NATURE-BASED SOLUTIONS FOR WATER IN THE PERI-URBAN

CASE STUDY BRIEF: NORWAY

Nature based solutions as a catalyst for city development, to mitigate potential flooding as a result of climate change and to improve water quality

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ABSTRACT

Skien municipality, located about 130 km south-west of Oslo, Norway, is considering NBS as part of a potential reopening of the Kjørbekk stream. A 4 km stretch of the stream is contained in an aging pipe infrastructure that is buried under two disused landfills. The pipe infrastructure does not have the physical capacity to cope with an increase in extreme precipitation that accompanies current climate change, and in certain areas, the integrity of pipe is compromised with the potential to leak. This means that surface water run off that cannot be accommodated by the pipe, as well as water that leaks from the pipe can become contaminated by the waste in the disused landfill. The water can furthermore be transported with the stream course to the final recipient, taking potential contamination with it. Reopening the stream and providing new water pathways can alleviate these problems, but it must be carried out in such a way that ensures contamination is not spread.

This case study shows how certain NBS that focus on reducing the amount of water in contact with contaminants from the landfill waste, reducing the amount of particle spreading, remediating contaminated water and remediating contaminated soil, could be implemented at the site and function as a catalyst for an incremental city development.

PURPOSE OF THE CASE STUDY

The Kjørbekk case study is in the planning phase and interventions are being considered in order to prevent the transport of contaminants from the buried landfills whilst at the same time allow for the stream to be reopened at selected locations and for the subsequent implementation of NBS. Knowledge is needed about suitable methods that support this aim as well as additional knowledge about the actual risk posed by the disused landfills.

AREA CHARACTERISATION

Country	Norway
Province	Vestfold and Telemark
Municipality	Skien
Town	Skien
GPS coordinates	59.2096056° N, 9.6090139° E

Outlet in to the Skien River

PHYSICAL CONTEXT

Local geography/ topography	Skien municipality is located in southern Norway, approximately 130 km southwest of Oslo. The municipality covers a total area of 778 km², with about 479 km² forest, 46 km² agriculture and 57 km² freshwater. The remaining 197 km² are inhabited including cities/towns, residential areas as well as industrial areas. The highest points are located north in the municipality (Skårråfjellet at 814 moh and Ørnenuten at 811 moh).
Main water courses	The Skien River (Skienselva) begins in Skien and runs through the city of Porsgrunn to the mouth of the river at the fjord Frierfjord with subsequent access to the sea. The waterfront is an important part of the Skien townscape and the access to the sea has most likely been important for the development of the area. Skien is one of Norway's oldest cities dating back to the Middle Ages (received privileges as a market town in 1358) and historically, Skien was an important port town for shipping.
Main soil types	Skien has a varied geology and after the last ice age, the area was submerged for thousands of years. Subsequently, the remaining deposits have made the area a very productive agricultural area. Main soil types include a thin layer of moraine between bare mountain, thick layers of marine clay, as well as glacial fluvial deposits (gravel and sand) as well as fluvial deposits dominated by sand.
Temperature and Precipitation	Skien has a moderate coastal climate, with relatively mild winters and warm summer weather. Average temperature and precipitation during the period 1971-2000 is 6.4 ° C / 840 mm (Klima2100 report). For Skien, seasonal temperatures vary from -2oC in the winter, between 1-10 oC in the spring, 16 oC in the summer and 12-8 oC in the autumn (no.climate-data.org). Precipitation in Skien varies between 370 to 880 mm per month. The amount of precipitation is expected to increase by the year 2100 with seasonal variation (winter: 30%, spring: 25%, summer 0%, autumn: 10%, Klima2100 Report).
Critical infrastructure	The municipality has all essential infrastructure in place, including transport, energy (electricity), water and wastewater, communications and data.
Other relevant physical factors	The case study area (Kjørbekk) is a stream that was diverted and buried in the 1960's. Some of the fill material used originated from industrial sites during this time period as well as from household waste. This resulted in two disposal areas in the valley of this stream (Kjørbekk 1 and Kjørbekk 2). With regard to NBSs, Skien's municipal strategy plan document specifically references urban green structure, in the form of the large interconnected cultural landscapes adjacent to and within urban areas. They also recognize that green structures are becoming an increasingly important role as urban areas become more populated. More info at https://snl.no/Skien.

SOCIO-ECONOMIC CONTEXT

Population	The population is 54 589 in the municipality (making it the 7th most populated municipalities in Norway) and population growth is only 0.2%. The conurbation of Porsgrunn/Skien is the seventh largest urban area in Norway according to Statistics Norway (SSB), straddling an area of three municipalities: Skien municipality (about 62% of the population), Porsgrunn (30%), and Bamble (8%). This area is home to more than 100,000 people. is the capital of Vestfold and Telemark with about 55.000 inhabitants, situated close to Porsgrunn and Bamble, which makes Grenland a working and living area for more than 100.000 people.
GPD/capita	The median income per household is about 600.000 kroner.
Economic status (i.e. low income, high income)	Percent of individuals in private households (excluding students and persons under 18 years) having low economic status as defined by EU- and OECD- scales (from 2017, SSB): EU-50: 7%, EU-60: 14%, OECD-50: 8%, OECD-60: 12%

OBJECTIVE OF THE NBS

The NBS addresses water quality and water quantity (excess). The NBS aims to safeguard water quality from potential pollution arising from the landfills. The two disused landfills received household waste, waste oil and a mixture of different hazardous waste. Due to the time at which they were built, they do not have bottom lining and hence the potential for surface water run off that is a result of increased rainfall amounts due to climate change, or stream water that leaks from the ageing pipe, to come in to contact with contaminants is increased.

POLICY AND GOVERNANCE CONTEXT

The local municipality has been the main driver for action, with broad participation from different divisions within the municipality (planning department, water and wastewater, environment). The County Authority has also participated in diverse meetings to provide advice and feedback as the authority responsible for approving potential proposals for permits related to interventions at the two disused landfills. The Norwegian Environment Agency has the potential to be involved in the work, both financially and via planning. Norwegian water quality policy is rooted in the Water Framework Directive and its target concentrations.

ACTIONS

The NBS is currently being planned and the following types of interventions are being considered:

- Altering the landscape using nature-based interventions and landscape modelling in order to reduce the amount of water that is in contact with potentially polluted soil and waste. By leading the water away from the landfill areas, infiltration is minimised and subsequently, so is the amount of contaminated leachate water.

- Concave topography, terraced ditches, ditches to collect surface water and dams which can pool water are possibilities. The density of natural vegetation in the area could be increased in order to reduce the amount and the speed of infiltration water as well as minimizing both airborne and waterborne particle spreading.
- Constructed wetlands (CW) which have been shown to efficiently reduce concentrations of total suspended solids (TSS), organic matter, nutrients (P and N), heavy metals and a range of organic contaminats such as pesticides, pharmaceuticals and contaminants of emerging concern are being considered. NBS that can remediate contaminated soil such as aeration, natural degradation, monitored natural attenuation and the addition of a sorbent that can bind the contaminants are also possible interventions for the site.

POTENTIAL (OR ACHIEVED) IMPACTS AND BENEFITS

The Kjørbekk stream is 4 km long, and the NBS will be used to transform the whole stretch. The potential impacts and benefits of using NBS at the site include reducing the risk of flooding and subsequent damage to property, which encompasses both social and economic co-benefits.

Industrial area built on top of the area landfill 1

SUSTAINABLE DEVELOPMENT GOALS AND/OR ANY OTHER WATER-RELATED DEVELOPMENT GOALS ADDRESSED

SDG6: Ensure access to water and sanitation for all, target 6.3: 6.3 “By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally”. NBS will be used to improve water quality by reducing the potential for contaminants from the landfill waste coming in to contact with the kjørbekk stream.

SDG9: Build resilient infrastructure, promote sustainable industrialization and foster innovation, target 9.1 “Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all”. The redevelopment of the kjørbekk stream as a green corridor supports sustainable and resilient infrastructure reducing pressure on the aging pipe system.

LESSONS LEARNT

The case study is still in the planning stage.

TRANSFERABILITY OF RESULTS

The case study is still in the planning stage.

The area around landfill 2

The upper part of the waterway before the Kjørbekk stream is diverted in to the pipe

CONTACT INFORMATION

Sarah Hale
Norwegian Geotechnical Institute,
sarah.hale@ngi.no

WHAT IS NATWIP?

NATWiP is an acronym for a project entitled: Nature-Based Solutions for Water Management in the Peri-Urban: Linking Ecological, Social and Economic Dimensions.

This is an EU-Cooperation project funded under the Water Joint Programming Initiative (JPI) Call 2018 and is led by an international consortium of scientists. The NATWiP team works towards promoting sustainable implementation of nature-based solutions to address water challenges in peri-urban areas.

EDITORS

Amy Oen

RiSC, Norwegian Geotechnical Institute, Oslo, Norway

Sarah Hale

Sustainable Geosolutions, Norwegian Geotechnical Institute, Oslo, Norway

AUTHORS

Amy Oen

RiSC, Norwegian Geotechnical Institute, Oslo, Norway

Sarah Hale

Sustainable Geosolutions, Norwegian Geotechnical Institute, Oslo, Norway

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