Urban storm water management in Augustenborg, Malmö

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The neighbourhood of Augustenborg, during the 1980s and 1990s an area of social and economic decline, was frequently flooded by an overflowing drainage system. Between 1998 and 2002 it was regenerated. The physical changes in infrastructure included the creation of sustainable urban drainage systems (SUDS), including 6km of water channels and ten retention ponds.

The rainwater from roofs, roads and car parks is channelled through trenches, ditches, ponds and wetlands, with only the surplus being directed into a conventional sewer system. Green roofs have been installed on all developments built after 1998, and retrofitted on 10,000 square meters on an existing building. As a result, problems with flooding have ceased and the image of the area has been significantly improved.

Case Study Description

Challenges:

The Augustenborg neighbourhood suffered from annual flooding caused by the old sewage drainage system being unable to cope with the combination of rainwater run-off, household waste water and pressure from other parts of the city. Resulting flooding was leading to damage to underground garages and basements, and restricted access to local roads and footpaths. Untreated sewage also often entered watercourses as a result of increasing pressure on the sewage treatment works.

Under the changing climate, the number of heavy downpours in autumn and winter are projected to increase, with up to 8 days with over 10mm of precipitation possible by 2080s. This is likely to exacerbate the problems associated with rain water runoff management in urban areas.

In addition, Augustenborg, one of the first housing estates delivered under Sweden’s social housing policy in the 1950s,was characterised by high levels of unemployment, high turnover of residents and high percentage of immigrants.

Objectives:

The regeneration efforts in Augustenborg started in the 1990s, and developed into the Ekostaden Augustenborg project. The key aim of the initiative was to create a more socially, economically, and environmentally sustainable neighbourhood. Whilst adaptation to climate change was not an explicit driver, the project aimed to address the issue of urban flooding in combination with measures aiming at reduction in CO2 emissions, and at improved waste management.

Due to recurring flooding problems it was proposed that stormwater from Augustenborg should be disconnected from the existing combined sewer, and drained by means of an open system. The main intention was that 70% of the storm water from roofs and sealed areas should be handled in the open system, eliminating combined sewer overflow completely, by both lowering the total volume of stormwater reaching pipes and reducing the peak flow rates.

Solutions:

While no climate change analysis was carried out on the open storm water system, it was designed to accommodate a 15 year rainfall event as the baseline. The project involved retrofitting SUDS within existing

development and infrastructure, and with residents in situ.

The completed stormwater management system includes a total of 6km of canals and water channels and ten retention ponds. Rainfall is collected in natural ditches and reservoirs before directing it into a conventional sewer system. The rainwater from roofs, roads and car parks is channelled through visible trenches, ditches, ponds and wetlands. These landscape features are integrated into the townscape within 30 courtyard areas, which also provide recreational green spaces for the area's residents. Whilst green spaces were increased in size and number, the specific style of the 1950's was maintained so as not to compromise the aesthetics of the area. Some of the green spaces can be temporarily flooded, which helps to manage water by slowing its entry into the conventional storm water system.

In addition, green roofs have been installed on all developments built post 1998. Some buildings existing prior to 1998, such as garages that have been reused as offices, have also been fitted with green roofs. Altogether, there are 30 green roofs in the neighbourhood and 2,100 square meters of green roofs are provided on houses. In addition, a Botanical Roof Garden, which covers 9,500 square meters of an old industrial roof, was developed between 1999 and 2001, and remains the largest green roof in Scandinavia.

As a result of the implementation of the initiative, there have not been any floods in the area since the open stormwater system was installed. Moreover, a 50 year rainfall event was experienced in the summer of 2007, which cut most of Malmö off from rest of Sweden. Augustenborg was not affected by this event, suggesting the design of the storm water system is performing better than conventional design standards and that Augustenborg is well prepared for more intense rainfall events in the future.

It is estimated that 90% of the stormwater from roofs and other impervious surfaces is led into the open storm-water system. In addition, the total annual runoff volume is reduced by about 20% compared to the conventional system. This is due to evapotranspiration from channels and retention ponds between the rain events. Also, the runoff peak flows are delayed and attenuated.

The implementation of an open stormwater system at Augustenborg has improved not only stormwater management in the area, but also the performance of the combined sewer system that serves the surrounding area. The volume of stormwater draining into the combined system is now negligible, and this system now drains almost only wastewater.

The alternative option of reducing flooding via a conventional separated stormwater system for Augustenborg would have meant major earthworks. This approach could also have caused problems further along the stormwater drainage network, such as bottlenecks where the system joins with older pipes. Moreover, the receiving areas could have suffered increased flood risk, erosion or water quality degradation. Therefore, the implementation of the open stormwater system described above was considered to be the most sustainable option aligning with the vision of the regeneration initiative Ekostaden Augustenborg.

Importance and relevance of the adaptation:
Case mainly developed and implemented because of other policy objectives, but with significant consideration of CCA aspects.

Additional Details
Stakeholder engagement:
The key actors involved in the regeneration of Augustenborg were the MKB housing company and the City of Malmö, represented by the Fosie district and the Service Department. However, several individuals were particularly important to the success of the project. The process of creation of Ekostaden Augustenborg began in 1997, and was started by discussions about closing down a nearby industrial area. Peter Lindhqvist from The Service Department, City of Malmö, suggested that an eco-friendly industrial park opened in the area. At the same time Bertil Nilsson, former headmaster at the school in Augustenborg, had become one of the co-ordinators of the Swedish Urban Program in Malmö. He contacted Christer Sandgren at MKB who was their housing manager for Augustenborg and had the mission to renew the area. The three men gathered a group of

senior officers, colleagues and active residents in the area who all wanted to turn the area into a sustainable district of Malmö. A project leader, Trevor Graham with experience from Groundwork in England, was hired in 1998. As the project progressed, local businesses, schools and the industrial estate became involved. The Botanical Roof Garden was developed in a partnership with several universities and private companies.

One of the main objectives of Ekostaden Augustenborg was to enable residents to play a significant role in the planning and implementation of the initiative. The Augustenborg project incorporated extensive public consultation. This included regular meetings, community workshops, and informal gatherings at sports and cultural events. The approach became increasingly open and consultative. Approximately one fifth of the tenants in the area have participated in dialogue meetings about the project, and some have become very active in the development of the area. Augustenborg school pupils were involved in a number of local developments, for example with the planning of a rainwater collection pond which is adaptable to an ice rink.Constant communication and in-depth community involvement enabled the project to accommodate residents' concerns and preferences regarding the design of the stormwater system. Consequently, the project encountered little opposition.

Success and limiting factors:
Challenges to implementation of Sustainable Urban Drainage Systems (SUDS) in Augustenborg:

- Finding physical space to incorporate the SUDS into the already existing development: (i) the SUDS had to be fitted around existing electricity, water, heating and telephone infrastructure; (ii) access for emergency vehicles had to be maintained; (iii) many residents were concerned that large percentage of the accessible green space was not suitable for recreation, and that some trees were removed.
- Buildings could not be damaged by water. Thus, all SUDS were underlain with geotextile, removing the possibility for increased deep percolation and limiting the system's function to water retention rather than infiltration.
- Health and safety issues had to be solved. The SUDS were located within and in close proximity to school grounds, and concerns were raised about the drainage channels posing obstacles to elderly and disabled.
- Other problems associated with the project were the unavoidable noise and dust during construction, which caused complaints from local residents. In addition, the retention ponds were prone to algae growth, and a technical solution was designed to solve this problem.

Success factors:

- The initiative and enthusiasm of the Service Department in Malmö and housing company MKB; strong leadership by individuals from these organisations and their professional networks allowed development of the comprehensive project. In turn, this leadership was only possible due to decentralisation of power from the city to the district level.
- The collaborative character of the project enabled joint management of the project.
- Involvement of the residents in the design phase meant that there was little opposition to the project, and resulted in sense of ownership, empowerment and raised awareness among the residents.
- Extensive funding provided by the local authorities and the housing company was another success factor.

Budget, funding and additional benefits:
The total sum invested in the physical improvements in Augustenborg and related projects was around SEK 200M (~€24M). Around half of the sum was invested by the housing company MKB. SEK 24M came from the Swedish national government within the LIP programme, and SEK 6M for building the Botanical Roof Garden came from the EU LIFE fond. Remaining funding mainly came from the local authorities, principally the City of Malmö. Management work is jointly funded through the housing company, which incorporates costs into rents, the water board through the water rates, and the city council's standard maintenance budgets.

There is a range of benefits additional to adaptation to more extreme rainfall events that stem from the comprehensive regeneration of the Augustenborg area:

- Reconfiguration of public spaces between housing blocks has given residents opportunities to grow their own food in small allotments, and has created places for leisure and attractive areas for children to play.
- Biodiversity in the area has increased by 50%. The green roofs, predominantly the Botanical Roof Garden, have attracted birds and insects, and the open storm water system provides better environment for the local plants and wildlife. In addition, flowering perennials, native trees and fruit trees were planted, and bat and bird boxes were installed.
- The environmental impact of the area (measured as carbon emissions and waste generation) decreased by 20%.
- The participatory character of the project sparked interest in renewable energy and in sustainable transport among residents, after they heard about similar plans for other areas.
- Between 1998 and 2002 the following social changes have occurred: (i) turnover of tenancies decreased by 50%, (ii) unemployment fell from 30% to 6% (to Malmö's average), (iii) participation in elections increased from 54 % to 79%.

As a direct result of the project, three new local companies have started: Watreco AB (set up by local resident and amateur water enthusiast), the Green Roof Institute, and the car pool established in 2000, which uses ethanol hybrid cars to further reduce environmental impacts.

Legal aspects:
None

Implementation time:
The project was started in 1997, and implemented between 1998 and 2002. The work on the SUDS infrastructure began in December 1999, and finished in the summer of 2000. The system is operational since May 2001.

Reference Information
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Websites:
http://malmo.se/Nice-to-know-about-Malmo/Sustainable-Malmo-/Sustainable-... [3]

Sources:
Green and Blue Space Adaptation for Urban Areas and Eco Towns (GRaBS)

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Links
[1] https://adaptecca.es/en/urban-storm-water-management-augustenborg-malmo
[2] mailto:eva.klammeus@malmo.se
[3] http://malmo.se/Nice-to-know-about-Malmo/Sustainable-Malmo-/Sustainable-City-Development-2016/Sustainable-City-Development/Augustenborg-Eco-City.html