Achieving healthier water quality in urban small rivers of the Baltic Sea catchment by restoration of water bodies and preventing of nutrients and hazardous substances inflow from watersheds

Deliverable D.I1.1.1 "Report on preparations for investments"

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1. Introduction

This document summarizes the preparations for investments within the HEAWATER project as of August 2019. Investments here refer to the design and construction of pilot solutions in the project cities Söderhamn, Tallinn, and Turku. The pilot investments aim to demonstrate the capability of technical or nature-based solutions to improve stormwater management, mitigate negative impacts of pollutants and nutrients being carried as surface runoff to urban streams, as well as flood risk originating from high discharge during cloudburst events.

A range of potential solutions for each city-specific problem has been reviewed earlier (see O.T.1.1). Subsequently, the most suitable solutions have been selected and developed further. To implement, i.e. construct, the solutions various steps are required: 1) Site selection, 2) assessment of site-specific environmental conditions, 3) application for potentially needed permits, and 4) selection of external expertise for design and construction works. The progress with these preparatory works is documented for each city in the following sections.

2. Söderhamn - Selection of pilot sites and solutions

Name of project partner: Söderhamn Municipality

Type of pilot investment: Vegetated detention pond/multifunctional area and biofilter

Place of implementation: Söderhamnsån, City of Söderhamn

Within the HEAWATER project, the City of Söderhamn is planning and building two separate stormwater management solutions: one vegetated detention pond serving as multifunctional area and a biofilter.

The following actions have been taken for the planning and design phase prior to the construction of the solutions: 1) pre-studies to select the optimal site of implementation, 2) assessment of needed permits, 3) application for permits, 4) tendering for design, 5) tendering for construction.

2.1 Background: Söderhamn and its impact on the river

Söderhamn will celebrate its 400-year anniversary in 2020. The area around Söderhamn River has been populated for a long period and the river played an important role for the inhabitants as harbour, for transport, fishing, trade and industry. These human activities have affected the river in multiple ways.

The river runs through a relatively flat landscape with few lakes that can reduce variations in flow. A large part of the river-catchment is cultivated landscape with soils that are prone to erosion. This causes high nutrient and suspended solid loads in the river. Already to-date the river is flooding frequently which is expected to increase due to climate change-induced increases of precipitation.

To mitigate the negative impacts of stormwater runoff, such as flooding and nutrient loading, a vegetated detention pond and a biofilter will be constructed. Both solution will integrate well in the existing cityscape and land use.

The vegetated detention pond will reduce the peak flows and clean the stormwater before it reaches the Söderhamn river. Further, it will reduce the peak discharge in the stormwater pipes. During dry periods, the area can be used for other purposes such as recreation or as a playground.

The second pilot solution to be built in the city is a biofilter. The biofilter will reduce the peak flows and clean the stormwater before it reaches the Söderhamn River. It will also reduce the loads of water in the stormwater pipes and add aesthetic values to the site.

2.2 Previous river monitoring and analyses

The river of Söderhamn has been monitored since long within the coordinated recipient control done by Ljusnan-Voxnan Waterboard. The results show that Söderhamn River does not reach good ecological status due to too high nutrient, mainly phosphorous, and suspended matter loads. However the, ordinary sampling program does not provide a complete description of the water status. To be able to propose and assess appropriate measures a more extensive sampling and testing was done between August 2016 and 2017. Storm water samples will be analysed later this year.

2.3 Selection of pilot sites

The process of selecting site for construction started with a survey to find sites in Söderhamn with a stormwater problem. These sites were then analysed deeper and a number of important variables were

identified. The variables were weighed together and added to a chart by all project members. The sites that received the highest scores were chosen.

Considered variables and questions included: does the municipality own the land? is it part of any planned program that was limiting the planned actions?, cost-benefit-analysis, effect of construction, low point mapping, risk for flooding, capacity of stormwater system, green area factor, pedagogic values, places were stormwater are under risk of being polluted by traffic or other sources, design, general hinders and possibilities.

2.3.1 Vegetated detention pond

Brädgårdsgatan, northern side. The site collects water from the street that is most affected by traffic in Söderhamn and a ridge situated north of proposed site. There is small green field that can be used as a detention pond but also for recreation during dry periods.

2.3.2 Biofilter

The site Apotektsgatan/Jazzparken was chosen because it is a low point in the centre of the city were flooding occur during heavy downpours. It is situated next to the intersection with highest traffic and cleaning of the stormwater will improve the quality of the stormwater that otherwise would discharge straight to the Söderhamn River. As added value the aesthetic value will increase.

2.4 Permissions

The required permits and the permitting processed for both, the vegetated detention pond/multi-functional area and the biofilter are similar. The following aspects had to be considered:

Agreement with landowner	Not necessary, land owned by Söderhamn Municipality
Building permit	Not necessary
Land permit	Not necessary
Intrusion into ancient monument	County Government, applied April 5 2019

The central part of the city of Söderhamn is classified as ancient monument and therefore a permit for “Intrusion into ancient monument” has to be applied before any sort of constructions including ground works are started. The permission “Intrusion into ancient monument” has been applied for and is expected to be handled by late summer 2019.

Further, the “Bygg- och Miljönämnden” that issues building and land permits has been contacted. It was confirmed that no further permits are necessary since the ground level will not be changed much. The municipality owns the land and therefore no agreement is necessary. The Traffic engineer and the Street- and Park manager have been informed about the constructions and had no objections.

2.5 Selection of technical solution

The city of Söderhamn will implement two pilot solutions. The solutions will be tendered and designed individually. A sub-contractor will examine and propose the most cost-efficient and technically most suitable solution for both pilot solutions.

2.5.1 Vegetated pond

The exact technical design will be clear when the procurement is done. We will build a vegetated detention pond that will collect and delay stormwater during downpours. The stormwater will also be cleaned from residues from traffic. During dry periods, the area can be used for other purposes as recreation or as a playground.

2.5.2 Biofilter

The exact technical solution will be clear when the procurement is done. We will build at least one raingarden but has left open for the possibility to build one more. Permeable surface might be added if it will improve the situation at the site and is economically possible.

2.6 Tender for design works

Söderhamn Municipality cooperates with Inköp Gävleborg (Purchase Gävleborg). It is an organisation where ten municipalities work together with procurement and the signing of agreements with companies.

For a workload below 200 hrs any actor may be chosen that has a framework agreement and the appropriate competence. Concerning the competence it should be ensured that the actor has:

- unique competence for the procurement
- experience and education for the project
- be available and able to deliver on time

For the HEAWATER procurement, Tyréns AB has been chosen since Inköp Gävleborg has a framework agreement with them and they fulfil the requirements asked for. Procurement for design is ordered and will be done before end of August.

2.7 Tender for construction

For the construction of the detention pond and biofilter, two further tendering processes will be used. Inköp Gävleborg will still be used but least three offers will be asked for. Procedure will start as soon as the tendering for the design is ready.

As far as known to date, the design and implementation of the pilot solution will follow the proposed schedule.

3. Tallinn - Selection of pilot sites and solutions

Name of project partner: Tallinn Urban Environment and Public Works Department

Type of pilot investment: Constructing bank protection

Place of implementation: Mustjõgi River, Tallinn City

The City of Tallinn will implement a solution that prevents bank erosion of the Mustjõgi River and supports the restoration of the stream. To identify the best solution and its place of implementation and to obtain all required permits for the pilot implementation, the following steps had to be considered: 1) assessment of the environmental status and possible problems in potential pilot streams, 2) selection of principle technical solutions, 3) initiation of a complex permitting process, 4) tendering for a design solution, 5) tendering for the construction.

3.1 Background

Mustjõgi is one of 16th rivers in the City of Tallinn. People have altered the river since 17th century, either through changing land management or by channelling the river. The majority of the river catchment consisted of meadows until the end of the 19th century. Since the beginning of 20th century, due to urbanization, the rural area was replaced by the current cityscape. During that times population density increased rapidly but the sewage system construction was delayed during the soviet times. For this reason, Mustjõgi River functioned as sewage drain for many years.

Now most of the river is piped, except the last 1.3 km before the river enters Kopli Bay, the Baltic Sea. Today the river functions mainly as a stormwater drain.

3.2 Previous monitoring, analyses, and restauration works

River water quality was included into the state's permanent monitoring programme in 1990s. The records indicate distinct periods with different trends in water quality. These trends seem to be linked to the shift in society at the beginning of the 1990s and economical fluctuations. A more detailed description of the river status, including scientific analysis, will be given in the project work package "Implementation" (August 2019).

Previous studies and investigation on Mustjõgi River include environmental studies like geological and hydrological surveys, as well as engineering studies. In 1996, engineers considered different options like the construction of a concrete canal or conversion of the river into a pipeline. However, any of the considered solutions were regarded as disproportionately expensive and associated with too many environmental risks.

In 2007, a design study considered a range of options to address mainly two problems: bank erosion and low water-carrying capacity. Because of the specific and unique milieu of the banks of Mustjõgi River, a major requirement was to maintain the natural appearance of the river. There are many bank protection types but only traditional river engineering techniques were under consideration: timber piling, geotextile with flint stones, and concrete blocks. Timber piling was selected as the best solution. The design project was completed but due to lack of funding, the construction work was not completed.

In 2014, the Mustjõgi drainage basin survey was carried out. The survey aimed to characterise the water regime of the basin: main inflows, see level effect on the water level of the river, stormwater management,

land use, and primary causes of flooding. Further, engineers sketched a design for a sedimentation basin with a hydro-engineering complex on River Mustjõgi to prevent impacts of see level rise. However, the plans did not proceed.

3.3 Selection of pilot sites and definition of main objectives

The Mustjõgi River was selected as pilot stream for restoration activities for the following reasons:

a) Bank erosion has been considered one of the most urgent problems, which needs solution. Some buildings on the bank of the river are endangered. Bank erosion favours high water turbidity in the river.

b) Alluvial deposits. Increasing hydraulic load and low maintenance of the river has caused accumulation of the alluvial deposits. This causes a low water-carrying capacity and release of phosphorus from alluvial deposits.

c) Poor river water quality affects local community and the public beach of Stroomi, at the Baltic Sea. This is one reasons for the beach not, yet, having received a Blue Flag status.

d) River Mustjõgi is prone to flooding because imperviousness increases in the catchment. Therefore, hydraulic load increases, which triggers more intensive bank erosion.

The specific aim of the actions carried out in HEAWATER is to decrease water turbidity and total phosphorus concentration up to 10 % in River Mustjõgi.

3.4 Selection of technical solutions

The major degree of restoration that may be achieved within HEAWATER, as well as the potential pilot site were decided in a meeting on 17 April 2018. Meeting minutes are documented in Estonian. The meeting included participants from Tallinn University of Technology, Tallinn Municipal Services Department, and Tallinn Environment Department. The decision making process was based on all past surveys/data records/designs on River Mustjõgi.

Initially two pilot investments were planned for the HEAWATER project: bank protection and wetland construction. However, for budgetary restrictions, it was decided to proceed only with the construction of bank protection measures and removal of alluvial deposits. Bank protection will decrease erosion and therefore water turbidity. Bank protection with removal of alluvial sediments and the reconstruction of the “Ojaveere” culvert will decrease the riverbed roughness coefficient and increase the water-carrying capacity. Flooding risks should be minimized as well.

After discussion, it was concluded that the wetland construction is also not feasible because of flooding risk. At the place where the wetland was supposed to be constructed, the river suffers from storm surges and the surrounding area is designated as a flood prone area. Therefore, the wetland efficiency will remain low. Also the option to construct a sediment was discussed but discarded for HEAWATER. Yet, the City of Tallinn will consider the construction of a sedimentation pond later. The change in activities by the City of Tallinn (TKKA) was presented as the first modification request to the Central Baltic JS/MA and approved on 19 November 2018.

During the meeting on 17 April 2018, also the final pilot site was decided. Two options were considered: either downstream or upstream of Paldiski road. As the downstream area is a flood risk area, it was decided to protect bank from Mustjõgi-Marja crossroad to the Paldiski road, altogether about 700 m.

3.5 Permissions

Table 1: Permits for construction work in the water bodies of Estonia

Permit type	**Is it obtained : *yes/no/in progress***
Application for design specifications	Yes
Construction permit	Yes (21st of June 2019)
The permit for the special use of water	Yes(1 st of August 2019)
Preliminary Environment Impact Assessment	Yes (January 2019) (no assessment is needed)
Permit for cutting trees in water protection zone	Yes (1st of August 2019)
Permit to cut trees	In progress

3.5.1 A short overview of applying permissions for construction works

The permitting process in Estonia is very complex, therefore a short overview is provided below to illustrate why obtaining all required permits is time consuming within a three-year project.

1. The overall process starts with the **application for design specifications**. It provides important instructions to the engineer for the design work.

2. With the preliminary design (outline design), it is possible to start applying for the **construction permit**.

3. Three options exist to start a **preliminary environmental impact assessment (EIA)** which is mandatory to obtain a water permit:

1) The applicant itself will present a preliminary EIA (e.g. consulting firm)

2) The municipality will make the assessment. When the construction permit is in progress, the environmental expert of the municipality carries out the preliminary assessment;

3) The Estonian Environmental Board will do the assessment. In this case, permit-applicant starts the process by applying for a permit for the special use of water;

All national institutions (local municipality and Estonian Environmental Board) have to approve the preliminary EIA.

<u>The preliminary EIA results may be:</u>

a) **EIA will not be initiated** because there is no large impact on the environment – water permit issuing can continue. Usually after this, the permit is granted.

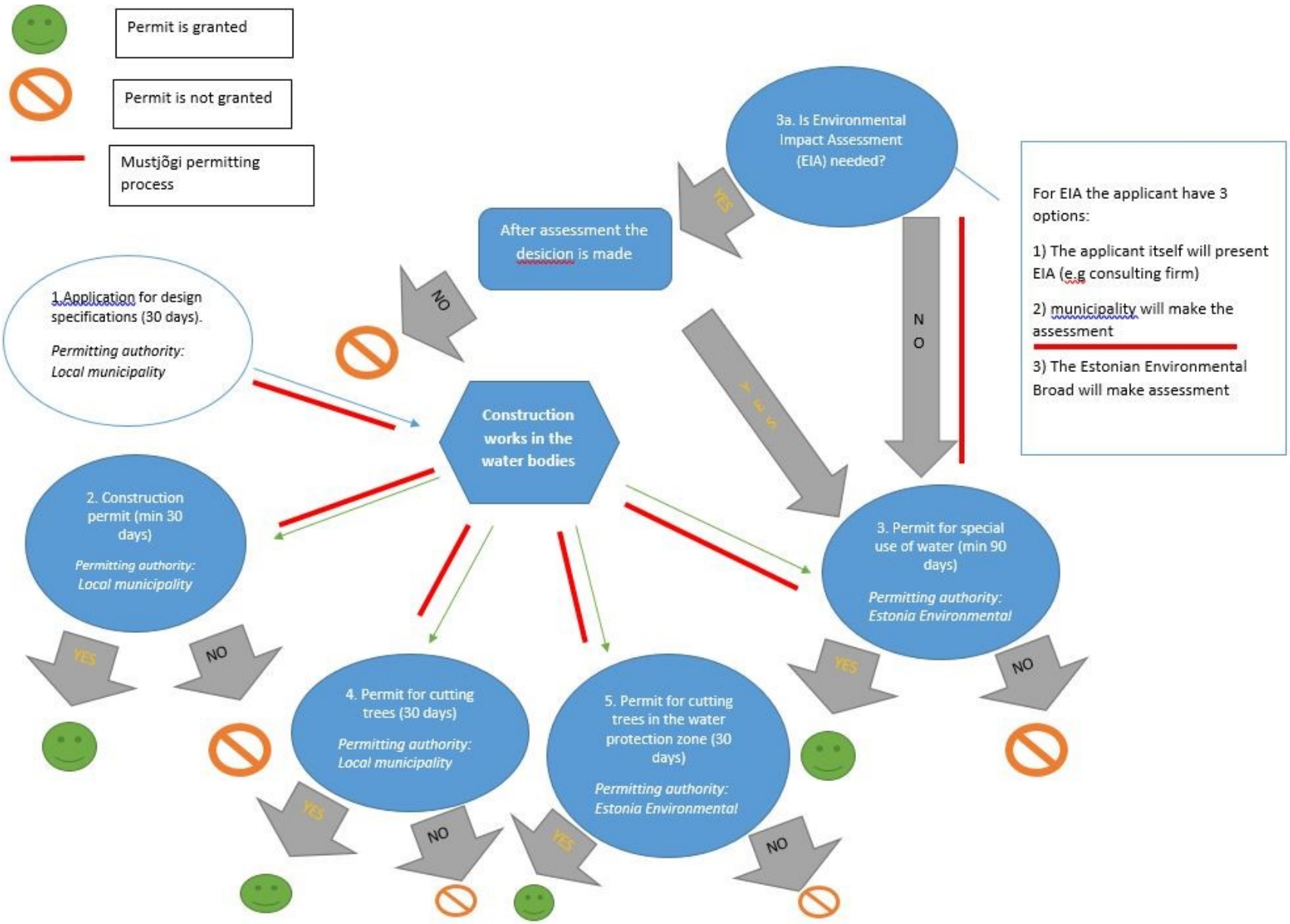
b) **EIA needs to be initiated** to investigate the impact of the planned construction work – the entire process takes about 1.5 years. It may have two results: 1) the permission is granted with obligatory actions (extra measures, etc.) or 2) the negative impact on the environment is significant and the action will not allowed to be implemented – permit is not issued.

4. When planning any kind of construction work in water, the **permit for the special use of wate**r needs to be applied for. The permit issuing process will include the preliminary EIA results (see 3) above).

5. If there is a need **to cut trees in water protection zone, a special** permit is needed from the Estonian Environmental Board.

6. To have **the right to cut trees** overall, the permit from local municipality is needed.

The scheme below illustrates the permitting process for the works planned at Mustjõgi River.


Permit is granted
Permit is not granted
Mustjõgi permitting process
1.Application for design specifications (30 days).
Permitting authority: Local municipality
Construction works in the water bodies
2. Construction permit (min 30 days)
Permitting authority: Local municipality
3a. Is Environmental Impact Assessment (EIA) needed?
YES
NO
After assessment the desicion is made
YES
NO
3. Permit for special use of water (min 90 days)
Permitting authority: Estonia Environmental
YES
NO
4. Permit for cutting trees (30 days)
Permitting authority: Local municipality
YES
NO
5. Permit for cutting trees in the water protection zone (30 days)
Permitting authority: Estonia Environmental
YES
NO
For EIA the applicant have 3 options:
1) The applicant itself will present EIA (e.g consulting firm)
2) municipality will make the assessment
3) The Estonian Environmental Broad will make assessment

3.6 Design and construction of the pilot solutions

The design and construction of the pilot solutions require external expertise. Below the relevant tendering processes are detailed.

3.6.1 Tender for design work

According to the tendering process-rules at Tallinn Environment Department, at least three offers need to be requested. Offers were asked from six potential service providers and two offers were received subsequently. The cheapest offer was accepted and contract signed on 12 September 2018.

The design work for the solutions at Mustjõgi included multiple design phases because of the project's complexity. Preliminary design and detailed design were done and approved at the Tallinn Municipal Services Department.

During the preliminary design phase, two alternatives were considered: riprap and timber piling. The riprap method was chosen as the most suitable option due to its sustainability in these particular conditions.

According to design and project plan, gabions and mattresses will be used which are rectangular wire boxes filled with small stones, stacked on steep slopes. These are expected to provide higher resistance in the velocity range of 2-5 m/s.

By now, the detailed design project is completed and has been paid out.

3.6.2 Public building

Tallinn Environment Department as awarding authority opened a call for proposals for the construction of bank protection measures at Mustjõgi during mid-May 2019. On the final day for submission of tenders (12 June 2019) two offers were received. The procurement outcomes were reviewed. It revealed that the actual costs for building bank protection are nearly twice higher (the cheapest offer 318 000 € + VAT) than we have money in the Heawater project. It was decided to seek financial assistance from the Tallinn City Government. On the Special Session of the City Government on 5th of July 2019, it was decided to allocate the amount not covered by the project budget.

On 23rd of July 2019 we signed the building contract. In addition, three offers were requested to get supervision of construction. Offers were asked from ten potential service providers and two offers received. The cheapest offer was accepted and contract will be signed in August 2019.

Preparation works have proceeded according to the schedule.

4. Turku - Selection of pilot sites and solutions

Name of project partner: Turku University of Applied Sciences

Type of pilot investment: Side-stream filters and litter collection

Place of implementation (Name of the water body and municipality)**:** Itäharjunoja/Jaaninoja, Kuninkoja, Topinoja, Turku

Various environmental and anthropogenic pressures, like runoff carrying nutrients and pollutants, littering, and structural modifications such as rectified beds, affect urban streams in Turku. To identify the parameters that are best targeted by the HEAWATER pilot solutions and the optimal site for pilot implementation, old data has been reviewed and new information been collected.

4.1 Background: Impacts on urban streams

The three selected pilot streams in in Turku, Jaaninoja, Kuninkoja and Topinoja, and their tributaries have rather heterogeneous catchments (approx. 14.2 km^2, 4.4 km^2, and 25 km^2 in size). The Jaaninoja and Kuninkoja catchments are dominated by build-up areas, accounting for more than 40% of the catchment, including residential, industrial, commercial, and mixed land uses. The predominant soil type is clay, followed by rock outcrops (ILKKA 2014, NLS, GTK). About 7 % of the Kuninkoja catchment is used for agriculture. Both, land use and soil properties cause high surface runoff coefficients. The main loading are nutrients but also heavy metals from road runoff.

The land use in the Topinoja catchment is mainly agriculture and build-up areas (both approx. 24%). The predominant soil type is clay (63%). Besides nutrient loading from agriculture, soils, and locally road runoff, the stream is affected by a landfill that covers about 6.7% of the catchment.

All streams also fulfil and important function as stormwater channels, that convey large portions of surface runoff. In this respect the Jaaninoja stream is the most important, as parts of its catchment entirely rely on the streams conveyance capacity of for stormwater management. At the same time, the streams, especially Jaaninoja and Kuninkoja, have a high recreational value.

Surveys in all streams indicated locally significant littering along the stream banks. Therefore, capture and removal of litter from the streams has been set as major objective for HEAWATER.

4.2 Previous monitoring and analyses

The three pilot streams have been intensively monitored and surveyed by TUAS during the past decade. Several years of continuous discharge monitoring data is available for Jaaninoja and Kuninkoja, and point data for the Topinoja. Water quality studies concentrated in assessing the suspended matter loads and associated nutrients (Phosphorus and Nitrogen). Further, data on water quality parameters such as pH, electrical conductivity and turbidity are available. Previous monitoring programs showed that robust correlations between in-situ measurements of turbidity and nutrient load may be established as well as those parameters and discharge. Abnormal pH excursions have been monitored in Jaaninoja and its tributary Itäharjunoja. Additional monitoring carried out within the HEAWATER project, indicated local elevations in heavy metal concentrations in Jaaninoja and Kuninkoja as well as slightly increased concentrations of PFAS in Kuninkoja when compared to average background concentrations. All HEAWATER measurements and samplings have been done during dry or base flow conditions.

To study transport processes of the observed litter in the pilot streams, pilot installations of litter traps and fences have been made. The preliminary results indicate that litter transport is bound to short-term high-discharge conditions and wind, primarily during spring when the vegetation cover is sparse.

4.3 Selection of pilot sites

The first tests to collect marco litter with a litter trap and litter fences have been carried out in the Kuninkoja stream new the “Länsikeskus” commercial and residential area.

The first tests of a filter solution targeting the removal of heavy metals and nutrients, shall be carried out in Itaharjunoja, a tributary of the Jaaninoja stream. The preferred test site at the Topinoja stream is in Koroinen, close to its connection to the Vähäjoki stream, that joins Aurajoki.

4.4 Selection of pilot solutions

To reduce the environmental pressures originating from littering and surface runoff, TUAS will pilot three solutions: 1) a floating litter trap, 2) litter collection campaigns, complemented by educational and awareness rising activities, and 3) a filter box that collects nutrients and heavy metals that adhere to micro particles during low-discharge conditions.

4.5 Permissions

All pilot implementations are, or will be, carried out on land that is owned by the City of Turku. Therefore, permits need to be applied only from the City. The permits for the piloting of the litter-trap prototype as well as short-term litter collection using litter fences were obtained from the Environmental department. An application for long-term deployment is pending and will be decided upon the final design of the solutions. Design criteria for both, the litter trap and filter box, were discussed with the Environmental Department. It was decided that priority must be given to maintaining an unobstructed flow and passage for fauna. Further, the design of the filter box was discussed with the City’s Infrastructure Department in August.

As by the end of project period 3, it is expected that no permission for longer deployments of pilot solutions will be denied and developments are proceeding according to schedule.

4.6 Design and construction of the pilot solutions

TUAS will do most of the design and construction work. Some external expertise for manufacturing of parts for the final solutions are needed. The requirements for the external expertise are scheduled to be defined during autumn 2019. A 3-bid process will be followed to select the most competitive supplier.