Co-implementation activities undertaken in Demonstrators A

Deliverable D2.7

Authors: TAUW, UFZ

Contributors: Demonstrators A

Acknowledgement

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 776866

Document Information

Project Number	**776866**	Acronym	**RECONECT**
Full Title	RECONECT- Regenarating ECOsystems with Nature-based solutions for hydrometeorological risk rEduCTion		
Project URL	http://www.RECONECT.eu/		
Document URL			
EU Project Officer	Nicolas Faivre		

Deliverable	Number	D2.7	Co-implementation activities undertaken in Demonstrators A	
Work Package	Number	WP2	Demonstration	

Date of Delivery	Contractual	10.31.2021	Actual	11.30.2023
Status	version 3		final □	
Deliverable type*	R			
Dissemination level	PU			

*R – Report, P – Prototype, D – Demonstrator, O – Other.

**PU – Public, PP – Restricted to other programme participants (including the Commission Services), RE – Restricted to a group specified by the consortium (including the Commission Services), CO – Confidential, only for members of the consortium (including the Commission Services).

Authors (Partner)	Christa Fung-A-Loi (TAUW), Ramon van Bruggen (TAUW), Diana Dushkova (UFZ)			
Responsible Author	Name	Christa Fung-A-Loi	Partner	TAUW
Contributors (Partner)	*Christian Ebel (FHH), Ana Julia Kuschmierz (FHH), Hartmut Dittrich (FHH), Dieter Ackerman (FHH), Luis Manuel López Zárate (FHH), Yohannis Tadesse (TUHH), Natasa Manojlovic (TUHH), Lars Sønderby (Odense), Eva Crego (ACA), Guido Paliaga (CNR), Fabio Luino (CNR), Laura Turconi (CNR), Francesco Faccini (CNR), Alessandra Marchese (GISIG)*			

Abstract (for dissemination, 100 words)	The presented report describes the co-implementation activities undertaken within Demonstrators A. By presenting and analyzing the local context and conditions, chosen NBS design and status of the project, co-implementation strategy, regulatory processes, public attitudes and stakeholder involvement as well as construction practices, it also reveals the barriers in the co-implementation process as well as suggest the ways / approaches to overcome them demonstrating the added value of of co-implementation to the whole RECONECT project.
Keywords	NBS, co-creation, co-implementation

Version Log				
Issue Date	Rev. No.	Author	Change	Approved by
12.20.2021	1	YAA, ZV		ZV
12.20.2022	2			ZV
24.11.2023	3			

Executive Summary

The aim of this deliverable is to report the co-implementation activities undertaken in Demonstrators A within the RECONECT project. This results in insights regarding barriers and added value of the co-implementation process for Nature-Based Solutions (NBS).

Co-implementation (along with operations and maintenance) is considered an important part for the success of an NBS. Co-implementation answers the question How do we do it and what is the potential for added value to the NBS? in terms of development and implementation of selected and co-designed NBS in land use management. Understanding of the potential to combine the solution with improvements for water, nature and people, regulatory processes, public opinion, stakeholder involvement and construction practices leads to support and acceptance of the NBS.

In the first place, collaborators and other partners within the RECONECT project can benefit from the lessons learned during the co-implementation within Demonstrators A. Additionally, this deliverable also addresses practitioners (beyond RECONECT) who are involved in the realization of NBS, in particular in regard to construction and implementation.

The key findings and lessons learned are:

- Apart from general on-topic discussions during on-site visits (bilateral and General Assemblies) and online sessions, there is barely any co-implementation between Demonstrators A. This is mainly due to the different (geological) conditions of their project area (urban, coastal, mountainous) and the projects being in different stages. This made exchanging specific experiences difficult.
- In terms of regulatory processes, the required permits are prepared by the main organization who carries out the project (RECONECT partner) and handled by local responsible authorities.
- In terms of stakeholder involvement and public opinion, mostly top-down approaches have been applied. A common activity in all the Demonstrators A is the stakeholder mapping done by UFZ at the start of the RECONECT project. This resulted in the preparation of the co-creation activities within RECONECT (presented in deliverable 2.1), which will be further expanded.
- An important identified encountered barrier in the co-implementation process between Demonstrators A within the RECONECT project is the impossibility to travel (because of COVID), causing bilateral in-depth discussions to be impossible. Another barrier is the general understanding of NBS and their multiple benefits, which may take away feelings of uncertainty from stakeholders. Also, the lack of mechanisms and networks in place that allow co-implementation, as well as the lack of cultural habits, makes it very difficult to change the common top-down planning and implementation approaches. Land acquisition is also mentioned as a potential barrier in co-implementation within DA2 Odense, DA3 Tordera and DA4 Portofino. Negotiations with landowners may take a lot of time and hamper the project timeline. Because of this, it is expected that DA3 Tordera will not do the construction in the RECONECT timeline and that Tordera will continue in the project as a Collaborator.
- Term clarification is needed for good communication and networking with different stakeholders, not only during the implementation, but also at the following stage of co-monitoring and co-evaluation as well as for the whole NBS concept which should be clear for non-professionals.
- The added value of co-implementation is mostly derived from involving local stakeholders and gaining acceptance and support for the project.

Although the NBS projects in Demonstrators A differ in terms of local -e.g. geological, geographical, environmental conditions and social contexts (institutional settings, hierarchy, bureaucracy, cultural contexts) as well as resources and capacities and the fact that the projects are all in different project stages, co-implementation is still possible on different topics. These topics can be addressed within the twinning activities which enable knowledge sharing, exchange of experience, inspiration, tutoring, regular communication and transparency.

A specific recommendation is to organize in-depth experience sharing on land acquisition with the specific needs from Demonstrators A. Both DA3 Tordera and DA1 Hamburg (for the retention areas) will have to go through this phase.

Contents

List of figures

1 Introduction

Implementation of Nature-Based Solutions (NBS) for hydro-meteorological risk reduction offers the possibility to break away from traditional practices and enables to reconnect our land management practices and developments with nature in order to achieve multiple benefits to services and functions of ecosystems. According to Olsen and Bishop (2009) and van der Nat et al. (2016), such measures are potentially more cost-effective and adaptable than traditional hard engineering measures. However, cost-effective design and implementation of NBS is only part of the answer. Of equal importance is the ability to address the effects of a changed climate with the biodiversity crises and place them in diverse local and cultural contexts and integrate them into broader land and risk management strategies.

It is therefore of crucial importance to understand the complexity of each case and to design the NBS in such a way that they not only minimize negative impacts, but that they also contribute to making social/economic and environmental/biodiversity improvements. At the same time, the use of an NBS shall increase resilience to hydro-meteorological events, and ensure upscaling, business models and financial viability of any interventions.

Examples of large scale NBS for hydro-meteorological risk reduction with a broader view on the potential positive impacts on social/economic and environmental factors, which can provide proof-of-concept for their upscaling and replication are currently lacking. There is a clear need to enhance their evidence base through demonstration within the European reference framework.

RECONECT is an interdisciplinary international project that aims to contribute to the European reference framework on NBS by demonstrating, referencing and upscaling large scale NBS and by stimulating a new culture for 'land use planning' that links the reduction of risks and improvements for biodiversity with local and regional development objectives in a sustainable way.

In order to contribute effectively to the EU reference framework on NBS and to generate higher impacts across Europe, RECONECT draws upon a number of Demonstrator sites. They have been carefully selected to cover a range of local criteria including i) climatic and geographic conditions, ii) type of hydro-meteorological events (floods, storm surges, droughts, landslides), and iii) vulnerability to these events. Besides these criteria, the potential for collaboration and upscaling has also played a role in the selection process.

The RECONECT network of cases includes Collaborators (European and international) and Demonstrators (European). Demonstrators are divided in two types: Demonstrators A and B (see Figure 1-1). In Demonstrators type A the large scale NBS will include the full co-creation and validation process during the project lifetime either by requesting co-funding from the EC and/or by deploying their own funds and resources. The Demonstrators Type B cases have a considerable track record in implementing large scale NBS in natural and rural areas and particularly those that are sensitive ones (e.g. mountainous and coastal areas, at watershed/landscape scale) with high local/national/international visibility. In order to capitalize on the experiences of already implemented NBS, RECONECT will demonstrate their NBS by co-monitoring, co-evaluating and validating their multiple benefits.

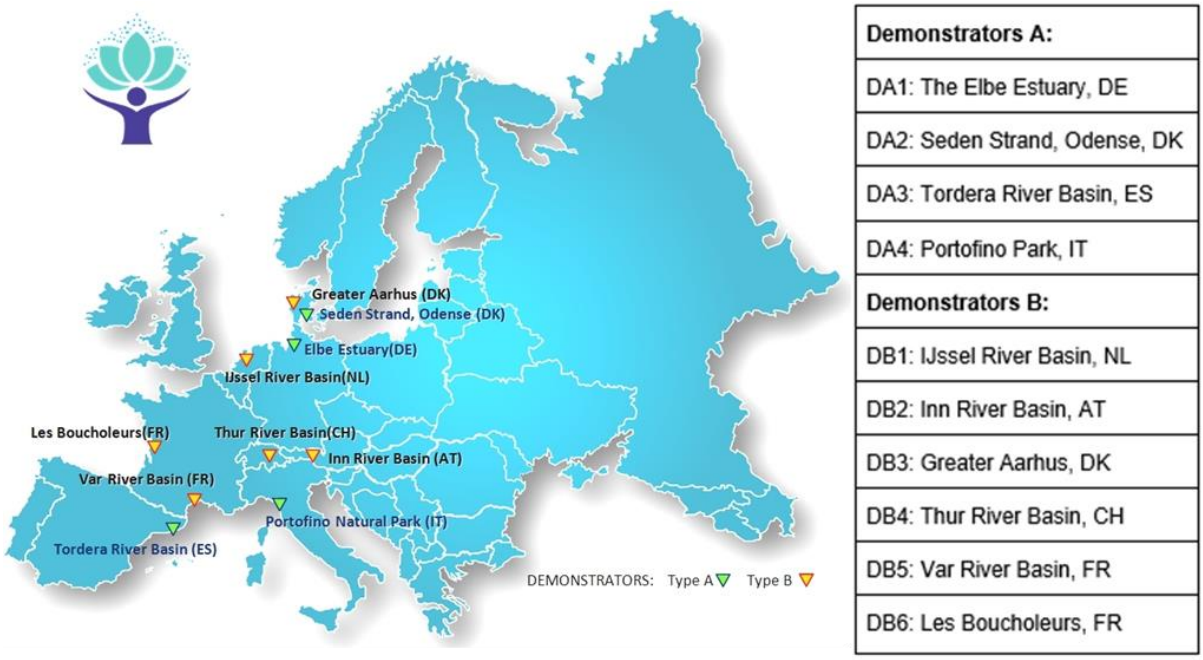


Figure 1-1 Geographic spread of the RECONECT Demonstrators

The co-creation process is identified as one of the key challenges within RECONECT. Preferable NBS and their associated methods that meet relevant stakeholders' needs by active involvement of a participatory process should be identified. The RECONECT co-creation strategy linked to the concept of social innovation (D.1.2) and a related approach to stakeholder mapping and analysis (D2.1), together with a Manual for practitioners presenting a participatory approach to co-creating NBS (D3.5) facilitates practical application of social scientific methods of stakeholders' engagement, providing them necessary knowledge to decide and act within their role in the process. Moreover, the co-creation process may lead to increased legitimacy and support from stakeholders by going through the following steps: firstly starting with informing (the first level of co-creation making stakeholders informed about NBS) and, secondly, going through consultancy (second level which enables two-ways dialog to enhance feedback from stakeholders) to subsequently having initial engagement (third level of co-creation when collaboration and partnership start) and active engagement (the highest level of co-creation with equal partnership enabling co-design, co-production and co-creation together).

Within the RECONECT project, four phases have been identified for the co-creation process to implement an NBS: co-assessment, co-design, co-implementation and co-evaluation and monitoring (see Figure 1-2).

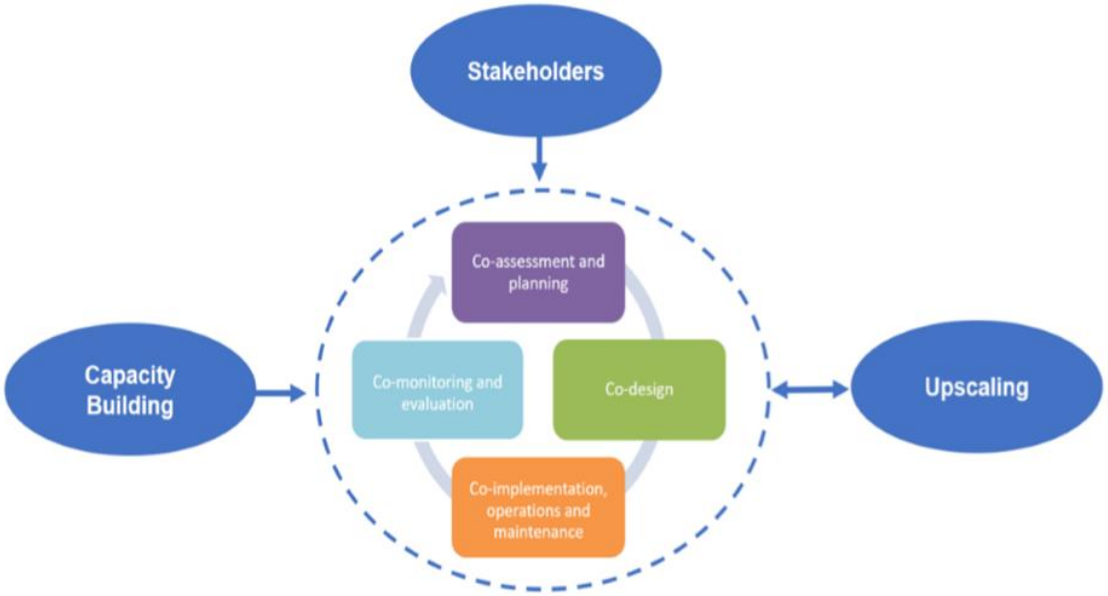


Figure 1-2 Co-creation process of NBS within RECONECT's Social Innovation Approach (Source: RECONECT D1.2)

Co-implementation is applicable to Demonstrators A, who develop and implement their NBS during the RECONECT project. Co-implementation answers the question *How do we do it and what is the potential for added value to the NBS?* in terms of development and implementation of selected and co-designed NBS in land use management. Co-implementation requires an in-depth understanding of the potential to combine the solution with improvements for water, nature and people, regulatory process, public opinion, stakeholder involvement and construction practices.

Within task 2.7 *(Co-implementation: Construction/Demonstration of NBS in demonstrators Type A)* information is acquired and analyzed to assess the co-implementation activities undertaken in Demonstrators A. This will be done mostly based on the outcomes of tasks 2.1 and 2.3. The aim of this deliverable (D2.7) is to report the co-implementation activities undertaken in Demonstrators A within the RECONECT project. This results in insights regarding barriers and added value of the co-implementation process for NBS. This deliverable describes a phase of the co-creation process within RECONECT and the links with other deliverables include:

- Deliverable 1.2: Social Innovation approach of RECONECT underpinned by co-creation processes provides the social innovation methodology which guides an inclusive approach to the exploration, production and implementation of innovative solutions for disaster risk reduction (DRR), including NBS.
- Deliverable 2.1: the co-creation process is prepared by conducting a stakeholder analysis and thus laying the groundwork for interaction between stakeholders in Demonstrators' sites.
- Deliverable 2.2: Demand and Supply – Demonstrators – provides details on Demand and Supply Analysis, especially the results of a scoping survey conducted among all Demonstrators in order to understand their objectives and motivations to participate in RECONECT, types of NBS they are focusing upon and which risks and tasks they address as particular relevant within RECONECT. It also provides the previous experience, expertise, capacities, policies and barriers as well as lessons learned by Demonstrators.

- Deliverable 2.3: a co-assessment has been conducted by specifying the baselines and scoping of detailed requirements of Demonstrators A and B. The scope of works for Demonstrators have been analyzed and provide substantial information about, among others, the NBS type, location characteristics, governance structures, stakeholders and plans of action
- Deliverable 2.4: the co-design process resulted in the technical specifications and procurement processes for Demonstrators. Within Demonstrators A, the focus lay on the assessment, design and preparation of construction works and within Demonstrators B the focus lay on operation and maintenance.
- Deliverable 2.6: the preliminary co-evaluation and co-monitoring plans for both Demonstrators A and B have been described in this deliverable which serves as a useful reference for researchers and practitioners in and beyond RECONECT who are engaged in activities concerning NBS implementation and in particular, activities related to monitoring and evaluation of NBS sites, providing the list of defined indicators for the Water, Nature and People challenge components.

This deliverable describes the status of the project and the co-implementation activities that have taken place up till now.

This deliverable aims to support numerous audiences. In the first place, collaborators and other partners within the RECONECT project may benefit from the lessons learned during the co-implementation within Demonstrators A. Additionally, this deliverable also addresses practitioners (beyond RECONECT) who are involved in the realization of NBS, in particular in regard to construction and implementation.

2 Methodology

To address the aim of this deliverable, information is gathered from the Demonstrators A and then analyzed to summarize the co-implementation activities undertaken in Demonstrators A.

2.1 Information gathering

Information is gathered through a survey template that was disseminated to the Demonstrators. The survey template is added in Annex A. The main contents of the survey template are:

1. Case description
   This section provides information of the Demonstrators' case in general and is derived from previous deliverables D2.3 and D2.4. If there is any additional information available besides what was already published in previous deliverables, Demonstrators were asked to add this information.

2. NBS design and status of the project
   This section provides information about the technical design of the NBS and the current state of the project. The Demonstrators A are in different project stages and the current state of the project gives insights in what kind of co-implementation activities may be expected. For example, if the project is still in the process of acquiring permits, co-implementation regarding construction activities are not yet expected. In D2.4 the technical specifications of the NBS are described which include the final NBS measure to be implemented. Demonstrators were asked to describe the status of the project (what is done up till now) and if there are any changes to the design of the NBS compared to what has been published in D2.4.

3. Co-implementation activities undertaken
   This section provides information about the co-implementation activities undertaken within the Demonstrators A projects. The demonstrators were asked to describe the co-implementation activities with partners or third parties within the RECONECT project but also within their country in terms of regulatory processes, public opinion and stakeholder involvement and construction practices.

4. Encountered barriers in the co-implementation process
   This section provides information about the barriers the Demonstrators A have experienced to derive insights for improvement. The demonstrators were asked to describe the barriers they have encountered in the co-implementation process of their project within the RECONECT consortium but also within their country.

5. Added value of co-implementation to the project
   This section provides information about the potential of added value of co-implementation to NBS projects. The Demonstrators were asked to describe the added value they have experienced in their project from co-implementation activities within the RECONECT consortium and/or within their country with other parties.

Within all the Demonstrator cases, the RECONECT project also has a role in assisting Demonstrators A through several activities such as on-site visits, workshops, webinars, etc. Information about the activities that stimulate co-creation and co-implementation is

gathered from the Demonstrators and other RECONECT partners who have contributed to these activities.

2.2 Information analysis

The gathered information is analyzed to derive conclusions about the co-implementation activities undertaken in Demonstrators A to answer the questions *How do we do it and what is the potential for added value to the NBS?*. General conclusions about the co-implementation activities within the RECONECT project are derived, and then specifically in terms of regulatory processes, public opinion and stakeholder involvement and construction practices.

3 Demonstrator DA1: Elbe “Vier -und Marschlande” Germany

3.1 Case description

The main goal of the demonstration activities in the German Demonstrator (DA1) is the reactivation and the distribution of the storage capacity upon need of the rivers Bille, Dove and Gose Elbe, including their tributaries and trenches (such as Brookwetterung or Curslack) and their flood plains which encompasses an area of 175 km^2 (Figure 3-1). This leads to more retention volume for water during flooding events and at the same time contribute to necessarily stable water levels in the rivers during drought events.

The main functional elements of this solution are the (natural) storages in the water courses and in the flood plains of the demonstration area. The distribution of the storage volume during flood events will be managed by the RECONECT NBS operation and controlling system. It will make use of previous studies and rainfall- runoff and hydrodynamic models as well as of the conceptual design of the operation system (mainly developed in STUCK Project, see Helmers et. al., 2017) and will be further developed to be ‘ready-to-use’ by the operators and asset owners.
The (improved) management of the retention areas in the Dove/ Gose Elbe river system is expected to generate the following benefits:

- Improved management of the hydrometeorological events being floods and droughts
- Improved ecological condition of the area due to optimised use of the retentions and floodplains
- Improved liveability and social value of the area also contributing to the tourism, that is gaining relevance in the area (Meine& Schruttke, 2018)
- The conversion of grey infrastructure into hybrid solutions by combining the existing grey assets (such as pumping stations) with the RECONECT NBS approach
- The expansion of the existing linear and disciplinary approach (a piecemeal approach to floods and drought management) into a holistic approach

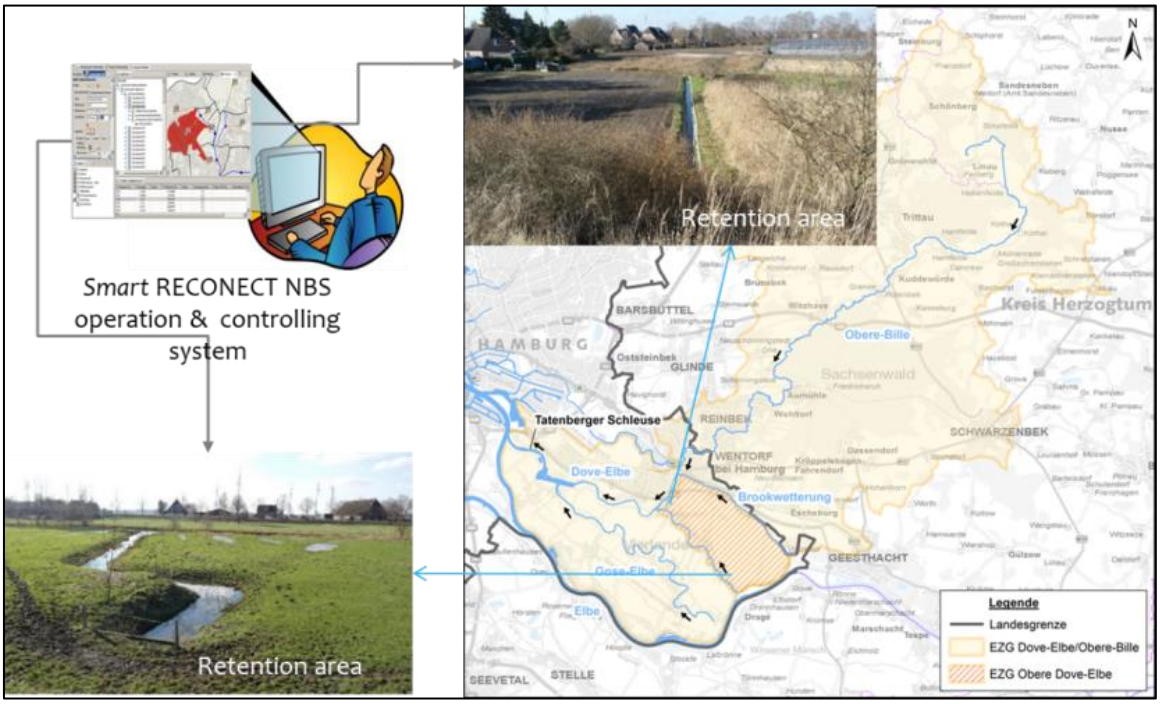


Figure 3-1 The demonstration area Dove/Gose Elbe (marked in yellow) and the typical retention areas

The construction/implementation phase of the NBS will include the following steps:

- Setting up and operation of the server for the control& operation system
- Setting up of the rainfall- runoff model for
- Technical implementation of the automatic data transfer from the forecasting system regarding surges, precipitation, discharges to the server
- Technical implementation of the optimised management of the retention areas due to control and distribution of the storage volume
- Adaptation of the retention areas (if required)

3.1.1 Geomorphological characteristics

The network of small rivers and streams Dove/ Gose Elbe is located in the south eastern part of the City of Hamburg in the borough of Bergedorf, the largest of seven boroughs of Hamburg. The river system belongs to the complex drainage network of the landscape area Vier- und Marschlande, which includes Bille / Schleusengraben and Brookwetterung rivers in addition to Dove Elbe and Gose Elbe (Figure 3-2).

The catchment size of the Dove/ Gose Elbe river system considered for the RECONECT demonstration is 175 km^2. It is dominated by the natural and agricultural areas (70%). Based on the soil measurements conducted on approx. 2500 measuring spots in the area (BUE, 2015) the soil type is typical for marsh areas. It has an impermeable top layer of on average 6m thickness, usually composed of clay or turf (kf = 1 * 10^{-8} to kf = 1*10^{-9} m/s). Beyond this layer, sandy and gravels till -30 m NHN. Only in the north-eastern part of the area (that belongs to the federal state Schleswig- Holstein) the geest soil type (sandy and silty) is dominating. It is a low-lying area with an elevation between NHN 0 m – 5m.

3.1.2 Climatic conditions

The demonstration area is subjected to the maritime climate due to its proximity to the North Sea. The most relevant parameter for the demonstration activities is the precipitation. Figure 3-2**Error! Reference source not found.** depicts the precipitation (N) in [mm] expressed in monthly values for the weather station Hamburg- Billwerder that is located in the demonstration area.

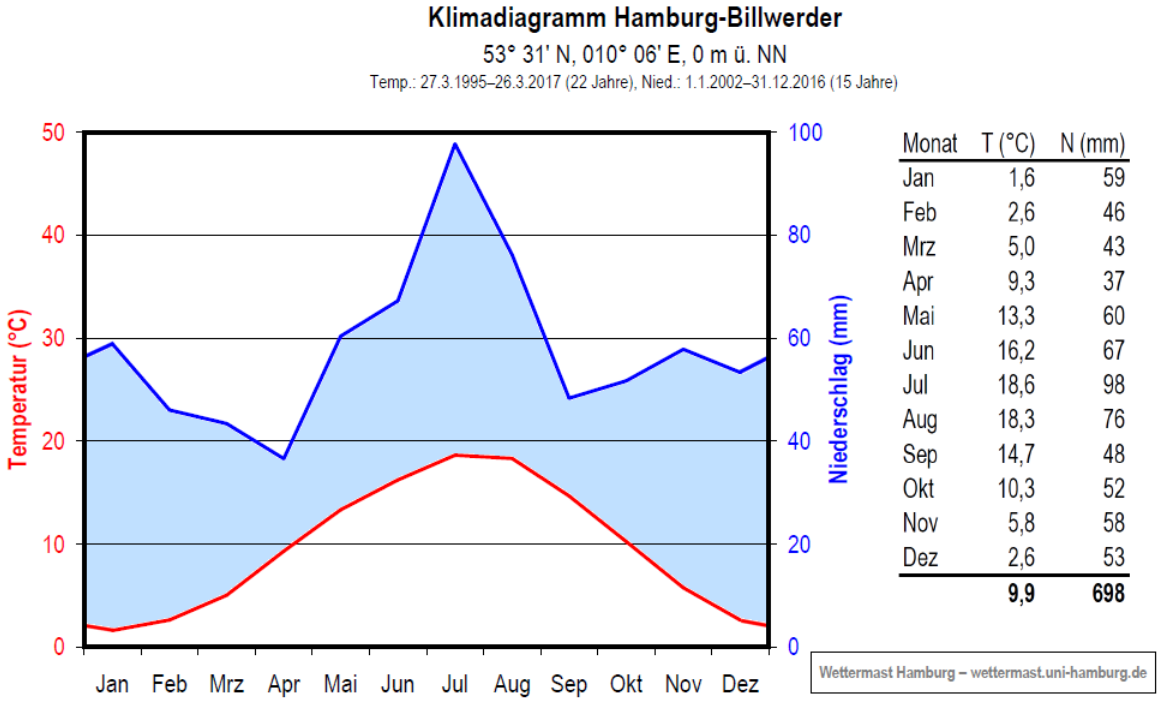


Figure 3-2 Precipitation values (N) in [mm] for the weather station Hamburg Billwerder location in the demonstration area (Source: University of Hamburg https://wettermast.uni-hamburg.de/frame.php?doc=Klimadiagramm20170328.htm)

3.1.3 Hydrological conditions

The hydrological conditions in the area areas highly complex and are based on the nature of the problem (tidal influenced marsh area) as well as due to the historical development of the area. By decoupling or (re)connecting the rivers, tranches or ditches in the area, a complex network of rivers has been developed.

The two main rivers of the system ***– Dove-Elbe and Gose-Elbe*** – are branches of the Elbe river that have been hydraulically decoupled from Elbe River by dikes and sluices. In order to regulate the water levels within the drainage area, a highly complex system, which consists of the above mentioned water courses and water management facilities (e.g. pumping stations, pumps, locks, gates) were developed over time (see figure 3-3).
The Dove-Elbe sluice divides the Dove-Elbe into upper and lower Dove-Elbe. The lower Dove Elbe begins at the Dove-Elbe sluice and runs up to the dike lock Tatenberger, where Dove-Elbe flows into Elbe river. The lower Dove-Elbe receives regulated flows at the upstream from upper Dove Elbe via Dove Elbe sluice and from Neuer Schleusengraben via Krapphofschleuse sluice, on the left side towards the end of the river from Gose Elbe via Reitschleuse sluice and the flow at the downstream outflow into Elbe river is regulated via the dike lock Tatenberger. These water management facilities control the potentially occurring unfavourable combination of inland floods and storm surges from the tidal Elbe river.

The upper Dove Elbe begins behind Elbe River dike as a ditch and ends at the Dove Elbe sluice. The catchment areas of the Dove Elbe and Brookwetterung (see figure 3-1) are approx. 54 km² and 37 km², respectively. About half the catchment of the Dove-Elbe is occupied by Curslack / Altengamme water extraction area and contains the drinking water production area of the Curslack waterworks, which has been supplying drinking water to Hamburg as part of Hamburg's largest waterworks since 1928.

The Gose-Elbe also begins behind Elbe river dikes as a ditch and flows in direction north-west. Gose-Elbe and Dove-Elbe are joining at the Reitschleuse sluice. Gose-Elbe has a catchment area of about 69 km² and is mainly drained via a pumping station into the Dove-Elbe as indicated in figure 3-3 as the elevation of the area is quite flat and water flow from the river to the area has to be prevented. The Gose Elbe is also directly connected to upper Dove-Elbe by the Neuengammer Durchstich.

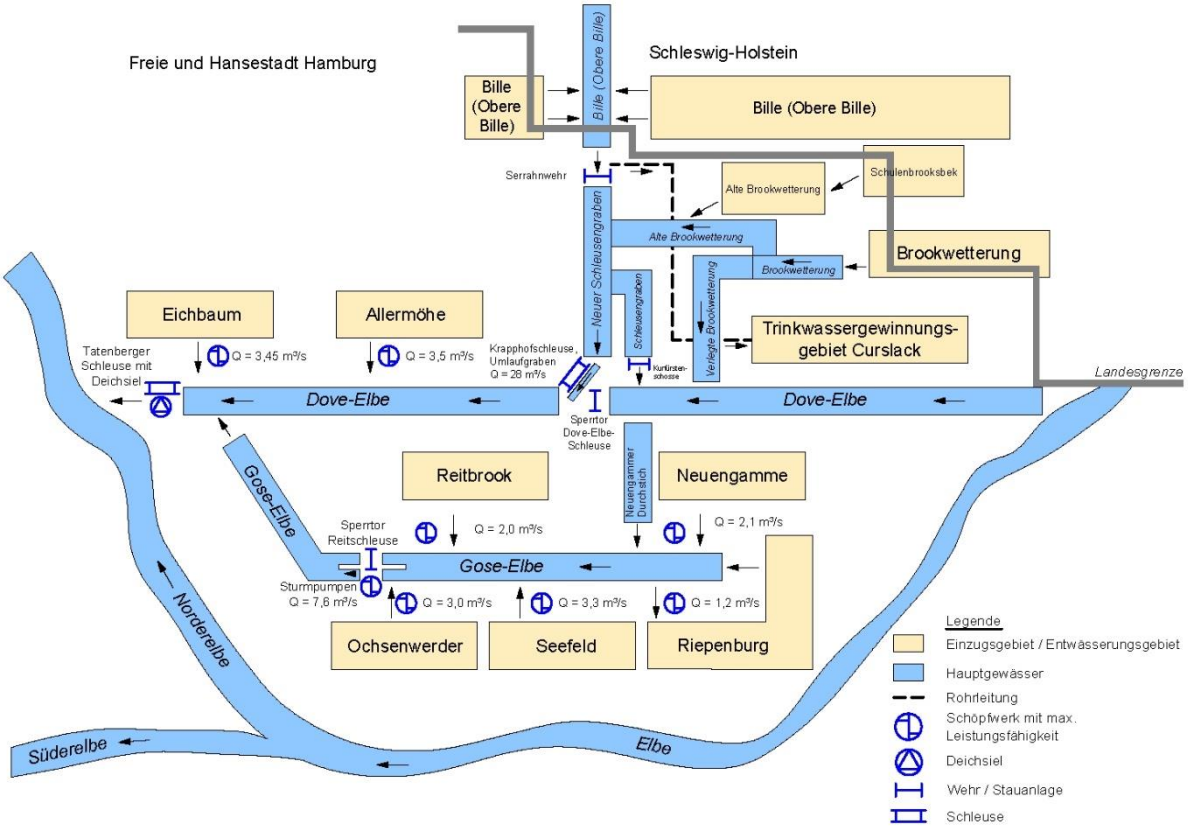


Figure 3-3 The Dove-/ Gose-Elbe river System with its main elements (subcatchments, main water courses, pipe network, pumping stations, dike outlets, weirs, locks)

Groundwater is a main parameter in the demonstrator area, due to its exploitation for drinking water supply.
The groundwater body (El12) is with respect to chemical and quantitative status in a poor state. The reason for the poor state are locally high concentrations of chloride caused by saltwater intrusions. Regional analyses specific for the project area can be made by the water analysis from groundwater observation wells. Groundwater levels in the area are depicted in figure 3-4.

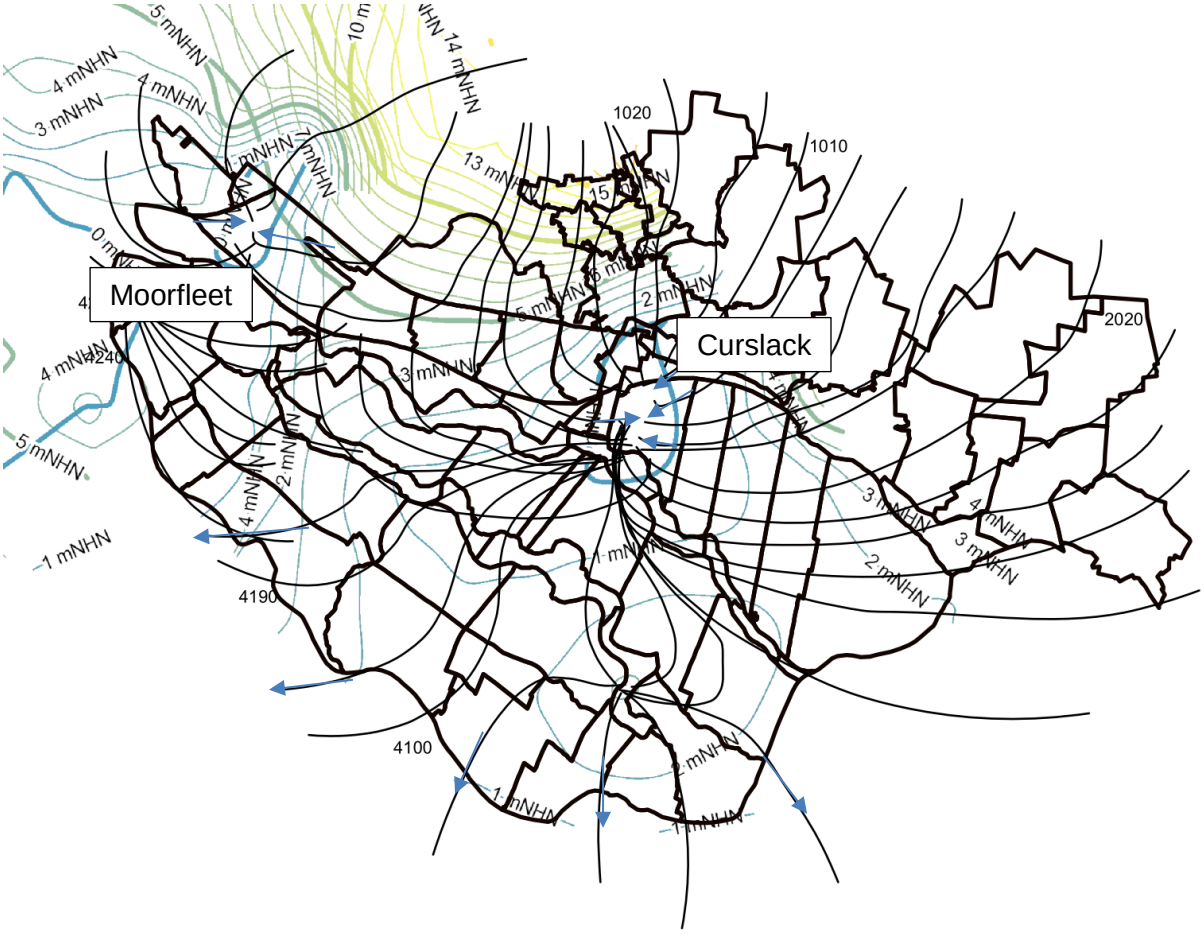


Figure 3-4 Groundwater level and flow direction. Curslack is the main potable water source in Hamburg; Moorfleet is the low-lying urban area (Source STUCK project)

3.1.4 Hydro-meteorological hazard and problem description

The NBS to be implemented in RECONECT will address the two main hydro-meteorological hazards:

- Flooding of the marsh area in the Dove/Gose Elbe catchment
- Droughts including the failure to provide the required potable water volume for the water supply of the City of Hamburg

In the demonstration area the flood prone areas has been designated as per the EC Floods Directive 2006/60/EC (taken up by the Hamburg and Federal Water Acts). The process of designation passed the public hearings and participation during the period of 2015-2017.

3.1.5 Nature

Different types of protected areas for the preservation of natural resources are located within the demonstration area.
The area is of prominent importance as groundwater extraction site for the drinking water supply of the City of Hamburg . The status of these areas regulated by the Federal Water Act and Water Act of the City of Hamburg. This area comprises a total of 28 km².
Furthermore, the following protected sites were declared or determined in the demonstration area.

- nursing grounds and growth areas of juvenile fishes,
- areas for recreational purposes and swimming (EC-Directive 76/160/EC),
- as hazardous area according to the Nitrate Directive (EC-Directive 91/676/EC),
- and as nutrient sensitive area according the waste water directive (Directive 91/271/EC),

16.01 km² of the working area comprises the extension of protected areas according to the European Directive on the Conservation of Wild Birds (79/409/EC) and *Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora* (92/43/EC). 15.99 km² comprise nature protection areas related to surface water according to the Hamburg Natural Environment Protection laws.

3.1.6 Stakeholders

In the demonstration area, there are a number of public and private stakeholders that are having an influence on or are affected by the NBS activities. The key public stakeholders have been identified as follows:
1. The Ministry of the Environment and Energy responsible for the management of water courses and groundwater (BUKEA)
2. The Agency for Roads, Bridges and Waterways (LSBG)
3. The Hamburg City Borough of Bergedorf
4. Hamburg Water Utility responsible for the water supply of the city of Hamburg (Hamburg Wasser)
5. Politics (including the Senate Chancellery)

Further, the following stakeholders have been identified and should be considered for the co-creation of NBS:

- Heritage Conservation Agencies
- Water boards
- Dwellers and general public
- Local organisations and associations such (e.g. the fishing clubs)
- Nature conservation actions and associations
- Business and Industry:
  - Shipping
  - Tourism
  - Agriculture
  - Real Estate Agencies
- Universities/ Science

Also, the politics and the developments at the political and strategic level are perceived as a potential risk and can have an impact on the NBS implementation in the area.

The actual roles and relevance of the above mentioned stakeholder groups are developing in a dynamic manner and the distribution of roles and relevance is discussed among the RECONECT team. An outcome of the discussion on the stakeholders is depicted in Figure 3-5.

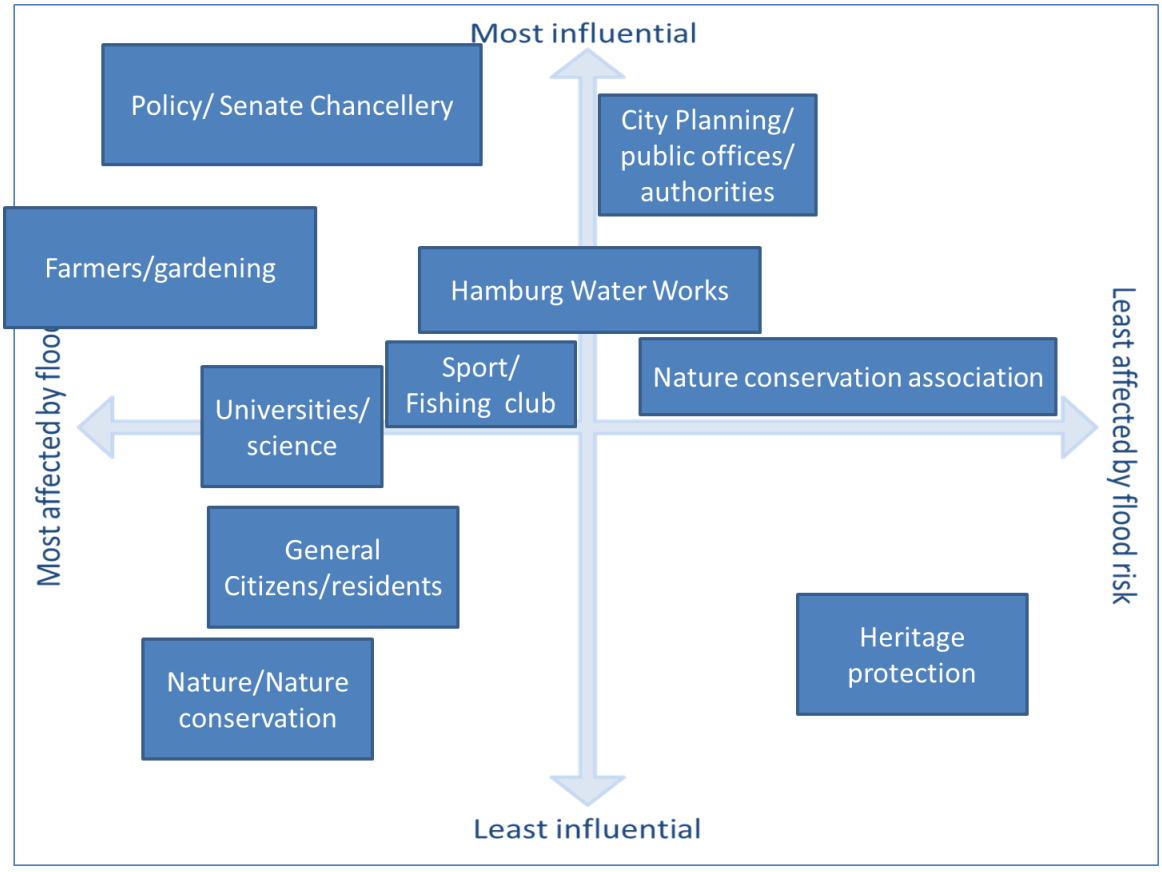


Figure 3-5 Organo-sociogram of the key stakeholders in the demonstration area (one version produced by the members of the RECONECT HH team)

The main authority involved is the Ministry of the Environment, Climate, Energy and Agriculture (BUKEA) who is the responsible for the design and implementation of the NBS. The borough of Bergedorf will operate and maintain the system with the support from the BUE.

The ministry of Environment and Energy is owner of the NBS. The maintenance and operation will be conducted by the Bergedorf district.

The NBS demonstration will be undertaken by the Ministry of Energy and Environment (BUE) supported by the Agency of Roads, Bridges and Waterways (LSBG) and the Bergedorf district. Hamburg University of Technology (TUHH) will provide the scientific support to the implementation. The Senate Chancellery coordinates the different project activities.

3.1.7 "People" – socioeconomic aspects

The Vier- und Marschlande is a rural and natural area of the State of Hamburg with 27. 431 Inhabitants (Census Data Hamburg North, 2015). It is dominated by the natural and agricultural areas, where typically vegetables, plants and flowers are grown. Due to the natural areas, some of them being under the protection of NATURA 2000, it is also often used as a recreational area (sports, fishing, boat tours) and for tourism.
Within the Communication and Participation Program Forum Tideelbe (https://www.forum-tideelbe.de/), the co-creation process has already been initiated involving the key stakeholders in the area while addressing the future development of the Dove/ Gose Elbe area (Meine& Schruttke , 2018)

3.2 NBS design and status of the project

This project is a hybrid implementation and consists of two elements: (1) a real-time controlling system of the dike lock Tatenberg (gates as part of a grey solution) and (2) retention areas / volume gained by real-time control of the drainage facilities (retention areas / volume as part of water storage solution).
The hybrid NBS implementation is based on a pro-active operation of the drainage infrastructure supported by weather forecasts. In the case, that unfavourable weather conditions are expected (i.e. high precipitation) the lowering of the water level of the Dove- / Gose-Elbe furthers system storage volume for rainwater, avoiding exceedance of critical water levels behind the main dike line. The implemented hybrid NBS contributes to an effective nature based flood protection in the project area.

The developed hybrid NBS can also be applied to develop the current flood plains present in area towards close to nature flood plains.

On the banks of the Dove- and Gose-Elbe the original vegetation to be expected in absence of human activities would consist of wood free vegetation, softwood and hardwood structure. Nowadays fragmented reeds and a tall perennial corridor as vegetation can be found as well as pioneering vegetation on the river banks of low slope. Due to the intensive use as grassland, most of the flood plains of the Dove- and Gose-Elbe are only reminiscent of the original autochthonous vegetation which can be found in fragmented extensions. The intensive agricultural use of the flood plains limits the natural succession of vegetational development to very scarce and confined (in extension) areas. With very little alterations of the physical environment (enhancement of the water level) these areas could potentially gain significant ecological value inducing the development of soft and hardwood forests.

The proactive operation mechanism of the dike lock Tatenberg, being implemented by RECONECT will also allow to enhance the water level of the surface waters in future. Currently the use of the flood plains does not allow the enhancement of the water level. Anyway, in the case of changes of the use of flood plains, which may be implemented in the future, the operation mechanism can be adapted to support the natural development of the flood plains by increasing water levels. Flood plains could be reactivated and vegetation and habits could recover and develop accordingly.

<u>The real time controlling system of the dike lock Tatenberg</u>
At the moment, the smart real time controlling system of the dike lock Tatenberg is already implemented and consists of the Tatenberg lock (locks, water level weirs) and the forecast system through Flood Early Warning System (FEWS).

The water management facilities at Tatenberg connects and separates the Vier- und Marschlande from the Elbe river. This complex structure consists of the sluice for the locking of ships and a dike lock with three culverts (see Figure 3-6) able to adjust outflow into the Elbe river for the drainage of the area (for location see Figure 3-1).

Figure 3-6 Inlets of the culverts of Tatenberg Sluice

The dike lock control is programmed to keep a water level of 90 cm in the main water bodies of the Vier- und Marschlande. Under average normal conditions this is done using one or two of the culverts. In case of a flooding event, actions take place when the water level reaches a threshold of 110 cm.

When drainage is not possible due to high water levels in the Elbe river, a backwater effect is caused in the lower-lying areas of the region. A complex system of pumping stations, gates and dams is operated to discharge and temporarily store the water. The river Bille from the neighbouring federal state of Schleswig-Holstein is an important tributary to the area. If high water levels occur inside and outside the area due to storm surges and high precipitation, the low-lying areas are at risk of flooding.

A smart NBS control system is being developed, which covers elements from prediction of hydrometeorological conditions to the control of the water management facilities. For this purpose, the control of water management systems was simulated with a 2D model and different optimization variants were calculated. The calculated optimization variants are put into practice and applied on the basis of precipitation and runoff forecasts. By applying of real-time controlling tools (RTC) the control of five water management facilities is specified in detail.

With the above mentioned model, various case scenarios were computed in order to get a better knowledge of the system and later optimize the Tatenberg Lock gate. This optimization includes three measures:

- Lowering of the inland water level in case of flood forecasts; this increases the retention volume of the basin, while simultaneously it delays the moment when the water level reaches the threshold of 110 cm.
- Regular drainage via three culverts during floods (from a certain water level) in order to increase the discharge capacity, shortening the duration of the flooding event.
- Extension of the drainage period, which also helps shortening the duration of the flooding event.

The measures do not require any construction changes, but the operation of the Tatenberg Lock gate will be modified in the event of a flooding event.

The measures are to be triggered by forecasting discharges and water levels with the use of a rainfall-runoff model in practice. The FEWS software combines forecast and calculation data and the output of signals for flood protection.

Retention areas for the real-time controlling scenario

In addition to the development of the hybrid NBS described in the beginning of this chapter the RECONECT team attempts to find nature areas in the project area which could also be developed in NBS. This is to be understand as an add-on to development and implementation of hybrid NBS being the focus of the project activities.

An intensive search for suitable and available retention/nature areas for NBS took place in Hamburg since the beginning of the RECONECT project. The demonstration site is densely populated and due to competing land use interests it is difficult to identify suitable areas for the retention areas. In 2021, the local RECONECT team was able to identify two potential areas that would not compete with other use purposes or even causing conflicts if modified as required.

It cannot be overstressed that within the highly urbanized City of Hamburg the competing interests are almost overlapping on every square meter of terrain.

The two areas identified (see Figure 3-7) on the banks of the Schleusenkanal were selected by using internal data bases and GIS systems to check all river bank located plots of land for potential conflicts or requirements of other uses. The map below gives the location and extension of the two identified areas. Both areas together cover a surface of approximately 3 ha.

Figure 3-7 Map of the two identified areas on the Schleusenkanal River Bank (Dove Gose river system). Source: Google Earth.

The aim is to further enhance the hydromorphological structure of the river banks of the Dove- / Gose-Elbe and adjacent surface waters with NBS through topographical changes of the flood plain and their shoreline, allowing a more nature favorable development. The Ministry of the Environment, Climate, Energy and Agriculture (BUKEA) agreed to finance two feasibility studies which will yield the planning cornerstones for a nature alike development. This activity can be understood as an offspring of the initiated RECONECT activities in Hamburg. The assessment of the two chosen areas are carried out in close cooperation with the borough of Bergedorf and the Department responsible for Nature Protection of the BUKEA.

3.3 Co-implementation activities undertaken

The continuous and active involvement of key stakeholders such as the Head of the Water Management Department in the Borough of Bergedorf, the Hamburg Port Authority (HPA), other relevant initiatives and projects, but also colleagues of the Hamburg Ministry of Environment, Climate, Energy and Agriculture (BUKEA) who possess precise knowledge and understanding of the local specifics of the respective area, has been essential for the process and success of the activities in Demonstrator A1 Elbe “Vier- und Marschlande”.

Also the exchange of knowledge and experiences within the RECONECT consortium has been beneficial for DA1. Site visits between Greater Aarhus, Denmark and Elbe “Vier- und Marschlande“, Germany took place in 2019. Unfortunately, due to COVID-19, site visit possibilities have been limited in 2020 and 2021. The conversations and workshops realized during the General Assemblies in Zwolle and Nice in 2019, but also the virtual monthly WP2 webinars, Demo A-Calls and meetings with partners DTU and UFZ served as fruitful co-implementation activities for DA1.

3.3.1 Regulatory processes

Every modification or introduction of measures which could/might have an impact on the water level or flood safety is subject to complex regulatory processes described in the corresponding legislation and ordinances according to the Federal Government and Hamburg Water Law. This is done in formal procedures that could also include mandatory public hearings and participation processes. Once the public permit or license is given in the format of an administrative act, the decision could be appealed by third parties at administrative courts. This could end up in a time consuming process to reach the final goals.

As the regulatory processes could not be separated from the legal setting, they are unique for every demonstrator area. The planning process itself might be similar as it requires intensive talks and exchange between public institutions and public stakeholders. It is observed that in Hamburg the exchange of information between the involved public institutions is traditionally well inserted in the acting of the public administration in Hamburg. However, the approach of public stakeholder involvement which is an important factor for realization of infrastructure projects is still underdeveloped. Public audiences and participative planning approaches are relatively young concepts which for this reason alone are still not so well inserted within the public institution’s cascade of decisions.

The measure of optimized control in the event of flooding is to be established through the extension of the operating regulation for the dike lock Tatenberg . This will also be integrated into the water law approval procedure for the construction and operation of a fish ladder in the dyke target.

Several discussions on the planned measure have been held with the operating staff of the dike lock Tatenberg and the local water authorities of the borough of Bergedorf. The measure will be implemented when the underlying boundary conditions occur and its effectiveness will be documented. This will be done in close coordination with the aforementioned persons and the further procedure will be agreed upon. Therefore, further discussions are to be held with the responsible persons.

3.3.2 Public opinion and stakeholder involvement

Numerous meetings on the implementation, the envisaged NBS and potential co-benefits have been realized in the course of the Project. This includes intensive exchanges between the FHH, the Agency for Roads, Bridges and Waterways in Hamburg (LSBG) and the Hamburg Port Authority (HPA) on the implementation of the envisaged measures, on the regulatory process, on data flows, water levels, and groundwater issues and on a planned fish ladder. Several meetings and calls with the Federal Maritime and Hydrographic Agency (BSH) on the data flow of measured and predicted tidal data have been realized.

Also getting in touch with other initiatives and projects, such as the major nature conservation project “Natürlich Hamburg” and actors of the Water Frame Directive contributed to a better understanding of the demonstrator area.

As part of the efforts to identify further NBS options, it was beneficial to meet with various experts who shared their detailed knowledge on the demonstration area. Together with colleagues working in the BUKEA´s Department for Management of Nature Conservation Division, Special Fund for Nature Conservation and Landscape Management, it has been possible to identify two areas in the demonstration area that would be suitable and eligible for additional NBS measures.

The early involvement of the concerned district has been important to enable a positive cooperation and the district´s support of the planned NBS measures. The close cooperation with the Borough of Bergedorf has been manifested in regular consultations and discussions on the planning and the process of the implementation of the NBS measures, but also on potential additional NBS such as the waterlogging of low-lying areas. This regular contact also granted an insight into the political perspective on the approach of the district to flood risk.

In order to promote the RECONECT project further and to raise awareness and acceptance of the envisaged NBS measures in the district, the organizers of the Bergedorf Regional Committee were contacted with the request to invite the project team for a presentation to all committee members, who represent different political parties in the Borough of Bergedorf. This event was accompanied by the local press, which published an informative article about the project afterwards.

Additionally a Hamburg Steering Committee was established in the early stages of the project, consisting of the Hamburg Senate Chancellery, BUKEA, LSBG, Hamburg University of Technology, and a representative of the Bergedorf district, which meets semiannually to discuss implementation, potential obstacles or difficulties, and public relations.

Site visits with the colleagues of the demonstrator area in Odense environment administration and Aarhus took place enhancing exchange of ideas between the participants. A delegation of the Hamburg team visited Arhus and Odense and the corresponding demonstrator sites.

3.3.3 Construction practices

Extensive model calculations were carried out to develop an optimized control of the structures and the utilization of the storage spaces in the waterbodies. These form the basis for the further procedure in the project. The results were presented to the operator of the structure (Hamburg Port Authority), upon which extended operating instructions in the event of flooding were agreed. These instructions are to be applied in future flood events. The prediction of discharges and water levels, which triggers the measure to operate the structure, is based on the operational application of a rainfall-runoff model. This was done by integrating the rainfall-runoff model into the FEWS (Flood early warning system) software. The system is now being installed on a server and will go into operational use with the establishment of the data paths (precipitation measurements, water levels, discharges, etc.) from different institutions.

To implement the measure consisting of retention areas/volume, it is necessary to make numerous measurements and forecast data continuously available online. For this purpose, discussions were held with the German Weather Service, the Federal Maritime and Hydrographic Agency, and the Schleswig-Holstein State Office for Landscape, Environment and Rural Areas. These institutions provide the necessary data digitally and online. The forecasts resulting from the application of FEWS with integrated precipitation-runoff model are transmitted to the borough of Bergedorf and Hamburg Port Authority online (e-mail and access to server with forecast data). Furthermore, selected data are

made available to the public via the warning service Warndienst Binnenhochwasser Hamburg.

The provision of retention volume is generated by proactive lowering of the water level in the Dove Elbe activating the residual volume of the water courses. This is reflected in the chosen hybrid solution.

3.4 Encountered barriers in the co-implementation process

At the beginning of RECONECT, the “roll out” of the project concept was hampered by another independent project carried out by the Foundation “Tideelbe Forum” which had announced a feasibility study to connect the Dove Elbe and Gose Elbe to the tide influenced Elbe river (the area is diked since the mid-50s past century) to gain flood volume and ecological quality. After the public presentation of the “Tideelbe Forum” project, the citizens living in the demonstrator area showed scepticism and concern. The local press covered the matter and gave a voice to citizens who stated that they felt completely surprised and unprepared to attend the proposal and activities presented by the public administration. A broad public protest movement started and created momentarily adverse conditions for the dissemination of the RECONECT project in the city of Hamburg. The protests were induced by the fear of a reduced flood protection against astronomical and wind surge induced tides coupled with unfavourable development of the area for recreational use.

The “seed of disturbance” produced by the feasibility study of Forum TideElbe (see above) produced severe misunderstandings of the citizens living in the demonstration area and almost complete rejection of any ideas coming from public institutions concerning the Dove-/Gose-Elbe system. In order not to endanger the results of the Reconect project goals and visions, the strategic decision was taken to involve the public and stakeholders at a later stage in the project lifetime after the anger of the public has settled down.
After the finalization of the feasibility study in 2020, the idea of connecting the Dove-Gose Elbe system to the tide was abandoned. This led to the opportunity to present the RECONECT project in a less controversial setting. The mentioned scepticism of the citizens against the public administration and its representatives in the beginning of the project where nourished by the fear that the implementation of different NBS measures might reduce flood protection safety. These worries certainly reflect the vital interests of the region and its population in Demonstrator A1.

In 2020, the local RECONECT Team started a more intense information campaign to the political decisions makers of the borough of Bergedorf (Council of Regional Development) and presented the conceptual approach of RECONECT in the demonstrator area. The representatives signalized support for the project and wished to be regularly informed by the project team. The Reconect team emphasized that all planning works are carried in form of an “open office door philosophy” i. e. the project team is always available to provide further information or answer any question which might arise from a third party. The project team also stressed the possibility that any advice or input is welcomed from the stakeholders on any occasion the team was in contact with stakeholders. This was done in order to provide transparency of the works and enhance the trust in the project goals.

Within the RECONECT consortium, there have been several WP2 virtual meetings and webinars, but there was no in-depth follow up by the participants. This fact had a wide range of reasons, one adverse effect was the COVID 19 pandemic which hampered visits and imposed travel restrictions. These shortcomings need improvement on the trail ahead of the project.

Contacts between the DA1 Team and RECONECT partner Eurosense were made to check whether technical assistance from Eurosense would be needed in the Hamburg case. But it revealed that the available spatial data concerning topography and hydrological information for the DA1 in Hamburg could be provided by own data. Nevertheless, the cooperation with the RECONECT partner EUROSENSE provides valuable expertise to the project.

3.5 Added value of co-implementation to project

The involvement of local stakeholders and decision makers has been crucial to the RECONECT project as the acceptance and support of the Borough of Bergedorf and other decision makers is essential for the success of the project.

The exchange of knowledge and experiences with other initiatives and projects, such as the above mentioned major nature conservation project “Natürlich Hamburg” and actors of the Water Frame Directive contributed to a better understanding of the demonstrator area.

Also the meetings with several BUKEA employees who have detailed expertise on the demonstration area have facilitated the forthcoming of the project. For example, the Institute for Hygiene and Environment (a Unit of BUKEA) is willing to share real time data from the Surface water quality station located upstream of the Bille weir located at the entrance/inflow of the Bille river into the demonstrator area. First contact with RECONECT partner Interact was made for the technical embedding and implementation of the data provided by BUKEA/HU. At the moment, the embedding of further measuring gauges and data is under study concerning technical issues as well as data provision in a sound approach (copy rights and use restriction might exist). The data expected to be incorporated into RECONECT ICT platform comprise water level, temperature, oxygen, conductivity, turbidity and pH from the measuring station Fischerhof (located at the entrance of the Bille river (over a weir) into the demonstrator area.

4 Demonstrator DA2: Odense Coastal Area, Denmark

4.1 Case description

Due to a rising sea level as a consequence of a changed climate, large areas around Odense Fjord are at the risk of flooding. Therefore, the area around the fjord is also designated as a flood risk area[1] according to the EU flood risk directives[2].

The Seden Strand is located in the bottom of the Odense Fjord (see **Error! Reference source not found.**). The project area within the RECONECT project covers the suburban area Seden Strandby, where up to 142 private homes are at the direct risk of flooding as well as up to 66 ha of agricultural land, which will increase with the rising sea level and more unstable weather.

[1] https://oversvommelse.kyst.dk/risikoomraader/odense-fjord/
[2] DIRECTIVE 2007/60/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 October 2007 on the assessment and management of flood risks (https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32007L0060&from=EN)

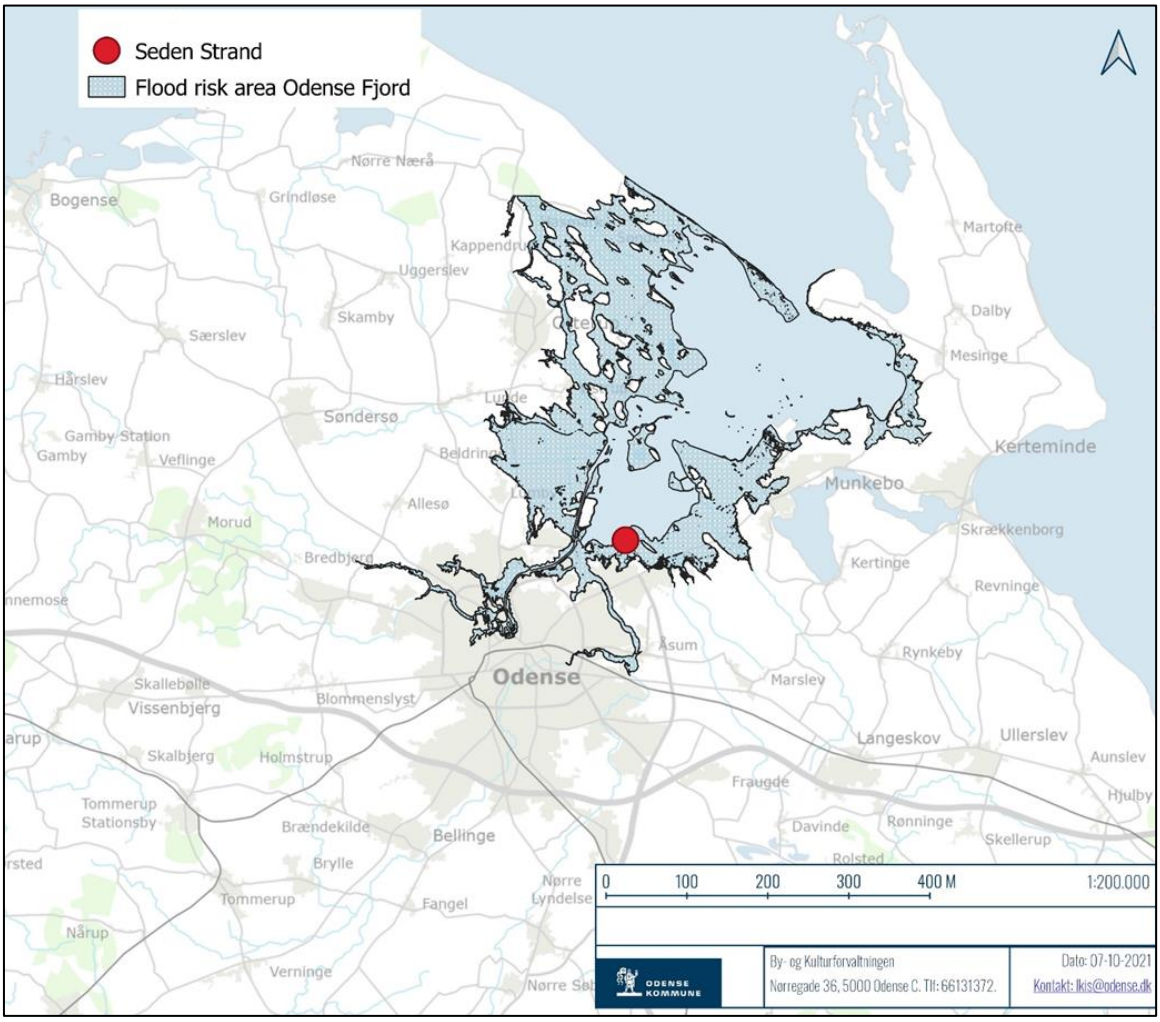


Figure 4-1 Location of the Seden Strand in the Odense Fjord which is designated as one of the 14 flood risk areas in Denmark (source: The Danish Coastal Authority)

Figure 4-2 shows the area affected by flooding in 2006, where a sea level up to 1,92 meter DVR90[3] above mean sea level close to the project area[4] was recorded.

[3] DVR90 is the reference level used in Denmark, based on the mean sea levels observed in ten harbours equally distributed over the Danish coast at year 1990.

[4] https://kerteminde.dk/borger/miljoe-og-natur/klimatilpasning/risikostyringsplan-for-odense-fjord-2015-2021-1-planperiode

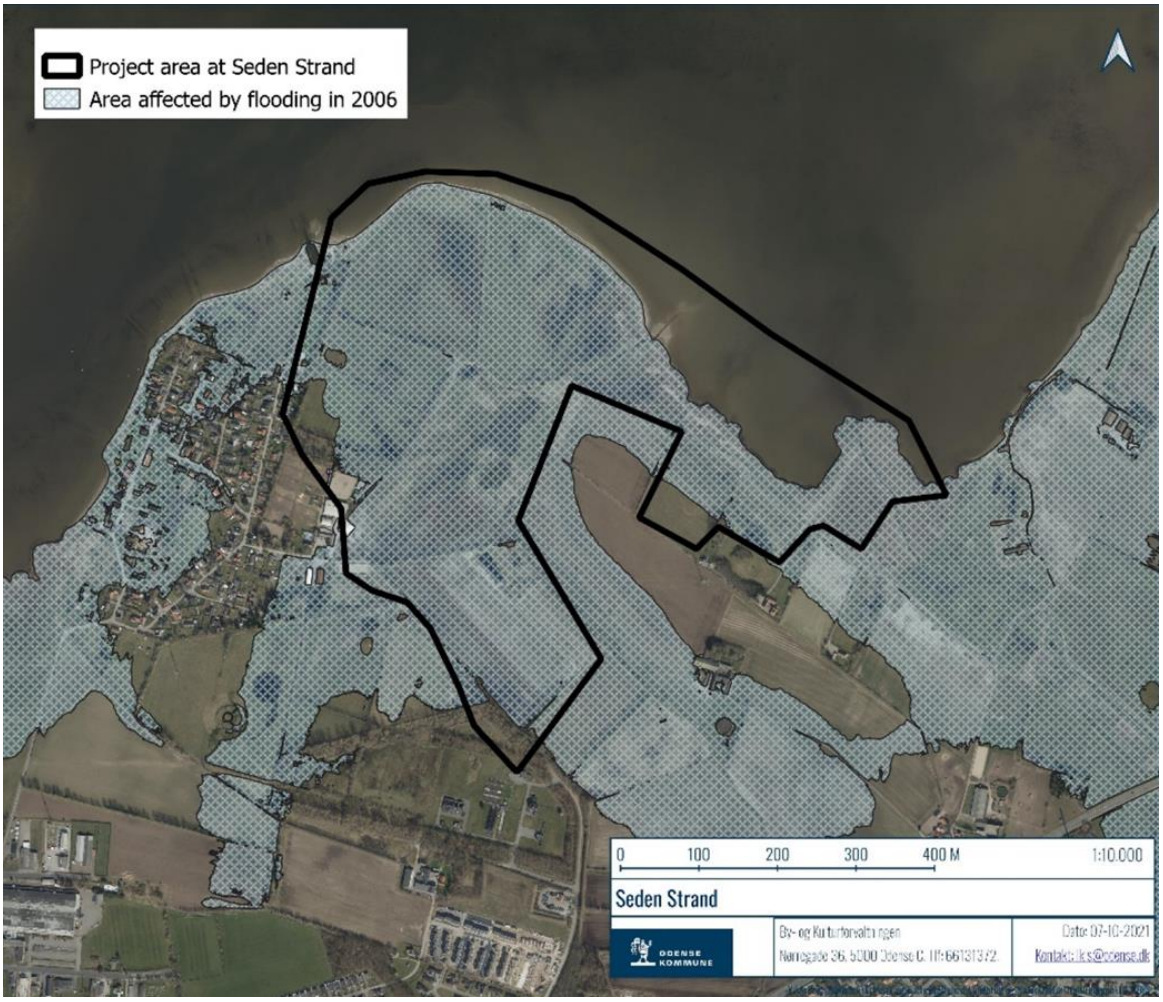


Figure 4-2 The project area at Seden Strand with area affected by flooding in 2006

Odense Fjord and the surrounding fiord habitats are designated as a Natura 2000 site DK008X075, protected both by EU´s Bird Directive and Habitat Directive. Around Odense Fjord, there has been a decline in habitats of up to 90% over the last 200 years, due to cultivation, drainage and land reclamation. This has had major impacts on the biodiversity around the fiord. With only half of the remaining salt meadows, which are important habitats for waders and amphibians, in good condition, the status of the Natura 2000 site has to be improved[5].

Therefore, the nature-based solution used at Seden Strand is trying to combine the interests in the area with a holistic approach look at solutions which make (more) space for people, nature and water. At Seden Strand this includes:

- Removal of existing low coastal summer dikes and moving them inland to a higher location and hereby “give room for the sea”
- Promote rehabilitation of new habitats (salt meadows - 1330) outside the new dikes
- Recreation of meanders of existing streams
- Focus on target species like the avocet (Recurvirostra avosetta) and the natterjack toad (Epidalea calamita)

[5] https://mst.dk/media/194224/n110_basisanalyse-2022-27-odense_fjord.pdf

4.1.1 Geomorphological characteristics

Seden Strand is located approx. 8 km northeast of the Odense city center by the Odense Fjord. The area which will be affected (both nature, urban and cultivated area) covers locally approx. 0,8 km^2 and includes:

- Building and roads: 25 %
- Farmland: 50 %
- Nature: 25 %

The area surrounding Seden Strandby is primarily used for farming including production of vegetables and grazing with horses.

The flood protection before implementation did only consist ts of primarily small, so called 'summer' dikes (up till ca. 1,5 m high), originally build against summer sea flooding to improve farming possibilities in the coastal areas.

4.1.2 Climatic conditions

The climate conditions of the project area near Odense are dominated by Atlantic coast conditions as shown below.

Snowfall happens from November to March, but due to climate change, periods with snowfall are decreasing. However, some winters with more continental weather conditions can include longer periods with snowfall and ice on Odense Fjord and even the more open seas.

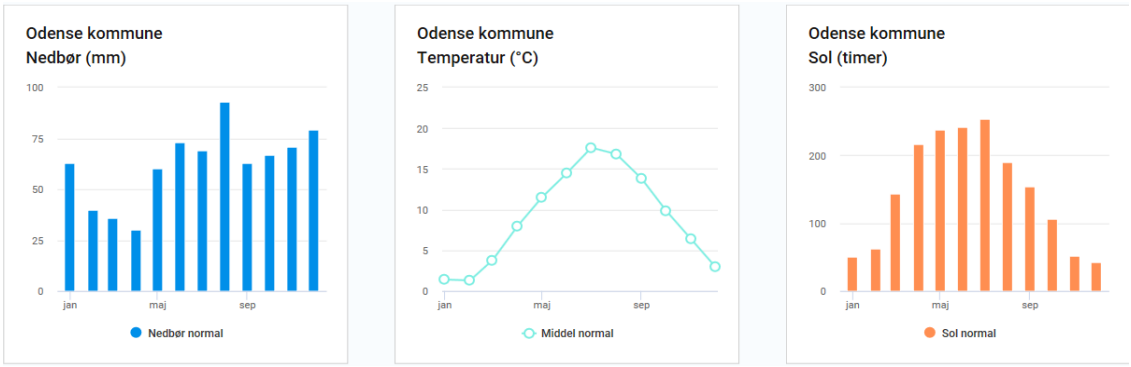


Figure 4-3 Climate conditions at Seden strand

4.1.3 Hydrological conditions before implementation

The catchment area of two minor streams crossing the project area is only 4,1 km^2. The two small streams were in the 1950ties replaced from their natural course to a channel with a sluice at the eastern border of the project area, in order to cultivate the march area.

River system:

- River length 3,5 km and 1,0 km
- River length within the NBS area 1,5 km
- Total catchment area 4,1 km^2

River discharge year average 39 l/sec.

Coastal systems:

- Mean sea level + 0,05 m, normal high tide 0,4 m,

- Significant wave height 0,5 m at NBS site,
- Storm surge + 1,95 m (100 years return period)
- Water salinity 2,5 %.
- Water quality in Odense Fjord is hampered of outlet of fertilizers form the catchment including one third of the area of Funen
- Bathing in the shallow water of Odense Fjord is not practiced due to better conditions at the nearby beaches at the open sea.

4.1.4 Hydro-meteorological hazard and problem description

The project is governed by storm surges with storm tide in Odense Fjord because of storm from north and northwest causing high influx of water from the North Sea to Kattegat and further into Odense Fjord.

The highwater level at the actual conditions is + 1,95 m with a 100-ears return period and +1,55 m with a 20-years return period. For planning use, a rise of 0,30 m of the sea level is expected at 2050 and storm surge will happen more frequently. The project will consider this forecast.

4.1.5 Nature

Odense Fjord is an important resting and breeding area for waders, ducks, geese and swans.

Odense Fjord and the surrounding fiord habitats are therefore designated as a Natura 2000 site DK008X075, protected both by EU´s Bird Directive[6] and Habitat Directive[7]. Approx. 50 % of the project area at Seden Strand is placed within the Natura 2000 area at Odense Fjord.

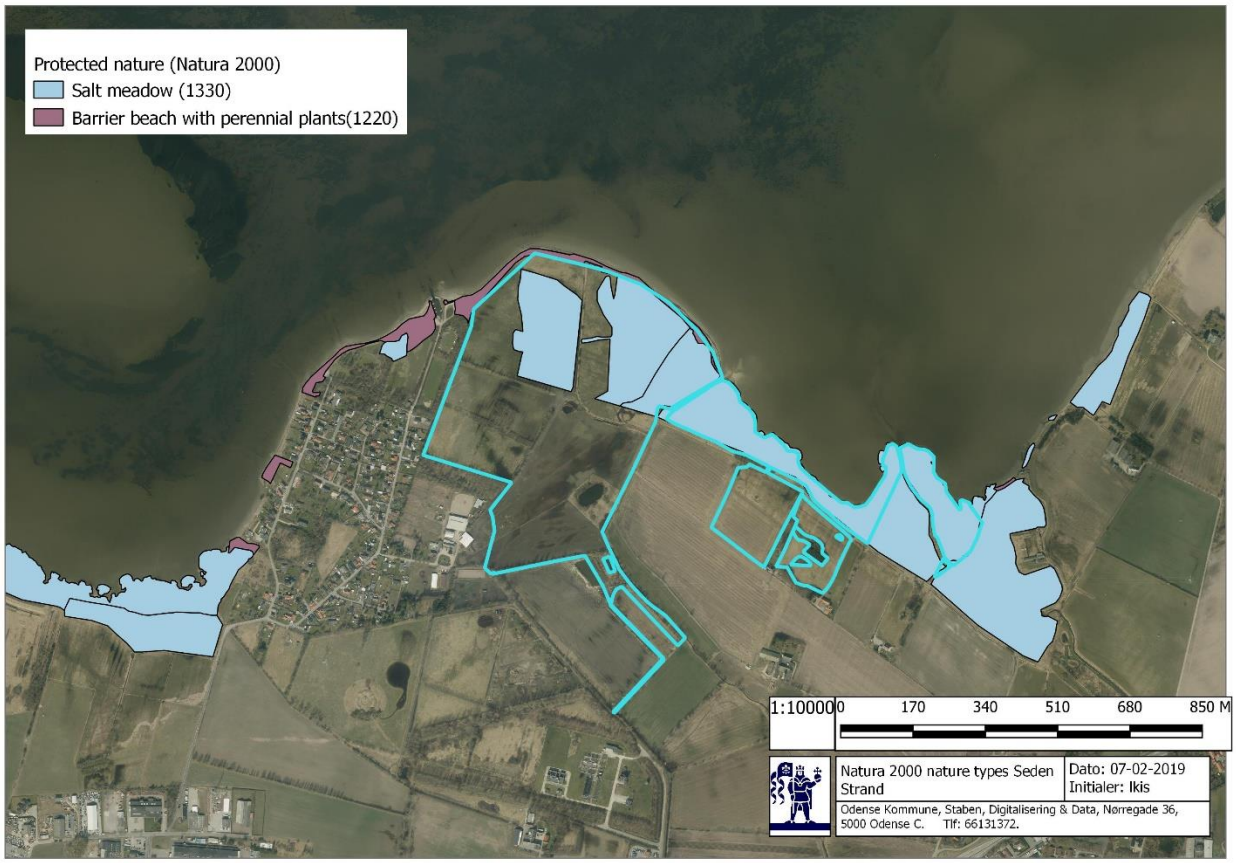
Birds:	Barnacle goose (*Branta leucopsis*)	Western marsh harrier (*Circus aeruginosus*)
	Whooper swan (Cygnus cygnus)	Mute swan (*Cygnus olor*)
	Eurasian coot (*Fulica atra*)	White-tailed eagle (*Haliaeetus albicilla*)
	Goosander (*Mergus merganser*)	Red-breasted merganser (*Mergus serrator*)
	European golden plover (*Pluvialis apricaria*)	Pied avocet (*Recurvirostra avosetta*)
	Common tern (*Sterna hirundo*)	Arctic tern (*Sterna paradisaea*)
	Sandwich tern (*Thalasseus sandvicensis*)	

The coastal areas are dominated by Atlantic salt meadows. The area of salt meadows has historically been larger but has declined due to cultivation. According to the survey of the habitat carried out in 2011 (http://naturereport.miljoeportal.dk/577060) the quality of the habitat has been assessed as moderate. The indicators of the habitat quality show

[6] Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds

moderate signs of change due to human activity and higher disturbance than under good condition.

Figure 4-4 Nature types within the project area. Codes are refering to the official Natura 2000 code; given for all Natura 2000 nature types



The Natura 2000 site DK008X075 has been established among others for protection of the Atlantic salt meadows (1330) and barrier beach with perennial plants (1220) habitat types.

4.1.6 Stakeholders and governance

The main authority within the project is Odense Municipality. The municipality is responsible both for dealing with climate changes locally and the conservation of nature excluding marine habitats.

The land where the NBS was constructed is privately own. The construction of the NBS was led by Odense Municipality as well as maintenance during 3 years after the construction is finished. Consequently, the maintenance will be handed over to the landowners. This is stated in the land register.

The demonstration project at Seden Strand was completed by a cluster including:

- The Municipality of Odense
  Permissions, developing of demonstration project, construction and maintenance (also including financing)

- Amphi International

Developing of demonstration project, monitoring

- Rambøll
  Developing of demonstration project, monitoring

4.1.7 "People" – socioeconomical aspects

The project area is located within distance of approx. 8 km from the Odense, the largest city on the island Fyn with 178.210 inhabitants (2018). Seden Strand, a suburban settlement of 338 inhabitants (2018) is bordering the area of the project from the West. 142 private houses/properties are at the direct risk of flooding. The prices for private housing range from approx. 1.200 -1.880 EURO per m2 (www.boligsiden.dk).
Ca. 50 % of the project area is used for agriculture. 66 hectares of agricultural land in the project area is at the risk of flooding. The land prices range from 6700 EURO/ha for meadows up to 25000 EURO/ha for plough land and are similar to the land prices along the coastline on the island.

4.2 NBS design and status of the project

4.2.1 Construction
The design for the NBS at Seden Strand consists of dike relocation and re-meandering (as part of the Room for the water bodies solution) and is seeking to maximize the multiple benefits of the project. In this particular area, the driving factors include risk of flooding and the nature interests.

The construction of the nature-based solution work was completed in november 2020. .
The construction included (see Figure 4-5):

- Construction of a new dike withdrawn from the coast
- Leaving land on seaside of withdrawn dike to natural succession with the purpose of allowing space for nature to adapt to a changed climate with higher sea level
- Habitat improvements on seaside of withdrawn dike including:
  - Removal of existing coastal near dikes
  - Removal of trees to improve the area for waders
  - Establishing of temporary ponds for the natterjack toad and improvement of pond for waterfowl
  - Establishing of new natural watercourses
  - Construction of nature plugins in the new dike

Figure 4-5 Nature based solution at Seden Strand

Parts of the construction of works is presented in Figure 4-6.

Figure 4-6 Left: new dike withdrawn from the coast. Right: land left on the seaside for natural succession.

4.2.2 Monitoring activities - nature

Before construction Amphi Consult has completed monitoring of the vegetation and habitats in the project area (figure 4-7).

Figure 4-7: Monitoring of vegetation before construction.

In 2023 this has been followed by new monitoring after construction.

4.2.3 Monitoring water

To monitor changes in flood risk Eurosense has made a Lidar survey of the project area. (figure 4-8). In 2022 the Municipality of Odense has initiated a lidar of the project area. (Figure 49). This will be followed by a final lidar by Eurosense in 2024.

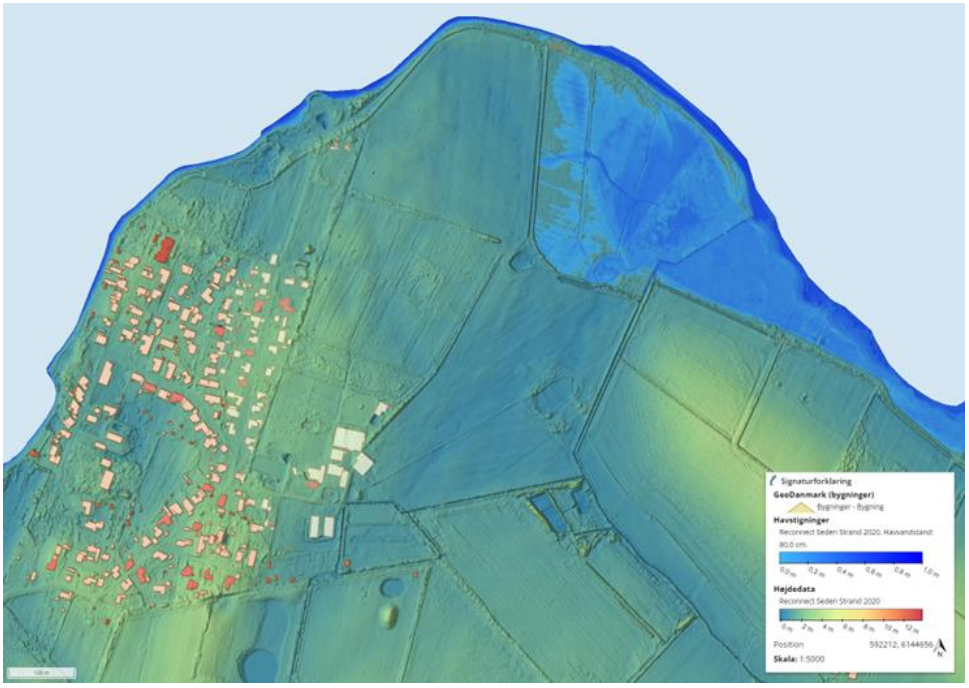


Figure 4-8: Lidar survey before construction. Flooding at 0,8 meters above mean sea level. The summer dike prevents the natural flooding of the area.

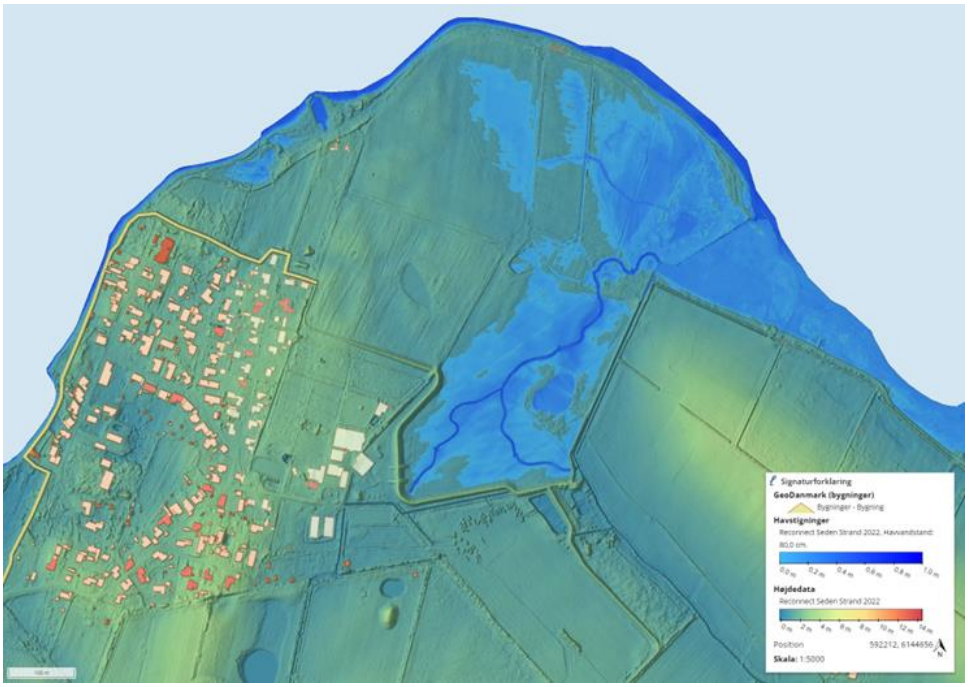


Figure 4-9: Lidar survey after construction. Flooding at 0,8 meters above mean sea level. The project area is flooded more regularly. Promotes developing of new habitats. On the other hand, the new dike has improved the protection of the area behind the new dike.

4.3 Co-implementation activities undertaken

The following co-implementation activities are undertaken within this project:

- Years of negotiating with landowners
- Inspiration and feedback from NGOs
- Early consultation (project screening) with relevant experts from private sector Rambøll and Amphi)
- Site visits in Hamburg and Portofino (Kick off GA) with demonstration cluster.
- Cooperation with demonstration cluster (RECONECT partners Rambøll and Amphi) in both design and the realization phase

4.3.1 Regulatory processes

For this particular project, the regulatory requirements have included 8 permissions covering:

- the Coastal protection act
- the Nature protection act
- act on planning
- the museums act
- act on environmental assessment of plans and programs and of specific projects
- act on watercourses
- assessments according to the EU habitat and EU bird directives

To obtain these permissions, local responsible authorities have been involved.

4.3.2 Public opinion and stakeholder involvement

Landowners as main stakeholders have been directly involved in the design process as well as the land acquisition process, together with the responsible authorities which include the Odense Municipality and the coastal authority under the Ministry of Environment and

Food of Denmark. As part of stakeholder involvement, guided tours have been organized in the project area.

4.3.3 Construction practices

During the construction practices, information boards was placed in the area and internal guided tours were organized. The official opening was done by the deputy mayor.

Figure 4-10 Information boards and guided tours in the area during the construction of works

4.4 Encountered barriers in the co-implementation process

Because of the competing interests, a more general understanding of the purpose of using a NBS would be helpful in implementing these projects. For example, NBS is not only about protection against flooding, but it is also about dealing with other challenges not at the least improving conditions for nature. This may lead to maximizing the multiple benefits of the project. In addition, the project at Seden Strand has also experienced barriers from one landowner in the co-implementation process, because of scepticism towards the forecast for future flood risk as a consequence of climate change. This finally resulted in changes in the project, where the landowner was no longer a part of the project.

4.5 Added value of co-implementation to project

The inspiration at this demonstration site was provided by consulting experts and a political will to allow a more holistic approach to climate adaption.

RECONECT partners Rambøll and Amphi Consult have been and still are crucial partners in the completion of the NBS at Seden Strand. This has included:

- Preliminary project with description of first design and baseline for the first landowner negotiations
- Support at landowner negotiations
- Development of nature plugins in the dike
- Design of habitat improvements on the coastal foreland
- Description of detailed project
- Creation of necessary documents for the procurement of the construction works including support with the procurement process
- Support at supervision of the construction works

5 Demonstrator DA3: Tordera River Basin, Spain

5.1 Case description

The Tordera River Basin is located in Catalonia, in the north-eastern part of the Iberian Peninsula, and it covers an area of 900 km². The Tordera river is born at Montseny Natural Park (1,076 m.a.s.l.) and it flows into the Mediterranean Sea forming the Tordera Delta. Several cities are located along its course (Blanes: 38,790 inh., Malgrat de Mar: 18,439 inh., Sant Celoni: 17,754 inh., Tordera: 16,937 inh., Hostalric: 4,139 inh.). Tordera River Basin has a typical Mediterranean rain regime (scarce and highly irregular) and flash floods occur often. Vulnerable activities are found in flood prone areas as the middle part of the basin is highly industrialized and the delta is a popular tourist spot where different camp sites are located.

In the context of the Tordera River Basin Levee Management Plan – a measure developed in the context of the Flood Risk Management Plan of the River Basin District of Catalonia – different types of NBS were analyzed with the aim to reduce flood risk by means of restoring the natural functioning of floodplains and wetlands, while at the same time enhancing the environmental value associated with these areas. The types of NBS that were studied included water storage areas, wetland restoration and setback of levees. As a result of the analysis, the only NBS that proved to be relevant in terms of flood risk reduction was the setback of the existing levees along the final reach of the Tordera river. This measure has been included in the Flood Risk Management Plan (FRMP) of the 2nd planning cycle of the Floods Directive, to be implemented during the 2022 – 2027 period. Two different alternatives or configurations of the measure have been considered in the feasibility study to provide enough room for discussion with stakeholders and to allow the introduction of changes in the final solution of the NBS that might stem from the co-creation process. The project area and the two alternatives that are being considered are visualized in Figure 5-4.

With the implementation of the NBS we aim to reduce flood risk in highly vulnerable areas as well as to improve the environmental status of the water body, especially with regard to its hydro- morphological quality.

5.1.1 Geomorphological characteristics

Different reaches with different geomorphological characteristics can be identified in the Tordera river. The upper reach, that stretches from the Tordera source to the municipality of Sant Celoni, presents the geomorphological characteristics of mountain streams (coarser riverbed material and steeper slopes). The middle and lower reaches of the Tordera river present lower slopes (< 1%) and finer bed material, becoming a sand-bed river from the confluence of one of its main tributaries, Riera de Arbúcies, to the outlet at the Tordera Delta. NBS are planned to be implemented in the lower part of the basin, as it is the most flood-prone area and where most of the vulnerable areas and activities lay.

The predominant land cover categories in the Tordera River Basin are forest (64%) and shrubs (15%). Urbanized areas account for 8% of the total area of the basin, whereas 11% of the area is covered by agricultural fields and 1% by infrastructures (roads and railways). An inventory of the existing flood protection measures in the Tordera River Basin has been carried out in the context of the Levee Management Plan. There are many discontinuous dikes and levees along the course of the Tordera River as well as along one of its main

tributaries, Riera de Santa Coloma – Sèquia de Sils. Most of them are intended to protect agricultural land. Besides, two artificial wetlands that function as water retention areas can be found in the Tordera River Basin: Estany de Sils and Les Llobateres.

On the other hand, there are important linear infrastructure systems (i.e. roads and railways) that cross through the basin and that may determine the characteristics of the flooding, functioning in some cases as dikes. These infrastructures, and their interaction with river flow and flooding, have been also studied in the context of the Levee Management Plan.

The dominant hydrological soil group is D (58%), following the classification of the US Soil Conservation Service. Soils in this group have high runoff potential when thoroughly wet.

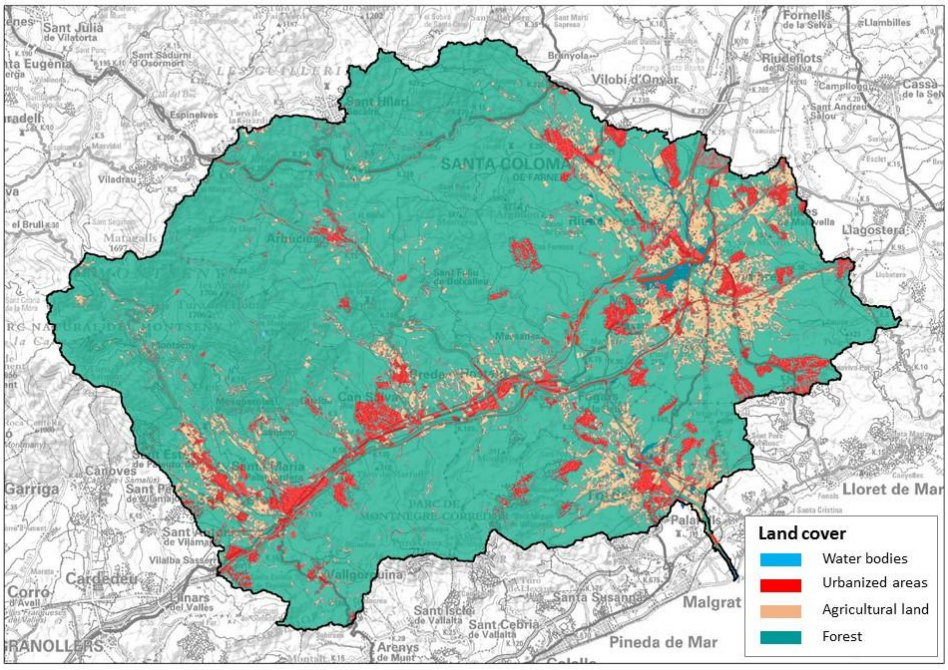


Figure 5-1 Dominant land cover in the Tordera River Basin

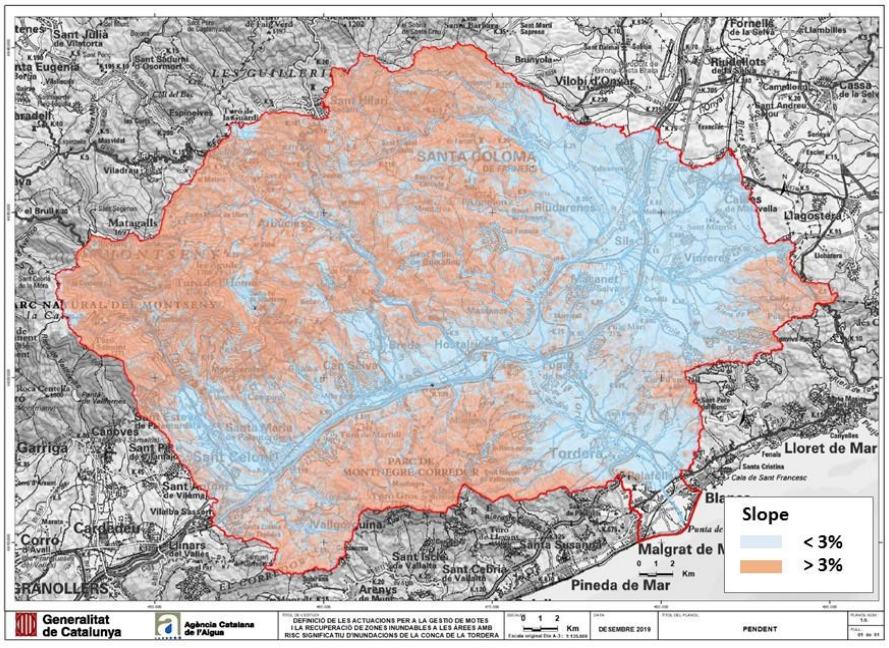


Figure 5-2 Terrain slope Tordera River Basin

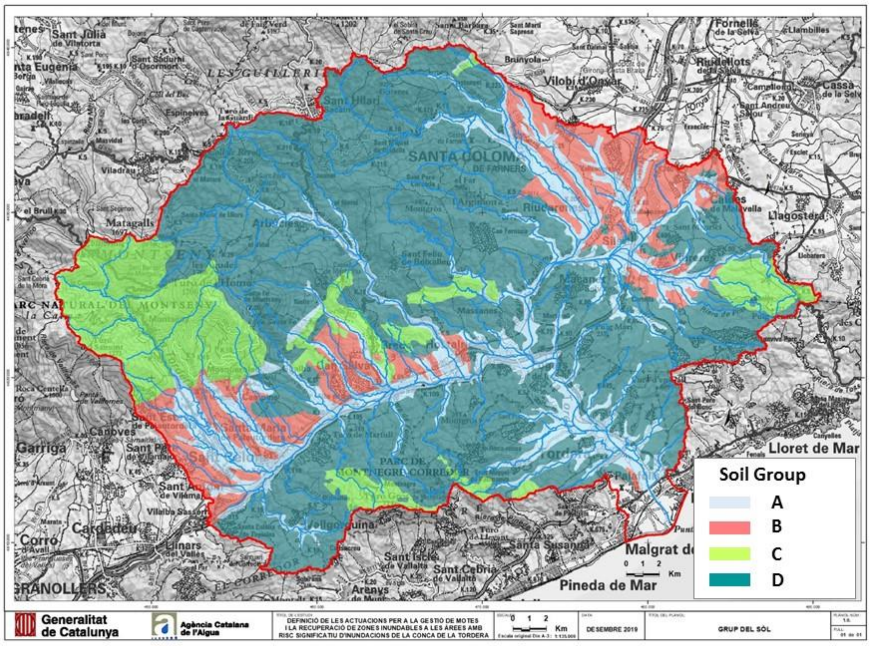


Figure 5-3 Soil groups in Tordera River Basin

5.1.2 Climatic conditions

The Tordera River Basin has a Mediterranean climate characterized by wet and mild winters and dry and hot summers. The precipitation regime is highly seasonal and irregular, with two dry seasons (January-February, June-August) and two rainy seasons (March–May, September–December), being the months of October and July the rainiest and the driest, respectively. Climatic differences between headwaters (mountainous area) and the outlet of the basin (coastal area) can be observed.

Climatic Characteristics of the Tordera River Basin				
Temperature			**Precipitation**	
Average annual temperature	**Average of the hottest month**	**Average of the coldest month**	**Rainy season**	**Average annual precipitation**
14.6 ºC	23.4 ºC	6.9 ºC	Spring and Autumn	800 mm

Table 1: Climatic Characteristics of the Tordera River Basin

Flash floods are the main climate driven hazard in the Tordera River Basin, occasionally causing serious material damages to vulnerable areas. Flash floods are caused by events of intense precipitation, occurring mainly in autumn, although one of the most catastrophic floods that the Tordera basin has experienced in the past years took place in winter (storm Gloria in January 2020) This fact might indicate a change in trends due to climate change. Important parameters that define flood hazard are total amount of rainfall, rainfall intensity, infiltration and retention capacity of the basin, topography, and land use, among others.

5.1.3 Hydrological conditions

The Tordera river flows for approximately 62.2 km from its source at Montseny Natural Park (1,076 m.a.s.l.) to the Mediterranean Sea. Its basin covers an area of 900 km².

River discharge is highly seasonal, to the point that the final reach of the Tordera river runs dry during summer months. There are four automatic river gauging stations located along the Tordera reach. Besides, hydrological and hydraulic models of the Tordera have been developed in the context of the Tordera River Basin Levee Management Plan with the aim to better characterize the response of the basin to heavy rainfall events and the flooding conditions associated to these events.
There are five groundwater bodies within the Tordera River Basin, all of them protected to certain extent:

- Montseny – Guilleries (ES100MSBT13): Good chemical status
- Maresme (ES100MSBT18): Bad chemical status
- La Selva (ES100MSBT14): Bad chemical status
- Al·luvials de l'alta i mitjana Tordera (ES100MSBT34): Good chemical status
- Al·luvials de la baixa Tordera i Delta (ES100MSBT35): Good chemical status. This water body had serious salinization problems in the past due to overexploitation. Nowadays, these problems have been solved with the construction and start of operation in 2002 of the Tordera Desalinization Plant, that supplies drinking water to 300.000 inhabitants in the area.

Regarding superficial water bodies, 20 of them have been identified in the Tordera River Basin: 7 have a good ecological status and 13 are in bad ecological status.

There are also 7 wetland areas of which only 1 is in good ecological status.

5.1.4 Hydro-meteorological hazard and problem description

As mentioned before, the main hydro-meteorological hazard to be addressed by the implementation of NBS in the Tordera River Basin are floods and flash floods.

There are other hydro-meteorological hazards affecting the Tordera River Basin, that we do not plan to tackle in the context of this project, as:

- Coastal erosion and storm surge flooding. In the Tordera Delta the coastline is receding and threatening infrastructures and other activities present in the area. Flooding due to storm surges also occur from time to time.
- Urban flooding due to in-site heavy rainfall is also a problem in some of the urban areas located within the basin.

5.1.5 Nature

There are different protected areas within the boundaries of the Tordera River Basin (e.g. Massís del Montseny natural park, fluvial protected areas, bird protection areas etc.). A detailed identification and characterization of these areas, as well as the mapping of riverine habitats, has been carried out in the context of the Tordera River Basin Levee Management Plan.

Some of the works that we plan to carry out and that may potentially change "Nature" are: setting back the levees providing more room for the river, landscape works, the construction of artificial ponds, and the planting of vegetation, among others.

5.1.6 Stakeholders and governance

Key stakeholders to be involved in the development of NBS in the Tordera River Basin are:

- **Catalan Water Agency (ACA):** It is River Basin Authority responsible for managing the water cycle in Catalonia. Among its responsibilities is to develop and implement the River Basin Management Plan (RBMP) and the Flood Risk Management Plan (FRMP) for the River Basin District of Catalonia, in compliance with the EU Water Framework Directive and the EU Floods Directive, respectively. ACA has developed the Tordera River Basin Levee Management Plan.The main objective of the Plan is to characterize flooding conditions in the basin as well as to analyze and plan the NBS to be implemented in the Tordera River Basin to help reduce flood risk.
- Thus, in the context of the Levee Management Plan, the feasibility study for the planned NBS has been carried out. Besides, the two final alternatives for the NBS have been included in the FRMP that was approved in July 2023. **Municipalities:** Municipalities are responsible for land use planning and civil protection at local level. In this sense, those municipalities in which NBS will be located and implemented (Palafolls, Blanes and Malgrat de Mar) will necessarily become key stakeholders to be taken into account in the design, implementation and maintenance of the measures.
- **Association of campsites located in the Tordera Delta**: The Tordera Delta is an important tourist spot where several campsites are located. The Delta area is very prone to flooding, so according to Spanish legislation campsites should adopt protection measures to reduce flood risk. In this sense, and in the context of the Tordera River Basin Levee Management Plan, NBS to reduce flood risk in the lower reach of the Tordera river will be analysed with the necessary participation of the Association of campsites. Furthermore, some campsites might be affected by the construction of the NBS, having to compensate the owners and/or relocate the activity.
- **Department of Climate Action, Food and Rural Agenda (DACAAR)**: It is the Department of the Catalan Government responsible for environmental and agricultural planning, as well as for climate change adaptation and mitigation at regional level.
- **Farmers and agricultural producers:** The Tordera Delta is an important hub for local food production in Catalonia. Local farmers in the Tordera Delta have come together creating the Espai Agrari Baixa Tordera, that aims to promote and to add value to their products. They are a crucial stakeholder in the project as one of the main objectives of the final solution will be how to make compatible food production and flooding.
- **Other key stakeholders (environmental NGO's, research groups, etc.)**: There are different groups of people that have worked or are currently working on the Tordera River Basin. Collaboration and participation of these groups as stakeholders will be promoted when relevant to the project. Besides, we must not forget that the NBS will protect urban areas from flooding, so citizens of those areas will also have to be taken into account as key stakeholders in the co-creation process.

All the authorities that might be involved at some stage of the project have been identified as key stakeholders. In this sense, the governance structure will be similar to the stakeholder map.

Questions about ownership of the land have not been addressed yet. However, as stated in previous sections, the construction of the NBS implies the need to make compatible food production and flooding when possible. Along the same lines, campsites activities might be affected by the construction of the NBS. In this sense, compensation schemes for both, farmers and campsite owners are being explored, as well as the possibility of signing stewardship agreements with land owners.

In relation to the ownership of the NBS, ACA will be the owner and the responsible for its maintenance and operation, as it helps to reduce flood risk in a large area of the basin.

The construction of NBS in the Tordera River Basin is a measure included in the Flood Risk Management Plan of the River Basin District of Catalonia, approved in July 2023. So, budget has been already allocated for its planning, design and implementation. In this sense, ACA will develop project management tasks (both financial and technical) throughout the different stages of the project, outsourcing the different works (elaboration of theexecutive projects, execution of the NBS, etc.).

11.3.1 "People" – socioeconomic aspects

Most relevant municipalities affected by flooding from the Tordera River are:

Municipality	Population (inh.)	Population density (inh./km^2)
Blanes	38,790	2,196.5
Malgrat de Mar	18,439	2,090.6
Sant Celoni	17,754	272,2
Tordera	16,937	201.4
Hostalric	4,139	1,220.9

Table 2: Demographics of most relevant municipalities in the Tordera River Basin.

No demographic, neither socio-economic, information at watershed level was available, but in comparison with other basins within the River Basin District of Catalonia, the Tordera cannot be considered a very densely populated basin.

Agricultural land accounts for the 11% of the total area of the basin, being 7% rainfed agriculture and 4% irrigated agriculture. Most of it is located in the Delta area and in the catchment of Tordera's main tributary, Riera de Santa Coloma – Sèquia de Sils.

The more relevant socio-economic benefits that we expect to achieve with the construction of NBS in the Tordera River Basin will be associated to the reduction of flood risk (e.g. reduction of material losses due to flooding, land value increase, etc.) and the restoration of natural areas (e.g. increase of recreational areas, environmental education associate to restored areas, etc.)

5.2 NBS design and status of the project

The project has not started with implementation yet. The measure (setback of existing levees) has just been included in the FRMP to be implemented during the 2022-2027 period. This NBS is considered a "Room for the water bodies" solution, and consists of, among others, dike relocation and widening of water bodies.

Two different alternatives have been analysed and their feasibility has been assessed in the context of the Levee Management Plan. The objective of defining two different alternatives for the same measure is that of providing enough room for discussion with stakeholders, as well as allowing to introduce in the final solution the changes and/or additional elements that might stem from the co-creation process.

These two alternatives consist in the following works/measures (as shown in Figure 5-4):

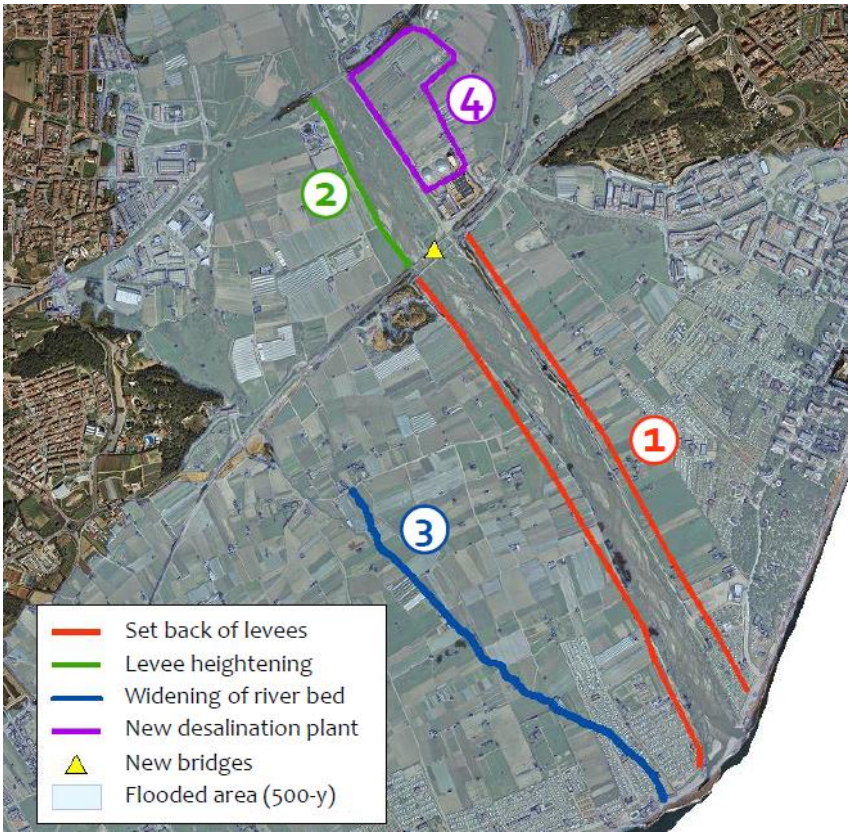
Alternative 1: It implies the minimum impact on agricultural land and on campsites, however its benefits in terms of risk reduction and improvement of environmental and hydromorphological status of the water body are also limited.

- Set back of the existing levees along the final reach of the Tordera river to give more room for the river. The new levees will be located 75 m away from its present location, at most in each of the banks.
- Heightening of the levee located along the right bank of the Tordera river, between the bridge of road B-682 and the bridge of the railway Barcelona – Maçanet – Massanes. The crest of the new levee will be 3 meters wide, to be used as service road, and will rise 1 meter above the current level of terrain.
- Widening, up to 10 m, of the riverbed of Rec Viver stream to improve the conveyance of flood waters.
- New desalinization plant and new embankment (11,2 Ha) at 10.8 m.a.s.l. The construction of the desalinization plant is not part of the NBS itself, but it will determine the flooding conditions in the area. This is the reason why its construction was also analyzed and considered in the feasibility study of the NBS.

Alternative 2: It implies a higher impact on agricultural land and on campsites, than alternative 1, but its benefits in terms of risk reduction and improvement of environmental and hydromorphological status of the water body are also higher.

- The only difference between Alternative 1 and Alternative 2 is the location of the new levee along the right bank of the Tordera, that will be set further away from Tordera's riverbed and along the right bank of rec Viver. All the other elements of the solution are common to both alternatives.

Moreover, the railway bridge and the bridge of road GIP-6831 have been recently replaced, after they collapsed during storm Gloria (January 2020). The new bridges have a much better hydraulic behaviour than the old ones, as the number of piers has been significantly reduced.



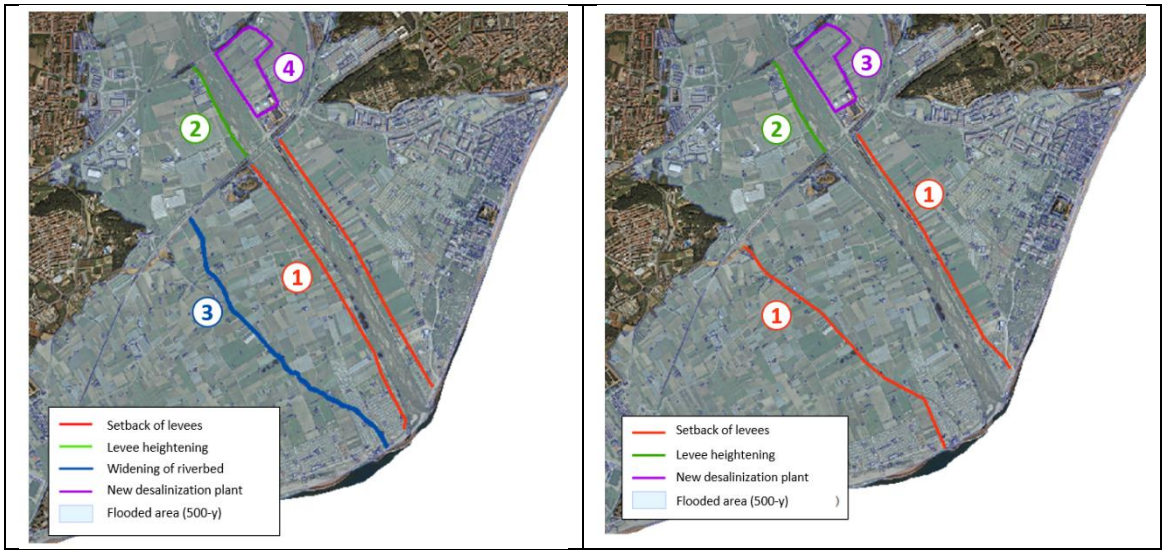


Figure 5-4 Layout of the NBS measures to be implemented in the Tordera river basin (Alternative 1 to the left and Alternative 2 to the right)

5.3 Co-implementation activities undertaken

In general, the activities undertaken up to this stage of the project (i.e. feasibility study) are only among local authorities in the area (Catalan Water Agency and municipalities).

5.3.1 Regulatory processes

The Catalan Water Agency (ACA), as watershed authority, is responsible for issuing the building and work permits in the riparian area (up to 100 meters away of the riverbed). In

this sense, there is no need to apply for any permit in this area as ACA is, at the same time, the regulatory authority and the authority that promotes the construction works.

Besides, hydraulic works (e.g. dykes) that are considered of general interest and/or that protect more than one municipality are exempt from work permits.

For works located further than 100 meters from the riverbed and that are not considered of general interest, a permit issued by the Municipality would be needed.

In addition, the NBS is located in a Natura 2000 site, so it will have to follow a strategic environmental assessment process and be subjected to environmental regulations.

5.3.2 Public opinion and stakeholder involvement

The level of stakeholder involvement has not been very high, so far. Co-design and co-implementation are not a common practice for planning and designing flood protection infrastructure in Catalonia and Spain. Usually, a top-down approach is taken to plan, design and construct this type of works, in which experts define the solution to a problem and then inform key stakeholders (municipalities, mainly).

This is so far the approach that ACA has taken. The ACA planned and pre-designed the NBS they would like to implement and then informed the municipalities. In this sense, ACA had several meetings with the affected municipalities: Blanes (3 meetings in February 2021, April 2021 and May 2022), Malgrat de Mar (3 meetings in February 2021, April 2021 and May 2022) and Palafolls (2 meetings in February 2021 and May 2022). ACA presented their proposal and collected the impressions and requirements of the municipalities. Overall, the acceptance of the solution has been positive. However, some municipalities have expressed concern about the agricultural land that will be affected by the construction. In this sense, the acceptance of the solution by agricultural producers will be key for the success of the project.

In addition, the different alternatives for the NBS in the Tordera Delta have been presented to key stakeholders (i.e. environmental organizations, agricultural producers and campsite owners, among others) in a plenary session on the 11th of May 2023.

Next step will be to develop a thorough map of stakeholders analysing their views and expectations to be able to define a detailed roadmap for the co-creation process and implementation of the NBS.

However, a stronger consensus has still to be built within the Regional Government of Catalonia to agree in a common view for the Tordera Delta before starting any participatory process. With this aim, meetings between representatives of different Departments involved in the final solution are being held.

5.3.3 Construction practices

This project has not reached the construction phase yet. First, key stakeholders, including ACA and Departments from the Regional Government involved in the construction of the NBS, have to agree upon the final solution. Once an agreement is reached, the project will be executed. Before the construction of the NBS will take place, a key aspect to be solved will be the acquisition of land. This process (I.e negotiations with landowners) will definitely determine the start of construction works.

5.4 Encountered barriers in the co-implementation process

Main barriers encountered in the co-implementation process are cultural and structural ones. The lack of mechanisms and networks in place that allow co-implementation, as well as the lack of cultural habits, makes it very difficult to change usual planning and implementation procedures. There is also a lack of knowledge among the public servers on how to undertake this type of approaches, as well as a lack of means to do it (mostly in terms of time and human resources). This is the reason why the level of stakeholder involvement in this project is, at the moment, very basic (informing and collecting stakeholder's views and impressions on the planned NBS).

It is also important to emphasize that the NBS planned at the Tordera Delta is a large-scale one, which adds difficulty to the whole co-implementation approach and process. On the one hand, there are many different stakeholders involved, with different objectives, interests and views, and on the other hand, the planning and design of the final solution require of certain technical understanding and expert view.

5.5 Added value of co-implementation to project

So far, ACA has developed the project on their own. However, RECONECT partner UFZ is helping demonstrators to define their goals in terms of co-implementation, as well as to choose the more suitable tools to involve and engage stakeholders in the co-implementation process. It is expected that this learning process will help to better define and undertake a co-implementation strategy.

6 Demonstrator DA4: Portofino Regional Natural Park, Italy

6.1 Case description

The Promontory of Portofino shows views and landscapes among the most famous in the world. Made by conglomerate rock masses overlying marly limestone flysch, it has geomorphologic and microclimatic features that, in a limited territory, have created very different environments. The increase of brief and intense rainfall events, as verified analysing rain gauges data over the last 100 years, tends to foresee a possible growth in flash flood events. The flash flood events considering the steepness of the slopes and the accumulated loose coarse soil, can cause favourable conditions for triggering increasingly disastrous debris and mud flows.

The analysis of geomorphological, geological, historical and socio-economic factors has clearly shown that the abandonment of the terraces led to an increase in geo-hydrological risk in an area already struggling to maintain a delicate balance between natural and historical aspects of its landscape.

The Portofino Natural Park is promoting interventions aimed at reducing geo-hazards and vulnerability against climate changes, above all the extreme rainfall events. Their interventions are mostly carried out through natural and nature-based solutions, aimed at exploiting and regenerating ecosystem services and natural functions of the area (Paliaga, Giostrella, & Faccini, 2016).

NBS Works done in the Portofino Natural Park within RECONECT:

- dry-stones walls construction and abandoned terraces restoration, with the aim to preserve the terraced landscape, and push the agricultural activities
- hydraulic-forestry operations on water courses
- riverbed and tributary operations
- natural engineering interventions along hiking paths
- interventions of forest amelioration and re-forestation

Some small catchments involved in RECONECT project: in the San Fruttuoso village Catchments (Rio dei Fontanini and Vallone di San Fruttuoso streams) and in the Paraggi village Catchments (Fosso dell'Acqua Viva and Fosso dell'Acqua Morta streams). These catchment areas are presented in figure 6-1

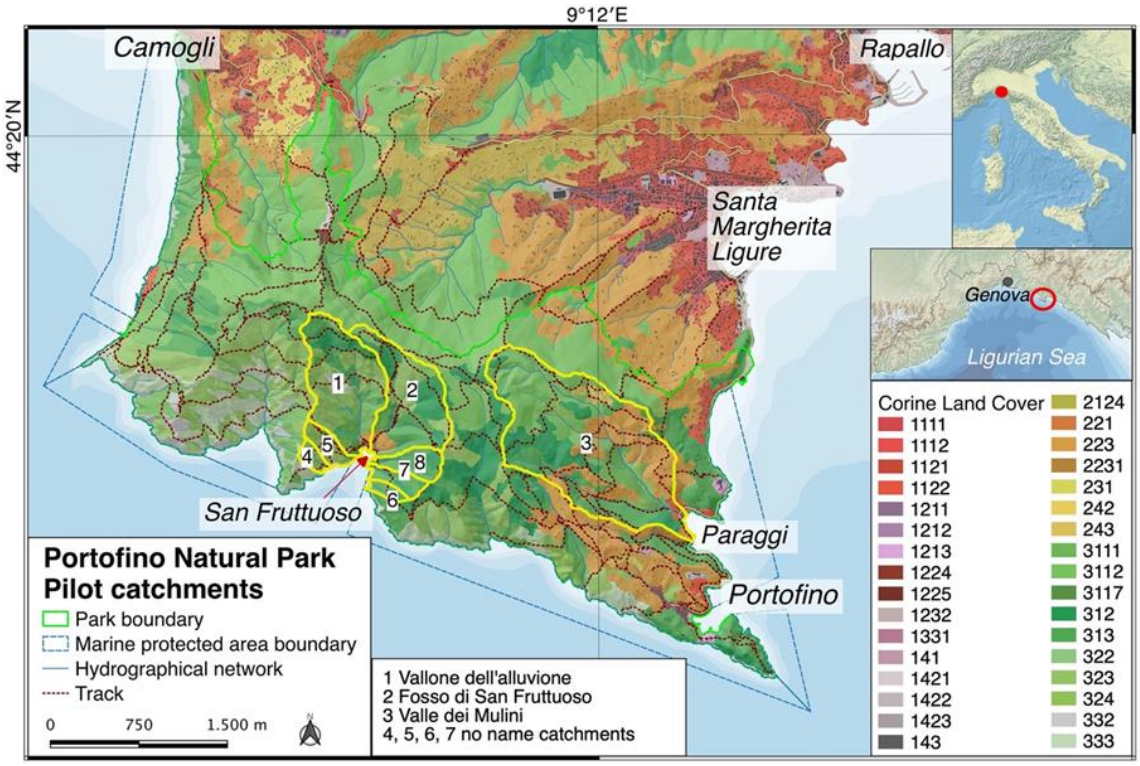


Figure 6-1 NBS project locations and their land use (Corine Land Cover code)

6.1.1 Geomorphological characteristics

The pilot areas are part of Portofino Park that is located about 20 km East from Genova. The promontory develops in a mountainous territory along the sea, culminating at Monte di Portofino (610 m asl): steep slopes, small catchments and high cliffs are the main morphological features. Three major catchments and four smaller ones compose the pilot area that extends on a conglomerate bedrock (tab 1, fig. 1).

Catchment	Area (km2)	Mean slope (%)
1 Vallone dei Fontanini/Vallone dell'alluvione	0.44	75
2 Fosso di San Fruttuoso	0.59	65
3 Fosso dell'Acqua Morta	1.48	50

Table 1. Main features of the pilot catchments.

Slope gradient frequently exceeds 75%.

Land cover is prevalently natural with a concentration of anthropic structures, historical heritages, roads, tourism facilities and houses at the stream's mouths. Dry-stone man-made terraces for agricultural purposes constitute an important human modification present in all the pilot areas and constitute a possible source of debris or hyperconcentrated flows threatening human structures in case of heavy rain-flash flood.

Some limited interventions have been realized locally to prevent cliff collapse and to recovery terraces; culverts at the streams' mouth are exposed to saturation by solid and floating transport.

6.1.2 Climatic conditions

The climate is Mediterranean, Csa according to Köppen, with hot summers, mild winters and rainy autumns. The microclimate is strongly conditioned by the morphology: elevation, slope and aspect cause local different conditions. The area may be subdivided into two zones: a) typically Mediterranean one on the southern slope, with dry, warm summers and mild winters; b) a mid-hill zone on the northern slope, with lower mean winter temperatures and higher rainfall, especially in the sectors exposed to the N.

Maximum rainfall usually occurs in fall, while minimum in summer; annual mean rainfall is comprised between about 1000 and 1600 mm. Mean annual temperature ranges between 12 and 13 °C, reaching 23-24 °C in summer and 7-8°C in winter.

Rainfall often occurs with strong intensity that appears to be increasing in both frequency and intensity. The present-day beach in San Fruttuoso was shaped in 1915 by intense precipitation (> 400 mm/12h) that triggered debris flows along the steep slopes. Recently intense events happened, causing spread damages: 23-24/9/1993, 4-5/11/1994, 6/10/1995, 22-23/10/1999, 6/11/2000, 24-26/11/2002, 31/10-2/11/2003, 1/6/2007, 4-5/11/2011, 18/1/ 2014, 26/7/2014, 16/10/2016. The area has been hit even by intense sea storm: 15-16/12/1993, 31/10-2/11/2003, 30/10/2008, 1/1/2010, 29/10/2018. Precipitation intensity is the crucial parameter, together with wind.

6.1.3 Hydrological conditions

The three small catchments of the pilot area (see figure 6-1), due to the morphometric asset of the area, are characterized by the presence of a stream network with high gradient and strong irregular discharge: hydrographical network in 'Vallone dei Fontanini' stream and 'Fosso di San Fruttuoso' stream catchments present water flowing only during and after rainy days. In Fosso dell'Acqua Morta main stream, on the opposite, a small amount of running water is always present, probably due to the relatively more extended catchment and a more extended hydrogeological one. The following table presents the main features of the hydrographical network.

Catch-ment	Hydrograph-ical network length (km)	Main stream length (km)	Main stream mean gradient (%)
1	2.82	1.14	44
2	1.96	0.82	48
3	7.51	1.83	19

Table 3. Hydrographical network feature of the three catchments.

In the three catchments several scarcely water flow springs are present and water is partially collected on aqueduct for drinking water. Due to the lack of pollution, chemical or biological, in the whole Portofino promontory, water quality is good.

NBS solution will be applied along slopes and will not interest the seaside, whose quality is optimal.

6.1.4 Hydro-meteorological hazard and problem description

Intense rain event presents a strong spatial variability along the coastal Ligurian zone: in the recent years many flash floods caused high damage often for the concurrent action of flooding and diffuse landslides triggering. Debris and hyperconcentrated flow have been often moving from terraced slopes: the main recent event of this type happened in 2011 in the 5 Terre area, together with the one in Gazzo di Leivi in 2014, about 12 km East from the pilot areas. Both the events caused casualties and heavy damages. A similar event in 1915 shaped the beach in San Fruttuoso and caused heavy damages to the ancient Abbey.

Moreover, wind storms recently destroyed several trees along the steep slopes and the ones that actually are close to the hydrographical network may potentially increase the floating transport that may occlude the culverts that are present at the mouth of the streams and where vulnerability of human structures is high: cultural heritage, as the San Fruttuoso ancient Abbey, tourism facilities and essential infrastructure in Paraggi, at the mouth of Fosso dell'Acqua Morta.

NBS will be crucial in reducing the potential instability of terraced areas, in regenerating wood areas and recovering the highly frequented tracks.

6.1.5 Nature

The pilot areas are included in Natura 2000 and in Portofino Natural Park, then natural features and peculiar habitats are prevailing. The inhabited zones are concentrated in the more exposed to geo-hydrological risk areas: the relationships between nature elements and anthropic ones are sometimes considered conflictual.

Planned works will comprise recovery of terraced areas to reduce the possible debris flow source and afforestation, trying to improve the natural recovery and reduce the hazard associated both to the absence of trees and by the presence of dead ones: floating and solid transport, in fact, occlude culverts in the inhabited areas. NBS will play the role of accelerating the nature recovery after occurred damage and to stabilize the anthropogenic diffused structures of terraces.

6.1.6 Stakeholders and governance

Portofino Park's stakeholders are represented by a series of categories such as: Administrators, President, Park Councillors and Regional Councilors for the Liguria Regional Authorities, mayors and councillors of the municipalities of the area and surrounding areas, related local and regional political forces, prevailing local economic subjects most of them from the tourism sector (both hospitality – hoteliers, owners of houses to be rented and BBs - and catering, sellers of objects and services such as environmental guides, tourism and MTB, bathing, boatmen, mooring, renting bicycles, cars, canoes etc., and transport in general) and of the property (real estate, building, gardeners).

In addition to the residents (in the Park about 600 people live), great relevance is given to the houses' owners. given the very high real estate values in the area. At the opposite side are landowners, not always coinciding with the previous ones, and the few subjects that cultivate land and raise animals, not having in that their major income.

Citizens are significantly organized in numerous local associations (local, cultural, voluntary, sports or mixed) if compared to the total number of inhabitants, supporting the

trade Associations. Finally, the University, teachers and students, and the numerous employees and technicians working in local administrations have relevant importance.

Portofino Park is managed by a Council, stating all the general issues, adopting the planning and programming instruments, approving all the administrative, accounting and financial measures. The Council is composed by 5 representatives appointed by the Park Community (its advisory body). Three of them are identified by the local authorities whose territory is interested by the Natural Park, and one (at least) represents general interests. The Board is chaired by the President, representing the Park Authority towards third parties, convening the Board, promoting and taking initiatives aimed at guiding the management activity of the entity according to the objectives of the Board.

One third of the Park territory is represented by public property, whilst the remaining part is private. Public properties, apart from the coastline, ports and waterways, are largely wooded areas, managed by the Park Authority in agreement with the Municipalities that own these areas. Hence, areas where NBS interventions will be implemented will be maintained by the Park Authority or by the related Municipality. Private properties are managed according to the rules stated in the Park's plan, which provide, upon a private - public agreement, that areas where NBS are implemented will be maintained in the future by the Park.

Portofino Park Demonstrator A is carried out by Italian partners grouped in a cluster. They are:

- Portofino Park Authority acting as institutional entity and beneficiary of NBS interventions.
- CNR-IRPI acting as scientific partners expert in geo-hydrological aspects (with subcontractor University of Genoa);
- GISIG Association in charge for the coordination of the contributions by the Italian cluster and the contacts with project coordination and WP leaders.

In addition, during the project external professionals and companies are appointed by the Portofino Park to carry out design and implementation of NBS interventions.

As beneficiary of the NBS interventions, the Portofino Park is responsible for managing and controlling works on a technical and financial point of view through its technical and administrative offices. Portofino Park manages the public bids for assigning work design and implementations as well as follows the environmental assessment procedures (if needed) requested by Liguria Regional Authority. It is supported on a scientific point of view by CNR-IRPI and for project management aspects by GISIG. Portofino Park, moreover, is the entity who takes direct contacts with main project actors (Municipalities of the area as well as private landowners) whilst general contacts with local and national RECONECT stakeholder are undertaken indistinctly by all the three partners of Italian cluster.

6.1.7 "People" – socioeconomic aspects

The Natural Park of Portofino has an extension of 10,55 km2 of protected area with less than 700 inhabitants, although it is frequented by about 4,000,000 visitors per year. The environmental quality is crucial for the local economy and interventions in the area must have an ecological and landscape function. Maintenance of terraced landscapes is, for example, important, apart from agriculture, for some habitats including semi-natural dry grasslands and shrub facies on limestone substrates (Festuco-Brometalia), where orchids are relevant (to this aim the Park is developing a LIFE NAT 2017 Life Orchids Project).

The planned NBS for geo-hydrological risk mitigation will enhance the economic value of properties, improving landscape and its use for recreational and touristic purposes.
The elevate touristic value of the coastal areas (Paraggi e San Fruttuoso di Camogli) that are annually visited by some 4,000,000 people and the high importance as cultural heritage of San Fruttuoso village (the ancient Abbey, the monastic complex and historical buildings as the Casa dell'Arco) suggest a positive social and economic impact of the planned activities.
All the maintenance cost will need to be scheduled by the Park, the municipalities and the private owners.

6.2 NBS design and status of the project

The peculiarity of the area requests the adoption of a risk reduction strategy at catchments scale with a holistic ecosystem-based approach. Therefore, a combination of measures has been considered to face the different hazards that affect the area. The combinations of measures for the two areas of San Fruttuoso and Paraggi have been chosen to approach critical situations at the catchment scale and to get to a general geo-hydrological risk reduction. The NBS measures for this demonstrator site consist of Source control (reforestation) and grey (terracing) solutions.

The designed measures are intended to:

- Reduce the streambed erosion
- Reduce the widespread erosion along the slopes and improve slope stability
- Improve hydraulic/geo-hydrological conditions
- Improve the knowledge of the rainfall regime capable of triggering geo-hydrological processes that are harmful to the territory
- Footpath maintenance and reinforcement

The measures final design is described separately for the two catchments. The design for San Fruttuoso is presented in Figure 6-2 and the design for Paraggi is presented in Figure 6-3.

San Fruttuoso design

1) Draining running water in the compluvium with dry-stone walls in order to reduce erosion along the slopes; protection of the footpath and the Casa dell'Arco house.
2) Compluvium maintenance with vegetation selective cut and erosion reduction**;** wood and dry-stone weirs to reduce solid transport along the stream. Rock slopes reinforcement for footpath and buildings safety.
3,4) dry-stone walls recovery and maintenance (historical olive orchard) and environmental engineering for slopes stabilization; proper planting of Mediterranean autochthonous shrub species to reduce erosion and improve slope and footpath stability and safety.

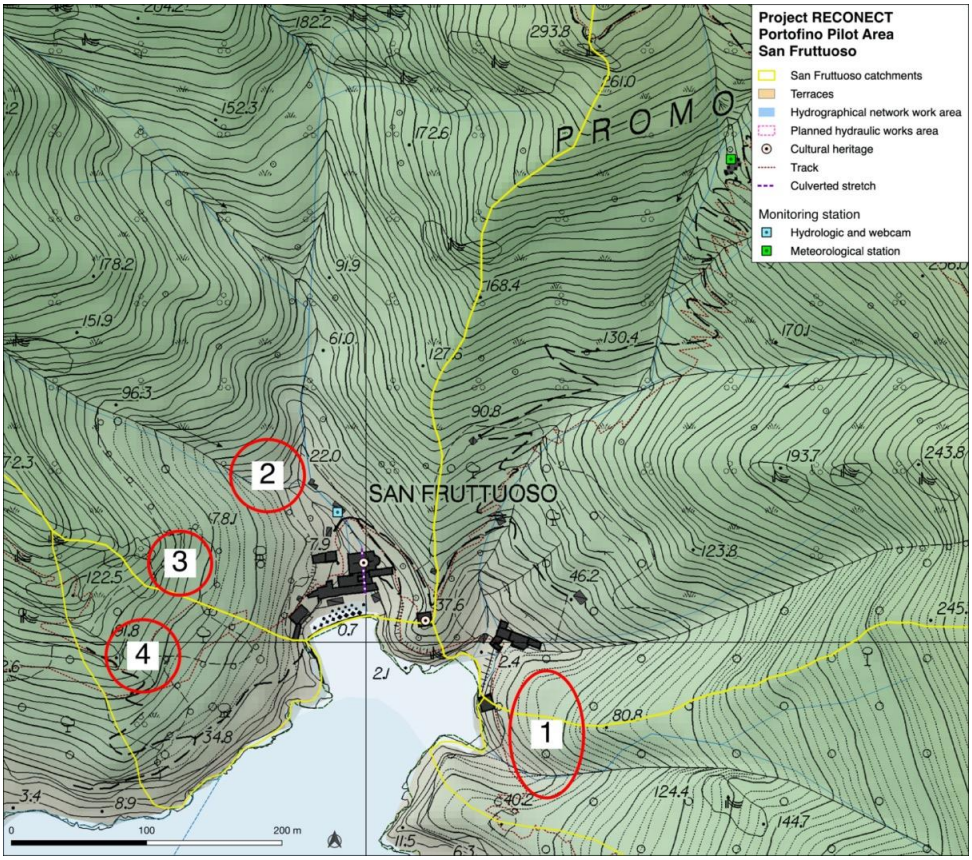


Figure 6-2 Localization of measures in the San Fruttuoso catchments

Paraggi design

1, 2) Terrace recovery in order to stabilize slopes and avoid strong contribution of solid transport along the stream.

3a) Selective weir to avoid saturating transport capacity of the culvert.

3b) dry-stone weirs in order to reduce water flow and then the stream-bed erosion.

3c) Vegetation maintenance along the stream and water flow improvement.

4a, 4b) Footpath maintenance and recovery; vegetation cleaning along the footpath and water flow improvement.

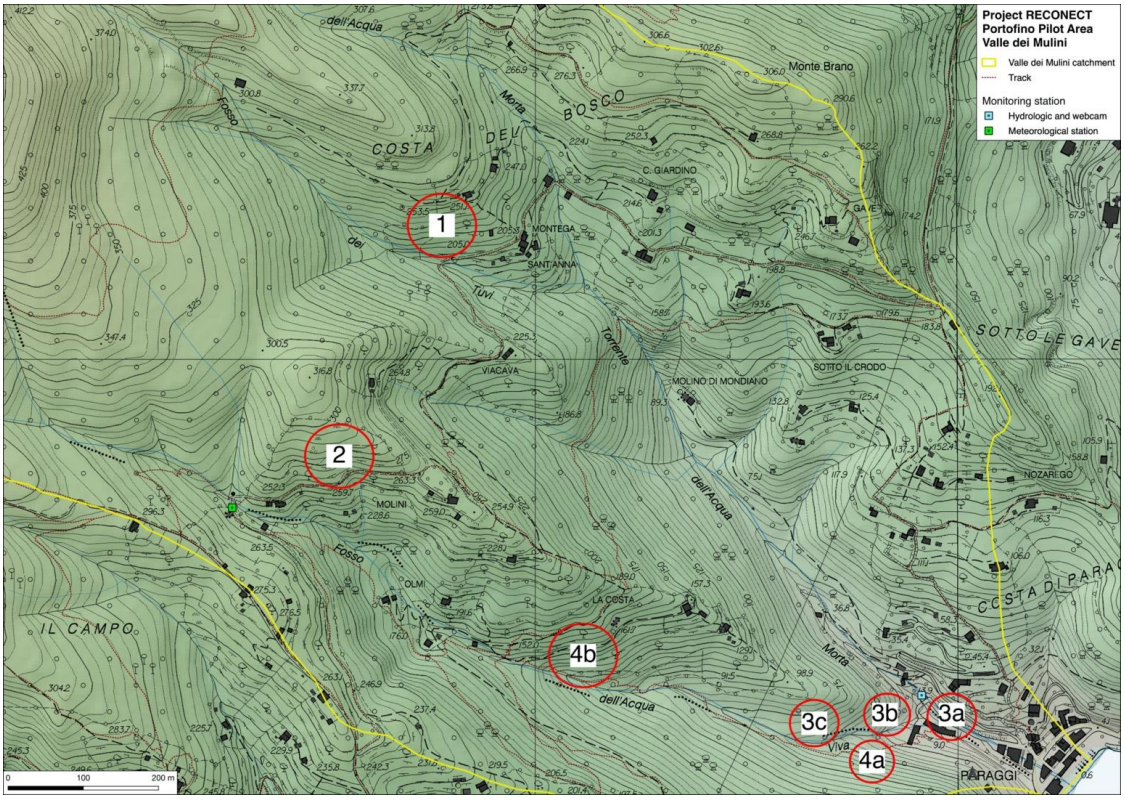


Figure 6-3 Localization of measures in the Paraggi catchment

6.3 Co-implementation activities undertaken

Co-implementation has been achieved according to the opinion and experiences exchange among the RECONECT partners during the GA, in particular, but not only, the 3rd one in Nice. During the 4th GA and after that, a knowledge and experiences exchange happened with collaborators, in particular regarding the shallow landslides' susceptibility in terraced areas, due to more similar landscape conditions among other demonstrators. Other important events of knowledge exchange happened during the webinars and through the peer-to-peer exchange with Ramboll and the technical consultation with InterAct, regarding the monitoring instrumentation link to the RECONECT platform.

6.3.1 Regulatory processes

The Portofino Park is a public body and the regulatory processes for the projects in the San Fruttuoso and Paraggi catchments have up till now been handled by local authorities.

Hereafter the different steps of the regulatory process are listed:

- 18/07/2017 – Portofino Park Council approves the participation in the RECONECT project.
- March 2019 – Conclusion of competitive tender for the design, including construction management. Then, Portofino Park Authorithy identifies the two pilot areas (San Fruttuoso – Paraggi) and entrusts the job.

San Fruttuoso

- 03/07/2019 - Portofino Park Council (resolution n. 14/2019) approves Preliminary Design.
- 07/01/2020 – Executive Decision n. 2/2020 approves Detail Proposal.
- 26/02/2020 – Portofino Park obtains the "Soprintendeza Archeologia, belle arti e paesaggio" Permit.

- 31/02/2020 - Portofino Park obtains from “Comune Camogli” the Landscape Permit.
- 11/03/2020 - Portofino Park obtains from “Regione Liguria – Soil Protection” the Hydraulic Permit.
- 08/01/2021 – Executive Decision n. 3/2021 approves Final Proposal.
- 19/01/2021- Portofino Park requires the Regional Contracting Authority (SUAR) to issue a call for competitive tenders for works.
- 26/03/2021 - Regional Contracting Authority (SUAR) communicates the successful tenderer.

Paraggi

- 13/07/2019 - Portofino Park Council (resolution n. 13/2019) approves Preliminary Design.
- 07/01/2020 – Executive Decision n. 1/2020 approves Detail Proposal.
- 26/02/2020 – Portofino Park obtains the “Soprintendeza Archeologia, belle arti e paesaggio” Permit.
- 06/08/2020 - Portofino Park obtains from “Comune Portofino” the Landscape Permit.
- 23/03/2021 - Portofino Park obtains from “Regione Liguria – Soil Protection” the Hydraulic Permit.
- 12/04/2021 – Executive Decision n. 79/2021 approves Final Proposal.
- 21/04/2021 - Portofino Park requires the Regional Contracting Authority (SUAR) to issue a call for competitive tenders for works.
- 06/07/2021 - Regional Contracting Authority (SUAR) communicates the successful tenderer.

6.3.2 Public opinion and stakeholder involvement

The stakeholder involvement has been pursued at two different levels: the first one through the so called “Park Community” which is a public participatory body of the Park that includes all the stakeholders in the Park area. The project has been presented and then, thereafter, the possible solutions have been illustrated and then approved by the Community. More information about the stakeholders can be found in deliverables D2.1 and D2.3.

6.3.3 Construction practices

The realization of works in “San Fruttuoso” started in the middle of September 2021, and continue for a maximum of 120 days. The realization of works in “Paraggi” will start in early September 2021, and continue for a maximum of 180 days.

In addition to the planned construction works for the NBS, the monitoring activities have also started. Portofino Park has realized a topographical survey of the area, which was preparatory to the LIDAR survey that was performed in February 2020; the final survey data have been available after the survey post processing in July 2020. Furthermore, the following are installed in the Portofino Park (some visualized in Figure 6-4):

- 3 weather stations:
  - Mulino Gassetta – in the San Fruttuoso area
  - Paraggi – in the Paraggi catchment
  - Portofino Municipal building
- 2 hydrologic stations:
  - Paraggi, before the culvert inlet
  - San Fruttuoso, before the Abbey culvert inlet

Figure 6-4 Installed weather stations in the Portofino Park

The timeline for the monitoring activities include:

- 27/03/2019 - Portofino Park requires 6 estimates of costs for “installation and maintenance” for 3 weather stations and 2 hydrologic stations.
- 28/08/2019 - Portofino Park assigns installation and maintenance of 3 weather stations and 2 hydrologic stations.
- 31/01/2020 - Portofino Park declares the end of the works.
- 02/03/2020 - Executive Decision n. 44/2020 approves the work of topographical survey of the Portofino’s area.
- 10/06/2020 - Portofino Park declares the end of the works.

6.4 Encountered barriers in the co-implementation process

The main encountered barrier is related to the possibility of realizing interventions on terraces that are not in good maintenance conditions. Terraces are usually on private areas and owners often do not want interventions made by others. Besides, it often happens that the property of terraced land is fragmented between several private owners, probably after being inherited: this is a further limitation, as it is furtherly difficult to find an agreement between several small owners. Besides, often some small owners, due to inheritance, live currently far away or abroad. Then, the high property fragmentation is a strong barrier, which limits the ability to implement recovery interventions at all sites where this would be needed.

To overcome this barrier a possible solution could be to encourage the aggregation of the very small private properties in association, whose aim should be to promote the use of terraced areas and then their maintenance through proper methods. Some examples of this kind already exist both locally and at the national level. Finally, some regulation at administrative level would be helpful to stimulate such aggregation.
Another action should start from a proper monitoring in order to evaluate a scale of priority areas, where performing terrace maintenance. Then, in the higher priority areas where the risk related to the possible terrace collapse may involve directly buildings or infrastructures, prevention measures should be compulsory and adopted by the owners or by the administration. This action would require the approval of a proper regulation or local legislation.

6.5 Added value of co-implementation to project

The general approach form the other Demonstrators gave a confirmation of the followed approach, even considering the peculiarities of Portofino Demonstrator A in respect to

other demonstrators. These differences resulted in little transferrable NBS experiences, but the exchanges about the general philosophy and approach have been crucial. A good exchange of information has been gathered in the monitoring field.

7 Co-creation activities within RECONECT

Within the RECONECT project, several activities took place to assist Demonstrators A in the different phases of the co-creation process. These include on-site visits at Demonstrators A sites, workshops during GA meetings, interaction with Demonstrators B and other RECONECT experts/consultants, webinars (under twinning activities) and also the reporting of lessons learned from Demonstrators B in the Technical Deliverables (D2.3 and D2.4).

The most recent activities include co-creation webinars by RECONECT partner UFZ, which are:

- "Kick-off workshop session on co-production & reflexive monitoring" on 16 June 2021
- "Introduction to the RECONECT Manual to support the co-creation process" on 22 July 2021 with the RECONECT Partners
- World Cafe sessions "Deep dive into co-creation: participatory approaches for all stages of NBS" on 17 June 2021 during the 5th GA

These webinars and sessions with RECONECT partners were aimed to clarify the following issues:

- Which aspects of co-creation are partners particularly interested in?
- Which opportunities and challenges do they see to start/continue the co-creation activities at their NBS sites?
- What kind of support would partners need to facilitate the co-creation?
- What kind of support could partners offer to share their experience with other RECONECT partners as activities within the Twining?

Most of the Demonstrator participants responded that they need support with co-creation especially for the co-monitoring and co-evaluation stage of the NBS process. They underlined the need for learning from others (Twinning), webinars on co-creation tools and methods as well as manuals for practitioners as the three main categories of type of support. A value of co-creation that was highlighted by participants refers to building up trust with the local communities and stakeholders, to increase interest, acceptance and cooperation. In this regard, the RECONECT partners mention that it is necessary that a methodology is developed on how to make an NBS socially attractive and accepted by a variety of stakeholders.

For the 6th GA on the 26 of November 2021 another session is planned: "Co-creation 2: Co- monitoring, Co-evaluation".

8 Co-implementation barriers

Main co-implementation barriers encountered by Demonstrators A revolve around;

- Lack of support of key stakeholders
- Conflicting interests
- Negative public opinions
- Land-ownership issues

On the project level, the main methods to overcome these co-implementation barriers revolved around educating and informing both the key stakeholders and general public on the necessity and benefits of the measures. Because of the competing interests, a more general understanding of the purpose of using a NBS is helpful in implementing these projects.

Information campaigns were done largely on-line due to COVID restrictions at the time.

For DA 1 co-implementation barriers resulted at the start of the project from the unhappy role out of a pure theoretical feasibility study which analysed to open the Dove-/Gose-Elbe system to a reduced but regular astronomic tide. The contents of this theoretical approach were presented to the public neglecting prior information of the stake holders and population. The inadequate but often classical top - down approach of the administration led to immediate rejection by the stake holders and culminated in political controversial discussions. This somehow bad and not expected experience (of insufficient communication) led the Reconect project team to communicate the project related information carefully and prepare the floor more thoroughly. The Reconect team offered open spaces for discussion and pursued to approach the formulated goals together with the stakeholders in an iterative process of communication and information dissemination. (see chapter 3.4)

On the execution level, main barriers involved finding the space for solutions, which involved various landowners. Whereas in DA4 Portofino some of the landowners of small plots were difficult to trace. The final design of the demonstration site in DA2 Seden Strand, Denmark had to be adjusted, because of changes in landowner support, which required intensive with negotiations with neighbouring landowners.

Nature-based solutions are defined as solutions that in shorts brings benefits for people and nature/biodiversity. To fulfil the potential of nature-based solution space/land is required for the implementation of these solutions. The case at DA2 Seden Strand is a good example of this. The flood protection alone could have been made involving less space. However, this would not have the same potential for multiple benefits and could therefore not be characterized as a nature-based solution.

The need for space is also crucial in the ambitions to restore degraded ecosystems, reduce emissions of greenhouse gases and to improve the aquatic environment. Therefore nature-based solutions have the potential to combine climate adaption with the other challenges that we need to solve.

In the case of DA3 Tordera, the lack of mechanisms and networks in place that allow co-implementation, as well as the lack of cultural habits, are factors that have hindered the co-creation process. At this stage of the project, main barriers encountered in the development and implementation of the NBS have been those of institutional and political matter. However, the project lacks a thorough assessment of barriers. Thus, a detailed roadmap and/or strategy on how to overcome them has not been devised yet.

Nevertheless, relevant experiences and lessons learned from Demonstrators A and B, as well as from Collaborators, will help the Tordera team to plan ahead.

For DA3 Tordera, a twinning event is planned for February 2024. Purpose of this event is to share experiences from other Demonstrators in Spain, to gain further understanding of the barriers encountered at Tordera and, if possible, help inform and educate key stakeholders on the necessity and benefits of NBS solutions in the Tordera river basin.

9 Conclusions and Recommendations

9.1 Conclusion

This deliverable intents to capture the co-implementation activities undertaken in Demonstrators A in terms of regulatory process, public opinion, stakeholder involvement and construction practices.

Apart from general on-topic discussions during on-site visits (bilateral and general assembly's) and online sessions, there is limited additional co-implementation between Demonstrators A. This is mainly due to the different (geological) conditions of their project area (urban, coastal, mountainous) and the projects being in different stages. This made exchanging specific experiences difficult. But within the Demonstrators A project, some co-implementation with local stakeholders took place.

All the Demonstrators A are at different stages in their projects:

- DA1 Hamburg has implemented one part of their project (real-time controlling system of the Tatenberg sluice) and has recently identified retention areas, which will be implemented in a spin-off project
- DA2 Odense has done all the construction works and the baseline monitoring
- DA3 Tordera has recently wrapped up the feasibility study and has presented their plans to some municipalities. The planned solutions have to be accepted by stakeholders, which will be followed by the process of land acquisition. Construction was expected in the period 2022-2027
- DA4 Portofino will start construction after the 15th of September 2021 and has already prepared the baseline monitoring (in terms of Lidar survey and installation of hydro-metrological stations)

Of all the Demonstrators A cases, the NBS construction in DA3 Tordera will not be carried out in the RECONECT project timeline. The process of land acquisition, which is also relevant for the other Demonstrators A, can take up a long time especially if multiple landowners are involved.

In terms of regulatory processes, the required permits are prepared by the main organization that carries out the project (RECONECT partner) and handled by local responsible authorities.

In terms of stakeholder involvement and public opinion, mostly top-down approaches have been identified. The plans and designs have been mostly made by experts from the local authorities. At the DA1 Hamburg project, first local authorities and political committees were invited and presented with the plans. This is the same for DA3 Tordera and DA4 Portofino, where the plans were first made by the local main organization (ACA and the Portofino Park respectively), followed by presentation to the stakeholders and getting their approval. DA2 Odense on the other hand, has already included landowners in the design phase. A common activity in all the Demonstrators A is the stakeholder mapping done by UFZ at the start of the RECONECT project, which resulted in preparation of the co-creation activities within RECONECT (presented in deliverable 2.1) and which will be further expanded (see chapter 7).

The current identified encountered barrier in the co-implementation process between Demonstrators A within the RECONECT project is the limited possibility to travel, which means bilateral in-depth discussions on site are not possible. Another barrier is the general level of understanding of NBS and their multiple benefits. If this information can be provided in a more convincing way, this may take away feelings of uncertainty from

stakeholders. Also, the lack of mechanisms and networks in place that allow co-implementation, as well as the lack of cultural habits, make it very difficult to change usual top-down planning and implementation approaches. Land acquisition is also mentioned as a potential barrier in co-implementation within DA2 Odense, DA3 Tordera and DA4 Portofino. Negotiations with landowners may take a lot of time and hamper the project timeline.

From the dialogue with RECONECT partners, another barrier for NBS implementation (and related operation and maintenance) is language and terminology (e.g. scientific terms are in many cases not broadly used and well known by other groups of stakeholders such as public authorities and political representation, private companies and citizens groups). Term clarification is needed for good communication and networking with different stakeholders, not only during the implementation, but also at the following stage of co-monitoring and co-evaluation as well as for the whole NBS concept which should be clear for non-professionals. Also, local contexts should be considered, e.g. NBS and legislation, local stakeholders and different degrees of readiness to communicate and being involved. There is a need for clear communication language and understandable presentation of NBS projects, this benefits stakeholder involvement and the usefulness of their contribution. Summarizing all above mentioned, it highlights the need for a step-by step guide for the partners/practitioners on how to involve the stakeholders in co-creation and make participatory processes operable.

The added value of co-implementation is mostly derived from involving local stakeholders and gaining acceptance and support for the project. For DA 1 Hamburg, the involvement of other actors leads to a spin-off project for the retention areas and also collaborations with other organizations. For DA3 Tordera, engaging stakeholders in an early stage of implementation may also lead to support for the project.

9.2 Recommendations

Although the NBS projects in Demonstrators A differ in terms of local -e.g. geological, geographical, environmental conditions and social contexts (institutional settings, hierarchy, bureaucracy, cultural contexts) as well as resources and capacities and they are all in different project stages, co-implementation is still possible on different topics. These topics can be addressed within the twinning activities which enable knowledge sharing, exchange of experience, inspiration, tutoring, regular communication and transparency.

The specific recommendations derived are:

- In-depth experience sharing on land acquisition with the specific needs from demonstrators. Especially DA3 Tordera will have to go through this phase. DA4 Portofino may also benefit as well as DA1 Hamburg (for the retention areas). Lessons learned from DA2 Odense as well as guidance in stakeholder approach and involvement regarding land acquisition may specifically be addressed
- The RECONECT partners mention that it is necessary that a methodology is developed on how to make an NBS socially attractive and accepted by a variety of stakeholders. A value of co-creation that was highlighted by participants refers to building up trust with the local communities and stakeholders, to increase interest, acceptance and cooperation.
- Because of the limited progress up to date, it is recommended that DA3 Tordera is continuing the project as a Collaborator rather than a Demonstrator A.

References

Hellmers, S., Ackermann, D., Einfalt, T., & Fröhle, P. (2017). Konzeptstudie zur Steuerung von wasserwirtschaftlichen Anlagen auf der Grundlage von Ensemble Kurzzeitvorhersagedaten. Tag der Hydrologie.

Olson, N., & Bishop, J. (2009). The Financial Cost of REDD: Evidence from Brazil and Indonesia. IUCN. Retrieved from https://portals.iucn.org/library/sites/library/files/documents/2009-047.pdf

Paliaga, G., Giostrella, P., & Faccini, F. (2016). Terraced landscape as cultural and environmental heritage at risk: an example from Portofino Park (Italy). *ANNALES Ser. hist. sociol. 26 2016 3*. doi:10.19233/ASHS.2016.32

van der Nat, A., Vellinga, P., Leemans, R., & van Slobbe, E. (2016). Ranking Coastal Flood Protection Designs from Engineered to Nature-Based. *Ecological Engineering*, 80-90. Retrieved from https://doi.org/10.1016/j.ecoleng.2015.11.007

Annex A. Template to produce D2.7

Case description

Leave this section empty, because this will be copied from D2.3 and D2.4. Unless you would like to improve it with additional information than already published earlier.

max 1 page

NBS design and status of the project

Describe the design shortly (derive this from D2.4 section X.2.2). If the final design is different (more/other features, new details, etc.) than previously described, please state the changes. Also elaborate on the status of the project

max 1 page

Co-implementation activities undertaken

Describe the co-implementation activities undertaken for (components of) your NBS for the following sections: regulatory processes, public opinion and stakeholder involvement and construction of works. These may include the following (among others):

- *The active involvement of key stakeholders who possess knowledge and understanding of local specifics but also in terms of raising capacity (through site visits, meetings, interviews, see also previous deliverables D2.1 and D2.2*
- *Exchange of (general) knowledge and experience within the Reconect consortium (GA meetings and workshops, bi- and mulilateral twinning, monthly webinars, site visits between demonstrators, etc)*
- *Exchange of specific technical assistance for design, construction/implementation, monitoring by Reconect experts/consultants (InterAct, Ramboll, etc.)*

max 3 pages in total

Regulatory processes

Public opinion and stakeholder involvement

Construction practices

Describe the execution of works and the co-implementation activities that took place. What are the activities that took place to mark the start, end and anything in between that can be considered as execution. For example: official start signal by mayor (or contractor), excavation of watercourse, construction of footpath, placement of sluices, etc. Include pictures/figures if available.

max 2 pages

Encountered barriers in the co-implementation process

Describe the barriers you have encountered in the co-implementation process (in general and in terms of regulatory processes, public opinion and stakeholder involvement, and during the construction/implementation phase)

max 1 page

Added value of co-implementation to project

Describe the added value of co-implementation to your project. For example: how has the identified best practices from another NBS inspired/supported your chosen NBS?

max 1 page