Interreg Baltic Sea Region

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SUSTAINABLE WATERS WaterMan

Water Recycling Toolbox

Natural stormwater treatment for use in municipal services

Klaipėda District Municipality

Klaipėda University

Real-world pilot replication blueprint

Interreg
Baltic Sea Region

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Introduction to the pilot measure

Natural stormwater treatment for use in municipal services

Klaipėda District Municipality

Klaipėda University

15 March 2023

WaterMan

Promoting water reuse in the Baltic Sea Region through capacity building at local level

Valdas Langas, Vytautas Bernadišius, Jurgita Maračkinaitė

Klaipeda University, Marine Research Institute

Kick-Off-Meeting
Kalmar & Västervik / SE
14-16 March 2023

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Promoting water reuse in the Baltic Sea Region through capacity building at local level

Klaipeda University, Marine Research Institute:

The **Marine Research Institute** is a subdivision of Klaipėda University, conducting fundamental and applied research on marine and coastal environment and maritime technologies. The Institute aims to facilitate science, study, and business cooperation, based on high-level scientific knowledge.

Research groups:

Biological Invasions and Environmental Genetics
Benthic Habitat Ecology
Plankton
Aquatic Biogeochemistry and Ecosystem Functioning
Aquatic Resources, Fisheries and Aquaculture
Coastal and Marine Management
Modelling
Environmental Remote Sensing and Water Quality
Waterborne Transport and Air Pollution
Modern Engineering Systems

Recently completed projects:

WaterMan

Promoting water reuse in the Baltic Sea Region through capacity building at local level

Klaipeda University, Marine Research Institute WaterMan staff

Valdas Langas – overall project management, inputs to project activities, deliverables and outputs

Jurgita Maračkinaitė - financial manager

Vytautas Bernadišius – water engineer, with focus on EIA, trans-municipal water reuse strategy, other issues

Mapping, GIS specialist - to be assigned

Sampling and precipitation specialists - to be assigned

WaterMan

Promoting water reuse in the Baltic Sea Region through capacity building at local level

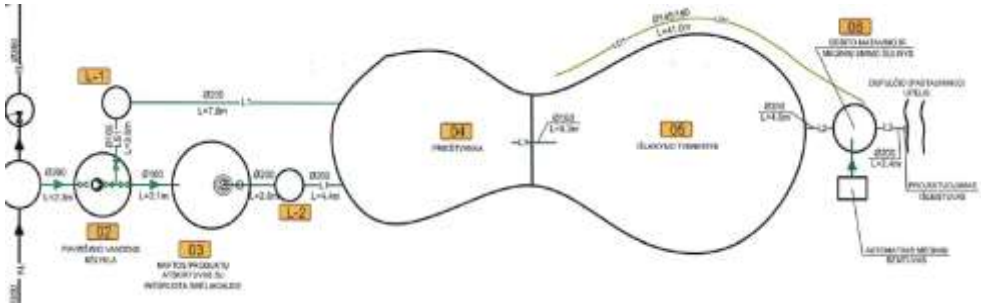
Two implemented partly related projects

WISA-Water Innovation System Amplifier, 2019-2022

The aim was to suggest preventive solutions and to develop and test new technologies to reduce pollution by stormwater from sea ports (Klaipeda, Gdynia, Åhus)

MOMENT-UP – Modern water management in SBR – upgrade project, 2010-2013

Ecological adapted stormwater investments in Kretinga town



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Promoting water reuse in the Baltic Sea Region through capacity building at local level

In WaterMan, LT partners:

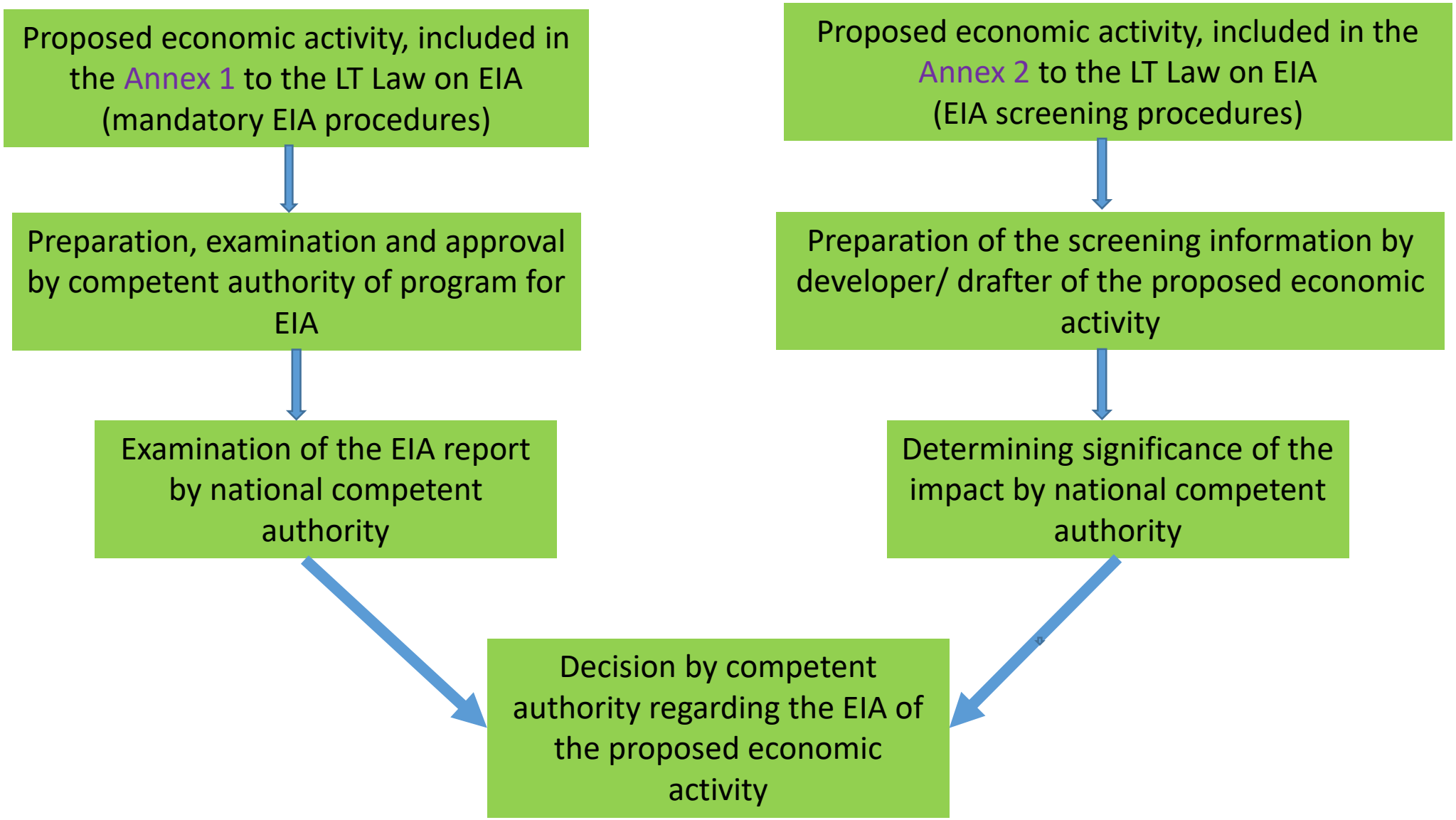
- Administration of Klaipeda District Municipality
- Association of Klaipeda Region
- Klaipeda University

will, among other things:

- Implement a pilot measure on recirculation of retained water in Gargždai town (storm water retention ponds in public areas to utilize water for e.g. firefighting or watering of parks & streets);
- Participate in and contribute to the transnational peer learning process;
- Elaboration of the trans-municipal water reuse strategy for Klaipeda Region

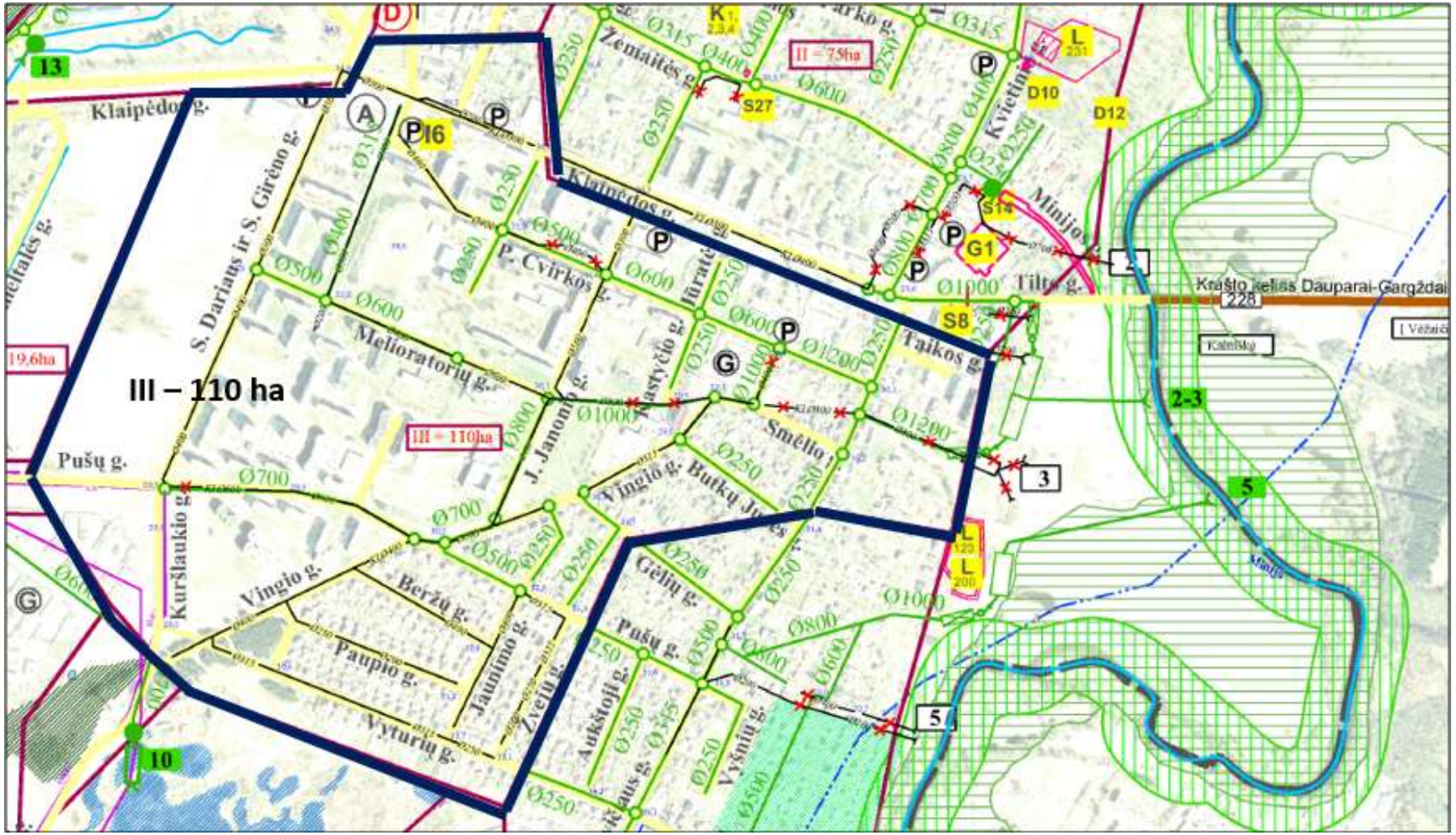
For the implement a pilot measure on recirculation of retained water the starting point is to apply

Procedures of Environmental Impact Assessment in Lithuania (simplified version)



Design and construction of stormwater treatment facilities - retention pond with reuse of retained water

The boundaries of the selected 110 ha storm water drainage area in Gargždai town marked in orange, with outfall no. 3



Preparation of the screening information for planned economic activity/LT project:
Design and construction of stormwater treatment facilities - retention pond with reuse of retained water

Screening shall be conducted in respect of the proposed economic activity included in the list of Annex 2 of LT EIA law, e. g. screening shall be initiated if

Run-off water/stormwater treatment plants (designed for the treatment of the run-off water collected by sewage networks from the area of 50 hectares and more)

The purpose of Screening is to determine whether or not an EIA is required for a particular Project listed in Annex 2

Screening information - description of the likely significant effects of the project on the environment resulting from:

- the size, nature of the proposed project, the construction and demolition works;
- the use of natural resources, in particular land, soil, water and biodiversity, with a focus on species and natural habitats – Natura 2000 sites, considering as far as possible the sustainable availability of these resources;
- the emission of pollutants, noise, vibration, light, heat and radiation, the creation of nuisances, and the disposal and recovery of waste;
- the risks to human health, cultural heritage or the environment (for example due to accidents or disasters);
- the cumulation of effects with other existing and/or approved projects, taking into account any existing environmental problems relating to areas of particular environmental importance;
- the impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change;
- flood risks;
- the technologies and the substances used, etc.

Design consideration of stormwater treatment facilities - retention pond with reuse of retained water

To keep in mind designs' **functionality, cost, safety, and environmental impact**

There are no clearly formulated national requirements for design of retention or detention ponds

International approach:
HELCOM Recommendation 23/5-Rev.1, 2021 *REDUCTION OF DISCHARGES FROM URBAN AREAS BY THE PROPER MANAGEMENT OF STORM WATER SYSTEMS*

For storm water planning:

- the ecosystem services approach should be applied; this means that storm water should be seen as a resource;
- should be catchment area based;
- designed and dimensioned according to future scenarios of climate change;
- for high intensity storm events, secondary runoff paths should be prepared to divert storm water exceeding the storm water systems capacity where appropriate, however the proportion on water released through the secondary runoff paths should preferably not exceed 30% of the total estimated annual volume of storm waters;
- to apply green technologies: to achieve the objectives, different techniques can be used. These techniques are generally categorised under **best management practices (BMPs)** or **sustainable urban drainage systems (SuDS)**, etc.

Design consideration of stormwater treatment facilities - retention pond with reuse of retained water

SuDS are more sustainable than traditional drainage methods because they take account of water quantity (flooding), water quality (pollution) biodiversity (wildlife and plants)**:**

- Manage runoff volumes and flow rates from hard surfaces, reducing the impact of urbanisation on flooding;
- Provide opportunities for using runoff where it falls;
- Protect or enhance water quality (reducing pollution from runoff);
- Protect natural flow regimes in watercourses;
- Are friendly to the environment and the needs of the local community;
- Provide an attractive habitat for wildlife in urban watercourses;
- Provide opportunities for evapotranspiration from vegetation and surface water;
- Encourage natural groundwater/aquifer recharge (where appropriate);
- Create better places to live, work and play.

Design consideration of stormwater treatment facilities -
retention pond with reuse of retained water

Retention pond's design approach recommended by **sustainable urban drainage systems (SuDS):**

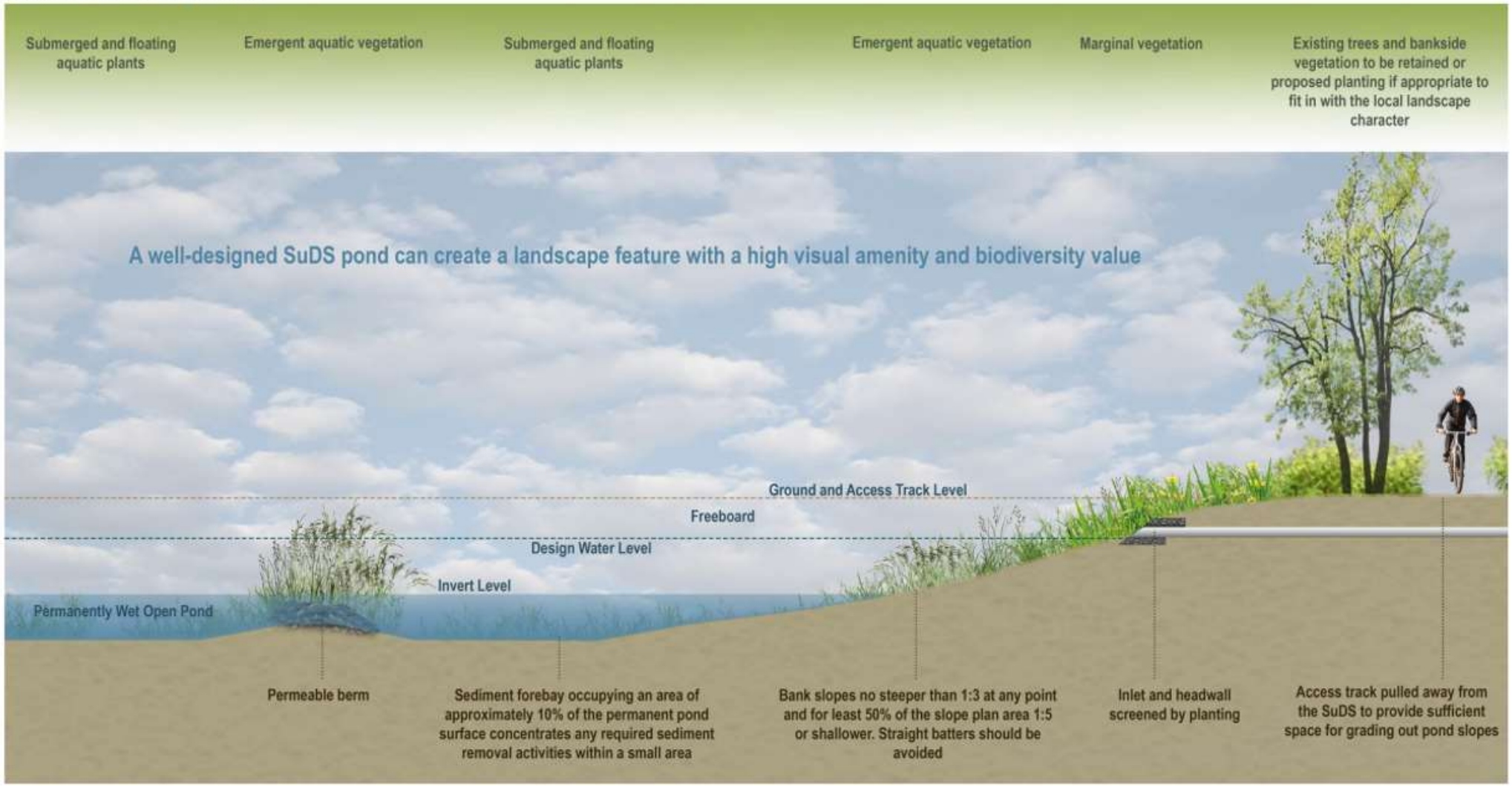
Ponds should contain the following zones:

- **sediment forebay** or other form of upstream pre-treatment system to allow sediment to settle from the incoming stormwater runoff before it is delivered to the permanent pool;
- **permanent pool** which will remain wet throughout the year and is the main treatment zone;
- **temporary storage volume** for flood attenuation, created through landscaped banks to the permanent pool;
- **shallow zone or aquatic bench** which is a shallow area along the edge of the permanent pool to support wetland planting, providing ecology, amenity and safety benefits.

For more info:
https://www.susdrain.org/
CIRIA (Construction Industry Research and Information Association), **SuDS Manual** https://www.ciria.org/

Retention pond - one of many possible solutions

Figure 4: Retention pond forebay example cross-section



Stormwater sampling

***To create stormwater sampling procedures and protocol with the* aims to answer the following main questions:**

- Selection of sampling site for the assessment of quantitative and qualitative indicators of storm water runoff;
- What kind of rain events can be identified and how do they affect stormwater quality in urban areas;
- How many measurable storm events should be sampled;
- How many samples should be collected per storm event to make statistically accurate estimates;
- Should stormwater runoff be sampled manually (i.e., grab), or composite (automatically);
- Parameters to be tested, etc.

Elaboration of the trans-municipal water reuse strategy for Klaipeda Region

Geographical area: Klaipeda coastal Region with 7 municipalities

Strategy combine three main measures:

- reuse of treated water
- recirculation of retained water
- promoting stakeholder & consumer acceptance for water reuse.

One of the main questions is how to select suitable WWTPs and stormwater management infrastructure facilities for water reuse in this large area?

Project jointly developed methodological guidelines, pilot measures in partners municipalities, external support, etc. will help as to find answers.

Municipal boundaries of Klaipėda County

THANK YOU

Interreg Baltic Sea Region

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SUSTAINABLE WATERS WaterMan

1st Peer-review session

Natural stormwater treatment for use in municipal services

Klaipėda District Municipality

Klaipėda University

5 Sept 2023

WaterMan

Pilot measure in Gargzdai town / LT
- Recirculation of retained water: Storm water retention ponds in public areas

Valdas Langas, Vytautas Bernadišius, Nerijus Eidimtas, Raimundas Baublys

Klaipeda University, Marine Research Institute

Partner meeting & on-site visit
Ringsted & Kalundborg / DK
5-6 Sept 2023

Pilot measure in Gargzdai town / LT

Recirculation of retained water: Storm water retention ponds in public areas

Storm water retention pond design and construction Environmental Impact Assessment screening scheme (Annex 2 of EIA regulations)

Organizer of the proposed economic activity or the drafter of EIA documents	**Organizer** Administration of Klaipeda District Municipality **Drafter** – KU. Screening information according to established regulations
Competent authority – LT EPA review the screening information	EPA request for additional information and to coordinate proposed activity with the Protected Areas Service
Supplementary information required from the Public and Entities to perform a screening for EIA. Proposals regarding screening of EIA (10 w/d)	Conclusion whether an EIA is required is greatly influenced by the opinion of the public, which it can express in the proposals. Proposals from public and entities of EIA (state institutions responsible for health protection, fire protection, cultural property protection, municipal executive authority) and the public) can be submitted within 10 w/d from the publication of the screening information on the Agency's website. **The final revised and supplemented information regarding the EIA screening was placed on the EPAs website on 08.21.2023**
LT EPA	Screening conclusion on whether an EIA is obligatory or not is made within 10 working days. **On August 31, the EPA concluded that full EIA is not obligatory.**

SUMMARY OF INFORMATION FOR THE SCREENING FOR ENVIRONMENTAL IMPACT ASSESSMENT

- description of the proposed activity (incl. description of technology to be used, related infrastructure, changes in traffic flows, etc.);
- scale of the proposed activity (e.g. area, size, production capacity, water, raw material and energy use, generation of waste);
- Information on the location (e.g. physical-geographical, socio-economic characteristics, with maps, drawings with a clear indication of the distance to the sensitive areas, e. g. “Natura 2000” and other protected sites, objects and sites of cultural heritage, residential areas, etc.);
- Information on expected environmental impacts and proposed mitigation measures: emissions into the atmosphere, discharges into the water, waste generation, noise, soil, climate, landscape human health and safety, flora and fauna, etc. Probability, duration, frequency and reversibility of the impacts, number of affected people, impacts on areas of special environmental value, etc.):
- information on possible cumulation of impacts, including impacts of other existing, approved and/or proposed activities;
- measures to prevent, eliminate, reduce or compensate for negative environmental impacts.

LT stormwater sampling regulations
Testing parameters for WaterMan project

According to Lithuanian legislation, economic entities/operators discharging effluents into the surface water bodies and having an IPPC (Integrated Pollution Prevention and Control Permit) or Pollution Permit must monitor the wastewater/stormwater quality.

The aim of the self-monitoring is to assess whether the pollution parametres/indicators discharged from pollution sources do not exceed the established limits and/or standards. Usually stormwater samples are taken and tested by private contract laboratories that must be accredited or licensed.

Self-monitoring frequency. Normally, operators must take grab stormwater effluent samples four time per year (once per quarter) during the storm event. Samples should be taken not earlier than 15 minutes after the rainfall begins. Only one grab sample is required.

EPA also implement compliance monitoring programs and pursue enforcement is provided through local environmental inspectors. Compliance monitoring procedures necessary to determine compliance and non-compliance with permit conditions.

Compliance monitoring – in accordance with the EPA's annual compliance monitoring plans, or as needed.

Parameters

Pollution Permits, in principle follow the Lt regulations:

--- mandatory parameters SS, petroleum products and recently - BOD have been set;

--- phosphorus, nitrogen, salts, metals, and other pollutants for activity-specific companies;

During the implementation of the WaterMan project, the following parameters are tested:

Selected 110 ha drainage area does not have a IPPC or Pollution Permit, therefore monitoring of discharged stormwater is not carried out.

One grab sampling taken for EIA purposes and these parameters, coordinated with LT EPA, were tested in the laboratory:

pH, Suspended solids, BOD_7, COD, Petroleum hydrocarbons, N_{total}, P_{total}, Sulfates, Chlorides

Stormwater monitoring approach

In 2017, a committee was created by the National Academies of Sciences, Engineering, and Medicine through support by the USA Environmental Protection Agency to address several concerns related to the stormwater monitoring in the Multi-Sector General Permit (MSGP). The committee 2019 report, **Improving the EPA Multi-Sector General Permit for Industrial Stormwater Discharges**, recommends several ways that EPA can strengthen the MSGP program to provide its intended environmental protection while balancing the overall burden of monitoring on industry.

The report highlights that *the volume-weighted (or flow-weighted) pollutant concentration, also called the event mean concentration (EMC), provides the most consistent and comprehensive assessment of stormwater pollutant discharges and loads. Pollutant loads are important for understanding longer-term water-body impairments and toxicity concerns,*

For stormwater monitoring the report recommend **to allow and promote the use of composite sampling for benchmark monitoring for all pollutants**. Multiple composite sampling techniques should be used that provide more consistent and reliable quantification of stormwater pollutant discharges compared to a single grab sample. EPA
see https://doi.org/10.17226/25355

In order to obtain reliable stormwater qualitative and quantitative data, it was decided to apply the following monitoring methods:

- **To use time-weighted composite sampling instead gab sampling;**
- **Flow measurements perform using flow meter, instead calculated by universally used formula:**

Wf = 10 x Hf x ps x F x K, m3 / year, where:
Hf - actual annual rainfall (mm) (according to the Lithuanian Hydrometeorological Service data);
ps - runoff coefficient reflects the surface characteristics (various pervious and impervious surfaces) of the contributing runoff basin. The range of runoff coefficient values varies from 0.2 to 0.85:
F - runoff basin area (ha);
K coefficient reflects snow removal from the drainage basin. If snow is removed, K = 0.85 if not removed (K = 1).

Monitoring sites

Stormwater sampling equipment

Transportable sampler Avalanche, ISCO

- 950 ml (x14) bottle kit
- 7.5 m vinyl suction hose with protection
- Wheels for transportation
- 12 VDC, 75 Ah battery with charger
- Cooling from rechargeable battery
- Additional rechargeable battery

Stormwater sampling

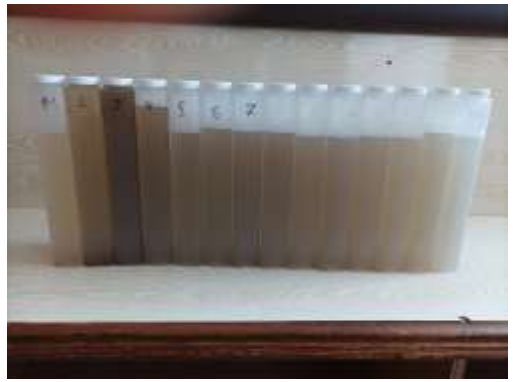
Sampling considerations

The sample should be collected where the wastewater is well mixed. Therefore, the sample should be collected near the center of the sampling well/manhole, at approximately 40 to 60 percent of the water depth, where the turbulence is at a maximum and the possibility of solids settling is minimized.

The sampler programmed to collect aliquots at a 15 minutes frequency after 15 minutes from the start of rain.

So far, two composite sampling campaigns have been conducted with an automatic sampler 14 aliquots/ bottles were collected.

First sampling campaign:
2023-07-18
14 aliquots/ bottles poured into 7 containers (due to lack of water in one bottle for chemical analysis)



Second sampling campaign:
2023-08-17
14 aliquots/ bottles poured into 1 containers.

LT stormwater quality limit values and results of the analysis

Stormwater permissible concentrations

	Endorsed by Stormwater Management Regulations, mg/l				Endorsed by Wastewater Management Regulations, mg/l								
	Suspended solids	BOD_7[1]	BOD_7	Petroleum hydrocarbons	N_{total}	P_{total}	Zn	Pb	Cd	Cu	Hg	As	Cr
Maximum allowable concentration	50	34	10	7	-	-	-	-	-	-	-	-	-
Average annual concentration	30	23	-	5	30	4	0,4	0,1	0,04	0,5	0,002	0,05	0,5

1 BOD parameter must be specified and monitored in stormwater effluents contaminated with organic substances (e.g. agricultural processing, food industry, organic waste management facilities, etc.). In other cases, the maximum allowable concentration of BOD7 is 10 mg O2/l, the average annual concentration is not determined.

Tested results

	pH	Suspended solids	BOD_7	COD	Petroleum hydrocarbons	N_{total}	P_{total}	Sulfates	Chlorides
Grab sampling 2023-04-25 for EIA	7,9	27	**10,4**	54	0,14	1,51	0,18	46	60
First composite sampling (average) 2023-07-18 8:10 – 10:10		5,7	9,9	45,3	0,23	10,2	0,3	21,1	60
Second composite sampling 2023-08-17 10:30 – 14:00 h	7,88	**158**	**34,0**	120	0,32	18,0	1,3	20	26

Results of the analysis

First composite sampling protocol, sample taken 2023-07-18

KLAIPĖDOS VANDUO

Laboratorija

TYRIMŲ PROTOKOLAS Nr. 23-472

2023-07-26

Užsakovas, adresas	Klaipėdos universiteto Jūros tyrimų institutas , Manto 84, Klaipėda
Mėginio paėmimo vieta	Gargždų m. Taikos g. 12, Šul. Nr. 203
Mėginio pavadinimas	paviršinės nuotekos
Mėginio paėmimo data	nenurodyta
Mėginio pristatymo į lab. data ir laikas	2023-07-19 8:35 val.
Mėginius pristatė	A. Skripkauskas

Analitės	Rezultatas							
Mėginio Nr.	1-2	3-4	5-6	7-8	9-10	11-12	13-14	Normatyvinis dokumentas, pagal kurį atliktas tyrimas
Mėginio registracijos Nr.	N23.1638_01	N23.1638_02	N23.1638_03	N23.1638_04	N23.1638_05	N23.1638_06	N23.1638_07	
Skendinčios medž., mg/l	4,2	4,5	4,9	2,8	8,0	12,0	3,3	LAND 46-2007
Biocheminis deguonies suvartojimas (BDS7), mg/lO2	6,6			6,8	10	24	14	LST EN ISO 5815-1:2019,
Biocheminis deguonies suvartojimas (BDS7), mg/lO2		3,6	4,2					LAND 47-2:2007
Cheminis deguonies suvartojimas (ChDSCr), mg/lO2	26	13	19	28	56	93	82	ISO 15705:2002
Chloridai, mg/l	61	58	61	65	56	58	61	LAND 63-2004
Sulfatai, mg/l	16	18	22	25	25	21	21	UM*, 50-52 psl.
Bendrasis azotas, mg/l	8,28	8,28	8,34	9,76	11,6	12,8	12,3	LAND 59-2003
Bendrasis fosforas, mg/l	0,128	0,162	0,160	0,212	0,466	0,606	0,352	LAND 58-2003
Naftos angliavandenilių indeksas C10-C40, mg/l	0,29	0,33	0,32	0,18	0,11	0,16	0,24	LAND 61-2003

Vyresnioji chemijos specialistė L. Minajeva

AB „Klaipėdos vanduo" TYRIMŲ ATSAKYMAI

Už mėginių paėmimą nuotekų tyrimo laboratorija neatsako.
Tyrimų rezultatai galioja tik pateiktam mėginiui.
Be raštiško laboratorijos leidimo draudžiama kopijuoti atskiras protokolų dalis.

AB „Klaipėdos vanduo"

Removal efficiency

The report *Natural Water Retention Measures* provides the following information **on average pollutant removal efficiency in retention ponds:**

- Suspended solids: 55%
- Total phosphorus: 32%
- Total nitrogen: 34%
- Metals: 26-65%

Retention ponds can be effective at pollutant removal, particularly as a result of settling of particulate pollutants. However, retention ponds, with permanent water, are likely to be less effective for removal of oils that stay on the water surface,

http://nwrm.eu/sites/default/files/nwrm_ressources/u11_-_retention_ponds.pdf

Flow Meter

NIVUS Type PCM flow measurement

A measurement system for portable flow measurements basically consists of a transmitter Type PCM for power supply, data entry, indication and data storage
plus a sensor for the recording of measurement data.
The portable Type PCM units are designed for use in part filled and full channels, pipes and flumes with various shapes and dimensions.
Flow cannot be measured directly
Q: average flow velocity and the flow cross section.
This leads to the general formula
below:

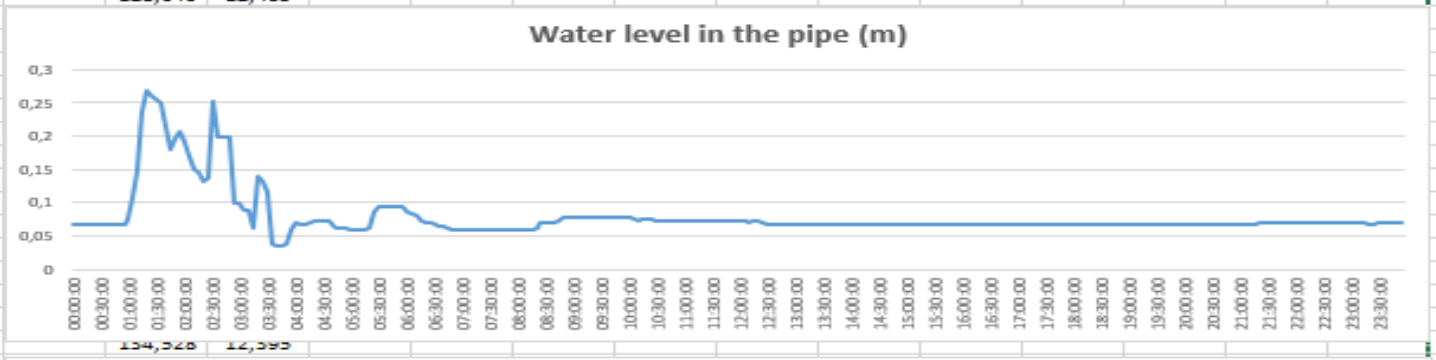
Q = v(average) • A

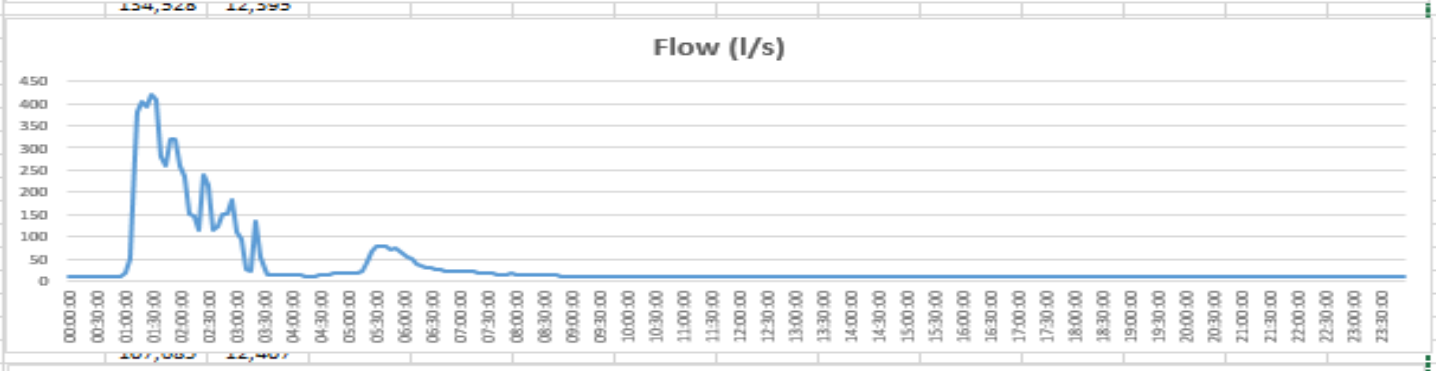
The flow cross section A is investigated by continuously measuring the filling level considering the channel shape. The flow velocity is detected via the velocity of the particles..
The particle velocity is measured by using ultrasound. The flow changes as soon as the velocity changes.

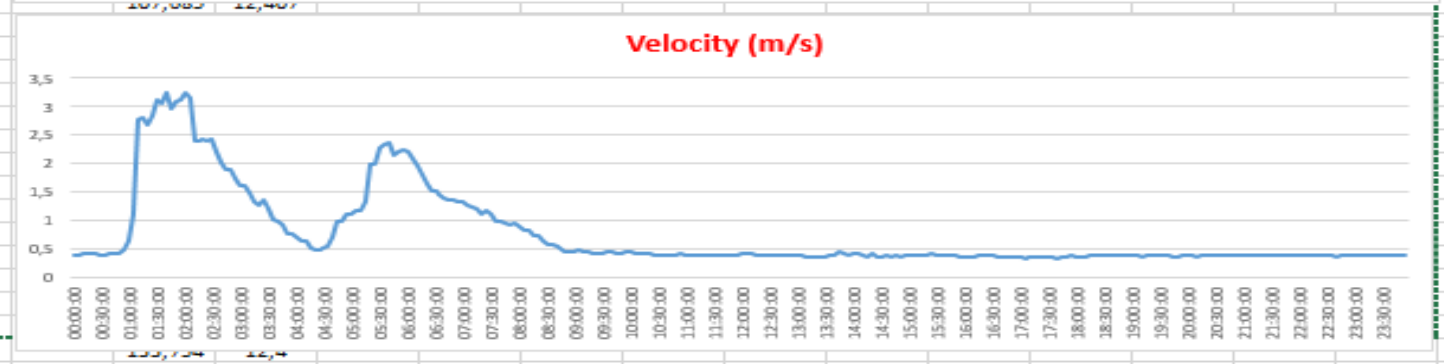
Stormwater flow measurement

July 25th 2023 flow data

Laikas	s vamzdyje	greitis (m/s	uto kiekis (	T [°C]	ADC_2 [mA	ADC_3 [V]
00:00:00	0,067	0,414	8,339	13,4	128,646	12,405
00:05:00	0,067	0,412	8,307	13,6		
00:10:00	0,067	0,418	8,429	13,6		
00:15:00	0,067	0,429	8,642	13,5		
00:20:00	0,067	0,422	8,507	13,5		
00:25:00	0,067	0,42	8,455	13,6		
00:30:00	0,067	0,41	8,268	13,6		
00:35:00	0,067	0,413	8,326	13,5		
00:40:00	0,067	0,42	8,455	13,5		
00:45:00	0,067	0,42	8,475	13,5		
00:50:00	0,067	0,419	8,436	13,6		
00:55:00	0,067	0,481	9,907	13,6		
01:00:00	0,075	0,664	19,314	14,8		
01:05:00	0,108	1,121	51,737	15,1		
01:10:00	0,149	2,786	273,771	18		
01:15:00	0,237	2,805	380,587	18,5		
01:20:00	0,268	2,698	402,558	18,6		
01:25:00	0,261	2,833	392,837	19,1		
01:30:00	0,254	3,136	**420,837**	19,1		
01:35:00	0,25	3,061	408,558	19,1		
01:40:00	0,216	3,24	278,603	19,1		
01:45:00	0,181	2,956	258,212	19,3		
01:50:00	0,197	3,091	320,956	19,4		
01:55:00	0,207	3,123	317,795	19,4		
02:00:00	0,19	3,257	260,565	19,1		
02:05:00	0,169	3,15	233,544	19,1		
02:10:00	0,15	2,405	149,423	19,1		
02:15:00	0,144	2,417	145,774	19,1		
02:20:00	0,131	2,423	114,578	19,1		
02:25:00	0,136	2,399	237,416	19,1		
02:30:00	0,252	2,42	216,626	18,9		
02:35:00	0,2	2,221	116,376	18,9		
02:40:00	0,2	2,034	122,199	18,7		
02:45:00	0,2	1,892	151,103	18,7		
02:50:00	0,2	1,893	151,489	18,5		
02:55:00	0,1	1,761	180,974	18,5		
03:00:00	0,1	1,612	111,877	18,1		
03:05:00	0,09	1,608	96,253	18,1		
03:10:00	0,09	1,51	26,508	17,8		
03:15:00	0,061	1,34	23,512	17,8		
03:20:00	0,139	1,282	133,159	17,6		
03:25:00	0,132	1,356	53,542	17,6		
03:30:00	0,116	1,222	27,938	17,3		
03:35:00	0,038	1,019	15,762	17,3		
03:40:00	0,036	0,989	15,304	17,2		
03:45:00	0,036	0,92	14,613	17,2		
03:50:00	0,037	0,777	12,331	16,8	125,896	12,402
03:55:00	0,06	0,765	14,747	16,8	143,113	12,398







Rain gauge

Operating Instruction
Precipitation Sensors (15189) + (15189 H)

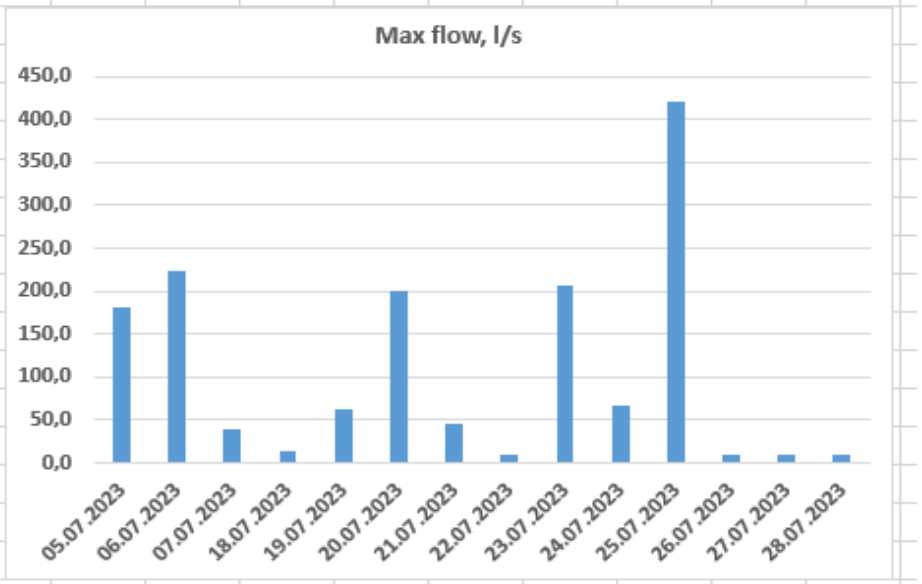
LAMBRECHT
METEOROLOGICAL INSTRUMENTS GERMANY

Features

- Precipitation Sensor for automatic weather stations
- Exchangeable, weighing tipping bucket system
- 2 cm³ (2g water) tipping bucket for precise precipitation measuring in regions with normal rain falls
- 4 cm³ (4g water) tipping bucket for precise precipitation measuring in regions with heavy rain falls/ tropical rain
- Connectable to external data logger
- Winter-fit model (15189 H) with electronically controlled 2-circuit heating
- Weatherproof materials (anodized aluminium, stainless steel) guarantee a long durability
- Funnel according to the WMO Standard No. 8

Flow data

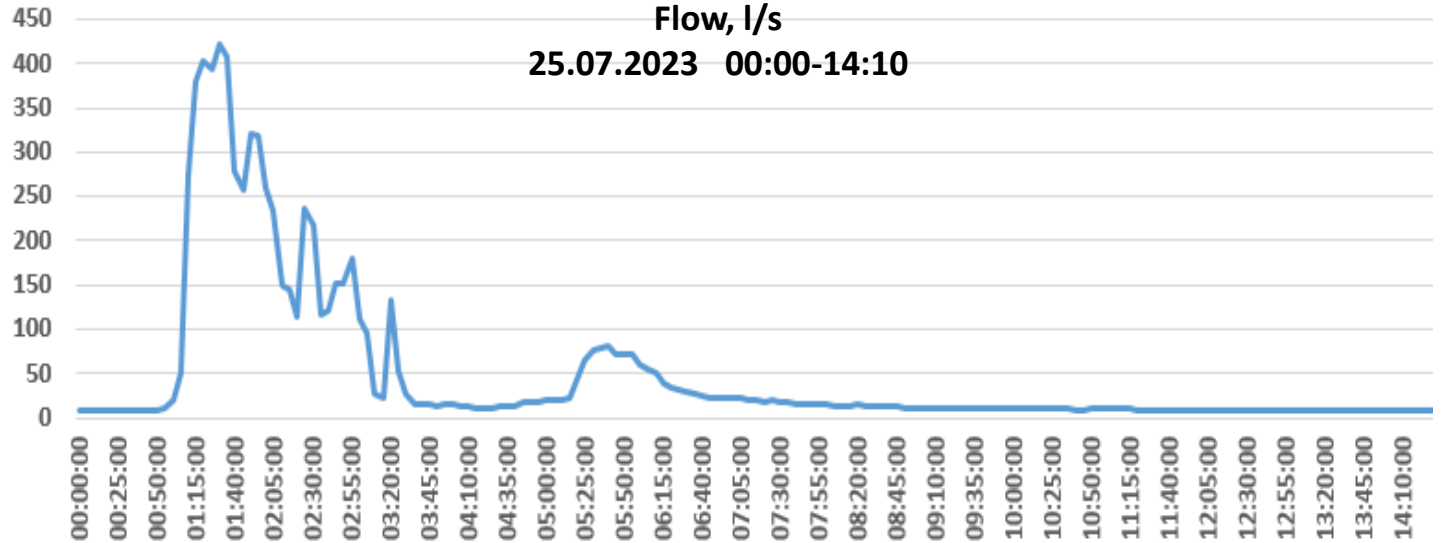
Data	Hr, min	Max flow, l/s
05.07.2023	11:41	182,3
06.07.2023	08:40	222,8
07.07.2023	09:36	39,0
18.07.2023	08:35	13,0
19.07.2023	06:00	61,8
20.07.2023	19:27	199,9
21.07.2023	03:55	45,7
22.07.2023	19:50	9,0
23.07.2023	12:50	207,5
24.07.2023	05:20	67,1
25.07.2023	**01:30**	**420,8**
26.07.2023	10:55	9,2
27.07.2023	16:30	10,4
28.07.2023	09:05	9,0



Average flow (l/s)	
25.07.2023	32,8

Base flow without rain ~ 7,8 - 8 l/s

Calculated max flow 500 l/s



Based on rainfall/flow measurements:

- flow data l/s and m3/d will be used for design purposes, and
- for the prediction of rainfall/runoff trends due to climate change

Thank you

1st Peer & expert review session: Recommendations & conclusions

- Not only the incoming water, but also the design of the pond can determine the water quality at its outlet (e.g. if your design attracts birds then there is unwanted “additional input” into the water, also the retention period influences the water quality). It is therefore important to determine in the beginning the water quality that is aimed for at the outlet and needed for the intended reuse (e.g. municipal irrigation, water for firefighting), and to choose the design of the retention pond accordingly
- Even though there may be no legal requirements for your use of retained water thus far in Lithuania, you can choose and refer to an existing quality norm, e.g. bathing water quality as in Västervik, other European Regulations (> have a look into the slides of the workshop in Schweinfurt) or Class A/B/C according to the Water Reuse Regulation 2020/741).
- In order to design the pond in an optimum way, it will be necessary to have a deeper look into and to measure some additional parameters of the storm water to be retained:
  - It may not be sufficient to measure suspended soils in general, but also their composition. Reason: Mineral suspended solids are in general no big problem since they settle faster. But if there are organic suspended solids, this may make it difficult or even prevent to use the water for irrigation. So it is advisable to survey organic suspended solids in addition. Also micro granular analysis could be conducted.
  - Consider testing in different weather conditions & seasons. For example during the melting of the snow, the composition of suspended solids can be very different than in the summer.
- As it is considered to use the retained water for municipal irrigation, it will be important to test also E. coli, Enterococci, and Legionella (in the summer period). Getting more in-depth knowledge on these water parameters enables to design the pond more accurately according to needs, and to optimise the ‘low-cost’ treatment process that takes place while the water is collected & retained:
  - Depending on the type of suspended solids, you can calculate the optimum retention time. In general, longer retention time increases treatment efficiency (except if you have “additional input” e.g. from birds). But too long retention time (e.g. 7 days) may be counterproductive, because you then reduce also nutrients (e.g. phosphorus).
  - If you select a design with long sedimentation time, consider a bypass for heavy rainfall & high intensity storm events that could disturb the sedimentation and degradation by mixing new rainwater with the retained one. 30% of the total estimated annual volume of storm waters could be discharged with this bypass.
- Consider also other functions of the ponds when elaborating and choosing the design (e.g. walking paths, creating a recreational area with it). This may be important for gaining / increasing the acceptance for the ponds by the population.
- Gdańsk University of Technology offers further assistance in adjusting the preparatory analyses and elaborating the design of the ponds.

Pilot replication bluprint: Gargzdai/ LT: Natural stormwater treatment for use in municipal services

Interreg
Baltic Sea Region

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SUSTAINABLE WATERS
WaterMan

Absorption report

Natural stormwater treatment for use in municipal services

Klaipėda District Municipality

Klaipėda University

07 November 2023

WaterMan

Pilot measure in Gargzdai town / LT

- **Recirculation of retained water: Storm water retention pond in public areas**

Uptake of recommendations & adjustments of the concept after the 1st peer & expert review session

Klaipeda University, Marine Research Institute
Klaipėda District Municipality
Association “Klaipėda Region”

Dialogue Forum & All-partner Meeting
Rønne / DK
7-9 Nov 2023

LT position on the implementation of EU Regulation 2020/741

EU Regulation 2020/741:

Article 2

Scope

1.This Regulation applies whenever treated urban waste water is reused, in accordance with Article 12(1) of Directive 91/271/EEC, for agricultural irrigation as specified in Section 1 of Annex I to this Regulation.

2. A Member State may decide that it is not appropriate to reuse water for agricultural irrigation in one or more of its river basin districts or parts thereof, taking into account the following criteria:

(a) the geographic and climatic conditions of the district or parts thereof;

(b) the pressures on and the status of other water resources, including the quantitative status of groundwater bodies as referred to in Directive 2000/60/EC;

(c) the pressures on and the status of the surface water bodies in which treated urban waste water is discharged; (d) the environmental and resource costs of reclaimed water and of other water resources.

LT position

- The LT Minister for the Environment by 2022-10-11 order determined that, taking into account the criteria set out in Article 2, paragraph 2 of EU Regulation 2020/741, wastewater collected by centralized wastewater collection systems is not reused in agriculture for the purpose of irrigation, as specified in Section 1 of Annex I of Regulation (EU) 2020/741;
- The decision above must be reviewed according to the criteria set out in Article 2, paragraph 2 of EU Regulation 2020/741 at least every 6 years from the entry into force of this order.
- To authorize the Environmental Protection Agency, at the request of the responsible authorities of the member states, to perform the cooperation functions established in Article 8 of EU Regulation 2020/741 on the use of wastewater collected by centralized wastewater collection systems in agriculture for the purpose of irrigation (cross-border water reuse relevance)

1st peer & expert review session comment:

Choose and refer to an existing quality norm, e.g. bathing water quality other European Regulations
Important to test also E. coli, Enterococci, and Legionella (in the summer period)
refer to an existing quality norm, e.g. bathing water quality as in Västervik, other European Regulations (> have a look into the slides of the workshop in Schweinfurt)

		Escherichia coli CFU/100 ml	Intestinal enterococci, CFU/100 ml	Legionella, CFU/L	Remarks
Composite sampling, 2023-09-14		2419,6	23	Not detected	
EU regulation2020/741	**Reclaimed water quality class, indicative technology, crop category**				
	A Secondary treatment, filtration, and disinfection. **Food crops**	≤ 10		*Legionella* spp.: < 1 000 cfu/l where there is a risk of aerosolisation Intestinal nematodes (helminth eggs): ≤ 1 egg/l for irrigation of pastures or forage	
	B Secondary treatment and disinfection. **Food crops**	≤ 100			
	D Secondary treatment and disinfection. **Food crops**	≤ 1 000			
	D Secondary treatment and disinfection. **Industrial, energy and seeded crops ***	≤ 10 000			
LT hygiene norm HN 92:2018 "Beaches and their bathing water quality"	**Limit values** (Surface water bodies (lakes, rivers)	≤ 1 000	≤ 100 400??		
Directive 2006/7/EC management of bathing water quality, Annex 1	**Bathing waters classification** **B.** Excellent quality	500 (1)	200 (1)		
	C. Good quality	1 000 (1)	400 (1)		
	D. Sufficient	900 (2)	330 (2)		
	(1) Based upon a 95-percentile (2) Based upon a 90-percentile evaluation.				

For now, we cannot say what the CFU-colony forming units will be in outfall **Discussions with LT responsible health care institutions have started**.

Summer sampling campaign completed
(1 grab and 4 composite sampling with automatic sampler 950 ml (x14) bottle kit

Fourth composite sampling

Changes in substances concentrations can be highly variable and depend on factors such as the intensity and duration of the storm, land use, land management practices, and the specific substances in question.

14 bottle kit	pH	SS	BOD_7	COD	N_{total}	P_{total}	Sulfates	Chlorides
Bottle No. 1	8.19	2,33	9,3	14	13,6	0,05	29	71
Bottle No. 2	8,21	4,3	4,1	14	14,8	0,07	36	69
Bottle No. 3	8,03	44	12	49	11,2	0,31	27	62
Bottle No. 4	7,9	38	12	71	9,8	0,35	20	54
Bottle No. 5	7,93	52	12	58	8,28	0,42	26	44
Bottle No. 6	7,84	59	11	57	7,58	0,31	18	44
Bottle No. 7	7,76	48	13	55	8,42	0,26	14	21
Bottle No. 8	7,72	38	13	52	7,28	0,22	13	19
Bottle No. 9	7,77	34	9,2	66	7,46	0,15	11	19
Bottle No. 10	7,75	27	9,1	65	7,27	0,16	12	19
Bottle No. 11	7,78	17	6,5	98	7,73	0,13	17	19
Bottle No. 12	7,79	19	6,6	31	8,18	0,10	17	20
Bottle No. 13	7,79	11	6,3	27	8,11	0,11	13	21
Bottle No. 14	7,77	7,3	6,2	27	7,96	0,09	11	20
Average	**7,29**	**28,64**	**9,31**	**48,86**	**9,12**	**0,20**	**18,86**	**35,86**
LT limit values	**6,5-8,5**	**30**	**23**		**25**	**4**	**300**	**1000**

2,33	lowest concentration
59	highest concentration

1st peer & expert review session comment:

If there are organic suspended solids, this may make it difficult or even prevent to use the water for irrigation. So it is advisable to survey organic suspended solids and micro granular analysis could be conducted.

Gdańsk University of Technology offers further assistance in adjusting the preparatory analyses and elaborating the design of the ponds.

For now no response from PL colleagues concerning methods for micro granular and organic suspended solids analysis.

KU suggested methods

Organic suspended solids:

The determination of suspended organic matter in surface runoff water can be achieved through a combination of methods. These methods involve collecting suspended matter on glass fiber filters (GF/F) with a nominal pore size of 0.7 µm. The collected matter is then dried at either 105 °C or 60 °C ?? for several hours to obtain the total amount of suspended matter per liter. By subsequently burning the collected matter at 55 °C, we can calculate the weight difference to estimate the amount of organic matter.

Micro granular analysis:

Particle size can be determined by collecting precipitating particles from the water column and analyzing them using a laser analyzer. This analyzer allows for the distinction of different size fractions and provides information on the grain sizes of the media.

Can these methods proposed by KU be applied??

Average COD concentration of 5 samples (1 grab, 4 composite) - 62 mg/l meanwhile, for discharges from urban waste water treatment plants the limit values must not exceed 125 mg/l. COD indicates nearly all-organic substances found in water. Low concentration means a low amount of oxidizable organic matter.

1st peer & expert review session comment:

The design of the pond can determine the water quality at its outlet. It is therefore important to determine in the beginning the water quality that is aimed for at the outlet and needed for the intended reuse (e.g. municipal irrigation, water for firefighting), and to choose the design of the retention pond accordingly

Consider testing in different weather conditions & seasons. For example during the melting of the snow, the composition of suspended solids can be very different than in the summer.

Additional stormwater sampling for:

chemical substances analysis

Suspended solids

BOD_7

COD

Petroleum hydrocarbons? (summer sampling average 0,21 mg/l)

N_{total}

P_{total}

Sulfates

Chlorides

and pathogens

Escherichia coli

Intestinal enterococci

Legionella

is planned during the upcoming winter time

The design technical specification also stipulate that a **monitoring program must be prepared**, not limited to chemical and pathogen tests to manage the contamination risks, but also for regular retention pond operation and maintenance purposes:

- Inspect for sediment and debris accumulation in pre-treatment sediment forebay for removal purposes;
- Inspect inlets, outlets and overflows, banksides, structures, for evidence of physical damage;
- Cutting grass, manage plants, etc.

1st peer & expert review session comment:

Depending on the type of suspended solids, you can calculate the optimum retention time. In general, longer retention time increases treatment efficiency (except if you have "additional input" e.g. from birds). But too long retention time (e.g. 7 days) may be counterproductive, because you then reduce also nutrients (e.g. phosphorus).

The volume ratio between the sediment forebay and the permanent pool in a retention pond can vary depending on the specific design and intended function of the pond. However, a common guideline is to size the sediment forebay to be a certain percentage of the permanent pool volume. This percentage can vary based on regulatory requirements, local design standards, and the pond's intended purpose. **A typical range is between 10% to 20% of the permanent pool volume, but it can be higher or lower depending on specific factors, with the available space** .

A wet pond is a constructed basin designed to retain a permanent pool of stormwater with limited biological treatment. Wet ponds aid in peak flow reduction and promote sedimentation. **If stormwater enters through a pipe, it should pass through a forebay, allowing initial sedimentation and velocity reduction. Once water reaches the permanent pool storage, additional sediment settling and biological uptake occur as stormwater is slowly released over 24-72 hours**.

A pond can deliver high aesthetic values to the site and host a large variety of vegetation and wildlife. However, it requires regular maintenance and the need for this is increased by the complexity of the design.

A 2-day retention is currently planned (for maximum daily flow, in other cases, there will be a much longer retention), this figure may vary slightly after rainfall-runoff measurement data analysis is completed

1st peer & expert review session comment:

*** If you select a design with long sedimentation time, consider a bypass for heavy rainfall & high intensity storm events that could disturb the sedimentation and degradation by mixing new rainwater with the retained one. 30% of the total estimated annual volume of storm waters could be discharged with this bypass.**

**** Consider also other functions of the ponds when elaborating and choosing the design (e.g. walking paths, creating a recreational area with it). This may be important for gaining / increasing the acceptance for the ponds by the population.**

The following technical requirements are listed in the design tender documentation:

- * *for high intensity storm events, secondary runoff paths/bypass system without treatment should be designed*;
- to design the retained/treated water flow measurement, sampling, water abstraction for reuse and emergency outlet closure technical appliances;
- ** *prepare a landscaping/planting plan with recreational infrastructure elements, footpaths, etc to increase amenity value*;
- taking into account the properties of the soil, the pond embankment slops should be designed to be stable. If necessary, anti-erosion protection means should be provided against heavy rains, ice, etc. effects (different liners materials could be used-clay, geomembrane …);
- the pond operation, maintenance and monitoring/surveillance plan should be prepared;
- to proposed location of the pond in such a way that it does not fall within the boundaries of the "Natura 2000" territory and the high-probability flood zone;
- to design the lighting of the area;
- it is recommended to use other provisions specified in the Sustainable Drainage Systems Manual (SuDS Manual)

1st peer & expert review session comment:

Consider testing in different weather conditions & seasons. For example during the melting of the snow, the composition of suspended solids can be very different than in the summer.

Main planned activities:

- Winter sampling (grab);
- Cooperation with Klaipėda District Municipality on design issues (acistance during the tendering process and in the preparation of project design solutions);
- Rainfall-runoff measurement data analysis;

Calculated flow values	m^3/year	Max m^3/day	Max m^3/hour	l/sec.		
	41150	4100	600	500		
Measured flow values		Cumulative flow, m^3/d	Flow rate, l/s and m^3/s	Base flow, l/s and m^3/s	Direct/storm flow, m^3/s	Runoff Coefficient

- Activities related to preparation of trans-municipal water reuse strategy for Klaipeda Region;
- In cooperation with Association “Klaipėda Region” to prepare an article/information focusing more on the partners' pilot measures and their implementation solutions (preliminary idea).
- Development of a questionnaire, meetings/discussions with municipalities, water companies, farmers to raise awareness and collect information on drought affected agricultural crops in Klaipėda region and to find out the needs and possibilities of water reuse in the seven municipalities of the region.
- Together with LT partners organize meeting with Klaipeda region and national stakeholders with pilot site visit in Gargždai.

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SUSTAINABLE WATERS
WaterMan

2nd Peer-review session

Natural stormwater treatment for use in municipal services

Klaipėda District Municipality

Klaipėda University

7 November 2024

WaterMan
All-partner Meeting
Berlin & Potsdam / DE
5-7 Nov 2024

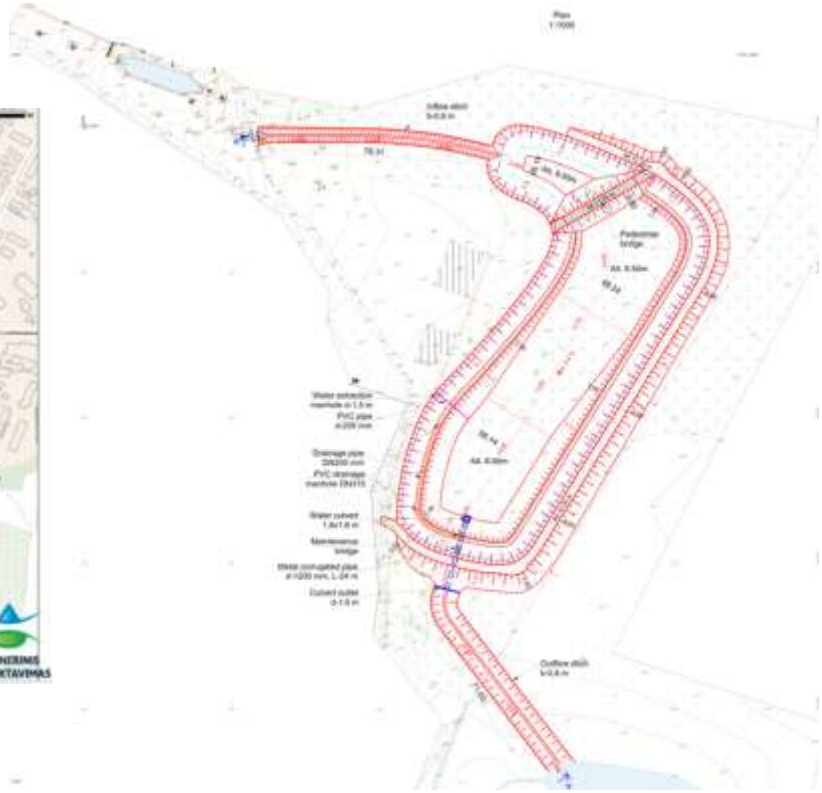
Users & utilisations for the recycled stormwater of the WaterMan pilot measure in Gargzdai / LT

Klaipėda University

Administration of Klaipėda District Municipality

WaterMan pilot measure - Retention pond in Gargždai town, LT

Designer: UAB "Inžinerinis projektavimas" (Engineering Design Ltd.)



Storm water catchment area – **110 hectares**;
Forebay (upstream) area – **1040 m²**, volume – **1666 m³**;
Main pond area – **7043 m²**, volume – **17400 m³**;
Planned duration of wastewater retention and treatment – **2 days**;

The envisaged user of the recycled stormwater

During the summer season, the marked in green central part of Gargždai is irrigated with drinking water
Approximately 50,000 - 60,000 square meters of irrigated green area

The envisaged user of the recycled stormwater

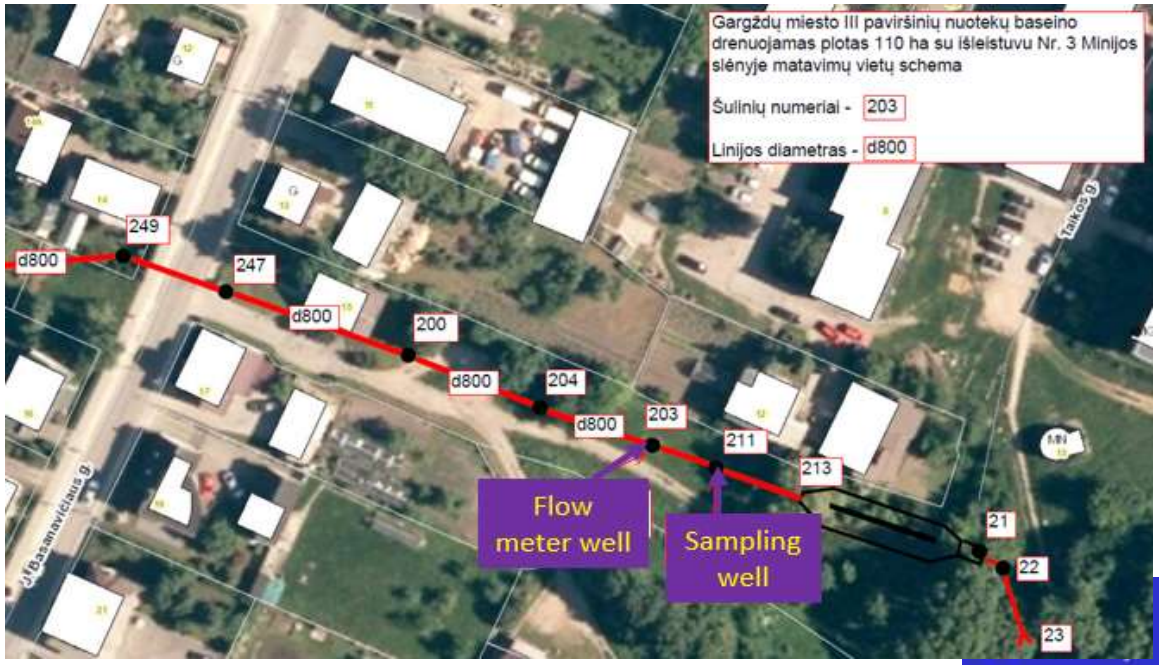
Responsible for irrigation is the Gargždai Town Eldership (smaller municipal administrative unit) of the municipality.

300 cubic meters of drinking water consumed per year/summer season

The methods for evaluating the utilisation of the stormwater

- **2023 stormwater sampling campaign completed: (2 grab and 4 composite samples)**
  For chemicals
  - Suspended solids
  - BOD7
  - COD
  - Petroleum hydrocarbons
  - N_{total}
  - P_{total}
  - Sulfates
  - Chlorides

  And 1 grab and 1 composite sample for pathogens
  - Escherichia coli
  - Intestinal enterococci
  - Legionella



Methods for evaluating the use of stormwater

Sampling and analysis of stormwater runoff in 2023

Chemicals, mg/l

	pH	SS	BOD_7	COD	Petroleum hydrocarbons	N_{total}	P_{total}	Sulfates	Chlorides
LT Average	7,7	64,2	11,1	50,9	0,27	9,2	0,39	29,3	86,8
Regulation 2020/741		A ≤ 10 B-D 35	A ≤ 10 B-D 25						

Microbiological tests (Legionella not detected in both samples)

E. coli (number/100 ml)				**Intestinal Enterococci (number/100 ml)**		
Regulation 2020/741	LT summer sample	LT winter sample (snowmelt water)	LT hygiene norm HN 92:2018 "Beaches and their bathing water quality"	LT summer sample	LT winter sample (snowmelt water)	LT hygiene norm HN 92:2018 "Beaches and their bathing water quality"
A ≤ 10 **B ≤ 100** **C ≤ 1 000** **D ≤ 10 000**	**2 419,6**	**913,9**	Excellent - 500* Good - 1 000* Sufficient - 900**	**23**	**780**	Excellent - 200* Good - 400* Sufficient - 330**

* Based on 95th percentile estimate.

** Based on 90th percentile estimate.

Klaipeda University

Methods for evaluating the use of stormwater

Post-construction stormwater runoff sampling and analysis

Two options for sampling and analysis are available:

1. **shortly after the completion of the retention pond, i.e. at the end of 2025**
2. **sampling before the irrigation season in 2026**

The first option is questionable because the pond ecosystem is not yet formed (the vegetation is not yet well established) and may give slightly biased results.

Therefore, the second option would be more acceptable.

Involving and motivating use groups to use recycled stormwater

After further testing, a final decision will be made by the municipality:

- **Turn off the drinking water taps and replace the drinking water currently used for irrigation in this green marked area with pond water and determine irrigation methods based on test results**

- **Other potential pond water user groups to be further considered:**
  - **Irrigation of other urban green spaces,**
  - **Irrigation of newly planted trees and other plants,**
  - **Industrial processes - cooling water, car washes,**
  - **Fire suppression systems**

Retention pond construction progress update

Environmental impact screening conducted - EPA conclusion that full EIA is not required	August 2023
Public procurement documents for design prepared and tender announced	September 2023
Design contract signed	November 2023
Project appraisal/expertize completed	October 2024
Project approval is planned	December 2024
Construction tender documents prepared and tender scheduled	Jan-Feb 2025
Construction scheduled for completion	Aug-Sept 2025

Thank you for your attention

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2nd Peer & expert review session: Recommendations & conclusions

- The presented project schedule doesn't include testing of users' perception. This is an important aspect that must be included.
- How do you distribute the water from the pond to the green areas?: mobile tanks (truck).
- How far is the distance between the pond and the irrigated area: several hundred meters.
- Responsibility for irrigation: Gargzdai municipality. Another institution will make investments into the mobile tanks, and infrastructure (pipes). If we want to expand irrigation area, we will need mobile units anyway.
- Think about how to enable water for other user groups of pond water in the future (to extend the user groups after project lifetime): for example there could be tanks/reservoirs placed somewhere else.
- Do you pick-up the water directly from the pond? No, similar to Västervik – we will have a tap point. It's part of the design.
- How much water can you use per day, considering that you have these 2 days retention time? Think about it, calculate it – to determine the potential for reuse and for extension of user groups after project lifetime. Difficult to say. About 7000 m3 per year?
- User acceptance: Consider to irrigate at night time (no movement of people).
- Consider if there are any possible problems with permissions to use it for irrigation of the green area? For this Gargzdai plans to have additional discussion with hygiene authorities.
- Consider risk assessment & management during monitoring of operation of the pond.
- We have to decide about the kind of method that could be used for irrigation (depending on the volumes of contaminants in the water, the KWB prepared a programme / algorithm what irrigation method to use).
- One very safe use case for Gargzdai to be considered: flushing the sanitary network (canalisation). Probably no permission needed.
- If you do not have one safe utilisation that is realised, evaluated and adjusted within the project lifetime, then you have failed formally. This can result in severe consequences from the Programme, including the obligation to pay back the whole amount already spent.

Pilot replication bluprint: Gargzdai/ LT: Natural stormwater treatment for use in municipal services

Interreg Baltic Sea Region

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SUSTAINABLE WATERS
WaterMan

Access the „BSR Water Recycling Toolbox" here.
https://www.eurobalt.org/waterrecyclingtoolbox/

The „BSR Water Recycling Toolbox" was elaborated as part of the project "WaterMan - Promoting water reuse in the Baltic Sea Region through capacity building at local level", The project is co-financed by the European Union (European Regional Development Fund) and implemented within the Interreg Baltic Sea Region Programme. More information:

eurobalt.org/WaterRecyclingToolbox
interreg-baltic.eu/project/waterman

WaterMan promotes a region-specific approach to water recycling, which intends to use the alternation of too much and too little water that has become typical in the Baltic Sea Region to make the local water supply more resilient, and supports municipalities & water companies in adapting their strategies.