D2.3 Final version of the ENHANCE scenarios & platform specifications

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

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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
EO	Earth Observation
GDPR	General Data Protection Regulation
IAM	Identity and Access Management
CMEMS	Copernicus Marine Environment Monitoring Service
CAMS	Copernicus Atmosphere Monitoring Service
C3S	Copernicus Climate Change Service
SAR	Synthetic Aperture Radar
MSI	Multispectral Instrument
OLCI	Ocean and Land Colour Instrument

Executive Summary

Deliverable D2.3 is the final WP2 specification package for the ENHANCE scenarios and platform. It consolidates the conceptual and co-creation work completed in D2.1 with the first technical specification baseline delivered in D2.2, turning them into a single reference for implementation in WP3 and configuration in WP4.

The deliverable stabilises the final user groups, personas, user stories, technical use cases, co-creation outputs and platform specification logic. It clarifies how the One Health framework is translated into case-study configurations for Barcelona metropolitan beaches and the Ebro Delta, and for the Pagasitikos Gulf. It also explains how Copernicus data, in-situ evidence, citizen-science inputs and MINKA-linked workflows contribute to the ENHANCE platform logic. The final specification defines the common platform principles, role and access model, user journey, data domains and conceptual architecture that will guide the next implementation and pilot-validation activities.

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

This is the final output of WP2 tasks reporting on the activities for the co-creation and specification of ENHANCE platform. Its purpose is to:

- Consolidate the WP2 outputs into a single, coherent specification baseline for the ENHANCE toolkit.

- Translate the validated user needs into a final set of user stories, requirements, access rules and technical use cases.
- Document the user-flow and interface logic that emerged from the co-creation, wireframing and prototype work.
- Define the platform architecture, data domains and Copernicus/EGNSS alignment that should guide WP3 implementation and WP4 pilot configuration.

In this sense, D2.3 is the main WP2 hand-over document for the AI-enabled ENHANCE toolkit.

1.2 Relation to other Deliverables and Work Packages

The deliverable D2.3 is the last deliverable of the WP2, providing a single point of reference for the results of this work package. More specifically, the WP2 deliverables' scope is summarized below:

- D2.1 established the ENHANCE One Health framework, the stakeholder mapping logic and the first co-creation outputs.
- D2.2 translated those results into an initial specification package composed of personas, user stories, requirements, use cases, user-flow logic and a preliminary architecture.
- D2.3 consolidates the validated backbone of D2.1 and D2.2, cleans inconsistencies, incorporates the prototype and workshop perspective developed in late WP2 and aligns the specification with the implementation logic of WP3.

Within the wider project, this document acts as a bridge between the conceptual work of WP2 and the technical and pilot activities that follow. D2.3 feeds directly into:

- WP3 (ENHANCE Toolkit): the architecture, data flows, access rules and technical use cases provide the implementation reference for the toolkit modules and integrations.
- WP4 (Pilot deployments & Living Labs): the final user groups, dashboards, alerts and workflows provide the basis for configuring the pilots and validating them with local stakeholders.

1.3 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	ENHANCE One Health Framework	Defines the operational meaning of the One Health approach in ENHANCE and explains how

		it shapes scenario design, indicator integration and platform logic.
Section 3	Stakeholder Mapping and Living Labs	Summarizes the stakeholder logic across the two case studies and explains the role of the Living Labs as validation environments for the final WP2 specification.
Section 4	Consolidation Factors	Synthesizes the main cross-cutting factors emerging from WP2 and WP3 materials that explain the final integrated platform logic proposed in D2.3.
Section 5	Co-creation, Prototype Work and Validation Inputs	Summarizes the co-creation results, shared user-flow logic, prototype validation approach and the main design implications for the toolkit.
Section 6	Platform Specifications	Presents the final design principles, roles and access model, technical use case mapping, user journey, logical architecture, data domains and alignment with Copernicus and EGNSS services.

Table 1: Overview of Deliverable Sections

2. ENHANCE One Health Framework

Within ENHANCE, the One Health framework provides the operational logic through which coastal pressures, ecosystem condition, aquatic animal health and human use or exposure are interpreted together for decision-making. In line with D2.1, the framework is structured around the DPSIR model (Driver–Pressure–State–Impact–Response) and three interconnected pillars: human and socio-economic well-being, aquatic animal health, and environmental ecosystem quality.

For D2.3, this framing has direct implications for platform design. The ENHANCE toolkit organises variables into integrated evidence chains that support interpretation across the full causal chain, from pressures and state changes to impacts and possible responses. These three pillars are translated into the ENHANCE indicator logic through the Human Health Outcome Index (HHOI), the Aquatic Animal Health Risk Index (AAHRI) and the Environmental Ecosystem Quality Index (EEQI). As a result, no single-domain dashboard is sufficient: the platform must combine Copernicus-based Earth Observation, in-situ monitoring and, where relevant, citizen-science evidence so that environmental stress, ecological condition, contamination relevance, public-health significance and stakeholder action can be understood within the same decision space.

The framework therefore acts both as the scientific backbone of ENHANCE and as an implementation rule for the platform. It defines what should remain common across the two case studies, namely the DPSIR logic, the three One Health pillars, the indicator families and the requirement for traceable and interpretable evidence, while still allowing local calibration of thresholds, indicator availability and data flows according to the pressures, datasets and monitoring practices of each pilot. In this sense, the framework ensures coherence across the project without forcing artificial uniformity. What must remain shared is the logic of interpretation; what may vary is the operational configuration through which that logic is implemented in each case study. This way, the implications for scenario and service design are:

Framework implication	Meaning
Cross-domain integration	User-facing scenarios should combine environmental, biodiversity and health-relevant evidence instead of presenting isolated indicators.
Actionability	Indicators must end in interpretation: alerts, response thresholds, recommendations, educational explanations or policy-ready summaries.
Participation	Citizen science and local contribution are embedded in the framework.
Traceability and trust	Because model-backed outputs may influence operational or public decisions, provenance, explainability context and access control are part of the core specification.

Table 2: One Health framework implications for scenario and service design

At implementation level, the same One Health backbone is preserved across the pilots, but the operationalisation of the framework remains case specific.

2.1 Case Study 1 (Barcelona metropolitan beaches and Ebro Delta)

In CS1, the One Health framework is operationalised in a coastal context where public-use conditions, biodiversity observation, protected-area dynamics, urban pressures and primary-sector activities need to be interpreted together. The CS1 configuration therefore combines Copernicus-derived indicators, in-situ and partner monitoring, and citizen-science contributions linked to MINKA and related local observation workflows. This makes CS1 particularly relevant for testing how ENHANCE can connect environmental monitoring with local participation and biodiversity-grounded evidence.

From a platform perspective, CS1 needs to support three complementary monitoring views: (i) public coastal-status and safe-use information for beaches and recreational users; (ii) professional and management-oriented views for urban coastal monitoring, protected areas and delta ecosystems; and (iii) citizen-science-linked participation flows through which users can discover biodiversity-relevant contexts and, where appropriate, contribute observations through linked channels. In this sense, citizen science forms part of the evidence and engagement model of the CS1 pilot.

At the operational level, the CS1 pilot combines coastal water-quality and public-use indicators, biodiversity observations, eutrophication and habitat proxies, and selected local monitoring data. The role of MINKA in this configuration is twofold: first, as a structured source of biodiversity and community-generated observations; second, as the contribution environment that supports citizen participation, expert feedback and learning-oriented engagement. ENHANCE should therefore expose and contextualise this citizen-science layer within its broader One Health logic while keeping the contribution workflow itself clearly linked to the appropriate external channel.

The CS1 implementation consequently emphasises urban coastal monitoring, public communication, delta and protected-area observation, and long-term engagement with citizen-science communities. This makes CS1 the pilot where interoperability between EO, in-situ and citizen-generated evidence is especially important, both for technical integration and for the credibility and actionability of the platform outputs.

2.2 Case Study 2 (Pagasitikos Gulf)

In CS2, the One Health framework is operationalised in a context dominated by climate-related disturbance, contamination concerns and recovery monitoring following the September 2023 floods in Thessaly. For that reason, the CS2 configuration places strong emphasis on an EO-first workflow, in which the relevant operational indicators are derived primarily from Copernicus satellite data so that they can feed the ENHANCE platform directly and support repeated, platform-ready observation over time. This design is particularly suitable for Pagasitikos, where the case study requires spatially continuous monitoring of environmental pressures, water-quality dynamics and recovery patterns across a large and highly affected coastal system.

This EO-driven workflow is complemented by targeted in-situ sampling campaigns in the Pagasitikos Gulf, including water samples and fish tissue analysis. These local measurements serve as the validation layer for satellite-derived information and strengthen the reliability, contextual interpretation and scientific credibility of the indicators exposed through the platform. Their role is especially important for those parameters that require stronger interpretation in relation to contamination pathways, aquatic animal health, pathogen or antimicrobial-resistance relevance, and food-safety concerns. In practical terms, Copernicus provides scale, temporal continuity and direct platform ingestion, while the in-situ campaigns provide calibration, ground-truthing and higher-confidence validation.

The CS2 implementation therefore preserves the full One Health logic rather than reducing the pilot to a purely environmental monitoring exercise. Environmental condition is tracked continuously through EO-derived layers; aquatic animal health is interpreted through water-quality and ecophysiological proxies complemented by local sampling and fish tissue analysis; and human-relevant interpretation is supported through indicators associated with contamination exposure, bathing-water relevance, food safety and climate-related stressors. This creates a structured evidence chain from pressure and state detection to impact interpretation and response support.

At the current stage, the operational shortlist of CS2 indicators can be described across the three One Health dimensions. For the human and HHOI-relevant dimension, the main variables include turbidity, sea surface salinity, 2 m air temperature, land-use pressures, PM2.5, precipitation and extreme rainfall, and heatwave days. For the aquatic animal and AAHRI-related dimension, the core variables include pH, turbidity, chlorophyll-a, salinity, dissolved oxygen, currents and mixing (sea water velocity), and ocean mixed-layer thickness. For the environmental and EEQI-related dimension, the operational set includes sea surface temperature, land cover and land-use classes, tree cover density, total precipitation, dissolved oxygen concentration, pH and chlorophyll-a. Taken together, these variables provide a workable basis for linking climate pressures, land–sea interactions, water-quality degradation, ecosystem response and health-relevant interpretation within one common monitoring logic. This shortlist should be understood as the initial CS2 operational configuration and may be refined further during WP3 implementation and pilot validation as data availability and threshold setting are stabilised.

From a platform perspective, this means that CS2 should be implemented as an integrated decision-support workflow combining maps, validation data and interpretation layers. The value of the pilot lies in combining EO-derived indicators, validation data and interpretation layers so that users can move from observation to meaning. In this sense, the Pagasitikos pilot becomes a concrete example of how the ENHANCE One Health framework is translated into an operational service: Copernicus supports continuous and scalable monitoring, local sampling provides validation and trust, and the platform integrates both streams into decision-support outputs relevant for environmental management, aquaculture, public health and coastal resilience.

3. Stakeholder mapping and Living Labs

As outlined in the introductory section and in line with the framework presented in Deliverable 2.1, the Living Lab (LL) approach was structured to support project implementation through stakeholder engagement actions tailored to the requirements of each project phase. More specifically, the present section addresses those co-creation methodological principles and related actions of this deliverable that required external stakeholder input, validation, and operational support. Building on the methodological framework and stakeholder engagement approach established in Deliverable 2.1, the section focuses on their application and further refinement in relation to the objectives of the present deliverable.

Phase	Time Frame	Aim	Main Focus
1	M1–M16	Shared vision and problem definition	Needs, One Health framing, early co-creation for initial toolkit feedback (prototype)
2	M17–M24	Tool refinement and pilot preparation	Further toolkit feedback if needed at local level, first pilot input, solution adaptation
3	M25–M30	Validation in pilot settings	Co-creation, social acceptance, final toolkit validation
4	M31–M36	Replication and upscaling	Exploitation alignment, lessons learned, roadmap and future scenarios

Table 3: Horizontal Living Labs Plan

3.1 Stakeholder mapping and engagement basis in the two case studies

In this context, the stakeholder lists initially developed under the framework established in Deliverable 2.1 were further reviewed, updated and expanded during Phase 1. At the present stage, the consolidated stakeholder mapping includes more than 120 entries overall, comprising approximately 49 stakeholders linked to Case Study 1, 48 linked to Case Study 2, and a further set of cross-cutting or strategically relevant actors associated either with both case studies or with broader project activities. A revision mechanism also remains in place to enable the inclusion of additional stakeholders where required by case study developments, pilot preparation, or emerging implementation needs.

The stakeholder lists prepared for each case study function as a structured operational tool for both stakeholder mapping and engagement planning. In addition to basic organisational information, they include data on stakeholder classification within the Quintuple Helix framework, field of activity, geographical scope, relevance to the One Health approach, and potential relation to ENHANCE objectives. They also include qualitative assessments of stakeholder power, interest, influence, trust, communication frequency, collaboration level and preferred forms of engagement, together with indications of their potential contribution to specific project activities and case study actions. This information also supports the identification of stakeholders as prospective users of the ENHANCE platform and helps distinguish in practice different user types in relation to the needs and functions addressed by each case study during the project implementation. In this respect, the lists should be understood as practical instruments for prioritising engagement and tailoring co-creation activities to the needs of each case study.

At the same time, the stakeholder-mapping work carried out in Deliverable 2.1 showed that, although the two pilots differ in their territorial and operational contexts, they have a comparable structural logic in stakeholder terms. In both cases, effective implementation requires the involvement of a combination of public authorities, operational users, research and education actors, businesses, and citizen or civil society organisations. It is precisely this shared structural composition that supports the feasibility of a common platform approach across the two pilots.

The two case studies mainly differ in the relative emphasis placed on different One Health dimensions and domains of engagement. In the case of the Barcelona metropolitan beaches and Ebro Delta pilot (CS1), greater weight is given to the environmental and societal dimensions of One Health, with particular attention to urban coastal monitoring, conditions of public use, biodiversity observation, urban planning, and primary sector activities. This case study also benefits from a comparatively more mature stakeholder community, which allows for a stronger prioritisation of participatory approaches, including citizen science actions. By contrast, the Pagasitikos Gulf pilot (CS2) places greater emphasis on the environmental, animal health and public health interface, with aquaculture, agriculture, public health, and post-event resilience emerging as more central domains of engagement.

Within this broader mapping, a smaller core group of stakeholders was identified for more focused engagement during Phase 1, in accordance with the co-creation needs associated with the development of the ENHANCE scenarios and platform specifications. This prioritisation was informed by the stakeholder maturity assessment conducted for each case study and previously presented in Deliverable 2.1. A more detailed account of this core engagement approach is provided in Table 4, which sets out the methodological principles for Phase 1 per case study, and in Section 5, which presents the results of the co-creation sessions. In this sense, the strategy adopted did not treat all mapped stakeholders uniformly, but considered their respective maturity, relevance to the case study context, and expected contribution to the co-creation and validation process.

3.2 Living Labs as validation environments

Within WP2, the activities contributing to the final version of the enhanced scenarios and platform specifications are closely linked to Living Lab Phase 1. This phase was designed to support the co-creation process, the methodological development of the work, and the preparation of the tools to be taken forward in the next stages of the project. During the first 16 months, its role was mainly to support the early structuring of the pilot intervention logic and to provide the basis for validating key elements of the platform concept.

The Living Lab process explains how stakeholder input is progressively connected to the ENHANCE framework, platform specifications and pilot evaluation. This link follows the sequence of the project deliverables. D2.1 defined the One Health framework and the initial approach to stakeholder mapping and co-creation. D2.2 translated this work into personas, user stories, requirements, use cases and the first platform architecture. The present deliverable, D2.3, consolidates these elements into the final specification baseline for the ENHANCE toolkit, creating the bridge from WP2 to platform implementation and WP4 pilot work. In this context, D4.1 defined how the toolkit and case-study outputs will be evaluated, covering technical performance, user experience and socio-economic dimensions. This makes it possible to connect the engagement actions carried out in WP2 with the indicators that will be used during pilot validation. The strategy adopted links each engagement activity to the evaluation dimensions it can realistically inform. As indicated in D2.1, these activities have been addressed progressively through the project implementation and pilot phases. In the early co-creation phase, stakeholder mapping, workshops, interviews and case-specific discussions supported the definition of needs, user groups, scenarios and initial platform requirements. During pilot preparation, these inputs began to inform the refinement of platform views, prototype feedback and decision-support expectations. This phased approach also defines how the activities contribute to the evaluation indicators: participation and Living Lab process satisfaction [SE-P6, SE-P1] are treated as cross-cutting indicators, while perceived usefulness, societal usefulness and policy relevance [SE-P2, SE-P8, SE-P12], user-experience indicators [UX-P1, UX-P2, UX-P3], and later decision-support and resilience indicators [SE-P4, SE-P5] are addressed according to the maturity and objectives of each phase.

At this stage, these indicators should be understood as baseline and preparatory evidence. The Phase 1 baseline consists of stakeholder mapping, participation records, co-creation feedback, identified needs, preliminary use cases and early perceptions of the relevance and usefulness of the proposed ENHANCE services. The perceived usefulness of the services was explored by asking stakeholders whether the proposed indicators, dashboards, data layers and decision-support outputs corresponded to their practical needs and case-study conditions. This feedback helped clarify whether the emerging platform outputs were understandable, relevant and potentially useful for monitoring, planning, risk communication, citizen-science participation, environmental management or policy support.

The two case studies contributed to this baseline in different ways because the Living Lab activities addressed different stakeholder conditions and pilot needs. CS#1, covering the Barcelona metropolitan beaches and the Ebro Delta, was assessed as a highly engaged, trust-based stakeholder network with strong scientific support, targeted private-sector involvement, and established links to citizen-science practices through MINKA platform-related workflows. For this reason, the evidence from CS#1 is particularly relevant for participation, citizen-science contribution workflows, biodiversity-observation practices, feedback to contributors, user engagement, and usability-oriented feedback. It therefore provides a stronger basis for participation rate in Living Lab workshops [SE-P6], Living Lab process satisfaction [SE-P1], likelihood to use ENHANCE services [UX-P1], and output clarity and perceived ease of use [UX-P3].

CS#2, focused on the Pagasitikos Gulf, was assessed as a science-driven and institution-heavy stakeholder context, where the Living Lab activities focused on the shared understanding of One Health challenges, institutional roles, cross-sector collaboration, user requirements, prototype validation, and stakeholder education on One Health and data processes. In this case, the discussions made the perceived socio-economic usefulness of ENHANCE outputs more explicit, because stakeholders considered the relevance of the platform in relation to post-flood monitoring, water-quality concerns, public-health interpretation, risk communication, and recovery planning. For this reason, the evidence from CS#2 provides a stronger basis for perceived socio-economic usefulness and value of One Health products [SE-P2], decision-support value [SE-P4], vulnerability and resilience potential [SE-P5], stakeholder perception of societal usefulness [SE-P8], and policy-relevant use cases [SE-P12].

Phase 2 focuses on tools development and pilot preparation. It links the WP2 specification baseline with the WP4 evaluation methodology by examining whether the proposed indicators, data layers, platform views and decision-support elements can be understood and used by the identified stakeholder groups. At this stage, Phase 2 continues to refine evidence for perceived usefulness [SE-P2], decision-support value [SE-P4], vulnerability and resilience potential [SE-P5], SDG-relevant use cases [SE-P7], societal usefulness [SE-P8] and policy-relevant use cases [SE-P12]. These dimensions are currently infomed through quantitative feedback.

The later Living Lab phases will support the three user-experience indicators [UX-P1, UX-P2, UX-P3 further along with additional indicators once pilot-validation, survey and uptake evidence has been collected. Phase 3 will further inform adoption intention [SE-P3], perceived economic benefit [SE-P10], early adopter engagement [SE-P11], and the further testing of user-experience indicators after the 1st pilot cycle and Phase 4 will address the indicators linked to uptake, replication and scaling, including economic-sector use cases [SE-P9], uptake of best practices and recommendations [SE-P13], and replication and scaling actions [SE-P14] after the second pilot cycle.

Accordingly, the present deliverable clarifies how the co-creation and pilot-preparation activities completed so far contribute to platform refinement, and how later Living Lab phases will generate the evidence required for adoption, uptake, economic relevance, user-experience validation and replication indicators. A key horizontal activity at this stage was the consolidation of feedback across both case studies before further adapting the tool specifications to each pilot context. This allows the project to identify common requirements for the ENHANCE platform and recognise in parallel where case-specific refinements are needed in relation to stakeholder maturity, data readiness, decision-support needs and user interaction with the proposed services. The following table (Table 4) presents the link between the Living Lab and pilot phases, the main engagement activities used in each phase, and the technical, user-experience and socio-economic indicators that these activities inform. The table distinguishes between indicators already supported as baseline or preparatory evidence and those that will be further assessed during later validation, uptake and replication phases.

Table 4 Link between Living Lab phases, engagement activities and evaluation indicators

Living Lab / pilot phase	Main activities / tools used	Technical indicators	User-experience indicators	Socio-economic indicators
Phase 1 – Co-creation framework design and early tool definition	Stakeholder mapping, engagement planning, co-creation workshops, interviews, surveys and case-specific discussions	Not directly measured at this stage; activities support the selection of relevant data products, indicators and technical validation needs	Early qualitative feedback on expected clarity, usability and accessibility of proposed platform views	Living Lab process satisfaction [SE-P1]; perceived socio-economic usefulness and value of One Health products [SE-P2]; participation rate in Living Lab workshops [SE-P6]; stakeholder perception of societal usefulness [SE-P8]; policy-relevant use cases [SE-P12]
Phase 2 – Tools development and pilot preparation	Prototype demonstrations, task-based feedback, discussions on monitoring, risk communication, planning, response and recovery needs	Preparation of technical validation; refinement of data layers, thresholds, visual outputs and decision-support components before pilot testing	Likelihood to use ENHANCE services [UX-P1]; likelihood to ask for help while using ENHANCE services [UX-P2]; output clarity and perceived	Perceived socio-economic usefulness and value of One Health products [SE-P2]; decision-support value [SE-P4]; vulnerability and resilience potential [SE-P5]; SDG-relevant use cases [SE-P7]; stakeholder perception of

			ease of use [UX-P3]	societal usefulness [SE-P8]; policy-relevant use cases [SE-P12]
Phase 3 – First pilot validation cycle	Pilot demonstrations, structured feedback, workshop tasks and validation exercises	Technical performance indicators defined in D4.1, including validation of Earth Observation products, citizen-science data products, AI-assisted validation workflows and One Health indicator outputs	Further testing of UX-P1, UX-P2 and UX-P3, with comparison between pilot iterations where possible	SE-P1; SE-P2; adoption intention [SE-P3]; SE-P4; SE-P5; SE-P6; SE-P8; perceived economic benefit [SE-P10]; early adopter engagement [SE-P11]; SE-P12
Phase 4 – Replication, uptake and upscaling	Final evaluation, lessons learned, replication roadmap, policy recommendations and upscaling discussions	Technical evidence from earlier validation used to support replication and scaling decisions	UX evidence from pilot cycles used to define final usability refinements	Adoption intention [SE-P3]; SDG-relevant use cases [SE-P7]; economic-sector use cases [SE-P9]; perceived economic benefit [SE-P10]; early adopter engagement [SE-P11]; policy-relevant use cases [SE-P12]; uptake of best practices and recommendations [SE-P13]; replication and scaling actions [SE-P14]

The feedback collected through Phase 1 activities also directly informed platform refinement. The co-creation sessions and workshops shaped the final version of the user personas and user stories, as stakeholder input on roles, needs and expectations allowed the project to move from initial assumptions to a grounded set reflecting the actual end-user types across both pilots.

Additionally, the second co-creation workshop focused on the ENHANCE toolkit mockups, and this work was further enhanced by the 1-to-1 interviews which helped refine the user interface specifications. More information can be found in Section 5.

Living Lab Phase 1	Stakeholder maturity	Main Living Lab Phase 1 aim	Stakeholder engagement actions	Co-creation sessions with stakeholders for scenarios and ENHANCE toolkit specification
Overall approach	Stakeholder mapping initiated as a practical instrument for prioritising engagement and tailoring co-creation activities to the needs of each case study.	Develop a shared vision/problem statement; identify stakeholder needs; support co-creation activities for ENHANCE scenarios and toolkit specifications.	Selection of main Phase 1 workshop formats and added actions following stakeholder maturity assessment and pilot design. Workshops supported co-creation and early validation of needs and scenarios. Interviews and surveys clarified stakeholder expectations, user types and practical requirements. Meetings supported coordination with specific actors. Training activities introduced relevant concepts and tools. Talks and dissemination actions raised awareness and extended outreach beyond the immediate project network.	A mixed portfolio of workshops, interviews and added case-specific validation actions was used across the two case studies. At this stage, the socio-economic information that can be reported horizontally concerns the number and type of engagement actions, participant numbers and stakeholder coverage, forming the basis for later reporting on participation rate in Living Lab workshops [SE-P6] and Living Lab process satisfaction [SE-P1]. Other socio-economic indicators are not measured at this stage; the feedback provides initial evidence for deciding how perceived usefulness, societal relevance, policy relevance and decision-support value will be assessed

				during later pilot-validation phases. User-experience input is limited to early qualitative feedback on the expected clarity, usability and accessibility of proposed platform views, creating the basis for later UX assessment [UX-P1–UX-P3].
CS#1 – Barcelona beaches and Ebro Delta	A highly engaged, trust-based stakeholder network, consisting mainly of public bodies and NGOs, with strong scientific support and targeted private-sector involvement.	Align ecological and environmental-health indicators with the ENHANCE framework and the ENHANCE–ENFORCE synergy; structure pilot intervention across Barcelona beaches and the Ebro Delta; integrate citizen science, including MINKA and BioMARató, into the measurement framework; focus on pilot-preparation support; validate user needs, scenarios and first toolkit expectations with selected end-user types.	**27 engagement actions delivered:** 10 workshops, 6 training activities, 6 meetings, 3 talks, 1 round table and 1 poster session. The actions included 12 in-person, 10 online and 4 hybrid activities. Workshops were used mainly for co-creation and early validation of stakeholder needs, scenarios and specification requirements. Meetings supported coordination and exchange with specific actors. Training activities supported capacity-building and the introduction of	**29.04.2025 – ENHANCE–ENFORCE synergy workshop / requirements session:** collected requirements for the ENHANCE digital platform and AI toolkit and clarified links between environmental-health indicators, citizen-science data and pilot needs. **02.2026 – MINKA-related prototype-evaluation inputs:** gathered inputs relevant to the citizen-science contribution layer, biodiversity-observation workflows, user interaction with observation systems, contribution expectations, and feedback/engagement mechanisms in CS#1. This action provided early qualitative feedback on the expected clarity, usability and

			relevant One Health, citizen-science and MINKA-related concepts and tools. Talks and dissemination actions helped raise awareness, strengthen engagement and extend outreach beyond the immediate project network.	accessibility of proposed platform views, creating the basis for later assessment of UX-P1, UX-P2 and UX-P3. Beyond UX, it also supported the basis for later reporting on citizen-science participation [SE-P6] and technical/service-readiness indicators linked to MINKA evidence: citizen-science fish biodiversity monitoring [TP2.1], AI-assisted fish identification and validation [TP2.2 / TP3], and coastal plant occurrence and ecosystem-health monitoring [TP5]. **03.2026 – qualitative interviews:** clarified stakeholder needs and stakeholder types and collected feedback on prototype expectations - feedback on the expected clarity, usability and accessibility of proposed platform views, which will inform later UX assessment [UX-P1–UX-P3]. For socio-economic assessment, these activities mainly provided

				countable Phase 1 evidence on engagement intensity, participant numbers and stakeholder coverage, supporting later reporting on [SE-P6] and [SE-P1]. Feedback on usefulness, societal relevance, policy relevance and decision-support needs is treated as initial input for deciding how later indicators such as [SE-P2], [SE-P4], [SE-P8] and [SE-P12] will be measured during pilot validation.
CS#2 – Pagasitikos Gulf	A science-driven, institution-heavy stakeholder ecosystem with increased trust-building needs, shaped by post-flood recovery, environmental monitoring, public-health relevance and institutional coordination.	Define a shared understanding of One Health challenges in the Pagasitikos Gulf; clarify stakeholder needs and institutional roles; identify priority requirements for monitoring, interpretation, risk communication and decision-support activities.	**29.04.2025** – First Stakeholder Workshop: discussed current challenges in waste management, animal health and environmental monitoring; mapped stakeholder roles and responsibilities across institutions; co-designed user requirements for the ENHANCE digital platform and AI toolkit. The workshop involved representatives	**29.04.2025** – requirements session for the ENHANCE digital platform and AI toolkit: collected requirements for the ENHANCE digital platform and AI toolkit and clarified links between environmental-health indicators, and pilot needs. In addition, identified expected needs for monitoring, interpretation, data use and institutional decision support in the Pagasitikos Gulf context. This created the basis for later

			from academia, the public sector and industry, with 16 participants. **06.03.2026** – Workshop with the academic community: focused on the ENHANCE One Health approach, training and prototype validation, with 69 participants. These actions were used to build shared understanding, clarify user needs and prepare the case study for later measurement and pilot validation.	assessment of perceived socio-economic usefulness [SE-P2], decision-support value [SE-P4], vulnerability and resilience potential [SE-P5], stakeholder perception of societal usefulness [SE-P8] and policy-relevant use cases [SE-P12]. **06.03.2026** – ENHANCE prototype validation session / exercise: gathered early feedback on the expected clarity, usability and accessibility of proposed platform views. This does not measure UX indicators as final results, but creates the basis for later assessment of likelihood to use ENHANCE services [UX-P1], likelihood to ask for help while using ENHANCE services [UX-P2] and output clarity and perceived ease of use [UX-P3]. **03.2026** – qualitative interviews: clarified the needs of stakeholder types and collected feedback on prototype expectations. This provided initial input for

				deciding how later socio-economic and UX indicators will be measured during the pilot-validation phase.

The Phase 1 table above (Table 5) applies this logic to each case study. It shows how the specific engagement actions, co-creation sessions and stakeholder conditions contributed to the baseline evidence for the relevant evaluation indicators. The table also distinguishes the stronger contribution of CS#1 to participation, citizen-science workflows and usability-oriented feedback, and the stronger contribution of CS#2 to perceived usefulness, decision-support relevance, resilience interpretation and policy relevance. More details in this regard are provided in Section 5.3 of this deliverable.

For CSs environmental & socioeconomic evaluation indicators in relation to the different use cases, Phase 1 mainly supported the specification of how later assessment should be organised. At this stage, only the number and type of engagement activities, participant numbers and stakeholder groups can be reported more directly. Other indicators, including perceived usefulness, societal relevance, policy relevance, decision-support value, uptake, replication potential and UX, remain preliminary and require evidence from implementation and pilot validation. This initial evidence is uneven across case studies and stakeholder groups. In the LL planning this is linked to Phase 2 implementation planned to generate more systematic evidence against the relevant indicators and sub-indicators.

4. Consolidation Factors

The development of the ENHANCE toolkit is the outcome of multiple interrelated factors that collectively shape its structure, functionality, and user relevance. Throughout the co-creation process, stakeholder engagement activities, and technical specification phases, a wide range of inputs have been gathered, analysed, and iteratively refined, and will continue to evolve in the future as additional feedback is collected from stakeholders and the technical specifications are further refined during implementation and validation phases.

In this context, the concept of *Consolidation Factors* emerges to bring these diverse elements together into a coherent and user-oriented logic. These factors represent the key cross-cutting considerations that ensure the ENHANCE toolkit remains aligned with its core objective: to deliver a solution that responds to real user needs, reflects the One Health approach, and supports meaningful engagement across different stakeholder groups.

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 and D2.2), representative user personas were developed to capture the motivations, challenges, and goals of different stakeholder groups involved in coastal zone management.

Consolidation factor	Evidence from the WP2/WP3 materials	Implication for the final specification
Single shared platform, case-specific views	The same core interaction pattern is needed across both pilots: select location, inspect indicators, understand alerts, act or contribute.	The toolkit should be implemented as one common platform with configurable case-study layers, dashboards and thresholds.
Actionable outputs over raw data	Stakeholders consistently ask for alerts, recommendations, summaries and exportable reports, not only raw datasets.	Analytics and visualisation must end in decisions: advisories, risk classes, recommended actions and reporting outputs.
Progressive disclosure of complexity	Public users, educators and volunteers need simplified views, while planners and technical actors need deeper layers and exports.	The interface must support role-based access and progressively reveal advanced data, model detail and configuration controls.
Interoperability and trust	The platform combines EO, in-situ, citizen science and institutional data across multiple organisations.	Data ingestion, metadata, provenance, consent, audit and quality control are first-class design requirements.
Co-creation remains essential during prototyping	User flow, wireframes and the first prototype were all shaped through partner sessions and planned external validation.	The architecture and UI specifications must remain modular so they can absorb partner and stakeholder feedback without structural redesign.
Guided participation and feedback loops	CS1 stakeholder input on MINKA validates the value of fast observation capture, expert/community feedback and educational participation, while also identifying friction in search, project discovery, profile dashboards, notifications, mobile flows and observation context.	ENHANCE should provide clear contribution entry points, MINKA-linked workflows, stronger feedback/status loops, and more visible contextual guidance for contributors, educators and citizen-science users.

Table 5: ENHANCE Consolidation Factors

4.1 Consolidated User Groups and Personas

Based on the refined stakeholder analysis conducted after the submission of D2.2, the ENHANCE project has consolidated a final set of target user personas that reflect the primary actors interacting with, contributing to, and benefiting from the platform.

The identified user personas represent a cross-sectoral ecosystem of stakeholders spanning public authorities, scientific communities, industry actors, and civil society. Their roles, expectations, and challenges are directly linked to the One Health approach, requiring integrated insights across environmental, human, and animal health domains.

The following six user persona groups have been defined as the core target users of the ENHANCE platform:

4.1.1 Scuba Divers, Snorkelers, and Swimmers

Goals	Ensure safe recreational activities Identify suitable locations and optimal environmental conditions
Needs	Access to real-time and forecasted water quality data (e.g., temperature, turbidity, salinity, chlorophyll levels) Visual dashboards, and alert systems for environmental risks
Challenges	Limited access to reliable and easy-to-interpret environmental data Constraints related to data resolution and integration from multiple sources
Role in Platform	End-users of monitoring and alerting services
Relevant CSs	CS1 & CS2

4.1.2 Citizen Scientists & General Public

Goals	Contribute to environmental monitoring Increase awareness and engagement in coastal sustainability
Needs	User-friendly tools for submitting observations Simplified dashboards Access to educational materials Interactive visualisations
Challenges	Complexity of environmental data for non-expert users Usability and accessibility barriers
Role in Platform	Data contributors and users of simplified environmental insights
Relevant CSs	CS1 & CS2

4.1.3 Urban Planners & Coastal Managers

Goals	Support sustainable coastal development Manage environmental and public health risks Enable evidence-based policymaking

Needs	Integrated multi-source datasets (environmental, health, biodiversity), Decision-support tools One Health indicators Risk maps Early warning systems
Challenges	Fragmented data sources Lack of interoperability across domains Need for coordinated cross-sectoral responses
Role in Platform	Advanced users and key decision-makers
Relevant CSs	CS1 & CS2

4.1.4 Aquaculture and Rice Farmers, Marine Agencies

Goals	Optimise production processes Reduce environmental and economic risks Ensure compliance with environmental regulations
Needs	Real-time and predictive information on water quality, pollution levels, salinity, and environmental risks Access to forecasting tools and AI-based recommendations
Challenges	Environmental variability Uncertainty in forecasting Data integration limitations affecting decision-making
Role in Platform	Operational users relying on analytics and forecasting tools
Relevant CSs	CS1 & CS2

4.1.5 Health Professionals

Goals	Detect, prevent, and respond to health risks linked to environmental conditions
Needs	Access to environmental health indicators, contamination data, and AI-powered early warning systems Tools supporting cross-sectoral coordination
Challenges	Limited integration between environmental and health data systems Delays in accessing actionable information
Role in Platform	Users of early warning systems and cross-domain insights
Relevant CSs	CS2

4.1.6 Education & Research Community

Goals	Support education, research, and capacity building in environmental and One Health domains
Needs	Access to real-world datasets, teaching materials, interactive tools, and case-based learning resources
Challenges	Limited availability of integrated, real-time datasets suitable for educational and research purposes

Role in Platform	Knowledge users, contributors, and disseminators of platform outputs
Relevant CSs	CS1 & CS2

4.2 Consolidated User Stories

Building upon the refined user personas presented in Section 4.1, this section defines the updated set of user stories that capture the key interactions between end-users and the ENHANCE platform.

No	User Story	Target Groups	Personas
	Scuba divers, snorkelers, swimmers		
US1	As a scuba diver or swimmer, I want access to real-time and forecasted water quality data, so that I can select safe locations for recreational activities.	TG7: NGOs, citizens, civil society organisations	Scuba divers, swimmers
US2	As a snorkeler, I want to receive alerts on pollution events or harmful environmental conditions, so that I can avoid health risks and unsafe areas.	TG7: NGOs, citizens, civil society organisations	Snorkelers
US3	As a snorkeler, I want to visualise key environmental indicators (e.g., turbidity, temperature), so that I can better plan my activities.	TG7: NGOs, citizens, civil society organisations	Snorkelers
	Citizen Scientists & General Public		
US4	As a citizen, I want to submit environmental observations through an easy-to-use interface, so that I can contribute to coastal monitoring.	TG7: NGOs, citizens, civil society organisations	Citizen scientists, general public
US5	As a citizen scientist, I want to participate in monitoring activities and receive feedback on my contributions, so that I remain engaged in environmental protection	TG7: NGOs, citizens, civil society organisations	Citizen scientists

US6	As a non-expert user, I want access to simplified dashboards and visualisations, so that I can understand environmental conditions without technical knowledge.	TG7: NGOs, citizens, civil society organisations	General public
	Urban Planners & Coastal Managers		
US7	As a coastal manager, I want integrated access to environmental, health, and biodiversity data, so that I can support evidence-based decision-making.	TG2: Local/regional authorities, decision & policy makers, regulators	Coastal managers
US8	As a policy maker, I want to receive early warnings and risk assessments, so that I can respond effectively to environmental and public health threats.	TG2: Local/regional authorities, decision & policy makers, regulators	Policy Makers
US9	As a public authority, I want to integrate cross-sectoral data (environment, health, biodiversity), so that I can develop policies aligned with the One Health approach.	TG2: Local/regional authorities, decision & policy makers, regulators	Public Authorities
	Aquaculture and Rice Farmers, Marine Agencies		
US10	As an aquaculture farmer, I want real-time monitoring and forecasts of water quality parameters, so that I can protect production and reduce economic losses.	TG6: Industries and private sector SMEs	Fish farmers
US11	As a farmer, I want access to environmental risk maps (e.g., salinity, pollution), so that I can optimise irrigation and farming practices.	TG6: Industries and private sector SMEs	Farmers (rice, agriculture)
US12	As a primary sector operator, I want data-informed recommendations for sustainable practices, so that I can adapt to changing environmental conditions and comply with regulations.	TG6: Industries and private sector SMEs	Farmers, aquaculture operators
	Health Professionals		

US13	As a health professional, I want access to environmental contamination data and early warning alerts, so that I can respond to potential health risks.	TG1: Scientific community & academic institutions	Doctors
US14	As a veterinarian or doctor, I want integrated environmental and health indicators, so that I can detect patterns related to disease risks	TG1: Scientific community & academic institutions	Veterinarians, doctors
	Education & Research Community		
US15	As a teacher, I want access to real-world environmental datasets and teaching materials, so that I can support One Health education.	TG7: NGOs, citizens, civil society organisations	Teacher, students
US16	As a researcher, I want access to integrated datasets from multiple sources, so that I can conduct environmental and health-related analysis.	TG1: Scientific community & academic institutions	Researcher

Table 6: ENHANCE Consolidation User Stories

4.3 Consolidated User Requirements

The consolidated user requirements are organised into five categories: implementation requirements, data collection requirements, data analytics requirements, visualisation requirements, and data governance requirements. Together, these requirements ensure that the platform supports environmental monitoring, One Health assessments, citizen engagement, decision-making processes, and sustainable coastal management. They also provide the basis for the development of the platform functionalities, data services, analytics capabilities, and user interfaces that address the needs of both technical and non-technical stakeholders.

4.3.1 Implementation Requirements

RQ1	The platform shall provide real-time and forecasted water quality information for coastal users.
RQ2	The system shall generate alerts when environmental thresholds are exceeded.
RQ3	The platform shall support early warning systems for environmental and health risks.

RQ4	The system shall enable cross-sectoral data integration across environmental, health, and biodiversity domains.
RQ5	The platform shall provide decision-support tools for policy makers and coastal managers.
RQ6	The system shall provide data-driven recommendations for sustainable practices in agriculture and aquaculture.

4.3.2 Data Collection Requirements

RQ7	The platform shall support citizen science contributions through user-friendly data input tools.
RQ8	The system shall allow collection of environmental observations from multiple stakeholders.
RQ9	The platform shall integrate Copernicus satellite data and in-situ environmental data.
RQ10	The system shall support data input from primary sector stakeholders (e.g., farmers, aquaculture operators).

4.3.3 Data Analytics Requirements

RQ11	The system shall provide forecasting capabilities for environmental risks (e.g., pollution, salinity, HABs).
RQ12	The platform shall support trend analysis across environmental and health indicators.
RQ13	The system shall generate AI-based insights and predictive analytics.
RQ14	The platform shall support risk assessment for public health and environmental conditions.

4.3.4 Visualisation Requirements

RQ15	The platform shall provide interactive dashboards for visualising environmental data.
RQ16	The system shall display key environmental indicators (e.g., water quality, temperature, turbidity).
RQ17	The platform shall provide simplified visualisations for non-expert users.
RQ18	The system shall generate maps for environmental risks (e.g., pollution, salinity).

4.3.5 Data Governance

RQ19	The platform shall ensure secure data access and sharing across stakeholders.
RQ20	The system shall ensure data quality and validation mechanisms.
RQ21	The platform shall support interoperability between different data sources.
RQ22	The system shall support export of data and reports for policy and research use.

4.4 Traceability Matrix

To ensure that stakeholder needs are systematically addressed withing the ENHANCE platform, a traceability matrix had been developed linking stakeholder groups and consolidated user requirements to specific platform functionalities, data layers, and decision-support components. The matrix provides a transparent mapping between user expectations, system requirements and the architectural elements responsible for delivering the required capabilities.

Stakeholder Group	User Requirement	Platform Functionality	Data Layer	Decision Support Component
Scuba Divers, Snorkelers & Swimmers	RQ1, RQ2, RQ15, RQ16, RQ17	Interactive dashboard, citizen interface	Copernicus Data + Citizen Science + Other Data Sources	Prediction Models and Risk Maps
Citizen Scientists & General Public	RQ7, RQ8, RQ15, RQ17	Citizen interfaces and feedback tools	Citizen Science Data Layer	Data contribution and visualization services
Urban Planners & Coastal Managers	RQ4, RQ5, RQ12, RQ14, RQ18, RQ21	Dashboards and reporting tools	ENHANCE One Health Core Platform	Impact Assessment Tools and Risk Maps
Aquaculture & Rice Farmers, Marine Agencies	RQ1, RQ6, RQ11, RQ13, RQ18	Operational dashboard and alerts	Copernicus Data + Other Data Sources	Prediction Models
Health Professionals	RQ3, RQ4, RQ12, RQ14	Early warning dashboard	ENHANCE One Health Core Platform + Governance Layer	Risk Maps and Impact Assessment Tools

Education & Research Community	RQ12, RQ15, RQ22	Interactive dashboards, reporting tools, educational visualisations	Data Acquisition & Integration Layer + Data Governance & Processing Layer	Trend Analysis, Prediction Models & Risk Maps

4.5 Consolidated Use Cases

Table 6 presents the consolidated ENHANCE technical use cases together with their MoSCoW (Must/Should/Could/Won't) prioritization across the two case studies as reported in the Deliverable D2.2. No updates on the prioritization and the use cases identification have been made as part of the consolidation of the ENHANCE design.

Technical Use Case	**User profile**	**CS1 – Barcelona Ebro Delta**	**CS2 – Pagasitikos Gulf**
Visualization & Monitoring			
UC1.1 – Public coastal alerts and safe-use monitoring	Public users / low-access users (e.g., swimmers, divers, beach visitors, tourism operators)	Must	Must
UC1.2 – Citizen participation and long-term engagement	Registered contributors, educators and citizen scientists	Must	Could
Sustainable Management & Risk Assessment			
UC2.1 - One Health indicators for urban coastal monitoring	Urban planners, coastal managers, local authorities, researchers	Must	Should
UC2.2 – One Health indicators for sustainable aquaculture	Aquaculture professionals, marine environmental agencies, health and food-safety professionals	Should	Must
UC2.3 - One Health indicators for protected areas and delta ecosystems	Protected area managers, researchers and primary-sector actors	Should	Won't

UC2.4 – Dynamic Coastal Risk Map for policy regulation	Policy officers, urban planners, coastal managers, civil protection	Could	Should
Training & Education			
UC3.1 – One Health Training (Formal Education)	Schools, teachers, university students	Could	Should
UC3.2 – One Health Training (Non-formal Education)	Tourism operators, NGOs, local communities, visitors	Should	Could
Training & Education			
UC4.1 – Role, consent and data-sharing governance	Administrators, professional users, registered contributors	Must	Must

Table 7: Mapping of the ENHANCE Technical Use Cases

5. ENHANCE Co-creation Workshops

To co-create the ENHANCE toolkit, multiple rounds of co-creation activities were organized, combining input from consortium partners and stakeholders. The co-creation process is iterative, as new insights during testing can result in updates to previous results. An overview of the work done after deliverable D2.2 is shown below.

Co-creation round 1 focused on consolidating and validating the already developed user groups and personas, user stories, requirements and technical use cases. Discussions between consortium partners enabled delineating these results more closely per case study. The first versions were described in deliverable D2.2 and the consolidated versions in section 4 of this deliverable. In co-creation round 2, the user flows developed in Autumn 2025 were further developed alongside the prototype. Insights gathered from the feedback session with the partners at the consortium meeting in Barcelona informed these improvements. The consolidated user groups also made it possible to align the prototypes with these respective stakeholders. In round 3, these updated prototypes were tested and validated with a combination of 1-1 interviews with representatives of the user groups and demos and feedback gathering during the Living Labs.

Round	Timing	Main focus	Results & deliverable
Round 1 – stakeholder needs consolidation	Spring - Autumn 2025	Update stakeholders, user stories, requirements and technical use cases, and relevance in the two case studies	First version in D2.2 and consolidated in this deliverable

Round 2 – user flows and prototype	Autumn 2025 – early 2026	Update of user flow with partners and feedback session for prototype with multiple iterations to develop final prototypes	First version of user flows & first prototype described in D2.2, final prototype described in this deliverable
Round 3 - prototype validation	Early 2026	Test the prototype through interviews and living-lab workshop; identify missing features, usability issues and MVP priorities	Results described in D2.3

Table 8: Co-creation for the development of the ENHANCE toolkit

5.1 ENHANCE toolkit interface prototype

Investing time in creating interactive prototypes has many advantages:

- They enable you to discuss interface features and representations of datasets in a visual and more straightforward way.
- They make it possible to test with end users and enable them to imagine the end result.
- They simplify creating an overview of the requirements for the interface and are an aid during the development process.

The updated prototypes for the ENHANCE toolkit were tailored to the consolidated user groups and technical use cases using the MoSCoW prioritisation. Six specific prototypes were developed for the following user groups:

- Swimmer/diver
- Education
- Health professionals
- Aquaculture sector
- Citizen Scientist
- Urban planner / coastal manager

All these prototypes shared common features but were tailored to address the needs and expertise of each stakeholder. The prototypes and specific features are discussed briefly below.

For the **swimmer/diver** group, we focused on supplying relevant information for planning a safe swimming or diving trip. Information about the water quality, where animals can be spotted and in which areas it is safe/allowed to swim is made available. With notifications, swimmers and divers can be alerted of possible health risks when water quality is below a certain threshold.

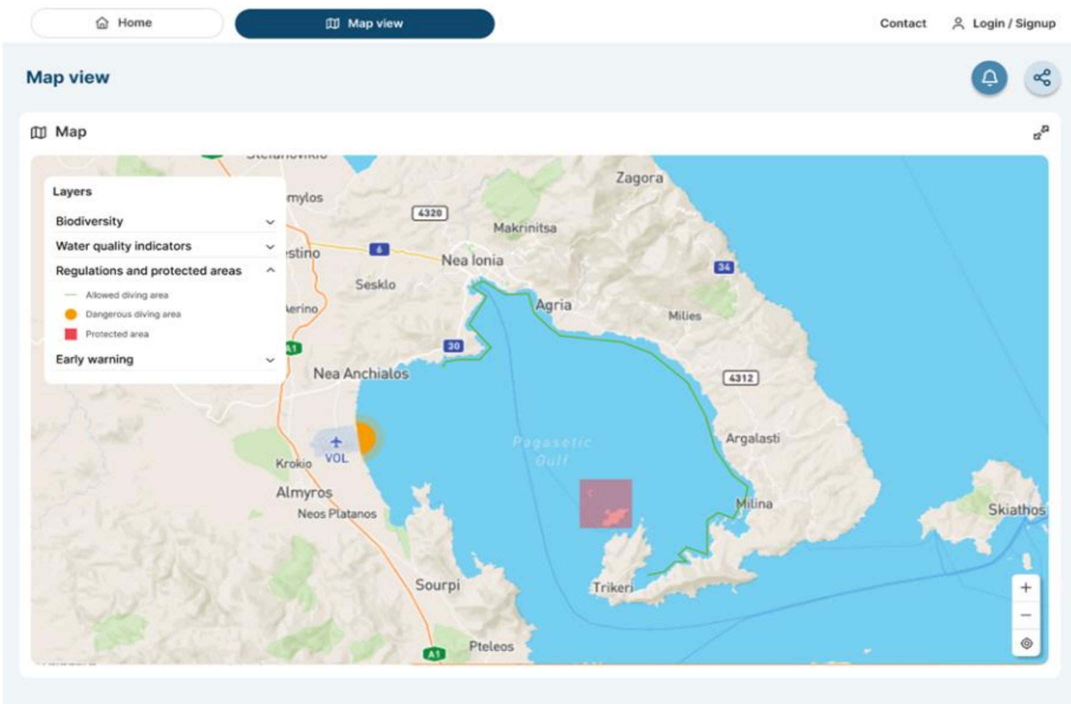

Figure 1: ENHANCE Toolkit - map view for swimmers/divers

For the **education group** (teachers & students), a learning hub was added in the prototype. On this page, learning material could be made available for the different aspects of One Health as well as a quiz to test the new knowledge. This material could be made available for download and sharing with colleagues.

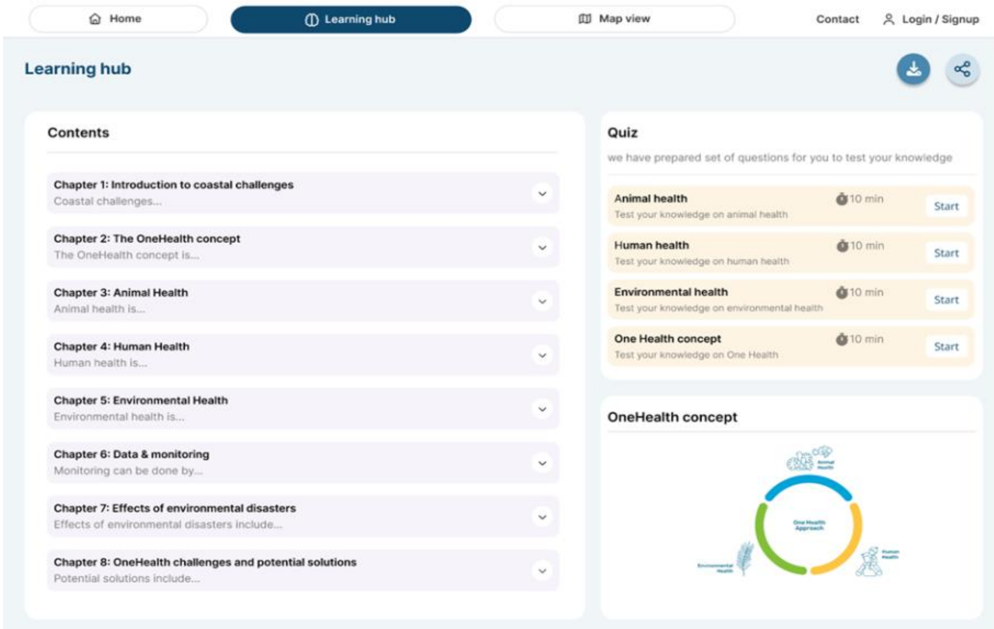

Figure 2: ENHANCE Toolkit - learning hub

For **health professionals**, early warning information with potential alerts was included in the prototype. OneHealth index scores for human, environmental and animal health are shown, together with the underlying parameters.

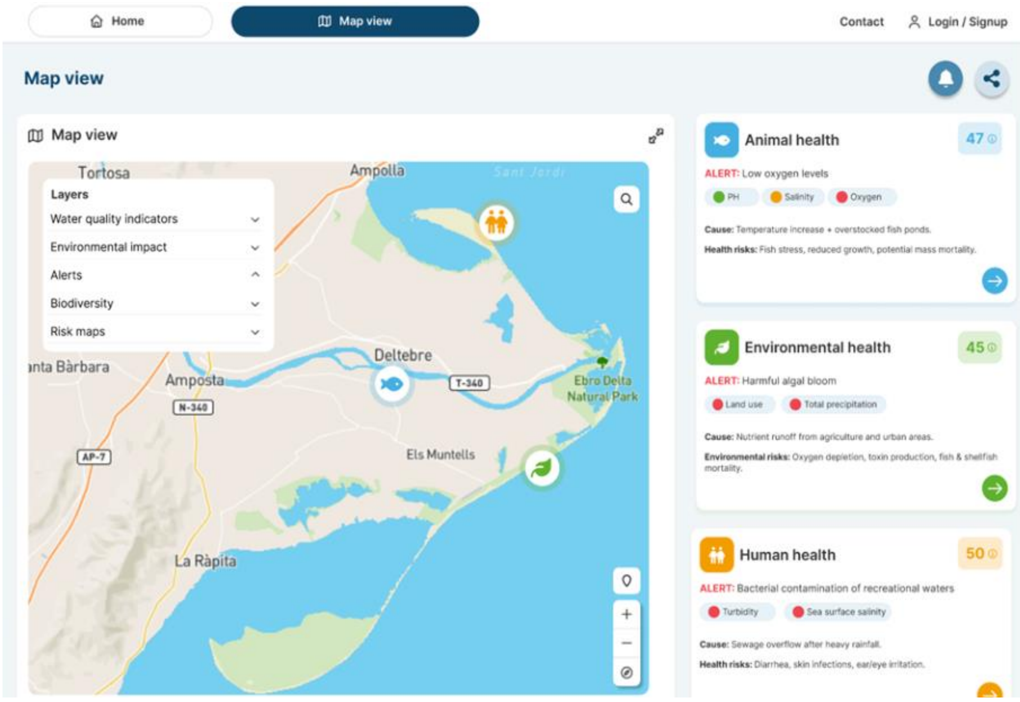

Figure 3: ENHANCE Toolkit - map view for health professionals

For stakeholders from the **aquaculture sector**, we developed a prototype with detailed water quality and risk information for a specific location. As we hypothesised that farmers will mostly be interested in the area where their farm is located.

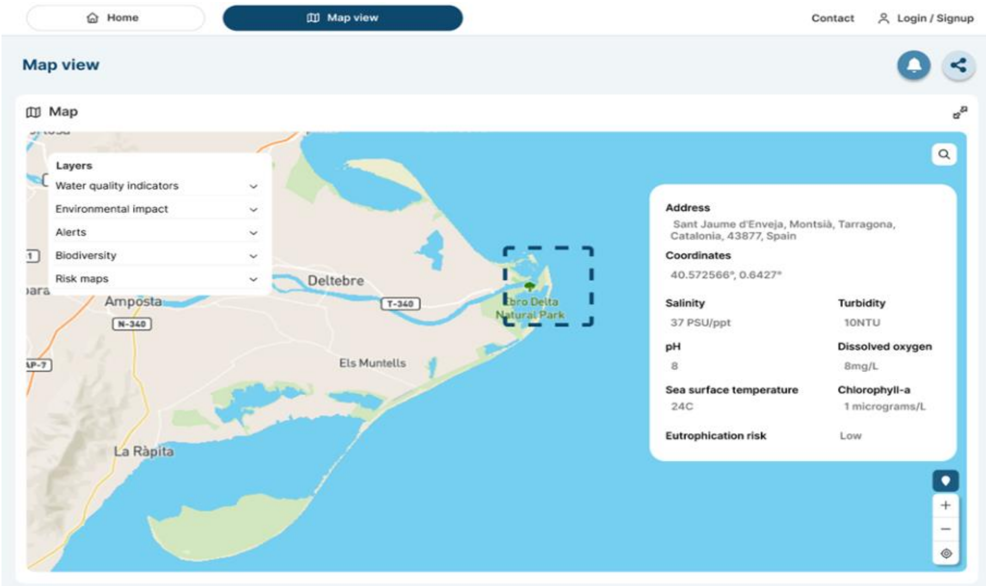

Figure 4: ENHANCE Toolkit - map view for the aquaculture sector

For the **citizen scientist** group, we tailored the prototype to show detailed information from the MINKA dataset and a link to contribute to the MINKA project.

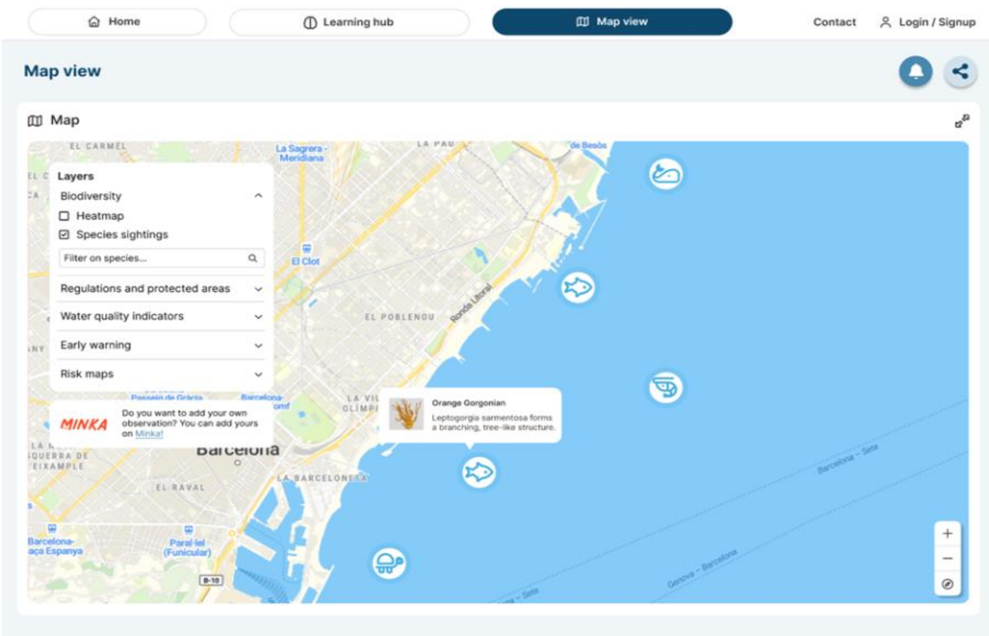

Figure 5: ENHANCE Toolkit - map view for the citizen science

Finally for the **urban planner** stakeholders, the prototype contained an additional feature: scenarios. Based on risk maps, they can select an area of high risk and run a scenario with possible interventions. In a dashboard they can analyse, share and export the results of the analysis.

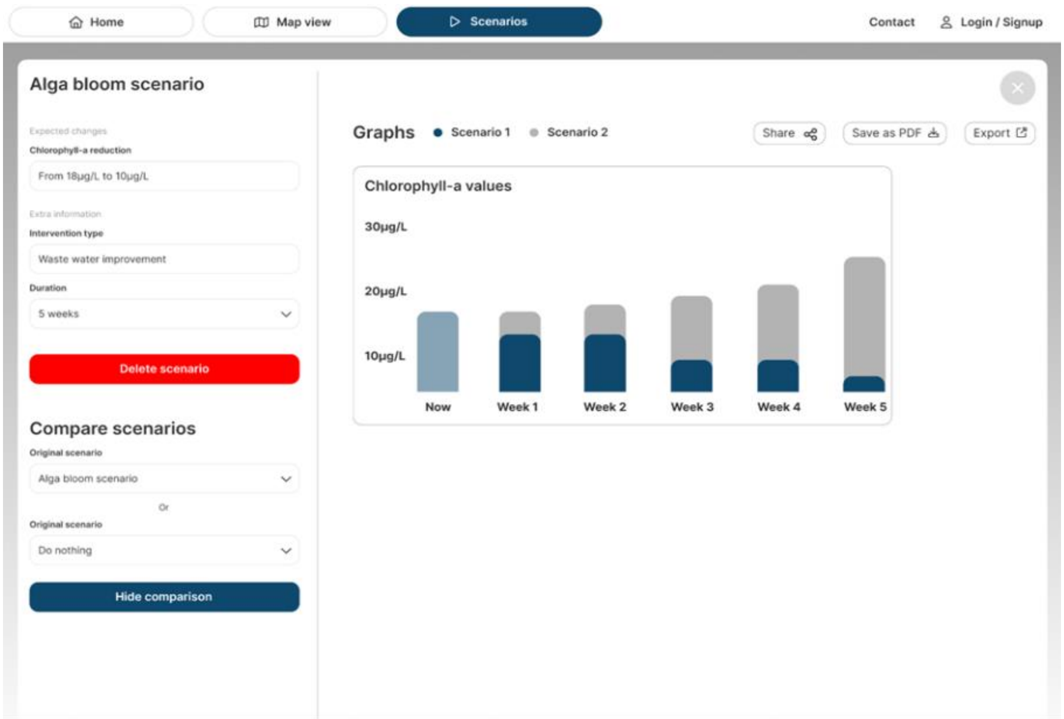

Figure 6: ENHANCE Toolkit - alga bloom scenarios for urban planners

The prototypes were made as a tool to discuss the future interface with stakeholders. In a next step, the requirements will be listed, and the feasibility of the different functionalities will be considered (this will be reported in deliverable D3.2).

5.2 Results 1-1 interviews

To learn how the ENHANCE interface can help stakeholders tackle challenges and satisfy their needs, we decided to ask them directly.

The interactive prototype views described in Section 5.1 were used as visual prompts during the interviews, allowing stakeholders to comment directly on the proposed mockups, navigation logic and role-specific interface features.

In each case study, we looked for representatives of these groups and interviewed them during 1-on-1 video calls. The interviews were organised both for validating the information we had gathered of their needs (complementary to the user requirements and use cases that were already described in section 4) as well as receiving feedback on the second version of prototypes. For the interviews we focussed on people from different backgrounds, ages and a good spread between the two case studies. Together with the consortium partners, we identified beforehand which stakeholders were available and relevant for both locations. Six interviews were organised during February and March 2026 with the following stakeholder types:

- Case study 1
    - Aquaculture sector
    - Human health professional
    - Education and citizen scientist and diver/swimmer
- Case study 2
    - Diver/swimmer
    - Education
    - Urban planner / coastal manager

The interviews were performed using a semi-structured questionnaire. In the first half of each interview the questions focussed on the background of the interviewee and the needs of the stakeholder type. In the second half of the interview the relevant interactive prototype was shared via a link. The interviewees were then asked to share their screen so we could observe as they went through the prototype. After asking for their consent, the interviews were recorded and notes were taken during the meeting. A summary of each interview was created and shared with the partners to inform the next steps (see example for diver/swimmer in figure 7 below). This summary contains an overview of their skills and expertise and a list of challenges, opportunities and goals. Finally, the prototype feedback was described.

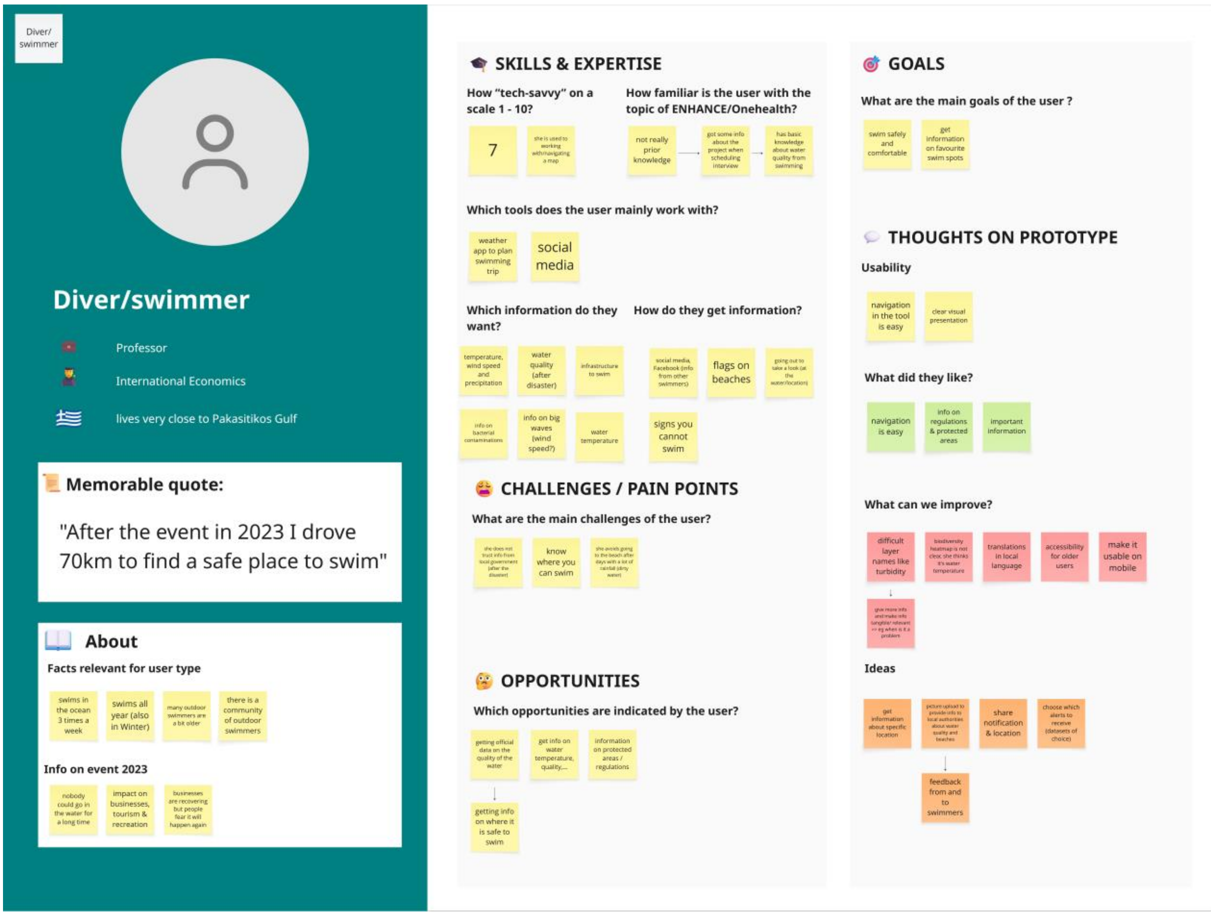

Figure 7: Example of interview summary for diver/swimmer user type.

Below you can find a summary of the learnings for each user type:

- Swimmer/diver
  - Accessibility of the tool is important as there are swimmers of all ages and backgrounds.
  - Information where it is safe and possible to swim is very helpful but should be very straightforward.
- Education
  - If we want to introduce a learning hub we need to identify the age groups of students.
  - To engage students we need to make it as interactive as possible.
- Aquaculture sector
  - More and freely available information on water quality parameters will be very interesting for them as their business could depend on this kind of information.
- Health professional

    - Time series of water quality issues could be very interesting for doctors to backtrack diseases.
- Urban planner
    - This stakeholder needs ready-to-use information for making informed decisions.
    - Urban planners could really benefit from scenario analysis to reduce One Health risks.
- Citizen scientist
    - Interesting to share and re-use MINKA data and combine it with other datasets.

Overall, the usability and navigation of the tool were found to be easy and clear. Interviewees liked that the data was shared on an interactive map and found the idea of alerts with notifications relevant. An important comment from multiple stakeholders was translating the tool in the local language. Finally, the idea of sharing water quality information with the general public was found to be of great relevance.

5.3 Results Living Labs

The results presented in this section build on the first round of Living Lab activities related to persona validation, initial requirements and service relevance in the two case studies, as outlined in D2.1 and further contextualized in Section 3.2 of this deliverable. However, in this section, focus is put specifically on the findings that informed the refinement of the enhanced scenarios and the finalisation of the platform specifications. In CS2, this includes the Living Lab workshop used for direct discussion of ENHANCE prototype views. In CS1, it includes targeted interviews used to validate needs and collect feedback on selected ENHANCE prototype views, together with stakeholder input from MINKA-related prototype evaluation and improvement activities relevant to the citizen-science contribution layer, biodiversity-observation workflows and long-term engagement logic of the CS1 pilot.

5.3.1 Case Study 1

For CS1, the inputs contributing to D2.3 were generated through two complementary channels, each addressing a different aspect of the platform validation process.

First, targeted 1-1 interviews were conducted with representatives of the main stakeholder groups to validate user needs, refine the consolidated personas, and collect direct feedback on selected ENHANCE prototype views. These interviews provided qualitative insights into usability, relevance of indicators, expected workflows and decision-support needs across different user types.

Second, MINKA-related prototype evaluation and improvement activities provided structured stakeholder input focused on the citizen-science participation layer, the associated contribution workflows, and the contextualisation of biodiversity observations within the CS1 implementation. This input reflects how users interact with observation systems, how they expect to contribute data, and how feedback and engagement mechanisms should be designed.

These two channels should be understood as complementary rather than overlapping. The interview process supported the validation of ENHANCE interface logic and user interaction patterns, while the MINKA-related activities informed the design of participation mechanisms and the integration of citizen-generated data within the broader platform.

Across the reviewed material, several consistent findings emerged. Stakeholders highlighted the importance of fast and intuitive observation capture, the need for clear feedback mechanisms (both expert-based and community-based), and the value of educational and engagement-oriented features. At the same time, recurring usability issues were identified, including search and filtering limitations, project discovery challenges, profile dashboard clarity, notification management, mobile usability constraints, and the need for richer contextual information in observation records.

From a specification perspective, these findings directly support the definition of UC1.2 as a MINKA-linked contribution pathway within ENHANCE. They also reinforce the need for clearer contribution entry points, stronger feedback and status loops, improved guidance for users, and more explicit visualisation of citizen-science outputs within the platform.

Overall, the CS1 validation results confirm that citizen-science participation is a key functional component of the ENHANCE platform. Its role is to extend the platform's evidence base through user-generated observations while maintaining a clear separation between the contribution environment and the ENHANCE interface, where those contributions are contextualised and integrated within the One Health framework.

5.3.2 Case study 2

The workshop held on 6 March 2026 at the University of Thessaly was a key activity of Living Lab Phase 1 for CS2, as it provided the main context for presenting and discussing the first version of the ENHANCE Toolkit prototypes. The session brought together scientific presentations and a participatory exercise, making it possible to collect feedback on both the content and the practical usability of the platform. A total of 69 participants attended the workshop, most of them students/ researchers. This is relevant to the interpretation of the results, since the group's familiarity with the toolkit in the ideation phase was generally limited. In the initial assessment, no participant reported a very high level of understanding of the toolkit, while only a small number indicated a moderate level of understanding. This shows that the presentation and demonstration were necessary not only to introduce the prototype itself, but also to clarify its purpose, structure and possible uses.

Figure 7: Pictures from the workshop held by CS2

Even so, the discussion that followed showed strong interest in the logic behind the toolkit. Participants raised questions about how different forms of data could be combined, especially qualitative and quantitative inputs, and whether the analytical models behind the toolkit could capture both linear and non-linear relationships. Another point that attracted particular attention was the relation between the One Health approach and flooding, especially the possibility of developing indicators that link environmental conditions with health-related data such as hospitalisations, pathogens and other epidemiological information. These comments are important because they show that participants were not only reacting to the interface but were also engaging with the methodological assumptions behind the platform.

The main part of the workshop was the participatory co-creation exercise, during which participants were asked to explore and comment on two prototype use cases: the swimmer/diver prototype and the teacher prototype. Their feedback focused mainly on usability, data accessibility, adaptation to different user groups, and the wider role that the platform could play in practice.

For the **swimmer/diver use case**, participants focused first on the way information is presented and accessed. A recurring question was whether the platform would provide only live visualisations or whether users would also be able to download data in formats such as CSV. Related to this was the issue of spatial resolution in the map views. Participants noted that the usefulness of the platform would depend largely on whether users could access information at different levels of detail. This suggests that the platform should support scalable map resolutions and allow users to move between more general and more detailed spatial views.

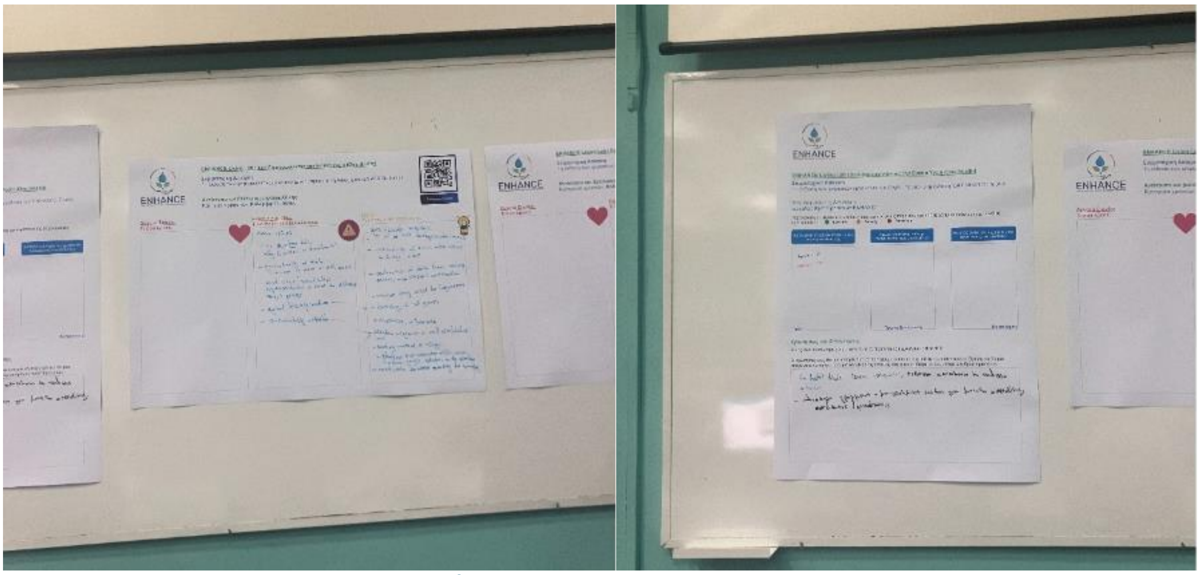

Figure 8: CS2 workshop: capturing insights from the co-creation activities

A second issue concerned accessibility for different audiences. Participants stressed that the platform should be understandable to non-experts and usable by people with different levels of digital familiarity. This was discussed particularly in relation to older age groups, for whom digital literacy was seen as a possible barrier. In response, participants suggested that the toolkit should include clear guidance and training material, and that information should be presented in ways that combine simplicity with sufficient depth. The need for both qualitative and quantitative forms of representation was mentioned several times in this context.

Participants also proposed several additions to improve the swimmer/diver prototype. These included notifications on water quality and swimming safety, location-based alerts, and the integration of observations from swimmers and divers through images or videos. Such contributions were seen as useful for capturing local conditions more directly, although this also raised the question of how citizen-generated content would be checked and validated. Another suggestion was that the toolkit should be connected, where possible, with other platforms to provide users with access to additional information. The issue of long-term sustainability was also raised repeatedly. Participants noted that regular updates, transparent data sources and integration with established platforms would be important if the toolkit is to remain useful and trusted over time.

The discussion of the **teacher prototype** raised a different set of issues. Here the main concern was not only usability, but also educational relevance. Participants considered whether the platform could be adapted to the needs of teachers and students, especially at secondary school level. As in the previous use case, technical issues such as zoom functionality were mentioned, but the more substantial point was that the toolkit should not be treated as a uniform product for all users. Instead, participants argued that it should offer different types of content and functions depending on age group, level of knowledge and educational purpose.

Several suggestions followed from this discussion. Participants proposed that the toolkit could be used as a support tool during lectures and as a study resource outside the classroom. They suggested that it should provide access to further reading, including academic papers and other relevant educational material. There was also strong support for the development of tailored exercises based on the toolkit's outputs, especially scenario-based activities using real data. In this form, the toolkit was seen not only as a source of information, but also as a way of helping students work with environmental and health-related questions in a more applied way.

Participants also suggested more interactive features, such as quizzes and flashcards, which could make the platform more useful in teaching and learning. In addition, they emphasised that educational content should be reviewed by experts. Another proposal was to make the data and methodologies behind the toolkit available through a GitHub repository. This was seen as important for transparency and for users who may wish to explore the technical basis of the platform more closely.

The discussion also moved beyond formal education. Participants suggested that the toolkit could include material such as short videos, podcasts and updates on climate action activities. In this sense, the platform was seen not only as a technical tool, but also as a possible channel for communication and public awareness on One Health and coastal sustainability issues. This wider role was considered especially relevant if the platform is to reach audiences beyond the immediate project community.

Overall, the workshop results show that participants valued the potential of the toolkit but also identified several points that need further work. Across both use cases, the main issues were clarity of use, accessibility for different audiences, flexibility in content and data presentation, and trust in the long-term functioning of the platform. The results also show that users expect the toolkit to do more than display environmental information. They expect it to support learning, provide practical guidance, and allow different forms of engagement with data and local conditions.

6. Platform specifications

This section presents the final platform specification baseline for the ENHANCE toolkit. It translates the One Health framework, co-creation results, stakeholder feedback, user personas, technical use cases and prototype-validation inputs into implementation-oriented specifications for WP3 and pilot-configuration guidance for WP4.

The ENHANCE platform is specified as a common modular system with configurable case-study views. Its design supports map-first interaction, role-based access, progressive disclosure of information, integration of heterogeneous data sources and traceable outputs for different user groups. The same core platform logic applies across the pilots, while dashboards, thresholds, indicators, contribution pathways and reporting outputs can be adapted to the operational needs of each case study.

The platform specification follows the following design principles:

Design principle	Meaning for implementation
Map-first interaction	The primary interaction pattern is location-based exploration: select area, inspect indicators, understand context, act or contribute.
Progressive disclosure	Public users start with simple status and explanation; advanced users can access richer layers, configuration and exports.
Modular service design	Ingestion, analytics, alerting, reporting and interface components should remain separable so the platform can evolve incrementally.
Trust and traceability by design	Access control, consent, provenance and model context are integrated design requirements from the start of implementation.

Table 9: Specification scope and design principles

Together with these design principles, the following cross-cutting implementation priorities should guide platform development and pilot configuration:

Area	Specification
Usability and accessibility	The interface must support non-specialist interpretation, consistent navigation, readable legends and accessible public views.
Multilingual support	Public and stakeholder-facing elements should support local-language deployment in the pilot areas.
Interoperability	Data exchange must rely on reusable interfaces, metadata and documented APIs so services can evolve without breaking the platform.
Security and privacy	Access control, consent capture, auditability and least-privilege access are mandatory for any restricted or contributed data.

Traceability and explainability	Model-backed outputs should be linked to input provenance, time stamp, model version and explanatory context suitable for the user role.
Performance	Public views should remain responsive for map exploration and alert consultation; heavy processing should run asynchronously where needed.
Scalability and maintainability	The architecture should allow new datasets, indicators and case-specific modules to be added without redesigning the full stack.
Reporting and export	Professional workflows require reproducible exports suitable for policy briefs, operational notes and partner reporting.

Table 9: Cross-cutting implementation priorities

6.1 Updated Conceptual Architecture

Building upon the conceptual design presented in D2.2 and the initial implementation results described in D3.1, the ENHANCE platform architecture has been further refined to reflect the project's evolving technical requirements towards a more mature, operational, and interoperable system. The updated architecture maintains the layered structure previously introduced, ensuring continuity in design principles such as modularity, scalability, and separation of concerns. However, it introduces significant enhancements in the areas of identity federation, data preprocessing and service interoperability. The following figure illustrates an overview of the conceptual architecture and its main layers. This deliverable presents the architectural updates made to the Identity Management and Data Governance & Processing layers. The remaining layers retain the architectural logic previously introduced and will be detailed further in D3.2. All components of the ENHANCE platform will be reported in detail in the upcoming WP3 deliverable D3.2.

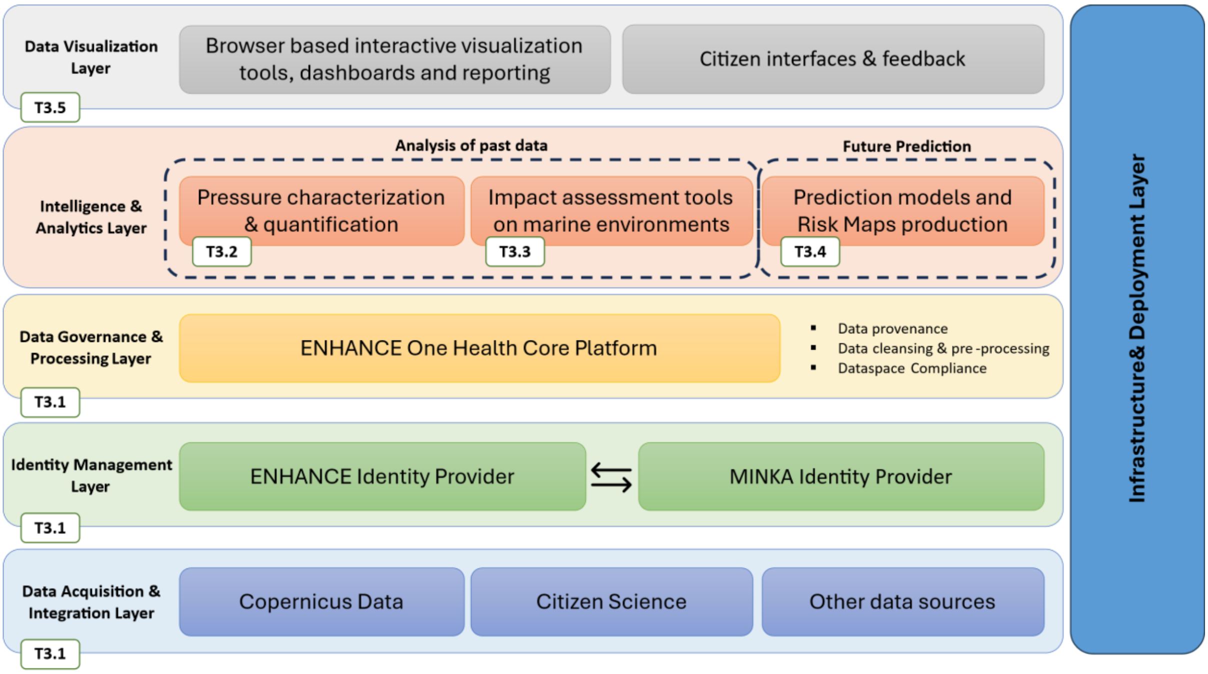

Figure 9. Updated conceptual architecture

6.1.1 Data Acquisition & Integration Layer

The final specification defines the ENHANCE toolkit as a data-fusion platform combining multiple dataset families. The key design question is how Earth Observation, marine and climate data, land-context data, in-situ measurements, citizen-science inputs and selected socio-economic or health-relevant datasets are combined, validated and exposed to users through the common One Health evidence chain.

Data domain	Typical sources	Integration mode	Role in the platform
Earth observation imagery	Sentinel-1, Sentinel-2, Sentinel-3 OLCI, Sentinel-5P	Raster services, APIs, staged file ingestion	Coastal water quality, shoreline change, eutrophication and atmospheric context.
Marine and climate reanalysis	CMEMS products, ERA5/C3S and related climate services	API / NetCDF ingestion	Historical baselines, hydrodynamics, weather and forecast support.
Land and urban context	Copernicus Land Monitoring Service, land-cover and imperviousness products, settlement layers	File ingestion / API	Exposure analysis, land-use context, runoff and planning scenarios.
In-situ monitoring	Water-quality sensors, meteorological stations, local sampling protocols	CSV, sensor APIs, partner repositories	Calibration, local validation, higher-

			frequency operational monitoring.
Citizen science	MINKA and related observation workflows	API and structured upload	Biodiversity observations, public participation and local ground truth.
Socio-economic and health context	Population, vulnerability, tourism, planning and public-health datasets where available	Institutional datasets / manual ingestion	Risk context, vulnerability analysis and policy-oriented reporting.

Table 10: Data sources to be integrated in ENHANCE

6.1.2 Identity Management, Roles and Access Model

The identity and access-management model defines how different ENHANCE users interact with the platform according to their role, permissions and operational needs. For the first implementation cycle, ENHANCE will follow a simplified role-based access approach aligned with the consolidated user personas defined in Section 4.1. This keeps the implementation manageable while supporting the main validated user journeys.

The simplified model distinguishes four operational access profiles: public explorers, registered contributors, professional or decision-support users, and administrators or technical stewards. These profiles determine which dashboards, data layers, contribution pathways, export functions, configuration options and administrative functions are available to each user type.

In CS1, citizen-science participation can be supported through MINKA-linked workflows. These workflows provide controlled entry points for biodiversity observations and contribution activities, while ENHANCE remains focused on contextualising citizen-science evidence within the broader One Health platform logic. Future implementation cycles may extend the identity model through stronger federation mechanisms with MINKA or other relevant systems, depending on technical feasibility and pilot needs.

Role / access level	Typical users	Main capabilities	Main access constraints
Public explorer	Anonymous visitors, beach users, tourists, students in guided sessions	Open public dashboards; bathing and coastal-quality views; local alerts; educational material; access to contribution entry points.	Only public layers and simplified indicators. No restricted datasets, no threshold configuration, no administrative actions.

Registered contributor	Citizen scientists, educators, NGOs, local community members	All public features plus saved areas of interest, access to linked observation workflows where relevant, richer contextual explanations, and participation-related feedback where integration is available.	Authenticated access required for personalised services. Observation submission may occur through linked contribution channels and remains subject to the consent, moderation and validation rules of the relevant system.
Professional / decision-support user	Planners, public authorities, health professionals, aquaculture and agriculture operators, researchers	Advanced layers, role-specific dashboards, historical trends, export functions, configurable thresholds where appropriate, reporting and collaboration features.	Restricted to approved users and group memberships; access depends on institution, case study and data-sharing policy.
Administrator / technical steward	Platform operators and authorised consortium technical staff	User and role management, dataset onboarding, connector configuration, quality workflows, consent handling, audit review and catalogue maintenance.	Full access subject to administrative privilege and audit logging.

Table 111: Final roles and access model

The access profiles defined above are directly aligned with the consolidated ENHANCE user personas presented in Section 4.1. Rather than introducing a separate user classification, the identity model translates those personas into operational access levels that determine how each user interacts with the platform.

In practice, each access profile may correspond to one or more personas depending on context, role and level of engagement:

- Public explorer: primarily associated with “Scuba divers, snorkelers and swimmers” and “Citizen scientists & general public”, as well as occasional access by the “Education & research community” in non-authenticated contexts.

- Registered contributor: mainly linked to "Citizen scientists & general public" and "Education & research community", particularly in scenarios involving observation, participation and learning activities.
- Professional / decision-support user: associated with "Urban planners & coastal managers", "Aquaculture and rice farmers, marine agencies", "Health professionals", and "Researchers", reflecting the need for advanced data access, analysis and decision-support capabilities.
- Administrator / technical steward: a transversal operational role supporting all personas, typically restricted to platform operators and authorised technical staff within the consortium.

This mapping ensures that the identity and access model remains consistent with the validated stakeholder structure while enabling a simplified and scalable implementation of permissions and user interaction logic.

6.1.3 Personal Data Protection & GDPR Compliance

The ENHANCE platform will process personal data according to GDPR principles and the project's data-management and ethics requirements. Personal data may include user-account information, authentication identifiers, role and permission attributes, saved areas of interest, user preferences, consent records, contribution metadata and audit logs. The platform will apply data minimisation, purpose limitation and role-based access control so that each user profile can access only the functions and datasets required for its validated use case.

Personal data will be stored in controlled environments with restricted administrative access, appropriate authentication mechanisms, auditability and least-privilege permissions. Where user-generated and citizen-science information is exposed through ENHANCE outputs, the platform will prioritise aggregated, pseudonymised or anonymised representations, especially in public dashboards. Direct personal identifiers will not be displayed in public views. Consent, moderation and validation rules linked to external contribution channels, including MINKA where relevant for CS1, will remain governed by the corresponding contribution system, while ENHANCE will only access or expose authorised data streams required for the platform workflow.

At implementation level, GDPR-related procedures will be aligned with the ENHANCE Data Management Plan and the relevant project ethics/data-protection documentation. These procedures will guide storage, access, retention, deletion, logging and incident-handling practices during WP3 implementation and WP4 pilot operation.

6.1.4 Data Governance & Processing Layer

The Data Governance and Processing Layer represents the core operational backbone of the ENHANCE platform, implemented through the ENHANCE Open One Health Core Platform. In the updated architecture, this layer manages data storage, validation, transformation and preparation for downstream analytics and visualisation. It integrates preprocessing capabilities directly within the platform, enabling heterogeneous data to be transformed into harmonised, analysis-ready and visualisation-ready formats. For geospatial data, this includes operations such as format conversion, validation, reprojection and preparation of tiled structures for efficient web-based visualisation.

Beyond preprocessing, this layer enforces a comprehensive data governance framework. Data quality assurance, validation, and metadata management are treated as integral parts of the data lifecycle. Each dataset is associated with metadata that captures its origin, structure, and usage conditions, while provenance information is maintained to ensure traceability of all transformations applied to the data. This is particularly important in the context of One Health applications, where data from multiple domains must be combined in a transparent and reliable manner.

The layer also supports the enforcement of access control policies. By integrating governance mechanisms directly into the core platform, ENHANCE ensures that data is accessed and processed according to predefined rules, supporting both security and regulatory requirements. At the same time, the architecture is designed to align with emerging data space principles, enabling interoperability with external systems through standardized interfaces and connectors.

Overall, the Data Governance and Processing Layer transforms the ENHANCE Core Platform into a structured data-management environment. Incoming data is stored, validated, enriched, transformed and governed in a consistent manner, providing a reliable foundation for the analytics and visualisation layers of the platform.

6.1.5 Data Visualisation Layer

The Data Visualisation Layer translates the prototype logic presented in Section 5.1 and the validation feedback summarised in Sections 5.2 and 5.3 into the core ENHANCE user journey. The mockups showed the need for a map-first interface, role-specific dashboards, alerts, educational content, scenario views and contribution links. The interviews and Living Lab activities further confirmed the importance of clear navigation, local-language support, simplified views for non-experts, export options and differentiated levels of detail for professional users.

A user lands on the platform, selects a location or area of interest, chooses a relevant perspective or dashboard, interprets the indicators shown for that location, and then acts on the information, exports or shares results, or follows a linked contribution pathway where relevant. In CS1, this contribution step may redirect users to MINKA or another approved observation channel.

ID	Use case

1. Discover and select context	Open the public view or sign in; choose the relevant pilot perspective or search a location.
2. Explore status and indicators	Inspect the map, legend, key indicators and status for the selected area.
3. Investigate local detail	Open time series, local layers, contributing observations or explanatory side panels.
4. Receive guidance or alerts	Interpret public advisories, professional alerts, trend summaries or recommended actions.
5. Contribute, export or share	Save the area, export a report, share the result with collaborators, or follow a linked contribution channel to submit observations where relevant.

Table 112: User journey and interface logic

6.2 Data domains and alignment with Copernicus and EGNSS

The table below lists the core Copernicus- and EGNSS-related sources that should be treated as the initial baseline for implementation planning.

Core source	Relevance
Sentinel-1 (SAR)	Coastline dynamics, flood and surface-state monitoring; all-weather support.
Sentinel-2 (MSI)	Nearshore water colour, turbidity, vegetation and land-cover context at higher spatial resolution.
Sentinel-3 OLCI	Chlorophyll, turbidity and broader marine colour indicators for coastal monitoring and HAB-related analysis.
Sentinel-5P / CAMS	Atmospheric composition context where air-quality or broader environmental pressure is relevant.
CMEMS products	Ocean physics and marine biogeochemical variables to support coastal water-quality interpretation and forecasting.
ERA5 / C3S	Meteorological and climate context for trend analysis, extreme events and scenario interpretation.
Copernicus Land products	Land-cover, imperviousness and other exposure-relevant layers for planning and risk assessment.
Galileo / EGNOS	Improved positioning and timing for field observations, mobile contributions and in-situ deployments.

Table 13: Core Copernicus and EGNSS related sources

6.3 Data access management, update logic and contingencies

Data access in ENHANCE will be managed through a combination of direct service access, API-based ingestion, staged file ingestion and partner-provided datasets. External operational dependencies include Copernicus services, such as Sentinel data, CMEMS, CAMS, C3S and Copernicus Land products, EGNSS-related positioning support where relevant, MINKA and related citizen-science workflows, and institutional or in-situ datasets provided by project partners and local stakeholders.

Update frequencies will depend on the source and operational role of each dataset. Copernicus and related Earth Observation products will follow the availability and publication cycles of the relevant services, with processing scheduled according to pilot needs, cloud conditions, product readiness and validation requirements. MINKA-linked citizen-science data will be updated according to observation submission and validation workflows, with ENHANCE using aggregated or filtered outputs where appropriate for visualisation and analysis. In-situ, institutional and campaign-based datasets will be updated according to the corresponding monitoring campaign, partner repository or data-sharing agreement.

To reduce dependency risks, ENHANCE will apply a staged ingestion and caching approach where appropriate. Each dataset exposed through the platform should include source metadata, timestamp, processing status and provenance information so users can understand data freshness and reliability. If an external API or provider service is temporarily unavailable, the platform should rely on the most recent validated dataset, clearly indicate the data timestamp, and avoid presenting outdated information as a current operational status. For critical workflows, fallback options may include delayed reprocessing, manual dataset upload, historical baseline layers or temporary disabling of affected layers until the source becomes available again. Detailed technical implementation of these mechanisms will be further specified under WP3, particularly in D3.2.

Conclusion

This deliverable marks the consolidation point of the WP2 work on ENHANCE scenarios and platform specifications. Drawing on the One Health approach, it brings together stakeholder needs, user stories, user requirements, technical use cases, user-flow logic and conceptual architecture into one coherent baseline for the ENHANCE toolkit.

The work is rooted in participatory engagement across the two case studies, Barcelona Metropolitan Beaches & Ebro Delta (Spain) and Pagasitikos Gulf (Greece). Through these pilots, a broad range of needs has been captured, from early warning and environmental monitoring to educational use, aquaculture support, citizen participation and cross-sector data sharing.

The iterative co-creation methodology described in this document ensures that the platform remains flexible, context-aware and technically grounded. At the same time, D2.3 moves beyond the earlier drafts by stabilizing the consolidated requirement inventory, the role and access logic, the user journey and the architecture that will guide WP3 implementation.

In summary, D2.3 provides the final WP2 specification baseline for the ENHANCE platform. It translates stakeholder expectations into actionable system design and gives the consortium a coherent reference for implementation, pilot configuration and subsequent validation.

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