NATURE-BASED SOLUTIONS FOR HÄSSLEHOLM MILJÖ AB

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All images are taken by Ecogain unless otherwise stated.

Cover image: Photo of the open water at Magle Wetland Park.

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SUMMARY

This report presents recommended nature-based solutions for Hässleholm's recycling centre (HKC) and the Magle Wetland Park, both part of Hässleholm Miljö AB's operations.

The recommendations for HKC and the Magle Wetland Park were developed as part of a wider innovation project, the Baltic Phytoremediation (BAPR). BAPR aims to increase the use of green techno-logy and nature-based solutions in order to decrease pollution in the South Baltic area.

The BAPR project also promotes awareness of nature-based solutions and helps increase knowledge of how they can be implemented. Hässleholm Miljö AB has engaged Egogain AB to prepare this report identifying additional nature-based solutions for potential implementation at HKC and Magle Wetland Park, as well as advising how existing solutions can be strengthened.

The recommended nature-based solutions for development or improvement at HKC are:

- Vegetational barrier for dust retention
- Effective vegetation for phytostabilisation, phytoextraction, as well as water absorption and transpiration
- Additional vegetated man-made islands in ponds
- Rainwater treatment ponds
- New wetland

Magle Wetland Park is in itself a nature-based solution for water treatment. The recommendations in this section all relate to wetland management:

- Fishing measures to reduce the amount of invasive fish
- Sediment removal using sensitive hydraulic dredging
- Increased diversity of plant species in the wetland
- Management of vegetation on islands to improve habitat for birds
- Increasing awareness and engagement among workers and visitors

This report is intended to present a broader scope of solutions that can be adopted, refined, and implemented at Magle Wetland Park and HKC in order to support Hässleholm Miljö AB's sustainability efforts.

FIGURE 1 Next page: Aerial view over Hässleholm's recycling centre. Photo: HMAB

1. INTRODUCTION

1.1 Purpose

Hässleholm Miljö AB (HMAB) wanted to investigate the potential of developing and increasing the use of nature-based solutions at their facilities.

Ecogain was therefore commissioned by HMAB to compile this report for the following purposes:

- Make recommendations on potential nature-based solutions at HMAB's facilities that would support HMAB's operations, as well as increase biodiversity and further utilise so-called "ecosystem services";
- Give an overview of funding programs to apply to for financing to carry out (or implement) the recommendations.

1.2 Why nature-based solutions?

Nature-based solutions are measures that utilise processes within nature to help solve problems or challenges in society. They not only generate functions of a natural environment that benefit humans, what are known as "ecosystem services", but also enhance those functions. There are several advantages to using nature-based solutions. They're often cost-effective ways to solve or help solve societal problems while boosting biodiversity. Their multifunctionality means that nature-based solutions can strengthen resilience against the negative effects of climate change, both in nature and society. They also support the well-being of humanity.

1.3 The areas of focus

After discussions with HMAB, two areas of focus have been chosen within the framework of this project:

- **Magle Wetland Park**, which is part of Hässleholm's sewage treatment plant
- **Hässleholm's recycling centre** (HKC).

The report identifies nature-based solutions for each area of focus and the potential value those measures can provide.

Environmental permits

No full legal assessment has been done within the scope of this report. It is, therefore, critical to discuss any uncertainties with a lawyer or the relevant authorities.

FIGURE 2 Magle Wetland Park

1.4 Background

Hässleholm Miljö AB

HMAB's responsibilities include the treatment and recycling of waste from households, various industries, and other businesses, as well as handling rainwater and wastewater.

HMAB is also responsible for heating production and supplying the heat networks in Hässleholm and Tyringe.

Actively working with nature-based solutions helps build a better world to work and live in and strengthens HMAB's environment and sustainability profile.

Baltic Phytoremediation

HMAB is currently participating in an interregional research project, Baltic Phytoremediation (BAPR), which aims to reduce pollution in the Baltic Sea. Sweden is a participant in BAPR, along with Poland and Lithuania.

The project aims to increase the use of phytoremediation as a way to clean contaminated land and water, as well as supply renewable energy. One of the goals of BAPR is to raise awareness and increase knowledge about phytoremediation solutions by creating a network where information and examples of implementation can be shared between countries.

Phytostabilisation

Phytostabilisation is a method that involves plant roots stabilising the soil and thus preventing contamination from spreading. It counteracts both erosion and nutrient leakage.
For effective phytostabilisation, it's best to use plants with a large and compact root system.

Phytocovering is a variant of phytostabilisation in which plants are set on top of landfills. Through the plants' transpiration (taking up liquid water from the soil and releasing water vapour into the air), less water gets down to the deposited masses underneath and thus, decreases the amount of leachate (explained on page 10). It's not permitted to use this method for the final cover over a finished landfill, only as a temporary cover of a landfill before its final cap.

FIGURE 3 The plants' roots bind pollutants and nutrients.

Phytoextraction

Phytoextraction is a method that utilises the ability of certain plants to accumulate pollutants in their biomass. How well the method works depends on how well the plant absorbs the current pollutant, as well as how bioavailable the pollutant is in the soil (see the fact box below). With phytoextraction, contaminants can be removed from the soil by harvesting the plant and incinerating the biomass. The remaining ash will be significantly less contaminated than an entire soil mass that would go into a landfill.

FIGURE 3 Pollution and nutrients are absorbed in the plant's biomass.

Bioavailability

Bioavailability is the measure of the potential absorption of a certain substance by an organism. The more bioavailable a substance is, the easier it is for a plant to absorb it. Bioavailability mainly depends on the substance and the organism absorbing it. The soil's grain size, organic content, pH, humidity, and biological activity also play a role.

2.THE AREAS OF FOCUS

2.1 Hässleholm's recycling centre

Hässleholm's recycling centre (HKC) handles waste from private individuals and businesses, see Figure 5. The facility also manages interim storage for contaminated materials and dangerous waste, as well as disposes of hazardous and non-hazardous waste.

One of the non-hazardous waste landfills at HKC is capped and covered with grass. Currently, there is an investigation into possibly installing solar panels there. Several active landfills are in the area. These active landfills are gradually covered to reduce leachate and lower the environmental impact.

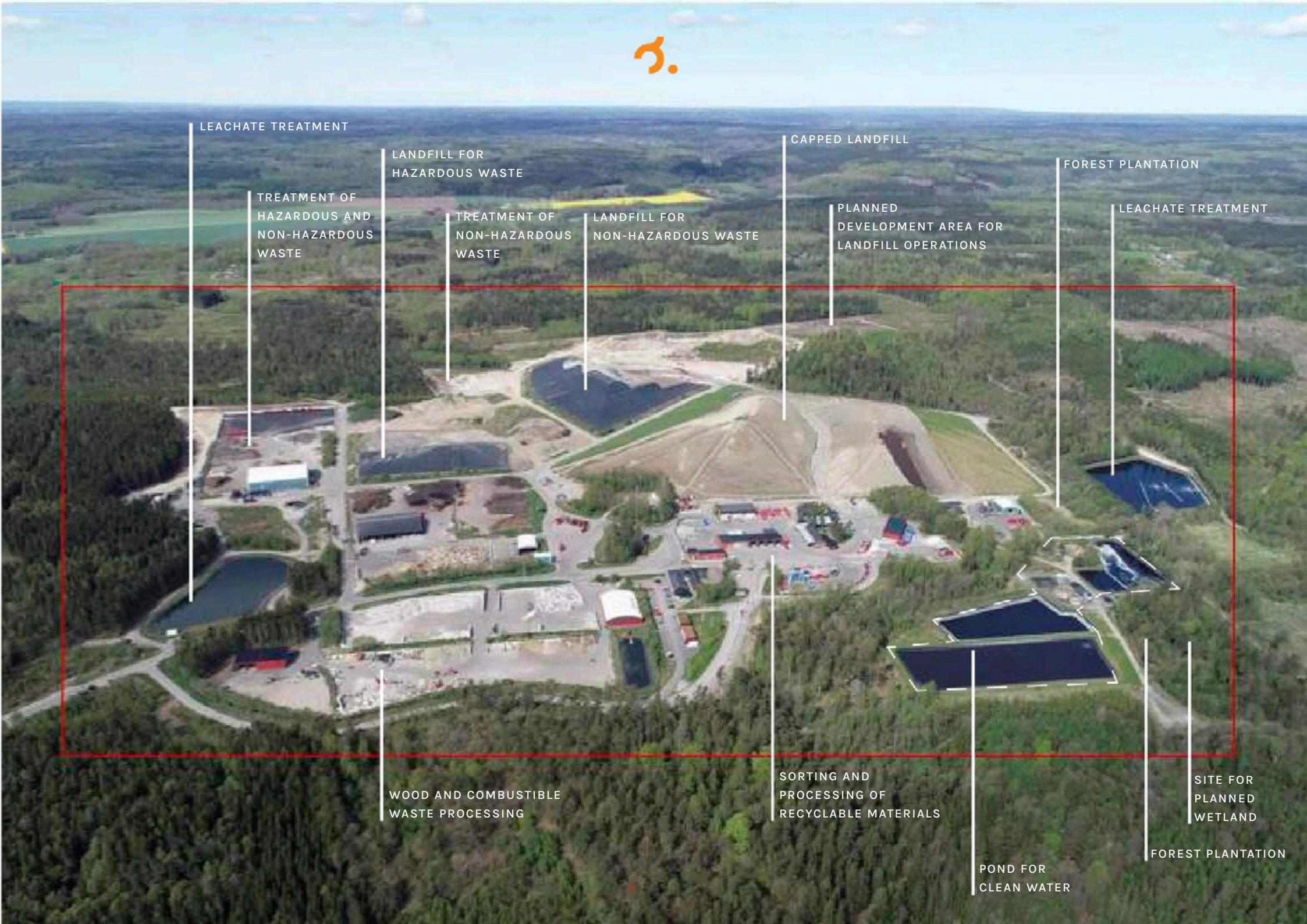
The leachate that occurs within HKC is managed internally through the facility's own treatment plant. After purification, the leachate goes out into the recipient Prästabäcken stream, which connects to the Almaån river. How much water HMAB can release depends on the amount of water already in the Prästabäcken stream. Because the Prästabäcken's water flow is often low, HKC must store purified leachate awaiting release in clean water ponds.

There are several solutions for managing rainwater and leachate currently in place at the recycling centre, but they can be developed further within the framework of this report. Another issue that was investigated is dust created by transport, matter decomposition, and sieving materials, and how it can be reduced.

LEACHATE

Leachate is rainwater that has flowed through any waste or contaminated mass. It must be collected and cleaned before it can be released to recirculate.

FIGURE 5 Next page: Hässleholm's recycling centre's areas of operation. Photo: HMAB


LEACHATE TREATMENT
TREATMENT OF HAZARDOUS AND NON-HAZARDOUS WASTE
LANDFILL FOR HAZARDOUS WASTE
TREATMENT OF NON-HAZARDOUS WASTE
LANDFILL FOR NON-HAZARDOUS WASTE
CAPPED LANDFILL
PLANNED DEVELOPMENT AREA FOR LANDFILL OPERATIONS
FOREST PLANTATION
LEACHATE TREATMENT
WOOD AND COMBUSTIBLE WASTE PROCESSING
SORTING AND PROCESSING OF RECYCLABLE MATERIALS
POND FOR CLEAN WATER
SITE FOR PLANNED WETLAND
FOREST PLANTATION

2.2 The sewage treatment plant and Magle Wetland Park

HMAB's water management operation spans 15 treatment facilities throughout the municipality. The Hässleholm sewage treatment plant is the largest facility, with a capacity to handle a population of 45,000 people.

There, the water is treated in four stages that include mechanical, biological, and chemical processes of purification. In the fourth stage, the water goes through filtration before finally ending up in the Magle Wetland Park. Biological processes of purification convert most of the nitrogen into ammonium nitrogen and nitrate nitrogen. The Magle Wetland Park is the last part of water purification, with the main task of denitrification.

Today, the Magle Wetland Park meets the required purification of nitrogen by a wide margin. After the water has been treated by the wetland, it is released to the recipient Finjasjön lake via the Maglekärrsbäcken stream.

Established in 1995, the Magle Wetland Park is approximately 20 hectares in size and located east of the sewage treatment plant. The land had previously consisted of a forest, a meadow, and a peat bog.

The water that reaches the wetland is purified, but in the wetland, the nutrients phosphorus and nitrogen are further reduced. The wetland is made up of several ponds, which are interconnected by distribution channels.

The Magle Wetland Park is a popular outdoor recreation area, and a section of the Skåneleden hiking trail passes through it, see Figure 5. The area is also rich with bird life, which attracts bird watchers and others. In recent years, however, local Göinge biologists have noticed that some bird species that had previously lived in the area have disappeared.

Today, there is a large population of carp living in the waters of the Magle Wetland Park. The carp fish is classified by the SLU Swedish Species Information Centre (SLU Artdatabanken) as a non-native species with a very high risk of invasiveness. The carp look for food on the bottom and then stir up sediment that clouds the water. They eat both insects and plants and can thus compete with native species. A contractor regularly fishes the wetland for carp.

HMAB participates in a project to strengthen the eel population by releasing elver, young eels, into the wetland. The eel is listed Near Threatened as a critically endangered species. Due to migration obstacles, such as hydroelectric facilities, it has difficulty reaching its breeding grounds. In the Magle Wetland Park, elver are therefore released as a way to strengthen the eel population.

FIGURE 6 Next page:
The Magle Wetland Park


N
OUTLET
THE SKÅNELEDEN HIKING TRAIL
INLET
0 25 50 100 150 200
Meter
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

3. RECOMMENDATIONS

The following section presents recommended measures for nature-based solutions at HKC and at the Magle Wetland Park. Each proposed measure can be linked to values and ecosystem services within the aspects of social, economic, and environmental sustainability.

3.1 Potential benefits

Synergistic effects can often occur when using nature-based solutions. A single solution can give rise to many results that are socially, economically, and environmentally beneficial. Nature-based solutions at HKC and Magle Wetland Park can contribute greatly to the potential benefits/ecosystem services listed below.

WATER TREATMENT

Helps ensure a future water supply

ADDITIONAL PLANT TRANSPIRATION

Contributes to lowering the local temperature

DUST REDUCTION

Improves air quality

INCREASED BIODIVERSITY

Raises the resilience of ecosystems and provides more ecosystem services

CLIMATE ADAPTATION

Creates resistance to changes that come from a changing climate

FORTIFIED GREEN CORRIDORS

Connects key habitats to strengthen ecosystems and help the spread of wildlife

RECREATION

Improves people's health and overall well-being

INCREASED AWARENESS

Public understanding of why we must protect our environment increases and so does commitment

COST EFFECTIVENESS

Unexpected costs can be minimised by being better equipped and working preventively

FIGURE 7 A species-rich flora contributes many ecosystem services

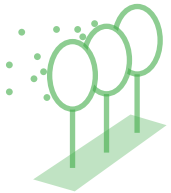
3.2 Recommendations for HKC

HKC's operations take up a large amount of land with many hard-surfaced areas to facilitate traffic. Much of the area is under constant development, and there are plans to expand the business. At the same time, there are issues regarding dust and challenges managing a large amount of rainwater and leachate.

This section presents potential nature-based solutions to introduce at HKC that are best suitable to help address those problems.

VEGETATION STRIPS FOR DUST REDUCTION

Tree curtains, bushes, and green walls.



PLANTS THAT HELP WITH WATER MANAGEMENT

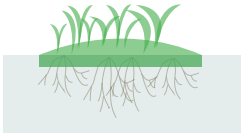
Plantations of large trees, tree curtains, bushes, green roofs, and ditches richly diverse in flora.

LANDFILLS ENRICHED WITH FLORA SPECIES

Phytostabilising plants, small bush plants, more species-rich vegetation, plug plants and bulbs, ecological structures and biodiversity alongside solar panels.

ISLANDS OF VEGETATION IN PONDS

Artificial islands that float in parts of the wetland and ponds.



RAINWATER PONDS

Efficient layout, helps combat invasive species, collects rainwater, and assists overall maintenance.

EFFICIENT WETLAND

Efficiency-focused planning and development, assists in overall maintenance; vegetation for phytoextraction, phytostabilisation, and biodiversity.

FIGURE 8 Next page: Proposed measures applied to a map of the HKC area.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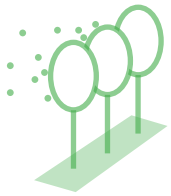
PLANNED LANDFILL
CAPPED INACTIVE LANDFILL
ACTIVE LANDFILL
ACTIVE LANDFILL
0 50 100 200 300
Meter
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Vegetation strips for dust reduction



COST: LOW

The cost estimate includes planting materials and work time. The cost is further reduced. If plants can be harvested in the vicinity for replanting.

Many of the daily activities at HKC create and spread dust. Crushing, sieving, and handling waste and other materials produce large amounts of it, while heavy transport vehicles stir it up as they drive through. Currently, spraying leachate is the main method used to handle loose dust. Planting vegetation is an effective measure to contain fine-grained dust to the ground and thereby reduce its occurrence. Taller vegetation, such as trees and bushes, can also limit dust that has become airborne from spreading.

The vegetation helps:

- Keep fine-grained dust in the ground by establishing a root system and branching that constitutes a ground-covering barrier.
- Stop and filter dust that has already become airborne and thus prevent it from spreading to surrounding areas.
- Create barriers via tree curtains, trellises, and shrubbery that lower the wind speed and limit the spread of dust.

There are already several strips of greenery at HKC between different parts of the operational area. There are also some lots with large trees. Additional planting is recommended, according to Figure 9.

ADDITIONAL PLANT TRANSPIRATION

Increased leaf mass means there's more transpiration

DUST REDUCTION

Plants capture and immobilise dust in the air and on the ground

INCREASED BIODIVERSITY

Boosts local area's resilience to climate change

RECREATION

Creates a more pleasant local environment for employees and visitors

CLIMATE ADAPTATION

Helps lowers the local temperature, reduces erosion and flooding from extreme downpours

FORTIFIED GREEN CORRIDORS

Improves ecological relationships

Green walls not only help with dust reduction but also contribute to biodiversity and an improved working environment. The prerequisites for building green walls with cultivation systems depend on whether the buildings in question are adapted to handle the extra weight. Climbing plants are a good option for green walls. They neither weigh much nor require a lot of care. Native species such as common ivy (Hedera helix), local blackberry varieties (Rubus spp.), European honeysuckle (Lonicera periclymenum) – which is not to be confused with the invasive variety Italian honeysuckle (Lonicera caprifolium) – and common hops (Humulus lupulus) are recommended.

Trellises or wires can be installed to prevent the plants from climbing directly on a wall's facade. Once the climbing plants have grown to their desired height, they need to be pruned approximately once a year.

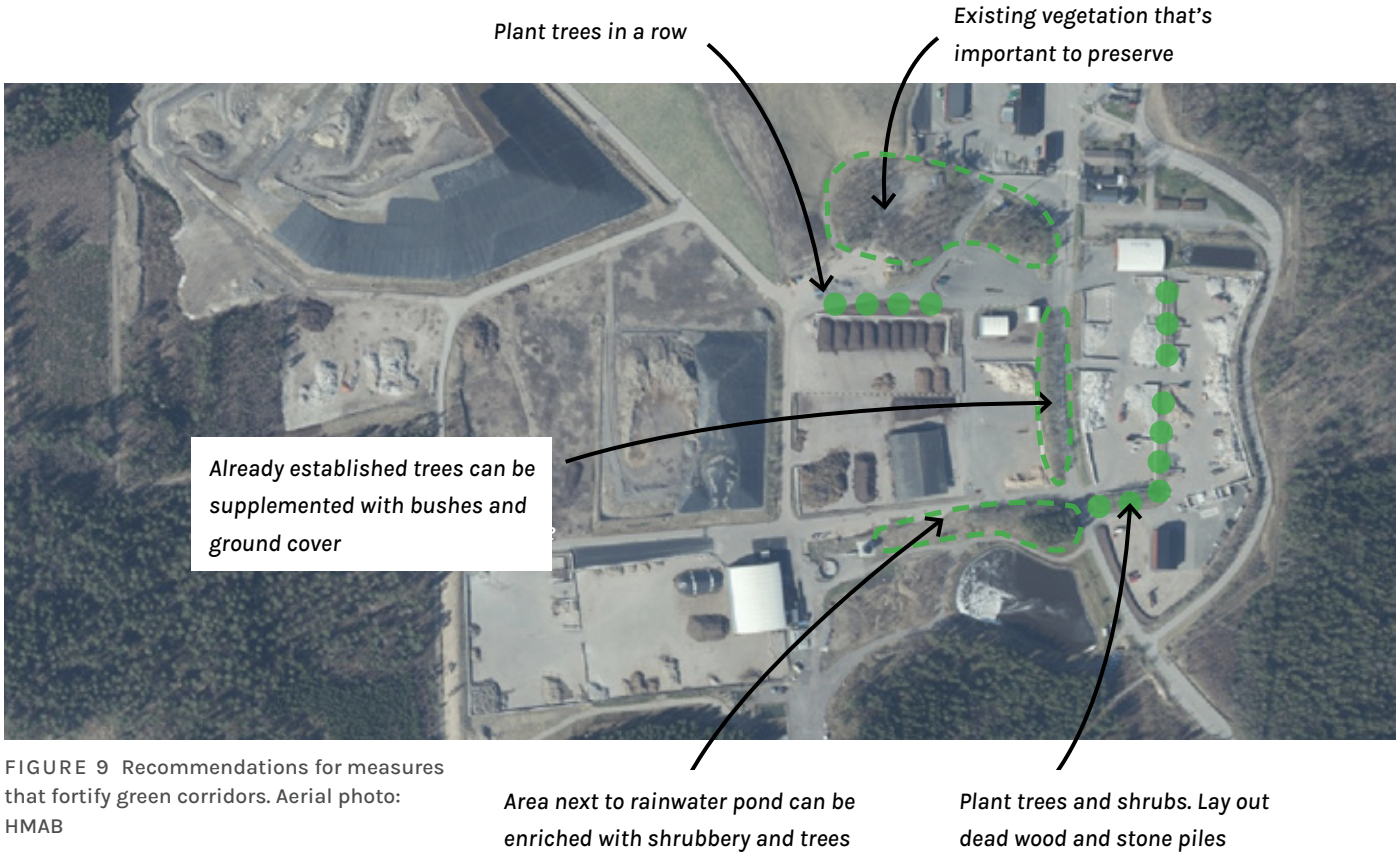


FIGURE 9 Recommendations for measures that fortify green corridors. Aerial photo: HMAB

Plants that help with water management

COST: LOW

The cost estimate includes plant material and working time. The cost is further reduced if plants and dead wood can be collected in the vicinity for relocation.

All water that ends up at HKC must be managed as either leachate or rainwater. Since rainwater has not passed through waste or contaminated masses, it, therefore, does not need to be purified. Instead, it can be released directly into the surrounding nature. Due to the Prästabäcken stream's generally low flow, as well as HKC expanding its area of operation, there is a great need for additional water management.

Using plants to manage water has several benefits. The plants absorb water via their roots and release water vapour into the atmosphere through their evaporation and transpiration. Perennial plants (those that live for two years or more) also loosen the soil with their root systems, which improves the soil's capacity to absorb water and allows the water to penetrate deeper. The bigger the tree, the better – they absorb large amounts of water through their roots, and tree crowns also capture water before it reaches the ground, all of which is partially evaporated.

In addition to the green corridors identified in Figure 9, the ditches around the active landfills can be planted with more bushes and trees to help absorb rainwater from the landfills.

When planning the new landfill area in the north, these ditches and green corridors

WATER TREATMENT

Plants absorb and remove nutrients and pollution

ADDITIONAL PLANT TRANSPIRATION

Increased leaf mass means there's more transpiration

INCREASED BIODIVERSITY

Boosts local area's resilience to climate change

RECREATION

Creates a more pleasant local environment for employees and visitors

CLIMATE ADAPTATION

Helps lowers the local temperature, reduces erosion and flooding from extreme downpours

FORTIFIED GREEN CORRIDORS

Improves ecological relationships

should be included to ensure continuous wildlife corridors and sufficient width of the ditches.

Green roofs are another possible measure for water management, dust reduction, and increased biodiversity. Today, there are already green roofs on two parking garages at the entrance of the recycling centre. The roofs are an efficient way to utilise an otherwise unused surface for water management. It can be particularly valuable in places where the amount of green space is otherwise scarce.

A sufficient thickness is required in plant beds for establishing vegetation on roofs. For meadow plants and grass, the bed needs to be at least 100 millimetres thick. The added weight of the substrate, plants, and water also means that existing structures have to be examined and calculations made to confirm they can tolerate it.

For the best water management, plants with high water absorption capacity and high transpiration should be chosen. Sedum roofs with succulents should be avoided because stonecrops primarily store water. It's best to have a green roof with a variety of plant species, which has been shown to have good levels of evaporation and better resistance to drying out.

TO CONSIDER WHEN PLANTING

- *Preserve primarily larger, older trees. Larger trees can handle more water than newly planted ones, and they also have higher natural values.*
- *Select native tree species that are particularly important for biodiversity. The goat willow (Salix caprea) is one such example.*
- *Plant trees with about ten metres between the trunks around the landfills. This way, there is plenty of room for the trees to spread out and for the root systems to take hold.*
- *Plant bushes between the trees to further improve water absorption.*

Landfills enriched with flora species

COST: LOW

The cost includes plant material and working time. The proportion of plug plants and seeds can be adjusted according to the budget.

WATER TREATMENT

Plants absorb and remove nutrients and pollution

ADDITIONAL PLANT TRANSPIRATION

Increased leaf mass means there's more transpiration

INCREASED BIODIVERSITY

Many different pollinators benefit from more species of plants and fauna

RECREATION

Adds aesthetic beauty

FORTIFIED GREEN CORRIDORS

Improves ecological relationships

Water runoff from landfills

The capped inactive landfill is designed so as little water as possible will infiltrate into it. The top layer consists of soil with a thickness of one metre. Beneath the soil and drainage layer is the waterproofing layer that limits the infiltration of rainwater, which causes large amounts of water to flow along the sides of the waterproofing layer into covered trenches that go around the landfill. Furthermore, the water is directed to an area in the northern part of HKC, the same area where there are plans to create a wetland. Read more about nature-based solutions linked to wetlands on p. 39.

The covered trenches and thin layer of soil at the base of the landfill mean that it is not possible to plant trees and bushes that can collect water around it. Phytostabilisation, on the other hand, can be used at the landfill.

Phytocoverage

Phytostabilisation, and more specifically phytocoverage (see fact box on p. 9), is currently not permitted as the sole final covering method for landfills. However, it can still be used for a landfill that has already been covered in a conventional way, to stabilise the soil and reduce the amount of water in it. Planting or seeding plants that have strong water absorption capacity and high transpiration reduces both the amount of water that flows from the landfill

FIGURE 10 A diversity of species is important for the landfill cover's resistance to disturbances, such as torrential rain and drought. The photo was taken from the capped landfill with a view to the west.

CASE STUDY: NATURE-BASED SOLUTIONS AT HAGBY ECO-PARK

The Hagby Eco-Park was built on top of an inactive landfill outside Täby. Leachate from the old landfill still needs to be treated, which is done with the help of several nature-based solutions. First, the leachate is aerated in a pond and bacteria in the water help break down nutrients and pollutants. The water then passes through a grass overflow area before streaming into a meandering wetland. The water is then pumped through a sand and peat filter to finally flow into several ponds, streams and waterfalls – all of which are part of the eco-park.

(https://www.sorab.se/hushall/hag-village-ecopark/)

and succeeds in infiltrating the landfill. Thus, it can further relieve both rain and leachate management.

When using phytocoverage in combination with a conventional landfill cover, it is important that the roots of the plants do not reach the landfill's sealing layer. Any plants chosen, however, should have compact root systems to achieve good coverage and capture as much water as possible. Plants that emit a lot of water generally have large leaves and little leaf wax.

Enriched biodiversity

The capped inactive landfill has been sown with a grass-seed mixture named "Vägsläntˮ from the Skånefrö seed company. It is a seed mixture consisting of red fescue (*Festuca rubra*) and sheep's fescue (*Festuca ovina*). Red and sheep fescue have dense roots and are resistant to drought, which makes them a suitable element for phytocovering. Several other species have established themselves spontaneously on the landfill, such as poppy (*Papaveraceae spp.*) and tansy (*Tanacetum vulgare*). To further increase water absorption and increase biodiversity, even more species can be introduced. Suggestions for species that benefit pollinators are:

- Oxeye daisy (*Leucanthemum vulgare*)
- Red campion (*Silene dioica*)
- Red clover (*Trifolium pratense*)
- Woodland geranium (*Geranium sylvaticum*)

Shrubbery

A further recommendation is to plant bushes to complement the grass and other plants that have established themselves organically. It is important not to choose strong-growing species with strong root systems. Some suggestions for native species of small shrubs that process a lot of water through transpiration and evaporation include:

- Guelder-rose (*Viburnum opulus*)
- Mountain currant (*Ribes alpinum*)
- Blackthorn (*Prunus spinosa*)

These species also have flowers and berries, which provide food for pollinators and birds. Bulbs or plug plants for flowering herbs can also be planted to increase biodiversity.

FIGURE 11 The photo was taken from the capped inactive landfill with a view to the south. The active landfills are covered continuously.

Ecological structures

After landfills are finally covered, they will eventually become part of the surrounding landscape again. When a landfill is finally capped, there is an opportunity to create the conditions for a high level of biodiversity, which has positive effects on the entire local area.

Structures that are generally in short supply in the cultivated forest and agricultural landscape, such as dead wood, can be advantageously placed on the capped landfill. Dead wood forms an important habitat for many living fungi, lichens, and insects. Many of these species have a ripple effect on the entire food chain, not least the local birdlife. Dead wood from forests felled in the immediate area can be saved and placed on the landfill (Figure 12), but also in other places around HKC. For example, logs can be placed near the planned wetland, by the rainwater pond and in green areas with bushes and trees. At the landfill, 3–5 logs can be placed in stacks in several places. Where there is a lack of space, individual logs can be placed instead. Sun-exposed dead wood is generally unusual and

TIPS!

- *Choose deciduous tree logs, with a trunk circumference of at least 30 cm, and keep as much of the attached bark and branches as possible.*
- *Sticks and small trees can be placed in smaller piles, so-called "fauna deposits".*
- *A rock pile can also be placed if stones and rocks are available. Rock piles and fauna deposits are ideal habitats for insects and small animals.*

Recently, the Research Institutes of Sweden (RISE), together with Ecogain, has produced a handbook for biodiversity in solar parks. The project is called Eko-Sol, and the manual can be read for free on RISE's website.

therefore placement of dead wood in sunny locations can be prioritised but shaded dead wood is also valuable.

Solar panels on landfills

There are plans to install solar panels on the southern side of the landfill. Solar energy means a financial gain for HMAB and a gain for the climate. In addition, a solar plant can also be designed with biodiversity in mind. Around and between the solar panels, native specimens of flowers or bushes with berries and flowers can be planted to benefit birds and pollinators. Planting low shrubbery alongside solar panels has been shown to have a positive impact on energy production.

FIGURE 12 Dead wood

Islands of vegetation in ponds

COST: MEDIUM

Purchasing pre-made products from a vendor means higher costs. Vegetation islands can be built on site if the know-how is available.

WATER TREATMENT

The roots hang like a curtain in the water, absorbing nutrients

ADDITIONAL PLANT TRANSPIRATION

Increased leaf mass means there's more transpiration

INCREASED BIODIVERSITY

Benefits animals that prefer to live close to water

INCREASED AWARENESS

Creates an interesting stop for visiting tours to learn about

There are two leachate ponds at HKC, see Figure 5. There also exist two ponds for treated water located on a hill to the northeast, see Figure 5. All ponds are sealed with canvas to prevent the water from infiltrating the groundwater, which also means that there is no vegetation in them. Establishing plants in the water can help with purification, nutrient uptake, and oxygenation. In addition, plants prevent the growth of algae, as less sunlight reaches the water surface, while zooplankton benefits.

Because there's a seal running along the edges of each pond, it is difficult to establish vegetation on their shorelines. The regulations requiring that the ponds be sealed also create certain risks in establishing vegetation on the bottom pond floor. However, artificial floating islands with plants can be placed in the middle of the ponds. Such wetland islands consist of a base with anchored wetland plants. The roots of the plants hang down like a curtain under the islands and thus do not need to be planted on the bottom. A biofilm of microorganisms forms on the roots, which absorb nutrients and break down pollutants. Ready-made wetland islands can be purchased from vendors like, for example, VegTech.

In addition to improving water quality, wetland islands create a surface for birds to land on and a habitat for amphibians, among other things. A couple of ramps should also be installed on the sides of the pond wherever wetland islands are constructed. The ramps can be simply designed and enable animals

to climb out of the water. Mounds of rock piles, piles of sticks, and large pieces of fallen trees can be placed next to the ponds for the benefit of amphibians, lizards, hedgehogs, and other animals.

FIGURE 13 The Kyrkviken bay in Arvika municipality has 170m² of floating wetland in the form of artificial islands of vegetation (photo via VegTech).

Rainwater ponds

COST: MEDIUM

The cost estimate includes planting materials and work time. Having construction equipment on site reduces the cost.

In addition to the fact that rainwater can be led to proposed vegetated ditches for purification, there is also an existing rainwater pond in the southern part of the area, see Figure 5. Water flows there from a surface made of inert construction material, as well as from other hardened surfaces. The pond is currently being excavated to handle more water. The proximity to the forest in the south and the fact that the pond is not dense mean that there are good opportunities to create additional benefits of biodiversity in it. At the same time, the pond, with the right design, can function as a collection surface for water during heavy rains.

Around the pond, there is a small population of Japanese knotweed (*Reynoutria japonica*) and some Canada goldenrod (*Solidago canadensis*) that must be controlled (see fact box on p. 31). The pond must then be designed so that native plants can thrive in and around it, reducing the risk of the Canada goldenrod gaining a foothold again.

General principles for constructing rainwater ponds:

- Build the pond with an uneven edge. The more bumps, the better.
- Build sloping edges where the water can rise with a maximum slope of 1:5, see Figure 15. If it is not possible to make slopes around the entire pond due to lack of space, it is better to

WATER TREATMENT

Plants absorb and remove nutrients and pollution

ADDITIONAL PLANT TRANSPIRATION

Increased leaf mass means there's more transpiration

INCREASED BIODIVERSITY

Enriched biodiversity benefits pollinators

INCREASED AWARENESS

Creates an interesting stop for visiting tours to learn about

CLIMATE ADAPTATION

Mitigates the effects of future extreme downpours

RECREATION

Adds aesthetic beauty

INVASIVE PLANTS AT HÄSSLEHOLM'S RECYCLING CENTRE

CANADIAN GOLDENROD

Canadian goldenrod can be found in several locations at HKC. The species is a tall, perennial plant which blooms with yellow flowers in September – October. It spreads very efficiently by seed – a single plant can produce more than 10,000 seeds. In addition, its root shoots form a dense mat in the top layer of soil that contributes to its ability to form large stands. At HKC, it is particularly important to control this plant, as the seeds risk ending up in compost soil sold at the facility.

Method of control

Canadian Goldenrod is controlled by mowing the plant before it has flowered, sometime in May – August. In this way, the seed spread is prevented. The procedure needs to be repeated every year until the plant has completely died out on the site.

JAPANESE KNOTWEED

Japanese knotweed has been discovered at a location at HKC. It is one of the worst invasive plants and it can be very difficult to get rid of. The species is characterised by its green, oval-shaped leaves with pointed tips and square bases. The trunks can resemble bamboo when the plant is fully grown. During the summer, Japanese knotweed can grow ten centimetres a day. It also develops a solid root system, where leaving root fragments as little as a gram in the soil can result in a new plant. It is, therefore, of great importance to combat the plant at an early stage before it forms a large population.

Method of control

There is no easy way to eradicate Japanese knotweed. Since the population at HKC is still small, digging it up can work, but then the plants must be excavated with a wide margin around and underneath them. The Swedish Environmental Protection Agency (Naturvårdsverket) recommends digging 3–4 metres laterally from the stand and 1.5–2 metres deep. All soil must then be managed correctly. It is then of great importance to keep an eye on the area afterwards and dig up any small plants that come up again.

You can read more about invasive species on the Swedish Environmental Protection Agency's website: https://www.naturvardsverket.se/amnesomraden/invasive-alien-arter/

to make a proper slope on one side rather than making “semi-steep” slopes around the whole pond.

Establish a beach zone above the slopes. By the shoreline, there’s meant to be a zone that can be flooded in case of overflowing water but is otherwise above the water’s surface.

Maintenance

It is important that the water surface does not grow any plants on it. The pond should be cleared of any vegetation about once a year or as needed.

Clearing should be done with care, taking into account possible insect and bird life that may establish themselves.

Rainwater ditch

To the west, next to the storage area for construction materials, a vegetation area has been identified as suitable for rainwater management. Rainwater management can look different depending on the location’s soil, plant conditions, and the slope of the ground.

One suggestion is that a wider rainwater ditch can be built between the installation site and the natural land, which can collect and clean rainwater before it flows onto the surrounding woodland. When the water is led into the ditch, some of it filters

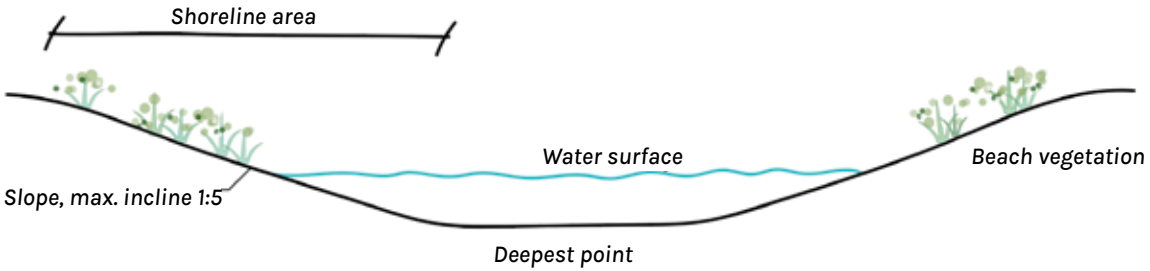


FIGURE 15 Design of shoreline zone and deepest point

into the ground and some of it is absorbed by plants. The ditch ends at an overflow area consisting of woodland where the water can drain during high flooding.

Some things to think about:

- Design the ditch as a two-step ditch, see Figure 16. A two-step ditch consists of a deeper central furrow surrounded by vegetated terraces on an upper level. The design enables the ditch to overflow if necessary while reducing the risk of erosion. The furrow and the terraces also form habitats for plants and animals with different needs.
- The centre furrow of the trench should be built on well-drained soil to increase runoff. If the soil on the site has low water infiltration, a layer of draining material, such as gritty moraine, can be placed on the bottom of the ditch.
- The plants that can be planted in the ditch and on its terraces depend on the water flow and how often the terraces are flooded.

BEFORE

Cross-section

AFTER

Cross-section

FIGURE 16 Design of two-step ditch

TIPS

Next to wetlands and rainwater ponds, piles of sticks or stones can be placed to create nesting and wintering burrows for amphibians.

Efficient wetland

COST: MEDIUM / HIGH

The cost estimate includes planting materials and work time. Having construction equipment on site reduces the cost.

WATER TREATMENT

Wetland plants absorb nutrients via phytoextraction

ADDITIONAL PLANT TRANSPIRATION

Increased leaf mass means there's more transpiration

INCREASED BIODIVERSITY

Wetland environments benefit many plants and animals

INCREASED AWARENESS

Creates an interesting stop for visiting tours to learn about

CLIMATE ADAPTATION

Manage future cloudbursts

A planned wetland for biologically purifying rainwater is part of the further effort to minimise HKC's environmental impact. The idea is for the wetland to be located in a forested area north of the water treatment plant, see Figure 5. That area has a high groundwater level and was previously the site of an attempted forest plantation for energy forestry. The water for the wetland will primarily be the rainwater that runs off the covered landfill.

The wetland will have a deeper section for sedimentation, and then the water will be led through a separate section shaped like a meandering waterway. Finally, the water will flow out into the Prästabäcken stream.

Before construction begins, it is important to identify the main purpose of the wetland and ensure that the area is large enough to handle current and future flows. The planned design of the wetland should also take into account future maintenance.

Layout

The shape of the wetland is important, potentially benefiting sedimentation, reducing the risk of erosion, and creating favourable conditions for biodiversity. Recommendations for the wetland's layout include:

- **Create an irregular shape**, see Figure 17. This gives the water the opportunity to stay long enough in the wetland for effective sedimentation

and the absorption of nutrients. An irregular shape also means a longer shoreline, which promotes biodiversity.

- **Work with different depths** to increase efficiency. Figure 18 shows the depth of a sedimentation section as approximately 1–1.5 metres, which keeps it from needing to be emptied as often. The vegetation section has a depth of about 20–40 centimetres, which allows for many plant species to establish themselves and also creates a steady flow of water.
- **Create a flatter shoreline** on at least one side of the wetland to provide a beneficial environment for animals and different types of plants. This allows animals to get in and out of the water and provides the right conditions for unique beach vegetation. A guideline for the shoreline angle is a slope of 1:6 above the normal water level and 1:8 below that level.
- **Create a ramp** with a maximum slope of 1:8 and surfaces at least 3 metres wide that can withstand heavy loads from an excavator. This facilitates the future emptying of sediment.
- **Make sure there are spaces for deposits** of sediment for temporary storage after emptying.

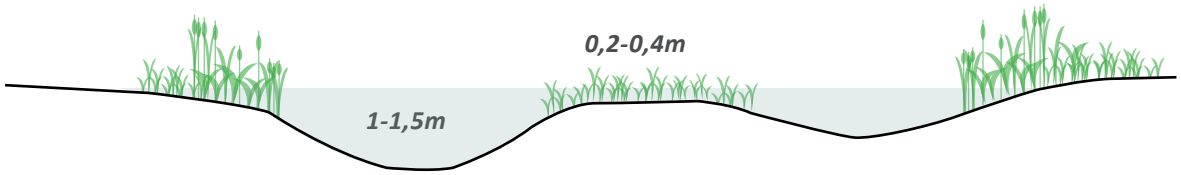
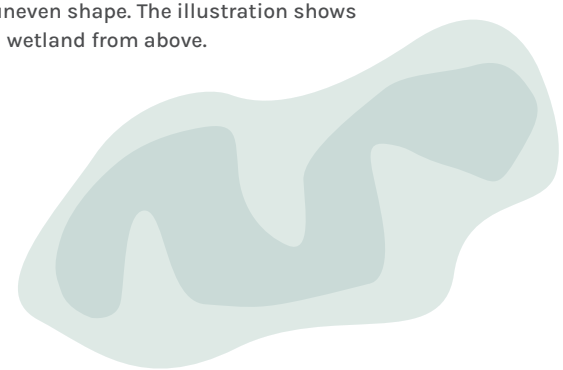


FIGURE 18 The illustration shows a typical example of how different depths can be distributed.

FIGURE 17 Design the wetland in an uneven shape. The illustration shows a wetland from above.



Plants

Examples of planned vegetation to be planted in the wetland are lakeshore bulrush, yellow lily, great manna grass, and narrowleaf cattail. These are species with a proven ability to absorb many nutrients and, in some cases, also pollutants. Vegetation also helps stabilise wetland edges and reduce erosion.

Recommendations for choice of plants:

- Choose species with a deep root system, such as yellow lily. This increases the oxygen level in the water. That, in turn, helps microorganisms, which play a vital role in plants' ability to absorb nutrients.
- Choose plants that do not grow aggressively. For example, great manna grass is a species that can effectively absorb nutrients, heavy metals, and chloride from water, but its aggressive growth means that it can out-compete other species. In many places where it is established, it is regularly mowed to keep beaches clear and allow for other species. If possible, other species should be chosen instead of giant manna grass.
- Choose native plants. It is important to avoid plant species that are, or risk becoming, invasive. All invasive plants should be removed during wetland constructions (see Fact box on p. 31). Otherwise, seeds and plant parts risk ending up in the water and being spread to new places. Table 1 lists various native wetland species and their characteristics.

TO CONSIDER WHEN PLANTING

- *Use native species and avoid invasive species entirely.*
- *A mix of seeds, plug plants, and potted plants (primarily suitable for edges), and plants in coconut fibre make for rapid establishment.*
- *Allow at least a five-metre-wide plant zone around the wetland, planting native trees, bushes, and grass there. This benefits biodiversity, reduces erosion, and lowers water temperature/evaporation.*

Phytoremediation

In a functioning wetland, plant life assists with various aspects of phytoremediation. One is phytostabilisation, or the use of vegetation to keep contaminants contained in a given area. This happens because the roots of plants bind to sediment, so phytostabilisation can increase depending on whether the chosen plants have strong root systems.

Plants' phytoextracting ability can also be put to good use. This depends on choosing plants that are effective at absorbing heavy metals and toxic substances from the sediments as well as water. The plants are then harvested to remove those elements from the wetland's system. Table 1 gives suggestions for plants with good phytoextracting and phytostabilising abilities, as well as other useful properties.

Species	Characteristics
Yellow iris – *Iris pseudacorus*	*Beautiful with yellow flowers. The root system increases the supply of oxygen in the water. Forms good erosion protection and absorbs nutrients in the water. Can easily be grown from seeds or bought as whole plants.*
Reed canary grass – *Phalaris arundinacea*	*Strong root system contributes to erosion protection. Effectively absorbs nutrients and chloride. Has a long growing season and withstands cold temperatures. Can handle both drier and more humid conditions.*
Narrowleaf cattail – *Typha angustifolia*	*Effectively absorbs nutrients. Host plant for several butterfly species. Grows less aggressively than its Bulrush relative but should still be maintained. Can be grown from seeds or bought as whole plants.*
Common reed – *Phragmites australis*	*Increases oxygen levels in the water and absorbs a lot of nutrients. Fast growing and spreads easily, so should be harvested every season.*
Lakeshore bulrush – *Schoenoplectus lacustris*	*Hardy plant that protects against erosion. Fast growing.*
Floating pondweed – *Potamogeton natans*	*Floating leaf plant. Fairly weak competitor against other plants, which can suit a wetland where the surface of the water is preferably kept open. May need harvesting to keep water open. Good food source for aquatic insects.*
Bur-reed – *Sparganium spp.*	*Food source for birds. Relatively weak competitor if there are many reeds and cattails. Simplestem bur-reed, unbranched bur-reed, and small bur-reed available.*
Sedge – *Carex spp.*	*Absorbs heavy metals. Food source for birds. Avoid tuft-forming sedge species and instead choose, e.g. bottle sedge, greater pond sedge, or bladder sedge.*
Other plants for phytoremediation	
Willows, sallows, & osiers – *Salix spp.*	*Absorbs heavy metals and polycyclic aromatic hydrocarbons (PAH). Can grow in wet environments.*
Silver birch – *Betula pendula*	*Absorbs och breaks down PAH*
Aspen tree – *Populus tremula*	*Absorbs lead.*

TABLE 1 Domestic plants that can be planted in and around the wetland.

Maintenance

Keeping future maintenance in mind is crucial to establishing a functioning wetland. Before the wetland is put into use, a maintenance plan should be drawn up that takes into account future changes in flow or nutrient levels. Here are some guidelines for wetland upkeep:

- Every year, vegetation in and around the wetland should be inspected and tended to. The surface in the largest section should be kept clear so that sunlight can penetrate, helping to maintain the water's oxygen level.
- Vegetation upkeep depends on the wetland's desired effect. Plants need regular harvesting and tending to allow for the largest potential treatment effect and maximum level of nutrients. The plants across the surface are then reaped to enable stocks to continue growing and absorbing nutrients and harmful substances. That mowing can be done once or twice a year but should be avoided during the nesting period (between March 15 and July 31) if birds are nesting among the plants.
- In the deeper section of the pond, where sedimentation takes place, wetland plants might only establish themselves at the edges. In that case, the vegetation in that section can be cleared as needed rather than annually, though the maintenance method is the same as for the shallower sections.
- The sediment should be measured in the deepest section of the wetland after it has been in operation for a few years. Measurements should be taken at both the inlet and outlet.
- The general rule is that sediment should be removed when it makes up half the pond depth or when the sediment layer is 30 centimetres thick. That emptying serves to maintain the wetland's water treatment capacity.

FIGURE 19 Picture from the Magle Wetland Park.
Here, the surface vegetation is low, and the oxygen level is high.

3.2 Recommendations for Magle Wetland Park

The Magle Wetland Park meets the requirements for the absorption of nutrients by a good margin. The wetland has a rich birdlife in addition to being a popular recreation area. However, some difficulties with invasive fish, as well as the handling of sediment, risk causing poorer purification capabilities in the future. There are several available measures to take that could benefit water purification, biological diversity, and recreational value.

The following section presents nature-based solutions that aim to increase biological diversity in and around the wetland and to perform preventative maintenance for a healthy, efficient wetland.

REDUCTION FISHING

Increased fishing to control the fish population in the wetland.

SEDIMENT CONTROL

Measurement of sediment and sensitive hydraulic dredging.

INCREASED BIODIVERSITY

More plant and species variety both above and below the surface.

CLEARING OF PLANTS

Clearing of trees, bushes, and beach vegetation on some of the islands, as well as ecological structures and measures to protect otters.

INCREASED AWARENESS

Educational information via signs and interactive means.

FIGURE 20 A variety of shoreline vegetation maintenance benefits birdlife.

Reduction fishing

COST: LOW

One major fishing event can reduce the cost of regular fishing with special gear.

WATER TREATMENT

Increased establishment of phytoextracting plants

INCREASED BIODIVERSITY

Greater proportion of frogs/reptiles, and different plant species

INCREASED AWARENESS

Engages the many visitors to the wetland

RECREATION

Ensures a continued pleasant environment

CLIMATE ADAPTATION

Mitigates the effects of future extreme downpours

The wetland has a large fish population with a substantial proportion of carp, which is an invasive species. Many fish contribute additional nutrients to the system in a wetland as they eat plants. Plants take in nutrients from the water and sediment, acting as part of the wetland's purification process. Carp also stir up nutrient-rich sediment from the bottom when searching for food.

Several attempts have been made to reduce the amount of fish in Magle Wetland Park. Since 2019, specially-made gear has been used for fishing. Additional measures are needed to control the carp population. The work is made difficult by stumps in the water and concerns for birdlife as well as the eels that have been introduced to the environment.

One method for removing many fish all at once is to host a fishing event where local people or fishing associations can get involved. If the carp stock were reduced to a fraction of its normal levels in the wetland, it would take a relatively long time to reach those levels again. Having an event that recurs every few years would thus make it possible to keep the stock down. With respect to birdlife, the event should take place outside the nesting period, March 15 to July 31. The retrieved fish would also need to be handled in a way that ensures no one takes them as food. This type of event is also valuable for raising public awareness of the wetland's function and the importance of fighting invasive species.

CARP

Carp are classified as an invasive species, introduced to Sweden from Asia. The fish live at the bottom of the wetland in oxygen-poor water. They look for food along the bottom, stirring up sediment that clouds the water. They are likely introduced to Magle Wetland Park via Finjasjön lake, carried as fish roe stuck in birds' feathers.

FIGURE 21 Shoreline along the Magle Wetland Park

Sediment control

COST: MEDIUM

This is due to the specific machine required for sensitive hydraulic dredging. However, it is an effective method as it reduces the need for repeated efforts.

WATER TREATMENT

Increased establishment of phytoextracting plants

INCREASED BIODIVERSITY

Greater proportion of frogs/reptiles, and different plant species

COST EFFECTIVENESS

Increase efficiency in the wetland

CLIMATE ADAPTATION

Mitigates the effects of future extreme downpours

Magle Wetland Park is estimated to have a high level of sediment. A measurement should be taken to determine the exact levels and which actions should be taken. For older wetlands with a high treatment strain, it is common to need to remove sediment to restore the wetlands' original treatment capacity, volume, and function. That doesn't reduce the treatment capacity, but sediment removal may still be needed to meet future challenges relating to population growth and increased strain on the wetland.

When Magle Wetland Park was created in 1995, the bottom was not cleared of stumps and other larger elements, which makes it difficult to do traditional dredging using excavation. That dredging method also has a major impact on the aquatic environment. Thus, if dredging is necessary, the sensitive hydraulic method is recommended.

Sensitive hydraulic dredging sucks up only the near-surface sediment (1–10cm), collecting it at a low speed and then processing and recycling it. Whether the sediment can be recycled depends on the pollution level. This method has a significantly lower impact on the environment than excavation and does not cloud the water to the same extent.

Enriched biodiversity in the wetland

COST: LOW

Cost includes plant material and labour and is determined in part by the size of the plant material.

WATER TREATMENT

Increased establishment of phytoextracting plants

INCREASED BIODIVERSITY

Greater species variety benefits many animals

RECREATION

Greater variety in plant material provides a pleasant environment for visitors

CLIMATE ADAPTATION

Mitigates the effects of future extreme downpours

Just after the wetland was built, it featured dense underwater vegetation. That has decreased in recent years, thought to be a consequence of the carp population. The fish feed along the bottom, searching for plants and insects to eat.

This, in turn, blocks the entry of light and disrupts the growth of new underwater flora. The hope is that scaled-up reduction fishing will allow those vegetation levels to be restored. Additional underwater vegetation should be planted after a reduction fishing event, at a point when the water is less cloudy.

Plants below the water's surface contribute to higher biological activity, a factor shown to be important in water treatment to remove pharmaceutical residue. That vegetation also provides a growth surface for microorganisms that filter out various particles and impurities in the water. Two such examples are the plants whorled water-milfoil (*Myriophyllum verticillatum*) and shortspike watermilfoil (*Myriophyllum sibiricum*). Both plants shed their green plant parts in winter, which means increased nutrients in the water environment. However, a well-functioning underwater flora is important to the ecosystem and its year-round nutrient intake.

Around the shallower parts of the wetland, with an average depth of 0.5 metres, the above-surface vegetation consists mainly of reeds. They include the common reed, cattails, common club-rush, and reed canary grass. There was an attempt to plant common reed in the deeper part when the wetland was created, but it was unsuccessful.

Planting more plants of various species can increase biodiversity and make the wetland more resilient to the effects of climate change and further population growth. More vegetation increases the separation of nitrogen and helps bind and stabilise sediment via the root system.

It is important to introduce only plants that are native to Sweden, avoiding species that are, or risk becoming, invasive. Suggestions for plants that can enrich biodiversity and phytostabilisation are given in Table 2.

TABLE 2 Suggestions on plants for increased biodiversity and phytostabilisation.

Species	Characteristics
Yellow iris – *Iris pseudacorus*	*Beautiful with yellow flowers. The root system increases the supply of oxygen in the water. Forms good erosion protection and absorbs nutrients in the water. Can easily be grown from seeds or bought as whole plants.*
Reed canary grass – *Phalaris arundinacea*	*Strong root system contributes to erosion protection. Effectively absorbs nutrients and chloride. Has a long growing season and withstands cold temperatures. Can handle both drier and more humid conditions.*
Narrowleaf cattail – *Typha angustifolia*	*Effectively absorbs nutrients. Host plant for several butterfly species. Grows less aggressively than its Bulrush relative but should still be maintained. Can be grown from seeds or bought as whole plants.*
Flowering rush – *Butomus umbellatus*	*Hardy and relatively fast-growing species. Thrives in nutrient-rich water and can grow in deeper water.*
Lakeshore bulrush – *Schoenoplectus lacustris*	*Hardy plant that protects against erosion. Fast growing.*
Floating pondweed – *Potamogeton natans*	*Floating leaf plant. Fairly weak competitor against other plants, which can suit a wetland where the surface of the water is preferably kept open. May need harvesting to keep water open. Good food source for aquatic insects.*
Bur-reed – *Sparganium spp.*	*Food source for birds. Relatively weak competitor if there are many reeds and cattails. Simplestem bur-reed, unbranched bur-reed, and small bur-reed available.*
Sedge – *Carex spp.*	*Absorbs heavy metals. Food source for birds. Avoid tuft-forming sedge species and instead choose, e.g. bottle sedge, greater pond sedge, or bladder sedge.*
Common water-plantain – *Alisma plantago-aquatica*	*Benefits biodiversity. Can grow in deeper water.*

FIGURE 22 Having several areas of the shoreline with a ‘messier’ appearance benefits biodiversity. Here the shoreline can be cut less often and supplemented with dead wood.

Clearing of plants

COST: LOW

The cost is low because the necessary machines are already used in other upkeep measures. This can be added as an entry to the existing maintenance schedule.

INCREASED BIODIVERSITY

Strengthened habitat benefits birds and other animals

RECREATION

Greater proportion of bird species attracts birdwatchers and other visitors

INCREASED AWARENESS

Educational environment showing the value of strengthened habitats

Today the islands scattered around the wetland have very high vegetation, consisting mainly of large birches and willow thickets. In many cases, reeds and cattails have also grown back on the beaches. This type of vegetation is not suitable for several bird species as it increases the risk from predators. To improve conditions for birdlife, the vegetation on some islands should be maintained by clearing. Trees and bushes can be removed, while the beach vegetation can be tended to create more open spaces.

Varied island vegetation can mean that a greater variety of bird species finds a suitable habitat in the wetland. Some islands can have high vegetation while others are kept clear and semi-natural. The trees that have been removed can be saved and placed out in piles to further benefit biodiversity.

MEASURES TO PROTECT OTTERS

Otters are found in and around the Magle Wetland Park. Otters thrive in wetlands with nutrient-rich water. They eat fish, among other things, and can consume as much as 1–1.5 kg per day.

Today the otter is classified as Near Threatened. Some reasons behind their decline in population include deteriorated habitats, exploitation, and lack of food.

Magle Wetland Park can possibly function as an important habitat for otters. Some vegetation should be preserved to strengthen that potential, such as bushes and trees. Otters can also help control the carp population.

FIGURE 23 Cut reeds along Magle Wetland Park.

Public awareness

COST: LOW

The cost includes the production and printing of graphic material.

RECREATION

Fostering participation and understanding is important for a visitor's buy-in and experience of the place

INCREASED AWARENESS

An educational environment engages both children and adults

Because the Magle Wetland Park is visited so frequently, it is important to inform the public about certain aspects of the space. For example, visitors could learn about the purpose of the wetland or why some areas look the way they do. Measures to promote biodiversity can appear messy to visitors, giving the impression that nobody is maintaining the habitat. It is, therefore, important to place informational signs at locations where conservation measures have been implemented. That could include areas where dead wood has been laid out or where wood piles have been created for local fauna, so-called "fauna deposits". Informational signs expand visitors' understanding of how the wetland functions and what value it creates, as well as the value of biodiversity in general.

The Skåneleden hiking trail passes through the Magle Wetland Park, attracting many hikers each year. Informational signs or interactive displays can be placed along the trail.

Interactive displays can take the form of explanatory sculptures that invite exploration, QR codes with more information available via mobile devices, or audio buttons that visitors press for further information.

FIGURE 24 An example of an informational sign.

4. FINANCING

In order to finance the measures proposed in this report, grants can be sought from government agencies, funds, and other organisations. Table 3 is a compilation of grants that would be suitable to finance the continued work with HKC and Magle Wetland Park.

Grant	Organisation	Purpose	Terms
Lokala naturvårdssatsningen (The Local Nature Conservation Initiative)	**The Swedish Environmental Protection Agency**	Stimulate long-term nature conservation commitment through projects that benefit nature conservation, outdoor life, and public health. It is possible to apply for nature conservation projects, wetland projects, and pollination projects.	Only municipalities can apply, but private actors can be initiators.
Våtmarksfonden (The Wetlands Fund)	**Svensk Våtmarksfond (The Swedish Wetlands Fund)**	Given to projects that aim to preserve, create, restore, or care for wetlands in the long term. Prioritises wetlands with benefits for nature conservation and birdlife.	Landowners, private individuals, associations, or other groups can apply.
Bidrag till åtgärder för en tryggad tillgång till dricksvatten (Grant for measures for secure access to drinking water)	**Swedish Agency for Marine and Water Management**	Contribute to measures that create secure access to drinking water. Can involve several different measures, as well as research and planning.	Municipalities and municipal water utility companies most often apply.
The Baltic Sea Conservation Foundation (BaltCF)	**BaltCF**	Contribute to projects that reduce eutrophication, reduce the spread of pollution to the Baltic Sea, develop or maintain habitats in the Baltic Sea drainage basins, etc.	Fundees can include public bodies, environmental organisations, or others who work to preserve and protect the Baltic Sea.
Baltic Sea Action Plan (BSAP) Fund	**The Nordic Environment Finance Corporation (NEFCO) and the Nordic Investment Bank (NIB)**	Contribute to projects that aim to restore the ecological status of the Baltic Sea.	Companies, authorities, and non-profit organisations can apply. There are examples of water treatment plants that have received funding.
Non-productive investment (Miljöinvestering)	**The Swedish Board of Agriculture**	Support the creation and restoration of wetlands and ponds for biological diversity or improved water quality.	Municipalities, agencies, regions, associations, organisations, companies, and individuals can apply.

TABLE 3 A compilation of grants to finance the continued work.

5. NEXT STEPS

This report presents the overall recommended measures with a focus on the breadth of nature-based solutions that can benefit HMAB's operations.

The following steps are recommended to enact the proposed measures in HMAB's operations:

- **Produce an ecological aftercare plan for the landfills.** The landfills consist of a large piece of land claimed by HKC but which will be returned to nature and society in the future. A landfill goes through many phases during its lifetime, so the way the land is used changes as well. When the gas in HMAB's covered landfill has dissipated, there is a possibility of using the area in other ways, such as redrawing the geographic perimeter so that the landfill ends up on the outside. Plans can already be drawn up for how the covered and active landfills can be repurposed and used in the future. In this way, the right conditions can be created to fit the intended purpose.
- **Produce a maintenance plan for Magle Wetland Park.** Hässleholm Municipality is growing, and Magle Wetland Park needs to be able to handle an increased population. Changing legislation may also place new demands on the wetland, such as the requirement that water treatment remove pharmaceutical residues. That is why it's important to stay at the forefront in maintaining Magle Wetland Park even now. Money spent on measures today can be saved in future reduced operating costs and in possible new installations in the wetland.

CASE STUDY – OBBOLA INDUSTRIAL AREA

Biodiversity was the focus of the aftercare of the Obbola industrideponi (Obbola Industrial Landfill) outside Umeå. On behalf of SCA and Ragn-Sells, Ecogain developed an aftercare plan that was specifically designed to enhance the ecological and social value of the site. That included the planned construction of many different natural environments and biologically important structures at the old landfill. Plans were also made for hiking and mountain biking trails, enabling various types of recreation.

- **Produce specific proposed measures for ecological compensation.** There is interest from HMAB to enact compensatory measures for the claimed land in connection with HKC's expansion. Those measures can be adapted to the surrounding landscape and set at a level equivalent to exploitation. Development is underway for a measurement method to calculate the value of the claimed nature based on the Changing Land Use Impact on Biodiversity (CLImB). Read more about CLImB here: https://climb.ecogain.se

- **Produce a signage programme for HKC and Magle Wetland Park.** The wetland offers good opportunities for spreaing information about its important functions and HMAB's environmental work. Informational signs should be posted to explain the nature conservation measures carried out. Signs or interactive displays can also be produced to highlight HMAB's water treatment process, birdlife, and overall biodiversity. There are also plenty of areas in the wetland suitable for sculptures or play environments that invite learning.

  Informational materials can be produced for HKC to show visiting students and customers the measures that have been carried out. This could take the form of posted signs, brochures, or information on the website.

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