankments built using silt taken from the bed of the river restrict the flow of the Saâne preventing it from overflowing into its floodplain, further contributing to the slow drainage of flood waters.

The flow control structures, culvert, non-return valve and ditches, manage the water levels in the lower valley but have a negative impact on the environment. The estuary culvert acts as a barrier preventing fish passage from the sea to the river. Amphihaline migratory fish are a priority for the Saâne and are classified in lists 1 and 2 under article L214-7 of the Code de l'Environnement (Environmental Code). Target species for the Saâne are brown trout sea, Atlantic salmon, eels, river lampreys and sea lampreys. The Ministry of Ecology has identified the area an essential priority work and the watercourse is classified as a priority action zone for the Eels national plan, an endangered species, protected on a European scale.

Fifteen years before the Basse Saâne 2050 project it had been planned to completely remove the coastal dyke over 400m and to reopen the valley to the sea over its entire width. However, the coastal road is an important asset linking the Pays de Caux to Dieppe

and used daily for primary and nursery school transport serving three towns. At the time, the study of an alternative solution involved diverting the road by several kilometres was considered financially and politically unacceptable.

7.4.2 Design Principles and Attributes

A preliminary hydraulic study made it possible to define the main technical guidelines for restoring ecological continuity at the mouth of the Saâne. Since then, several studies have been carried out in parallel: detailed preliminary study define future works, initial assessment, geotechnical studies, environmental assessment. Work will begin in 2024-2025.

The main design options to reconnect the sea to the Saâne and restore habitats are:

- 10m wide opening to the sea, replacing existing culvert with a bridge
- In the lower valley, lowering and breaching of embankments, reconnecting the Saâne to its floodplain and recreating 50ha of wetlands and intertidal habitats.
- Management of site won material to control the costs and the ecological impact of the project
- Creation of a new riverbed increasing sinuosity, manage the river slope and increase the channel volume (figure 7.9)
- Restoration of 5ha of natural habitats upstream of the lower valley: removal of a poplar plantation, management of invasive species, restoration of wetland features and creation of a bird area

Figure 7.9 Potential design of sinuous channel crossing the floodplain. Source: © Atelier de l'Île, 2020

7.4.4 Summary

Modification of the Saâne is already aggravating river and coastal flooding and will increase with sea level rise impacting property and people. In addition, the existing outfall does not comply with national and European regulations for migratory fish. Still in the design phase, the project will restore the ecological continuity between the Saâne and the sea and restore the functions of floodplain (expansion of the channel, intertidal habitats and hydraulic improvements).

7.5 Conclusion

The Saâne Valley has been modified since the 16th century. Dykes were constructed, and later in the 19th century, a wooden culvert was installed to drain the land for agricultural purposes. Floods of recent decades have impacted Sainte-Marguerite cabins, roads, campsites and sewerage networks. The river and the beaches are subject to pollution due to insufficient wastewater treatment (obsolete stations, leaking networks, direct discharges into the river) and accidental discharges during floods. The project aims to reconnect the Saâne to the sea and its floodplain to better manage floods, restore biodiversity and the functionality of natural environments and increase the resilience of the coastal area facing climate change. Water quality issues and economic development of the area are also integrated into the project.

A new sewage treatment system, accounts for urban development in the next 20 to 30 years and reduces the impacts of wastewater on the watercourse and the coast. The new wastewater treatment plant is located out of the floodplain and provides an open-access educational area on the heights of Longueil. Complete and detailed design studies, precise phasing of the site and reinforced monitoring of its implementation made it possible to meet project deadlines.

The campsite, an important asset socially and economically for the region has been moved to the hillside, 600m from the seafront, reducing exposure to fluvial and tidal flooding. Surface water modelling defined the location of infiltration basins, retention ponds, swales and ditches, reducing flood risk and improving water quality. Additional drains were installed to catch the water runoff from nearby farmland. Native shrubs stabilise surface soils, reducing sediment mobilisation, and trees integrate the site into the surrounding landscape.

Current and future fluvial and tidal flooding put properties in urban areas at risk, and waterfront developments create an ecological and geomorphological divide. The project will breach the embankments to create 50ha of intertidal habitats, using existing ponds and creating new creeks.

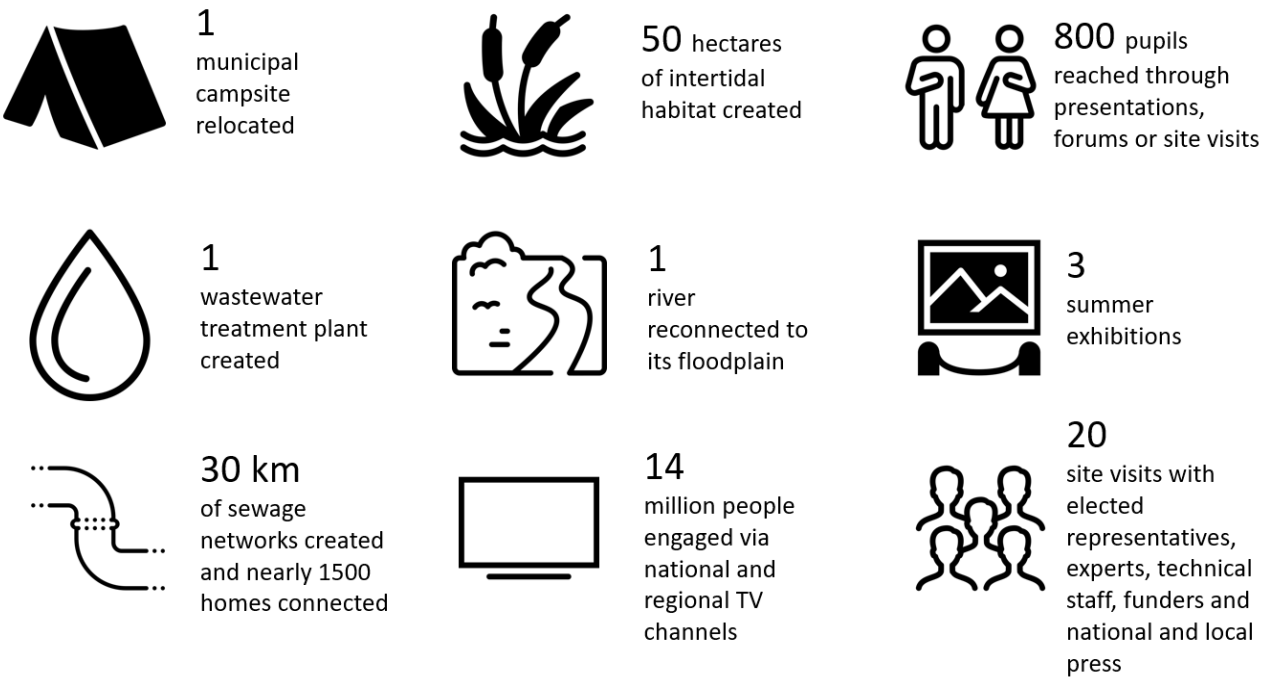
The renaturation of the Longueil poplar plantation improves hydraulic connectivity. The ecological risk will be mitigated by adopting a reduction and compensation approach, and the evolution of the meanders of the river will be monitored to prevent their expansion into urbanised areas.

The existing under capacity culvert, will be replaced by a prefabricated concrete bridge with a 10 m span, improving drainage. The bridge abutments will dissipate the energy, and a reinforced concrete slab with integrated rockfill protection will prevent erosion.

Overall, the Basse Saâne Valley Project draws similar parallels with the LORP. It is a fully integrated project increasing community resilience to the current and future risk of flooding while considering the economic issues of the territory and restoring the natural environment and biodiversity.

Figure 7.10 summarises some of our main achievements in the Saâne Valley.

Figure 7.10 Achievements within the Saâne valley (Source: EDPHCT)



Chapter 8. Project Risks and Solutions

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Affiliated authors (listed alphabetically): Delphine Jacono & Lydia Burgess-Gamble.

This chapter describes two tools developed as part of the project which can be used to define project risks, issues and solutions. The tools use real life examples of project risks and issues derived from both estuaries and sets out solutions which were implemented.

The tools may be of use for future managed realignment or climate change adaptation projects because they summarise risks, issues and solutions which may be common to other sites. In addition, the ways in which the tools are structured could act as a template for developing risk registers for new sites.

In this chapter we describe each of the tools in turn, then provide some examples from both projects.

8.1 Introduction

A key component of project management involves the identification, management and mitigation of risks and issues which could affect the pace of project delivery and budget.

The PACCo project was delivered using a programme-level risk register, which enabled the project partners to work together to identify and mitigate risks. This risk register was an invaluable project management tool which aided its smooth delivery.

Within each estuary, each of the construction sites had their own programmes and risk registers to help them identify and mitigate site level construction risks.

As part of the PACCo project we have developed two tools to help define some of the risks and issues we encountered, and solutions we implemented to resolve these risks.

8.2 Risks Register and Issues Register

We developed a tool to record risks and issues encountered in both estuaries. The risks and issues tool is an Excel spreadsheet and accompanying report which sets out different ways to mitigate the risks and issues that could be encountered during the following four phases of a project:

- Set-up
- Design and planning
- Construction and implementation
- Post-construction

The tool has one tab for risks and one tab for issues (Table 8.1).

Table 8.1 Definition of a risk and an issue

A risk is	An issue is
A hazard or undesirable event, the occurrence of which is uncertain. Due to its consequences, the project may fail to meet its objectives regarding time, cost, quality. A risk is a danger of varying predictability that may impact the outcome of the project. It is not possible to eliminate all risks entirely, but preventative actions may be implemented to mitigate them.	An existing situation or a risk that has already occurred. An encountered difficulty which must be resolved to obtain the desired result: an unstable or hazardous situation which requires a decision to be made. Issues can vary in their severity and significance, and are often unexpected, which is why they need to be dealt with urgently. To avoid being caught off-guard, it is important to predict as many potential issues as possible that may arise during the project.

The tool starts off by describing the risk and its potential consequence. A matrix is used to define the probability, severity and consequence of the risk materialising (see Figure 8.1). The matrix helps to identify the extend of a risk and assigns a priority level for resolving it.

Figure 8.1 Matrix used to define the severity and consequences of a risk materialising

Criticality		Impact			
X		1 - Minor	2- Significant	3 - Severe	4 - Catastrophic
Probability	1 - Very unlikely	1	2	3	4
	2 - Unlikely	2	4	6	8
	3 - Likely	3	6	9	12
	4 - Very likely	4	8	12	16

Criticality	Score	Colours
Low	1 to 3	
Moderate	4 to 7	
Significant	8 to 9	
Critical	10 to 16	

Issues are risks that materialized during the PACCo project. Unlike risks, issues do not have potential consequences for which mitigation is needed. Instead, they have direct impacts for which actions must be put in place. The pace at which an issue is addressed can impact the implementation of the project (budget, work, schedule).

8.3 Solutions Tool

Building on the risks and issues tool (described in the section above) we next developed an accompanying tool which sets out ways to resolve identified problems. This is referred to as the solutions tool. The solutions tool is built the same way as the risks and issues register with two Excel spreadsheet and accompanying report (Drouet, Simon, & Fouqué, 2022b) which sets out different ways to mitigate risks and issues that could be encountered during the following four phases of a project:

- Set-up
- Design and planning

- Construction and implementation
- Post-construction.

The tool has one tab for risks and one tab for issues. Risk and issues are defined in Table 8.1. The tool starts off by describing the risk and its potential consequences or issue and its impact. The solutions are of two different types:

- Mitigation measures put in place in advance so that the identified risks do not turn into problems
- Corrective actions implemented when problems arise, either because the risk had not been anticipated, or because the risk management solution was not sufficient.

The solutions register indicates all the solutions proposed for each of the risks identified and the solutions implemented when problems were encountered.

8.4 Examples of Solutions to Risks/Issues

The following section provides some examples of risks, issues and solutions. They help bring the tools described above to life.

8.4.1 Funding Shortfall (Saâne Valley)

Table 8.2 describes a funding issue which is currently affecting all construction sites, but in the case of PACCo had a particular impact on the relocation of Quiberville campsite.

Table 8.2 Description of a funding issue encountered in the Saâne Valley

	Description of the issue
Issue #	P09
Phase of the project	Design and planning
Issue identification	Climate change adaptation projects can require large financial investments from the delivery partners
Nature of the issue	Financial
Issue description	• With the health crisis (COVID-19) and the geopolitical context in Europe, the price of materials has increased significantly, which has had a major impact on construction. • Due to these events, the tourist facility project in Quiberville has seen its forecast budget increase by 1,700,000 euros which represents 30% more than the initial budget. • This increase in forecast budget occurred prior to the project implementation but after the initial budget had been set and agreed by Interreg.
Impacts/consequences	• Due to the health crisis and the geopolitical context, construction costs have increased significantly, affecting all partners. • The town of Quiberville (the client for the new campsite), could not fund alone the increased construction costs associated with the raw materials needed for the new tourist facility. The town requested help from the project partners to find additional funding to offset these costs. Without the help from the partners, the town of Quiberville would have either been unable to finance the new tourist

	Description of the issue
	equipment or the town would have incurred significant debt to cover the costs. • This increase in cost could have also jeopardized the project by causing delays in delivering the tourist equipment, impacting the overall programme.
Priority	High priority 4

The risk and issues tool is useful in that it helps identify likely risks and recognised issues. In Table 8.3, the risk became an issue which needed to be managed.

Table 8.3 Description of the solution to the funding issue encountered in the Saâne Valley

	Description of the solution
Remedial action	Due to the increased cost of the raw materials, the client (Quiberville) requested additional funds from the funder (INTERREG). They also liaised with other partners to see if they had additional funding that could be redistributed to them.
Further mitigation measures	The funder (INTERREG) agreed to provide additional funds to Quiberville (69% of the increased cost). Though a condition of their funding is that 31% match funding must be provided by the project partner. Quiberville is seeking extra funds from other sources, such as the department (le Conseil Départemental de la Seine-Maritime) and the region (Normandie) to meet this requirement. One of the project partners, EDPHCT, were also able to transfer some of their budget savings from changes to project outputs (visitor infrastructure etc) for this purpose.

8.4.3 Flooding During Construction Period (Lower Otter)

Table 8.4 describes an issue which arose on the Lower Otter when the construction site was flooded overnight. This led to some delays to the overall programme whilst the contractor waited for flood waters to recede.

Table 8.4 Description of an issue related to the flooding of the construction site on the Lower Otter

	Description of the issue
Issue #	P16A
Phase of the project	Implementation and construction
Issue identification	Flood during construction
Nature of the issue	Environmental
Issue description	In autumn 2021, a flood inundated the Otter Valley. This event, which had not been fully anticipated by the contractor, submerged some construction machinery.
Impacts/consequences	• A flood event increased the risk of pollution because construction machinery was in the flood plain. • Had the machinery not contained sealed units, there would have been the risk of fuel being released in the flood water causing a negative environmental impact.
Priority	High priority 4

In this case the solution to this issue (Table 8.5) is to anticipate extremes of weather when working in a floodplain, removing materials and equipment, ensuring machinery is designed not to be impacted by flood water and have sufficient contingency plans in place.

Table 8.5 Description of the solution related to the flooding of the construction site on the Lower Otter

	Description of the solution
Remedial action	• The construction machinery contained sealed units preventing water from infiltrating and mixing with hydrocarbons. • To prevent this risk from becoming an issue again, the flood contingency plan of the site was reviewed using this event to help understand what had happened and how this same risk would be addressed in the future.
Further mitigation measures	The flood contingency plan needs to be reviewed regularly depending on the construction phases. The plan needs to be rigorously implemented, especially during periods of stormy weather.

8.4.4 Impacts of an Historical Tip (Lower Otter)

Table 8.6 describes the risk associated with the disused tip on the Lower Otter and the potential that if left un-mitigated this could have led to negative environmental impacts.

Table 8.6 Description of a risk related to the ancient tip on the Lower Otter

	Description of the risk
Risk #	27
Phase of the project	Design and planning
Risk identification	Risk of pollution due to the presence of a landfill in the middle of the valley
Nature of the risk	Environmental
Risk description	Historic landfills are often located in coastal areas. If these sites are not protected against floods, contaminants can be released into the environment affecting water quality and species located on site.
Impacts/consequences	The presence of a landfill in the Otter valley increases the risk of pollution. If the landfill capping fails during a flood event or if the design is inadequate, contaminants can leak, and waste can be uncovered. It could impact the wildlife, the water quality and human health. This risk is already present from fluvial flooding but could be made worse through the increased frequency of tidal inundation.
Probability	2
Likelihood	4
Consequence	Significant

In this case (see Table 8.7) identifying this risk early and planning for it at all stages of the project enabled the risk of pollution to be minimised to a very low level.

Table 8.7 Description of the solution related to the ancient tip on the Lower Otter

	Description of the solution
Management strategy	Eliminate the risk/ reduce as far as practically possible
Mitigation measure	During the planning and design phase of the project, man-made threats such as the presence of a landfill site were considered and anticipated. The contents of the tip were investigated and the level of risk quantified more accurately. Engineering solutions have been designed to prevent any impacts. The impact of the tides on the site were modelled to demonstrate that this risk could be mitigated through the way in which the site was designed and constructed, reducing the risk of pollution as far as practically possible.
Probability	1
Likelihood	2
Consequence	Low

	Description of the solution
Monitoring of mitigation measure(s)	Post-project, the maintenance and the monitoring of the ground where the disused tip is located should ensure that the protective design solutions in place are sufficient and not damaged.

8.5 Further Reading

Disused tip case study – Lower Otter (Fouqué, B., 2022)

Methodology for evaluating and managing man made historical threats (Drouet, T., 2022)

Transferable methodology for identifying and cataloguing risks/issues (Drouet, T., Fouqué, B. and Simon, C., 2022)

Transferable strategy for addressing risks and problems (Drouet, T., Fouqué, B. and Simon, C., 2022)

See bibliography for further details.

Lessons Learnt & Recommendations - Part D

Design and construction of large-scale adaptation projects poses a high level of uncertainty due to the relative infancy of their implementation and the risks inherent in their flood plain and estuary locations. As such it is important to be vigilant to continually changing climatic and ground conditions to reassure stakeholders that decisions are being made based on the latest evidence. Many of the project recommendations revolve around this theme.

The lessons learnt in relation to design and construction are as follows.

Table 8.8 Key recommendations and lesson learnt

Key recommendations and lessons learnt
Design
• Early and continuous engagement allowed to relocate assets. It avoided or decreased the number of people being opposed to the project. If not conducted, planning permission could have been more difficult to obtain, delaying the project. • Show foresight and integrate provision for future civil engineering projects, as once habitat has established, works become restricted due to the tide. For example, on LORP this involved incorporating the FAB Link project. • Landfill sites are a common problem in estuarine environments. Check historical records and confirm risk through detailed ground investigation (GI). • Do not assume ground conditions are the same across large sites. Carry out a detailed GI with competent subcontractors to inform design and strategies for re-using site won materials. • Modelling multiple scenarios highlights areas of increased erosion, informing where assets need to be reinforced. • Design to restrict vehicular access across the floodplain and seek alternative diversions particularly if it is the only access point. • Extensive monitoring on the potential impacts of saline intrusion will be required. To avoid delays in design and costs during construction, incorporate this into the project phasing. • Partnership funding and equitable sharing of costs is critical for adaptation projects. Asset owners should be engaged as early as possible, preferably before timescales for a project have been set. Responsibility of asset owners need to be clearly defined and translate into financial support for the project. It is likely senior discussions between organisations will be needed for a resolution to be reached.
Construction
• Maintain and improve public access throughout as it familiarises the public with the scale of restoration projects. Visitor information and billboards are necessary to communicate the works with the public to minimise misconceptions. • Monitor soil behaviours and ground conditions, particularly when reusing cut and fill. Have contingency plans in place if the soil is not behaving as expected. • When reusing cut and fill, account for time to dry material in project phasing. • Monitor weather forecasts and clearly define responsibilities between contractor, designer and client should a flood event be anticipated. • Trial low carbon concrete or alternative materials to reduce carbon footprint and to integrate assets more naturally into the landscape.

Key recommendations and lessons learnt
• Use pre-cast units where possible as this provides more consistent results and has a lower carbon footprint. However, restricted vehicular access and increased health and safety risk of installing large pre-cast units may prevent this. • Inflation allowances in budgets are unlikely to account for fuel price volatility. Projects with a high fuel cost component should review registers and accommodate fluctuations as soon as possible. Alternative consideration should be given to electrical plant machinery with lower fuel requirements and carbon output. • Vegetation clearance over large areas can be costly and time consuming and may be carried out the year before well in advance of construction. However, this may not always be possible due to strict funding windows, the need for planning permissions and the cost of repeated maintenance to deter species from returning. • Consider and agree access points and routes across site prior to construction. • A materials management plan is key to project phasing, particularly when re-using site-won material.

Part E. Monitoring and Legacy

The next two chapters describe the project's approach to monitoring (before, during and after the project), legacy infrastructure and long-term tools.

Context & Background | Engagement & Comms | Funding and Natural Capital | Design and Construction | **Monitoring and Legacy** | Summary and Conclusion

- Monitoring
- Legacy Infrastructure
- Tools

Chapter 9. Monitoring

Authors: Camille Simon, Thomas Drouet**,** Lydia Burgess-Gamble **&** Delphine Jacono**.**

Affiliated authors (listed alphabetically): Sam Bridgewater.

This chapter provides an overview of the importance of monitoring and provides a high-level introduction to developing a monitoring plan. It then summarises the types of monitoring undertaken in both estuaries.

9.1 Introduction

Why is monitoring needed?

Monitoring is an important but often overlooked activity which is necessary to:

- Demonstrate success
- Learn from mistakes
- Know when adaptive management is needed
- Fill known research gaps
- Inform funders, partners and local stakeholders about project outcomes and to what extent project objectives have been met.

On innovative pilot projects such as the Lower Otter and Basse Saâne, monitoring is key because it enables us to share our learning in full and demonstrate how other similar estuaries might respond to the implementation of climate change adaptation measures.

Monitoring and evaluation need to be both planned and budgeted for at the start of a project. If monitoring is not considered until after a project has been constructed it may be too late to collect any useful data. Monitoring can also help to secure future funding and engage local communities.

How do I develop a monitoring plan?

One of the first steps when developing a monitoring programme is to articulate the overall aim of the project, i.e., to describe what it is that you are trying to achieve. Defining clear objectives will help ensure that monitoring is cost-effective and aligned to the project's targets. It will also help to identify what baseline data and resources are required for monitoring.

Several types of resources are used to establish an environmental monitoring program:

- Technical guides and reference methodologies:
    - In England the River Restoration Centre's Monitoring Guide sets out useful steps for developing a monitoring programme (see Figure 9.1).

- In France, the Office Français de la Biodiversité (the French Office for Biodiversity) has published several technical guides for monitoring rivers
- Regulatory standards, for example, the assessment of the ecological status of rivers and coastal waters in application of the European Water Framework Directive

Figure 9.1 Planning your monitoring (Source: Adapted from RRC, 2017)

Setting Monitoring Objectives

Monitoring should primarily focus on demonstrating that project objectives have been achieved. Project objectives should be developed using the SMART approach set out in Table 9.1.

Table 9.1 Definition of smart objectives (Source: Adapted from RRC, 2017)

SMART	Objectives should:
Specific	Target a **specific** area of improvement or answer a specific need.
Measurable	Be quantifiable, or at least allow for measurable progress.
Attainable	Be realistic and based on a review of evidence of success by others.
Realistic	Be based on available resources (money, people, time) and existing constraints.
Time-bound	Have a deadline or defined end.

Planning Monitoring Work

Once monitoring objectives are defined it then becomes possible to develop a monitoring plan. The RRC's monitoring planners (RRC, 2014) asks useful questions such as:

- Why are you doing the project and what are the project objectives?
- What is your monitoring objective / what are you trying to observe?

- How will you collect data and what assessment methods are you using?
- Do you have any access to pre-project baseline data?
- When are you collecting data (when, how often and how long)?
- Who is going to monitor data? Who is going to evaluate the data?
- How much will the monitoring AND its evaluation cost?
- How confident are you that the monitoring will show what you are trying to observe?
- How will your collected monitoring data be processed, analysed and reported?

The amount of time needed to monitor any particular measure will depend on how long it may take to become effective. For some measures this is nearly immediate (for example: reduction of organic and microbiological matter content in a watercourse after improvement of wastewater discharges), but for other habitats to mature it can be much longer (at least five to ten years for the restoration of aquatic habitats).

It is important to prioritise monitoring activities. It is likely that potential monitoring will exceed the available budget, so it is useful to divide the activities into those that are deemed essential and those that are desirable. This could result in alternative, lower cost methods (e.g., citizen science) being sought to deliver the lower priority activities, but it should also be recognised that control over quality and consistency may be harder to achieve.

Delivering Monitoring Activities

Once a monitoring plan is in place the next step is to implement the plan and start to collect the necessary data.

Analysing and Using the Results of Monitoring

As the monitoring programme starts to yield results these need to be analysed and interpreted to understand and communicate the findings from the study. Monitoring results may also identify adaptive management that might be needed within a project to potentially fix a problem. Sharing learning - both positive and negative - is also vitally important as this will enable project-level learning. These findings may be applicable at other sites.

9.2 Monitoring as part of PACCo

For coastal climate change adaptation projects, including managed realignment, environmental monitoring and evaluation is particularly important to understand the environmental and social benefits and disbenefits of the project. The visitor surveys carried out as part of the socio-economic work, which included data collection and monitoring of socio-economic issues, perceptions and attitudes, are covered in section 3.2.5.

The monitoring of such projects can be undertaken for many reasons (see Table 9.2). When the objectives and monitoring plan are developed it is important to bear these reasons in mind as they will help shape what you monitor, how you monitor it and when you monitor.

Table 9.2 Reasons for monitoring a project (Source: adapted from EDPHCT, 2023)

Reason for monitoring	Description/example
Statutory/legal	There may be a statutory or legal obligation to undertake monitoring so that during the construction phase protected species are not disturbed, for example. There may also be a requirement to demonstrate that the desired outcome has been achieved (e.g., the required compensatory habitat types) In France, large-scale projects are also subject to environmental assessment to verify that all environmental impacts have been identified and considered via an Avoid – Reduce – Compensate sequence.
Managing an environmental risk	Where a project has the potential to have a negative impact on the environment. An example of this might be the intrusion of saltwater within the influence zone of a freshwater abstraction borehole, or the risk of contaminants being released into the environment
Adaptative management	Collecting long-term data to see how a project is performing allowing elements of a project to be adapted as part of a long-term maintenance programme if needed.
Long-term learning to demonstrate value of project	Collecting a pre-construction baseline and long-term scientific dataset to demonstrate a change in condition. For example: carbon capture; change in habitat; change in opinion; new species. Monitoring reports can provide useful evidence for new projects in development.

The PACCo environmental monitoring report provides a detailed description of the monitoring undertaken across both estuaries, splitting monitoring into three specific phases of the project's lifecycle (see Table 9.3).

Table 9.3 Description of the phases of monitoring (Source: adapted from EDPHCT, 2023)

Phase	Description/example
Project development	Collation of environmental information to identify any constraints to project delivery and to inform project design. For example, survey work to understand the presence of protected species on site and how they might be impacted if the scheme is

Phase	Description/example
	progressed. Or studies to understand the significance of the level of risk of pollution posed by an old tip site.
Construction/delivery	The monitoring of the environment during construction works to ensure that the project is legally compliant with environmental legislation, the Environment Statement and any related specified planning conditions. This is also important to ensure that works methodology follows best environmental practice. This might include the surveying of breeding birds to ensure they are not impacted during works, or the day-to-day services of an Ecological Clerk of Works ensuring there are no oil spills resulting from the use of machinery.
Legacy	The monitoring of environmental change caused by the delivery of the scheme into the future to ensure that the desired outcomes are achieved, and potential risks do not become issues. Planning conditions and statutory obligations related to environmental monitoring may also extend into the project's legacy phase. By undertaking long term monitoring this allows the project to be adapted over time if necessary. This might include, for example, the establishment of any new landscape plantings or verifying the anticipated movement of sediment or shingle because of changes in the hydrological regime. Funding of post-project monitoring can be difficult. Typically, it is desirable to close projects down as soon as possible after the construction phase is complete. However, with habitat restoration projects it is not uncommon for there to be a need to monitor for 5 – 10 years post-construction. It may be necessary to include the budget for such funding within the construction phase.

The next two sections provide a summary of the sorts of monitoring being undertaken on both estuaries. In addition to what is described in the rest of this chapter, socio-economic monitoring was also undertaken. The surveys, community workshops and their results are discussed in chapter 3. Additionally, the natural capital assessments which are summarised in chapter 6 are also a useful form of data collection which long-term monitored results could be compared against. The monitoring associated with historic landfill site is summarised in the tip case study.

9.3 Lower Otter

9.3.1 Introduction

It is important to establish appropriate governance systems to track monitoring progress. In the case of the Lower Otter this involved the creation of monitoring steering and working groups. These groups were set up to develop monitoring objectives, priorities, reporting format and reporting timescales.

9.3.2 Phase 1. Project Development

During the initial phases of a coastal climate adaptation scheme there will likely be the need to undertake initial bespoke environmental surveying monitoring to provide baseline data to help build the initial Business Case for the project. The needs of each project will be unique but a long baseline period (the length depends on the catchment setting) is always preferable to gain a basic understanding of the background hydrological processes, habitats and species that could be affected by the project. The boundary for this assessment will vary depending on what is present. For example, it may be necessary to consider the impact on mobile species at a considerable distance from the project area.

In some cases, baseline data may already exist, so it is worth spending some time to see what data exists already before developing a monitoring plan. It is essential to consider what monitoring equipment may already be present in the catchment, and the duration and quality of the datasets. Other organisations and landowners within the catchment may also hold or collect monitoring data which could be useful. For example, on the Lower Otter useful existing data was available including:

- A report on flooding history
- Annual bird surveys including Wetland Bird Survey (WeBS) data and a vantage point survey to understand the functional connectivity of the Otter estuary to adjacent estuaries (commissioned by the Estate as part of their preparatory pre-project work)
- Baseline studies to understand the conservation value of the existing habitats within the valley through a National Vegetation Classification (commissioned by the Estate as part of their preparatory pre-project work)
- Data from people counters on the main footpaths and
- Historic maps.

Once the initial Business Case for a project is accepted the monitoring work will likely become more detailed and formalised and with a significantly wider scope. In the case of LORP this included survey work to understand what protected species were present at the site and the digging of test pits within an old tip site to ascertain the kind of pollutants were contained within it.

The primary mechanism for undertaking these assessments during the development phase of a project is through the Environmental Impact Assessment (EIA) which is a legal

requirement for large landscape scale schemes in England. Depending on the scale of the project this may or may not be a statutory requirement. The role of an EIA is to assess all the likely significant environmental effects of the proposed project together with ways to avoid or reduce any negative environmental effects. Table 9.4 summarises the different assessments undertaken as part of the EIA[18]. The Environmental Assessment undertaken as part of the Lower Otter project is reported in a very large document and it is important to recognise the cost and time required to produce such a report. There are likely to be timing constraints on some aspects of the work (e.g.bat surveys) that, if not done at the appropriate period, could result in lengthy delays.

Photo 9.1 Monitoring fish in the Lower Otter Valley (Source: EDPHCT)

[18] The planning application and associated EIA for LORP can be accessed here: https://planning.eastdevon.gov.uk/online-applications/applicationDetails.do?activeTab=summary&keyVal=QHES3QGH09100 [Accessed: 11/11/22]

Table 9.2 Broad themes covered as part of the Lower Otter Environmental Assessment (Source: Adapted from EDPHCT, 2023)

EIA theme	Purpose of assessment
Population and Human Health	Potential impacts of the scheme on population and human health including local community, access and recreation, and biting insects.
Biodiversity	Potential impacts of the scheme on biodiversity, marine ecology and fish.
Geology, soils and contamination	Direct potential impacts of the scheme on geology, soils and contamination.
Water Environment	The impact of the scheme on the water environment including hydraulically linked surface water and groundwater features.
Landscape & Visual	The landscape and visual impacts from the Scheme.
Historic Environment	Impacts from the scheme on the historic environment including archaeology, built heritage and the historic landscape.
Traffic and Transport	The potential construction impacts of the scheme on traffic and transport.

9.3.3 Phase 2. Construction / Delivery

The environmental monitoring and evaluation undertaken during the construction and delivery phase of the project is largely guided by the recommendations of the Environment Impact Assessment with the work undertaken by suitably qualified specialists. The importance of this work throughout the delivery phase should not be under-estimated. For example, if the necessary surveys and monitoring are not undertaken this can result in a project being delayed due to works having to halt because of the presence of an overlooked protected species or can even result in the project not being compliant with the law. In the case of LORP, at key project periods during early vegetation clearance a team of more than eight ecologists were employed for a period of months to oversee work method statements to ensure that the scheme was fully compliant with all protected species licences (see Photo 9.2). In addition, an Environmental Clerk of Works (ECoW) undertook site visits weekly reporting back to the project team with this including checking on measures to ensure no pollution resulted from works.

Photo 9.1 Ecologists undertaking a fingertip search before vegetation clearance (Source: EDPHCT)

The key areas of monitoring undertaken during the construction phase are summarised in Table 9.5. Most coastal climate change adaptation schemes are likely to have broadly similar needs to the Lower Otter. Therefore, this table provides a useful framework to guide what might be required.

Table 9.3 Monitoring required during the construction phase (Source: Adapted from EDPHCT, 2023)

EIA theme	Why monitor?
Biodiversity - protected species	To prevent disturbance, be legally compliant and abide by planning conditions.
Biodiversity - other species	To ensure the impact on all species is properly considered.
Geology, soils and contamination	To prevent pollution and contamination.
Water Environment	To prevent pollution and contamination
Archaeology	To prevent disturbance, be legally compliant and abide by planning conditions
Traffic	To safeguard health and safety and minimise scheme delivery impact on local communities

9.3.4 Phase 3. Legacy

Once the managed realignment project has been completed there will be a requirement to monitor environmental change caused by the delivery of the scheme to ascertain whether

the desired outcomes are being achieved and to ensure that any identified potential risks do not become issues. Monitoring may also be required to ensure that any planning conditions are met that extend into the project's legacy phase. This may include, for example, the monitoring of the establishment of any new landscape plantings specified as a planning condition and the development of new intertidal habitats. Photo 9.3 shows carbon baseline data being collected.

Many environmental benefits are associated with managed realignment schemes that create saltmarsh and mudflat. These include the sequestration of carbon and the creation of high-quality nursery grounds for fish species. Environmental monitoring and evaluation into the legacy phase ensure that these benefits are achieved. Along with socio-economic monitoring it and can help support the development of other schemes by helping to prove a project's value to society.

Two key conditions related to environmental monitoring and evaluation during the legacy phase of LORP were associated with the planning consent granted. These were the submission of a Landscape and Ecological Management Plan (LEMP) and the submission of a Habitat Monitoring Plan. The key areas of monitoring being undertaken in the legacy phase are summarised in Table 9.6.

Photo 9.3 Taking soil samples on the Lower Otter to understand how much carbon is stored in the soil pre-construction (Source: EDPHCT)

Table 9.6 Legacy phase monitoring (Source: adapted from EDPHCT 2023)

Category	Summary
Carbon	Sequestration – The capture of carbon
Fauna – Birds	Bird use
Fauna – Fish	Use of site by juvenile species
Fauna – Fish	Change in fish passage outside of the site
Fauna – Invertebrates	Invertebrate sampling of site
Flora and Fauna	Translocation of nationally scarce species
Flora and Fauna	(Mainly) Mitigation work monitoring. Rare and protected species (e.g. dormice)
Geomorphology	Geomorphological change within the existing lower estuary
Geomorphology	Geomorphological change within the project site (agricultural land) to become tidal
Habitat	Habitat change within the existing lower estuary SSSI
Habitat	Habitat development within the project site
Habitat	Mitigation planting for habitats lost due to project delivery
People	Visitor use and management
Water - Groundwater	Ground water
Water – Quality	Water quality of surface water (site and estuary)
Water – Quantity	Water levels and quality of ground water + estuary salinity.

9.4 Saâne Valley

9.4.1 Introduction

Monitoring carried out outside the scope of the Project

Certain monitoring procedures have been implemented, but not as part of the Saâne project. These have contributed to building the “knowledge baseline” of the ecological state the lower Saâne valley and agreeing priorities for restoration.

Monitoring of the river water quality was organized within the framework of monitoring imposed by the European Water Framework Directive (WFD) and regulatory monitoring of bathing water quality for health authorizations on the beaches of Quiberville and Sainte-Marguerite.

See support document No. 4 of SDAGE Seine Basin and Norman coastal watercourses on the Water State Monitoring Programme[19] and the annual reports of the Regional Health Agency on Baignades.[20]

These elements of monitoring are long-term and occur independently of the territorial project.

Monitoring Carried out as part of the Project

Studies undertaken as part of the project have also contributed enhancing the database on the ecological state of the Saâne valley. They are the result of regulatory obligations or have been commissioned to inform project design.

This includes: studies implemented as part of the LiCCo project; the monitoring of water quality undertaken by Communauté de communes Terroir de Caux; the environmental assessment; inventories of natural environments; hydrological and piezometric monitoring managed by Syndicat Mixte des bassins versants Saâne Vienne Scie; the monitoring of landfalls and transfer of sediments and pyrotechnic and archaeological studies.

[19] https://www.eau-seine-normandie.fr/sites/public_file/ inline-files/4_resume_prg_de_survence_de_l_etat_eaux_et_etat_actu7f5588.pdf

[20] https://www.normandie.ars.fr/qualite-des-saux-den-en- Normandy-94-des-sites-de-Baignades-sont-de-Bonne-Ou-dexcellente

Environmental Assessment[21]

An environmental assessment is underway for the entire project. It is supported by the Syndicat Mixte des Bassins Versants Saâne Vienne Scie.

In France, large-scale projects are subject to environmental assessment, to verify that all environmental impacts have been identified and considered via an Avoid – Reduce – Compensate sequence.

For the Saâne territorial project, this environmental assessment includes the results of the case-by-case studies carried out for the operations of the wastewater treatment plant, the wastewater networks and the campsite of Quiberville. It provides an overview of the project and its environmental impacts, rather than evaluating each of the project operations independently.

Designing and implementing “lower environmental impact” projects implies respecting the sequence “avoid, reduce, offset” (known as ERC in France) and the related regulations. Indeed, this sequence constitutes the foundation of the environmental process for assessing projects (e.g. impact studies; clearing; water law; Natura 2000; protected species, etc.).

All of these environmental assessments require:

- Assessing the initial environmental state of a site that is the subject of an construction project
- The assessment of the direct and indirect impacts of the project on the environment,
- Search for avoidance, reduction and compensation measures by the project owner.

The paragraph III of article L. 122-1 of the environmental code specifies that the environmental assessment is a process consisting of:

- Carrying out of an impact study by the contracting authority: its purpose is to enable it to develop a project while simultaneously evaluating its effects on the environment in order to avoid them, reduce those which could not be sufficiently avoided and, if possible, to compensate for the significant effects which could

[21] Extract from the specifications of the consultation for the recruitment of the design office in charge of preparing the environmental assessment file

not be avoided or sufficiently reduced. To this end, carrying out the environmental assessment must start from the design of the project and intends to improve the quality of the project and its integration into the environment.

- Consultations of the environmental authority, local authorities and their groups as well as the public. This provides feedback to the contracting authority, the public and the competent authority to inform decision making.
- The avoidance, reduction and compensation measures proposed by the contracting authority in the impact study. Undertaking the impact study (article R. 122-5 of the environment code), is the responsibility of the project owner, who must propose the appropriate measures to avoid, reduce or even offset the impact of its project on the environment. The impact study must be drawn up by competent experts (VII of article R. 122-5);
- A decision to authorize the project meeting the conditions defined in article L.122-1-1 of the environment code. The competent authority to issue this decision prescribes, on the basis of the project owner's proposals and the opinions collected, "the avoidance, reduction and/or compensation measures that the project owner must respect" and specifies the procedures for monitoring the impact of the project on the environment and human health. The point II of this same article regulates the case of projects not subject to an authorization that meets these conditions.

The objective of the impact study is to follow an environmental assessment process, which integrates the environment from the start and throughout the project development and decision-making process, to inform the public and to allow the competent authority to authorize the project. The project must be evaluated “as a whole, including in the event of phases being separated in time and space and in the event of a multiplicity of contracting authorities, so that its impact on the environment can be assessed in its entirety”. Furthermore, the impacts are assessed when the first authorization is issued.

The impact study must therefore assess the environment as a whole and be proportionate to the environmental challenges of the project and the area. It must also justify the project, its choices, its location and report on the foreseeable effects of the project including during the construction phase. It must also offer measures to avoid, reduce or compensate for potential impacts, and indicate how these measures and their effects will be monitored after completion of the project.

The continuous, progressive and iterative environmental assessment process is carried out under the responsibility of the project owner (client). It requires, from the start of the project development, exchanges between the project designers and the design office(s) in charge of the impact study. The iterative approach makes it possible to study different development approaches and to compare their impacts on the environment in order to define a project with the least environmental impact. This approach should not be reduced to the production of a study which would justify the choices already made without having contributed to the development of the project.

In accordance with article R.122-5 of the environment code, the study must include the following items:

1. A non-technical summary, which may be required to be undertaken independently
2. The description of the project: location; infrastructures; main characteristics of the operational phase (including demolition work if applicable); estimate of the types and quantities of waste and emissions
3. The description of the relevant aspects of the current state (called "reference scenario") and their evolution in the event of implementation of the project, as well as an overview of the potential evolution of the environment in the absence of project implementation
4. Description of the factors likely to be significantly affected by the project: population; human health; biodiversity, land, soil, water, air, climate, material assets; cultural heritage and landscape
5. A description of the significant impacts that the project is likely to have on the environment resulting from several elements: the construction; existence and demolition of the project; the use of natural resources; the emission of pollutants, noise, vibration, light emissions, heat, radiation; creation of nuisances; disposal and recovery of waste; risks to human health; cultural heritage or the environment; the accumulation of impacts with other existing or approved projects; the impacts of the project on the climate and the vulnerability of the project to climate change; the technologies and substances used
6. Description of the significant negative impacts of the project
7. Description of the alternatives and an indication of the main reasons for the choice made
8. Measures to avoid, reduce or compensate for the effects (ERC), accompanied by the estimate of the corresponding expenses
9. Methods for monitoring ERC measures and monitoring their effects
10. Description of prediction methods or evidence used to identify and assess significant environmental effects

9.4.2 Phase 1: Project Development

River Water Quality

A water quality measurement station has been installed in Longueil since 2010. The measurements are to be taken monthly and assess in particular the physicochemical and microbiological quality of the river (Diatom Biological Index or DBI; Global Normalized Biological Index or IBGN; Macrophytic Biological Index in River or IBMR).

The data is made available in Naïades.[22] Each station has its own unique SANDRE code which makes it possible to find all the available results. In Longueil, the SANDRE station code is: 03216000. This monitoring is commissioned by the Seine-Normandy water agency.

Bathing Waters

This monitoring is carried out by ARS Normandie (ARS: Agence Régional de Santé - Regional Health Agency). It makes it possible to check the quality of bathing water, in particular for contamination of *Escherichia coli.* The results made it possible to highlight the current defects of ageing sewage systems in the valley. For example, in 2016, bathing waters were assessed as “non-compliant” with “poor” water quality, leading to the beach being close for days.

LiCCo – Coastlines and Coastal Changes

During the LiCCo project (Living with a Changing Coast), significant monitoring was undertaken and used for the development of the Saâne territorial project. This was prior to monitoring carried out in recent years. Changes have already been noted between the LiCCo project (2011-2014) and the PACCo project (2020-2023). The monitoring that was carried out between 2011 and 2014 are as follows:

- Ecological features for avifauna,
- Functional approach of fish and carcinofauna species,
- Composition of fish stocks,
- Sources of disturbance of fish populations,
- Fish data,
- Flora and plant communities of the lower Saâne valley,
- Topography of the Saâne

Water Quality Monitoring Upstream and Downstream of the Wastewater Treatment Plant Discharge

This study was commissioned by Communauté de communes Terroir de Caux in 2021 and aimed to assess the state of the bacteriological quality of the waters of the Saâne. It accompanied and complemented an allied survey undertaken in 2020 on the physico-chemical and hydrobiological quality in the Ouville-la-Rivière and Longueil sectors. In order to define the baseline, four one-off studies will be carried out during:

[22] http://www.naiades.eaufrance.fr/

- High water periods in dry weather
- High water in rainy weather
- Low water periods in dry weather
- Low water periods in rainy weather.

Hydrological and Piezometric Monitoring

As part of the Reconnection Project, the legacy requires the implementation of monitoring with the use of qualitative and quantitative indicators. To this end, long-term monitoring of surface water and groundwater has been undertaken to measure qualitative and quantitative changes.

In 2021, work to define a monitoring network was developed in partnership with agence de l'eau Seine-Normandy and local stakeholders involved in this project. Following this, a system for monitoring water levels and salinity in surface and groundwater was set up over the entire depth of the lower valley. The installation took place during the September 2022 with data collection occurring subsequently.

Initial State

This was one of the most important studies included in the environmental assessment. It consisted of listing the natural environments on an annual cycle. This was completed in June 2022 and aimed to establish the most exhaustive possible inventory over the project area, which covers 260 hectares.

Wetland

The objective of this part of the study is to characterize and map the wetland within the project boundary most likely to be impacted by the project.

Flora and Fauna

Ecological surveys will define the ecological functionality of the site; detailed inventories have been undertaken on the different species present on the site (for example, odonates (dragonflies), batrachians (amphibians), molluscs, birds, fish, etc.)

Water Quality

To better understand the quality of the watercourse, this study includes the Diatom Biological Index or IBD, the Macrophytic Biological Index in Rivers (or IBMR), the River Fish Index (or IPR), flow measurements and water sampling and analyses. It informs other environmental assessments. Other monitoring will also be implemented, such as an acoustic study to assess the impact of the work on the tranquillity of the lower valley, or a vehicle count to assess the impact of the work in comparison to 'normal use' of the valley.

Photographic Monitoring

In order to better illustrate the changes of the lower valley, photographic monitoring has been established comprising:

- Cameras fixed on supports and taking regular fixed-point photos, making it possible to capture the evolution of the construction sites presented as a timelapse.
- Regular aerial views (from drones) to capture the evolution of the construction sites but also of the lower valley as a whole. Viewpoints have been defined to try to best capture the evolutions of the lower valley.

IQE-L: Indicator of Ecological Quality on the Coast

The IQE-L is the result of a partnership between the Museum National d'Histoire Naturelle (National Museum of Natural History (MNHN)) and the Conservatoire du littoral, as part of the Adapto project.

The indicator makes it possible to study the ecological quality of reinstated environmental sites at a given time. It can take into account future developments and changes in sea level.

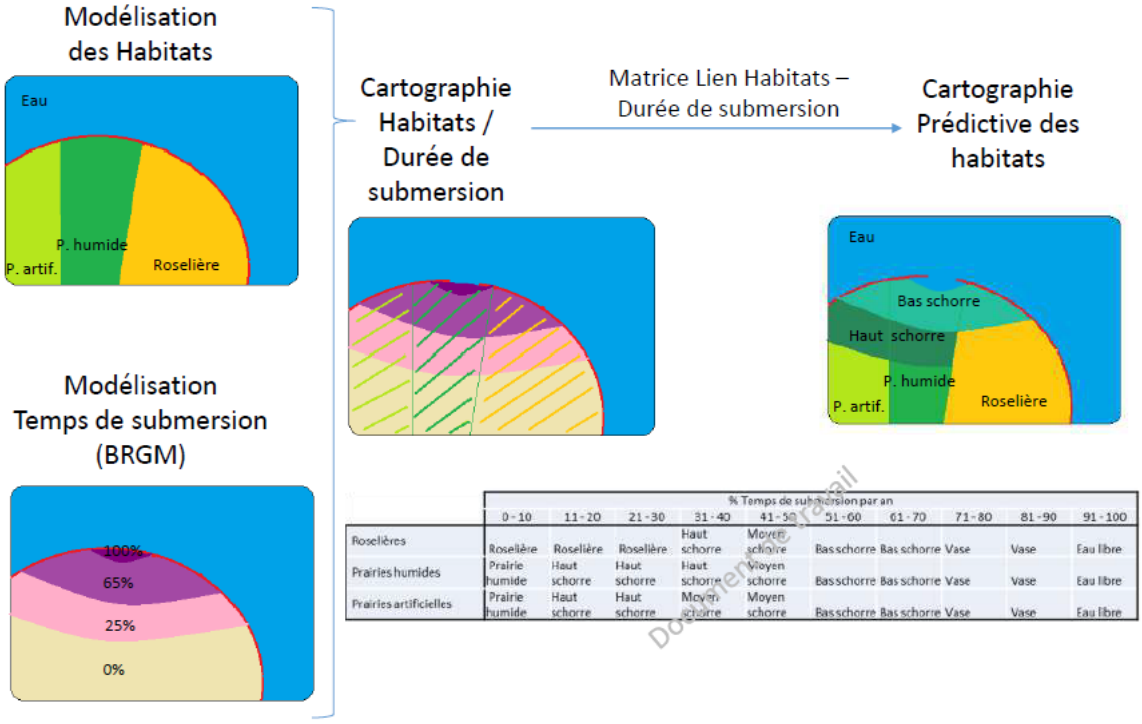
To assess ecological quality, a simplified habitat map coupled with a matrix of biological capacity was used. When considered with radar data this data makes it possible to evaluate the various characteristics of the site (defined with the Conservatoire du littoral): functionality; structure; diversity; heritage.

In the absence of habitat mapping, it is possible to carry out modelling based on the interpretation of aerial images (orthophotos and topography from the Institut Géographique National - National Geographic Institute) and supplemented by a field visit.

The biological capacity matrix makes it possible to evaluate the ecological importance of each habitat in relation to a given criterion. It associates a score per criterion for each habitat. These ratings are defined on the basis of expert opinions and bibliographic research. It is currently being drafted and should be finalized during summer 2023.

To assess the site following developments and changes in sea level, submersion mapping is used, produced by the Bureau de Recherches Géologiques et Minières (Bureau of Geological and Mining Research (BRGM)) and which provides submersion times on a given site. This submersion mapping, associated with a submersion matrix, makes it possible to obtain predictive mapping of habitats. Indeed, depending on the time of submersion and the type of habitat present, the submersion matrix indicates the probable evolution of the habitat itself.

Figure 9.2 Submersion mapping (Source : BRGM)



The example overleaf (Figure 9.3) shows the impact of the restoration of intertidal habitats on the functionality, heritage, diversity and structure of a site (test carried out by the MNHN during the construction of the IQE-L, to present the tool).

Figure 9.3 Radar diagram showing ecological quality potential on a site (Source : BRGM)

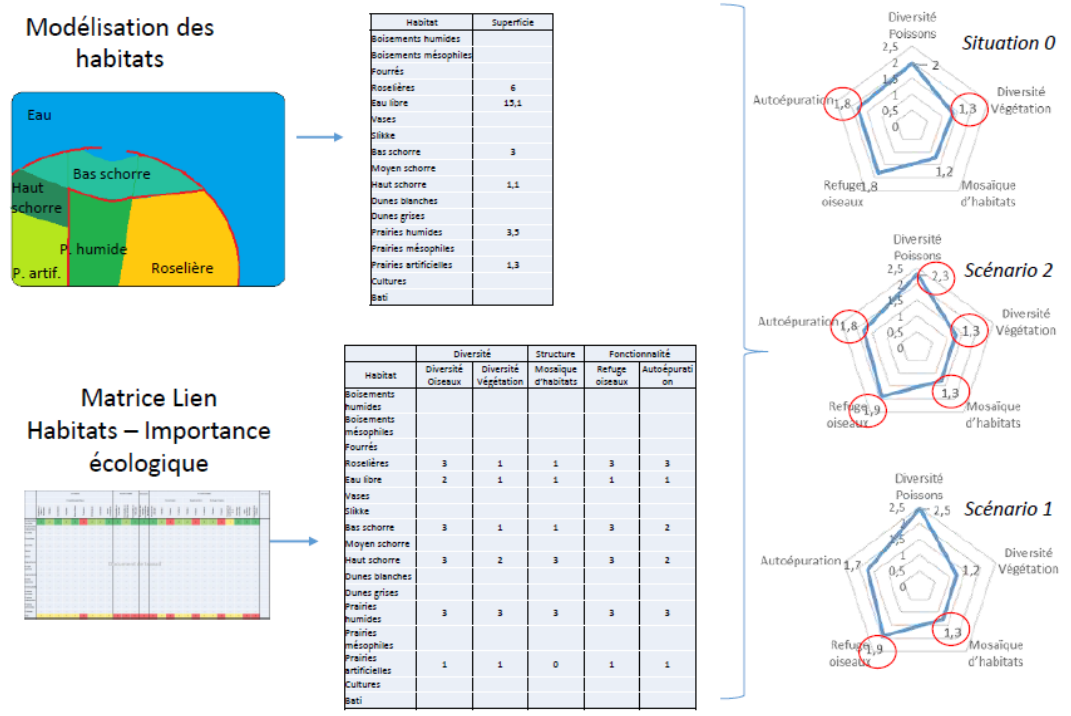
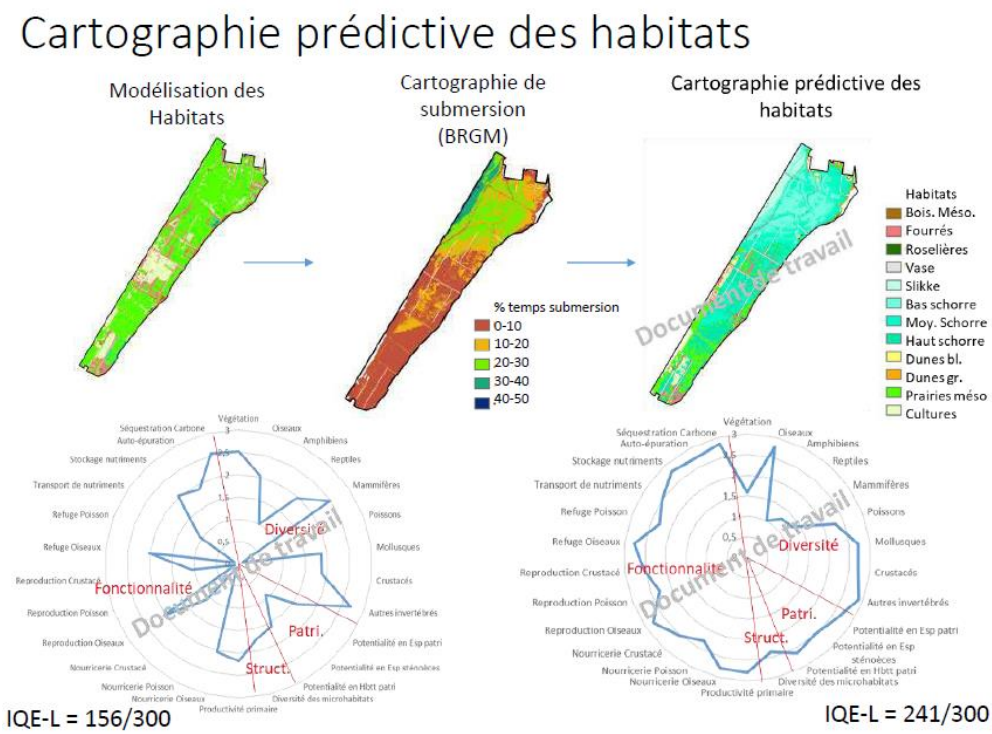


Figure 9.4 Diagram showing the impacts of restoration on intertidal habitats (Source : BRGM)



9.4.3 Phase 2. Construction / Delivery Phase

During construction monitoring of the quality of river water and bathing water, the water quality upstream and downstream of the discharge point of the wastewater treatment plant and the hydrological and piezometric monitoring is continued. In addition, attention is paid to any pyrotechnic or archaeological findings discovered during the work.

9.4.4 Phase 3. Post Works (legacy)

Photographic Monitoring

Photographic monitoring will continue after construction, with photos taken more often to capture rapid changes to the environment.

Timelapses can effectively highlight the impact of the machines used on the environment and underline, for example, the need to think about a traffic plan to avoid having an excessive impact on fragile environments.

UXO Survey

These surveys are only carried out in sensitive areas, where it would be possible to discover UXO (unexploded ordnance). Many UXOs from the Second World War are still potentially located on the Normandy coast. Therefore, it aims to protect the people who

will subsequently carry out the archaeological study as well as the work to reconnect to the sea.

Archaeological Survey

These surveys are defined according to maps of known or anticipated archaeology from the Direction Régionale des Affaires (Regional Department of Cultural Affairs (DRAC)). They are created using old maps and all the historical evidence available to the DRAC to locate likely archaeological remains. These maps are approximate. During development, they are used by the services of the Institut national de recherches archéologiques préventives (National Institute for Preventive Archaeological Research (INRAP)), in charge of the survey. The analysis of the results of these can assess that further research is required, including archaeological excavations.

The objective of these surveys and excavations is to preserve important archaeological remains (and the contribution of knowledge they constitute), which could be buried in area where development projects are planned.

As part of the Saâne project, a DRAC map suggested that vestiges could be discovered, whether on the site of the new tourist facilities in Quiberville or in the lower valley, on the site of the reconnection works at the sea.

A first survey was carried out in 2021, on the site of the new tourist facility in Quiberville. The discoveries of the INRAP services were not sufficiently conclusive to give rise to excavations.

A second survey (2022-2023) targets the lower valley, where work will be carried out to reconnect to the sea and restore wetlands. Discussions between the Conservatoire du littoral, the Syndicat Mixte des Bassins Versants Saâne Vienne Scie (SMBVSVS) and the services of the DRAC and INRAP made it possible to target the areas where the work will be carried out. Indeed, the fauna flora habitats study, carried out by the SMBVSVS in 2021, showed that these lands support interesting habitats and protected species. Given that the reconnection works do not cover the entire downstream area of the lower valley, it seemed relevant that the archaeological surveys cover the same area. Part of the structure at the mouth of the river was on the beach (in a public area) and the Département des recherches archéologiques subaquatiques et sous-marines (Department of Underwater and Underwater Archaeological Research (DRASSM)) was called upon to manage the implementation of archaeological surveys on the top of the beach, also made by INRAP.

Study Fauna Flora Habitats

Regarding biodiversity (fauna, flora and habitats), inventories similar to those informing the initial baseline studies undertaken in 2021-2022 will be renewed after the reconnection of the valley to the sea. These will have a strong focus on protected species and estuarine features.

LIDAR Hydro Sedimentary Monitoring with Photo Infrared

LIDAR monitoring is carried out across the entire coast of Normandy and Hauts de France by the Réseau d'Observation du Littoral (Littoral Observation Network (ROL)) every three years. The use of these data will make it possible to observe the topographic evolution of the lower valley.

A scientific partnership is being formalized with the University of Rouen M2C (Continental and Coastal Morphodynamic Laboratory) for the organization of monitoring:

- The collection and interpretation f piezometry, hydrometry and salinization data of surface and groundwater: data collection of the initial state began in the summer of 2022 with post-opening evolution envisaged for a period of five to ten years. The use of artificial intelligence will make it possible to build models and simulations of hydrological variability.
- The construction of a hydro-sedimentary trajectory assessment program in the reconnected lower valley. Initial monitoring is planned for the 2nd half of 2023. Post-works monitoring will make it possible to understand the mobility of sediments on a regular basis (infra-annual frequency to be defined) and after particularly intense events (floods and storms).

The techniques used will include topographic monitoring and thermal imaging by drone.

The objective is to be able to map the evolution of areas under the influence of saltwater intrusion (by the measurement of the electrical conductivity of the subsoil from the surface and from intertidal habitats). Monitoring may also be required to understand water exchanges between the river, the aquifers and the unsaturated zone.

Monitoring of the Soléa Wastewater Treatment Plant

Permanent Diagnosis

The decree of July 30, 2020, modifying the decree of July 21, 2015, imposes for existing sewage systems intended to collect and treat a gross load of organic pollution of less than 600 kg/d of BOD5 and greater than or equal to 120 kg/d of BOD5, a requirement to establish a permanent diagnosis no later than December 31, 2024.

In anticipation of this, permanent monitoring will be implemented to ensure the asset management of the sewage system will consider the following impacts:

- Environmental, related to the failure of the waterproofing or the structure which can lead to leaks and infiltrations.
    - Enhanced monitoring every five years will be implemented
- Operational, related to the complete or partial obstruction of the system or even related to an electrical failure on the discharge stations which can lead to additional

operating costs
    - All workstations will be remotely managed with anomaly alarms
- Structural, related to the collapse or weakening of the structure of the collectors.

Monitoring will be specified as the network project progresses. It will be strategically located to inform on and control the performance of the networks in the different towns independently. Piezometer will be installed on the structures likely to be subject to rising water tables, mainly at the discharge stations. Groundwater level information will be transmitted via remote monitoring.

Discharge Monitoring

Infrastructure will be installed to allow samples to be taken from:

- The effluent entering the treatment plant
- The clarified effluent before discharge into the natural environment.

Two types of analyses will be carried out on the effluents from the treatment plant:

- Self-monitoring analysis carried out by the operator of the treatment plant site
- Analysis carried out by an inspection body approved by agence de l'eau Seine-Normandy.

The results will be communicated to the Water Police and the water agency.

Self-monitoring

Self-monitoring will comply with obligations of the decree of July 21, 2015. It imposes a minimum frequency of measurement for several parameters making it possible (in particular) to assess the polluting loads discharged. The regulations impose the following minimum treatment performance for the BOD5, COD and MES parameters.

Table 9.7 Minimum performance of treatment

Parametres	Maximum concentration to be respected Daily average	Minimum yield to be achieved Daily average	Redhibiting concentrationDaily average
DB05	25 mg (02)/l	80%	50 mg (02)/l
DCO	125 mg (02)/l	75%	250 mg (02)/l
MES	35 mg/l	90%	85 mg/l

The equipment allowing self-monitoring of the station is as follows:

- **Upstream self-monitoring -** In the context of self-monitoring, an electromagnetic flowmeter measurement system with a sampling point pre-equipped to receive a refrigerated mobile sampler controlled by the flow rate is planned to count all the effluents collected towards the treatment facilities.
- **Downstream self-monitoring -** In the context of self-monitoring, there is provision for flow measurement by venturi channel associated with an ultrasonic probe. The outlet metering channel will be equipped with a pre-equipped sampling point to receive a refrigerated mobile sampler controlled by the flow rate, to count all the treated water discharged into the natural environment.
- **Sludge -** A flow meter will make it possible to count the sludge generated on the station as well as that outside. A sampling system will be possible to assess the sludge before treatment.

9.5 Further Reading

Carbon assessment – Lower Otter (Mossman, H., Dunk, R., Sparkes, R. and Preston, P., 2022)

Fish surveys - Lower Otter (Colclough, S., 2021)

Summary of visitor surveys – Lower Otter and Saâne Valleys (Petersen, C., 2023)

Visitor Survey – Full Report Lower Otter (ABPmer, 2023a)

Visitor Survey – Full Report Saâne Valley (SMLN, 2022)

Summary of environmental monitoring & evaluation tools (Bridgewater, S. & Simon, C. 2022)

See bibliography for further details.

Chapter 10. Legacy Infrastructure and Tools

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Affiliated authors (listed alphabetically): Camille Simon, Carolyn Petersen, Delphine Jacono, Régis Leymarie, Sam Bridgewater & Thomas Drouet.

This chapter describes the legacy infrastructure used on both sites to help explain the project to visitors and the public. It also describes different educational tools used to help explain the project to students and potential approaches that could be used in the future to enable civil society to collate monitoring data.

10.1 Introduction

A key component of the PACCo project involved developing 'hubs' on both sites to explain to visitors the reasons why the project was undertaken, to explain what climate change is and the need for adaptation. This included the development of educational tools.

The hubs and the tools are designed to help engage local communities, visitors, conservation organisations, recreational groups and educational organisations. The hubs will show people how the sites have changed over time and the benefits of the project to local communities, biodiversity, ecosystem services, local economies, businesses and wellbeing.

This chapter is closely linked to 'Part B Engagement and Communication' because developing legacy infrastructure and educational tools is linked to how we communicate about a project and our approach to engagements.

10.2 Legacy Infrastructure (The Hubs)

When landscape scale projects are implemented, it is important that legacy infrastructure is put in place so that when the final construction works are complete, and the project is delivered that the local community and visitors to the site have information in place to help explain and understand what has been delivered. This legacy infrastructure can help to not only explain the project but can also provide interesting local information such as the site's historical context and / or raise awareness of the wildlife present or important issues such as describing what climate change is and its impacts.

For the PACCo project this legacy infrastructure is referred to as an interpretation and educational hub. The purpose of these hubs is to describe the:

- Benefits of adaptive change in heavily modified estuaries
- Changes to ecosystem services (pre- and post-project)

- Socio-economic benefits of adapting to climate change
- Future impacts of climate change
- Benefits of early adaptation
- Applicability of the project to other estuaries in England and France.

These hubs are designed to be accessible by the public but can also be used for environmental education, or by project partners during site visits for different user groups (e.g., elected officials, technicians, funders, etc.).

The hubs took a different format in the two estuaries as described below. This shows that it is important to develop legacy infrastructure to suit your site and end users.

10.2.1 The Lower Otter

On the Lower Otter the hubs have taken a different format. Throughout the project's construction period temporary signage across the site explained what was being undertaken and why, with different measures put in place to enable community members to interact with the project to ask questions or raise concerns (see Part B).

The hubs by contrast have been designed to be erected towards the end of the project across five key locations (see Map 10.1), timed to be installed when engineering work on these locations is completed. They include signage and some physical infrastructure such as seating areas and viewing platforms across different parts of the site.

Figure 10.1 and 10.2 depicts an artist's interpretation of what one of the larger hubs could look like. Figure 10.3 and 10.4 shows three of the main signs which will be put in place to describe the PACCo project, climate change the benefits of the project to people and the site's history.

Map 10.1 The five locations on the Lower Otter where hubs which include viewing platforms and signage are being installed (Source: EDPHCT)

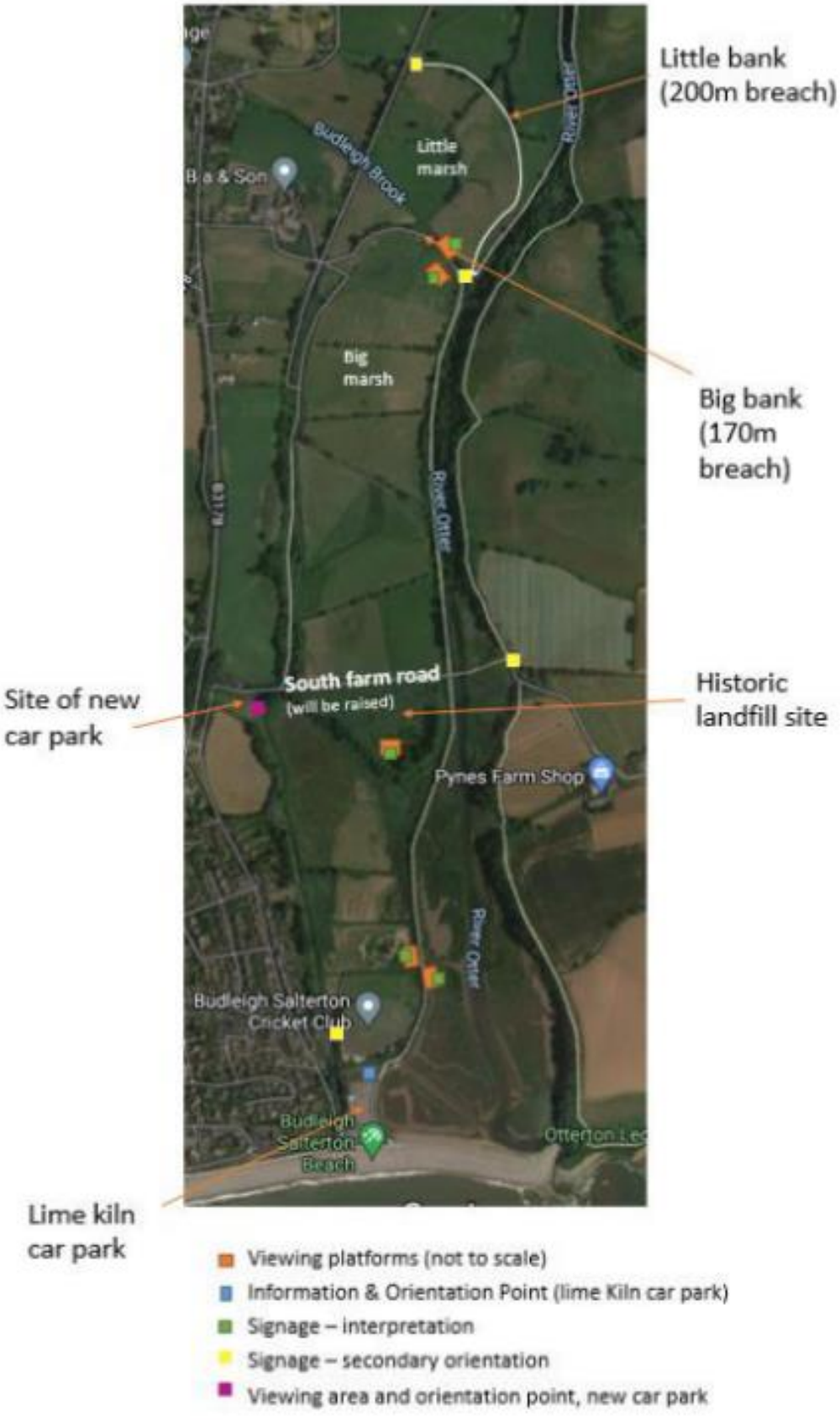


Figure 10.1 Artist's design for one of the hubs on the Lower Otter (Source: Greenspace Designs Limited)

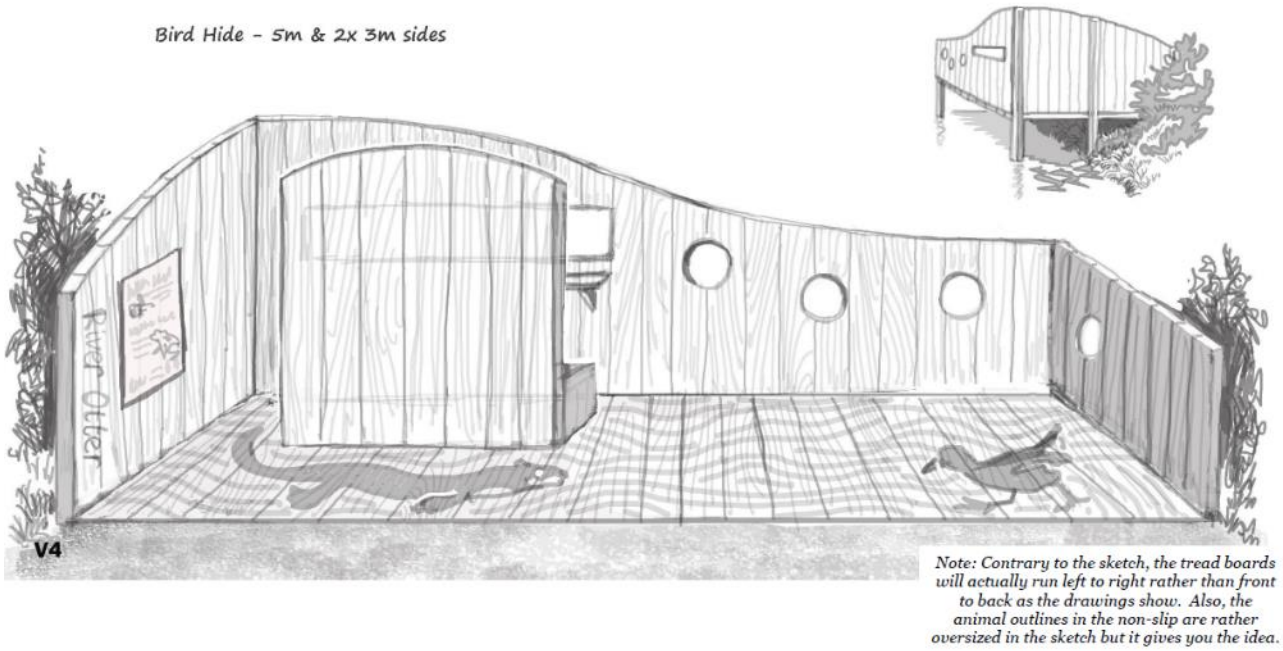


Figure 10.2 Little Marsh visitor viewpoint prior to interpretation signage being added Jan 2023 (Source: EDPHCT).

Figure 10.3 Examples of three of the interpretation boards which will be installed on the Lower Otter (Source: EDPHCT)

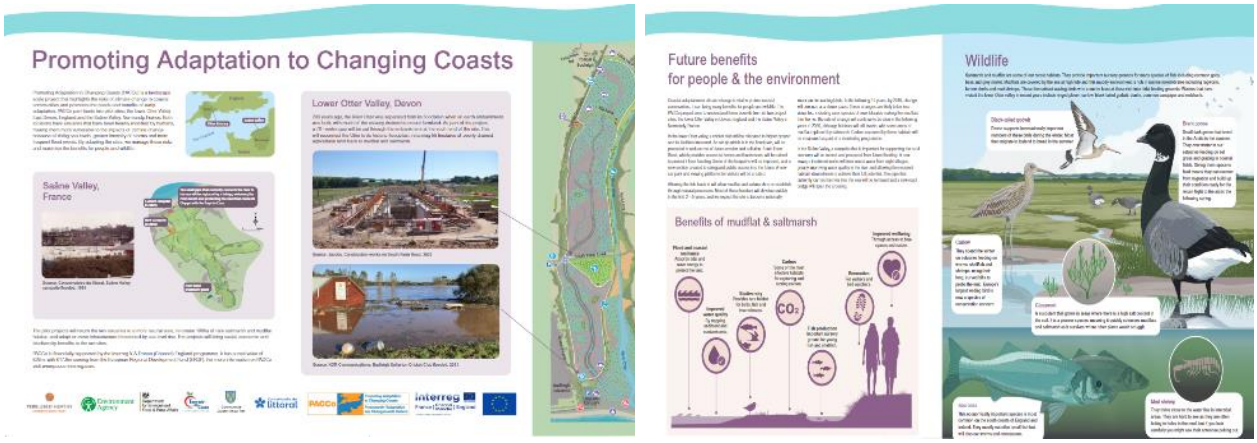


Figure 10.4 PACCo Hub interpretation boards installed in initial location (Source: EDPHCT)

10.2.2 The Saâne Valley

In the lower valley of the Saâne, the PACCo hubs which were erected in the first year are like interpretation boards. Their purpose is to raise awareness within the local community, especially the inhabitants of the three towns, and occasional visitors to the estuary.

These panels are located in 3 places in the valley, and in each of the town affected by the project: seafront in Quiberville and Sainte-Marguerite, and near the Longueil marshes. There are two types:

- The wall newspapers, which describe and track the progress of the project and are renewed quarterly
- The summer exhibitions which are annual and highlight a theme (the project, the biodiversity of the valley, the inhabitants and users of the valley).

These boards are clearly visible and located in popular places and can also be used during site visits organized by the project partners (see Photo 10.1).

Photo 10.1 Interpretation boards being used at the summer exhibition (Source: Fabien Chenel, Agence Nature/ Conservatoire du littoral, 2021) and being viewed by the public (Source: Lydia Burgess-Gamble, Environment Agency, 2022)

Using photos, the wall newspaper describes the risks and issues, the objectives and the different component of the Basse Saâne 2050 project. Seven wall newspapers were developed and displayed.

The summer exhibitions, focus in on specific themes, and are displayed for at least 6 months in each of the three towns. Past themes include:

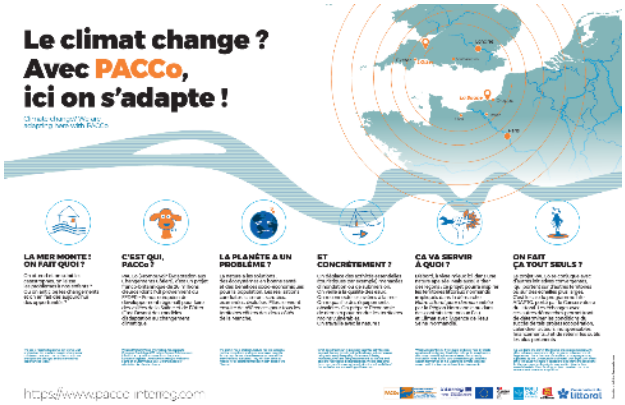
- In 2021, the exhibition described the Saâne, Otter and PACCo projects
- In 2022, the exhibitions described the heritage of the valley, protected or rare habitats and species of the Saâne valley
- In 2023, the exhibitions focused on the voices of the local inhabitants and users of the territory.

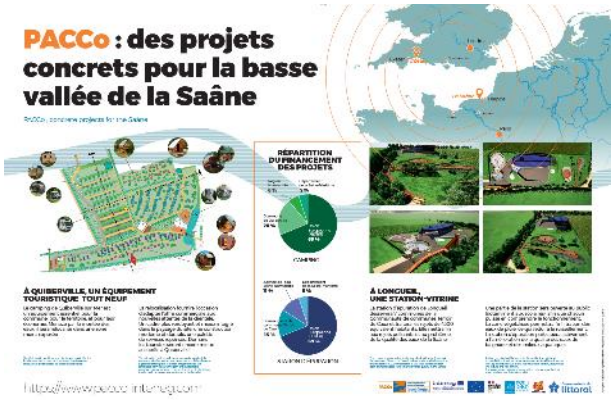
In 2021, the boards allowed to:

- Describe the PACCo project
- Explain the different components of the Basse Saâne 2050 project
- Describe the Lower Otter Restoration Project
- List the project's partners.

These boards can be seen in Photo 10.2.

Photo 10.2 Four interpretation boards describing the PACCo project (Source: Conservatoire du littoral)





As part of the Basse Saâne project the project team are considering the future development of pathways, including the establishment of new interpretation and observation points over the lower valley. These elements will be put in place after the PACCo project has ended and will build on the experience gained during this project. The Basse Saâne project is considering the development of wildlife observation areas, with a few boards explaining the project and the species present on the site.

At the Soléa wastewater treatment plant in Longueil, boards have been developed to describe the:

- Site and its operation
- Fauna located nearby and in the valley

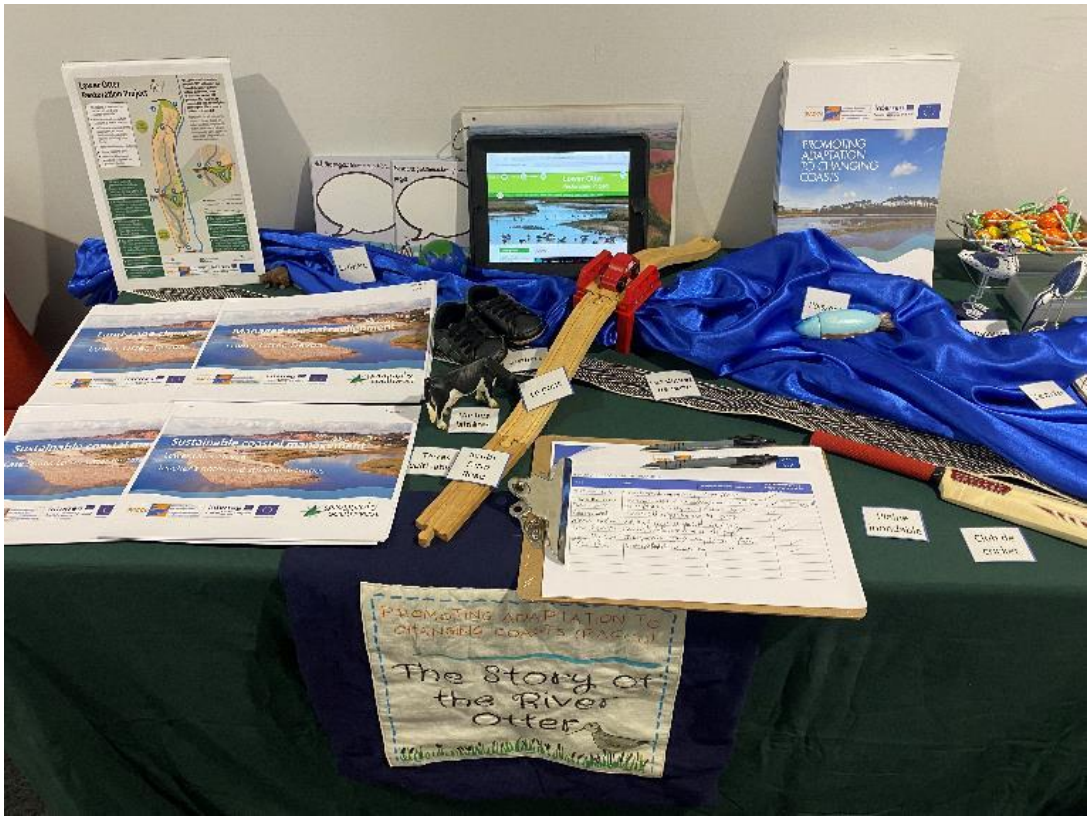
- Basse Saâne 2050 project and
- PACCo project.

10.3 Long-term Tools

The PACCo project delivered numerous educational outreach events at primary, secondary and tertiary levels on both sides of the channel. This was an important part of the project because it enabled us to raise awareness of climate change in general and its specific impacts on coastal areas. It also enabled us to the describe what climate change adaptation involves in coastal areas.

In addition to these outreach events bilingual educational tools have been developed. These include educational packs and programmes for school visits. These tools can be used to help embed the understanding of the principles of PACCo across future generations (see Photo 10.3).

Photo 10.3 Example of the educational pack being used at a Geography conference (Source: Kate Ponting, EDPHCT)



The educational pack is freely available on-line from the PACCo website and includes interactive materials such as videos, citizen science data collection packs and historical maps. The packs will be used in England at the hubs (described above) giving an overview of the resources developed for the PACCo project and signposting the reader in the direction of other helpful resources.

The education pack includes:

- Resources for primary and secondary schools
    - Worksheets
    - Slide packs

- GCSE, Key stage 3 and A Level lesson plans and resources
- Information on relevant citizen science data collection methods
- Project videos
- Historical maps.

This pack could also be used in the future by a site ranger to help guide volunteers in the collection of useful citizen science monitoring data to keep track of the site's evolution over time. For example, collecting ecological data or using tools like 'CoastSnap' – a citizen science mobile phone application - which encourages the collation of fixed-point photos over time to capture coastal change (Photo 10.4).

Participatory science is important as it involves civil society in the collection and sharing of scientific knowledge (Conservatoire du littoral, 2022). This in turn expands knowledge and understanding of climate change and coastal processes within communities.

Photo 10.4 Example of citizen science (Source: Dorset County Council)

10.4 Further Reading

Communications and engagement strategy

Educational resources Lower Otter

Educational resources Saâne Valley

PACCo educational pack

PACCo educational resources

See bibliography for further details.

Lessons Learnt & Recommendations - Part E

Part E of this report has described the monitoring planned for the PACCo project and set out the legacy tools and infrastructure developed for both sites. There are several key lessons learnt and recommendations from this part of the report described below.

Table 10.1 Key recommendations and lessons learnt

Key recommendations and lessons learnt
Monitoring
• Identify the need for monitoring at the outset of a project and secure budget for it. • Develop a monitoring plan with SMART monitoring objectives. This will enable you to ensure that your monitoring answers specific questions. • Prioritise monitoring activities based on available budget. • Be aware that there may be a statutory requirement for your project to be monitored (e.g., part of planning application or a permit) as such ensure that this is budgeted for. • There will be different reasons for monitoring and your monitoring plan will help ensure you are collecting the right types of data for the right purpose. • The presence of protected species on site has the potential to seriously disrupt project work programmes. Make sure that work plans factor in the likely restrictions on seasonality of works and method statements that will govern them so that timescales are realistic. • The monitoring program does not stop with the construction works, but must include sufficient time to be able to assess the environmental impact of the project on the ecosystems and their evolution
Legacy infrastructure and tools
• When delivering landscape-scale projects it's important to think at the outset about the sorts of legacy infrastructure that needs to be put in place to acknowledge the funding sources, partners and also provide long-term interpretation boards and facilities for the local community. Make sure the community is consulted on what type of infrastructure works best for them. • Budget for legacy infrastructure so that it is planned and not an add-on. • Understand the needs of partners and stakeholders so that any boards or facilities meet their needs. • Don't underestimate how much time is needed to agree on suitable wording related to a project's financing to ensure all partners feel acknowledged. • Design information boards and visitor infrastructure with the public in mind – making materials visual and easy to follow. • Develop packs of materials and tools which can be used by the local community in the long-term to engage with the project, for example, through citizen science.

Part F. Summary and Conclusion

This final chapter summarises and concludes this report.

- Main Findings
- Recommendations
- Next Steps

Chapter 11. Summary and Conclusions

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This chapter draws together the main findings, recommendations and lessons learnt from across Parts A to E of the report.

11.1 Introduction

The PACCo project has piloted the delivery of pre-emptive climate change adaptation on the Lower Otter and the Saâne Valley. The project has funded a blend of research-based activities and construction work, summarised in the guide.

This guide described in detail PACCo's approach to:

- Engagement and communication
- Funding and natural capital
- Design and construction
- Monitoring and legacy infrastructure.

Throughout we described:

- What we did
- The outcomes of our actions
- Lessons learnt and key recommendations.

11.2 Main Achievements

The PACCo project involved delivering a wide range of different activities which formed part of the climate change adaptation strategies for the Lower Otter and the Saâne valley.

11.2.1 Achievements across both Estuaries

Figures 11.1 and 11.2 summarise the key achievements across both estuaries. These successes were achieved by:

- Communicating about climate change and raising awareness
- Protecting and restoring lost intertidal habitats
- Relocating businesses and amenities to areas at lower risk of flooding
- Developing resilient design for new infrastructure.

Figure 11.1 Achievements within the Lower Otter (Source: EDPHCT)

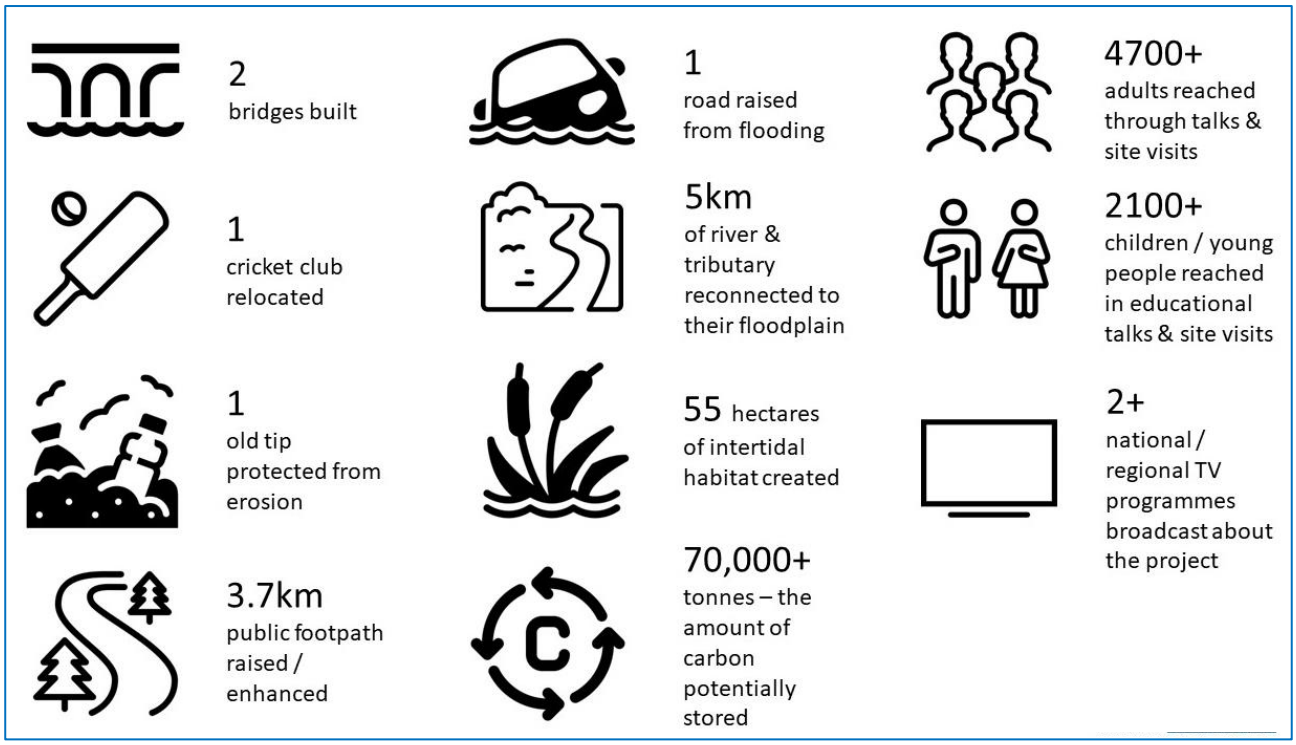
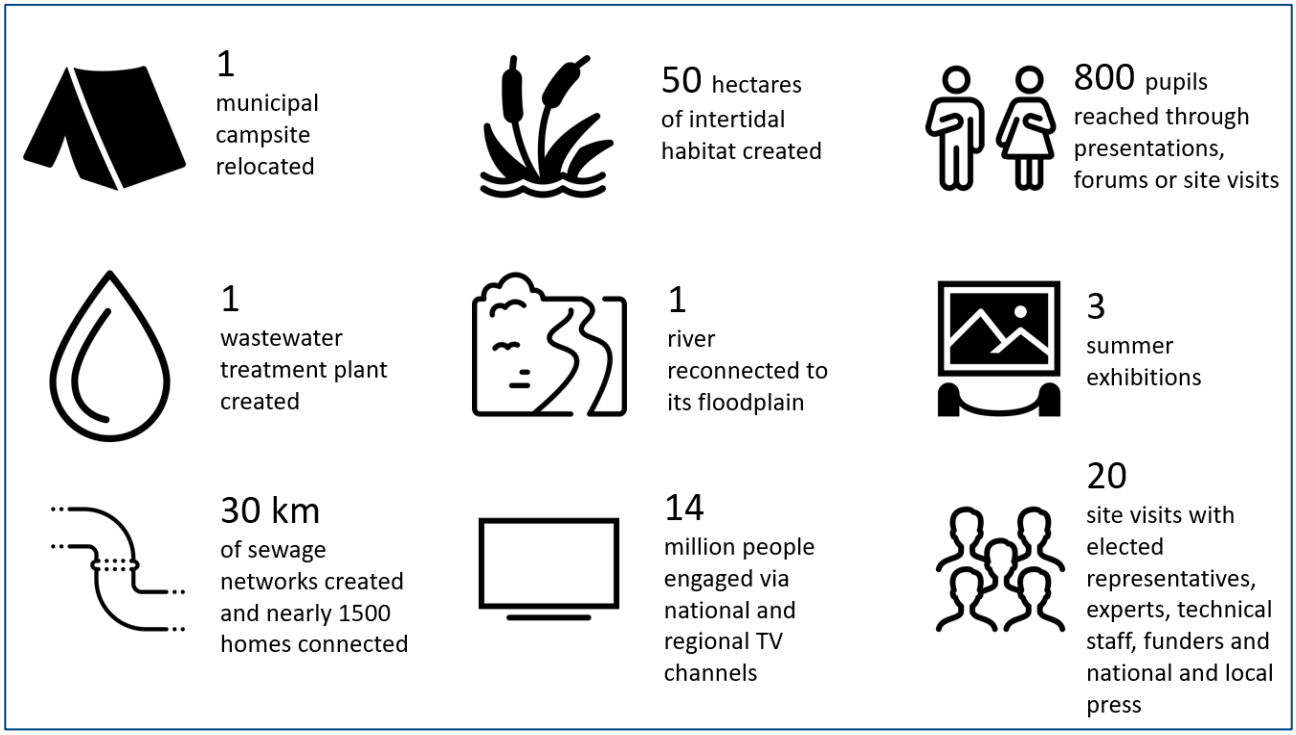


Figure 11.2 Achievements within the Basse Saâne (Source: EDPHCT)



11.2.2 Achievements from a Climate Change Adaptation Perspective

Below (figures 11.3 – 11.6) we summarise the key achievements from the PACCo project under the headers of our four-pronged strategy for climate change adaptation.

Figure 11.3 Awareness raising (Source: adapted form EDPHCT)

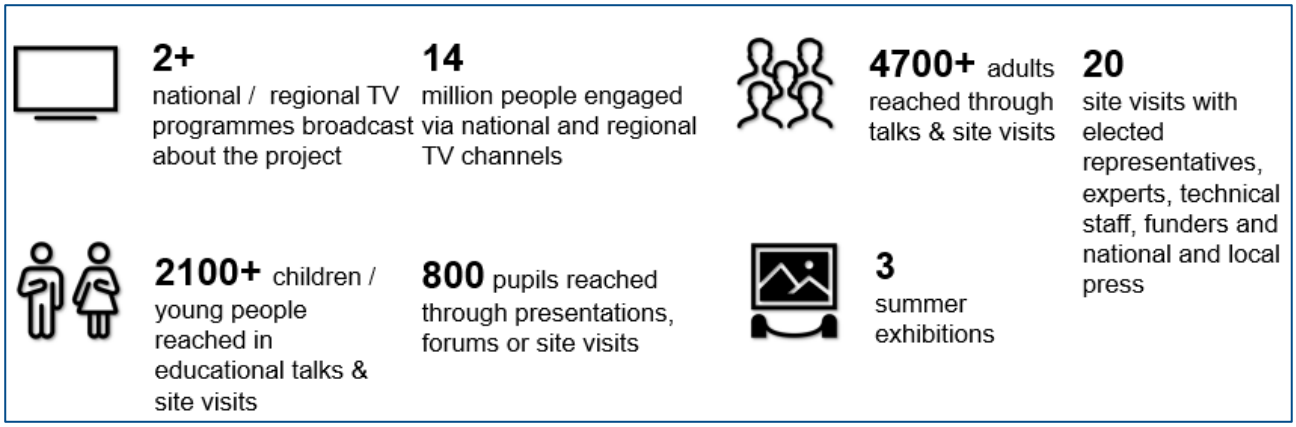


Figure 11.4 Protecting and restoring nature (Source: adapted form EDPHCT)

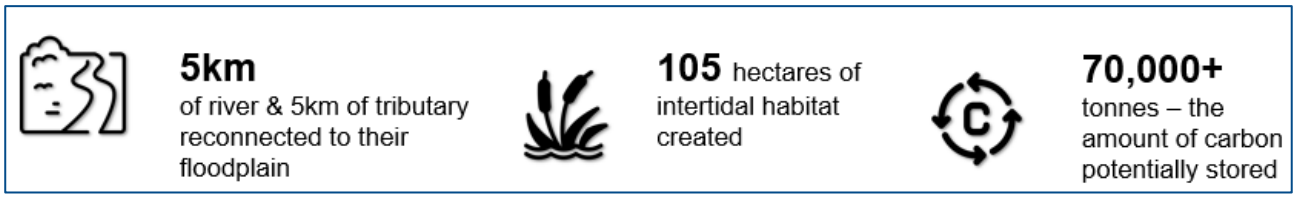


Figure 11.5 Relocating business and amenities (Source: adapted form EDPHCT)

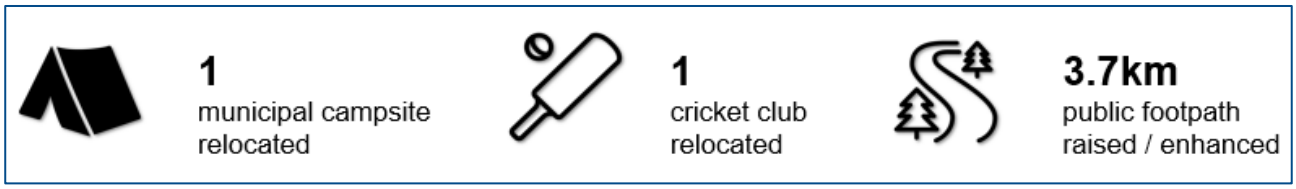
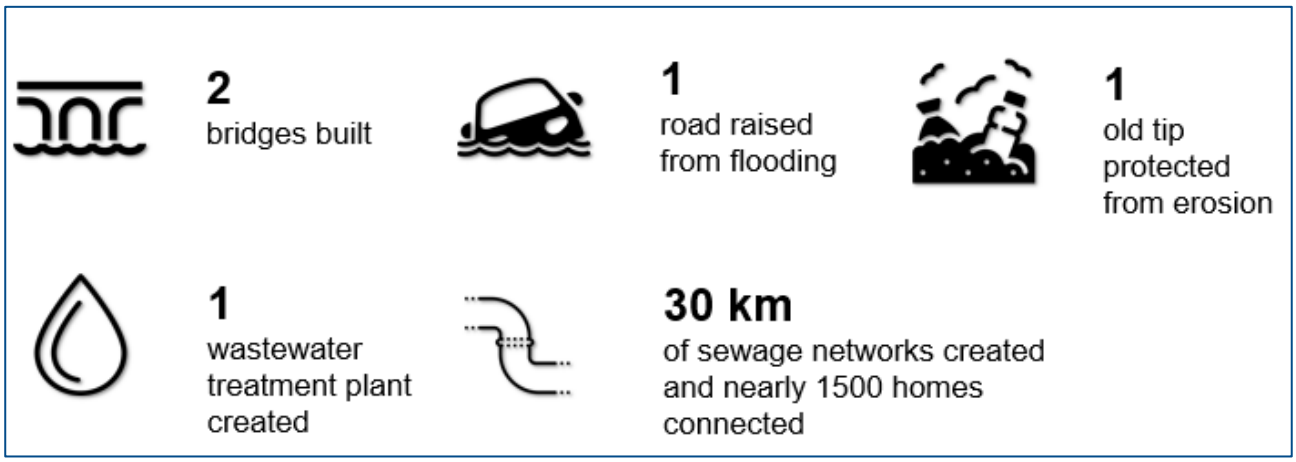


Figure 11.6 resilient design (Source: adapted form EDPHCT)



11.3 Lessons Learnt

The main lessons learnt from the PACCo project are described in this section.

11.3.1 Context and Background

- Build partnerships early. Finding landowners and partners to work with, agreeing a project vision and design and securing any legal agreements related to land release/occupation and legacy management can take many years to complete. Where multiple landowners are involved, this can be especially difficult.
- Securing funding to deliver a project can also take time.
- Take time to build a strong partnership throughout a project because this will act as the foundation of the project's successful delivery.
- Understand the scientific and policy context of your project because this will help you to find suitable funding and partners and develop a project which is aligned to current scientific and policy needs.
- Understand the historical context of your site – this is key to developing a robust solution to an environmental problem and it will also help you engage stakeholders in the project's development and delivery.

11.2.2 Engagement and Communication

Engagement

- Engagement with local communities should seek to empower stakeholders and communities in the development process, particularly those who are most likely to be affected or are living in the vicinity. It is important to recognise and understand the different types of knowledge and the opinions they may be able to contribute. Empowerment in the process will require an openness to feedback where, if it is necessary, could lead to changed ways of thinking or changes in design.
- Climate change adaptation projects will interact with multiple interests and groups. Engagement should have good representation of all interest groups and will likely include political or statutory bodies, landowners, landscape users, and local communities. An effectively managed stakeholder or steering group can be a good forum for ongoing, two-way exchange of feedback and knowledge throughout the development of a project.
- Climate change adaptation projects intersect with many interests and community groups and will involve an acceptance of changes in a landscape. To gain acceptance of these changes there is a need for trust between groups. When stakeholders and communities feel empowered and represented, they can access clear information, and feel their concerns have been recognised and understood. To enhance trust, it is necessary to be engaged in a way which is transparent,

honest, and open. Partners should ensure they work with communities in an inclusive way and that they listen to and empathise with community voices and opinions.

- Whilst awareness and acceptance of climate change itself may be growing, there can be disagreement about its impacts and levels of local environmental risk. This can result in disagreement about whether proposals may be the “right” course of action to take. Opening with discussion and education about local (or global) environmental risk, prior to introducing ideas for the solution, may reduce levels of uncertainty and instil confidence in the actions proposed.
- Climate change adaptation projects address multiple objectives simultaneously, have multi-faceted designs and intersect with many different interest groups. This level of complexity can make it hard to communicate project motivations, decisions, or actions. This in turn can make it difficult for different groups of people to visualise. It is therefore important to consider how best to make the information accessible to different audiences and help them to understand the project. Projects should seek to share information through multiple methods, to increase the likelihood of reaching as many different groups as possible.
- Facilitated team building events should be held as early as possible to enable staff to meet each other, start to build relationships, understand each other’s roles, and agree how to work with each other and deal with challenges. This must be in-person for all team members and include as many people as possible (technicians, engineers, funders, mayors etc). As a team it is important to know when you should make the effort to work together in person.
- Develop close working relationships with your consultants and contractors.
- Work with your contractors so they are part of your communications team. It is useful if your contractor nominates a public liaison officer who can liaise with the local community in relation to the construction site.
- Bringing different organisations together on a single project also means working with several different IT systems. Setting up SharePoint sites or similar systems can help partners collaborate more effectively.
- Team meetings provide essential opportunities to identify and agree in advance how to handle sensitive issues so that everyone is prepared. Adequate time should be allowed for the team to discuss the situation and see things from different points of view, e.g. those of diverse stakeholders.
- Never stop engaging the local community and stakeholders on your project. There is always an appetite for information and opportunities to get involved.
- People get their information from a variety of sources, not all of them accurate or supportive so the best way to keep stakeholders (old and new) up to date is to keep engaging with them.
- Capturing stakeholder feedback is an essential activity to check how they feel, what they understand and to identify knowledge gaps or concerns.
- At the beginning of a new project, it can be difficult for stakeholders to visualise what the site / features will look like once the work is complete. Planning drawings and illustrations help although sharing real examples of similar completed projects

(including offering visits if feasible) may be a stronger tool to help stakeholders see the outcome for their site.

Communication

- Every piece of communication must consider the audience and timing, as well as the key project messages, plus the specific information and action.
- Research into how and where stakeholders get their news provides valuable insights as to which channels will help your messages reach them.
- Plan and map out communications activities across the project. This communications map will highlight gaps and overlaps enabling the team to streamline all the input into regular proactive communications across the project partners.
- Partnership working brings expanded stakeholder networks and contacts. However, using this increased resource effectively in a partnership project needs to be carefully managed to comply with General Data Protection Regulations.
- During a project audiences' interest will ebb and flow. Whilst energy and capacity to engage may vary, interest usually remains so continue to communicate with all your identified audiences through your mix of communications channels whether they are active or not.
- Put yourself in the stakeholders' shoes to consider how you would feel about your project if you lived there and then use this fresh insight to refine communications activities.
- At the project's outset work with partners and funders to develop a brand and logo so the project is recognisable and all those involved feel recognised.

11.2.3 Funding and Natural Capital

- Funding adaptation projects is not straightforward – there is no single funding source available.
- A blended approach to financing might be needed – drawing on multiple funding pots to finance your project. This can be time consuming to put together and take many years.
- Taking a natural capital approach is recommended because it can help you articulate the wide range of benefits your project can deliver, and this can be used to lever different funding sources or attract a wider range of partners.
- Natural capital assessments can be usefully used at a project's option development stage to help different partners and stakeholders articulate the challenges and opportunities associated with different options.

11.2.4 Design and Construction

Design

- Targeted stakeholder engagement helps to inform the relocation of assets. If not conducted, planning permission could be denied, delaying the project.
- Create a flexible procurement strategy with contingency measures in place for specialist contractors if required.
- Show foresight and integrate provision for future civil engineering projects, as once habitat has established, works become restricted due to the tide. For example, on LORP, this involved incorporating the Fab Link project.
- Landfills are a common problem in estuarine environments. Check historical records and confirm risk through detailed GI.
- Do not assume ground conditions are the same across large sites. Carry out a detailed GI with competent subcontractors to inform design and strategies for re-using site won materials.
- Modelling multiple scenarios highlights areas of increased erosion, informing where assets need to be reinforced.
- Design to restrict vehicular access across the floodplain and seek alternative diversions particularly if it is the only access point.
- Ensure adequate resources are available to produce an Environment Impact Assessment (EIA). If this fails to identify potential environmental risks project delivery may be severely compromised

Construction

- Maintain and improve public access throughout as it familiarises the public with the scale of restoration projects. Visitors' information and billboards are necessary to communicate the works with the public to ease misconceptions.
- Monitor soil behaviours and ground conditions, particularly when reusing cut and fill. Have contingency plans in place if the soil is not behaving as expected.
- Monitor weather forecasts and clearly define responsibilities between contractor, designer and client should a flood event be anticipated.
- Trial low carbon concrete or alternative materials to naturally integrate assets into the landscape and to reduce carbon footprint.
- Use pre-cast units where possible as it is more consistent and has a lower carbon footprint. However, restricted vehicular access and increased health and safety risk of large pre-cast units may prevent this.
- Inflation allowances in budgets are unlikely to account for fuel price volatility. Projects with a high fuel cost component should review registers and accommodate fluctuations as soon as possible. Alternative consideration should be given to electrical plant machinery with lower fuel requirements and carbon output.
- Do not underestimate the degree (both time and cost) to which ecological method statements and planning conditions related to species may impact on project delivery. This is especially pertinent if project phasing is constrained.

- Vegetation clearance over large areas is costly and time consuming and ideally should be carried out years before construction. However, this may not always be possible due to strict funding windows and planning permissions.
- Consider and agree access points and routes across site prior to construction.
- A materials management plan is key to project phasing, particularly when re-using site won material.

11.2.5 Monitoring and Legacy Infrastructure

Monitoring

- Identify the need for monitoring at the outset of a project and secure a budget for it.
- There may be a statutory requirement for you to monitor your site.
- Develop a monitoring plan with SMART monitoring objectives.
- Prioritise monitoring activities based on available budget.
- Ensure you collect the right data for the right purpose.
- Consider involving the local community in monitoring and citizen science where appropriate.

Legacy Infrastructure and Tools

- Plan legacy infrastructure at the outset so it is budgeted for.
- Understand the needs of partners and funders so that any information boards or facilities meet their needs.
- Design information boards and visitor infrastructure with the public in mind – making materials visual and easy to follow.

11.4 PACCo Top Tips

The project's lessons learnt have been summarised into the following top tips:

- Anticipate problems and resolve them collectively.
- Be realistic about project phasing, especially if there are multiple dependencies between different project parts.
- Be vigilant to continually changing climatic and ground conditions during construction. Working in flood plains can be very challenging.
- Bring your community with you through effective engagement.
- Communicate constantly and effectively using a wide range of approaches.
- Conduct a detailed site wide ground investigation and survey species present on site.
- Do not under-estimate the degree to which habitat and protected species constraints may impact on project delivery (time and cost).

- Do not under-estimate the difficulty of gaining landowner agreement for a scheme and the length of time and cost of ensuring that all necessary legal agreements are in place to deliver it.
- Ensure you know what the key constraints are.
- Identify suitable funders, landowners, stakeholders and partners at an early stage.
- Involve local communities from the earliest stage, engage effectively and be receptive to local views.
- Know your site's history to shape its future design.
- Maintain and improve visitor infrastructure during and post-construction.
- Nurture your partnership throughout as it is the foundation for project success.
- Plan monitoring of project outcomes in advance and secure budget for it.
- Show foresight and accommodate future engineering projects.
- Take a natural capital approach to articulate options and benefits, whilst recognising that there are other benefits of early adaptation, such as to the local economy.
- Think about the project's legacy when developing signage and infrastructure.
- Understand your funders, landowners and partners requirements.
- Use the project as an opportunity to engage the next generation.

11.5 Next Steps

Throughout this report we have provided a summary of both the construction works and research delivered as part of this project. We have provided hyperlinks to additional resources and more detailed reports all available on the PACCo webpage.

We believe that this report is the first of its kind – providing an overview of what climate change adaptation entails. By sharing the specific details on how PACCo was delivered we hope that our lessons learnt can be used to help inform similar projects across many other estuaries.

11.6 Further Reading

The following documents and detailed reports were developed as part of the PACCo project and can be downloaded from our webpage: Homepage - Promoting Adaptation to Changing Coasts [Accessed: 29/092022].

Table 11.1 List of references and other materials produced as part of the PACCo project

Topic	Reference	Work package
Blogs, Newsletters, leaflets:	PACCo blogs posts	WPC5.1
	Leaflets and information packs	WPC5.1
	Newsletters	WPC5.1

Topic	Reference	Work package
Communication:	Communications and engagement strategy	WPC 3.1 T2.5.1
	PACCo Final Conference Report	WPC5.1
Education:	Educational resources Lower Otter	T2.5.1
	Educational resources Saâne Valley	T2.5.1
	PACCo educational pack	T2.5.1
	PACCo educational resources	T2.5.1
Monitoring:	Carbon assessment – Lower Otter	T1.4.1
	Fish surveys - Lower Otter	T1.4.1
	Summary of environmental monitoring & evaluation tools	T1.4.1
	Summary of visitor surveys – Lower Otter and Saâne Valleys	T2.3.1
	Visitor Survey – Full Report Lower Otter	T2.3.1
	Visitor Survey – Full Report Saâne Valley	T2.3.1
Natural capital:	Qualitative Natural Capital Assessments - Lower Otter and Saâne Valley	T2.1.1
	Quantitative Natural Capital Assessment – Lower Otter	T2.1.1
	Summary of natural capital assessment (Lower Otter) and surveys (Lower Otter and Saâne Valleys)	T2.1.1
Overarching Guide	Promoting adaptation to Changing Coasts – Practical Guide Summary	T3.3.1
	Promoting adaptation to Changing Coasts – Practical Guide Full report	T3.3.1
Risk and solution tools:	Transferable methodology for identifying and cataloguing risks/issues	T1.1.1
	Transferable strategy for addressing risks and problems	T1.2.1
Site history:	Disused tip case study – Lower Otter	T1.5.1
	Methodology for evaluating and managing man made historical threats	T1.5.1
	The history of both estuaries - Lower Otter and Saâne Valley	T2.2.1
Socio-economics:	Socio-economic engagement (Executive Summary) – Lower Otter and Saâne Valleys	T2.4.1

Topic	Reference	Work package
	Socio-economic engagement (Documentary evaluation) – Lower Otter and Saâne Valleys	T2.4.1
	Socio-economic engagement (Stakeholder interviews) – Lower Otter and Saâne Valleys	T2.4.1
	Summary of visitor surveys – Lower Otter and Saâne Valleys	T2.3.1
	Visitor Survey – Full Report Lower Otter	T2.3.1
	Visitor Survey – Full Report Saâne Valley	T2.31.
Social media:	PACCo Facebook page	WPC 1.1 WPC 2.1
	PACCO Linkedin account	WPC 1.1 WPC 2.1
	PACCo Twitter account	WPC 1.1 WPC 2.1
Videos, animations, drones:	Cross-border exchange – Natural capital and socio-economic	WPC5.1
	Cross-border exchange - Virtual tour of the Lower Otter	WPC5.1
	Lower Otter drone Flyover	WPC5.1
	PACCo videos and animation	WPC5.1
	PACCo YouTube channel	WPC5.1
Webpages:	Basse Saâne 2050 webpage	WPC 1.1 WPC 2.1
	Lower Otter webpage	WPC 1.1 WPC 2.1
	PACCo webpage	WPC 1.1 WPC 2.1

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Appendix 1. Summary of Visitor Surveys

A1.1 Lower Otter – Visitor Survey Analysis

Although broadly the French (Saâne valley) and English (Lower Otter) surveys were developed to be comparable, the Saâne valley survey incorporated more questions, especially related to climate change. On the other hand, the Lower Otter survey, because it was repeated, enables some comparison between views and perceptions in 2021 and 2022. This analysis is based on 334 valid survey responses (88 of which were face-to-face) in 2021 and 269 valid responses in 2022 (41 of these were from in-person interviews.

Visit frequency: For the Lower Otter survey, respondents stated that they tend to visit fairly frequently - around 50% of respondents indicated they visited at least 1-3 times a week; with 5% visiting more than once a day (2022 figures). 18% of respondents visited 1 to 3 times a week, and 17% 1 to 3 times a month (2022); respondents stated that they visited slightly more frequently in 2022 than 2021 (Q6a).

Proportion of residents and visitors surveyed: The majority of respondents were local residents - in 2021 the split between local residents and visitors was 79% to 21%[23]. In 2022 this was even more pronounced with 84% local residents and 16% visitors (Q4a).

Proportion of day visitors / those staying in holiday accommodation: Of those respondents who were not local residents (68), 46% stated they were day visitors and 37% staying in holiday accommodation, with 9% staying with friends / family[24] (2021 figures). In 2022 there were slightly less day visitors and more staying in holiday accommodation, but the number of responses was small (32 in total) so this may not be representative (Q4b)).

Length of stay for holidaymakers: A significant proportion of holidaymakers are staying for several days - in 2021, 33% of holidaymakers indicated they stayed for 7 days; 40% that they stayed for 7 days or more (up to 21 days). In 2022, this was up slightly with around 50% indicating they stayed for 7 days or more, and 22% staying for 7 days. However, the numbers are again very small (only 33 responses in 2021 and 18 in 2022) so are unlikely to be representative (open-ended question 4c)[25].

[23] Q4a: “Do you live locally (within a few miles / km)?”.

[24] Q4b "Do you typically stay overnight (nearby), or just visit for the day?"

[25] Q4c "Please specify length of stay (in days)".

User / visitor group composition: In 2021, most (41%) of respondents visited with family / children, with around 20% visiting with family and friends, 19% with partner / spouse and 9% visiting with friends. Compared with the previous year, in 2022, a higher percentage of respondents visited with a partner / spouse (34%; up 15%) and with friends (+3%). (This may have been influenced by Covid restrictions in place the previous year.)

Spend: The stated spending profile while at the site (including Budleigh Salterton town centre) showed a range of £0 - 200 (2021); and of £3 - 800 (2022); with a median spend of £10 for both years (Q7). This includes spending in local shops, including food shops, charity shops and antiques shops, as well as for parking etc., but not for accommodation.

Characteristics of the site most valued by respondents[26] were 'wildlife', 'scenery', 'nature' and its 'peaceful' and 'beautiful' quality and (summary of 2021 and 2022 responses) (Q9a).

Characteristics of the lower Otter valley valued least[27] in 2021 were 'people' (referring to visitor pressure); narrow paths (during Covid making it difficult to do social distancing); and dogs (dog poo also featured in responses). In 2022 the most frequently cited responses were again 'people' (referring to visitor pressure and perceptions around inconsiderate dog owners, with reference to wildlife disturbance); and disturbance / pollution related to the construction works, including construction vehicles and disruption to normal parking arrangements / availability (Q9b).

'Natural' characteristics of the site: Most respondents (56%) perceived the valley / estuary as very natural in 2021 (Q10)[28] – this probably reflects the appreciation of the natural features present in the valley prior to the scheme but does not indicate a great deal of awareness of past human-influenced changes to the valley (e.g., the building of the embankment, railway, draining of the valley to make way for the development of agriculture etc.). There was a reduction of 13% for this view in 2022 (slightly modified question)[29]. This is likely to have been influenced by the start and visibility of the construction works in 2022.

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[26] Multiple response question - Q9a: "What do you like best about the lower Otter valley?"

[27] Multiple response question – Q9b: "What do you like least about the lower Otter valley?"

[28] Q10: Agreement with statement "The valley/estuary as it is at present is very natural." 56% includes 'agree' and 'completely agree'; 27% selected 'disagree' or 'completely disagree' and 17% selected 'neutral/neither'.

[29] Q10 modified for 2022: Agreement with statement "Besides the construction works, the valley/estuary as it is at present is very natural." There was a 10% reduction in those selecting 'agree' and 3% for 'completely agree'.

Positive/negative feelings about the scheme: General feeling expressed about the scheme was mostly positive (or neutral) in 2021 (Q12b: agreement with statement 'I am very happy that this scheme is happening') with 44% selecting 'agree/completely agree'), 32% selecting 'neutral' and 25% negative (disagree/completely disagree). In 2022 the results were similar but responses at the extremes were slightly higher showing slightly greater polarization of views (completely agree 6% greater; completely disagree 4% higher).

Awareness of climate change impacts as a result of the project: The project seems to be having some positive impact on awareness of issues around climate change in coastal communities. In 2021 33% of respondents stated that their awareness of climate change and its impacts on coastal communities had increased as a result of the lower Otter restoration project - 23% selected 'agree' and 10% 'completely agree' (Q12c). A slightly lower proportion, 27%, selected 'disagree' or 'completely disagree' and 33% selected 'neutral / neither agree nor disagree'[30]. Again, the responses for 2022 were similar apart from a slight increase at the extremes.

Concerns about the project: The most frequent concerns expressed about the project (Q13; open ended) included about impacts on local wildlife (terrestrial and marine) during the construction phase and due to land-use changes; over-engineering of nature and disruption caused by the construction works. Other concerns expressed in 2022 in addition to the above were changes to the nature of the site (including change / loss of existing habitat); and accessibility (including site access, footpaths, roads and parking).

Benefits of the scheme: expressed by respondents in 2021 (Q14)[31] included improvements to flood risk and resilience to climate change (24% of responses); increases in biodiversity (20%) and natural habitat increases (16%). In 2022 the responses were similar except that wildlife was the most mentioned (27%), with flooding improvements (27%), habitat creation / restoration (23%) and an additional type of benefit mentioned - economy / infrastructure benefits (16%).

Effects on the attractiveness of the valley: In 2021, the majority of respondents (45%) thought the scheme would make the lower Otter Valley a more attractive landscape compared to only 18% who expressed a negative view (and 26% neutral) (Q15c)[32].

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[30] Q12c: Agreement with the statement "Thanks to the LORP, I am much more aware of climate change and its impacts on coastal communities"

[31] Multiple response question – Q14: "What do you see as benefits of the scheme – now and future?"

[32] Q15c: Answers in response to statement "The Lower Otter Valley will become a much more attractive landscape as a result of the scheme". Responses reported above aggregate the 'agree' (31%) and 'completely agree' (14%) categories (45%); and the 'disagree' and 'completely disagree' categories (18%).

Interestingly, in 2022 the ‘completely agree’ rating for this question increased by 13% compared to 2021.

Impacts of the new wetlands for the area: In 2021, 52% of respondents perceived the new managed wetland environment as being positive for the local area (Q15d)[33] with only 15% perceiving it as being negative and 22% selecting ‘neutral’. However, when split between visitors and local respondents, a greater proportion of visitor respondents selected positive responses (as well as ‘not sure’). The responses were similar in 2022 with 50% perceiving the new wetland environment as positive for the local area.

Impact on the local economy: Perceptions about the impact on the local economy were less clear, however, with 26% agreeing that the new managed wetland environment will benefit the local economy but 30% of respondents selecting a neutral view, 17% stating a negative view and 16% selecting ‘not sure’ in 2021[34]. In-person respondents expressed uncertainty about the future and an inability to predict the impacts of the proposed scheme at the time. The responses in 2022 showed a 9% increase in the ‘completely agree’ response category and a decrease of 5% for ‘neutral’ and 8% for ‘not sure’.

Disruption caused by the construction works (question asked in 2022 only): 26% of respondents indicated that they had experienced disruption to date and 23% indicated a lack of disruption, with 22% neutral (Q15f)[35].

Information provision as part of the consultation process: Regarding information about consultation carried out as part of the lower Otter scheme (Q16), the most frequently cited sources of information were a newspaper, social media and the website; with the planning application consultation and the public meetings also featuring.

Perceptions of the consultation: On the consultation process itself the views seem to be neutral or evenly split, with 48% of respondents stated a neutral view in response to the statement “The consultation for the LORP was very genuine, and I felt like I was listened to”; with 17% positive and 17% negative (Q17a). Similarly, with regards effectiveness and

[33] Q15d: Answers in response to statement “The new managed wetland environment will be very good for the local area”. 35% selected ‘agree’ and 17% selected ‘completely agree’.

[34] Q15e: Answers in response to statement “The new managed wetland environment will be very good for the local economy”.

[35] Q15f: Answers in response to statement “The constructions works have not been disruptive to date”: 26% ‘disagree’; 23% ‘agree’; 22% ‘neutral/neither agree nor disagree’.

timeliness of the consultation, 42% of respondents expressed a neutral view; with 16% expressing a positive view and 16% 'not sure' (Q17b)[36].

Suggestions for improvement to the consultation process: these included that provision of more information would have been beneficial, along with more acceptance / taking on board of local views (Q18)[37]. However, aspects of the consultation that were perceived as having gone well included the plethora of information provided to the public about the scheme (44% of responses); the fact it was 'well publicised' (28% of responses) and that it was 'helpful' (7% of responses) (Q19)[38]. In terms of which consultation methods were preferred, the top three were social media, the project website and newspaper article (Q20). Multiple mentions were also made of face-to-face contact with town officials and Environment Agency staff as being helpful, as well as local people helping them form opinions of the scheme.

An open question on any thoughts the respondent wished to share about the consultation yielded only 50 valid responses, with 37% expressing general negative feelings towards the project, 22% expressing lack of clarity of the consultation 14% raising concerns about the local wildlife (Q21)[39].

Demographic Characteristics

Gender: there was a roughly even split of female/male. 52% respondents stated they were female in 2021, and 31% male, but 12% of responses were by mixed couples, i.e., a male and female answering the survey together, producing a larger 'other' response. 50% of respondents stated they were female in 2022, with 48% male.

Age: The age profile shows that a large proportion of older and retired people participated in the survey. The majority (45%) of those who responded indicated they were in the '65 and over' category (74 respondents skipped this question) (Q23).

Educational level attained: Responses to the question about highest educational level attained of respondents indicates a range of levels attained, but with a skew towards relatively well-educated respondents, with undergraduate degree (20%), professional

[36] Q17b: Answers in response to statement "The consultation for the LORP was very effective, and I felt I had the chance to contribute in a timely fashion."

[37] Q18: "How could the consultation have been improved?"

[38] Q19: "What was done well?"

[39] Q21: "Please use this text box if there are any other thoughts you would like to share".

qualification (20%) and postgraduate Masters qualification (19%) accounting for the majority of respondents (Q24)[40].

Employment status: Similarly to the age question, 45% of respondents selected 'retired' as their primary employment, with 25% selecting 'employed full time' (2021 figures; 2022 figures were 43% and 30% respectively)[41] (Q25).

A1.2 Saâne Valley – Visitor Survey Analysis

A total of 347 valid questionnaires were collected and analysed for the Saâne valley, including 96 completed online, 5 on paper, and 246 (>70%) in person (face-to-face). The French survey contained more emphasis on the effects, risks and hazards of climate change than the English survey, but less emphasis on disruption as a result of construction works, influenced by the differences in phasing and extent of the construction work in the two sites. Only one round of surveys was conducted in the Saâne valley.

Visit frequency: In the Saâne Valley, users indicated they visit fairly frequently (although the frequency reported was slightly less than for the Otter Valley). 38% of respondents visit at least 1-3 times per week (11% of these visits either daily or more frequently)[42]. Therefore, just under two thirds (62%) of respondents visit less frequently than once a week.

Features of interest and activities: Various features were highlighted as of interest by respondents: the river, the beaches and cliffs (for hiking and foreshore fishing) and wetlands (lower Saâne valley). The varied landscape enables a variety of outdoor activities: in question 6 ("What are the main activities you do in the valley?"), the most cited outdoor activities were walking, beach activities and wildlife watching (there are several long distance and local hiking trails in the area). The data shows that the quality of the natural and landscape heritage is important for the users of the site: almost 50% cited the observation of fauna and flora as their main activity, with 28% citing photography.

Proportion of residents and visitors surveyed: Of the 347 respondents, around 60% indicated that they were 'residents' (209 respondents; based on data from more than one question).

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[40] Q24: "Which of the following academic qualifications do you have? Please tick the highest level attained, or nearest equivalent:…"

[41] Q25: "What is your employment status?"

[42] This figure is slightly lower than for the Otter valley (50%).

Proportion of day visitors and length of stay for holidaymakers: 85% of visitors stated they stayed at least one night (only 7% were day visitors). The information reported indicates that around 60 families stay for extended periods (in summer at the municipal campsite) and the median value for length of stay was 10 nights. This underlines the importance of the municipal campsite for the local economy (especially in summer).

User / visitor group composition: The data indicates that users of this valley are mainly residents or holidaymakers who come to the lower valley with their families. Only 11% of the respondents were in the 18-29 age group (Q37); and only 11% stated they visited with friends.

Characteristics of the site most valued by respondents (positive associations) (multiple questions): Most frequently cited word associations with the valley were 'natural' / 'nature', with 'calm', 'beach', 'beautiful' and 'sea' also featuring strongly. In a related question[43], the responses were similar, with respondents stating they also valued the countryside, landscapes, summer atmosphere and outdoor activities (hiking). A separate question highlighted the wellbeing felt by users of the Saâne Valley; more than 95% of respondents agreed with the statement, "The valley is quiet and rejuvenating, I feel good here."

Characteristics of the site least valued by respondents (negative associations) (multiple questions): Only a few negative associations were mentioned in the word association question, such as the dam, a lack of activities, pollution, over-tourism, developments (impact on the landscape), the culvert, vehicle traffic and the lack of a cycle path. Similarly, in a related question[44], respondents mentioned the lack of cycle paths, the presence of the concrete road-dike, the over-tourism in summer and its consequences (pollution, waste), the dangerous traffic (sharing of traffic lanes by cars, bicycles and pedestrians), and the lack of activities or restaurants.

'Natural' characteristics of the site: Almost 88% of respondents perceived the valley as it is today as natural[45].

Visitor pressure: Less than 30% of respondents indicated that they felt the site was overcrowded in summer, although a spatial analysis suggests that residents of areas close

[43] All question wording provided here has been translated. The original questions can be found in the full French survey results. Question wording: "What do you like most about the Saâne valley?"

[44] "What don't you like about the Saâne valley?"

[45] Agreement with the statement "The Saâne valley as it is now is natural" (includes responses for 'agree' and 'fully agree'). This figure is much higher than for the comparable question in the lower Otter valley, although the wording was stronger for the Otter valley question – 'very natural' (only 56%).

to the beach / seafront (near shops, cafes etc) did perceive it as overcrowded, whereas in the lower valley they did not.

The data presented indicates that the number of visitors to the Quiberville municipal campsite increased significantly in 2022 compared to previous years (including 2019) likely due to a post-COVID effect: the search for natural outdoor spaces and constraints of international travel opportunities having led to more local holidaying or 'staycationing'.

Awareness of / knowledge about climate change, risks and hazards (multiple questions): perceptions about respondents' own knowledge of climate change was variable, with 49% of respondents indicating they had good or very good knowledge about climate change, but 51% stating they did not have good knowledge. However, awareness of climate change and associated risks / natural hazards was much higher: 94% of people considered the Saâne Valley to be vulnerable to climate change, with nearly 90% of respondents perceiving the lower Saâne valley as subject to one or more natural risks. The related natural hazards cited included flooding (most commonly mentioned - 87% of respondents who mentioned a hazard), run-off, erosion and cliff erosion / recession. Of resident respondents, around 60% felt their homes were affected or could be affected by natural hazards (half of which identified flooding as the major risk); compared to about 37% who felt that their homes were not affected by natural hazards. Over 80% of respondents felt that the dyke / sea defences were not adequate protection against the risk of flooding from the sea. Survey responses also indicated significant awareness of historical flooding events (in 1999 and 2018).

Support for different climate change adaptation options / solutions: almost 47% of respondents were in favour of letting nature take its course, with nearly 31% supporting the maintenance of sea defences and groynes[46]. 20% of respondents were in favour of relocating populations and services[47].

Awareness of climate change impacts as a result of the project: Around 45% indicated that they now have better knowledge of climate change and its impacts on coastal areas as a result of the project (PACCo and Basse Saâne), with 22% saying the project has had no such effect[48].

[46] As the number of people who support the maintenance of sea defences / groynes is higher than the number who think they provide adequate protection from flooding, this implies greater investment would be needed into the dyke / raising of the structure.

[47] Question wording: "What do you think would be the best solution to adapt to climate change?"

[48] Question wording: "Thanks to the territorial project, I am more informed about climate change and its impacts on coastal municipalities" (includes responses for 'agree' and 'fully agree').

Effects on the attractiveness of the valley: More than 80% of respondents thought the project would make the Saâne valley more attractive, with only 7% disagreeing with this view[49].

Impact on the local economy: Similarly, 78% of respondents thought the project would be beneficial for the local economy, with only 15% disagreeing.

Benefits for biodiversity of the project: 90% of respondents agreed that the project would benefit biodiversity[50].

Concerns about the project: The most frequently expressed concern was regarding the economic benefits of the project, especially the new campsite (which is reported to be targeting a different clientele than the current municipal campsite) - it is likely that many users of the campsite were respondents of the survey. Other frequently expressed concerns were safety of homes / residents; environmental benefits (impact of restoration of flood plain on particular species); attractiveness of the site and over-tourism (accentuating traffic issues and conflicts between vehicles, cyclists and pedestrians). Other concerns mentioned (in a separate open-ended question) included inconvenience caused during the works with problems of access to the seafront or to houses.

Benefits of the project: The benefits most frequently cited were improvement in the quality of the ecosystems; tourism benefits and reduction in vulnerability to natural hazards.

Most effective information sources / communication tools about the project: The most frequently cited media for information and most effective communication tools were the wall newspapers and summer exhibitions; followed by quarterly newsletters, and TV news (based on data from two questions)[51]. Word of mouth was also cited as important as an information source. Interestingly, websites and social media were the least effective communication tools cited.

Demographic Characteristics

Gender: The gender split of respondents was 52% female and 48% male; broadly consistent with the general characteristics of the local population (51/49%).

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[49] Question wording: "The landscape of the Saâne Valley will be more attractive as a result of the implementation of this project" (includes responses for ‘agree’ and ‘fully agree’).

[50] Question wording: "The Saâne territorial project will benefit biodiversity" (includes responses for ‘agree’ and ‘fully agree’).

[51] Two questions - question wording: “How did you hear about the project?” and “What are the most effective communication methods in your opinion?”

Age: Of the 346 responses to this question, the most represented age group was 45-59 (33% of respondents). 31% of respondents were over 60 years old, compared to 36% under 44 years old. This is a younger age profile than the general population (and compared with the lower Otter survey) and may have been influenced by the times and season that the data was collected, when more families with young children were likely to be in the area.

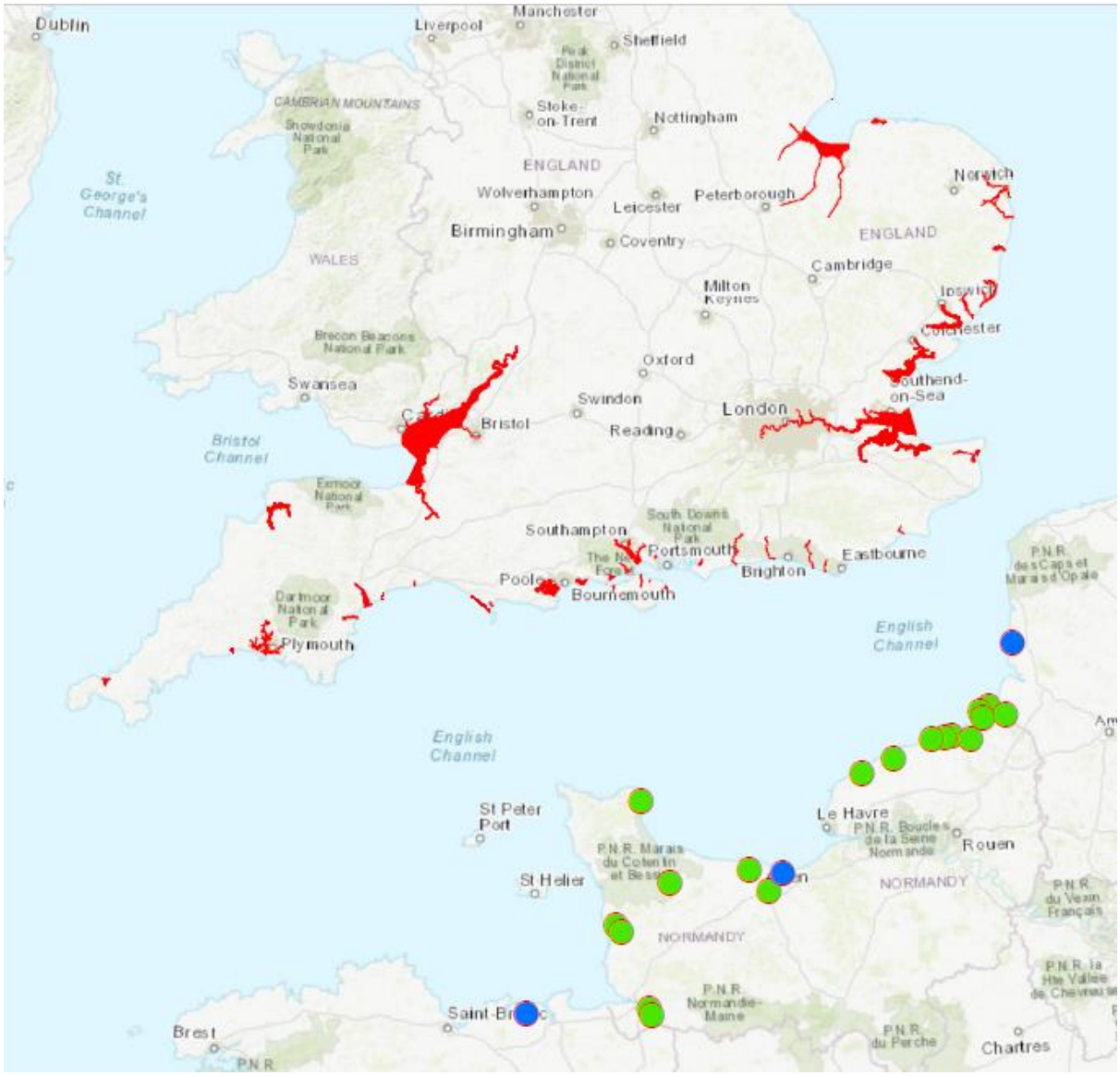
Educational level attained: Around 90% of the respondents were almost equally split across four categories of educational level: "Baccalaureate or equivalent", "BTS or licence", "Professional diploma" and "Master, Engineer, DESS". This shows that the site attracts users from a variety of socio-economic and professional backgrounds. These figures were reported to reflect the general population characteristics.

Employment status: 46% of respondents indicated they were full-time employees; 24% retired; 15% self-employed and 8% part-time employees. (This again reflects the different age profile to the Lower Otter survey.)

Appendix 2. 70 Estuaries which could benefit from the PACCo Guide

As part of the PACCo project we identified over 70 estuaries in Southern England and Northern France which face similar challenges to the Lower Otter and Basse Saâne. It is felt that these sites could benefit from the findings of this guide should climate change adaptation project be developed on them in the future.

Map A.1 Map showing sites which could benefit from the findings from the PACCo guide



Appendix 3. Memorandum - Creek and Breach Design Philosophy (Source: Pontee, N. and Wilson, T., 2022.

Memorandum Jacobs

- **Date:** 17 November 2022
- **Project name:** Lower Otter Restoration Project
- **Project no:** 684492CH
- **Attention:** Lydia Burgess Gamble, Megan Rimmer, Dan Boswell
- **Company:** Environment Agency
- **Prepared by:** Nigel Pontee, Toby Wilson
- **Document no:** ENVIMSW002045-CH2-000-000-RP-GEN-0008

Background

Creeks are important features of natural mudflats and saltmarshes, helping ensure that sites flood and drain correctly and that a range of habitats for vegetation and other species are created.

The recently produced Saltmarsh Restoration Handbook (Hudson *et al.,* 2021) covers various aspects of saltmarsh restoration in coastal and estuarine environments. With regards to the creation of saltmarshes by the process of managed realignment, Chapter 4 (Pontee *et al.,* 2021) offers the following guidance on creek design (those marked with an asterisk are applicable to the Lower Otter site):

- Land that was formerly used for agriculture often contain extensive ditch and watercourse systems which need to be rerouted and connected to new outfalls. *
- Typical site works also include the infilling of the existing field drain and borrow dyke system on the site, to break the linear drainage system and facilitate the reinstatement of the ‘natural’ creek network. *
- Sites that lie are low in the tidal frame or are expected to have high sedimentation rates new creeks would be expected to arise naturally. *
- Sites that lie higher in the tidal frame, that are expected to have lower sedimentation rates or have compacted sediments that are difficult to erode, may require the construction of artificial creek systems.
- Artificially constructed creek networks should look to maximise flooding and draining of the site whilst mimicking the channel and network properties of natural marshes. Deeper pools can be created within creek channels to provide refuges for fish during low water. *

The design of any creek system is also related to the design of the breaches, since the creek networks need to connect through these to the adjacent estuary or sea. Breach design is governed by multiple considerations including:

- Choice single of multiple breaches
- Position of existing drainage outfalls
- Condition of existing embankments
- Existing topography within the site
- Impact of breach position on water levels and flows with the wider estuary

- Access requirements over the breach.

Lower Otter Restoration Project

Overarching project objectives are:

- Deliver more sustainable management in the face of climate change
- Improve natural functioning of the Otter estuary
- Improve the quality of habitats and wildlife
- Provide compensatory intertidal habitat
- Safeguard public access
- Reduce risk of contamination from the old municipal tip
- No increase in flood risk to property
- No impact on groundwater abstractions for drinking water.

The design has evolved over the course of the development of the project in response to constraints and opportunities not all of which were known at the outset.

The design of creek system within the site considered the following aspects:

- Hydrodynamic connections with:
    - the breach at the southern end of the site to connect with the wider estuary to allow tidal water to enter the site
    - lowered cross banks in the northern part of the site to allow fluvial flood water to enter the site with culverts crossing scaled to creek dimensions
    - an existing freshwater stream – Budleigh Brook which formally crossed over the floodplain in an aqueduct
    - an existing freshwater trunk drain (main land drain) to the west of the site, formally passing under South Farm Road through a culverted crossing and exiting to the sea via a culvert.
    - an existing freshwater stream – Kersbrook
    - existing areas of low land elevation within the scheme.
- The network form and dimensions of natural creek systems from comparable refence marshes.
- Reuse of portions of existing drains to minimise cut
- Overlap with low lying areas of land to minimise cut
- The blockage of existing linear field drains to avoid creation a rectilinear drainage network
- The volumes of fill material required for construction works within the site – to minimise import of material
- Requirement to maintain vehicular access along South Farm Road
- Historic landfill at South Farm Road with need to avoid significant disturbance
- The avoidance of existing sewer main running through the southern part of the site.

The design of the breach was developed by considering:

- The position of an existing flood relief culvert and channel through the fronting saltmarshes at the southern end of the site.
- The stable breach dimensions based on a regime relationship (Townend, 2008).
- The results of a hydrodynamic flow model which illustrated the maximum flow speeds through the breach and the extent of inundation within the site.

- The requirement for the continuity of the South West Coast Path such that any breach or breaches are crossed by a footbridge Cost effectiveness e.g. one breach vs multiple.

The main elements of the scheme are shown in Figures A.1 to A.3 and are as follows:

- a single breach connecting at the south of the site connecting to an existing channel to the fronting saltmarsh
- a single meandering main channel or creek which decreases in depth and width from south to north
- numerous smaller meandering channels leading off the main channel
- retained existing raised embankment between the Otter Estuary and new site, including a bridge over the breach to preserve the route of the South West Coast Path
- lowered cross embankments in the northern part of the site to reconnect the river to its floodplain
- South Farm Road relocated to the south and raised on an embankment with a new bridge crossing for the creek to pass though the embankment
- blockage of sections of the trunk drain and connection to the creek system. Existing beach culvert remains in place.
- Budleigh brook removed from an aqueduct and realigned into the creek system
- Construction of raised bird roosts/islands
- Land fill covering with inert material
- Improvement to the footpath running along the western side of the site
- Landscape planting.

References

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Townend, I. H., 2008, Breach design for managed realignment sites, Proc. Inst. Civil Eng., Maritime Eng., 161,March 2008, Issue MA1, pp 9-21.

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Figure A.1 Constructed creek system in the south part of the site

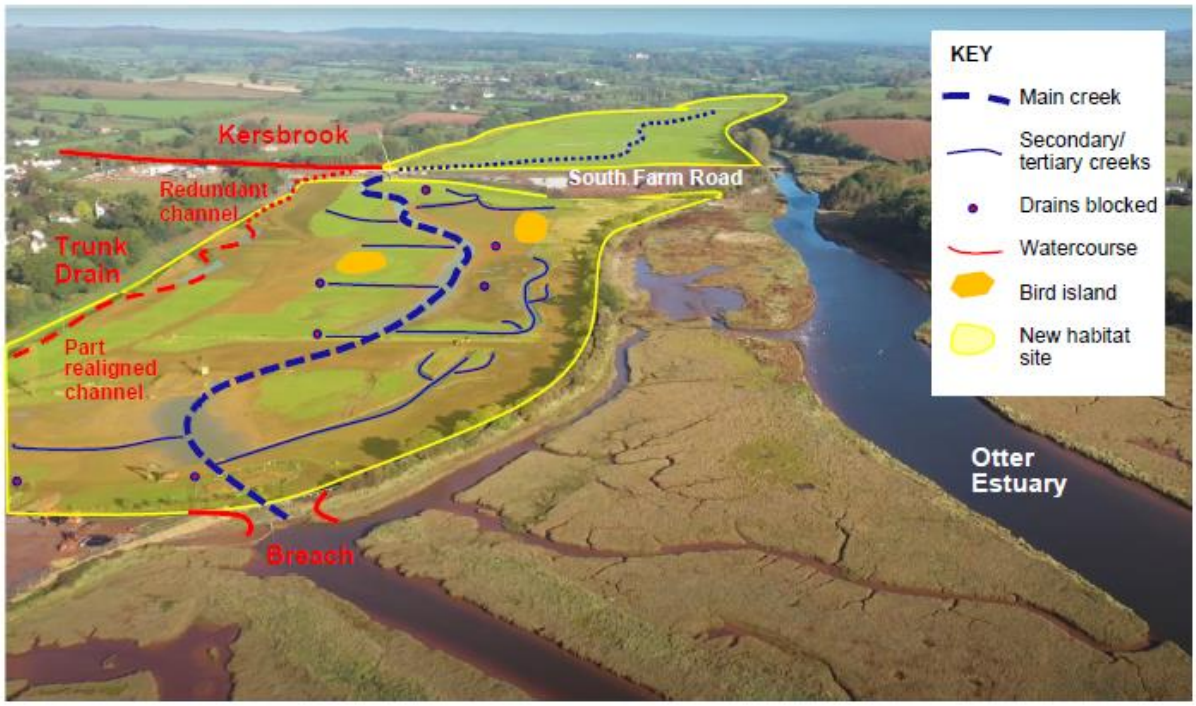
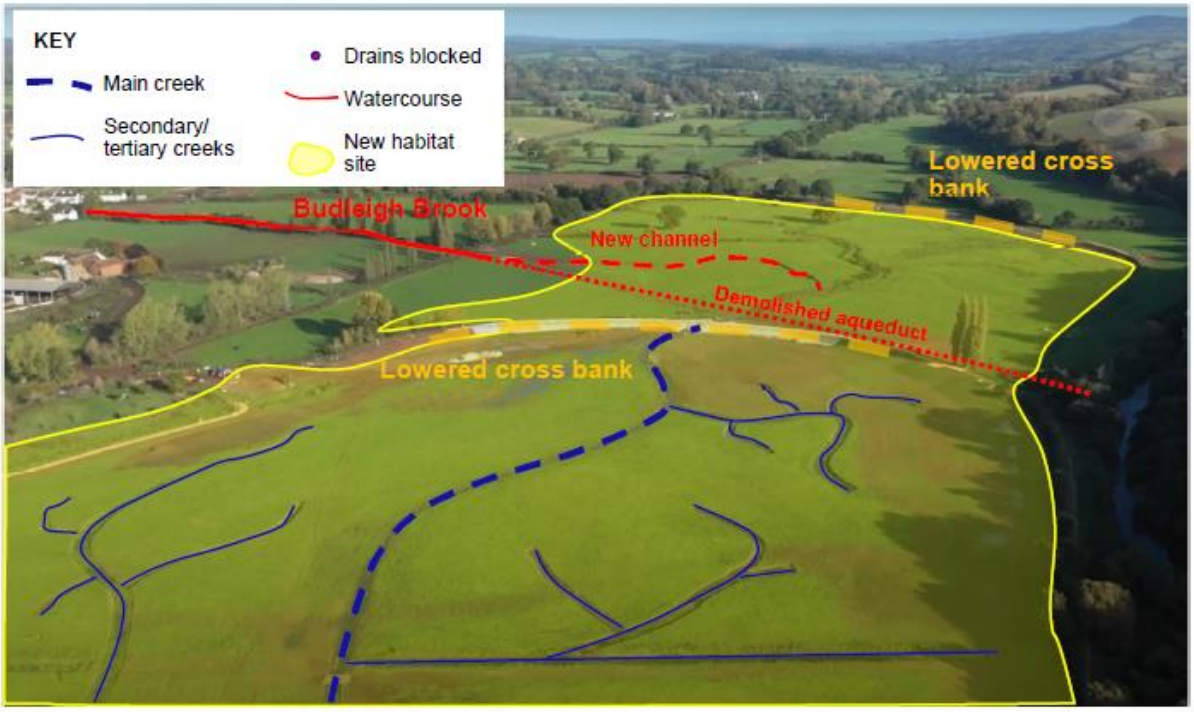


Figure A.1 Constructed creek system in the central/north part of the site.

Figure A.3 Constructed creek system in the north part of the site.



Appendix 4. General Site Risks and Mitigation

General Site Area

Dust and pollution created as part of the works creates a general health hazard to the public, particularly those with respiratory diseases. To minimise pollution and dust created from the embankment construction and traffic, dust suppression techniques such as water bowsers pre wetted areas where required.

Multiple large mature trees with bat roosting potential were removed to enable the car park and embankment construction, potentially disturbing natural activity. All trees were surveyed using climbing and endoscopes during the active bat season. Where no bats were found the tree was immediately felled or roosting features blocked. Where bats were identified, European Protected Species (EPS) derogation licenses were required before commencing any work. Bat boxes have been installed on retained mature trees.

Other existing vegetation potentially suitable habitats for dormice and nesting birds along South Farm Road and the trunk drain required removal or cutting to ground level disturbing natural activity. Where bird nests were identified buffer zones were established with a minimum radius of 5m. No works were permitted until young had fledged the nest as confirmed by the Ecological Clerk of Works. Suitable dormouse scrub removal did not take place until an EPS license had been granted. Once they were in place, one stage clearances were done in April and May. If clearance was not finalised by then, further clearance did not take place till September.

Where hedgerow habitat loss has occurred through construction or will be lost due to saline inundation, new species rich planting will occur beyond the tidal limits along South Farm Road and bordering the car park, providing further habitat for terrestrial invertebrates.

The proximity to waterbodies exposes personnel to waterborne diseases such as Leptospirosis and falls into water resulting in drowning or hypothermia. Works have been undertaken from landward side where possible, watercourse fencing erected and remedial health and safety equipment such as life buoys strategically placed.