DA NANG UNIVERSITY OF SCIENCE AND TECHNOLOGY

**FACULTY OF ARCHITECTURE**

# EXPLANATORY REPORT

**GRADUATION PROJECT – CLASS OF 2020–2025**

## PROJECT TITLE

## WATER RESOURCES RESEARCH & RAINWATER PARK COMPLEX

| | |
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| **Supervisor** | **Assoc.Prof. Dr. Architect. Nguyễn Anh Tuấn** |
| **Student** | **Đặng Hưng Long** |
| **Class** | **20KTCLC** |
| **Student ID** | **121200070** |

**Đà Nẵng, June/2025**

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**ACKNOWLEDGMENTS**

I would like to sincerely thank Assoc. Prof. Dr. Architect Nguyễn Anh Tuấn for his dedicated guidance and valuable support throughout the process of completing this graduation project. His professional insight and encouragement were essential in helping me shape and develop my ideas.

I would also like to express my gratitude to the Faculty of Architecture for providing favorable conditions, academic support, and an inspiring learning environment during my studies.

This graduation project, despite my best efforts, still contains limitations and shortcomings. I truly hope to receive constructive feedback and suggestions to improve and further develop the work.

**STATEMENT OF COMMITMENT**

I, Đặng Hưng Long, a student of class 20KTCLC, cohort 2020, Faculty of Architecture, University of Science and Technology – The University of Danang, hereby make the following commitments:

- I have completed the graduation project entitled: WATER RESOURCES RESEARCH & RAINWATER PARK COMPLEX in accordance with the assigned design tasks;
- This project is the result of my own work and creativity, and does not copy any existing works;
- I commit to fully complying with the current regulations on academic integrity of the University of Science and Technology – The University of Danang.

If any of the above statements are found to be untrue, I take full responsibility before the Faculty of Architecture and the University.

Đà Nẵng, June 6th, 2025

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# CHAPTER 1: INTRODUCTION

## 1.1 Problem Statement and Reasons for choosing the topic:

### *1.1.1 Current State of Water Resources and Urgent Challenges:*

Water is a very precious resource. It is necessary for production, daily life, and for keeping ecosystems healthy. However, many **scientific reports** say that Vietnam now faces serious problems with water resources:

**Risk of Water Shortage and Instability**

According to the Department of Water Resources Management (Ministry of Natural Resources and Environment), by **2030**, national water demand will grow by over **30%** compared to today. At the same time, the supply of clean water is under pressure from drought, saltwater intrusion, and climate change.

During the rainy season, heavy rain and storms cause **urban flooding** and damage the economy and society. In the dry season, there is **lack of water** and local droughts in some areas.

**Water Pollution and Damage to Aquatic Life**

About **70%** of household and industrial wastewater in Vietnam is **not fully treated** before being discharged into the environment (from the 2020 National Environment Report).

This makes many rivers and lakes in cities polluted with organic and microbial substances, affecting public health and increasing disease risks.

**Low Rate of Rainwater Collection and Reuse**

Although Vietnam's yearly rainfall is quite high (**1,600 – 2,500 mm/year**, depending on the region), the World Bank says **80 – 90%** of rainwater flows away into canals, rivers, or the sea without being collected.

This wastes a potential water source and increases pressure on drainage systems, especially during heavy rains.

**Climate Change and Urbanization**

Models from the Intergovernmental Panel on Climate Change (IPCC) show that the central coastal area of Vietnam (including Da Nang) may face **rising sea levels** and more extreme weather.

Fast urbanization and lots of concrete reduce water infiltration, which leads to **more frequent urban floods**.

### *1.1.2 The Need to Build a "Rainwater Park & Water Resources Research Center":*

To address these problems, a **multi-purpose** water-related project is urgently needed. This project should fulfill:

**Research & Development (R&D)**

Focus on collecting, treating, and reusing rainwater, combined with the "Sponge City" approach.

Create a central link between universities, research institutes, and companies working on water technology.

**Education & Raising Public Awareness**

Organize a museum or interactive exhibition space (AR/VR) so that local residents, students, and visitors understand the water cycle and the importance of saving and protecting water.

Form an off-campus learning and eco-tourism destination that connects science with everyday life.

**Landscape & Ecological Recreation**

Combine regulating lakes, wetlands, and native plants to store rainwater, reduce flooding, and keep city climates cool.

Build a park for leisure and relaxation, promoting sustainable green tourism.

**Economic & Social Development**

Attract human resources and investment for water treatment technologies, opening up startup opportunities in the environmental field.

Help turn the area into a **green landmark**, improve living standards, and draw both tourists and media attention.

### *1.1.3 Conclusion: Reasons for Choosing This Topic:*

Looking at the data, analysis, and context above, we see:

**Urgent Needs**: Vietnam, especially the central coastal region (such as Da Nang), faces major pressure from flooding, water pollution, clean water shortage, and serious effects of climate change.

**Overall Solution**: Creating a "Rainwater Park & Water Resources Research Center" will not only help manage, study, and teach about water, but also improve the urban landscape and raise public awareness.

**Sustainable Value**: This project focuses on green architecture and balances environmental, economic, and social factors. It can serve as a **core** for a modern city model that adapts to climate change.

Based on these solid reasons, the **"Rainwater Park & Water Resources Research Center"** proposal is chosen. It aims to be an effective solution and a symbol of protecting and sustainably developing water resources in both the local area and the nation as a whole.

## 1.2 Significance of the Topic

**Helping Solve Urgent Water Problems**

Supports collecting, storing, and reusing rainwater, which reduces pressure on urban drainage systems and adds more clean water sources.

Provides space for research and application of modern water treatment technology (filtration, desalination, groundwater storage), meeting real needs.

**Creating Architectural, Landscape, and Tourism Highlights**

A rainwater-themed park with a regulating lake and large scenic spaces, attracting visitors for tours and relaxation.

Forms a futuristic, "green" urban icon, where both local and international tourists, investors, and experts can visit and learn.

**Community Education & Environmental Communication**

Hosts exhibitions and interactive simulations (AR/VR) about the water cycle, water pollution, and climate change.

Sparks awareness of saving and protecting water resources, especially in the younger generation, laying the foundation for a lasting "green" lifestyle.

**Promoting Research, Innovation, and Interdisciplinary Cooperation**

The Water Resources Research Center becomes a key link for cooperative projects between universities, research institutes, and high-tech companies.

Encourages startups in water management, IoT (Internet of Things) for rainwater monitoring, and wastewater treatment.

**Contributing to Green Urban Development Plans**

Combines the park with green infrastructure (Sponge City) to lessen the negative impact of urban floods and improve the local climate.

Upgrades the local image and creates a path that fits the goal of building a "smart, sustainable city."

# CHAPTER 2: SCIENTIFIC BASIS FOR THE STUDY

## 2.1 Relevant Codes and Standards

- **QCVN 01:2021/BXD** – National Technical Regulation on Construction Planning
- **QCVN 06:2022/BXD** – National Technical Regulation on Fire Safety for Buildings and Structures
- **TCVN 5687:2010** – Ventilation and Air Conditioning
- **TCVN 14214:2024** – Housing and Public Buildings – Requirements for Indoor Microclimate Parameters
- **TCVN 5641:2012** – Museum Design
- **TCVN 4601:2012** – Administrative Office Design
- **TCVN 9257:2012** – Planning of Public Green Spaces in Urban Areas

## 2.2 Referenced Projects and Documents

### *2.2.1 WRRF Yixing Water Resource Recovery Facility (Wuxi, China)*

Figure 1:WRRF Yixing Water Recovery Facility (Wuxi, China)

This project in Yixing (China) transforms a wastewater treatment plant into a resource recovery complex (water, sludge, biogas), designed to be eco-friendly and publicly engaging. The facility repurposes wastewater tanks into creative spaces like the “Tank Cafe” and mini gardens, breaking away from an industrial, closed-off image.

**Good Points to Learn:**

- Industry–Community Integration: Converting a wastewater plant into a science park open to the public.

- Resource Utilization: Achieving self-sufficiency in energy, reusing water and sludge.

- Friendly Architecture: Incorporating greenery and user-focused design to soften the typical industrial look.

**Points to Avoid:**

- Closed-off design lacking open spaces risks opposition from nearby residents.

- Overlooking in-process resource reuse can lead to wasting water and energy potential.

### *2.2.2 Sechelt Water Resource Centre (Sechelt, Canada)*

Figure 2: Sechelt Water Resource Centre (Sechelt, Canada)

Located in Canada, this open-concept wastewater treatment center blends seamlessly with the surrounding neighborhood. It has earned awards for sustainability by integrating hydroponic plants for water filtration, reducing sludge, and providing a small garden environment for the community.

**Good Points to Learn:**

- Open Design: Glass walls allow the public to observe water treatment firsthand.

- Vegetation Integration: Growing plants using reclaimed water, creating a mini eco-park out of industrial infrastructure.

- Economic Efficiency: Significantly lower operational costs and higher value for adjacent residential areas.

**Points to Avoid:**

- Enclosing the facility behind barriers loses the educational potential and public acceptance.

- Hydroponic systems require regular monitoring and maintenance to remain effective and avoid failures.

### *2.2.3 Wetland Research and Education Center (Shanghai, China)*

Figure 3: Wetland Research and Education Center (Shanghai, China)

Positioned in a wetland conservation area, this center combines research and environmental education on fragile marshland. The design splits into small building clusters connected by elevated walkways to minimize ecological impact.

**Good Points to Learn:**

- Environmental Preservation: Constructing on stilts, using small building footprints, avoiding significant disruption to the marsh.

- Research–Tourism Experience: Zigzag boardwalks let visitors observe wetland flora and fauna without harming their habitat.

- Harmony with Nature: Low-rise forms and rustic materials blend respectfully into the landscape.

**Points to Avoid:**

- Oversized, continuous building footprints could destroy delicate wetland ecosystems.

- Uncontrolled tourist influx without ecological oversight may lead to pollution and habitat degradation.

### 2.3 Overview of the Research Location: Da Nang city

**Geographical Location:** The mainland of Da Nang City lies between 15°15' to 16°40' North latitude and 107°17' to 108°20' East longitude. It is centrally located in Vietnam, about 766 km south of Hanoi and 961 km north of Ho Chi Minh City along National Highway 1. The city covers an area of approximately 1,285.4 km².

It borders Thua Thien Hue Province to the north, Quang Nam Province to the west and south, and the East Sea to the east.

Da Nang is also located near three world cultural heritage sites: the Imperial City of Hue, the ancient town of Hoi An, and the My Son Sanctuary.

The city lies along the North–South transportation corridor (road, rail, sea, and air), making it an important gateway to the sea for the Central Highlands and neighboring countries such as Laos, northeastern Cambodia, Thailand, and Myanmar.

Distances from Da Nang to major Southeast Asian cities like Bangkok (Thailand), Kuala Lumpur (Malaysia), Singapore, and Manila (Philippines) range from 1,000 to 2,000 km.

**Topography:** Da Nang's terrain includes both coastal plains and mountainous areas. High and steep mountains are mainly located in the west and northwest, with several ranges extending toward the sea. Low hills intersperse with narrow coastal plains.

Mountainous areas cover a large portion, with elevations from 700–1,500 meters and slopes over 40°, containing many upstream forests vital for ecological protection.

The coastal plains are low-lying, salt-affected areas and house many agricultural, industrial, residential, military, and service facilities.

In river mouths such as the Han and Cu De rivers, the seabed terrain is complex, forming shallow banks and underwater depressions.

At the bay entrance, the seabed gradually slopes toward the northeast with relatively consistent contour intervals.

**Climate:** Da Nang has a typical tropical monsoon climate with high and stable temperatures. The city lies in a transitional zone between the humid subtropical climate of the North and the tropical savanna climate of the South, with southern tropical features dominating.

There are two distinct seasons each year: the rainy season from September to December, and the dry season from January to August. Occasional cold spells in winter are mild and short-lived.

The average annual temperature is about 25.8°C. The hottest months are June to August (28–30°C), and the coolest months are December to February (18–23°C). In Ba Na Hills (nearly 1,500 m elevation), the average temperature is around 20°C.

Average annual humidity is 83.4%.

Average annual rainfall is 2,153 mm, with the heaviest rainfall from September to November (average 465 mm/month), and the driest period from February to April (average 27 mm/month).

The city receives about 2,182 hours of sunshine per year, most during May–July (246 hours/month), and the least during November–January (121 hours/month).

Da Nang is affected by 1–2 typhoons or tropical depressions annually. In 2006, it was severely impacted by Typhoon Xangsane, one of the strongest in the past 100 years.

**Rivers and Waterways:** The river system in Da Nang is short and steep, originating from the west, northwest, and Quang Nam Province.

The two main rivers are the Han River (204 km long, 5,180 km² basin area) and the Cu De River (38 km long, 426 km² basin area).

Other rivers include the Yen, Chu Bai, Vinh Dien, Tuy Loan, and Phu Loc Rivers.

All rivers have two distinct flow seasons: the dry season (January–August) and the flood season (September–December).

The city also has over 546 hectares of water surface suitable for aquaculture.

**Socio-economic Conditions:** Da Nang is a multi-sector, multi-field urban center. It plays a leading role in politics, economy, society, and functions as a hub for industry, finance, tourism, services, culture, education and training, high-quality healthcare, science and technology, entrepreneurship, and innovation in the

Central–Highlands region and Vietnam overall.
The city regularly hosts regional and international events.
Da Nang is a core city in the Central Key Economic Region and one of Vietnam's five centrally governed municipalities. It is classified as a Tier 1 national urban center, along with Hai Phong and Can Tho.

## 2.4 Site Information for the Construction Project (Planning Context)

### Location:

- Located in the southeastern expansion zone of Da Nang, the construction site holds a strategic position as a regional highlight. Upon completion, the project can serve as a new landmark when approaching from Vo Chi Cong and other major roads. Furthermore, this site is centrally placed in a newly developing area near FPT City and Hoa Quý, reflecting the city's growth south and east toward Quang Nam Province.

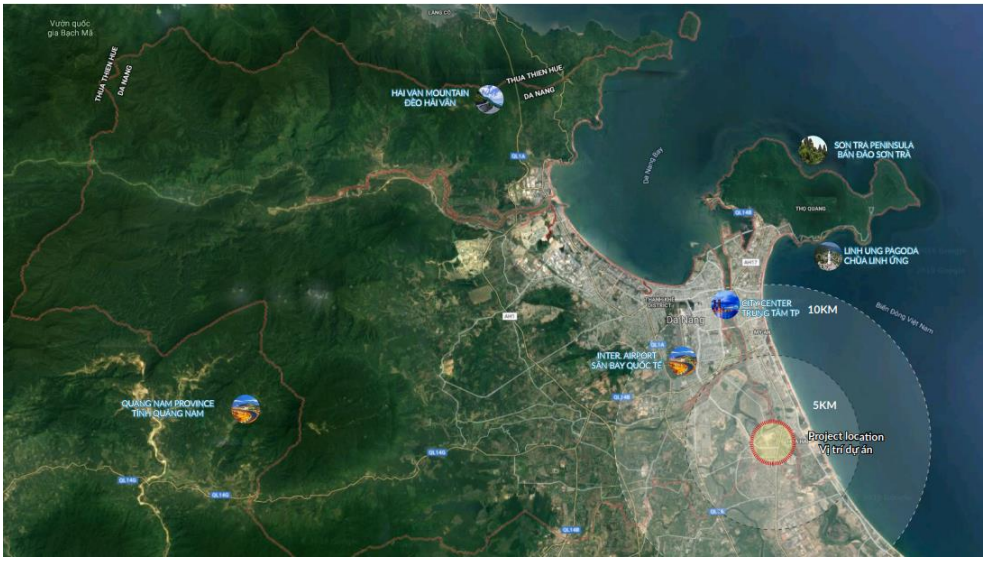



Figure 4:Distance from the site to important locations

- The site is located on the Vo Chi Cong route, which effectively connects major roads of Da Nang such as Tran Dai Nghia. This leads directly to Tuyen Son bridge and the city center. Thanks to this positioning, the project can easily attract both local residents and

visitors, thus evolving into a landmark that stands out in the southern gateway expansion of Da Nang.


Figure 5: Main traffic routes around the site

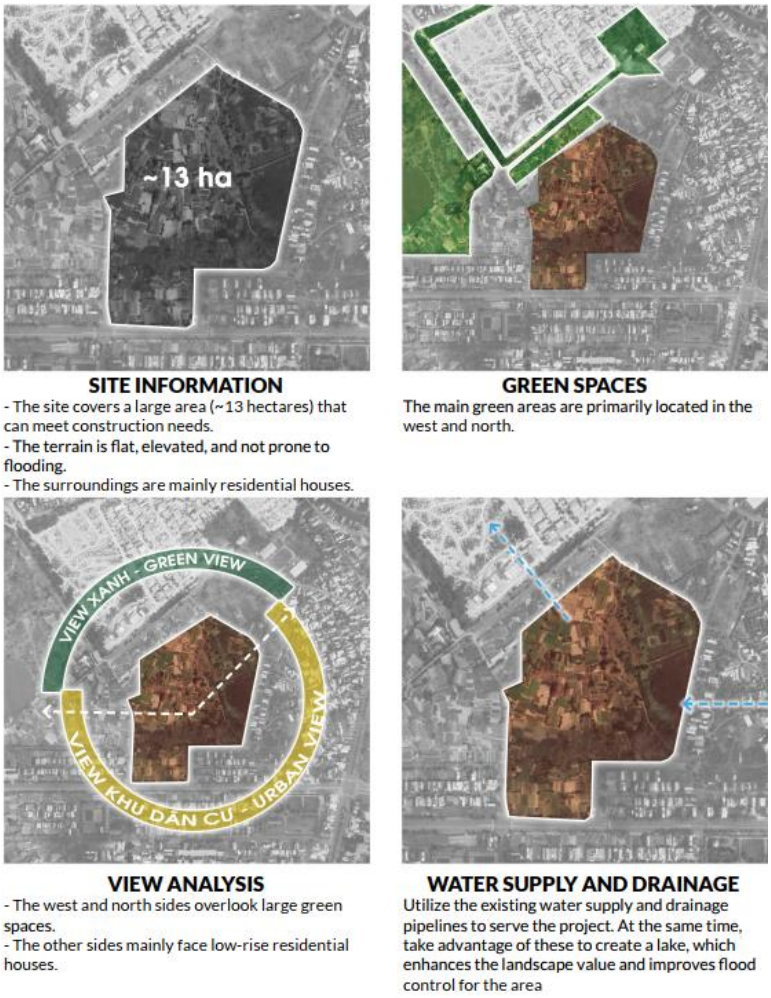



Figure 6: Surrounding elements of the site

**Climate:**

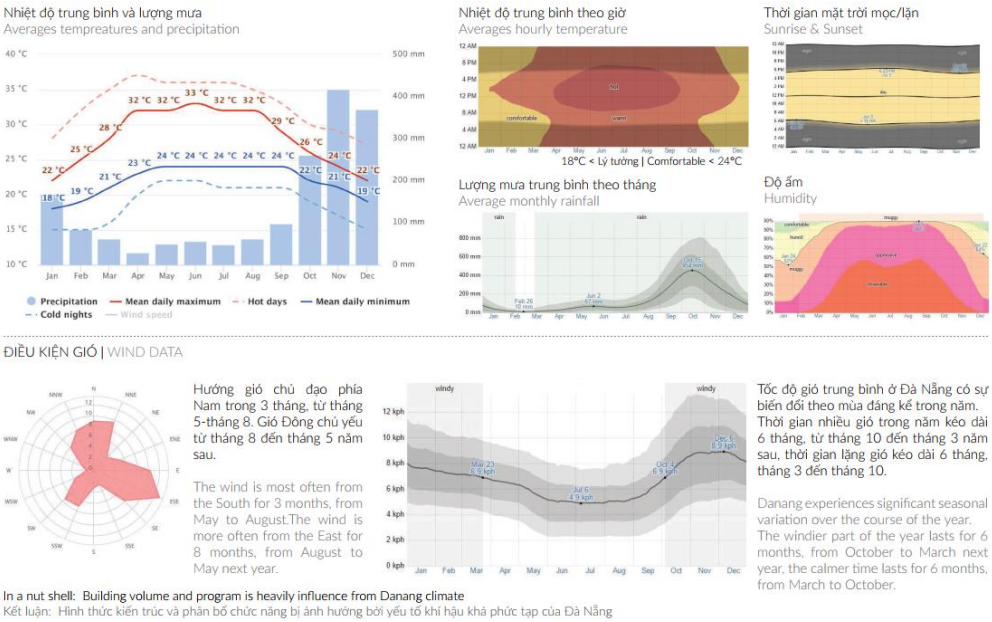



Figure 7: Climate analysis

## 2.5 Site Analysis (Strengths, Weaknesses, etc.)

**Strengths:**

- Conveniently located near Vo Chi Cong and major roads, ensuring easy access to the city center and surrounding areas.

- A contiguous 13–15 ha plot with minimal subdivisions, suitable for complex master planning.

- Eastern areas (FPT City, Hoa Quy) are rapidly growing, boosting land value and investment potential for unique projects.

- Surrounded by farmland and rural scenery, offering potential for urban farming or eco-park concepts.

**Weaknesses:**

- Current use includes farmland, sandy hills, small residences; requires compensation and land-use conversion, which can be time-consuming.

- Sandy or agricultural soil may be weak; requires detailed geotechnical surveys for proper foundation solutions.

**Opportunities:**

- The city's "green, sustainable" agenda favors rainwater-focused projects, likely attracting policy support.

- Connects with FPT City, coastal tourism, forming a destination network and a research–education nucleus.

- Improves infrastructure, creates jobs (tourism, research), enhances microclimate, and mitigates flooding via retention lakes.

**Threats:**

- The city has numerous parks and resorts; the project must be innovative (rainwater theme) to stand out.

- It's required a unique design, forming a landmark building, being the face of the city.

# CHAPTER 3: DESIGN SOLUTIONS

## 3.1 Detailed Design Tasks

### ADMINISTRATIVE BLOCK

| No. | Room name | Quantity | Area/room (m2) | Height (m) |
|---|---|---|---|---|
| 1 | Director's Office | 1 | 25 | >2.4 |
| 2 | Deputy Director's Office | 2 | 25 | >2.4 |
| 3 | Large Meeting Room | 1 | 48 | >2.4 |
| 4 | Open Office | 1 | 472 | >2.4 |
| 5 | Small Meeting Room | 3 | 33 | >2.4 |
| 6 | Document Storage Room | 1 | 11 | >2.4 |
| TOTAL | | 9 | 705 | |

Table 1: Design tasks for the administrative block

### RESEARCH & EDUCATION BLOCK

| No. | Room name | Quantity | Area/room (m2) | Height (m) |
|---|---|---|---|---|
| 1 | Loading Lobby | 1 | 38 | >3 |
| 2 | Ingredient Storage | 1 | 41 | >3 |
| 3 | Food Preparation Kitchen | 1 | 11 | >3 |
| 4 | Reheating & Serving Area | 1 | 44 | >3 |
| 5 | Beverage & Order Counter | 1 | 67 | >3 |
| 6 | Canteen | 1 | 733 | >3 |
| 7 | Coffee Shop | 1 | 450 | >3 |
| 8 | Technical Room | 6 | 27 | >3 |
| 9 | General Reading Room | 1 | 65 | >3 |
| 10 | Expert Reading Room | 2 | 34 | >3 |
| 11 | Computer Search Area | 1 | 34 | >3 |
| 12 | Group Study Room | 2 | 30 | >3 |
| 13 | Book Storage | 1 | 40 | >3 |
| 14 | Research Office | 2 | 74 | >3 |

| | | | | |
|---|---|---|---|---|
| 15 | Expert Room | 4 | 34 | >3 |
| 16 | Meeting Room | 2 | 56 | >3 |
| 17 | Microbiology Lab | 1 | 202 | >3 |
| 18 | Water Chemical-Physical Analysis Lab | 1 | 261 | >3 |
| 19 | Hydrology Simulation Lab | 1 | 300 | >3 |
| 20 | IoT Lab | 1 | 192 | >3 |
| 21 | Multipurpose Room | 1 | 235 | >3 |
| 22 | Preparation Room | 2 | 40 | >3 |
| 23 | Recreation Room | 1 | 106 | >3 |
| 24 | Gym | 1 | 152 | >3 |
| 25 | Men's Changing Room | 1 | 15 | >3 |
| 26 | Women's Changing Room | 1 | 15 | >3 |
| 27 | Teachers' Refreshment Room | 1 | 17 | >3 |
| 28 | Practice Room | 3 | 100 | >3 |
| 29 | Storage Room | 3 | 24 | >3 |
| 30 | Self-Study Area | 1 | 154 | >3 |
| 31 | Lecture Room | 4 | 52 | >3 |
| 32 | Creativity Room | 1 | 114 | >3 |
| 33 | Staff Rest Room | 2 | 57 | >3 |
| 34 | Medical Room | 1 | 67 | >3 |
| 35 | Auditorium (300 seats) | 1 | 288 | >7 |
| 36 | Secondary Auditorium (100 seats) | 1 | 137 | >3 |
| 37 | Chair Storage | 1 | 11 | >3 |
| 38 | Equipment Storage | 1 | 117 | >3 |
| 39 | Restroom (Male/Female) | 18 | 30 | >3 |
| TỔNG CỘNG | | 77 | 5906 | |

Table 2: Design tasks for the research & education block

## EXHIBITION & MUSEUM BLOCK

| STT | Phòng/Khu | Số lượng | Diện tích/phòng ($m^2$) | Chiều cao (m) |
|---|---|---|---|---|
| 1 | Khu ăn uống (nhà hàng ~100–120 khách) | 1 | 400 | >3 |
| 2 | Khu soạn, bếp | 1 | 80 | >3 |
| 3 | Café – giải khát (ven hồ) | 1 | 150 | >3 |

| | | | | |
|---|---|---|---|---|
| 4 | Quầy lưu niệm, gian hàng xanh | 1 | 60 | >2.4 |
| 5 | Phòng quản lý dịch vụ | 1 | 20 | >2.4 |
| 6 | Kho lạnh, kho khô (mỗi loại) | 2 | 30 | >2.4 |
| 7 | WC (nam/nữ) | 1 | 50 | - |
| 8 | Sảnh nhập (vận chuyển thực phẩm, hàng hóa) | 1 | 30 | - |
| 9 | Phòng nghỉ nhân viên | 1 | 40 | - |
| 10 | Phòng y tế mini | 1 | 12 | >2.4 |
| 11 | Hành lang, khu phụ trợ | - | - | - |
| TỔNG CỘNG | | 11 | 872 | |

Table 3: Design tasks for the exhibition & museum block

## TECHNICAL & UTILITIES BLOCK

| No. | Room name | Quantity | Area/room (m2) | Height (m) |
|---|---|---|---|---|
| 1 | Central Control Room (SCADA) | 1 | 70 | >2.4 |
| 2 | Main Server Room (IT) | 1 | 54 | >2.4 |
| 3 | Security Camera Room | 1 | 54 | >2.4 |
| 4 | Transformer Station | 1 | 54 | >2.4 |
| 5 | Backup Generator Room | 1 | 54 | - |
| 6 | Water Engineering Room (Water Tank, Pump) | 1 | 54 | >3 |
| 7 | Local Wastewater Treatment Room | 1 | 54 | - |
| 8 | Central Air Conditioning Room | 1 | 90 | - |
| 9 | Fire Protection and Alarm Room | 1 | 95 | - |
| 10 | Maintenance Tools Storage, Engineer Room | 1 | 90 | - |
| 11 | Low Voltage Electrical Room | 1 | 43 | - |
| TỔNG CỘNG | | 11 | 712 | |

Table 4: Design tasks for the technical & utulities block

## OUTDOOR YARDS & PARKING

| No. | Room name | Quantity | Area/room (m2) | Height (m) |
|---|---|---|---|---|
| 1 | Car Parking Lot (100–150 spaces) | - | 3.000–4.000 | - |

| | | | | |
|---|---|---|---|---|
| 2 | Motorbike Parking Lot (300–500 spaces) | - | 1.000–1.500 | - |
| 3 | Resting Spots, Hardscape Yard | - | ~500 | - |
| 4 | Internal Roads, Sidewalks, Landscaping | - | - | - |

Table 5: Design tasks for Outdoor yards & parking

**RAINWATER PARK & WETLAND AREA**

| No. | Room name | Quantity | Area/room (m2) | Height (m) |
|---|---|---|---|---|
| 1 | Regulating Pond, Wetland Zone | 1 | 50000 | - |
| 2 | Walking Paths, Walkways, Landscaping Features | - | ~10.000 | - |
| 3 | “Sponge City” Demonstration Area | 1 | 350 | - |
| 4 | “Water Science Experience” Zone | 1 | 350 | - |
| 5 | Aquaponics Area | 1 | 350 | - |
| 6 | Artistic Aquatic Garden | 1 | 350 | - |
| 7 | Water Puppetry Performance Zone | - | 350 | - |
| 8 | Sân cỏ, bãi trống cho sự kiện ngoài trời | - | 2000 | - |

Table 6: Design tasks for rainwater park & wetland area

## 3.2 Design Concept

### *3.2.1 General Concept*

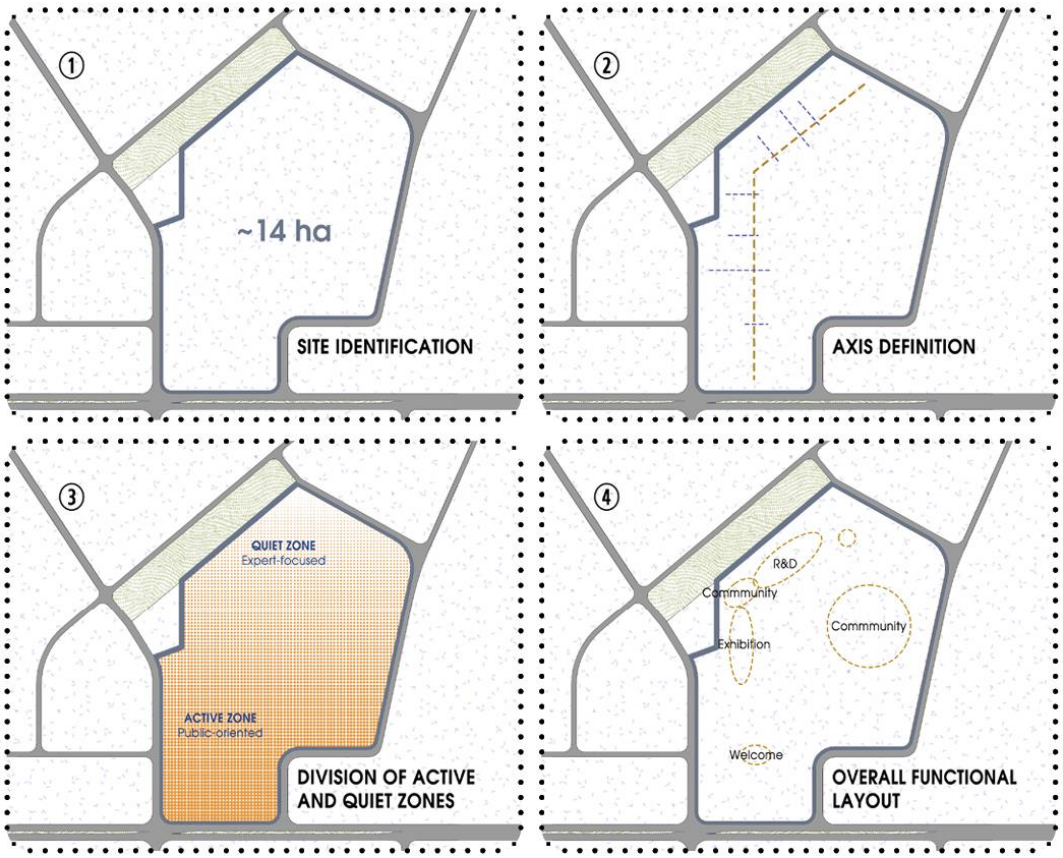
The project "Water Resources Research & Rainwater Park Complex" combines scientific research with public education. The main idea is to create a space for learning, innovation, and experience about water. This complex helps people understand the value of water and solutions for water problems like floods, droughts, and pollution caused by climate change and fast urban growth.

It follows the "Sponge City" concept, using green spaces and smart water systems to slow, store, and reuse rainwater. The project includes areas for science,

exhibitions, performances, and outdoor learning. It aims to connect experts and the public through water-related activities.

### *3.2.2 Massing Concept*

The building layout uses both straight and curved lines to show balance between technology and nature. The buildings are arranged along movement paths and views. The massing creates an open space in the middle with a man-made lake, which helps with climate control and creates a nice view. Each block is placed to allow easy movement, interaction, and natural light.



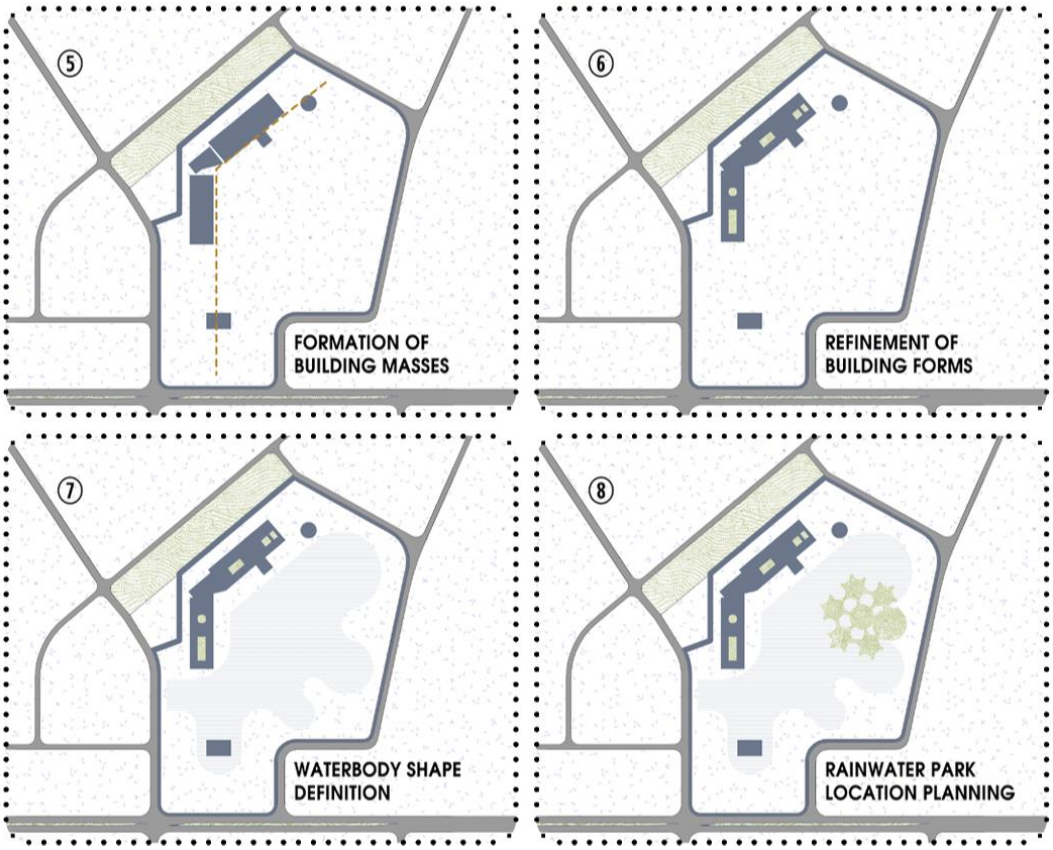



Figure 8: Steps in developing the layout concept

### 3.3 General Site Planning Solution

The total land area is divided as follows: over 69% is green space and water surface; construction area is just over 10%. The plan separates two main paths:

- One for researchers (experts)
- One for visitors (public)

These two paths meet at a central zone: the **Rainwater Park**, where outdoor events, exhibitions, and performances happen. This strategy helps people learn about water while enjoying the space. Supporting zones include parking lots, boat docks, and a solar energy field.


Figure 9: Master plan

## 3.4 Spatial Organization and Floor Plan Design

The complex has four main functional zones:

**Research & Education Block** – 4 floors with labs, offices, and testing areas for water management.

**Exhibition Block** – rotating and permanent displays, science experiences, and media rooms.

**Observation Tower** – a vertical landmark with views of the whole area.

**Rainwater Park** – includes water puppet theater, artistic aquatic garden, aquaponics, Sponge City demo area, and water science play zones.

Paths and bridges connect these areas. The experience moves from observing to learning to participating.

### *3.4.1 Research & Education Block*

**Ground floor**: administrative offices, a canteen-cum-café, and technical rooms. Small inner courtyards improve natural ventilation and daylight.

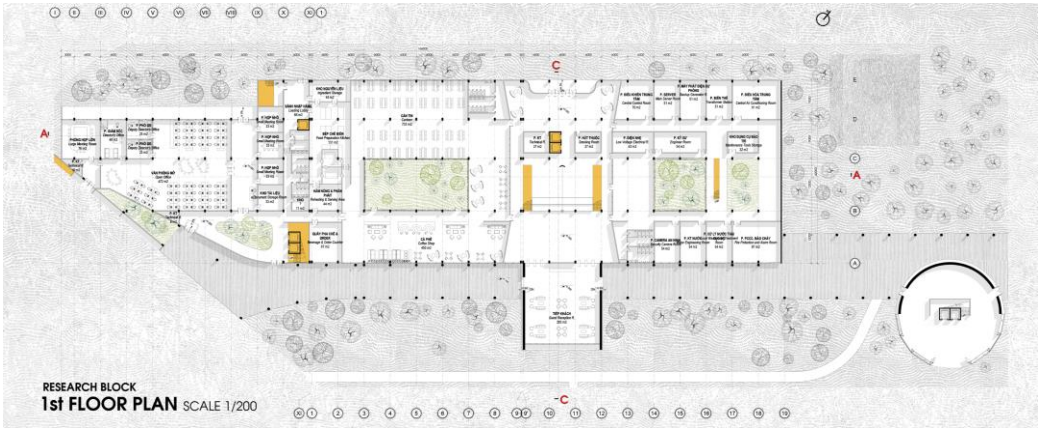



Figure 10: Research block - ground floor plan

**Second floor**: a specialist library connected to the main research laboratories.

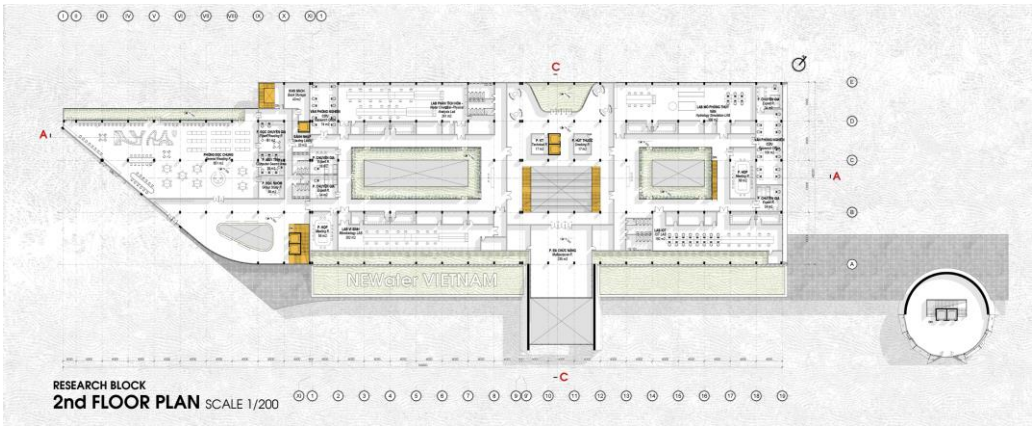



Figure 11: Research block – 2nd floor plan

**Third floor**: the academic zone, with conference rooms, an auditorium, and theory-plus-practice classrooms for visiting students. Staff facilities—such as a lounge and a gym—are also placed here.

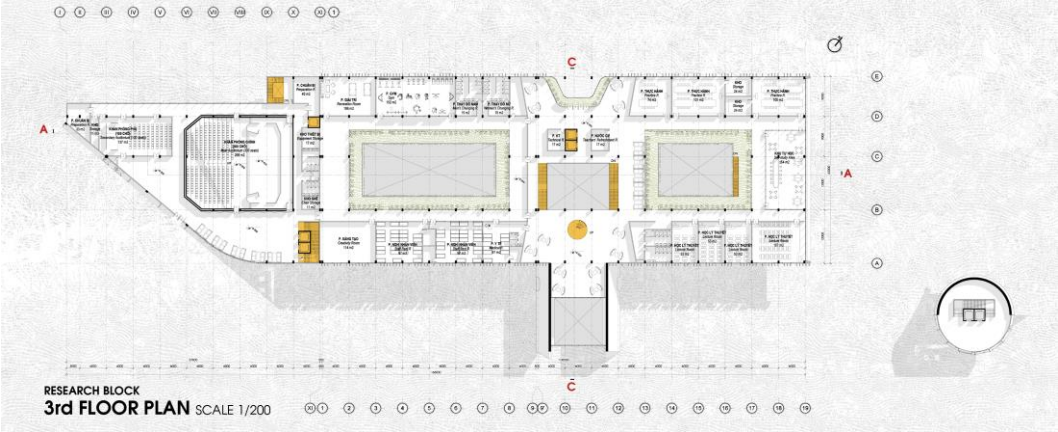



Figure 12: Research block – 3rd floor plan

**Fourth floor**: support rooms for the auditorium—AV control, storage for stage equipment, and event logistics areas. Above them lies an extensive **green roof** that insulates the building, absorbs rainwater, and offers a small eco-garden for relaxation, outdoor classes, and community workshops, while also helping to lessen the urban heat-island effect.

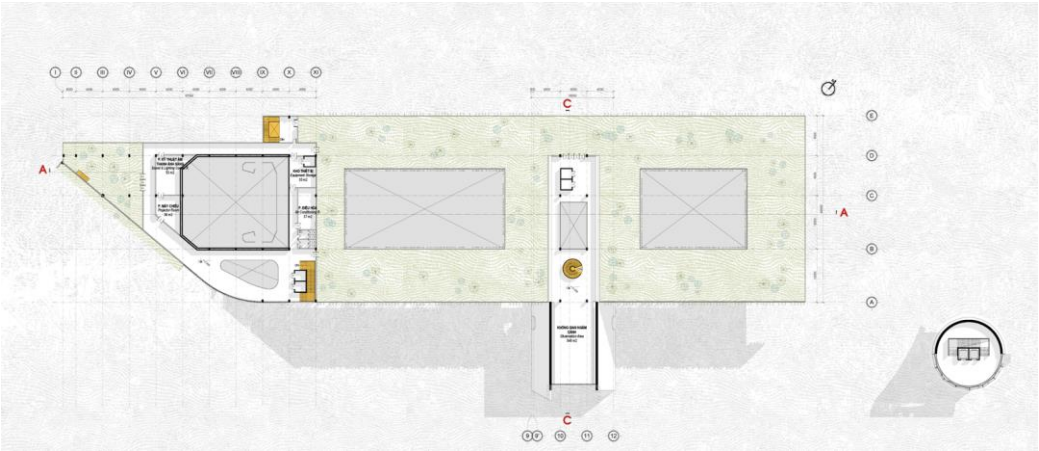


Figure 13: Research block – 4th floor plan

### *3.4.2 Exhibition Block*

**Ground floor**: A ceremonial lobby sits at the base of a striking glass cylinder, serving as the main welcome space. Around it are rotating exhibition areas that

change seasonally and the museum's management offices. The open layout links directly to the outdoor landscape, providing wide views and generous daylight.

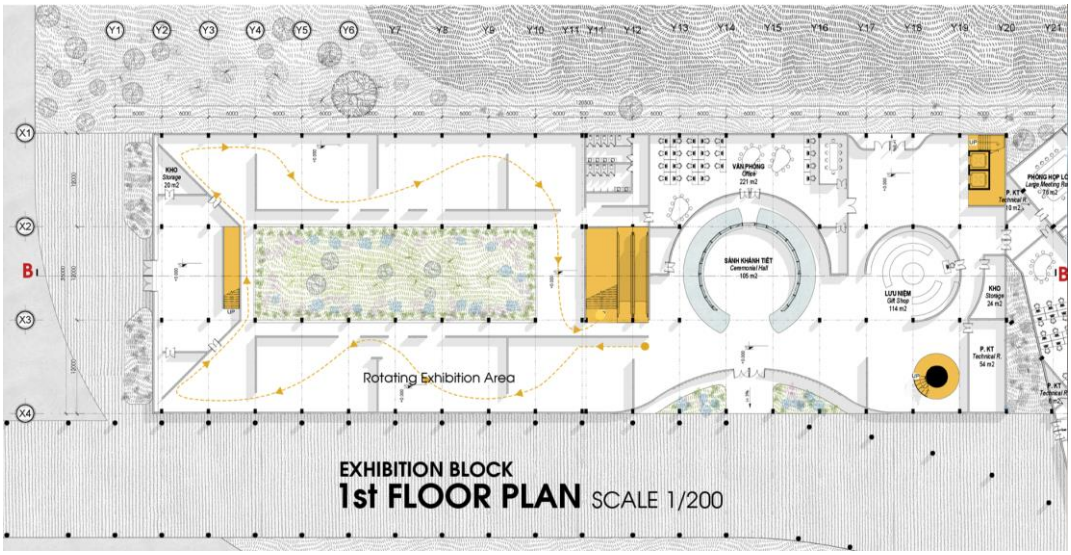



Figure 14: Exhibition block - Ground floor plan

**Second floor**: The main display level offers permanent galleries on different themes: history of water use, Sponge City technology, aquatic biodiversity, and new water-management innovations. Interactive models and digital screens create an engaging visitor experience.

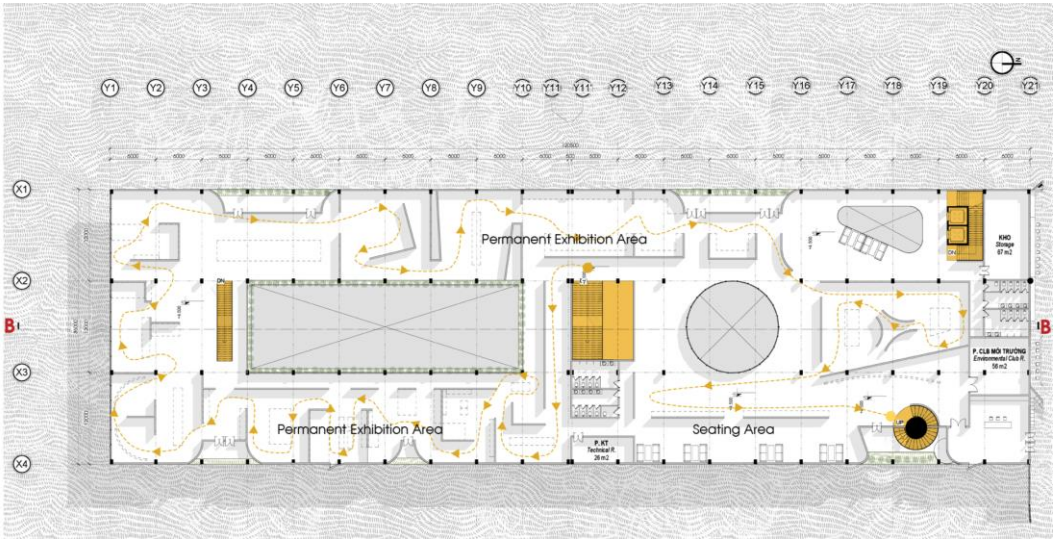



Figure 15: Exhibition block – 2nd floor plan

**Third floor**: A small cinema shows documentaries on world water cultures, climate-change impacts, river stories, and sustainable design solutions. A second

rotating exhibition zone presents the latest research findings, student projects, and community art focused on water and sustainability.

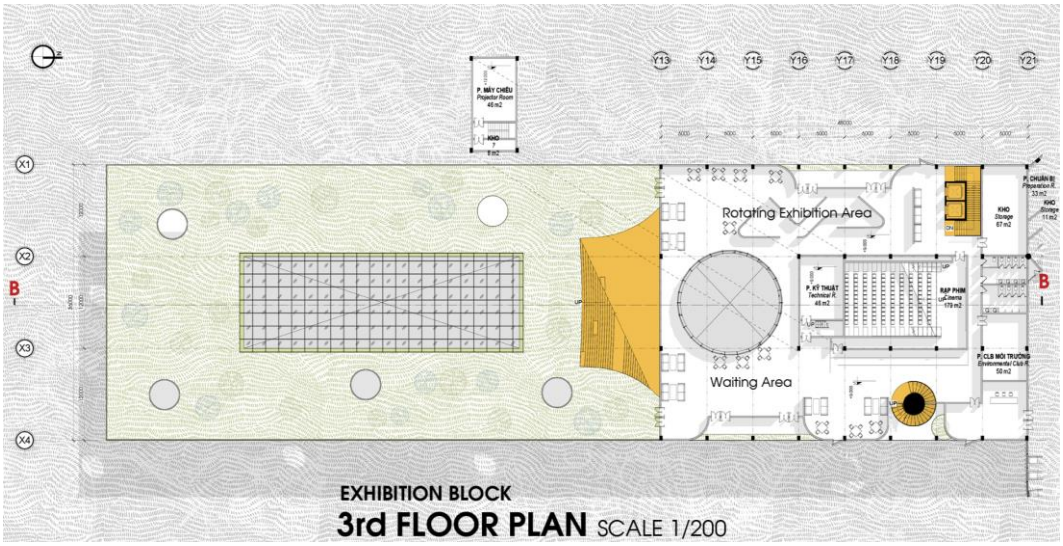



Figure 16: Exhibition block – 3rd floor plan

### *3.4.3 Rainwater Park*

**9A Outdoor gathering lobby** – starting point linking all lake-side paths.

**9B Fountain plaza** – event space with water shows; permeable paving.

**9C Water science zone** – cycle-of-water models and live IoT sensors.

**9D Sponge City demo** – rain gardens, sample green roofs, porous trenches.

**9E Artistic aquatic garden** – floating walkway over a natural filter pond.

**9F Aquaponics area** – fish-and-vegetable loop showing water-saving farming.

**9G Water-puppet stage** – traditional shows on the central lake, tying culture to water themes.

A ring path around the lake guides visitors smoothly through each stop.

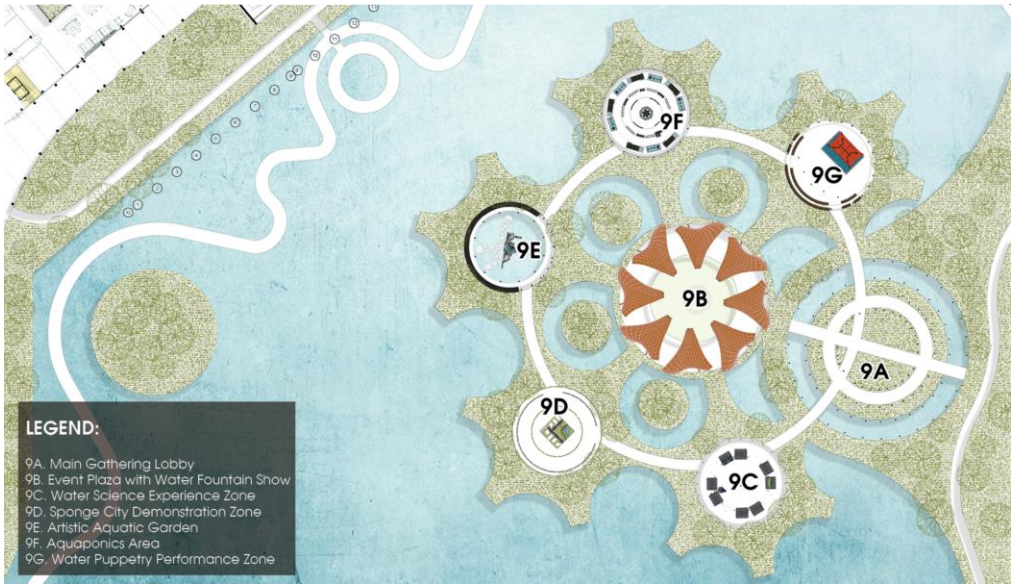



Figure 17: Rainwater park plan

## 3.5 Elevation Design Solution

The building's facade uses **sun-shading louver panels and perforated metal** to reduce heat and allow natural airflow. Shapes on the outside are inspired by water patterns—waves, drops, and flow—creating a feeling of movement and peace. The design is friendly, open, and sustainable.


Figure 18: Elevation I-19


Figure 19: Elevation Y1-Y21

## 3.6 Interior Design Solution

Interior spaces use **natural light** through skylights and open corridors

Figure 20: Courtyard and skylight space

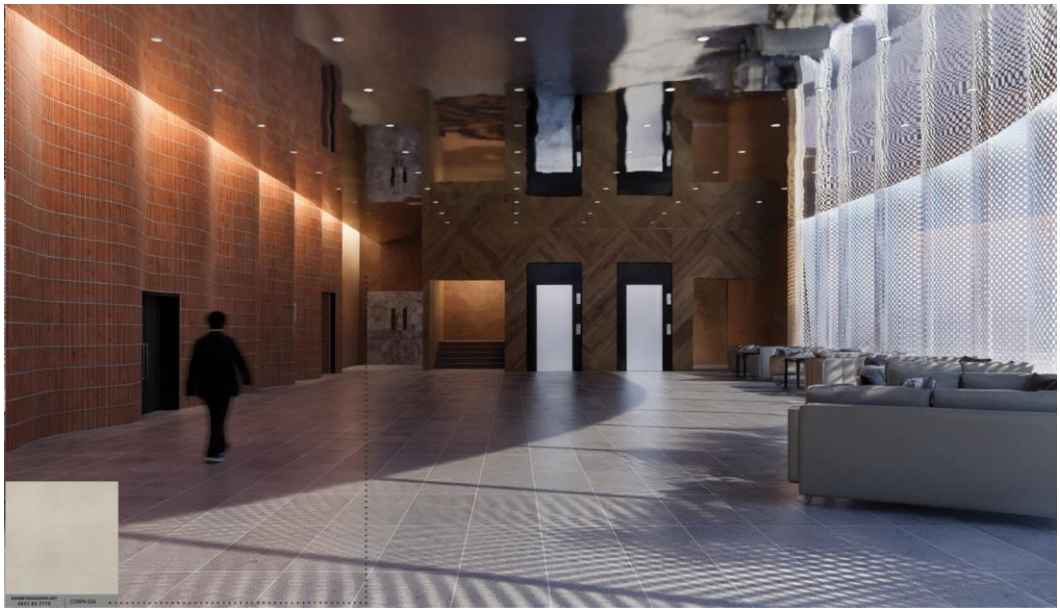


Figure 21: Auditorium lobby space

Figure 22: Central staircase space

Figure 23: Museum center space

Exhibition rooms use curved projection screens, modern projectors, and LED lights to make science content fun and easy to understand. Materials are simple, warm, and clean.


Figure 24: Exhibition room

### 3.7 Technical Design Solutions

Façade structure detail: This assembly fuses energy efficiency with biophilic strategies. External louvers and Low-E glass moderate solar gain, while the green roof and integrated planters enhance biodiversity and provide passive cooling. The steel-and-concrete hybrid frame ensures structural robustness and ease of maintenance. Together, these layers create a high-performance façade that is both

climate-responsive and visually coherent with the overall “water-and-greenery” concept of the complex.

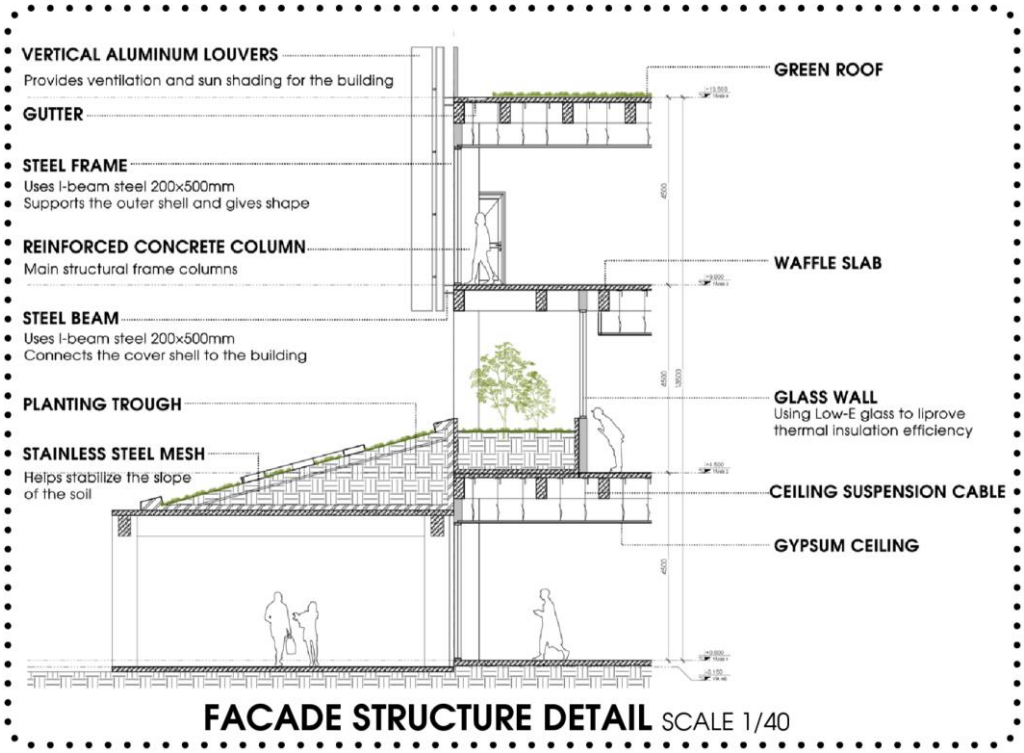



Figure 25: Facade structure detail

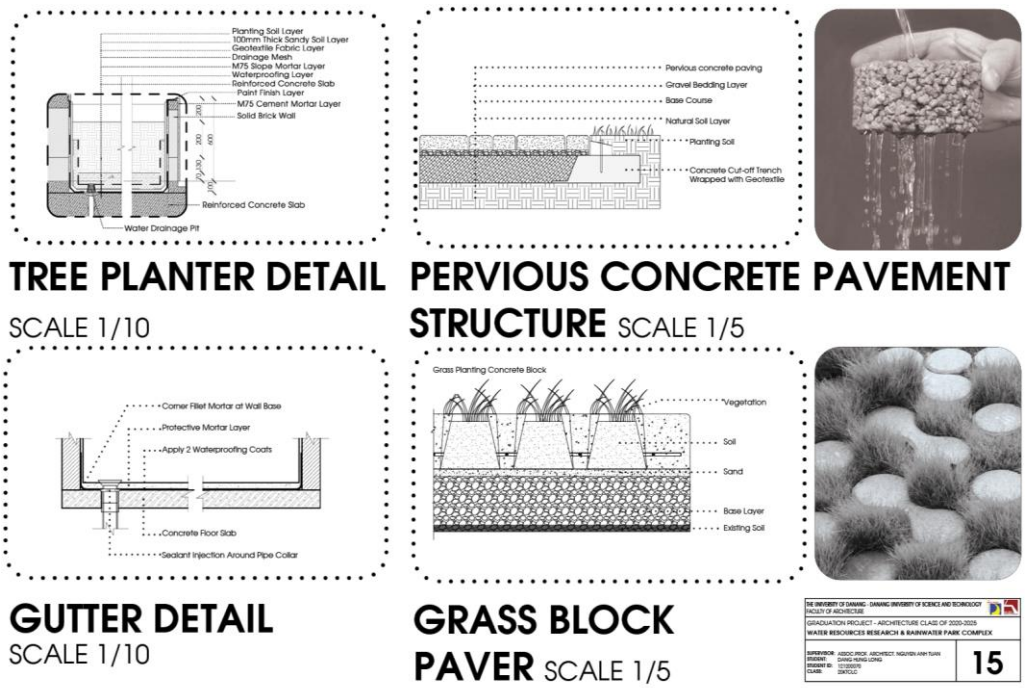



Figure 26: Other details

# CHAPTER 4: CONCLUSION

In the context of Da Nang – a coastal city – facing constant problems like flooding, drought, and water pollution, the project **"Rainwater Park & Water Resource Research Center Complex"** is a multi-dimensional response: scientific, cultural, and ecological. This project shows that when we see rainwater not as a "risk" but as a "resource," we can design spaces for learning, experience, and creativity—where communities and experts work together to solve water challenges now and in the future.

## 4.1 Các kết quả chính của đồ án

**A 14-ha "Sponge Campus" masterplan**: includes detention ponds, rain gardens, green roofs; green and water surfaces cover ~70% of the site.

**Clear functional zones**: "quiet zone" for research, and "active zone" for public education, connected through a central landscape axis.

**Unique architecture & landscape design**: research block, exhibition block, observation tower, and water puppet stage create strong identity.

**Sustainable technical solutions**: vertical aluminum shading, Low-E glass facade, pervious pavement, IoT-based rainwater monitoring, and waffle slab to reduce materials.

**Integrated construction details**: sections for green roofs, sloped planting, and systems for rainwater collection – drainage – reuse.

**Interactive user journey**: 7 themed experience zones, music fountain & water puppet show, outdoor science workshops.

**Initial impact assessment**: 30% reduction in runoff, cooler surface temperature, and higher local biodiversity.

## 4.2 Strengths and Limitations

### *4.2.1 Strengths*

**Clear climate adaptation strategy**

The “sponge campus” planning includes retention ponds, rain gardens, and pervious surfaces that help reduce surface runoff, improve microclimate, and increase flood resistance in the area.

**Distinctive architectural language**

The combination of the “quiet” research block and the “active” exhibition block, along with the observation tower and water puppet stage, creates a unique identity that blends local culture with modern technology.

**Eco-friendly technical solutions**

The Low-E glass facade, vertical aluminum sun-shading system, green roofs, and rainwater-monitoring IoT system are all integrated with the waffle slab structure. These help save energy and optimize material usage.

**Seamless public experience**

The visitor path through seven experience zones, with science workshops and music fountain events, turns the complex into an outdoor classroom. It promotes STEAM education and raises awareness about water resources.

### *4.2.2 Limitations*

**Need for deeper hydrological modeling**

The performance of rain gardens and retention ponds under 50–100-year extreme rainfall scenarios still requires detailed hydraulic simulations to confirm effectiveness.

**High initial investment pressure**

Large building volumes, high-end materials (e.g., Low-E glass, green systems), and IoT devices lead to high construction costs. The project may need staged investment or public-private partnerships.

**High operation and maintenance demand**

Green roofs, rainwater sensors, and the music fountain system need trained technical teams for regular maintenance to ensure long-term performance.

**Financial sustainability of education programs**

Exhibitions, workshops, and community events need stable funding. Without a dedicated maintenance and operations fund, the long-term vitality of the project could be affected.

### 4.3 Recommendations and Proposals

**Detailed feasibility study**: complete hydraulic and structural simulations, cost–benefit analysis, and propose phased investment plan.

**Pilot small-scale zones**: start with rain gardens – green roofs – retention ponds to test effectiveness and attract funding.

**Cross-sector collaboration**: connect universities, water tech companies, and local government to share data, run IoT systems, and develop STEAM education programs.

**Policy & maintenance fund**: suggest tax incentives for green materials; create a fund for landscape, green roof, and sensor system maintenance.

**Community outreach**: develop AR/VR apps showing the water cycle; organize an annual "Water & City Day" to promote sustainable living.

With its contributions in green planning, water technology, and public education, this project offers a model for Vietnam's coastal cities to **adapt to climate change**, and shows the **potential of rainwater as an opportunity** for sustainable development.

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