

STOCKHOLM'S BLUE-GREEN INFRASTRUCTURE

SECTOR:
BLUE-GREEN INFRASTRUCTURE
COUNTRY: SWEDEN

BACKGROUND

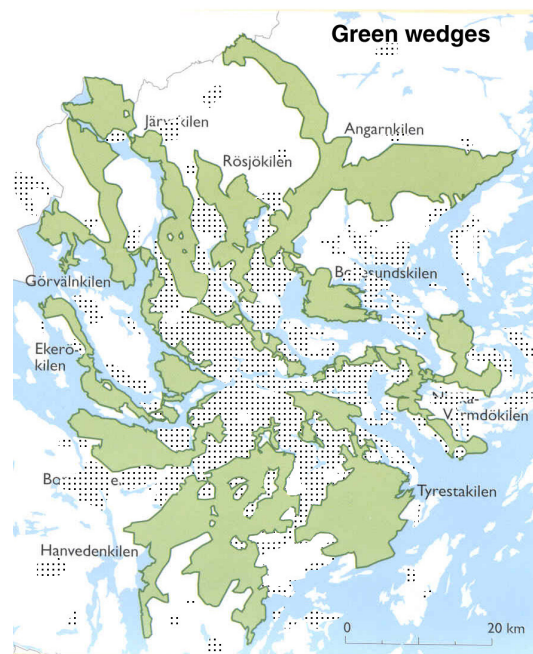
Greater Stockholm has retained a great deal of its natural and cultural landscape. The population growth has certainly meant that an increasing amount of land has been required for urban settlement but the built-up area is still limited. Even in the city of Stockholm the undeveloped area (land and water) is 47% of the total area.

The urban settlement has mainly been developed in a star-like pattern. From the beginning the undeveloped wedges to a great extent were royal parks, land belonging to noble families, or military exercise fields. When the urbanised area expanded, the building of neighbourhoods have been coordinated with the building of railway and underground systems, and have been situated to areas between royal, military and other restricted areas. Later on, these areas with restricted access have been transformed to recreational, forestry or agricultural areas.

The star-shaped urban development has formed a sort of structure with green wedges between the settlement and traffic zones. That means that most of the stockholmers have good public transport as well as green areas in the vicinity.

The green wedges begin in the city centre of Stockholm, stretching out to the rural area outside Stockholm. They support many functions. Firstly, they are of great importance for the amenity of the city, as well as for recreation. And the link between the city's greenery and the surrounding

countryside is of great significance for the potential for maintaining a functioning ecosystem and a natural biological diversity even in the central parts of the region. The vegetation improves the air quality in a considerable way, and storm runoff water from the built-up areas can be infiltrated in these areas.

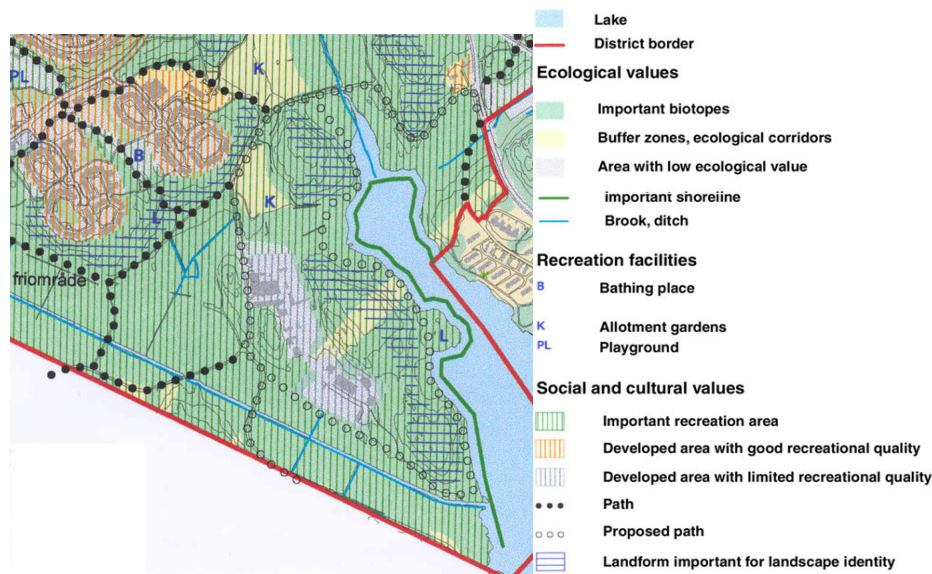


Stockholm's green wedges ("...kiln" = wedge). Grey = developed areas (including parks and small natural areas)

The City of Stockholm is developing a "Green map" as a tool for land use planning. It consists of three parts: biotope map, recycling map and sociotope map. The biotopes are identified from landscape ecology

points of view, and the map makes it possible to value biodiversity. The recycling map identifies areas for recycling of nutrients from composting and treated waste water, for storm runoff water treatment, for energy forestry, for shelterbelts and so on. The sociotope map introduces the

concept sociotope in planning, and is a way of managing sociocultural aspects. A sociotope is a defined area (a biotope, or several biotopes) used for social functions (shore - bathingplace; meadow - recreation area).



INDICATORS

- Amenity
- Recreational use
- Biodiversity
- Areas for storm runoff water treatment
- Areas for recycling of nutrients
- Areas for waste water treatment
- Areas for energy production
- Areas for shelterbelts and improvement of urban climate

EVALUATION

The green wedges are, among other things, meant as ecological corridors. To be efficient for migration for many groups of plant and animal species, they should contain a broad spectrum of biotopes within distances these species can bridge over. At certain places they show significant problems due to lack of space, which means that the corridors can not contain all

biotopes needed for migration. Therefore they are broken for many groups of species at these places.

Significant areas can be used for waste water treatment, for recycling of nutrients, for energy forestry, and so on. Evaluation is going on in the Stockholm region and in other city areas.

Preliminary results from Stockholm are:

- The green wedges are of great social and recreational value to the local occupants. There is usually room for measures for sustainability without making significant impact on recreational values. Measures as ponds and shelterbelts can be designed to increase amenity as well as biodiversity and recycling functions.

- An area to a distance of about 70 km should be used to recirculate all nutrients from waste water and solid waste to agriculture.

Preliminary evaluation from other areas and other cities implies:

- In suburban areas, almost all storm runoff water can be infiltrated and percolated in small areas between the buildings and in the green wedges. Design is of great importance to avoid problems. Just in areas with very poor infiltration capacity, usually lowlands with clay or silt dominated soils, problems occur. In densely built-up areas just part of the runoff water can be infiltrated.
- Nutrients from private household composts can usually be recirculated within the green infrastructure. The close relationship between built-up areas and green area, which is supported by the green wedge structure, is important for this.
- The amount of nutrients produced in waste water plants are about 6 times bigger than that from solid compostable waste. Just a limited part of these nutrients can be fully treated and recirculated within the greenstructure of the city. However, defined areas can be used for the last treatment stage, that is final nitrogen reduction. For this purpose, ponds and small creeks should be used. A wedge structure supports this.
- Green areas can be used for energy production. Areas within the city are far less than those needed for heating ordinary residential areas in the Swedish climate. On the other hand, "ecological buildings" can be designed for a very limited energy use. In that case energy forestry within the city might be sufficient. A

wedge structure has limited importance for this.

However, it must be pointed out that the main values of the green wedges still are recreation and amenity.

BENCHMARK DATA

There are no benchmark data agreed for green infrastructure as area for amenity, recreation, biodiversity, nutrient recirculation and so on.

DRIVERS

Formally, there are international drivers like Agenda 21 and other agreements, often coming from UN meetings, and national drivers like the Swedish Planning and Building act, which was altered in 1996 to include preservation of green structure within cities.

However, there is little attention paid to these agreements and acts if there are no or weak public opinion. The main driver for preservation of green structure is, and has always been, the political pressure formed by the opinion by the people using the green structure for recreation. This has led to that the green wedges has been taken care of by the local authorities in the comprehensive plans. The last decade this has been supported by the insight of the possibility to utilize the green structure for such needs as water treatment, shelterbelts and so on.

LESSONS LEARNT

If one makes a map of proposed new highways, deposits, sites for motor competitions and so on, and puts it over a map of the green structure, these two images will to a great extent overlap. That means, that noisy and polluting activities are proposed to recreation areas. The decision makers will not locate such activities close to residential areas, and therefore the disturbances are proposed to areas

where nobody lives. On the other hand, such activities has many times been rejected from the green wedges due to public opinion. For example, a highway proposed to a part of the green structure to the west of Stockholm City, has so far been rejected. New solutions should be created. In this case, traffic could be decreased by measurements presented in the Zürich case (see xxxx...).













APPLICATION

A wedge-like green structure can be established if there are non-developed areas within the city structure, or if developed areas are abandoned. The latter will usually happen according to economic changes. In the latter case, the land has to be reclaimed. This can be quite expensive. However, there are many examples that planning can solve the problem. New development on attractive sites can create economic circumstances to reclaim areas at the site.

TRANSFERABILITY

Due to economic driving forces, cities often will expand all over the land. A wedge-like green structure is seldom created by physical planning, and if it is, it usually is hard to keep development out of the structure. In the Stockholm case, other strong forces have created many parts of the present green structure. That means, that for establishment of a green structure, planners and politicians have to be prepared, and take the opportunity to act when the chance appears. This can occur when military forces move out from exercise fields, or when industrial areas, harbours, railway areas a. s. o. are abandoned. Preparation not just means that physical plans should be prepared, it also means that the decision makers have to inform public in advance to make the possibilities aware. In that sense, green structure could be established anywhere.

SUMMARY OF IMPACT ON SUSTAINABILITY

Ecology		Economy		Social aspects	
Emissions? ^{a)}		Cost/effective? ^{c)}		Participation? ^{f)}	
Use of natural resources? Recycling?		Willing to pay? ^{d)}		Transparency? ^{g)}	
Bio-diversity? ^{b)}		Effective organisation? ^{e)}		Safety? Health? Amenity? ^{h)}	
Total		Total		Total	

a) Possible (but not measured) increased car use for transportation due to increased transportation distances.

b) Very high; parts of the green wedges of Stockholm are unique in an international perspective, and are conserved by law in a "National Urban Park".

- c) Possible (but not measured) impact on production economics due to increased transportation distances.
- d) Not studied within the area, but several studies indicates willingness to pay for green infrastructure, and increased property values for properties located close to green areas.
- e) Supervising organisation without formal power; many institutions involved; weak organisation within local governments.
- f) Good possibilities for NGOs and the public to communicate with local governments and authorities.
- g) Information is easily available and easy to understand, but the fact that many institutions are involved in the planning process makes the process difficult to follow.
- h) Many parts of the blue-green structure give Stockholm its special image ("The Venice of the North"), and are looked upon as national heritage.

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