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TREASURE – Living Lab Nieuwpoort
Blueprint and Roadmap

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Aim of the Nieuwpoort blueprint and roadmap

This document was prepared at the start of the TREASURE project (first semester) as a blueprint for the Living Lab Nieuwpoort. This action plan should clarify the activities, ambitions and progress for this site for all partners, stakeholders, interested parties and the general public. This action plan will be updated during the TREASURE project into a roadmap summarising the progress of activities and research for the Living Lab Nieuwpoort.

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TREASURE project and context

In the Interreg North Sea TREASURE project, 15 partners from Denmark, Germany, the Netherlands, Belgium, and France are jointly tackling the problem of plastic pollution flux towards the North Sea. It had been generally assumed that a significant amount of plastic litter enters the sea via rivers and inland waterways. However, recent research suggests that only a small proportion of plastic litter that enters terrestrial and aquatic compartments of river systems also effectively reaches the sea (e.g., van Emmerik et al., 2022; Everaert et al., 2022; Kaandorp et al., 2023). As a result, some river systems can act as accumulation areas of plastic, with significant impact at ecosystem level and in economic activities, leisure-related or for example navigation impairment. These accumulation areas can further serve as reservoirs, that during extreme events, such as heavy rains, can release a large number of litter debris to nearby coastal areas. Led by the University of Oldenburg, the TREASURE project consortium aims to map the plastic flux and reduce the outflow of plastic litter from rivers and inland waters into the North Sea. An integrated cross-sectoral approach to identify, eliminate, and reduce this riverine litter is thus expected to make an important contribution to solving the plastic problem.

The project addresses four interrelated dimensions (pillars):

- Governance and policy – improving cross-sectoral governance for effective collaboration and joint action among stakeholders in functional areas and water systems (river basins, estuaries, metropolitan areas, …). Improve policies at different levels (local, regional, (trans)national) for effective waste prevention in rivers by combining (binding) legislation and informal policy frameworks.
- Data collection and analysis – using various proven and new methods with the aim of increasing knowledge on nature, composition and sources of litter and comparing and harmonizing approaches.
- Prevention and behavior change – raising awareness and educating specific target groups in business (e.g. tourism), government (municipalities, regions) and the general public about the need and opportunities to reduce plastic pollution in their respective capacities and processes.
- Plastic waste removal – applying different techniques to remove waste from rivers to gain knowledge on the effectiveness of different solutions under different conditions (e.g., environment or type of pollution).

The core of the project consists of Living Labs at different river-sea interfaces (Figure 1), representing different areas typical of the North Sea region (e.g., estuary, urban water system, port, coast): Nieuwpoort (BE), Dutch Deltas (NL), French Ports (FR), Plastic-free SIA (DE), Westcoast Watersheds (DK).

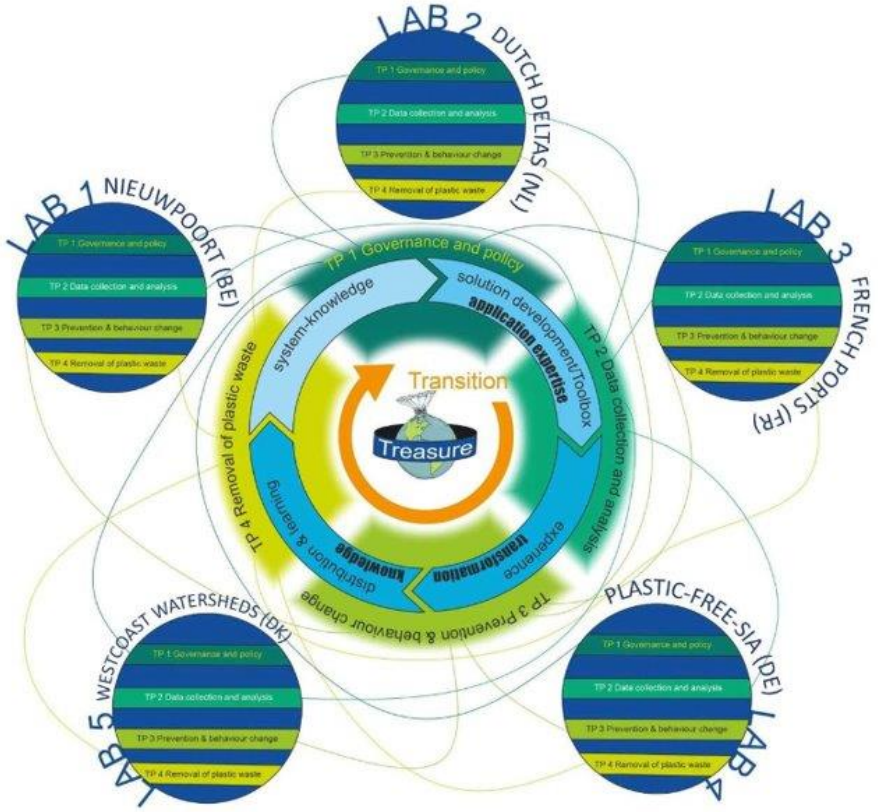


Figure 1: Different river-sea interface living labs of the TREASURE project.

Living Lab Nieuwpoort

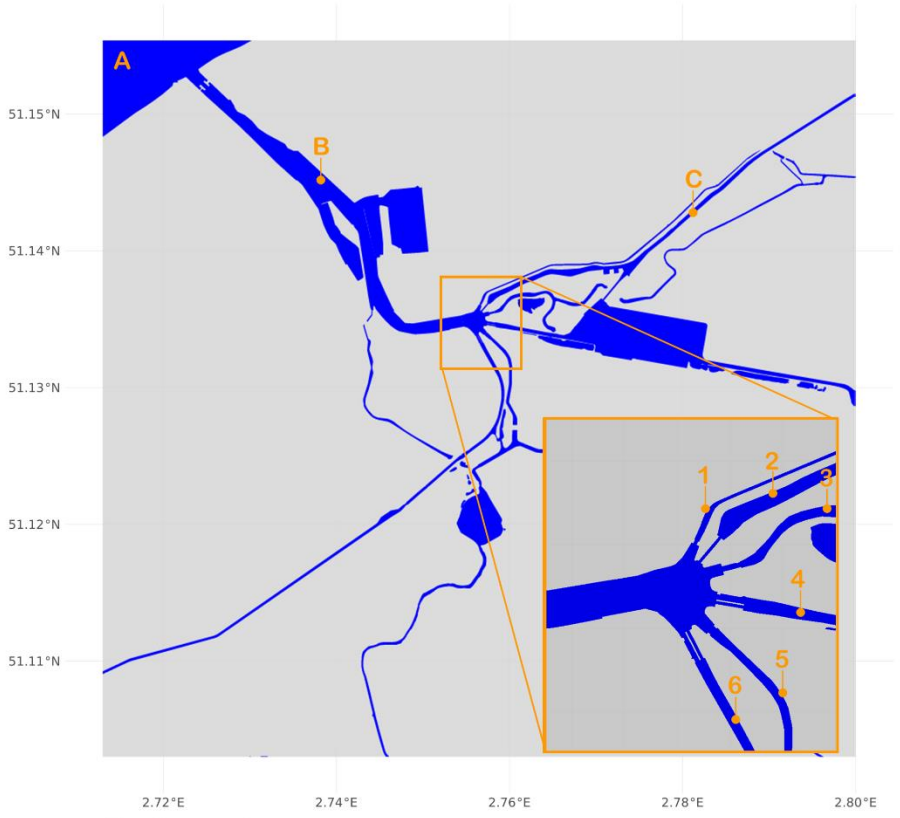
Focus area

Nieuwpoort is a town and seaside resort on the Belgian coast, home to one of the largest marinas in Europe, with more than two thousand leisure boats. Nieuwpoort is important due to its historical significance, particularly its role in the Battle of Nieuwpoort, its maritime and commercial importance, its tourism industry, and its cultural heritage. These factors have contributed to its enduring relevance in the region.

The focus area of the Living Lab in Nieuwpoort is the *Ganzepoot* ('goose foot') water system (Figure 2)[1], which plays a crucial role in managing water levels and tidal flow in the Nieuwpoort harbour area/ estuary and the adjoining Yser River. It helps regulate the water levels to prevent flooding and allows boats to enter and exit. It comprises a lock complex in the inner port area: six waterways meet here, connecting the Yser estuary and the North Sea. Each waterway is controlled by a hydraulic structure on the east side of the complex, which provides drainage for part of the inland polders via spillways. In each, shipping connection for inland vessels is provided through a lock.

[1] It's called the *Ganzepoot because of the resemblance of the water system to the foot of a goose.*

- The *Overlaat van het Nieuwbedelf (1)*: consists of three openings and provides drainage for part of the Grote Westwatering polder and the Vladslo Ambacht polder north of Diksmuide. There are no ships sailing on these waters.
- The *Gravensas (2)*: shipping lock that connects to the Canal Plassendale-Nieuwpoort (C), the connection to the east coast (Ostend and Bruges) for inland vessels.
- The *Springsas (3)*: a sluice on the Creek of Nieuwendamme, the former meandering lower course of the Yser. The creek drains precipitation water from the *Nieuwlandpolder* north of the Yser.
- The *Iepersas (4)*: disused shipping lock and a spillway. In the 17th century, the Yser from Nieuwpoort to the Union Bridge was straightened by a canal. Along the *Iepersas*, the canalized Yser discharges into the sea via the swing basin and the harbour channel. Along the spillway, the Yser drains precipitation water from the polder upstream of Diksmuide.
- The *Noordvaart (5)*: along this spillway, precipitation water is drained from the Polder of the Noordwatering Veurne.
- The *Veurnesas (6)*: shipping lock with a spillway. Gives access to the Veurnevaart. The Veurnevaart opens up the west coast, flows through Furnes and connects Nieuwpoort with Dunkirk. Along the spillway, the *Veurnevaart* can drain water from the Noordwatering Veurne.



The Ganzepoot.
A) Noordzee, B) Ijzer, C) Kanaal Plassendale-Nieuwpoort
1) Overlaat van het Nieuwbedelf, 2) Gravensas, 3) Springsas, 4) Iepersas,
5) Noordvaart, 6) Veurnesas

Figure 2: Water system (Ganzepoot) in Nieuwoort (Claudia Meneses)

Aim and approach

As plastic litter often tends to accumulate closer to urbanised areas, this has led to fascinating additional research questions that require a holistic approach to map plastic flux into the North Sea region. For example, how does plastic behave in the different estuaries of the North Sea region? Given that very little information and knowledge is available about plastic pollution in Nieuwpoort's water system, we aim to answer several burning questions:

- Is riverine/marine litter a major problem for the water system in Nieuwpoort?
  We will build on surveys of experts, stakeholders, and user groups to capture their insights, experiences, and perspectives. In addition, both visual inspections and scientific monitoring activities will be conducted to identify any problem areas.
- How much plastic litter flows into the North Sea via Nieuwpoort? How does plastic litter behave in Nieuwpoort's water system?
  Based on intensive monitoring and observation activities supplemented by citizen science, plastic pollution will be mapped. A hydrodynamic transport model will map and visualize the plastic transport towards the North Sea. Can the Yser Estuary act as a reservoir for plastic litter?
- What measures can help avoid this plastic litter?
  Surveys with experts and water managers, as well as the analysis of samples taken will help identify potential sources. In cooperation with experts, scientists and society, viable measures will be examined to see what remedies can be taken.
- How can we best cooperate with citizens and stakeholders to tackle this issue efficiently?
  From the start of the project, the activities in strategies will be coordinated with the stakeholders involved. Citizens and students will be involved through citizen science, based on the well-established Plastic Pirates (Horizon Europe) methodology, already established in Flanders. In addition, the project is actively raising awareness and creating support for the problem and solutions for plastic litter.
- Can we develop a system to collect and remove the plastic specifically for the water system in Nieuwpoort?
  Multi.engineering nv, Herbosch-Kiere and IMDC will work together to develop a prototype to collect and remove plastic litter. This will be done in close cooperation with the water authorities and city of Nieuwpoort, as well as with government agencies responsible for waste management.
- How can we valorise the knowledge and new insights on plastic transport for the North Sea region?
  The insights from the various living labs will be pooled and capitalized on for the wider North Sea region, through joint events, knowledge transfer meetings and policy briefs. Innovations in plastic removal and collection will also be used to improve the approach at the North Sea level.

To address all these questions, the Nieuwpoort living lab activities will be divided into three working strands: Plastic litter monitoring and transport, plastic litter removal, and public and stakeholder engagement and collaboration (Figure 3). Living Lab Nieuwpoort (LLN) partners and Advisory Board stakeholders are listed in Annex I.

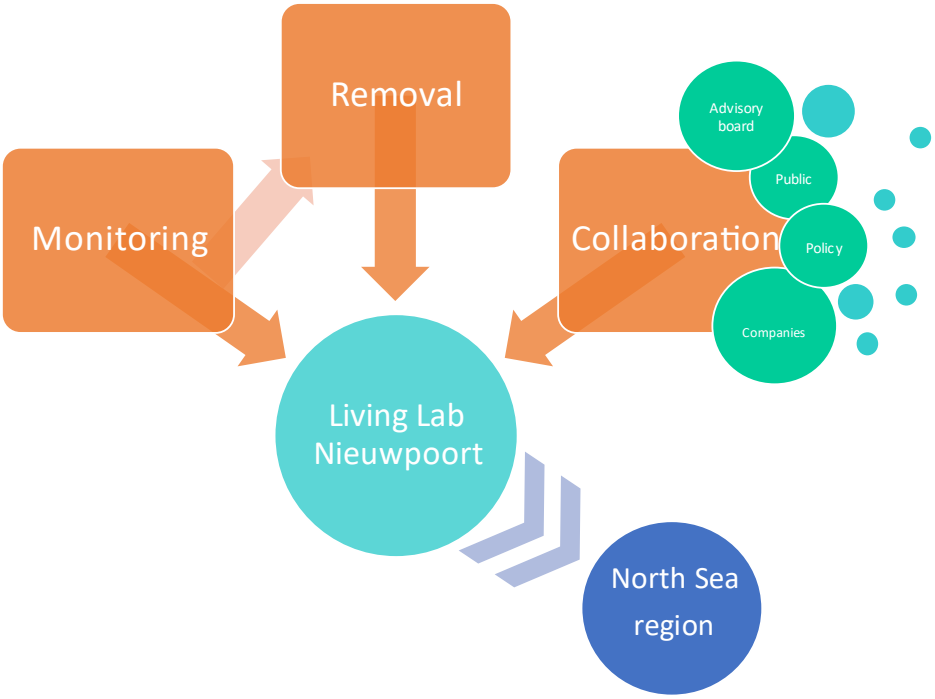


Figure 3: Blueprint with main working strands for living lab Nieuwpoort

- **Part I.: Monitoring (plastic transport and fate):** The goal of this pillar is to conduct field observations of plastic debris (> 1 mm) for identification of accumulation zones in the estuarine and riverine environments adjacent to the Ganzepoot, in Nieuwpoort. The quantification of plastic debris will inform on the seasonal baseline litter density, location of hotspots and on the efficiency of the installation of the removal technology. We will sample both water and sediment, key compartments for transport and accumulation of litter, throughout different seasons and tidal regimes and adjust our methodological approaches to assess different size classes of plastic items, namely macroplastics (> 25 mm), mesoplastics (5-25 mm) and microplastics (1-5 mm). To do so, we will use a broad portfolio of techniques, from citizen science and expert observations to plastic items collections using manta nets, and sediment core sampling. We will obtain as an output detailed information on the spatial and temporal distribution of plastic litter. This information will enable us to not only map the accumulation zones of plastic litter, but also to provide advice and recommendations on areas and seasons for efficient collection of plastic litter in the Ganzepoot-Nieuwpoort area. To produce high quality data, compatible with international and well-established standards, we will follow a detailed data management strategy, according to the 'FAIR Guiding Principles for scientific data management and stewardship'. Datasets will be archived using the Marine Data Archive (MDA, mda.vliz.be, VLIZ, Belgium), and searchable via a Digital Object Identifier (DOI, www.doi.org) through the Integrated Marine Information System (IMIS, www.vliz.be/en/imis, VLIZ, Belgium). Final datasets are intended to be submitted to the European beach litter database managed by EMODnet Chemistry.
- **Part II.: Removal (plastic collection and removal):** An important objective is to demonstrate solutions for removing litter from the environment. To date an increasing amount of plastic

remediation technologies are commercially available, and for water managers and users it is often difficult to select value for money. Although laudable, unregulated clean-up technologies may be inefficient and have unintended negative consequences on ecosystems (Figure 4). Despite these concerns, plastic clean-up technologies can play an important role in reducing litter in the environment. The concept is to build and validate a multicriteria guidance tool (TREASURE Toolbox) to support stakeholders in their search for a suitable plastic removal technology. Three companies (Multi Engineering, Herbosch-Kiere and IMDC) will develop a prototype of the DeMarc plastic catcher. The demonstration activity with this device will provide unique aspects of collecting objective field data to quantify plastic retention efficiency of the tested infrastructure.

- **Part III.: Collaboration (public engagement and stakeholder collaboration):** In cooperation with the Province of West Flanders, VLIZ will involve and conduct surveys to key stakeholders. In this way, we want to gain insight into the enablers or constraints related to the implementation of mitigation measures, identify gaps in regulation and gain a better understanding of the plastic pollution and accumulation areas in Nieuwpoort. Together with these stakeholders, intervention strategies or awareness-raising campaigns will be considered that might be desirable for the Nieuwpoort-Treasure living lab.

Figure 4: Unregulated clean-up technologies may be inefficient and have unintended negative consequences on ecosystems (Falk-Andersson et al., 2023).

Timeline for the Living Lab Nieuwpoort

Figure 5 provides a schematic overview of the activities for Living Lab Nieuwpoort. This schedule is only an indication and will be adjusted based on the results achieved. Below we focus mainly on the activities in the first year for the three major components.

Part I.: Monitoring (plastic transport and fate):

This part was started right at the beginning of the project, mainly focusing on sampling strategy and harmonization of methods. The exploratory survey of the water system of Nieuwpoort was organised on the 9th of August 2023. The start of the sampling surveys will take place during the second semester of 2023, during Autum/Winter, and these will be repeated seasonally during Spring/Autumn. Sampling events will cover coastal waters (A, Figure 2), the Izer estuary (B, Figure 2) and selected canals/river based on the preliminary observations which took place on the 9th of August 2023. We will combine litter observations with assessing the efficiency of the cleanup technology demonstration site.

Part II.: Removal (plastic collection and removal):

Currently, the preliminary study of the area is ongoing, and the design is being further developed. The design will be finished around 6 weeks after the preliminary study, after which a year of construction will be required. It will then be installed in Nieuwpoort at the desired location after which it will be operational for 6 weeks. Decommissioning will follow at the end of the use.

Part III.: Collaboration (public engagement and stakeholder collaboration):

Collaboration with the advisory board, stakeholders, international scientists, and the public is done from the start of the project to the end and after. The first stakeholder meeting is scheduled for Oct. 6, 2023. The first citizen science activities will take place in 2023, Autumn/Winter which will be repeated during 2024. We will follow the Plastic Pirates (Horizon Europe) methodology, which has been trailed in Flanders, in particular in Nieuwpoort (https://www.plastic-pirates.eu/en/results/data/6437). Teachers will receive information concerning litter observation methodologies, which can be worked at a school level integrated with their curriculum. This is an opportunity for discussions on brother topics such as science, pollution, reporting the news, statistics etc.

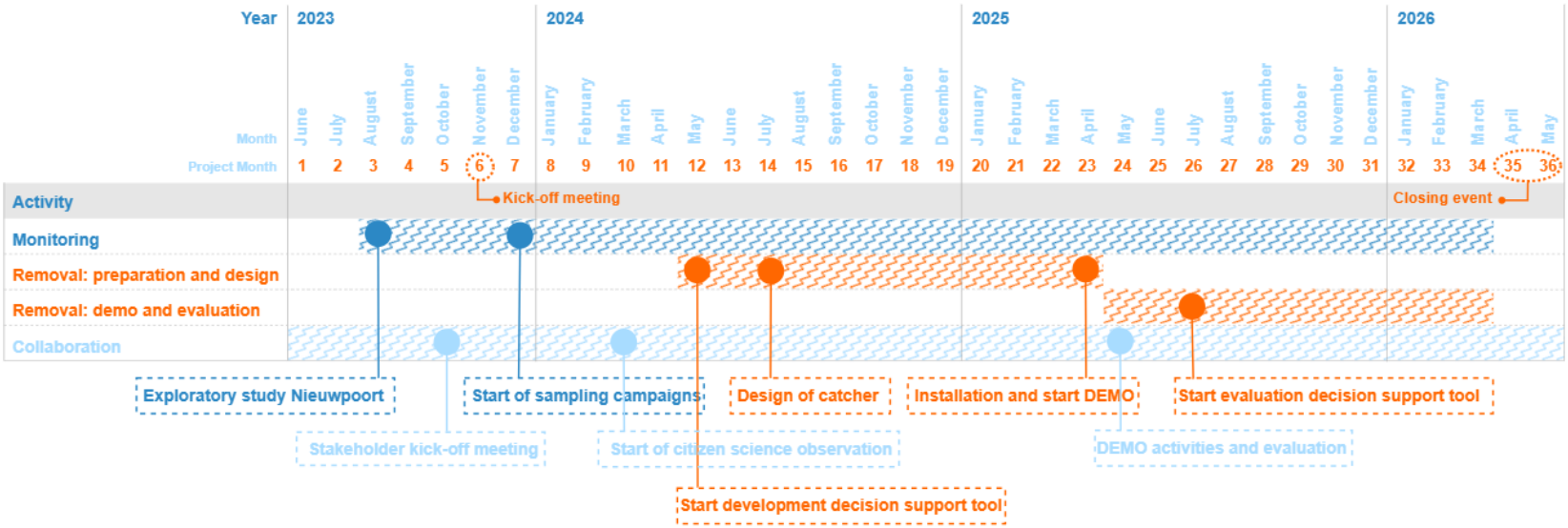


Figure 5: Timeline for the Living Lab Nieuwpoort (LLN) with an indication of the requested time for each key activity within the Pillars of TREASURE, as well as important milestones of the LLN

Part I. Monitoring: Plastic transport and fate

Sampling strategy and monitoring activities

Exploratory study of the LLN area

A preliminary study of the Ganzepoot will be carried out prior to deployment and sampling, and will consist of three parts:

1) Interviews with members of the advisory board, to gather their insights on presence of hotspots for waste accumulation, and regulations for the deployment of the clean-up systems.
2) A desktop study to gather knowledge that was collected prior to the start of TREASURE. This desktop study will focus on current knowledge of plastic concentrations in water and sediments in the Nieuwpoort area (data from previous projects such as PLUXIN), and water transport and hydrodynamics based on data gathered by IMDC, results from the PLUXIN project and other literature available.
3) A first visual survey of the Ganzepoot area was done on 9th of August 2023 (Figure 6).

The aim of this visual survey was to map this area in the context of TREASURE ambitions, e.g., to locate possible plastic accumulation ("hotspots") and "clean" areas without visible accumulation of plastic, to evaluate interesting infrastructures (e.g., bridges, docks, riverbanks, see also Annex II) as locations for future visual inspection and deployment sites, to identify areas that are accessible for sampling campaigns or citizen science initiatives.

A. B.

Figure 6: A. Participants of the bike tour in front of the Westfront Nieuwpoort monument; B. Four bike roues were planned prior to the preliminary excursion in Nieuwpoort, https://www.geopunt.be/

Four routes were planned prior to the start of the field study, to ensure all water systems would be inspected visually (Figure 6). The routes ranged from 7.8 km until 12.7 km. While biking along the route, participants identified interesting locations. At each stop, three tasks were completed: 1) indicating the observation point on a paper map of the area (with coordinates) taking one or more overview pictures of the area,

followed by taking pictures detailing the accumulation of plastic, or the structure that could be of interest for monitoring, or deployment of other technologies; 3) filling out a template that was provided to describe the observed litter and area. Over the four different routes, 43 stops were made, of which 18 in the proximity of a bridge, 13 of a dock and 12 of a riverbank. More information can be found in Annex II.

This preliminary visual inspection of the area provided a rough idea of the visible litter. A more up-to-date estimate of the plastic contamination will be obtained through all the monitoring activities and data collection, the modelling work, and the insights of the experts.

Plastic pollution – preliminary results

Preliminary observations of plastic litter in the Nieuwpoort area indicate that plastic was detected in the water column, surface, and sediment, both in the Yser (NL: IJzer) estuary as well as in the coastal areas (Everaert et al 2022). The plastic litter densities (mean concentration of macroplastics in water of 0.6 g / 1000 cubic meters, and in sediment of 8.2×10^{-5} g per Kg of dry sediment) were however less than those observed in other areas, in particular in the Scheldt estuary, which hosts the port of Antwerp and many important industrial and navigation activities. However, citizen scientists, using the methodology of Plastic Pirates (https://www.plastic-pirates.eu), have observed in the nature reserve of *Natuurreservaat De IJzermonding* an important accumulation of large litter items (unpublished data 2022, 4.5 Kg [20 x 50 m] and 1.3 Kg [60 x 20 m]), including an important proportion of single use items and fishing lines/ropes (Figure 7). These observations point to a potential important contribution of accidentally discarded items from recreational activities, which can have an impact on local protected fauna (bird reserve). Furthermore, the observations undergone on the TREASURE LLN activity led by VLIZ (9th August), also indicate an important number of bottles, cans and packaging litter accumulation near the sluices and locks (unpublished data, see Annex II), together with other debris. These important structures for navigation and water flow management can have the potential of being hotspot areas for litter accumulation, and it would be extremely important to follow up on these observations to better understand the litter flow dynamics as well as the major contribution for various sectors on litter accumulation (recreation, hospitality, navigation etc).

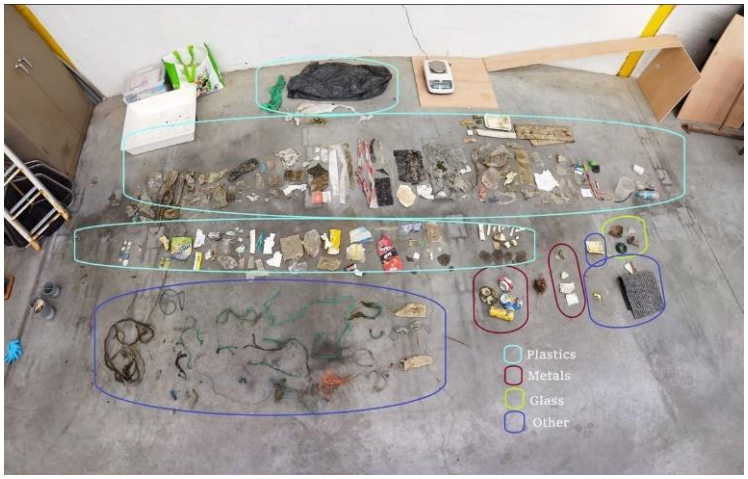


Figure 7. Litter collected during a Plastics Pirates sampling activity in Nieuwpoort during July 2022

Sampling strategy

In collaboration with the partners and stakeholders of LLN, VLIZ will establish a sampling strategy for the area. In the project TREASURE we will target the following size fraction of litter items: micro- (1 – 5 mm), meso- (5 – 25 mm) and macrolitter (> 25 mm) (Catarino et al., 2023) (Figure 8). The sampling strategy will include campaigns done at river/estuary banks (experts and citizen scientists), in sediment and water compartments (e.g., done by experts using water drone, mantanet, ferrybox etc), visual inspections (experts and citizen scientists) and assessment of accumulation rates of litter in slipways (citizen scientists) and locks and sluices (experts, in collaboration with local authorities) (Table 1). The sampling plans will be adjusted to the location, season and to the accessibility of each area. We will further include seasonal coastal sampling campaigns using the VLIZ research vessel Simon Stevin, to broaden the data collection and acquire information on the potential litter flow to and from the Izer estuary. All collected data will be managed by the VLIZ Data Centre (VMDC) and will be submitted to open access platforms (data will be citable using a DOI and will be open access and FAIR[2]). The goal is for the data collect to be used by modelling (see below), but also to be accessible for information/policy briefs and scientific publications. The first draft of the sampling strategy will be briefly presented during the first stakeholder meeting on October 6th, 2023. A dedicated meeting will be organised with the relevant water managers to optimise and finalise this strategy.

Table 1. Summary of techniques that will be included in the sampling strategy, specified for each environmental compartment (water or sediment), and targeting specific litter size fractions.

Compartment	Target size fractions of litter	Potential sampling technique used	Final sample unit	Data Collectors
Water surface	All	Visual inspections (macro), mantanet (meso/ micro), drone/s (all size fractions)	Number of items per water volume	Experts and citizen scientists
Water column	Meso/micro	Ferrybox	Number of items per water volume	Experts
River/estuary/coastal bed (sediment)	Meso/micro	Cores/Van Veen Grab	Number of items per dry sediment weight	Experts
Riverbanks/shorelines	Macro/meso	Plastic Pirates methodology (transects)	Number of items or weight per area	Citizen scientists
Slipways	Macro/meso	Plastic Pirates methodology (transects)	Number of items or weight per area (per unit of time)	Experts and citizen scientists
Accumulation in the water near locks and sluices	Macro/meso	Active collection of litter	Number of items or weight per area (per unit of time)	Experts and local authorities

[2] FAIR = complying with the guidelines for data findability, accessibility, interoperability, and reusability, https://www.go-fair.org/fair-principles/

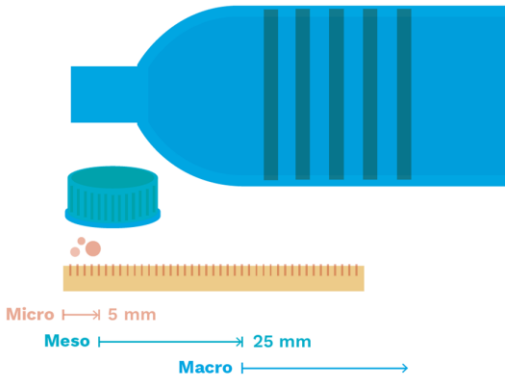


Figure 8. Size fraction of litter (plastic) items targeted in the project TREASURE: micro- (1 – 5 mm), meso- (5 – 25 mm) and macrolitter (> 25 mm) (Catarino et al 2023)

Sampling methodologies

The sampling methodologies to be used in the Living Lab Nieuwpoort in TREASURE are well established and mostly have been applied by VLIZ in previous projects (e.g., PLUXIN, Plastic Pirates Belgium). Macro- and mesolitter will be classified according to the OSPAR guidelines (Wenneker et al 2010). Microlitter will be classified following current data vocabularies (NOC, https://vocab.nerc.ac.uk/collection/?filter=litter).

- Visual inspections of surface litter will be done following the methodology by Van Emmerik and Schwarz 2020 and Plastic Pirates (www.plastic-pirates.eu/en/material/download). Briefly, this technique consists in accessing the surface waters flow in a river/estuary, and to enumerate the number of litter items visible for the observer for a fixed period of time (e.g., from a bridge). Given the complexity of the Ganzepoot, and the effects of tidal currents in the Izar estuary, it will be of interest to assess the number of items discharged during the opening of sluices and locks, and the potential flow of litter during flood and ebb tide periods, as well as accessing potential seasonal effects.
- Various dimensions of mantanets (mesh > 1 mm) will be used to collect meso- and micro-sized litter. Professional mantanets will be used by experts and deployed from vessels (e.g., VLIZ RIB Zeekat, Simon Stevin, www.vliz.be/en/what-we-do/infrastructure-supply/research-vessels) in the estuary, for example during a complete tidal cycle (Bouwens et al 2021). These observations will be complemented by citizen science initiatives, which use a small dimension adapted mantanet, which can be operated by a small group of few people (Plastic Pirates). Finally, mantanets will be further used by experts, while coupled to water drones, in areas where the RIB Zeekat of VLIZ will not have access to (see below).
- The Ferrybox is an operating oceanographic sampling system, which can be used both in vessels and deployed from a dock, using a portable generator. Ferrybox systems may be equipped with plankton nets or pumps that capture plankton from the water as it flows through the system. At VLIZ, we have adapted the use of a Ferrybox to sample meso- and microplastics from vessels and from docks (www.andromedaproject.net/news/new-microlitter-sampler, project Andromeda, JPI). This system will be employed by VLIZ during the sampling campaigns.

- To sample sediment, we will reply on well-established sampling and microplastic extraction methodologies used during the project PLUXIN (Bouwens et al 2021). We will use cores or Van Veen Grabs to sample sediments from our vessels fleet, and the meso and large microplastics will be extracted and further analysed at VLIZ.
- In riverbanks and shorelines, as well as in slipways, we will collect litter items along transects, with the assistance of citizen science participants (work with schools, Plastic Pirates www.plastic-pirates.eu/en/material/download). These exercises also include the sorting and identification of litter items, for example according to applications/sectors (e.g., ropes/fishing gear or packaging). The information acquired from these exercises will further inform on which types of litter are dominant in Nieuwpoort, and therefore in which direction mitigation measures to reduce litter should be prioritised.
- Litter accumulation in the water near locks and sluices should be assessed, to inform on the real flow of macrolitter. Given the complexity of the water flow dynamics in the Ganzepoot, we will assess which waterway system is the major contributor of litter from inland water to the estuary, or if adjacent coastal waters contribute with litter items accumulation in the estuary. This exercise should be developed in collaboration with local authorities.

Aquatic drone measurements

The partner ULCO (France) will collaborate in sampling events at Nieuwpoort. They will use and test an innovative methodology which uses manta nets coupled to aquatic drones (Figure 9). The drone that will be used is an adaptation of the Jellyfishbot®, an aquatic surface drone developed by IADYS which looks like a little catamaran (70 cm width, 70 cm long and 50 cm height). It is a compact, easy-to-use and a handy robot operated by remote control which can deliver information such as the sampling speed, duration and distance or the exact drone position (Pasquier et al.,2022). It is equipped with a removable metal frame designed with two nets (36 cm X 25 cm) to sample the water at two different level (Figure 9 b, c). A flowmeter is fitted on each net. Aquatic drone sampling will be carried out in collaboration with the VLIZ in selected plastic pollution hotspots to collect data about plastic pollution level and develop a harmonized protocol of monitoring. The target size fraction for the use of the single drone sampling is micro and mesolitter.

Moreover, with the second aquatic drone to be purchased- at the beginning of the TREASURE project, the ULCO team will develop a method of towing a net using the two drones in parallel to collect macroplastics (Figure 10). The length of the net will be adapted according to the width of the area to be studied, between 3 m and 6 m with a height of 50 cm in the water column. The target size fraction for the use of the innovative double drone sampling methodology is meso and macrolitter.

Figure 9: Aquatic drone a) and the removable metal frame b) designed with two nets levels (c)

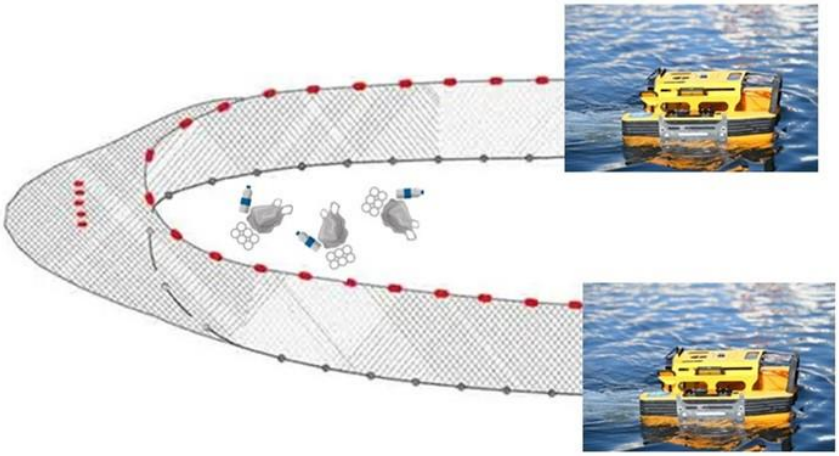


Figure 10: Test of a new method to macroplastic sampling with two aquatic drones

Citizen science activities

Citizen science is an opportunity for scientists and the civic society to interact, since participants are included in the research process, which should have genuinely open access scientific outcomes (Severin et al 2023). The participation of students in activities such as systematic litter observations can have a positive impact not only in their well-being, but also on their pro-environmental behaviour and perception of the litter problematic (Severin et al., 2023b). Therefore, including the public (schools and the broader civic

society) in the Living lab Nieuwpoort activities of TREASURE is an opportunity to not only increase the information concerning the observations of stranded litter, but also to inform and contribute to increase the scientific literacy of local communities. In this living lab we will mainly focus on the methodologies developed by the Horizon Europe project Plastic Pirates (Figure 11), of which VLIZ is leading their activities in Flanders[3]. The methods have been applied in various countries in Europe, with Germany having the longest data series available. Thanks to the continued investigation and observations done in Plastic Pirates, within the German context, for example, researchers have identified hotspots of floating litter in rivers (Kiessling et al., 2021). Furthermore, citizen science data can inform at local and European level on the efficiency of mitigation measures to reduce litter, such as the EU single-use plastics directive (Kiessling et al., 2023). Finally, there is a call for the involvement of the civic society within the current high-level negotiations for the UN Plastics Treaty using citizen science (Oturai et al., 2023), as well as for the EU goals to reduce plastics by 2030 in the environment by Mission Ocean and Clean Waters (COM (2022) 674) and the Zero Pollution Action Plan (COM (2021) 400) (Devriese et al., 2023). Besides the collaboration with Plastic Pirates, we will further engage with other ongoing civic citizen science initiatives for the observation and collection of litter, such as the well-established and popular Proper Strand Lopers (PSL), which mostly focus on coastal areas (www.properstrandlopers.be). We will further inquire the interested stakeholders to identify other ongoing local or regional initiatives and broaden our collaboration.

Figure 11: Plastic Pirates activities taking place in Flanders during the sampling campaign of Autumn 2022

Model study

IMDC will prepare a mathematical model able to predict the transport pathways of macroplastics throughout the Yser estuary. We want to establish this model for two main reasons:

1. Insights in the pathways of plastics and the processes leading to a net import or net export of plastics from the Yser estuary;

[3] Flemish schools investigate waste in rivers as part of European 'Plastic Pirates' initiative: https://www.plastic-pirates.eu/en/news/flamish-schools-investigate-waste-rivers-part-european-plastic-pirates-initiative (28/09/2022)

2. Selection of the optimal location to position a plastics catcher. The selection considers two main criteria, more specifically the location at which most plastics pass by and secondly locations at which the flow conditions lead to efficient operation of the catcher's air bubble screen.

IMDC will deploy the TELEMAC software to prepare the mathematical model, in two steps:

1. First a three-dimensional tidal flow model will be set up for the tidally influenced areas of the Yser estuary. The model solves the Saint Venant equations to compute the tidal wave propagation throughout the Yser estuary, considering wetting and drying of intertidal areas. The simulated water levels and flow velocity will be validated by means of comparison with measurements.
2. Secondly, the plastics transport module will be coupled to the tidal flow model. This step is validated by comparing concentrations of macroplastic in the model to the observed plastic quantities in the field. The plastics transport module has been validated in the DeMARC project recently (Figure 12).

After deployment and validation of the mathematical modelling tools, they can be applied to help solving the research questions at hand in the LLN. In Part I, the main research questions are:

1. where do plastics enter the estuarine system?
2. how do they propagate through the system and
3. where do they leave the system?

The model can help solving the latter two questions. Observations will clarify the first question. Once information is available on plastics enter the system, a number of items with relevant properties can also be released at the open model boundaries (Ganzepoot and offshore boundary). After release of these items in the model, the transport within the estuary is computed. Plastics will follow the tidal excursion with ebb and flood flows (Figure 12). Due to the nature of the residual current, the plastics will follow a preferred pathway. This might be mainly up and down the estuary but might also have major components into the marinas or onto the intertidal areas.

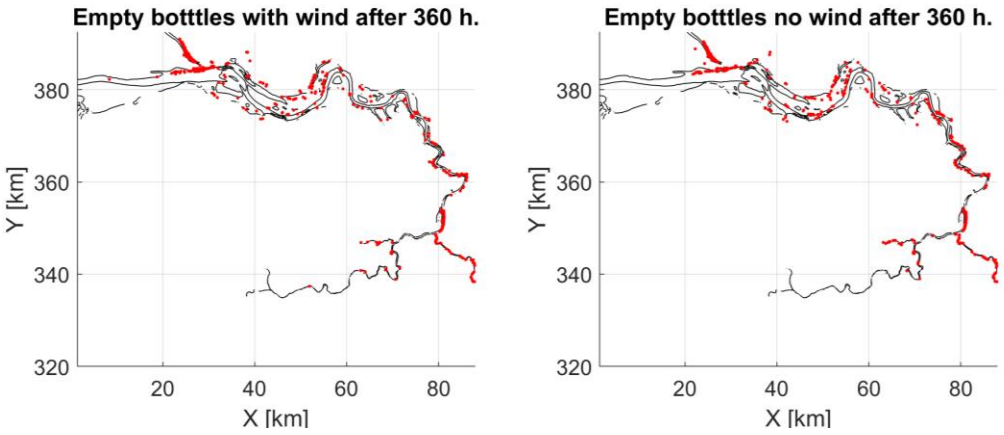


Figure 12: Example of a mathematical simulation of transport of plastics items through a tidal estuary (Breugem et al., 2023).

Data collection and storage

A Data Management Plan (DMP) is a structured document that outlines how R&I data will be collected, organized, stored, documented, preserved, and shared throughout the lifecycle of a research project (and after as part of the legacy building). DMPs are commonly used in academic and scientific research settings to ensure that data is managed effectively and in compliance with ethical, legal, and funding agency requirements. A DMP is not only a best practice but can also facilitate efficient data management, improve data quality, and enhance the transparency and reproducibility of research. It also helps researchers anticipate and address potential challenges and risks related to data management early in the research process.

Within TREASURE, a data management plan (DMP) will be created to make sure there is a clear overview of what data will be collected and how these data will be handled during and after the project. The DMP helps ensuring that the project data will be standardized, well documented, securely archived in one place and eventually made publicly accessible. The goal is to have valuable litter data from the Nieuwpoort area which are freely available for everyone to use, even after the end of the project, and which can be compared to or analysed together with other litter data. This will enable local and regional/national stakeholders to identify important litter characteristics, such as the sources, amount, and accumulation spots of plastic litter in the area, and consequently facilitate the implementation of targeted mitigation actions to reduce plastic litter.

Data visualisation and assessments

Plastic transport patterns may be visualised based on model results in different ways:

- A vector map of the residual flow at the water surface will show the tendency of plastic transport due to tidal flows only;
- Evolution of the location of different released items through time is shown in maps, showing qualitatively the distribution;
- Net fluxes through several cross sections in the estuary can be calculated quantitatively. For example, sections through the main channel at different distances from sea, and sections across the entrances of the marinas. The net transport direction and quantity are shown in a map with arrows;
- A balance for each area between two cross sections will be prepared: the difference between net import and net outflow. This will indicate in which zones there is a tendency for accumulation of plastics;
- Transport flux is the product of plastics concentration and flow velocity. This quantity indicates the amount of plastics passing by a certain point per unit of time. This quantity is important to determine the optimal location for a plastic cleaner because it shows where most plastics pass by and consequently at which point a plastics catcher can catch most plastics.

Part II. Removal: Plastic collection and removal

Identification of plastic accumulation areas

Identifying plastic accumulation areas helps us understand where plastic litter is most concentrated and where it can have the most detrimental effects on the environment. Moreover, knowledge on plastic accumulation can be used to prioritize cleanup and conservation efforts in these areas, and to introduce mitigation measures. Governments, policymakers and water managers can use data on plastic accumulation areas to inform regulations and policies aimed at reducing plastic pollution. Besides, identifying plastic accumulation areas contributes to the public awareness raising about the issue of plastic pollution.

Knowing plastic accumulation areas is crucial for addressing the complex issue of plastic pollution comprehensively. To identify potential accumulation areas, various TREASURE activities are brought together. The results from the exploratory study give a first indication, the discussions with the advisory board give the insights on problem areas, and this will be complemented by scientific data for the LLN area, as well as the predictions based on the model study.

Overview of plastic collection systems

As the global plastics crisis grows, numerous technologies have been invented and implemented to recover plastic pollution from the environment (Moulaert et al., 2021; Leoni et al. 2023; Falk-Andersson et al., 2023). Moulaert et al. (2023) concluded that most plastic catchers are designed to capture floating plastic from stormwater drains and inland waterways; catching plastics before it reaches the sea and ocean is a more cost-efficient and technologically feasible solution than removing the plastics from the marine environment. Also, to have a high catch-efficiency and be cost-efficient, plastic catcher designs need to take a lot of parameters into account and data is needed to guide the decision. It was also emphasised that information on the operational efficiency and environmental impact of the solutions is lacking and needs more attention in the future and that improved and automated techniques for both monitoring and collection are crucial to develop efficient and economically feasible solutions for catching plastic from aquatic environments. (Moulaert et al., 2023).

Plastic clean-up technologies can play an important role in reducing litter in the environment, however laudable, unregulated clean-up technologies may be inefficient and have unintended negative consequences on ecosystems, for example, through bycatch or removal of organic matter important for ecosystem functions (Falk-Andersson et al., 2023). The study of Leone et al. (2023) shows that, despite the challenges, clean-up technologies provide a promising pathway to assist in improving the environmental quality (via plastic removal) but also in raising awareness on plastic litter. To create a framework where plastic remediation technologies contribute most effectively to reducing plastic pollution in the environment, it is advised that more information be made accessible on the effectiveness and potential impacts of using plastic remediation technologies.

These concerns and advises will be taken into consideration when designing and deploying the removal method in the Treasure project and especially the Living Lab Nieuwpoort and in the development of the TREASURE toolbox.

Design and prototype of the plastic catcher

The goal of the DeMARC (*Design of Marine and River Cleaner*) study was to verify if it would be possible to operate a plastic catching device in the Schelde river running only on green energy. To verify this the plastic behaviour in the Schelde river has been modelled to determine the best suitable location for the plastic catcher. With this input a plastic catcher (MARC – Marine River Cleaner) has been designed and tailored to fit the location and the power requirements to operate the catcher on green energy (solar, wind and tidal energy). This concept is used as the basis the further design of the system for Living Lab Nieuwpoort. The plastic catcher will be built by Herbosch-Kiere and operated for 6 weeks on location before it will be decommissioned.

Several sub-studies are considered in the process of development and design:

- The water system will be modelled to determine the optimal location for the plastic catcher.
- A second type of mathematical flow model will be deployed to verify the air flow required to make the air bubble screen efficient in generating the circulations needed to divert the plastics towards the collector. This will be done using the Computational Fluid Dynamics (CFD) model developed by IMDC in the past in the DeMARC project (Figure 13).
- Infrastructure and requirements for operationalization (e.g., power supply) are considered in determining final location.
- The efficiency of litter collection needs to be tested and assessed.

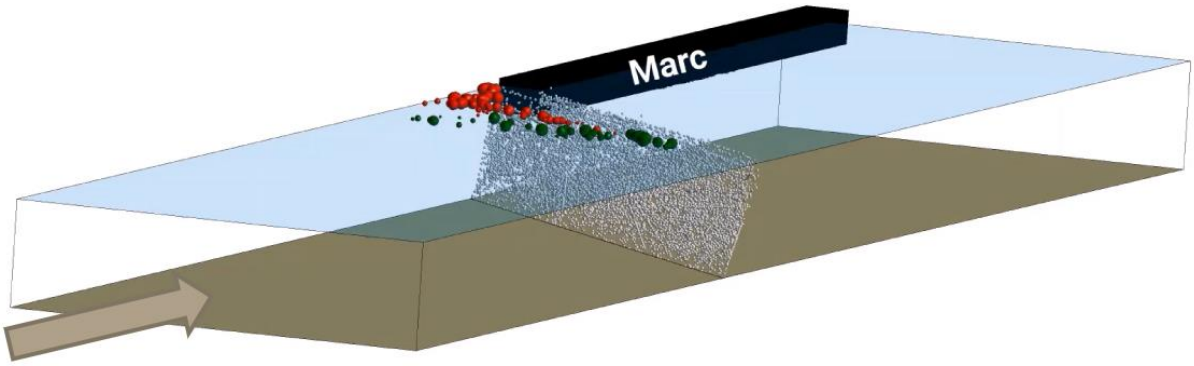


Figure 13: CFD model capable of simulating the interactions between plastics and air bubble screen

Suitable location and testing of the plastic catcher

Suitable locations.

Based on mathematical model results, the following quantities will be mapped:

- Plastics flux (potential amount of plastics that can be caught per unit of time);
- Flow velocity (the catcher's efficiency is inversely proportional to flow velocity).

The optimal location of the plastics catcher is, roughly, the location with the highest flux, at which the flow velocity stays below a certain threshold.

Testing the collector

The efficiency can be tested by simply inserting dummy plastics into the water flow upstream of the collector. It will be observed what is the percentage of items diverted by the bubble curtain to the collector. Also, it will be tested whether certain types of items are captured better than others (different size, density, type of plastic item).

Demonstration event

Further into the project, once the prototype for the plastic catcher has been created and tested, we will work with the advisory board to see how this can be linked to a demonstration session and public event in Nieuwpoort.

TREASURE Toolbox

A hands-on tool for decision making (TREASURE Toolbox) will be established, supporting water managers and stakeholders to select best possible plastic-removal systems in specific areas. Based on available information in scientific literature, a decision tree model will be developed. This decision tree model provides a structured approach for evaluating and comparing different options or strategies for collecting plastic litter from water bodies like oceans, rivers, or lakes. By using the intuitive model, one can make informed and transparent decisions about which plastic collecting devices or strategies are most suitable for your specific environmental conservation project. In order to reach a decision, multiple factors (objective scientific data, local characteristics and desires) as well as stakeholders' input will be considered, facilitating a more comprehensive decision-making process.

The pilot project in Nieuwpoort will provide data for the optimisation of the decision-supporting TREASURE Toolbox. To do so, based on the data obtained in the living lab, the first versions of the decision-making model will be tailored based on a sensitivity analysis to see how changes in criteria weights or scores affect the overall ranking. This helps assess the robustness of the decision suggested.

In summary, the TREASURE pilot project in Nieuwpoort will provide information on pollution types, feasibility of plastic disposal systems, a validation and optimisation of the decision-supporting TREASURE Toolbox, as well as serve to raise awareness among the public and stakeholders.

Part III. Collaboration: Public engagement & stakeholder

Stakeholder engagement strategy

Stakeholder engagement and participation are essential for the success of the TREASURE Living Lab Nieuwpoort. Stakeholder participation ensures that a broader spectrum of viewpoints is considered, leading to more well-rounded and informed actions and decisions. Stakeholder engagement is an ongoing process that requires dedication and commitment. Together with the province of West Flanders, it will be agreed how the advisory board, public and other stakeholders can be involved in the TREASURE living lab Nieuwpoort (public events, citizen science, steering meetings). Depending on the needs from the project and the wishes of the stakeholders, the approach and frequency will be adjusted. The stakeholder engagement strategy will be adapted as the external environment and stakeholder priorities evolve. Flexibility is key to this process.

Stakeholder interviews and consultations

The first advisory board meeting (6 October 2023) will mainly explain the TREASURE project and question the advisory board about their experiences, knowledge, responsibilities, and concerns. Together, we will consider the best approach for this LLN. The first consultation on October the 6th, will focus on several key aspects of the TREASURE activities during three interactive sessions (posters are provided in Annex V):

Session 1: Occurrence of litter & clean-up activities; collaborations with public organisations

Goals of this session: to have an overview of the (protected) nature areas in Nieuwpoort and the environmental status in relation to litter; to create insights into the responsibilities and current measures to prevent littering or the removal of litter.

Guiding questions:

- Clean-up activities organized by local government or public initiatives: what activities are already in place and in what area is covered?
- Who is responsible for those protected areas? What about initiatives cleaning protected areas (as mapped on the poster)?
- Public/civil organisations/ schools: what organisations are active in Nieuwpoort (e.g. Proper Strand Lopers, Natuurpunt) and what activities are already on the agenda (must be a link with nature, litter, sustainability).
- What type of public activities would be of added value in Nieuwpoort? Or complementary to existing events/ initiatives?
- Does anyone know of any measures that are already being implemented or currently under consideration to avoid or prevent litter?

- Do we know some litter accumulation spots (e.g. river beds) or problem areas?
- On what locations or areas do we expect litter based on model study (IMDC)?

Session 2: Responsibilities in the context of water system and infrastructures

Goals of this session: Gain insight into the responsible authorities for different parts of the water system (both towards environmental pollution and as a function of infrastructures and deployment or plastic collectors).

Guiding questions:

- What authorities are responsible for the different parts of the water system in relation to I) deployment of catchers and in relation to II) environmental issues and pollution?
- Are there regular litter removal actions undertaken by the city, or waterway authorities (or marina)?
- Is it possible to evaluate the collected litter (e.g. citizen science) in the context of TREASURE?
- Based on the currents in the different waterways and parts, are there hot spot areas (accumulation areas) to be expected? On what locations or areas do we expect litter based on model study (IMDC)?
- Can environmental circumstances be evaluated as drivers for litter accumulation in Nieuwpoort area? For example, is there any seasonality in the prevalence of visible plastic pollution in waterways? Or is it related to storms, or heavy rainfall?
- Effect of storm surge barrier construction on flow in the Yser River?
- What are the possible known sources of litter in the water system of Nieuwpoort?
- Policy perspective: who is responsible for waste management in relation to removed litter?
- Are there already possible measures or solutions that stakeholders wish to share with us to address this issue in a phased manner?

Session 3: Infrastructure, accessibility, and private concessions

Goals of this session: Here we aim to gain insight into potentially interesting locations for the deployment of a system to capture plastic. In addition, the requirements are discussed to perform the tests, and fields of interest are aligned.

Guiding questions:

- What requirements (regulations) are in place to deploy a plastic catcher or plastic monitoring robot?
- What locations might be considered for deployment of a plastic catcher (based on initial insights – accessibility, power supply)?
    - Access for a crane nearby (about 1 000 kg)
    - Space to place the compressor (1 TEU) and power connection (100 kW)
    - Infrastructures to mount both the catcher and the end of the bubble curtain to
- What are the decommissioning requirements for those areas?

- Noise: the compressor will make the necessary noise. Are there any areas where this would be problematic?
- Do we have to consider private/industrial properties which are not accessible without permission? (Probably not relevant)
- What are the insights of the stakeholders on the selected areas for the plastic catcher? Are our suggestions in the best focus area? Where do you think we best retain the litter?
- The currents can be too strong upwards the sea. What about the area below the Ganzepoot?

Stakeholder & public events

Date & venue	Members	Type
6th October 2023- Nieuwpoort	Strategic advisory board meeting	In person meeting

Storytelling

Storytelling is the art and practice of using words, images, sounds, or other mediums to convey a narrative or story to an audience. A story map is a visual representation used in various fields, including storytelling, to help plan, outline, or analyze the elements of a story, narrative, or project. A **story map** will be created to inform stakeholders and the wider public about the activities of this Living Lab Nieuwpoort and disseminate the project results also in a visual and comprehensible way. This story map will serve as valuable aid in understanding and communicating the highlights, activities and output of the TREASURE project.

The story map is made using ArcGis and can be accessed through: [TREASURE (arcgis.com)]

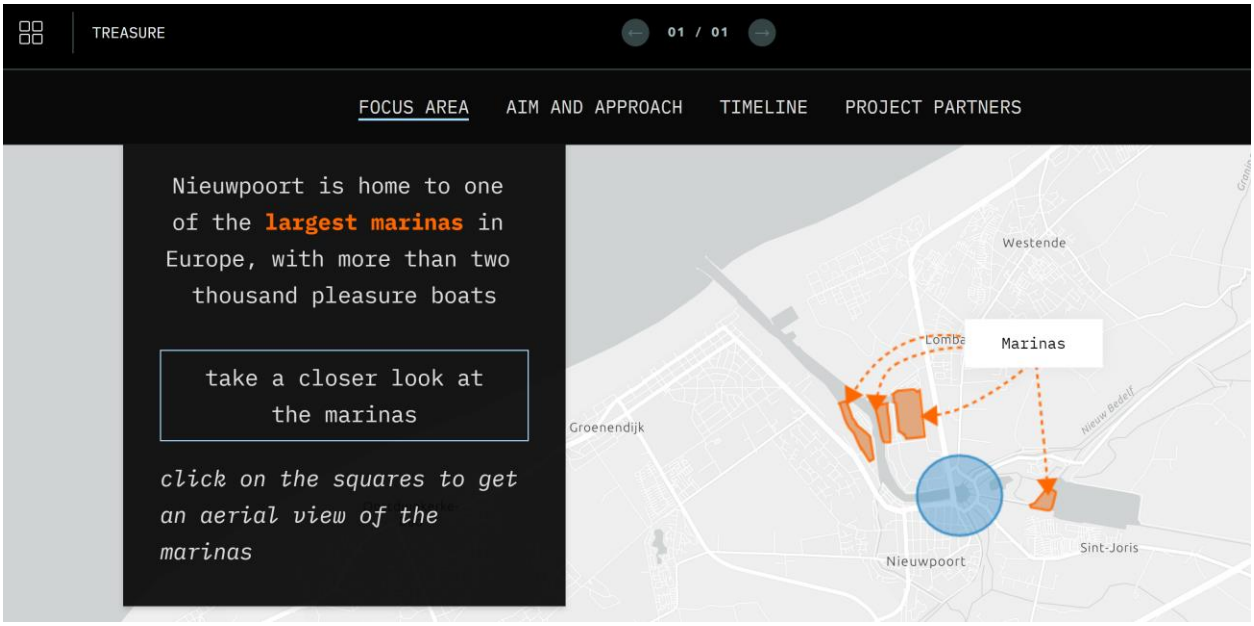


Figure 13: Screenshot of the interactive story map of LLN (draft version)

TREASURE legacy and policy brief

Collaboration with established experts within but also outside our consortium will enhance the quality and impact of the TREASURE results and build on the TREASURE Legacy. The TREASURE Legacy will be anchored in the entire North Sea region through the creation of action plans for the development of competence centres in each living lab region, which will further ensure that the know-how and support for implementing solutions is available for future adopters. The FAIR data and open science practices enhance the transparency and reproducibility of the TREASURE output. The consortium members will engage in public outreach, give talks, and write articles to communicate the significance of the TREASURE results to a broader audience. Collaboration between researchers from different disciplines will be promoted to address complex societal challenges (such as plastic litter) and broaden the impact of the TREASURE output. The professional online story map, where we can share your research, thoughts, and insights with a wider audience ensures a strong online presence.

Together with the advisory board of the LLN and the Province of West Flanders (North Sea Commission) we will evaluate what is needed for Nieuwpoort, the Flemish coast and the North Sea area in terms of knowledge transfer and cooperation.

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Annex I: Role of the project partners and advisory board

Flanders Marine Institute (VLIZ)

The mission of the Flanders Marine Institute (VLIZ) is to strengthen science-based knowledge about our coasts, seas and the ocean and share it as widely as possible. VLIZ coordinates the Belgian living lab, Living Lab Nieuwpoort (LLN), in collaboration with the project partners and the stakeholders. VLIZ will be involved in the data collection on plastic pollution to quantify the overall degree and the behaviour of plastic litter in the Nieuwpoort water system. VLIZ will be responsible for the development of the TREASURE toolbox, a decision support tool to help water managers and stakeholders to select best possible plastic-removal systems in specific areas. Stakeholder engagement will contribute to the understanding of enablers and constraints related to the implementation of mitigation measures, as well as identify gaps in existing regulations and knowledge. The development of a detailed data management strategy will be coordinated by VLIZ. In this living lab, three departments of VLIZ work together: Ocean and Human Health research division, VLIZ Data Centre (VMDC), and Policy and Innovation division.

Contacts: Lisa Devriese, Charlotte Van den Auwelant, Ana Catarino, Ine Moulaert, Charlotte Dhondt, Claudia Meneses Moreno

Website: Vlaams Instituut voor de Zee (vliz.be)

Université du Littoral Côte d'Opale (ULCO)

The Oceanology and Geosciences Laboratory, part of the Université du Littoral Côte d'Opale (ULCO), is amongst the most important laboratories in the field of coastal oceanography in France. The Institut des Sciences de la Mer et du Littoral (ISML) houses a micro- and macroplastics research platform dedicated to sampling, monitoring and analysis of plastic pollution in different water bodies. ULCO will be involved in both the Belgian and the French living labs, where they will address the data collection and prevention pillars. They will share their expertise of aquatic drones, used for sampling of micro- and macroplastics in all types of waterbodies, including hard to reach, confined areas such as harbours, rivers and inland waterways. They also test different sensors for automatic recognition of plastics on the water surface and rivers banks.

Contacts: Rachid Amara, Périne Doyen

Website: https://www.univ-littoral.fr/

MULTI.engineering nv

MULTI engineering (MULTI NV) offers engineering solutions for maritime and offshore businesses, focused on sustainable themes such as reduced emissions of ship powering, offshore renewable energy production and global waste solutions for waterways.

In the TREASURE project, MULTI.engineering is responsible for the design of the plastic catcher device, including a small-scale floating garbage collection tool and a bubble screen. (DeMarc) They will define the ideal ranges of and balance between technical variables and provide input to subcontractor Herbosch-Keire,

to ensure optimal conditions for the manufacturing, building and installation of the demonstrator. MULTI.engineering will be responsible for follow-up of the installation and operation of the demonstrator.

Contacts: Niko Fierens, Diederick van Welij, Floris Roelofsen

Website: Homepage | MULTI Engineering

International Marine and Dredging Consultants NV (IMDC)

The International Marine and Dredging Consultants NV (IMDC) is an international engineering and consultancy company in the field of natural waters: precipitation, groundwater, rivers, estuaries, coastal areas, ports and marine waters. IMDC will assist the placement of the plastic removal device by preparing simulations of currents and plastic transport in the water system of the LLN, based on which the best location for optimal efficiency can be selected. Additionally, feasible water depths and currents velocities will be assessed to ensure optimal functioning of the bubble screen.

Contacts: Boudewijn Decrop

Website: https://imdc.be/en

Subcontractor: Herbosch-Kiere

Marine contractor Herbosch-Keire will coordinate the manufacturing and installation of the demonstrator, based on design data provided by MULTI and IMDC.

Contacts: Tom DEPYPERE, Ronnie WEYMANS, Bartosz POZORSKI

Website: https://herbosch-kiere.be/en/

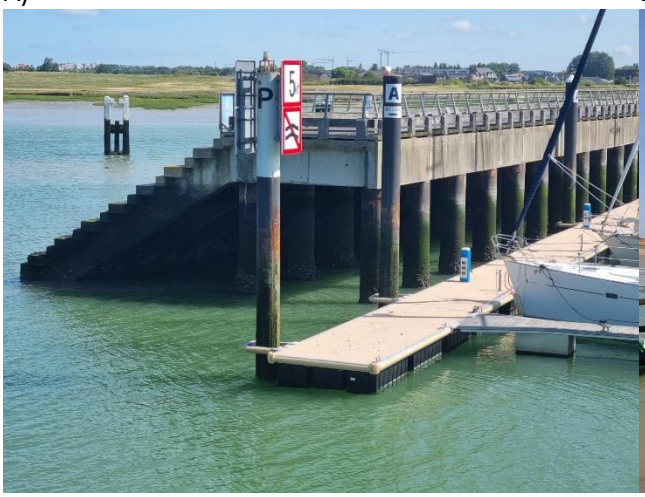
Advisory board:

Name of organisation	Detail of organisation, relevance to TREASURE
Streekhuis Kust (Province of West Flanders)	The 'Streekhuis Kust' strengthens the operation of the Province of West Flanders on the coast. Streekhuis is a meeting place for authorities and regional partners. We offer support to local and regional administrations and focus on current coastal themes. Chair of the advisory board.
City of Nieuwpoort	City of Nieuwpoort is represented by the council member in charge of fisheries, environment, and water protection.
VY Nieuwpoort	Nieuwpoort Marina (Vlaamse Yachthaven Nieuwpoort).
Flanders Environment Agency (VMM)	The Flanders Environment Agency of the government of Flanders sets out to have a positive impact on the living environment in Flanders and to help make it climate-proof.

Public Waste Agency Flanders (OVAM)	The public waste agency of the government of Flanders is responsible for the protection of people and the environment from the harmful effects of the production, use and management of waste and materials.
Federal Public Service Health, Food chain safety and Environment	The Marine Environment Department of the Federal Public Service strives for a clean, healthy, safe, and productive North Sea with a wealth of biodiversity.
Blue Cluster	Spearhead cluster (innovation cluster) of innovative organisations and companies in the sustainable blue economy.
Wind and Water Sports Flanders (WWSV)	WWSV is the unisport federation for sailing, surfing, sail car racing and related sports in Flanders.
Proper Strand Lopers	PSL is a citizen organisation with focus on clean-up activities (beaches, dunes, etc.).
Department of Mobility and Public Works (MOW)	MOW of the government of Flanders is responsible for public works of roads, waterways and air infrastructure.
Vlaamse Waterweg NV	Manages and operates Flemish Waterways including the bridges over them and the grounds along them.
Agency for Nature and Forests (ANB)	The Agency for Nature and Forests of the government of Flanders cherishes, protects and develops over 90,000 hectares of natural areas, forests and parks in Flanders.
Research Institute for Nature and Forest (INBO)	INBO evaluates biodiversity policy and management through applied scientific research, data and knowledge disclosure; link to a.o. salination and eel migration.
The Outsider Coast	Organises (group) activities in and around Nieuwpoort, e.g. Kayaking on polder rivers, water sports, etc.
Le Boat	Organization for boating vacations, also in Belgium (river cruises and boat rentals).

Annex II. Results from the exploratory study of the LLN area

A)



B)

C)

D)

Figure Annex II: Examples of structures identified during the preliminary study in Nieuwpoort; A) Dock, B) Dock, C) Bridge with sluices, D) Riverbank

In 20 of these locations (stops), plastic or other litter was found. More than half of the locations where plastics were found, were in the proximity of a bridge, accounting for 11 out of 18 (61%) bridges identified. Plastic and other litter was found in 7 out of 12 (58%) riverbank locations, and in 2 out of 13 (15%) docks. A total of 124 (plastic) litter items were found. The highest number of litter items was found near bridges, totalling at 70 items (56%), followed by 43 items (35%) near riverbanks and 11 items (9%) near docks.

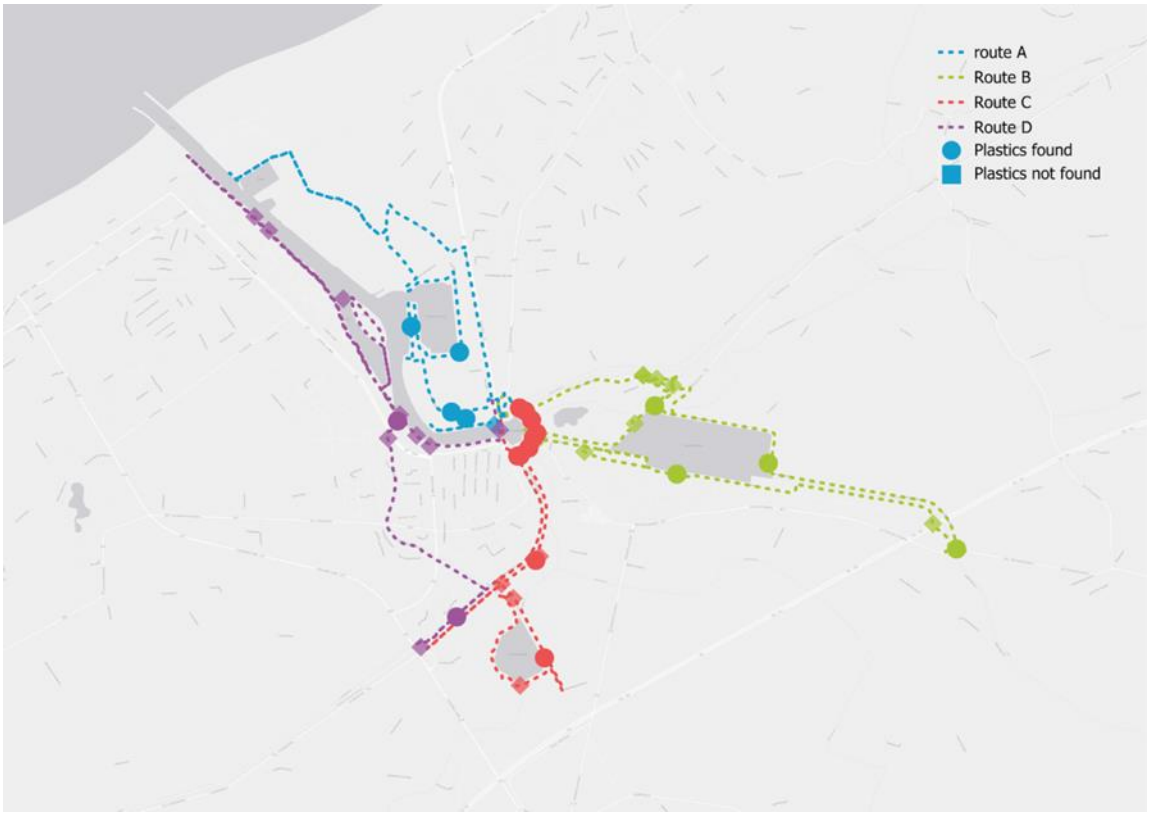


Figure Annex II: Routes and results obtained during the first exploratory study of the LLN area. Colours represent routes, and circles the presence (filled circle) or absence (empty circle) of plastic

Litter categorized as discarded drinking bottles and food packages or wrappers were found most often, both totalling to 24 items (19%) respectively. The second most common group of litter that was found, consists of foams and sponges, with 22 items (18%). After analysis of the data, a category was added for cans, of which 15 (12%) were found. Remaining items of which more than one was found, were plastic bags (7, 5%), caps and lids (4, 3%), plants pots (2.2%), sanitary waste (2.2%), recreational fishing gear (2.2%), rubber ducks (2.2%). For the categories bottles (not food related), lighters, balloons, large containers, textile, and rubber gloves, only one item was found (<1%). There were 18 items (14%) which could not be identified.

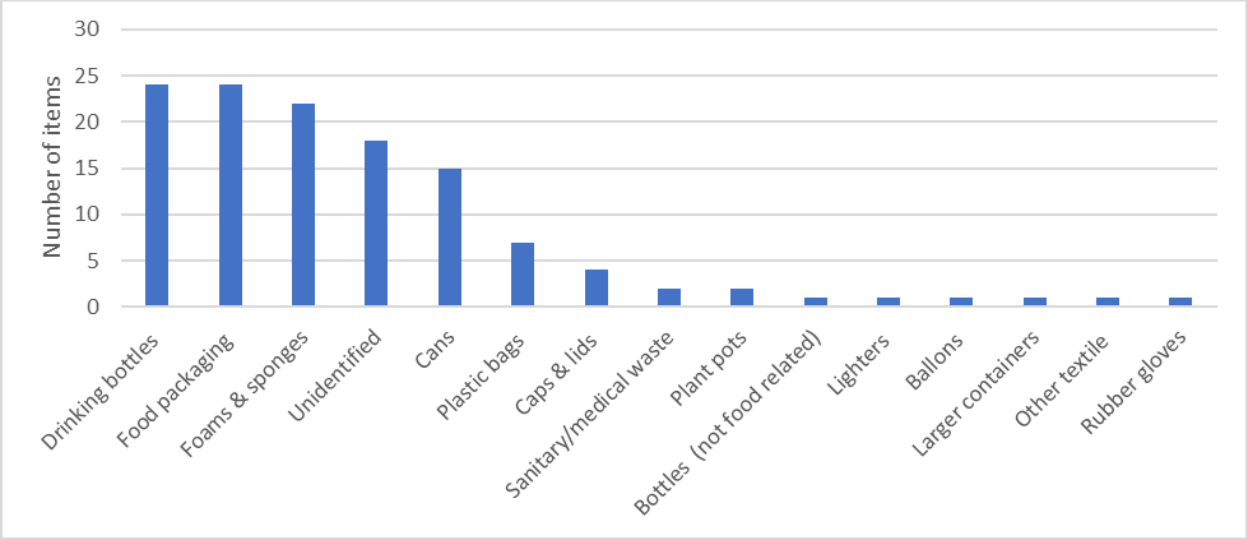


Figure Annex II: Abundance of litter items per category, adapted from the OSPAR Beach litter protocol

Figure Annex II: Examples of litter found in and around the waterways of the Ganzepoot, Nieuwpoort.

Annex III. Overview of the stakeholder and partner meetings

Hybrid LLN Partner meeting in Ostend (VLIZ) – 12th of July 2023

Present: VLIZ, Multi engineering, ULCO (online), IMDC (online)

All project partners of the Living Lab Nieuwpoort (LLN) came together to discuss the respective tasks and responsibilities of each partner in the project. The overall project objectives were presented and discussed, as well as a preliminary timeline. The interaction and cooperation between partners were discussed to ensure smooth collaboration.

Figure Annex III: LLN partner meeting at VLIZ

LLN Stakeholder Kick-Off meeting in Nieuwpoort (centrum Ysara) – 6th of October 2023

Present:

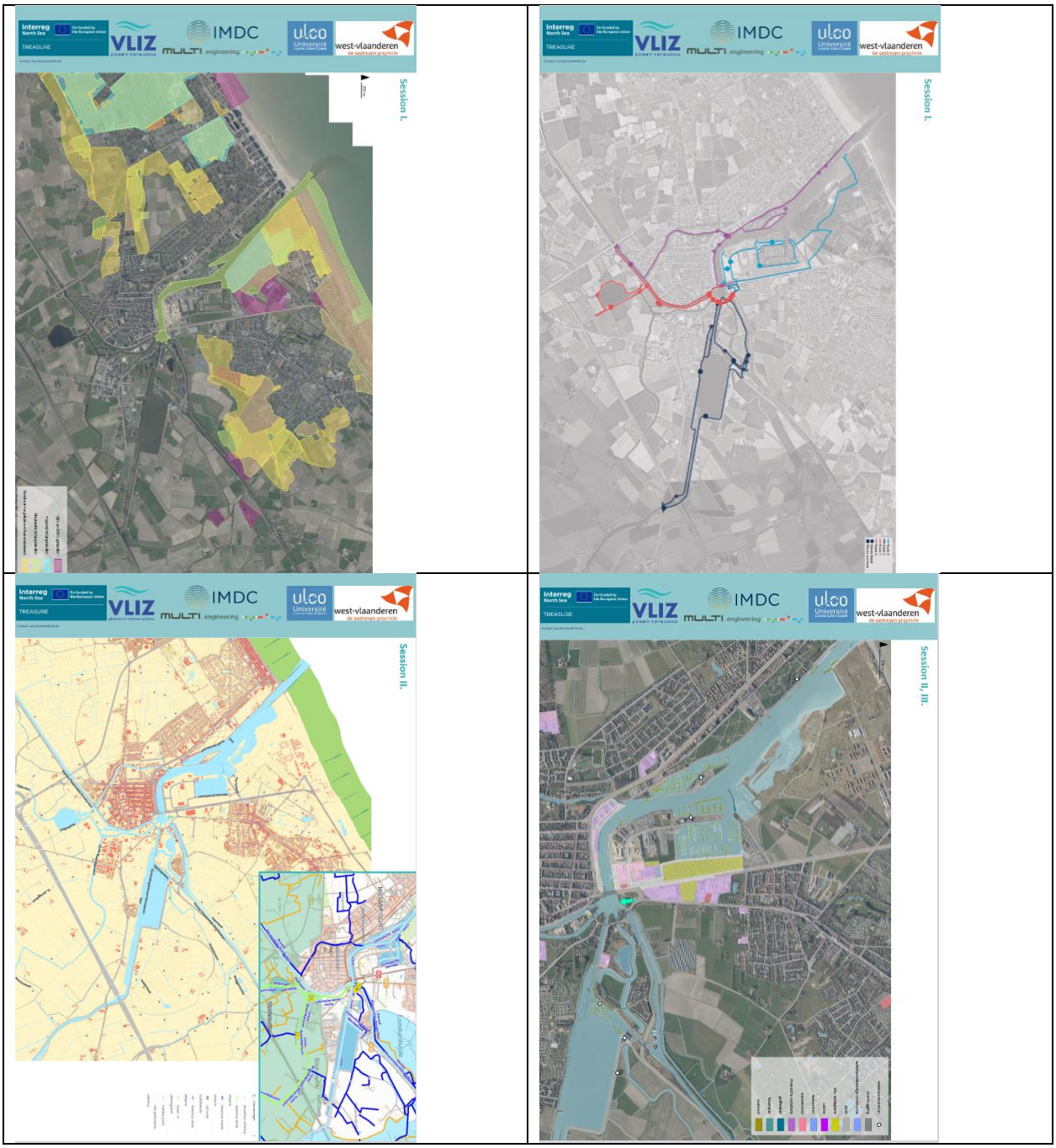
All stakeholders are invited to this meeting, which will be the official stakeholder Kick-off of the TREASURE project. The flow of information will be bi-directional: the project will be presented to the stakeholders, and project partners will inquire for their knowledge of the water system and needs and questions regarding the project. Information gathered here will provide input for all four pillars.

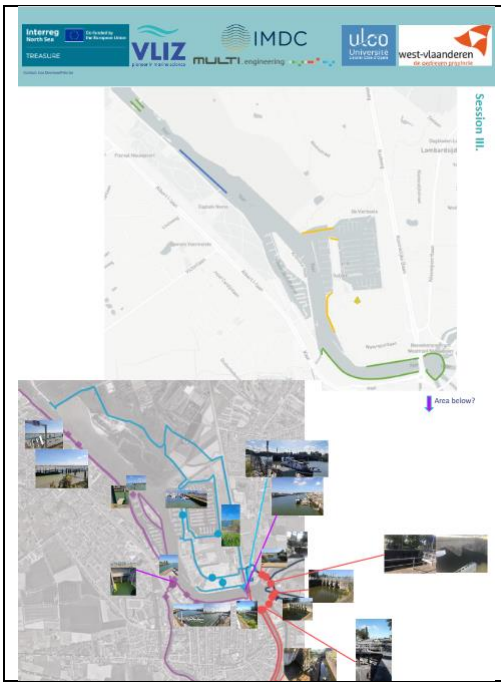
For Pillar 1: Monitoring and Data, input from stakeholders will add knowledge on known plastic accumulation sites, thus informing the sampling strategy. Identifying the needs and requirements of stakeholders surrounding the installation of plastic catcher technologies will provide site specific information to inform the decision support tool of the TREASURE TOOLBOX, designed in Pillar 2: Collection and Removal. Together with stakeholders, intervention strategies and awareness-raising campaigns, such as citizen science activities, will be considered that might be desirable for Nieuwpoort Living Lab, as part of Pillar 3: Prevention and Behaviour change. Here, activities will link up with existing initiatives as much as possible. The stakeholder Kick-Off meeting is the first activity planned in the framework of Pillar 4: Governance and Policy.

Annex IV. Social media posts

Media & date	Snapshot post
Twitter post on the start of the TREASURE project (June 2023)	**Ana I Catarino** @Zebrazuli · 30 jun. What a week! Kick-off of 2 #solutionsforplasticpollution European projects, one hosted here @VLIZnews! Happy to start @HorizonEU @INSPIRE_EUROPE & the @NorthSeaRegion @interregeurope #TREASURE_NS! And a recuerdo of the amazing group of inspiring colleagues we welcomed!... Meer weergeven  6 28 1.549
Twitter post on the biking tour to explore the Nieuwpoort water system (9th August 2023)	Je hebt deze post opnieuw geplaatst **North Sea Region** @NorthSeaRegion · 10 aug. Go, #TREASURE team! We are proud to support the fight against #plasticpollution in our waterways **Ana I Catarino** @Zebrazuli · 9 aug. Perfect finale w/ Ice Cream after hunting for #litter in Nieuwport, the Belgian Living Lab of the #TREASURE_NS project! Looking forward to investigating how to tackle the #plasticflux from rivers to the North Sea! @VLIZnews @interregeurope @NorthSeaRegion @LisaDevriese... Meer weergeven 

Annex V: Maps of the Nieuwpoort water system



 Interreg North Sea TREASURE VLIZ IMDC MULTI engineering ulco Université Littoral Côte d'Opale west-vlaanderen de gedreven provincie Session III. Area below?	