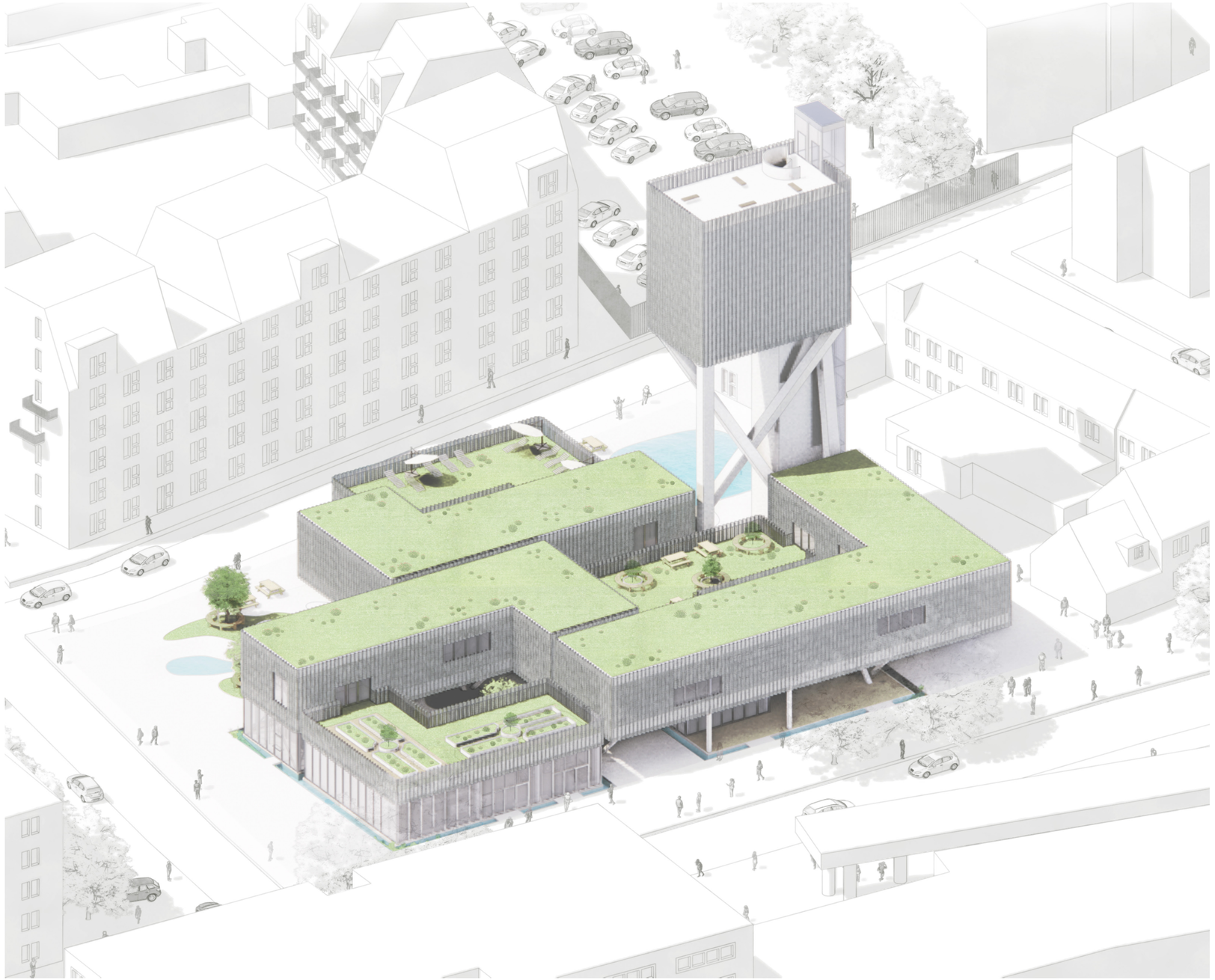


P5 Presentation

17/06/2025 | P4 PRESENTATION

THE WATER HUB

Celebrating diversity through a Water Infrastructure

JOYCE DE LOUW
5326486

PAUL KUITENBROUWER
STEFANO CORBO
ELINA KARANASTASI

PUBLIC BUILDING
GRADUATION STUDIO

Figure 1: Significant flooding in Kłodzko, Poland (September 2024)

Figure 2: Significant flooding in Pas-de-Calais, northern France (January 2024)

Figure 3: Significant flooding in Valencia, Spain (October 2024)

Figure 4: Significant flooding in Ostrava, Czech Republic (September 2024)

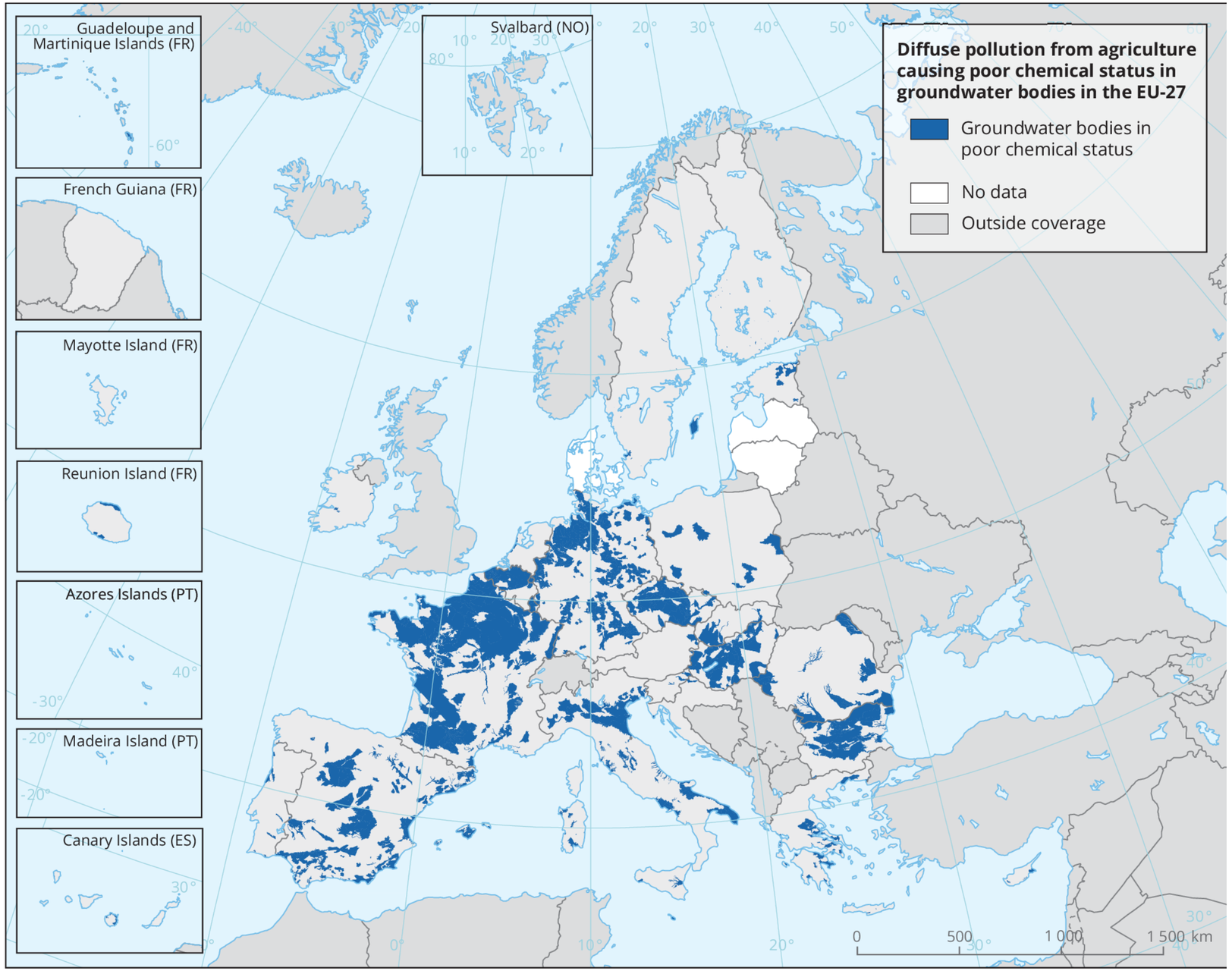
"As climate change unfolds in Europe, managing flood risk become increasingly important. Intense rainfall has already increased in parts of Europe. Flooding affects human well-being and ecosystems, with potential loss of life and significant economic losses."[1]

Europe's State of Water Report

Figure 5: Social media platforms can produce echo-chambers, which lead to polarization and can encourage the spread of false information[3]

"Europeans overestimate both the number of immigrants residing in Europe and the proportion of illegal migrants. This can be explained by the way media report on immigration and integration matters."[2]

European Commision Report



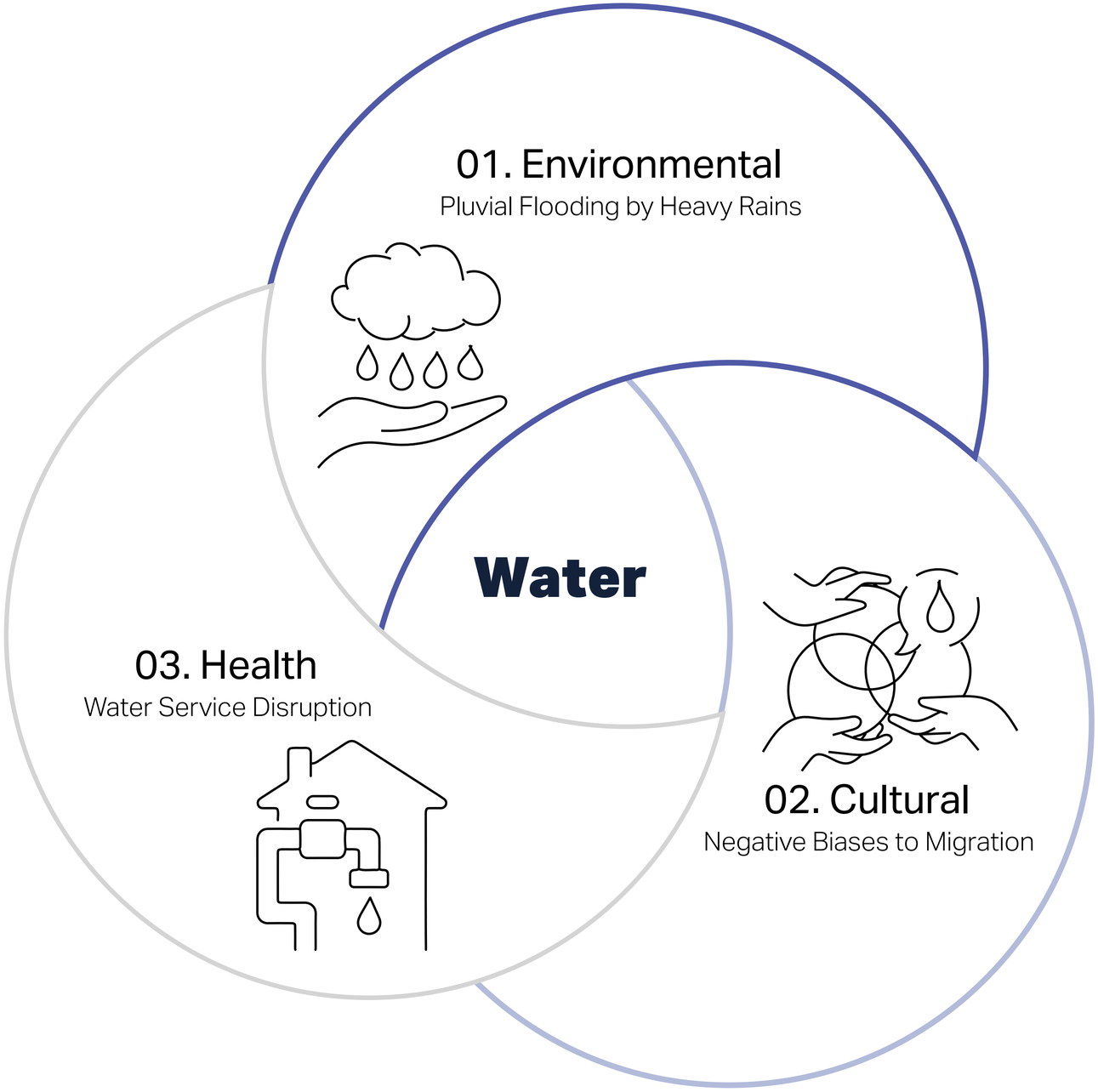
Reference data: ©ESRI | ©EuroGeographics

Figure 6: Groundwater bodies of poor chemical status in Europe[4]

"Urgent action is required to improve Europe's water resilience. Climate change is disrupting weather patterns and further increasing pressures on our water resources. Europe's water management practices are poorly adapted to cope with such rapid and large-scale change."[1]

Europe's State of Water Report

So, ***why*** water as a common theme?



However, these problems all share a unique relation with water. Architecture can tackle these three problems on environmental, cultural and health levels through water as common theme.

Disruption, Water & Architecture

A public condenser providing an accessible water infrastructure can overcome health problems.

Flooding, Water & Architecture

A public condenser can collect and reuse rainwater to overcome environmental problems.

Biases, Water & Architecture

A public condenser can celebrate water as a common ground between different cultural groups to overcome cultural problems.

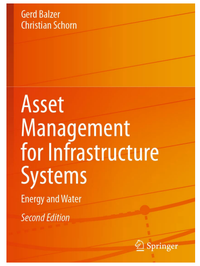
“How can a public condenser celebrate cultural variety through water and at the same time provide a water infrastructure for the neighborhood in Nordvest, Copenhagen?”

This research question will be answered by focusing on all the three issues (environmental, cultural and health) and answering the following sub questions:

1. How can rainwater be collected through design in architecture?

2. How do different cultures use water as a common ground in architecture?

3. How can architecture provide water accessibility to address neighborhood issues?



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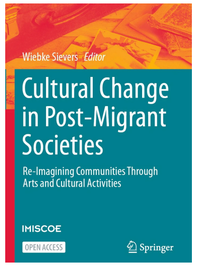

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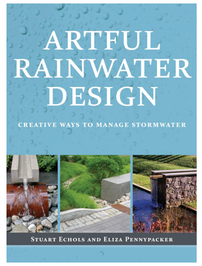

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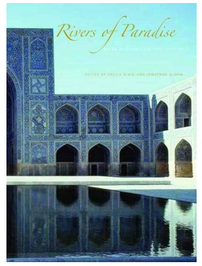

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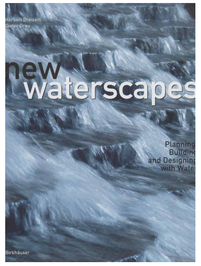

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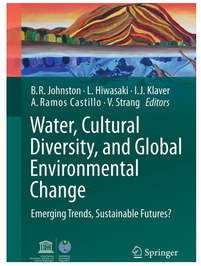
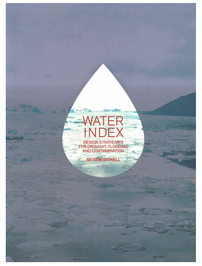


Johnston, B. R., & Hiwasaki, L. (2012). *Water, cultural diversity, and global environmental change : emerging trends, sustainable futures?* UNESCO ; Springer. http://site.ebrary.com/id/10520158



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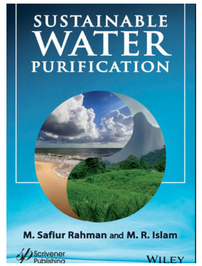

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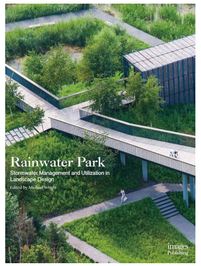

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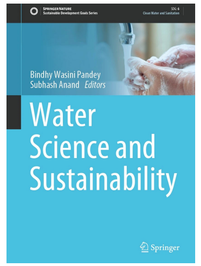

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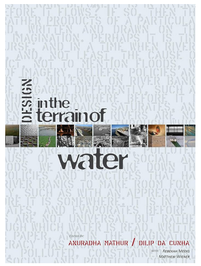

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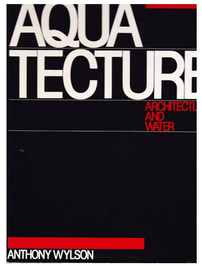

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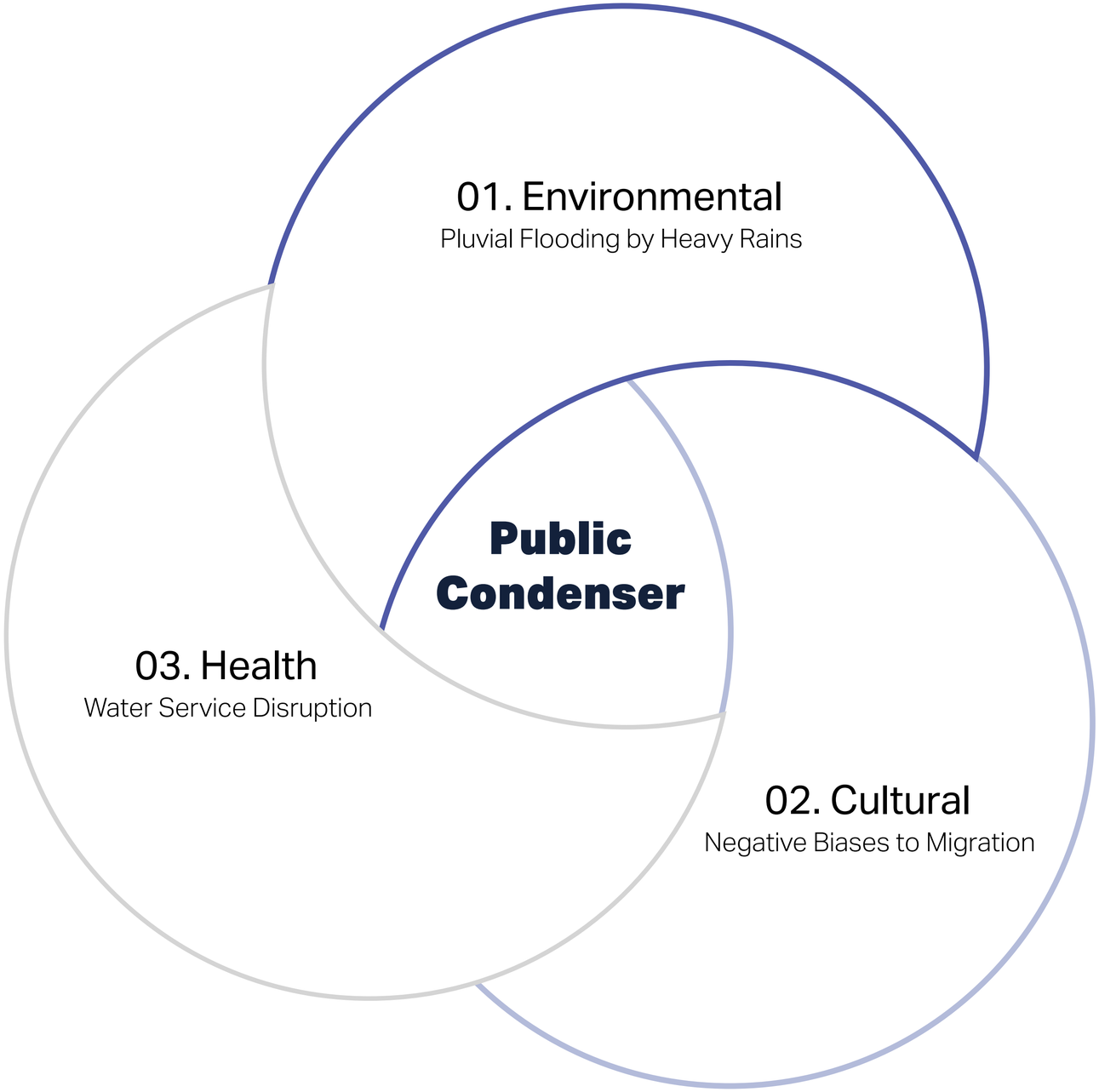
This proposal is a combination between quantitative (literature review) and qualitative (case study examples) research, leading to a multi-method approach. Above this, the research that I am conducting is also defined by my studio's approach: "research by design".

So, ***why*** is it applicable for this location?



In the last two decades, Copenhagen and its city authorities have also been experiencing problems with pluvial flooding, negative biases to migrants and water service disruption. These problem statements are touching three different levels: environmental, cultural and health.

Figure 7: Nordvest, Copenhagen

Figure 8: Nordvest, Copenhagen

The site is located in Nordvest, a district 5–8 km Northwest from Copenhagen's city center with approximately 56 000 residents. It features repurposed and in-use (post-)industrial buildings and social housing, much of it built between the 1930s and the 1960s.[5] Focusing on Nordvest, all three environmental, cultural and health problems are extremely applicable.

Figure 9: Nordvest, Copenhagen

Figure 10: Nordvest, Copenhagen

Why? Environmental

Figure 11: Water Drainage Management in Copenhagen as one of the implementations of the Copenhagen's Cloudburst Management Plan[10]

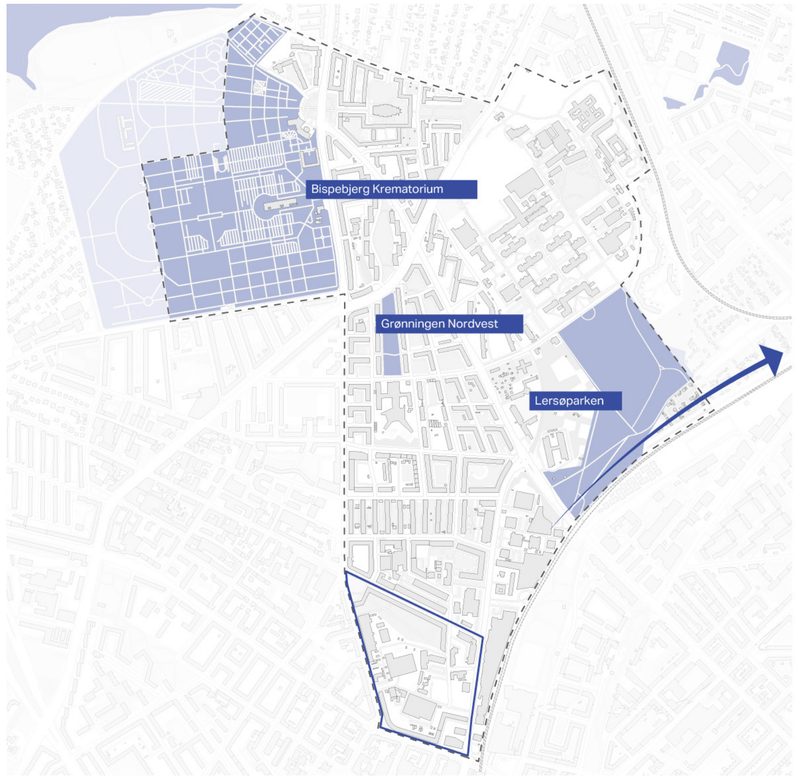


Figure 12: The water drainage management and the surface level projects as current implementations in Nordvest[9]

Copenhagen

- In the summer of 2011, Copenhagen faced the most devastating cloudburst in its history[6];
- Copenhagen's Cloudburst Management Plan is a comprehensive strategy aimed at tackling the growing threat of extreme rainfall and urban flooding[7];
- This plan consists of an expansion of the sewer network, but also prioritizes 300 surface-level projects[6].

Nordvest

- The surface-level projects in Nordvest were not prioritized in timeline as the district is higher in elevation[6];
- Rikke Larsen: "It is even more important to control the flooding before the water goes down"[8];
- Two surface projects are realized in Nordvest, and the one is in development[9];
- However, these surface projects are not located on the site of our plot.

Why?
Cultural

Figure 15: Women getting water for ablutions, Mausoleum of Moulay Idris II, Fes, Morocco, Photograph courtesy of Charles O. Cecil / Alamy Stock Photo.

Figure 16: Percentages of residents with a non-Western background in Bispekvarteret and Bispeparken[13]

Copenhagen

- The Ghetto plan has received a lot of criticism that it is discriminatory and potentially racist in its targeting of non-Western immigrant communities[10];
- Research shows that three in four Danes believe that integration is far less successful than facts show[11];
- Non-western individuals revealed that 84% have personally experienced illegal discrimination[12].

Nordvest

- Over a quarter of the residents in the Bispekvarteret have a non-Western background, compared to 15 percent[13];
- Nordvest is experiencing increasing gentrification, leading to significant and often unnecessary cultural displacement[14];
- Non-Western residents feel that the “Ghetto” plan is meant to isolate and scatter them[15].

Why?
Health

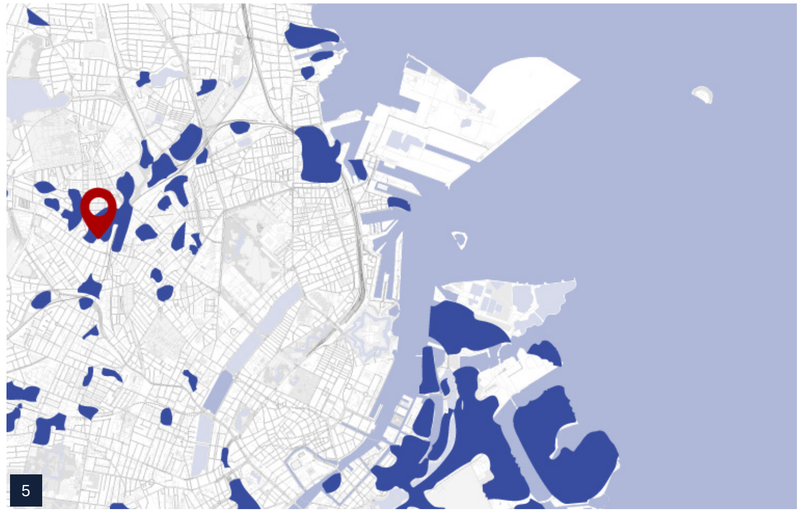


Figure 13: Polluted sites in Copenhagen that serve for groundwater[17].

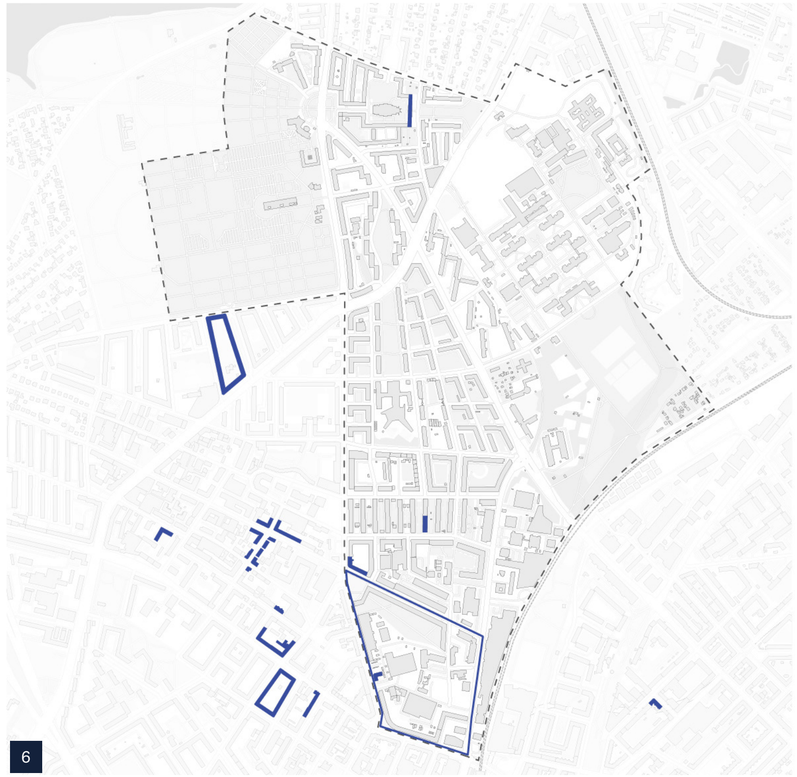


Figure 14: Residential places in the neighborhood of Nordvest that are currently lacking either a bath or a toilet, or both[13]

Copenhagen

- More than half of Denmark's drinking water resources are contaminated with toxins[16];
- In Denmark, all drinking water is produced from groundwater[17];
- However, several sites are polluted because of its industrial harbour history[17].

Nordvest

- Nordvest also deals with the problem of polluted sites[17];
- Above this, Nordvest is an older urban area with several buildings that do not meet today's standards[13];
- Some properties in the area are currently lacking either a bath or a toilet, or both[13].

So, ***what*** do we want to build?

The Common Ground

What?
The Common Ground

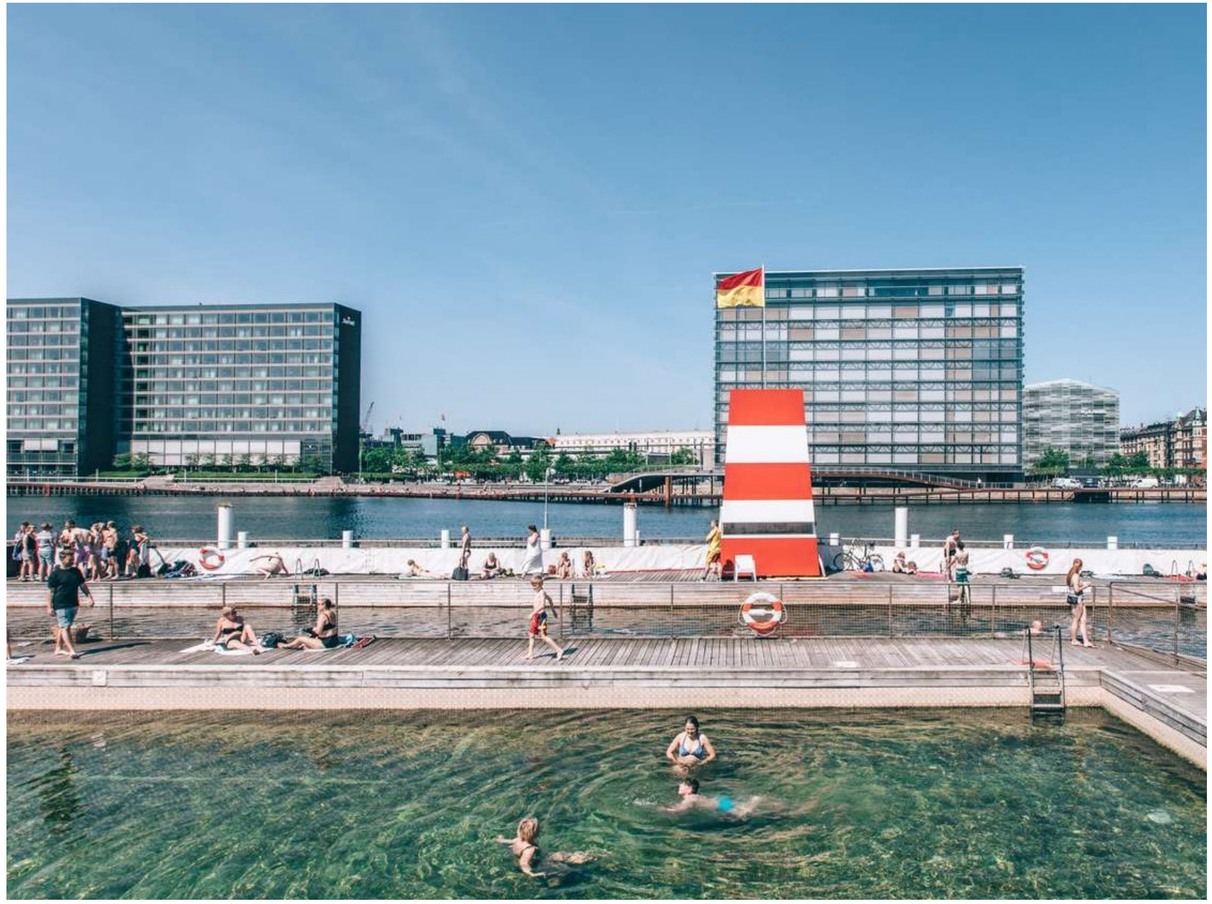


Figure 17: Havnebadet Islands Brygge in Copenhagen, Denmark

Figure 18: Hot Springs in Nepal, Asia

What?
The Common Ground

Figure 19: Roman public baths in Bath, England

Figure 20: Hammam Al Ándalus Arab Baths in Granada, Spain

What?
The Common Ground

Figure 21: Ablution at Suleymaniye Mosque in Istanbul, Turkey

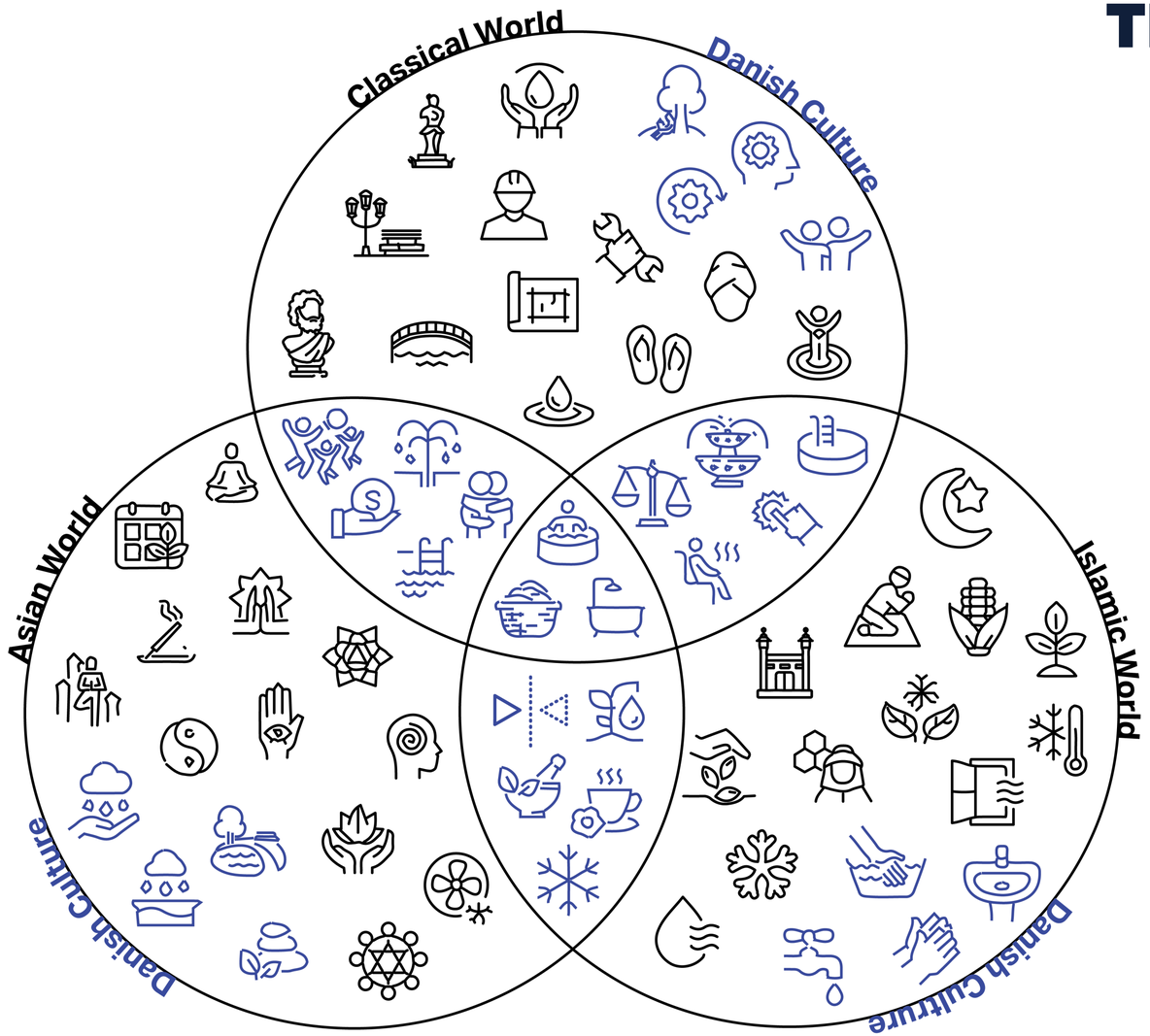
Figure 22: Tirtha Empul Water Temple in Bali, Indonesia

What?
The Common Ground

Figure 23: Stepwells in India

Figure 24: Lavoir in France

What?
The Common Ground



1. Nature Swimming Pool

There are three indoor swimmingpools < 3km, but no outside nor nature swimmingpool

2. Spa

There is one spa in < 3km, but it is old and neglected

3. Laundry

There is one laundry room in < 3km, but it is paid, can I design one for public and free?

4. Bathing

There is one bathing space in < 3km, but it is old and neglected

5. Community Garden

There is one community garden in < 3km, but it is not for the direct neighborhood

6. Sauna / Hammam

There is one sauna in < 3km, but very small, also there is no hammam

7. Recreation Space

There is one water recreation space in < 3km, but mainly for summer time also providing urban cooling

8. Tea House

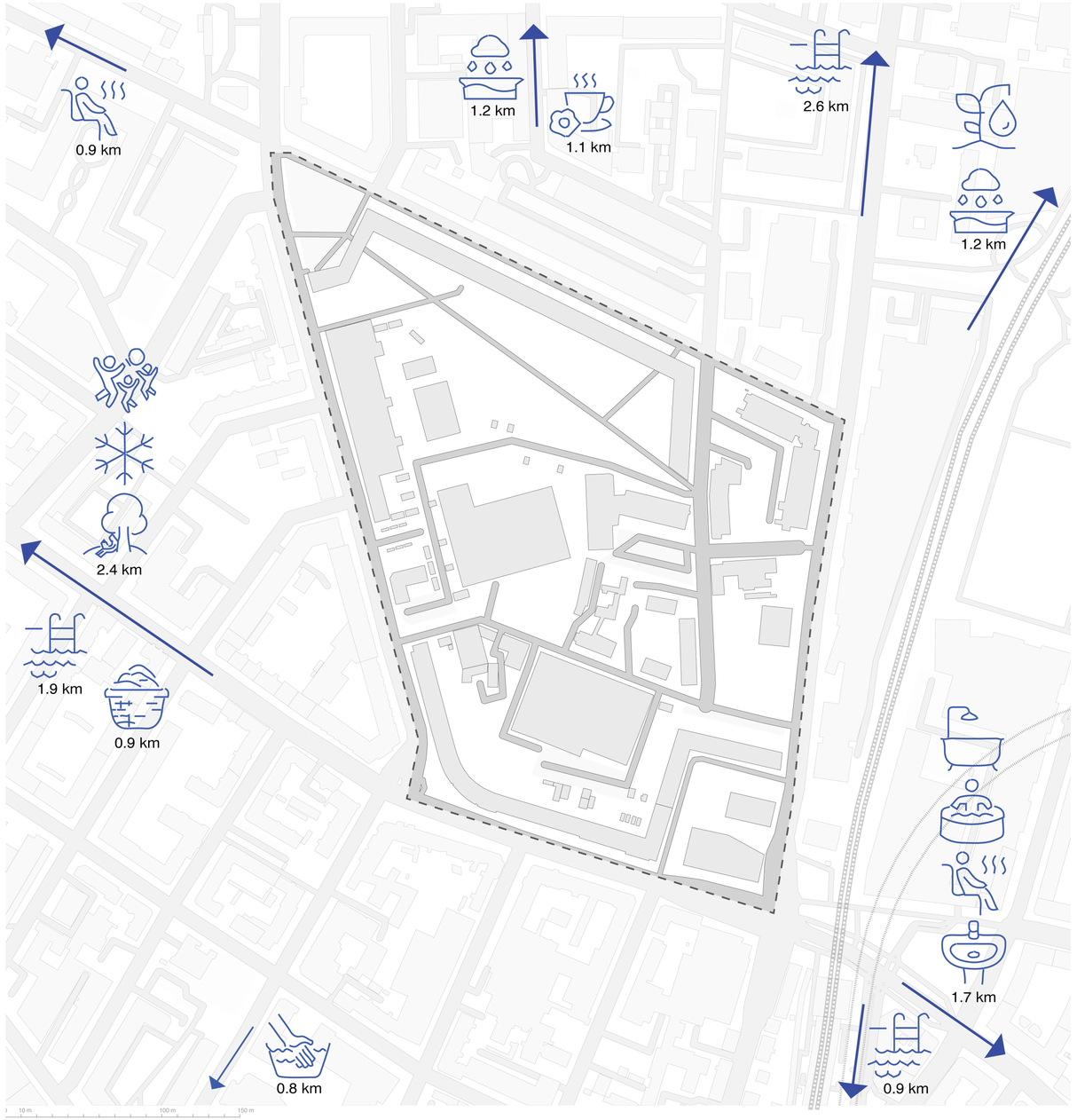
There is one tea house in < 3km, but also serving as a normal café and only focusing on Turkish Culture

9. Rainwater Collecting

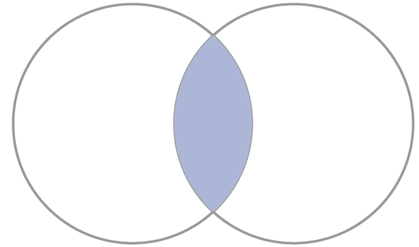
There is two rainwater collecting areas in < 3km, but also needed for our plot

10. Purification Room

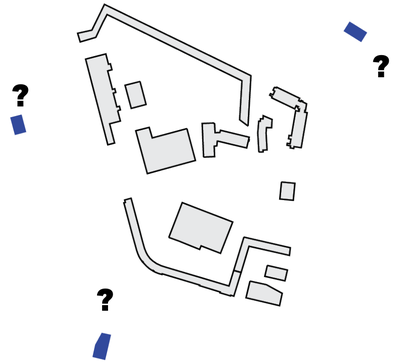
There are more than one ablution rooms in < 3km, but only in mosques serving for Islamic religion



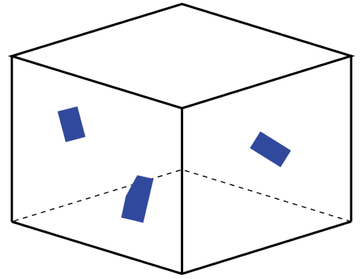
1 What is the **common ground**?

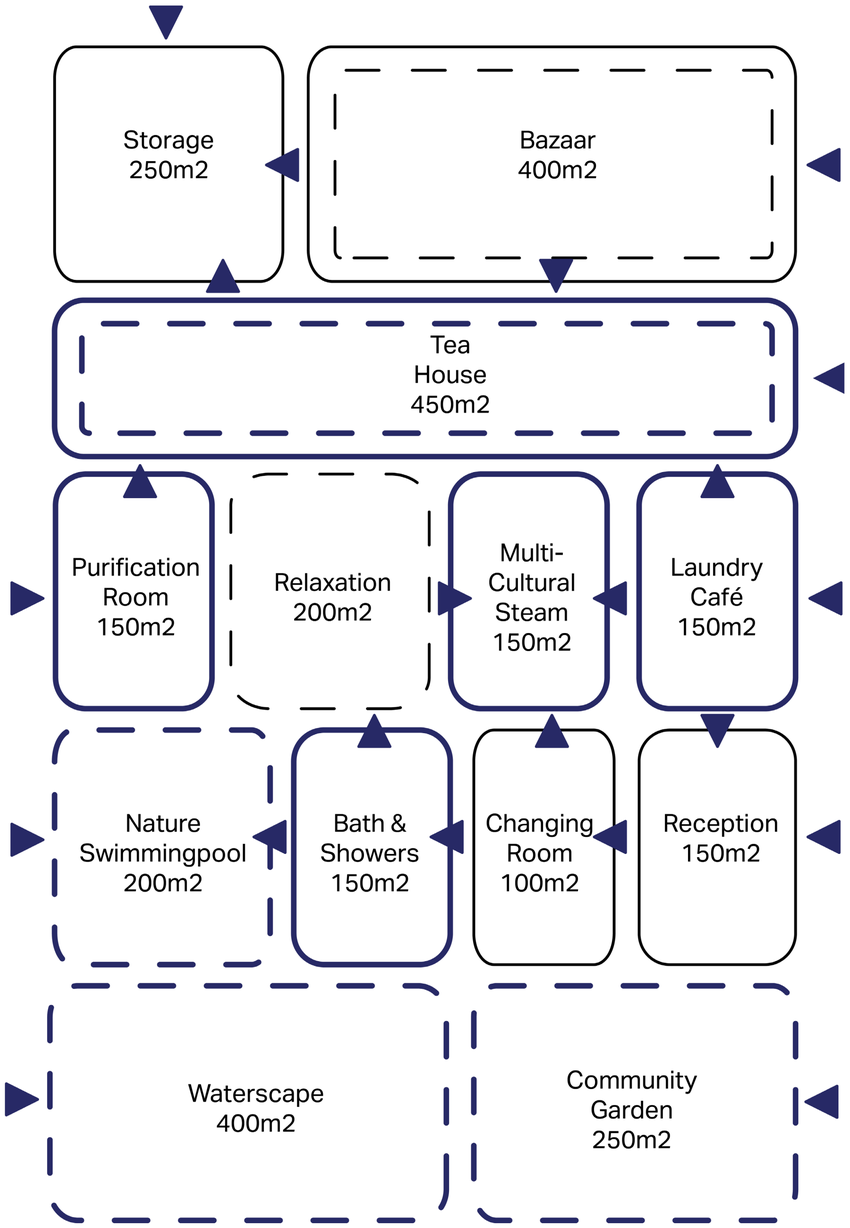


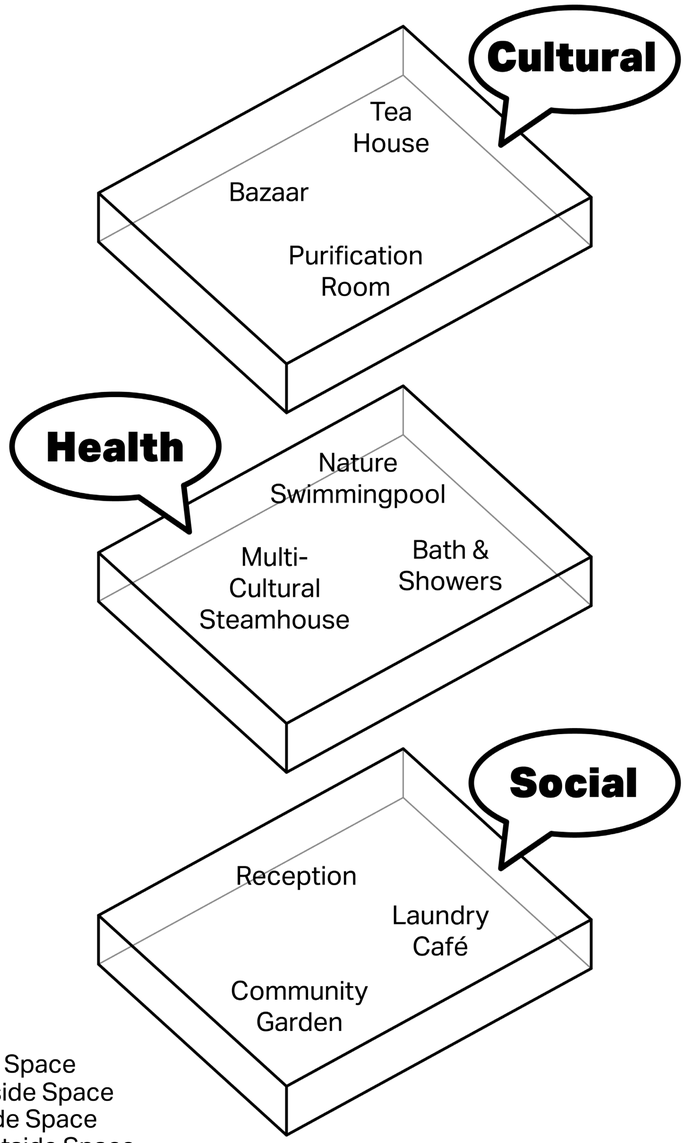
2 Are these functions **located closeby**?



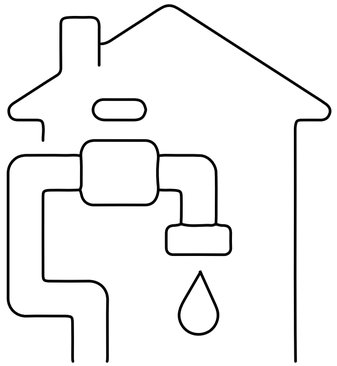
3 What contributes to **people's needs**?



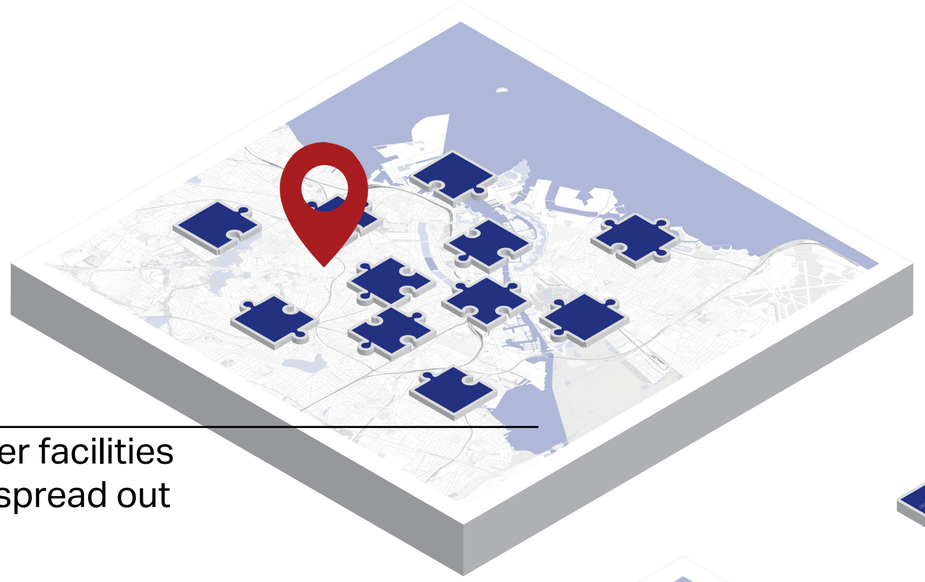




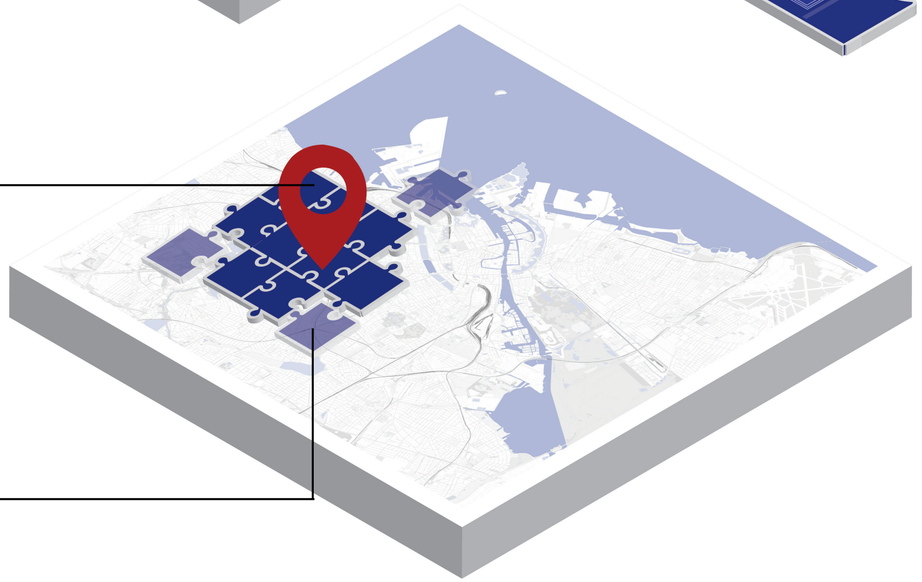
Water Usage Inside Space
No Water Usage Inside Space
Water Usage Outside Space
No Water Usage Outside Space



Water Accessibility



1 Water facilities are spread out



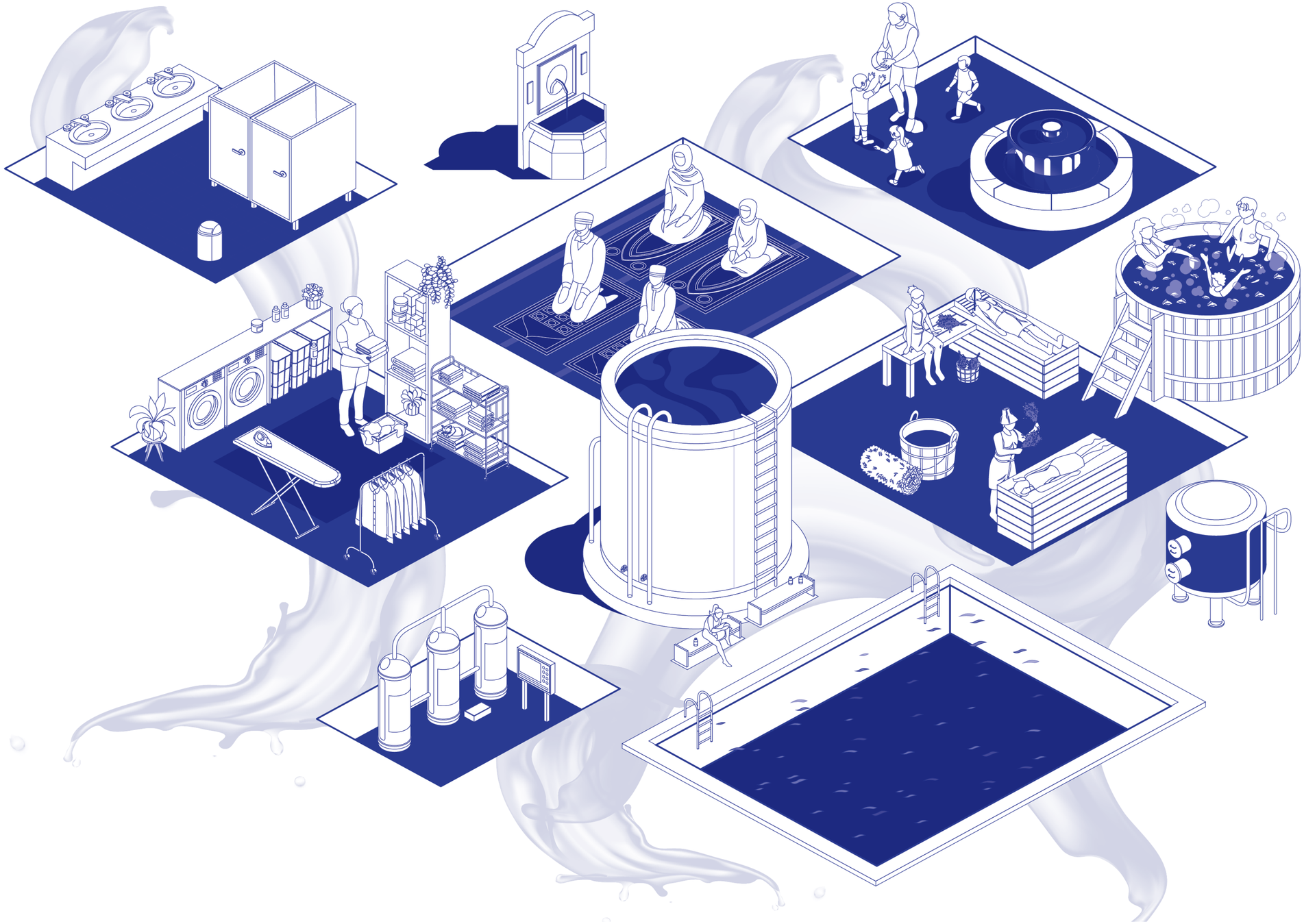
2 Bringing together where needed

3 Open for future changes

The Water Hub aims to bring all water facilities together in Nordvest, which are now spread out over the whole city.

Like a puzzle, these pieces will be all put together in a building that functions independently.

However, the puzzle will stay unfinished so the design will always be open to future implementations.



A Public Condenser where people can identify themselves through water, a place that connects people by water and a place that gives accessibility to water as valuable source of life.

Rainwater Collection

What?
Rainwater Collection

1. Nature Swimming Pool (330m2)

- Natural pools don't need frequent refilling but experience evaporation and seepage losses
- Evaporation Rate: approximately 5–7 liters per square meter per day (depending on climate)
- Assumption: 6 liters/m²/day evaporation, minimal leakage
- Monthly Water Loss = 330m2 x 6 litres/m2/day x 30 days = **59,400 liters/month (59m3)**

2. Kitchen (100m2) & Tea House

- Water Usage per m2: On average, commercial kitchens use 50 liters/m²/day for cooking, cleaning, and dishwashing
- Monthly Water Usage for Kitchen = 100m2 x 50 liters/m2/day x 30 days = **150,000 liters/month (150m3)**

3. Laundry Room (150m2)

- Water Usage per Wash: A modern washing machine uses 50 liters per wash (range: 40–60 liters
- Assumption: 10 Washing Machines in total and each is used 4 times per day
- Monthly Water Usage for Washing Machines = 10 machines x 4 washes/day x 50 liters/wash x 30 days = **60,000 liters/month (60m3)**

4. Purification Room (220m2)

- Water use per Sink: On average, 3 liters per use
- Assumption: 20 Sinks in total and each sink is used 30 times/day, for tasks such as hand washing
- Monthly Water Usage for Sinks = 20 sinks x 30 uses/day x 3 liters/use x 30 days = **54,000 liters/month (54m3)**

5. Bath & Showers (100m2)

- Water Usage per Shower: A standard showerhead uses 9 liters/minute, and an average shower lasts 8 minute
- Assumption: Each shower is used 10 times/day
- Monthly Water Usage for Showers = 6 showers x 10 uses/day x 9 litres/min x 8 min x 30 days= **129,600 liters/month (129m3)**
- Water Usage per Bath: An average bathtub uses 150 liters per bath
- Assumption: Each bath is used 5 times/day
- Monthly Water Usage for Baths = 6 baths x 5 uses/day x 150 litres/bath x 30 days = **135,000 liters/month (135m3)**
- **Total Water Usage for Public Bath: 129,600 liters + 135,000 liters = 264,600 liters/month (264 m3)**

6. Multicultural Steam (150m2)

- Includes multiple rooms: warm room (tepidarium), hot room (caldarium), cold room (frigidarium)
- Steam Generation: Hammams use water to generate steam, and this depends on the size and duration of operation
- Average Water Usage: 10–15 liters/hour for every cubic meter for steam production
- For a hammam of 150 square meters with 3-meter-high ceilings (900 m³ total), this equates to appr. 9,000–13,500 liters/day during continuous operation
- Assumption: The hammam/sauna operates 10 hours/day and serves 20 - 40 users/day
- Monthly Water Usage for Steaming = 6,750 litres/day : 2 (consumption is halved) x 30 days = **101,250 liters/month (101m3)**

7. Community Garden (500m2)

- Plants typically need 2.5–5 liters of water per square meter per day during active growth, depending on the climate and plant type
- Lower range: Cooler climates or drought-tolerant plants, like in Denmark
- Efficient systems (e.g., drip irrigation) reduce water usage by ~30–50%
- Local rainfall can significantly reduce water needs. Adjusting for rainfall involves subtracting the effective precipitation from total water requirements
- Water Usage for Community Garden: 2,5liters/m2/day x 500m2 x 30 days x 0,7 (reduction of drip irrigation) = appr. **26,250 liters/month (26m3)**

8. Toilets (100m2)

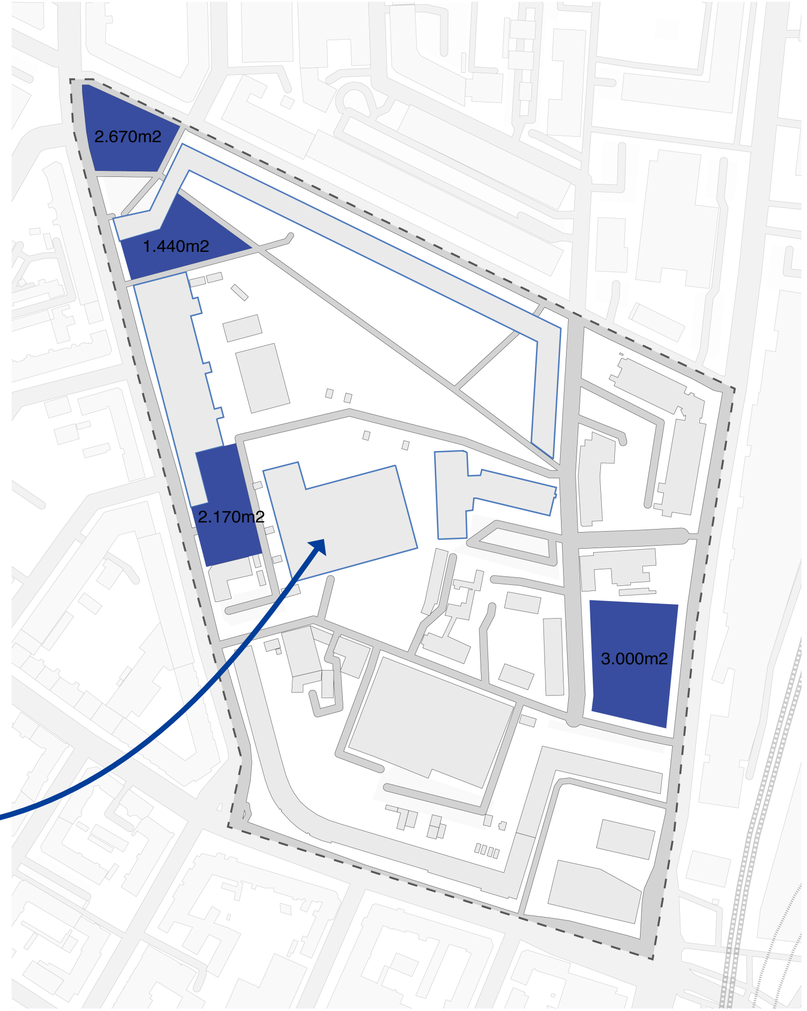
- Water Usage per Flush: Modern toilets use 6 liters per flush (low-flush models may use less, e.g., 3–4 liters)
- Assumption: Each toilet is flushed 20 times/day
- Water Usage for Toilets: 10 toilets x 20 flushes/day x 6 liters/flush x 30 days = **36,000 liters/month (36m3)**

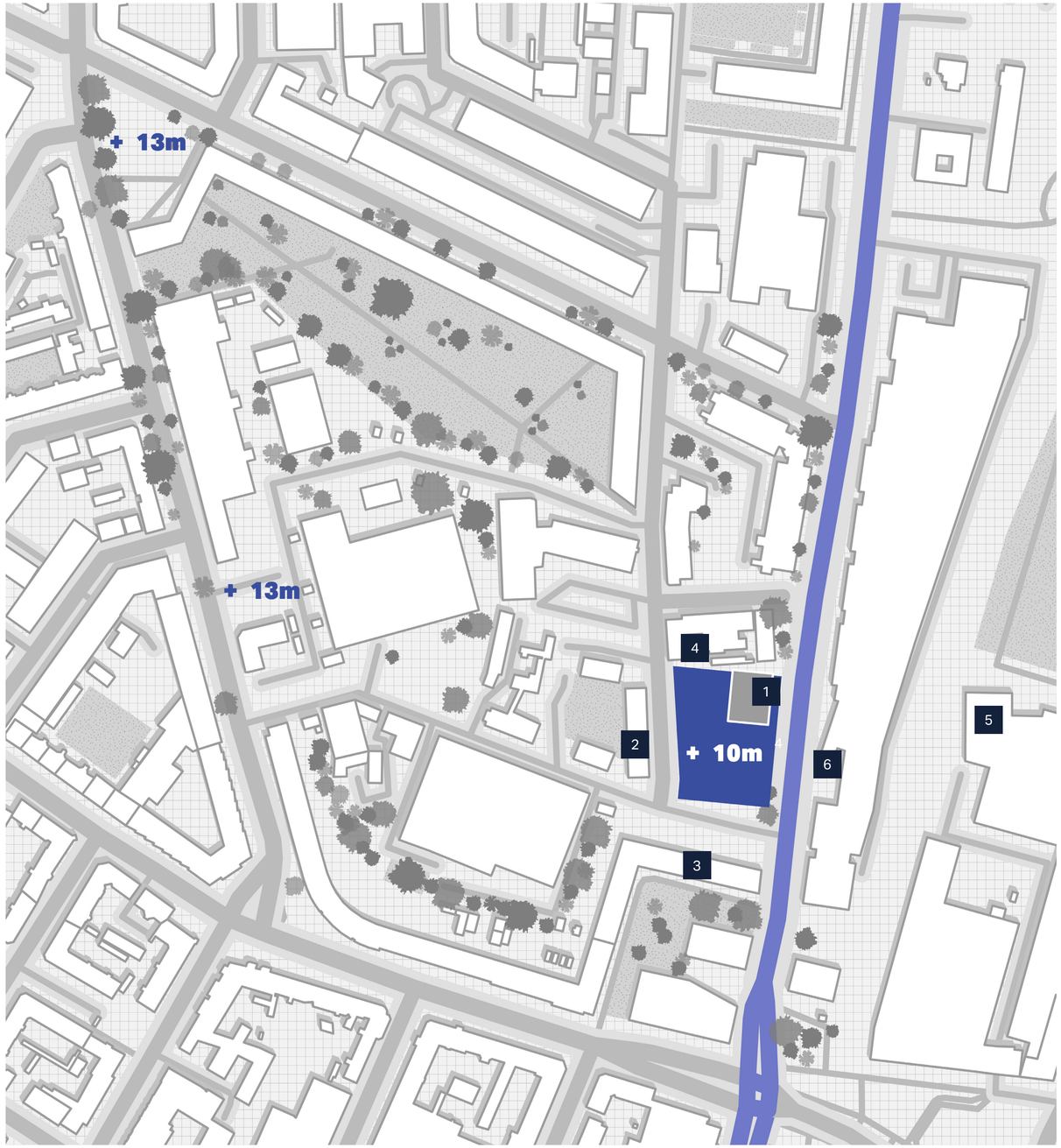
TOTAL = 750,000 litres/month (750m3) x +/- 25% = appr. 1.000,000 litres/month (1000m3)

But, water can be reused!

HOW MUCH RAINWATER NEEDS TO BE COLLECTED?

- Copenhagen receives approximately 613 mm (millimeters) of precipitation annually. This includes rain, snow, and other forms of precipitation
- 1 mm of rain corresponds to 1 liter of water per square meter.
- Therefore: 613 mm/year = 613 liters of water per square meter per year
- Harvested Water (liters): Rainfall (mm) x Collection area (m2) x Runoff Coefficient)
- In total, my project will collect rainwater from three surfaces, which is in total 2.670m2 + 1.440m2 + 2.170m2 + 3.0000m2 = 10.700m2
- In addition to this, the rainwater will be collected by a slope of 1.700m2
- Harvested Water (liters): 613mm × (9.280m2 + 1.700m2) × 0.85 = appr. 5.700,000 litres per year / 12 = appr. **477,000 litres per month (477m3)**
- **Do the roofs in the area also need to contribute to rainwater harvesting?**
- So, in total, my project needs an additional collection of 500.000 litres rainwater per month, which counts for 500.000 : 613mm : 0,85 x 12 = appr. 11.500m2 of roofs contributing to the rainwater harvesting
- Total surface of roofs close to the already implemented water application area: 12.000m2

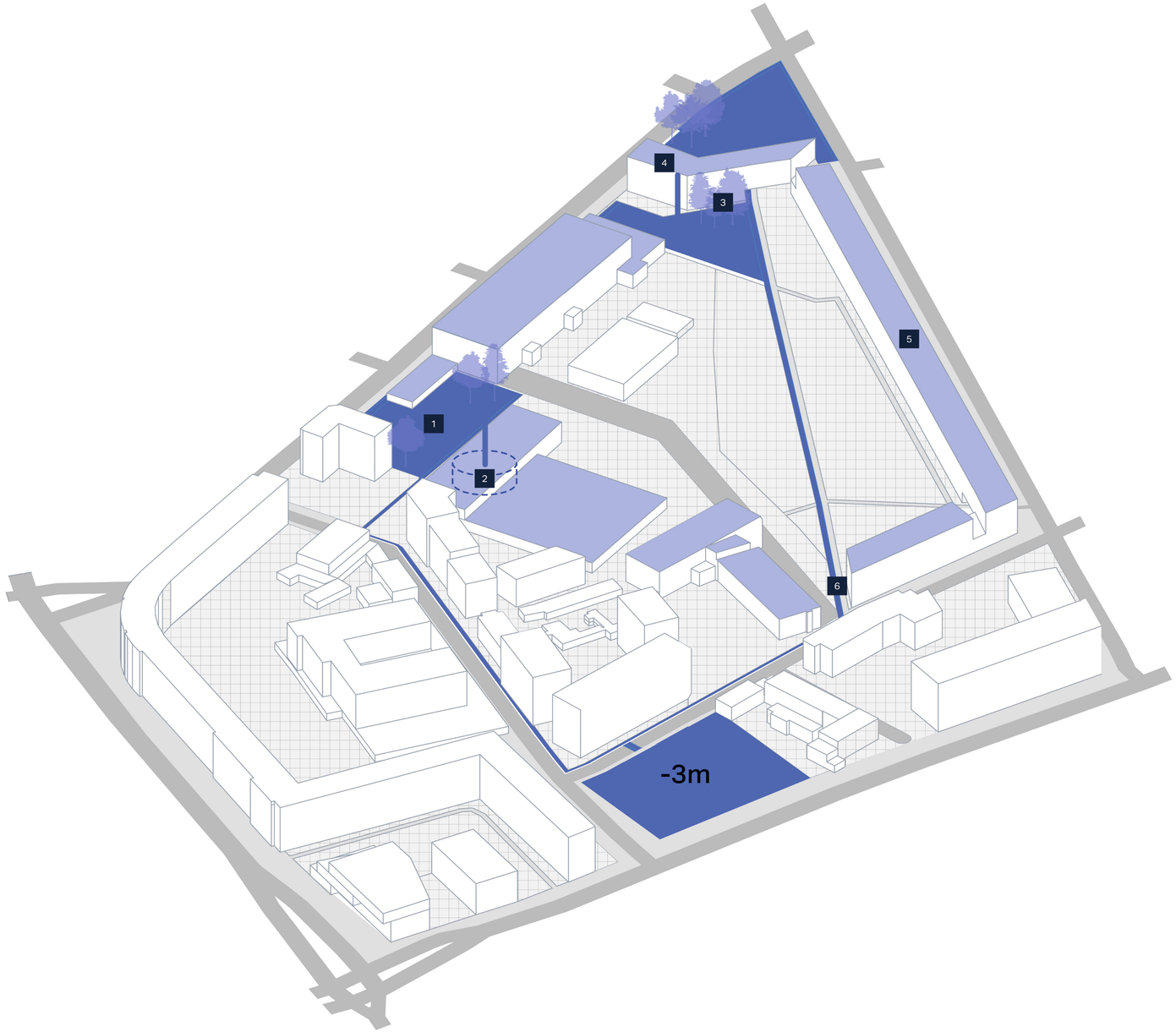




The project will be located at this plot, because it is lower in elevation, which allows to collect rainwater at higher elevated surfaces.

Furthermore, the site is already fragmentated, allowing my design to not be homogeneous and have is own unique appearance.

Lastly, is next to the mainstreet, which fits the landmark character and creates a unique identity for the district.



1 Collecting rainwater on project surfaces with a public function

2 Surfaces having its own watertank in cases of extreme flooding

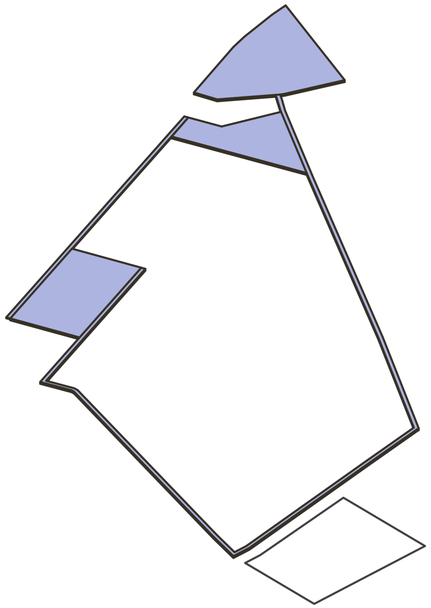
3 Surfaces containing 20% of new green spaces for bio-diversity and wellbeing

4 Collecting rainwater on roofs, transforming some into green blue roofs

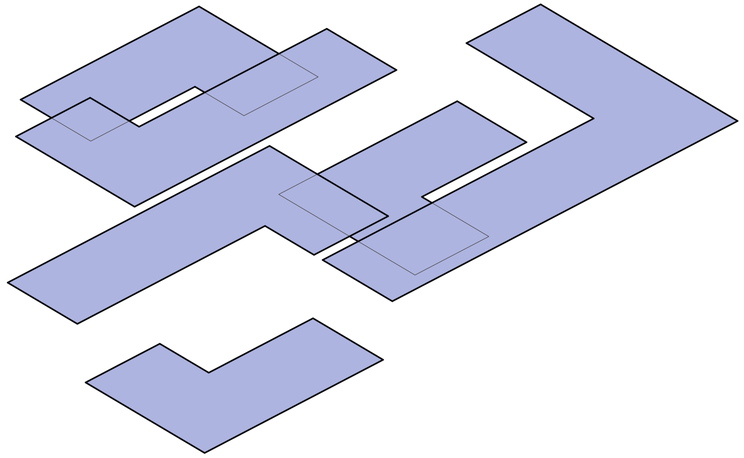
5 Green Blue roofs also enhances insulation & Reduces Urban Heat Island effect

6 Bringing collected rainwater to the plot, bridging 400m in +3m elevation = 0.5 cm/m

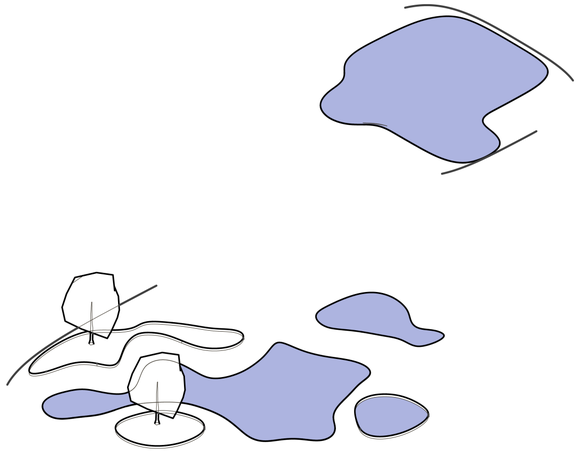
1 Project Surfaces



2 The Green-Blue Roofs



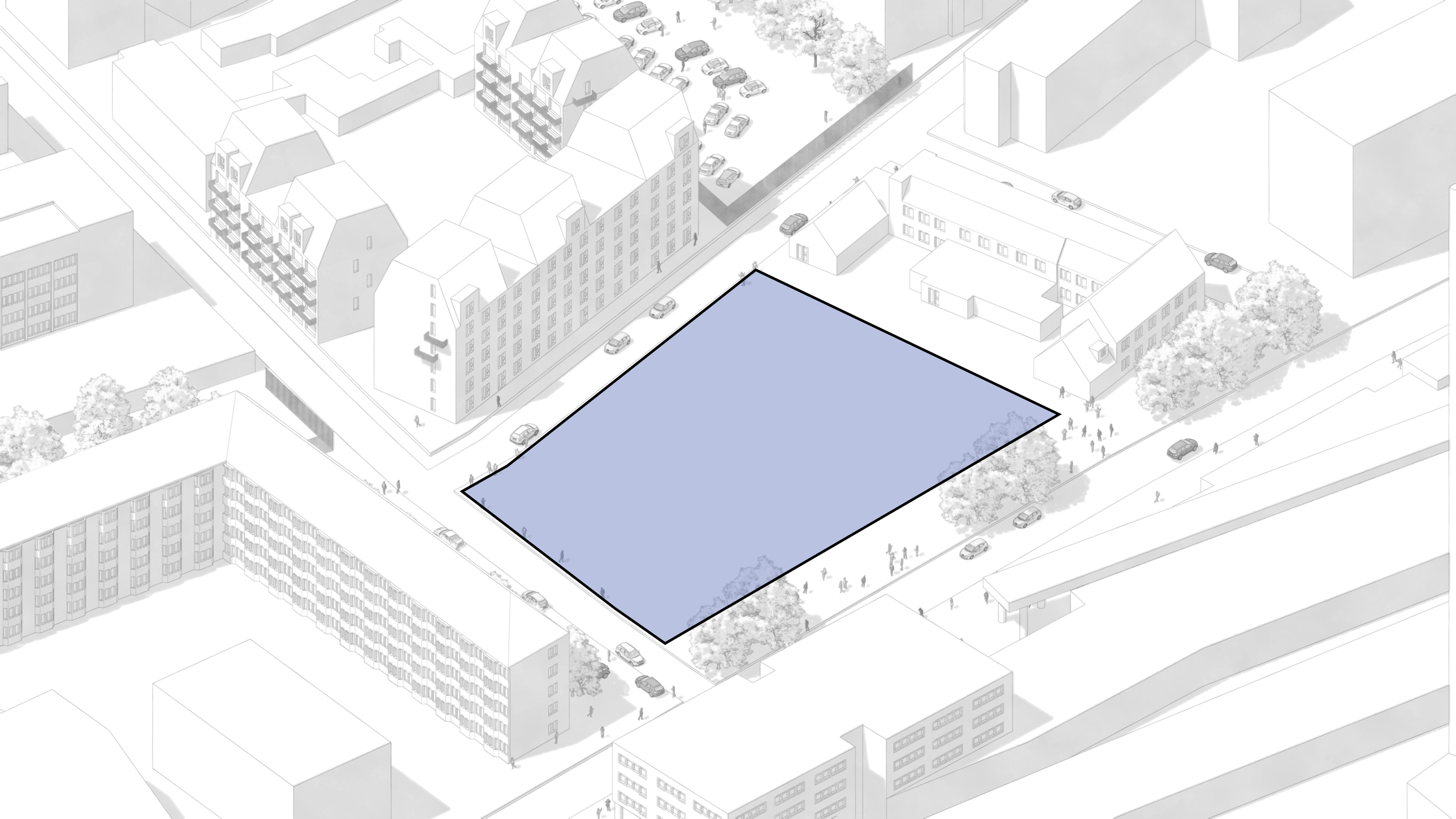
3 The Waterscape

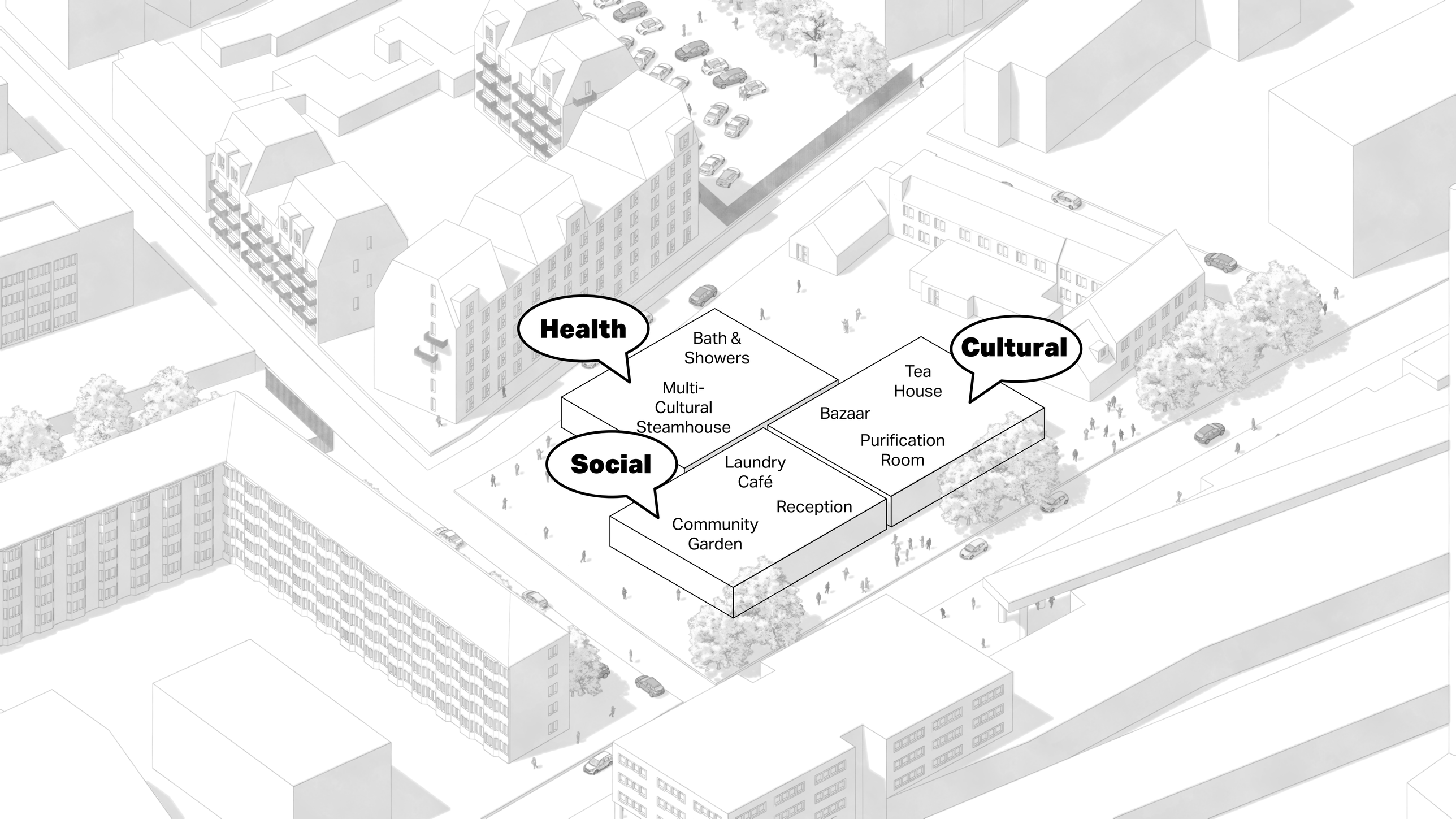


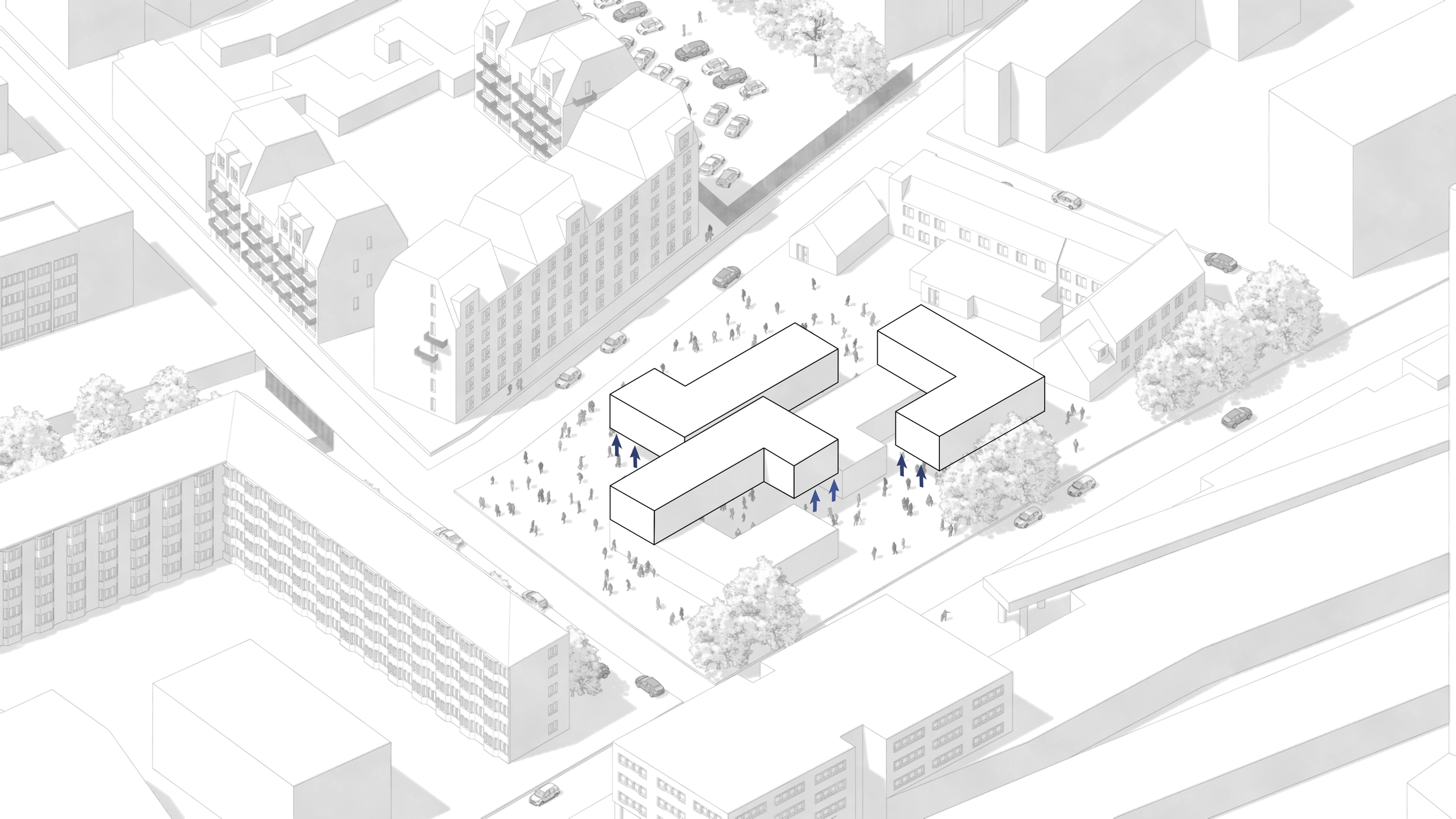
The Masterplan

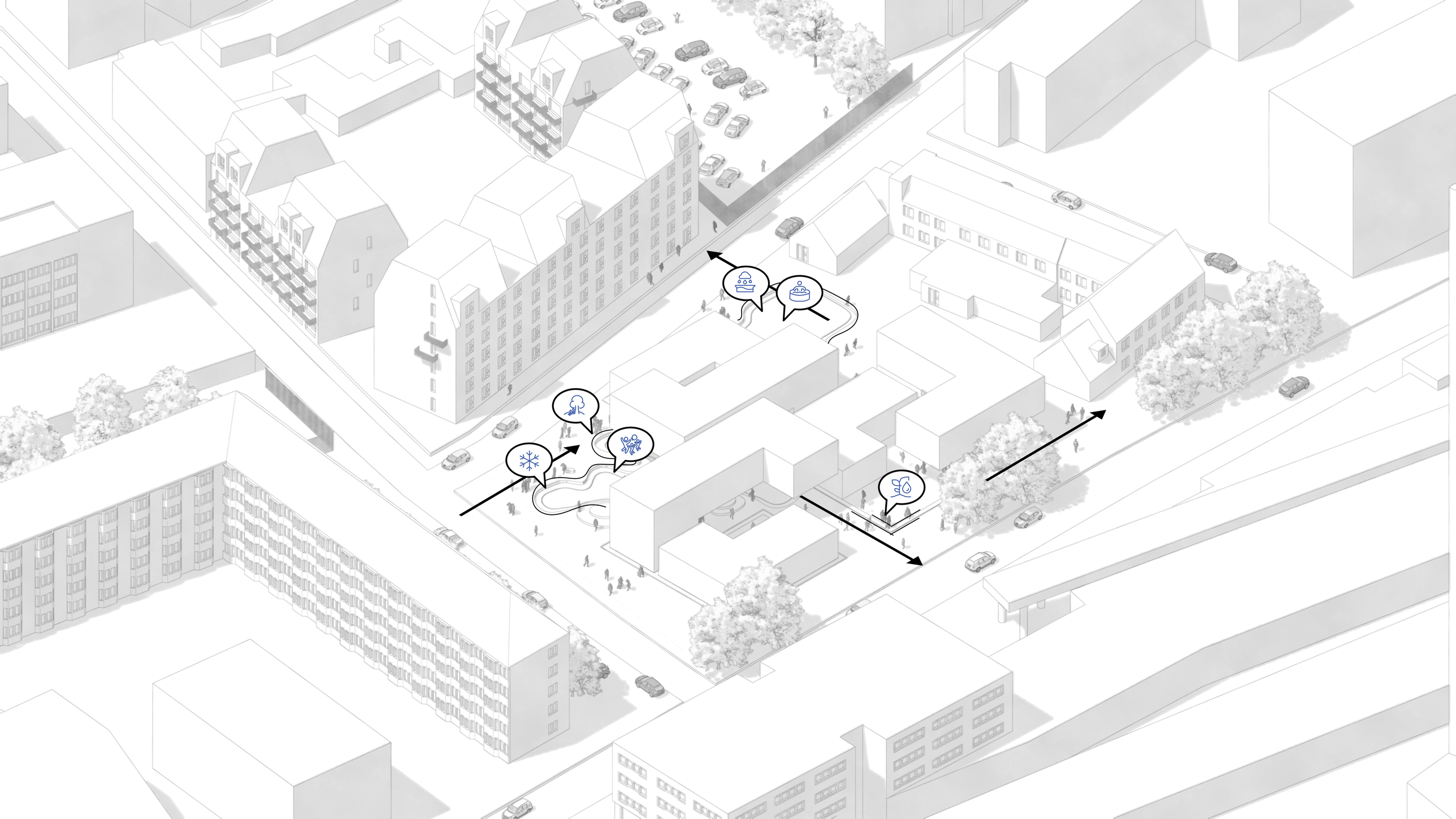
The Plot

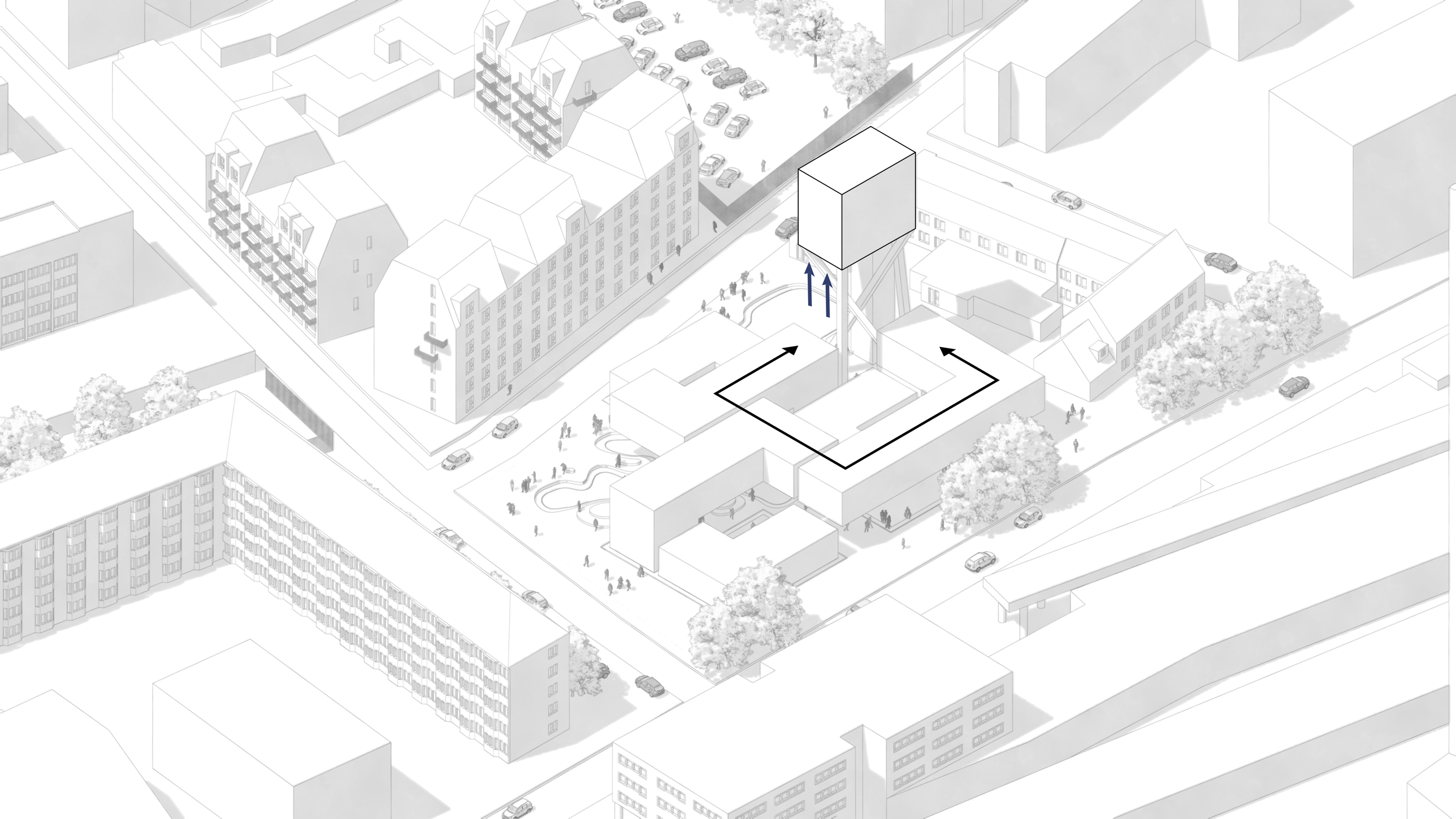
So, ***how*** do we want to design
on the urban context?




Health
Bath &
Showers
Multi-
Cultural
Steamhouse
Cultural
Tea
House
Bazaar
Purification
Room
Social
Laundry
Café
Reception
Community
Garden

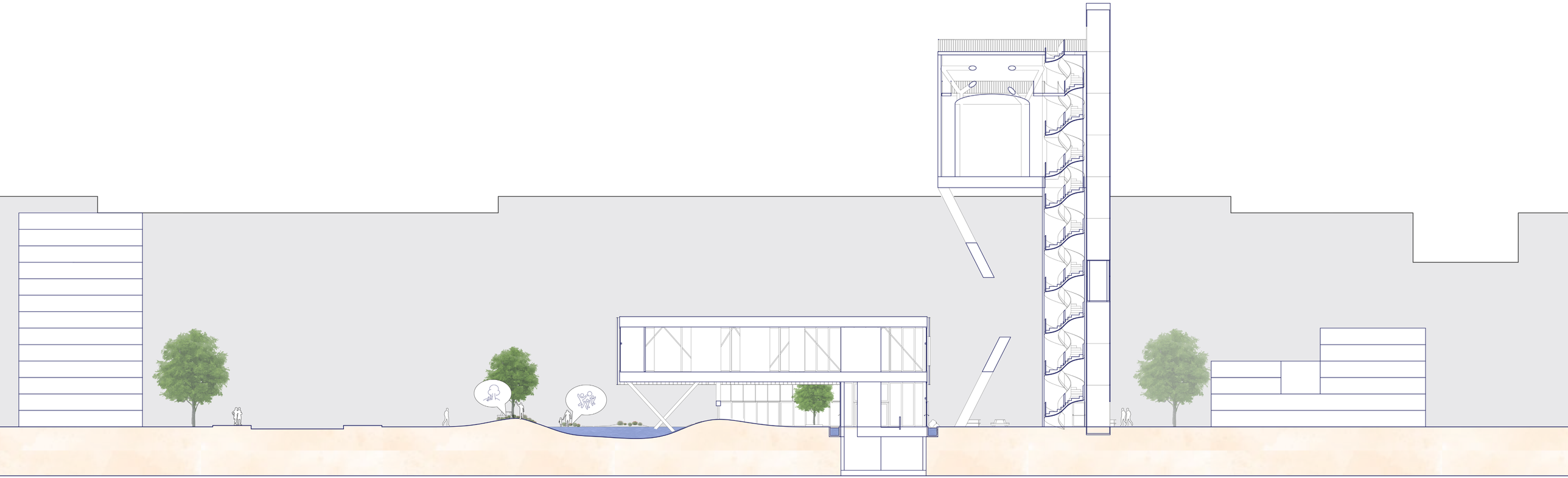




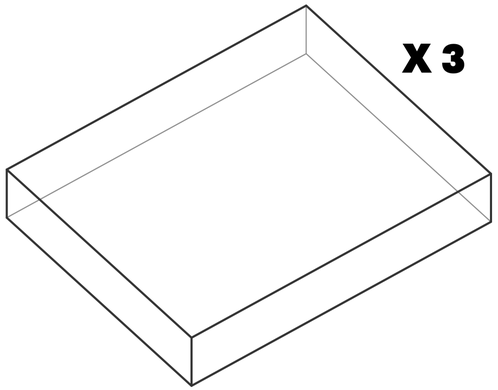


Urban Flows

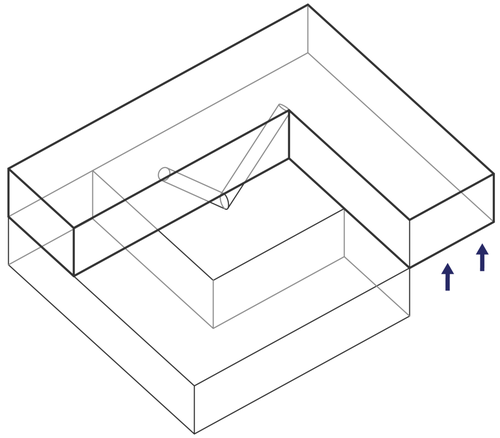
Urban Section



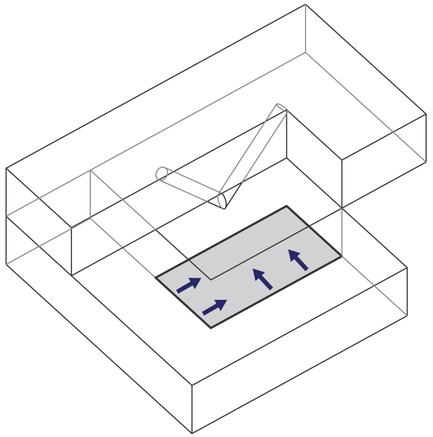
So, ***how*** do we want to design
on the architectural level?



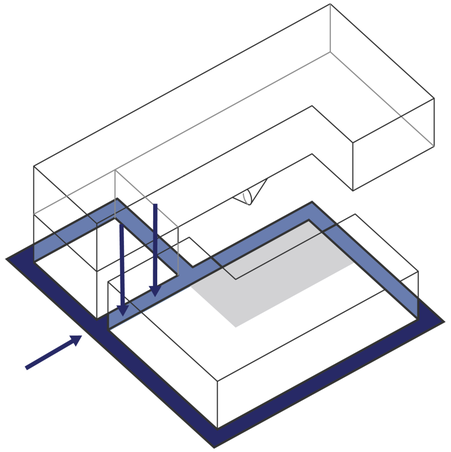
1 Program clustered in three masses



2 Half lifted up to create more ground floor (water)space



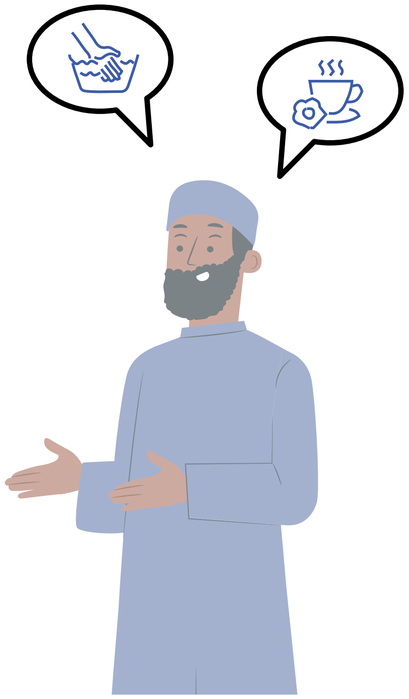
3 Extension of indoor spaces possible by outdoor courtyards



4 Water running horizontally and vertically through buildings

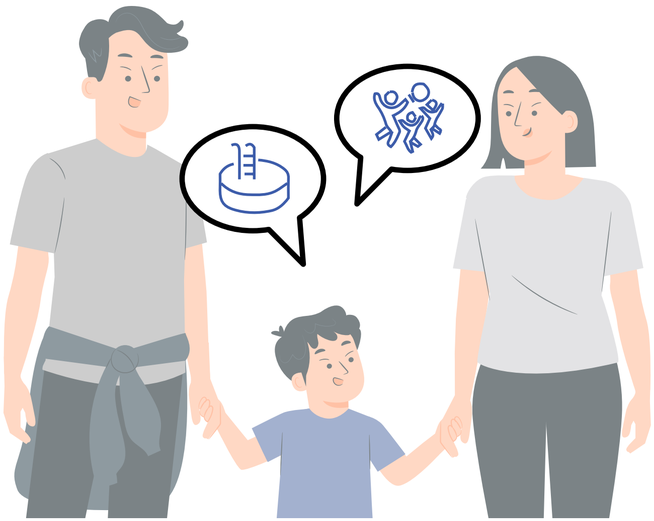
Person 1

A resident living in an older property that is lacking water accessibility



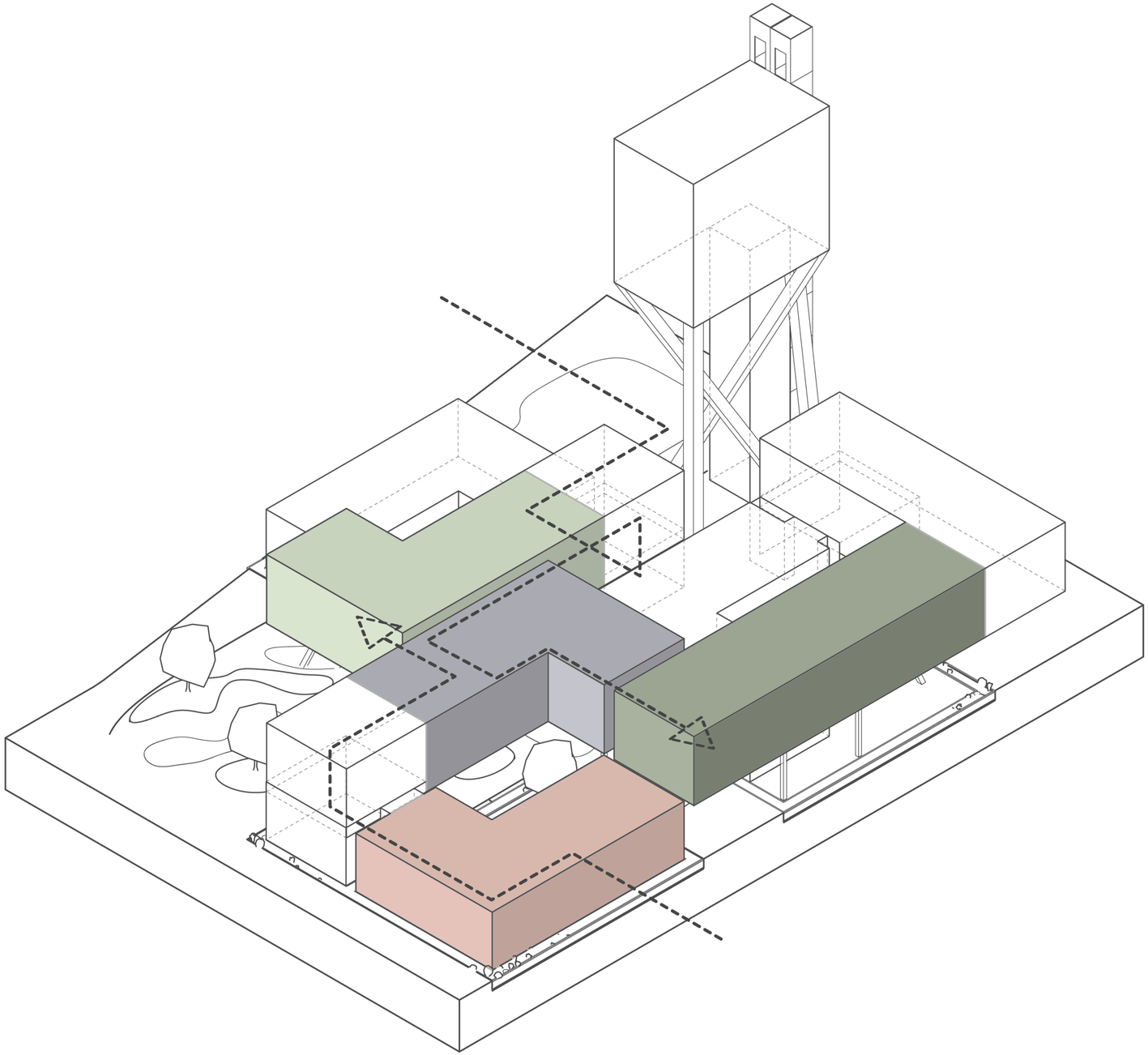
Person 2

An Islamic resident living for 40 years in Nordvest who witnesses increasing gentrification



Person 3

A child that wants to have a fun and educative day out with his parents



Laundry Café

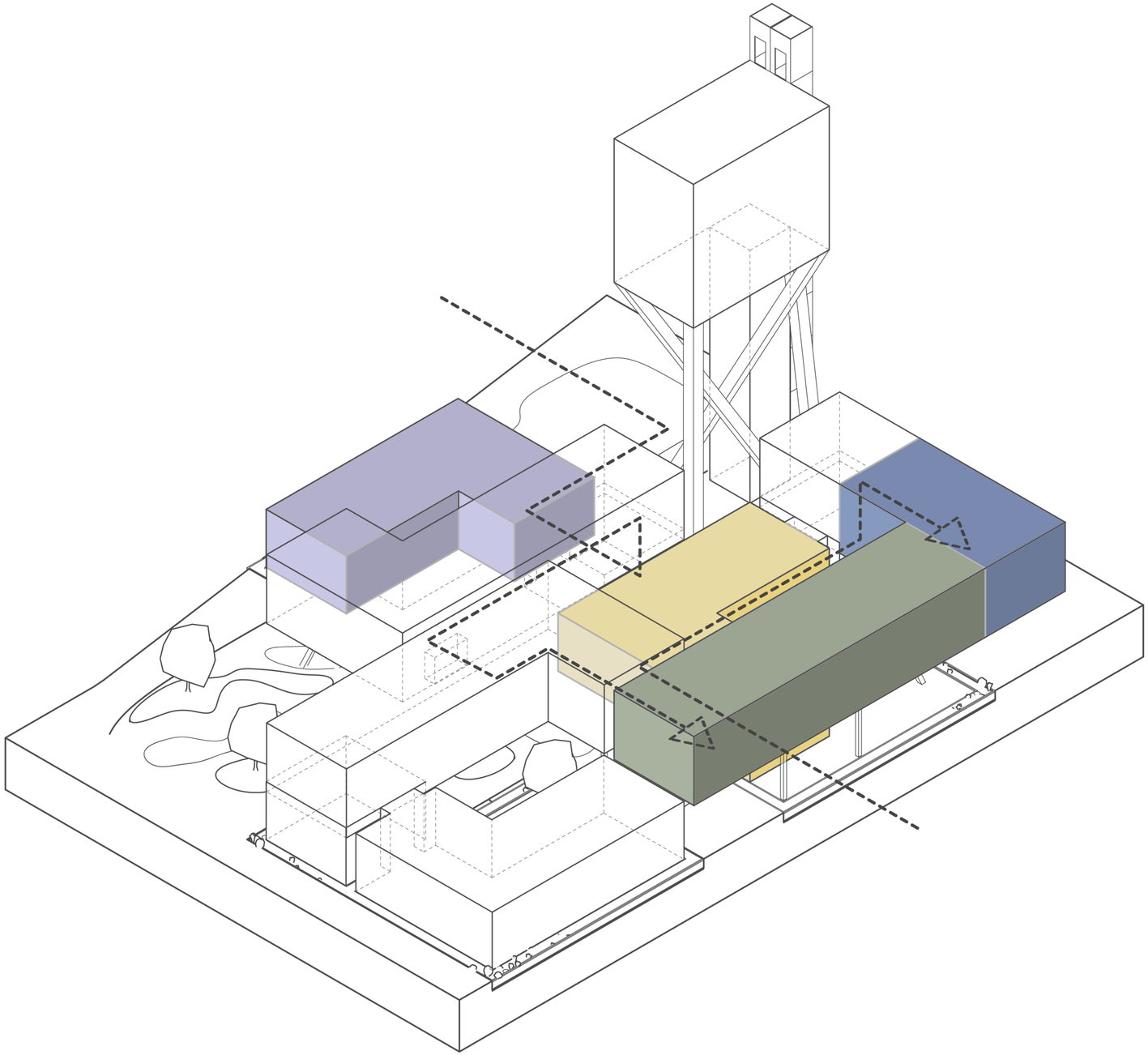
Reception

Bath House

Tea House

Person 1

A resident living in an older property that is lacking water accessibility



Bazaar

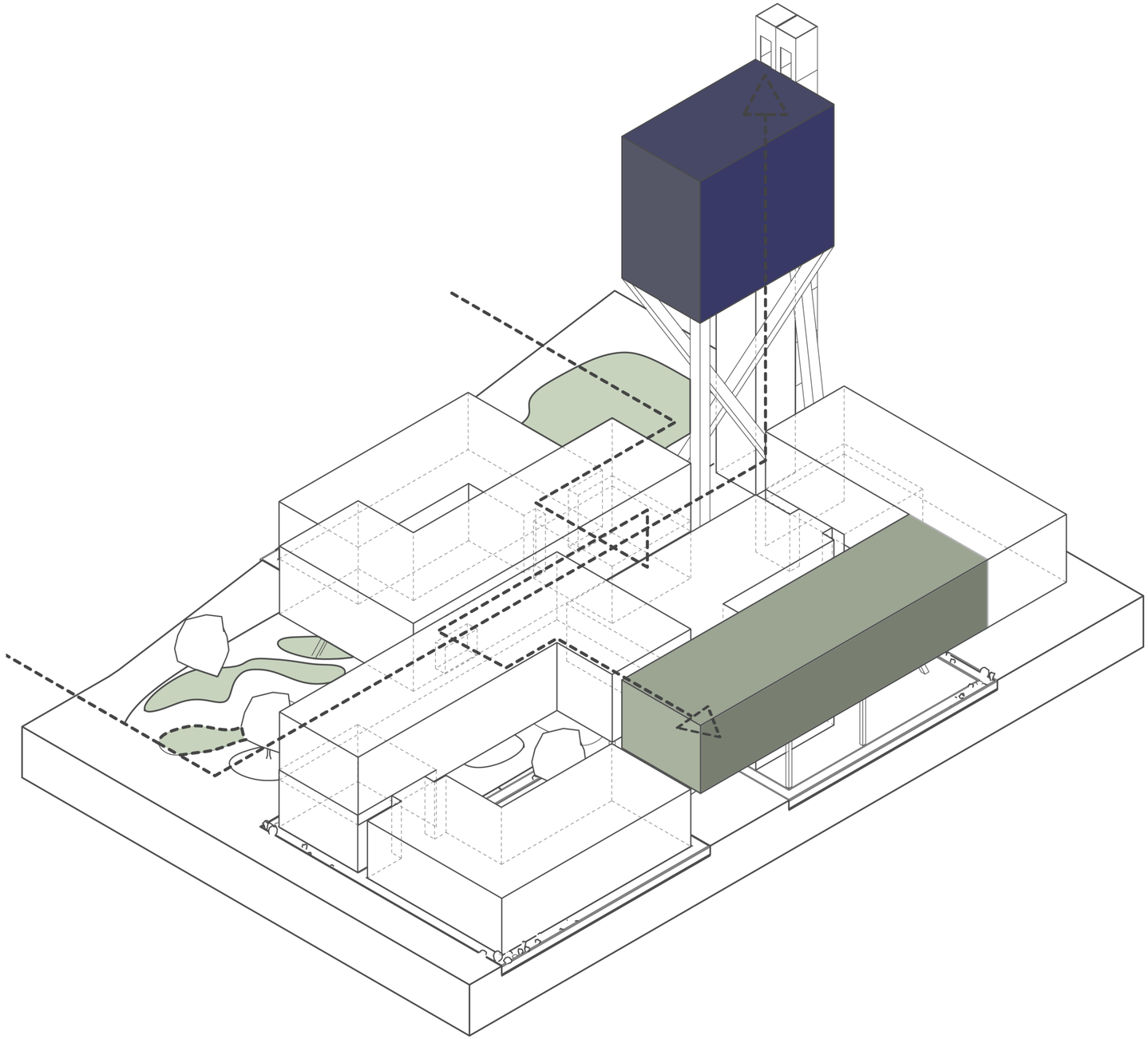
Purification Room

Tea House

Multi-Cultural Steamhouse

Person 2

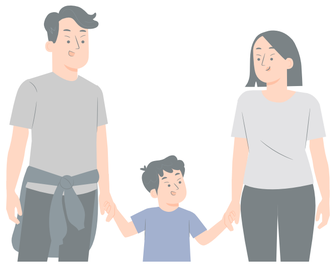
An Islamic resident living for 40 years in Nordvest who witnesses increasing gentrification



Waterscape

Water Tower

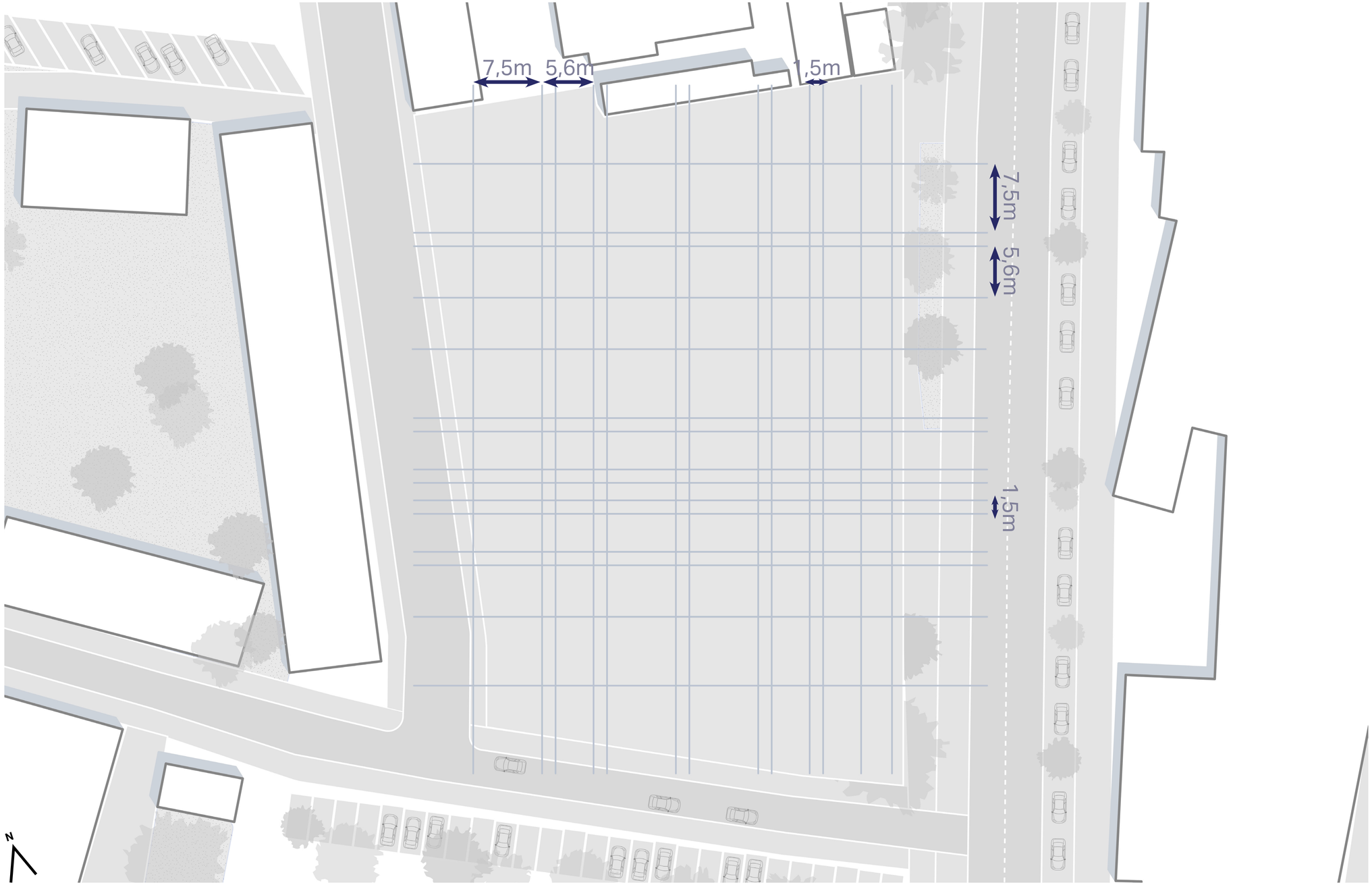
Tea House



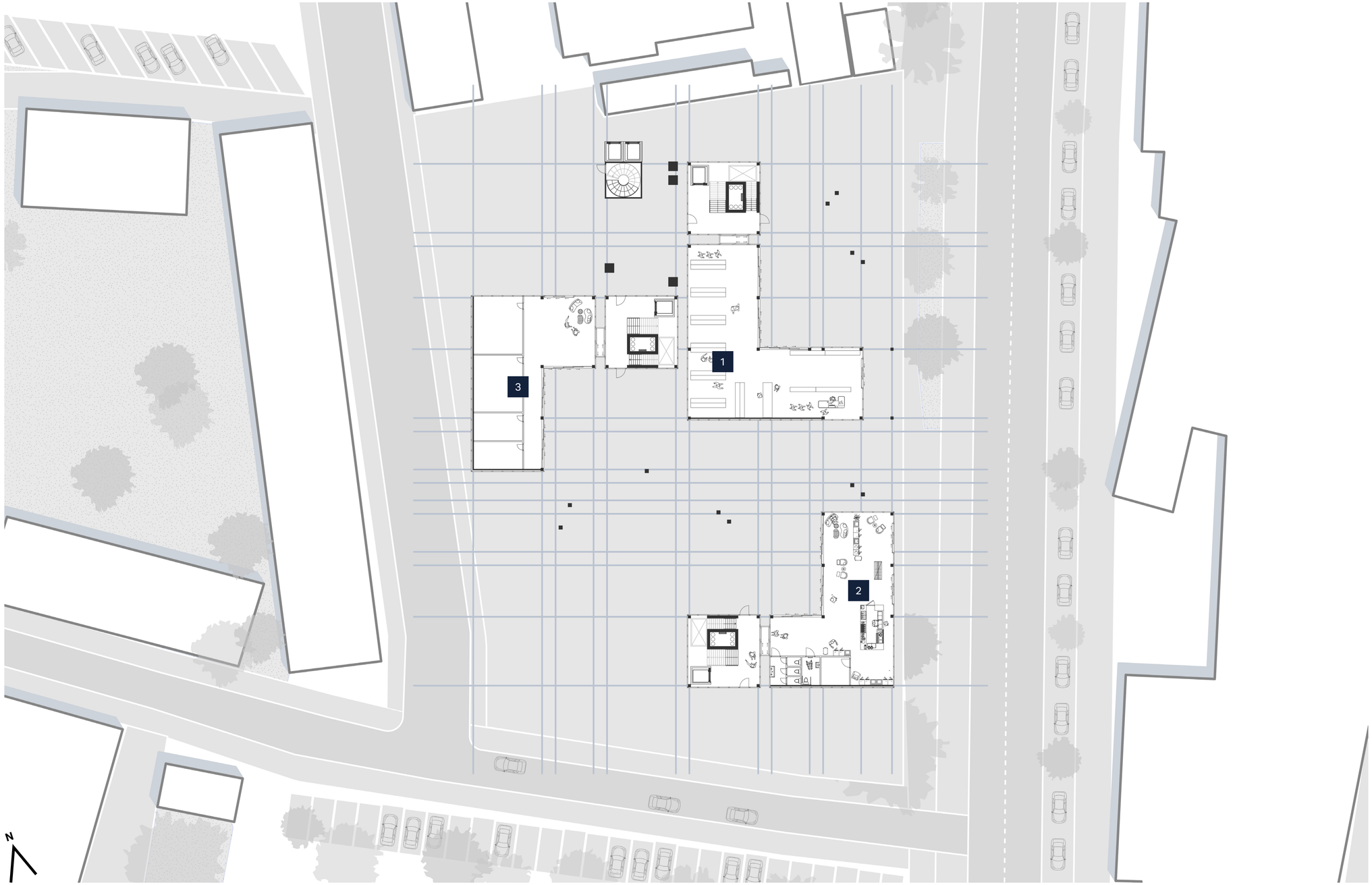
Person 3

A child that wants to have a nice day out with his parents while learning more about water

Grid



Clusters

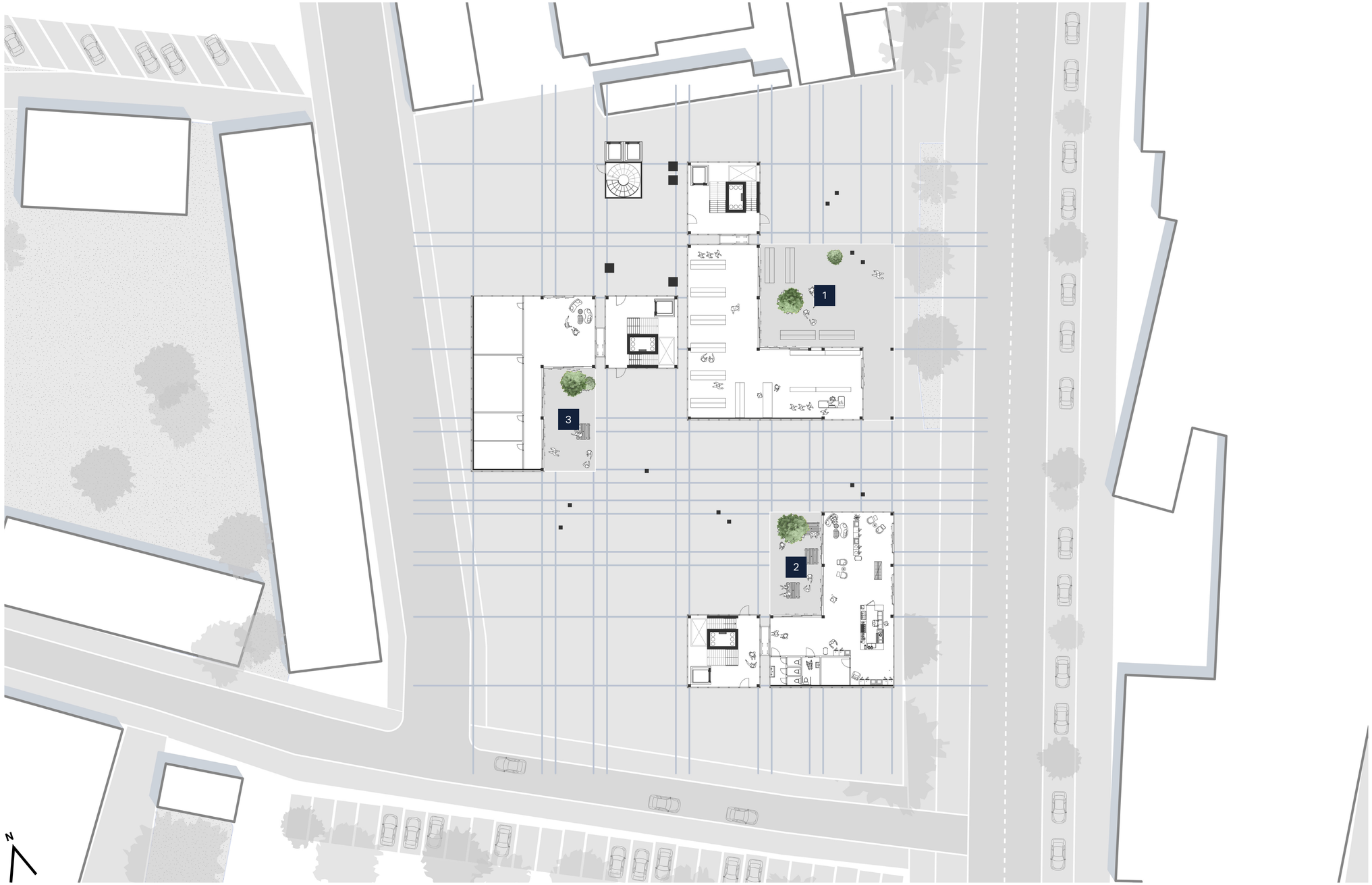


1 Cultural Cluster: Bazaar

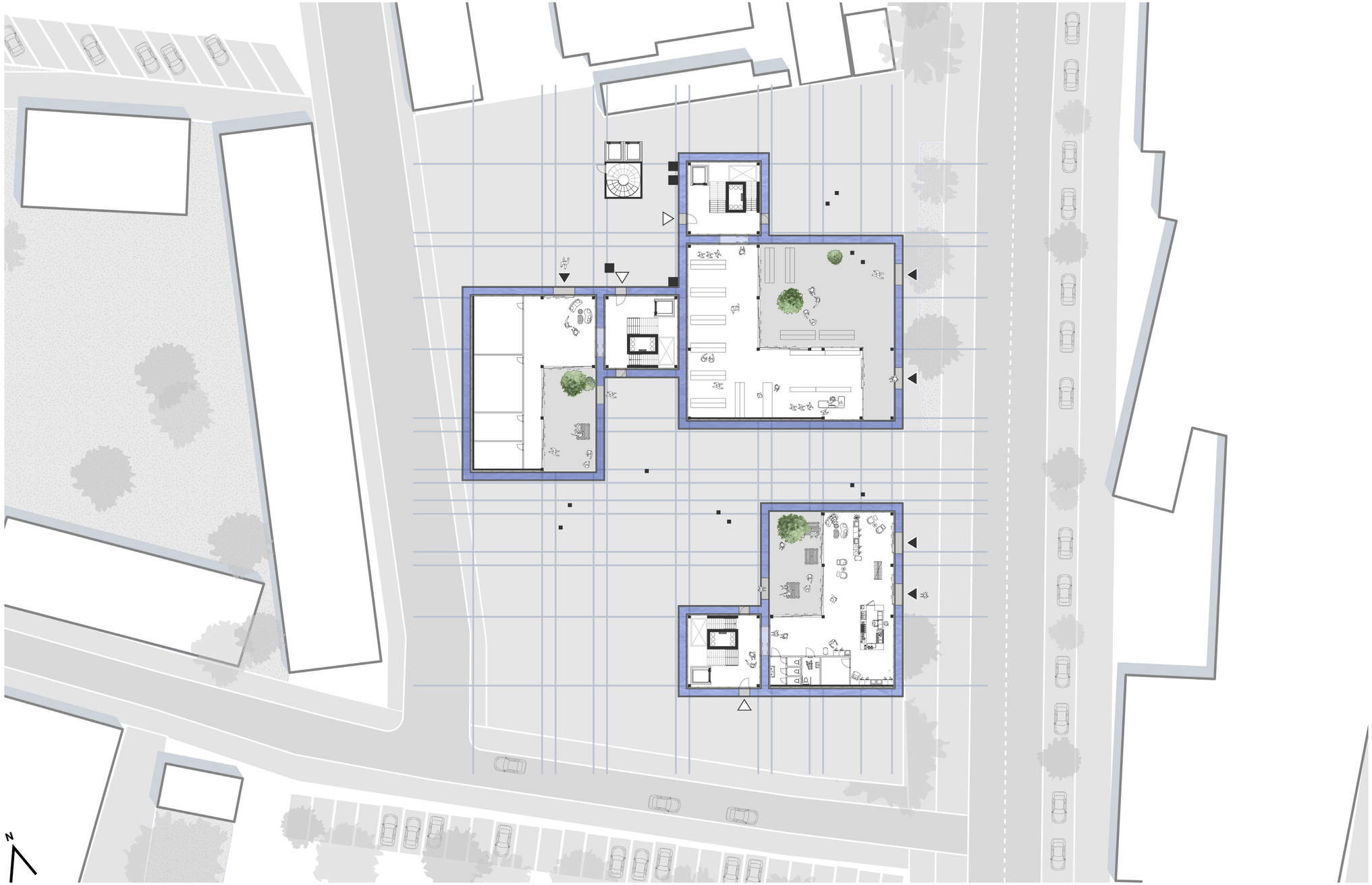
2 Social Cluster: Laundry Café

3 Health Cluster: Multi-Cultural Steamhouse

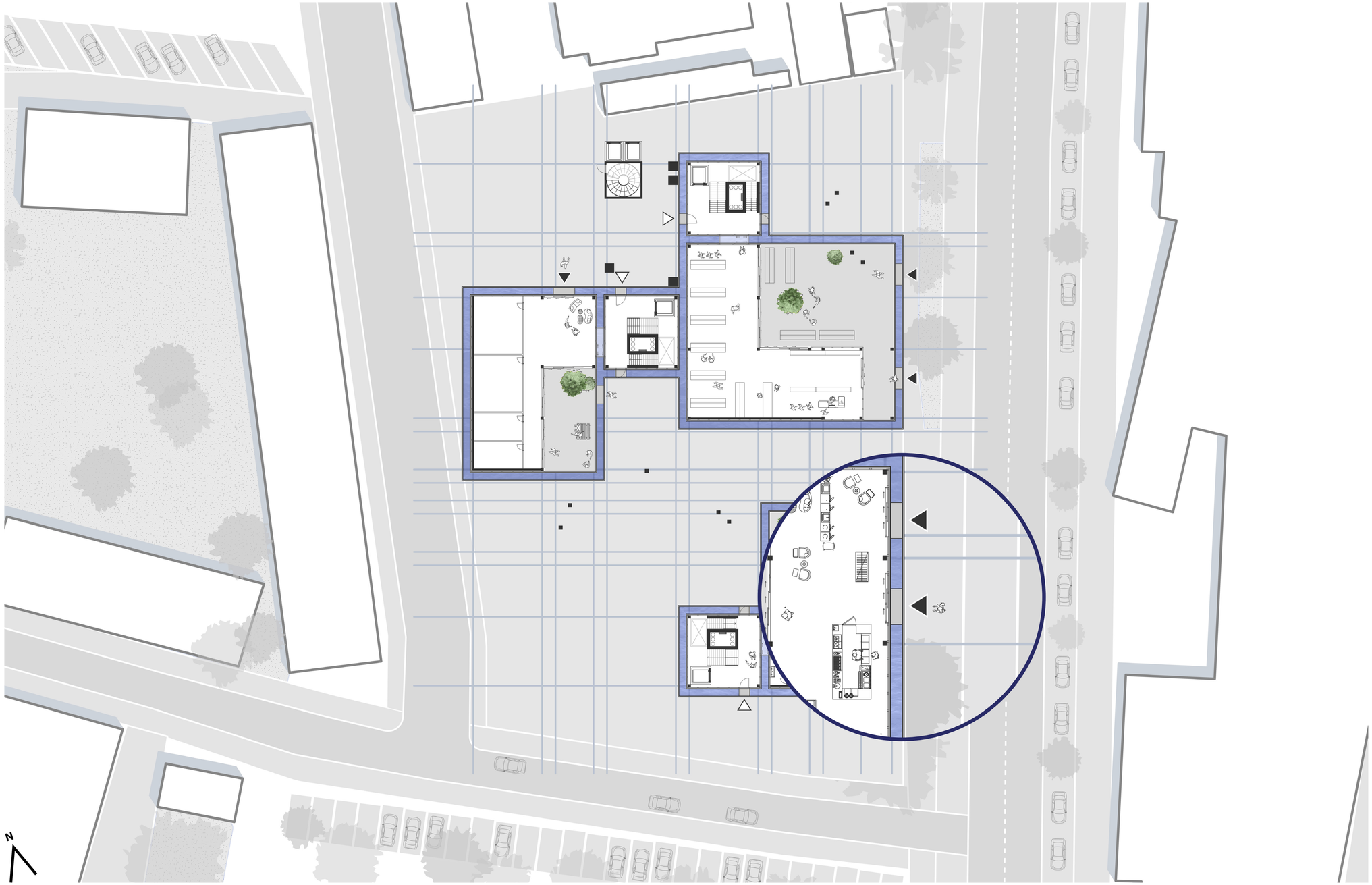
Courtyards



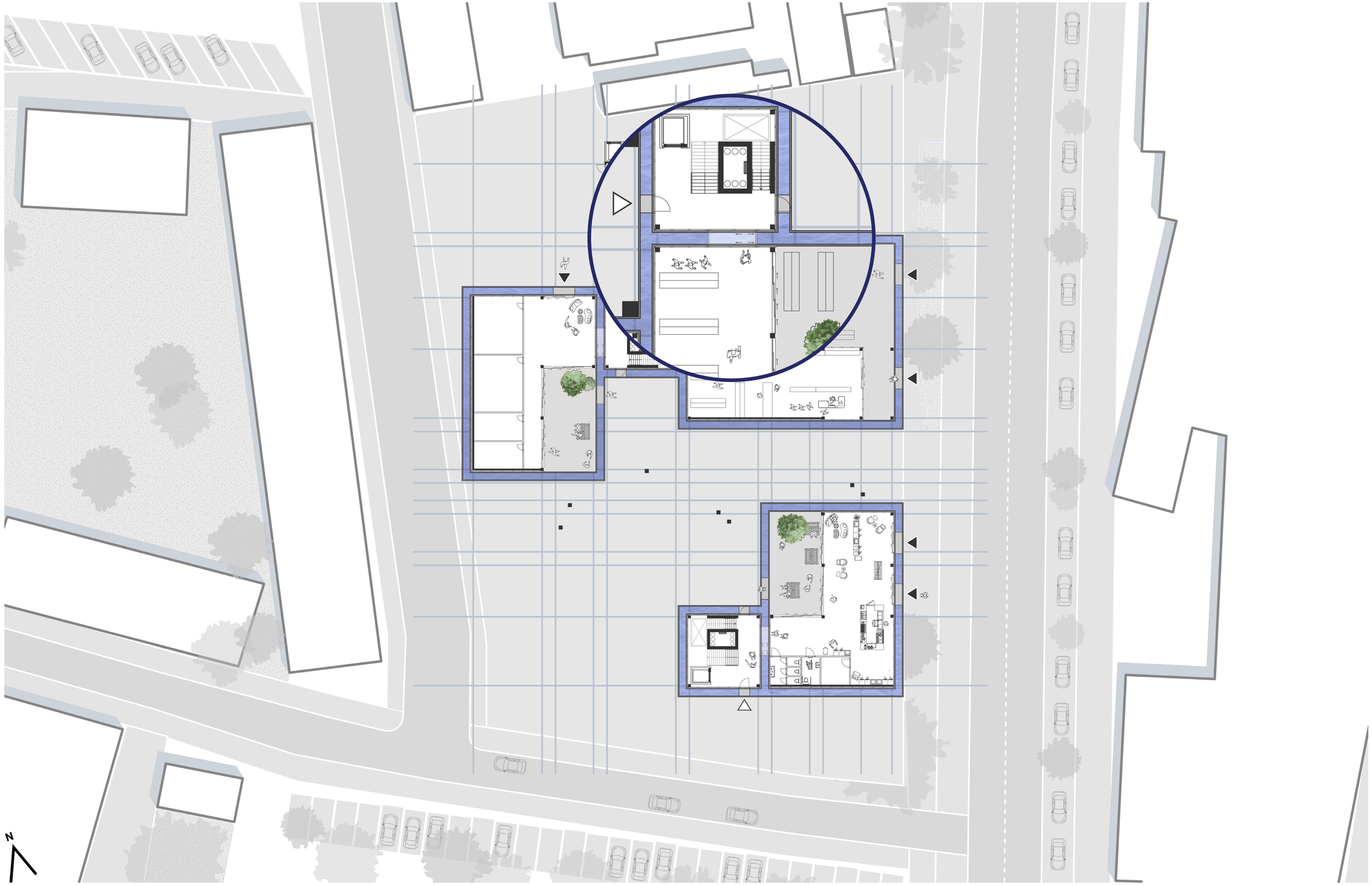
Water Ponds



Physical Connection



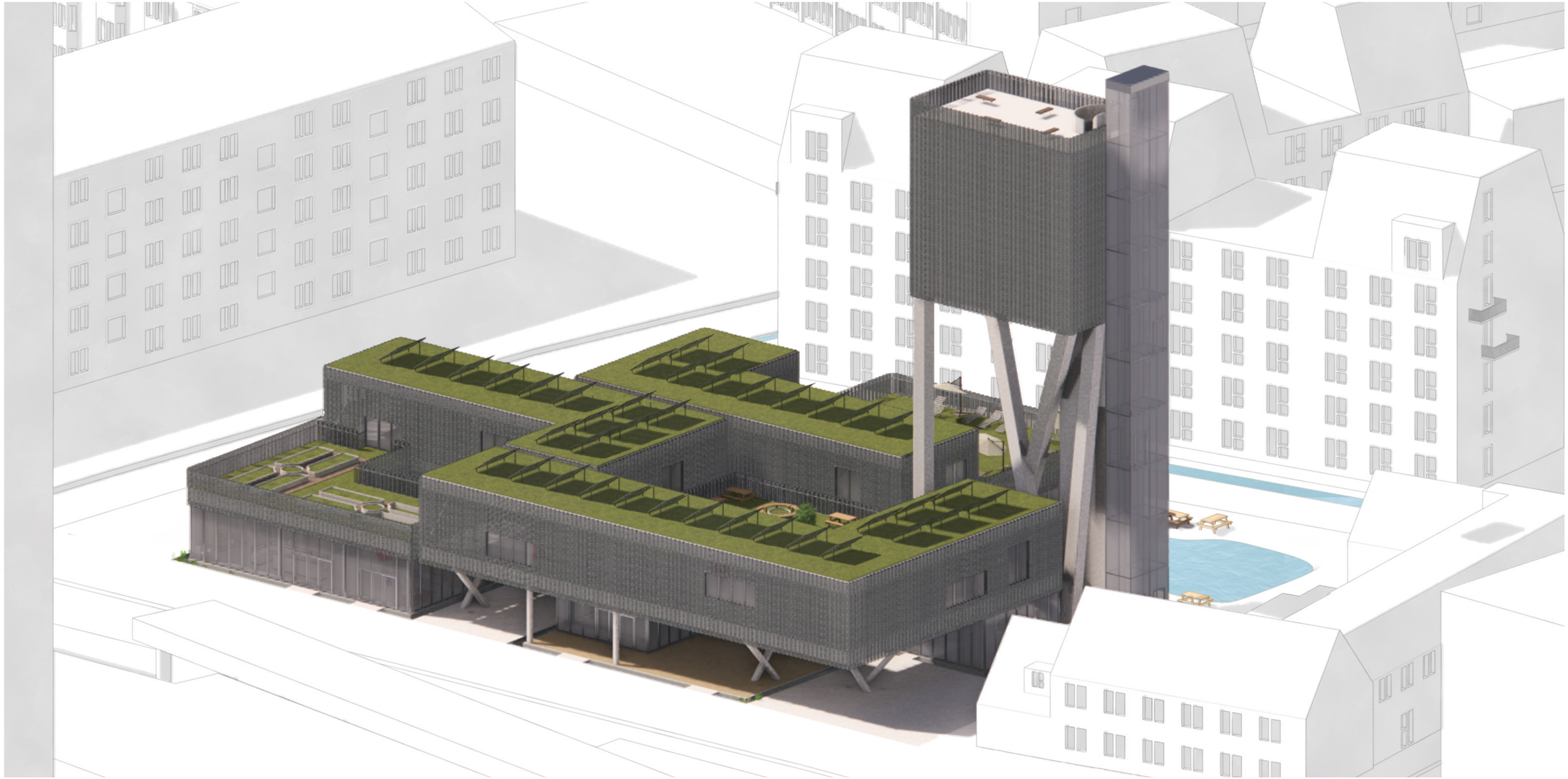
Visual Connection



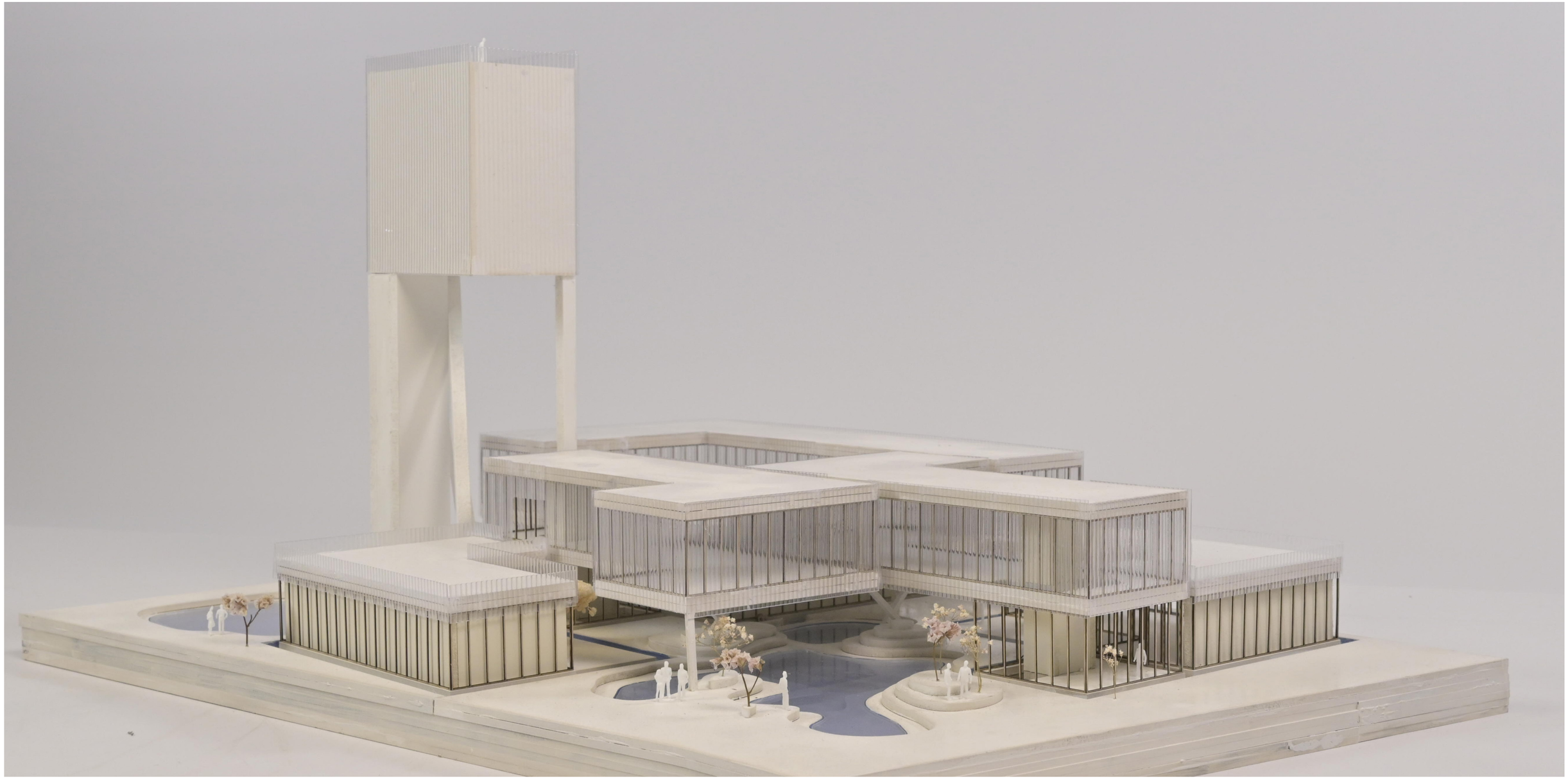
Waterscape

Public Space

Main Street



Waterscape

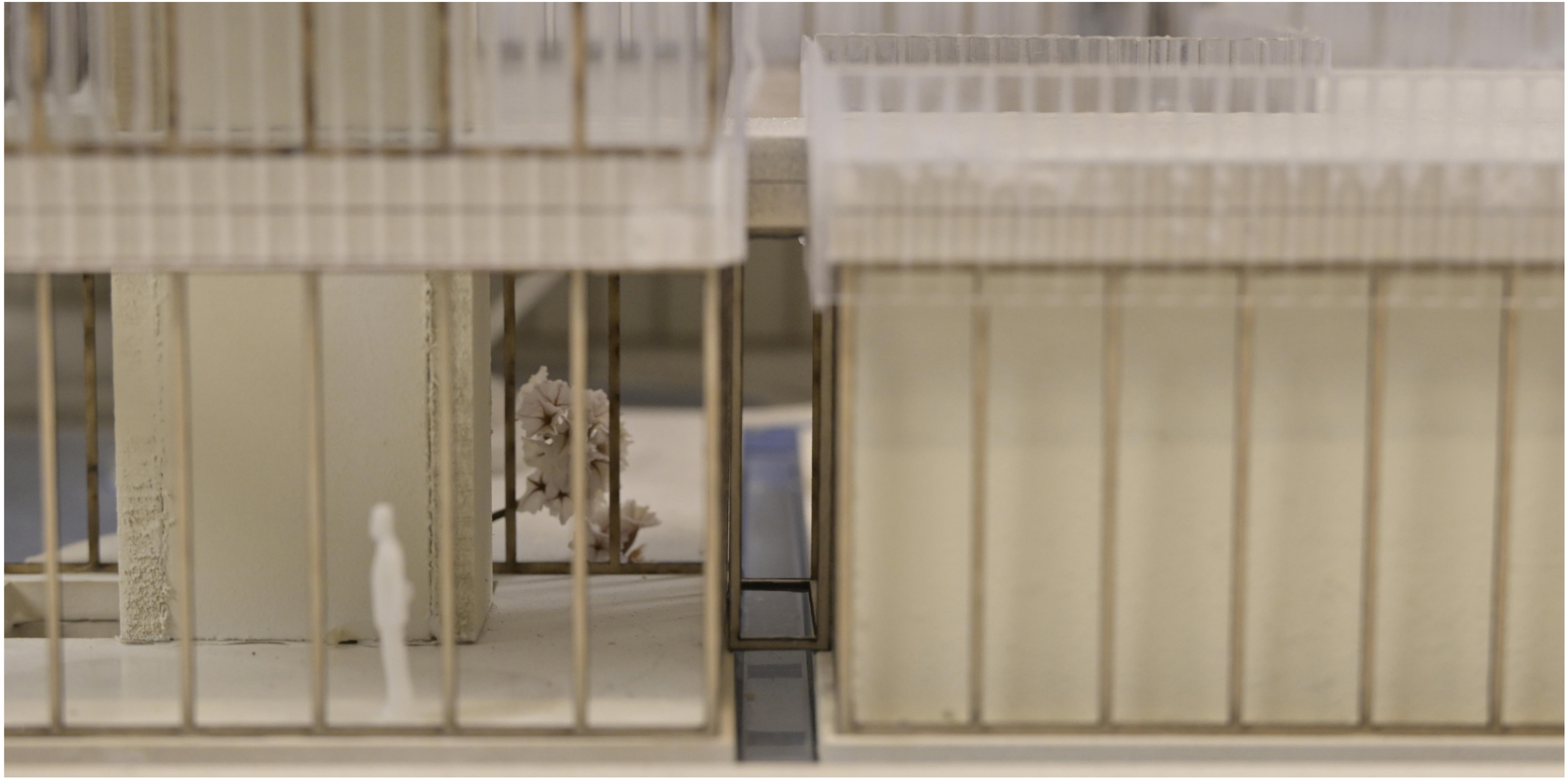


Courtyards

The Laundry Café

Courtyards

Visual Connections



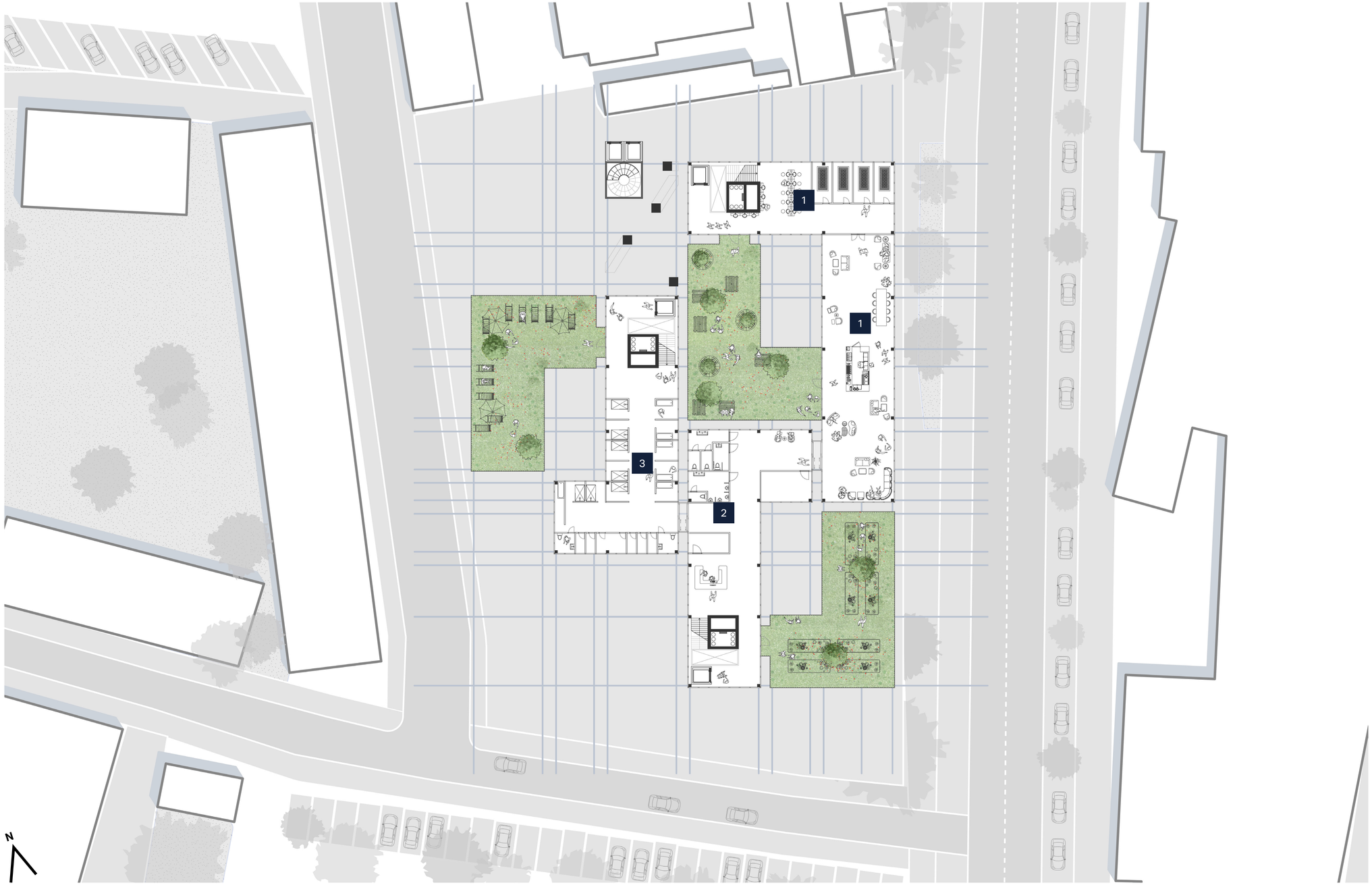
Green-Blue Roofs

1 Cultural Cluster: Outdoor Terrace

2 Social Cluster: Community Garden

3 Health Cluster: Relaxing Area

Clusters



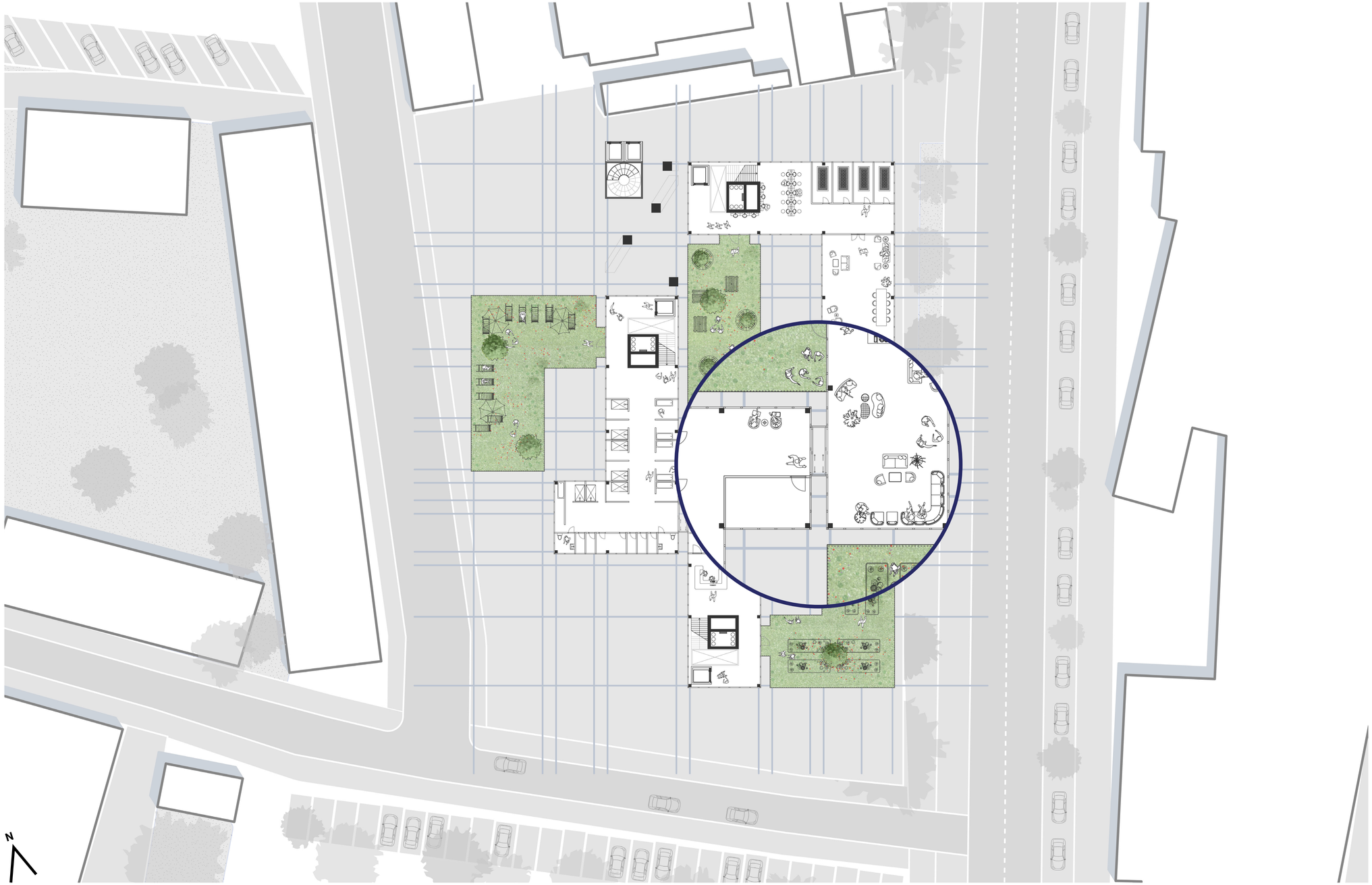
1 Cultural Cluster:
Purification Room

1 Cultural Cluster:
Tea House

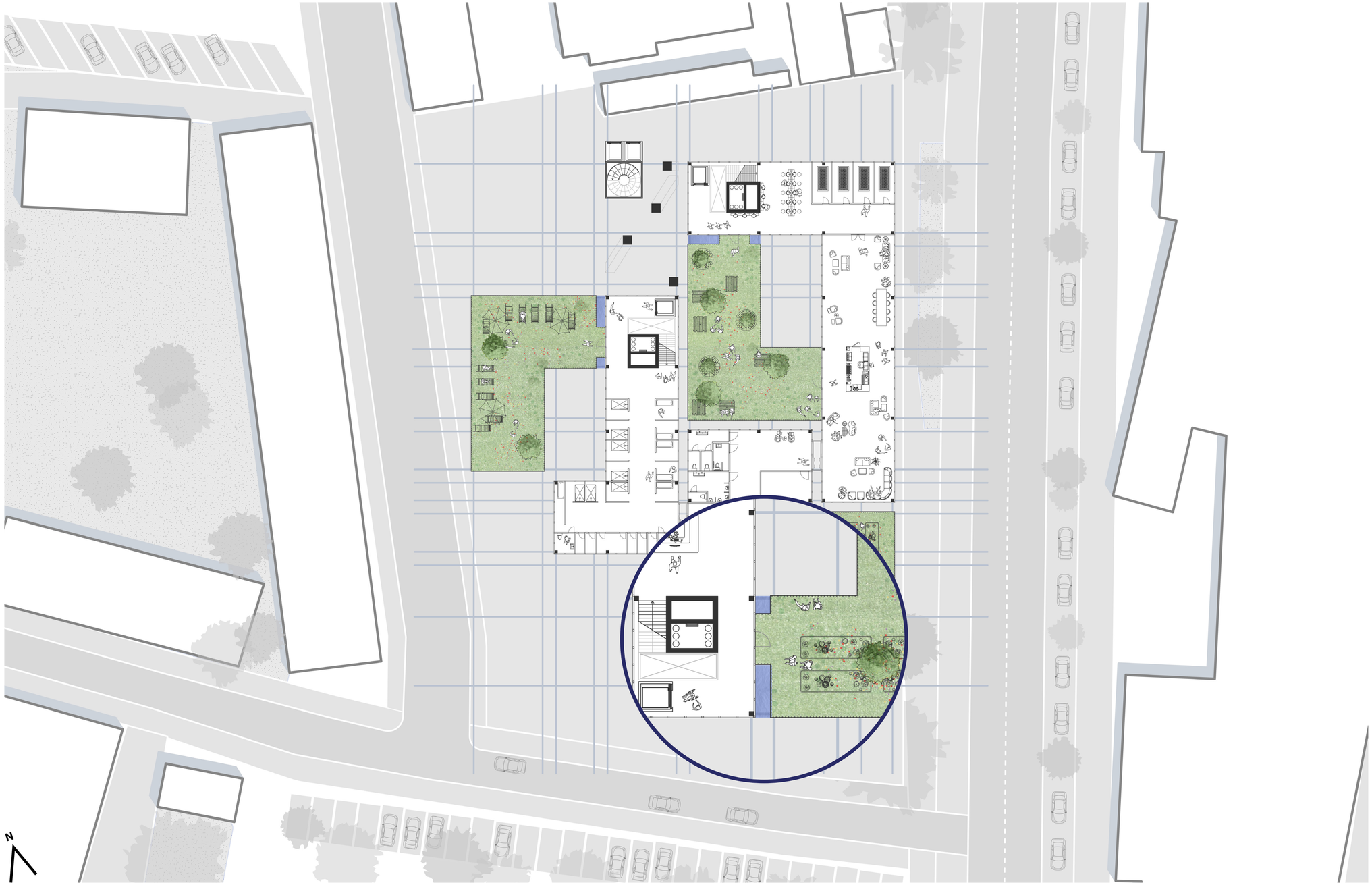
2 Social Cluster:
Reception Area

3 Health Cluster:
Bath House

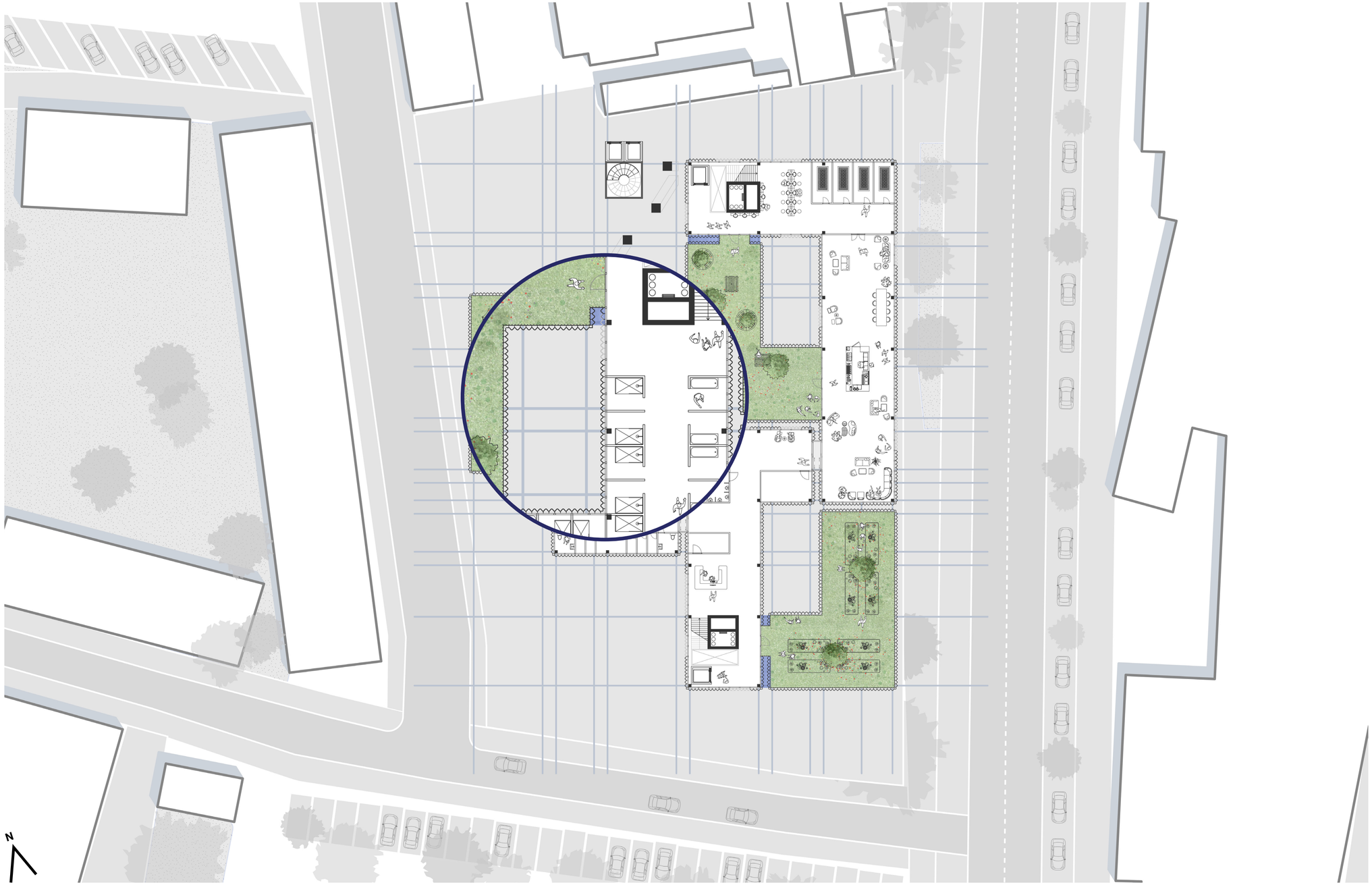
Visual Connection



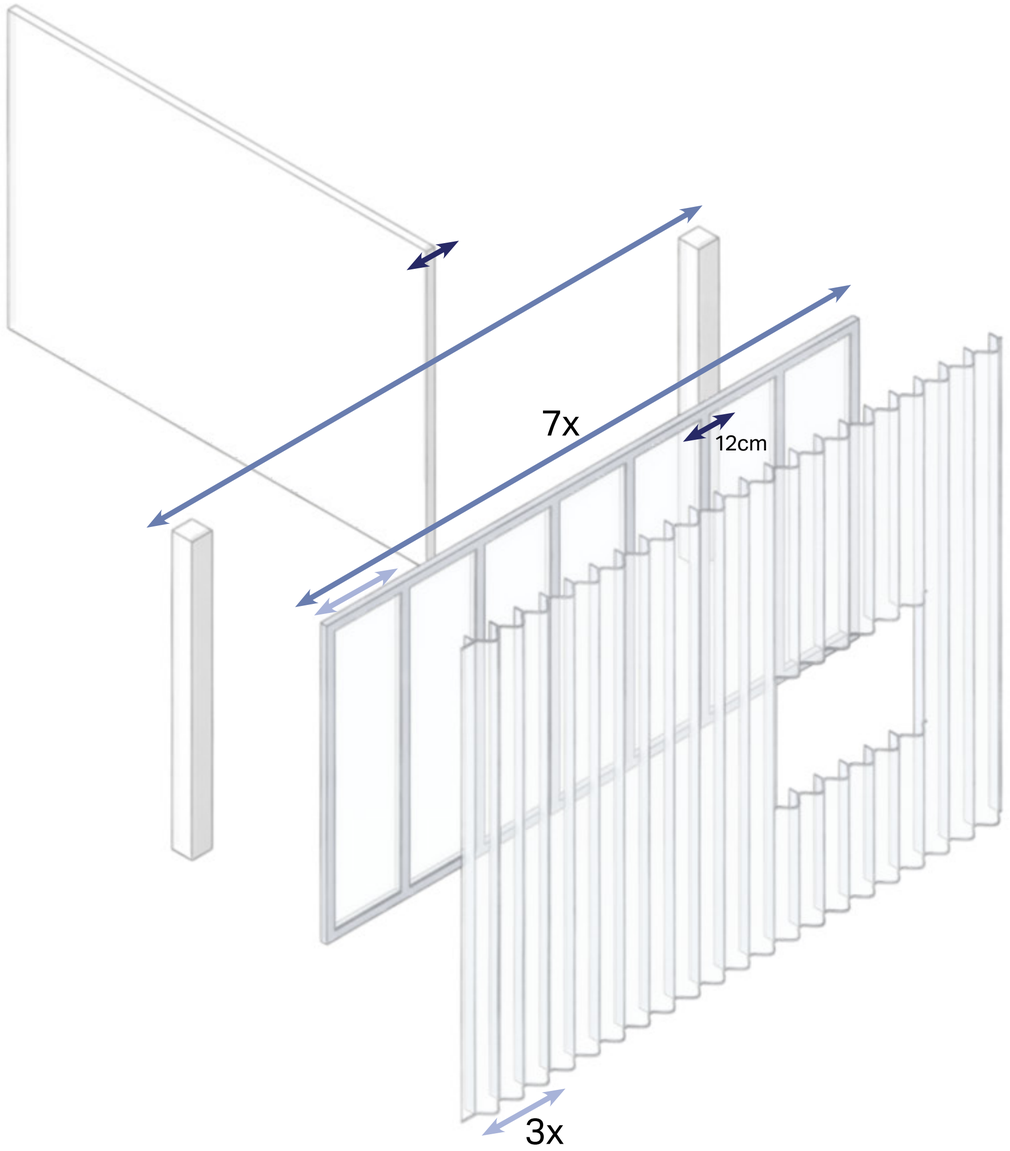
Physical Connection



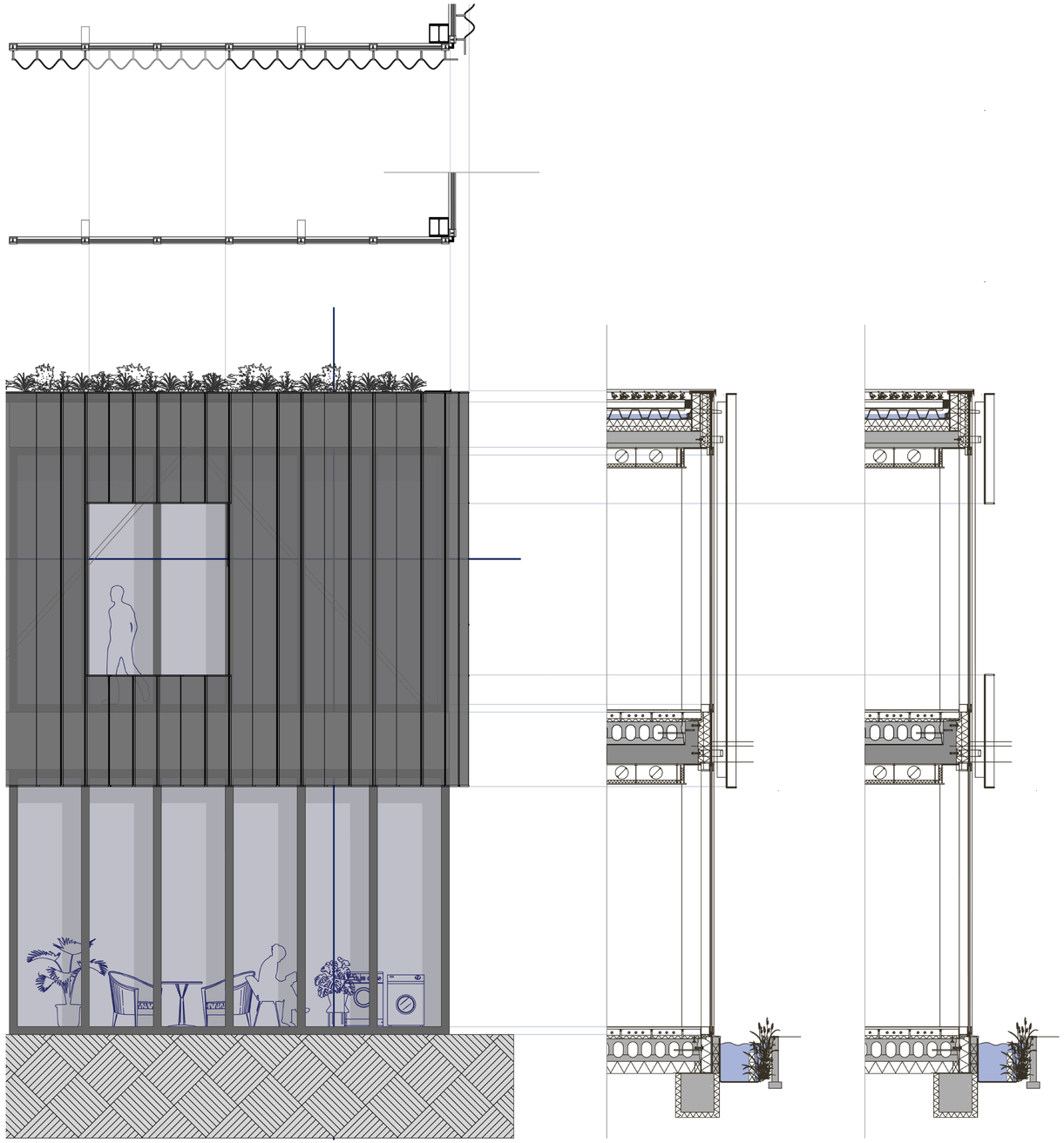
Privacy

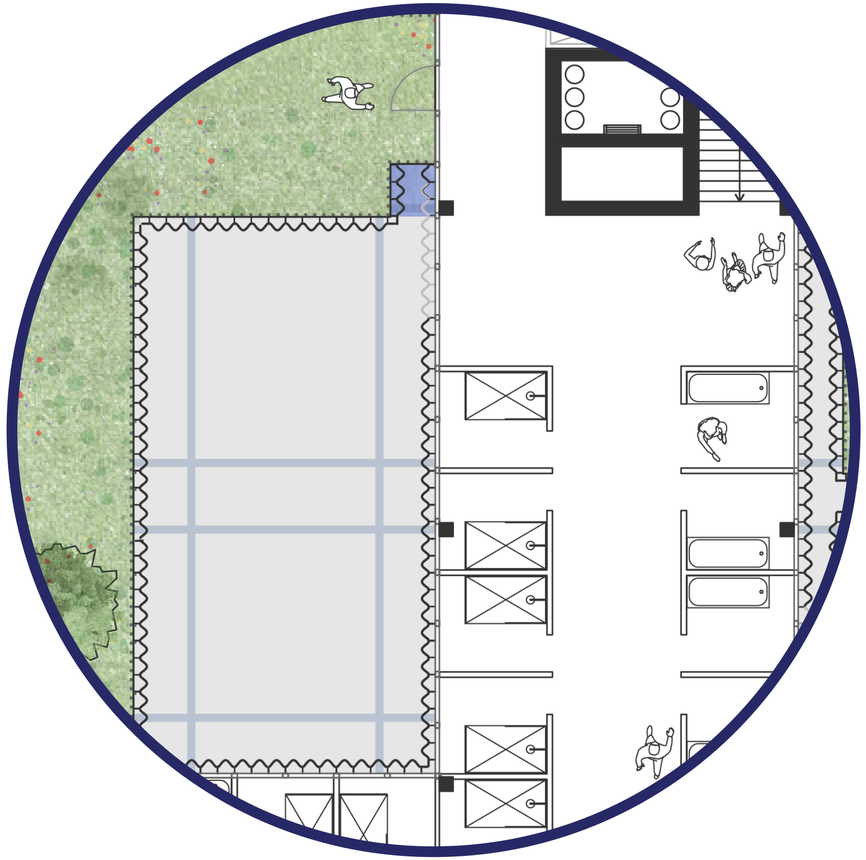


Facade System

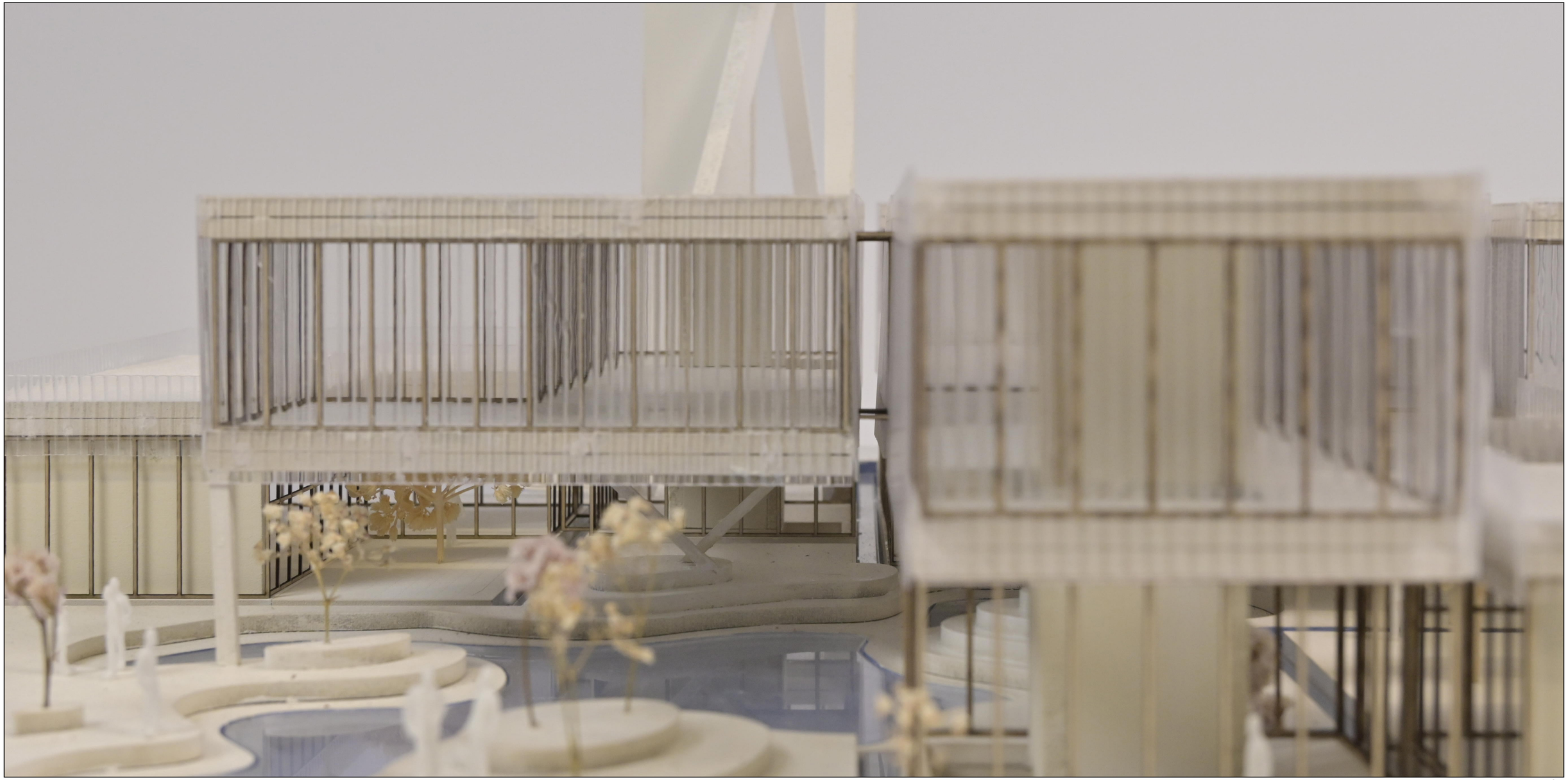


Second Skin





Visual Connections



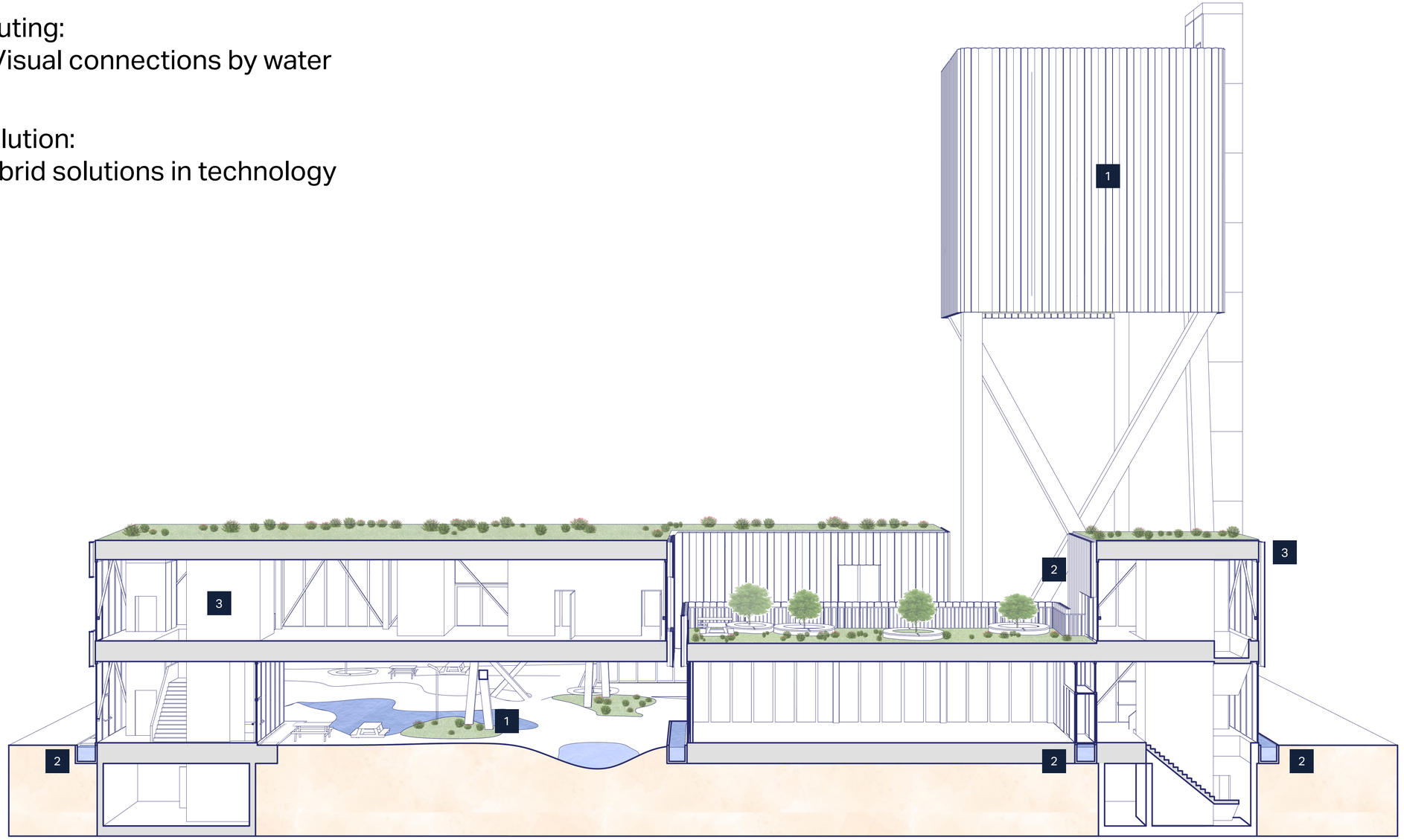
So, ***how*** do we want to design
on hybridity, sustainability and health levels?

Hybridity

1 Water as function:
Merging functions by water

2 Water as routing:
Physical & Visual connections by water

3 Water as solution:
Creating hybrid solutions in technology



1 Water as function:
Merging functions by water

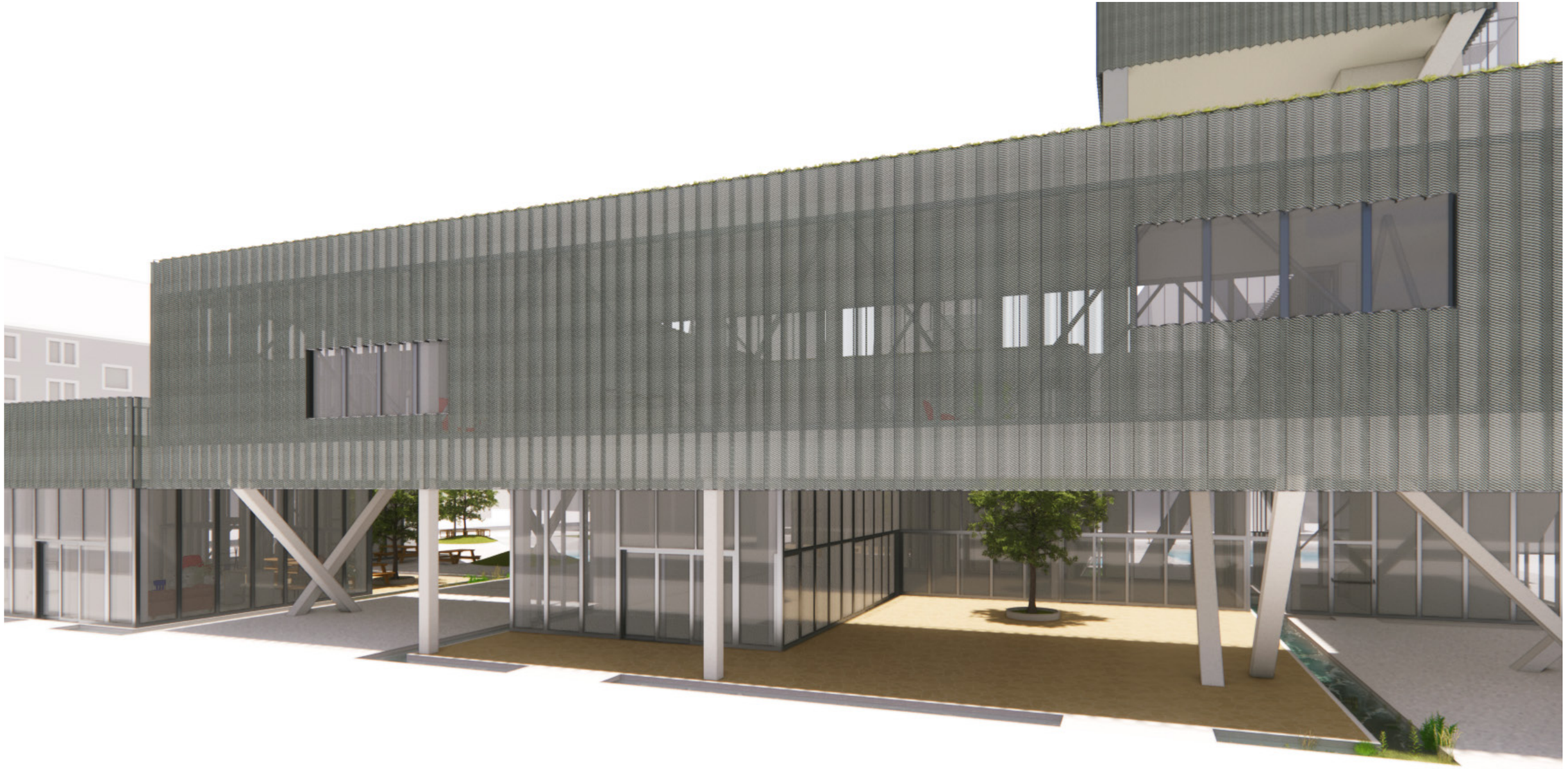
Recreation & Retention

Viewing & Storing

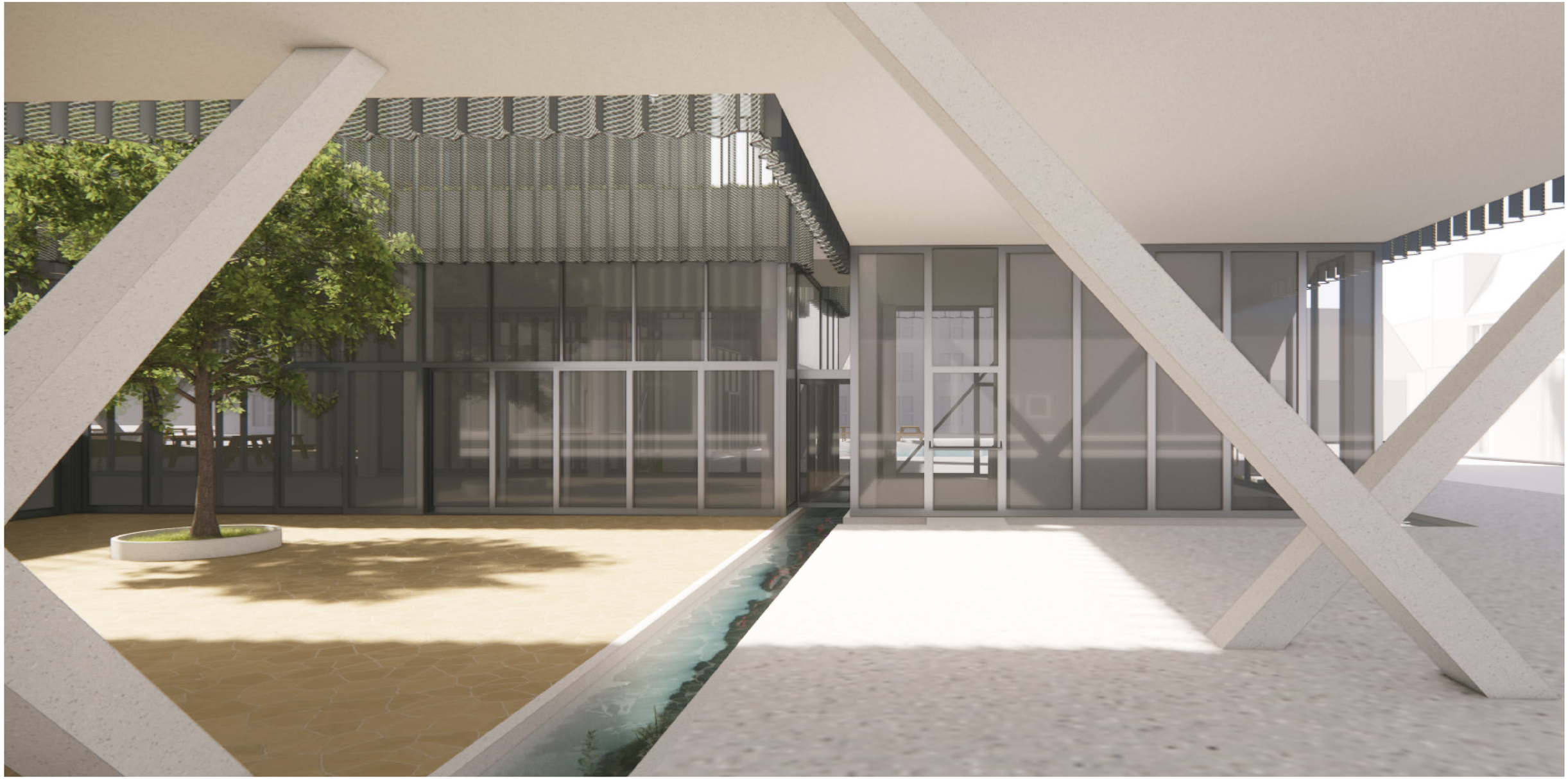
2

Water as routing:
Physical & Visual connections by water

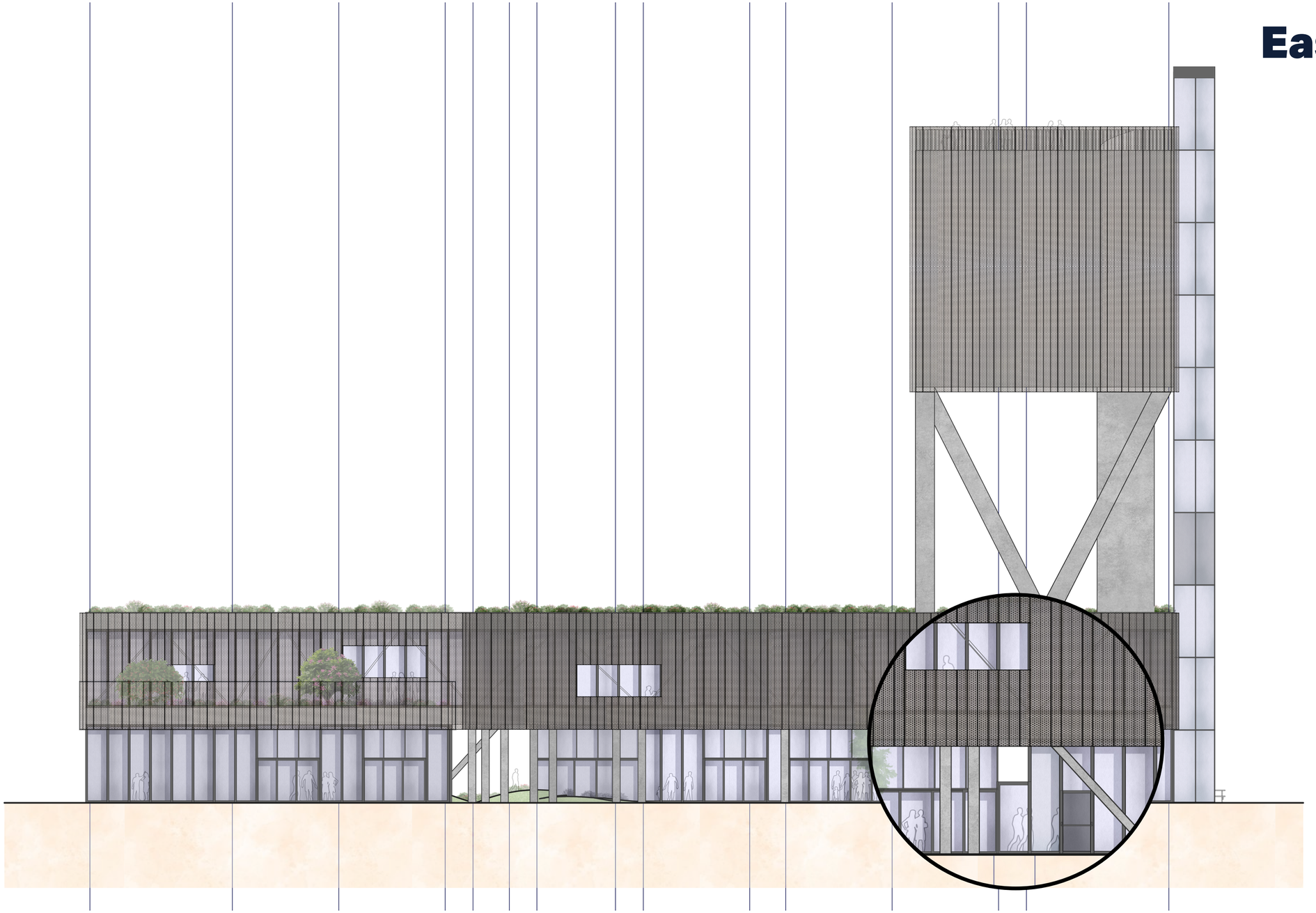
Physical Connection



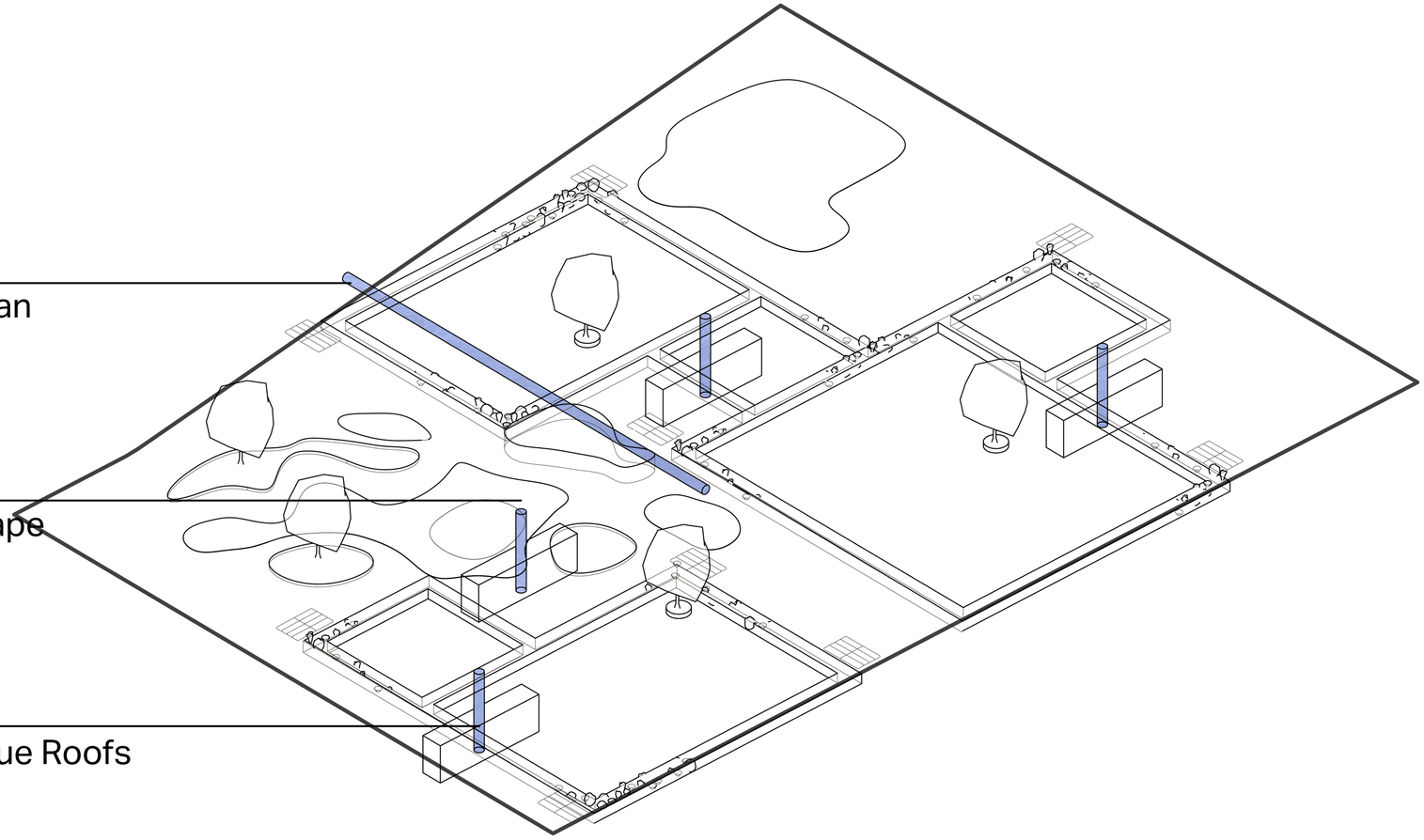
Visual Connection



East Facade



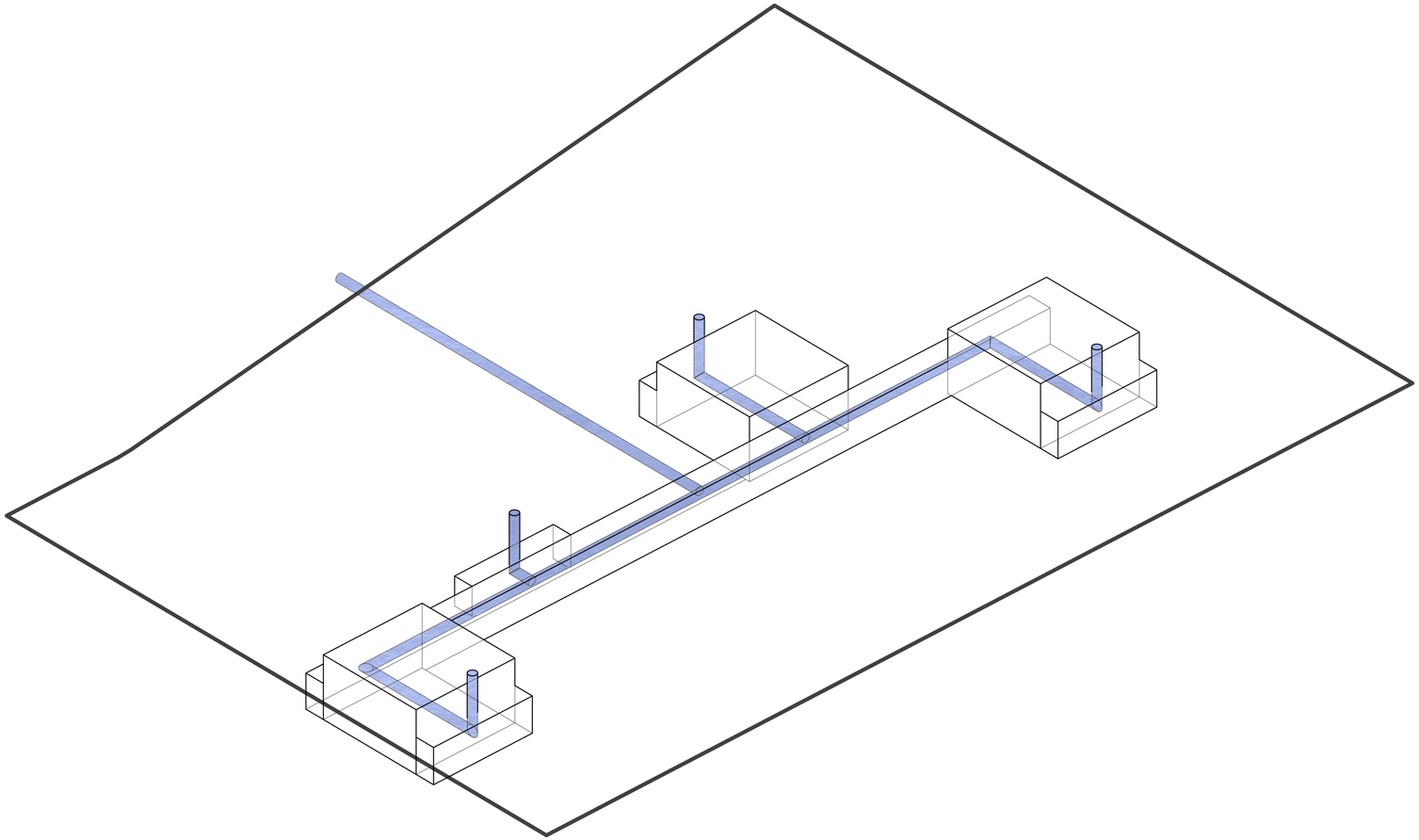
3 Water as solution:
Creating hybrid solutions in technology

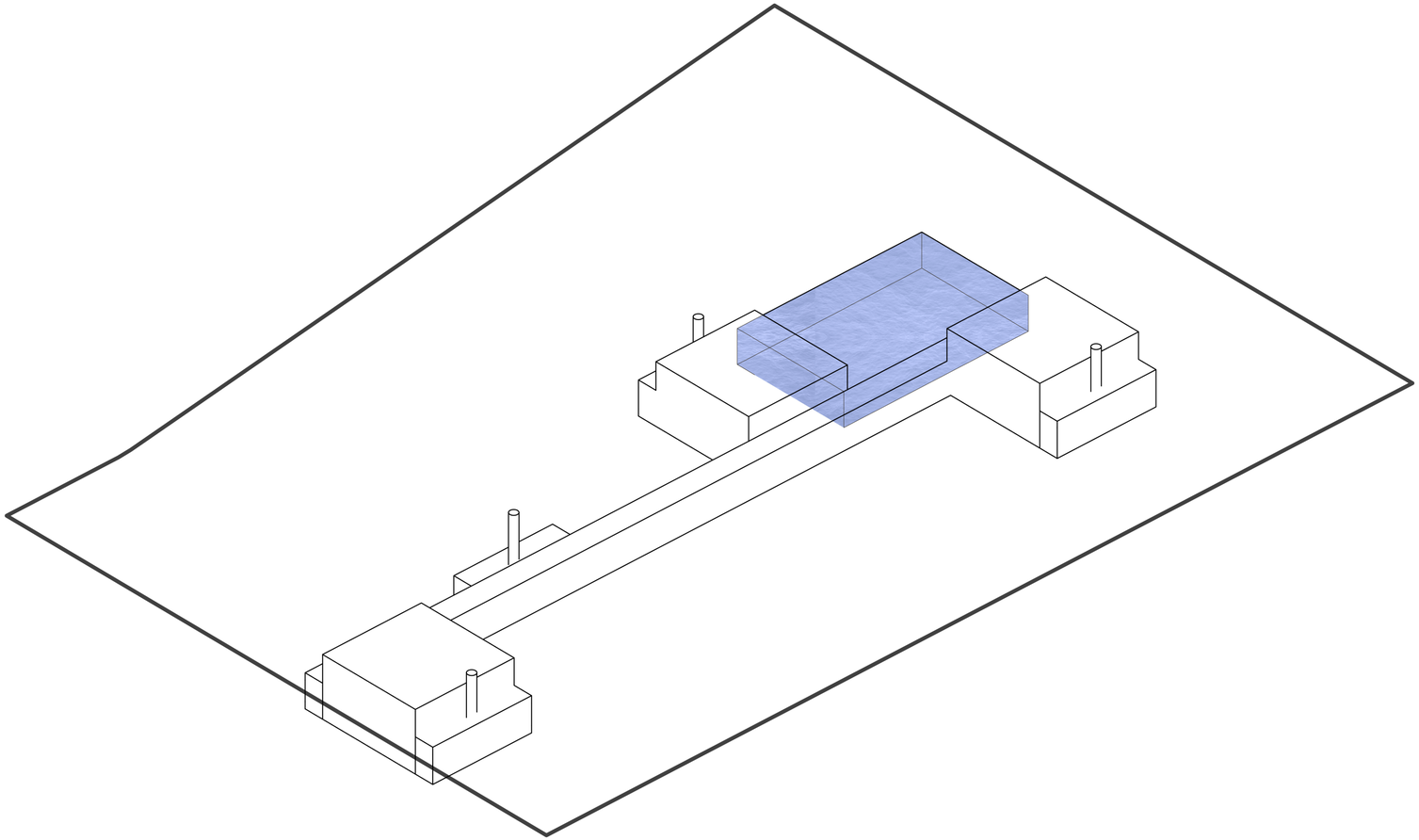


1 Rainwater of Masterplan

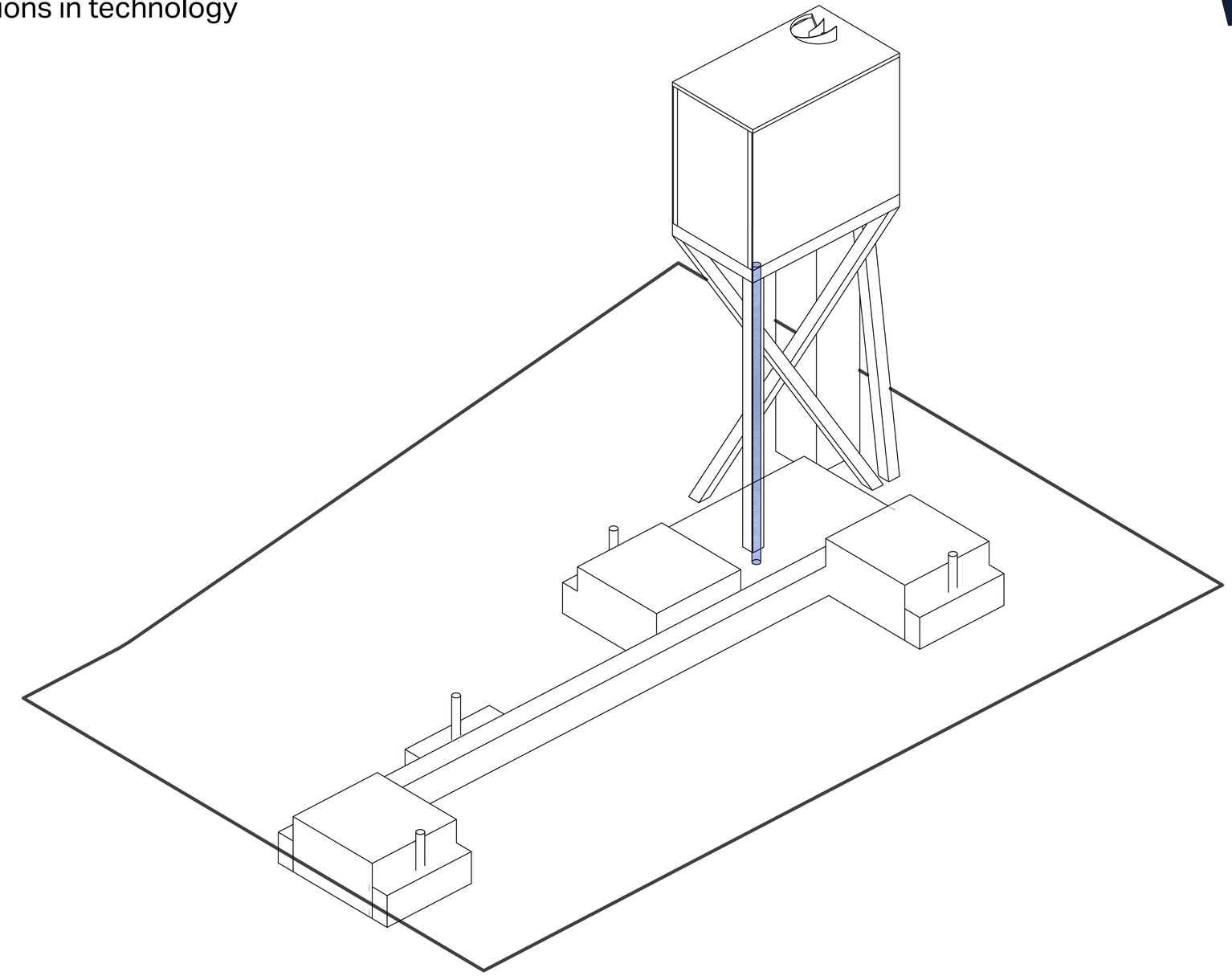
2 Rainwater of Waterscape

3 Rainwater of Green-Blue Roofs





Water as solution:
Creating hybrid solutions in technology



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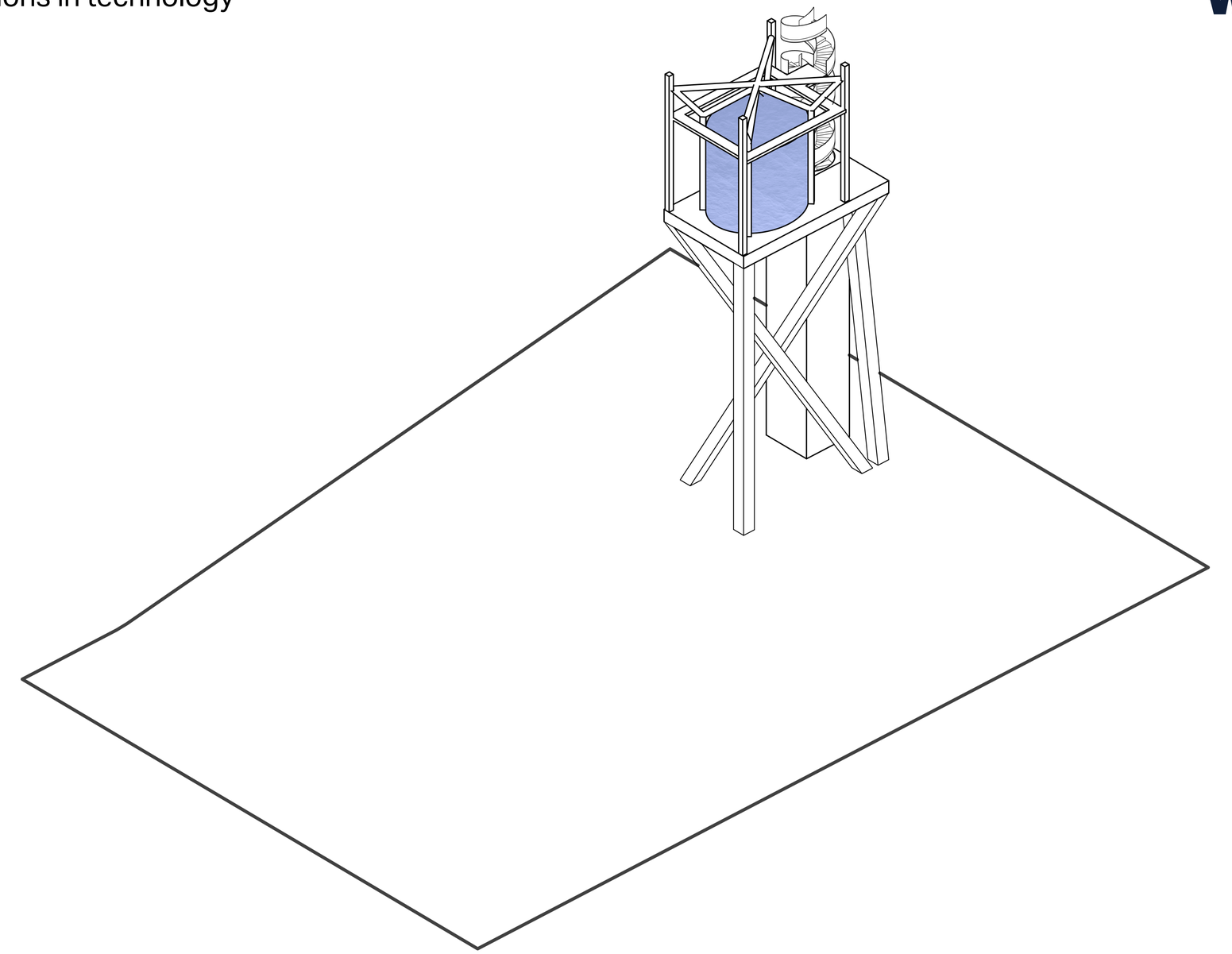
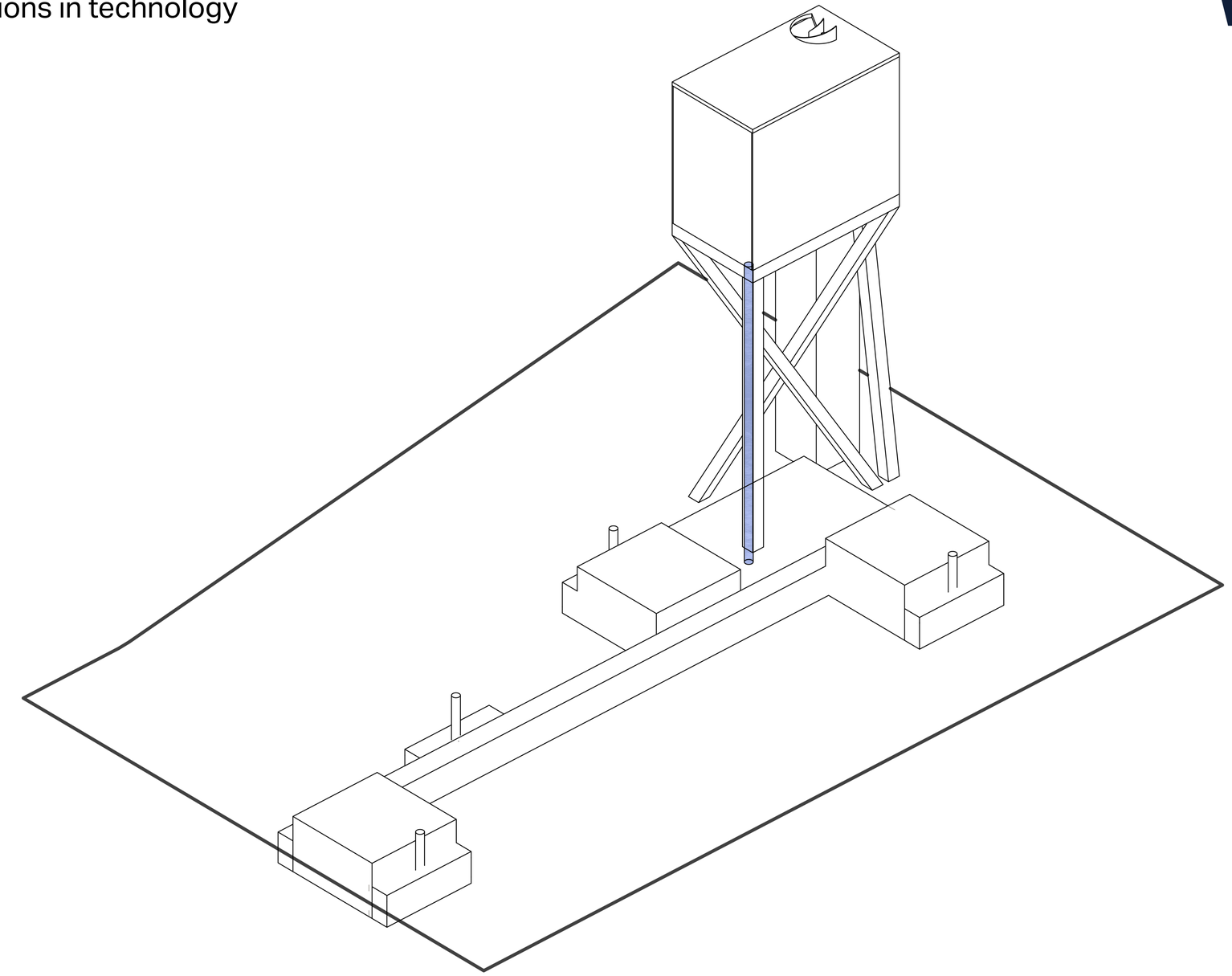
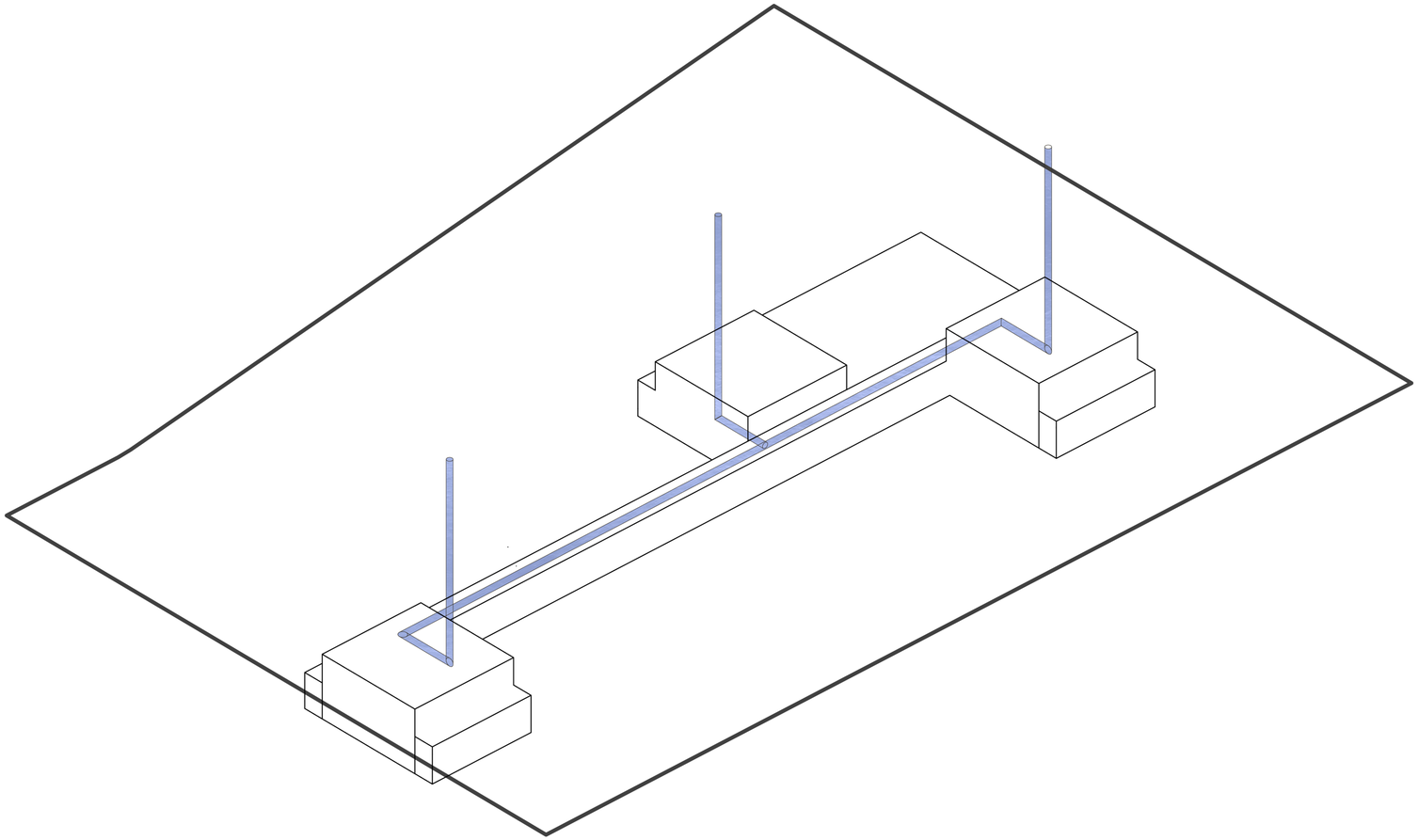
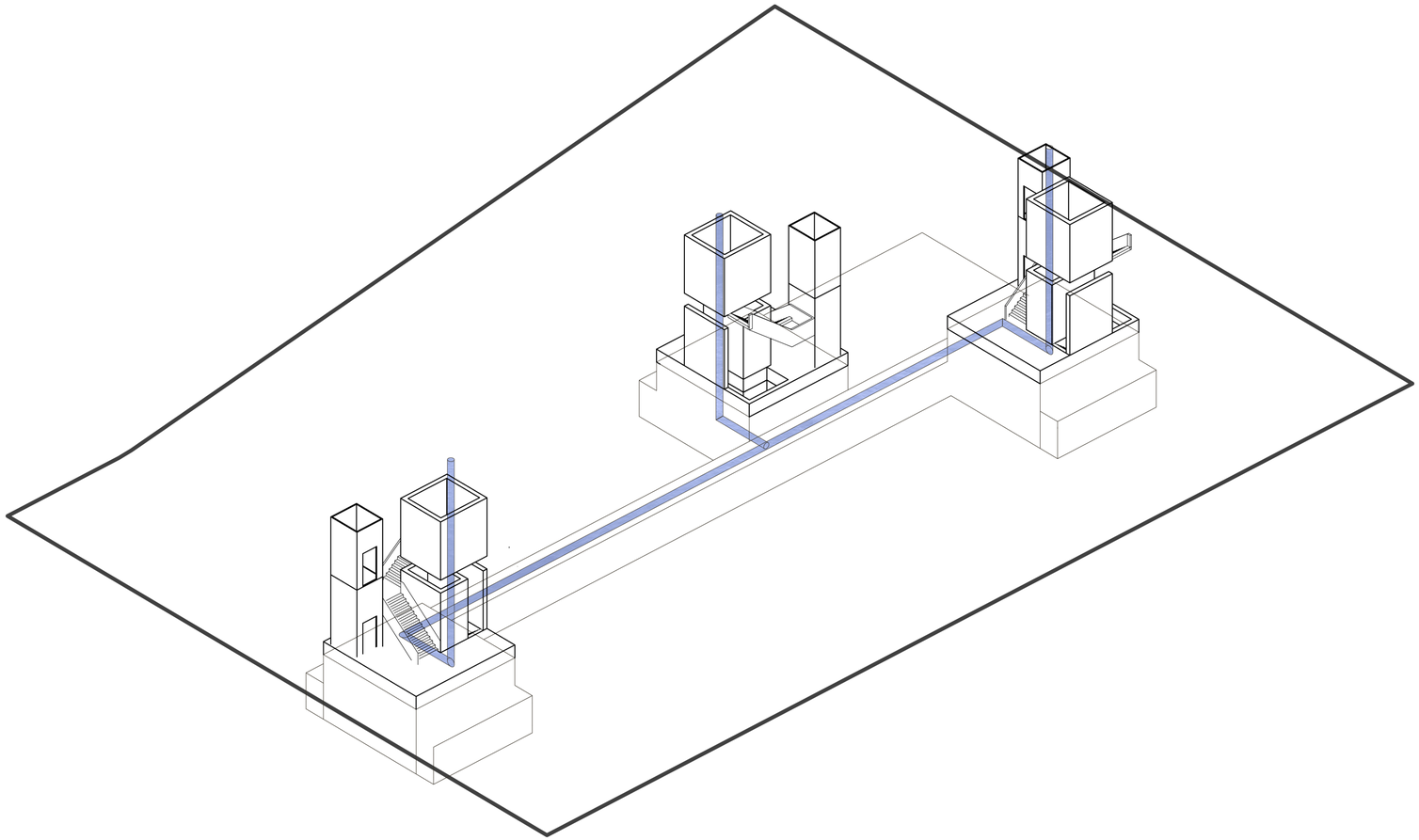


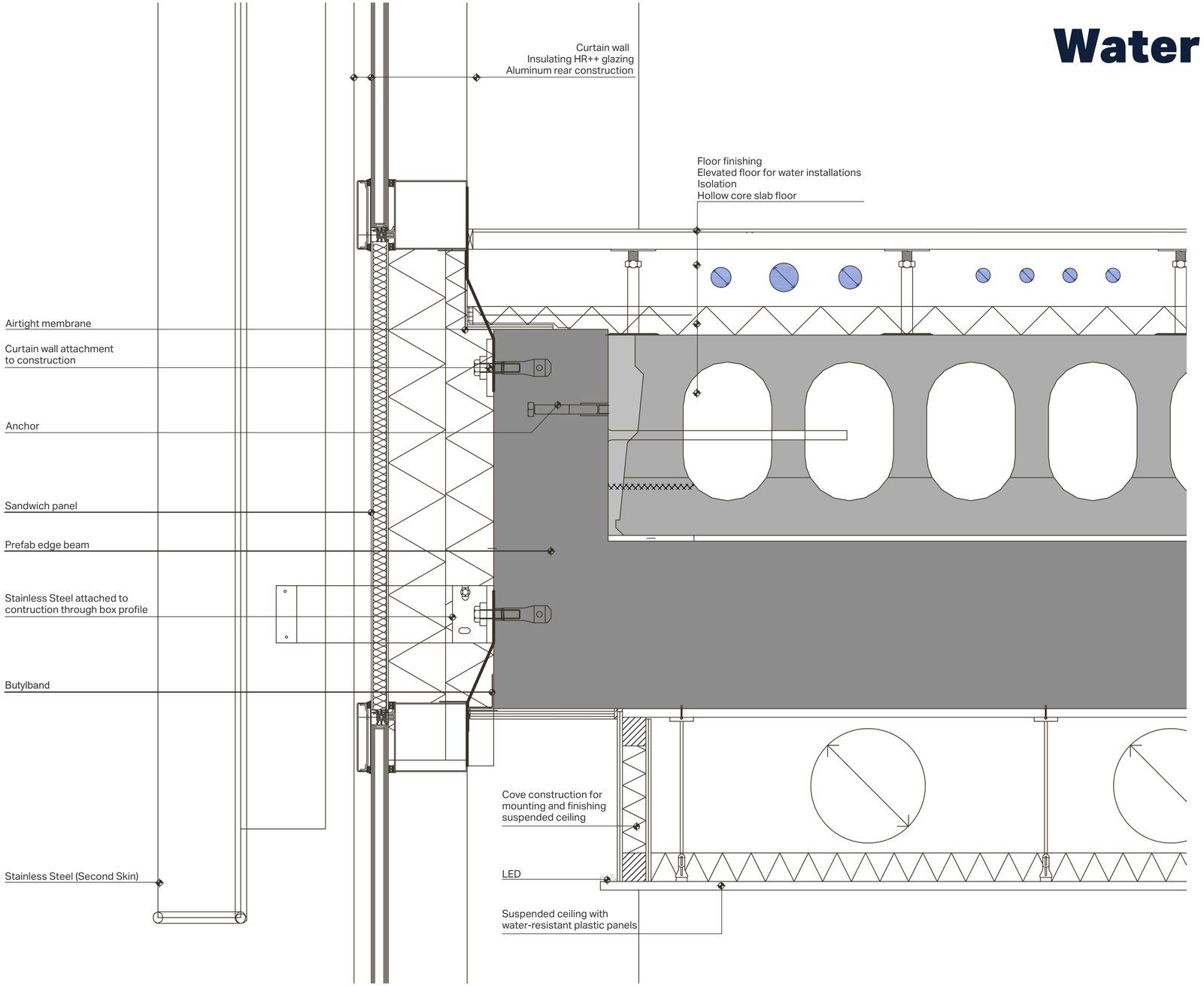




Water as solution:
Creating hybrid solutions in technology



Water Distribution



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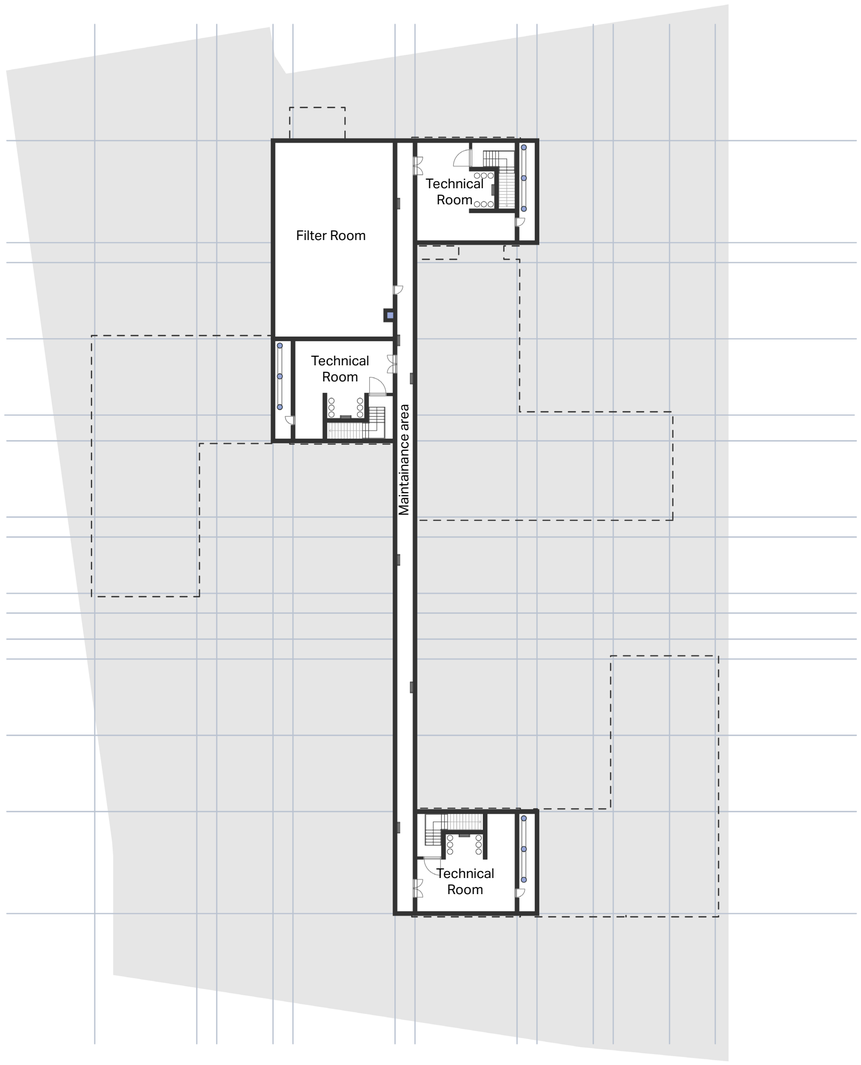
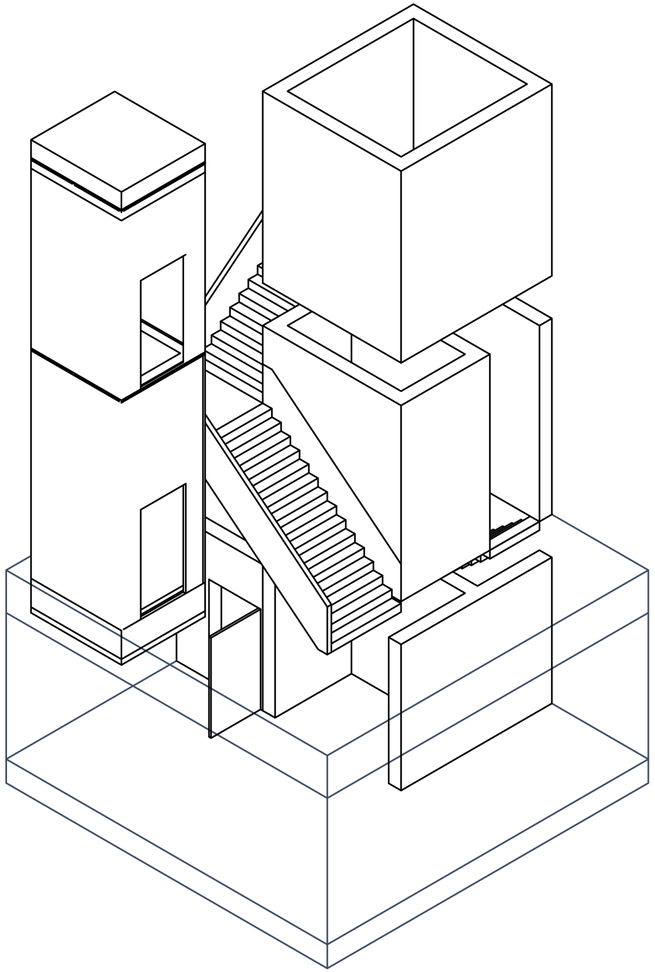
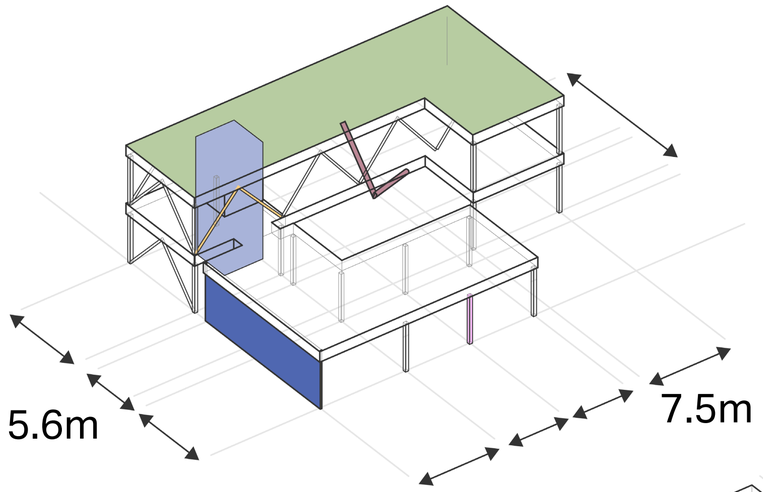
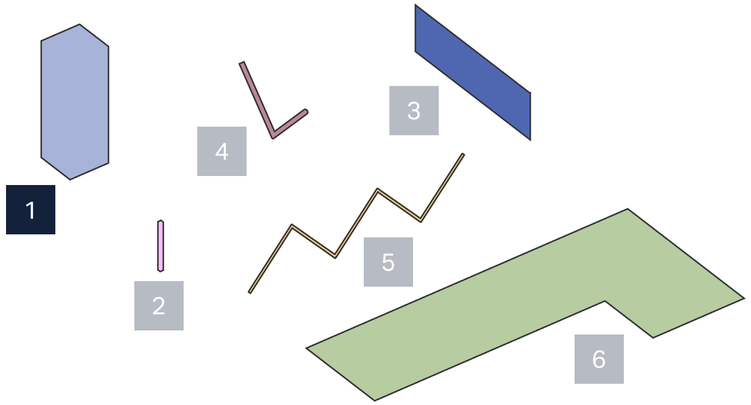
Water as solution:
Creating hybrid solutions in technology

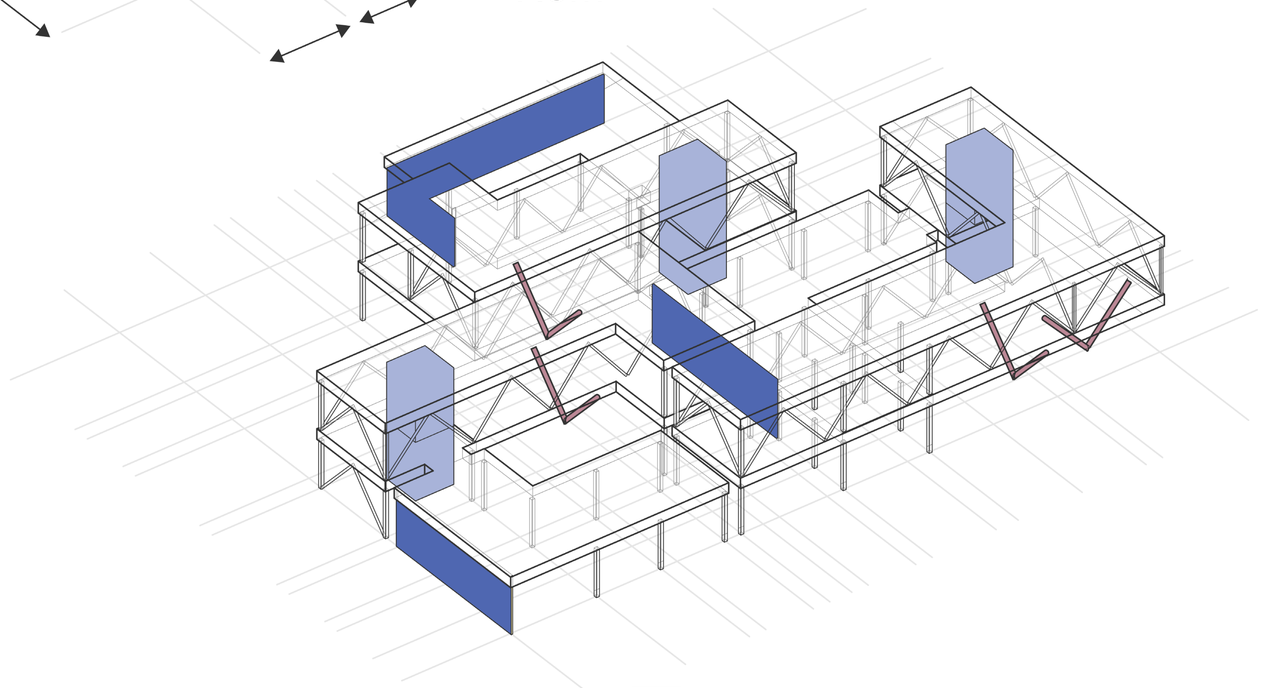


3 Water as solution: Creating hybrid solutions in technology









1 Concrete Core with room for Technical Facilities

2 HEB280 Columns in a Grid of 7,5m/5,6m

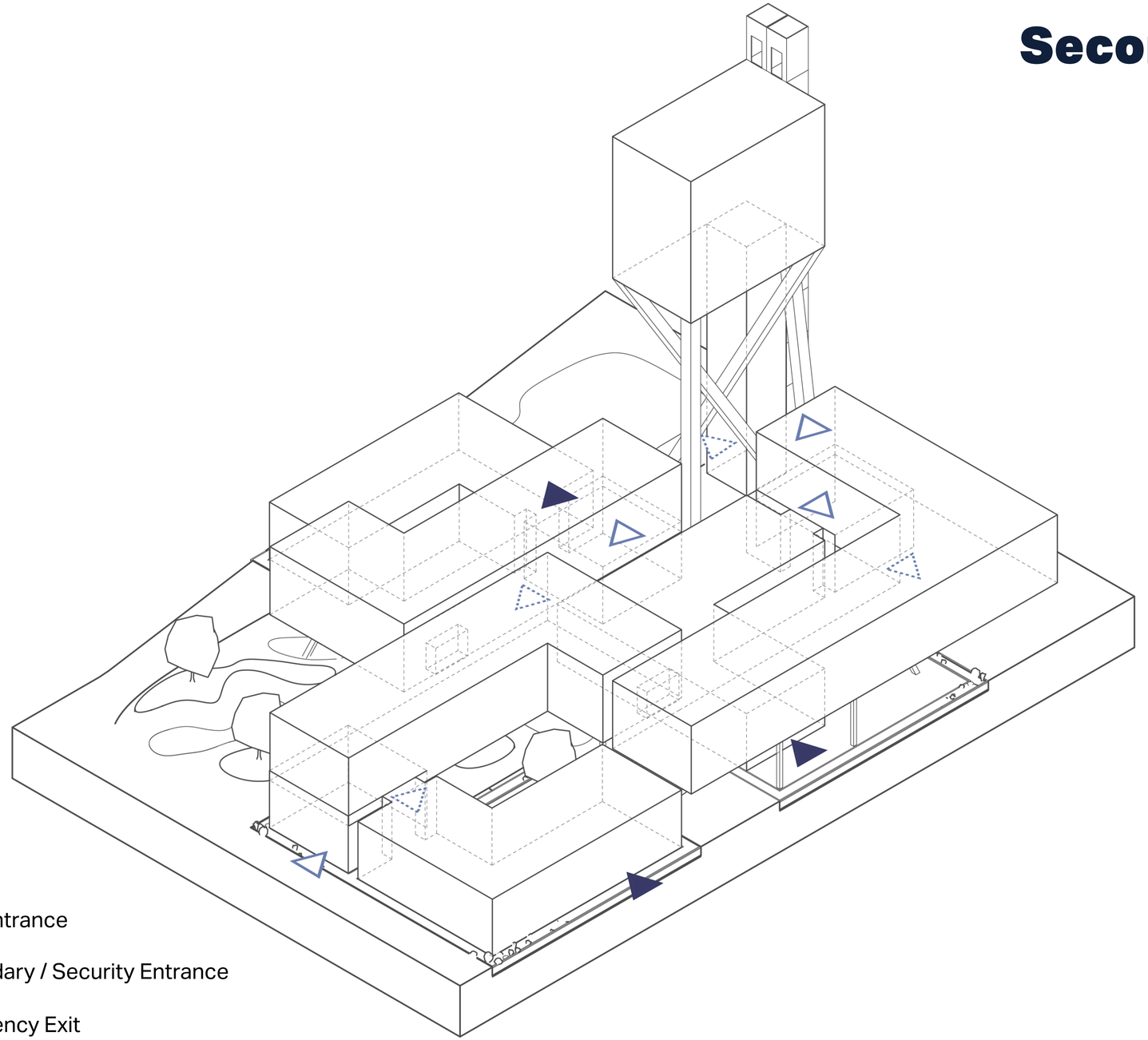
3 Concrete Bricks on Southern Facade (Trombe Wall)

4 V-Columns to support First Floor

5 (Wind) Braces to increase Structural Stiffness on First Floor

6 Roofs are reinforced to transfer Wind Forces efficiently

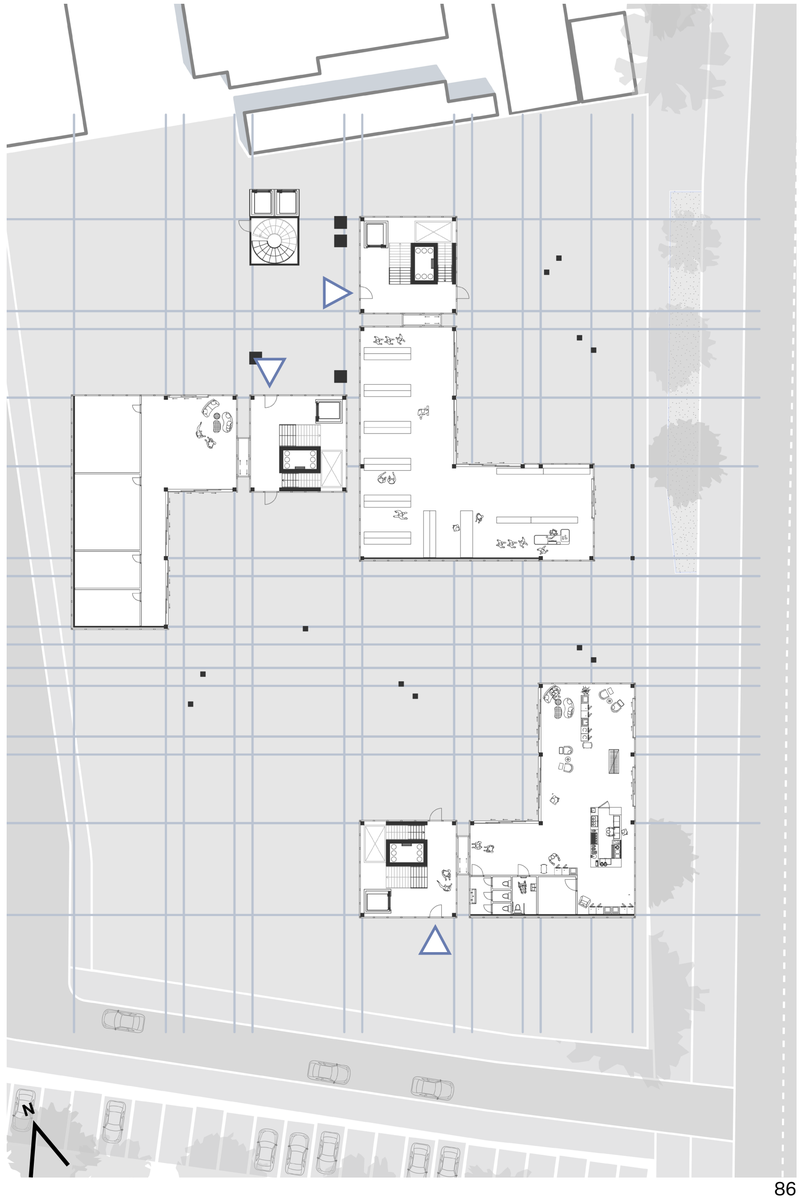
Secondary / Security Entrances



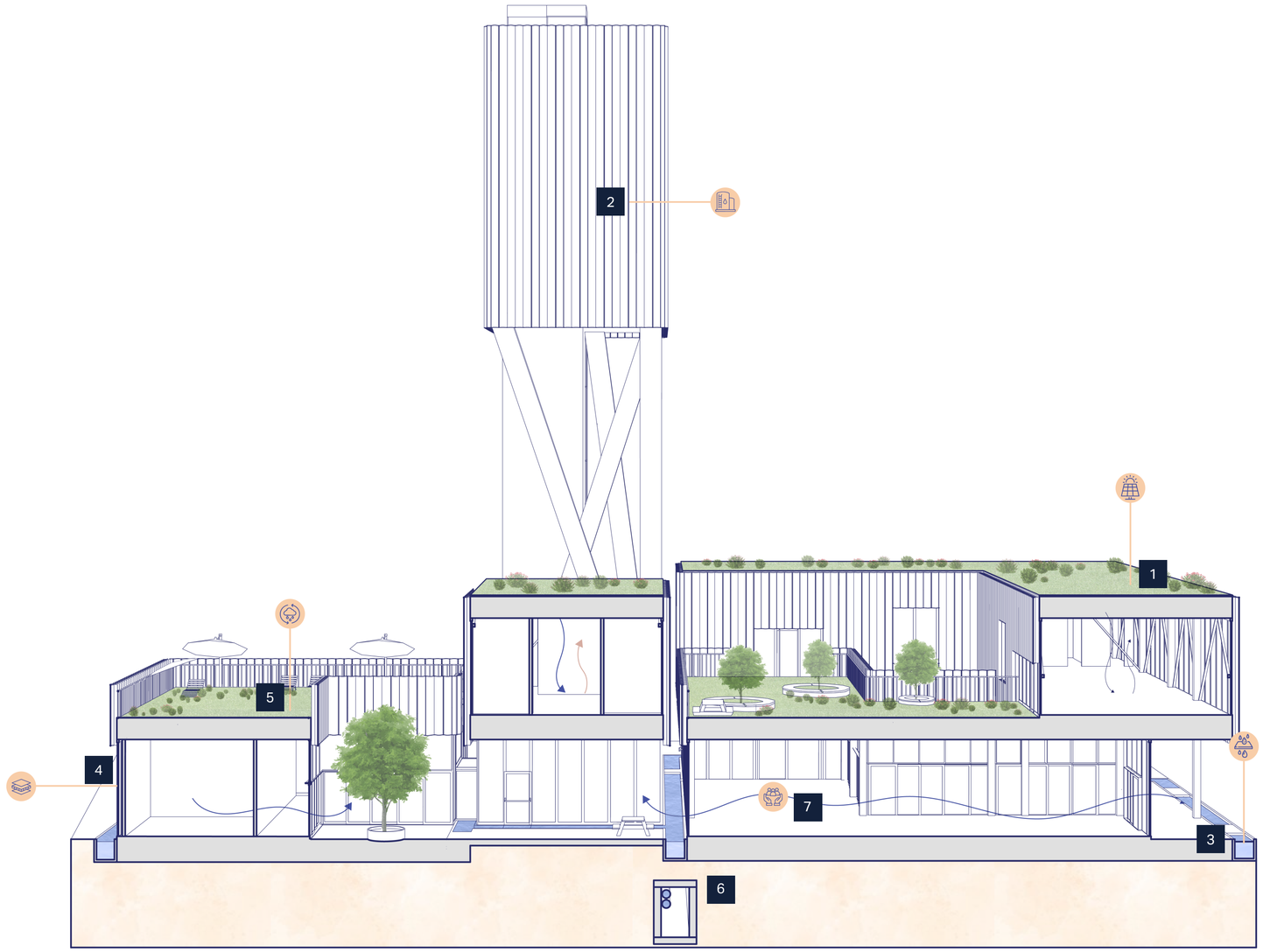
Main Entrance

Secondary / Security Entrance

Emergency Exit



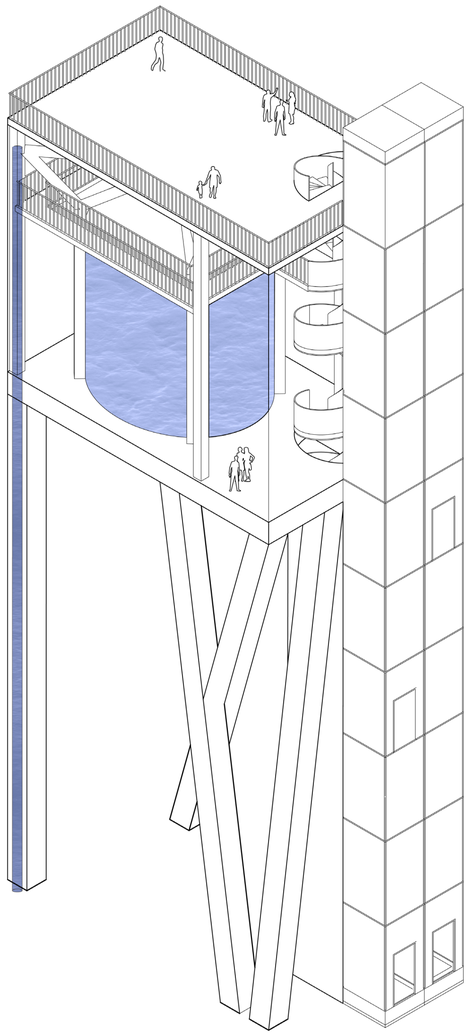
Sustainability & Health



1. 200m2 of solar panels that contribute in total for 56,000 kWh/year
2. Storing rainwater in the water tower with a buffer of 25% in dry periods
3. Water is filtered naturally in water ponds by aquatic plants, microorganisms and soil
4. Trombe Wall absorbing solar heat through the glass and storing it in concrete bricks
5. A green-blue roof stores rainwater on the roof in order to slow down the process
6. Addressing social sustainability by designing inclusive for the community
7. Green roofs contribute to health by improved air quality and mental wellbeing

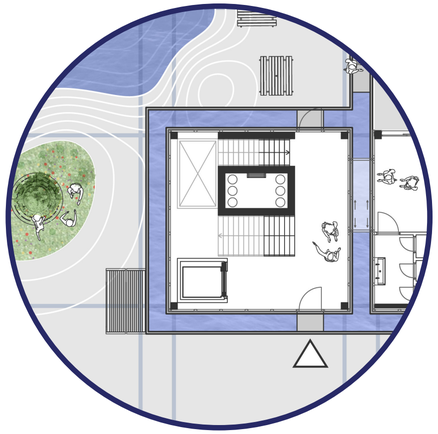
Fourth Floor

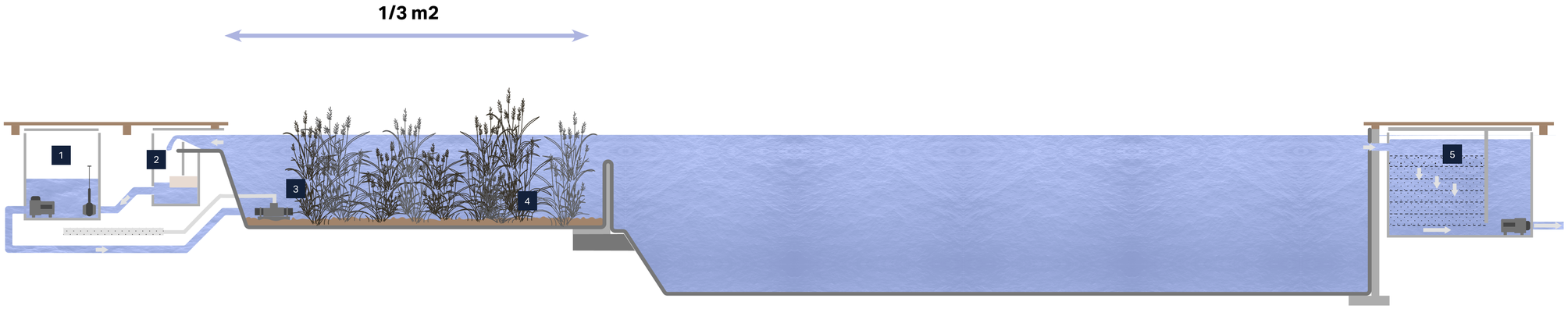
1. 200m2 of solar panels that contribute in total for 56,000 kWh/year
2. Storing rainwater in the water tower with a buffer of 25% in dry periods



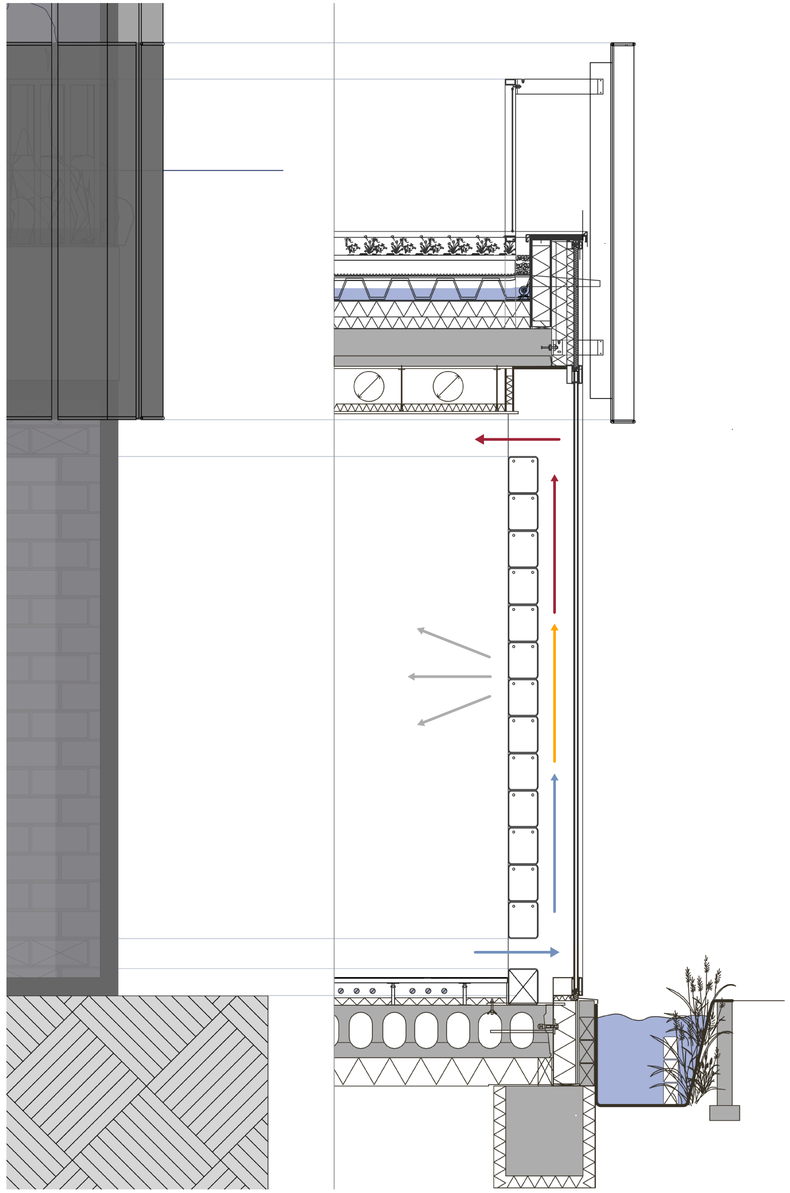
3

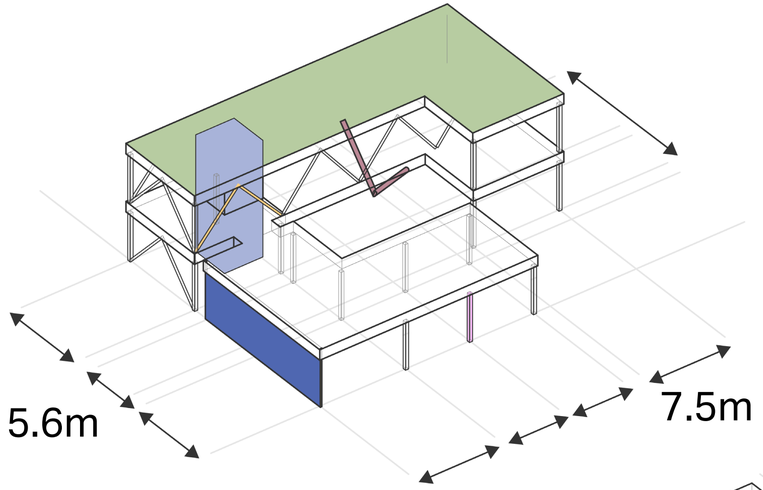
Water is filtered naturally in water ponds by aquatic plants, microorganisms and soil

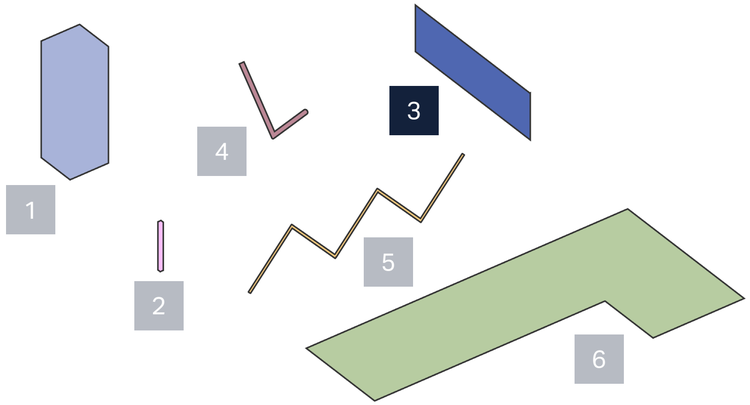


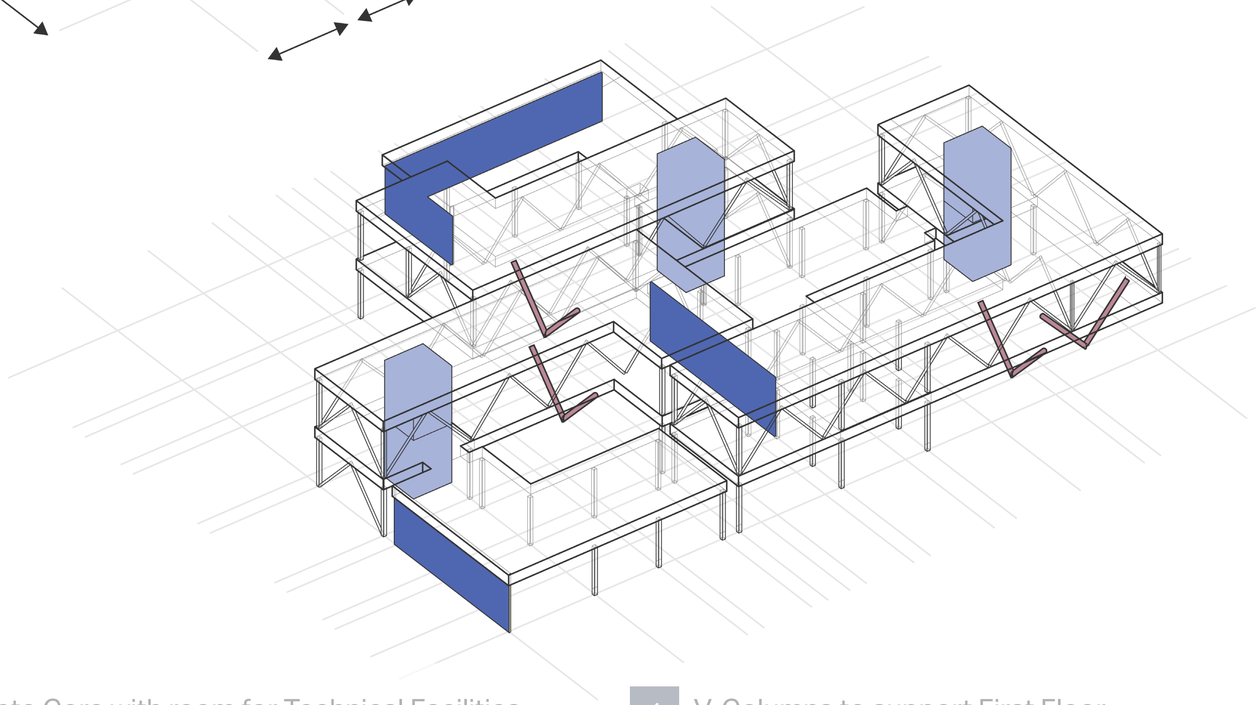


4 Trombe Wall absorbing solar heat through the glass and storing it in concrete bricks









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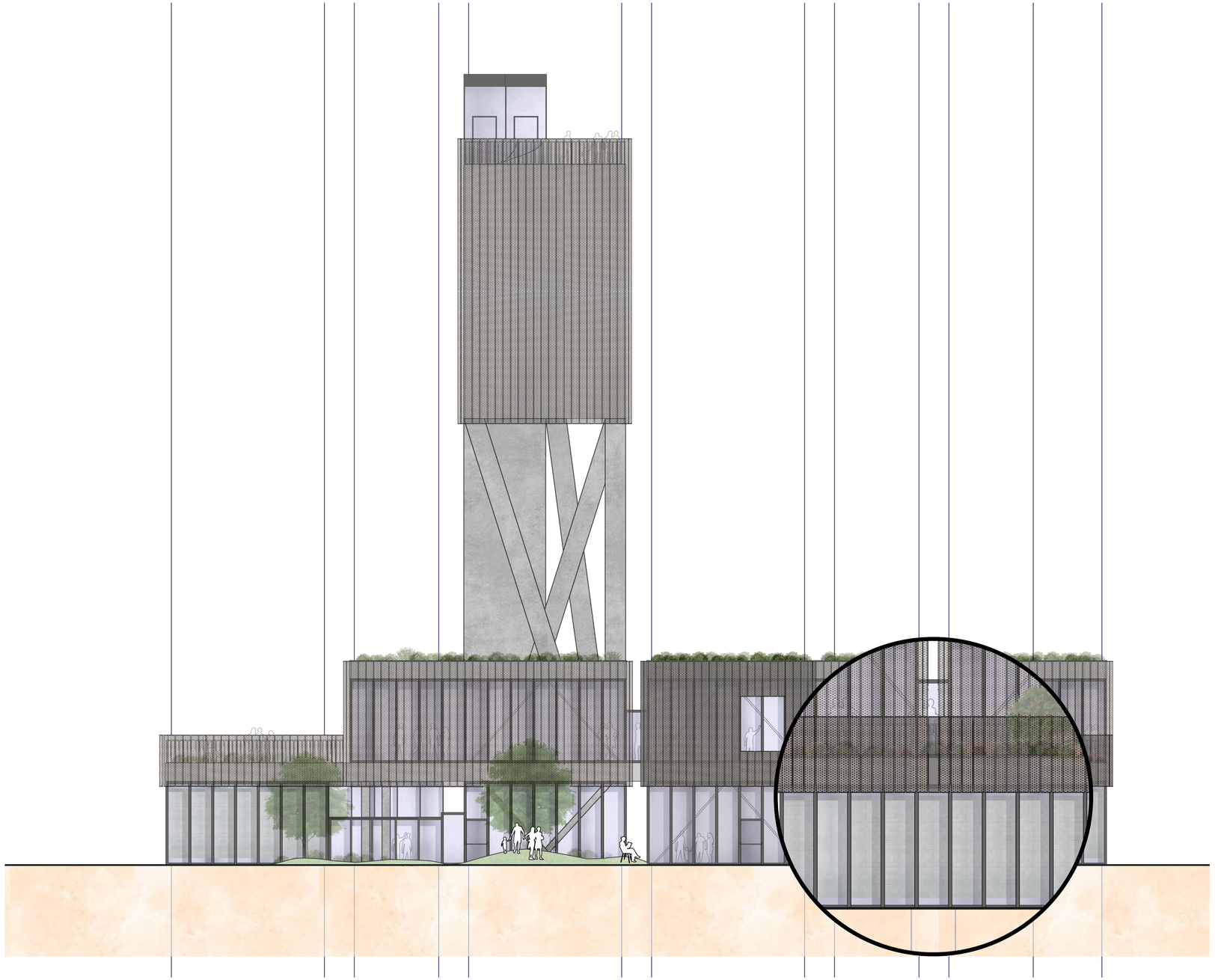
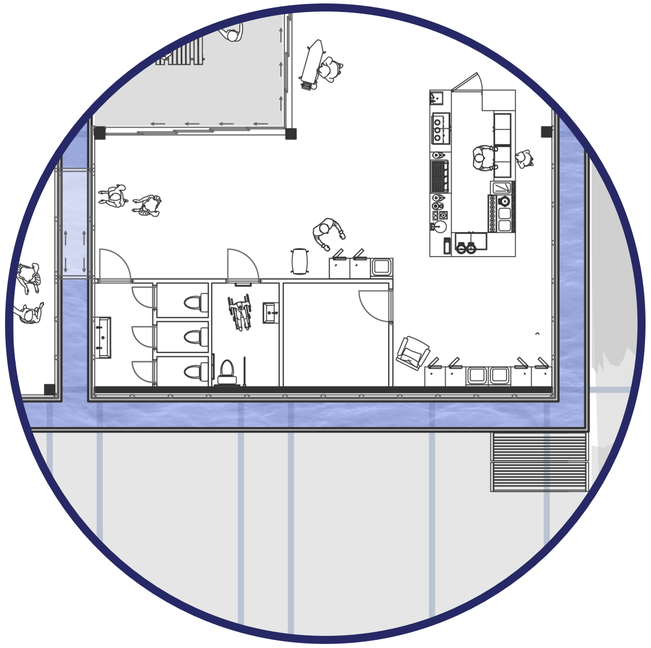
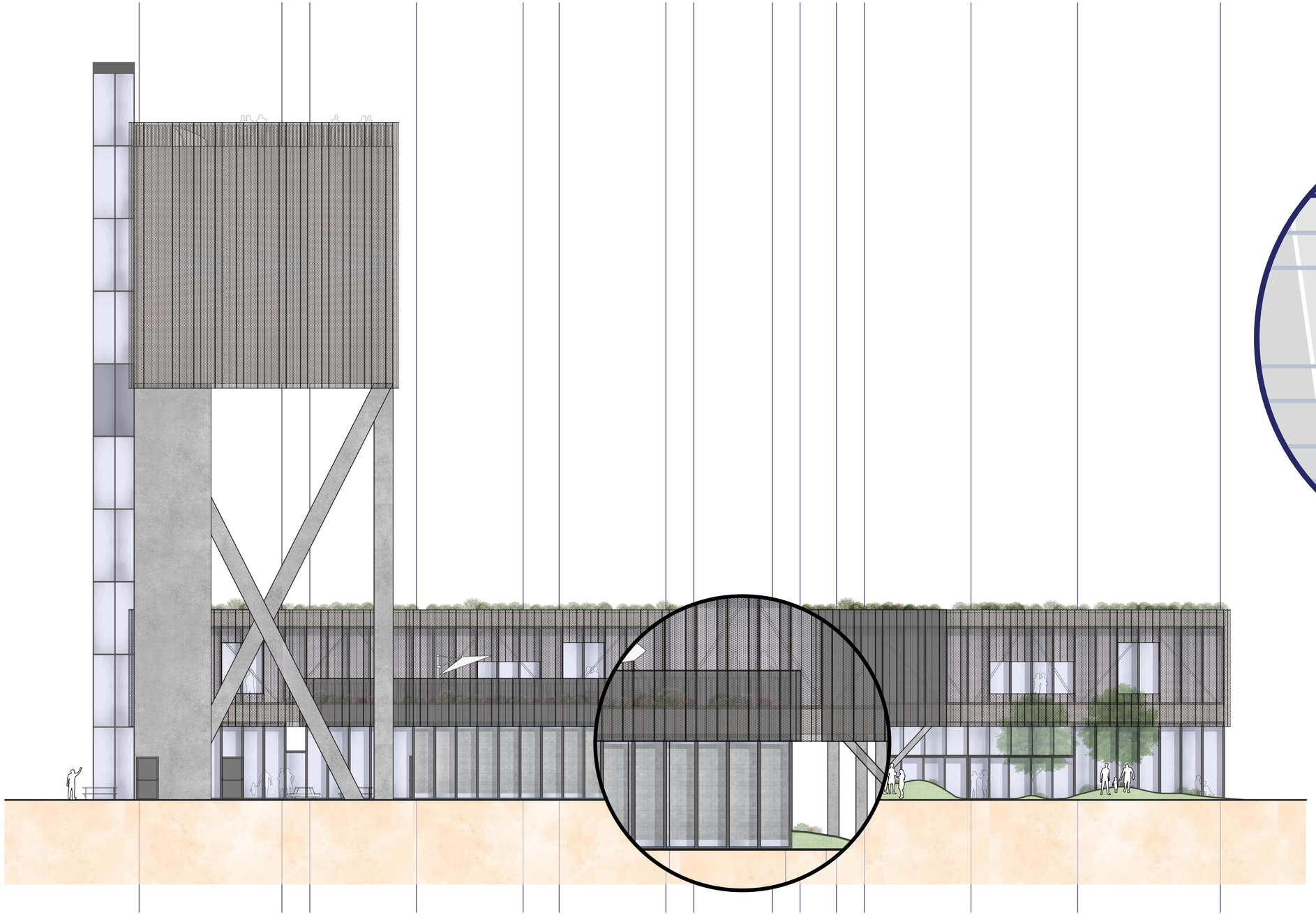
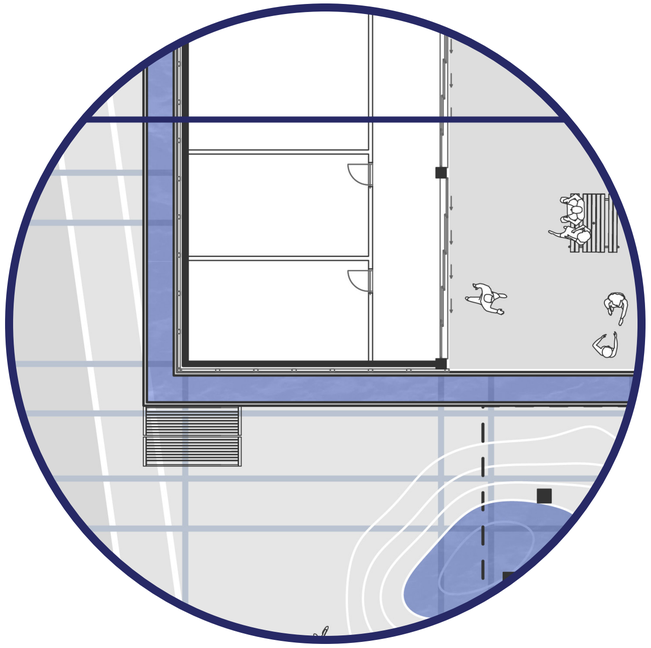
South Facade



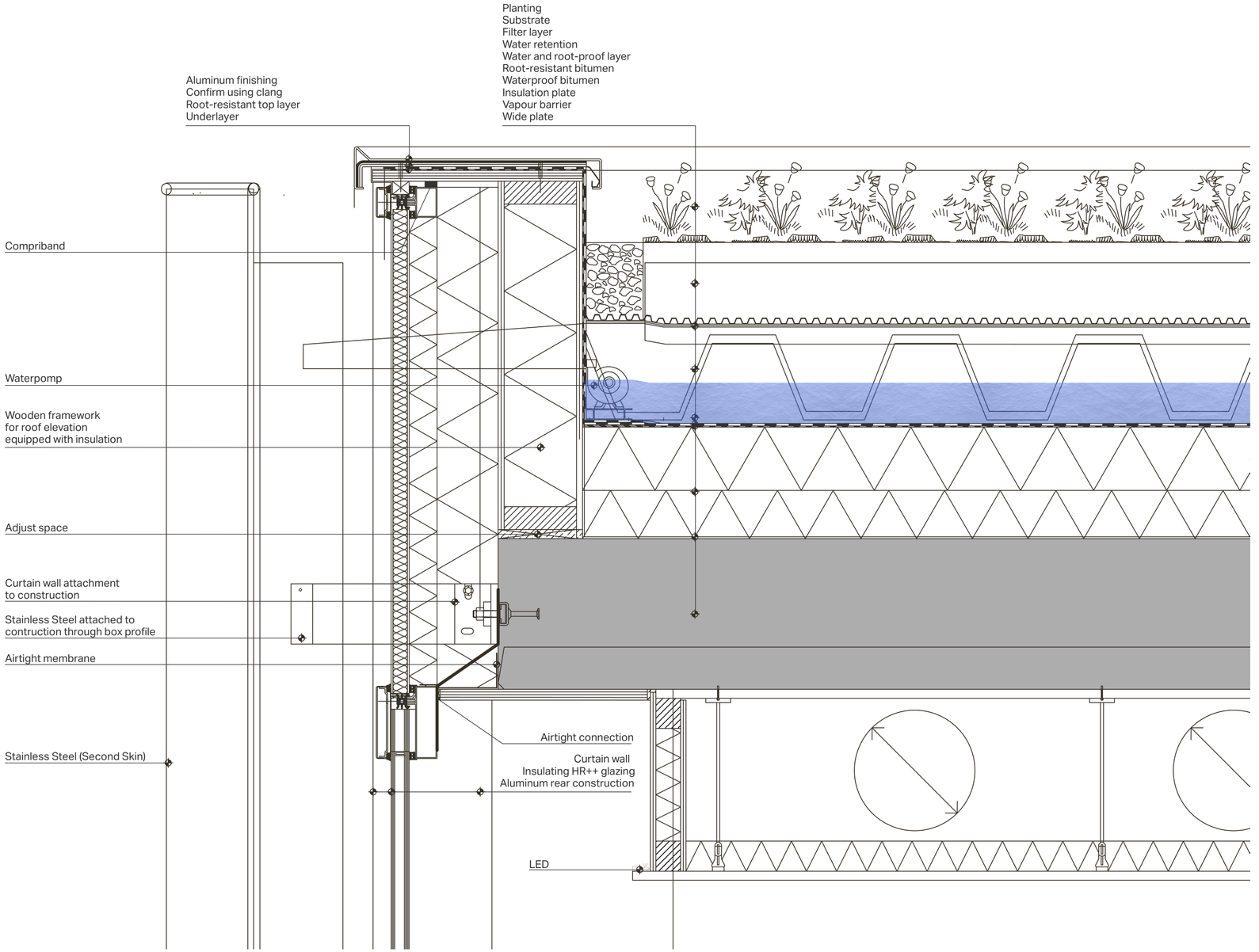


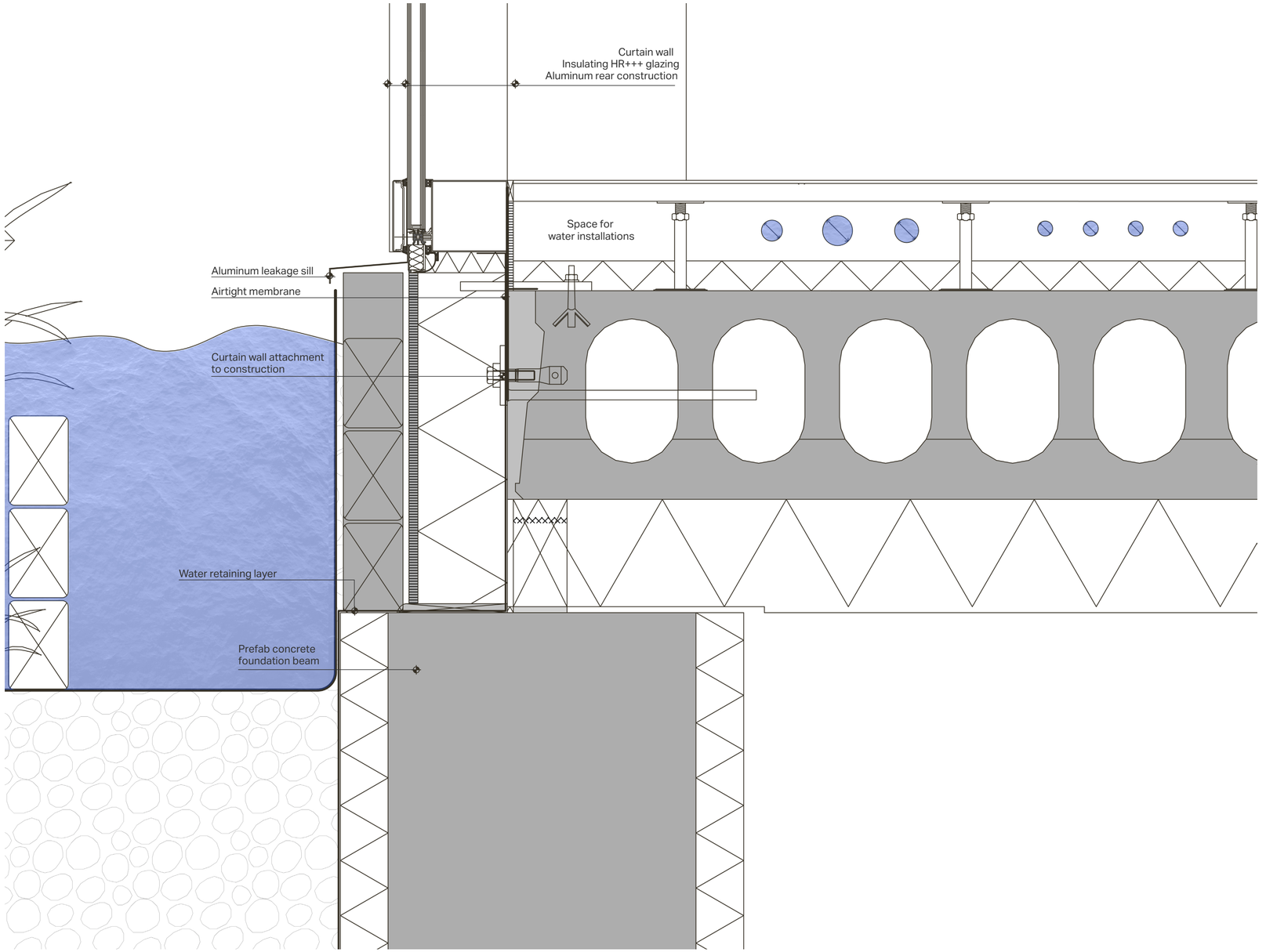
West Facade





5 A green-blue roof stores rainwater on the roof in order to slow down the process

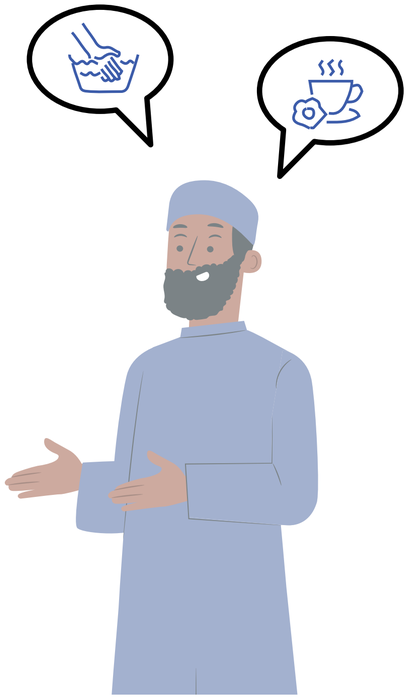



Curtain wall
Insulating HR+++ glazing
Aluminum rear construction
Space for
water installations
Aluminum leakage sill
Airtight membrane
Curtain wall attachment
to construction
Water retaining layer
Prefab concrete
foundation beam

6 Addressing social sustainability by designing inclusive for the community

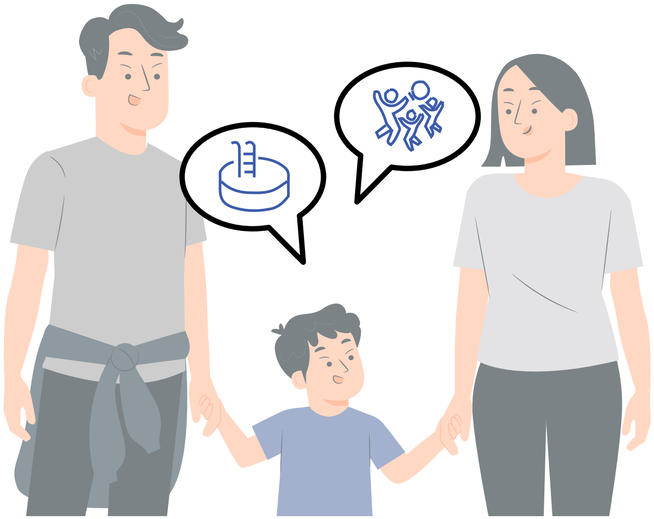
Person 1

A resident living in an older property that is lacking water accessibility



Person 2

An Islamic resident living for 40 years in Nordvest who witnesses increasing gentrification

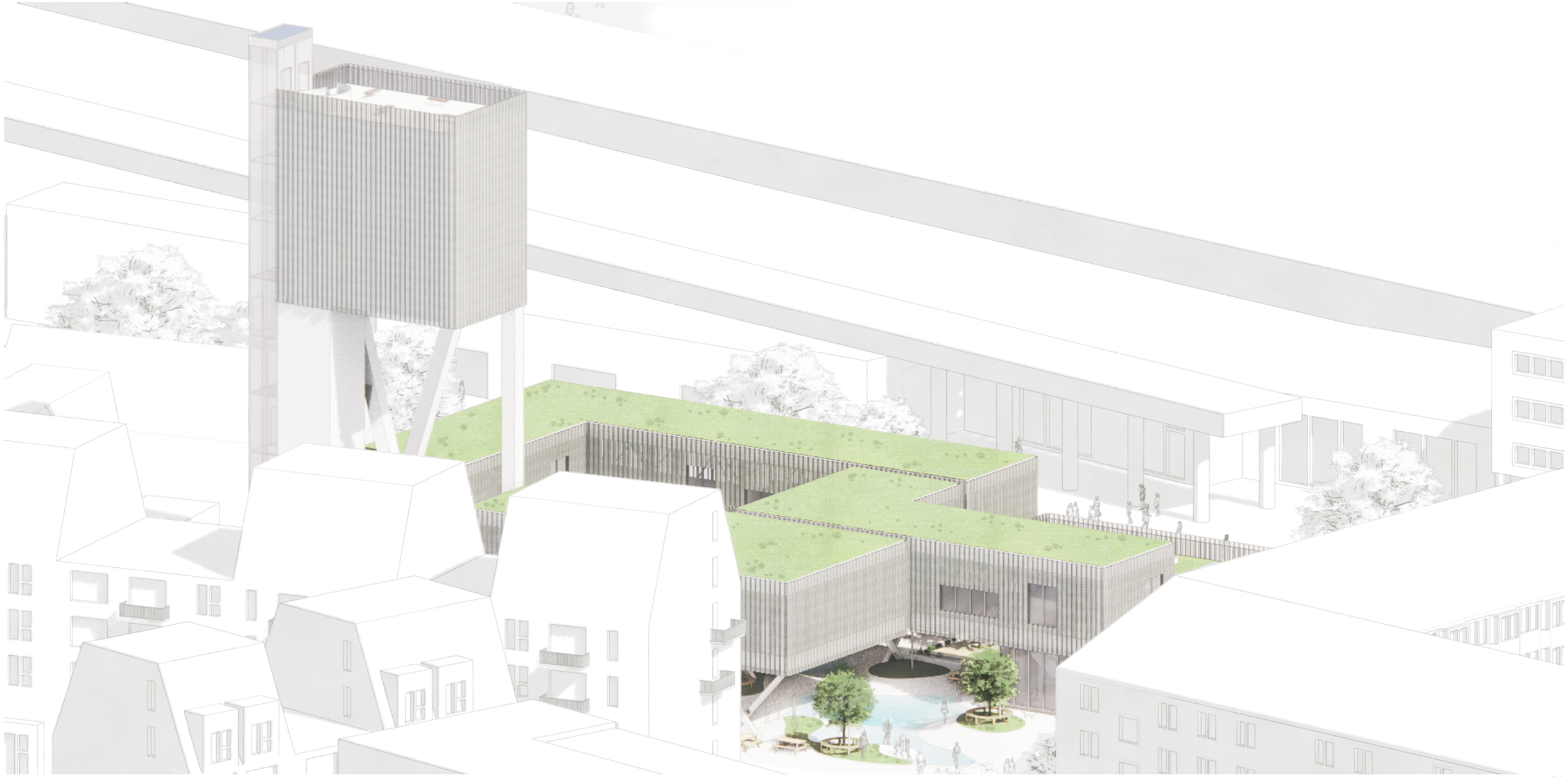


Person 3

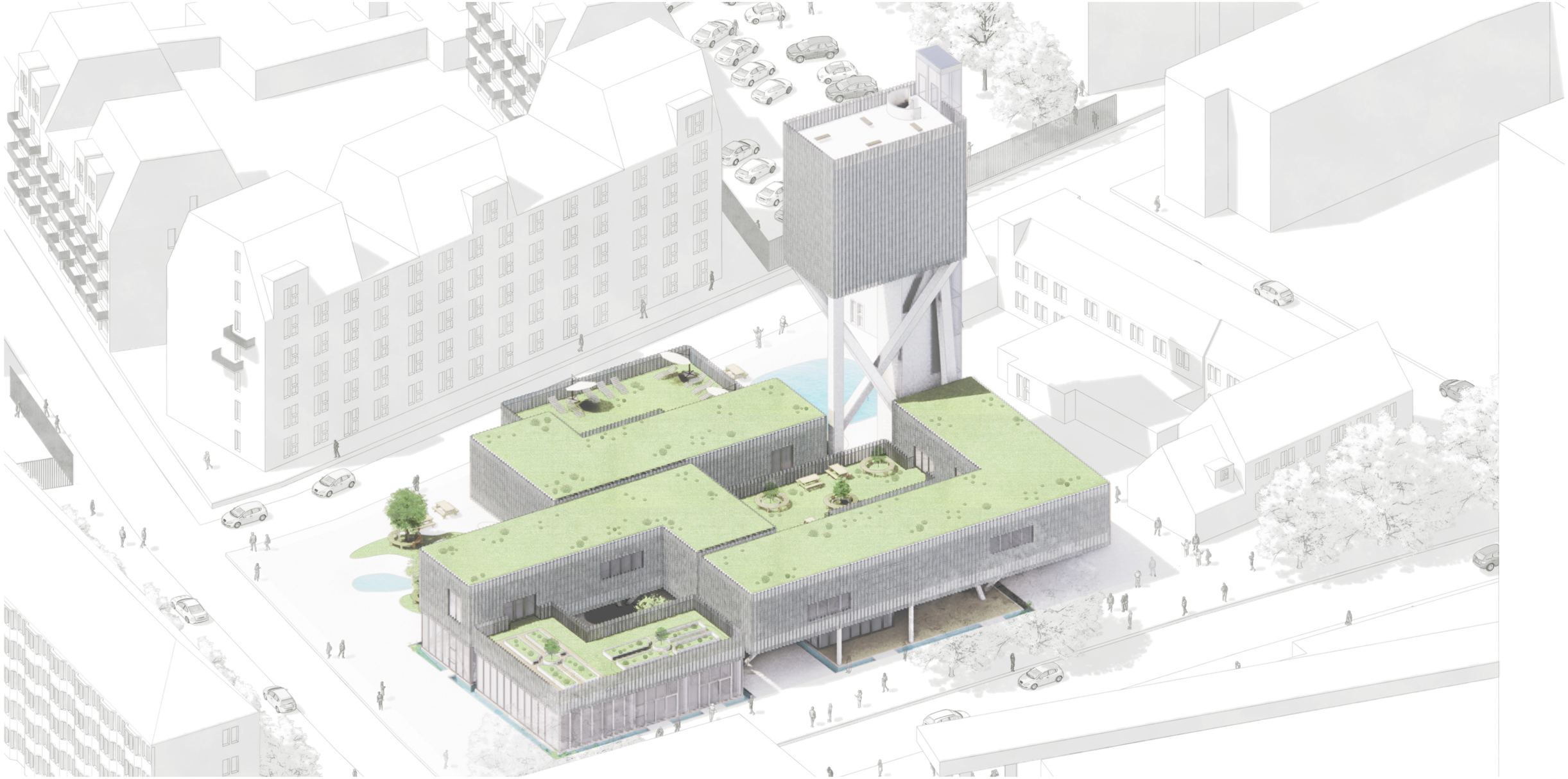
A child that wants to have a fun and educative day out with his parents

7 Green-blue roofs contribute to people’s health by improved air quality and mental wellbeing

Green-Blue Roofs



A New Way Of Thinking



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