



NBS FOR CATCHMENT SCALE CLIMATE ADAPTION



URBAN WATER SYSTEMS

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School of Engineering



Interreg



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Central Baltic Programme

MUSTBE

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SUSTAINABLE WATERS

City Blues

NBS AS STRATEGICAL APPROACH

- EU Strategy on Adaption to Climate Change:
 - Blue-green (as opposed to grey) infrastructures are **multipurpose**, “**no regret**” **solutions** and simultaneously provide environmental, social and economic benefits and help build climate resilience.
- Nordic Council of Ministries, Working with Nature-Based Solutions:
 - ... clear **political prioritization** is needed to mainstream NBS into policy and practice...
- Tallinn Stormwater Strategy 2030:
 - For new developments only **contemporary stormwater solutions** (ponds, wetlands) are used. **Significant increase in green areas** are foreseen for developments to favor infiltration and decrease flooding risk

PROPERTY BASED NBS – DO THEY WORK?



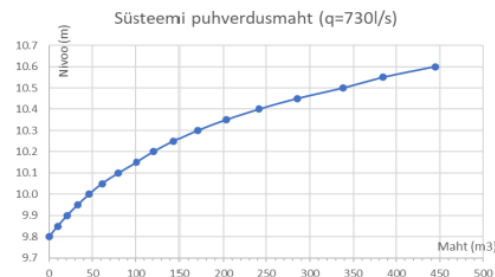
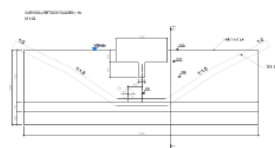
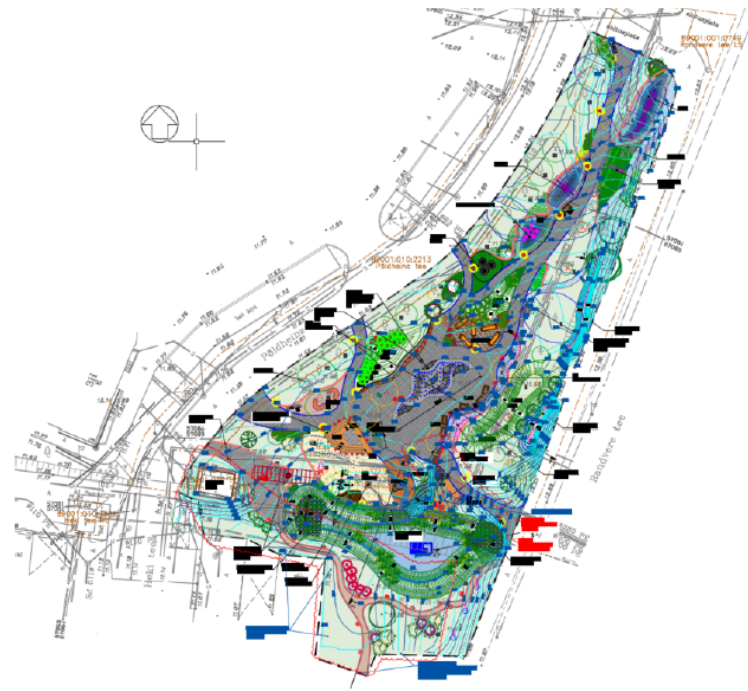
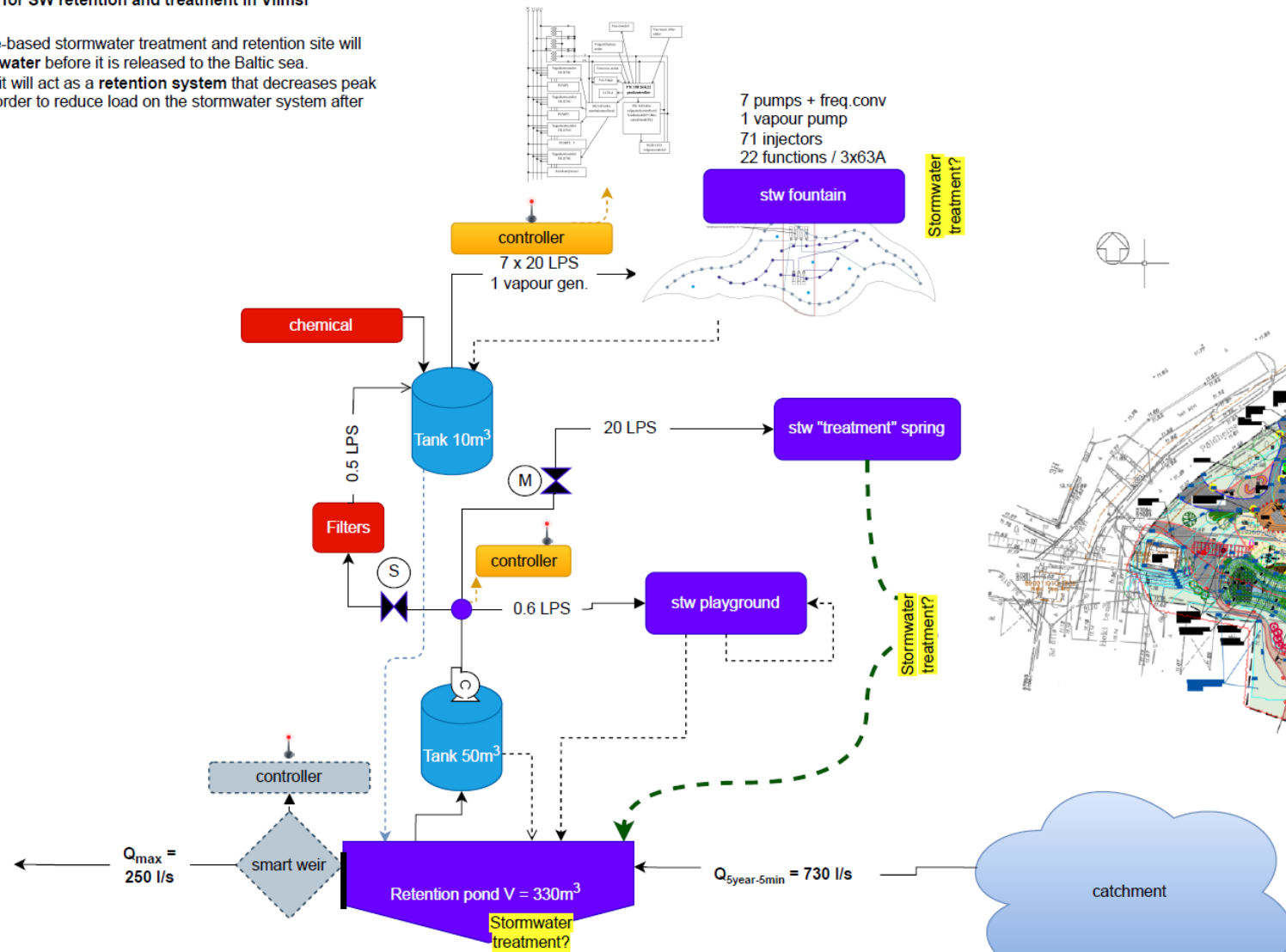
Photo: Kaupo Kalda





Smart NBS for SW retention and treatment in Viimsi

Smart nature-based stormwater treatment and retention site will **clean stormwater** before it is released to the Baltic sea. Additionally, it will act as a **retention system** that decreases peak flowrates in order to reduce load on the stormwater system after heavy rain.



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WHY WE IMPLEMENT NBS?

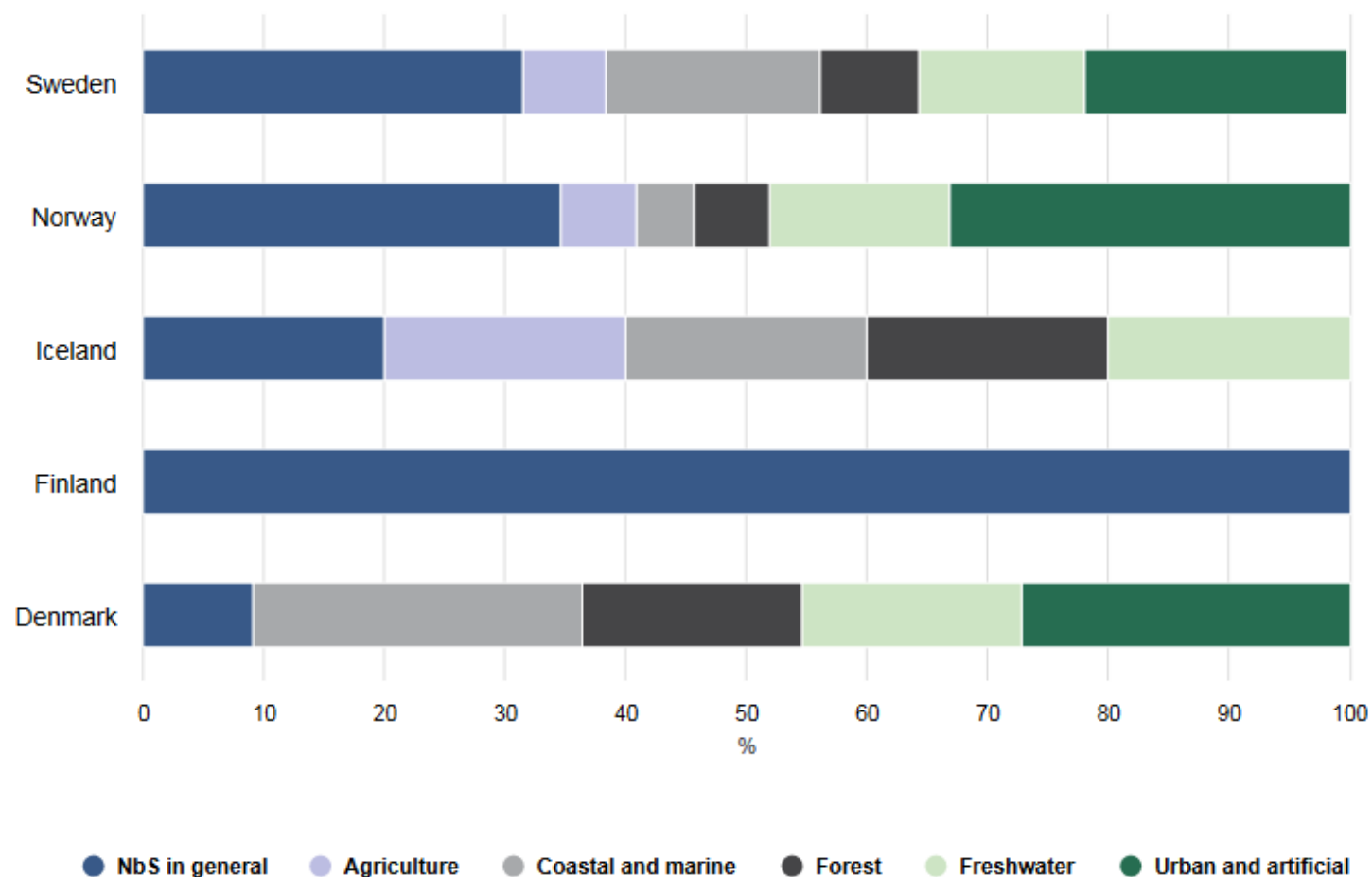
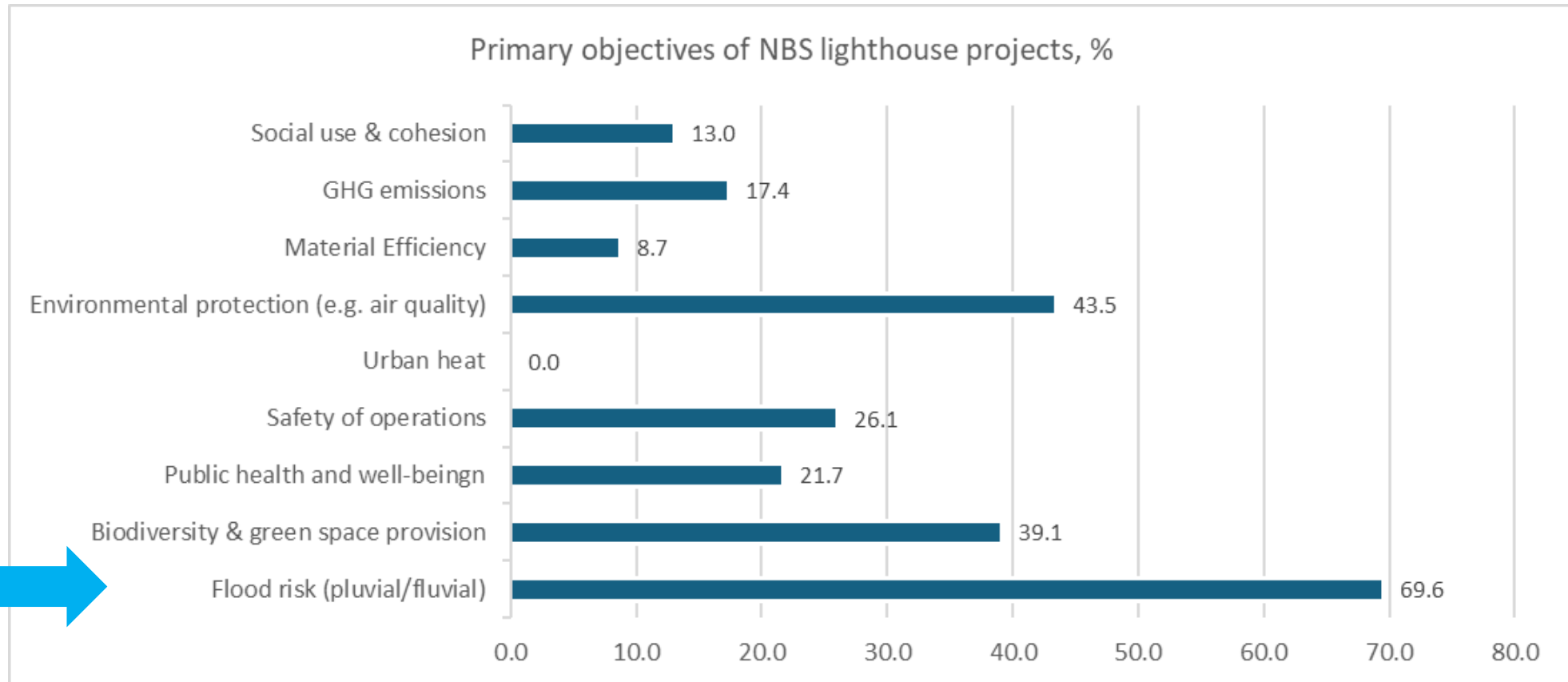


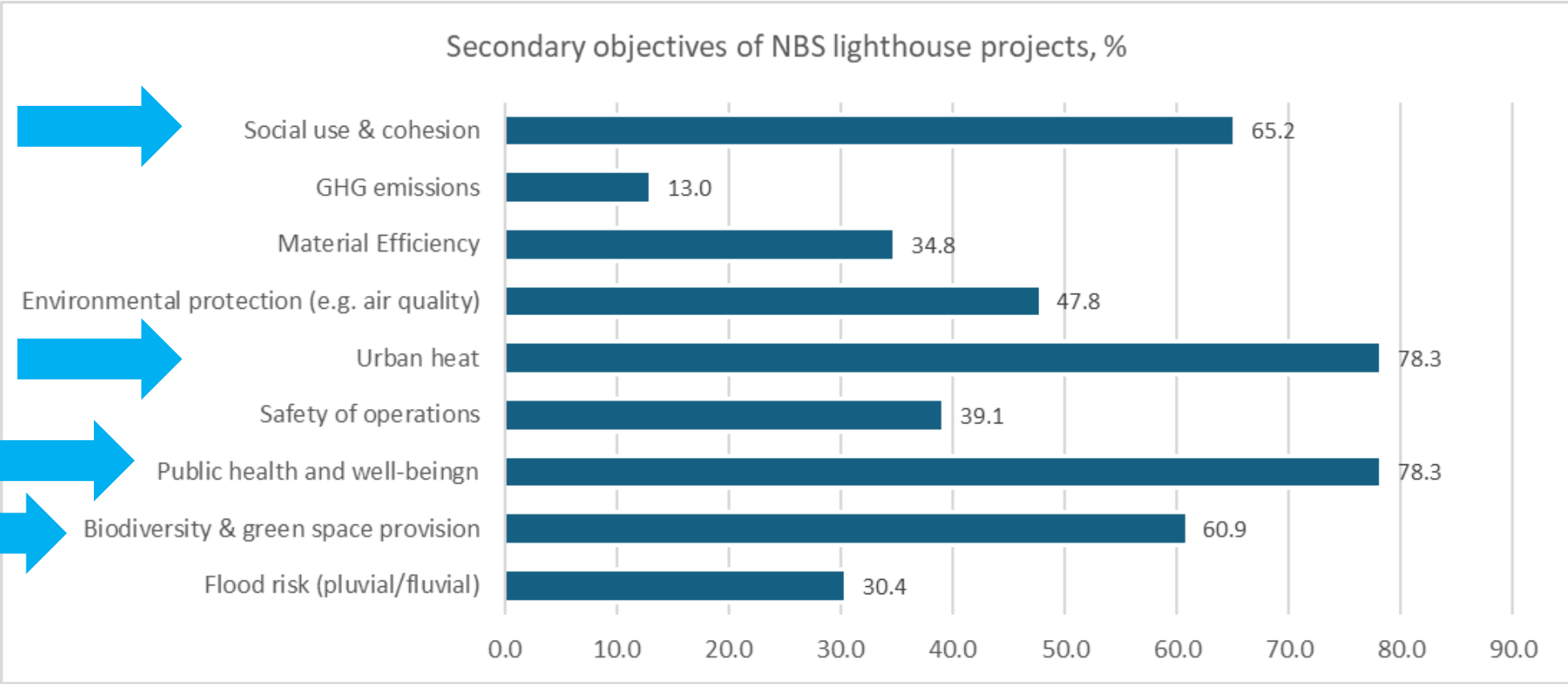
Figure 6A. Ecosystems addressed in policy documents (incl. laws, regulations, strategies and plans) and guidelines reports (e.g., research reports, status reports, analysis and more).

WHY WE IMPLEMENT NBS?

- 23 already implemented lighthouse projects were analysed in CityBlues pilots



WHY WE IMPLEMENT NBS?



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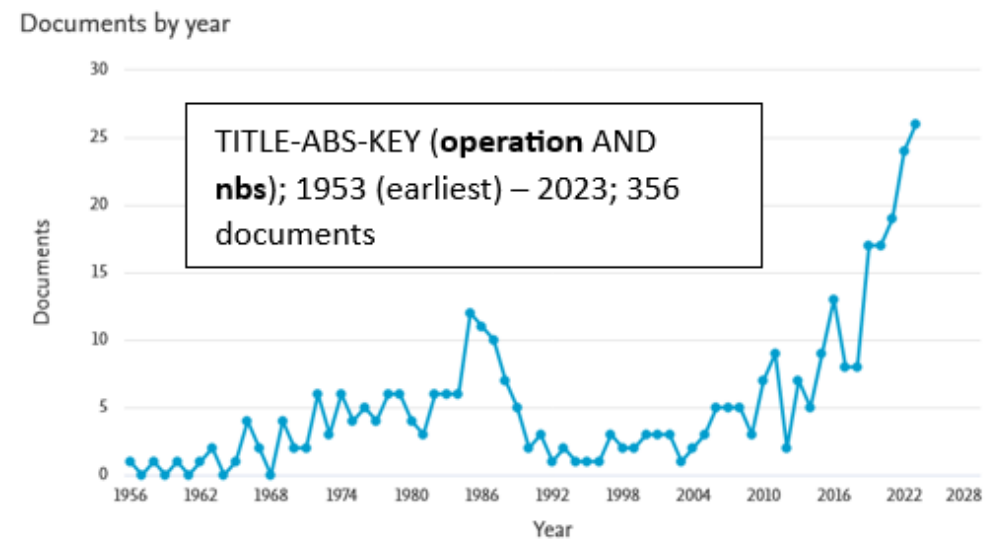
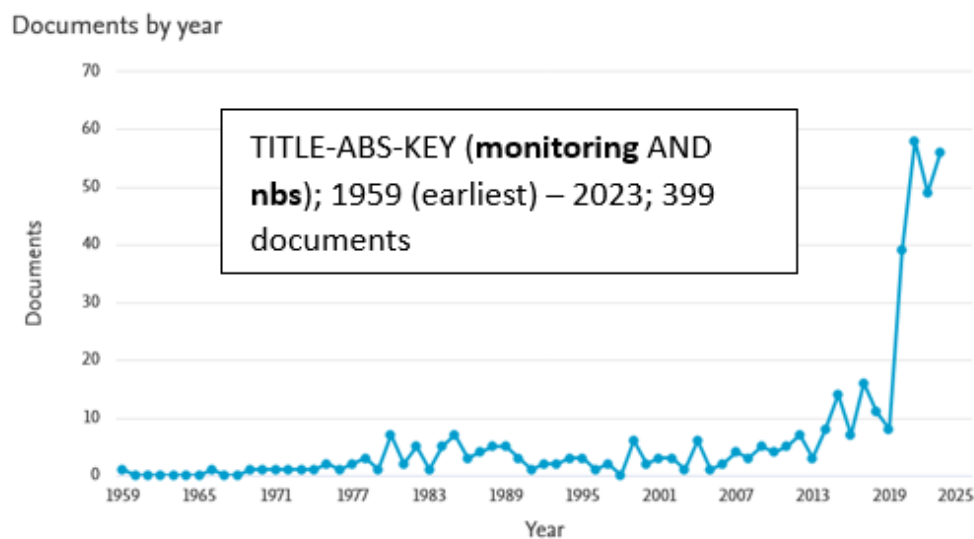
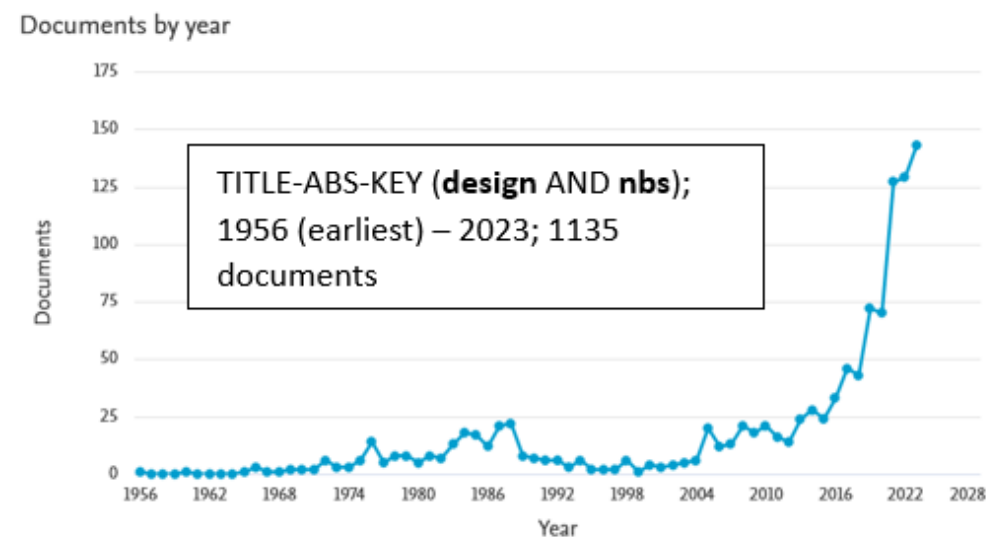
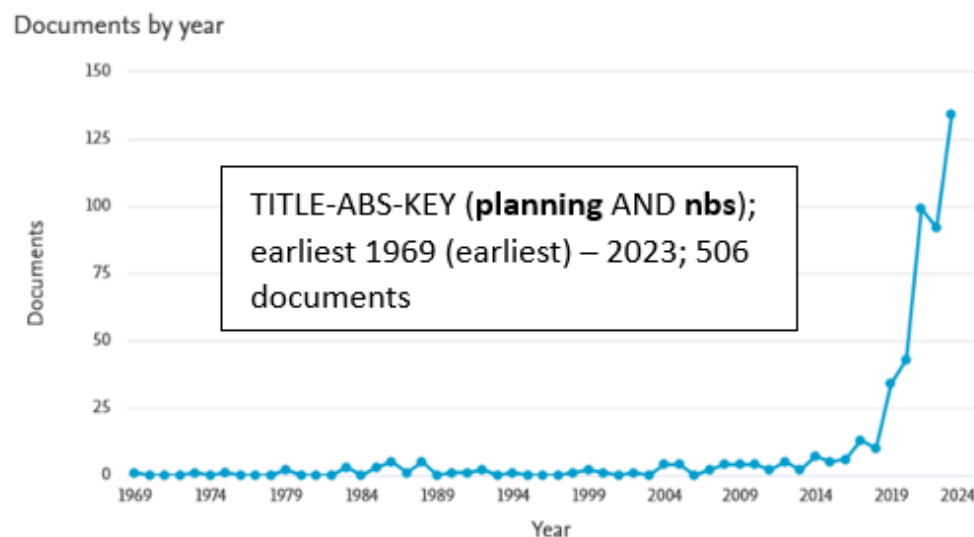
MUSTBE

- **Primary objectives:**
 - Flood risk reduction
 - Improvement of water quality
- **Secondary objectives:**
 - Biodiversity and increase in green space
 - Public health and well-being
 - Urban heat
 - Social use and cohesion
 - Education
 - Research
 - Mitigation of seasonal water scarcity
 - Fun factor

TAL
TECH



RESEARCH GAPS IN NBS PLANNING, DESIGN AND MONITORING



RESEARCH GAPS IN NBS PLANNING

- **Long-term impact:** A lack of longitudinal studies makes it difficult to fully understand how effective NBS are over time, and whether they adapt well to changing conditions.
- **Context-specific:** There's limited research comparing different participatory tools and how well they work in different societies and cultures.
- **Quantifying environmental impacts:** While there's an emphasis on using NBS to improve environmental justice, methods for measuring the real impact on social equity are underdeveloped.
- **Adapting NBS to extreme climates:** Most research focuses on typical environments, leaving a lack of guidance on how to best adapt NBS to extremely challenging settings such as arctic or colder regions.

RESEARCH GAPS IN NBS DESIGN

- **Prioritization:** A scheme to prioritize between different NBS benefits and limit trade-offs in the planning and design phase is needed.
- **Standardization:** A standardized design process for hybrid infrastructures that aligns with the regulatory framework and includes a maintenance commitment is lacking.
- **Performance analysis:** Data (cross-city and -scale comparison) on the multifunctional performance of NBS to inform design standards is lacking.
- **Adapting NBS to extreme climates:** Lack of information of correlation between contingent effects (climate, hydraulics and design) and NBS performance to predict the efficiency in the design phase and to mitigate risks and ensure functionality in weather extremes.

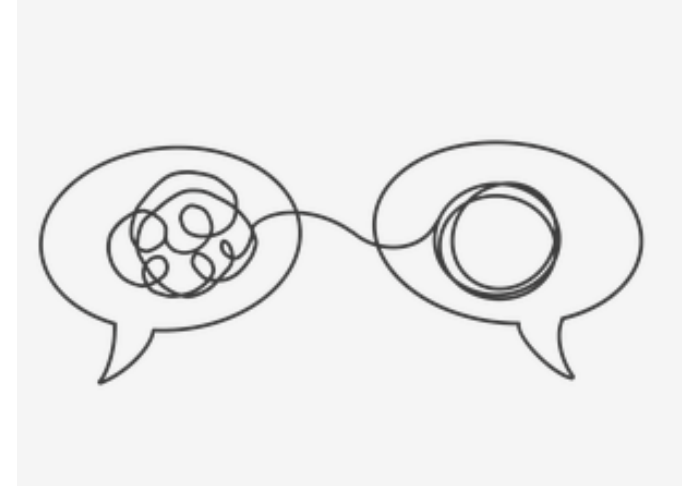
RESEARCH GAPS IN NBS MONITORING

- **Standardization:** Currently there is no specific widely recognized standard or code to determine the hydrological performance of green roofs as a whole system. This could be extended to different NBS.
- **Data deficiency and lack of know-how:** The knowledge on green roof (GR) performance is quite good, due to relatively easy monitoring of them, however, other NBS which are not as spatially defined as GR are lacking on monitoring and knowledge on the performance due to failure modes. Furthermore, there is a lack of long term monitoring of NBS implemented in municipalities.
- **Maintenance:** Lack of understanding how water utilities and municipalities take care of maintenance of NBS. There is a large variety of different NBS maintenance guidance's, but are they, due to resource (financial & time) fulfilled? There is a need for a survey in the BSR region for water utilities & municipalities.
- **Optimization and cost-efficiency:** How can existing monitoring strategies be optimized? Can simple data-driven models be created that give maintenance prediction based on open accessible data, e.g. based on climate, traffic, design & construction data.
- **Remote sensing:** How to expand, optimize and systematically use remote sensing and drones as data sources.

WHAT IS THE SOLUTION?

■ What are the challenges?

- Strategical goals are not supported by operational actions
- Property based NBS are not always solutions but can be problems
- How to smarten NBS cost-effectively?
- We design according to what we can quantify
- Although research in this field has increased exponentially, we still use more our engineering judgement than data



City Blues project has set an objective to **develop a joint operational model** for planning, design and implementing NBS in Baltic Sea Region (BSR). The expected joint operational model developed in City Blues, **will not be a standardized norm**, but rather **a set of validated best practices developed, tested and transferred across the consortium** via mutual learning and experience exchange.

JOINT OPERATIONAL MODEL



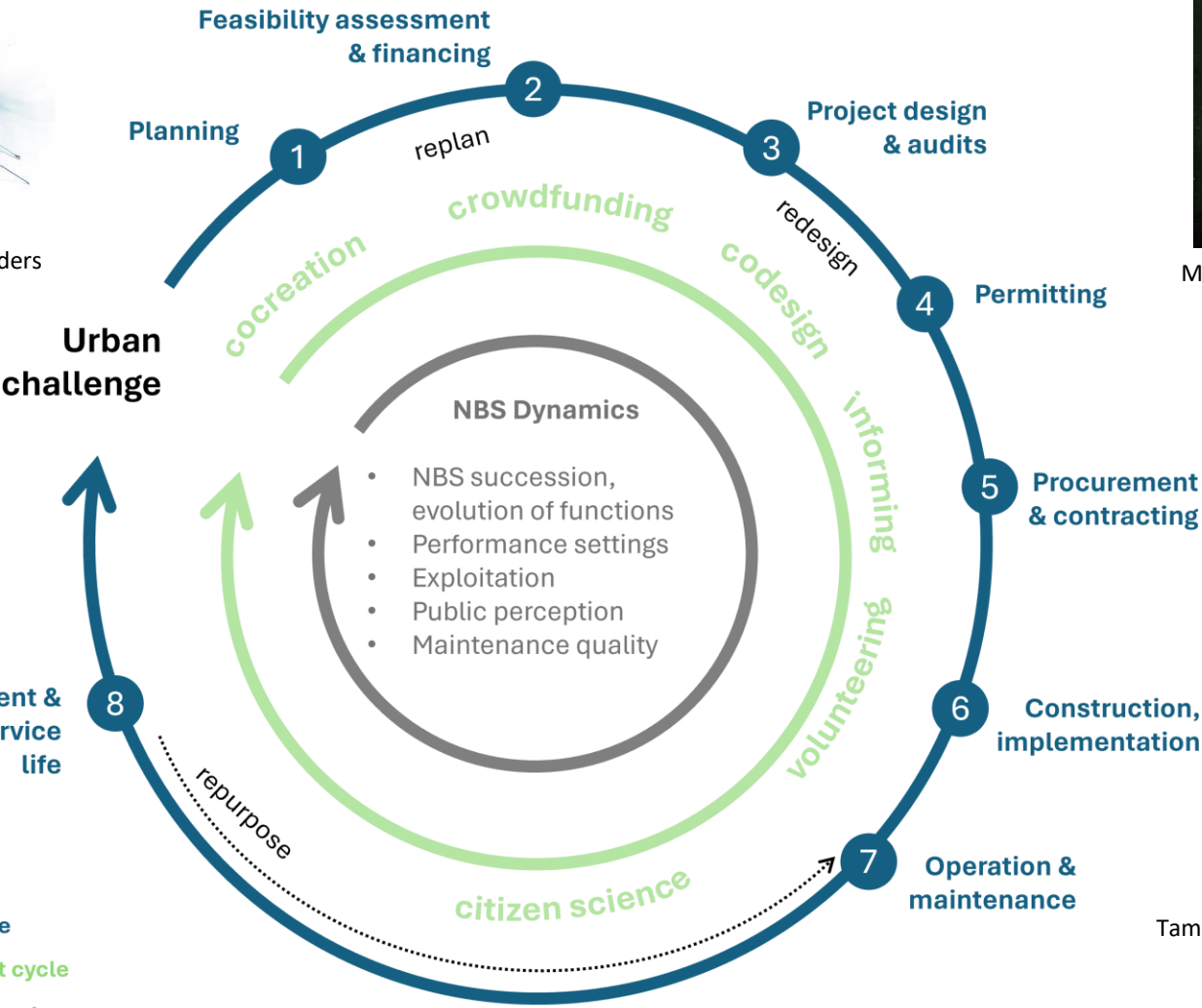
Aarhus – collaboration with different stakeholders



All – don't underestimate the informal in formal models



Project cycle
Engagement cycle
Monitoring cycle



Malmö – high internal capacity, practice makes perfect



Tampere – stormwater fee to finance NBS and monitoring



TAL TECH

PROF. IVAR ANNUS

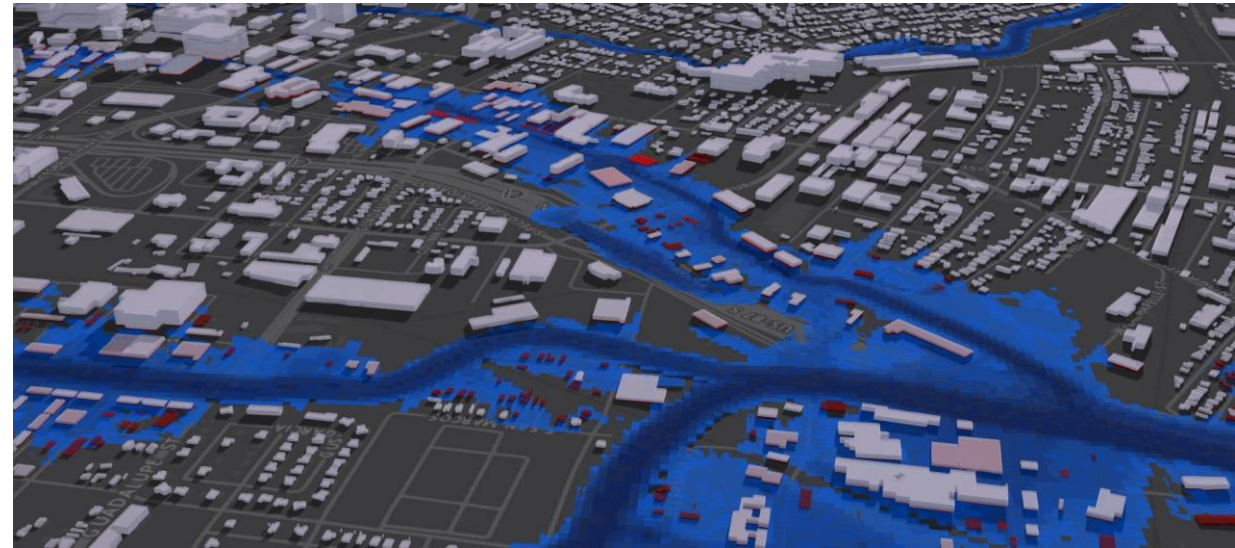
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URBAN WATER SYSTEMS

FLOOD MODELLING

- Flood modelling **as one potential tool** for flood risk management:
- Define flood prone areas, forecast water levels and future flood prone areas
- Design and analyze the impact of mitigation measures
- Resilience analysis on property and development level
- Zoning the floodplains to guide appropriate development
- Flood mapping and visualization to raise community awareness



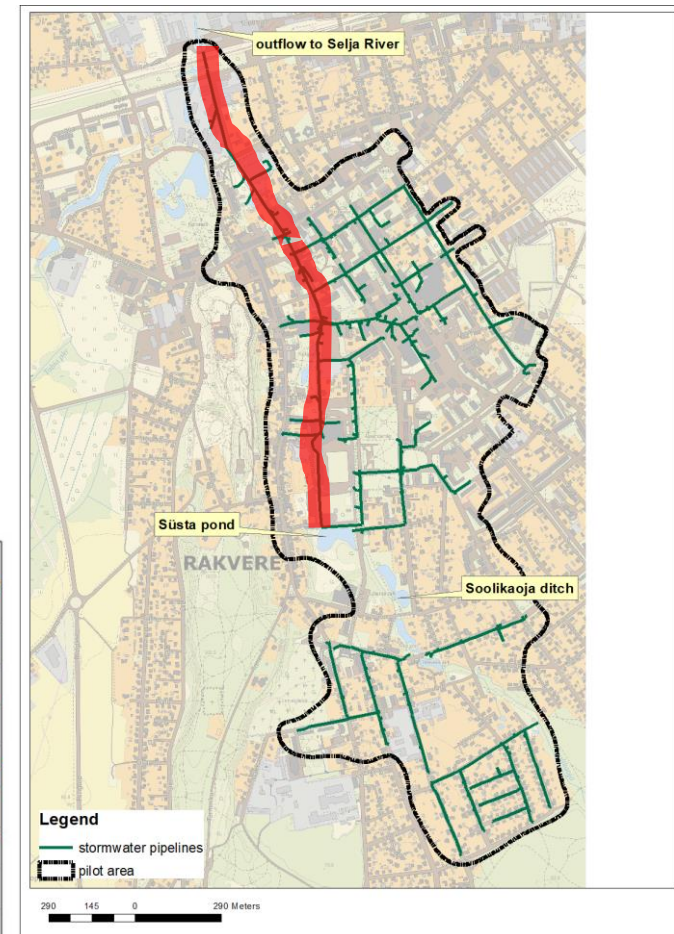
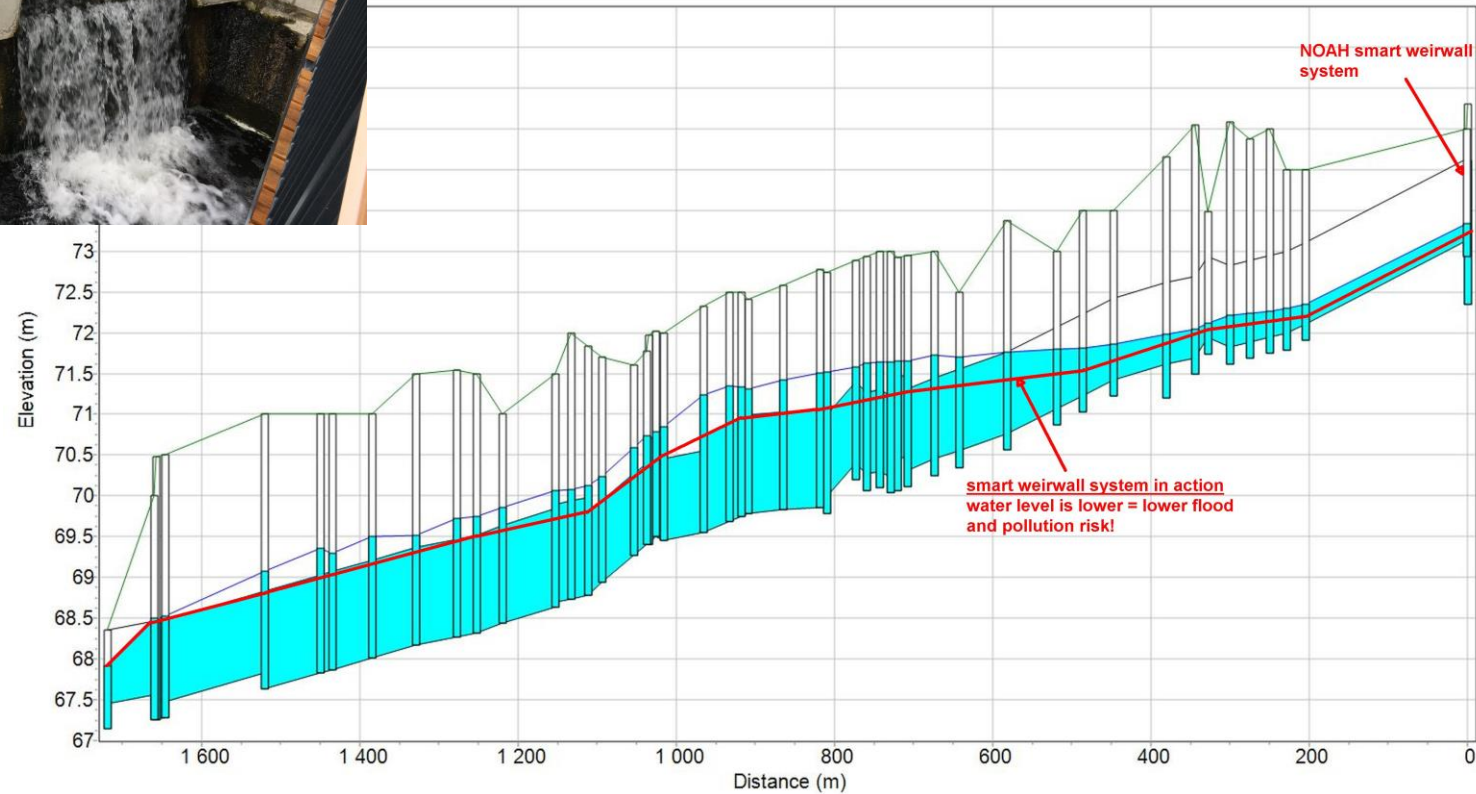
MODELLING IN CITY BLUES (GOA 1.2)

- We have promised to use **digital twins** (modelling) to generate **map-based visualizations of different scenarios** including the implementation of NBS considering climate and man-made hazards (e.g. system failures).
- In addition we have promised **static and dynamic simulations** based on the capacity of the city.
- **To be decided**: just analyze and visualize **what are the extremes** (highest water level, highest temperature etc.) in case of the hazards occur (e.g. static flooding map in case of intense rainfall) or **visualize the process** (how water is flowing in the city streets causing a cascade of failures during an event).
- **To be decided**: **what approach to use** (static vs dynamic), **what is the purpose of the modelling** and **what scenarios to model** (high intensity rainfall, heat wave, high water level in receiving water bodies, system status before and after implementation of NBS etc.).
- **Deliverable 1.2** - we need to include **the process** (what was modelled, how and why), **results** (visualization and short description) and **assessment of the impact** (based on the modelling the NBS in the chosen location improved this and that of this amount, percentage etc.).

EXAMPLE – ANALYZING THE EFFECT OF THE INTERVENTION



Water Elevation Profile: Rakvere main stormwater tunnel



EXAMPLE – ANALYZING THE CHANGE IN CLIMATE CONDITIONS

