Stormwater management & NBS for reducing emissions of harmful substances from urbanized areas

Local experiences & practices from Lahti

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Juhani Järveläinen
Water resources engineer, City of Lahti

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1. Stormwater as a source of surface water pollution (in Lahti)
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Stormwater?

- Definition: *Surface runoff resulting from rainfall or snowmelt in constructed areas*
- Stormwater sewers from cities typically discharge directly into receiving waters
  - Efficient drainage systems formed the cornerstone of traditional flood control schemes
  - However, pollutants are also carried along with the stormwater
  - Problems manifest in terms of both quantity & quality

Stormwater-related problems illustrated (all photos are from Lahti)

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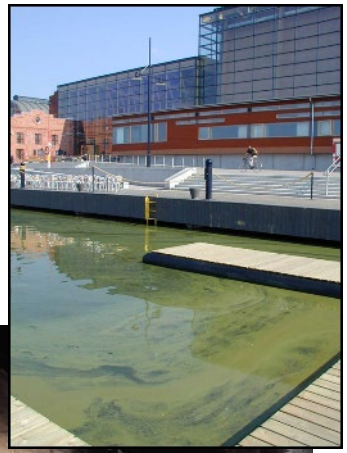

Factors influencing stormwater quality

- Degree if urbanization closely tied to severity of problem
  - More impervious surfaces= more stormwater
  - More intensive human activity (e.g. traffic) = more pollutants in stormwater
- In Lahti stormwater from the city is a significant source of surface water pollutant loading
  - Approx. 13 % of total annual phosphorous load
  - Other harmful substances include heavy metals, bacteria, (micro)plastics, suspended solids
- Majority of pollutants are particulate-bound

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Urbanization and stormwater pollution

- Urbanization causes changes in the hydrologic regime (esp. during the warm season)
  - Significant increase in runoff depth & peak flows
  - Increase in mean runoff intensities
  - Reduction in catchment lag
- Key takeaways:
  - **Very large variations in pollutant concentrations** (seasonal, event-based & in-event) complicate quantification efforts
  - **Greatest changes** in runoff response occur **during frequent summer storms**
  - **Construction** works typically have a **profound adverse impact** on water quality
  - Common perception of a **"first flush" effect does not necessarily apply** in areas where rainfall events are frequent

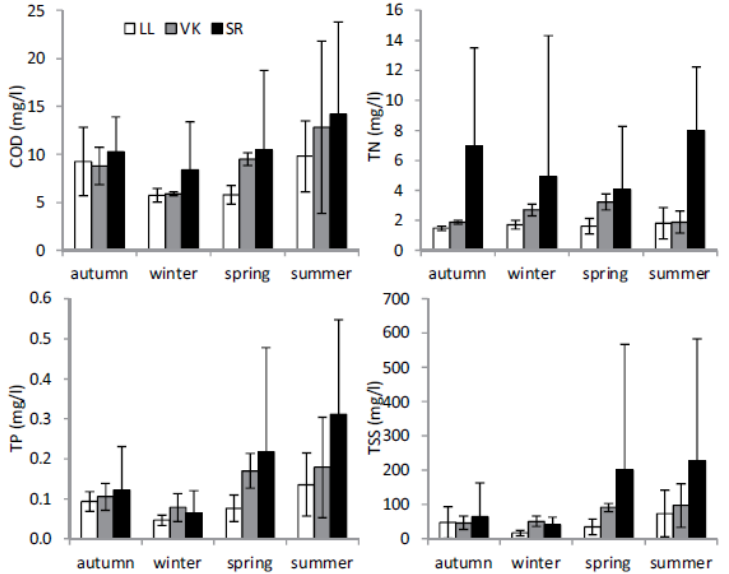


Figure 22. Average seasonal three-month concentrations with their 95% confidence intervals based on the Student's T distribution. The number of seasons (LL/VK/SR): summer (4/5/5), fall (5/5/5), winter (4/4/3), and spring (4/5/3).

Source: Sillanpää 2013

NBS in stormwater management

Used to manage stormwater runoff close to its source as part of Low Impact Development (LID) design approach

- Synonyms: SUDS (UK), WSUD (ME and Australia)

Aim is to maintain a pre-development hydrologic regime

- Detention pools, wetlands, infiltration swales, green areas etc.
- Reduction in pollutant loading, flood risks, stream erosion & negative effects on groundwater

Benefits and limitations of NBS for stormwater management

Benefits

- Proven effectiveness in quality control (bioinfiltration)
- Adaptable & easy to integrate into green spaces
- Cost-effective
- Multifunctional; can provide various ecosystem services
- Provides both quality & quantity management

Limitations

- Space-intensive (some systems)
- Optimal implementation requires planning in early stages of development
- Requires maintenance (varies)
- Limited knowledge base on engineering specifications (e.g. materials)

Stormwater management in Lahti

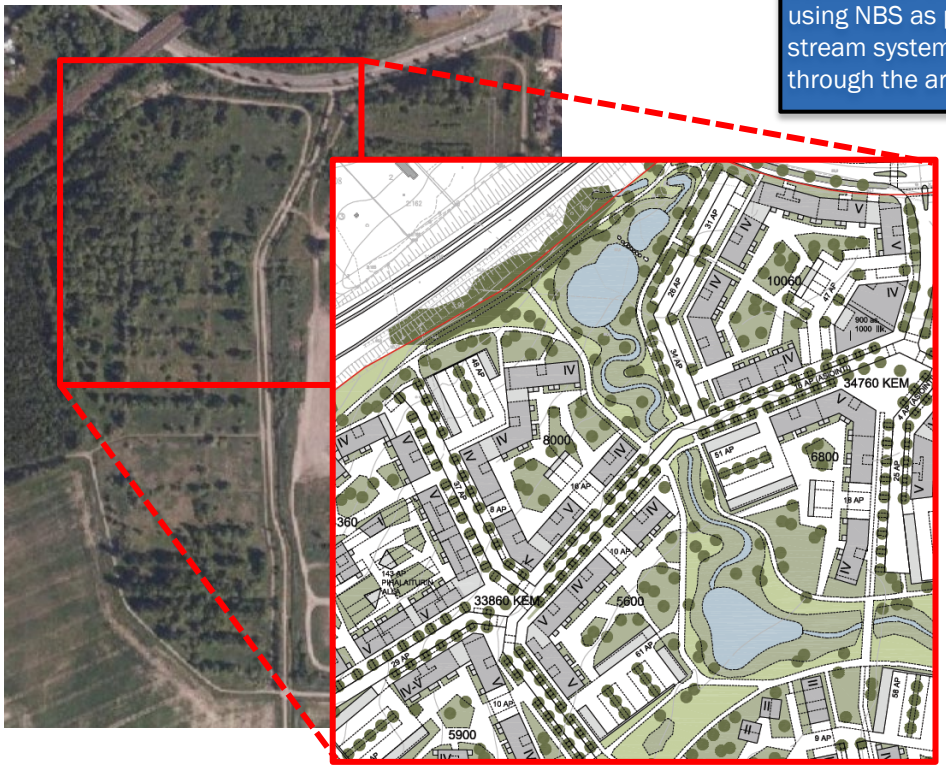
- Lahti has a separate stormwater programme (2010)
  - Goals for stormwater management
  - Definition of areas of responsibility
  - Priority of management options (local infiltration prioritized)
- Goal: using NBS to manage majority of annual stormwater runoff
  - Frequently occurring small showers (i.e. less than 10 mm)
  - Calls for both small, decentralized systems & larger systems where needed
  - Local groundwater & soil conditions have a large impact on management options
- Implementation of NBS begins in the zoning phase
  - Allocation of space needed for NBS systems
  - Existing areas are more challenging; individual “best that can be done” – solutions

Aerial photograph of the Karisto area, showing constructed wetlands and plentiful urban green areas.

Example 1: Hennala NBS system

Länsi-Hennala overview

- Area undergoing zoning process, residential construction to begin in the next few years
- Implementation & research platform for new stormwater management solutions (e.g. biofiltration)
- Prototyping & development of pre-commercial infiltration solutions in co-operation with local companies
- Pre-trials of infiltration performance of various materials conducted by Helsinki university
- NBS system was built in mid-2018



Stormwater treatment using NBS as part of a stream system running through the area

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Example 1: Hennala NBS system in pictures

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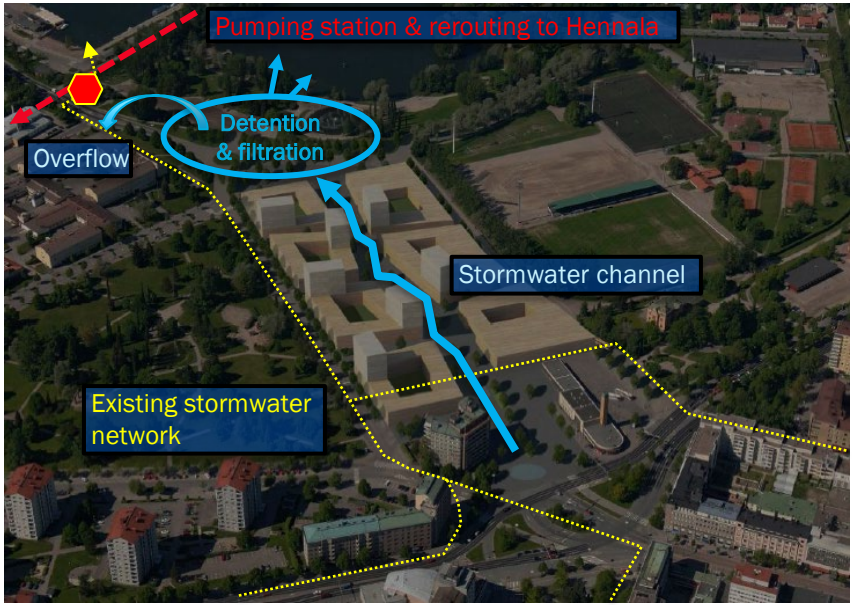
Example 2: Ranta-Kartano area



Ranta-Kartano overview

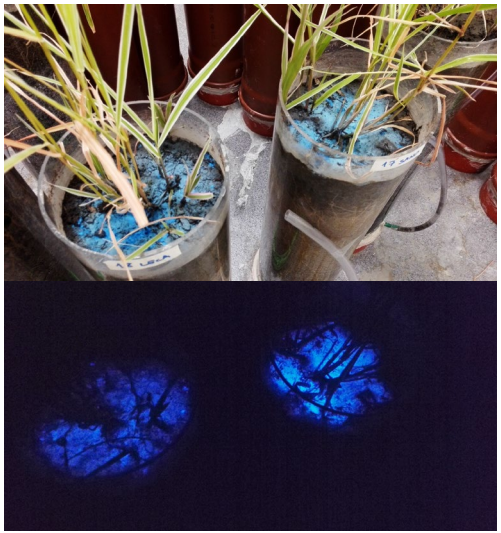
- Construction 2017 - 2020, a showcase of LID implementation in new construction projects
- Co-operation with local businesses to implement new stormwater management solutions
- Linked to a larger project aimed at reducing stormwater runoff to adjacent Lake Vesijärvi

Stormwater management based on a 3-step system utilizing green spaces:

1. Detention of light rainfall on individual plots
   - Combination of LID elements results in a 5 mm detention capacity
   - Green roofs and –pockets, rain gardens etc.
2. Stormwater channel running through the area collects excess runoff from individual plots
   - Detention capacity & scenic element
   - Some stormwater ”upstream” from city center also routed into the channel
3. Detention & infiltration pools collect runoff from channel
   - Filtration north towards Lake Pikku-Vesijärvi
   - Overflow to existing SW network & pumping to Hennala area for treatment using NBS

Local experiences & recommendations

- The importance of **good communication** cannot be overstated
  - Public generally lacks knowledge of stormwater issues
- Effective **NBS implementation requires strategic vision** to achieve impact on a larger scale
  - Pilots are useful as “proof-of-concept” & to acquire needed experience
  - NBS and traditional solutions are both required to cope with different scenarios
- **NBS construction should precede other development** to manage construction phase stormwater runoff
- **Co-operation with academic institutions is encouraged** to accurately estimate impact, expand knowledge base & carry out monitoring efforts



Thank you for your attention!

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Juhani Järveläinen
juhani.jarvelainen@lahti.fi

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