D2.2 First Version of the ENHANCE Scenarios & Platform Specifications

WP2: ENHANCE Framework, Co-creation, Services Co-design

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Date: 13/11/2025

ENHANCE

enhance-onehealth.eu

Title of Deliverable	D2.2 First Version of the ENHANCE Scenarios & Platform Specifications
Type of Deliverable	R
Dissemination Level	Public
Work Package	WP2 – ENHANCE Framework, Co-creation, Services Co-design
Lead Beneficiary	CSIC
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Data Due.	30/09/2025
Date Submitted	13/11/2025
Status (In progress / Draft / Completed)	Completed
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Suggested Citation	Jaume Piera (2025) First Version of the ENHANCE Scenarios & Platform Specifications. ENHANCE Deliverable 2.2, Horizon Europe grant no. 10113447

Date	Version	Contributors	Comments
09/07/2025	v01	Jaume Piera (CSIC)	First Draft of the Deliverable
30/07/2025	v02	Antonia Vronti, Sotiris Aspragkathos (SLG), Lien Bakelants (NAZKA), Efi Bataka (UTH), Nikolaos Kokosis (UTH)	Contribution to the Deliverable
03/09/2025	v03	Inna Petrenko (EG), Antonia Vronti (SLG)	Internal Review of the Deliverable
25/09/2025	v04	Jaume Piera (CSIC), Andreu Fornos Bautista (CSIC)	Final Consolidation of the Deliverable (V1.0)
10/11/2025	v05	Stamita Rizou (SLG)	Consolidation Pilot cases
12/11/2025	v06	Antonia Vronti (SLG) Jaume Piera (CSIC), Andreu Fornos Bautista (CSIC)	Final Consolidation of the Deliverable (V1.1)

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Table of Abbreviations

Abbreviations	Explanation
AI	Artificial Intelligence
AMB	Metropolitan Area of Barcelona
BCASA	Barcelona Cicle de l'Aigua, SA (Barcelona Water Cycle, Public Limited Company)
CS	Case Study
D	Deliverable
EGNSS	European Global Navigation Satellite System
EU	European Union
FECDAS	Federació Catalana d'Activitats Subaquàtiques (Catalan Federation of Underwater Activities)
GIS	Geographic Information System
ICATMAR	Institut Català de Recerca per a la Governança del Mar (Catalan Institute of Research for the Governance of the Sea)
ICM-CSIC	Institute of Marine Sciences – Spanish National Research Council
NGO	Non-Governmental Organisation
RQ	Requirement
SME	Small and Medium-sized Enterprises

T	Task
TG	Target Group
TL	Task Leader
ToC	Table of Contents
WP	Work Package
WPL	Work Package Leader

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Executive Summary

This document presents the first version of the ENHANCE scenarios and platform specifications (Deliverable D2.2) within the ENHANCE project.

Its purpose is to outline the initial steps and preliminary outcomes in the co-creation of the ENHANCE toolkit. Building on the stakeholder engagement and mapping activities documented in D2.1 « Development of ENHANCE One Health Framework for Coastal Management », this work focuses on identifying user needs through targeted user stories, translating these into technical requirements, co-developing relevant use cases, and designing intuitive user environments. These contributions are intended to support the creation of resilient strategies for sustainable coastal management.

The document also establishes a foundation for future developments by detailing the initial set of user stories and requirements, their transformation into technical specifications, and the creation of user journey maps and wireframes. It provides a detailed account of the preliminary efforts undertaken to support the co-creation of ENHANCE's platform specifications and the early formulation of technical use cases. These elements will be further refined and expanded in the next iteration of the report (D2.3), enriched by insights from the second round of co-creation sessions.

To ensure alignment with project objectives and stakeholder expectations, all ENHANCE partners are expected to adhere to the methodological framework set out in this document. The structured approach and key findings outlined here will guide the development of ENHANCE tools under Work Package 3 (WP3).

1. Introduction

The ENHANCE project is dedicated to preserving and restoring vulnerable coastal ecosystems by leveraging a combination of cutting-edge technologies and interdisciplinary collaboration. At its core, the project integrates advanced artificial intelligence (AI), Copernicus satellite observations, citizen science contributions, and in-situ environmental data to support sustainable coastal management strategies.

ENHANCE adopts the One Health approach as a guiding framework, focusing on the interconnectedness of human, animal, and environmental health. Rather than treating these domains in isolation, the project emphasizes integrated solutions that reflect the complex realities of coastal zones. Through close engagement with stakeholders, ENHANCE fosters a co-creation process to ensure that the tools and services developed are context-aware, practical, and tailored to real-world needs.

1.1 Purpose of the Document

The initial version of the ENHANCE scenarios and platform specifications (D2.2), developed within WP2: "ENHANCE framework, co-creation, services co-design," represents a critical step toward shaping KER1: the ENHANCE One Health framework for coastal management.

By integrating the work from T2.3 ("Co-creating the ENHANCE solutions and user scenarios") and T2.4 ("Specifications of the ENHANCE Platform – Copernicus/EGNSS alignment and synchronization"), the deliverable provides the methodological and technical foundation upon which KER1 is built. These early scenarios ensure that the framework reflects stakeholder needs through co-creation, while the platform specifications guarantee its interoperability with key Earth Observation and navigation data sources.

Furthermore, the alignment with WP3, the development of the AI-enabled ENHANCE toolkit — directly supports the operationalization of KER1. The combination of co-designed user scenarios, platform synchronization, and AI-based coastal management tools strengthens the One Health perspective, enabling integrated monitoring and management of coastal ecosystems, human health, and socio-economic resilience.

This document serves several purposes, including:

a) identifying user stories and capturing user requirements;
b) providing an initial conversion of these user needs into technical specifications, which will be further refined for D2.3 "Final version of the ENHANCE scenarios and platform specifications" following the outcomes of co-creation sessions;
c) outlining the preliminary user flow of the user interface;

d) defining technical use cases based on the derived technical requirements.

At this stage, D2.2 focuses on conceptualisation and groundwork. It captures and structures the first set of user stories and requirements and translates them into preliminary technical specifications, while also setting out early user flows and initial technical use cases. The emphasis here is on laying the foundation, ensuring interoperability with Copernicus and EGNSS, and preparing the ground for refinement. The follow-up deliverable, D2.3, will be built directly on this basis. It will consolidate the results of the Living Lab and co-creation sessions across the pilot sites and will provide a more detailed and finalised version of the scenarios and specifications. In particular, D2.3 will specify the final user groups together with their roles and access levels, validate and update the technical specifications, and present consolidated user flows and use cases. In this way, D2.2 acts as the starting point that defines the direction of development, while D2.3 will deliver the validated framework that guides the technical implementation in WP3.

As a foundational element for the ENHANCE project, this deliverable initiates the development path by conducting a comprehensive analysis to extract user needs and expectations. These findings are then translated into corresponding technical inputs that guide the subsequent development stages. Creating early versions of user flows and initiating the co-creation sessions for each pilot site are essential milestones that influence the overall design and direction of the ENHANCE platform. These tasks contribute significantly to shaping both the technical solution and the strategic methodology, grounded in conceptual scenarios, user demands, and operational limitations. This work builds upon the conceptual framework outlined in D2.1 and will be refined and validated in D2.3, which will consolidate results from ongoing Living Lab activities and inform the technical implementation in D3.1.

1.2 Case Studies

ENHANCE is applying its integrated tools and methods in two distinct coastal regions to improve ecosystem monitoring and management.

In the Catalan Coast, the project focuses on Barcelona's urban beaches, which face eutrophication and erosion from urbanization and storms, and the Ebro Delta, impacted by agricultural runoff and aquaculture activities. Using Copernicus satellite data, citizen science, and local monitoring, ENHANCE aims to map environmental pressures and support sustainable coastal management that balances biodiversity, tourism, and food production.

In Pagasitikos Gulf, Greece, the project addresses the aftermath of severe 2023 floods that introduced pollutants and pathogens threatening marine life and human health. ENHANCE conducts ongoing water quality and pathogen monitoring, combined with satellite observations, to assess ecosystem recovery and guide local efforts in managing risks to biodiversity, food safety, and public health.

1.3 Underlying Definitions

To ensure a consistent interpretation of core concepts used throughout the ENHANCE project, this section outlines definitions for key elements such as user personas, user stories, user requirements, technical requirements, use cases, and conceptual architecture.

User Personas

User personas are archetypal representations of target user groups, constructed to embody typical goals, behaviors, motivations, and environmental contexts. They serve as design tools to foster empathy and ensure solutions are tailored to real user needs rather than abstract assumptions. Effective personas are grounded in qualitative research and help align development with user expectations (Cooper, Reimann, Cronin, & Noessel, 2014).

User Stories

User stories are concise, natural-language descriptions of a user's goal or need, often following the template:

"As a [user], I want to [action], so that [goal]."

They facilitate clear communication between stakeholders and developers and support agile, iterative delivery by focusing on user value (Cohn, 2004).

User Requirements

User requirements articulate the specific functionalities and qualities the system must provide to satisfy user needs. Expressed in user-centric language, they are refined through stakeholder engagement and validation processes. These requirements act as a bridge between user stories and technical specifications (Sommerville, 2015).

Technical Requirements

Technical requirements translate user requirements into detailed system specifications, defining performance criteria, security standards, interoperability, and compliance measures necessary for implementation. Clear and measurable technical requirements are essential for system verification and validation (Wiegers & Beatty, 2013).

Use Cases

Use cases describe step-by-step interactions between users and the system to achieve particular goals. They are valuable for capturing and illustrating how system components respond to user actions under different scenarios (Cockburn, 2000).

Conceptual Architecture
Conceptual architecture provides a high-level blueprint of the system's structure, identifying core components, their relationships, and external interfaces. It guides system design decisions, ensuring scalability, maintainability, and alignment with external frameworks or standards (Bass, Clements, & Kazman, 2012).

1.4 Document Structure

The structure of this deliverable reflects the logical progression from methodology and user engagement to the technical design of the ENHANCE platform. It is organized as follows:

Section	Topic	Description
Section 2	Methodology	Describes the methodological framework used in the project, including user-centered design practices, co-creation, and requirements elicitation.
Section 3	Identification of User Stories & Requirements	Details the process of developing user personas based on two case studies, formulating user stories, identifying user needs, and translating them into technical requirements.
Section 4	Technical Use Cases	Outlines the technical use cases derived from user needs, which guide the design and development of the ENHANCE solution.
Section 5	Co-creation of User-friendly Environment	Focuses on the development of the user flow diagram, illustrating the logical steps and interactions users follow within the ENHANCE platform, based on co-design sessions and iterative feedback.
Section 6	Conceptual Architecture	Presents a high-level view of the system architecture, including a literature review and alignment with relevant European satellite services such as Copernicus and EGNSS.
Section 7	Conclusion	Summarizes the main outcomes of the deliverable and highlights the next steps within the project development.

Table 1: Overview of Deliverable Sections

2. Methodology

The co-design and development approach for the ENHANCE Toolkit follows a phased and iterative methodology, where each activity is intrinsically linked to previous outputs and feeds into subsequent actions. The process is divided into three main phases, each comprising interrelated tasks and feedback loops to ensure continuous refinement and user-centric development.

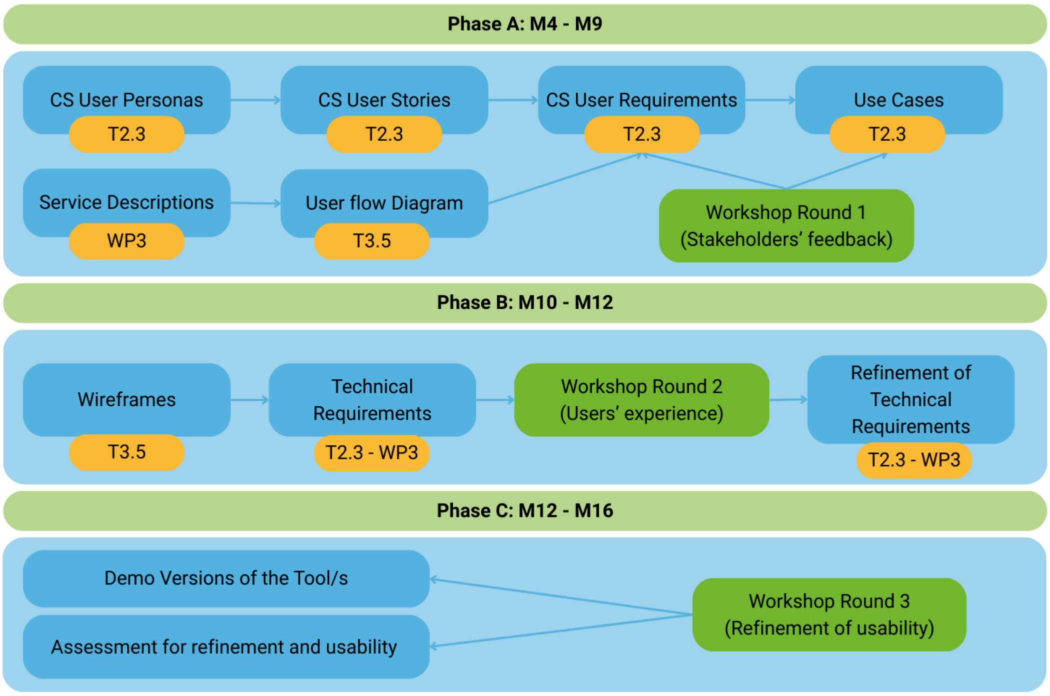

Figure 1: Methodology used for the ENHANCE scenarios and platform specifications

2.1 Phase A (M4–M6): Groundwork and Requirement Structuring

This phase lays the foundation of the ENHANCE platform by identifying user needs and defining early functional expectations.

- **User Personas → User Stories → User Requirements (T2.3):**

The process begins by defining user personas that represent the different stakeholder types in the coastal management domain. These personas inform the development of user stories, which articulate real-life scenarios. The user stories are then analyzed to extract user requirements, which serve as the basis for platform functionalities.

- **Service Descriptions (WP3) & Initial User Flow Diagrams (T3.5)**

In parallel, relevant coastal services are described, ensuring alignment with Copernicus/EGNSS capabilities (WP3). These inform the design of initial user flows (T3.5), mapping how users interact with these services.

- **Workshop Round 1 (Stakeholder Feedback):**
  A first co-creation workshop is organized to validate the defined personas, requirements, and prioritization. The feedback received here feeds back into refining the user requirements and confirming service relevance. This co-creation workshop was held by the case study leaders separately in their native languages in May 2025. More information on the first round of the workshop can be found in D2.1.

2.2 Phase B (M7–M10): Technical Translation and Iterative Refinement

Phase B focuses on translating the user-centric information from Phase A into technical specifications, with further validation through user testing.

- **Enhanced User Flow Diagrams (T3.5):**
  Building on Phase A, the user flow diagrams are refined to incorporate feedback and reflect more precise user interactions and service integration logic.

- **Technical Requirements (T2.3–WP3):**
  The prioritized and validated user requirements are translated into concrete technical specifications, which define what the ENHANCE platform must deliver at a system and module level.

- **Workshop Round 2 (User Experience):**
  A second workshop involving end users is conducted to test early versions of the tool's user flows and conceptual designs. The main aim of this stage is to gather feedback on the structure and content of the flows, including whether additional steps are needed, whether certain processes should be reordered, or if specific elements require modification.

- **Copernicus/EGNSS (T2.4):**
  Ongoing discussions with UC Leaders focus on determining the specific types of EGNSS and Copernicus data required for their CSs, while also clarifying how these considerations are integrated, for example, by identifying which Copernicus Earth Observation products and EGNSS capabilities are most relevant to user needs, in coordination with Task 2.4.

- **Refinement of Technical Requirements (T2.3–WP3):**

Insights from Workshop 2 directly inform the revision of technical requirements, ensuring they are feasible, relevant, and aligned with user needs and technological constraints.

2.3 Phase C (M11–M16): Prototyping and Usability Enhancement

The final phase involves building, testing, and refining demo versions of the ENHANCE tools based on the outputs of Phase B.

- **Demo Versions of the Tools:**
  The refined technical specifications and user flows from Phase B guide the development of demo versions. These demos represent the first integrated view of the tools in action.

- **Assessment for Refinement and Usability:**
  The demos undergo structured usability evaluations, focusing on user satisfaction, functional coverage, and interface clarity.

- **Workshop Round 3 (Refinement of Usability):**
  A third round of workshops is conducted with users to test the demo version of the platform. The purpose of this stage is to collect feedback from both direct and indirect users, ensuring that the assessment reflects the needs of all relevant stakeholder groups. In addition, the workshop specifically aims to evaluate the user-friendliness of the tool. Whether the interface is intuitive, the navigation flows are clear, and the functionalities are accessible to users with different levels of expertise.

This iterative methodology ensures that the ENHANCE platform is co-designed with direct involvement from stakeholders and end-users, facilitating the development of a user-centered and technically robust coastal management solution. Each phase incorporates feedback loops through workshops and continuously refines both user and technical requirements, paving the way for a solution that is both effective and adaptable.

3. Identification of User Stories & Requirements

Understanding the needs and expectations of end users is central to the development of effective, usable, and impactful solutions within the ENHANCE project. This section outlines the process undertaken to identify and define user requirements through the creation of user personas and user stories, ensuring that the services and tools developed are grounded in real-world needs.

To ensure relevance and usability, ENHANCE adopts a user-centered approach, engaging a diverse range of stakeholders from policy, science, industry, and civil society. Through workshops, interviews, and co-creation activities (described in D2.1), representative user personas were developed to capture the motivations, challenges, and goals of different stakeholder groups involved in coastal zone management.

These personas serve as the foundation for a set of user stories that reflect typical interactions with the ENHANCE services. The user stories help translate broad stakeholder needs into concrete functional and technical requirements, guiding system design and development.

3.1 User Personas

The resulting personas represent a diverse and multidisciplinary set of stakeholders who are either directly involved in coastal zone management or are significantly impacted by coastal environmental changes. These include:

- **Health professionals**, such as general practitioners and veterinarians, who require early-warning systems, data on zoonotic disease risks, and information on water and food safety to protect public and animal health.
- **Primary producers**, including fish and aquaculture farmers, rice growers, and vegetable producers, who are concerned with water quality, pollution monitoring, biodiversity risks, and sustainable farming practices.
- **Public authorities and civil servants**, such as municipal environmental officers and coastal ecosystem managers, who are tasked with implementing environmental policies, coordinating ecological monitoring, and managing citizen engagement.
- **Tourism and recreation stakeholders**, including accommodation owners and SME operators offering ecotourism or snorkelling activities, who depend on clean and safe coastal waters, real-time environmental information, and sustainability indicators to promote responsible tourism.
- **Educators**, such as secondary school teachers, who seek educational resources, real-time data, and experiential learning tools to engage students in One Health and Environmental Literacy topics.

This wide range of user types reflects the project's cross-sectoral scope and the integrated nature of the One Health approach. Each persona highlights specific needs—such as data access, risk mapping, environmental monitoring, stakeholder collaboration, and AI-based alerts—that guide the design and prioritization of ENHANCE services.

By grounding system requirements in the everyday challenges and expectations of these users, ENHANCE ensures that its solutions are not only technically sound but also socially relevant, inclusive, and actionable across a variety of coastal contexts.

3.1.1 Case Study 1

This section presents the primary user groups identified for Case Study 1, Barcelona Metropolitan Beaches and the Ebro Delta, under the ENHANCE project framework. The focus is on capturing representative user archetypes relevant to coastal management in this region, with particular attention to One Health challenges. These personas are derived from co-creation workshops and contextual research, offering a foundation for downstream analysis in later sections.

Case Area Overview
The Barcelona Metropolitan Beaches and the Ebro Delta are emblematic Mediterranean coastal zones, marked by:

- High population density and touristic pressure (e.g., Barcelona's ~10 million annual visits).
- Significant agricultural and aquaculture activity (e.g., Spain's largest rice fields and mussel farming in the Ebro Delta).
- Persistent environmental challenges: eutrophication, coastal erosion, habitat loss, and public health risks from declining water quality.

Stakeholder Clusters
Six major user groups have been delineated, each corresponding to distinct roles or motivations in the context of coastal sustainability management:

Group	Example Institutions	Interest in ENHANCE Platform
Coastal Managers, Authorities, Public Administration	Barcelona City Council, Ebro Delta Natural Park, Regional Management Agencies as *Area Metropolitana de Barcelona* (AMB).	Monitoring, policy support, emergency alerts, outreach actions.
Urban Planners	Municipal planning departments	Sustainable development, risk analysis
Researchers and Scientists	ICM-CSIC, universities	Data analysis, environmental & health studies
Business & Primary Sector	Mussel farmers, rice growers, local SMEs	Operational management, compliance, forecasting

Civil Society & Volunteers	NGOs, diving clubs, Blue Schools, citizen initiatives	Environmental stewardship, participatory science
General Public & Beach Users	Residents, tourists	Safe recreation, water quality awareness

Table 2: Overview of primary user persona groups identified for the Barcelona Beaches & Ebro Delta case study.

Persona Profile Summaries

- **Coastal Managers and Public Authorities:** Responsible for regulatory oversight, enforcement, and rapid response to hazards. Require synthesized, validated environmental data and robust alert systems.
- **Urban Planners:** Need access to integrated spatial and environmental datasets to inform infrastructure, development, and climate adaptation decisions.
- **Environmental/Health Researchers:** Seek open, quality-controlled data streams from diverse sources (satellites, sensors, citizen science) to support analyses linking environmental and socio-health variables.
- **Primary Sector Operators (Farmers, Aquaculture):** Depend on timely, actionable information about water quality, salinity, and ecosystem changes to optimize productivity and meet regulatory standards.
- **Civil Society and Volunteers:** Engage in grassroots monitoring and educational activities; require user-friendly tools for submitting validated observations and accessing relevant results.
- **General Public (Residents & Tourists):** Motivated by personal health, safety, and enjoyment of coastal areas; value transparent, easy-to-understand information about water safety and beach conditions.

Role of Personas in the Project
These archetypes ensure that platform development is grounded in a representative analysis of real-world users and their strategic needs, without venturing into either specific functional requests or detailed user journeys, which will be addressed in subsequent sections.

Collectively, these personas embody the multidimensional nature of the Barcelona Beaches & Ebro Delta pilot, supporting a participatory, One Health-driven approach to coastal observation and decision support

3.1.2 Case Study 2

This section presents the primary user groups identified for Case Study 2, Pagasitikos Gulf, within the ENHANCE project framework. It focuses on representative user personas engaged in coastal and rural activities in the region, particularly to One Health priorities. These personas were developed through co-creation workshop and stakeholder inputs, and serve as a basis for user needs analysis and toolkit design in subsequent phases.

Case Area Overview

Pagasitikos Gulf, located in central Greece, is a semi-enclosed coastal ecosystem that combines urban settlements, tourism, agriculture, aquaculture, and natural habitats. The area is characterized by:

- A strong interconnection between land-based and marine pressures, such as runoff pollution, fish farming impacts, and tourism-related waste.
- Multiple socio-economic activities (e.g., olive cultivation, fish farming, small-scale tourism) that depend on environmental quality.
- Emerging challenges related to water quality degradation, climate-linked health risks, and the need for cross-sectoral coordination in environmental and public health management.

Stakeholder Clusters

Six major user groups have been delineated, each corresponding to distinct roles or motivations in the context of coastal sustainability management:

Group	Example Institutions	Interest in ENHNACE Platform
Health Professionals	General Practitioners, General Hospital of Thessaly	Early warnings for outbreaks linked to water
Aquaculture Professionals	Fish farmers, Fish farming unit owners	Real-time water quality monitoring, AI-powered risk forecasts for harmful algal blooms & pathogens
Agriculture Producers	Olive, Vegetable Growers, Farm Owners	Risk maps and forecasts on irrigation water quality and salinity; support for sustainable farming
Vets	Local vets, animal health services	Early detection of zoonotic risks, biosecurity monitoring, coordination with health/environmental sectors
General Public	Accommodation Owners, Residents, Tourists	Access to real-time water quality indicators, eco-

		label tools, and safe tourism information
Educators & School	School Teachers, Researchers, Professors	Environmental stewardship, participatory science

Table 3: Overview of primary user persona groups identified for the Pagasitikos Gulf CS.

Persona Profile Summaries

- **Public Health Professionals (e.g., General Practitioners):** Require access to environmental health data and collaborative tools to receive early warnings and improve preparedness for outbreaks linked to water and climate risks.
- **Aquaculture Operators (e.g., Fish Farming Unit Owners):** Need real-time water quality monitoring and AI-powered forecasting to reduce economic losses and support adaptive, sustainable aquaculture practices.
- **Agricultural Producers (e.g., Olive and Vegetable Growers**): Seek environmental risk insights and support for sustainable farming to improve irrigation practices, manage pollution risks, and engage in data-driven agriculture.
- **Veterinary and Animal Health Professionals:** Rely on environmental surveillance and integrated data systems to detect zoonotic threats early, guide farm biosecurity, and contribute to cross-sectoral health strategies.
- **General Public (e.g., Accommodation Owners, SMEs):** Aim to access real-time coastal water quality data and sustainability indicators to ensure visitor safety and promote eco-friendly tourism experiences.
- **Educators and Schools (e.g., Secondary School Teachers):** Look for educational tools, real-world data, and citizen science activities to engage students and enhance environmental and One Health literacy.

Role of Personas in the Project

Personas such as general practitioners, veterinarians, aquaculture producers, and farmers provide insight into the diverse impacts of water contamination, ecosystem degradation, and public health risks. Their profiles inform the selection of relevant indicators (e.g., pathogens, agrochemical runoff), the design of early warning systems, and the development of recovery monitoring tools. By grounding the case study in the needs of these users, ENHANCE ensures that the solutions delivered are targeted, actionable, and capable of supporting local recovery and resilience-building efforts.

3.2 User Stories

Based on the user personas identified for both case studies, a set of 15 user stories was developed to capture the specific needs and goals of the intended users of the ENHANCE toolkit. The method followed for formulating the user stories was: *"I, as [persona], want to [need], in order to [expected outcome]."* These user stories provide a structured approach to translating stakeholder input into actionable insights, systematically mapping them to relevant target groups and stakeholder categories to support the development of tailored services and functionalities.

CS	US No	User Story	Stakeholders	Target Groups	Personas
CS 1	US1.1	As a municipal officer responsible for monitoring beach water quality, I want integrated access to Copernicus and citizen science data, so that I can detect environmental risks early and issue timely public health alerts.	Policy Makers & Local Authorities	TG2: Local/regional authorities, decision & policy makers, regulators	Community Services Coordinator, Urban Planning Officer, Environmental Officer, Administrative Officer
	US1.2	As a water quality official, I want tools to support collaboration with environmentalists, NGOs, and health authorities, so that we can build joint early-warning protocols and respond to climate-linked outbreaks more effectively.	Environmental Professional	TG2: Local/regional authorities, decision & policy makers, regulators, TG7 : NGOs, citizens, civil society organisations)	Local Water Inspector, Urban Water Planner, Environmental Regulator
	US1.3	As a secondary school teacher, I want access to real-time marine data and teaching materials aligned with the One Health approach, so that I can engage students in environmental education	Education	TG7: NGOs, citizens, civil society organisations	Teachers, Students, Locals

	and citizen science activities.			
US1.4	As an aquaculture farm owner, I want predictive dashboards and alerts about harmful algal blooms and water pollution, so that I can protect livestock health and reduce economic losses.	Aquaculture Professionals	TG6: Industries and private sector SMEs	Fish Farmer Owner,
US1.5	As an aquaculture producer, I want data-informed guidance on sustainable farming practices, so that I can adapt operations to changing environmental conditions and comply with safety standards.	Aquaculture Professionals	TG6: Industries and private sector SMEs	Fish Farmer
US1.6	As a rice farmer near the coast, I want access to environmental risk maps and water quality data, so that I can improve irrigation practices and minimize harmful runoff into marine ecosystems.	Agriculture Professionals	TG6: Industries and private sector SMEs	Organic Rice Producer
US1.7	As a Civil Servant, Coordinator of Urban Ecology, Barcelona City Council, I want to integrate biodiversity and health monitoring with citizen data collection, so that I can better understand coastal ecosystem dynamics and	Policy Makers & Local Authorities	TG2: Local/regional authorities, decision & policy makers, regulators	Local Officers, Administrators

		inform urban planning decisions.			
	US1.8	As a snorkel tour operator, I want real-time water quality updates and access to citizen science tools, so that I can ensure tourist safety and contribute to environmental awareness and monitoring.	Tour Operators	TG6: Industries and private sector SMEs	Guide, Snorkel Instructor
	US1.9	As a public sector stakeholder, I want cross-sectoral data integration between environmental, health, and biodiversity domains, so that we can develop policies aligned with the One Health paradigm.	Policy Makers & Local Authorities	TG2: Local/regional authorities, decision & policy makers, regulators	Locals
CS 2	US2.1	As a general practitioner in a coastal health center, I want access to water and food contamination data and AI-powered alerts, so that I can respond early to environmental health risks and protect vulnerable populations.	Healthcare Professionals	TG1: Scientific community and academic institutions, TG2: Local/regional authorities, decision & policy makers, regulators	Doctors
	US2.2	As a fish farm owner, I want real-time water quality monitoring and early warnings for harmful algal blooms and pathogens, so that I can protect my production and minimize economic losses.	Aquaculture Professionals	TG6: Industries and private sector SMEs	Fishfarmer Associations
	US2.3	As an olive oil and vegetable farmer, I want	Agriculture Professionals		

	risk maps and forecasts on irrigation water quality and salinity, so that I can adjust my farming practices to reduce land-sea pollution and support One Health objectives.		TG6: Industries and private sector SMEs	Producer, Local Market Vendor, Agri-Tourism Host
US2.4	As a veterinarian, I want access to environmental data on zoonotic disease risks and tools to coordinate with health and environmental bodies, so that I can help prevent animal disease outbreaks and promote responsible farm biosecurity.	Animal Healthcare Providers	TG1: Scientific community and academic institutions	Vets
US2.5	As a tourist accommodation owner, I want real-time water quality updates and eco-label tools, so that I can promote safe, sustainable tourism and contribute to citizen science initiatives.	Tourist Accommodation Owner/Operator	TG6: Industries and private sector SMEs	Citizen and Business Owners
US2.6	As a secondary school teacher, I want access to One Health teaching materials and real-world marine data, so that I can engage students through citizen science and coastal monitoring projects.	Education	TG7: NGOs, citizens, civil society organisations	Teachers, Students, Locals

Table 4: List of User Stories for CS1 & CS2

A total of 15 user stories were developed across the two ENHANCE case studies, nine from the Barcelona Metropolitan Beaches and Ebro Delta (CS1) and six from the Pagasitikos Gulf

(CS2). These stories reflect a diverse set of user needs and priorities across sectors such as public health, aquaculture, agriculture, education, urban planning, and tourism.

In Case Study 1, the stories highlight a strong focus on integrating environmental and citizen science data for early risk detection, coastal monitoring, sustainable farming, and public engagement. Key stakeholders include local authorities, aquaculture professionals, educators, and tour operators. Their needs emphasize predictive tools, real-time alerts, and participatory monitoring.

In Case Study 2, user stories underscore the demand for tools that support environmental health recovery and resilience following recent flood-related crises. Stakeholders such as doctors, veterinarians, fish farmers, and hospitality operators seek real-time environmental data, early-warning systems, and cross-sectoral coordination to protect public health, food safety, and ecosystem integrity.

All user stories were mapped to corresponding target groups and stakeholder categories, ensuring alignment between real-world needs and the development of the ENHANCE toolkit. This mapping supports targeted service design that responds to local challenges and fosters cross-disciplinary cooperation under the One Health framework.

3.3 User Requirements

User requirements were extracted through the validated user stories. A total of 47 user requirements (RQs) were collected across both case studies, representing a diverse set of user needs from stakeholders, including policymakers, educators, aquaculture professionals, healthcare providers, and citizen scientists. These requirements were mapped to functional and non-functional categories, covering five core areas of platform functionality: implementation, data collection, data analytics, visualization, and data governance. This structured breakdown supports the development of a user-centered platform that aligns with real-world operational contexts and stakeholder expectations. The first co-creation workshop, organized by the case study leaders separately in their native languages in May 2025, was used to validate the personas, requirements, and prioritization. The feedback received fed back into refining the user requirements and confirming service relevance. More information on the first round of the workshop can be found in D2.1.

Below is a summary of the identified user requirements, grouped according to their high-level functionality, to highlight the key capabilities expected from the ENHANCE toolkit.

Implementation (18 User Requirements):

This category captures the operational features required to run the platform, including alerts, recommendations, coordination protocols, and training resources. These functionalities form the backbone of real-time monitoring, stakeholder coordination, and adaptive management.

- Data integration and access control (**RQ01, RQ05, RQ27, RQ31**): Enable secure integration and joint access to environmental, health, and citizen science data to support coordinated decision-making and early detection of risks.
- Early warning and coordinated response (**RQ02, RQ03, RQ07, RQ32, RQ35, RQ40)**: Support automated alerts for contamination or disease risk, allow custom risk thresholds based on regulation, and enable drafting of joint early-warning protocols across sectors.
- Education, recommendations, and stakeholder guidance (**RQ09, RQ13, RQ15, RQ16, RQ19, RQ39, RQ43, RQ47)**: Deliver case studies, downloadable teaching materials, and AI-informed recommendations for sustainable practices and pollution reduction. Also includes tools to notify stakeholders of contamination events or recommended actions.

Data Collection (7 User Requirements)

This category addresses how information enters the system, from citizen science inputs to professional and institutional data. It supports participatory monitoring, custom input options, and structured reporting to enhance environmental intelligence.

- Citizen science and stakeholder inputs (**RQ20, RQ21, RQ23, RQ26, RQ44)**: Allow input from farmers, citizens, and local authorities, including biodiversity observations, beach reports, and environmental planning data.
- Structured reporting and feedback (**RQ34)**: Support standardized reporting formats for policy use and stakeholder-specific summaries of contamination risks.
- Cross-sector data contributions (**RQ42**): Facilitate secure data exchange across veterinary, environmental, and health domains to promote integrated decision-making.

Visualisation (8 User Requirements)

Visualization requirements define how users interact with and explore environmental and health data. Emphasis is placed on usability, educational outreach, and spatial understanding.

- Maps, dashboards, and coastal indicators (**RQ11, RQ14, RQ17, RQ25, RQ37)**: Provide real-time and historical visualizations for water quality, pollution, HABs, salinity, and aquaculture conditions through maps and charts.

- Educational and simplified views (**RQ08, RQ46)** : Offer simplified dashboards and coastal visualizations for public understanding, including One Health–oriented displays for non-specialist audiences.
- Policy-relevant summaries (**RQ29)**: Generate data dashboards tailored for communication with decision-makers and policy stakeholders.

Data Analytics (10 User Requirements)

This category enables pattern discovery, forecasting, and actionable insights based on environmental and health data. Analytics empower adaptive planning, policy formulation, and operational readiness.

- Forecasting and risk analysis (**RQ04, RQ10, RQ12, RQ18, RQ38)**: Enable analysis of past and predicted contamination trends, runoff risks, and environmental stressors affecting agriculture, aquaculture, and public health.
- AI-powered insights and trend detection (**RQ13, RQ22, RQ28, RQ36, RQ41)**: Detect and relate cross-sectoral patterns such as biodiversity-health links, water quality–illness trends, or animal disease emergence based on environmental conditions.

Data Governance (6 User Requirements)

Governance requirements ensure data validity, accessibility, and responsible sharing, especially across institutional and disciplinary boundaries. They underpin platform credibility and compliance.

- Joint access and quality assurance (**RQ06, RQ24)**: Ensure data quality thresholds trigger notifications and allow users to explore relationships between health and environmental risks.
- Policy-relevant integration (**RQ19, RQ30)**: Recommend best practices aligned with policy goals while promoting sustainable behaviour.
- Ethical sharing and risk communication (**RQ33, RQ45)**: Equip tourism actors and local businesses with performance indicators and eco-label tools to responsibly communicate environmental health risks.

UR No	Description of user requirement	Category	High-Level Functionality
RQ01	The toolkit shall integrate Copernicus and citizen science data for beach water quality monitoring.	Functional	Implementation, Data Governance

RQ02	The tool should provide alerts when contamination levels exceed safety thresholds.	Functional	Implementation
RQ03	The tool should allow the configuration of local alert parameters based on regulatory standards.	Functional	Implementation
RQ04	The system should support historical data analysis to identify pollution trends over time.	Functional	Data Analytics
RQ05	The toolkit should allow jointcow access and sharing of environmental and health-related data.	Functional	Implementation, Data Governance
RQ06	The toolkit should give information to the stakeholders when risk levels require coordinated response.	Functional	Data Governance
RQ07	The toolkit should support drafting of early-warning protocols and response plans.	Functional	Implementation, Data Governance
RQ08	The tool should provide an educational dashboard with simplified marine and coastal data visualizations.	Non-functional	Visualization
RQ09	The system should include downloadable One Health teaching materials linked to real case data.	Functional	Implementation
RQ10	The toolkit could deliver alerts and forecasts for Harmful Algal Blooms (HAB) events using satellite and in-situ data.	Functional	Data Analytics
RQ11	The system should display marine Copernicus indicators relevant to aquaculture safety.	Functional	Visualization
RQ12	The tool should support risk forecasts based on marine and meteorological data.	Functional	Data Analytics
RQ13	The tool should suggest sustainable practices based on environmental data trends.	Functional	Data Analytics, Implementation
RQ14	The tool should visualize historical and current water quality trends near farms.	Functional	Visualization
RQ15	The system should give recommendations to reduce pollution and increase resilience.	Functional	Implementation
RQ16	The platform should provide case studies of successful sustainable aquaculture implementations.	Functional	Implementation

RQ17	The toolkit should display maps of salinity and pollution based on sensing data.	Functional	Visualization
RQ18	The toolkit could help farmers to plan their irrigation by forecasting environmental risks.	Functional	Data Analytics
RQ19	The toolkit should recommend practices to protect water quality.	Functional	Implementation, Data Governance
RQ20	The platform should allow input of local farming data to enhance recommendation accuracy.	Functional	Data Collection
RQ21	The tool should collect and visualize biodiversity observations from citizens.	Functional	Data Collection
RQ22	The system should relate biodiversity trends to human health indicators.	Functional	Data Analytics
RQ23	The platform should support reporting for urban environmental planning.	Functional	Data Collection
RQ24	The system should enable geospatial analysis of biodiversity and health data correlations.	Functional	Implementation, Data Governance
RQ25	The toolkit should display water quality in the beaches of the area.	Functional	Visualization
RQ26	The toolkit should allow tourists to submit observations for the local beaches.	Functional	Data Collection
RQ27	The toolkit should validate and integrated useful citizen science data.	Functional	Implementation
RQ28	The tool should support trend analysis across domains (e.g., water quality and illness).	Functional	Data Analytics
RQ29	The toolkit should generate policy-relevant summaries and visualization dashboards.	Functional	Visualization
RQ30	The toolkit should allow the export of reports in formats suitable for policy briefs.	Functional	Data Governance
RQ31	The tool should provide access to environmental health indicators related to water contamination.	Functional	Implementation
RQ32	The toolkit should generate AI-based alerts for contamination and health risk events.	Functional	Implementation

RQ33	The tool should provide reports for groups that should be aware of the risks of contamination.	Functional	Data Governance
RQ34	The toolkit should provide monitoring of water quality parameters relevant to aquaculture.	Functional	Data Collection
RQ35	The toolkit should indicate HABs and potential contamination events.	Functional	Implementation
RQ36	The toolkit should display AI-predicted trends affecting aquaculture safety.	Functional	Data Analytics
RQ37	The tool should show environmental risk maps for irrigation water quality and salinity.	Functional	Visualization
RQ38	The system should provide forecasts and runoff and soil salinity risks.	Functional	Data Analytics
RQ39	The toolkit should offer data-informed guidance on sustainable irrigation and fertilization practices.	Functional	Implementation
RQ40	The toolkit should provide data relevant to animals disease risk for monitoring of potential events.	Functional	Implementation
RQ41	The toolkit should support trend analysis for animal disease emergence based on environmental conditions.	Functional	Data Analytics
RQ42	The toolkit should facilitate data sharing between veterinary, health, and environmental stakeholders.	Non-functional	Data Governance
RQ43	The system should provide updates on water quality on the local coastlines.	Functional	Implementation
RQ44	The tool should support citizen science contributions through input of environmental observations.	Functional	Data Collection
RQ45	The toolkit should offer environmental performance indicators for tourist communication.	Non-functional	Data Governance

Table 5: Initial User Requirements List

The user requirements above have been reviewed and translated into preliminary technical specifications for the platform. In this deliverable, we treat the user requirements as the initial technical requirements, identifying which parts of the system (data ingestion, analytics, interface, etc.) will address them, as reflected in the technical use cases (Section 4) and architecture (Section 6).

4. Technical Use Cases

In this section, we outline the preliminary technical use cases for the ENHANCE AI-enabled coastal management toolkit. These use cases, co-created with stakeholders in Task 2.3, correspond to real-world scenarios from the project's pilot case studies. Each use case illustrates how different end-users will interact with the platform to address coastal challenges under the One Health framework.

Table 6 shows the ENHANCE technical use cases along with their MoSCoW (Must/Should/Could/Wont) prioritization with respect to the two case studies

Technical Use Case	User profile	CS1 – Barcelona Ebro Delta	CS2 – Pagasitikos Gulf
Visualization & Monitoring			
UC1.1 – Alerts for One Health risks monitoring	No login users (e.g., Scuba divers, swimmers)	**Must**	**Must**
UC1.2 – Citizen participation and long-term engagement for One Health monitoring	No login users (e.g., citizen scientists, general public)	**Must**	**Could**
Sustainable Management & Risk Assessment			
UC2.1 - One Health indicators visualization for urban coastal monitoring	Urban planners & Coastal Managers	**Must**	**Must**
UC2.2 – One Health indicators for Sustainable Aquaculture	Animal, Human and Environmental Health professionals	**Should *(subcase of 2.3)***	**Should**
UC2.3 - One Health indicators monitoring for sustainable management of protected areas	Protected Area Managers ; Health professionals Researchers and scientists	**Should**	**Wont**
UC2.4 – Dynamic Coastal Risk Map for Policy Regulation	Urban planners & Coastal Managers	**Wont**	**Should**
Training & Education			
UC3.1 – One Health Training (Formal Education)	Schools, University students	**Could**	**Should**

UC3.2 – One Health Training (Non-formal Education)	Tourists, snorkel	**Should**	**Could**

Table 6: ENHANCE Technical Use Cases Overview

4.1 Visualisation & Monitoring Use Cases

Use case	**UC1.1 Alerts for One Health risks monitoring**	
Identifier	UC- RISKMON-1	
Use case status	In Progress	
Related requirements	Functional	RQ01, RQ02, RQ04, RQ12, RQ17, RQ25, RQ32, RQ35,
	Non-Functional	N/A
Description	Scuba divers, snorkelers, swimmers, businesses would use forecast data on water temperature, turbidity, salinity, and chlorophyll levels. This data will be useful for checking visibility conditions, identify optimal dive locations for clients, avoid polluted areas that might pose health risks. Forecast data reduces the risk of cancellations and improves customer satisfaction. Last, adapt to changing sea conditions or rising temperatures affecting marine life.	
Actors	Scuba divers, swimmers, snorkelers, citizens	
Inputs	Copernicus satellite data (water quality parameters), in-situ data (water quality and meteorological parameters).	
Modules / external tools	Copernicus data module, Risk Map Generator, Visualization Dashboard	
Related documents and data sources	Copernicus API	
Preconditions	System access granted; active data feeds	
Challenges before (that hinder the execution)	Data harmonization complexity	
Sequence of actions and alternative pathways	Step	Action
	1	Login to the system
	2	Fetch Copernicus and in-situ data
	3	Validate and harmonize data
	4	Run threshold checks for water quality parameters
	5	Display alerts on dashboard or Notify via pop-up alerts
	6	Pollution Risk Map
Outputs	Water quality dashboard, Alerts	
Challenges after (that limit the full exploitation)	Data integration limits, Insufficient spatial resolution of available data	
Other open issues	Local language adaptation needed	

Table 7: UC1.1 - Alerts for One Health risks monitoring

Use case	**UC1.2 – Citizen participation and long-term engagement for One Health monitoring**

Identifier	UC-RISKMON-2	
Use case status	Draft	
Related requirements	Functional	RQ09
	Non-Functional	Usability and accessibility requirements (the interface should be easy for non-specialists to use; support multiple languages given diverse users in Barcelona). Also, data handling must ensure privacy and safety
Description	A simplified dashboard to show to promote citizen participation: requested areas for exploring, target species alert to be monitored	
Actors	Citizen Scientists, Educators, Students	
Inputs	Dashboards with water quality, meteorological variables, Copernicus satellite data, filtered citizen (MINKA) observations	
Modules / external tools	Copernicus data module, Visualization Dashboard, areas of interest (to explore), target species to be aware	
Related documents and data sources	Citizen Science filtered datasets (target species)	
Preconditions	Non-login users access to ENHANCE platform; internet connectivity	
Challenges before (that hinder the execution)	Lack of accessible, user-friendly data formats	
Sequence of actions and alternative pathways	Step	Action
	1	Direct access (no-login) to ENHANCE dashboard
	2	Select marine/coastal data visualization tools
	3	Download One Health educational materials
	4	Filter and explore data
	5	Engage citizen with challenges: unexplored areas, target species to monitor
	6	Assign citizen science tasks
	7	Submit observations (via MINKA)
	8	Visualization of results with other OH indicators
Outputs	On-line training material, selected observations from citizens, Increased awareness	
Challenges after (that limit the full exploitation)	Data complexity for non-expert audiences	
Other open issues	Local language adaptation needed	

Table 8: UC1.2 - Citizen participation and long-term engagement for One Health monitoring

4.2 Sustainable Management & Risk Assessment

Use case	**UC2.1- One Health indicators visualization for urban coastal monitoring**	
Identifier	UC-VISCOAST-1	
Use case status	Draft	
Related requirements	Functional	RQ01, RQ02, RQ03, RQ04, RQ05, RQ06, RQ07, RQ25, RQ26, RQ27
	Non-Functional	N/A
Description	This use case describes how key stakeholders (municipal water managers, public authorities, policy makers, tour operators, educators, and citizen scientists) interact with	

	the ENHANCE platform to monitor and manage One Health indicators in urban beaches Human Health (wastewater overflows), Environmental Health (eutrophication levels) and Animal Health (marine biodiversity, using fish species richness as proxy indicator). Users receive alerts when wastewater overflows levels, eutrophication risk, or target species are detected, configure local thresholds, and use the integrated information to collaborate across organizations to coordinate responses.	
Actors	Municipal Officers and Local Authorities, Water Quality Officials and Environmental Regulators, Citizen Scientists, Volunteers, and Local Community Members, Academic and Research Staff, Tourism and Private Sector Operators, NGOs and Community Leaders	
Inputs	Copernicus satellite data (Wastewater overflows, Water quality, [Chla a], measurements) MINKA observatory (Fish observations, as proxy for Biodiversity)	
Modules / external tools	Copernicus data module, Risk Map Generator, Alien species, Visualization Dashboard	
Related documents and data sources	Copernicus Sentinel Documentation EGNSS Technical Docs (ESA, EUSPA) Barcelona Annual Water Reports EU One Health Guidelines (WHO, ECDC)	
Preconditions	System access granted; active data feeds	
Challenges before (that hinder the execution)	Data harmonization complexity, acknowledged contributions (data provenance for citizen science)	
Sequence of actions and alternative pathways	Step	Action
	1	Access the Platform:
	2	Authenticate and Assign Access Level: .
	3	Explore and Select Base Layers.
	4	Define Area of Interest:
	5	Generate Local One Health Indexes: .
	6	Visualize Results on Map
	7	Click on Map Elements for Local Detail:
	8	Export or Share Results
Outputs	One health indicators dashboard, Alerts	
Challenges after (that limit the full exploitation)	Data integration limits, Insufficient spatial resolution of available data	
Other open issues	Cross-agency data sharing protocols, High variability in small-scale site data	

Table 9: UC2.1- One Health indicators visualization for urban coastal monitoring

Use case	**UC2.2 – One Health Indicators for Sustainable Aquaculture**	
Identifier	UC-SUSAQUA	
Use case status	In Progress	
Related requirements	Functional	RQ2, RQ3, RQ4, RQ06, RQ07, RQ11, RQ12, RQ17, RQ28, RQ31, RQ34, RQ35, RQ36, RQ43
	Non-Functional	N/A
Description	A municipal officer, a citizen or a business owner monitors water quality using satellite and local water utility data. The system issues alerts when contamination thresholds are	

	exceeded. Aquaculture farmers access environmental parameters and pollution risk maps to optimize site management and protect aquaculture stock.
Actors	Municipal Officer, Aquaculture farmers, Marine envrionmental agencies, Citizens
Inputs	Copernicus satellite data (water quality parameters—myocean pro), in-situ data (water quality and meteorological parameters).
Modules / external tools	Copernicus data module, Risk Map Generator, Visualization Dashboard
Related documents and data sources	Copernicus API, sampling collection
Preconditions	System access granted
Challenges before (that hinder the execution)	Data harmonization complexity
Sequence of actions and alternative pathways	Step: Action 1: Login to the system 2: Fetch Copernicus and in-situ 3: Validate and harmonize data 4: Run threshold checks for water quality parameters 5: Display alerts on dashboard 6: Enable historical data download 7: Notify public via pop-up alerts
Outputs	Water quality dashboard, Alerts
Challenges after (that limit the full exploitation)	Data integration limits, Insufficient spatial resolution of available data
Other open issues	Local language adaptation needed

Table 10: UC2.2 – One Health Indicators for Sustainable Aquaculture

Use case	**UC2.3 - One Health indicators monitoring for sustainable management of protected areas**	
Identifier	UC-EBD-1	
Use case status	Draft	
Related requirements	Functional	RQ10, RQ11, RQ12, RQ05, RQ06, RQ07
	Non-Functional	N/A
Description	This use case describes how key stakeholders (municipal managers, public authorities, policy makers, tour operators, educators, and citizen scientists) interact with the ENHANCE platform to monitor and manage One Health indicators in the Ebro Delta Natural Parc Human Health (Algal blooms), Environmental Health (eutrophication risk) and Animal Health (, using plant and birds species richness as biodiversity proxy indicator, presence of alien species and water temperature for shellfish and fish aquaculture industry). Users receive alerts when temperature levels, eutrophication risk, or target species are detected, configure local thresholds, and use the integrated information to collaborate across organizations to coordinate responses.	
Actors	Aquaculture and Rice Farmers, Marine Environment Agencies, Protected Area Managers, Researchers, Local Communities	

Inputs	Copernicus satellite data (, Water quality, [Chla a], measurements) MINKA observatory (Plant, Birds observations, as proxy for Biodiversity)	
Modules / external tools	Copernicus data module, Risk Map Generator, Alien species, Visualization Dashboard	
Related documents and data sources	COPERNICUS SENTINEL DOCUMENTATION EGNSS TECHNICAL DOCS (ESA, EUSPA) BARCELONA ANNUAL WATER REPORTS EU ONE HEALTH GUIDELINES (WHO, ECDC)	
Preconditions	System access granted; active data feeds	
Challenges before (that hinder the execution)	Data harmonization complexity, acknowledged contributions (data provenance for citizen science)	
Sequence of actions and alternative pathways	Step	Action
	1	Access the Platform
	2	Authenticate and Assign Access Level
	3	Explore and Select Base Layers.
	4	Define Area of Interest
	5	Generate Local One Health Indexes
	6	Visualize Results on Map
	7	Click on Map Elements for Local Detail
	8	Export or Share Results
Outputs	One health indicators dashboard, Alerts	
Challenges after (that limit the full exploitation)	Data integration limits, Insufficient spatial resolution of available data	
Other open issues	Cross-agency data sharing protocols, High variability in small-scale site data	

Table 11: UC2.3 - One Health indicators monitoring for sustainable management of protected areas

Use case	**UC2.3 – Dynamic Coastal Risk Map for Policy Regulation**	
Identifier	UC-PG-3	
Use case status	In Progress – Methodology designed	
Related requirements	Functional	RQ07, RQ10, RQ12, RQ19, RQ23 RQ24, RQ25, RQ28, RQ29, RQ30, RQ33, RQ36, RQ37, RQ38, RQ43
	Non-Functional	RQ45
Description	A policy officer or decision-maker uses a dynamic web-based Risk Map to classify and visualize coastal areas according to their multi-hazard risk level. The assessment integrates three dimensions: Hazard, Exposure, and Vulnerability in order to produce a composite risk score per coastal unit. • Hazards: droughts, erosion, coastal floods, heat excess. • Exposure: land uses, infrastructures, population density, low elevation coastal zone • Vulnerability: elderly and young population, unemployment rate (sensitivity) & GDP per capita, share of open spaces (adaptive capacity) The system supports scenario-based simulations (e.g., increasing open areas, improving infrastructure resilience, or demographic shifts) to evaluate how policy interventions influence risk intensity.	

Actors	Policy Officers, Urban Planners, Environmental Agencies, Civil Protection Authorities, Coastal managers	
Inputs	Multi-hazard layers (drought, coastal flood, erosion, heat excess); socio-economic and demographic data (population structure, unemployment); land-use/land-cover datasets (CORINE, Urban Atlas); critical infrastructure data (points of interest)	
Modules / external tools	Risk Map Generator; Scenario Simulation Engine; GIS-based Visualization Dashboard; Copernicus Data Module; Statistical Analytics Module	
Related documents and data sources	Copernicus Emergency Management Service (CEMS) for hazard detection; CORINE Land Cover (CLC) for Exposure; JRC Risk Data Hub; socio-economic and demographic datasets for national statistical authorities for vulnerability assessment	
Preconditions	System access granted	
Challenges before (that hinder the execution)	Data interoperability and harmonization across hazard, exposure, and vulnerability datasets; inconsistent spatial and temporal resolutions; limited socio-demographic granularity	
Sequence of actions and alternative pathways		
	Step	Action
	1	Login to the ENHANCE platform
	2	Select coastal area or municipality of interest
	3	Fetch and harmonize hazard, exposure, and vulnerability datasets as new Copernicus or socio-economic data become available
	4	Compute normalized indicators per dimension (Hazard–Exposure–Vulnerability)
	5	Aggregate indicators into a composite multi-hazard risk index
	6	Classify and visualize coastal areas by risk intensity
	7	Run scenario-based simulations (e.g., land-use change, increase of green spaces, improved social resilience)
Outputs	Coastal risk map; composite risk index (hazard–exposure–vulnerability); scenario-based simulations	
Challenges after (that limit the full exploitation)	Data update frequency and spatial gaps; limited integration of socio-economic indicators at local level	
Other open issues	Local language adaptation needed	

Table 12: UC2.3 – Dynamic Coastal Risk Map for Policy Regulation

4.3 Training & Education Use Cases

Use case	**UC3.1 – OneHealth Training (Formal Education)**	
Identifier	UC-TRAINING-1	
Use case status	In Progress	
Related requirements	Functional	RQ09
	Non-Functional	RQ08
Description	A primary/secondary school teacher or professor accesses simplified dashboards and downloadable One Health materials to teach students / undergraduate students about marine ecosystems and public health.	
Actors	Educators, students / undergraduate students	
Inputs	Dashboards with water quality and meteorological variables, Copernicus satellite data, educational material from workshops and Living Labs	

Modules / external tools	Copernicus data module, Visualization Dashboard, Educational material module	
Related documents and data sources	One Health case materials, Marine datasets	
Preconditions	System access granted	
Challenges before (that hinder the execution)	Lack of accessible, student-friendly data formats	
Sequence of actions and alternative pathways		
	Step	Action
	1	Log into ENHANCE dashboard
	2	Select marine/coastal data visualization tools
	3	Download One Health educational materials
	4	Filter and explore data
	5	Assign citizen science tasks
	6	Submit student observations
Outputs	Interactive lessons, Student observations, Increased awareness	
Challenges after (that limit the full exploitation)	Data complexity for younger audiences	
Other open issues	Local language adaptation needed	

Table 13: UC3.1 – OneHealth Training (Formal Education)

Use case	**UC3.2 – OneHealth Training (Non formal Education)**	
Identifier	UC-TRAINING-2	
Use case status	In Progress	
Related requirements	Functional	RQ01, RQ02, RQ04, RQ12, RQ17, RQ25, RQ32, RQ35,
	Non-Functional	
Description	A scuba dive	
Actors	Scientific Tourism business would use information from ENHANCE platform to improve their services. This data will be useful for environmental conditions to practice,for example identifying optimal locations for underwater activities, or the presence of target species for adding value to the proposed activities (challenges to provide information about alien species already identified and reported in the platform).	
Inputs	Copernicus satellite data (environmental quality parameters), Citizen Science (MINKA Observatory), in-situ data (water quality and meteorological parameters).	
Modules / external tools	Copernicus data module, Risk Map Generator, Alien species, Visualization Dashboard	
Related documents and data sources	Copernicus API, MINKA documentation	
Preconditions	System access granted; active data feeds	
Challenges before (that hinder the execution)	Data harmonization complexity	

Sequence of actions and alternative pathways	Step	Action
	1	Login to the system
	2	Fetch Copernicus , in-situ data, and selected MINKA data
	3	Validate and harmonize data
	4	Run threshold checks for water quality parameters
	5	Display alerts on dashboard
	7	Notify via alerts
Outputs	Environmental quality dashboard, Target areas for exploring, Alerts	
Challenges after (that limit the full exploitation)	Data integration limits, Insufficient spatial resolution of available data	
Other open issues	Cross-agency data sharing protocols, High variability in small-scale site data	

Table 14: UC3.2 – One Health Training (Non formal Education)

5. Co-creation of User-friendly Environment

The first important step in the co-creation process of the task "ENHANCE Interactive Map Interfaces" is the creation of a user flow. A user flow[1] visualises the steps a user will take in an application to reach a desired end goal. It makes it possible to focus on the user in the early phase of the design process and draft a first version of the application structure. This flow will guide the next steps of the design process and make it possible to keep the user in mind in the further development process.

To create the user flow two remote co-creation sessions were organised with the partners of the 2 case studies: the Catalan coast case study in Spain and the Pagasitikos Gulf case study in Greece. This way it was possible to investigate whether the requirements of both use cases coincided or not and decide on the creation of two separate user flows or one that fits both. By means of a Miro board it was possible to collaborate remotely. As a first step, the relevant user groups were selected (based on the personas mentioned in chapter 3.1) together with their starting point. Why do they need to use the application? Secondly, the end goals were defined, it was decided not to link specific end goals to specific user groups as they can overlap. What do the people in these user groups want to accomplish? Finally, the different steps a user has to take to reach these goals were identified step by step. The same methodology was used in both co-creation sessions. In a third session, it became clear that an overall user flow could be constructed covering both case studies. The consortium partners

[1] https://www.interaction-design.org/literature/topics/user-flows#:~:text=User%20flows%20are%20diagrams%20that,Foundation%2C%20CC%20BY%2DSA%204.0

thereupon decided to focus on building one application that caters to the needs of both case studies.

The overall use case is shown below in Figure 2. The following user groups were selected during the user flow process:

- Vets
- Doctors
- Educators
- Citizens and business owners
- Fishermen association
- Policy makers and local authorities
- Scuba divers

The starting point, or reason these user groups got into contact with the ENHANCE Onehealth toolkit, is the following:

- Doctors and vets are concerned about the transfer of diseases in coastal areas.
- Doctors, educators, citizens and business owners are concerned about the water quality in a local area.
- The fishermen association, citizens and business owners and policy makers and local authorities are concerned about environmental disasters in coastal areas.

The following end goals were defined:

- They want to mitigate the transfer of diseases.
- They want to have early warning information on environmental health risks.
- They want to enhance water resilience.

Next, the different steps of the user flow will be described in detail.

All users can open the application without login and can access some basic information and results. A disclaimer will inform the user that the results shown in the application are merely suggestions. Users can create an account by filling out a questionnaire that will suggest the preferred user type based on the information they are looking for. There are three different user types defined: high access, medium access, and low access. This will be explained in detail in the application before signing up.

All users (also low-access users) can consult base layers like the Habitat Directive (synergy with the ENFORCE project), Copernicus layers, and MINKA citizens science datasets. The application will also direct interested users to assist in the collection of citizen science data for MINKA. Users can search for a location of interest on the map and select an area by drawing an area on the map. In the next step, indices are calculated for this area and shown as heatmaps. Heatmaps are available for multiple years to understand the evolution of the indicators. Users can also click on a certain location (pixel of the heatmap) to receive more information in the side panel. These results can be downloaded afterwards.

Medium and high access users are additionally able to consult the layers used for the calculation of the indices and export those layers for their own calculations. They will also receive more information on the data-panel after selecting a location on the heatmap and be able to export those advanced results. Finally, the availability of the base layers will be linked to the type of access.

High access users are the only user type having access to detailed explanations of the AI models.

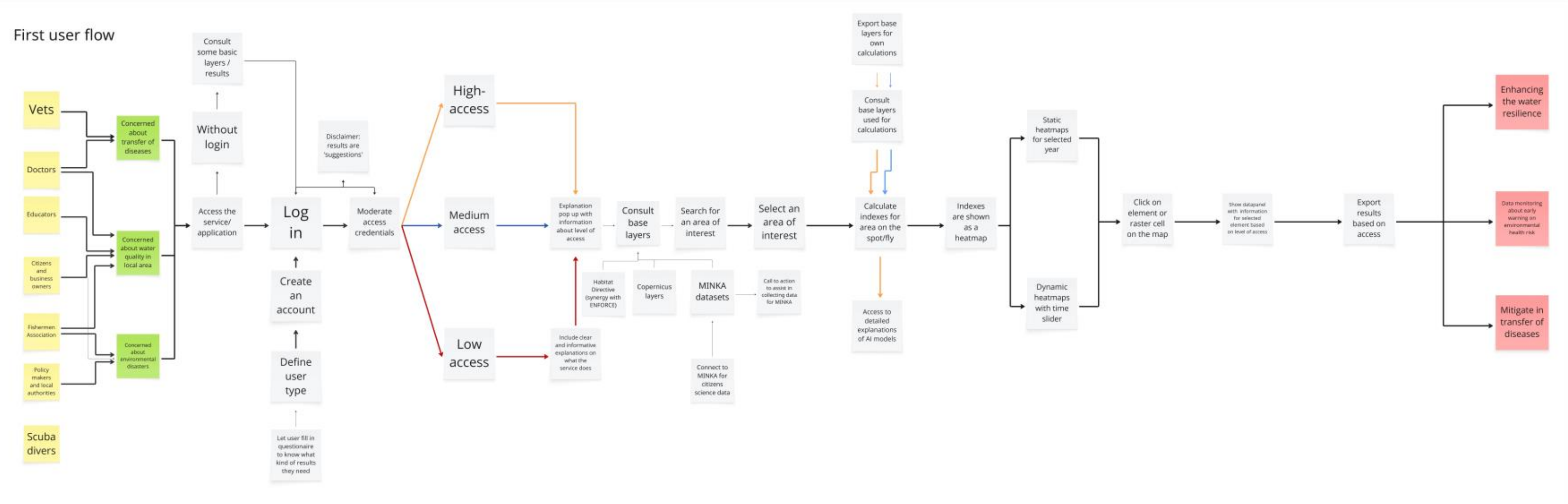

Figure 2: User-flow Diagram for the ENHANCE Toolkit

User flow is the first step in the design process of the interface of the map application of the ENHANCE One Health toolkit for coastal management. In the next step the user flow will be refined further to make sure the needs of the different user groups are incorporated and include all the information that was gathered in the other tasks of the co-design methodology (see above). Some additional discussions with the consortium partners will clarify some topics that are not final yet, for instance, the access levels for different user groups. After internal discussions, specific user types will be linked to appropriate access levels. This will be explained in detail in the next deliverable (D2.3).

After the user flow is finalized, the next step in the design process is the creation of wireframes. Wireframes are the first sketches of an application that act like a blueprint of a digital tool. They define the overall structure of the application and the different functionalities it should include. Wireframes will be shared, and feedback will be gathered from relevant stakeholders. Both the refined user flow and the wireframes will be explained in detail in D2.3.

6. Conceptual Architecture

6.1 Literature review

Developing an AI-enabled One Health toolkit for coastal management requires drawing on state-of-the-art concepts in data integration, environmental monitoring, and decision support. A review of relevant literature and frameworks highlights several guiding principles for ENHANCE's architecture:

1) **One Health & Integrated Coastal Monitoring:** The One Health approach – linking human, animal, and environmental health – is increasingly applied in environmental management to address complex challenges holistically. In coastal zones, this implies an integrated system that can correlate ecosystem indicators (water quality, biodiversity) with public health data and socio-economic factors. Previous studies and projects underscore that effective coastal management tools should break down data silos between environmental science and health science, enabling cross-domain insights. This holistic perspective informs ENHANCE's architecture, ensuring that data from diverse sources (satellite, marine sensors, health surveillance, etc.) can be combined and analyzed together. [One health]
2) **Data Sharing Frameworks:** Modern data space initiatives like the International Data Spaces Association (IDSA) and GAIA-X provide reference models for secure and interoperable data sharing. The IDSA, for example, defines a reference architecture for data sovereignty, where data providers can enforce usage policies while sharing data.

GAIA-X promotes federated cloud infrastructure with compliance with European data standards. ENHANCE's platform concept aligns with these principles – the architecture is being designed to enable secure data exchange among multiple stakeholders (research institutions, local authorities, citizens) in a federated manner. By adopting standards and building blocks from IDSA/GAIA-X, the toolkit will ensure data interoperability, security, and governance, which are crucial for trust among stakeholders sharing environmental and health data. This literature insight drives the inclusion of a dedicated data governance layer and the use of Data Space Connectors in our architecture (see Section 6.2).

3) **Copernicus & EGNSS Synergy:** Literature and prior applications emphasize that combining Earth observation data with satellite navigation services unlocks new capabilities for environmental management. Copernicus provides timely geospatial datasets (e.g. ocean colour, land cover, climate indicators), while EGNSS (Galileo/EGNOS) offers precise positioning and timing that can improve data collection and geolocation of observations. The ENHANCE toolkit's design takes into account this synergy – for example, ensuring that field data collected via mobile apps can utilize Galileo positioning for higher accuracy, or that time-series analyses are synchronized with reliable timestamps. By reviewing such successful integrations (e.g. in precision agriculture or disaster management domains), we ensure our architecture can natively support EO+GNSS combined services. This is reflected in our high-level design which accommodates both Earth observation data flows and location-based data streams.

In summary, the conceptual architecture of ENHANCE is informed by a broad state-of-the-art context: the need for cross-domain One Health data fusion, adherence to data space principles for sharing, leveraging cloud-based federated infrastructures, and maximizing the value of Europe's space assets (Copernicus & Gallileo). These considerations set the stage for the high-level architecture described next.

6.2 High-level Architecture

The high-level architecture of the ENHANCE toolkit is organized as a multi-layer system that separates concerns from data ingestion up to user interaction. This layered design ensures scalability, maintainability, and clear allocation of the project's technical components (WP3 tasks) to specific architecture building blocks. Figure 3 below illustrates an overview of the conceptual architecture and its main layers.

Figure 3: Conceptual architecture of the ENHANCE AI-based toolkit for coastal management

Below, we describe each layer and its role in the ENHANCE architecture:

- **Data Acquisition & Ingestion Layer:** This layer handles the integration of heterogeneous data sources such as Earth Observation datasets (e.g. Copernicus), in situ sensors, and legacy databases from institutional partners. The ingestion modules are being designed to support scheduled data pulls, user submissions, and API-based integration with external sources.
- **Data Governance & Processing Layer:** Central to ENHANCE's data reliability is the governance layer, ensuring that all incoming data is validated, catalogued, and enriched with metadata for provenance and policy compliance. This layer supports secure access, semantic harmonization, and rule-based processing pipelines. Future versions will also include a dedicated provenance registry aligned with Data Spaces standards. This layer also will support security and privacy management. Hence, only authorized personnel/users will be able to access certain datasets and potentially existed personal data (if any) will be handled in compliance with the GDPR.
- **Intelligence & Analytics Layer:** This layer hosts the core reasoning, assessment and analytics modules. It will provide predictions, trends, and scenario-based insights on environmental and public health variables related to coastal management. These functionalities, while in early stages, xAI functionalities are being scoped to guarantee

transparency and interpretability of model outputs, especially in citizen-facing applications.

- **Integration & API Layer:** As a cross-functional hub, this layer provides secure RESTful APIs for all toolkit services and modules. It ensures that front-end tools, dashboards, and external systems can interact with ENHANCE data and models, while also enforcing access control policies and supporting modular integration.
- **Infrastructure & Deployment Layer:** This layer reflects the technical backbone of the platform, including cloud-based and edge deployment strategies depending on partner needs. The system is being designed to support containerization (e.g., via Docker), scalable orchestration, and federated deployment options if required by stakeholders.
- **User Engagement & Visualization Layer:** The upper layer of the architecture focuses on how insights are delivered to end users. This includes dashboards, interactive maps, mobile apps, and user-specific interfaces designed through persona mapping and journey co-design workshops. It also accommodates alert systems, scenario planners, and participatory visualizations.

Overall, this high-level architecture ensures a modular and layered approach: data flows upward from sources to insights, while each layer encapsulates specific functionality. Such a design makes the ENHANCE platform flexible – for instance, new data sources can be added at the ingestion layer without affecting the analytics algorithms; or a new visualization component can be introduced without altering core data processing. The architecture is aligned with the project's technical objectives (WP3), mapping each major component to the corresponding development tasks. In the next subsection, we discuss how this conceptual design aligns with Copernicus and EGNSS services, which are integral to ENHANCE.

In its current form, this high-level architecture serves as a foundational blueprint, integrating early insights from pilot site requirements, stakeholder feedback, and the technical expertise of WP3 partners. It ensures a clear flow of information from raw data to actionable insight, with careful attention to transparency, interoperability, and adaptability across coastal management contexts.

To ensure the ENHANCE conceptual architecture accomodates diverse data needs across pilot sites, we've developed a high-level data classificataion that reflects the most relevant dataset types. This complements the layers shown in Figure 3 by clarifying the kinds of information feeding each modules – from ingestion and governance to analytics and visualization.

Table 15 outlines:

- Dataset category (e.g., EO imagery, in-situ sensor, citizen science),

- Typical data format,
- Spatial/temporal resolution,
- Access modality (e.g., API, manual upload),
- Primary use within the toolkit (e.g., detection, trend analysis, alert triggering).

This table will serve as a guide during implementation—helping development teams anticipate ingestion strategies, metadata needs, and analytics pipelines. As dataset inventories become finalized for each case, this table will be updated with actual resource names and specifications.

Dataset Category	**Common Formats**	**Spatial/Temporal Resolution**	**Access Modality**	**Intended Use in Toolkit**
Earth Observation	.nc, SAFE	Depending on the sensor: Spatial resolution from 5m (Sentinel 1) to 35Km (SMOS)/ Temporal resolution from 4 days (Sentinel 3) to 12 days (Sentinel 1)	Published in Copernicus Browser (direct download and API) and BEC (available through FTP service)	Depending on the sensor, it can be all of them: detection, trend analysis, alert triggering
In-situ sensors	.csv, .nc	Depending on the sensor: Spatial resolution at least covering the sites of the case studies / Temporal resolution can be minutes, hours, days	Published in Zenodo (example). If it possible by API-RESTful	Depending on the sensor, it can be all of them: detection, trend analysis, alert triggering
Citizen Science	.csv (with Darwin Core DwC standard)	Depending on the project/dataset.	Published in GBIF (example). Accesible by API from MINKA	Detection – alert triggering of alien species,

Table 15: Dataset Overview for Toolkit Integration

This conceptual view will evolve into a detailed implementation plan as the project approaches **Milestone M13**, when the first operational release of the ENHANCE toolkit will be delivered in **Deliverable D3.1**. This next step will include the deployment of key modules and validation across selected pilot sites.

6.3 Alignment with Copernicus & EGNSS services

The ENHANCE toolkit is designed to integrate and leverage key components of the European Earth Observation and navigation ecosystems, particularly the Copernicus programme and the European Global Navigation Satellite Systems (EGNSS). These services offer a wealth of high-quality, open-access data that is highly relevant for One Health coastal management scenarios.

At this stage, most pilot sites have confirmed their intention to use Copernicus Sentinel data, particularly Sentinel-2 (optical imagery) and Sentinel-1 (SAR) for coastline monitoring, vegetation mapping, and marine pollution tracking. Use of EGNSS is also foreseen in mobile data collection apps to provide enhanced geolocation accuracy for citizen-submitted observations and sensor placement.

While the final list and typology of datasets per Case Study is still under refinement, early alignment indicates that:

- Copernicus products will serve as baseline environmental layers, enabling trend analysis and event detection.
- EGNSS will support ground-truthing and validation for citizen and sensor data.
- Integration with the DIAS (Data and Information Access Services) platforms (e.g., CREODIAS or MUNDI) is being explored to facilitate efficient access and data fusion.

The current conceptual architecture, as already discussed, anticipates integration with some open Copernicus resources and DIAS platforms. Attempting to provide a strong foundation, and as the dataset requirements evolve, the table below will be expanded to include specific measurements such as coastal erosion index, chlorophyll concentration, or marine debris indicators.

Source name	Repository / platform	Data types	Access methods
Sentinel-1 (SAR)	Copernicus Data Space Ecosystem & DIAS	C-band SAR (Stripmap, Interferometric Wide Swath, Extra Wide Swath)eoportal.org	Data Space API, openEO, WMS/WCS (via DIAS); NetCDF/GeoTIFF products
Sentinel-2 (MSI)	Copernicus Data Space Ecosystem & DIAS	Multispectral optical imagery (13 bands: 10 m, 20 m, 60 m)	Data Space API, openEO, WMS/WCS; L1C/L2A

			NetCDF/SAFE/GeoTIFF
Sentinel-3 (OLCI)	Copernicus Data Space Ecosystem & DIAS	Ocean/land colour imagery (21 bands at 300 m)	Data Space API, CMEMS portal; NetCDF/GeoTIFF
Sentinel-5P (TROPOMI)	Copernicus Data Space Ecosystem & DIAS	Atmospheric composition (spectrometer) with 3.5 × 5.5 km sampling for most products	Data Space API; NetCDF products via CAMS
CMEMS GLORYS12V1	Copernicus Marine Service	Global ocean physics reanalysis (temperature, salinity, currents, sea level, ice) at 1/12° (~8 km) and 50 vertical levels	CMEMS service API; NetCDF files
ERA5 (C3S)	Copernicus Climate Data Store	Atmospheric reanalysis (hourly surface/upper-air variables) on 31 km grid with 137 vertical levels	CDS API (download & API); NetCDF/GRIB
CGLS-LC100	Copernicus Land Monitoring Service	Global land-cover maps at 100 m with class fractions (2015–2019)	CLMS portal, openEO; GeoTIFF/NetCDF
HRL Imperviousness	Copernicus Land Monitoring Service	Imperviousness density (sealing %) and built-up layers; 10 m, 20 m and aggregated 100 m resolutions	CLMS portal; GeoTIFF/NetCDF
GHS-BUILT	JRC / Copernicus Global Human Settlement	Built-up presence grids (30 m, 250 m, 1 km) across epochshuman-settlement.emergency.copernicus.eu	JRC GHS portal; GeoTIFF
Sentinel-5P high-level atmospheric products (CAMS)	CAMS (Copernicus Atmosphere Monitoring Service)	Daily trace-gas columns (NO_2, SO_2, CH_4, etc.) derived from TROPOMI; ~3.5 × 5.5 km sampling	CAMS API; NetCDF
EGNSS: Galileo HAS	EUSPA / ESA	GNSS positioning corrections delivering 20 cm horizontal & 40 cm vertical accuracy	Signal-in-space (E6 band), internet corrections
EGNSS: EGNOS Open Service	EUSPA / EC	GNSS augmentation; ~3 m horizontal & 4 m vertical accuracy	SBAS broadcast corrections; internet via Ntrip

Table 16: Core EO Data Sources for ENHANCE Toolkit Intergration

These datasets are considered “core” because they provide the essential spatial and temporal coverage needed for coastal One Health applications, ranging from high-resolution optical imagery and radar to atmospheric, marine and land reanalyses. EGNOS and Galileo augment positioning accuracy for citizen science apps and in situ sensor networks.

Dataset name	Domain	Data type	Main variables	Horizontal coverage	Horizontal resolution	Vertical resolution	Temporal resolution	File format	ENHANCE case study
Sentinel-1	Marine/ coastal	SAR backscatter	Surface roughness; coastline & flood mapping	Global / EU coasts	5 m (SM), 5×20 m (IW), 20×40 m (EW)	N/A	≤6-day repeat (two satellites)	NetCDF / GeoTIFF	Barcelona/ Ebro & Pagasitikos shoreline change
Sentinel-2	Land/coastal	Multispectral reflectance	Reflectance in 13 bands (NDVI, turbidity, land cover)	Global 56°S–84°N	10 m (RGB/NIR), 20 m (red-edge/SWIR), 60 m (cirrus)	N/A	5-day revisit	GeoTIFF	Water-quality, vegetation and turbidity monitoring
Sentinel-3 (OLCI)	Marine/ coastal	Ocean/ land colour imaging	Chlorophyll, turbidity, SST	Global	300 m	N/A	1–2-day revisit	NetCDF / GeoTIFF	Water-quality & HAB detection
Sentinel-5P (TROPOMI)	Atmosphere	Imaging spectrometer	Trace gases (NO_2, SO_2, CO, O_3, CH_4)	Global	3.5×5.5 km (most), 7×5.5 km (SWIR)	N/A	Daily global coverage	NetCDF	Air-quality risk assessment
CMEMS GLORYS12 V1	Marine	Ocean reanalysis	Temp., salinity, currents, sea level, ice	Global ocean (−80° to 90° lat)	1/12° (~8 km)	50 levels	Daily & monthly	NetCDF-4	Hydrodynamics & larval dispersion
ERA5 (C3S)	Atmosphere/climate	Reanalysis	Surface & upper-air variables; waves	Global	31 km (0.25°)	137 levels	Hourly (1940-present)	NetCDF/GRIB	Climate trends & extreme event context
CGLS-LC100	Land	Land cover map	Classes & fraction	Global	100 m	N/A	Annual (2015-2019)	GeoTIFF /	Land-use baseline &

			s (forest, grassland, wetlands, urban)					NetCDF	habitat mapping
	Urban	Imperviousness density	% sealing & built-up presence	Pan-European	10 m (2018), 20 m (2006-2015); aggregated 100 m	N/A	Multi-year snapshots (2006–2018)	GeoTIFF / NetCDF	Urban expansion & runoff risk
GHS-BUILT	Urban	Built-up presence grid	Built-up land (presence/absence)	Global	30 m, 250 m, 1 km	N/A	Epochs (1975, 1990, 2000, 2014)	GeoTIFF	Long-term urban growth analysis
Sentinel-5P derived (CAMS)	Atmosphere	Assimilated trace-gas maps	NO_2, SO_2, CH_4 columns	Global	~3.5 × 5.5 km	N/A	Daily or 6-hourly assimilation	NetCDF	Early warning for air-quality impacts

Table 17: Alternative List of EO Data Sources for ENHANCE Toolkit Integration

Table 10 complements the core sources with data types that support specific coastal One Health needs, ranging from high-resolution urban mapping (HRL Imperviousness, GHS-BUILT) to climate and ocean reanalysis (ERA5, CMEMS GLORYS12V1). Sentinel-5P and its CAMS-derived products expand environmental monitoring into atmospheric composition, while CGLS-LC100 and ERA5 offer land-cover and climatic baselines. These alternatives provide more detailed or domain-specific information and can be combined with core Sentinel products in the ENHANCE analytics pipeline.

As data access agreements and technical interfaces mature, the WP3 team will work to ensure seamless ingestion, processing, and display of Copernicus and EGNSS-derived datasets in the ENHANCE toolkit. This alignment ensures that the platform can capitalize on **European digital public infrastructure**, fostering continuity, reliability, and interoperability with external systems and future initiatives like the Green Deal Data Space.

Conclusion

This deliverable marks a critical milestone in the ENHANCE project by establishing the foundational elements required for the co-creation and development of a user-driven, AI-enabled toolkit for coastal management. Drawing on the One Health approach, the document captures the initial synthesis of stakeholder needs through detailed user personas, user stories, and user requirements, translating them into technical specifications, conceptual system architecture, and user flow.

The work carried out in this first iteration is deeply rooted in participatory engagement across the two case studies, Barcelona Metropolitan Beaches & Ebro Delta (Spain) and Pagasitikos Gulf (Greece). Through these case studies, a wide array of user needs has been identified, ranging from early-warning systems and environmental monitoring to educational tools and data-sharing mechanisms across sectors. These insights have guided the creation of 47 structured user requirements and a suite of technical use cases, ensuring that future development is aligned with real-world needs, operational priorities, and sustainability objectives.

Moreover, the iterative co-creation methodology outlined—comprising stakeholder workshops, phased development, and feedback loops ensures that the platform remains flexible, context-aware, and responsive to evolving environmental and societal challenges. The technical groundwork laid here directly informs the implementation of the ENHANCE tools under Work Package 3 and provides a clear trajectory toward the next deliverable (D2.3), which will refine and expand on these outputs following the next round of co-creation sessions.

In summary, D2.2 provides a solid, methodologically sound, and user-centered foundation for the ENHANCE platform. It translates stakeholder aspirations into actionable system design, setting the stage for a robust, inclusive, and innovative digital toolkit that advances sustainable coastal management through interdisciplinary collaboration and advanced technologies.

Annex I: User Personas

Case Study 1 – Barcelona Beaches & Ebro Delta				
Full Name	**Job Title**	**Age**	**Needs**	**Expected Outcomes**
Maria Jose Chesa	Responsible for the water quality monitoring in the urban beaches of Barcelona (public company)	50	Access to complementary data on watercontamination (for example. target species as bioindicators)	Access to AI-based alerts on environmental risks (e.g., waterborne pathogens)
			Early prevention tools for environmental health risks	Integration of Copernicus data into public health monitoring
			Collaboration with environmentalists and NGOs	Better preparedness for outbreaks linked to water or climate
			Informational material for vulnerable groups	Creation of early-warning protocols linking environmental signals to human health
David Tarrasón	Secondary School Teacher	48	One Health educational materials	Access to educational platforms using real marine data & AI visualizations
			Local case studies and experiential activities	Engagement of students in citizen science (e.g., water sampling, biodiversity logs)
			Collaboration with NGOs	Increased environmental literacy and understanding of One Health
			School participation in community-based	Support for raising student awareness

			coastal monitoring activities	
Silvia Ramírez	Aquaculture Farming Unit Owner	47	Systematic water quality monitoring	Timely alerts on harmful algal blooms or pollution events from AI models
			Dashboard with marine Copernicus data for aquaculture safety	Early warnings for harmful algae and pathogens
			Guidance on sustainable aquaculture	Reduced economic losses through predictive water quality forecasting
			Networking with producers and authorities	Guidelines for adaptive aquaculture management based on real-time data
Joan Soler	Rice producer	55	Access to environmental risk maps (e.g., runoff or salinity zones) via Copernicus	Clean irrigation water
			Support for using organic inputs	Use of AI tools to link environmental conditions to animal/human health risks
			Control of invasive species (based on citizen science based programs)	Monitoring invasive species (potential damage for the rice)
			Awareness of farming impacts on water quality	Improved freshwater management practices based on data insights
Coloma Rull	Civil Servant. Coordinator of Urban	45	Updated biodiversity records	Periodic updates about biodiversity status of the urban beaches

	Ecology, Barcelona City Council		Collaboration with volunteer monitoring activities	Integration of AI-assisted trend analysis for animal disease emergence
			Collaboration with health/environmental bodies	Cross-sectoral data flow between health, animal, and environmental domains
			Education on responsible use of beaches installations	Participation in One Health decision-support systems powered by Earth observation
Eli Bonfill	SME owner (snorkel guided tours)	33	Real-time water quality updates for safe bathing and recreation	Bathing information (near real time)
			Use of AI-powered "eco-labels" or environmental indicators to attract visitors	Promotion of eco-identity of the region
			Participation in ecotourism initiatives	Contribution to local citizen science via beach cleanups or mobile apps. Services to support volunteer based pictures (identification and validation)
			Health info relevant to tourism	Positioning the region as a smart & sustainable coastal destination

Case Study 2 - Pagasitikos Gulf				
Full Name	**Job Title**	**Age**	**Needs**	**Expected Outcomes**
Eleni Alexiadou	General Practitioner at the Local Health Center	45	Access to data on water and food contamination	Access to AI-based alerts on environmental risks (e.g., waterborne pathogens)
			Early prevention tools for environmental health risks	Integration of Copernicus data into public health monitoring
			Collaboration with environmentalists and veterinarians	Better preparedness for outbreaks linked to water or climate
			Informational material for vulnerable groups	Creation of early-warning protocols linking environmental signals to human health
Antonis Psaropoulos	Fish Farming Unit Owner	51	Systematic water quality monitoring	Timely alerts on harmful algal blooms or pollution events from AI models
			Early warnings for harmful algae and pathogens	Dashboard with marine Copernicus data for aquaculture safety
			Guidance on sustainable aquaculture	Reduced economic losses through predictive water quality forecasting
			Networking with producers and authorities	Guidelines for adaptive aquaculture management based on real-time data
Nikos Laderos	Olive oil and vegetable producer	55	Clean irrigation water	Access to environmental risk maps (e.g., runoff or salinity zones) via Copernicus
			Support for using organic inputs	Use of AI tools to link environmental conditions to animal/human health risks

			Training on agroecological practices	Improved soil and water management practices based on data insights
			Awareness of farming impacts on health	Participation in local citizen science to monitor land-sea pollution pathways
Dimitrios Gatos	Veterinarian	40	Data on zoonotic disease outbreaks	Early detection of zoonotic risk hotspots through environmental surveillance
			Biosecurity protocols for farms	Integration of AI-assisted trend analysis for animal disease emergence
			Collaboration with health/environmental bodies	Cross-sectoral data flow between health, animal, and environmental domains
			Education on responsible antibiotic use	Participation in One Health decision-support systems powered by Earth observation
Anna Papadimitriou	Tourist accommodation owner	33	Clean coasts and marine water	Real-time water quality updates for safe bathing and recreation
			Promotion of eco-identity of the region	Use of AI-powered "eco-labels" or environmental indicators to attract visitors
			Participation in ecotourism initiatives	Contribution to local citizen science via beach cleanups or mobile apps
			Health info relevant to tourism	Positioning the region as a smart & sustainable coastal destination
Sofia Papakosta	Secondary School Teacher	48	One Health educational materials	Access to educational platforms using real marine data & AI visualizations
			Local case studies and experiential activities	Engagement of students in citizen science (e.g., water sampling, biodiversity logs)

			Collaboration with NGOs	Increased environmental literacy and understanding of One Health
			School participation in community-based coastal monitoring activities	Support for raising student awareness

Annex II: Use Case Template

USE CASE DOCUMENTATION TABLE		
Use case	*UCX – Name of the Use Case*	
Identifier	*Unique identification code for the use case.*	
Use case status	*Current status of the use case Draft/In Progress/Final*	
Related requirements	*Functional*	*List of the related functional requirements linked to the use case*
	Non-Functional	*List of the related non-functional requirements linked to the use case*
Description	*Brief description of the actions to be carried out in the use case.*	
Actors	*Identification of actors interacting in this use case (e.g., end user).*	
Inputs	*List of inputs required for this use case*	
Modules / external tools	*Identification of involved modules or external tools (if any).*	
Related documents and data sources	*References to other documents and data sources that can be used to support the use case application.*	
Preconditions	*Actions that should have occurred or conditions that should be met before executing this use case.*	
Challenges before (that hinder the execution)	*Specific rules or constraints that obstruct the execution of this use case.*	
Sequence of actions and alternative pathways	*Step-by-step actions to follow during the execution of the use case and alternative ways within each step in case difficulties emerge.*	
	Step	Action
	1	*Step 1 to be followed when executing the Use Case*
	2	*Step 2 to be followed when executing the Use Case.*
	3	…
	4	…
	5	…
	6	…
	7	…
Outputs	*List of outputs obtained after executing the use case.*	
Challenges after (that limit the full exploitation)	*Specific rules or constraints that obstruct the execution of this use case.*	
Other open issues	*Any known issues or questions needing resolution for this use case.*	

Table 18: Use Case Documentation Template

ENHANCE

One Planet, One Health for Coastal Resilience

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"This project has received funding from the European Union's Horizon Europe under grant agreement No 101180146 —ENHANCE. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the granting authority. Neither the European Union nor the granting authority can be held responsible for them."