IFLA ASIA-PAC LA Awards 2024
Award Category – Flood and Water Management

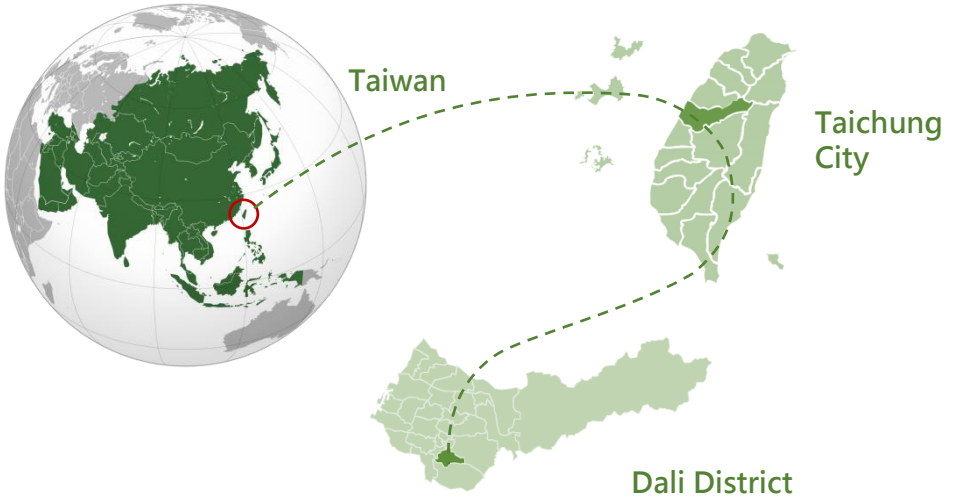
PROJECT BINDER

Walking along the Drainage of Hanxi River

The Drainage of Hanxi River (detention basin) Engineering Projects
and Sand & Gravel for Sale

Project Location

Project Name	**Walking along the Drainage of Hanxi River** The Drainage of Hanxi River (detention basin) Engineering Projects and Sand & Gravel for Sale
Project Location	From the downstream of Wan'an Bridge on Hanxi to the confluence with Green River
City & Country	Shuwang Village, Dali District, Taichung City
Area	Approximately 5.0 HA
Year of Completion	October , 2023
Award category	Flood and Water Management



Project Statement

The Hanxi River, located in central Taiwan, incorporates numerous drainage tributaries along its course, causing frequent flooding in the downstream areas. In the residents' memory, it was merely a stream overgrown with weeds, making it unapproachable. After redirecting part of the river in 1989, the Hanxi River was renamed to "the Drainage of Hanxi River," and urban flood control planning commenced according to the management plan.

By expropriating some dry fields to serve as flood detention spaces, the initiative aimed to reduce peak flood flows and decrease disaster risks.

The creation of urban flood detention spaces aimed to share runoff and enhance disaster prevention safety. Through the design of aquatic environments, it provides habitats for wildlife and optimizes the ecological environment. Preserving the memorable old camphor trees and other local features, it offers citizens a space for cultural life and multifunctional leisure, achieving the goal of sustainable resilience.

Honors

- **2023 Ministry of Economic Affairs Quality Award**
- **The 11th Taiwan Landscape Award - Environmental Facilities Category - Quality Award**

Project Background

The Hanxi River Drainage Management Plan has been implemented since 2019 in stages, optimizing the stream's drainage system functions to enhance the flood prevention capacity of the drainage.
Since 2019, the concept of "**Waterfront Stitching**" has been applied to the management ; in 2020, the concept of "**Ecological Network**" ; Starting from 2021, the goal has been to create a "**Water Environment**".
Among these, the detention basin is located at the central point of the drainage, serving as a crucial hub in the management efforts.

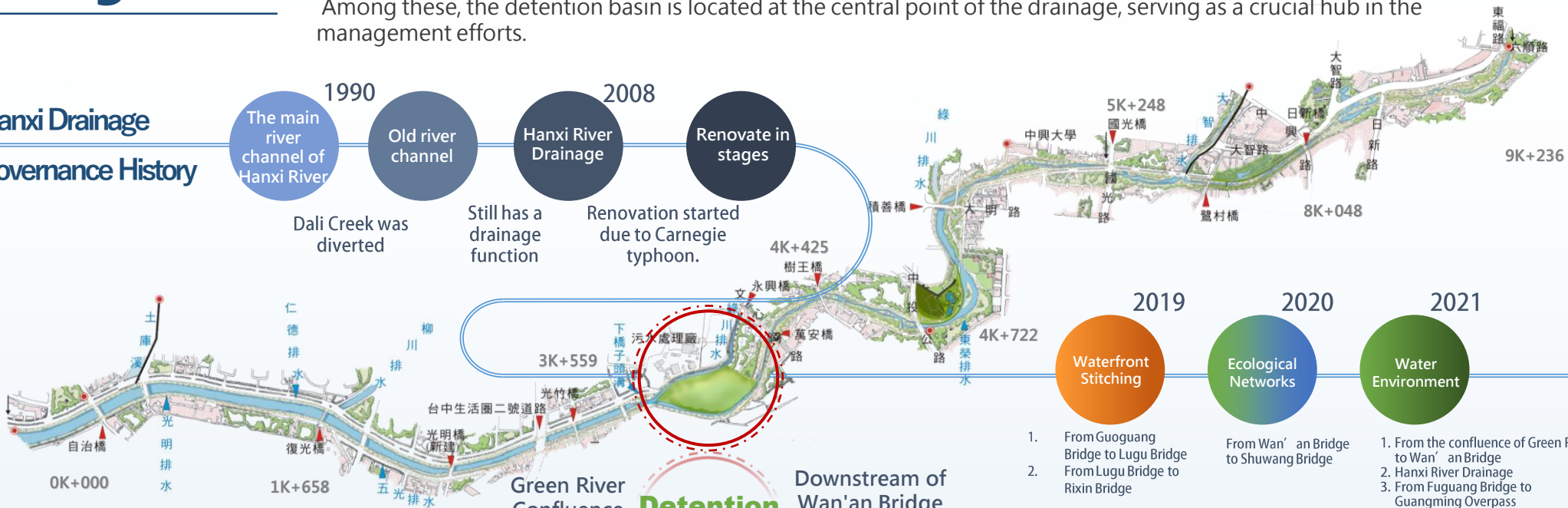
Hanxi Drainage Governance History

1990 — The main river channel of Hanxi River

Old river channel — Dali Creek was diverted

2008 — Hanxi River Drainage — Still has a drainage function

Renovate in stages — Renovation started due to Carnegie typhoon.



Green River Confluence — **Detention Pond** — Downstream of Wan'an Bridge

2019 Waterfront Stitching

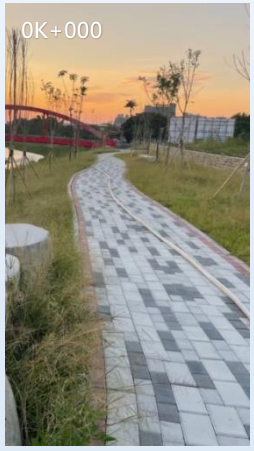
1. From Guoguang Bridge to Lugu Bridge
2. From Lugu Bridge to Rixin Bridge

2020 Ecological Networks

From Wan'an Bridge to Shuwang Bridge

2021 Water Environment

1. From the confluence of Green River to Wan'an Bridge
2. Hanxi River Drainage
3. From Fuguang Bridge to Guangming Overpass
4. From Guangming Overpass to the confluence of Green River



FU GUANG~ GUANG MING

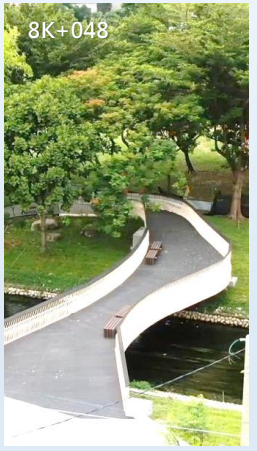
GUANG MING~ Green River Confluence

Hanxi Drainage Detention Basin

WAN' AN~ SHU WANG

JI SHAN ~ GUO GUANG

GUO GUANG ~ LU CUN



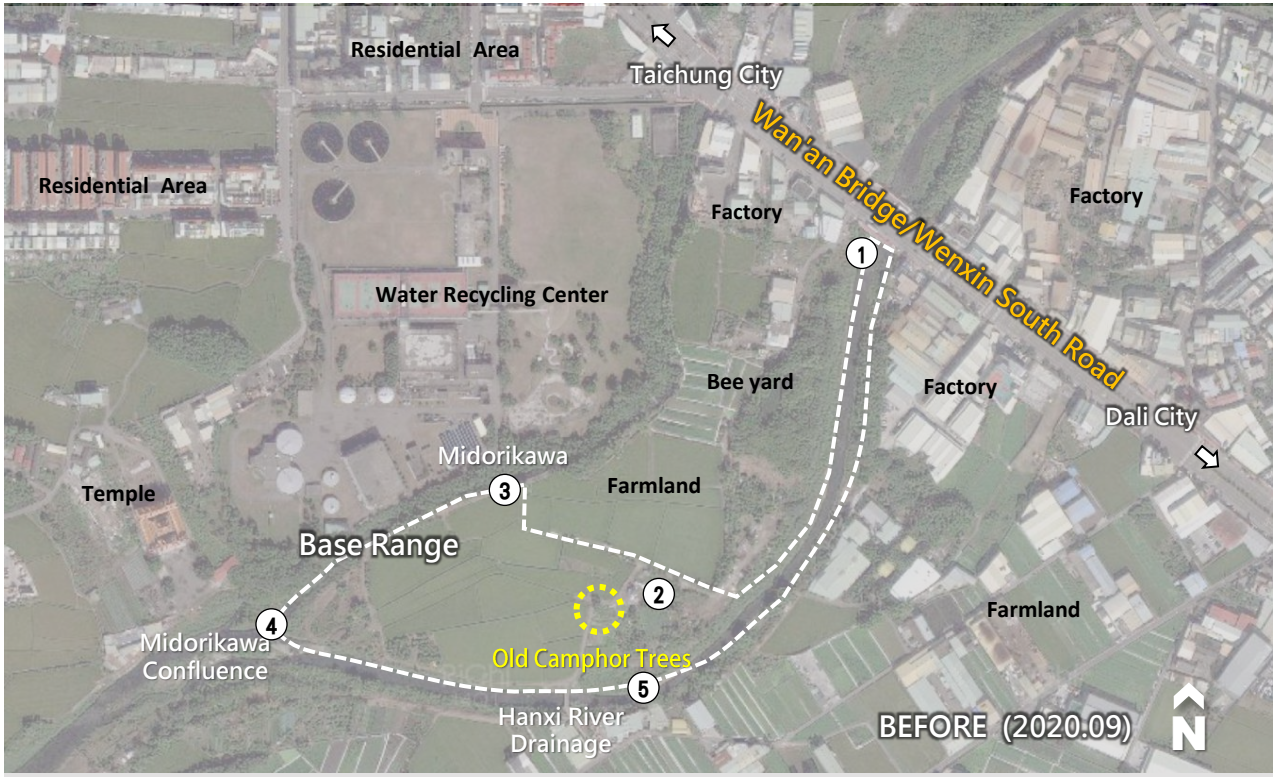
LU CUN~RI XIN

Base Environment Overview

Detention basin is located on the edge of the Taichung City.It used to be farmland and wasteland, rice and water spinach was the main crops. As times changed, factories gradually sprang up around the area. The environment suffered from the dumping of miscellaneous waste and the construction of pigeon lofts; waterways and riverbanks were occupied and littered with garbage.

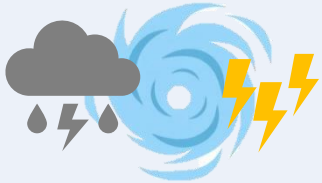
Due to the surrounding areas being predominantly farmland, there is a historic camphor tree within the site that not only provides shade and rest for farmers but also holds the memories of the local residents. The natural ecosystem, belonging to the farmlands and rivers, includes field mice, amphibians, birds, and more, with the special presence of "Black-winged Kites" hunting over the fields at dusk.

In recent years, with the acceleration of urbanization and the proliferation of residential buildings in the nearby areas, the need for park green spaces has become more pronounced. The design also takes into account the usage needs of the surrounding citizens.



Program Objectives And Countermeasures (Potential And Challenges)

Objectives



Enhance disaster prevention capabilities in reponse to climate change.

Issues

1. Climate change has led to a 13% increase in heavy rainfall.
2. Urban development has resulted in a 22% increase in the rate of impermeable surfaces.
3. Low-lying downstream areas are prone to flooding during heavy rain.
4. With high groundwater levels, how can we meet the required capacity for flood detention?

Countermeasures

Urban Flood Control and Drainage Sharing

1. Based on the management plan, a detention basin is planned to meet flood control requirements.
2. Downstream flow reduction of approximately 16%.
3. A wet detention basin with operational mechanisms to handle peak rainfall demands.

Create open hydrophilic spaces based on environmental friendly construction.

1. How can the needs of residents in nearby densely populated areas be met?
2. With the existing mixed forest green belt on the right bank slope and the north side of the detention basin, which has ecological potential, how can ecological impacts be mitigated?
3. Horizontal expansion of the detention basin's functions?

Waterfront Environment and Multifunctionality

1. Utilize scattered spaces and integrate them with lakeside trails to create urban recreational areas.
2. Design with an ecological "service" focus, including habitat compensation and eco-friendly approaches.

Establish an enviromental education field with local culture

1. How can consensus be obtained from the residents? For instance, should the old camphor tree in the middle of the field be preserved?
2. How should local features and culture be preserved or presented?
3. The site is located at the junction of Taichung City and Dali City, with heavy pedestrian and vehicle traffic, holding potential as a venue for environmental education.

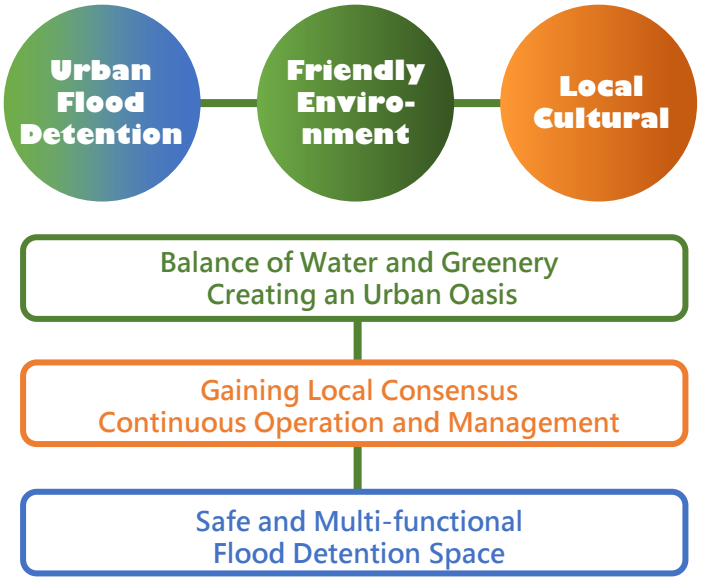
Preserving Local Characteristics

1. Incorporate local cultural features.
2. Combine educational interpretation and guided facilities.
3. Engage in interviews and public hearings to address local needs.

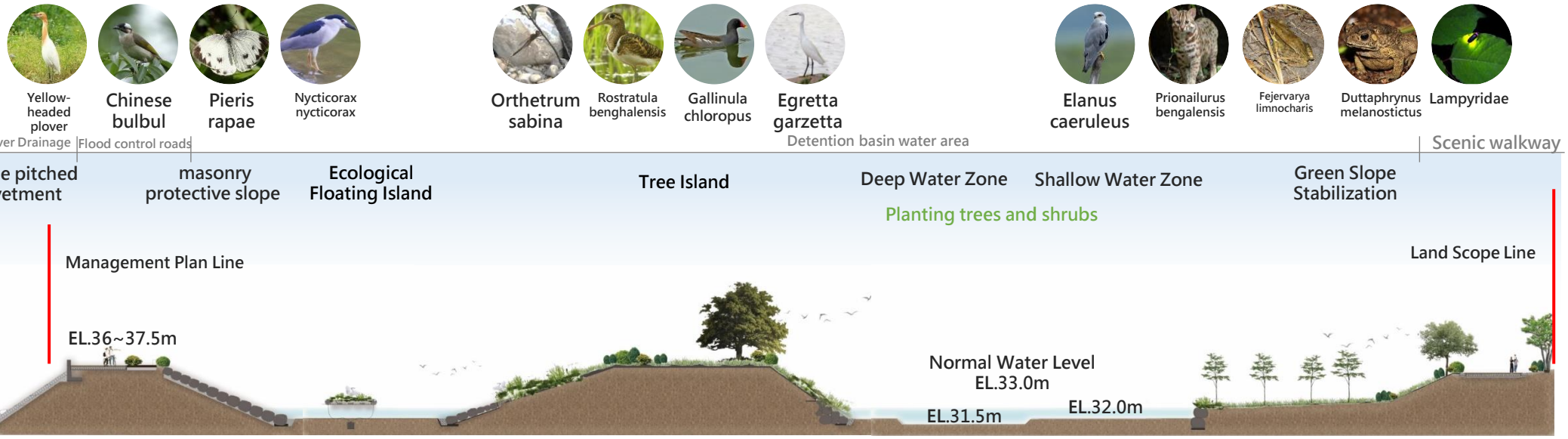
Strategy

1. Disaster Prevention Functionality and Safety Assurance
2. Ecological Sustainability and Environmental Creation
3. Economic Durability and Energy Efficiency
4. Innovative Actions and Challenge Overcoming
5. Holistic Thinking and Comprehensive Design

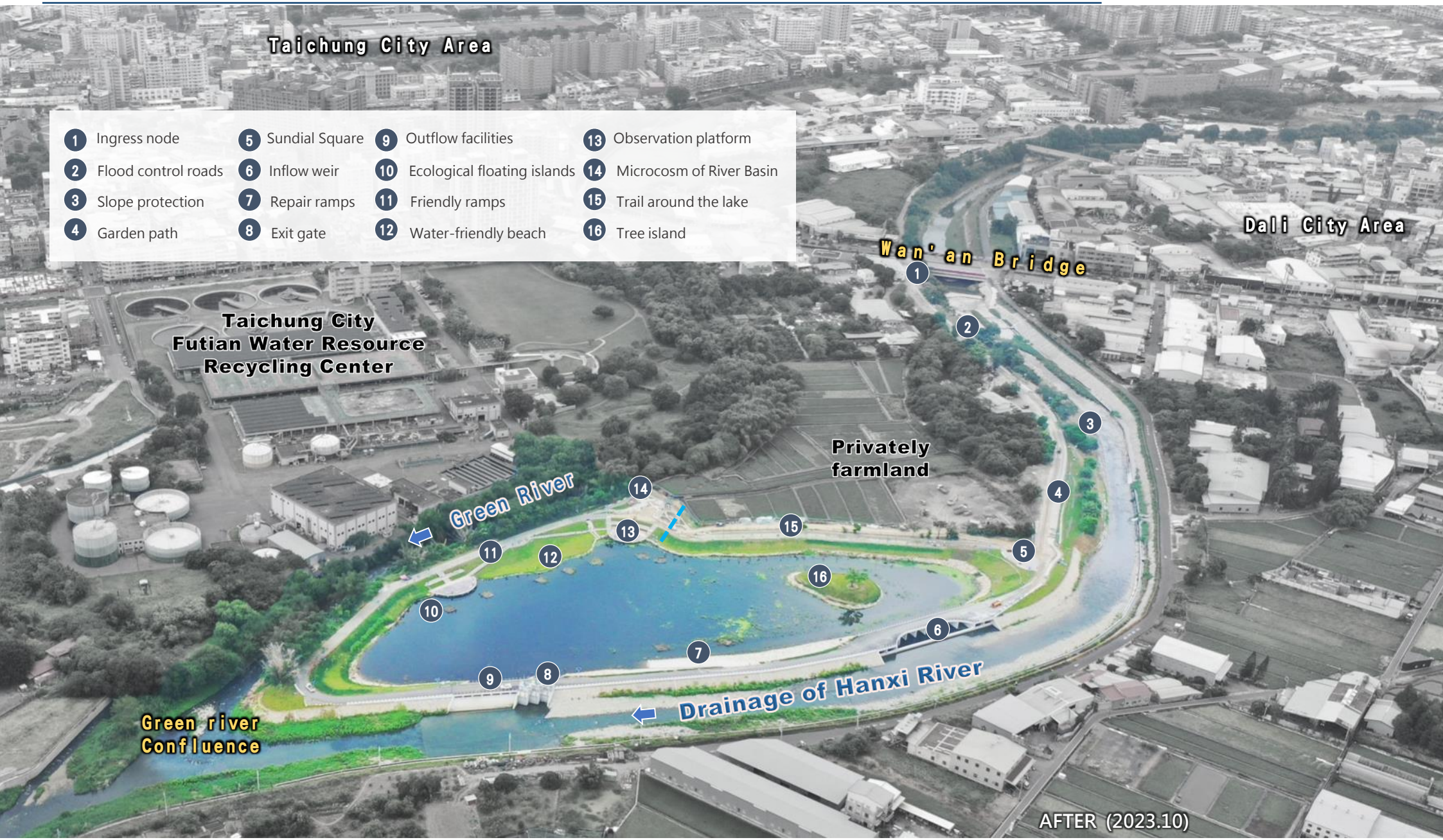
Design Methods



Sectional Map of the Whole Area and Distribution of Animal Resources



Plot Plan


Taichung City Area
1 Ingress node
2 Flood control roads
3 Slope protection
4 Garden path
5 Sundial Square
6 Inflow weir
7 Repair ramps
8 Exit gate
9 Outflow facilities
10 Ecological floating islands
11 Friendly ramps
12 Water-friendly beach
13 Observation platform
14 Microcosm of River Basin
15 Trail around the lake
16 Tree island
Dali City Area
Wan'an Bridge
Taichung City Futian Water Resource Recycling Center
Privately farmland
Green River
Drainage of Hanxi River
Green river Confluence
AFTER (2023.10)

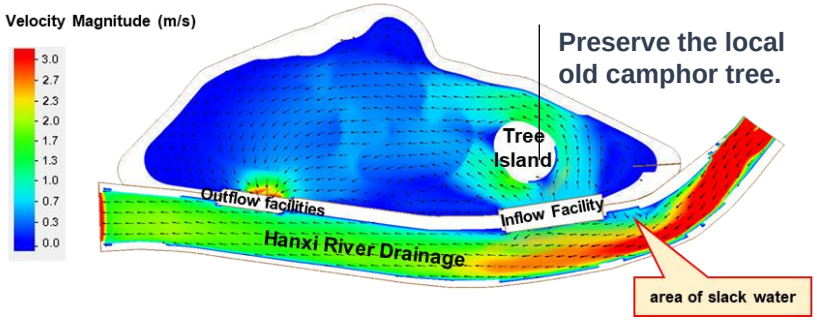
Urban Flood Control Space & Enhancing Disaster Resilience

1. The design surpasses the requirements of the management plan, with all facilities analyzed for stability and safety：Slope stability analysis/Inflow weir stability analysis/Seepage analysis/Culvert structure analysis

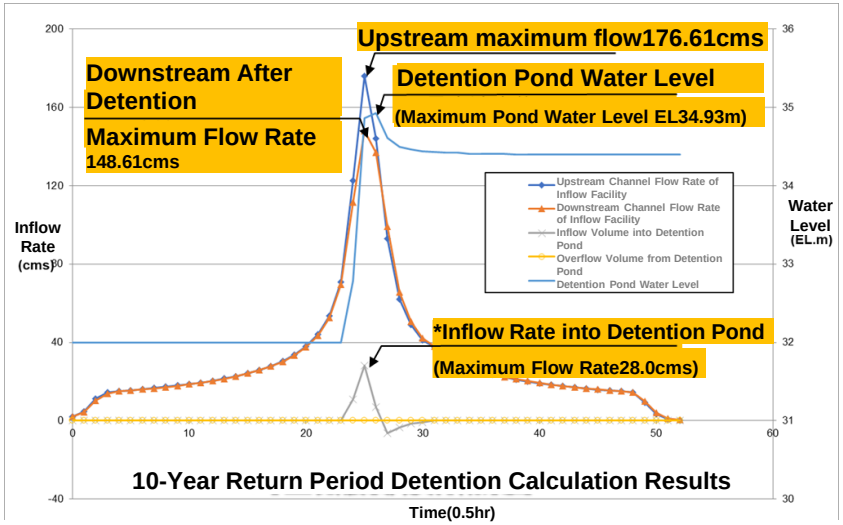
2. The originally planned weir length of 80 meters was revised to an Ogee-shaped weir, reducing it to 63.1 meters and minimizing the structural volume.

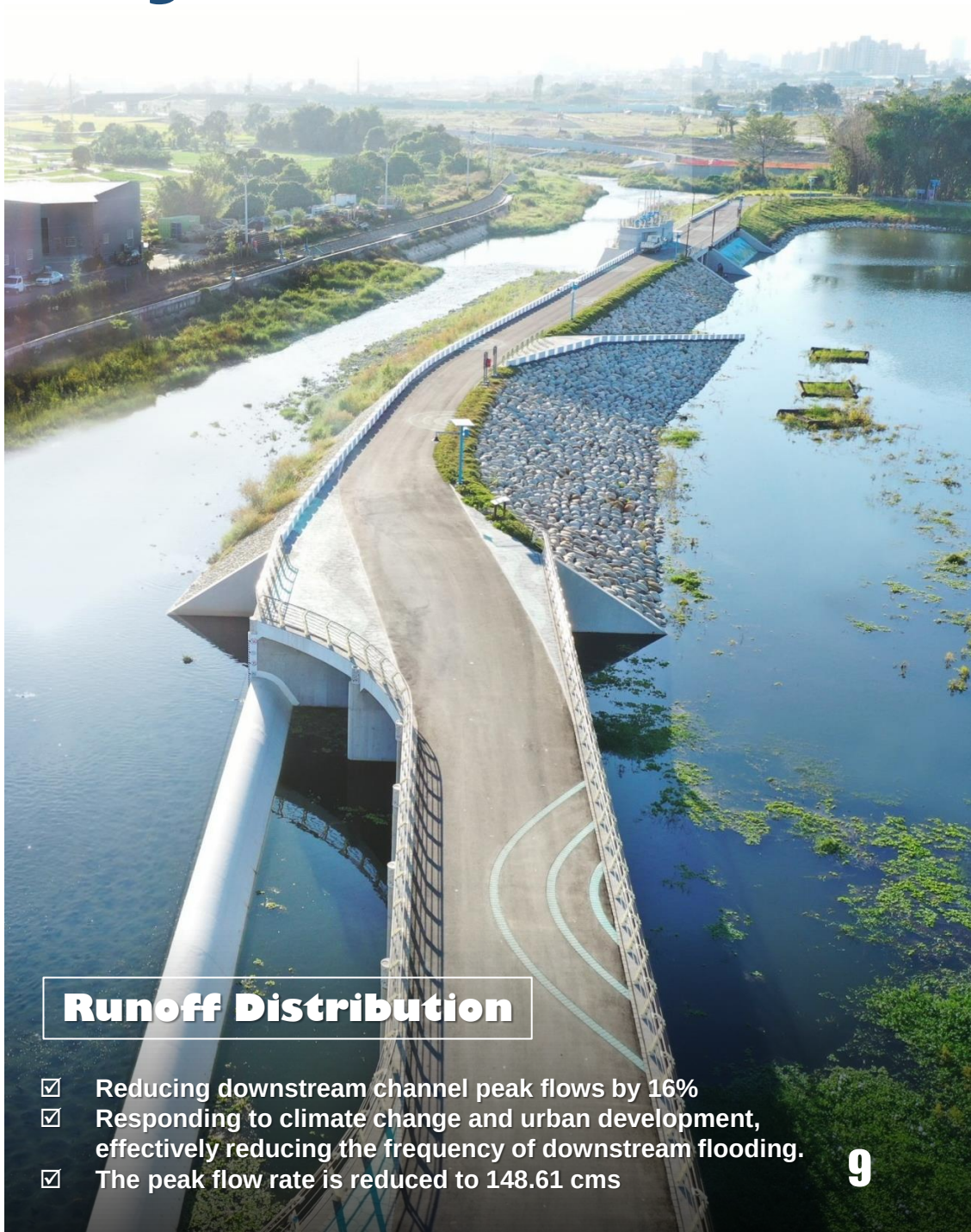
3. Even if the pond area is not fully emptied, the peak flood can still be reduced by 17.14 centimeters. The highest water level in the pond remains below the design crest level, ensuring the safety of the detention basin.

HEC-RAS Modeling Determines Inflow and Outflow Locations and Dimensions



Hydraulic verification surpasses the requirements of the management plan





Runoff Distribution

- ☑ Reducing downstream channel peak flows by 16%
- ☑ Responding to climate change and urban development, effectively reducing the frequency of downstream flooding.
- ☑ The peak flow rate is reduced to 148.61 cms

Urban Space Of Flood Control & Enhancing Disaster Resilience

Culture

Preserve the Ancient Camphor Trees on Site

1. The camphor tree is approximately 22 meters away from the inflow facility, with peripheral flow velocities ranging from 0.4 to 1.6 meters per second.
2. The camphor tree is retained in the form of a "tree island.“
3. Slope protection using stone blocks at the normal water level.

Hydraulic

Introducing 2dHydraulic Simulation to Adjust Inflow Structure Location

1. The gentle flow area near the Drainage of Hanxi River spillway embankment tends to accumulate sediment, making subsequent maintenance challenging.
2. Adopting overflow inflow through side channels in the river.
3. The angle of river inflow has a minor impact.

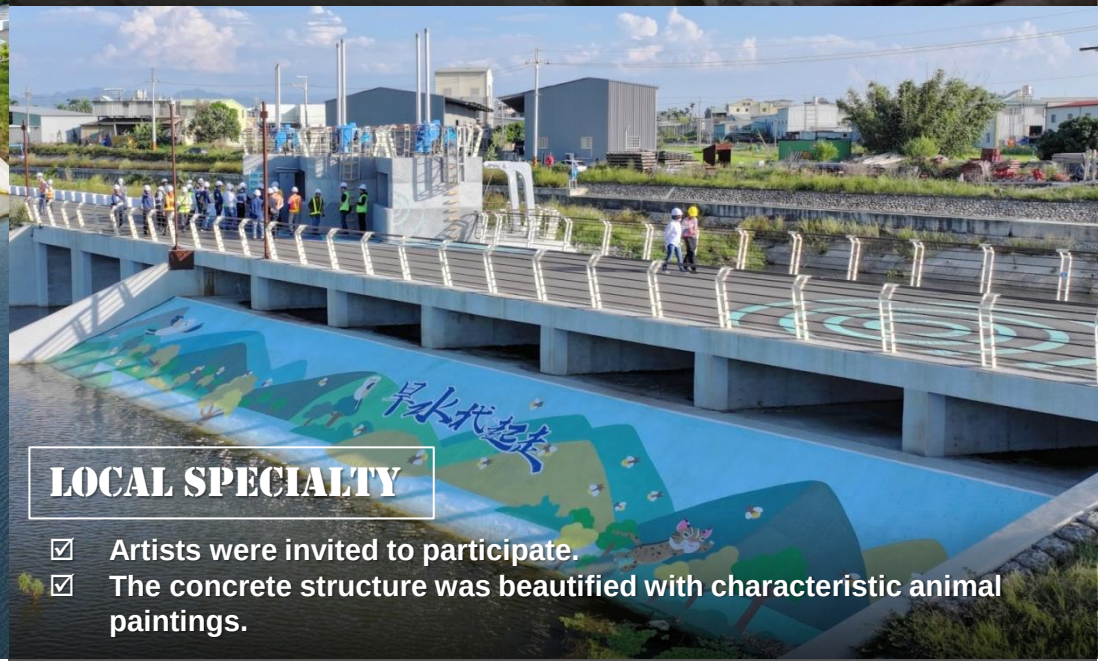
Urban Space Of Flood Control & Enhancing Disaster Resilience

EASY TO OPERATE

- ☑ Inflow (automatic side overflow weir): No operation required
- ☑ Outflow gate (3 controls): Drain 4 hours before typhoon
- ☑ Outflow culvert (gravity overflow): No operation required during typhoon

ENABLE IN ADVANCE

- ☑ June 3,2023, Taichung City experienced a short-delayed heavy rainfall
- ☑ The Dali rainfall station recorded 99mm/hr, which is greater than the recurrence interval of 10 years.
- ☑ The flood detention was activated ahead of schedule and achieved the expected results.



LOCAL SPECIALTY

- ☑ Artists were invited to participate.
- ☑ The concrete structure was beautified with characteristic animal paintings.

Friendly Environment | Green Construction Methods, Habitat Creation

The detention basin is located at the junction of urban and farmland areas. Although it requires large-scale excavation, special attention is paid to the life cycle assessment of the project, adhering to the 'four major ecological principles - Avoid, Minimize, Lighten, Compensate'. After completion, the detention basin has increased a large area of water sources and plantings, which has accelerated the ecological and environmental restoration. Compared to the previous farmland environment, the biodiversity has become more diverse and rich. By making good use of green construction methods, a friendly and diverse aquatic habitat has been successfully created.

Elanus caeruleus
photographed during construction

Bubulcus coromandus
& Egretta garzetta

Dicrurus macrocercus

Nycticorax nycticorax

Duttaphrynus melanostictus

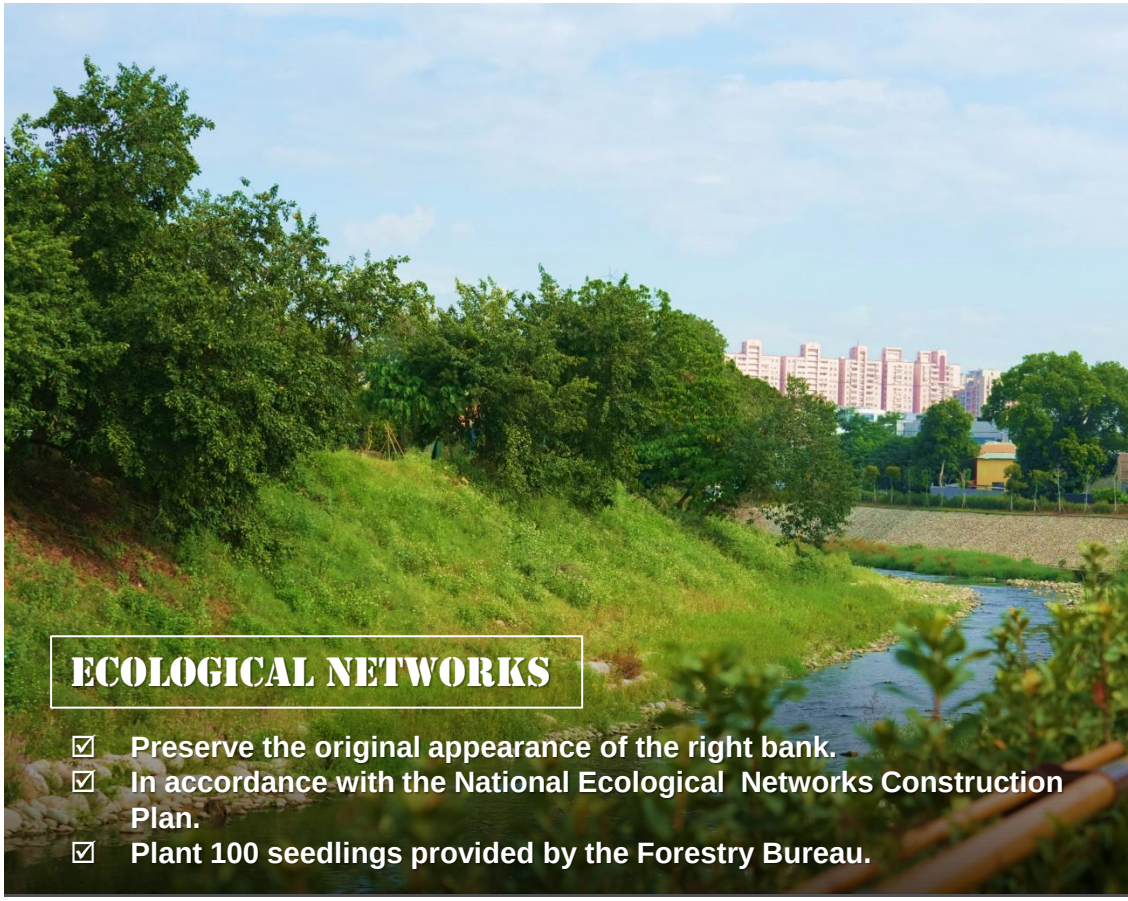
Parantica swinhoei

Friendly Environment | Environmental Regeneration, Ecological Sustainability: Terrestrial

- A multi-layered landscape pattern is adopted, selecting plants with changing foliage colors and flowering species to add color to the area, creating visual focal points and spatial layers.
- In the larger open spaces, plants that attract butterflies and birds are cultivated, providing a food source for animals and an opportunity to explain the characteristics of flora and fauna, shaping an environmental education space.
- Approximately 100 trees within and around the site are preserved, including camphor trees, mango trees, Zelkova trees, banyans, and Bischofia javanica, among others.
- Through the extensive planting of seedlings, the environment is enhanced, including 341 trees, 24,492 shrubs, and 8,581 riparian and ground cover plants, all of which are native species from Taiwan.
- The total green coverage area is about 17,000m², with the green coverage above the normal water level being about 59%."

NATURAL SLOPE

- ☑ Replace concrete revetments with natural slopes (<1:3)
- ☑ Slope greening is all gentle slope design. The existing dead wood in the area is crushed and laid under the grass seeds in the area, which can retain water and serve as base fertilizer, reducing transportation and carbon emissions



ECOLOGICAL NETWORKS

- ☑ Preserve the original appearance of the right bank.
- ☑ In accordance with the National Ecological Networks Construction Plan.
- ☑ Plant 100 seedlings provided by the Forestry Bureau.

Tree Island
（Habitat Avoid）

- Preserve ample growth space for an old camphor tree with a radius of about 60 cm, avoiding the impact of excavation.
- On the side facing the inflow weir, use a 1:1.5 ratio to lay mixed masonry stones to prevent the foundation from being hollowed out by water flow.
- Design a 1:3 gentle slope on the side of the pond area, planting riparian plants to provide animals and insects with food and hiding places.

Ecological Floating Islands
（Habitat compensation）

- Through the use of floating island habitat blocks (Habitat Patch), provide a movement path for wildlife.
- Provide a more diverse habitat for birds, amphibians, or fish, avoiding human disturbance.
- Mainly use natural materials (anti-corrosion bamboo branches), supplemented by durable materials, with large unit sizes, making construction challenging.

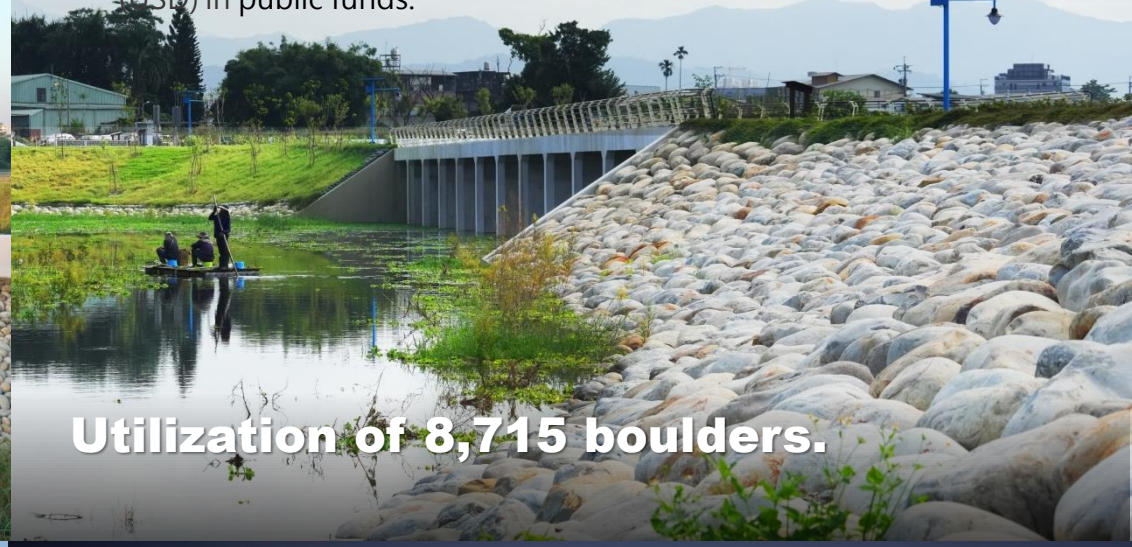
Create a friendly ecological habitat won’t be disturbed

Friendly Environment | Engineering Green Living

- Replacing concrete revetments with boulders, stone embankments, and natural slopes.
- Reduced the amount of concrete by 4500m³, resulting in a carbon reduction benefit of approximately 2120 tons(tCO2e).

Carbon emissions decreased by 46%.

- In line with the Water Resources Agency's policy of dematerialization, boulders from the Dajia River dredging project were utilized.
- A total of 8,715 boulders were used, saving more than 533 thousand (USD) in public funds.



Utilization of 8,715 boulders.

- Vegetation coverage area: approximately 17,000m²
- Microclimate regulation: Reduces summer temperatures by 3-5.5℃ and increases winter temperatures by 6-6.5℃.

Carbon sequestration of 58 tons.

- Adoption of solar lighting fixtures.
- Designed for minimal lighting requirements to reduce nighttime environmental disturbance.

Energy-saving and carbon reduction of 3.3 tons.

Challenge | How to Respond to Extreme Weather Conditions such as Drought and Torrential Rain?

Drought:

- The groundwater layer is not sealed, retaining existing facilities for reverse siphoning and collecting irrigation tailwater, making use of existing water sources.
- Utilize permeable pavements, infiltration stone ditches, and green cover to effectively collect water resources.
- Set up Qwater placement spaces, irrigation systems, and water storage facilities to provide a water supply during water shortages and droughts.

Torrential Rain:

- Play a flood detention function during torrential floods.
- Install three outflow gates, using the upper levels of the gates to control water levels according to needs.

Local Culture | Civic Participation and Consensus

2019-2021

Reach Consensus

- Through local interviews and invite NGO groups to deepening public-private dialogue to reach a consensus.

2021-2023

Continuous Attention

- Maintain open communication channels with community
- Hold an event for naming the detention basin, named " Ying Tsai Lake" after the local crop (water spinach).

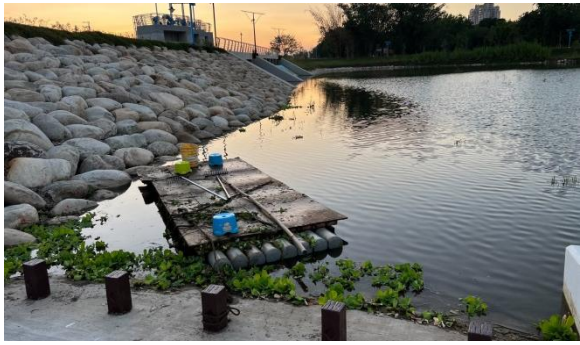
2023-continue

Local Adoption and Maintenance

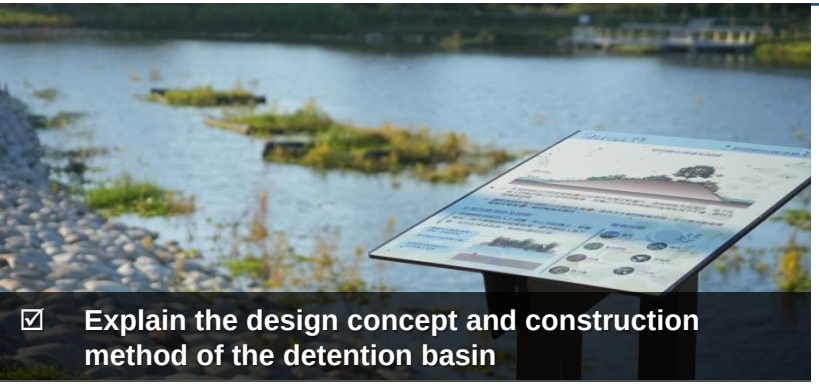
- Sign mutual maintenance agreement with local groups (Tree King Riverside Volunteers).
- Leverage cross-domain value addition and sign an MOU with the Taichung City Wildlife Conservation Association.

Local Culture | Integrating Humanistic Features

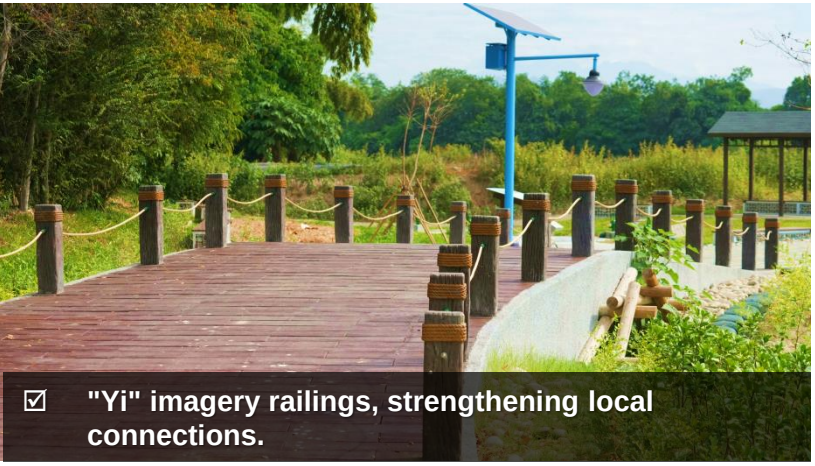
- The entrance landmark is named "Ying Tsai Lake," showcasing local culture. It reflects the imagery of the lake's surface and also represents the meaning of the surrounding crop "water spinach" in the Hoklo language.
- Continuing the function of the mooring post “Yi" in Dali, imitation wooden posts are installed to provide mooring for bamboo rafts at the shore, with “Yi" imagery as the railing.
- It serves not only as a flood prevention road but also as a place for people to walk, power walk, jog, and cycle around the lake, becoming a local feature and recreational space.



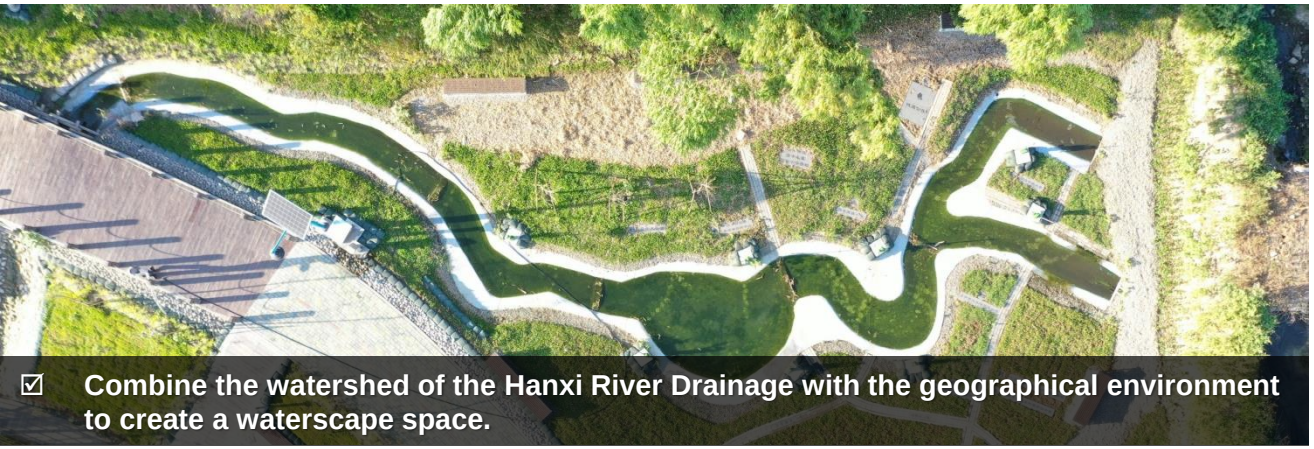
Local Culture | Environmental Education Field



☑ Explain the design concept and construction method of the detention basin



☑ "Yi" imagery railings, strengthening local connections.



☑ Combine the watershed of the Hanxi River Drainage with the geographical environment to create a waterscape space.

☑ Install water play facilities to increase fun interaction.

Local Culture | Multi-functional field

Create diverse values by making different uses of the spaces

1. Gates are installed to control the water level, and the deep-water area can be used for light boating activities, meeting local needs.
2. The platform allows for close observation of the water surface and ecological floating islands, can accommodate 450 people, and can also serve as an educational field for nearby elementary schools.
3. The plaza features a shaped sundial that incorporates imagery of the black-shouldered kite and traditional toys.

Conclusion

The detention basin project is a key engineering work and disaster prevention hub for the Hanxi River Drainage. When torrential rains come, it can reduce the flood peak by 25 CMS, accumulating 850,000 cubic meters of floodwater, reducing the risk of flooding for the 16 hectares of downstream flood prevention areas, and achieving the standard of not overflowing for 25 years. The use of green construction methods has also successfully created an environment friendly for wildlife habitation, bringing back a more diverse and rich ecology of insects, fish, wild birds, and plants. The sunset clouds reflected on the surface of ' Ying Tsai Lake' resemble a beautiful natural painting; the detention basin serves both as a park and a scenic spot, providing the public with a beautiful space for walking, jogging, cycling around the lake, and a high-quality waterside area.