



Interreg
Euregio Meuse-Rhine



LIVES litter free rivers
and streams

EUROPEAN UNION
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Development Fund



Overview of known plastic hotspots in the catchment

A review and digital map of the known hotspot, removal, clean-up and monitoring locations in the catchment area of the Meuse (NL/BE/DE)

project number 0473971.100
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Abstract

The importance of a hotspot map

The digital hotspot map provides an overall view of known plastic litter hotspots in the catchment areas of the Meuse and Rhine. A hotspot location is a place where large numbers of (plastic) litter are visibly present in the water, in or on the river banks or near locations such as locks or weirs.

The hotspot map shows, besides known hotspot locations, the locations where volunteers conduct clean-up actions (clean-up locations), where contractors remove litter from the water (removal locations) and locations where litter is collected and analyzed (monitoring locations). Since the hotspot map is cross border, it provides insight into known information regarding litter in the Meuse basin in the Netherlands, Belgium and Germany. Combined with the monitoring strategy (building block 5 from WP 1), the hotspot map provides an important base for the elaboration of this plastic litter monitoring strategy. It is an ever-growing document in which information about the different types of locations can be added and serves as a foundation for the monitoring approach and information exchange in the coming years.

Constructing the hotspot map

By conducting desk research and interviews with involved international LIVES partners (German, Flemish and Dutch organizations), information was collected about the aforementioned different types of locations important for tackling the macroplastics problem. The interviews were conducted with a pre-designed questionnaire. In addition, collected documents, information from various websites and data files supplied by the LIVES partners were used to compile the hotspot map. Information received from the LIVES partners was considered reliable, and therefore added to the map.

MAIN CONCLUSIONS

- ✓ The known plastic litter hotspots are mainly located along the Meuse. In the other tributary water flows and streams, knowledge about hotspot is limited. Mainly because insights are often only available at a local level (contractors and local municipalities) and not at the level of policy makers and authorities.
- ✓ Valuable steps have recently been taken in starting up and executing monitoring, cleaning up and removal actions and pilots. These locations are included in the hotspot map. These pilot projects will provide additional information in the future about the presence of macroplastics in the water systems of the Meuse and Rhine.
- ✓ Additional information such as potential monitoring locations is included in the map. Those require further research and elaboration to determine their possible worth and reliability.
- ✓ The available information is mainly a result of the efforts of volunteers and local initiatives. The insights are valuable, but vulnerable. The value of NGO/ citizen science produced data is currently under research by governments. Additional insight in the reliability, reproducibility, transparency and cost-effectiveness needs to be collected. Therefore, however valuable, the information collected by volunteers in the catchment area of the Meuse/ Rhine needs to be carefully assessed.

RECOMMENDATIONS

The importance of objective information is recognized

To determine policy and actions, it is important for any (local) water authority to have reliable information about the location and dispersion of microplastic litter in the catchment area. In recent years, information was collected both from within the organizations and from external organizations such as Schone Rivieren¹.

These observations provide first insights into the litter problem but were insufficiently to serve as long term sources. In order to proceed structurally, additional and more detailed information more data is required about the amount and distribution of macroplastics in the water system to make it suitable for monitoring purposes. Further data collection according to established, coordinated methods and protocols, and intensive measurements at interrelated sites are of importance. Setting up and developing a cohesive monitoring strategy is therefore crucial.

Fill in the gaps in the map

There are differences in the amount and detail of information received. Most expertise is available about the Meuse in the Dutch province of Limburg and a number of tributary waters connected to it (particularly the river Geul). The litter related knowledge upstream (managed by the water managers in Limburg, Flanders and Germany) is limited or was not available to the interviewed LIVES partners. This makes different areas in the map are vacant. Information focuses in particular on the waste on the river banks. Knowledge about floating waste and waste below the water level is limited. This requires additional actions to gain insights, which can then be incorporated into the hotspot map in the future.

An important action is to map out these blind spots/ vacant areas and to supplement the current information to create an overview that is more complete, which can be used in relation to the monitoring strategy (see next recommendation) and monitoring results for future approach.

Monitoring strategy for a structural and sustainable approach

The activities that are currently being carried out are mainly activity-oriented and have been initiated and supported by a number of organizations such as Clean Rivers (Schone Rivieren) and some pilots (Rijkswaterstaat). Volunteers currently play a major role in the monitoring. There is no overarching approach, while all parties endorse the importance of a joint approach for an overall view. The monitoring approach for 2022-2027 (building block 5) is an important step towards a structural and sustainable approach, in which the information regarding litter in the Meuse is collected and shared in the hotspot map and/or via the open access database.

Collecting information about separate locations together into a cohesive system

The current information provides insights into the situation at relevant locations and monitoring moments. In order to bundle the information into a systematic approach, it is advised to model a small area in the Euregio, and pinpoint the known hotspot, removal, monitoring and clean-up locations in that area. This could serve as a basis for determining suitable removal locations, and as a test for the further elaboration of monitoring, removal and preventive approaches. The experience from this local approach later can be extended to other areas in future.

¹ Additional information Schone Rivieren: www.schonerivieren.org (2022)

Aligning schedules and activities to the dynamics of the water

The hotspots, removal, cleaning and monitoring locations are visibly diffused in the research area. Due to the dynamics of the water system (peak discharge, high water and seasonal influences), it is important to adapt the monitoring and clean-up activities to these variables. Doing so, these places are monitored at the most suitable moments. When the information in the hotspot map is further supplemented, this provides a valuable source of information to be able to follow the rhythm of nature and direct activities accordingly.

Ensuring capacity in the organization and between organizations for structural monitoring and recording of information

The capacity and priority for tackling macroplastics differs within the various partners. The issue is largely recognized by LIVES partners. Due to the internal division of tasks and roles, the differences between the various partners in organizational structure and lack of clear assignments and task descriptions, monitoring in particular does not receive the necessary attention needed. Scaling up monitoring and registering the information requires capacity and budget within all organizations which is currently scarce. By initially working with ambassadors from the LIVES partners who maintain close contact with each other, a first step is made as a follow-up to the LIVES project. This temporary solution is converted into definitive agreements when the various LIVES partners have established the approach for the monitoring strategy.

Overview of known plastic hotspots in the catchment area of the Meuse

A review and digital map of the known hotspot, removal, clean-up and monitoring locations in the catchment area of the Meuse (NL/BE/DE)

Supported by the Interreg V-A Euregio Meuse-Rhine program. The Lives project is being carried out within the context of Interreg V-A Euregio Meuse-Rhine, with 735.300 euro from the European Regional Development Fund

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1 Introduction

Litter pollution – How did we get here?

The past 70 years have seen a worldwide exponential increase in the production and consumption of products². New materials such as plastic revolutionized our way of living. However, this leap forward also has a shadow side to it: a large portion of these products have ended up in the environment through improper waste disposal and littering. This so-called litter pollution is now everywhere: large amounts of plastics have accumulated in our oceans (also known as the 'plastic soup'), in our rivers, and on land. We even find microplastics, which mainly stem from litter that is broken down in the environment, in the food we consume and the water we drink.

Litter in rivers – A serious problem

Litter pollution is produced on land through mismanagement of waste and littering. Only a small fraction of litter pollution ends up in the famous 'plastic soup' in seas and oceans. Most litter is (temporarily) retained in rivers³. Here it has a range of negative effects on nature and fauna, it can increase flood risk due to blockage of drainage systems, and cause economic damage^[4] Due to the longevity of the materials in our waste streams, the ubiquity and large volume of it, litter pollution has become one of the most significant and challenging environmental problems of our times.

Key knowledge required to effectively tackle the litter problem is currently lacking. For example, very little is known about the sources of litter pollution, how much litter is exactly in our rivers, and where hotspots of litter can be found. Such knowledge is key for the design of effective litter reduction, mitigation, and removal strategies. This knowledge can only be gained through effective monitoring of litter in our rivers.

Rivers run cross-border; litter pollution therefore is a cross-border problem as well which requires international cooperation to solve. Monitoring is one of the areas where international cooperation is needed the most. International standardized methods to monitor riverine litter are currently lacking. This leads to data gathered by different countries to often be incomparable with each other, hindering the design of effective solutions to the litter problem.

The LIVES project – Cross border cooperation to reduce litter pollution

The Litter Free Rivers and Streams (LIVES) project is a cross-border initiative with the aim of reducing the presence of litter in the catchment of the Meuse river through international cooperation. This project unites governments, water managers, and scientists from Germany, Belgium, and the Netherlands to jointly tackle the litter pollution. This is done on three fronts: 1) creating a shared understanding of the litter pollution problem through cross-border monitoring and data sharing, 2) implementation of measures aimed at reducing litter, and 3) creating institutional arrangements to anchor these changes in future policy.

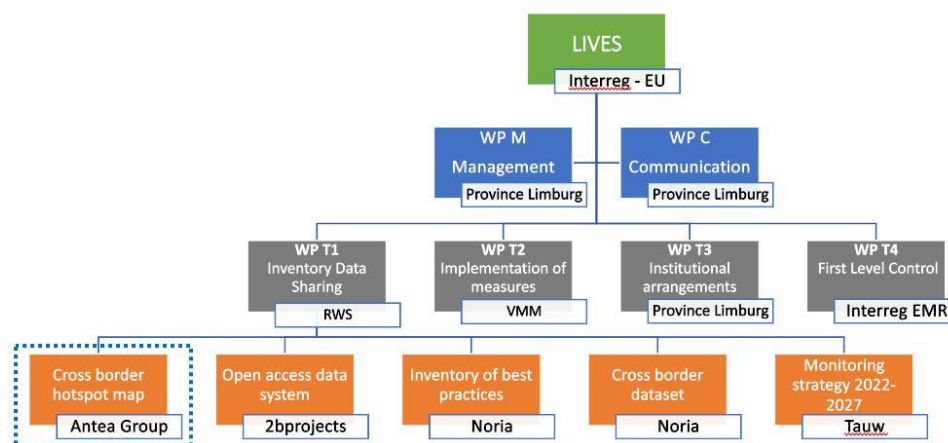
² For example, plastic production increased from 2 to 381 million tons worldwide per year over this period of time, Geyer et al., 2017

³ Stored for example on riverbanks, Meijer et al., 2021

⁴ van Emmerik & Schwarz, 2020; Deloitte – The price tag of plastic pollution

Structure of the LIVES project

The LIVES project follows a layer-based approach, whereby the first two layers comprises six different work packages, namely: Management (WP M), Communication (WP C), Inventory Data Sharing (WP T1), Implementation of Measures (WP T2), Institutional Arrangements (WP T3) and First Level Control (WP T4). This report is part of WP T1. WP T1 consists of five building blocks which each block having their own deliverables. This report focuses on the ‘Cross border hotspot map’ (first orange box). The main objective is to give insight into the locations in the Euregio (catchment area of the Meuse) which are (potentially) interesting for understanding and take measures aimed at reducing litter.



Reading guide

Chapter 2 contains an explanation of the hotspot map and further explanation of the various location types and approach. Chapter 3 presents the main conclusions and findings.

Detailed information about the methods, sources, interviews and the various map layers from the hotspot map are included in the appendices.

2 Definitions and explanation map

This chapter provides explanations of the different location types connected to this project: hotspot, monitoring, removal and clean-up.

2.1 Project and research area

This project has been conducted in the Euregio Meuse- Rhine. Figure 1 shows the project area. It consists of regions of Belgium, Germany and the Netherlands. Both the rivers Meuse and the Rhine flow through those countries, and therefore organizations in the Euregio are essential partners in solving and exploring the plastic litter in water problem.

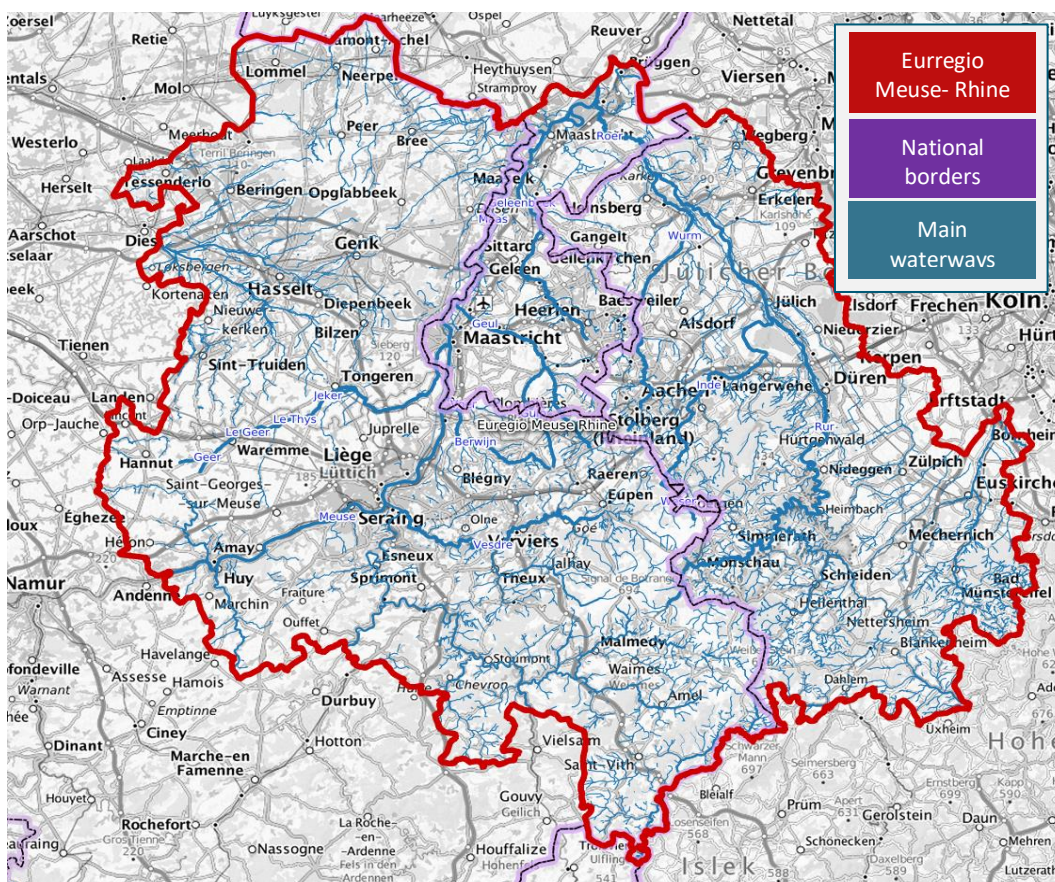


Figure 1: Map of Euregio/ catchment area of the Meuse and Rhine

2.2 Definition different locations in the hotspot map

The hotspot map provides an overview of four main types of locations, relevant to this project's goal. The map shows the different locations (geographical) related to the plastic in litter problem in the catchment areas of the Meuse and Rhine. The different types of locations as shown on the hotspot map, are explained below.

Hotspot location

A hotspot location is a place where large numbers of (plastic) litter are often visibly present in the water, in or on the river banks or near locations like e.g. locks or weirs. It usually accumulates near litter catchment installations or on locations where the river meanders. The quantity of litter is dependent on many factors, like seasonal influences (high water or more recreational litter) or fluctuation in the water column.

The knowledge about the different hotspot locations was mainly obtained from the interviews with LIVES partners and factsheets from Schone Rivieren⁵. The hotspots are both located in the water and on land. Most known hotspots have been monitored by volunteers since 2017 (Schone Rivieren). They are located in the catchment area of the Meuse and have a constant presence, meaning their locations barely shift, even when seasonal influence is regarded.

The hotspots near large weirs and the river banks are the most visible, especially during periods of peak discharge, and therefore the most well-known by the interviewees. There is less known about these locations during normal discharge, since most monitoring is done after periods of high water.

Some research has been done about the causative factors of the hotspots, like analysis of the composition of the litter. Addition research like litter counting or detailed insight in possible causing agents (e.g. vacationers) is not a usual practice.

Monitoring location

A monitoring location is a place of constant monitoring in or the near the water or river banks. This can be to gain insight in litter characteristics, e.g. composition, quantity, possible sources or causing agents. Monitoring can also be done to retrieve information about water quality (chemically or from a biological point of view). Monitoring can be performed by both volunteers or organisations, if the method used is tried and proven. Monitoring locations are also used as testing locations, e.g. for new methods of dirt traps in the water column, or to validate them.

The locations for monitoring are wide spread in the region of (Dutch) Limburg. They are mostly located near the Meuse, but also in the Geul. The Geul river is a right bank tributary to the Meuse and flows in both Belgium and the Netherlands.

⁵ See: Schone Rivieren (Results): <https://www.schonerivieren.org/doe-mee/resultaten-onderzoeken/>

Monitoring is mostly started at known litter hotspot locations, to gain an insight in the characteristics of the hotspot (e.g. consistency and gravity of the situation). Monitoring in general is not a constant and usual practice, the vast majority of the locations have been monitored only in relation to a study or pilot. Certain organizations (e.g. Rijkswaterstaat) are investigating new ways of monitoring, not only in the water but also from bridges and on the river banks.

Removal location

A removal location is a location where (plastic) litter is collected and removed from the river or rivers bank. It can be removed with dirt traps, weirs, locks, culverts and water mills. The ownership of these locations differs, it can be owned by e.g. the local Water Board or private ownership.

The vast number of traps and removal locations in the catchment area of the Meuse and Rhine were difficult to establish in the short duration of this project. Most (local) Water boards and municipalities close to the rivers have control of a large number of weirs, locks and culverts. Litter is removed from those locations. Additional insight in these locations was requested. Not all the data required was obtained before the ending of this project and therefore not everything could be recorded in the hotspot map.



Figure 2: Example of a removal location

Clean-up location

A clean-up location is a place where organisations, municipalities close to rivers or residents of a certain area conduct litter clean-up actions or/and events. It is usually done by (large numbers of) volunteers. They mainly take place at known hotspot locations. Locations are well reachable for both people and vehicles (to collect the litter). They are generally near residential areas or nature reserves, or before or after the river crossed a city or residential area.

Clean-up actions are usually organized at least two times a year, once in spring time and once in autumn (often at World Clean-up Day in September⁶). Clean-up actions organized by third parties (organizations or municipalities) are not done in summer time, the quantity of litter can be distorted because of an increase in recreational waste. Besides that, factors like the breeding season (in nature areas) and times of plant growth should also be considered.

Clean-up actions are mostly conducted from intrinsic motivation of volunteers. The main purpose of the actions wasn't to analyse the collected litter, but this was gradually implanted and became more of a common practice. However, monitoring during clean up actions is still incidental. When litter is monitored, the OSPAR method is often used for analysis. This method uses a detailed item list for data collection, consisting of 10 main categories and over 100 specific items. Some foundations that are intensively involved in clean-up actions with volunteers and citizen science are Schone Rivieren⁷ (in The Netherlands and in the Meuse Valley in Belgium) and Mooimakers (in the Flemish part of Belgium).

⁶ For additional information about World Clean Up day; see: www.worldcleanupday.org

⁷ Additional information Schone Rivieren: www.schonerivieren.org (2022) and Mooimakers: www.mooimakers.be (2022)

2.3 Map content

Screenshots of the hotspot are included on the following pages to illustrate and clarify the results and conclusions. Figure 3 gives an overview of the map, it shows the catchment area of the Meuse and Rhine with all the layers made visible. The table on the next page provides an explanation per layer.

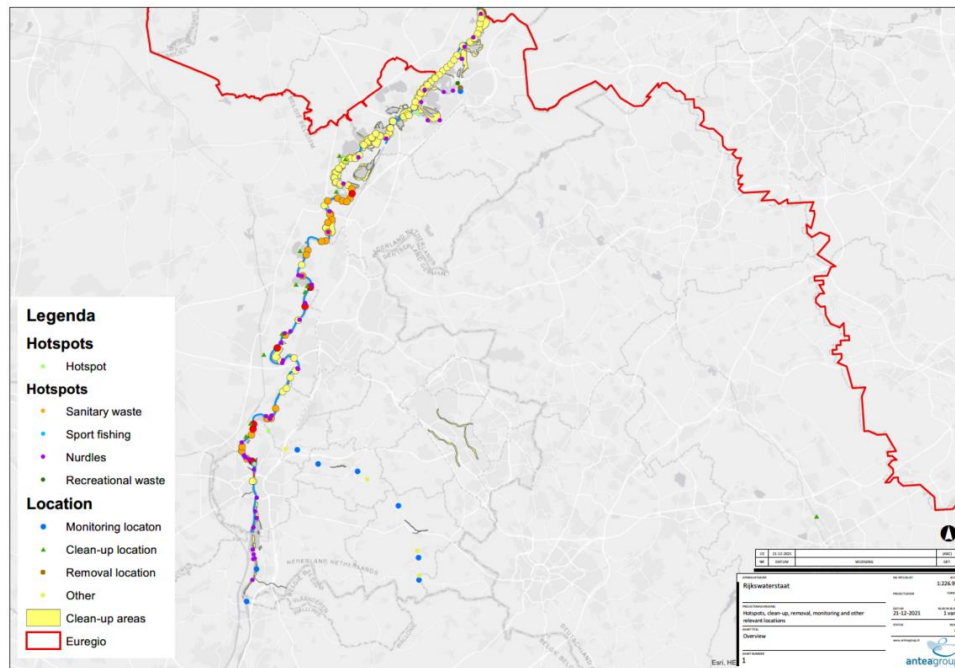
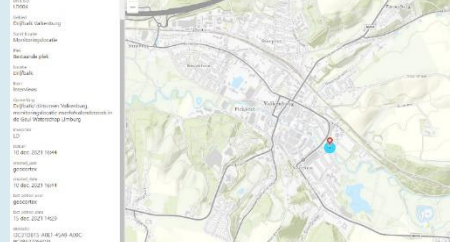
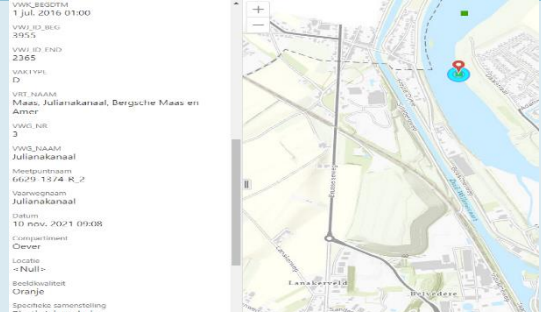



Figure 3: View of the hotspot map with on the left side the different layers

Overview of known plastic hotspots in the catchment area of the Meuse

A review and digital map of the known hotspot, removal, clean-up and monitoring locations in the catchment area of the Meuse (NUTS 2) project number 0473971.100
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 Rijkswaterstaat



Layer	Detailed content	Source
<p>Hotspot Zuid Nederland</p> <p>Legenda</p> <p>Hotspots</p> <ul style="list-style-type: none"> ● Hotspot <p>Hotspots</p> <ul style="list-style-type: none"> ● Sanitary waste ● Sport fishing ● Nurdles ● Recreational waste <p>□ Euregio</p>	 <p>An overview of the different types of locations as explained in paragraph 2.3. For each location, information about the source, exact location and a short explanation is given.</p>	<p>The locations originate from data provided through interviews.</p>
<p>Schone rivier (Clean river)</p> <p>☑ HotspotkaartZuidNederlandProjectdata</p> <p>☐ ● Schone_rivier_pdf</p>	<p>Schone River: the litter hotspots from the Schone Rivieren campaign 2020 and 2021. Additional information includes the number of items found, if this insight was available.</p>	<p>Data originating from factsheet Schone Rivieren (Clean Rivers), 2020/ 2021.</p>
<p>Compartments Legend</p> <ul style="list-style-type: none"> ■ Quay ■ Riverbank ■ Bankwater □ No data 	 <p>Compartments: locations on the quay, river shores, and water banks where litter was found, including the number, types and pictures of items (when available). Due to intellectual property (IP) and property rights, this layer will not be added in the final map.</p>	<p>Rijkswaterstaat (Water Authority of the Netherlands)</p>
<p>Schone rivieren</p> <p>Legenda</p> <p>Locations</p> <ul style="list-style-type: none"> ▲ Clean-up location ■ Clean-up areas 	 <p>Locations on the map where litter-clean-up action have been organised and executed, often by volunteers.</p>	<p>Schone Rivieren (Clean Rivers)</p>

3 Results and recommendations

In this chapter, the results of this project are given per location type. Information from the interviews (e.g. quotes from the interviewees) and data sources are shared and analyzed. In addition, recommendations are given to improve the collection of information and insights for each location type. Subsequently, general conclusions and recommendations from this building block are described in paragraph 3.2. The recommendations are for the authorities, persons and organizations involved in the catchment areas of the Meuse and Rhine and provide a base to improve (data) collection.

3.1 Results by location type

3.1.1 Hotspots

As previously explained, hotspot locations are locations where vast quantities of litter are cumulated in or near the river (banks). The following map gives an overview of the different hotspot locations in the Meuse that were named in either the interviews or other data sources⁸. The hotspots locations haven't been monitored long time or in an organized way. Thus, there is uncertainty in these locations and additional monitoring and research is required.

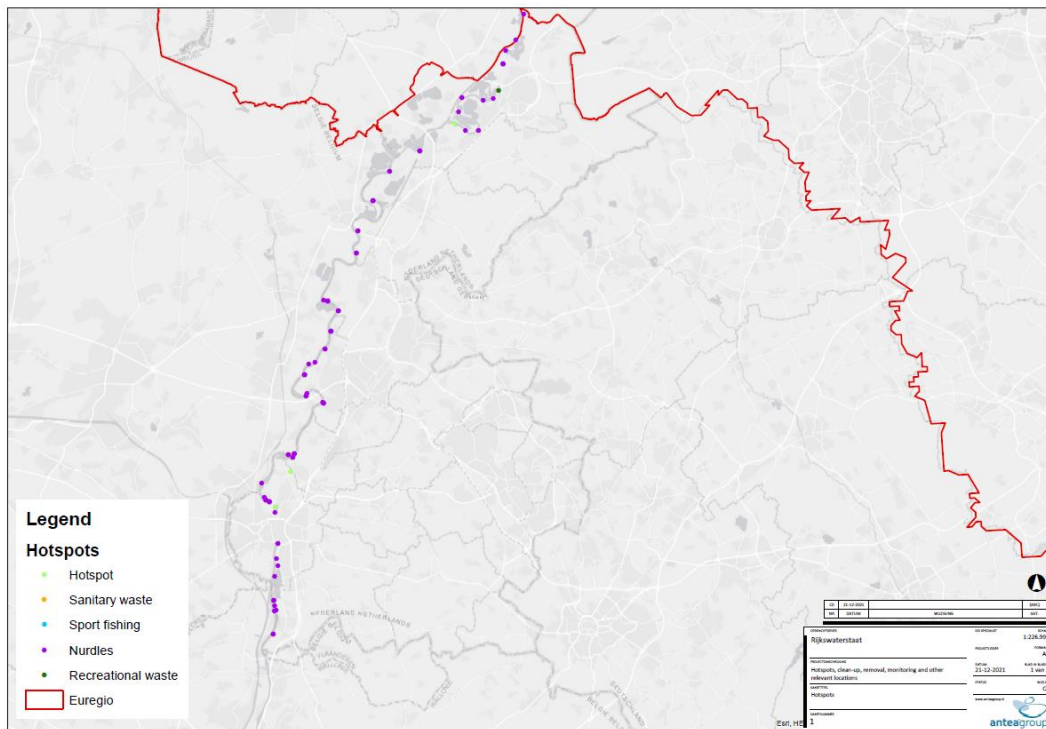


Figure 4: Hotspots in the Euregio area as named during the course of this project

⁸ Hotspots were also mentioned in the factsheets of Schone Rivieren (<https://www.schonerivieren.org/doe-mee/resultaten-onderzoeken/>)

Hotspot locations have been found and **captured mostly in the region of Limburg** along the river banks of the Meuse (both Dutch and Belgium sides) and the Geul.

Few hotspots have been registered (some monitored) in the **smaller waterways** in the Netherlands. It has been mentioned during the interviews that those involved know of the presence of litter concentrations in the rivers, but clear locations hotspots could not be pointed out. It was stated that additional and more precise information about hotspot locations in the smaller rivers, might be known by contractors or maintenance people active in the area, since they are often present in the field. These are **unmonitored hotspots**.

‘There is a lot of skill and knowledge in the field. But those people working in the field near the river and litter (the people with experience and those who collect the data) and the persons behind the desks (analyzing the data) often don’t know each other.’

Some information is available for the **monitored hotspots**. This is mainly considered for the hotspots that were researched by volunteers of Schone Rivieren (see paragraph about monitoring locations). Additional information about possible **recreational hotspots** was received by the Water Managing Authority of the Netherlands. The locations were based on a geographical data analysis. The information and approach used for this analysis wasn’t sufficiently validated and therefore the information cannot be used in the final version of the map. The method of predicting possible hotspot locations based on geographical data analysis can however prove insightful.

The following recommendations are given for hotspot locations:

- On the basis of available data, develop an area-oriented model of the behavior of the macroplastics in the water (hydrological model in combination with information about the presence of plastics). A theoretical hotspot map for a (sub) area can be drawn up from this as a first step in setting up an area-covering hotspot map.
- Secure the hotspot location that are only known by contractors, practitioners or other people working in the field by conducting interviews (the unmonitored hotspots). Especially for hotspots in the smaller waterways, information about the concentration and locations of litter is not always known on official levels. Initiate conversations with those parties for monitoring specifics on the hotspot location during maintenance work.
- Classify known hotspot locations on level of magnitude (quantity of litter) and other factors, to establish and prioritize which locations to tackle first.

3.1.2 Monitoring

Monitoring locations are locations where litter is monitored, in or the near the water or river banks. This can be to gain insight in litter characteristics, e.g. composition, quantity, possible sources or causing agents.

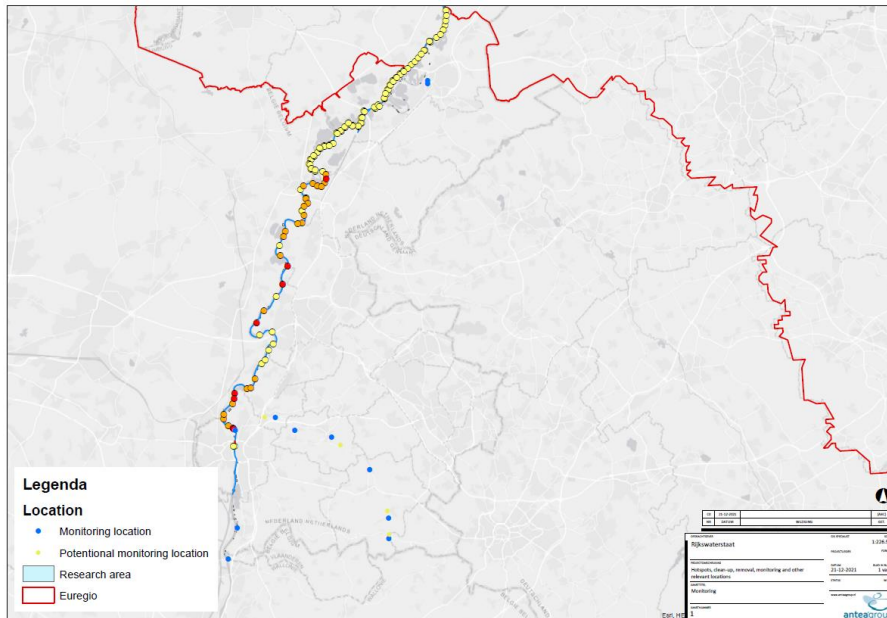


Figure 5: Monitoring locations in the Euregio/ catchment area of the Meuse and Rhine area as named during the course of this project

As shown on the monitoring map (figure 5), there are multiple locations in both the Meuse and Geul basin where litter is monitored. **Monitoring isn't done by one single organization**, but by multiple organizations with multiple methods and purposes (e.g. monitoring on the litter quantity, or the composition, with litter traps or just visual etc.). Monitoring in the smaller water ways is scarce. Because not the whole catchment area of the Meuse and Rhine is consistently monitored, the gained insights provide a limited rough impression of the dispersion of litter in the rivers. A refined and widely used method of monitoring is required to present a reliable insight⁹.

'We only monitor situational and when it's project based, like e.g. during LIVES. We first started monitoring for plastic waste during a LIVES pilot project. There is no structural monitoring, but we are in the process of devising a strategy for the future.'

There are multiple locations that are promising and suitable as **future monitoring locations**, e.g. like water mills, bridges, weirs and locks. They haven't fully been checked as monitoring location yet. Most of the potential locations are found in the catchment area of the Geul, there has been little mention of potential locations in the Meuse (possibly because more monitoring is already being performed in the Meuse in comparison with the Geul). The potential locations are well

⁹ One of the building blocks of WP1 is to compose a monitoring strategy for 2022-2027 (see introduction of this report for additional information).

reachable for inspectors. Additional information about more potential locations in the whole region of Limburg was requested but was received too late to add to the final hotspot map.

The available information mostly considers litter on the shores and floating waste. Insights about [pollution in the water column and bottom have not been mentioned](#) during the course of this project. Monitoring is frequently done (2 times a year, once in spring and autumn time) on the river banks of the Meuse. In other areas of the Euregio, there is less monitoring (or it hasn't been communicated in the interviews).

The managing water authority of the Netherlands has recently executed a [monitoring pilot](#). Litter on the river banks was [visually counted](#) and based on findings, locations were given a certain class of pollution (e.g. many litter, some litter etc.). The findings and results have been shared for this project, but since the information and approach wasn't sufficiently validated, results cannot be used in the final version of the map. In some small pilots from the same authority, visual observation from bridges was done to gain insight in the floating waste. These pilots however have potential to be further developed and executed in the future.

Most information has been collected through monitoring with [volunteers, mostly on the river banks and with some exceptions in the water \(using canoes\)](#). They are therefore a valuable source of information. It should however be considered that the information and data obtained by the volunteers was not objectively checked. The comparability of different data sets from different sources (e.g. from volunteers, from monitoring pilots or some from frequent monitoring) must therefore be done with a certain degree of caution. Collected waste on the river banks often gets analyzed on quantity and specifics, using a peat list. These lists are based on the river OSPAR method. This method uses a detailed item list for data collection, consisting of 10 main categories and over 100 specific items. By using this method, detailed insight is collected about the type and composition of the litter laying on the banks. For each monitored location, it is indicated which and how many items have been found.

'OSPAR is the best method we have right now. If there are better ones available, we would consider those. OSPAR is time consuming and therefore costly. If we can automate or improve the process, then we can increase the frequency of our monitoring. It is a choice to be made'

At the level of regional authorities, there [is willingness and energy to track litter on a more consistent base](#). There are people with knowledge and experience in conducting monitoring, it is mainly a shortage of time and absence of a clear framework that makes that consistent monitoring has not been fully performed.

The following recommendations are given for monitoring locations:

- Compose a clear framework for monitoring in the catchment area of the Meuse and Rhine. This way, the monitoring can be jointly organized, and the LIVES partners can work together in framing the approach and implementation of monitoring.
- Monitoring locations have been identified in the local, smaller water systems that may be of interest. These locations have not yet been mapped out due to the lack of the correct datasets and considerations. Visualizing this information from a monitoring point of view is a valuable addition to the potential monitoring locations of the hotspot map and provides additional input for future monitoring actions.

- Make an assessment framework for possible monitoring locations. This appoints all factors that make a location suited for monitoring. It helps by determining the possible success of a location for the purpose of monitoring. And provides a clear framework that can be widely used.
- Knowledge from people working in the field (e.g. contractors) is indispensable. Those people are only liminary involved in monitoring right now, while they know a lot of detailed information about the specific region they work in. These 'field experts' can assist by performing the monitoring and determine right locations.

3.1.3 Removal

A removal location is a location where (plastic) litter is collected and removed from the river or rivers bank.

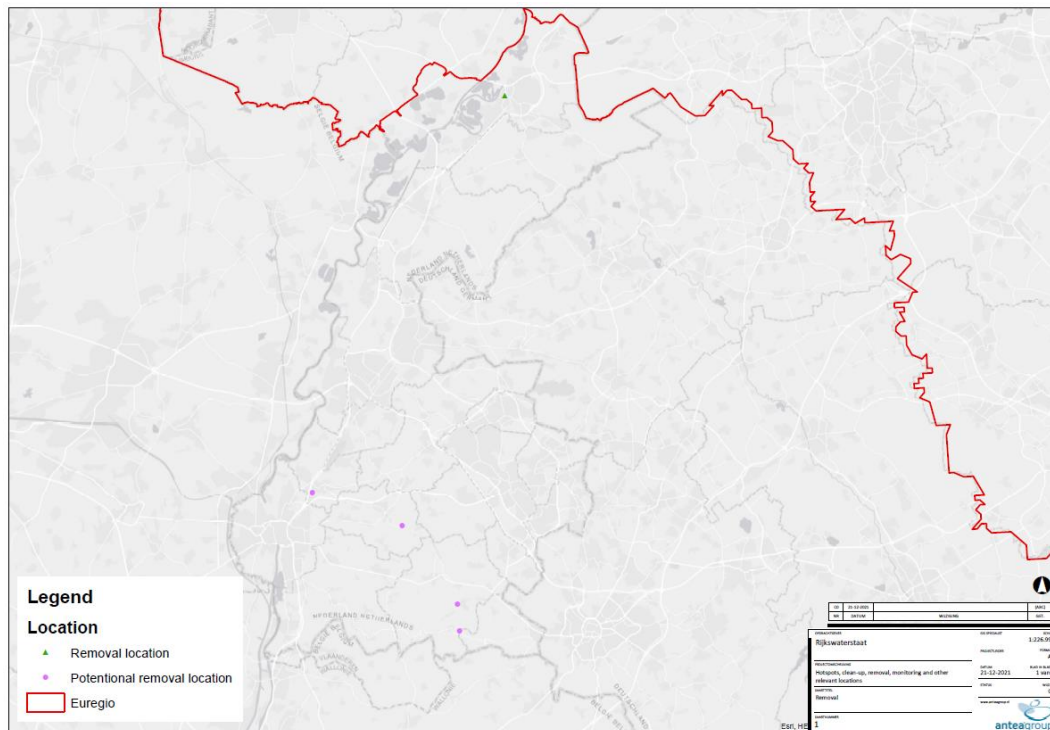


Figure 6: (potential) removal locations in the Euregio area as named during the course of this project

There are multiple removal locations in the [downstream catchment area of the Meuse and Geul](#). They are mostly located near constructions like weirs and locks. Plastic litter is actively removed from the water in these locations, like after the high water in Limburg in June 2021. After a period of peak discharge, it became highly visible where litter was collected, mainly near large weirs. A good example are the locks south of Maastricht.

Other logical locations for the removal of litter, are places like culverts and [litter traps](#). Dutch and Flemish managing water authority organizations already remove litter at those locations, like for example at the Dutch cities of Roermond and Valkenburg. These locations are well known hotspots, where the collected litter is also monitored to determine composition and possible

causing agents. Besides that the locations also offer opportunities to work closely with regional partners.



Figure 7: Litter trap in the Roer in Roermond (source: <https://litterfreeriversandstreams.eu/litter-traps-in-roer-en-geul/>)

Since the flow of water in the Meuse shouldn't be obstructed, there are only a **few potential removal locations in the Meuse**. Some locations in and around the city of Maastricht are appointed as possible removal locations. Such as the locks south of Maastricht, the bridges in the city and the weir of Borgharen. The regional managing water authority conducted several small pilots with a litter trap at Borgharen in recent years.

Natural filtering abilities of vegetation in the water systems also prevents litter from flowing freely. Depending on the course of the river (straight or meandering), litter can be ceased in plants and bushes on the banks of the river. However, there is great attention by water (management) authorities in the Meuse to ensure water flow isn't obstructed during peak flow. To secure the free flow of water, vegetation on the banks has been removed at some locations. That means that when there is peak discharge, there is no natural barrier to obstruct the litter and prevent it from flowing to the river mouth and further on.

'The ownership, responsibility and management of the river differs for the water column and the river banks. We clean where it is our responsibility to do so. But often, litter stays on hard-to-reach locations or locations under different management, until there is another period of peak discharge. Not all authorities, organizations and third parties that have ownership over (part of) the river are occupied or involved with the removal of litter. And only some of them see it as part of their responsibility or job to do so.'

Instead of monitoring all the collected waste, it **often gets discharged** without counting or additional analysis using e.g. the river OSPAR method. Little is known about the composition and quantity of removed litter, because discharge mostly gets done by local contractors and it is not part of their contract/ obligation to perform monitoring. Besides that, an analysis of the collected litter using the OSPAR method is time consuming and therefore costly.

The following recommendations are given for removal locations:

- Utilize natural removal locations. Due to the course of the rivers, there are recurring hotspot locations during peak discharge. These locations are important and valuable to pinpoint.
- Most interviewed persons of the partner organizations have limited knowledge about removal locations. This can be hotspot locations during peak discharge, or locations where contractors remove litter from the water. These removal locations are valuable locations for monitoring and should there also be pinpointed on the map. During some interviews, it was stated that there were about almost a 1000 (small) removal locations in the south of Limburg (NL). These are locations in small ditches, where converts or small grids were placed. Additional data about these locations was requested, but not received in time. It is however important to gain all possible information on these locations. And start monitoring there.
- Include removal locations as possible locations for monitoring. Especially the composition and quantity of the litter makes for valuable information and also gives insights in possible causing agents for waste in small ditches.

3.1.4 Clean-up locations

A clean-up location is a place where organization, municipalities close to rivers or residents of a certain area conduct litter clean-up actions or/and events. It is usually done by (large numbers of) volunteers and often performed at or near well know hotspot locations.

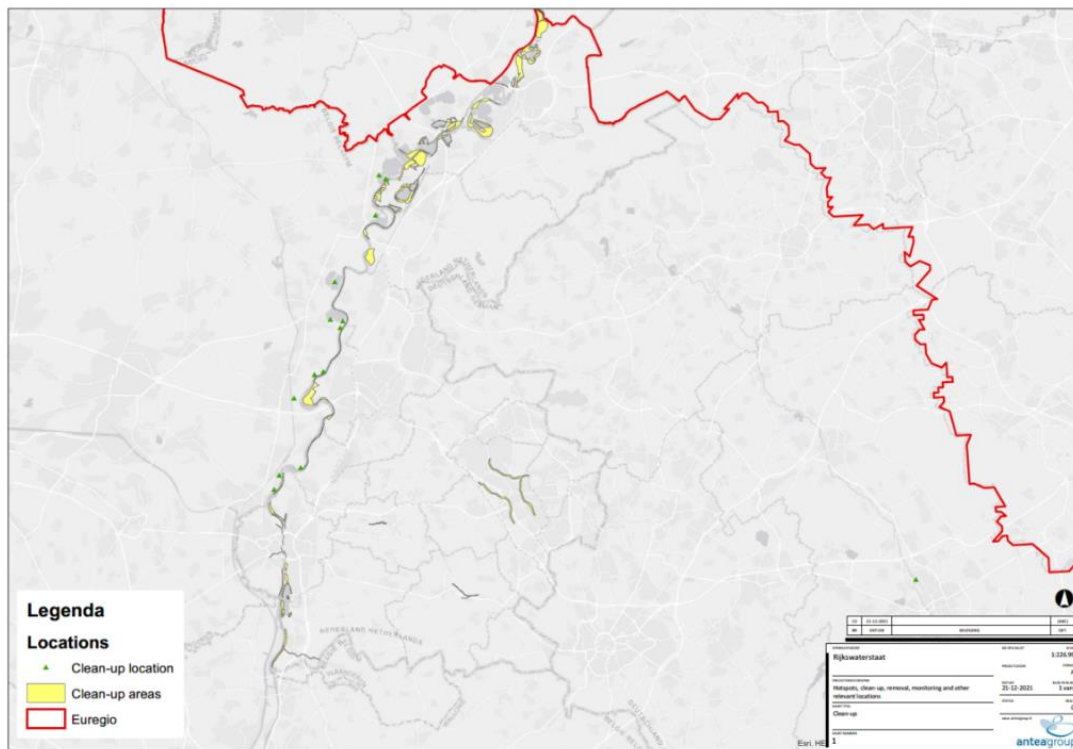


Figure 8: Clean-up locations in the Euregio area as named during the course of this project

Clean-up actions are mostly organized through [organizations that work with volunteers](#), e.g. the Schone Rivieren foundation in the catchment area of the Meuse (both Dutch and Flemish area),

but also RLKM (a regional partnership between the province, municipalities, nature organizations and agricultural organizations, set up to stimulate sustainable tourism and nature) in Flanders. Local municipalities alongside rivers also organize small clean-up actions with their residents.

In the Netherlands, clean-up actions are mainly organized during [the national clean-up day in March](#) and [the World clean-up day in September](#). Collected waste during this day is mostly analyzed as well. During summer times, there is additional recreational waste and therefore the quantity and composition of the litter differs and the results of monitoring would not be comparable. Additional clean-up actions are also spontaneously organized when called for, e.g. during the period of peak discharge of June 2021.

‘Volunteers often want to clean-up alongside the river, so we facilitate them by providing materials such as gloves and litter pickers. We have selected some clean-up locations ourselves in the last years, which we choose based on characteristics such as accessibility and the amount of litter (this because of the expectations of the volunteers, people like to collect large numbers of waste so we make sure we pick places that are visibly littered).’

Alongside the Dutch shores of the Meuse, the managing water authority (RWS) has composed the [Zwerfvuil Ophaal Regeling \(ZOR, or the litter collect regulation\)](#). This means that litter collection by volunteers is freely collected and processed by contractors that work for RWS. Prior to the clean-up action, arrangements are made between the contractor and volunteers about where to collect and drop off the litter. This takes away a boundary for volunteers (it is no longer needed to lift and discharge of the litter themselves) and makes cleaning-up easier and accessible. Such a regulation isn't known for other rivers or areas.

‘We have a few fixed locations where we know volunteers regularly clean-up. These are mostly (small) local clubs, like a sport club. We are in favor of finding more of these associations, like a fishing club. They clean-up the area, but there is of course also a social component to it.’

[Small water ways](#) depend on the organization of clean-up activities by the local municipalities, or spontaneous clean-ups organized by local residents. Therefore, less clean-up actions are performed/ registered in the smaller rivers.

Recommendations

- Explore the possibilities for regulations alike the ZOR in other regions. This makes for a clear overall-approach and promotes clean-up actions.
- Increase the roles of volunteers in monitoring and clean-up activities. There is an increasing interest in the importance of volunteers and their part in data collection. The efforts of volunteers are therefore extremely valuable and will be growing in the coming years. It calls for additional attention to their training, citizen science will be an important contribution to insights in the litter problem.
 - a. Organizations concerned with clean-up actions should also increase the attention to safety training of volunteers (where they should and should not go during e.g. periods of peak discharge) and agreements for litter collection with local contractors.
- A regional approach to clean-up actions should be created. The efforts of volunteers are valued and a regional approach would make for a streamlined organization of the clean-up actions. Besides that, it would also achieve that possible rewards (e.g. a monetary reward or coupon) and communications for the volunteers would be comparable.

3.2 Conclusions & recommendations in general

The following paragraph states the main conclusions (in blue) and recommendations for the LIVES partners on how to approach further research and extension of the hotspot map.

1) The litter hotspot map and this report provide the currently known information about the different location types in the catchment areas of the Meuse and Rhine. A complete and more detailed hotspot map will provide additional information in the future and serve as a base for policy, projects and initiatives. The current hotspot map should therefore be further elaborated. The gathered information about the different location types makes for an important observation; a clear, generic overview of all know information doesn't exist (yet). Insights are divided between different (regional) authorities, and information exchange between those parties is scarce.

The hotspot map provides a first summary of what has already been done (e.g. litter monitoring pilots) and is known (hotspots, removal, clean-up and monitoring locations) in the catchment area of the Meuse and Rhine. Through the map, it is evidentially visible that in some regions in the watershed of the Meuse and Rhine, not all information regarding hotspots etc. is known (there are no recognized locations in Germany and only some in Belgium). The map therefore provides an important basis on which additional research can be done.

Recommendations:

- The hotspot map provides an important source of information for the long-term monitoring strategy 2022-2027 (this monitoring strategy is part of WP1, see the introduction for additional information). The hotspot map is an ever-growing source of information which, together with the open access database (idem from building block 2), will play a central role in analyzing information and insights in the Euregio. By tackling the litter in water problem together with the involved LIVES partners and increasingly adding new information to the hotspot map, patterns and developments become visible.
- Conduct further research with regards to plastic litter in the Meuse, blind spots in the map (e.g. for monitoring locations, hotspot or clean-up actions) in a similar local and regional approach in the Euregio. Linking the blind spots to the already existing actions and activities in the adjacent areas. It is best to work in the catchment areas where the natural flow of the water connects.

2) Mutual and coherent relationships between monitoring, removal-up and hotspots locations are yet to be made visible. However, there is a correlation between hotspot locations and clean-up locations.

In an ideal situation, in places where pollution occurs, litter is also removed and analyzed nearby. Analysis of collected litter is scarcely done, mainly as a result of pilot projects. The hotspot map shows that the removal and monitoring locations are often not overlapping. The removal locations alongside the Meuse are primarily the river banks. In the tributary waterways, it mainly concerns the weirs, pumping stations, dirt traps and other structures in the water. There are opportunities to connect them, however additional insights are needed. Due to limited knowledge and research of the flow of litter pathways of in the water, it is not yet possible to make the most informed decision for removal locations. Regarding hotspots and clean-up actions, the known hotspot locations are often the sites of clean-up actions. This mutual interaction is an important point of attention, especially for monitoring, because litter is removed at these locations where monitoring is/ could be taking place.

Recommendations:

- Start by mapping out/ modelling a small area in the Eurregio, and pinpoint the known hotspot, removal, monitoring and clean-up locations in that area. This could serve as a basis for determining suitable removal locations, and as a test for the further elaboration of monitoring, removal and preventive approaches.
- The distribution of different locations over the catchment area of the Meuse and Rhine is an important point of attention. There are certain areas on the map where no (removal) locations are shown. It is however presumed that those locations are present, but the knowledge about them is incomplete. The missing locations should be filled in together with the LIVES partners and people with knowledge from the field for a more complete picture.
- Monitoring and cleaning up/removal are linked. This should be given further attention and could be the base of research and collaboration. Since this connection could lead to economies of scale, cost efficiency and collaboration.
- Connect the natural rhythms of pollution (e.g. during seasonal peak discharge, the quantity of litter increases) to the monitoring strategy. Monitoring and clean-up activities after or during these events, provide reliable and profound information. This should be considered for the monitoring strategy 2022-2027 (building block 5 in this work package).

3) Partners should share in the information flow originating from volunteers & organizations

The majority of the collected information is originating from volunteers and external organizations (e.g. Schone Rivieren). This information is currently the main source, knowledge at an authority level is limited. A shortage of available time and not prioritizing the litter problem in the day-to-day business were mentioned as causative factors. The water management authorities are currently in the process of composing their own monitoring strategy (aforementioned building block 5).

Recommendations:

- Construction of a vision and strategy for structural monitoring (building block 5) in combination with cleaning-up actions and the third-party removal of litter. Whereby the division of roles between government and other parties involved is well elaborated.
- Establish possible opportunities and limitations for collaboration with different parties. Based on opportunities and risks, determine when the authority level has the leading role in monitoring or removal and when deployment of e.g. volunteers is an option.
- Citizen science based on intrinsic motivation cannot be neglected and therefore should be included within the overall monitoring strategy. Hereby, the efforts of the LIVES partners are bound as closely as possible with the efforts of citizen science. In addition, the available capacity and motivation from the volunteers, provides an opportunity to obtain additional information. This information would presumably not become available in the coming years if research was only conducted by water managing authorities, because of required efforts (time wise) and budgets.

4) Innovative methods to further develop and deepen the themes from the hotspot map.

Several innovations have been tested in recent years, such as the pilot in the Meuse near the lock at Borgharen and a recent pilot in the Meuse near Maastricht regarding floating waste. These pilots show an interesting potential when applied as methods for monitoring macro litter in the water system. It is expected that in the coming years a number of innovations will be implemented in the area for monitoring or removal purposes in pilots or definitive concepts.

Recommendations:

- Based on the hotspot map, it is possible to identify locations where removal or monitoring applications can be applied or piloted. Based on the monitoring strategy (building block 5), locations can be named where monitoring will take place. Innovations for monitoring for both floating and waste in the water column, are valuable additions to the current information. Especially insights from riverbanks and hotspot locations of macroplastics waste in water.

5) Collaboration between the various disciplines within the organizations and between the organizations themselves contributes to gaining insights

The responsibility for identifying hotspots and organizing monitoring, clean-up campaigns and removing litter appears to be divided within many departments, teams and officials within the organizations involved, as became apparent during the interviews.

At the Limburg Water Board and Vlaamse Waterweg, the local managers and dike keepers play an important role between policy and practice. They are the so-called 'eyes in the field'. This division makes bundling the information in the right way labor-intensive and often person-dependent; there is no common goal or a coordinated approach, which means that important insights are not available or are only available to a limited extent. Frequently mentioned initiatives such as Schone Rivieren appear to be strongly connecting different organizations (e.g. there is considerable collaboration between organizations concerned with the Flemish and Dutch parts of the Meuse) and offer insight and inspiration. However, limited capacity and different priorities mean few opportunities for structural action, partly due to the lack of clear policy and frameworks.

Recommendations:

- A joint responsibility for registering information in an (open access) database contributes to the bundling of information and knowledge in and between organizations. This open access data system is also an element of work package 1.
- In addition to the methods and techniques, the monitoring strategy (building block 5) should also provide insight into the time, commitment and resources required so that these can be secured. This makes it possible to record the hotspots, monitoring results and information about waste removal in aforementioned database.

Appendix

Appendix 1: Methods

Different methods of data collection have been used for the construction of the hotspot map. As previously stated, there was collaboration between the different projects for the data collection, for efficiency reasons. The figure below gives an overview. Through the other projects (e.g. interviews carried out by other LIVES partners), additional digital data was collected and added. This makes for a transparent process in which every partner was able to use the same information.

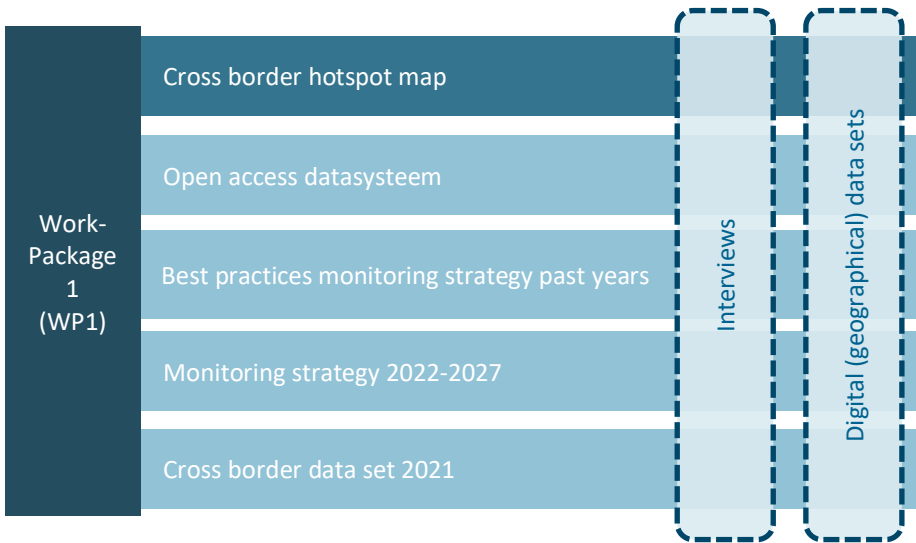


Figure 9: Overlap in data collection from the different projects in work package 1

Interviews and questionnaire

Interviews with LIVES participants were conducted in November and December of 2021. The LIVES project consists of a broad alliance between regional authorities and stakeholders. The figure below shows the 10 partners, and 3 associated partners of LIVES.



Figure 10: Participants and associated partners of the LIVES project

Overview of known plastic hotspots in the catchment area of the Meuse

A review and digital map of the known hotspot, removal, clean-up and monitoring locations in the catchment area of the Meuse (NL/BE/DE)

project number 0473971.100

December 23, 2021 revision 2

Rijkswaterstaat



Together with the other projects from WP 1, a joint questionnaire was composed for the interviews. The questions were about the topics as told in the introduction, differing from hotspot locations to previously used monitoring methods and questions related to data. Consequently, through using this combined questionnaire, information and insights for each project could be collected even though not every project partner was present at each interview. Interviews were conducted online (Microsoft Teams) and recorded. Both the recordings and notes were then shared between all the building blocks. This made for an efficient way of questioning all the regional authorities, stakeholders and associated LIVES partners as shown in figure 10.

Data collection and processing

The data used for the hotspot map was mainly provided by the organizations shown in figure 10. It was either received as written information (e.g. in a report, factsheet or news article), open geographical data sources (like digital online maps) or geographical data files (e.g. shapefiles or Geoweb) which were shared or collected. Not all the data received by the LIVES partners has been entered in the final hotspot map. This due to intellectual property (IP) and property rights. The hotspot map was constructed in ArcMap.

Not all the locations from the hotspot map have a written/ or data source. A number of hotspot locations were known by the interviewees, but have not been researched, observed or monitored to quantitatively determine they are hotspots. They are hotspot locations based on expert opinion.

Appendix 2: Interviews

Partner or associated partner	Category	Organisation	Noria sustainable Innovators	Antea Group	Tauw	2bprojects
Partner	Water managing authority	Provincie Limburg - NL	07-12-2021	07-12-2021	07-12-2021	06-12-2021
Associated Partner	n/a	IVN natuur educatie				short conversation instead of full interview
Partner	Water managing authority	Rijkswaterstaat Zuid Nederland	07-12-2021	07-12-2021	07-12-2021	
Partner	Water managing authority	Rijkswaterstaat Zuid Nederland	16-11-2021		16-11-2021	
Partner	Water managing authority	Rijkswaterstaat Zuid Nederland	16-11-2021		16-11-2021	
Partner	Water managing authority	Rijkswaterstaat Zuid Nederland				02-12-2021
Partner	Water managing authority	Rijkswaterstaat Zuid Nederland	25-11-2021	24-11-2021		
Partner	Water managing authority	Vlaamse Waterweg				
Partner	Garbage processor	OVAM	24-11-2021	23-11-2021	23-11-2021	
Partner	Water managing authority	Waterschap Limburg				
Partner	Water managing authority	Waterschap Limburg	30-11-2021	30-11-2021	30-11-2021	29-11-2021
Partner	Water managing authority	Waterschap Limburg	30-11-2021	30-11-2021	30-11-2021	29-11-2021
Partner	Water managing authority	Vlaamse Milieu Maatschappij	21-12-2021			
Partner	Water managing authority	Wasserverband Eifel Rur	26-11-2021		03-12-2021	short conversation instead of full interview
Partner	Educational institution	Open Universiteit Heerlen				
Partner	Educational institution	Zuyd Hoge School	02-12-2021			02-12-2021
Partner	Water managing authority	RWTH Aachen				
Partner	Water managing authority	RWTH Aachen				
Associated Partner	n/a	Regionaal Landschap Kempen en Maasland			08-12-2021	

Overview of known plastic hotspots in the catchment area of the Meuse

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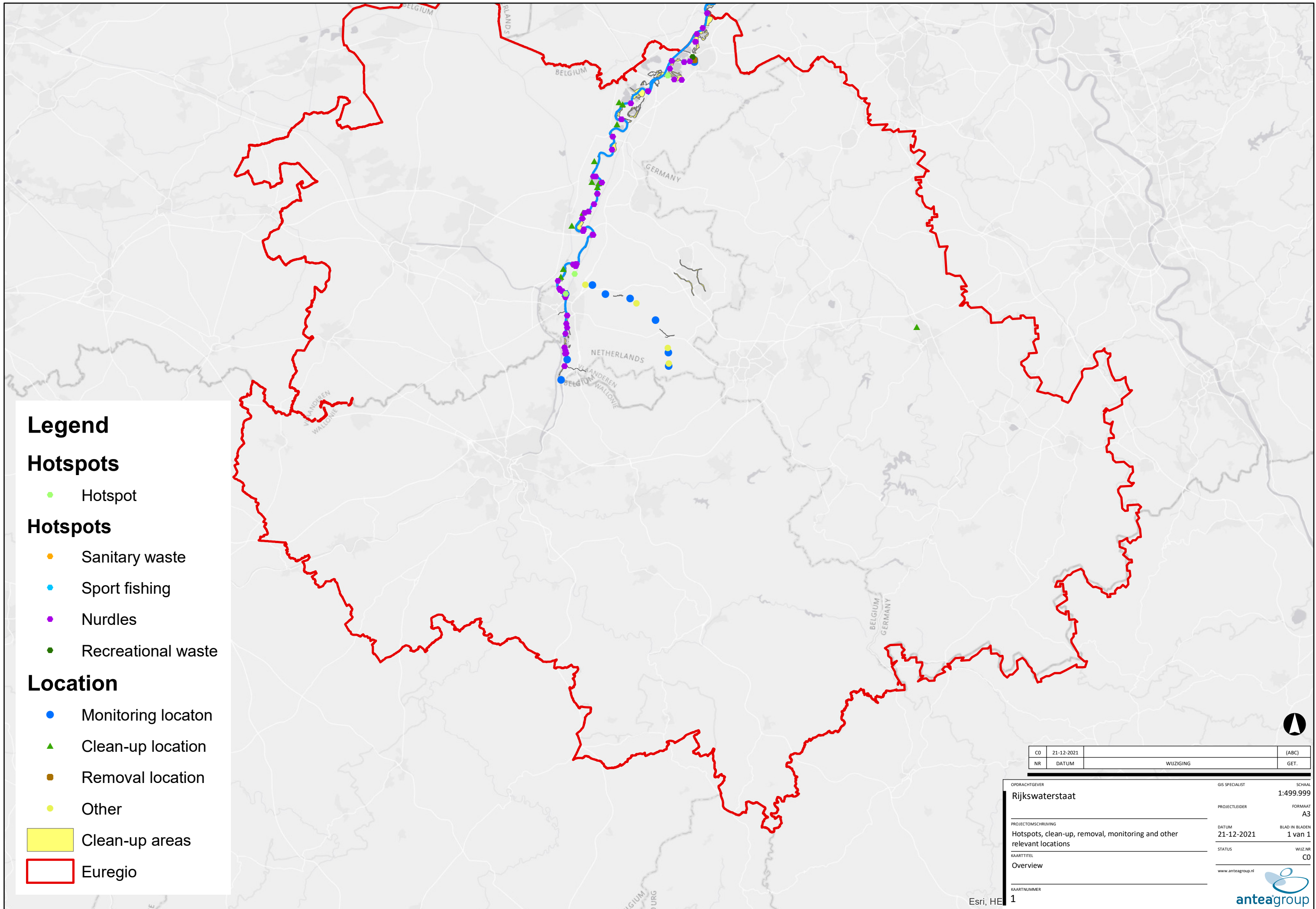
Rijkswaterstaat

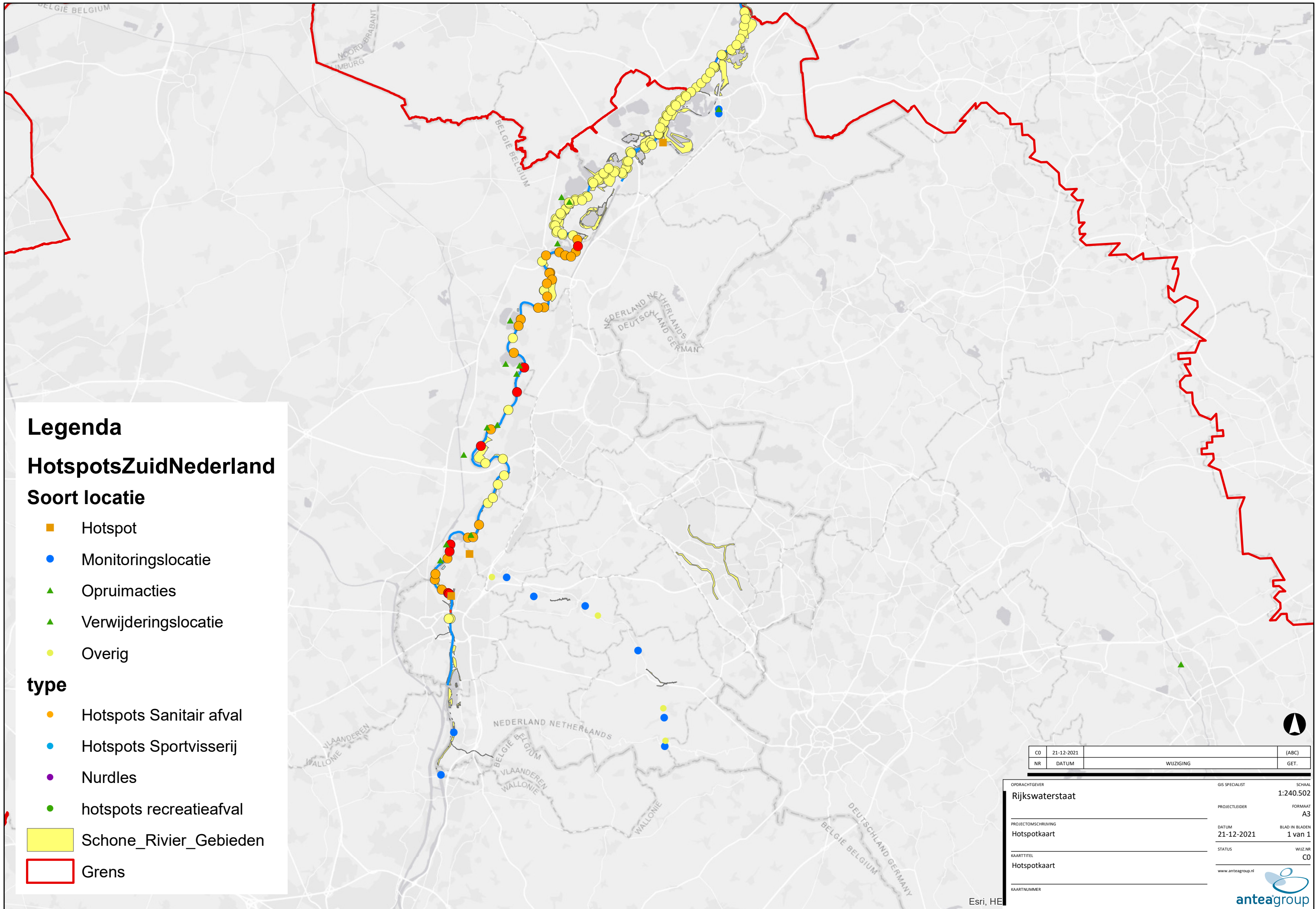


Appendix 3: Maps

The following maps are included:

- #1: Overview
- #2: Overview zoomed
- #3: Hotspots
- #4: Cleanup locations
- #5: Monitoring
- #6: Removal locations



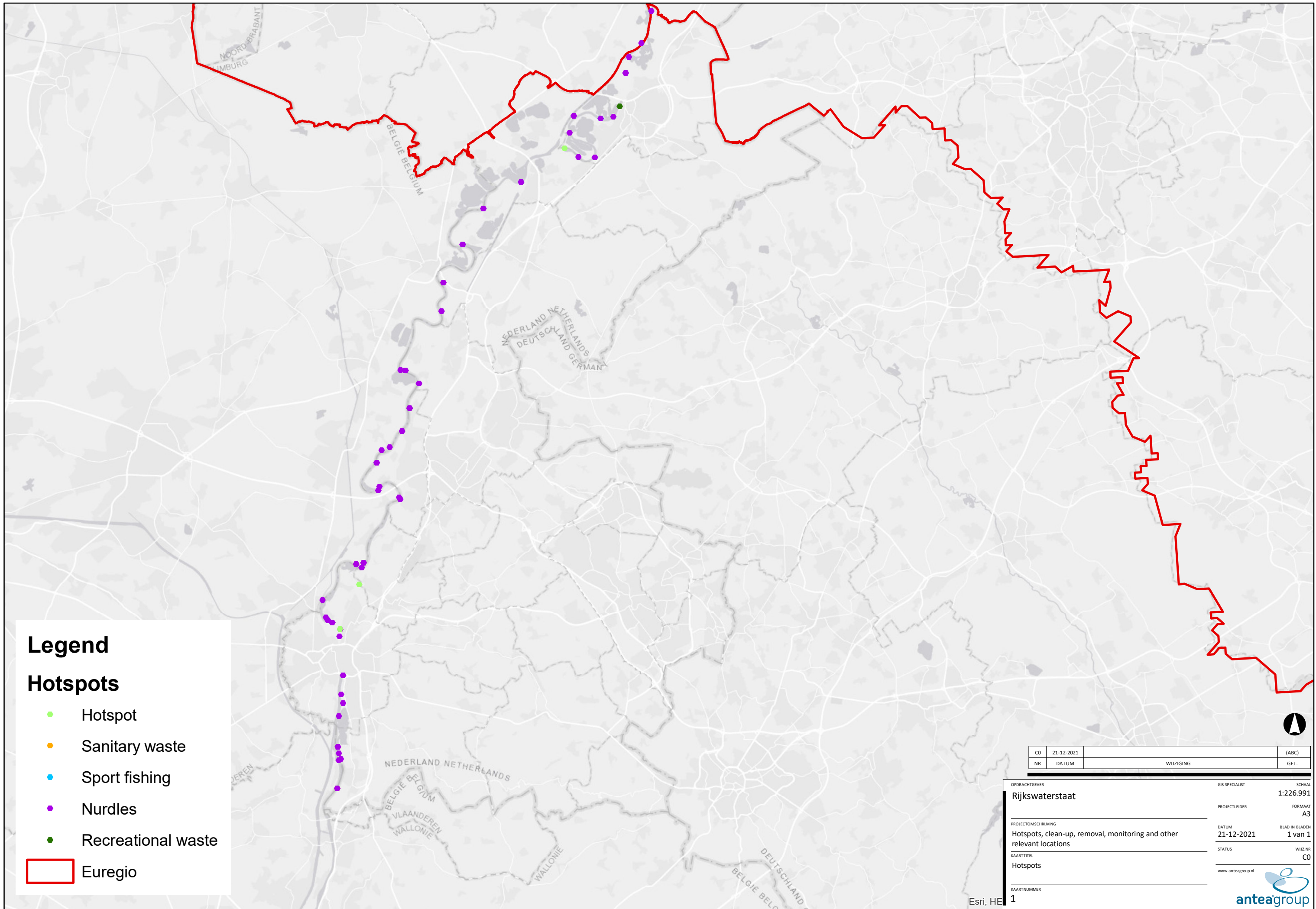


CD	21-12-2021		(ABC)
NR	DATUM	WIJZIGING	GET.

OPDRACHTGEVER	Rijkswaterstaat	GIS SPECIALIST	SCHAAL	1:240.502
PROJECTLEIDER		FORMAAT	A3	
PROJECTOMSCHRIJVING	Hotspotkaart	DATUM	21-12-2021	BLAD IN BLADEN
KAARTTITEL	Hotspotkaart	STATUS		1 van 1
KAARTNUMMER		WIJZ.NR	C0	
		www.anteagroup.nl		



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Legend

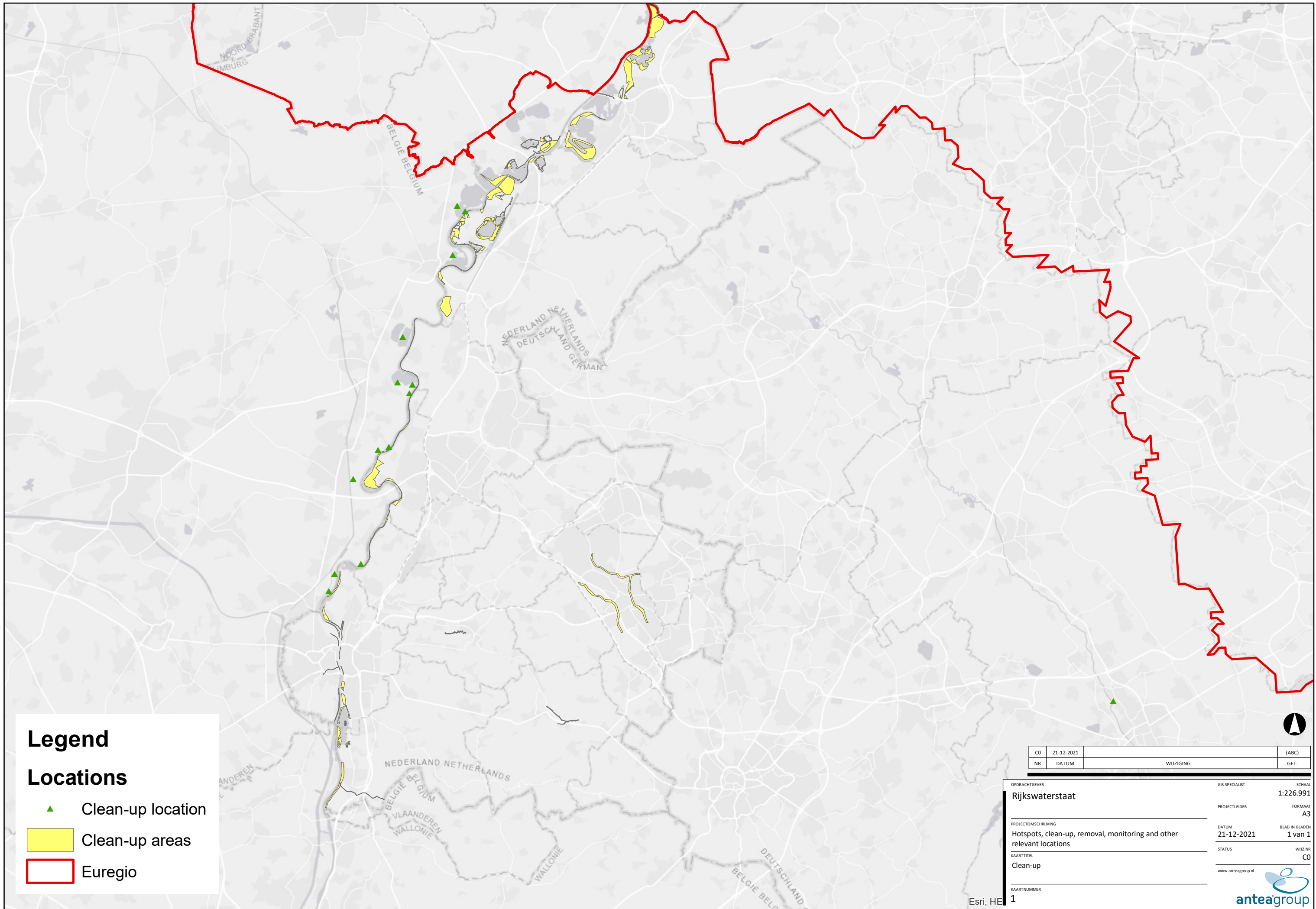
Hotspots

- Hotspot
- Sanitary waste
- Sport fishing
- Nurdles
- Recreational waste

Euregio

CD	21-12-2021		(ABC)
NR	DATUM	WIJZIGING	GET.

OPDRACHTGEVER	Rijkswaterstaat	GIS SPECIALIST	SCHAAL	1:226.991
PROJECTLEIDER		FORMAAT	A3	
PROJECTOMSCHRIJVING	Hotspots, clean-up, removal, monitoring and other relevant locations	DATUM	21-12-2021	BLAD IN BLADEN
KAARTITEL	Hotspots	STATUS		1 van 1
KAARTNUMMER	1	WIJZ.NR	C0	
		www.anteagroup.nl		



Legend

Locations

- ▲ Clean-up location
- Clean-up areas
- Euregio

CD	21-12-2021		(ABC)
NR	DATUM	WIJZIGING	GET.

OPDRACHTGEVER: **Rijkswaterstaat** GIS SPECIALIST: **1:226.991** SCHAAL

PROJECTLEIDER: **FORMAAT** A3

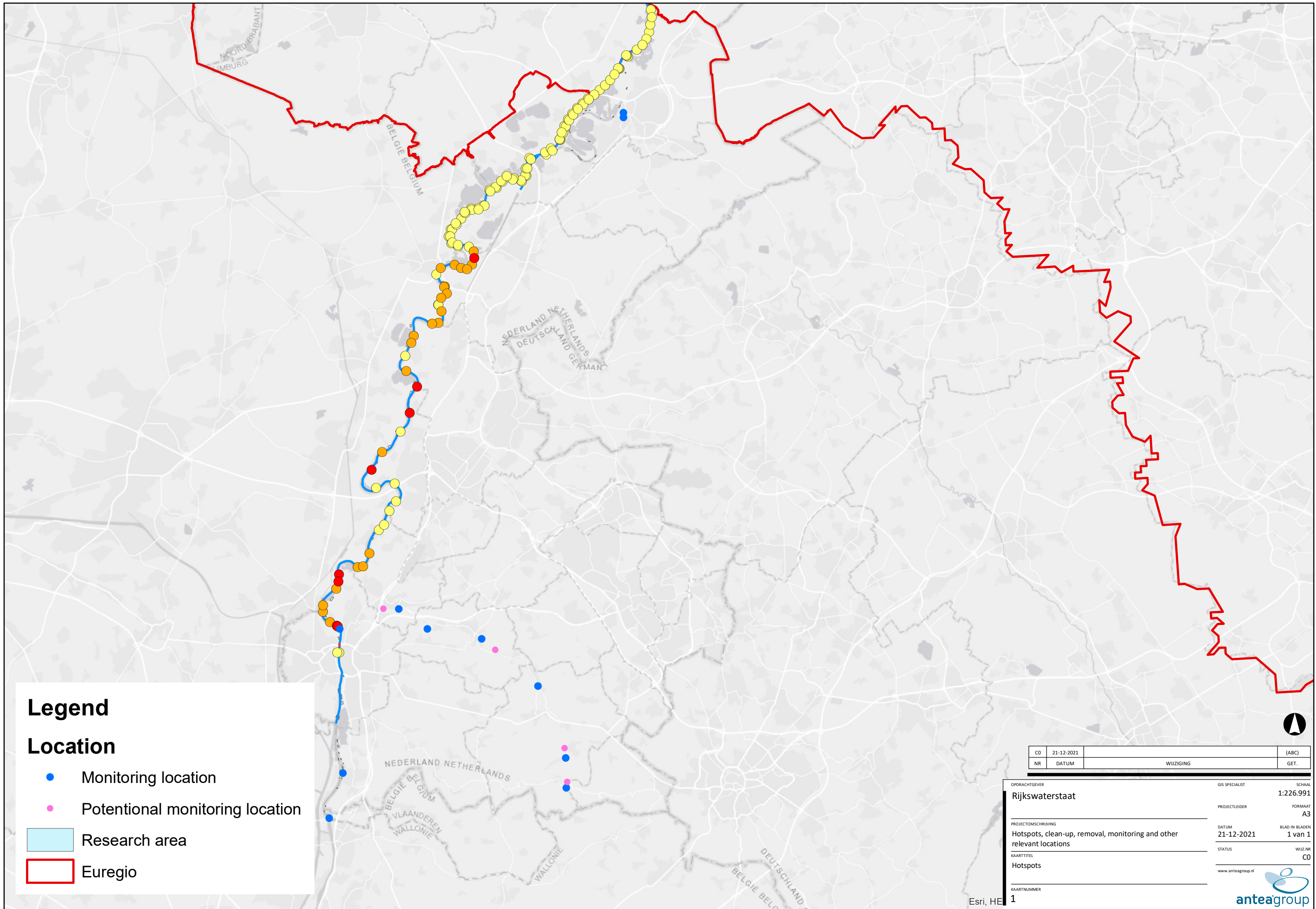
PROJECTOMSCHRIJVING: **Hotspots, clean-up, removal, monitoring and other relevant locations** DATUM: **21-12-2021** BLAD IN BLADEN: **1 van 1**

KAARTTITEL: **Clean-up** STATUS: **WIJZ.NR** C0

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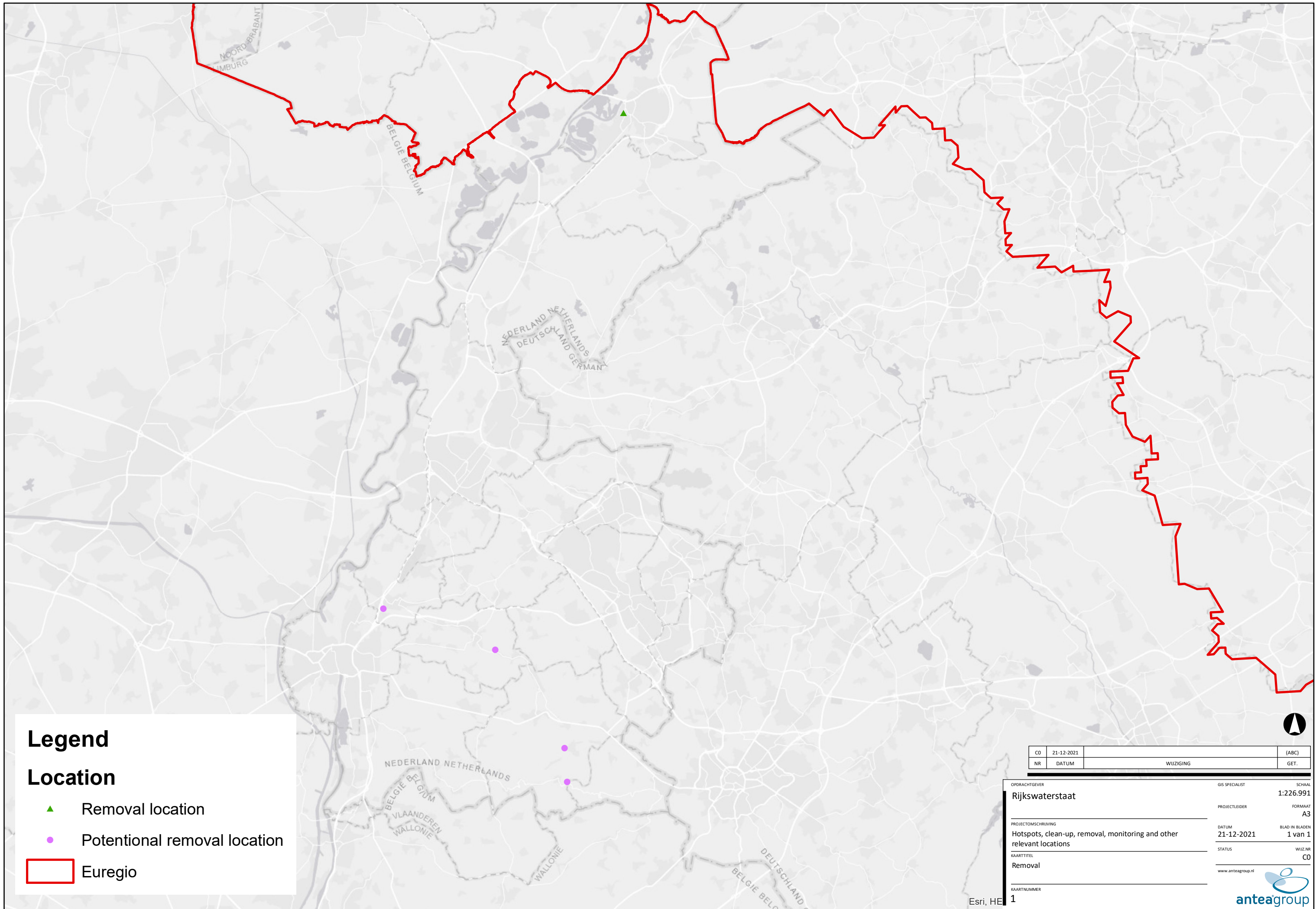
Legend

Location

- Monitoring location
- Potential monitoring location
- Research area
- Euregio

CD	21-12-2021	(ABC)
NR	DATUM	GET.
		WIJZIGING

OPDRACHTGEVER	Rijkswaterstaat	GIS SPECIALIST	SCHAAL	1:226.991
PROJECTOMSCHRIJVING	Hotspots, clean-up, removal, monitoring and other relevant locations	PROJECTLEIDER	FORMAAT	A3
KAARTITEL	Hotspots	DATUM	21-12-2021	BLAD IN BLADEN
		KAARTNUMMER	1	1 van 1
		STATUS	WIJZ.NR	C0
		www.anteagroup.nl		



Legend

Location

- ▲ Removal location
- Potential removal location
- Euregio

CD	21-12-2021	(ABC)
NR	DATUM	GET.
		WIJZIGING

OPDRACHTGEVER	Rijkswaterstaat	GIS SPECIALIST	SCHAAL	1:226.991
PROJECTLEIDER		FORMAAT	A3	
PROJECTOMSCHRIJVING	Hotspots, clean-up, removal, monitoring and other relevant locations	DATUM	21-12-2021	BLAD IN BLADEN
				1 van 1
KAARTITEL	Removal	STATUS	WIJZ.NR	C0
		www.anteagroup.nl		
KAARTNUMMER	1			

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