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# URBAN GREENERY & NATURE

With the Frankfurt Bridges, one million square meters of green space are being created above busy roads: The Frankfurt Bridges stretch through the city like a green lung - a recreational area in the middle of the city. The bridges' water infrastructure also makes it possible to supply the city's greenery along their entire course, supporting the unsealing of vast areas of Frankfurt and transforming it into a "green city of the future".

In addition, wild meadows are being created in protected areas on the bridges, and nesting and breeding sites are already being planned on the bridge corpus during construction, so that Frankfurt's bridges also function as stepping-stone-biotopes in a previously fragmented urban structure.

The Frankfurt Bridges create a second green level in the city, giving nearby residents at formerly grey wide car streets access to a park right on their doorstep, thus significantly improving the quality of life in large parts of the city.

# Old New Territory Frankfurt

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#### Green on the Bridges

Green landscapes emerges above gray car roads in Frankfurt



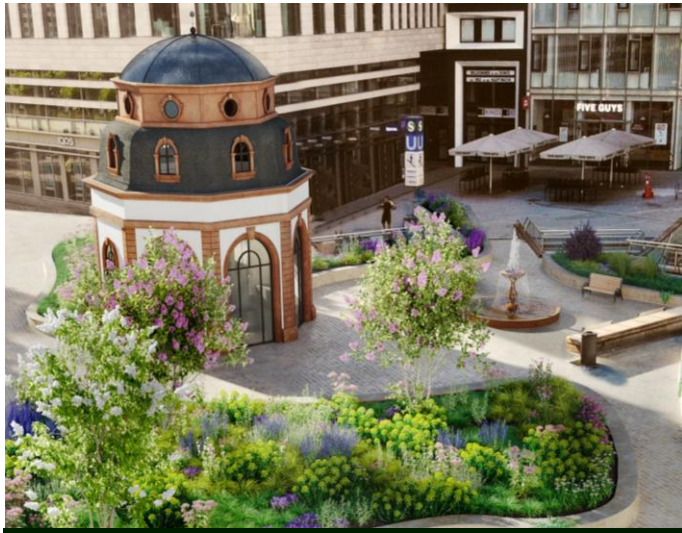
#### The Flora along the Bridges

The bridges can save plants right and left of them from stunting



#### Nature Conservation and Biodiversity

The bridges serve as stepping-stone-biotores for animals and plants



#### Unsealing of the City Center

Green life instead of gray asphalt: Greening becomes possible by the water supply of the bridges



#### Vitalization of the Urban Greenery

No more dying trees and dead dried green spaces in Frankfurt



#### The Green Metropolis of the Future

The bridges can save plants right and left from stunting

Green on the Bridges

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## A park on bridges - spread like a green fresh net over the city

1,000,000 square meters of magnificent greenery will be created by the Frankfurt Bridges - with busy streets directly below, similar to New York's High Line.

The green areas on the bridges offer a diverse world of experiences, including therapy gardens, inclusion playgrounds, and yoga meadows, as well as botanically valuable plant beds and gardens. A sophisticated and at the same time sustainable irrigation system ensures that the green bridge world is beautiful all year round.

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## Content: An overview of the green spaces on Frankfurt's bridges

The green space landscape of the Frankfurt Bridges is diversified: There are special sections for the most diverse user groups, which are appropriately designed in terms of landscape architecture. This diverse offer creates a colorful world of experience.

Bed planning on the bridges is based not only on aesthetic principles, but also has a research and conservation character.

The green areas on the bridges are also irrigated in an environmentally friendly and water-saving manner with the help of a continuous underfloor irrigation system.

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## The goal of the bridges: Bringing more local recreation to the city center

Frankfurt can gain 1,000,000 square meters of green space through the flower beds and meadows on the bridges without having to change the existing urban structure: The plants on the Frankfurt Bridges provide a better urban climate by creating a pleasant coolness through evaporation - and the new green areas open up spaces of a whole new quality for people in the city.



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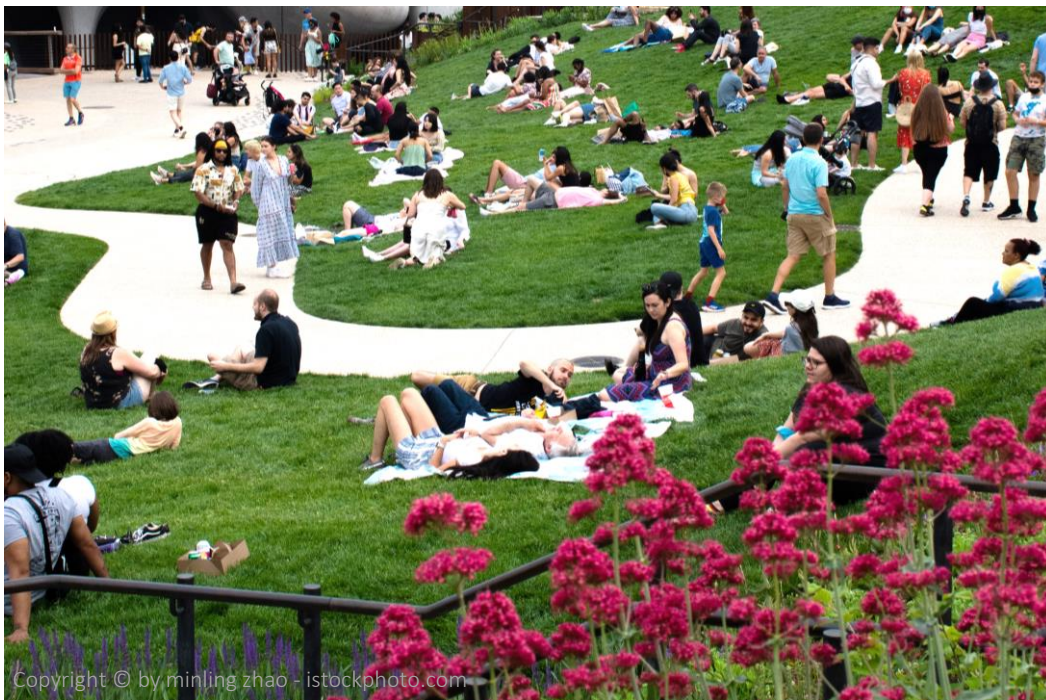
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The landscape architecture of the future is found on the bridges

Therapy gardens, yoga meadows, inclusion playgrounds, berry pavilions and nature trails are colorfully mixed into the neighborhoods on the bridges.

The bridges serve as a way home, jogging route or for walking and experiencing:

Innovative and eventful offers are created for all target groups.

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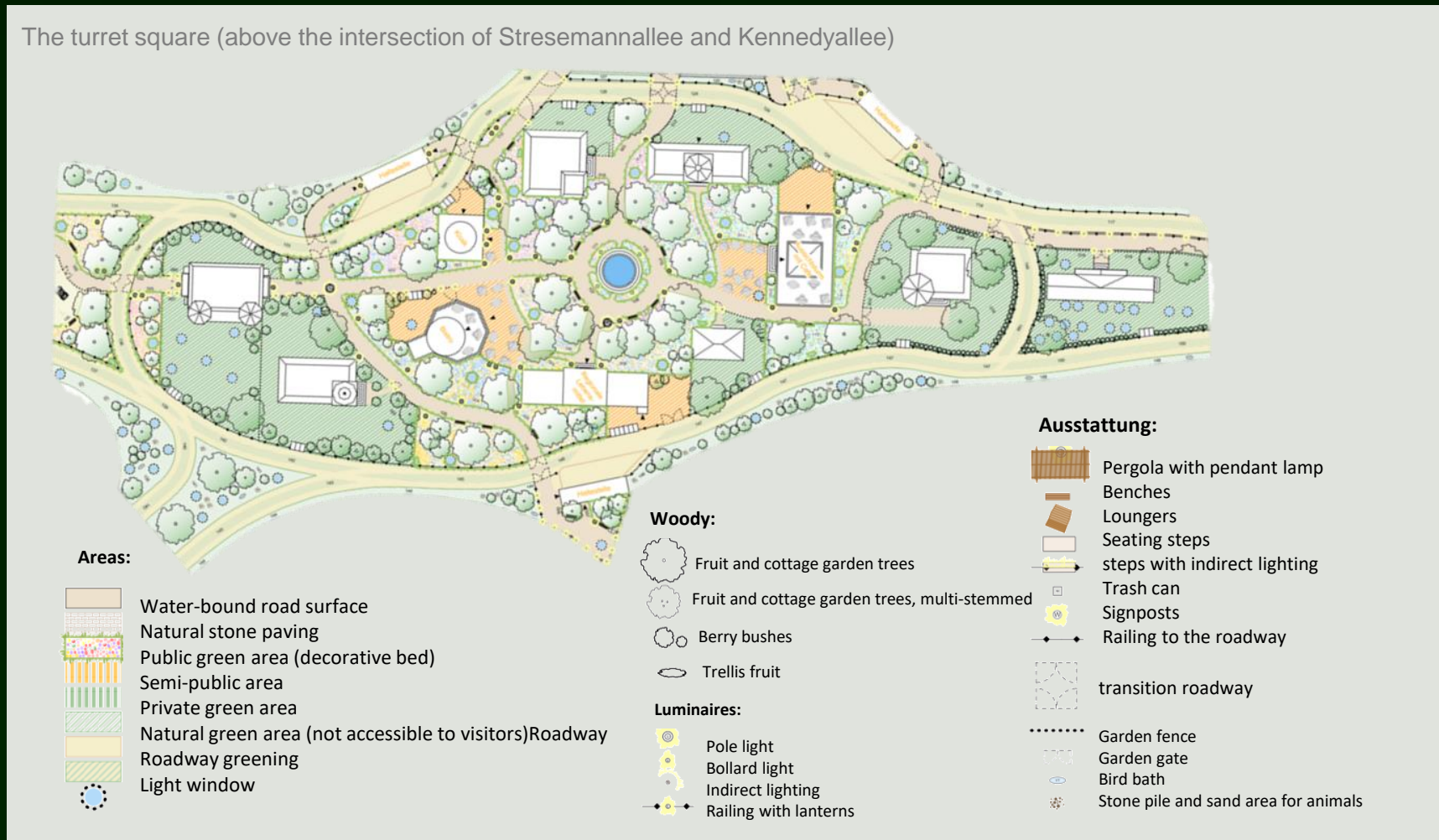
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# Open space planning deals not only with plants and flower beds, but with all elements in the perceptible outdoor area

In addition to green spaces main paths, side paths, street lighting, benches, signposts or even waste garbage cans are defined: Each section of the Frankfurt Bridges must be planned in detail in this form in the course of the preliminary planning phase and checked with regard to user-friendliness.

The turret square (above the intersection of Stresemannallee and Kennedyallee)





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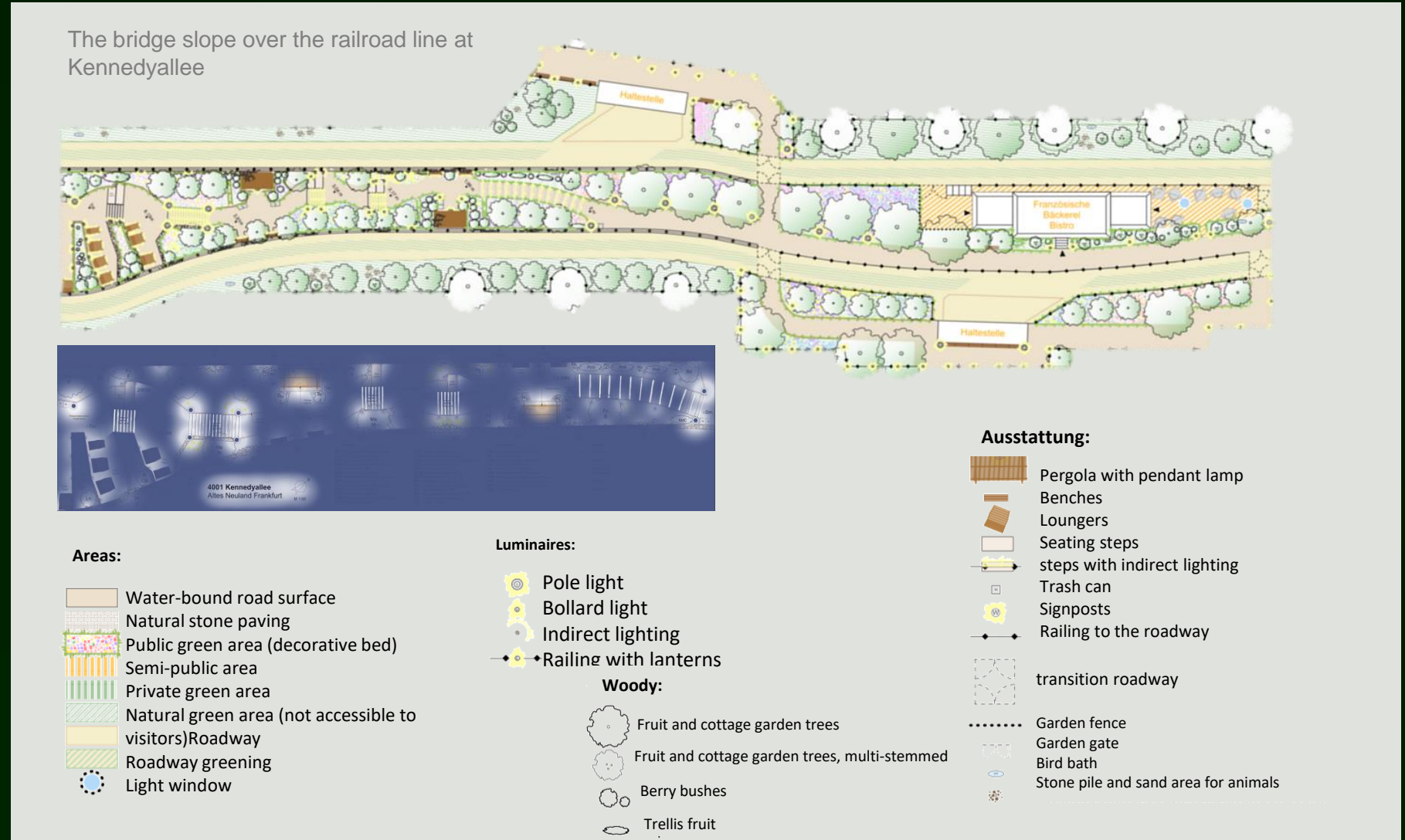
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All sections on and also under the bridge also need their own lighting concept, which should be energy-saving and insect-friendly, and should take into consideration all safety aspects,



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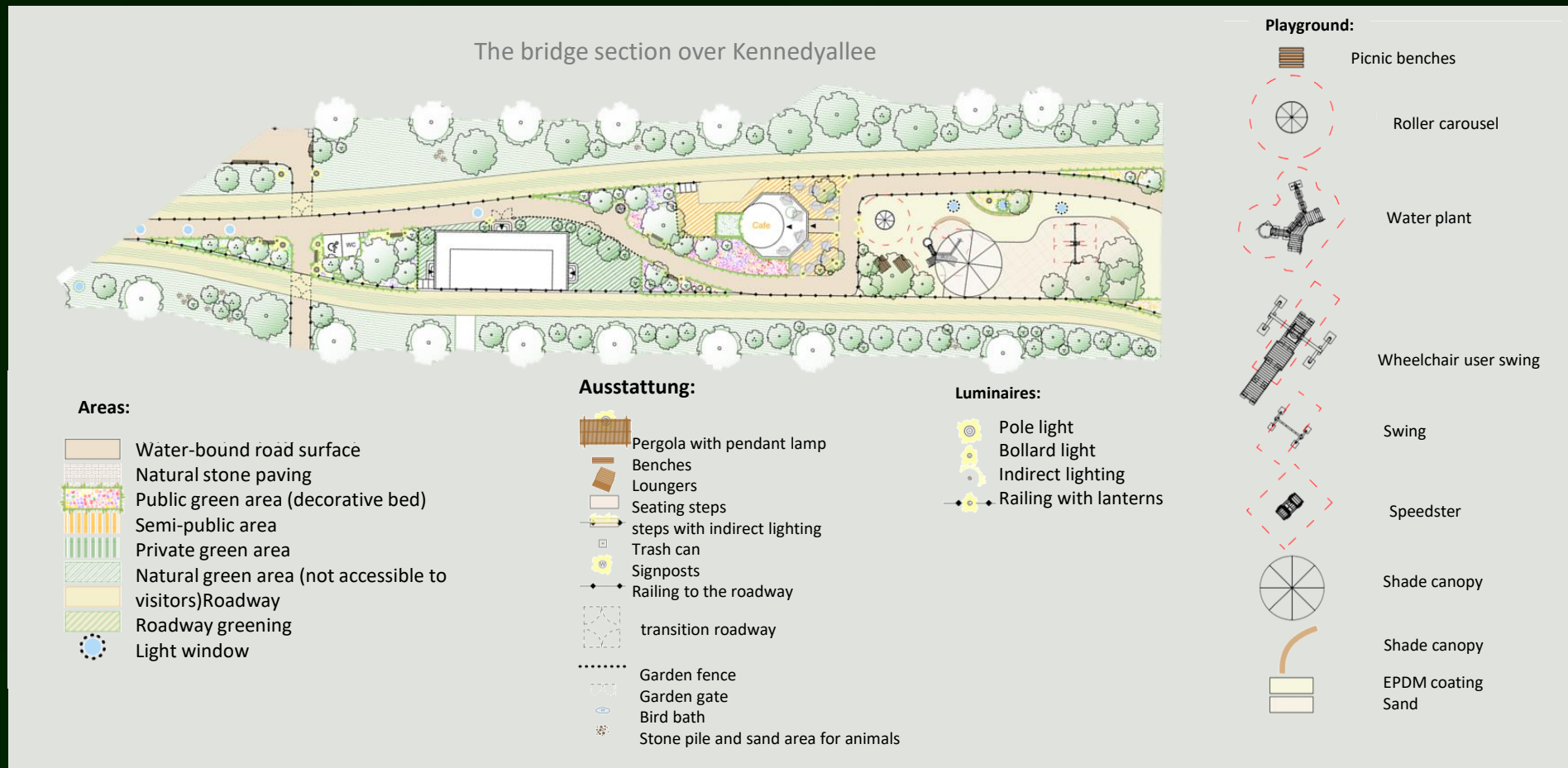
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The bridges should be inclusive for everyone: accordingly, all playgrounds on the bridges are planned as inclusion playgrounds



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Even small playgrounds with little space always include playing opportunities for children with impairments



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On the Frankfurt bridges there are also therapy gardens for people with disabilities, trauma patients or even people with dementia



Therapy gardens are completely barrier-free and can thus be easily explored with wheelchairs and walkers. Generous outdoor seating areas, some of which are covered with canopy-roofs, offer plenty of space for group activities such as sowing seeds, processing cuttings or preparing harvested vegetables. All paths are wide and provide ample seating at short intervals.

At raised beds, visitors can work with plants from wheelchairs or experience scents and colors firsthand. Familiar vegetables and fruits, as well as native woody plants and perennials or herbs are preferably planted.

# Altes Neuland Frankfurt

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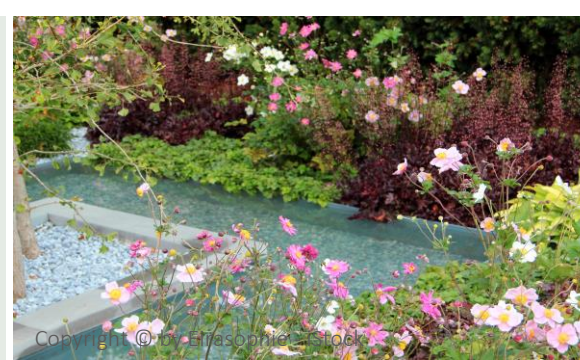
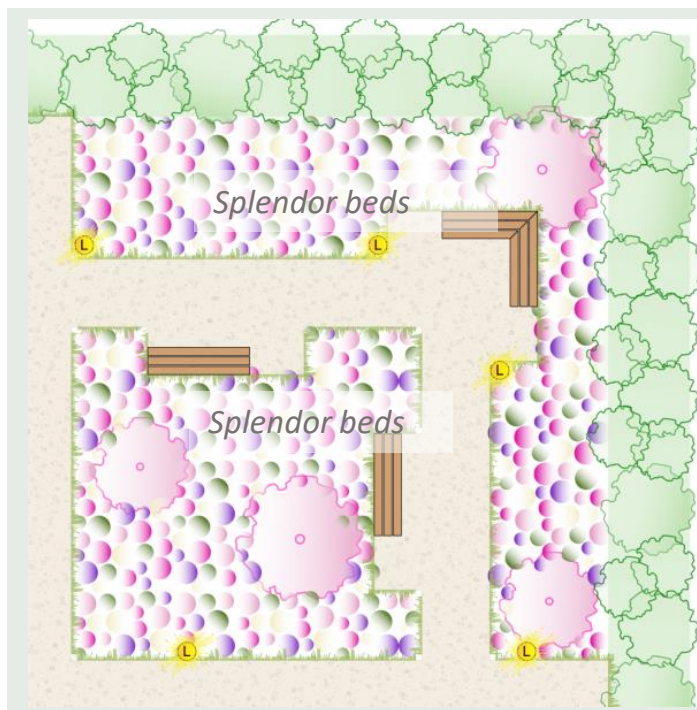
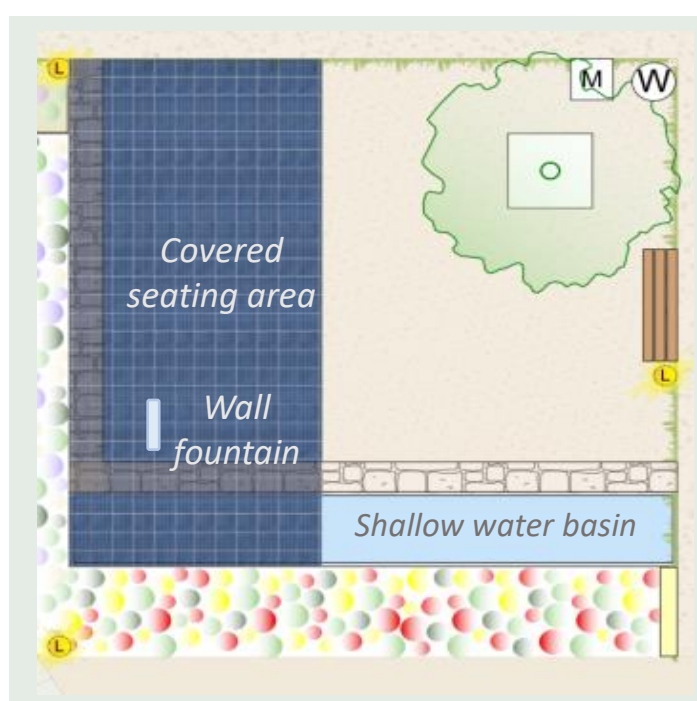
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At the entrance there is usually a meeting point

Meeting places are partly covered and invite you to rest on the seatings. Tables serve for picnics, and fruits or herbs from the therapy garden can be washed in a drinking fountain.

**Seeing:** Beds as a pleasure for the eyes

Particularly magnificent plants in one part of the therapy garden present visitors with a visually beautiful area throughout the year that triggers positive emotions. To get along without alternating planting, gardeners need a good aspect calendar here.

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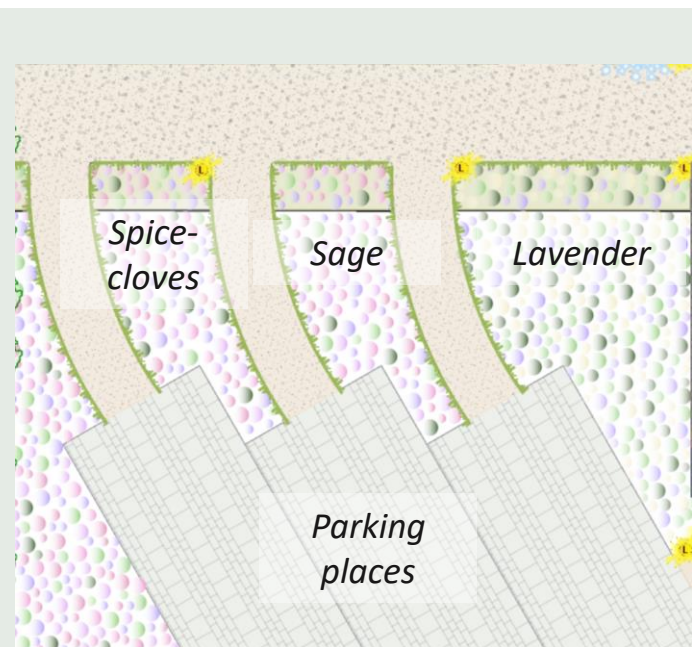
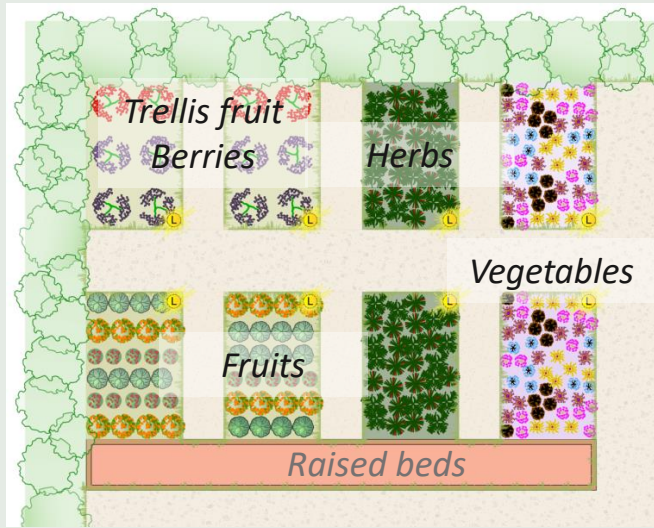
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## A culinary experience: Tasting

Edible plants of all kinds can be tended, harvested and then prepared here by visitors all year round. The raised beds ensure that people in wheelchairs can also access the beds at a comfortable working height.

## Smell: a gateway to memories

Smells can sometimes remind us very directly of places or experiences from long ago. Accordingly, in addition to lavender, sage and many other fragrant plants, therapy gardens also contain flowers and herbs that are hardly cultivated today, anymore, such as *Hyssopus officinalis*, fragrant columbine or santolina.

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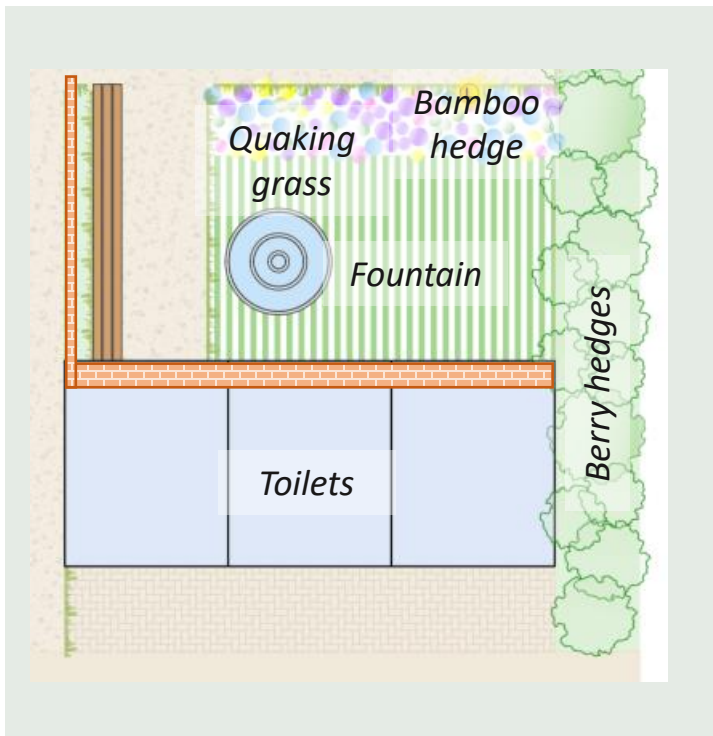
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## Relaxed close your eyes and just **listen**

When exhaustion from the multitude of sensory impressions takes over, you can retreat to the protected "listening" area and close your eyes.

The splashing of a fountain or the rustling of quaking grass create a beautiful atmosphere, as does birdsong.

Dense diverse berry hedges at the edge of the area attract a particularly large number of birds here.

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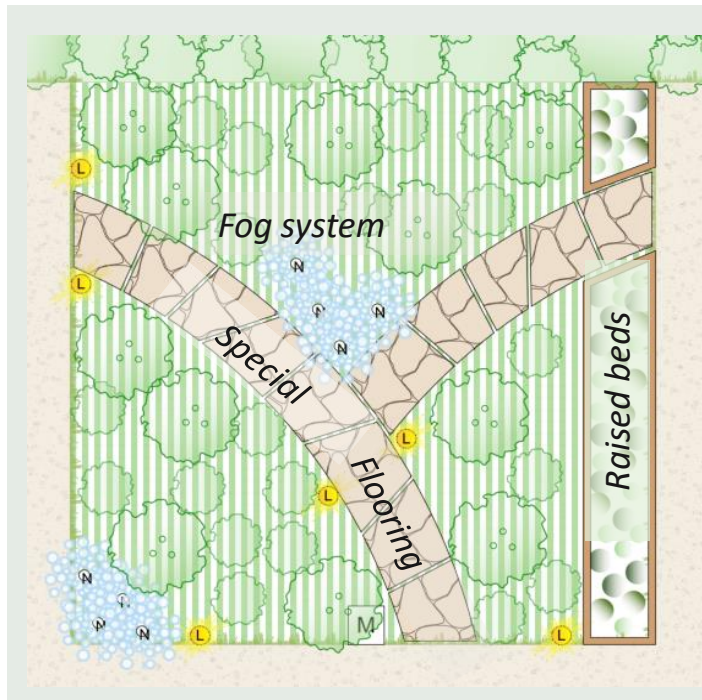
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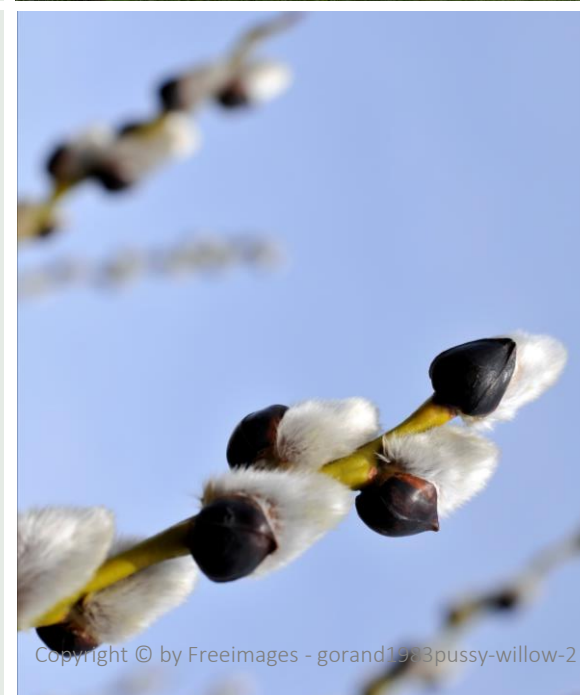
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## Experience through touching

In therapy gardens there are also people whose eyesight is not or no longer so good.

For them, in addition to smelling and hearing, there is also the "feel" area to perceive plants directly.

Through various elements such as fog plants, tall soft grasses, or willow catkins, the sense of touch is particularly addressed in this area.



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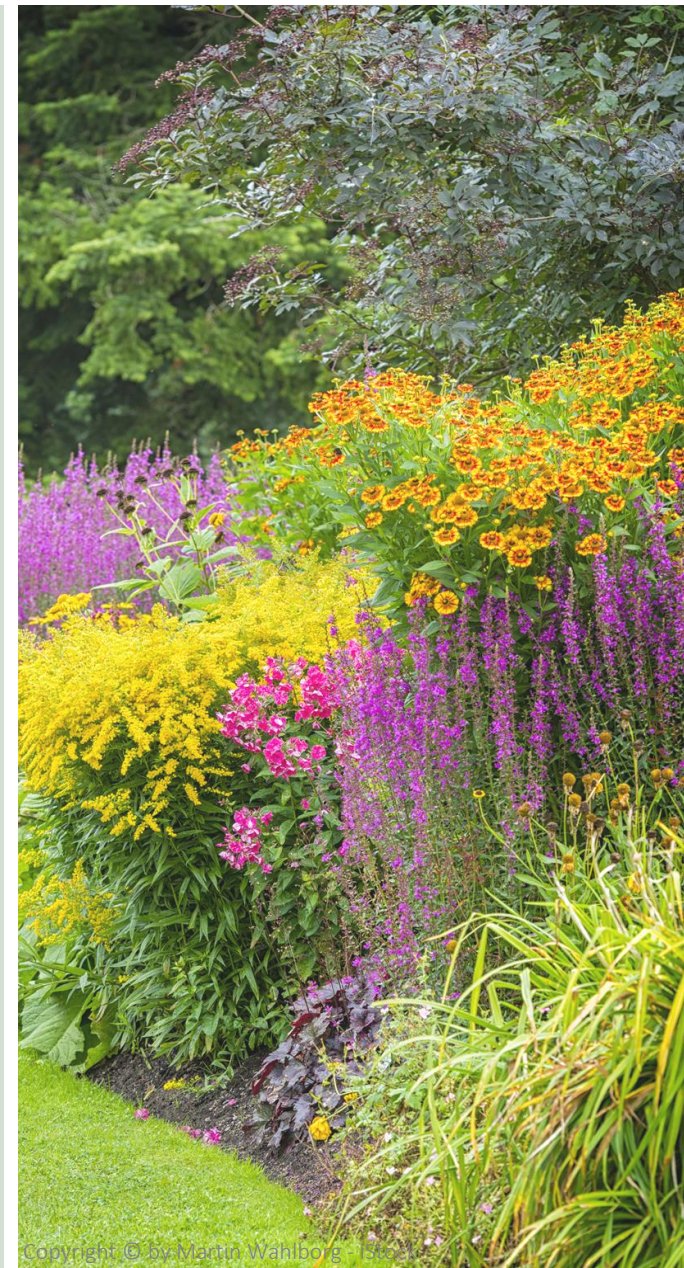
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Shade beds - many plants of which are also suitable under trees

## In principle, all green areas on the Frankfurt Bridges are planned in detail

The concept on the bridges: The planting there is no ordinary green space, but particularly varied and diverse.

A suitable plant world is planned for each section - which can also be a kilometer-long test area for the urban greenery of the future.



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Splendor beds - which require more water and care

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Wild meadows - not quite as handsome  
in autumn and winter, but much  
needed in the city

## Special bed types with environmental aspects and adaptation to climate change

Special types of beds can not be missing on the Frankfurt Bridges: for example, wild meadows, where biodiversity can develop without fertilizers and heavy irrigation, as well as drought-resistant plants as a great experimental area for the possible consequences of climate change.

R&D projects have to answer the question: Are Mediterranean plants a good idea in our part of Europe?



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Drought-resistant native survival artists

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## Plantings adapted to environmental changes could be realized in the past with the cities' seed databases: a forgotten tradition

Until the 90s of the last century, many cities and towns still had their own city nurseries: For decades, these collected seeds in the urban area from the plants that were best adapted to the environment.

This approach could also be used today to develop alternatives to importing Mediterranean or drought-resistant non-native plants: For even among the native plants in Germany there are survival artists that can cope with low rainfall or higher temperatures. If one applies the same principle as the city nurseries did in the past, a seed pool that is robust for the future can be created.

The development of climate-adapted urban greenery will play an increasingly important role against the background of the climate change that is already being felt.

## Our cities need more green - and planned in a differentiated way

### Planting principles on the Frankfurt Bridges

**Varied:** thereby entertaining and adapted to many different target groups

**Instructive:** with informative inscriptions or informative explanatory panels

**Biodiversity:** enhancing biodiversity - in the middle of the city

**Research relevant:** Test plots of all kinds for institutes and universities

**Sustainable:** no alternate planting but permanent vegetation

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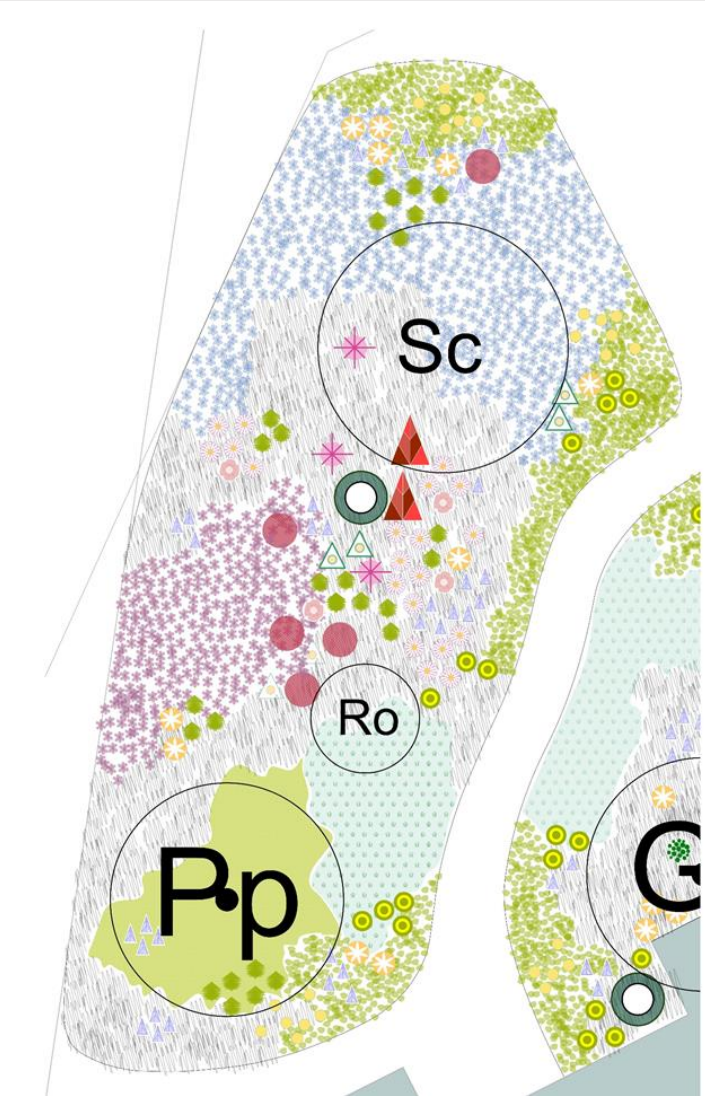
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# Professional bed planning is the basis for aesthetics as well as research



**Woody plants:**

- Pp** *Parrotia persica* 'Vanessa', Eisenholzbaum
- Ro** *Rhododendron oreodoxa*, Rhododendron
- Sc** *Syringa x chinensis*, Chinesischer Flieder

**Matrix types:**

	<i>Alchemilla epipsila</i>	II-IV	11/m² <-> 30 cm
	<i>Epimedium pin. ssp. 'Colchicum'</i>	II-III	11/m² <-> 30 cm
	<i>Geranium gracile-Hybride 'Sirak'</i>	II-III	8/m² <-> 35 cm
	<i>Geranium x cant. 'Berggarten'</i>	II-III	16/m² <-> 25 cm
	<i>Hakonechloa macra</i>	I	6/m² <-> 40 cm
	<i>Liriope muscari 'Big Blue'</i>	II	16/m² <-> 25 cm

**Leading perennials:**

	<i>Anemone hupehensis 'Ouverture'</i>	I-II	<-> 35 cm
	<i>Aruncus sylvestris</i>	I	<-> 100 cm
	<i>Aster divaricatus</i>	I-II	<-> 60 cm
	<i>Bistorta amplex. 'JS Caliente'</i>	I	<-> 90 cm
	<i>Centaurea dealbata 'Steenbergi'</i>	I-II	<-> 35 cm
	<i>Erigeron cu. 'Sommerneuschnee'</i>	II	<-> 35 cm
	<i>Physostegia virg. 'Bouquet Rose'</i>	II	<-> 30 cm <-> 40 cm

**Companion perennials:**

	<i>Gillenia trifoliata</i>	I-II	<-> 40 cm
	<i>Primula elatior</i>	II	<-> 20 cm

**Filler perennials:**

	<i>Campanula persicifolia 'Grandiflora Coerulea'</i>	II	<-> 30 cm
	<i>Corydalis lutea</i>	I-II	<-> 35 cm
	<i>Knautia macedonica</i>	I	<-> 60 cm

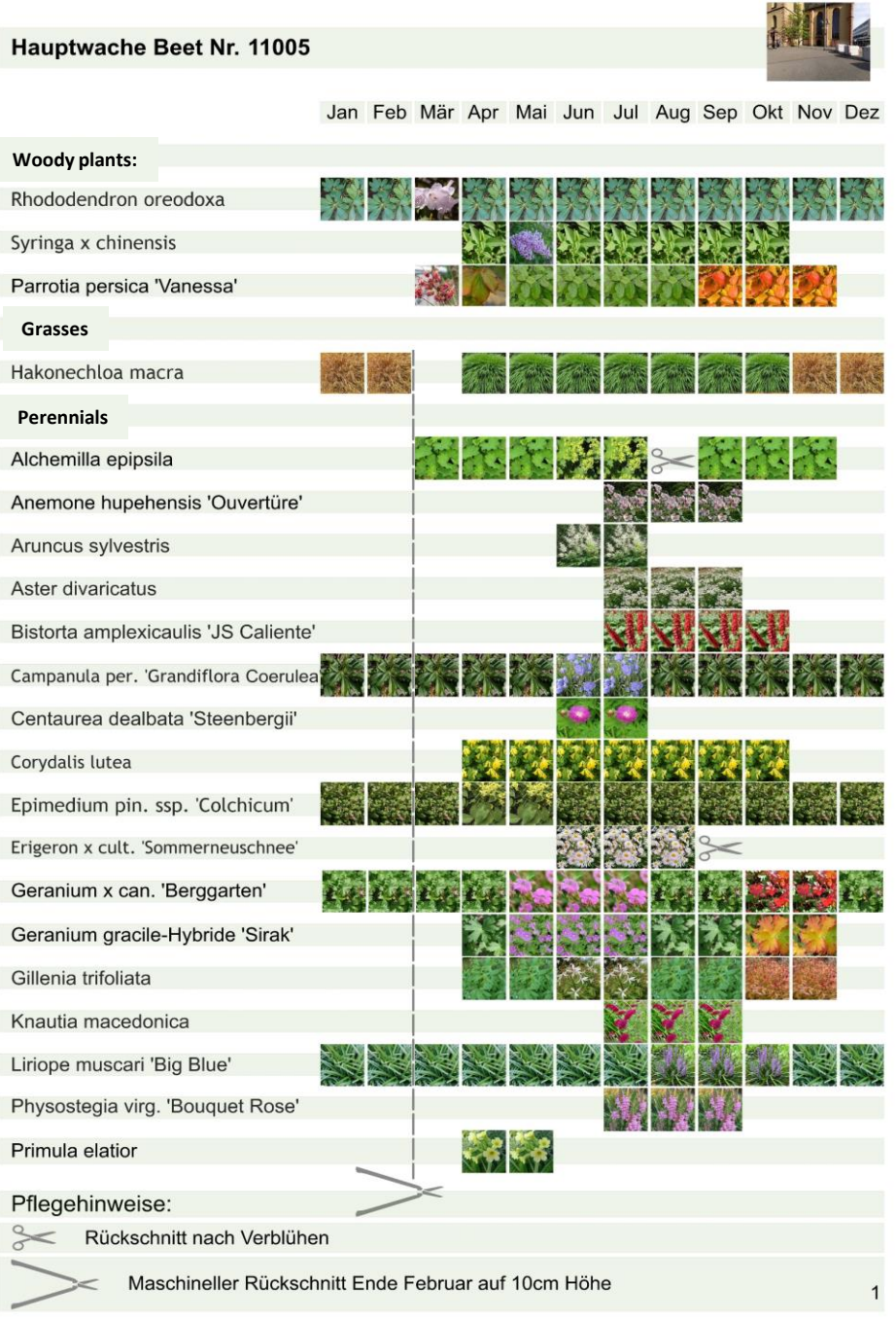
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And with so-called aspect calendars you ensure a composition of plants that provide a beautiful sight throughout the year

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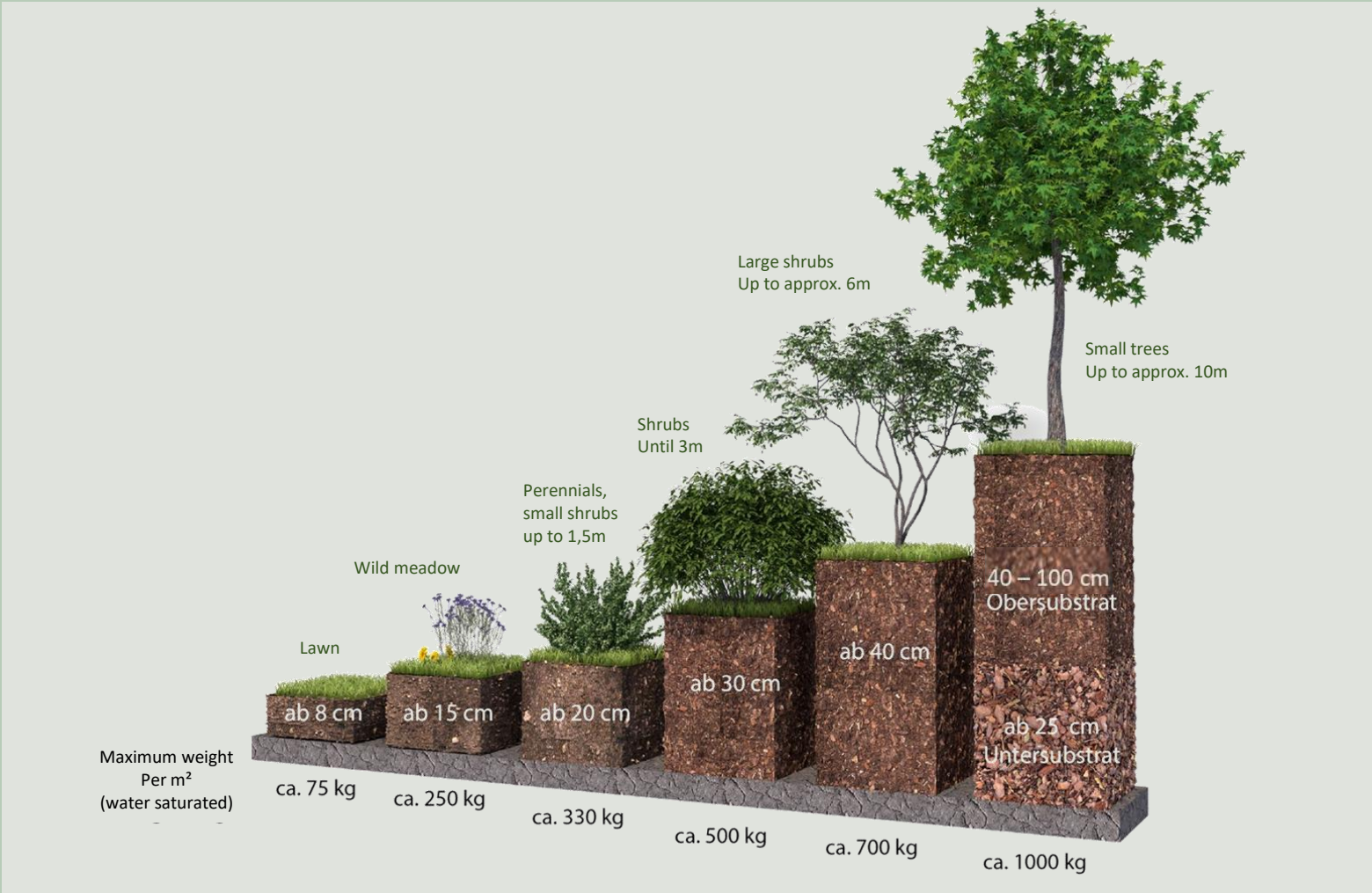
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# The bridges - a single rooftop garden: But how do you create functioning beds there?

The principle of bridge planting is similar to that of a green roof: The plants grow in a substrate layer 15 to 100 cm high, depending on the planting.



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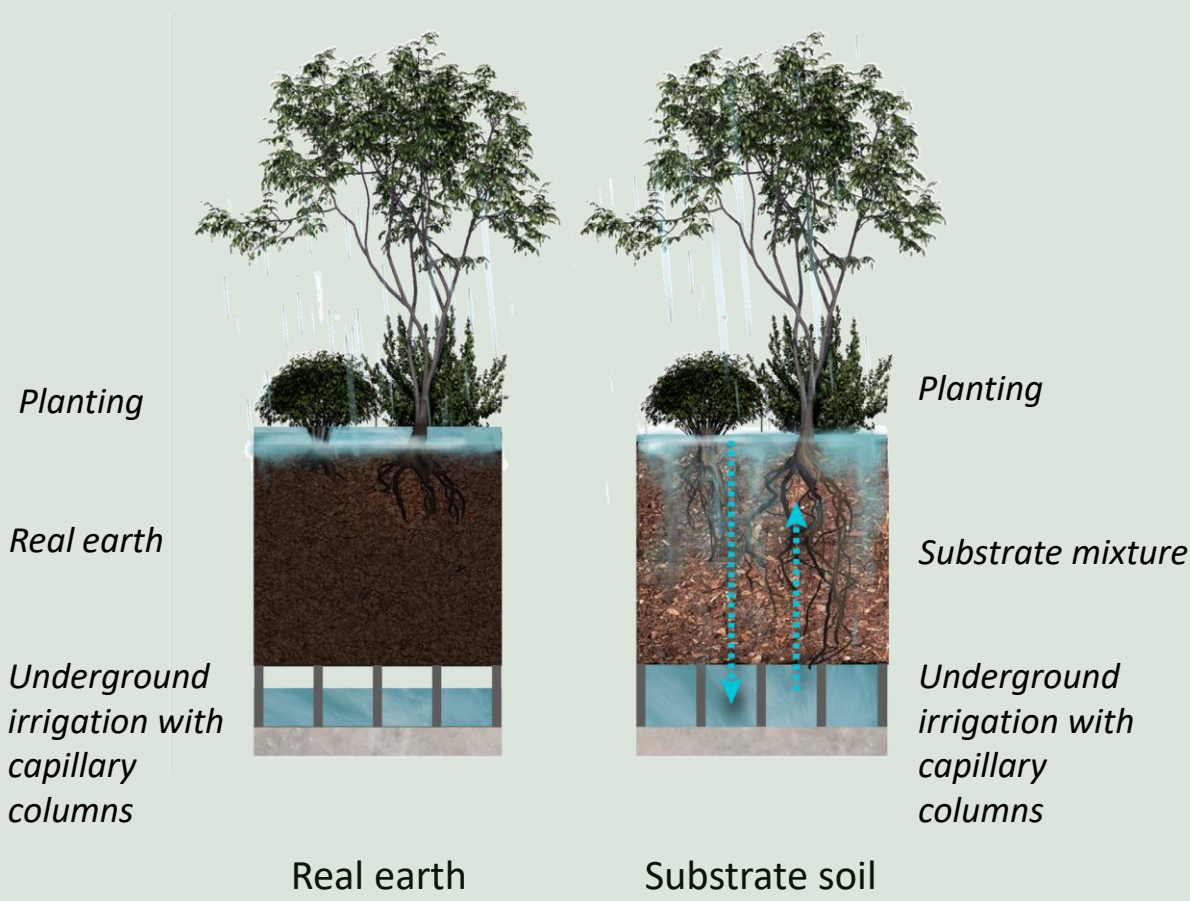
## The biggest challenge on bridges: Providing the plants with everything they need without making the load too heavy

While with conventional soil it is not possible to determine exactly how much water it can ultimately store, special roof garden substrates have a specific water storage capacity.

Once the maximum possible storage amount of water is reached, the further water runs into the irrigation and drainage system below. This prevents the planting soil from becoming too heavy for the bridge due to too much water; and on the other hand, it ensures that the plants do not stand in water and rot.

## ADVANTAGES OF SUBSTRATE SOIL

Weight, rooting, aeration  
water distribution, water drainage, capillary effect



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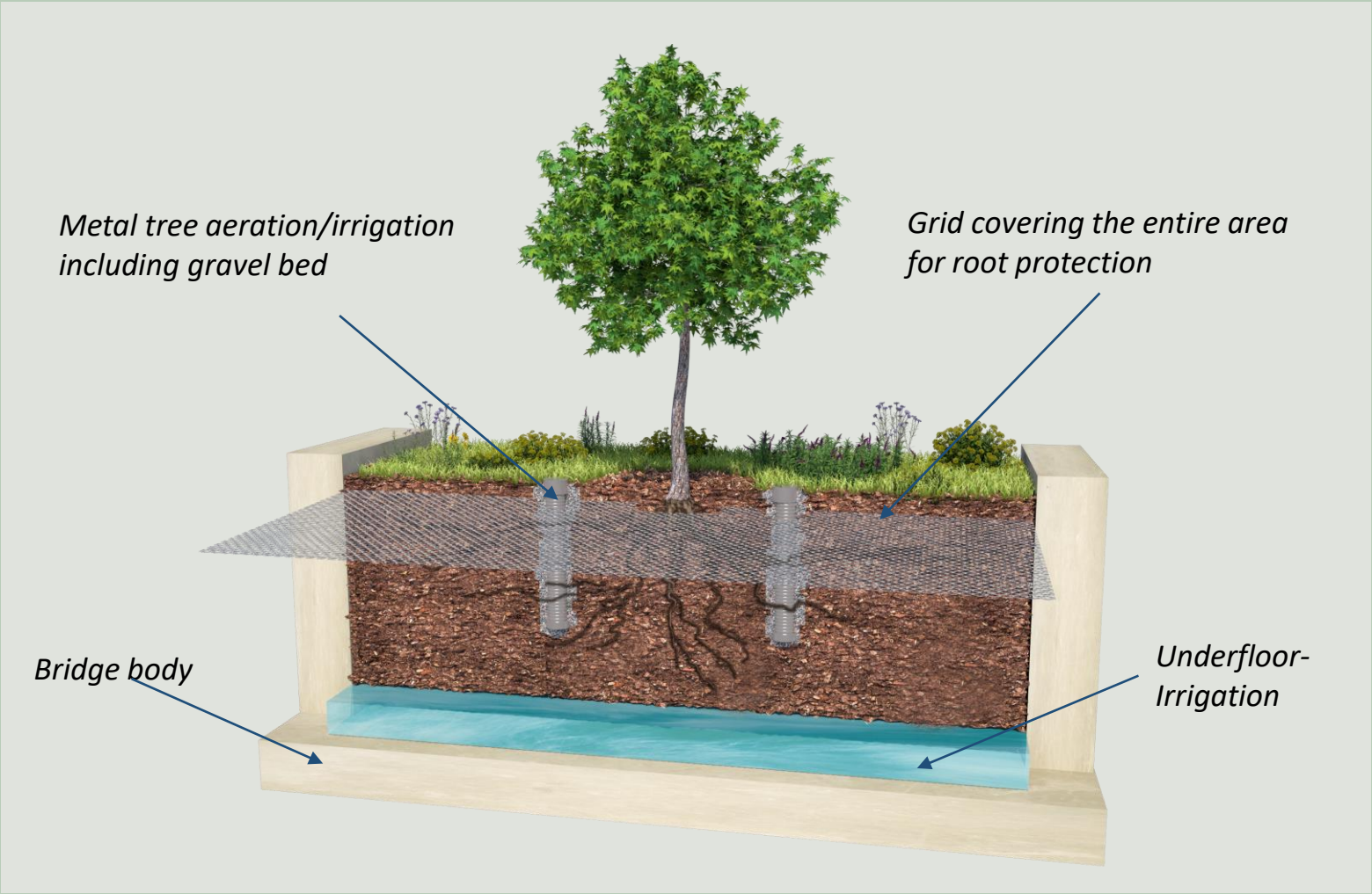
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Trees and individual shrubs are secured by a lattice in the substrate to prevent them from being uprooted in their exposed position during storms





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## The New York Highline is still watered by hand

On the Frankfurt Bridges, though, the plants receive the water they need in dry periods not through drip irrigation, but by means of "subsurface irrigation" - unlike conventional green roof systems,

Under the substrate layer is a water-bearing layer that provides irrigation and drainage of the beds. Capillary forces cause the water in the substrate to rise from there.

## Something more effective is planned for the Frankfurt bridges

Since the plants are supplied with water from below, less irrigation water evaporates on the surface. The system can also be designed with a minimum of plastic and thus durable.

Compared to drip irrigation on the surface, it is less susceptible to external influences such as vandalism or weathering.

Drip irrigation is only used in a few places such as slopes.

## A sophisticated irrigation system is planned

Underground irrigation saves water and is low on plastics.

The principle works similarly to innovative building greening: Water washes around small columns that support the substrate above.

The columns are slotted, allowing water to enter the columns, where it is drawn upward toward the substrate by a capillary-ready packing.

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## How is the water-bearing layer held?

The load-bearing elements of the retention layer are columns made of carbon concrete, a composite material consisting of two components: concrete and carbon fibers as reinforcement.

Carbon concrete is significantly more expensive than reinforced concrete; but it is also four times lighter and five to six times stronger.

It also has a higher tensile strength, which means that less material has to be used to achieve the same effect - thus saving resources. In addition, carbon concrete has a significantly longer service life, as it is more resistant to corrosion than conventional reinforced concrete.

Carbon concrete can even be broken down into its components again during recycling: But while one has many further uses for the component concrete, there is currently little research result on the use of recycled carbon fibers.

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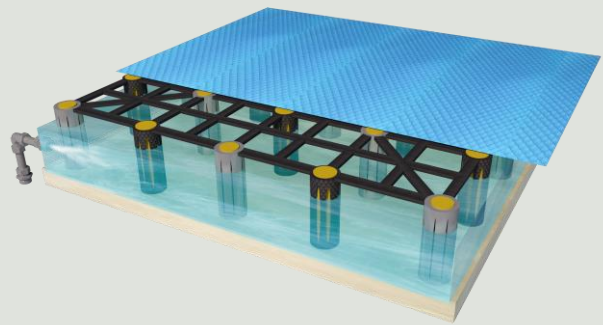
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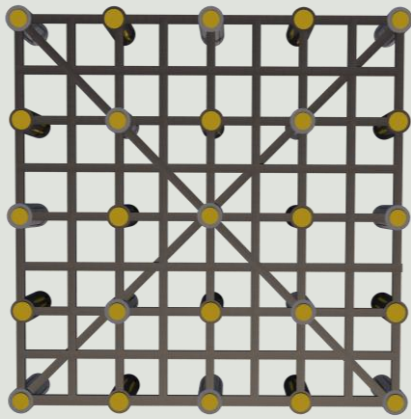


# The principle works similarly to innovative green roofs – only with less plastic and longer lasting

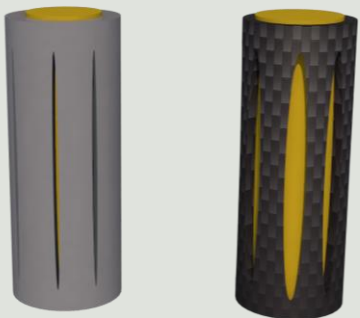
Carbon concrete and carbon columns between bridge deck and substrate: water can wash around them unhindered



On top of the columns are carbon concrete slabs with slots through which wastewater can drain from above (mostly rainwater)



Also, many of the columns themselves are hollow inside and have slits: this allows water to reach the rock wool filling (yellow) inside them



The carbon concrete columns are hollow from the inside and slotted on their surface. They are filled with capillary rock wool fibers. The water from the retention layer passes through the slits to the capillary rock wool fiber, which transports it to the top. There, it releases the water to a nonwoven layer covering the entire surface, over which the substrate lies. This supplies water to the root zone of the plants - also through capillary action. If the plants need more water on hot days, they also draw more water from the capillary system. At the bottom of the retention layer, a sophisticated control system ensures that there is always enough water available. Beds with very high water requirements are equipped with more hollow, rock wool-filled carbon concrete columns than beds with lower water requirements.

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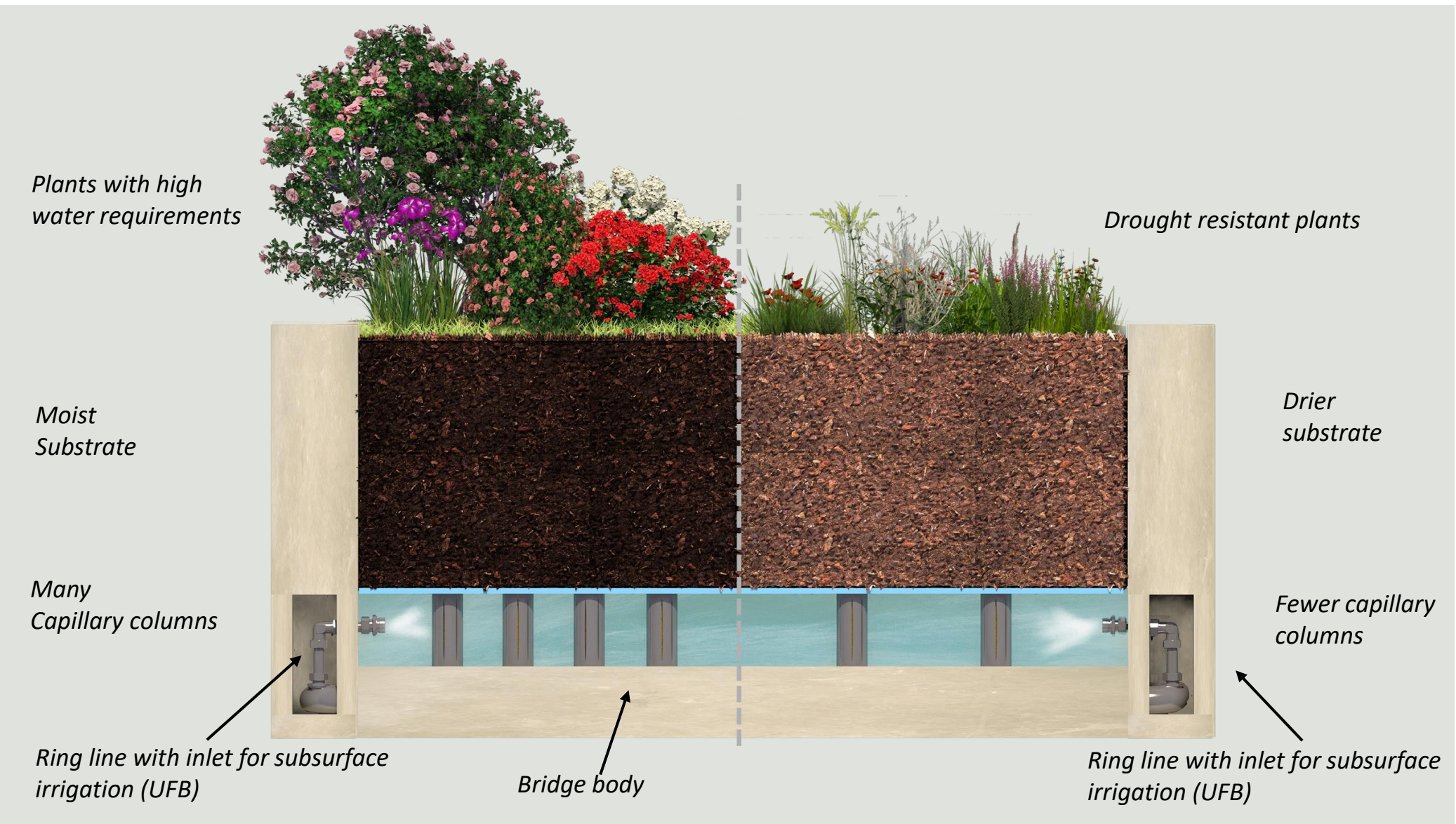
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Water-needy decorative beds on the bridges have more carbon concrete columns than a Mediterranean bed with moderate water needs



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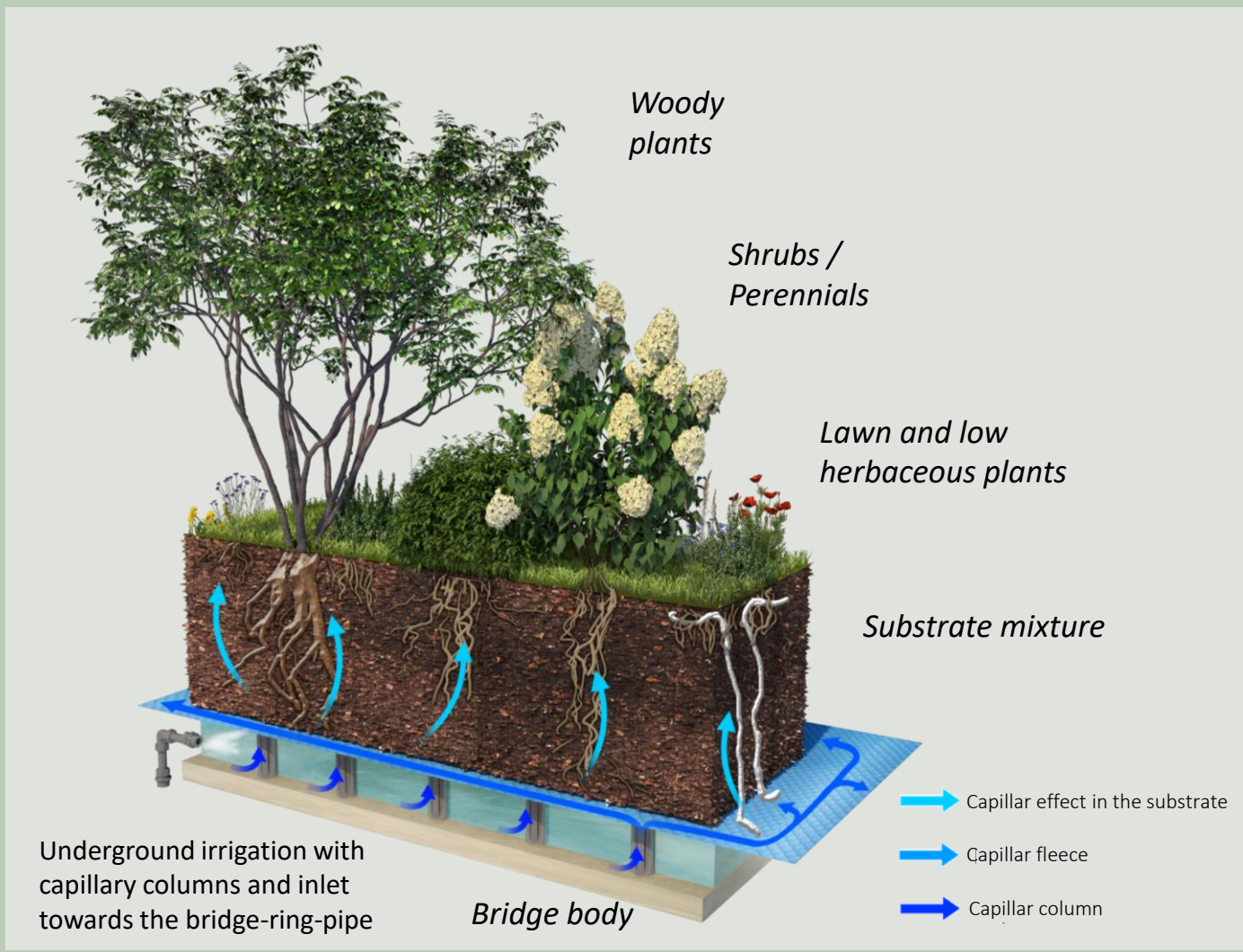
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# Self-regulating capillary forces bring the water from "below ground" to the top of the plant roots!



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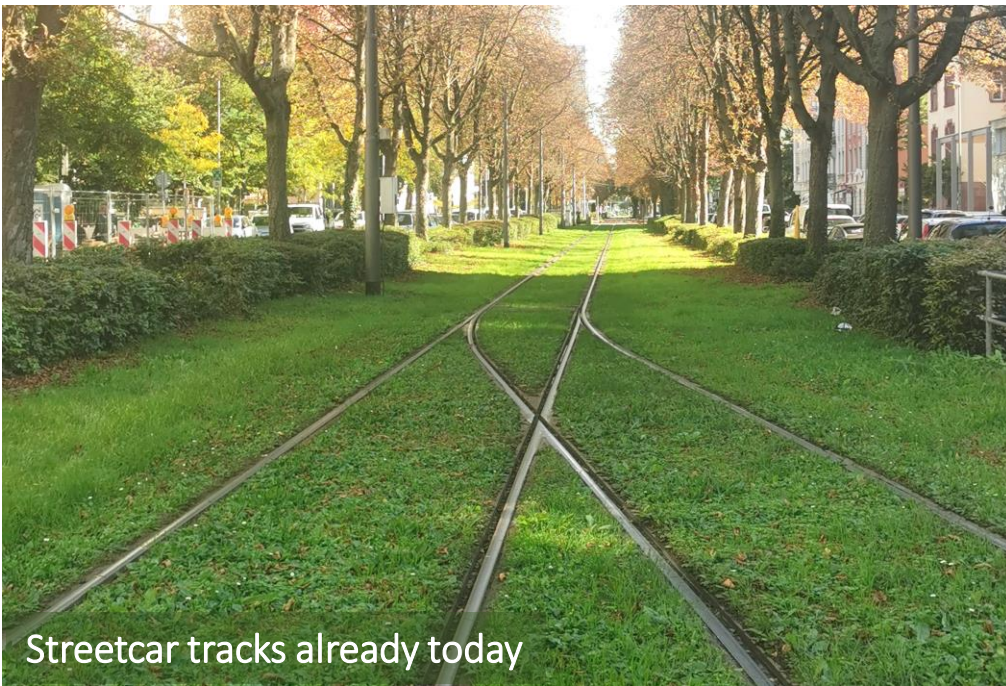
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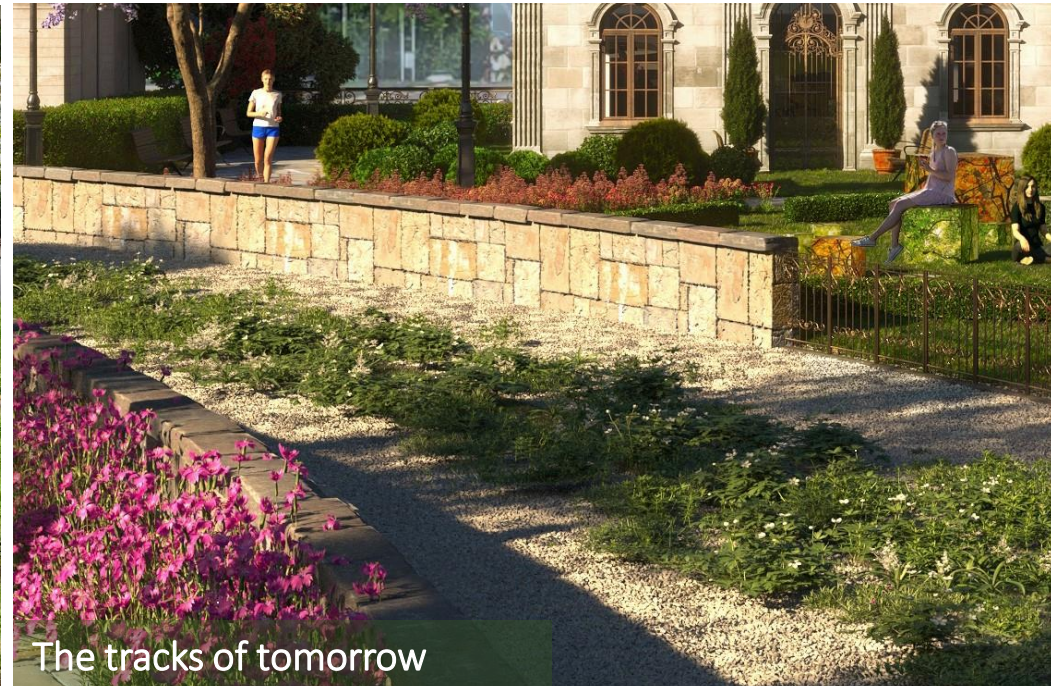
# On the Frankfurt bridges, autonomous driving also makes green traffic routes possible

We already know grassed roadways from rail lines: More and more transport companies are deciding not to remove grass between the rails, but to even plant it there, deliberately. Unsealed traffic routes are an important step on the way to a "Sponge City."

Similarly, on the bridges, the central area of the roadways is equipped with low vegetation. This is because when vehicles drive autonomously, overtaking and braking maneuvers are eliminated: The space between the wheels remains largely unaffected.



Streetcar tracks already today



The tracks of tomorrow

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The underfloor irrigation is also located below the roadway, so that the irrigation of the greened mid stripe on the vehicel road is ensured



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## Conclusion: With the Frankfurt Bridges, a green world of experience and nature is created above the gray entrance roads of Frankfurt

The green spaces of the Frankfurt Bridges offer citizens a wide variety of experiences: from yoga meadows to inclusion playgrounds to therapy gardens, each section is planned in a differentiated manner in terms of landscape architecture.

At the same time, the botanical planning of the individual areas is carried out under a wide variety of aspects: There are test areas for the climate-resistant urban greenery of the future as well as near-natural areas for protected species, or aesthetically sophisticated flower beds.

The Frankfurt Bridges irrigation system ensures a year-round water supply for Frankfurt's green spaces without using drinking water. Underground irrigation is most effective, because it protects against evaporation losses. Moreover, the use of carbon concrete columns in the retention layer makes the system on the bridges durable and low in plastic.



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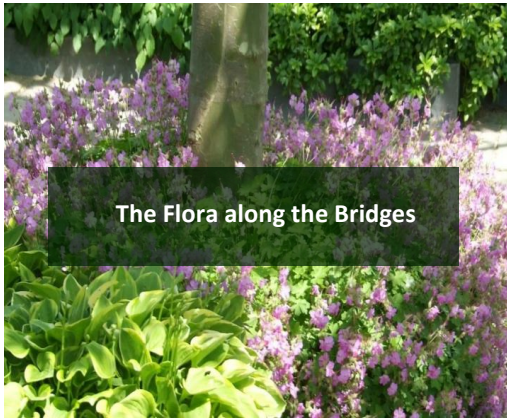
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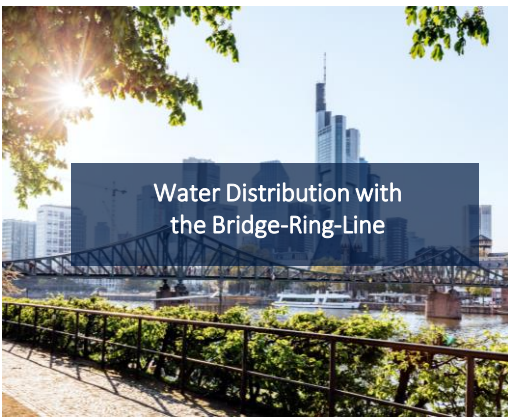
Vitalization of the Urban Greenery



The Green Metropolis of the Future



The Goal: To Arm the City against Drought and Floods



Water Distribution with the Bridge-Ring-Line



Frankfurt: Current Urban Climate

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# The Flora on the Bridges

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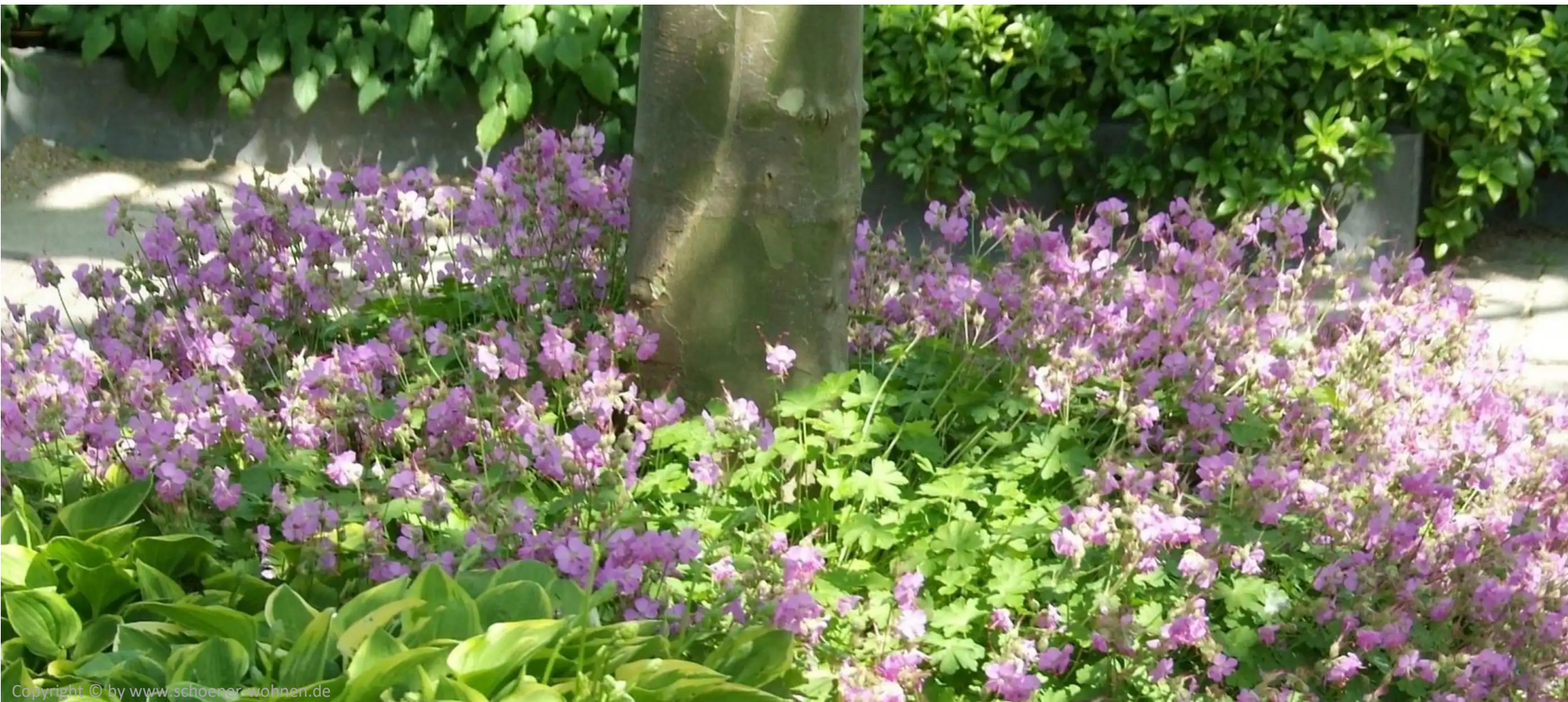
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The flora along the bridges is supplied with water by the bridge and enhanced with new plantings

All plants directly adjacent to the bridges can be strengthened both in the course of the construction work and afterwards through needs-based water supply and care by the bridge company's gardening teams. In this way, beautiful green spaces of high quality for nature as well as citizens are created along the entire length of the route, and all areas near the bridges in Frankfurt are significantly upgraded.



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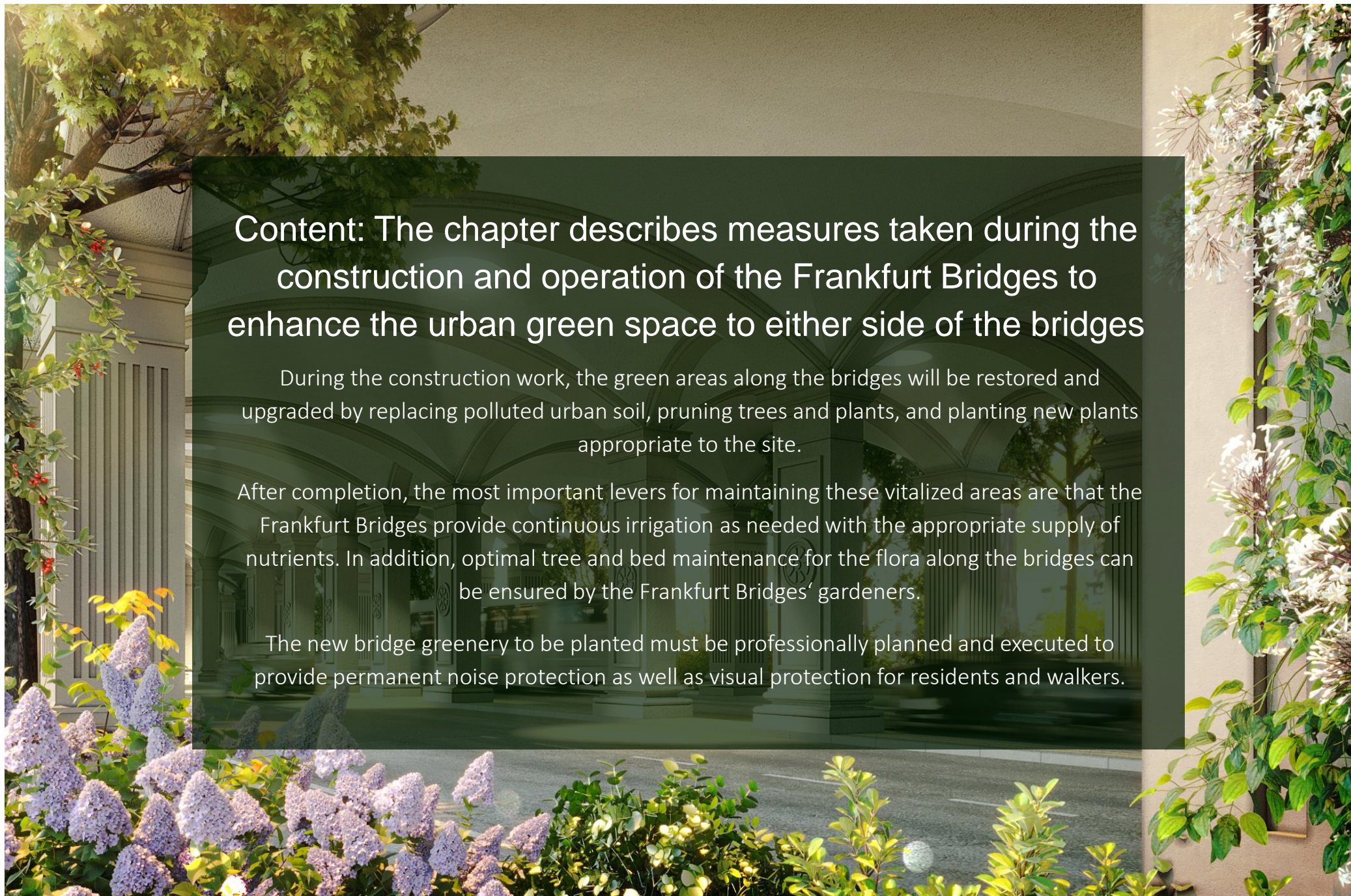


**Content:** The chapter describes measures taken during the construction and operation of the Frankfurt Bridges to enhance the urban green space to either side of the bridges

During the construction work, the green areas along the bridges will be restored and upgraded by replacing polluted urban soil, pruning trees and plants, and planting new plants appropriate to the site.

After completion, the most important levers for maintaining these vitalized areas are that the Frankfurt Bridges provide continuous irrigation as needed with the appropriate supply of nutrients. In addition, optimal tree and bed maintenance for the flora along the bridges can be ensured by the Frankfurt Bridges' gardeners.

The new bridge greenery to be planted must be professionally planned and executed to provide permanent noise protection as well as visual protection for residents and walkers.



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The flora to the right and left of the Frankfurte Bridges is supplied by the water of the bridge ring pipe and cisterns under the bridges - therefore it becomes more lush and dense than before

A ring main runs in the bridges, which not only supplies the plants on the bridges, but is also tapped every 50 to 100 meters for the plant life along the bridges. In addition, cisterns are laid in the ground under the bridges that could collect rainwater from the bridges as well as roof rainwater from the adjacent roofs. They, too, water the greenery directly at the bridges when needed.



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# About 8000 trees are located along the planned route of the Frankfurt Bridges: They are thus directly affected by the construction of the bridges

However, no vital tree along the bridges is to be felled or damaged in the course of the construction measures. On the contrary, the construction project can be used as an opportunity to create better living and growing conditions for the trees.

This is because part of the asphalt is removed for the construction of the bridges, so that the soil, which has been compacted and polluted over the years, can be extensively vitalized and trees made healthier and more resistant.

Urban trees are, as forestry scientist Peter Wohlleben says, the street kids among trees. They have learned to fend for themselves under the most adverse conditions and to cope with the meager, sometimes toxic nutrient supply of urban soil, which is heavily polluted by tire abrasion and the use of road salt - even from decades past.

Many of Frankfurt's urban trees have therefore been struggling with the adverse conditions for years. Many damages to trees are already visible to the expert, and the death of the trees seems to be only a matter of time. Even in the Frankfurt urban forest, only 3% of trees were vital after 2019.



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## Construction measure as "wellness cure": Trees weakened by city life are vitalized in the course of the construction measures by so-called „site improvement“

Usually, construction measures are more of a danger for urban trees and not an enrichment. A unique paradigm shift is to be made when constructing the Frankfurt Bridges: The construction measures should not only include the prescribed minimum consideration for urban trees, but should integrate their vitalisation as a target component in their planning from the very beginning.

Before starting to build the bridge on a section, it is necessary to analyze the soil underneath and the course of its roots for each older tree. Only then can improvement of the growing conditions be targeted: Soil aeration, soil replacement, adapted nutrient and water supply or even pruning are among the most important measures here.



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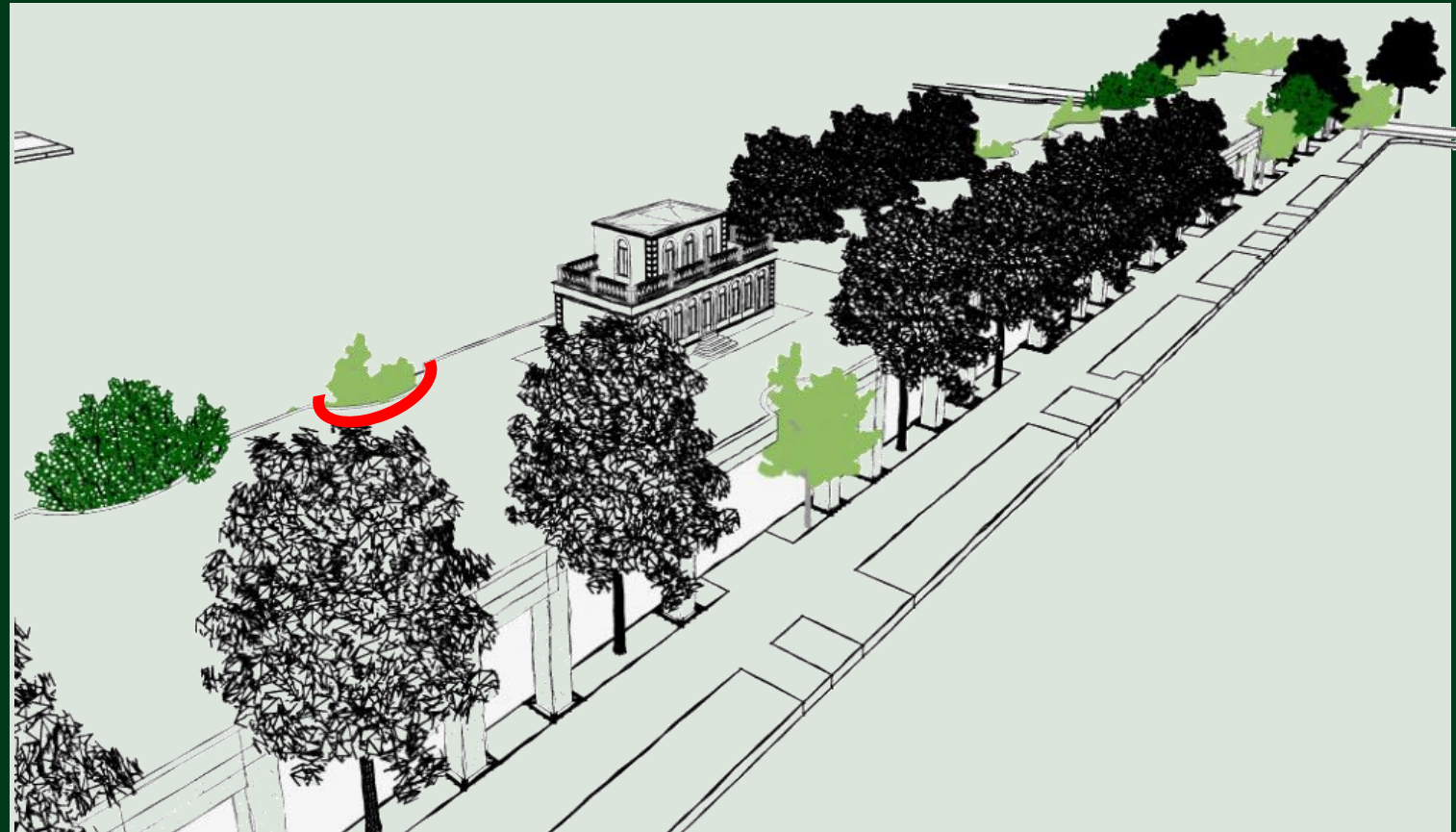
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All trees along the bridges should not only be preserved, but also strengthened - so the Frankfurt Bridges become lush treetop-paths at the same time

Cutouts are provided for each tree along the surface of the bridges. By pruning the trees, the crowns unfolds only above the bridges, so that the bridges are framed by the building crowns. The cutouts are sized large enough and the trees are professionally pruned so that no damage occurs to the bridges or trees in the event of a windy storm.





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## The pruning of the trees should already be started in the years of preliminary bridge planning

The cutouts in the bridges' surface allow all trees along the Frankfurt Bridges to develop naturally as far as possible. If, however, things do get tighter, trees can also adapt to the structural environment with professional pruning. But this should not be necessary along the bridges – at least not to the extent that is found everywhere in the city.



## Trees are true adaptation artists

They even manage to "dodge"  
obstacles, as can often be seen in  
the street scene.

However, this is to be avoided  
along the Frankfurt Bridges by the  
circular recesses, which are  
dimensioned according to the  
tree species and the spacing of  
the trees next to the bridges.

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Especially in the old tree-rich neighborhoods of the city, trees had to come to terms with houses

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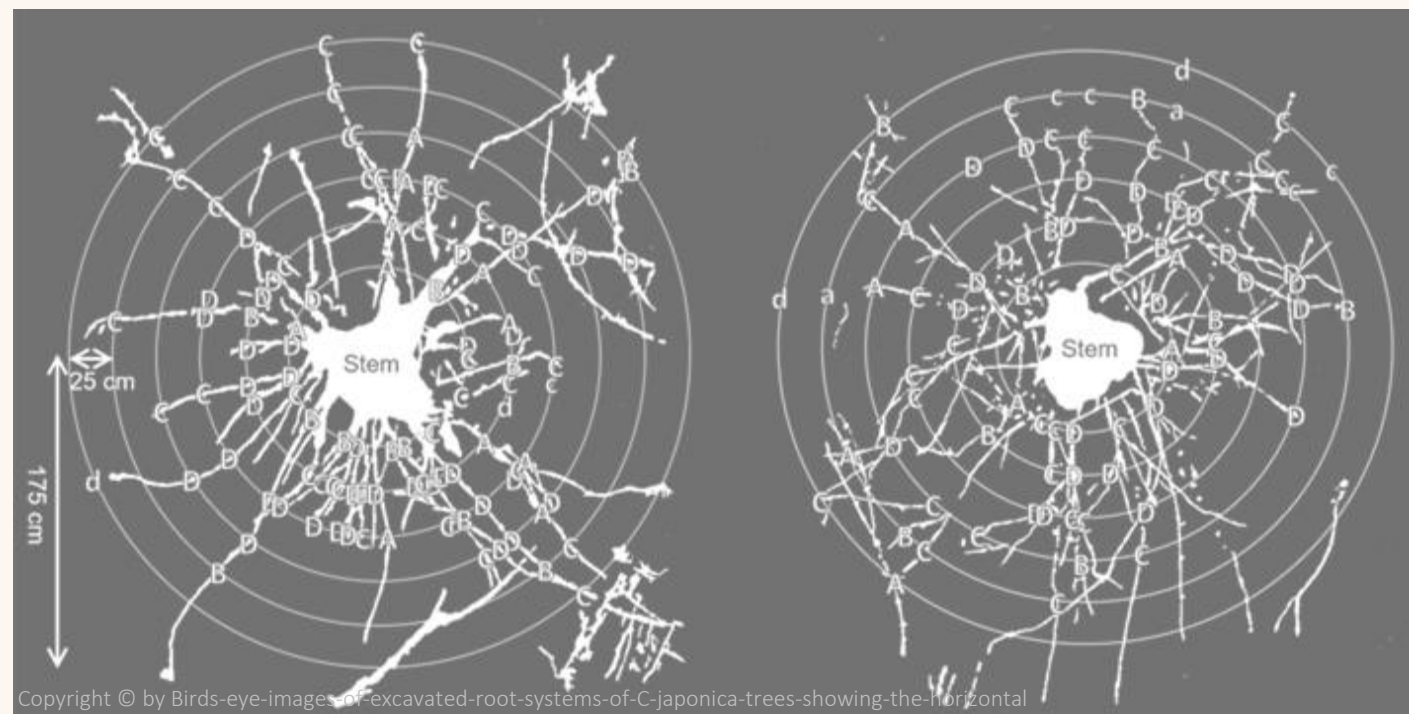
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## Who uses the space under the sealed surface? Pipes and cables often compete for the same space as tree roots

Root scans are used to check the exact spread and course of the tree roots in advance of the construction work. This enables the optimum position of the bridge piers to be determined: This is because the structural system for the bridges is already designed so that each pier can be moved at least one meter to the right or left. This means that in many cases the main supply roots of trees can be avoided.



Copyright © by Birds-eye-images-of-excavated-root-systems-of-C-japonica-trees-showing-the-horizontal

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# Nutrient and water addition are effective and easy to implement measures to vitalize trees

Poor nutrient supply causes yellowing of the trees. Through proper fertilization and adequate water supply significant revitalization can be achieved, which is reflected in much greener foliage.

*Professor Härtmüt Balder*



Test area trees with vitalization

Test area trees without vitalization

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## Greenery as visual and noise protection: especially for adjacent residents

In the course of the city redesign, it is also possible to hide car roads: in the green areas between the columns of the bridges, lush beds with taller bushes will be replanted after the construction work.

In the process, the plants not only improve the air and provide further coolness; above all, they also hide what today characterizes the cityscape in those places: the gray asphalt of the street and the passing cars.

Thus, they serve as visual, noise and exhaust gas protection for the people living nearby.



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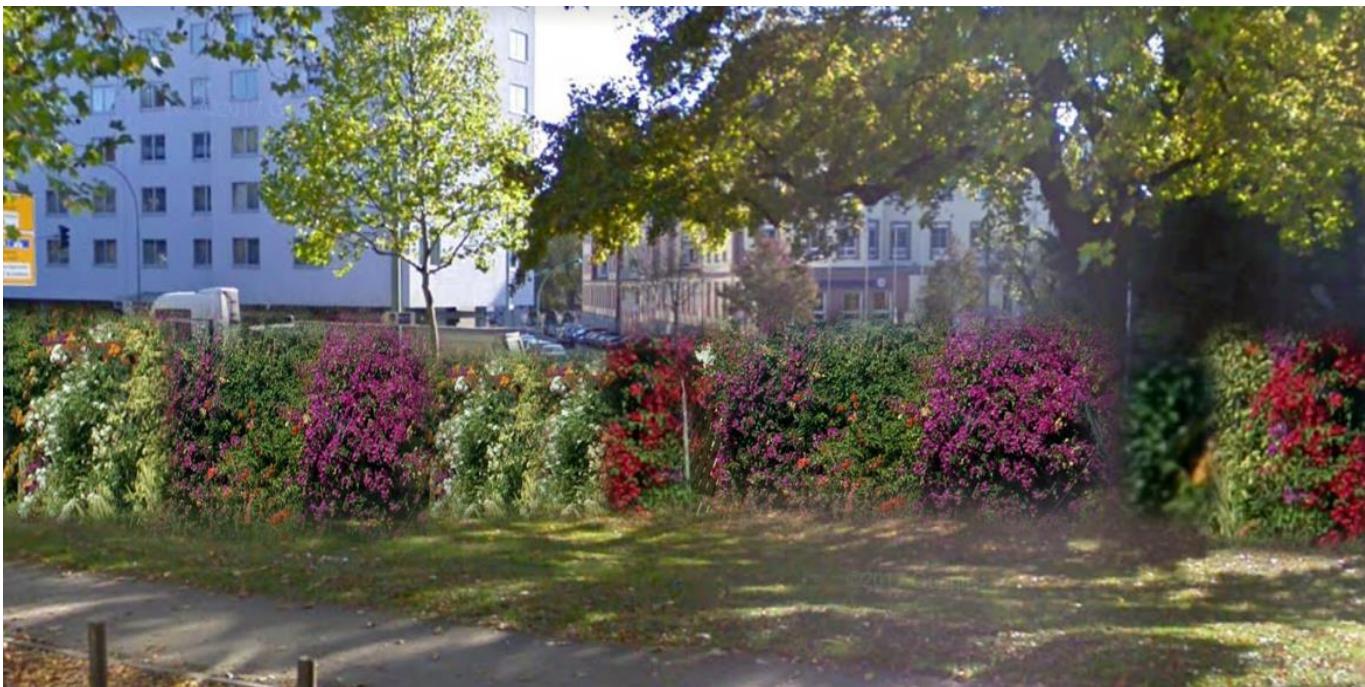
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Walkers on grass  
verges between  
motorways also benefit  
from the new visual and  
noise protection

The Frankfurt Bridges create the conditions for "plant walls" to emerge in the city: Through the bridges, water can be transported to planting strips along the streets that were previously left to themselves.

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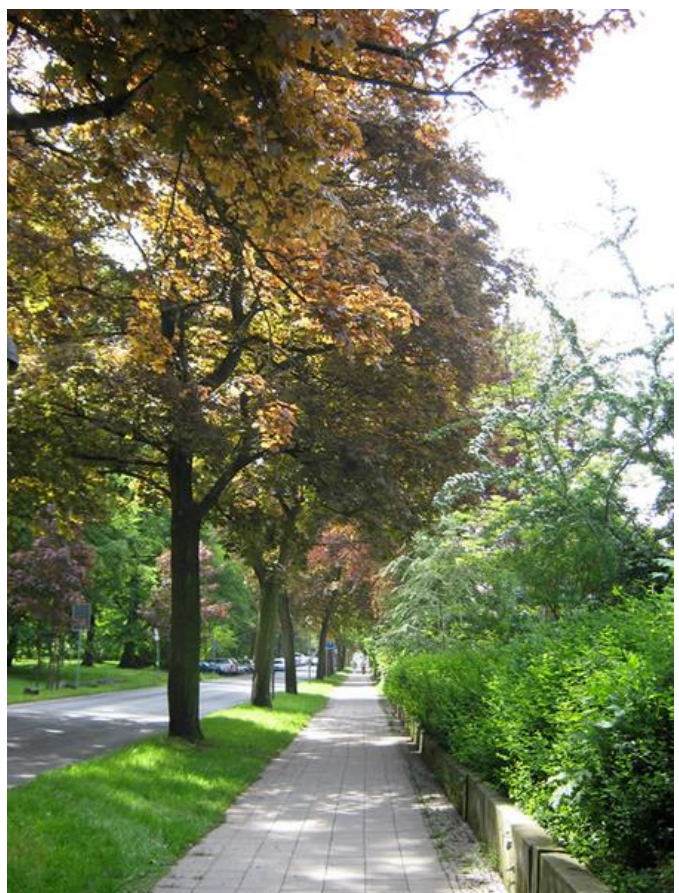
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Currently, roadside greenery is often monotonous and sparsely planted. The bridge greenery, however, will be consistently varied and lush

The challenge here is a differentiated site-specific bed planning that takes into account sunlight, temperature, water, pH, nutrient concentration, climate, relief of the site. This can ensure that a permanent planting can be established there.



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The green areas along the Frankfurt Bridges are planned in advance with beds adapted to the location - in shade, partial shade and sun are the most important factors here

### Planting plan and aspect calendar of a roadside evergreen semi-shade bed

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez

#### Shrubs

- Pyracantha coccinea 'Red Column'
- Photinia fraseri 'Red Robin'
- Osmanthus burkwoodii
- Berberis julianae
- Cotoneaster salicifolius 'Parkteppich'
- Arbutus unedo 'Compacta'
- Lonicera pileata
- Euonymus fortunei 'Emerald'n Gaiety'
- Philadelphus 'Snowbelle'
- Daphne mezereum 'Rubra Select'

#### Ground cover

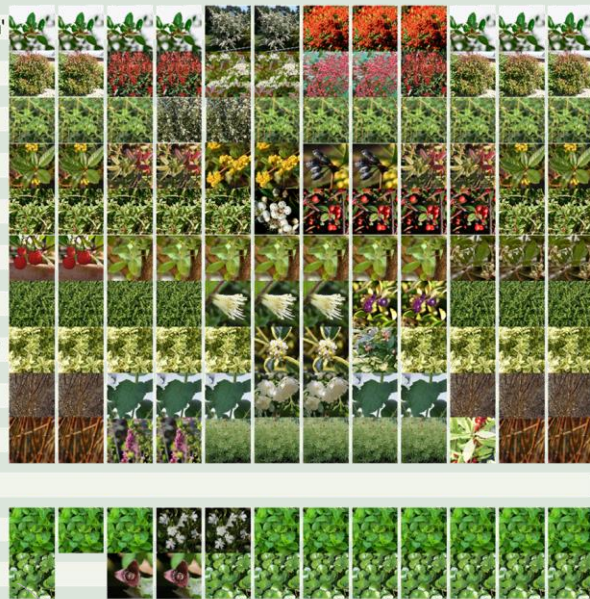
- Vinca minor 'Alba'
- Asarum europaeum

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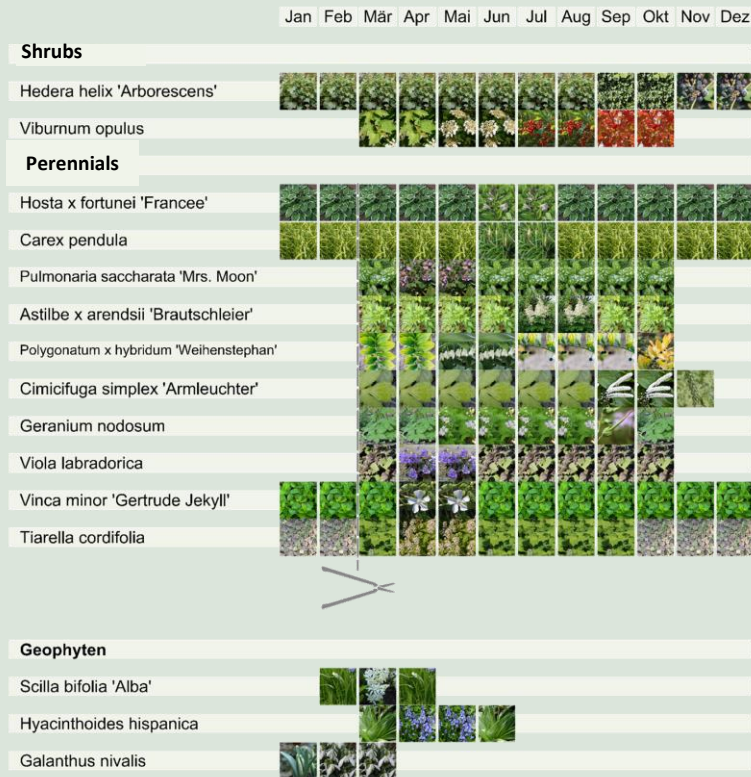
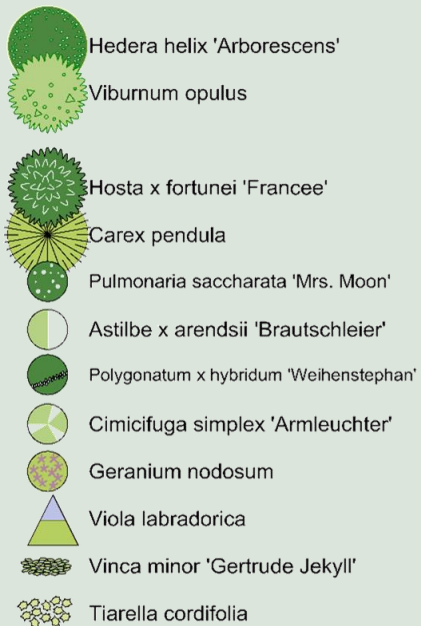
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## Planting plan and aspect calendar of a shady forest bed on the roadside



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## Conclusion: The Frankfurt Bridges as a construction project let the existing green spaces and trees along the bridges become more lush and vital

While a construction project usually tends to harm the plant world or even costs trees their lives, the exact opposite is the case with the Frankfurt Bridges: Existing green spaces are planted more lushly, vitalized and expanded.

The trees along the bridges are integrated into the structure and vitalized by the structure in such a way that magnificent treetop paths are created.

The quality of stay for residents and walkers is significantly increased by the noise and visual protection provided by the more lush and varied street greenery.

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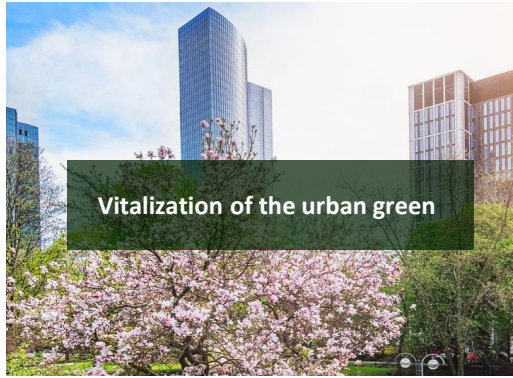
Green on the bridges



Nature conservation and biodiversity



Unsealing of the city center



Vitalization of the urban green



The green metropolis of the future



The goal: to arm the city against drought and floods



The water distribution with Bridge ring line



The goal: improve urban climate

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Image & Photos	Green & Nature	Statics	Packing	Finance	
Bridges	Communication	Transportation	Webpage & Design	Implementation	
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# Nature Conservation and Biodiversity

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## Nature conservation and biodiversity: bridges as stepping stone biotopes

Birds, bees, butterflies and other animals can find more food on all the new green spaces on the Frankfurt Bridges - and structural provisions are also being made for them : The bridges functioning as a model research area for structural species protection. In addition, there are natural wild meadows on the Frankfurt Bridges where endangered species can flourish undisturbed. The Frankfurt Bridges are thus not only a green lung through the city, but also serve as a stepping stone biotope for species previously separated by roads and the city, which can now come together again and mate.

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## Content: The network of bridges offers new habitats and a stepping stone biotope structure with its diverse green spaces

Already during the construction of the bridges, nesting, breeding and staging areas for animals and insects are created on the bridges; and the excavated material produced during the construction project is used directly to create nature conservation mounds.

Thus, in the course of a major construction project, new habitats are simultaneously created for Frankfurt's flora and fauna.

Moreover, stepping stone biotopes are created: birds, butterflies, smaller mammals, but also bats can cross gray roads with the help of the green bridges.

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Around 1 million m<sup>2</sup> of green space will be created on the bridges - of which 300,000 m<sup>2</sup> will be special protection areas for flora and fauna

On the Frankfurt Bridges, the wild meadows are located behind the lanes of the autonomous vehicles - in other words, in an area to which humans have no access. They are deliberately set aside so that the flora and fauna can develop undisturbed.



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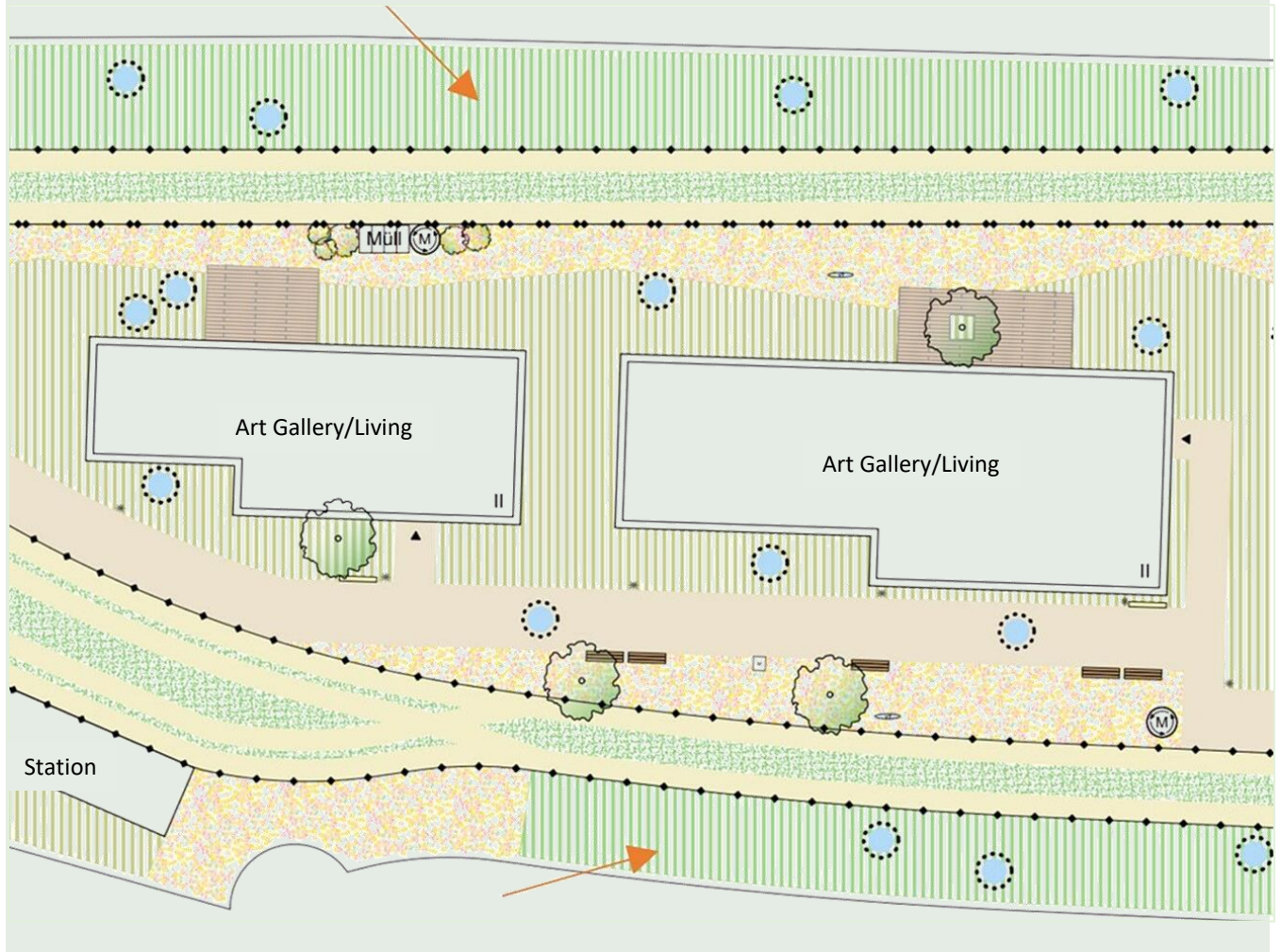


# Accordingly, the bridges function in large parts as an ecosystem in the middle of the city

There is the "normal" urban greenery and there are wild meadow areas: In the case of the normal urban greenery, attention is already paid to a balanced selection that is friendly to animals and insects, plants with double flowers are preferred for nutrition, plants that require bog soil are avoided, and more wild-looking plants that provide breeding and feeding opportunities are also found on the decorative beds.

In addition, the wild meadow areas specifically have an almost natural flora in which biodiversity can develop undisturbed, as the areas are completely inaccessible to public traffic.

Wild meadows on Frankfurt bridges behind the roadway - example Mainzer Landstraße





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## How do wild meadows work?

Wildflower meadows are cut on the bridges at certain times once in summer after seed ripening and once in autumn - preferably manually. Because true wildflowers and meadow grasses are self-seeding, the meadow, properly treated, becomes more beautiful from year to year.

This creates a cycle: The plants grow, blossom and bear fruit, and as soon as they dry out and decompose, they serve as humus for the next year's plants.

Additional fertilizers thus become completely unnecessary. The watering of wild meadows is similarly economical: Watering is really only done in extreme dry phases.

This is how wild meadows can develop in the first place: Because as soon as you irrigate and fertilize generously, plants with high water and nutrient requirements assert themselves and displace other (often endangered) plant species that are more modest.

For wildlife and especially for insects, (almost) natural wild meadows are being created as a valuable biotope.

Even if natural scrubs or insect hotels in the wild meadows are sometimes a bit unsightly, this is a way to promote biodiversity

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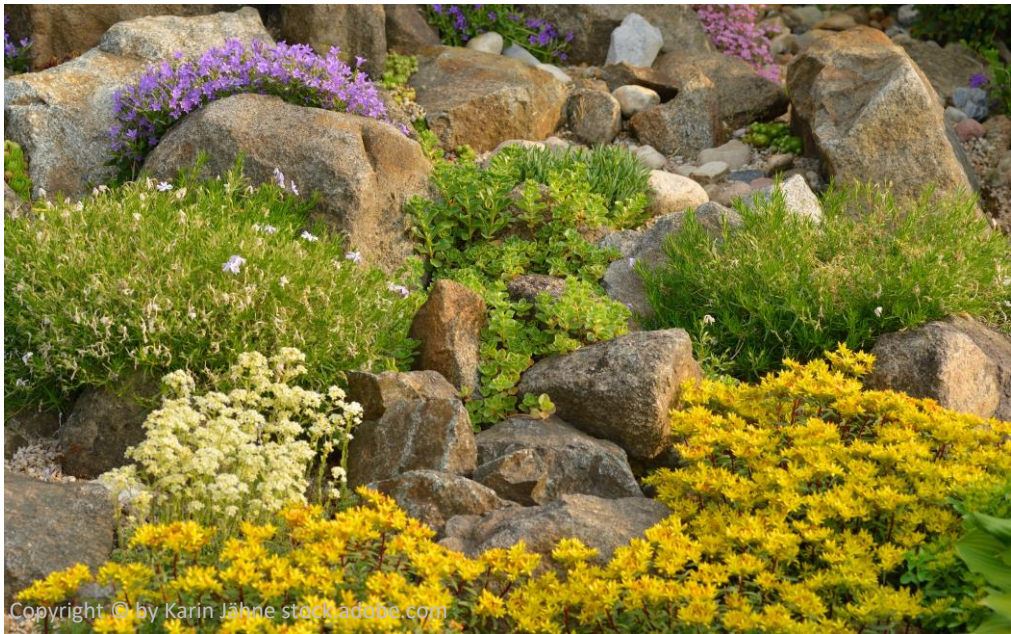
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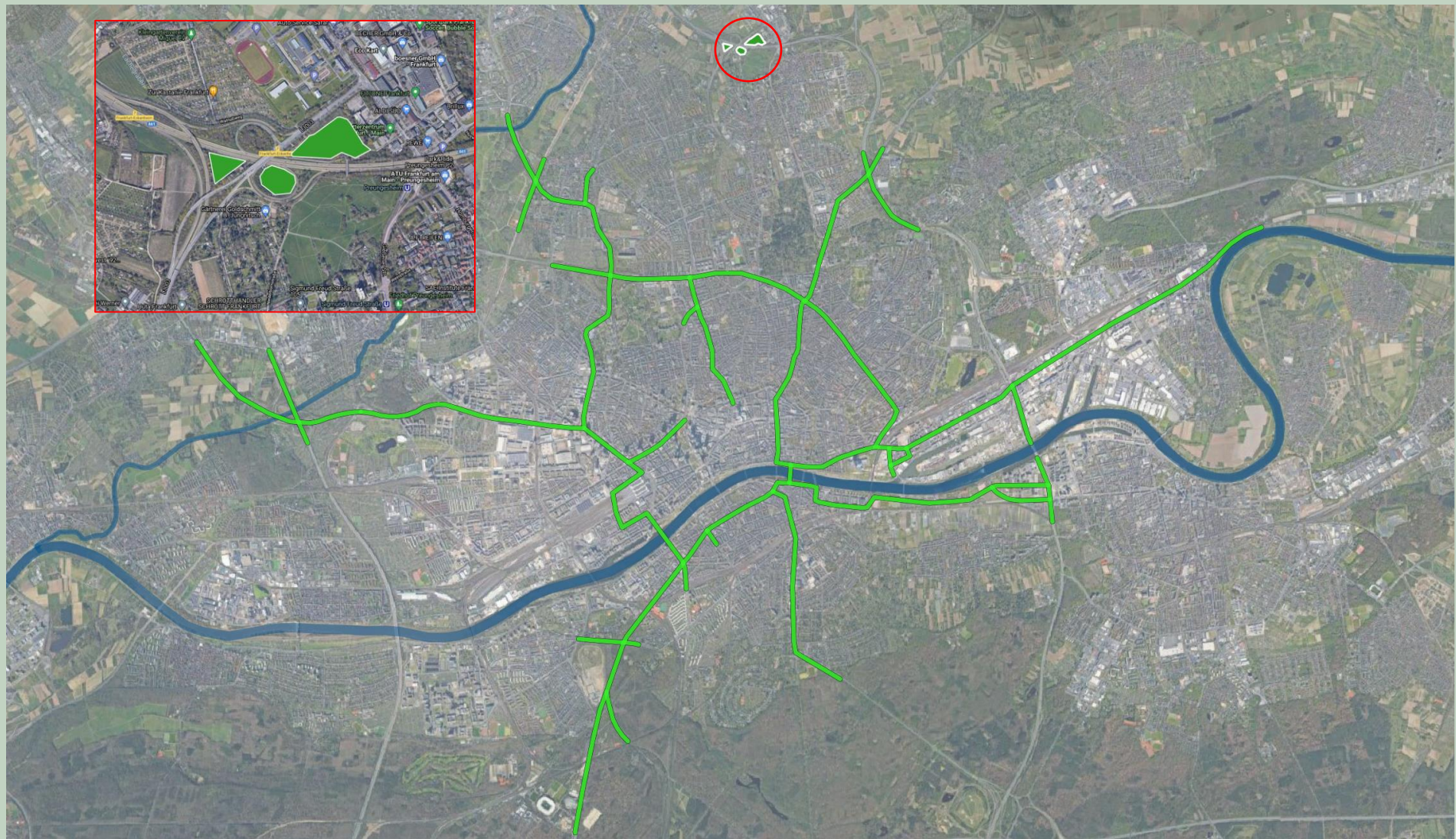
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With the help of the bridges, new ecosystems are also being created in the Frankfurt area: the excavated earth produced by the construction of the bridge columns is recycled on site and backfilled as "bio-hills" nearby



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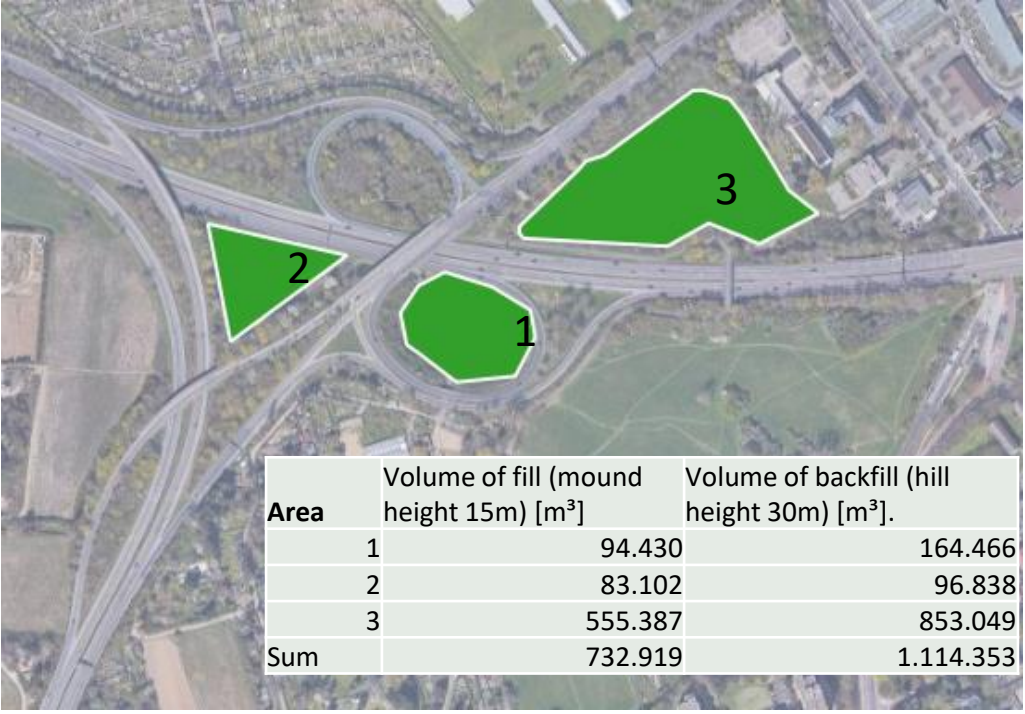
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In this way, long distances for the removal of excavated material are avoided, and high-quality biotopes are created by backfilling the material in Frankfurt's surrounding area - true to the environmental compatibility principle on which the Frankfurt Bridges are based.



The columns of the bridges have a base area of one square meter and go down 20 meters. With approximately 15,000 columns, this results in 300,000 m<sup>3</sup> of excavated earth.

The concept should be applied to all infrastructure projects because it is sustainable in two ways

Reducing transport distances leads to significant CO2 savings for such immense quantities of excavated earth. At the same time, valuable protected ecosystems are created close to the city.

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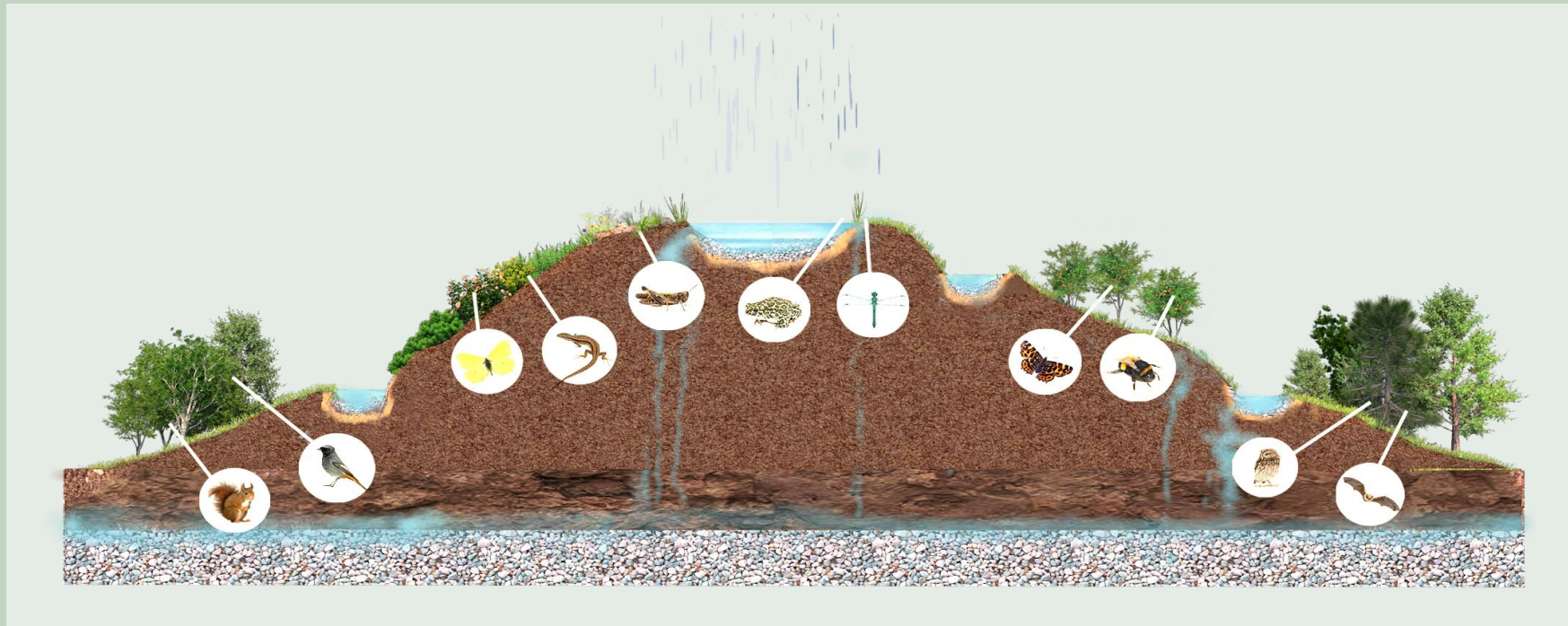
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The backfills create structurally rich habitats and nature is left to its own devices as far as possible

The mounds will be designed to provide a valuable habitat for birds, amphibians, grasshoppers, bats butterflies, beetles, all other insects, fungi and some mammals. A permanent still water body will be created on the top of the hill, fed by rainwater.

On the sides are smaller depressions and pools that fill up during rain events and controlled overflow of the stillwater. The water can thus seep away with a delay, erosion events are prevented and the groundwater is enriched. Appropriate monitoring documents the development of this measure and, if necessary, provides nature conservation instructions for action to ensure lasting success.

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With clay layers can be distributed on the hill, shallow sealed troughs collect rainwater

Excavation in Frankfurt usually also unearths larger quantities of the Frankfurt clay. This is well suited to creating particularly valuable wetland biotopes on the backfilled hills.



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## Species protection measures are also integrated directly at the bridge body during construction

In this respect, too, the Frankfurt Bridges should serve as a model for the infrastructure projects of the future: Structural promotion of biodiversity should accordingly be an important component of planning from the outset.



## The bridges are structurally designed for endangered species as a protective refuge

With various nesting boxes or built-in bricks on and in the body of the bridges along the entire route, countless roosts can be created for swifts, bats, various swallow and other Frankfurt bird species.

The green areas along the bridge also provide a species-appropriate food and nesting base.

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# Species diversity is promoted in a variety of ways on all green spaces at the bridges

Public green spaces on the bridges, as well as gardens of bridge residents, are designed from the outset to promote the biodiversity of Frankfurt's plant and animal life.





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1. Large, thorny shrubs
2. Built-in stones
3. Temporary water area
4. Densely overgrown areas
5. Sandy areas
6. Nest boxes
7. Structural roosts
8. Water trough
9. Water trough and feeding station
10. Woodpile
11. Dry stone wall
12. Pond

Even if it is not obvious to the layman at first glance, a large part of the one million square meters of green space on Frankfurt's bridges is designed to be ecologically valuable: Even in splendor beds, plants with unfilled instead of filled flowers are planted, structurally rich nutritive woody plants are preferred to solitary ornamental woody plants, and so on. But not only ecologically valuable plants but also species-promoting elements such as nesting boxes, woodpiles, water troughs, etc. are integrated into the bridges' green spaces.

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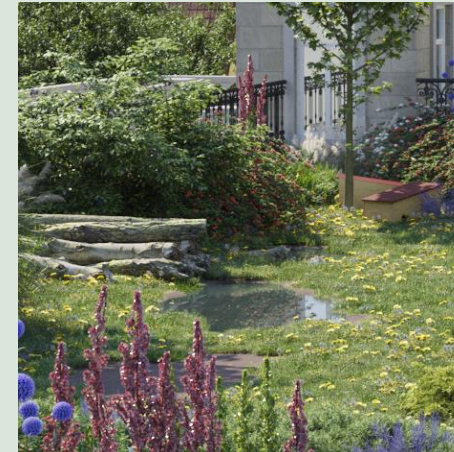
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Thorny shrubs as habitat for birds and food base for all fauna



Building blocks in the facade as a roost for bats



Temporary water puddle - source of drinking water for animals and habitat for insects and amphibians.



Densely vegetated areas as habitat for sensitive animal species



Sandy area for sand baths for birds or warm up for reptiles



Various types of nesting boxes to provide nesting sites for Frankfurt's birdlife.

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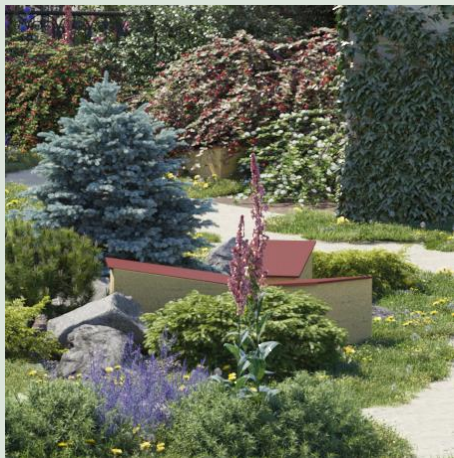
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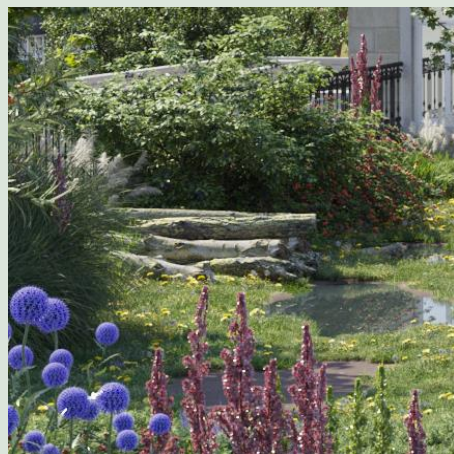
Structural roosts as a refuge, breeding and resting place for smaller mammals.



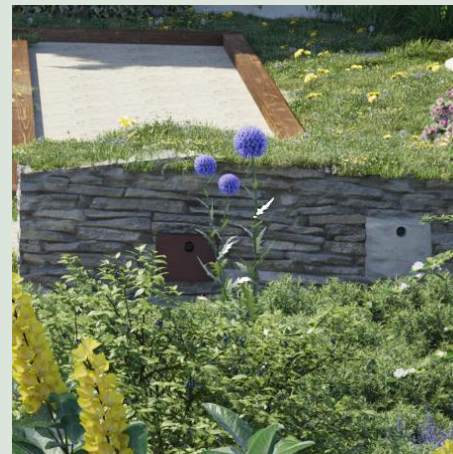
Water trough near the ground for birds, insects but also small mammals including open earth floor



Bird bath and feeding station, elevated as a safety measure against predators



Woodpiles as habitat for ground-dwelling insects and shelter for small mammals



Dry stone wall for heat-loving species such as reptiles - hibernation site for smaller creatures



Permanent water surface with rocky environment provides habitat and food source for diverse animals

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Thanks to the green bridge network, animals can now once again mate with conspecifics from which they were previously cut off by concrete and asphalt:  
Frankfurt's bridges thus also function as stepping stone biotopes



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Animals and plants  
can expand their  
habitats with the help  
of the bridges

The bridges serve as so-called "stepping stone biotopes", i.e. they connect green spaces in the city with each other: populations can thus use the new green corridors through the city to reproduce more with their conspecifics.

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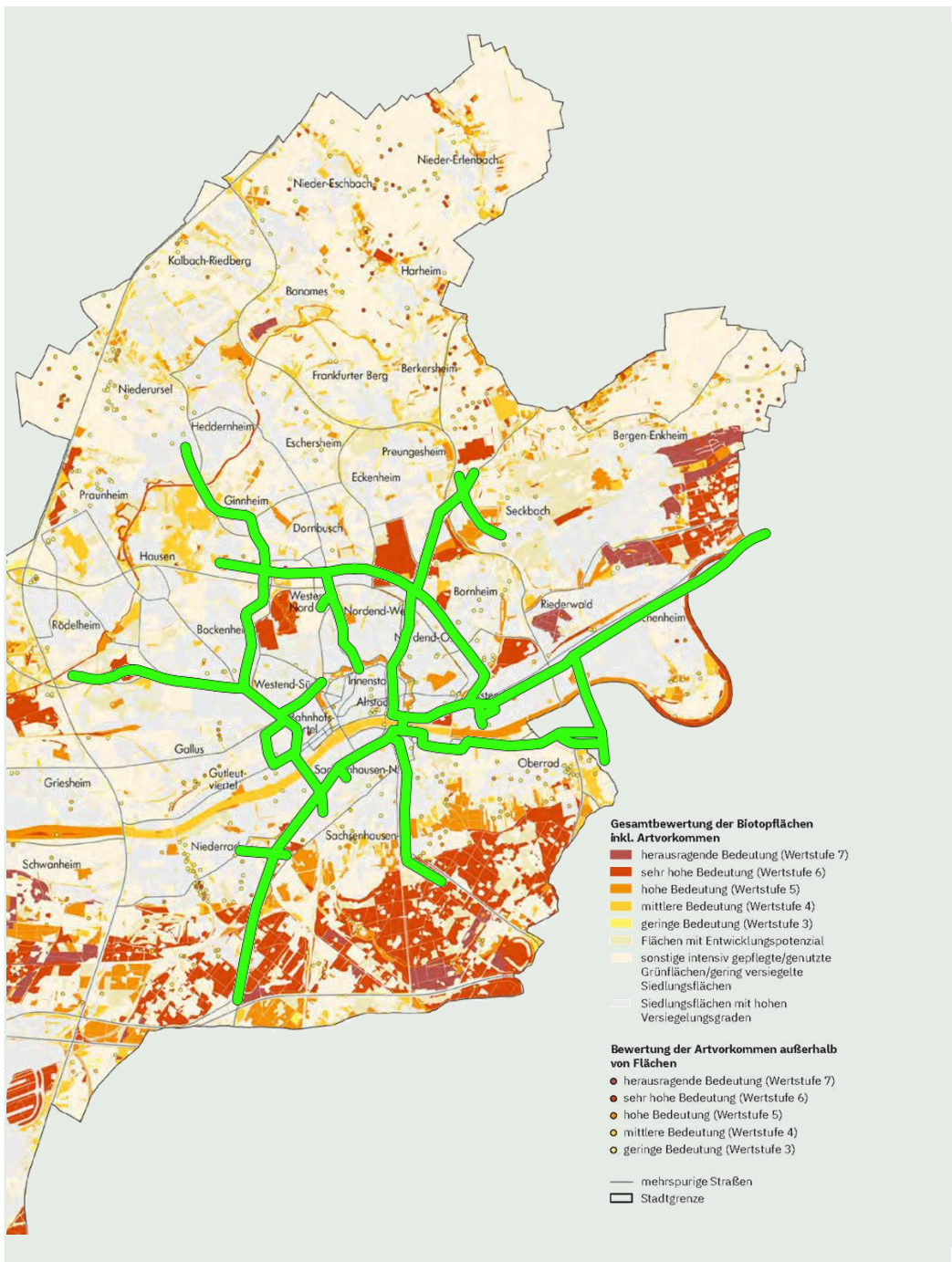
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## The bridges thus become an integral part of Frankfurt's species and biotope protection concept (ABSK)

The bridge can connect natural habitats classified as valuable in the ABSK.

It is examined in detail, through which target areas of the ABSK the bridge runs - Then the ABSK target concept is considered both on and in the immediate vicinity of the bridges and implemented with appropriate measures.

### Result of the overall evaluation

Value level	Meaning	Single surface	Total area (ha)	ha
7	Outstanding	1.109	677	
6	very high	1.826	1.771	
5	high	2.296	1.241	
4	medium	3.981	1.494	
3	low	1.911	269	
2		6.276	2.219	
1		11.524	7.987	
0		18.992	9.175	

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## Conclusion: Frankfurt bridges create an intact urban ecosystem

The Frankfurt bridges are a major structure that already integrates species protection measures (structure-compatible) during the planning phase.

This makes the Frankfurt bridges a model for future infrastructure projects, not only in Germany, but also worldwide.

In addition, protected areas are created where animals, insects and plants can develop and reproduce undisturbed by humans.

The diverse green spaces of the Frankfurt bridges create new habitats for plants and animals that also function as stepping stone biotopes.

In addition, this significantly supports the City of Frankfurt's species protection goal.

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Grün auf den Brücken



Pflanzenwelt entlang der Brücken



Entsiegelung der Innenstadt



Vitalisierung des Stadtgrüns



Die grüne Zukunftsmetropole



Das Ziel: Die Stadt gegen Trockenheit und Flut wappnen



Regenwasser „ernten“



Frankfurt: Stadtklima aktuell

## TEAM MEMBERS

Architecture	Geoinformation	Urban Climate - World Climate	Water	Law	<b>Critical Sparring Partners:</b> Professors Inspirers & Supporters
Image & Photos	Green & Nature	Statics	Packing	Finance	
Bridges	Communication	Transportation	Webpage & Design	Implementation	
Energy	Art & Culture	Technology & IT			





# Unsealing of the City Center

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## Unsealing the inner city - green life instead of gray asphalt

Around 40,000 m<sup>2</sup> of asphalt in the city center are to be unsealed and planted - with planting of a total of 1,000 new trees in the city. The unsealed areas can be co-watered by the Frankfurt Bridges' ring main. The cistern system of the bridges can be supplemented in more remote areas by local cisterns that can store rainwater on site from the building roofs around the unsealed area.

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## Content: Valuable green spaces can be created by unsealing areas within Frankfurt's urban area

Thanks to the ring main, these unsealed areas can be well irrigated. In addition to the water source "ring main", rainwater from the surrounding buildings can also be collected in cisterns for the unsealed areas.

Where water cannot be supplied to more remote unsealed areas during dry periods by direct connection to the Frankfurt Bridge irrigation system, tankers can tap water from the ring main and transport it to the green spaces.

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## The unsealing of cities should be further promoted

In the meantime, there are also hot summer days in Germany with maximum temperatures of over 40 degrees. It gets particularly hot and stuffy during such heat waves in cities like Frankfurt: The air comes to a standstill in the urban canyons and heated buildings, walls and streets can literally turn city centers into baking ovens.

The reason for this is the materials from which cities have been built since the post-war period: Asphalt, concrete and especially glass heat up much more than wood, clay or most natural stones.

On hot days, the difference between downtown Frankfurt and the surrounding area can be as much as ten degrees.

In addition, in recent years there is the other extreme: heavy rain and flooding.

Unsealing is the solution: Just as every square meter of asphalt and concrete heats up the city, every little green space cools it down. At the same time, every unsealed infiltration area absorbs floodwater from the streets.

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Inner cities as green hotspots - where there was gray before, lush greenery will provide fresh air and cooling in the future

The ring of bridges around the city center serves as a water supplier.



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This is what public staircases in cities usually look like today....

..and this is how they can look in the future with rainwater harvesting



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Downtown not just a gray open space....

..but also as a lively recreational area





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2021



The plan



## Flowers instead of asphalt

Everyone knows them: the squares and pedestrian areas concreted over in the sixties, seventies.

The Hauptwache in Frankfurt is just one example - large areas, almost without greenery.

Squares like the one in front of St. Catherine's Church can become green oases where everything except the walking areas is unsealed and greened - making them more attractive for people: a living space and not just a functional area.

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The permanent preservation of the unsealed areas is planned in cooperation with the bridge company

Unsealed green spaces need water and care - both can be synergetically supported by the Frankfurt Bridges:

The ring main of the bridges represents the basic structure of a watering network that can be used by the Parks Department for Frankfurt's urban green spaces.

It also makes sense to cooperate with the bridges' gardening crews in the maintenance of the new high-quality areas in order to realize synergies.

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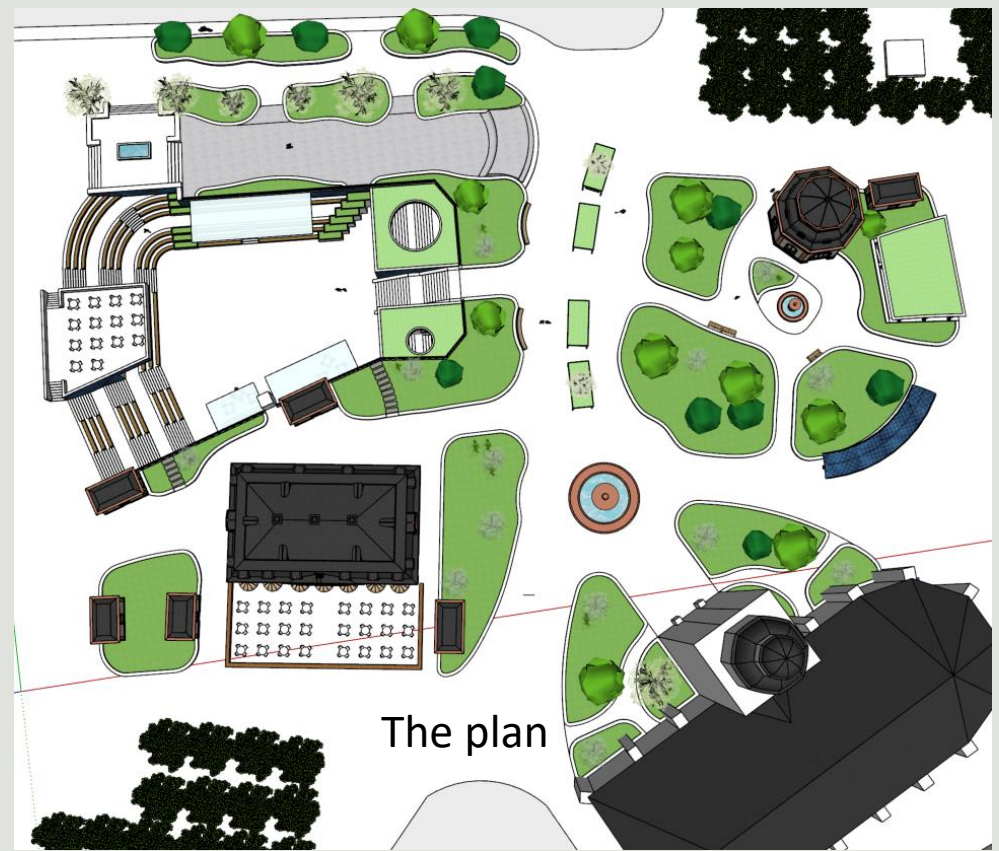
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For each area to be unsealed, it is necessary to check the subsoil and the light conditions.

Basic plan Hauptwache: Almost all beds are planted in tubs, as the B-level is located below.



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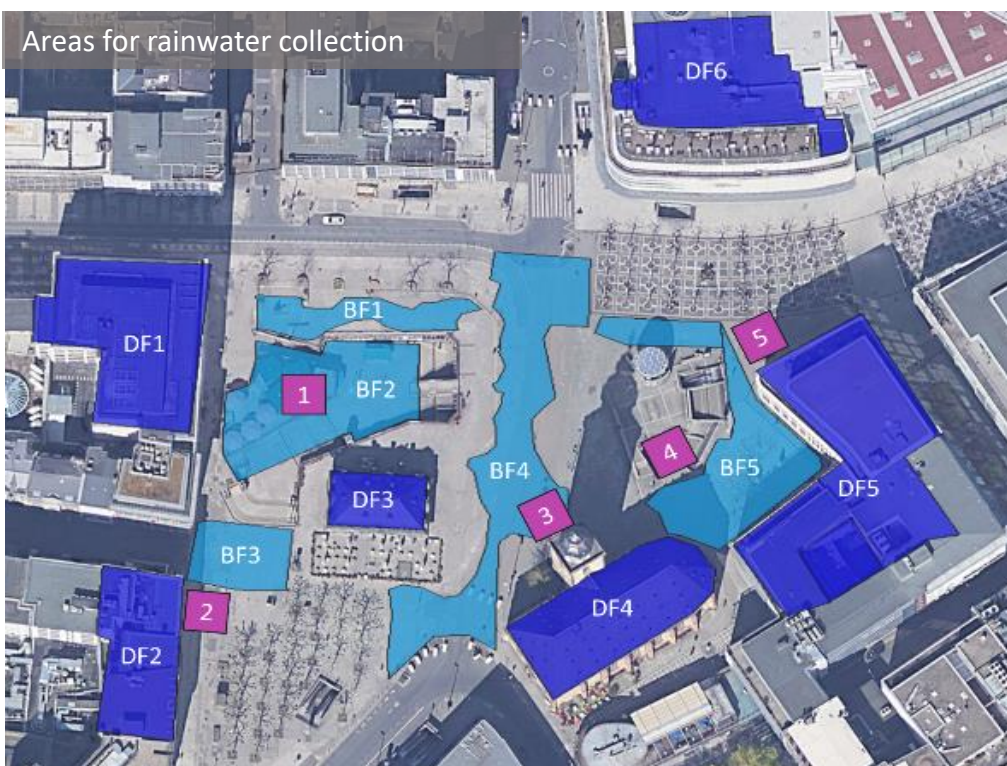
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## Exemplary irrigation of a large unsealed inner city area: In addition to the water source "ring main", rainwater from the surrounding buildings can also be used for unsealed areas

For 2000 m<sup>2</sup> of unsealed and planted new beds at the Hauptwache, for example, so much water is needed that, in addition to the tank runs from the ring main, cisterns should be sunk into the ground to collect and store rainwater from the surrounding roofs. It should be noted, however, that coordination with surrounding building owners for use of their roof runoff could be difficult, as most of them will probably have still one combined drain pipe for rainwater and wastewater close to or within their buildings using conventional piping structures.



Potential cistern locations



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## Why should only the prominent spots of a city actually be unsealed and greened?

With good planning and pragmatic irrigation solutions, entire neighborhoods can be unsealed and greened.

Not only prominent places should be greened: Wherever possible in the city, the soil should be unsealed and new green spaces created: on pedestrian islands, at roadsides, on squares and in pedestrian zones.

Even if this cannot be implemented from one day to the next, it should be conceived as infrastructure planning and implemented successively.

As part of the planning of the Frankfurt bridges, an unsealing plan for the city center has been drawn up as an example, because with the help of the bridges there is an extensive network of standpipes for the irrigation of the unsealed and greened areas: No matter where new greenery is to be created.

No drinking water should be used for watering at all, but a connection to a source of irrigation water or rainwater must be ensured, instead.

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In Frankfurt, a total of around 40,000 m<sup>2</sup> can be unsealed and greened - and there is also room for around 1,000 trees in the city center

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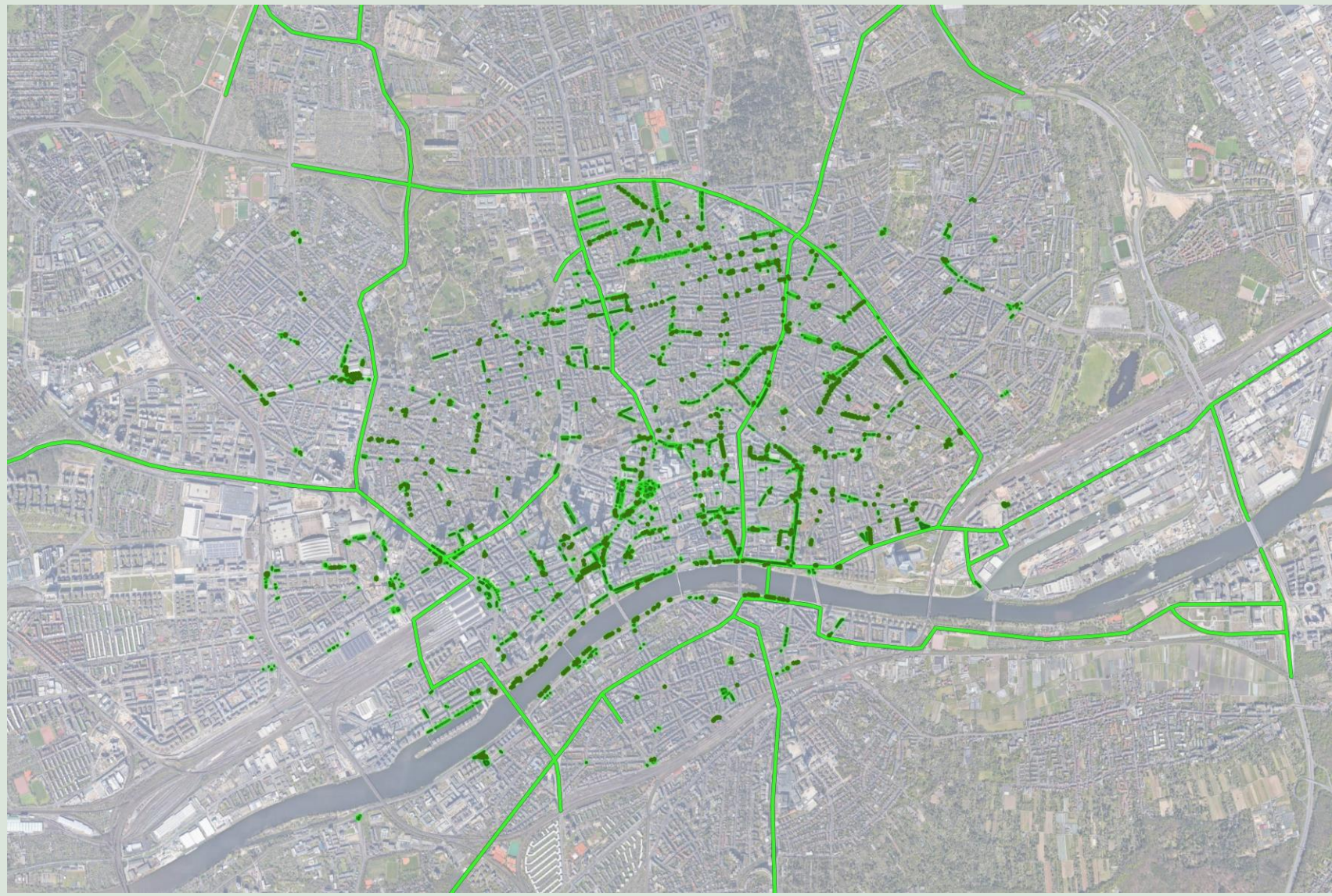
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## The unsealing program for the city center works with different modules

Not everywhere the ground can simply be torn up and trees and flowers placed: The unsealing plan therefore provides suitable modules for different locations.

**Trees:** Within the bridge ring 1000 trees can be planted, along the outer arms another 2000.

**Bucket:** Along the roads, in many places there are rows of posts facing the roadway, which are replaced by planters without a bottom: This way, the plants in them are protected and can root in the soil.

**Area:** Usually, smaller dead corners or even larger traffic islands are lending themselves to unsealing.

**Plat Arches:** In particularly narrow, but also particularly bleak places next to the roadway, where no wider tubs fit, slender planting arches can provide a more beautiful streetscape.

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When planting urban trees, tree species must be selected according to their location: Above B-levels or underground car parks, for example, only trees that are suitable for buckets can be planted



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Heavily trafficked streets with narrow sidewalks are also to be upgraded by planting arches - especially those with residential buildings.

Lighting on the planting arches ensures well-being in such streets even after dusk.

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## Green bus and tram stops enhance the cityscape

Green stops already exist in Frankfurt. This concept can be extended to hundreds of stops in Frankfurt with the help of the Frankfurt Bridges irrigation system. To ensure long-term greening, ground-based planting is recommended.



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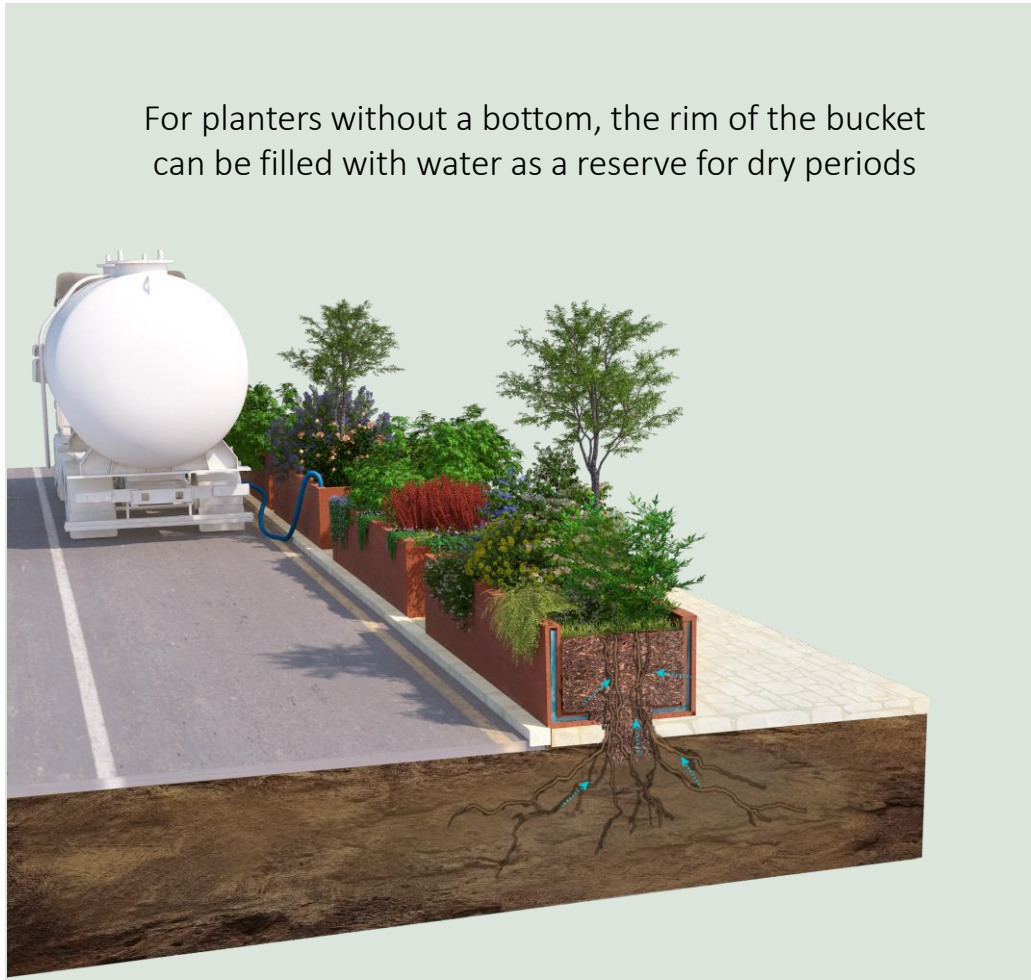
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However, the areas to be unsealed are not directly adjacent to the bridges with their ring mains. Their irrigation is therefore a challenge - The solution: clay planters with integrated water reservoir

For planters without a bottom, the rim of the bucket can be filled with water as a reserve for dry periods



These special tubs have no bottom - the tub substrate has direct connection to the soil. This allows the roots of the potted plants to spread in the soil and supply the plants with water.

The water storage system is integrated into the bucket wall: This is double-walled (outer wall glazed, inner wall without glaze), which means: hollow inside.

The water can be poured in through an opening at the edge. It is held there temporarily and only trickles down successively. Thus, unlike conventional tubs, the root spaces do not simply dry out, because they have access to the reserves in the soil - and quite a while through "wall storages" surrounding them.

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## The solution for smaller plants in the middle of the asphalt: the invisible water reservoir

There are also areas where tubs cannot be placed (e.g., because an important viewing angle for cars would be blocked), but where small (lower) plants would still be an asset. There you have to switch to planter boxes that can be sunk into the ground.

Also, since only low planting is possible in these places, you do not need as much water as when a bush or shrub is to grow in a planter for years and decades. So these planter boxes normally have a closed bottom, which facilitates water retention.

Such a planter box of, for example, a size of one meter by one meter contains 40 centimeters of substrate in the upper part, while in the lower part there is a retention space. This holds up to 600 liters of water, which can be filled via an inlet pipe. This allows small low plants to get by for several dry weeks.

Thus, plants on traffic islands can survive dry spells by using a potted water reservoir.



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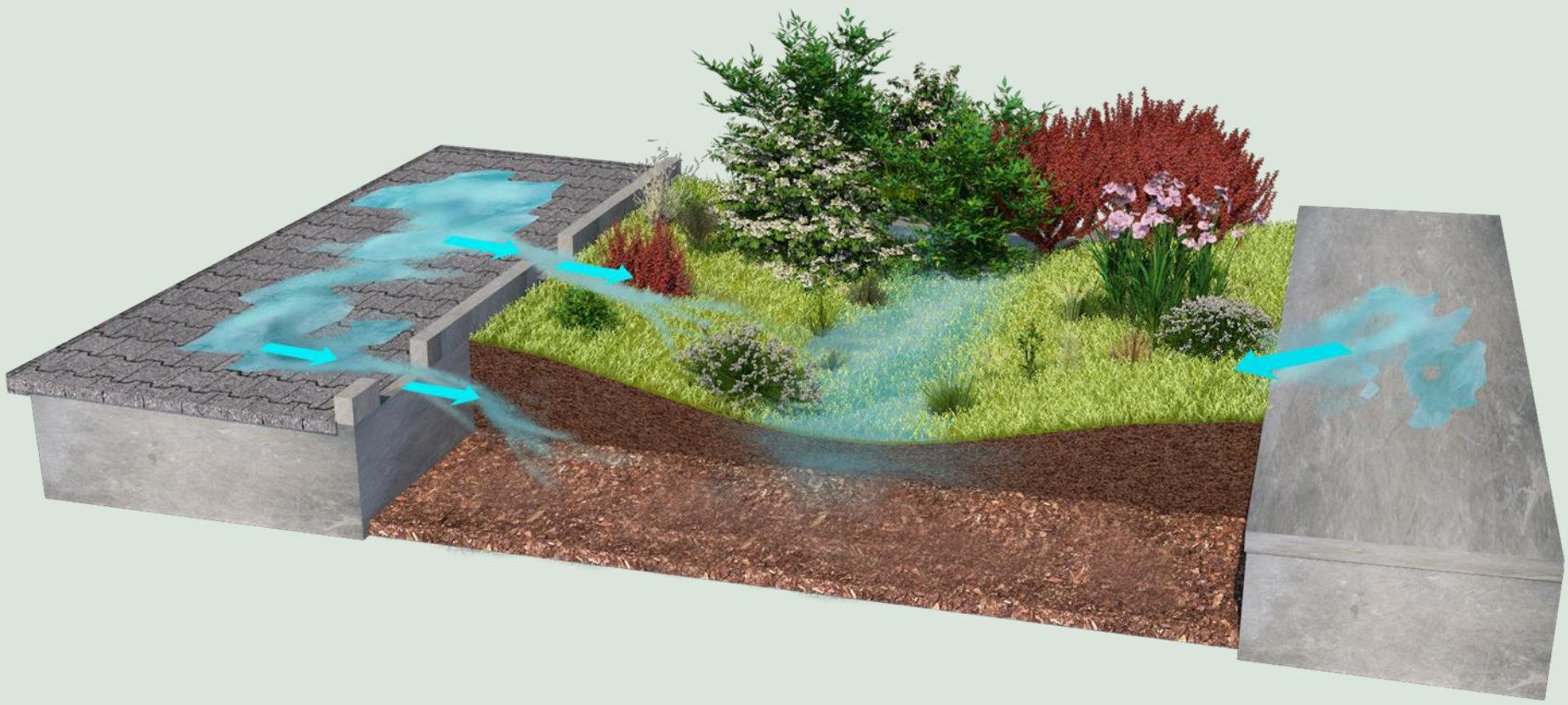
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In the course of unsealing, new beds will be created. There, infiltration from the surrounding road area is a suitable source of irrigation.

The bed is designed like a trough so that surrounding water can drain into the bed and seep away. The pollutants that are brought in from the sidewalk or the street should be decomposed and bound by an intact soil life, so that negative effects on the groundwater do not occur.



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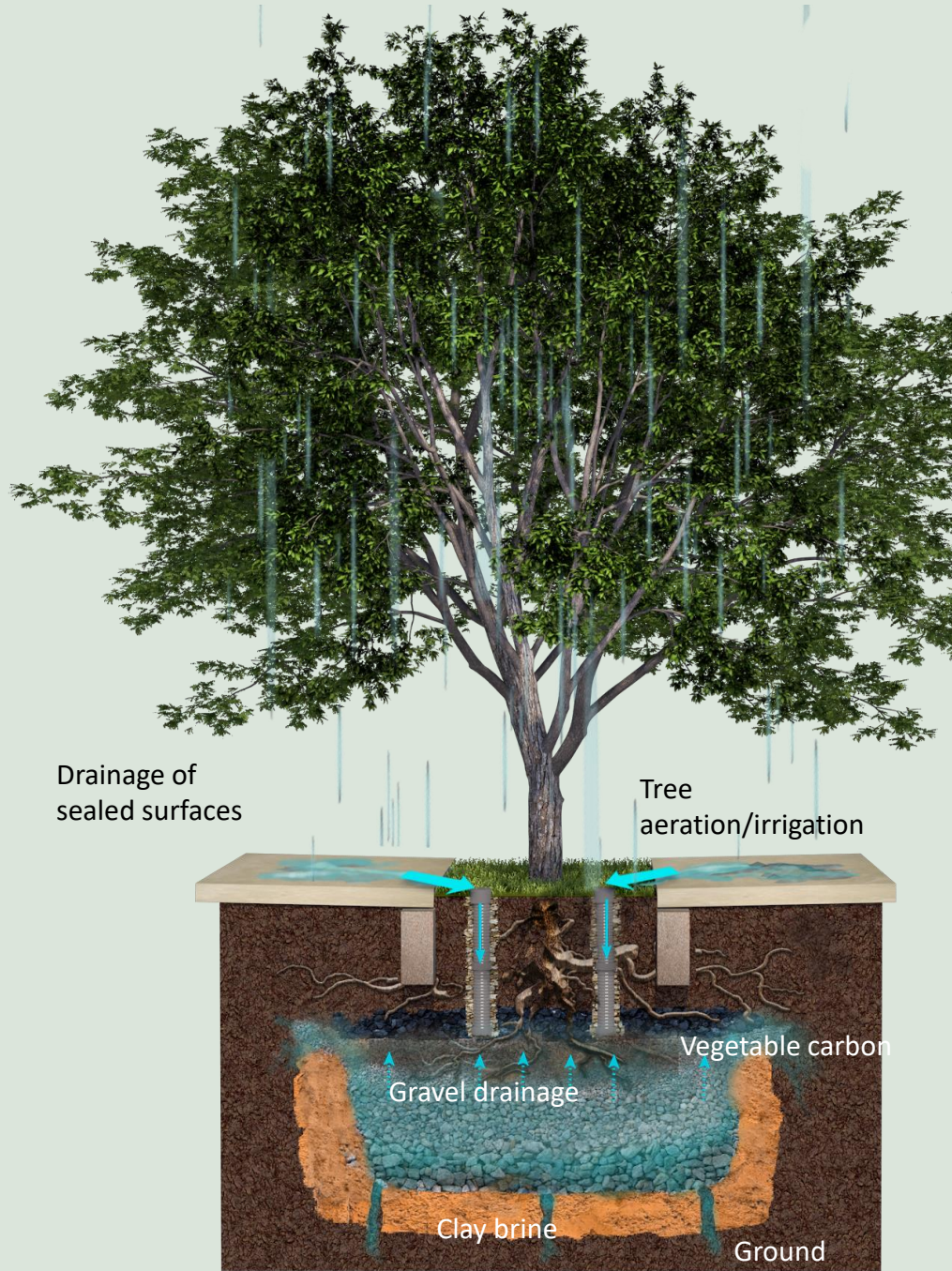
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If urban trees are newly planted, they can be equipped with "survival aids" from the very beginning - and wherever possible, be connected to the rain gutters of the adjacent roofs

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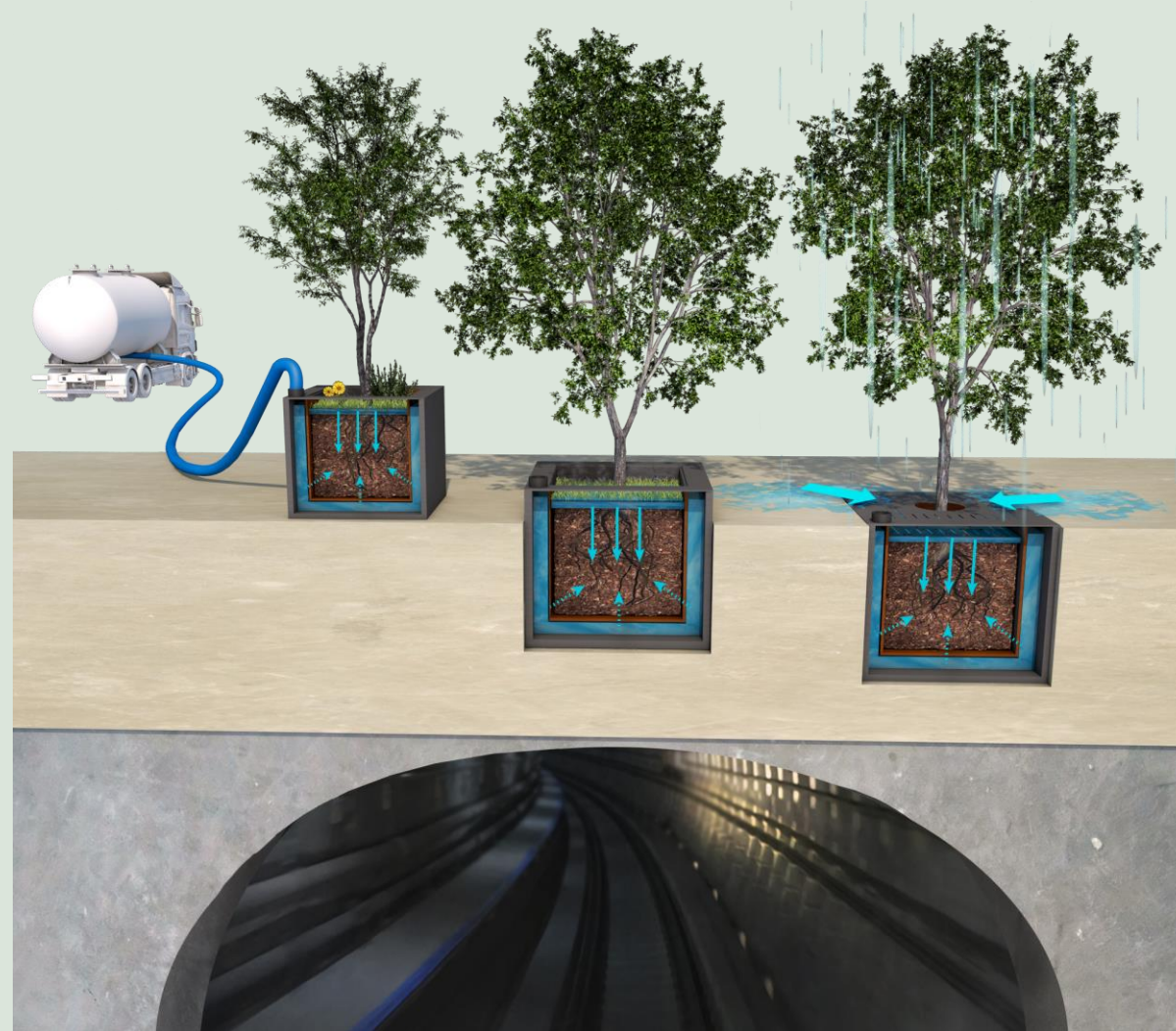
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## City trees over B levels or Subway tunnels

If you want to unseal and plant trees in areas where there is no soil below the surface, but only tunnels, you have to limit yourself to trees that can be planted in tubs - they need special water reservoirs, as there is no corresponding layer of humus as a reservoir.

Even if the bucket is designed as a reservoir - these trees need to be watered more often by tanker truck.



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## Conclusion: With the help of the Frankfurt Bridges, the water supply can be ensured for unsealed areas of the city center

Unsealed surfaces in the city have positive effects on the urban climate, biodiversity and the well-being of people.

Suitable planting and irrigation modules have been developed for a wide variety of verified areas such as pedestrian islands, narrow strips on sidewalks or former parking lots.

The unsealing plan for Frankfurt's city center is an integral part of the bridge planning. It also includes the planning of an irrigation system for the unsealed areas that, like the irrigation on the bridges, functions with little plastic and with the least possible loss of irrigation water through evaporation.



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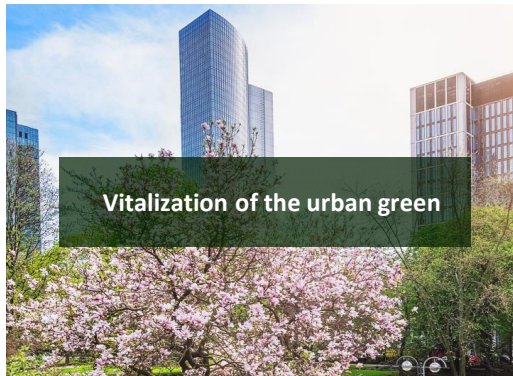
Green on the bridges



Plant life along the bridges



Nature conservation and biodiversity



Vitalization of the urban green



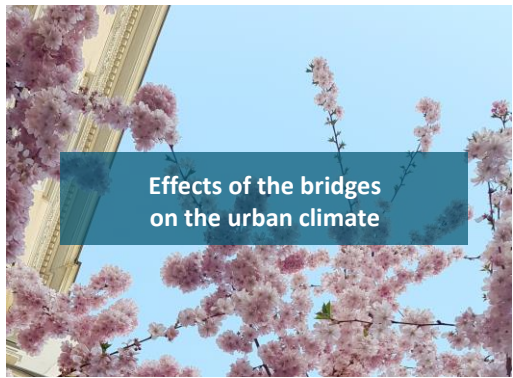
The green metropolis of the future



The goal: to arm the city against drought and floods



The water distribution with Bridge ring line



Effects of the bridges on the urban climate

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## Vitalization of the urban green

Not only on or along the bridges is the supply of the plants ensured, but also more distant parks and green strips in the city center are co-vitalized by the bridge. The bridges bring the water to the city districts for this purpose, and from there the fine distribution takes place partly via tankers, partly with the help of further pipelines in the ground, or also in parks via watering water geysers connected to the bridge system.

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## Content: Green areas and trees in the entire city area are watered as well

For inner-city trees, there is surge irrigation with a tanker or connection to rain gutters of neighboring buildings.

Beds are also connected to rain gutters and also equipped with a clay pipe system that can also be filled with the tanker truck like a reservoir.

In Frankfurt's city parks, on the other hand, water tower-like columns are installed to distribute water like geysers at night during dry periods.

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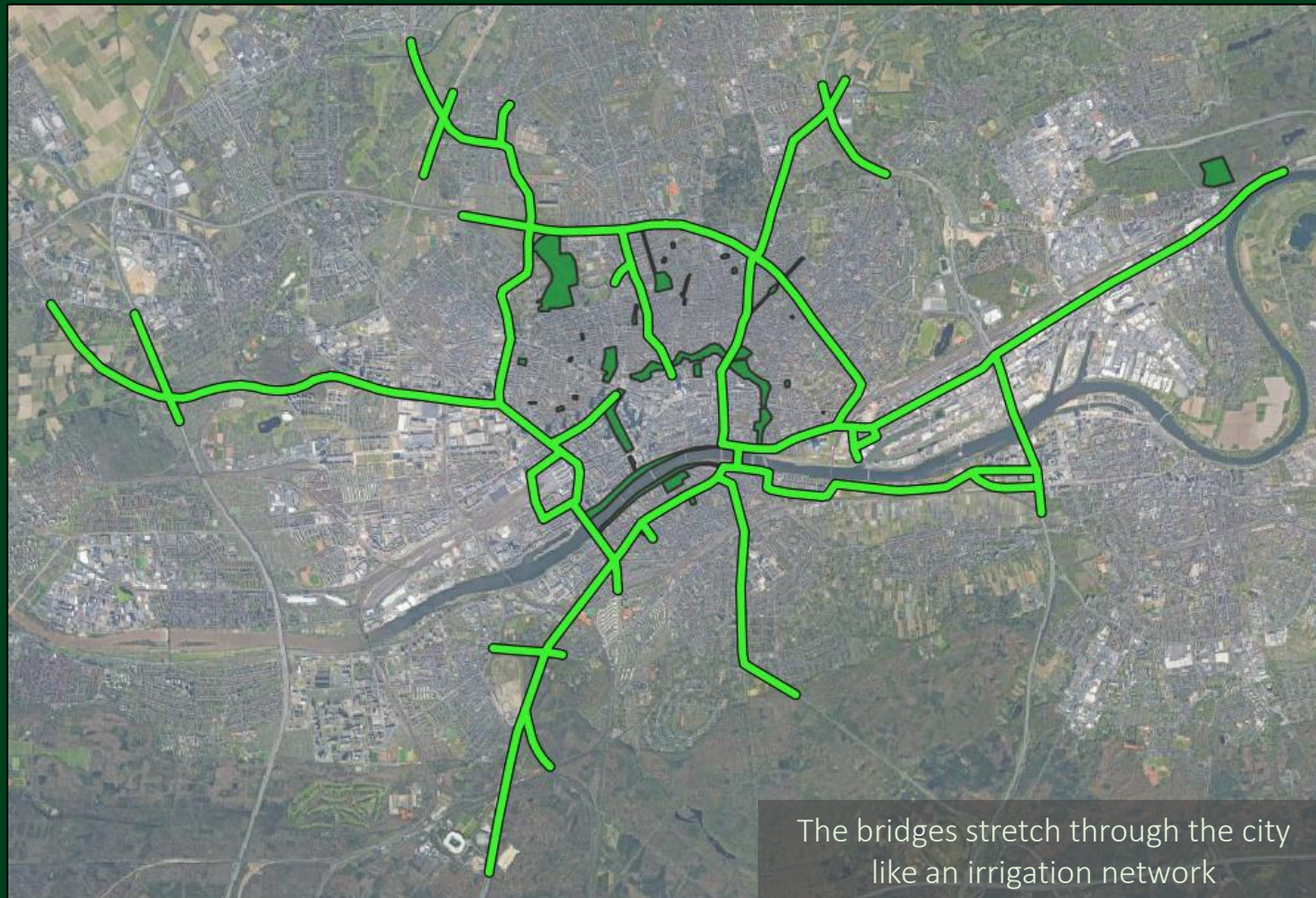
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# Water supply must be ensured for plants and trees throughout Frankfurt - not only for those on or along the bridges

Irrigation of plants is part of a concept that aims to turn Frankfurt into a "sponge city". Thus, in the city of the future, rainwater should not be discharged into the sewage system but, wherever possible, collected and deliberately kept in the city by irrigating urban greenery with it.



The bridges stretch through the city like an irrigation network

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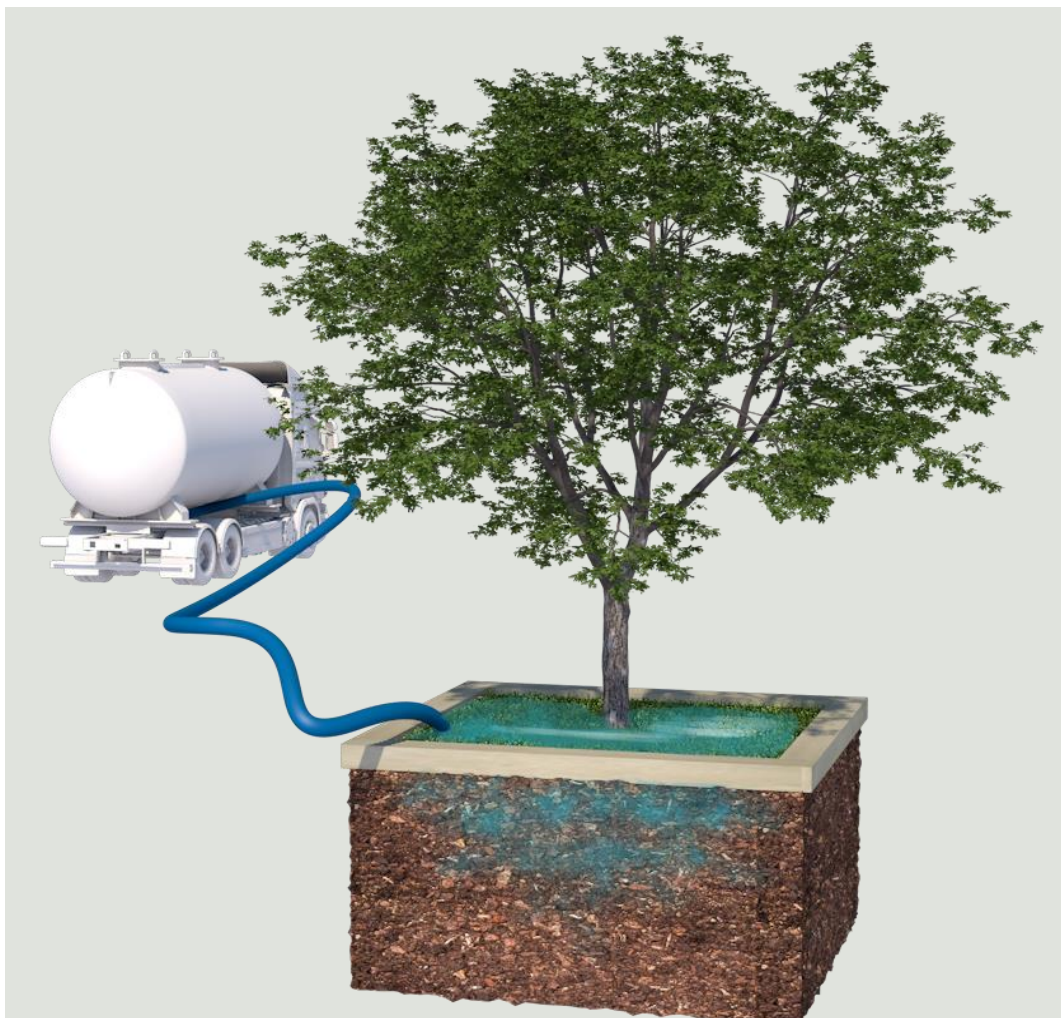
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A tanker truck manages about 20 trees with one filling. Refueling must therefore take place at the closest pumping station to the bridges



Existing trees on the road receive "tanker irrigation" two to three times a year

Since trees get most of their water needs from the soil and groundwater, watering them in March and July with 1000 liters of water in one burst is enough to get them through the summer. Most important: The trees need a kind of catch basin that can be filled quickly and then let the water slowly seep into the ground.

The catch basin should be 25cm high and only 10cm deep in the ground: This is because no concrete work should be done on existing trees. The border should be made of natural materials from the region - in Frankfurt, for example, Taunus quartzite would be suitable.

If it becomes apparent at the end of August that the fall will also be rather dry, the tree can be shock watered a third time at the end of September. Tankers can always fetch the water at the nearest tap of the bridge ring main. This eliminates the need for lengthy water transport trips.

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To reduce tanker truck trips, some trees with catch basin borders can also be supplied from the gutter branches of the nearest houses



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For trees with asphalt around it, tree underplanting is the best solution

Every tree in the city should have at least one to two square meters of planting around it: That adds up to another 10,000 m<sup>2</sup> of planted area in the city.

Underplanting protects against dirt and damage, retains moisture and promotes natural decomposition processes in the soil.

However, it should only be provided for trees that are already established on the site to avoid competition for water and nutrients.





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It is not only trees  
that are at risk during  
dry periods:  
Existing green  
spaces in the city  
without trees also  
suffer in low-rainfall  
months

While trees can be shock irrigated, green areas without trees but smaller plants, need water more regularly.

Earlier generations already knew a sustainable solution for this: Clay cones in the ground are filled with water and, as "mini reservoirs," continuously release this water to the plants.

To fill these reservoirs more efficiently than is done in private gardens with clay cones, a clay pipe system can be laid in the ground instead of individual cones. This system can either be connected to rain gutters or filled by tankers during extreme dry periods.

The water slowly seeps through the clay into the bed. Because the last filling of the pipes takes place in September, they can also be laid near the surface of the earth, because they lose enough water until the frost period, so they will not be damaged during the winter period.

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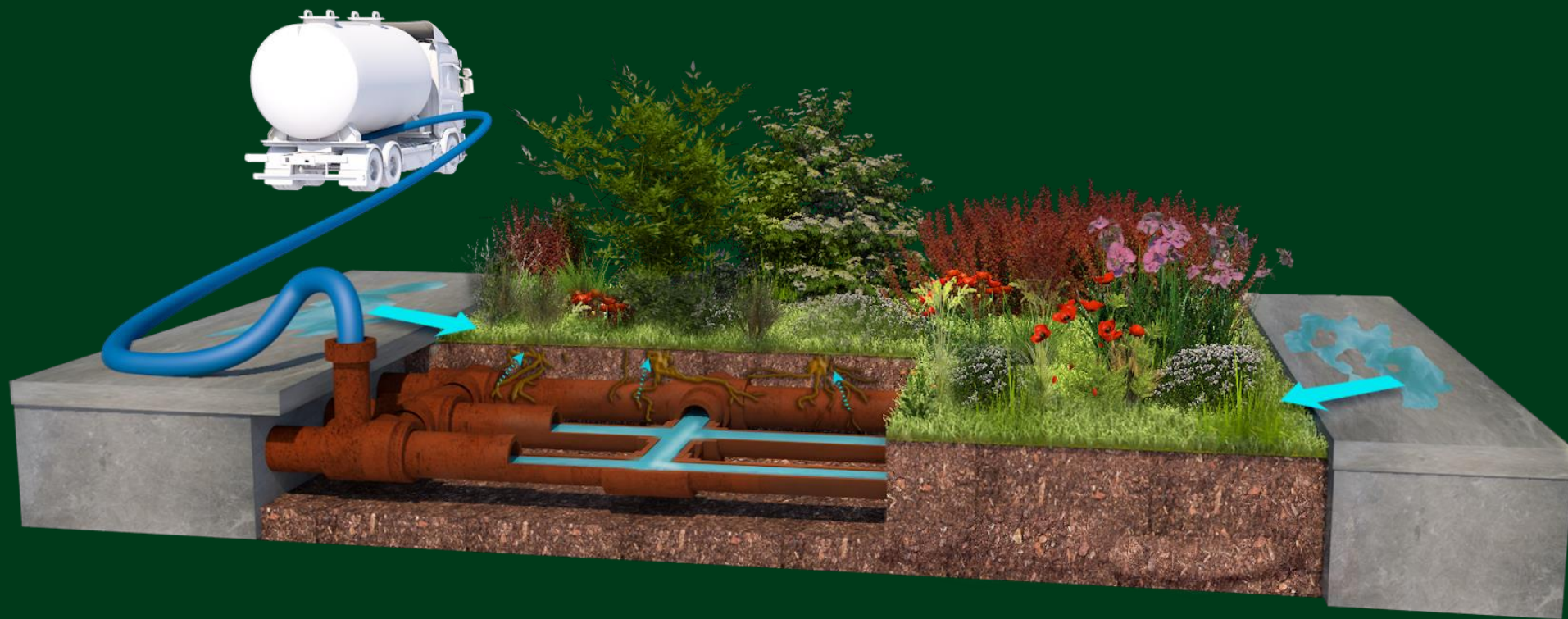
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## Water can slowly seep from the clay pipe reservoir into the surrounding dry beds

In the course of pipe laying, compacted and contaminated soil can be removed and replaced: This also contributes to the vitalization of the plants there and also offers - at least in "clean" streets - the possibility to favor the infiltration of street water into the beds by light trough shape.



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# Bridges can bring water to neighborhoods - but fine distribution to downtown parks is difficult, though – the solution: „night geysers“

The "night geysers" were developed for this purpose: They are built similarly to small water towers, about 2.20 m high and equipped with water nozzles. In dry phases they (controllably) eject water in high arcs in different directions, and for the park this is like a heavy rain event after midnight, only without thunderstorms.



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While it is costly to create artificial rainfall events during dry periods, it is essential to ensure the survival of urban trees.

Inner-city parks serve as a space for recreation and are invaluable for the urban climate. In dry years, however, the plants there suffer because irrigation is historically not provided for such large green spaces.



The columns are designed like small water towers, so that they visually enhance the park. These "water tower columns" must be placed in parks so that they reach as many trees as possible and at the same time do not get in the way of recreational activities such as soccer, etc.

The irrigation intentionally imitates night rain: although it is strictly speaking a "surge irrigation", it is de facto carried out over several days in smaller quantities. The soil can thus absorb the water better, no waterlogging collects under the trees, the surrounding smaller plants also get some, and even the animals in the park can quench their thirst in the morning after the "rainy nights".

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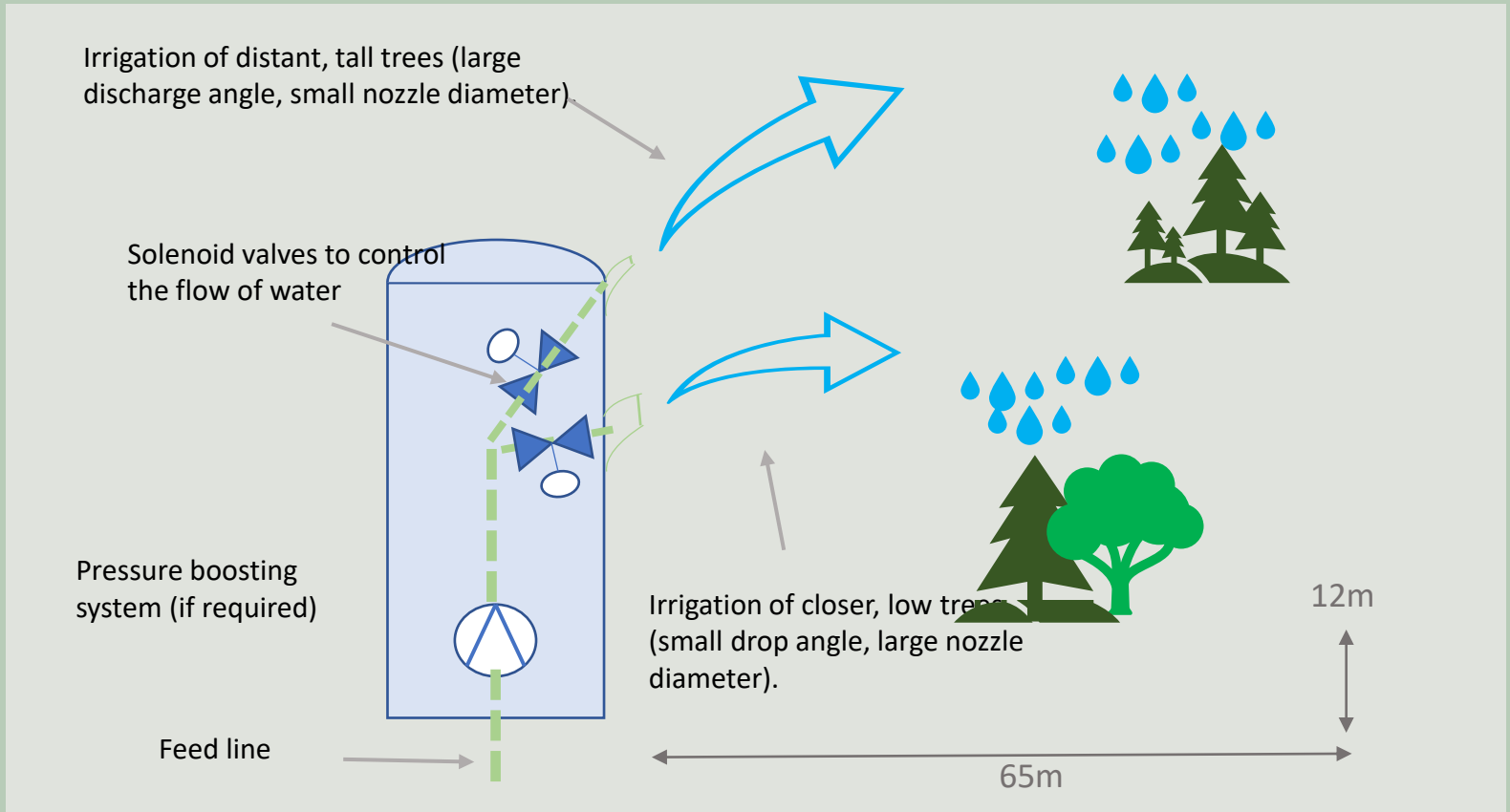
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# The operation of the "city geysers"

The water geysers have many nozzles, through which with high pressure large amounts of water can be applied, preferably at night. The range as well as the amount of water is variably adjustable. The duration of the rain should be as long as possible, so that the soil can soften and the water can reach the roots successively. With moderate amounts of water being distributed over longer time periods, animals are also protected from drowning. The aim is to wet the soil over a large area so that trees can also develop deep root growth.



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Conclusion: The vitalization of the entire urban greenery in Frankfurt can be achieved with the help of the water system of the bridges

The vitalization of the city's greenery works similar to the irrigation of the newly unsealed areas in Frankfurt: Through direct connection to the irrigation system of the Frankfurt's Bridges or through their numerous water taps for tankers, large areas in Frankfurt can be irrigated with collected rainwater.

In addition, there are special concepts such as shock irrigation of street trees at certain times of the year or night rain showers in parks.

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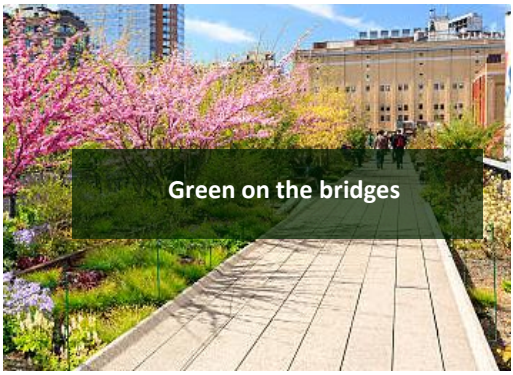
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Green on the bridges



Plant life along the bridges



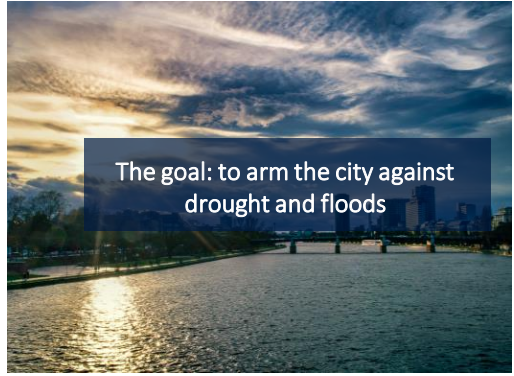
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Unsealing of the city center



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The goal: to arm the city against drought and floods



The water distribution with Bridge ring line



Frankfurt: Current urban climate

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## The green metropolis of the future - greening in other dimensions

The city can be densely populated, culturally exciting, and technologically advanced, while still offering a pleasant urban climate and beautiful nature - and teaching people about the value of food and ecologically sustainable cultivation with urban gardening spaces on the Frankfurt Bridges.

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## Content: For the green metropolis of the future, there are a number of innovative greening concepts in addition to the creation of classic beds

In the city of the future, as many surfaces as possible will be greened: For example, vertical greening on building facades will have a positive influence on well-being and the urban climate. But even untraveled median road stripes of autonomous traffic will be greened with low vegetation in the future. These green spaces do not heat up as much as sealed areas, they absorb rainwater and represent a valuable area for biodiversity.

By implementing urban gardening spaces, the city of the future can also help raise awareness about food production and bring people together from diverse populations.

Similar to the green spaces on the bridges, all green spaces in the green metropolis of the future are equipped with humidity-, temperature- and nutrient-sensors so that centrally controlled space management can be carried out for each individual area.

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Near the Main River the city is very green

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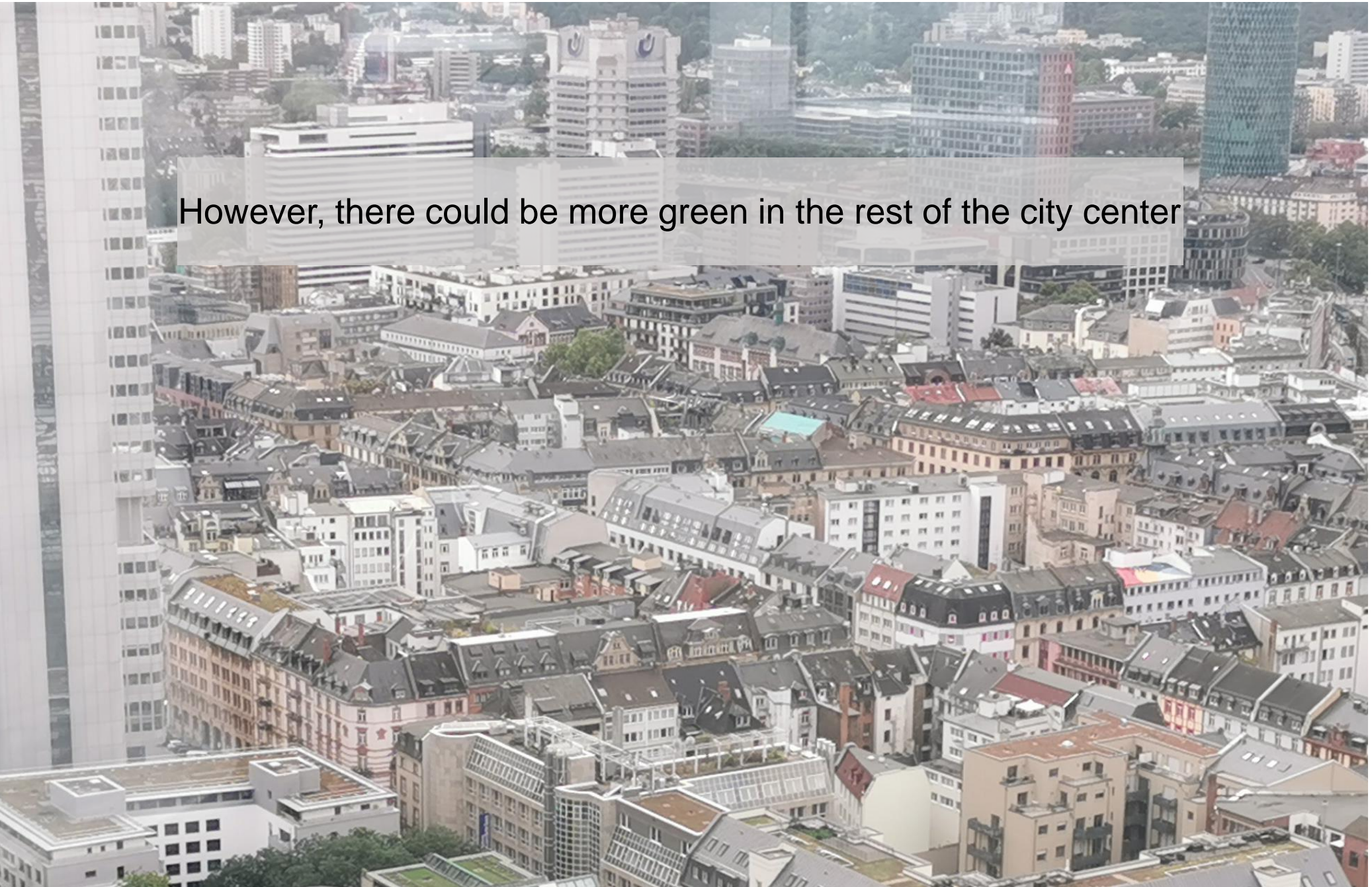
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However, there could be more green in the rest of the city center

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The vision: in a few decades, gray car lanes in street canyons will become green aisles in urban development



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To achieve this, there are a variety of concepts for greening the city - many of which are already being applied

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With the help of the  
Frankfurt Bridges  
water distribution  
system, almost any  
spot in the city can  
be greened

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Where there are bare house walls and roofs today, there is refreshing green in the city of the future



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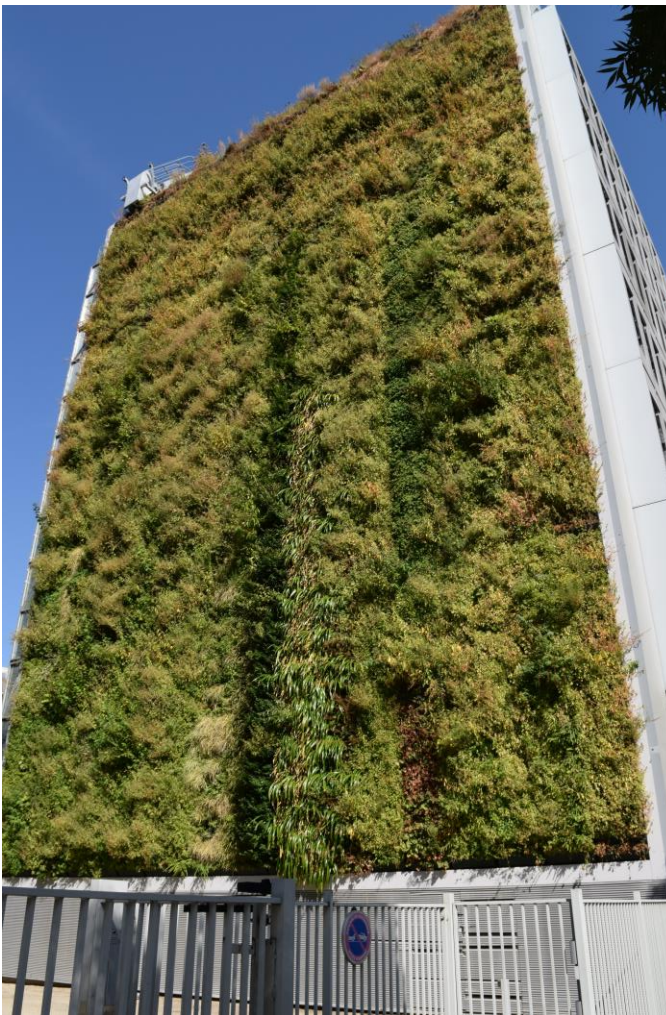
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Wall systems for vertical greening - also called "architect's consolation" are used today, already, and more of it will be seen in the future



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## Facade greenery - even in winter

In the case of facade greening, it is advisable to plant an evergreen as the first climbing plant, and to take a light deciduous climbing plant as a supplement so that the facade does not look so bare in winter with only brown undergrowth being visible.

The solution: In a way, you can also create aspect calendars for facades.

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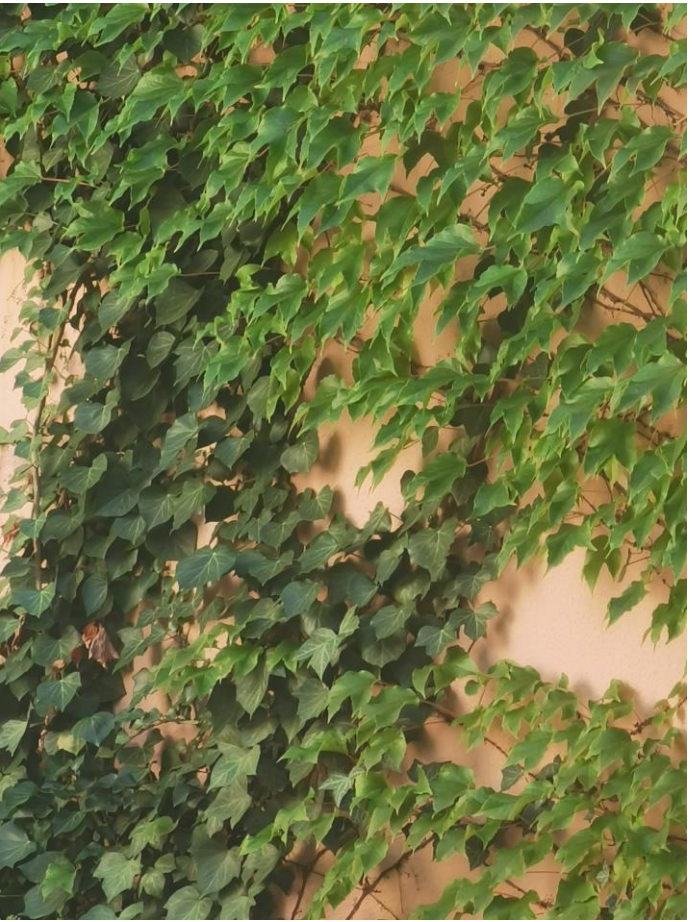
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## Example of evergreen climber under deciduous climber – a sort of aspect calendar for wall greenery

Even if ivy is rather not recommended for most facades: It shows here in a beautiful example, how the ivy still creates a green impression in winter, when the wild vine has long been turned into fine dry branches on the wall of the house.



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And as soon as there is more space due to autonomously driving traffic, every city can become a green metropolis - provided it has the irrigation water: In Frankfurt, it will be possible without any problems with the help of the Frankfurt Bridges

If all vehicles drive autonomously and are centrally controlled, then they will drive up "on demand" as if with a chauffeur, and no longer have to be kept in parking lots.

If treated wastewater or rainwater can be stored close to the city and distributed through an irrigation water network during dry periods, an abundance of urban greenery can replace or cover gray concrete and asphalt surfaces.

Then large metropolitan areas can become green living spaces without creating „monstrous“ large green cities of the future.

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On the one hand, the planting in the parking lots serves as a visually appealing demarcation from autonomous driving traffic; on the other hand, it serves as a linear biotope structure on previously parked street sections.

Only at the exit and entry points gaps must be left in the planting.



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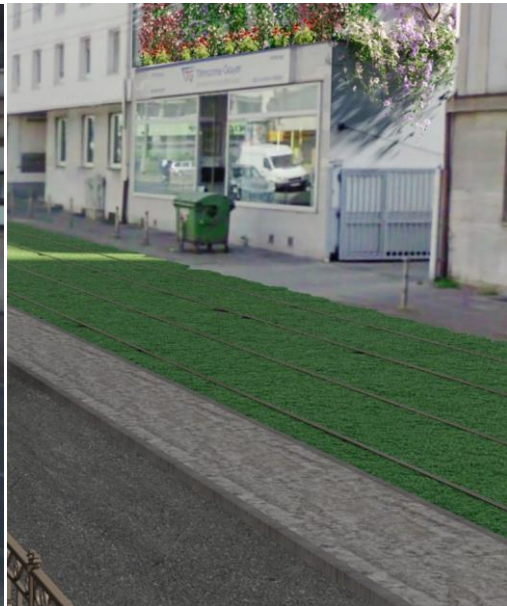
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Green traffic routes such as those on Frankfurt Bridges or streetcar tracks will also be possible on car roads in the future thanks to autonomous driving

Unsealed traffic routes are already known from greened railway lines. Roadways can also be greened in a similar way: Because all vehicles are controlled centrally, all positions, speeds and next maneuvers of all vehicles are always known in advance.

All driving movements are coordinated, and the system drives with such foresight that overtaking maneuvers become superfluous. As a result, the median strip of a roadway generally remains unused and can be landscaped, because the space between the wheels remains largely unaffected.



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## Another important aspect in the city of the future: Urban Gardening

Urban gardening, which has become fashionable, will never be able to make an actual contribution to feeding the urban population. But learning about how food is grown, how slowly it grows, and how costly it is to care for it in an ecologically sustainable way raises people's awareness of not being as wasteful with food as they currently still are: more than 10% of our food is thrown away, a third of which is fruits and vegetables.



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For city children in particular, learning about the origins of food and helping to grow it is educational, positively formative - and fun, too!

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Urban Gardening in Frankfurt is marked by a lack of space - homemade boxes can be found in places that the city has often not designated for it.

Urban Gardening is becoming "Guerilla Gardening" in many places in Frankfurt.





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Even in front of office buildings, the supporters of urban gardening spread out



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## On the Frankfurt Bridges, the popular hobby gets additional space

On the Frankfurt Bridges, most neighborhoods have areas for urban gardening.

Nestled between walking paths and residential buildings, they are equipped with the same subsurface irrigation system as the flower beds on the Frankfurt Bridges.

Tool sheds, small fountains or even benches make it possible for school classes to stay and work there.

A special feature of the bridges is also the possibility to keep the planting ground frost-free by geothermal heat. and to keep isolated small greenhouses in winter also by solar heat at a temperature level that allows the cultivation of vegetables and fruits that otherwise would not grow in our latitudes without risk of frost.

Urban gardening on Frankfurt's bridges can produce a world of plants and fruits that is otherwise only known from "Little Nice" on the Main.

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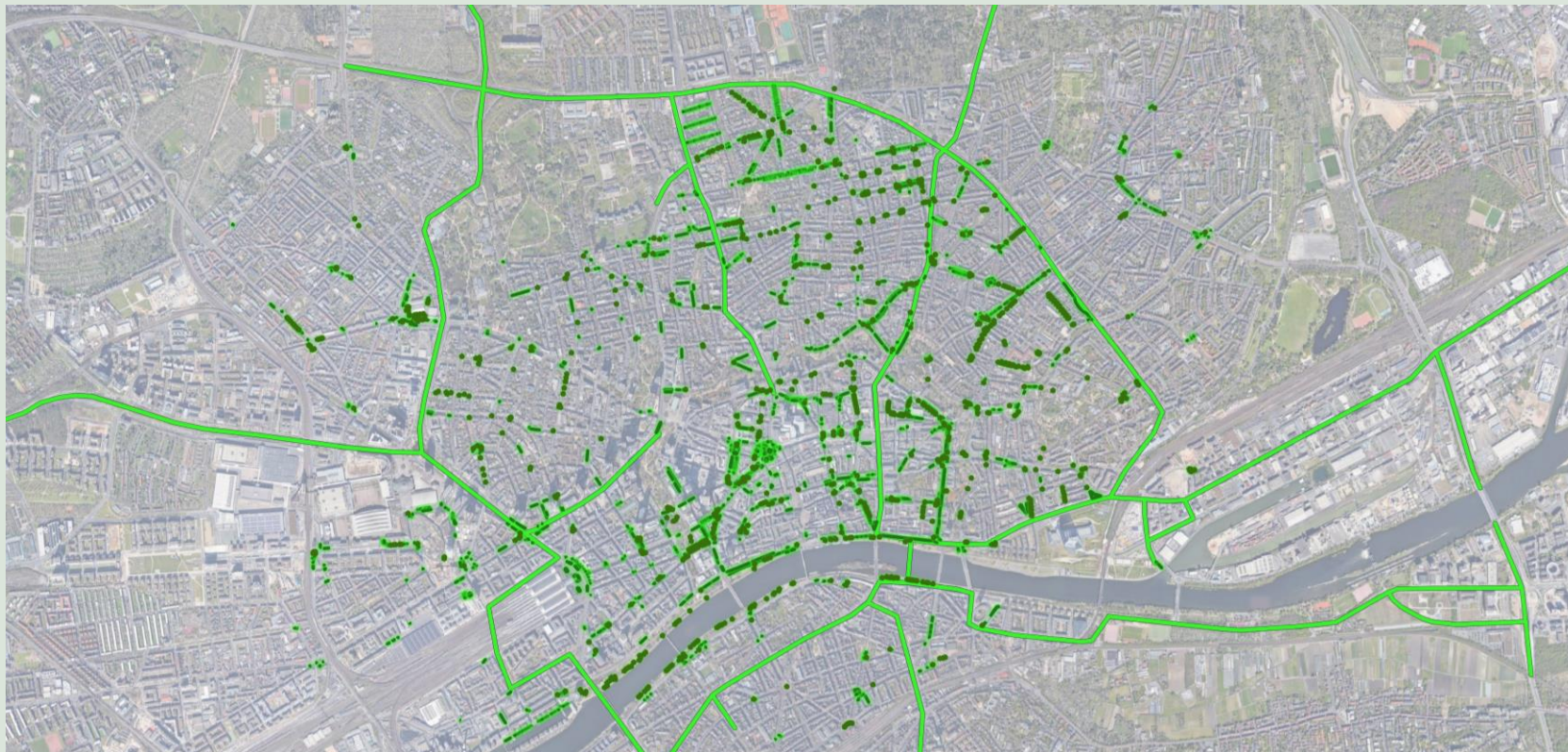
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# The massive greening of the city of the future will only work with digital tree and green space management

When creating new beds, during vitalization measures or when planting new trees, appropriate sensors can be inserted into the substrate. For example, the soil moisture, oxygen and nutrient content, but also the pollutant load can be checked around the clock by a central digital green space management system and, if necessary, appropriate measures can be taken. This primarily involves the networking of biological and technological knowledge. An algorithm can be continuously adapted and improved using the data obtained. New insights into the changing urban climate and plant development can be incorporated and contribute to the effective management of urban green spaces.



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## So much greenery: aren't we bringing a lot of varmints and pests into the city?

The implementation of the Frankfurt Bridges is accompanied by a significant increase in green spaces - and thus of flora and fauna - in the middle of the city. And as much as people usually like to have nature around them, it still has to be questioned critically on a permanent basis: What are the consequences of implementing the "Green Metropolis of the Future"?

Lush planting can also have unexpected, undesirable effects:

- More butterflies would be wonderful, but their caterpillars can become real pests.
- More field hamsters and dormice - that sounds cute and sweet at first, but they serve as food for foxes or even wolves. Do we want more of them in our cities?
- At present, pests are often cut off by asphalt and concrete from further green spaces where they could infest plants. If, on the other hand, you have continuous greenery, many pests can also spread more easily in the city.

Conclusion: Creating habitats in the city must be well planned. Observation and test series should be carried out in close cooperation with universities and the Frankfurt Green Spaces Office already during the initial planting, but also for all subsequent replacement plantings on the Frankfurt Bridges, in order to assess the effects both for the bridge greenery and for the urban greenery and, if necessary, to be able to take countermeasures in good time.

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**Conclusion: The bridges depict the city of the future with their massive greenery**

All greening concepts that are applicable in a city are realized on the Frankfurt bridges.

They also bring urban gardening areas into the city center, promoting people's experience of growing fruit and vegetable plants in the city. In this way, they support a positive attitude of the population towards sustainable concepts.

In the green city of the future, consideration for flora and fauna in human-dominated habitats is part of everyday life.

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**Green on the bridges**



**Plant life along the bridges**



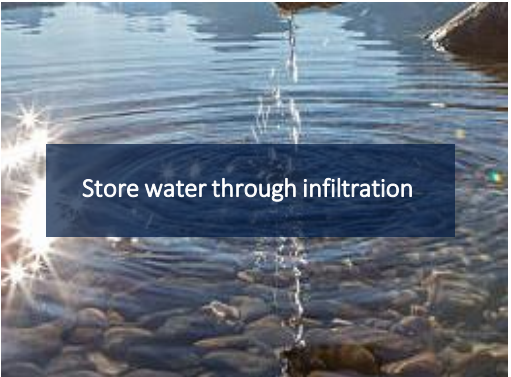
**Nature conservation and biodiversity**



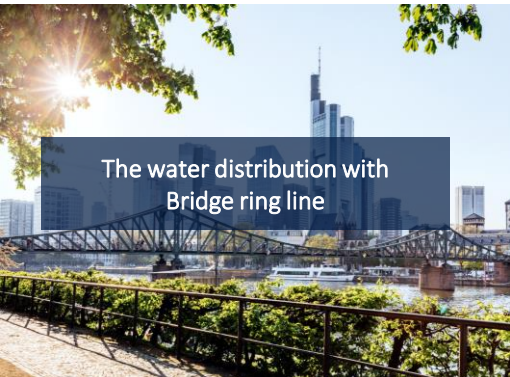
**Unsealing of the city center**



**Vitalization of the urban green**



**Store water through infiltration**



**The water distribution with  
Bridge ring line**



**Frankfurt: Current urban climate**

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