

SAFE CITY

Manual on the development of underground shelters in Vinnytsia

**Restart
2024**

Urban Innovation Lab. Recovery Plans Bureau



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TABLE OF CONTENTS

Introduction	8
<hr/>	
Research	10
<hr/>	
Shelters in Ukraine International examples City scale analysis Shelter standards	
Mitechko district	74
<hr/>	
District scale analysis Conclusions from the interviews	
Maintenance guidelines	122
<hr/>	
Architectural guidelines	136
<hr/>	
Shelter design solutions Spatial reconfiguration	
Programming guidelines	160
<hr/>	
Programming solutions Culture & engagement program Education & skill sharing Leisure & sport	

INTRODUCTION

Grounded in international shelter standards and practices, this document draws from a detailed study of Ukraine's shelter infrastructure, particularly in Vinnytsia's Mistechko district. It offers a comprehensive research on maintenance, renovation, and transformation of underground shelters.

Document provides the essential guidelines for planning, developing, and maintaining these crucial spaces. Beyond offering practical advice on improving shelter conditions, the document also serves as a source of inspiration and tools for converting these spaces into supportive environments that enhance well-being and foster community cohesion to create vibrant, supportive environments that bring people together.

Repurposing these shelters for commercial use, such as retail or community centers, can generate revenue and ensure their effective utilization and maintenance, providing ongoing benefits to the community even during times of peace.

Disclaimer

In this manual, the term "shelter" is widely used to describe different types of collective protection measures. The use of the term "shelter" simplifies the text and makes it more understandable for the general public, but does not replace the concepts officially defined by the Civil Protection Code of Ukraine.

On the territory of Vinnytsia city territorial hromada and in the city of Vinnytsia, the following collective protection means are available: shelters¹, anti-radiation shelters², simple shelters³ and places of temporary stay of the population during the announcement of the "Air Alert" signal.

Places of temporary stay of the population during the announcement of the "Air Alert" signal are mostly basements of residential or other buildings. During their design, construction, and maintenance, their use was not defined as a means of collective defence. The arrangement of such places was determined by the decision of the Vinnytsia City Commission on Technogenic and Environmental Safety and Emergencies on 09 February 2022.

This guide suggests ways to make such places more suitable for collective protection.

¹ Shelter — a sealed structure that provides conditions for people to stay and protect themselves for a certain period of time (at least 48 hours) by eliminating or reducing the predicted impact of hazards that may arise as a result of an emergency, use of weapons of mass destruction and conventional means of destruction during military (combat) operations and/or terrorist acts;

² Anti-radiation shelter — a non-hermetic structure that provides conditions for people to stay and protect themselves for a certain period of time (at least 48 hours) by reducing the predicted impact of hazards that may arise as a result of an emergency and ionising radiation exposure in the event of a radiation accident and radioactive contamination of the area and indirect effects of conventional munitions during military (combat) operations and/or terrorist acts;

³ The simplest shelter — a basement or basement premise or other underground structure that provides conditions for a temporary stay of people (at least 48 hours) in case of a threat to their life and health in order to reduce the indirect effects of conventional munitions during military (combat) operations and/or terrorist acts.

What does it contain?

The guidelines document contains research, information and recommendations for the maintenance, renovation and transformation of the underground shelter network. It identifies key problems of shelters and formulates practical advice for solving them with examples and descriptions.

Who was it created for?

The guidelines provided here are intended to aid local authorities in their efforts to plan, develop, and maintain underground shelters. They are designed to provide public organizations and activists with valuable insights into the current state of shelters in Ukraine. The aim is to offer practical advice to communities seeking to enhance the conditions of their local shelters.

What is it based on?

The guidelines are created based on research of international shelter standards and practices, as well as Ukrainian laws and regulations. Additionally, they draw on an extensive study of the existing shelter infrastructure in Ukraine, focusing specifically on the city of Vinnytsia and the Mistechko district.

How to implement it?

Addressing the challenges of the underground shelter network demands a holistic approach. The effective implementation of guidelines necessitates the seamless integration of infrastructure improvements with enhanced regulatory frameworks and community engagement initiatives.

RESEARCH

This section of the research examines the current state of underground shelters* and focuses on the city of Vinnytsia, Ukraine. Based on international examples, this section reviews shelter policies, alternative models of use and financing to develop recommendations. The chapter also includes mapping and classification of shelters, emphasising the importance of the concept of well-being. Furthermore, the analysis at the city level provides a broad perspective for urban planning. Additionally, a comparison of international shelter standards with Ukrainian regulations reveals gaps that need to be addressed.

Using this knowledge, this section aims to empower stakeholders to strengthen shelter infrastructure to create safer and more resilient communities.

* Hereinafter, the word "shelter" refers to "collective protection means" as defined by the Civil Protection Code of Ukraine, which are mainly the simplest shelters and places for the temporary stay of the population during the "Air Alert" signal.

For more information, see the [Disclaimer](#) on page 8.

Shelters in Ukraine

State of underground shelters in Vinnytsia

Main issues found in the shelters

International examples

Underground shelter policies in various countries

Alternative use of shelters

Economy and funding

Well-being

Shelters in Vinnytsia

Map of existing shelters

Existing shelters by type

City scale analysis

Shelter standards

International standards

State building code

Research

State of underground shelters* in Vinnytsia

The evaluation of shelters in Vinnytsia, Ukraine, reveals many challenges, identified through on-site visit. Some of the most prevalent issues are the lack of clear information on shelter entrances, the presence of dangerous pipes running through the shelters, the absence of emergency exits, and the problems posed by makeshift floors or the complete lack of proper flooring and drainage. Despite the efforts of residents to adapt basements for temporary shelter use, the conditions often remain unsafe.



Information sign



Information sign in front of the entrance



Pipes running through the shelter



Long basement corridor serving as a shelter



Make-shift floor



Lack of flooring and drainage



Entrance to the shelter



Pipes and cables placed at a head height



Basement adapted by residents



Basement prepared by residents



Basement adapted by residents



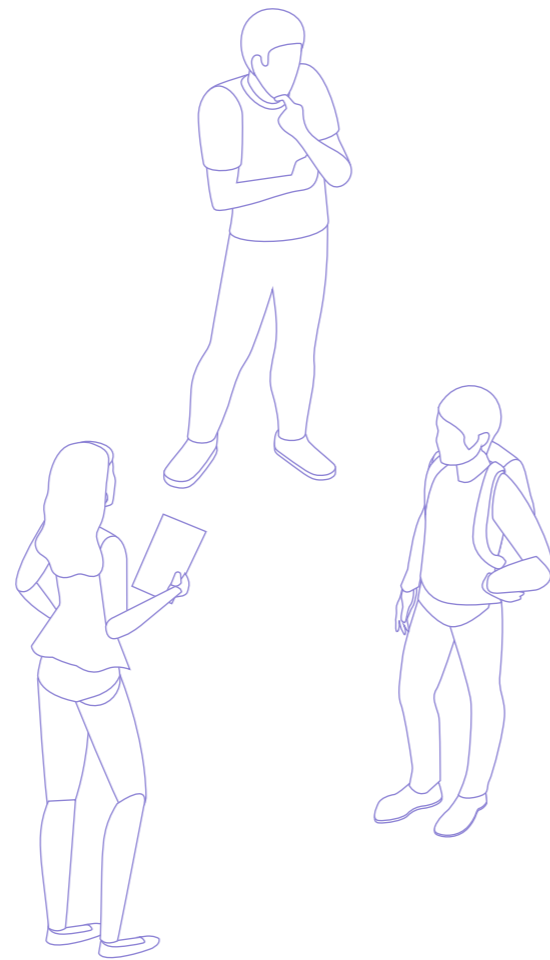
Cardboard used as flooring

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Research

State of underground shelters in Vinnytsia



Opinions of people of Vinnytsia:

"The shelter is flooded, and nobody removes the water"

"The shelter on the map is on a private property and is locked"

"The basement is locked and I do not know who has the key"

"There is a strong stench of dampness in the basement"

"I'm worried about the building collapsing on top of the shelter"

"The shelter smells badly and is full of trash"

Research

Main issues found in the shelters

The issues found in shelters range from structural deficiencies to inadequate facilities, posing significant risks to the safety and well-being of shelter occupants.

Key concerns include flooding and dampness, poor ventilation, insufficient sanitation facilities, and limited access to emergency supplies. Additionally, many shelters lack proper maintenance and oversight, exacerbating their vulnerability during emergencies.

Basements and underground shelters are often locked, making access difficult

Ventilation issues in some basements result in dampness

Basements are often cluttered with debris, affecting functionality and safety

Proper lighting is lacking in many basements

Accessibility for persons with disabilities or reduced mobility is not adequately addressed in most shelters

Basements have very low ceilings, pipes running under the ceilings are creating obstacles and disrupting emergency routes

Keys to access shelters are held by a limited number of residents, and locating these key-holders can be challenging

Sufficient sanitation facilities are often absent

Water leakage and humidity issues are prevalent in many basements



Locked entrance

Entrance to the shelter

Broken pipes



Low hanging pipes and electric cables

Sharp elements

Flooding and dampness



Clutter and debris

Debris

Lack of proper lighting

Research

Main issues found in the shelters

The discomfort and substandard amenities within these shelters compel residents to opt for remaining in their apartments during air raids. This decision poses grave safety risks, underscoring the urgent need for shelter improvements.

Lack essential amenities such as drinking water, sanitation facilities, benches, chairs, warming tools like blankets

There's a deficiency in primary means of fire extinguishing and emergency tools like shovels, crowbars, etc.

The public lacks awareness and preparedness regarding shelter locations, conditions, and their significance in times of need

Incomplete and inaccurate shelter readiness, signage and location information

Discrepancies in shelter records and actual existence

Lack of communication tools

The shelters' distant locations and perceived unreliability compel residents to risk staying in their apartments rather than evacuating

Maintaining and enhancing shelters poses a challenge in assigning responsibility, as it falls under the purview of various entities

Lack of coordination in shelter management



Clutter on the ground

Dangerous pipes

Inadequate lighting



Debris inside the shelter

Residents sheltering inside the apartments



Publicly accessible shelters behind closed gate

Inaccurate shelter records and signage

Shelters closed during air-raid alarms

Research

International examples

Exploring shelter policies and practices on a global scale offers valuable insights into different approaches and best practices. This chapter delves into various strategies for managing underground shelters in different countries, including alternative uses, economic factors, and funding mechanisms. By examining international examples, it seeks to inform and enhance shelter development and maintenance initiatives in Vinnytsia, Ukraine.



Research

International examples: Switzerland

Number of shelters: 360 000 shelters, of which 5100 public

Population: 9 mln

Capacity: 100%, for all 9 mln citizens

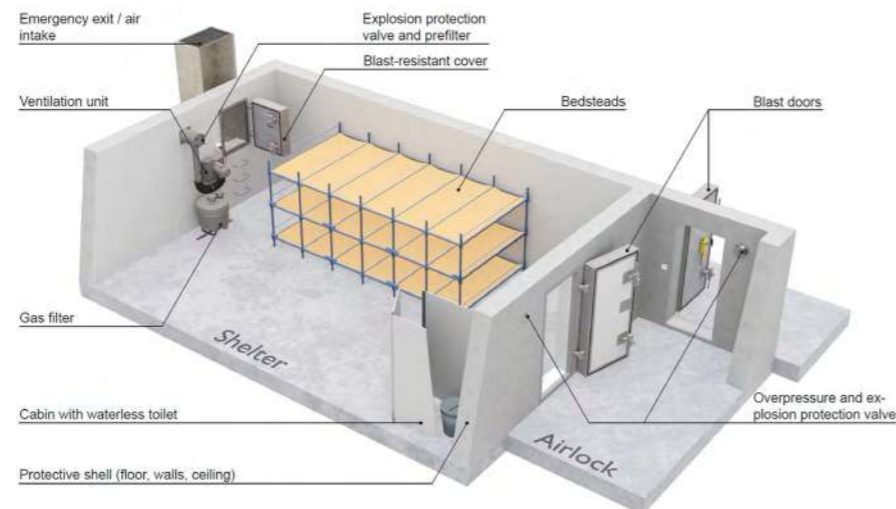
Law: Shelter requirements part of the building law. The construction and equipment of shelters are standardized by technical specifications for residential projects. The majority of private buildings include shelters.

Construction and Maintenance: Reinforced concrete, with airlock and emergency exit/air intake; equipment has to be maintained by owners.

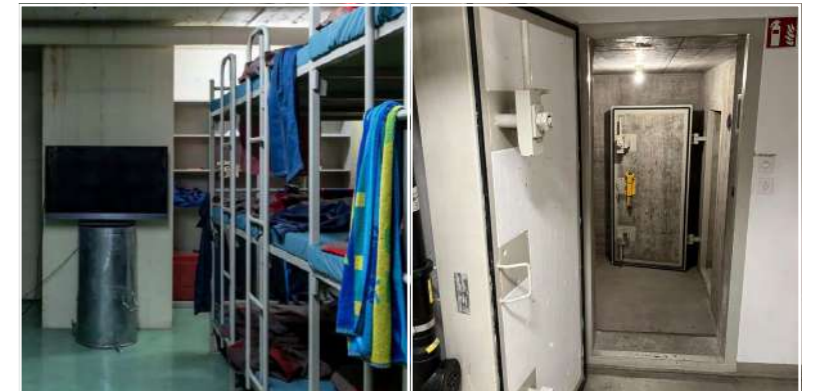
Funding: Owners of private residential buildings have to include a shelter or pay for an assigned spot in a public one

Scheme of a typical shelter

Typical shelter in Switzerland should include Airlock entrance, Ventilation system and emergency exit. Such shelters are mandatory part of each building.



Well-organized chambers furnished with durable fixtures. Storage areas are strategically positioned to facilitate easy access to emergency supplies, promoting efficiency during crises.



An airlock serves a crucial role as a transitional space that helps maintain the integrity of the shelter environment. Functioning as a buffer zone between the outside and inside atmospheres, an airlock prevents the influx of contaminants into the shelter.



Despite their discreet exteriors, these mountain shelters are integral to Switzerland's national emergency preparedness strategy. Positioned in remote yet accessible locations, they offer safety to both locals and visitors.

Research

International examples: South Korean

Number of shelters: 19 000, with 3200 in Seoul

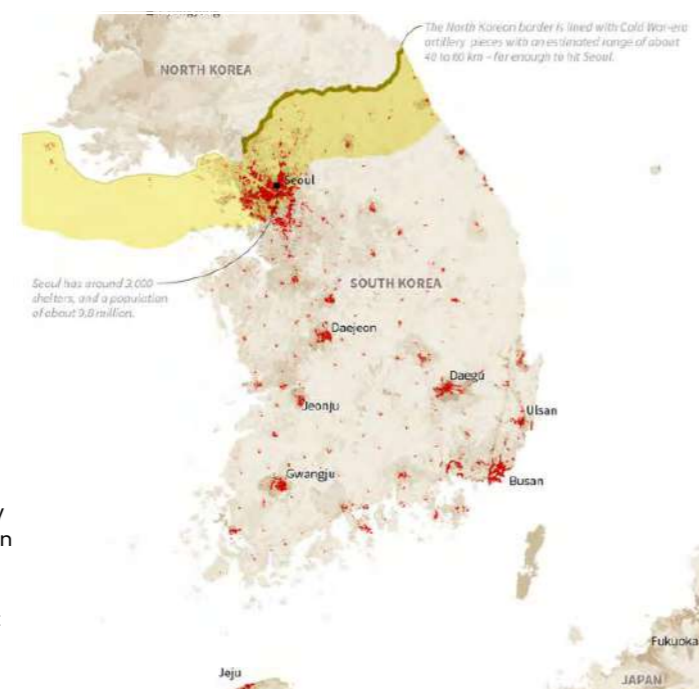
Population: 51 mln

Capacity: nearly 100% of Seoul citizens

Law: In the 1970s, the country had a law requiring buildings over a certain size in major cities to have a basement, which would serve as a bunker in war. But in Seoul, due to soaring property prices, most private buildings have converted those basements into parking space or the dank subterranean flats.

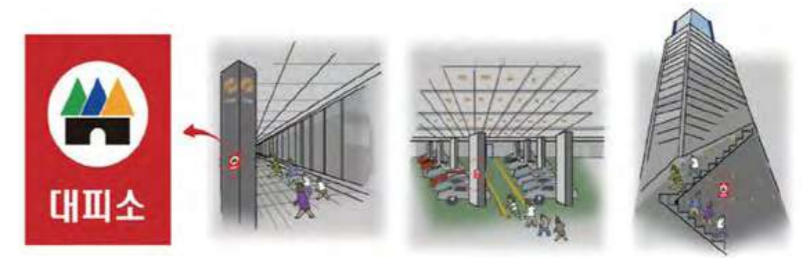
Construction and Maintenance: Most bomb shelters have no long-term supplies of food, water, medical kits or gas masks.

Funding: No public funding is provided



Shelter density map

Presence of shelters in South Korean is directly connected to the proximity of the North Korean boarder and the threat of nuclear attack. Country's capital has the highest density of such structures in the country as a city closest to the boarder.



In South Korea, signage programs for shelters are integral components of civil defence strategies, aiming to ensure public awareness and efficient evacuation during emergencies.



The utilization of public spaces as shelters represents a key aspect of the country's civil defence strategy. Places such as subway stations, underground shopping malls, and parkings are strategically designated as shelters due to their structural resilience and accessibility.



In addition to public shelters, many South Korean households have private shelters. While public shelters are maintained by the government and open to all, private shelters are owned by individual homeowners or building owners and are primarily for their use.

Research

International examples: Finland

Number of shelters: 50 500, with about 5 500 in Helsinki

Population: 5.5 mln

Capacity: 87%, for 4.8 mln people

Law: Finland made the construction of emergency shelters mandatory under apartment blocks and office buildings as early as in the 1950s, which explains their current high number.

Construction and Maintenance: The law requires appropriate maintenance and inspection of shelter equipment and tools. The statutory time limit for shelter deployment is 72 hours. The shelters are equipped and are maintained by each building's owners.

Funding: Finland has built a civil protection infrastructure worth billions of euros. A mix of public and private funding.



In Finland, the maintenance of shelters is a critical aspect of ensuring their functionality and effectiveness during emergencies. Regular inspections and upkeep are conducted to guarantee that these facilities remain in optimal condition and ready for use at any time.

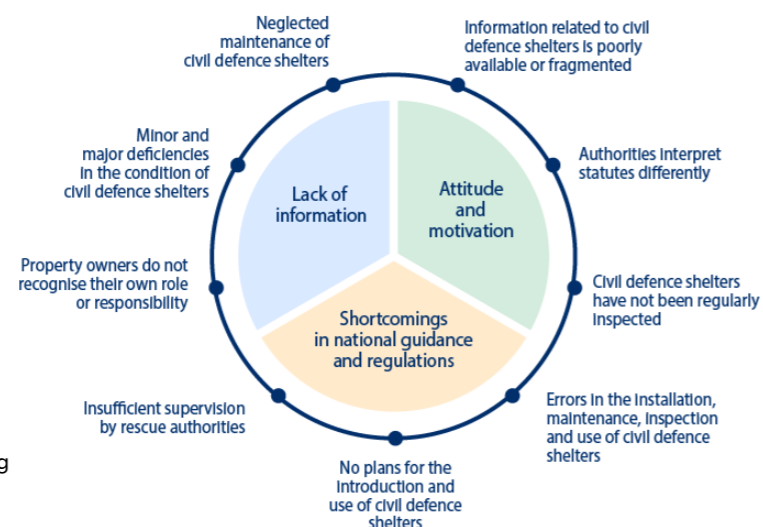


The city of Helsinki has implemented public spaces into its extensive underground shelter network as part of a large civil defence program.



As part of this strategy, public spaces such as metro stations, parking facilities, and or even sport halls are designed to serve dual purposes, functioning not only as everyday amenities but also as shelters during emergencies.

Three root causes for deficiencies in civil defence shelters



Evaluation of national civil defence system

Finland commissioned an assessment of its current shelter system, revealing that a commendable 91% of facilities are in satisfactory condition. The comprehensive study identified key issues and their underlying causes, laying the groundwork for targeted improvements.

Research

International examples: Taiwan

Number of shelters: 105 000

Population: 23.6 mln

Capacity: over 300 %, for 86 million people

Law: The shelter sites are designated by planning units, based on the local population density and similar factors.

Construction and Maintenance: Official Web site of the National Police Agency shows designated bomb shelters. Most of them are regular basements of existing residential buildings. There is a rich labyrinth of old bomb shelters called Keelung, they were mapped out and built by Japan in 1800s.

Funding: Shelters (basement) in regular residential buildings are privately founded.

Alternative use of shelters

Some of the older shelters that are a part of the famous complex called Keelung (built by Japan in 1800s) area re-purposed and serve as variety of public underground spaces. Some were even transformed into underground temples.



Most of the shelters in Taiwan are in basements in residential buildings. By law each basement in Taiwan has to be able to withstand an earthquake.



Underground shelters are re-purposed during peacetime for various activities, such as cultural events, educational programs, and recreational gatherings. By utilizing these spaces for non-emergency purposes, communities can maximize their utility and foster stronger social cohesion.



Some of the shelters are transformed into vibrant galleries, showcasing local artistic talent and providing a creative outlet for residents during times of uncertainty. Beyond aesthetics, art in shelters can serve as a source of inspiration, fostering a sense of community resilience and solidarity.

Research

International examples: Sweden

Number of shelters: 65 000

Population: 10.4 mln

Capacity: 67.5%, for 7 mln people

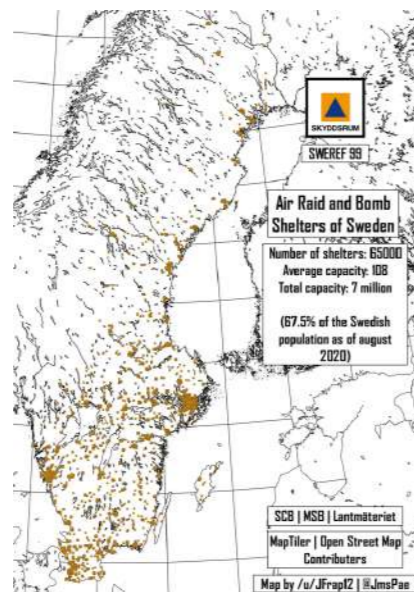
Law: During the Cold War Sweden had a policy of Total Defence, during that time it build the large network of fallout shelters

Construction and Maintenance: Public shelters are equipped with ventilators, impervious doors, stackable beds and are able to withstand nuclear explosions. Private shelters in times of peace are used as bike parking or storage.

Funding: The country's Defence Commission recommended modernizing existing shelters while planning the construction of the first new ones in more than 15 years.

Map of public civil defence structures

Official map with designated shelters, coloured by neighbourhood. Most of them are basements of residential buildings and may not be maintained. By law each basement in Taiwan has to be able to withstand an earthquake.



By integrating the shelter entrances into the rocky terrain, Sweden maximizes the shelters' effectiveness while minimizing their visual impact on the landscape, reflecting a thoughtful and strategic approach to civil defence planning.



In Sweden, the "Skyddsrum" policy, which translates to "Protection Rooms," forms the backbone of the country's civil defence strategy. These distinct signs can be found all-over the country providing safety to citizens in the event of emergencies.



Swedish shelters boast well-maintained interiors, featuring essential amenity areas with ventilation systems, sanitation facilities, and emergency supplies. Their layout is well-organized with designated zones for sleeping, dining, and hygiene.

Research

International examples: Japan

Number of shelters: Japan has 52,490 designated temporary evacuation (1,591 underground)

Population: 120 mln

Capacity: about 1%

Law: Japan has no clear guidelines for what qualifies as a shelter, and the term can be used to describe anything from temporary evacuation sites to bunkers stocked with supplies.

Construction and Maintenance: Due to insufficient number of public shelters a market for private shelters is growing.

Funding: Japanese policymakers consider providing government aid for building bomb shelters in an effort to better protect the population.

Model nuclear bomb shelter

Amid growing security concerns over North Korea's missile ambitions, a non-profit organization in Japan has built a model nuclear shelter near Tokyo to raise awareness and encourage people to consider digging a doomsday bunker of their own.



Historical shelters re-purposed as museums offer visitors a unique opportunity to delve into the past and gain insight into the experiences of previous generations during times of conflict or crisis.



In Japan, the private shelter market caters to individuals and organizations seeking to enhance their preparedness for emergencies such as natural disasters or conflicts. These shelters range from small-scale residential installations to larger communal facilities.



Typically constructed with reinforced materials and equipped with essential amenities such as ventilation systems, emergency supplies, and sanitation facilities, private shelters offer a sense of security and peace of mind to their occupants.

Research

Alternative use of shelters

Underground shelters are not merely spaces of refuge during emergencies; they embody versatility, adapting to meet diverse needs during peacetime. This chapter delves into the innovative potential of underground shelters for both dual and alternative purposes.

From re-purposing shelters as cultural hubs to integrating them seamlessly into urban infrastructure, the following exploration unveils the multifaceted roles these subterranean spaces play in enhancing resilience, sustainability, and community well-being.



Hotel in a shelter, Switzerland



Hotel in a shelter, Switzerland



Hostel in a shelter, Verbier



Holiday house in a bunker, UK



Restaurant in a shelter, Chongqing



Bar in a former shelter, Czech Republic



Club in a former shelter, China



Catering in a salt mine, Soledar



Wine museum, Shanghai



Installation in a bunker, South Korea



Multi-media gallery, Taiwan



Underground museum, Helsinki



Multi-media space, Taiwan



Event space in a salt mine, Soledar



Concert space in Soledar salt mine



Techno club in a bunker, Berlin

Temporary accommodation

**Restaurants
Bars**

**Museums
Galleries**

**Event Venues
Concert spaces**

Research

Alternative use of shelters



Underground pool, Helsinki



Underground football pitch, Helsinki



Bookstore in a former bomb shelter, China



Library in a bomb shelter, China



Amusement Park in a Salt mine, Romania



Amusement Park in a Salt mine, Romania



Underground parking in a shelter, Finland



Underground parking in a shelter, Tel Aviv



Shooting range, Finland



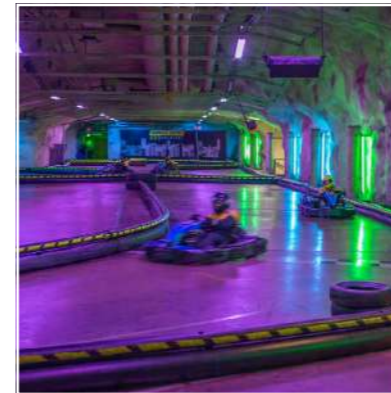
Judo competition in a salt mine, Poland



Commercial space in a shelter, China



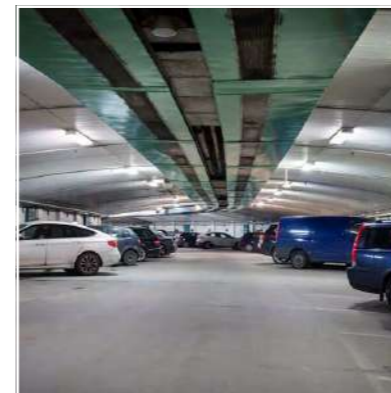
Commercial space in a shelter, China



Go-kart ring in a shelter, Helsinki



Playground in a shelter, Helsinki



Underground parking in a shelter, Sweden



Underground parking in a shelter, Norway

Sports facilities

Commerce

Entertainment

Parking

Research

Alternative use of shelters



Gas station in a former shelter, China

Data storage in a shelter, Sweden



Seed Vault in a shelter, Norway

Power plant in a bunker, Hamburg



Wine cellar in a shelter, China

Winery in a former shelter, Georgia



Winery, Bakhmut

Wine cellar in a shelter, Moldova



Farm in a former bank vault, Japan

Farm in a former bank vault, Japan



Underground mushroom farm

Farm in former metro station, London



People cooling down in a shelter during a heatwave, China

Public space in a shelter, China



People cooling down in a shelter during a heatwave, China

Public space underground in Helsinki, Finland

Infrastructure Data storage

Wine production

Food production

Community spaces

Research

Well-being

Extended or frequent stays in an underground shelter can have a significant impact on a well-being of people exposed to it. These challenges can be categorized into two distinct groups, namely:

A - Physical well-being

A.1. Sleep Deprivation: Disrupted sleep patterns, discomfort, and noise disturbances in underground shelters lead to sleep deprivation, fatigue, affecting overall well-being and mental acuity.

A.2. Physical De-conditioning: Lack of space for exercise and movement results in muscle atrophy, decreased cardiovascular fitness, and overall physical de-conditioning among individuals in the shelter.

A.3. Weakened Immune System: Limited sunlight exposure contributes to vitamin D deficiency, weakening the immune system and making individuals more susceptible to infections and illnesses.

A.4. Respiratory Issues: Poor ventilation leads to stagnant air and the accumulation of pollutants, increasing the risk of respiratory problems and allergies among shelter occupants.

A.5. Increased Disease Transmission: Living in close quarters facilitates the spread of infectious diseases, leading to higher rates of illness and contagion among shelter inhabitants.

A.6. Nutritional Deficiencies: Limited access to fresh food and reliance on non-perishable rations result in a diet lacking in essential nutrients, contributing to malnutrition, and health problems.

A.7. Hygiene-Related Illnesses: Sanitation challenges such as inadequate toilet facilities increase the risk of gastrointestinal infections and other hygiene-related illnesses among shelter occupants.

B - Mental well-being

B.1. Decreased efficiency in performance

B.2. Challenges in maintaining focus and attention

B.3. Heightened levels of irritability

B.4. Increased likelihood of experiencing depression

B.5. Disturbances in personality

B.6. Vulnerability of special groups such as children, pregnant women, and the ill

B.7. Frustration emerges as a common response to environmental stress, leading to behaviours like aggression, depression, and withdrawal

B.8. Lack of stimulating activities exacerbates feelings of despair and hopelessness

B.9. Existential crises may arise, with individuals having thoughts and discussions about suicide

B.10. Cognitive abilities become compromised, with individuals unable to maintain clear thinking for extended periods, affecting their decision-making and problem-solving skills

Research

Well-being

Learning area



GOAL: Improve cognitive abilities through creative expression

Addressed issues:

- B.1.
- B.2.
- B.6.
- B.10.

Meditation zone



GOAL: Promote relaxation and inner peace

Addressed issues:

- A.1.
- A.2.
- B.1.
- B.2.
- B.3.
- B.4.
- B.5.
- B.8.
- B.10.

Fitness zone



GOAL: Improve physical health and group activities

Addressed issues:

- A.1.
- A.2.
- B.2.
- B.3.
- B.4.
- B.5.
- B.6.
- B.7.
- B.8.

Community space



GOAL: Improve social cohesion and fostering a sense of community

Addressed issues:

- B.4.
- B.5.
- B.7.
- B.9.

Kid's corner



GOAL : Enhance the well-being of children

Addressed issues:

- B.6.

Private space



GOAL: Ensure personal space and privacy needs

Addressed issues:

- A.1.
- A.5.
- B.5.
- B.6.
- B.7.

Research

Shelters* in Vinnytsia

Underground shelters in Vinnytsia can be divided into seven categories:

1. Underground passages;
2. Publicly accessible underground parking lots;
3. Underground rooms of industrial or storage facilities;
4. Underground spaces belonging to commercial businesses, retail or gastronomy;
5. Basements of residential buildings;
6. Shelters in educational institutions;
7. Shelters in healthcare facilities.

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For more information, see the **Disclaimer** on page 8.

1. Underground passages

2. Underground parking lots

3. Underground warehouse

4. Underground space of businesses

5. Basements of residential buildings

6. Shelters in educational institutions

7. Shelters in healthcare facilities

Research

Shelters in Vinnytsia

1. Underground passages

3 — Number of shelters (according to government information);

450 < n < 1 500
Capacity range;

Accessible by general population;

2 550 — Total capacity of this category (according to the government information)



Underpass

2. Underground parking lots

3 — Number of shelters (according to government information);

800 < n < 950
Capacity range;

Accessible by general population;

2 650 — Total capacity of this category (according to the government information)



Underground parking

3. Underground warehouse

3 — Number of shelters (according to government information);

750 < n < 1 500
Capacity range;

Accessible by general population;

3 750 — Total capacity of this category (according to the government information)



Underground storage



Underpass



Underground parking



Underground storage

4. Underground space of businesses

10 — Number of shelters (according to government information);

35 < n < 2 000
Capacity range;

Accessible by general population;

3 735 — Total capacity of this category (according to the government information)



Underground of retail

5. Basements of residential buildings

1 184 — Number of shelters (according to government information);

5 < n < 1 800
Capacity range;

Accessible by general population;

519 070 — Total capacity of this category (according to the government information)



Underground parking



Underground parking

6. Shelters in educational institutions

71 — Number of shelters (according to news information);

—
Capacity range;

Accessible for staff and students;

—
Total capacity of this category (according to the government information)



Shelter in a school

7. Shelters in healthcare facilities

19 — Number of shelters (according to a map of shelters);

80 < n < 2 560
Capacity range;

Not accessible by general population;

—
Total capacity of this category (according to the government information)



Underground of a club/
restaurant



Basement



Shelter in a kindergarten

Research

Map of existing shelters in Vinnytsia

Types of underground shelters in Vinnytsia include:

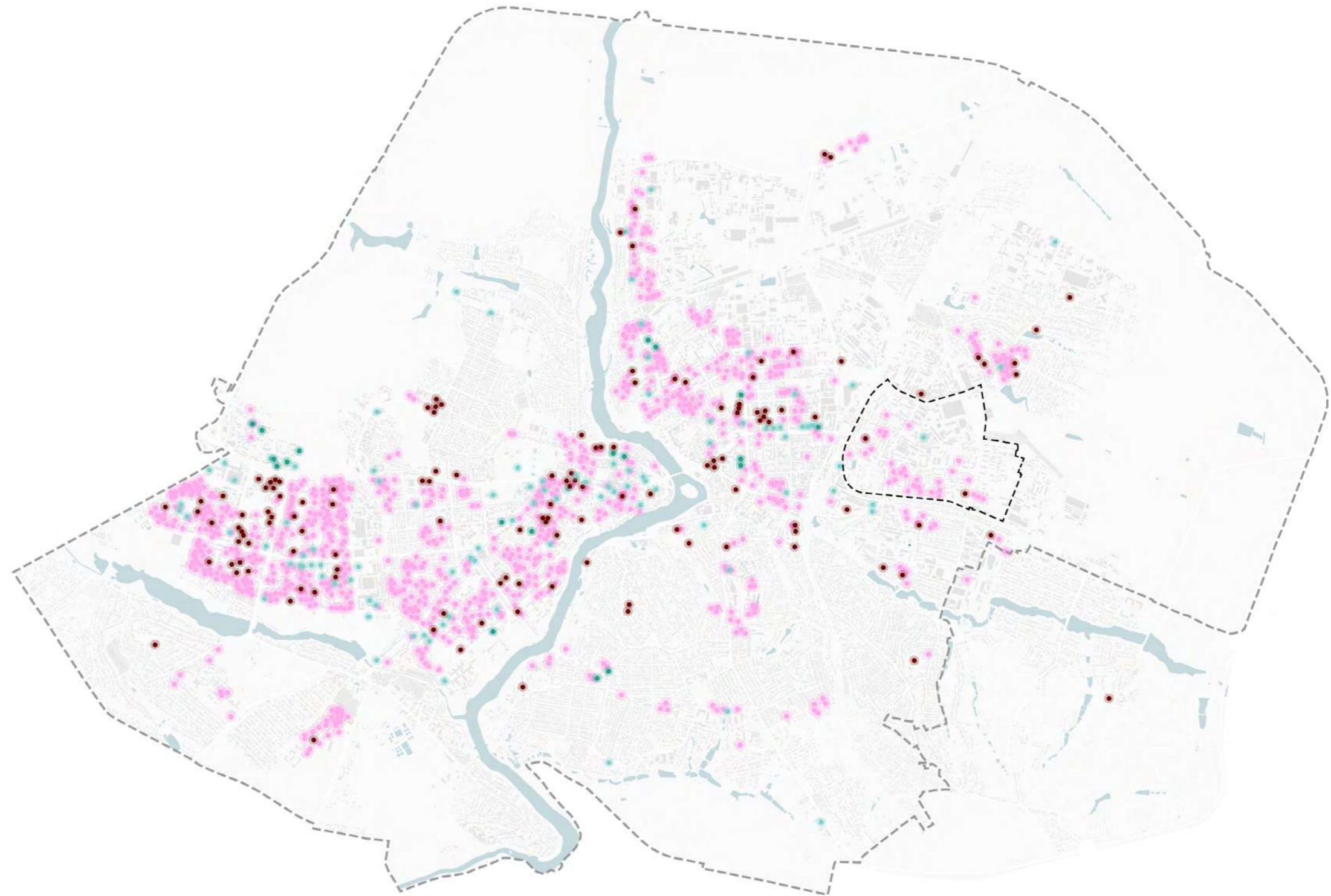
Publicly accessible shelters in basements of commercial facilities, restaurants, warehouses, parkings and underpasses.

Shelters in residential buildings, accessible mostly by their residents.

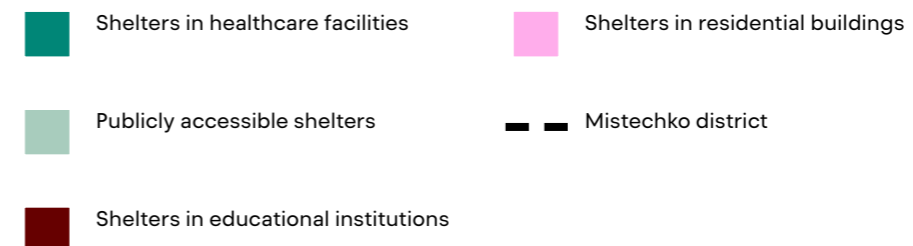
Underground shelters in healthcare facilities, hospitals, clinics, etc.

Not accessible by a wider public, used to host patients.

Underground shelters in educational institutions, kindergartens, schools, universities, etc.

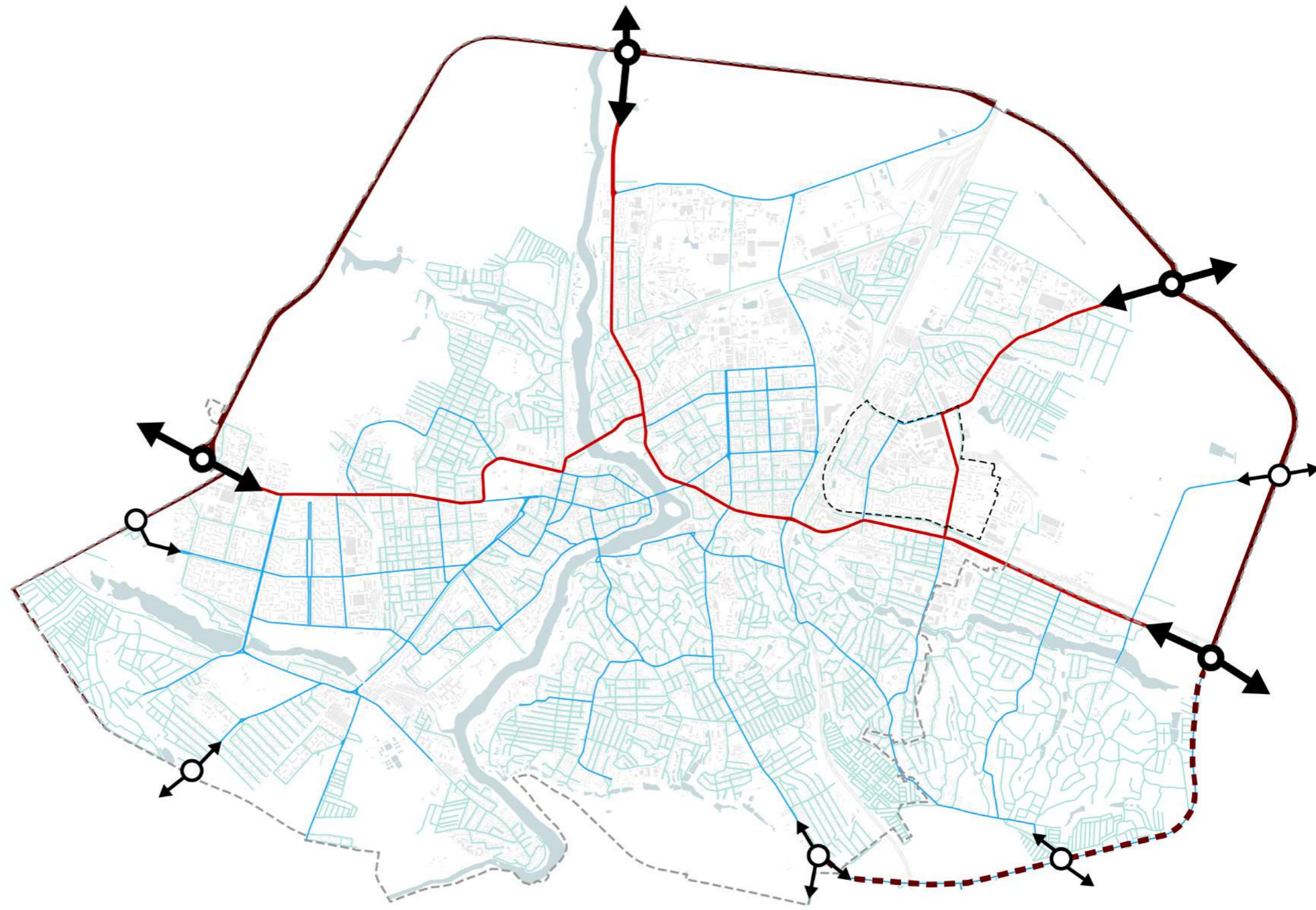


SHELTERS IN VINNYTSIA



Research

City scale analysis Mobility



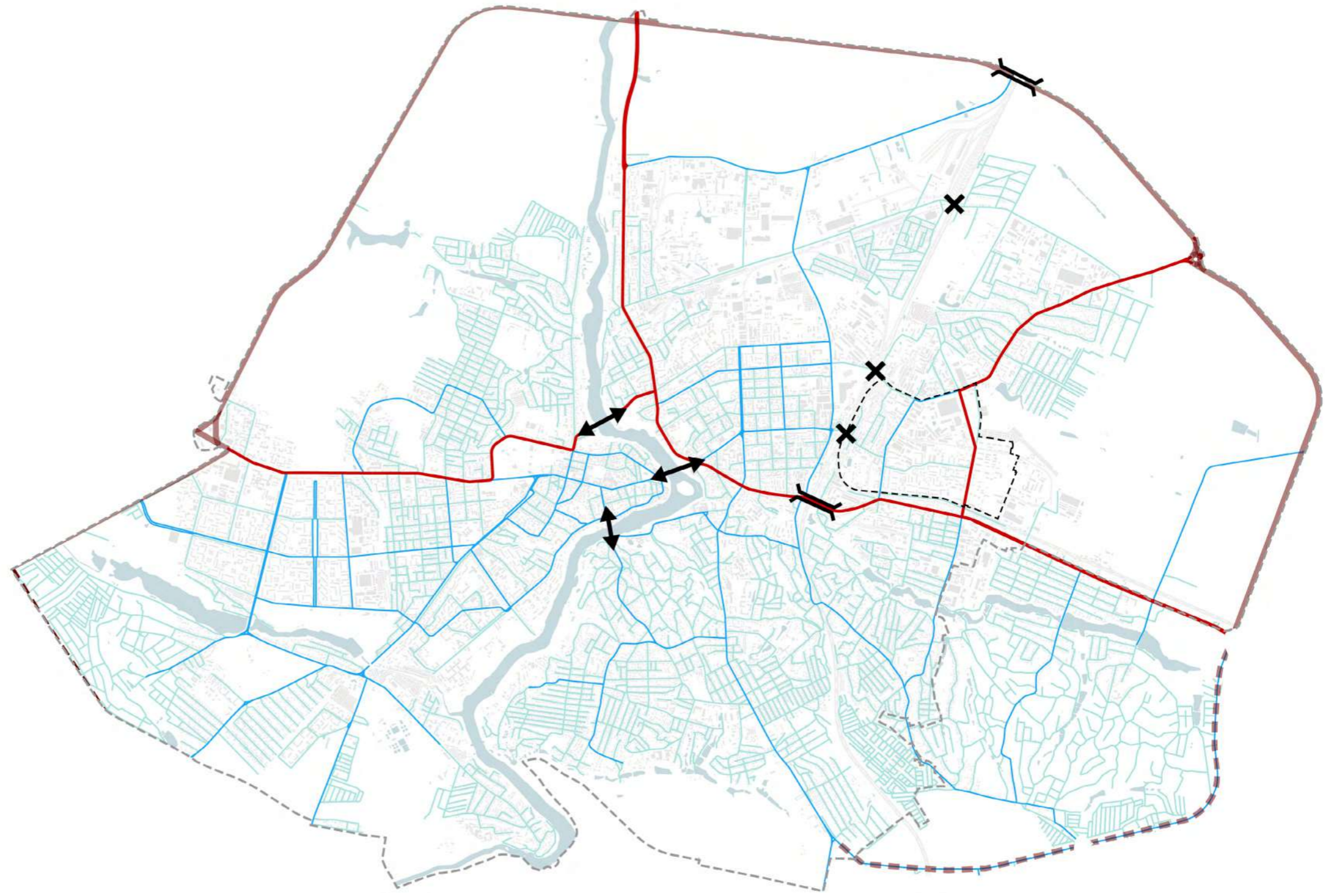
MOBILITY IN VINNYTSIA








Research

City scale analysis Barriers

Barriers within the city, limiting the mobility.



BARRIERS AND CONNECTIONS


- | | | |
|---|--|---|
|  Local roads |  Main roads |  Connections over the railways |
|  Secondary roads |  Mitechko district |  Missing connections over the railways |
|  Ring |  Bridges over the river | |

Research

City scale analysis Public transportation

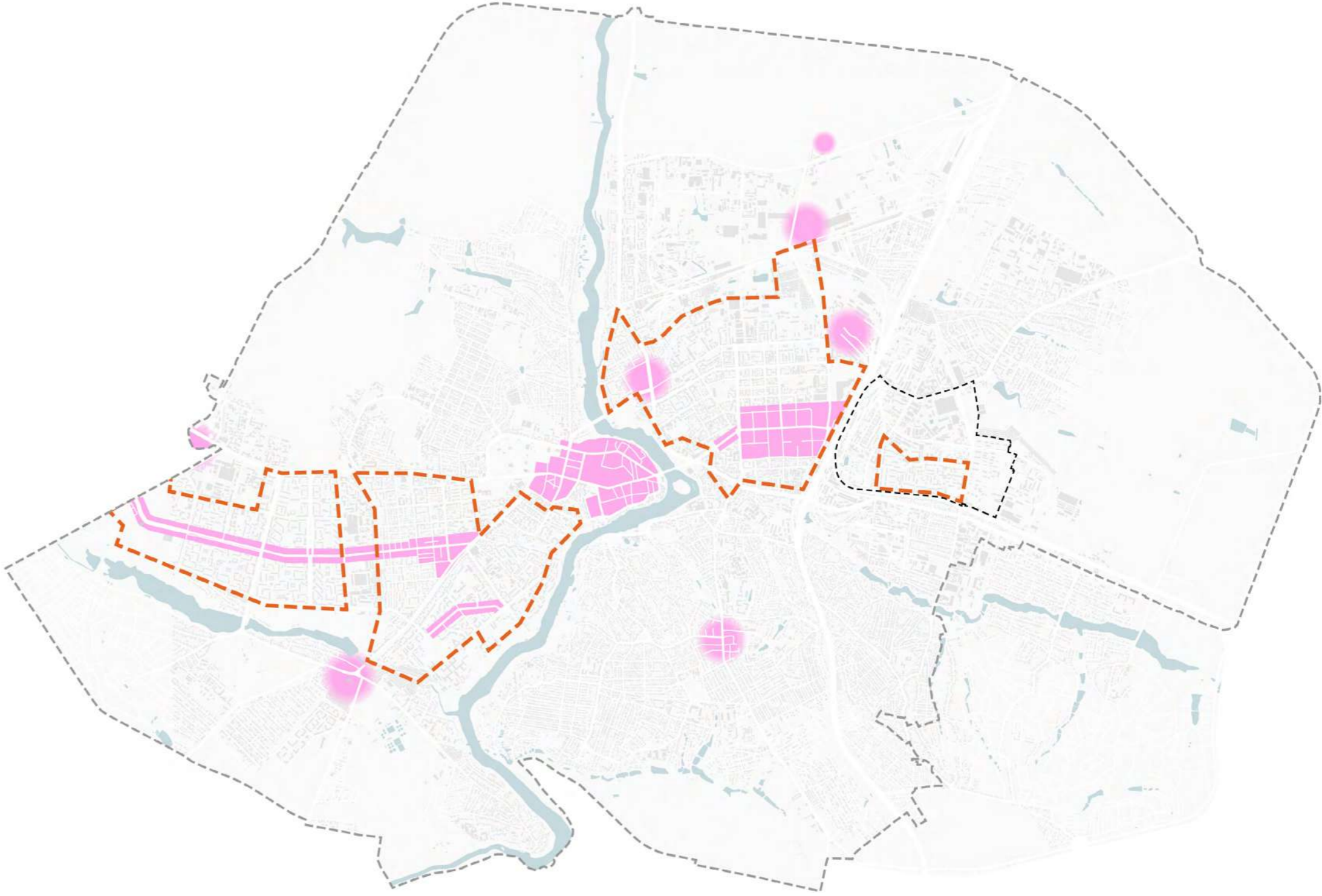


PUBLIC TRANSPORTATION

-  Trains
-  Trams
-  Bus stops
-  Mistečko district

Research

City scale analysis Pedestrian activity

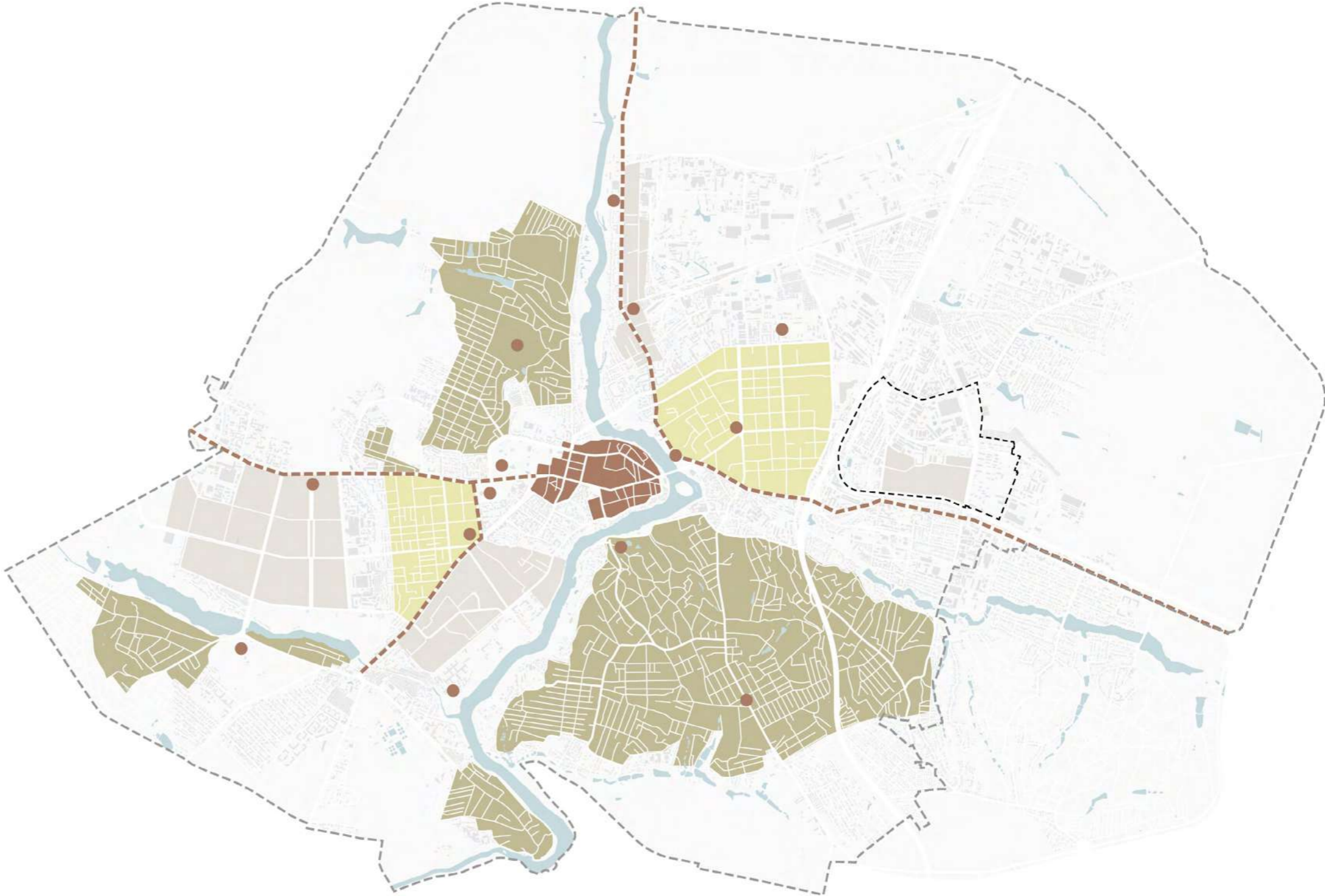


PEDESTRIAN ACTIVITY

- Crowded pedestrian areas
- Dense residential areas
- Mistečko district

Research

City scale analysis Historical character

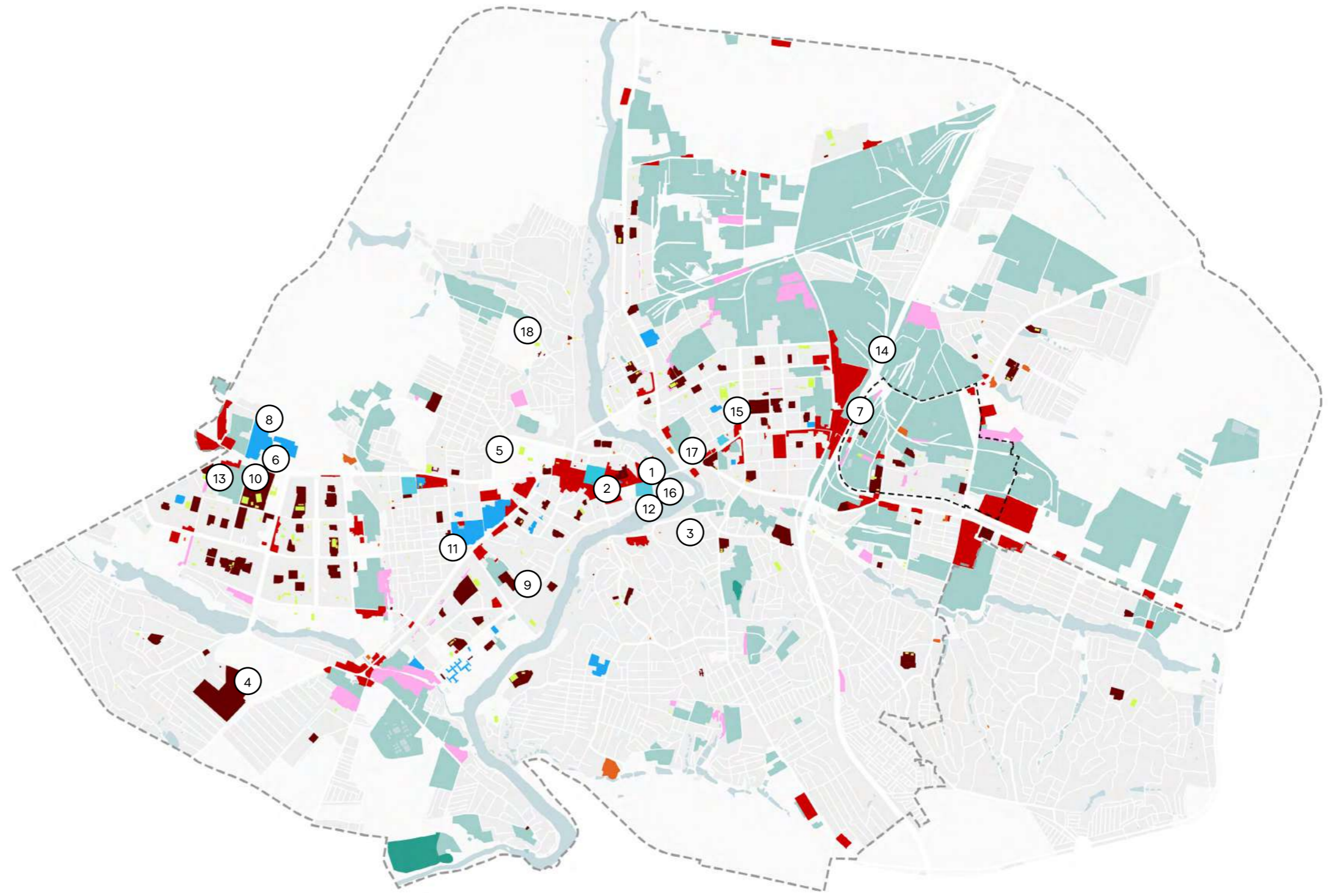


HISTORICAL CHARACTER

- Historical sites
- Early 20th century buildings
- Detached housing areas
- Modernist residential areas - Mikrorayons
- Mistechko district

Research

City scale analysis Functional zoning



FUNCTIONAL ZONING



Research

City scale analysis



1. Water Tower



2. Music and drama theatre



3. Regional Art Museum



4. The National Pirogov's Estate



5. Leontovych Park



6. Clinical Hospital No 1



7. Clinical Hospital No 2



8. Children's Hospital



9. Regional Hospital



10. Olimp Stadium



11. Medical University



12. Institute of Trade



13. European University



14. Faculty of Economy



15. Central City Stadium



16. Vinnytsia Tower



17. Old Vinnytsia Castle



18. Zamok-Palats Grokhol'skykh

Research

Shelter standards International standards

Types of shelters according to the international standards, divided by:

- A. AVAILABILITY AND USE
- B. SIZE

Based on: Studies of international examples.

A.1. EMERGENCY SHELTERS

USE: Offer immediate, emergency protection against small-arms fire and artillery shells.

LOCATION: private building basements (residential, offices etc.)

AVAILABILITY: available immediately.

A.2. COLLECTIVE PROTECTION SHELTERS

USE: Temporary shelters for displaced, offer food water and medical aid

LOCATION: public building (schools, sport halls)

AVAILABILITY: < 48h to prepare them

A.3. BUNKERS

USE: Used by army, public service forces, medics and those in the most dangerous areas

LOCATION: special structures

AVAILABILITY: < 72h to prepare them

B.1. SMALL

CAPACITY: inhabitants of one or few residential buildings,

LOCATION: private buildings basements, mostly in residential buildings and businesses, smaller public underpasses

PURPOSE: provide immediate refuge during the air raid alarms

B.3. LARGE

CAPACITY: for a few thousand people

LOCATION: large public facilities, stadiums, conference centers, dedicated underground structures

PURPOSE: provide refuge to the displaced people

B.2. MEDIUM

CAPACITY: able to accommodate larger population

LOCATION: public buildings, community centers, schools, larger residential and commercial basements

PURPOSE: provide refuge and temporary accommodation to the displaced people

Research

Shelter standards International standards

There are many parameters that should be taken into account when planning the underground shelter. Based on the international standards we can divide them into following groups:

A. LOCATION

Parameters for determining the shelter location;

B. LOCATION

Places to avoid when determining location of a civil defence structure;

C. TECHNICAL FEATURES

Technical features of civil protection structure.

Based on: Studies of international examples, "DBN V.2.2-5:2023 Protective structures of civil protection", Ministry of Development of Communities, Territories and Infrastructure of Ukraine, 2023.

A.1. DENSITY OF THE POPULATION

It should be taken into account to ensure the right capacity and identify the gaps in the shelter network.

A.2. GEOLOGICAL CONDITION AND TOPOGRAPHY

The type of soil can have an impact on construction, natural features such as hills can provide additional safety.

A.3. DISTANCE FROM THE RIVER, WATER LEVELS

Keeping the distance from the river and checking the water levels is important to prevent flooding and water infiltration into the shelter.

A.4. PROXIMITY TO THE INFRASTRUCTURE

Proximity to the public transport and places of temporary crowding makes the shelter more accessible.

A.5. PROXIMITY TO THE DANGER

Keeping the distance from tall buildings which could collapse blocking the outage is important.

B.1. DANGEROUS SUBSTANCES

It's prohibited to place shelters under production and storage facilities with harmful and explosive substances

B.2. SLOPES

It's prohibited to place shelters on slopes not protected from landslides or other dangerous geological processes

B.3. HIGH VOLTAGE ELECTRICITY, TRANSIT PIPES

It's prohibited to place shelters in premises with transit heat and water pipes or inputs of high-voltage electricity

B.4. DISTANCE FROM STORAGE FACILITIES

Shelters should be placed no closer than 30m from storages or warehouses with combustible substances

B.5. DISTANCE FROM WATER NETWORKS

Shelters should be placed no closer than 5m from external networks of water and heat supply or pressure sewerage.

C.1. CONSTRUCTION

Thick walls and ceilings made of reinforced materials to withstand blasts, additionally flexible joints can help absorb the shock

C.2. SAFETY FEATURES

Blast-proof doors, Airlock with double blast proof doors; additional emergency exit with a safe outage few meters away

C.3. WATERPROOFING DRAINAGE

The structure should be waterproof to prevent water infiltration, additionally special barriers could be installed to prevent flooding

C.4. VENTILATION SYSTEMS

Emergency, protected air intake with a gas filtration system to prevent entry of the contaminants

C.5. ENERGY AND POWER SUPPLY

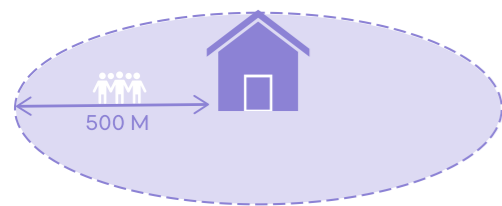
Emergency power supply such as generators or solar panels

Research

National regulations

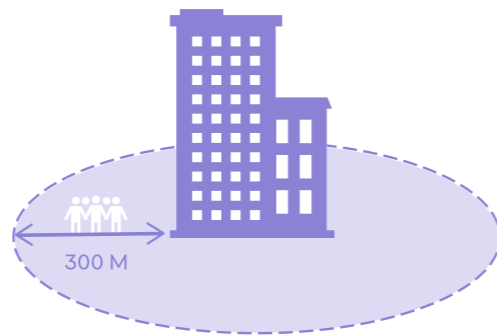
Based on: "DBN V.2.2-5:2023 Protective structures of civil protection", Ministry of Development of Communities, Territories and Infrastructure of Ukraine, 2023

Catchment area for different types of buildings



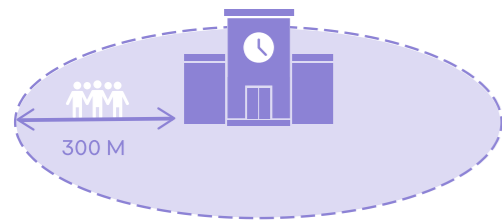
LOW-RISE BUILDINGS

Collection area for shelters in medium and low-rise buildings is 500m.



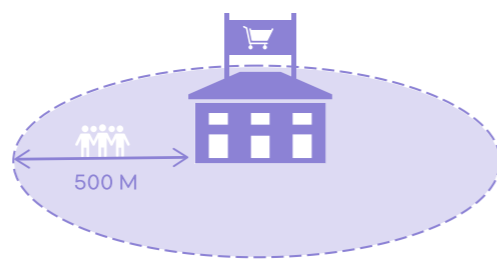
HIGH - RISE BUILDINGS

Collection area for shelters in multi-storey buildings and high-rise buildings is 300m.



BUSINESS ENTITIES OF CIVIL PROTECTION

Collection area for shelters in business entities assigned to the relevant category of civil protection is 300m.



REGULAR BUSINESS ENTITIES

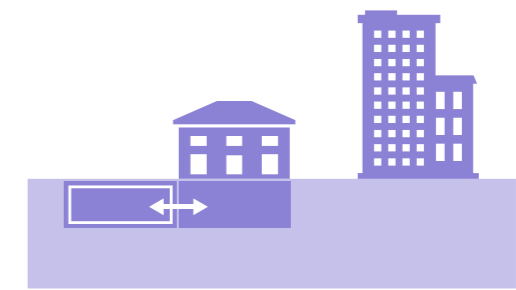
Collection area for shelter in other, regular business entities is 500 m.

Types of shelters based on placement within the building



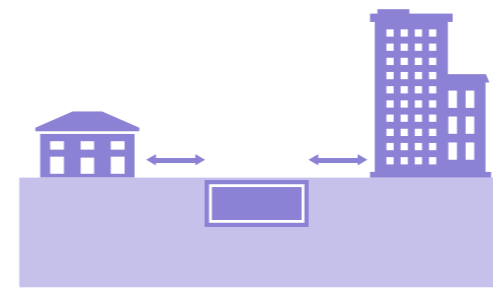
BUILT-IN

Built-in protective structures are designed in underground, basement. 1st priority should be low-rise buildings.



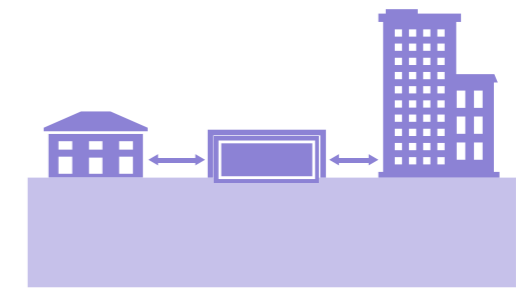
ATTACHED

Attached structures are designed in underground, basement. 1st priority should be low-rise buildings.



SEPARATED UNDERGROUND

Separate, buried structures are to be built outside the zone of collapse of neighbouring buildings. In case that is not possible, the structure has to be resistant to additional loads.



SEPARATED ABOVE THE GROUND

Separate structures above the ground have to have multi-layer structure, to be covered by protection screen or additional cladding with concrete. To be located outside the zone of collapse or resistant to additional loads.

Research

Shelter standards National regulations

Based on: "DBN V.2.2-5:2023 Protective structures of civil protection", Ministry of Development of Communities, Territories and Infrastructure of Ukraine, 2023

mandatory program

recommended program

ANTI-RADIATION SHELTERS

MAIN PROGRAMS

main room; sanitary space or room;
medical room (capacity of >600); control point (capacity of >300, or in special types of shelters)

control center (maintenance); areas for children (under 1 y.o.); medical center (capacity of <600);
food distribution areas; area for pets (temporary stays)

AUXILIARY PROGRAMS

sanitary room; ventilation equipment area; storage for contaminated clothes

emergency power supply; storage room; food storage (one for each 500 people);
water storage; food serving area; feeding areas and changing places for babies

SHELTER AND DUAL-USE SHELTERS

MAIN PROGRAMS

main room; sanitary space or room;
medical room (capacity of >600); control point (capacity of >300, or in special types of shelters)

medical center (capacity of <600); feeding areas and changing places for babies; food distribution areas;
area for pets (temporary stays); areas for children (under 1 y.o.); control center; control center (maintenance);

AUXILIARY PROGRAMS

ventilation equipment area; emergency power supply; premises for a heating station; autonomous power supply;
drainage and pumping station; vestibule; storage for contaminated clothes; storage for tools, protective equipment;
water storage area; room for cylinders; premises for dosimeter; waste storage room;
locker rooms (clean clothing storage); sanitary premises

Research

Shelter standards National regulations

Based on: "DBN V.2.2-5:2023 Protective structures of civil protection", Ministry of Development of Communities, Territories and Infrastructure of Ukraine, 2023

TYPE OF BUILDING WHICH THE SHELTER IS ASSIGNED TO

Enterprises **Health care facilities** **Public Buildings**

Newly constructed shelter
(per person in sqm)

0,5 1,1 0,6

Re-constructed shelter
(per person in sqm)

0,4 1,0 0,6

Residential Buildings

Educational institution. Pre-school

Educational institution. 1-2 grades

0,6 3,0 2,0

0,6 2,0 1,6

TYPE OF BUILDING WHICH THE SHELTER IS ASSIGNED TO

Educational institution 3-4 grades

Educational institution 5-12 grades

Educational institution Universities <500 people

Newly constructed shelter
(per person in sqm)

1,6 1,3 1,6

Re-constructed shelter
(per person in sqm)

1,2 1,0 1,0

Educational institution. Universities 500< <1000 people

Educational institution. Universities >1000 people

Extra-curricular Educational institution

1,4 1,2 1,5

1,0 0,9 1,2

MISTECHKO DISTRICT

This chapter undertakes a comprehensive examination of Mistechko district's shelter infrastructure, focusing on its topography, functional zoning, and resident perspectives gathered through interviews.

The aim is to analyze existing shelter network, identify gaps, and propose optimal locations for new shelters. Through this research, valuable insights are aimed to contribute to urban design and emergency preparedness discussions, with the ultimate goal of enhancing the district's resilience and safety.

District scale analysis

Neighbourhood typologies

Functional zoning

Mobility on site

Shelters on site

District scale analysis

District scale conclusions

Conclusions from the interviews

Residents negative comments

Residents positive comments

Neighbourhood improvement ideas

Mitechko district

Neighbouring areas

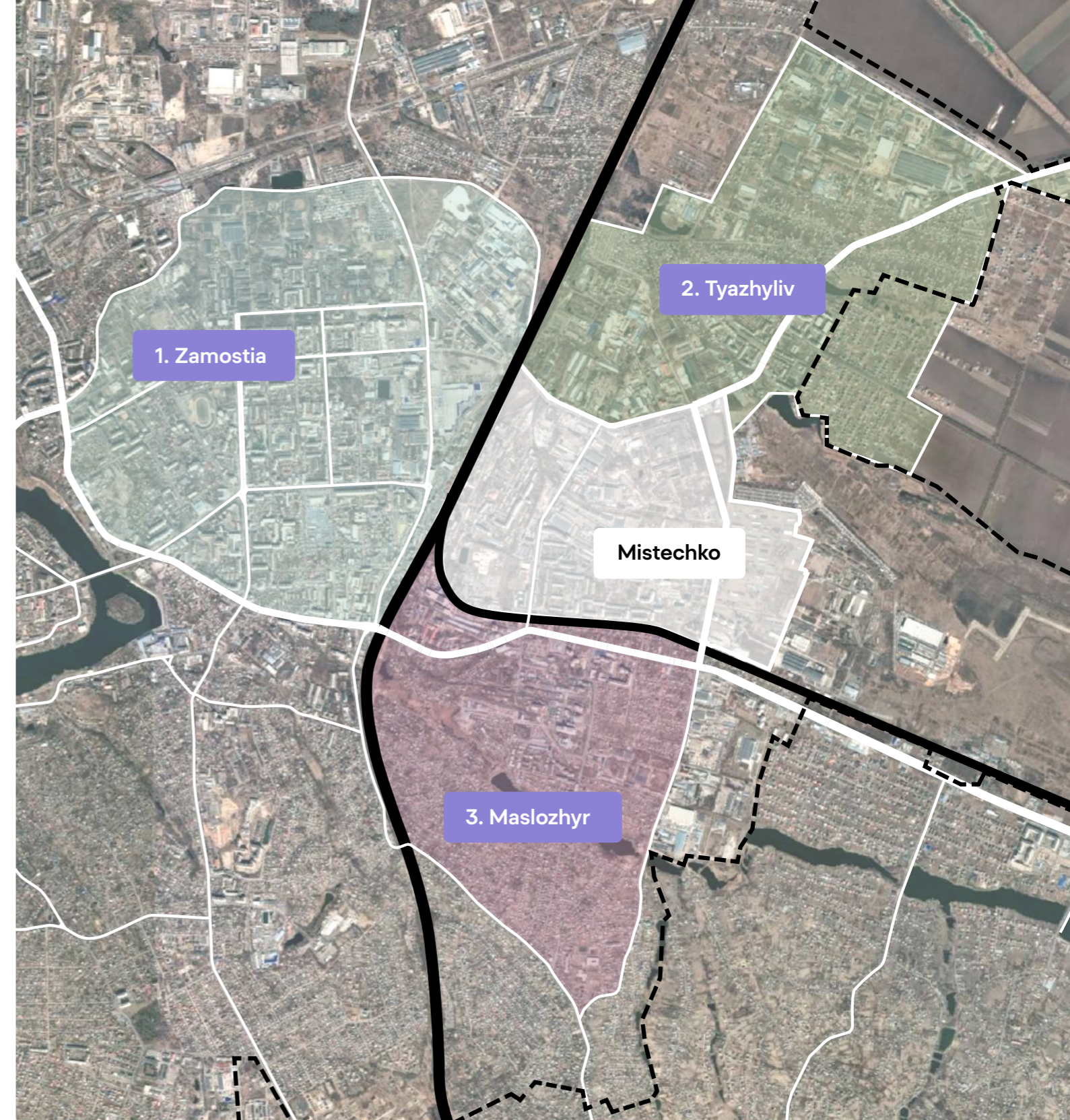
1. ZAMOSTIA
One of the most densely populated districts of Vinnytsia. It includes blocks of heritage buildings.



2. TYAZHYLIV
A neighbourhood populated mostly by relatively recent, detached housing with a few apartment buildings.



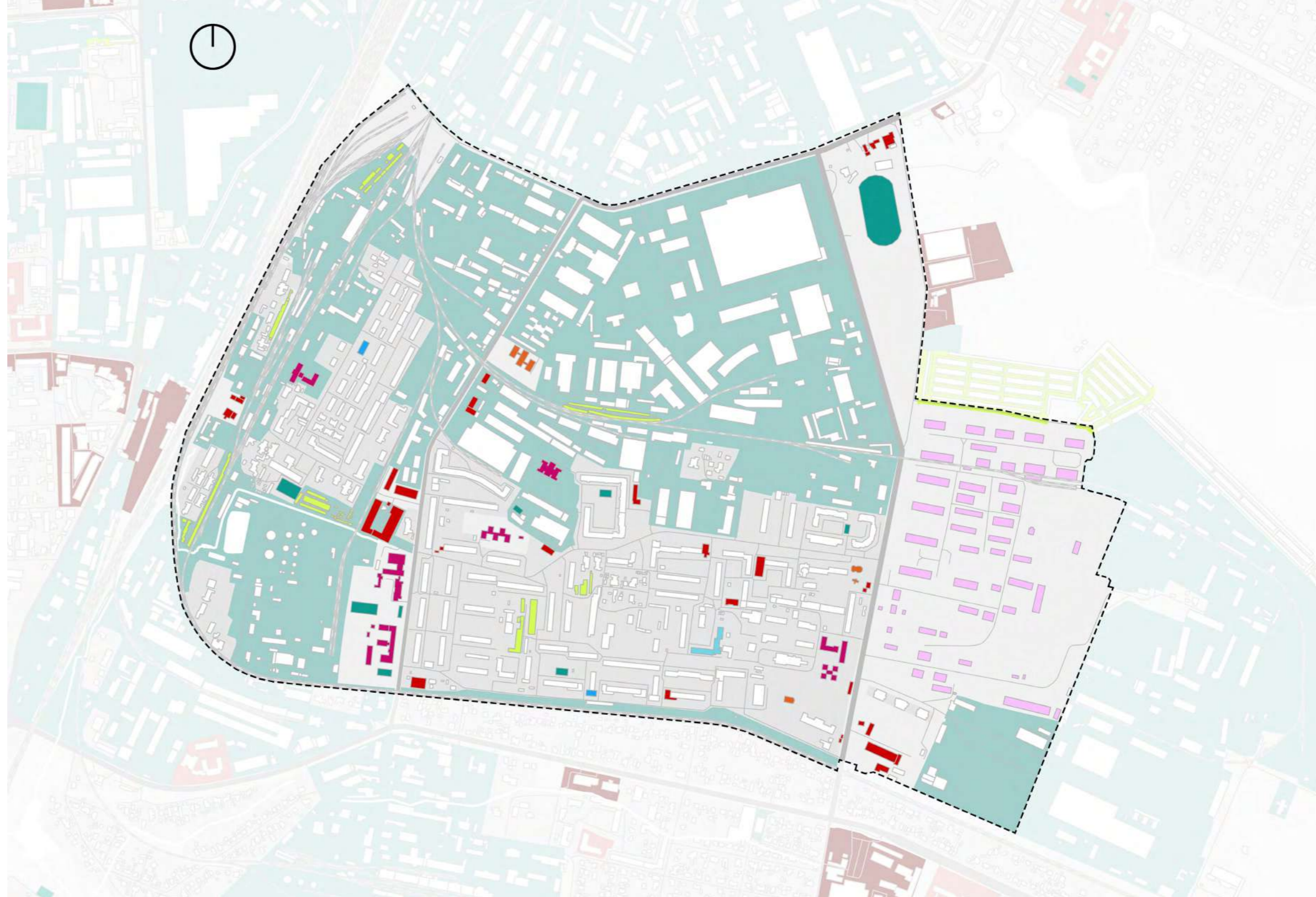
3. MASLOZHYP
An area characteristic for its lakes, hilly landscape and greenery. Filled with older, residential buildings.



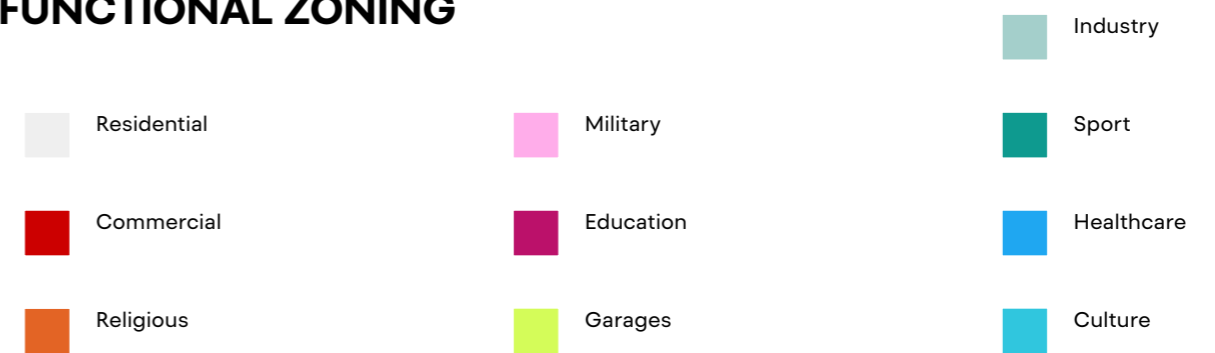
Map of neighbouring districts

Mitechko district

Functional zoning

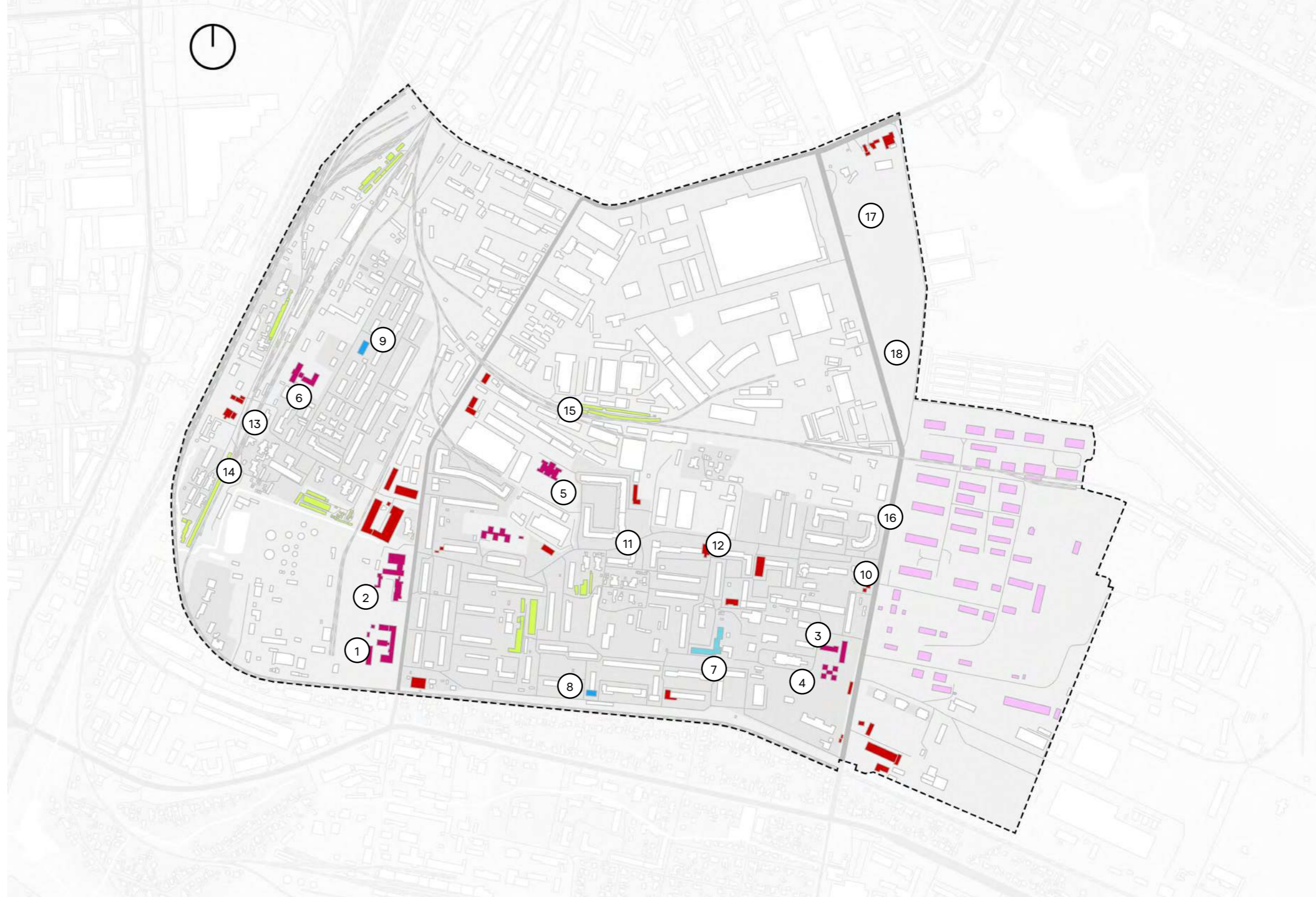


FUNCTIONAL ZONING

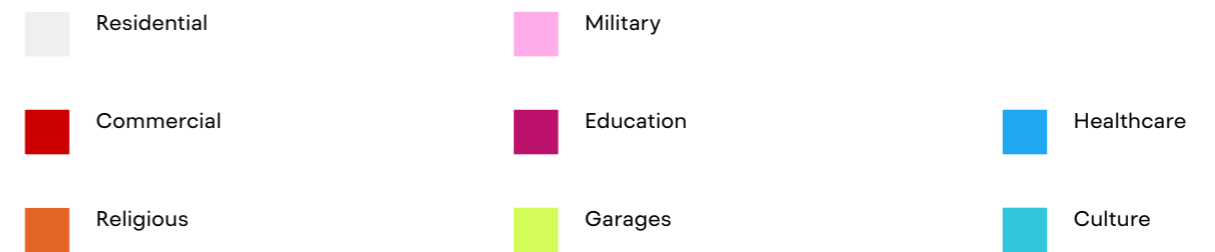


Mitechko district

Functional zoning



FUNCTIONAL ZONING



Mistechko district

Functional zoning analysis



1. Lyceum No. 13

2. Lyceum No. 12

3. School No.13



4. Kindergarten No. 43

5. Kindergarten No. 20 in "Andorra" Complex

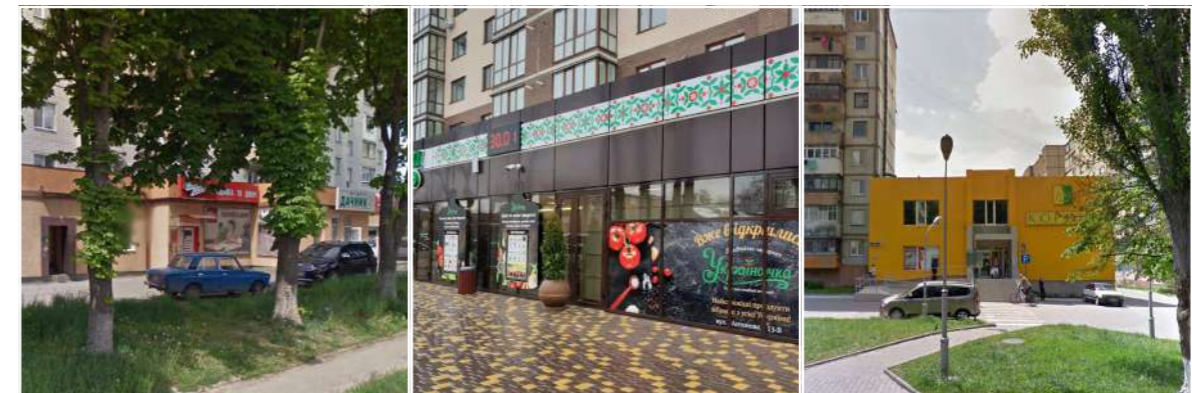
6. Kindergarten No. 16



7. Local library

8. Ambulance station

9. Primary healthcare center No. 1



10. Shop on Chekhova street

11. Market in "Andorra" Complex

12. Shop on Antonova street



13. Commercial area in front of the train station

14. Garages on Zaliznychna Street

15. Garages



16. Military city

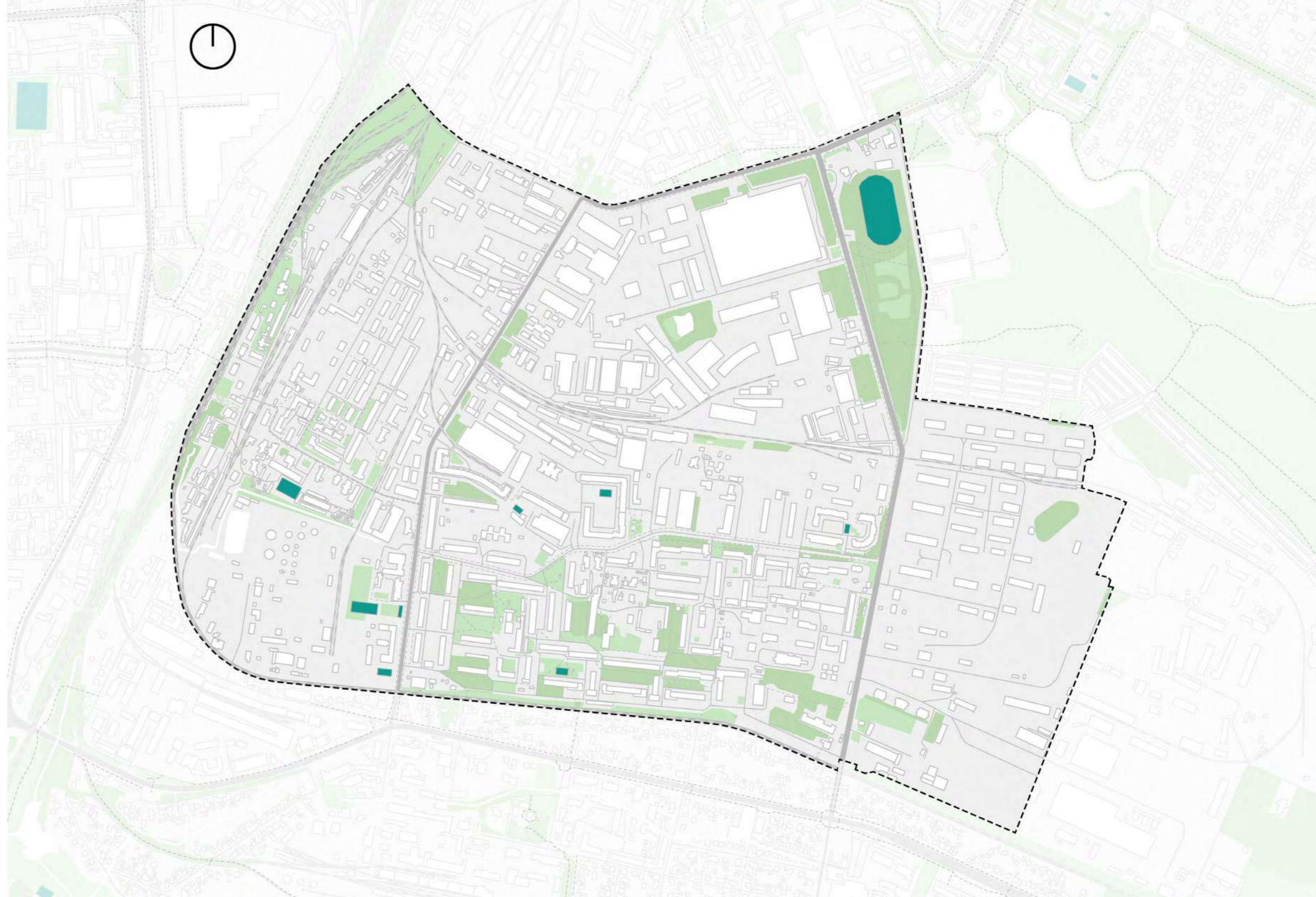
17. Playing field in Park Integral

18. Park Integral




Mistechko district

Functional zoning

Green areas within the Mistechko district with highlighted sport facilities.



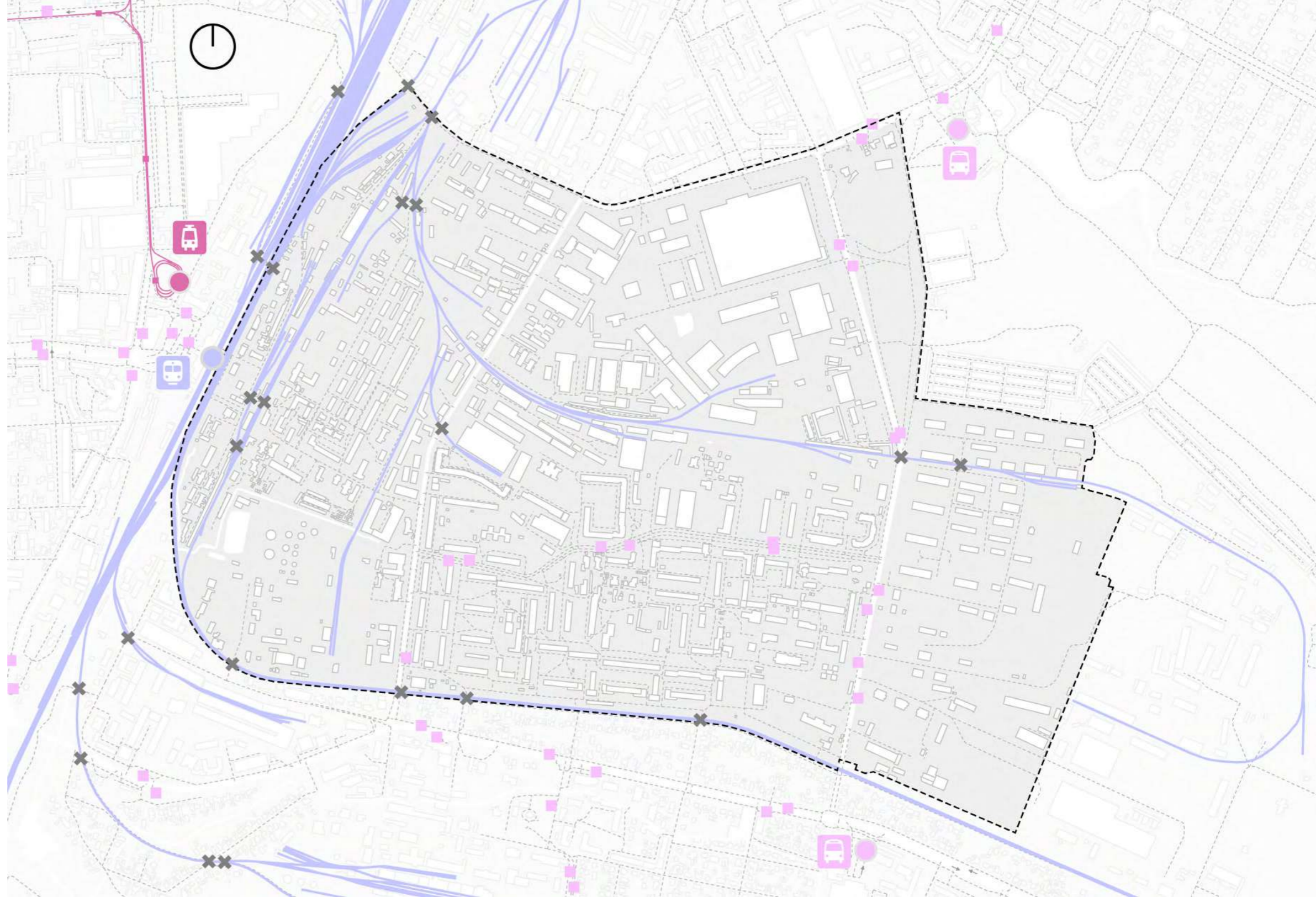
GREEN AREAS

-  Low vegetation
-  High vegetation
-  Sport facilities








Mistechko district

Mobility analysis

Public transportation in the Mistechko district includes buses and trolley buses. It is located in a close proximity to the Main Train Station and a tram station.



PUBLIC TRANSPORT

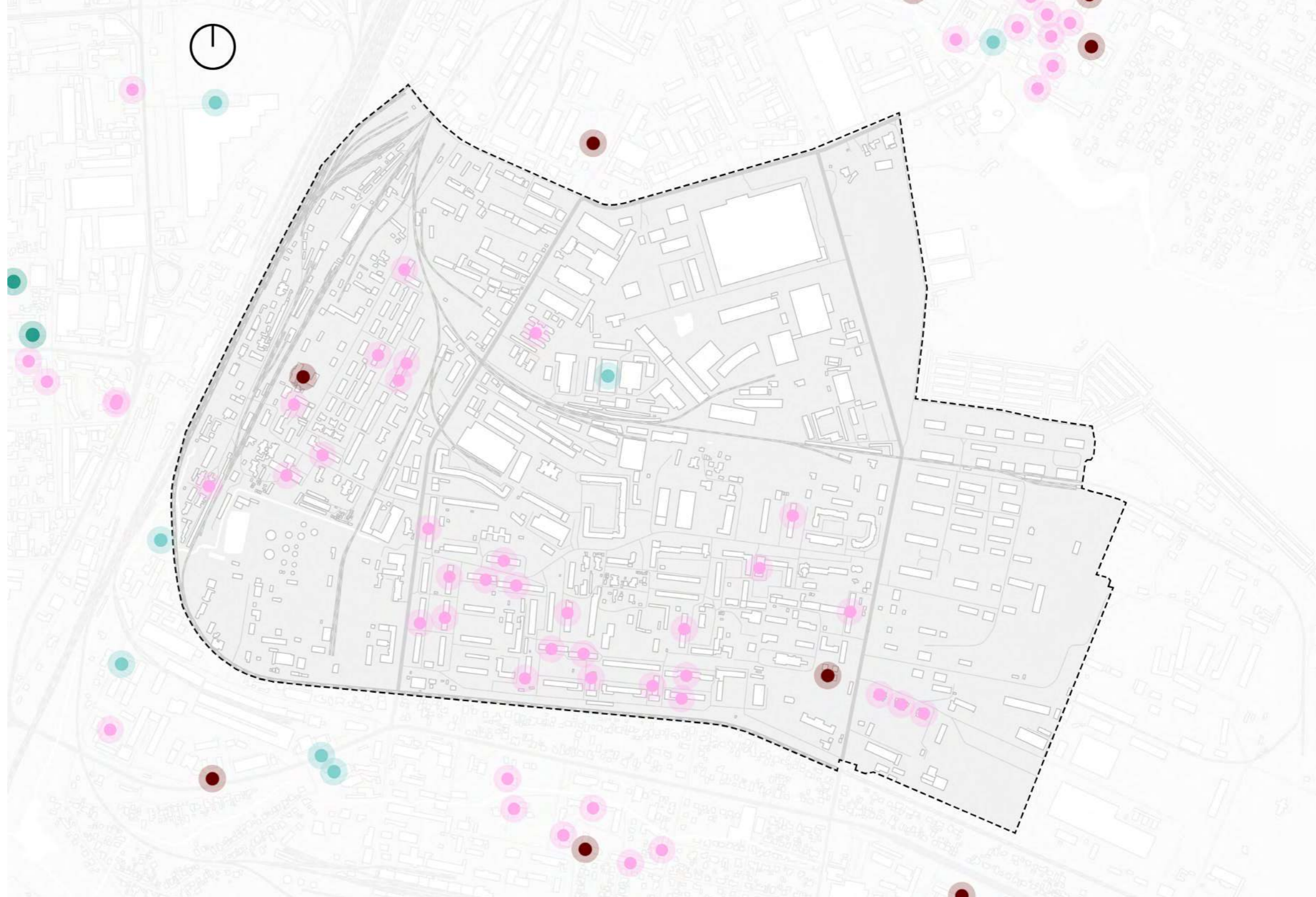
-  Railway
-  Bus lines
-  Tram line
-  Main train Station
-  Bus & Trolley Bus Stations
-  Tram station
-  Crossings through the railway tracks

Mitechko district

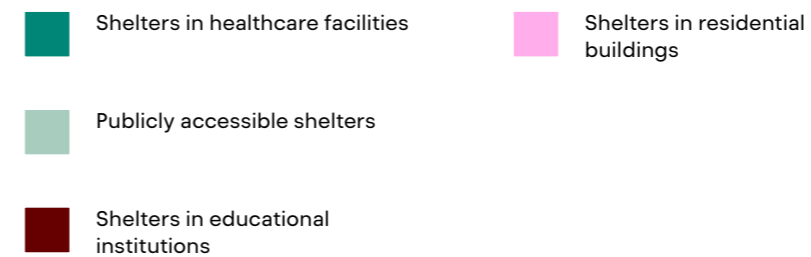
Shelters on site

Underground shelters in Mitechko district can be organized into four categories:

1. Publicly accessible shelters in basements of commercial facilities, restaurants, warehouses, parkings and underpasses.
2. Shelters in residential buildings, accessible mostly by their residents.
3. Underground shelters in healthcare facilities, hospitals, clinics, etc. Not accessible by a wider public, used to host patients.
4. Underground shelters in educational institutions, kindergartens, schools, universities, etc.



UNDERGROUND SHELTERS




Mitechko district


Shelters on site Catchment area

Shelter collection areas calculated for the Mitechko district. The catchment area for the types of buildings present in the area is equal to 300m. All existing shelters should be checked for maintenance.



SHELTER COLLECTION AREA

 Buildings with underground shelters

 Collection area - 300m







Mitechko district

Shelters on site Public buildings

Shelter collection area overlaid with public facilities available in the area, such as schools, kindergartens, healthcare facilities and a library that do not currently have a shelter. This public buildings should be considered during planning for new shelters.



SHELTER COLLECTION AREA

- | | |
|---|--|
|  Buildings with underground shelters |  Religious |
|  Collection area - 300m |  Healthcare |
|  Education |  Culture |


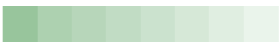


Mitechko district

Shelters on site Shelters within public spaces

Shelter collection area of the existing shelters overlaid with public spaces and most frequently visited areas. This spaces should be considered during planning for new underground shelter location.



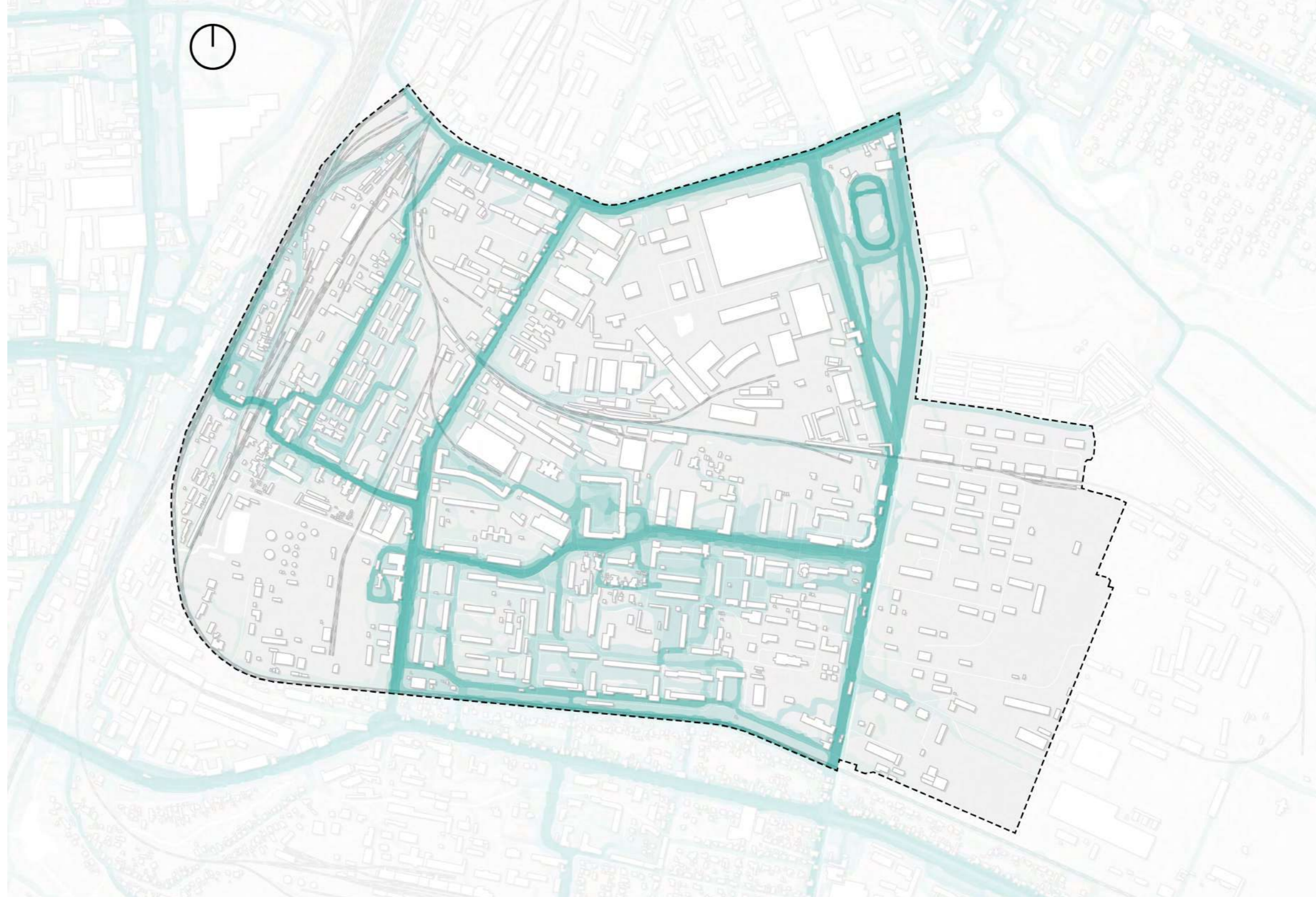
PUBLIC SPACES COLLECTION AREAS

-  Shelters to be checked for maintenance
-  Areas most frequently visited by pedestrians
-  Collection area of existing shelters
-  Areas open to the public, potential placement of new shelters

Mitechko district

District scale analysis Pedestrian activity

Areas most frequently visited in the Mitechko district.



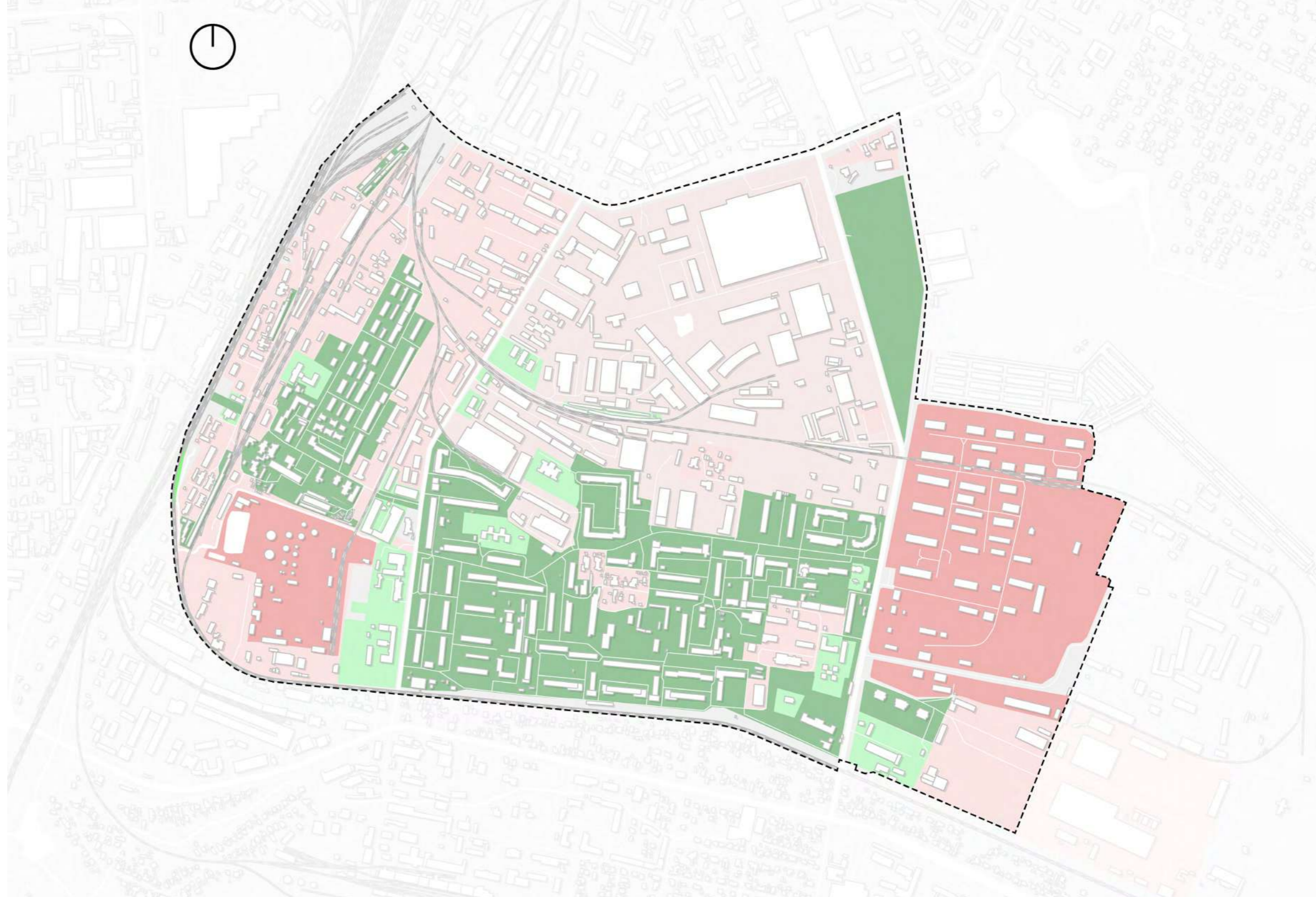
PEDESTRIAN ACTIVITY

Areas most frequently visited





Mitechko district

District scale analysis Accessibility

Areas accessible to the public, enclosed and those with restricted access.



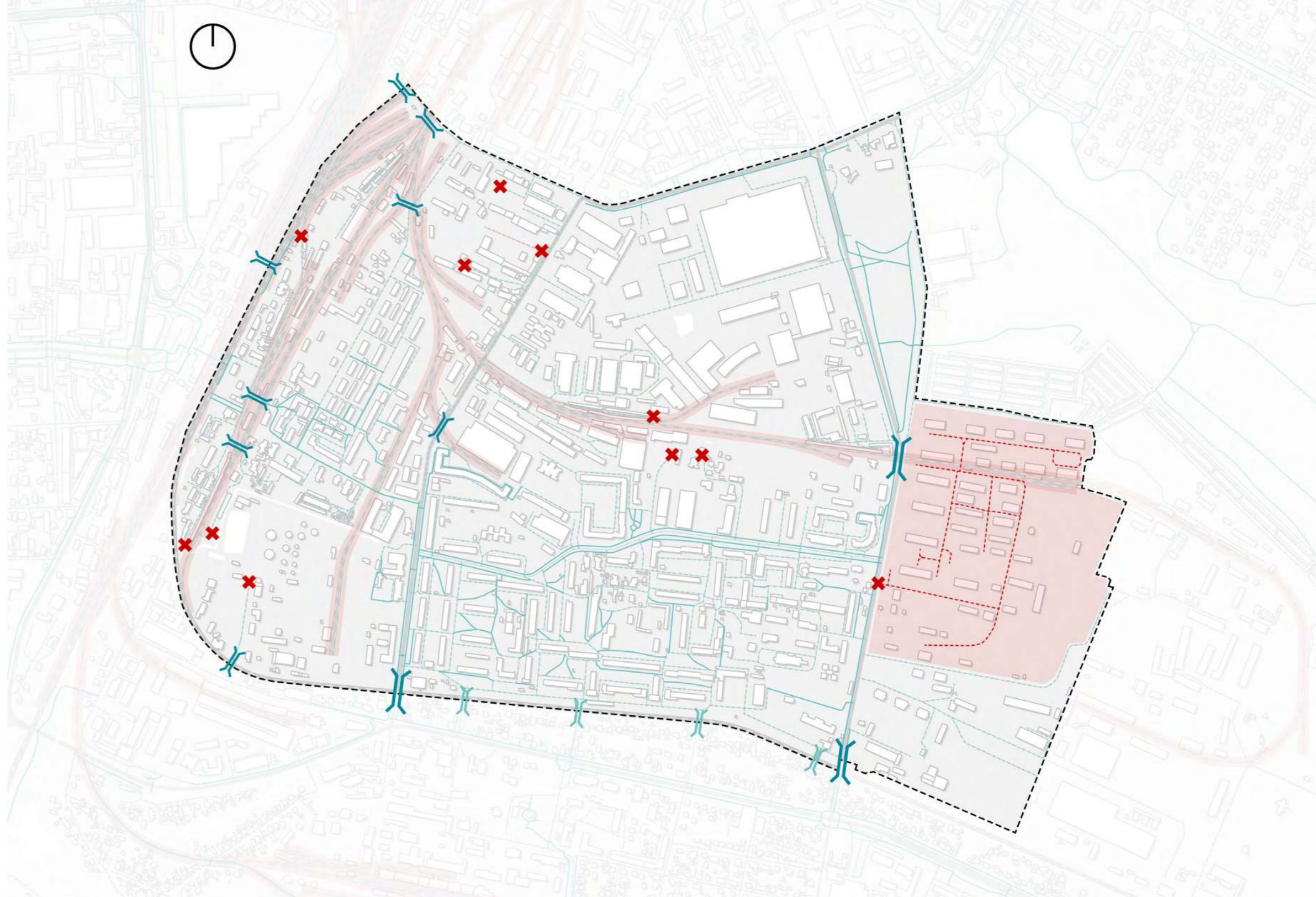
ACCESSIBILITY OF THE LAND

-  Restricted areas
-  Closed areas
-  Areas open to the public, without a fence
-  Areas accessible to the dedicated users (e.g. schools)








Mistechko district

District scale analysis Barriers and pedestrian paths

Barriers restricting pedestrian movement within the Mistechko district.



BARRIERS AND PEDESTRIAN PATHS

-  Restricted areas
-  Paths not accessible to the public
-  Cul-de-sac, blockers
-  Main pedestrian paths with sidewalks
-  Pedestrian paths along the roads with no dedicated sidewalk
-  Unofficial crossings over the rails
-  Crossings over the rails

Mistechko district

District scale analysis Building heights

Heights of the buildings in the area.



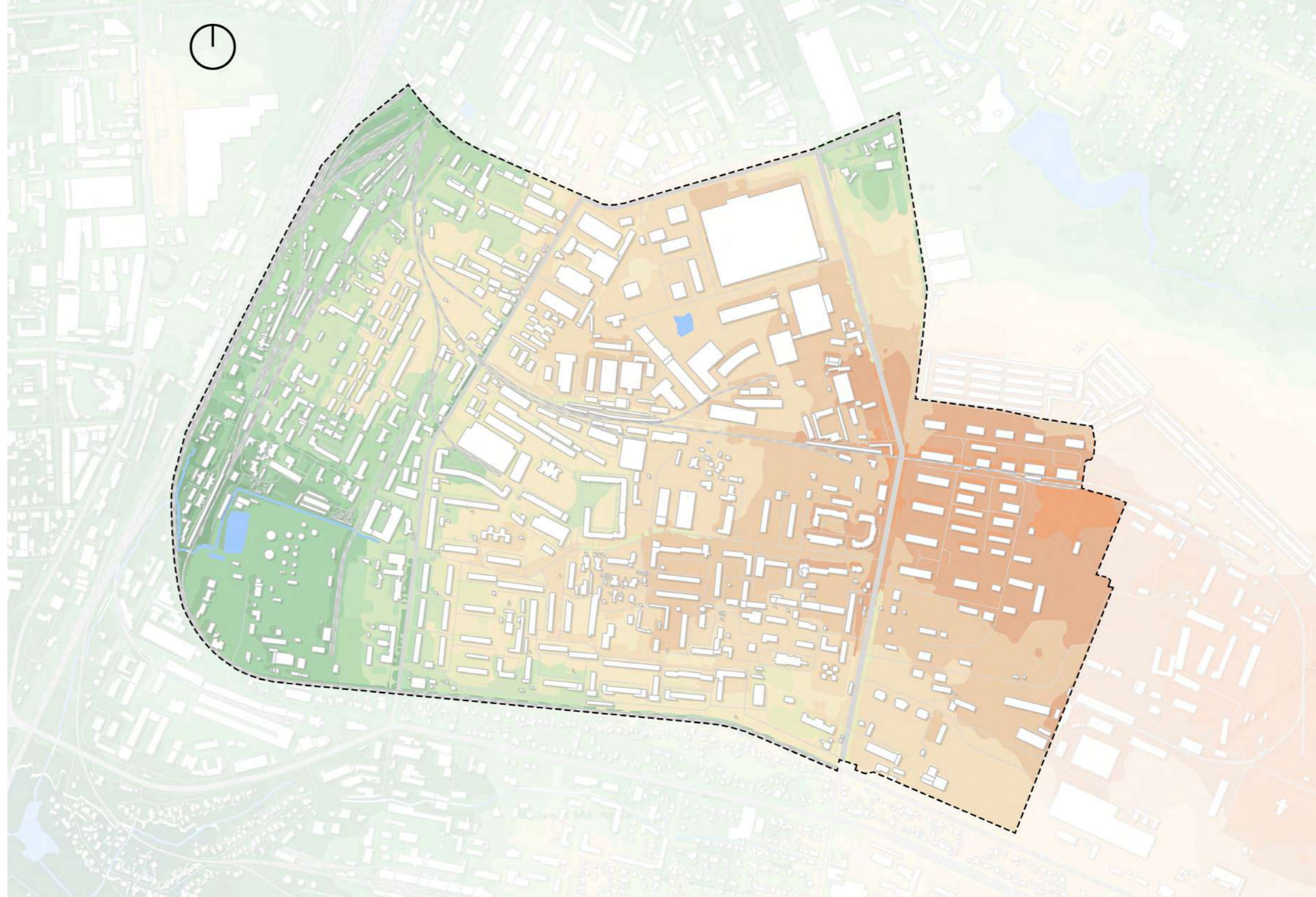
BUILDINGS HEIGHTS



Mistechko district

District scale analysis Topography

Topography in the area of Mistechko district.



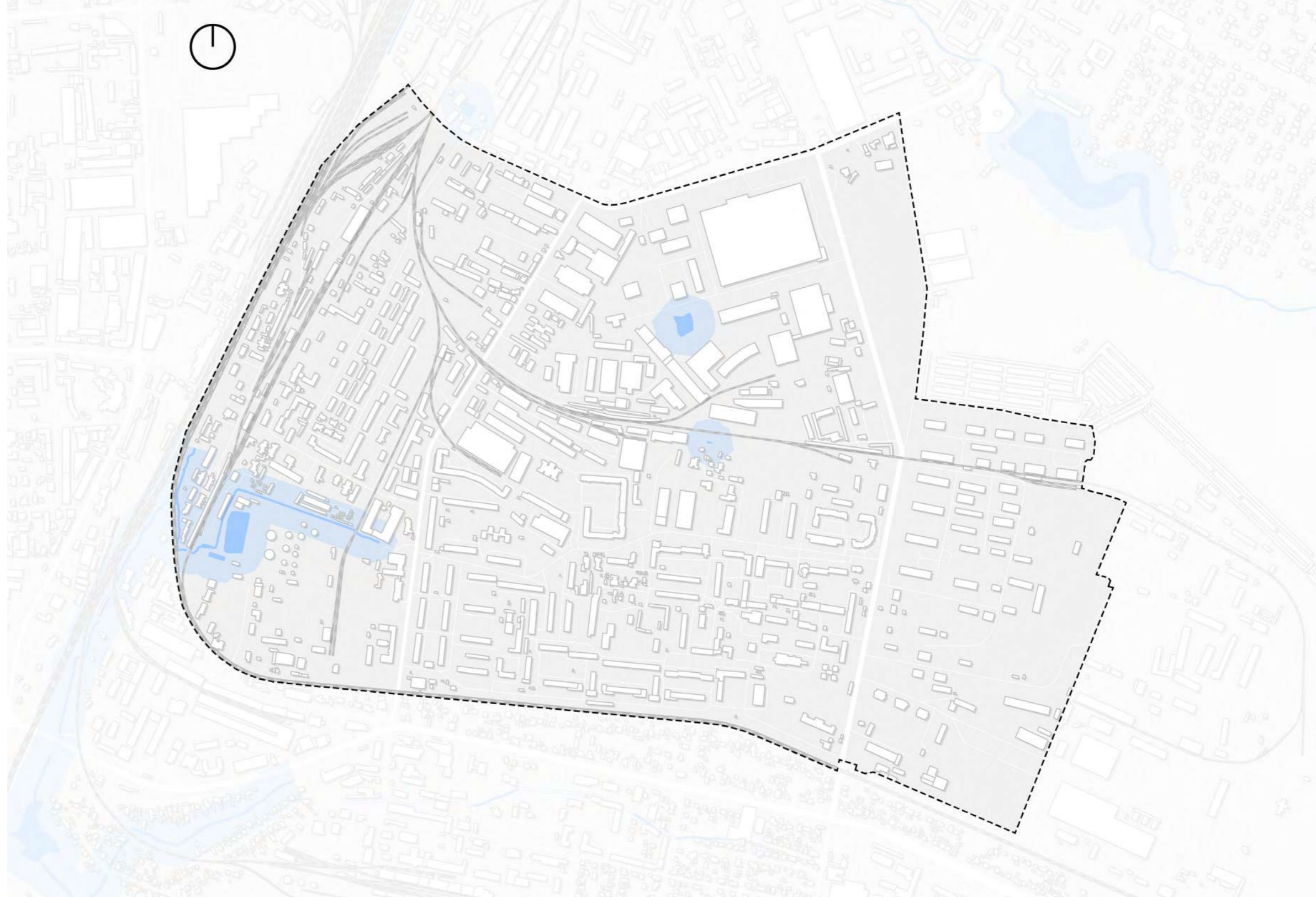
TOPOGRAPHY





Mitechko district

District scale analysis Water

Bodies of water in the area with the approximate ground infiltration area of 100m.



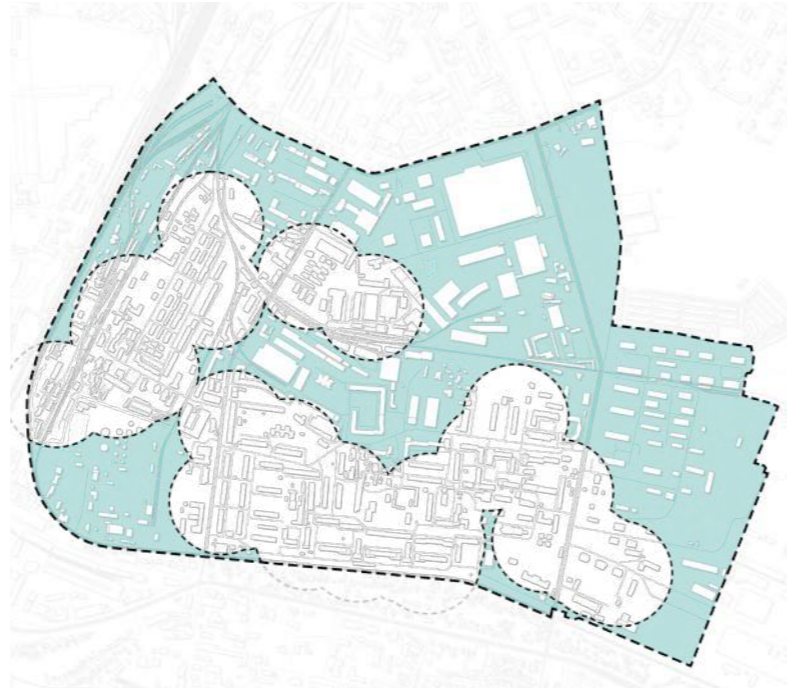
BODIES OF WATER

-  Water sources
-  Distance from water sources - 100 m

Mitechko district

District scale conclusions

Areas outside of the shelter catchment zone, and areas most vulnerable within and outside of the collection area.



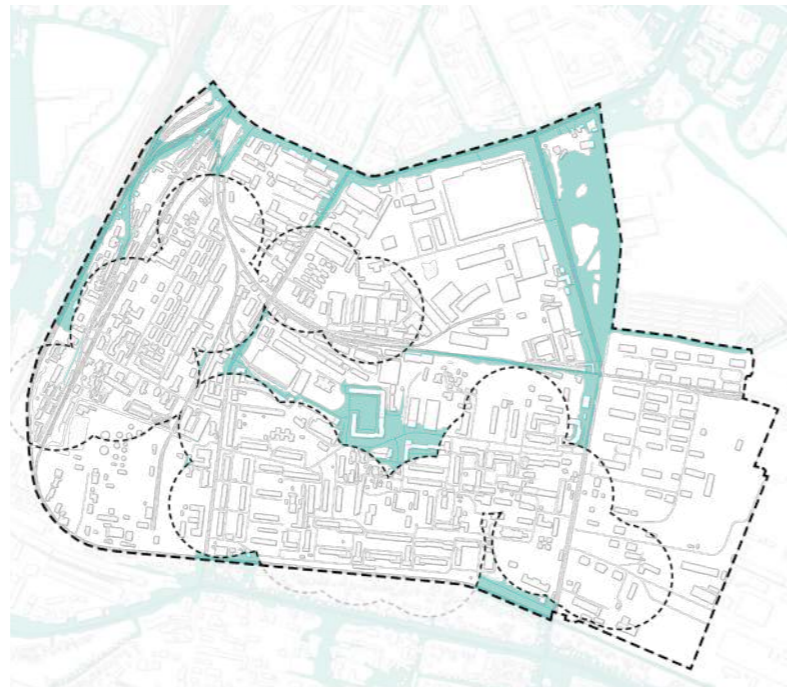
AREAS NOT COVERED

Areas outside of the shelter catchment zone.



RESIDENTIAL AREA

Residential areas outside the shelters catchment/ collection zone



PUBLIC SPACES

Most visited, pedestrian areas outside the shelters catchment/ collection zone



PUBLIC INSTITUTIONS

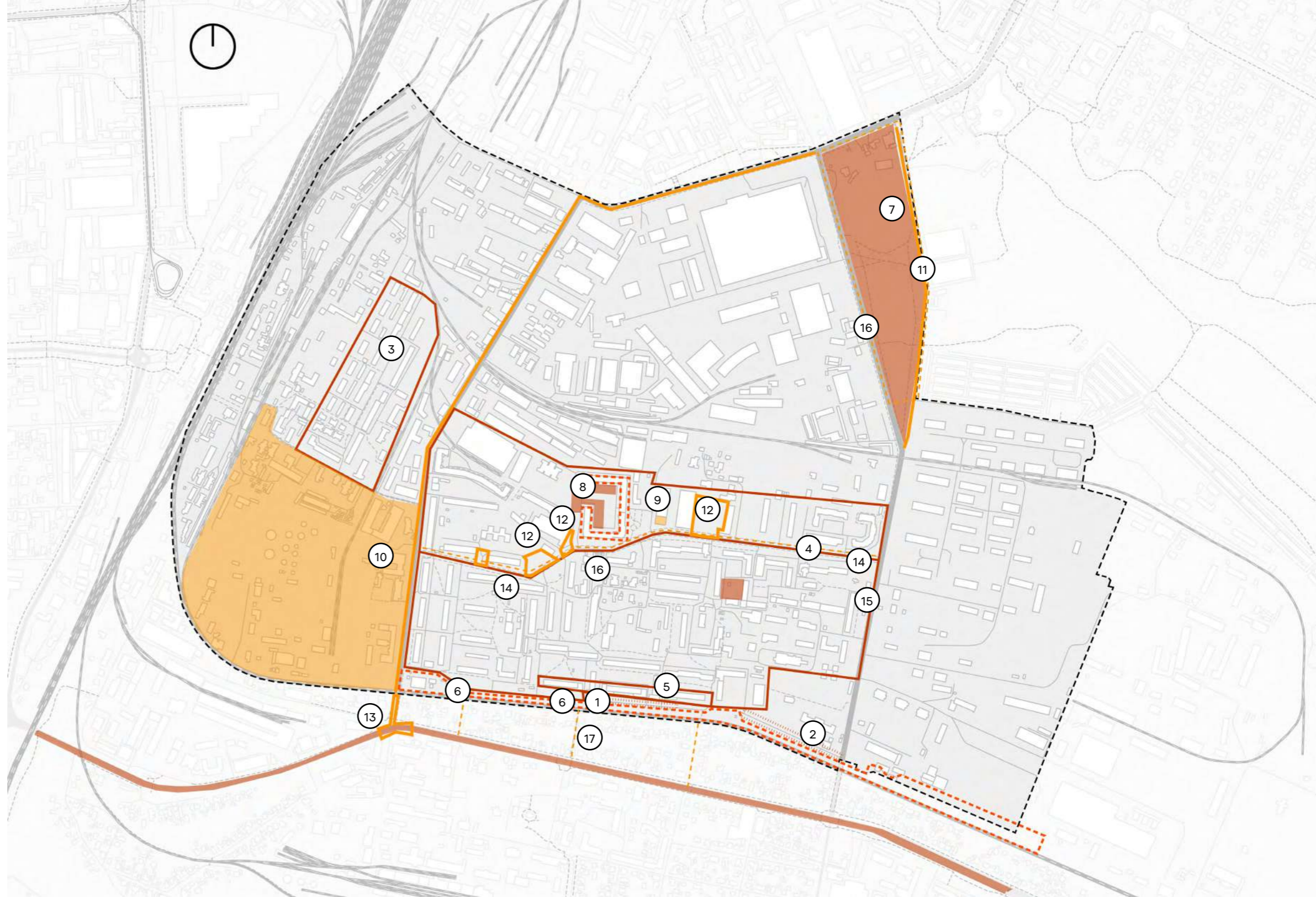
Educational institutions without the shelter in and out of the catchment zone

Mistechko district

Conclusions from the civic workshop. Residents negative comments

The evaluation of Mistechko district highlights several issues across different areas. Infrastructure decay includes roads needing paving and inadequate storm water drainage causing flooding and damp basements. Segregation is evident, with neighborhoods like “poetry streets” and the Military Town isolated from each other, and boundaries drawn along major streets.

Vacant and abandoned spaces, such as overgrown areas under railroad tracks and empty parts of Andorra, are common. Landscape neglect is visible, with seasonal changes affecting the neighbourhood’s perception, Integral . Transportation issues include traffic jams on Shymka Street, a lack of bike lanes, and poor parking. Pedestrian mobility is hindered by insufficient sidewalks and cross-walks, inconvenient pedestrian transit, and narrow paths. Social issues include danger from traffic and marginalized people, fear of stray dogs, and social tension due to a school being turned into a refugee shelter. The district also lacks community and social amenities, with few children’s centers, insufficient lighting, a need for a dog area, lack of garbage bins, limited recreational facilities for the elderly, and no active community groups or activities. There is also a lack of community initiative and insufficient clothing stores.



NEGATIVE COMMENTS

- Landscape neglect
- Environmental Pollution
- Segregation
- Transportation and Traffic issues
- Vacant and abandoned spaces
- Pedestrian mobility issues
- Infrastructure decay

Mitechko district

Residents negative comments



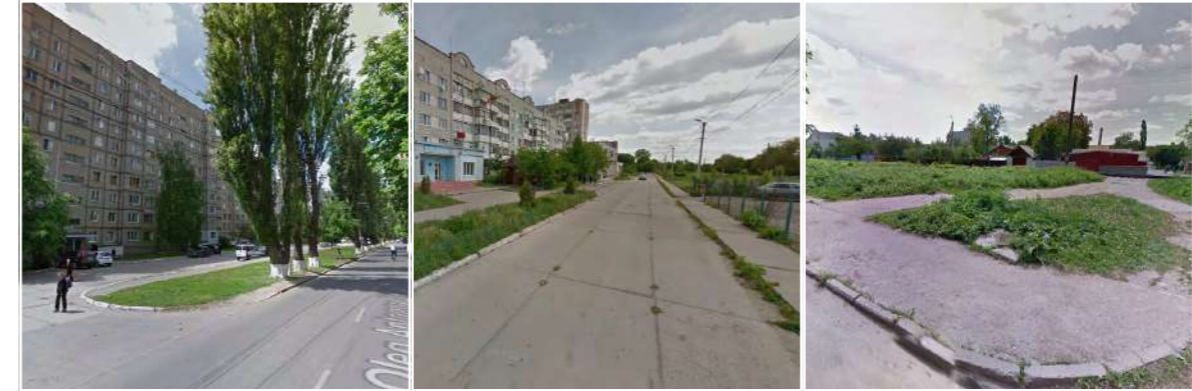
1. Infrastructure Decay 2. Infrastructure Decay 3. Segregation (Poet neighbourhood)



7. Transportation and Traffic Issues (No public transport) 8. Transportation and Traffic Issues (No public transport) 9. Landscape Neglect (Chaotic Parking)



13. Pedestrian mobility issues 14. Transportation and Traffic Issues (No bike lane) 15. Pedestrian mobility issues (Around Integral park)



4. Segregation (Military neighborhood) 5. Segregation (Senior neighborhood) 6. Vacant and Abandoned Spaces by the railway)



10. Landscape Neglect (Chaotic Parking) 11. Landscape Neglect (Chaotic Parking) 12. Transportation and Traffic Issues

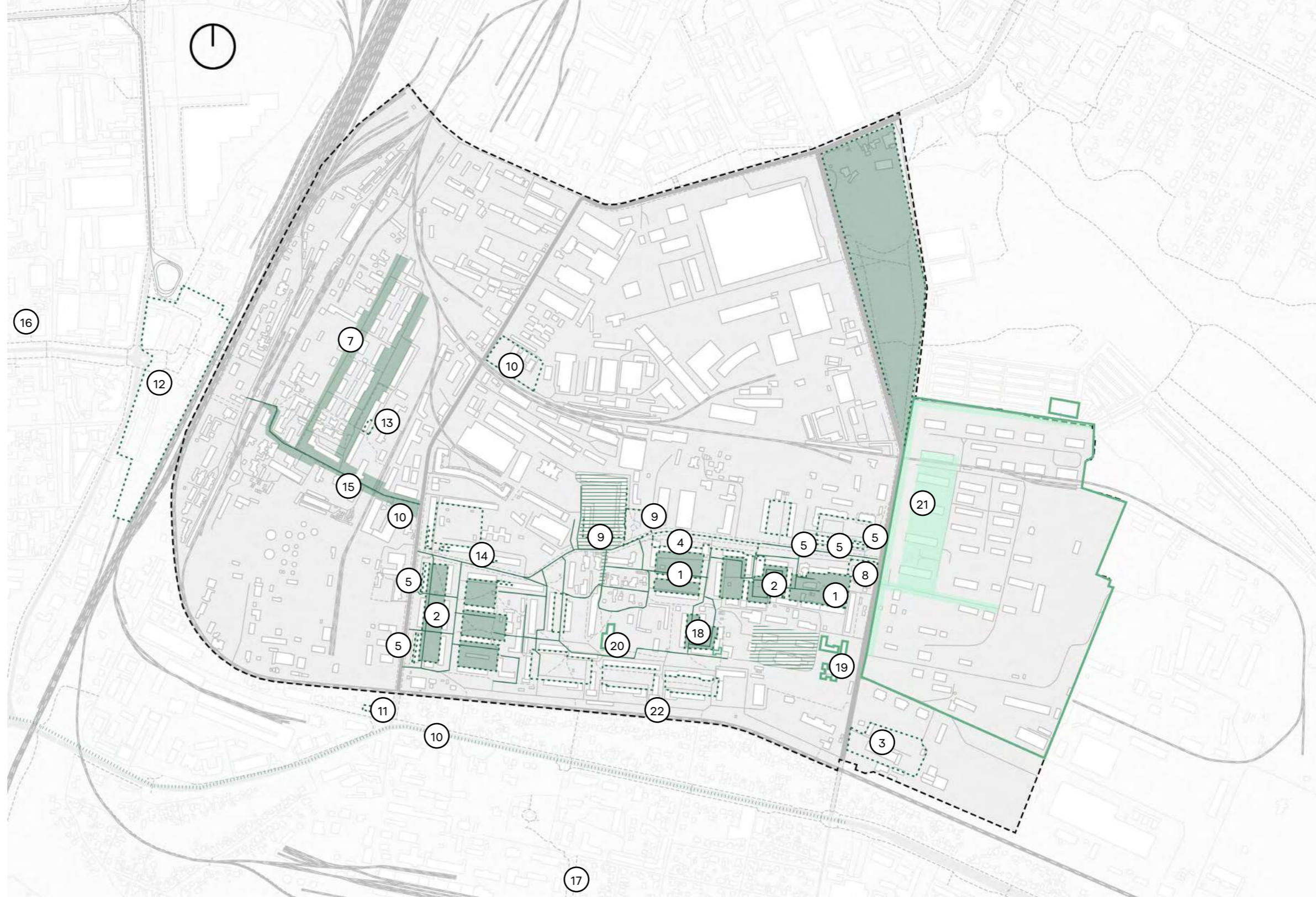


16. Pedestrian mobility issues 17. Pedestrian mobility issues (Around Integral park) 18. Pedestrian mobility issues (Passing through railway neighbourhood to the highway)

Mistechko district

Conclusions from the civic workshop. Residents positive comments

The evaluation of Mistechko district highlights several aspects across different areas. Environmental quality and enjoyment are high, with Antonov Street featuring homely courtyards, abundant greenery, and a quiet atmosphere. Locals value green spaces, often planting trees and creating communal areas for picnics and gatherings. Courtyards near Shymka and the proximity to nature, lakes, and trees are particularly valued. Community and social amenities include the driving school on Hetmana Mazepa Street, a strong committee at 40a O. Antonov Street, and various retail and food establishments under residential buildings. Important public locations are VinSmart at 28 O. Antonov Street, Integral Park, and the Andorra residential complex, which replaced an industrial zone. Other notable places include Cafe Smak, Assa restaurant, and the station market in summer. The Rio store serves as a community center. Urban planning and design are enhanced by the chestnut alley on O. Antonova Street, the arrival of young people with new residential complexes, and well-integrated facilities like the printing factory. Safety and security are good, with no major incidents and a general feeling of safety. The neighbourhood identity is characterized by concrete features, military elements, and a strong sense of community where residents feel like relatives.



POSITIVE COMMENTS

- Environmental Quality and Enjoyment
- Historical significance
- Community and Social Amenities
- Identity
- Pedestrian movement
- Transportation
- Urban Planning and Design

Mitechko district

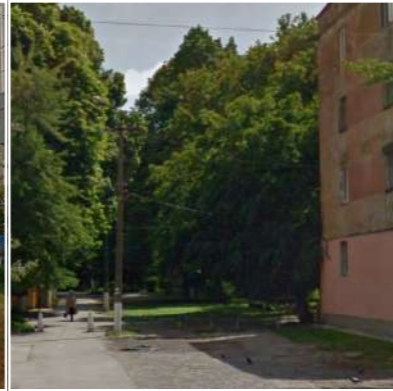
Residents positive comments



1. Environmental Quality and Enjoyment (homey and green courtyards)



1. Environmental Quality and Enjoyment (homey and green courtyards)



2. Environmental Quality and Enjoyment (full of trees and green courtyards)



5. Community and Social Amenities (Retail and F&B under residential building)



6. Community and Social Amenities (The space around Andora complex)



6. Community and Social Amenities (The space around Andora complex)



9. Community and Social Amenities (Andora complex courtyard)



9. Community and Social Amenities (Andora complex courtyard)



9. Community and Social Amenities (Andora complex courtyard)



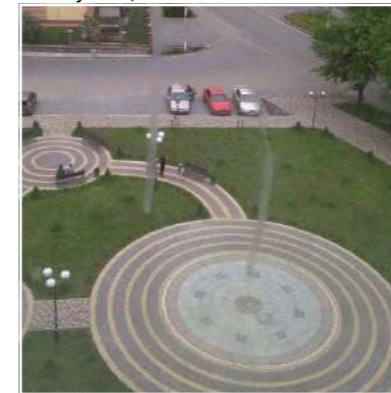
2. Environmental Quality and Enjoyment (full of trees and green courtyards)



3. Community and Social Amenities (The driving school)



4. Community and Social Amenities (committee of residents office)



6. Community and Social Amenities (The space around Andora complex)



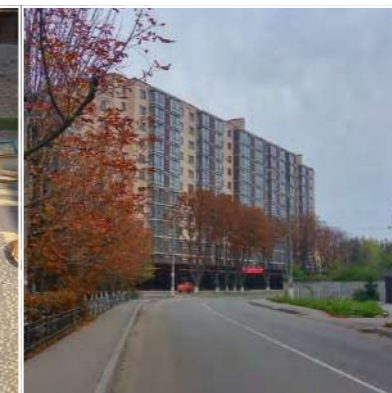
7. Environmental Quality and Enjoyment (Poet green neighborhood)



8. Community and Social Amenities (Events held in church)



9. Community and Social Amenities (Andora complex courtyard)



9. Urban Planning and Design (Andora complex)



10. Community and Social Amenities (Events held in church)

Mitechko district

Residents positive comments



10. Community and Social Amenities (APK center)



10. Community and Social Amenities (APK center)



11. Community and Social Amenities (Assa restaurant)



12. Community and Social Amenities (Station market)



13. Community and Social Amenities (Rio)



13. Community and Social Amenities (Rio)



16. Pedestrian movement (green boulevard outside project district)



17. Pedestrian movement (eco-path outside project district)



18. Historical and Cultural Significance (Library)



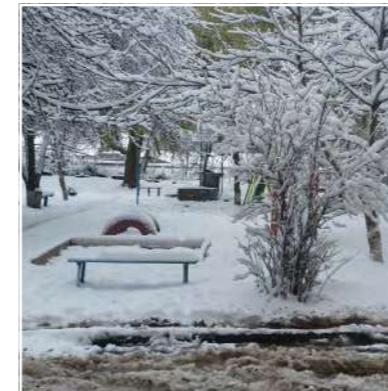
11. Community and Social Amenities (Assa restaurant)



12. Community and Social Amenities (Station market)



12. Community and Social Amenities (Station market)



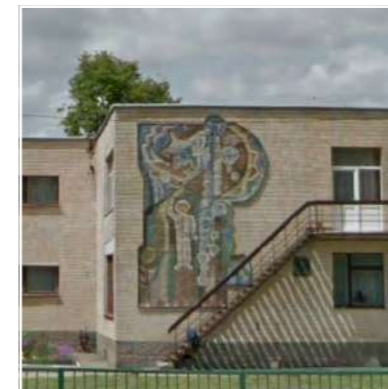
13. Community and Social Amenities (Rio)



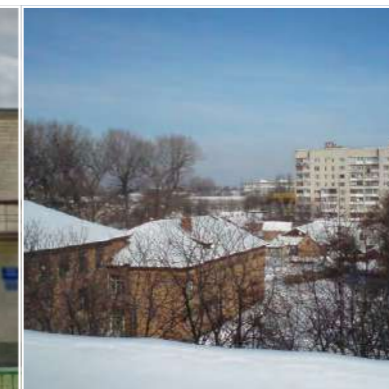
14. Pedestrian movement (Common choice for walking of residents)



15. Pedestrian movement (Important path for walking of residents)



19. Historical and Cultural Significance (Mosaic)



20. Historical and Cultural Significance (Abandoned house)



21. Identity (military barracks)

Mitechko district

Conclusions from the civic workshop. Neighbourhood improvement ideas

Improvement ideas mentioned by the residents during the civic workshop interviews.



Light bulb factory

Residents are interested in the transformation of the former Light Bulb (an abandoned factory).



Light bulb factory

Current state of the light bulb factory.



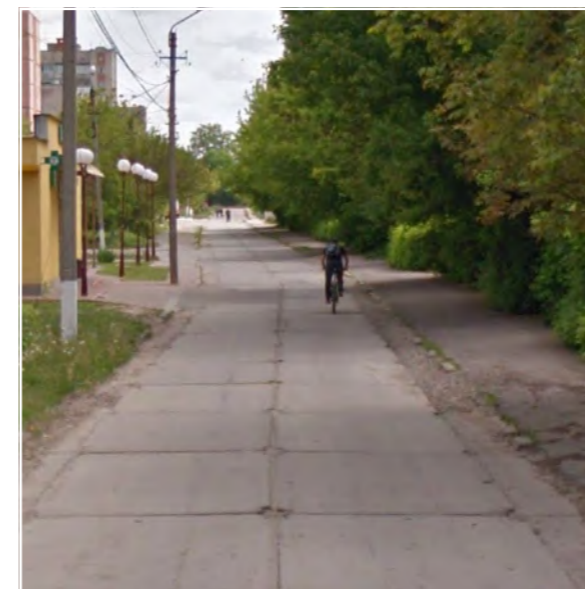
Abandoned house

Residents see a potential in the abandoned house in the yards is marked They see it as an interesting object.



Railway crossings

Residents would like to see more accessible crossings along the Nemyrivske street. They highlight the importance of their barrier-free arrangement.



Street improvement

Residents believe it would be a good idea to build a bicycle path along the streets.



Sidewalks

Residents find it important to add pedestrian sidewalks on Zerova street.

MAINTENANCE GUIDELINES

Ensuring the safety and well-being of residents during emergencies is paramount, and well-maintained shelters play a crucial role in this regard. This chapter focuses on the principles of maintenance and renovation for the shelters in Vinnytsia, offering comprehensive guidelines to enhance their functionality, comfort, and accessibility. Drawing on best practices from international standards and local insights, this section provides a detailed framework for the upkeep and improvement of these critical infrastructures.

Effective shelter maintenance involves regular inspections, prompt repairs, and adherence to safety standards to ensure that these facilities remain in optimal condition. Renovation efforts, on the other hand, aim to modernize shelters, addressing both structural integrity and the need for more comfortable and supportive environments. By incorporating advanced materials and technologies, renovations can transform basic shelters into multi-functional spaces that not only provide protection but also contribute to the community's well-being.

This chapter outlines key strategies for both maintenance and renovation, emphasizing the importance of a proactive approach. It includes practical advice on routine maintenance tasks, identification of common issues, and implementation of improvement measures. Additionally, it highlights the benefits of involving local communities in the upkeep of shelters, fostering a sense of ownership and responsibility.

Urgency of the existing issues

Response to the existing problems

Steps 1, 2, 3, 4, 5

Maintenance guidelines

Urgency of the existing issues

Addressing the issues present in shelters is of paramount importance, and urgency is a key factor in tackling these challenges effectively. Urgency in shelter management can be categorized into several critical areas: accessibility, safety, cleanliness, refreshments, and equipment.

By prioritizing urgent areas of concern and developing a comprehensive plan with actionable steps, stakeholders can effectively address the challenges present in shelters and ensure the well-being and safety of all occupants.

1. ACCESS

- Improve the information on location of shelters
- Ensure that residents know who is responsible for opening the shelter

2. SAFETY

- Ensure the safety of the existing shelters to prevent people from getting hurt
- Remove or secure all dangerous elements (electric infrastructure, sharp objects etc.)
- Close any openings apart from doors (old windows etc.)

3. CLEANLINESS

- Clean all the debris
- Pump out any existing water and secure the space from flooding

4. REFRESHMENT

- Renovate the premises (paint the walls, add a flooring)
- Provide adequate ventilation to remove excessive humidity
- Ensure that a water source and restroom are available

5. EQUIPMENT

- Install a light source (to be working also during electricity outage)
- Secure an internet connection to enable communication
- Add possible equipment, like beds, chairs
- Stockpile food and water and all the first-aid products

URGENCY



Maintenance guidelines

Response to the existing problems. STEP 1: Access

Problems

Incomplete and Inaccurate Shelter readiness ,signage and location Information

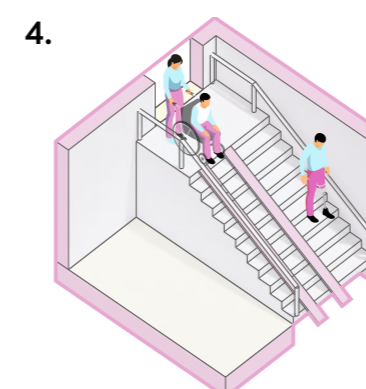
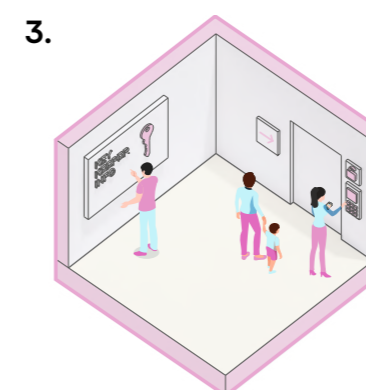
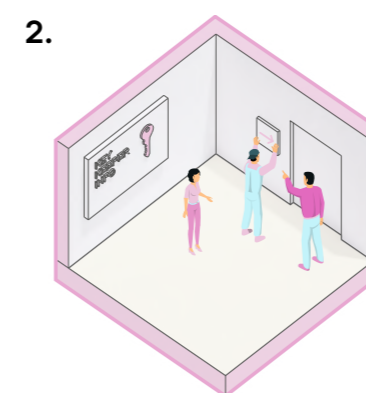
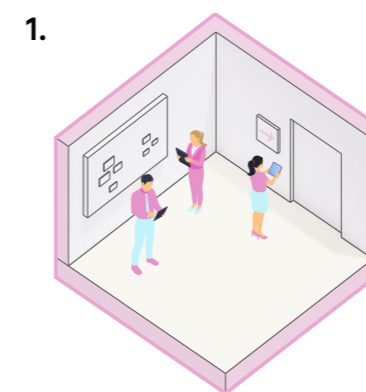
Discrepancies in Shelter Records and Actual Existence

Basements and underground shelters are often locked, making access difficult during emergencies

Keys to access shelters are held by a limited number of residents, and locating these key-holders can be challenging, particularly during working hours.

Accessibility for persons with disabilities or reduced mobility is not adequately addressed in most shelters

Solutions



Steps

1. Information update

1. Compile a comprehensive list of all shelter locations in the building;
2. Verify the existence and readiness of each shelter;
3. Update building maps and provide digital copies to all residents;
4. Post updated maps in common areas, such as lobbies and elevators.

2. Signage Improvement

1. Design clear, durable signs indicating shelter locations;
2. Install signs at strategic points throughout the building, including entrances and hallways;
3. Use weatherproof and vandal-resistant materials for signage;
4. Include information about key-keepers and emergency contact numbers on signs.

3. Key Management

1. Designate multiple key-keepers to ensure availability;
2. Implement a coded lock box system at the shelter entrance;
3. Ensure all residents know the lock box code and key-keeper contact details.

4. Accessibility

1. Assess shelter entrances for accessibility compliance;
2. Install ramps and handrails where necessary;
3. Provide adequate lighting and audio guides along accessible routes.

Maintenance guidelines

Response to the existing problems. STEP 2: Safety

Problems

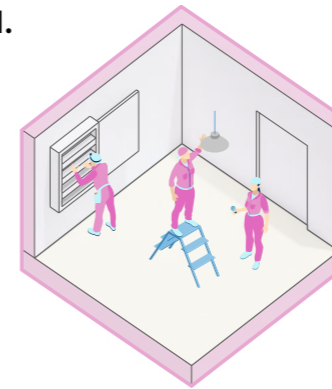
Basements may lack proper lighting

Dangerous elements

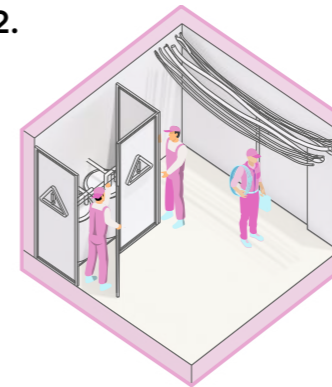
Dangerous openings

Solutions

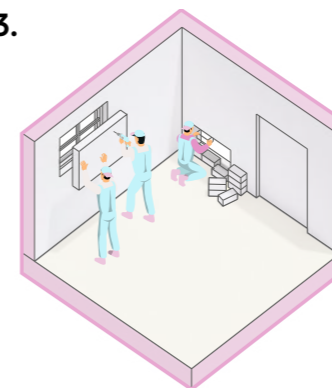
1.



2.



3.



Steps

1. Lighting

1. Conduct a lighting assessment to identify dark areas;
2. Install LED lights along exit routes and within the shelter;
3. Install emergency lighting with battery backup;
4. Regularly check and maintain lighting fixtures.

2. Hazard Removal

1. Identify and document all dangerous elements (e.g., exposed wires, sharp objects);
2. Remove or secure these elements safely;
3. Cover exposed wires and secure loose cables;
4. Install protective barriers around hazardous areas.

3. Seal Openings

1. Identify all unsafe openings (e.g., old windows, vents);
2. Seal these openings using appropriate materials (e.g., concrete, metal grates);
3. Reinforce walls and doors to withstand impacts;
4. Install weatherproof seals to prevent leaks.

Maintenance guidelines

Response to the existing problems. STEP 3: Cleanliness

Problems

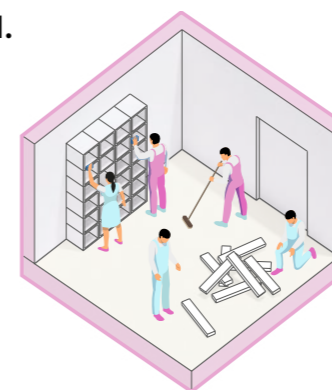
Basements may be cluttered with debris

Lack of Coordination in Shelter Management

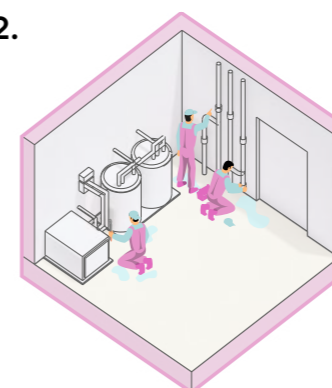
Some basements may have issues like water leakage

Solutions

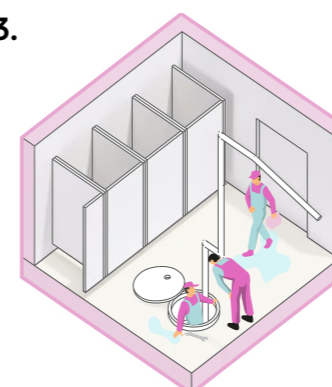
1.



2.



3.



Steps

1. Cleaning

1. Schedule regular cleaning sessions for the shelter;
2. Remove all debris and unnecessary items;
3. Organize and store essential items properly;
4. Assign cleaning responsibilities to a maintenance team or residents.

2. Leak Management

1. Inspect the shelter for signs of water leaks;
2. Repair leaks using appropriate materials (e.g., sealants, waterproofing membranes);
3. Install dehumidifiers to manage moisture levels;
4. Regularly check and maintain waterproofing measures.

3. Drainage

1. Conduct a survey to identify areas prone to water accumulation;
2. Install sump pumps at the lowest points to remove water;
3. Ensure proper drainage systems are in place;
4. Regularly inspect and maintain drainage systems.

Maintenance guidelines

Response to the existing problems. STEP 4: Refreshment

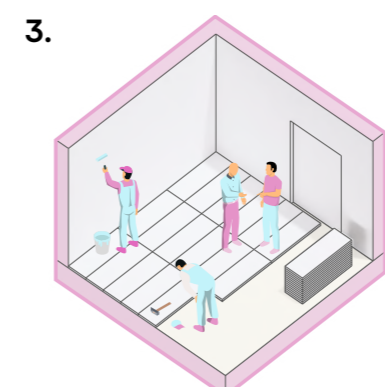
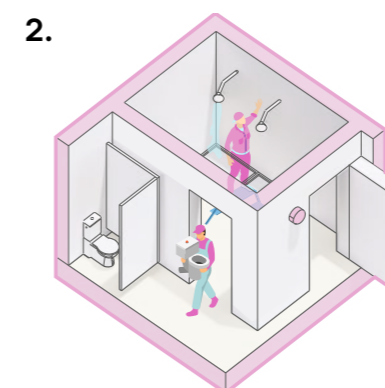
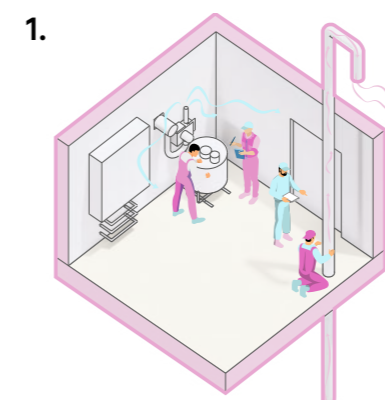
Problems

Some basements may have issues like poor ventilation

Basements may have insufficient sanitation facilities

Inconvenient interior conditions

Solutions



Steps

1. Ventilation

1. Assess the current ventilation system;
2. Install or upgrade ventilation units to ensure adequate airflow;
3. Use air filtration systems to improve air quality;
4. Regularly maintain ventilation equipment.

2. Sanitation Facilities

1. Ensure access to a water source;
2. Install dry or chemical toilets if plumbing is unavailable;
3. Set up decontamination showers at shelter entrances;
4. Maintain cleanliness and sanitation supplies.

3. Interior Upgrades

1. Paint and repair walls to improve aesthetics;
2. Install durable, easy-to-clean flooring;
3. Arrange furniture to optimize space and comfort;
4. Ensure proper lighting and electrical outlets for convenience.

Maintenance guidelines

Response to the existing problems. STEP 5: Equipment

Problems

Many shelters lack essential amenities such as drinking water, food, first aid kits, benches, chairs, sleeping arrangements, warming tools like blankets.

Lack of communication tools.

There's a deficiency in primary means of fire extinguishing tools.

There's a deficiency of emergency tools like shovels, crowbars, etc.

Emergency lighting source in case of power outage.

Solutions

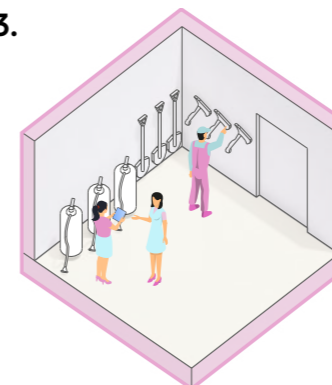
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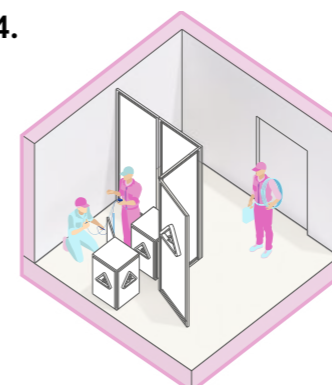
2.



3.



4.



Steps

1. Amenities

1. Stockpile essential supplies (e.g., drinking water, non-perishable food, first aid kits);
2. Ensure availability of benches, chairs, and sleeping arrangements;
3. Provide blankets and warming tools;
4. Regularly check and replenish supplies.

2. Communication Tools

1. Install communication devices such as radios or intercom systems;
2. Ensure devices are accessible and easy to use;
3. Conduct regular tests to ensure functionality;
4. Train residents on using communication tools.

3. Fire Safety

1. Install fire extinguishers in accessible locations;
2. Provide emergency tools like shovels, crowbars, and first aid kits;
3. Conduct fire safety drills and training;
4. Regularly inspect and maintain fire safety equipment.

4. Emergency Lighting

1. Install battery-powered emergency lights throughout the shelter;
2. Ensure lights are fully charged and operational;
3. Conduct regular checks to ensure readiness;
4. Provide additional portable lighting sources, such as flashlights.

ARCHITECTURAL GUIDELINES

Architectural planning for shelters requires a comprehensive approach that integrates structural resilience, efficient spatial design, and appropriate equipment. This chapter explores the best practices in architectural planning to ensure that shelters are safe, functional, and comfortable for their occupants. Effective shelter design hinges on several critical elements.

Equipping shelters with the right tools and systems is vital for their functionality. This includes ventilation systems, emergency power supplies, water and sanitation facilities, and communication equipment. We will explore the best practices for selecting and integrating these systems to ensure they meet the needs of shelter occupants during emergencies.

By combining these elements, this chapter aims to provide a holistic view of architectural planning for shelters. The goal is to equip architects, planners, and local authorities with the knowledge and strategies necessary to create shelters that not only provide immediate safety but also support the well-being and resilience of communities. Through detailed analysis and practical guidelines, we aim to promote the development of shelters that are both protective and sustainable.

Shelter design solutions

Matrix of Architectural guidelines

Double-floor system

Airlock entry system

Emergency exit

Double-door system

Sanitary area with showers

Modular furniture

Water and gas

Storage and power supply

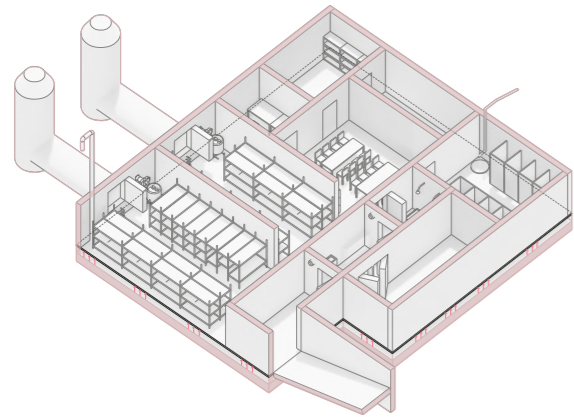
Spatial reconfiguration guidelines

Storage transformation

Interior elements

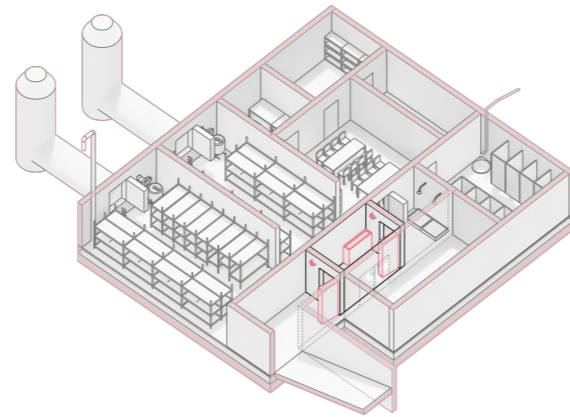
Architectural guidelines

Shelter design solutions Matrix of Architectural guidelines



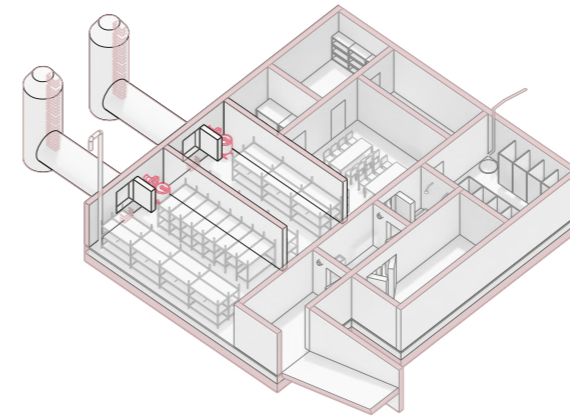
Double-floor systems

Implement an elevated or double-floor system to prevent water accumulation from broken pipes or seepage.



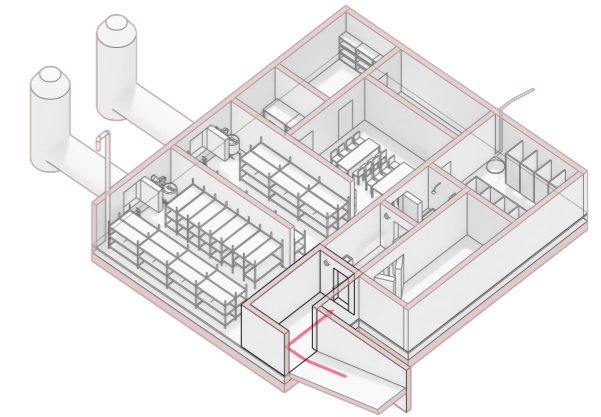
Airlock entry system

Incorporate airlock systems at entrances to prevent contaminants from entering, along with overpressure and explosion protection valve beside every blast door.



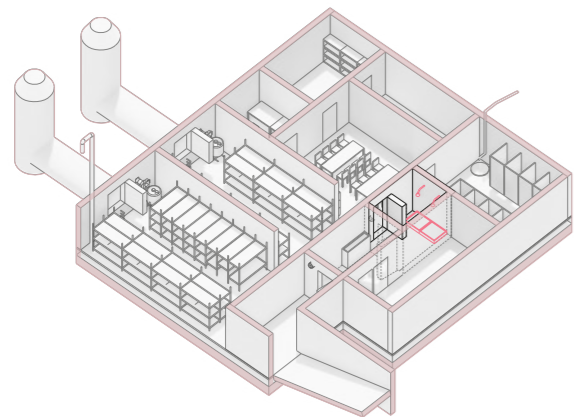
Emergency exit with air intake

Construct underground escape tunnels accessible only from inside, with reinforced walls and secure exits.



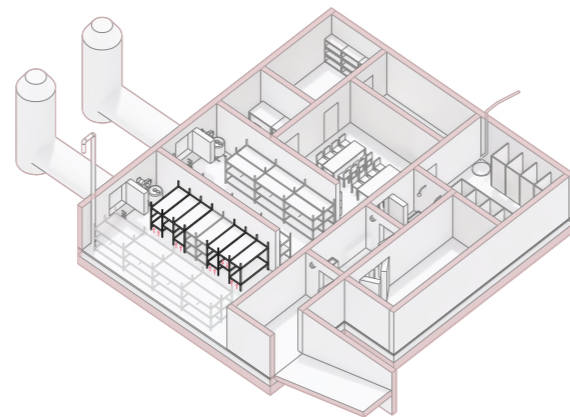
Double-door system

Use an alcove system to prevent direct missile impacts on double doors.



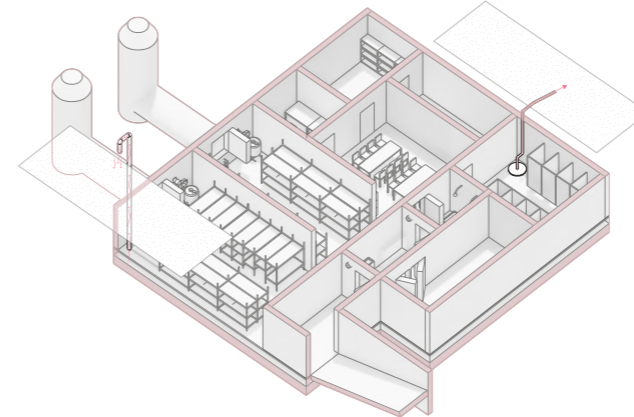
Sanitary area with showers

Install a shower and sanitary area at the entrance of the shelter. This area is used to remove contaminants from individuals entering the shelter.



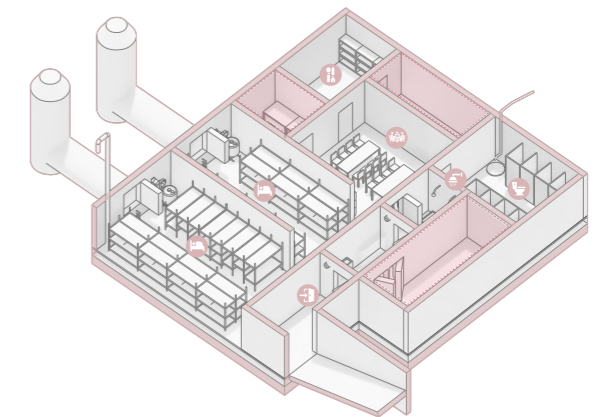
Modular furniture

Furniture pieces designed to serve multiple purposes, providing versatility and adaptability in various settings and efficient space utilization.



Water and gas removal systems

Install water and gas removal systems.



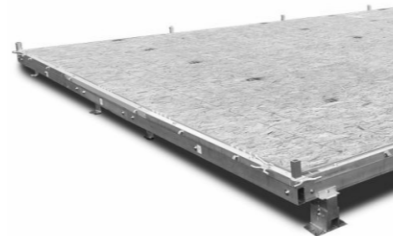
Storage and power supply

Plan for the correct location of the emergency power supply system, storage areas and communication devices.

Architectural guidelines

Double floor systems

- Implement an elevated or double-floor system to prevent water accumulation from broken pipes or seepage.
- The space between the floors channels water to drainage systems, keeping the shelter habitable even during plumbing failures.
- Construct a secondary floor above the foundation with a gap to house plumbing, drainage, and electrical systems.



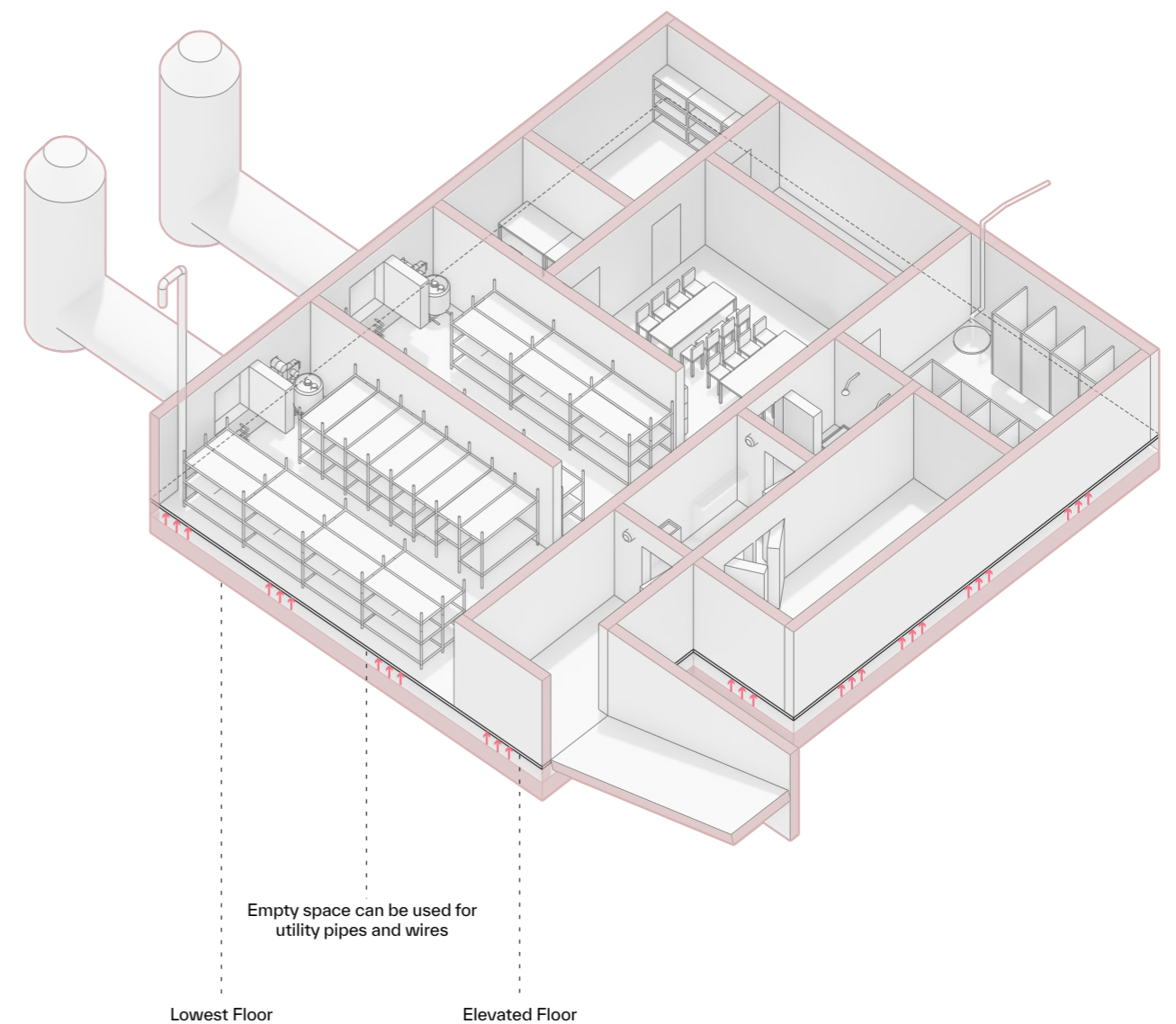
Double layer system

Double-floor design ensures that any water infiltration is contained in the lower floor, thereby protecting the upper levels from damage and maintaining a dry, safe environment for occupants.



Installation

Installing a double-floor system involves creating a secondary elevated platform above the primary floor, incorporating waterproof materials and drainage channels to manage water flow effectively.

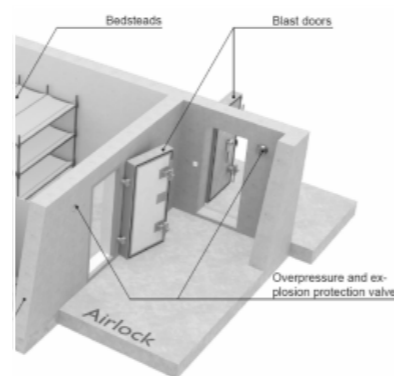


Double-floor system

Architectural guidelines

Airlock entry system

- a. Incorporate airlock systems at entrances to prevent contaminants from entering, along with overpressure and explosion protection valve beside every blast door.



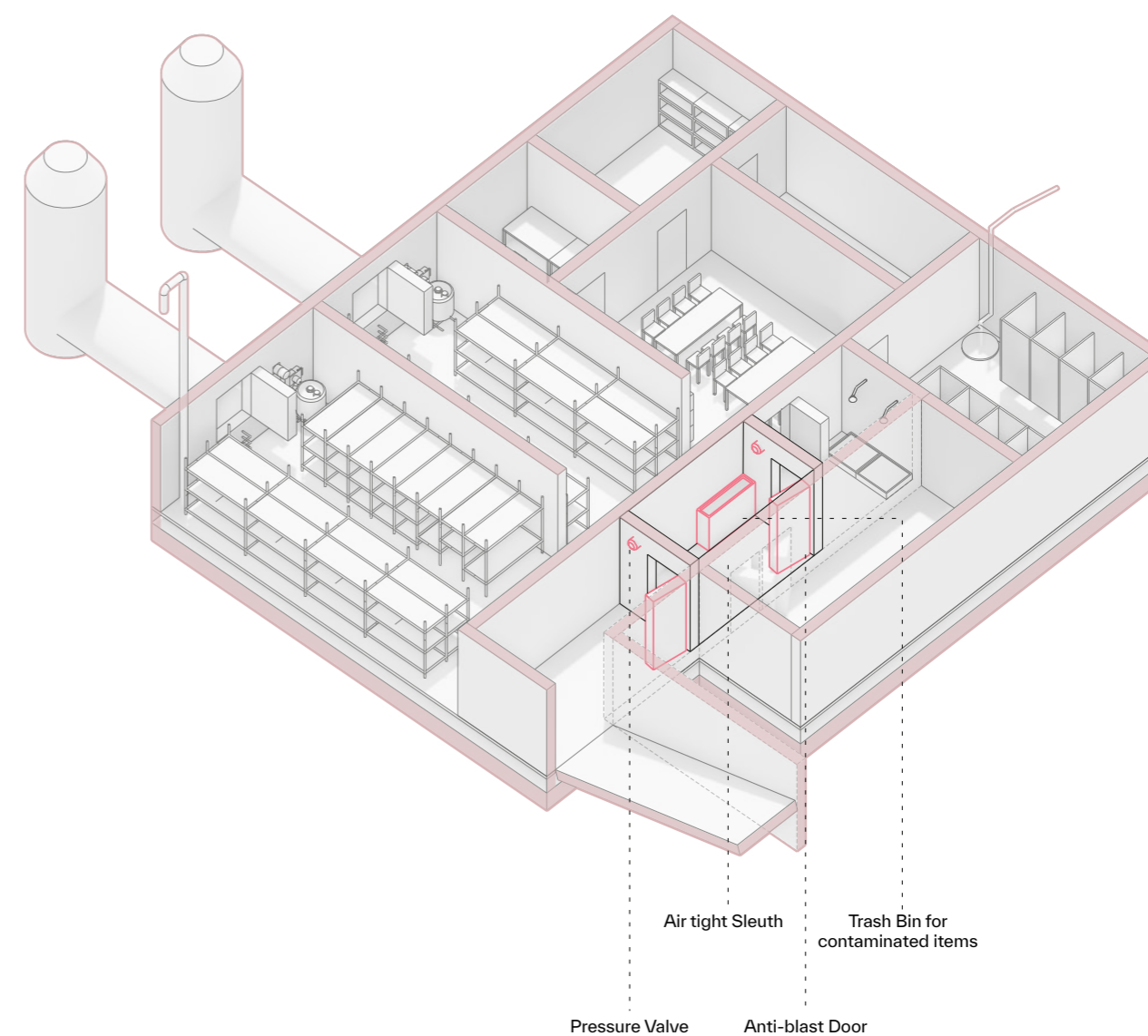
Sealed entry

Airlock system typically consist of a sealed entry chamber with airtight doors on both sides, allowing one door to close before the other opens, thus preventing unfiltered air from entering the main shelter area.



Blast-proof door

Proper installation and maintenance of airlock systems are essential for ensuring their effectiveness in providing a secure and contaminant-free environment.

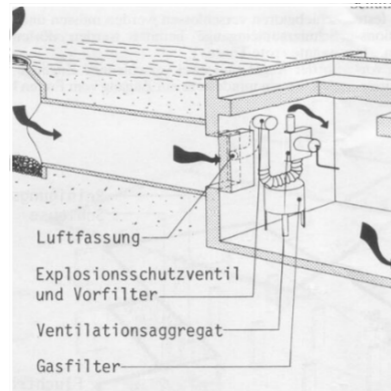


Airlock entry system

Architectural guidelines

Emergency exit with air intake

- Construct hidden escape tunnels accessible only from inside, with reinforced walls and secure exits.
- Ensure these escape tunnels or emergency elevators are available in every room if the shelter space is divided into different rooms.
- These tunnels also function as air ventilation sockets, where the incoming air passes through an air filtration system. The air pressure is then stabilized before entering the shelter area. Therefore, wherever we have these tunnels, we must have an air filtration device system.



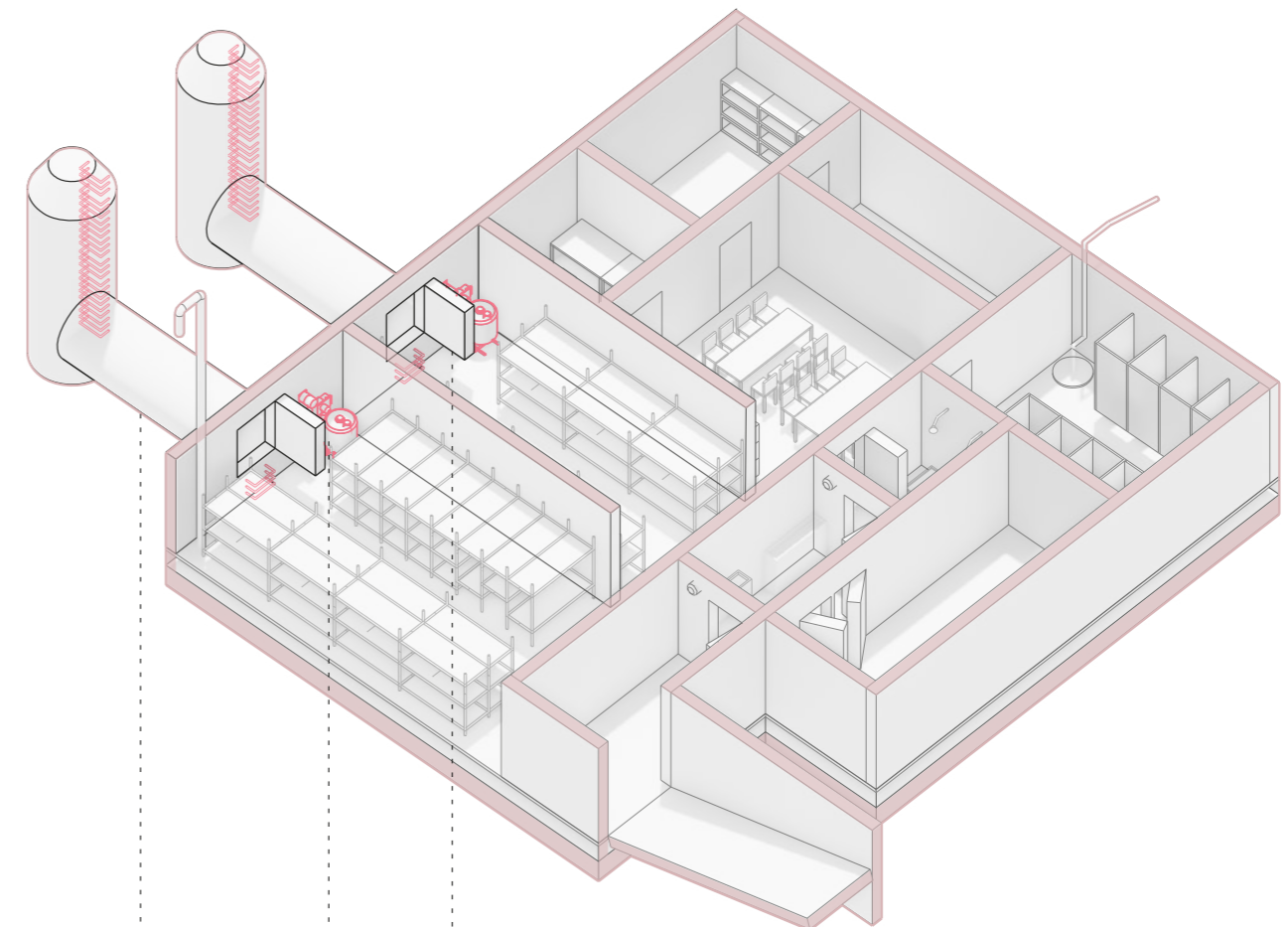
Emergency exit scheme

The emergency exit tunnel in shelters often doubles as an air intake, providing a dual function that enhances both safety and ventilation.



Airtight door

This tunnel is designed with reinforced walls and a secure, airtight door to ensure protection while allowing fresh air to circulate into the shelter.

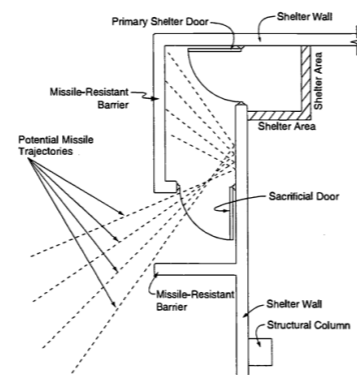


Emergency exit

Architectural guidelines

Double-door System with 90 degree entrance

a. Use an alcove system to prevent direct missile impacts on double doors. Extend the shelter roof past the wall and connect to the missile-resistant barrier. Shelters that do not have an L shaped or 90 degree turn at the entrance are going to let in the prompt radiation at the time of the blast



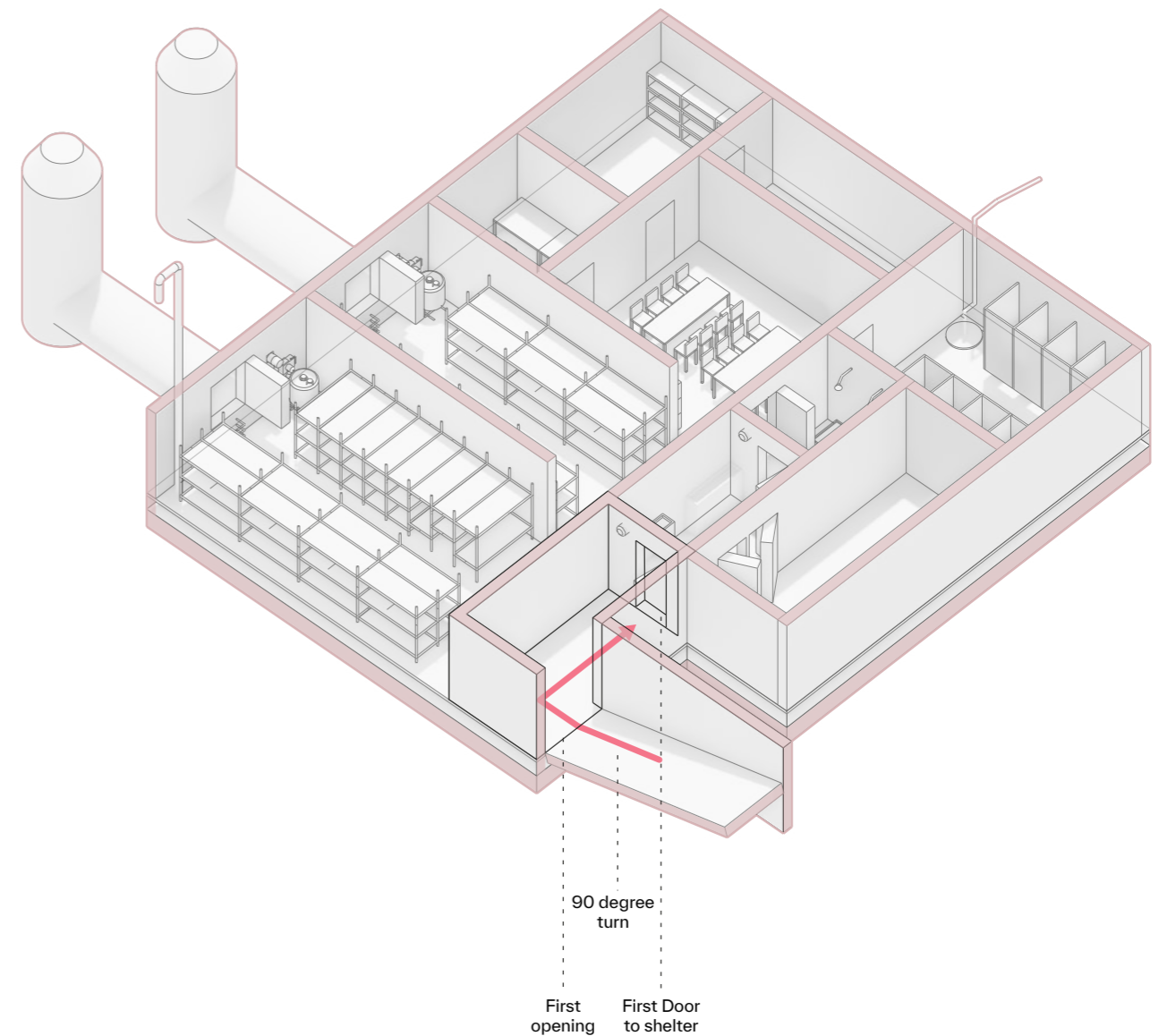
Missile protection

The entrance door is set back within a recessed area, which helps to deflect and absorb the energy of a direct missile impact, reducing the likelihood of breach.



Recessed entry

Incorporating an L-shaped or 90-degree turn in the entry path further enhances protection. This design prevents direct line-of-sight from the outside to the interior, thereby blocking prompt radiation and shock-waves from entering the shelter during a blast.

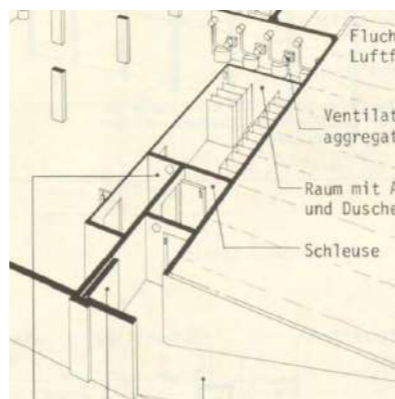


L-shape entrance

Architectural guidelines

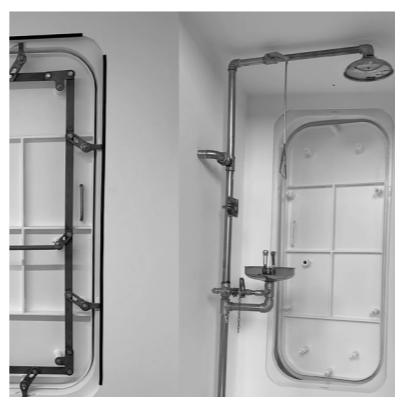
Cleaning area with showers

- Install a decontamination shower and cleaning area at the entrance of the shelter. This area is used to remove contaminants from individuals entering the shelter.
- Ensure a reliable water supply and proper drainage system for the decontamination showers to function effectively. (They are usually adjacent to the toilettes for better water management)



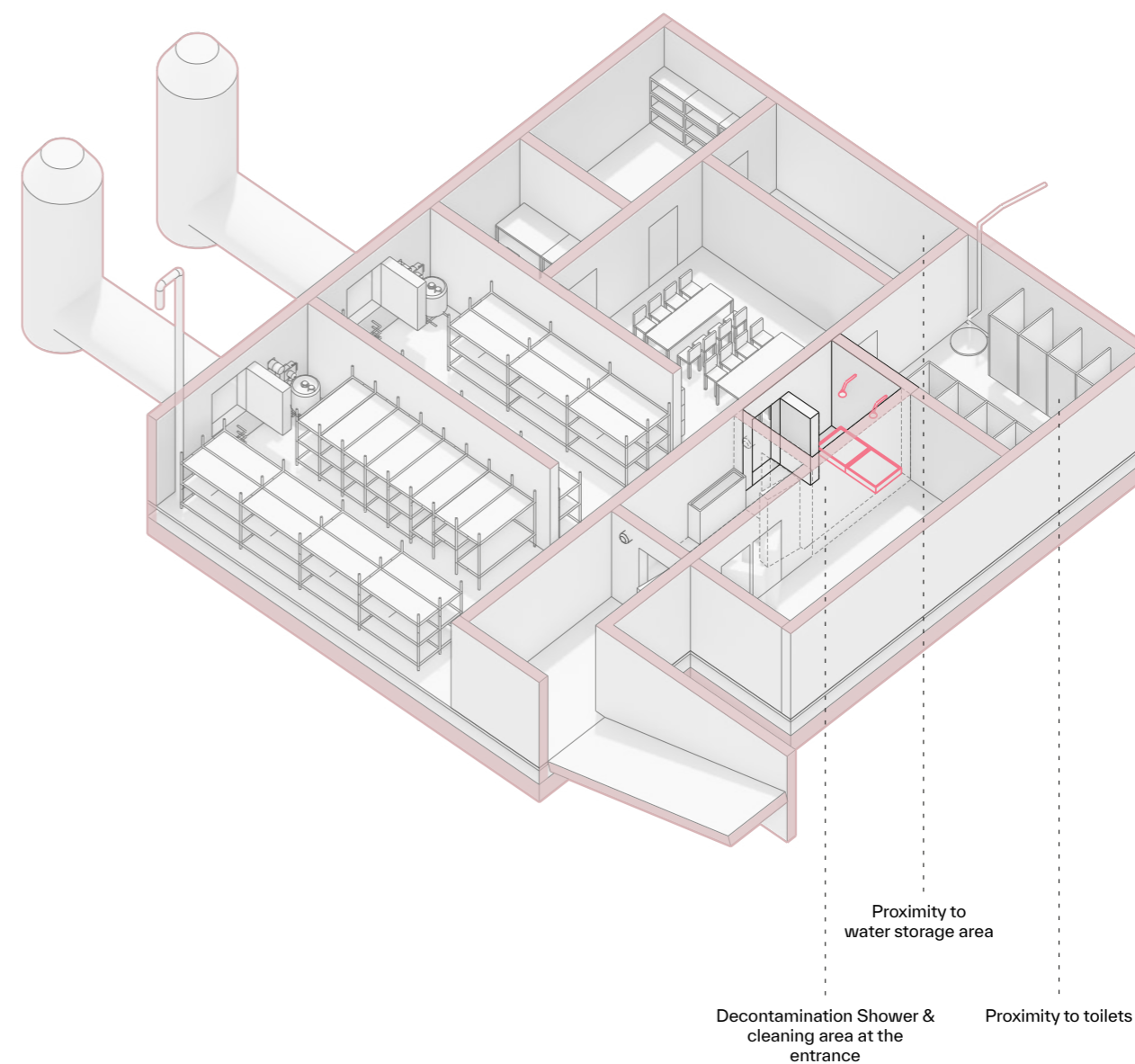
Location

The sanitary area is typically partitioned off from the main living and sleeping areas to maintain privacy and reduce the spread of germs. It includes distinct zones for toilet facilities, handwashing, and showering.



Compact design

A compact design enables the sanitary area to have a well-organized layout, with facilities strategically arranged to minimize wasted space and ensure ease of use. For example, toilets, showers, and sinks may be arranged in close proximity to each other to streamline access and movement for occupants.

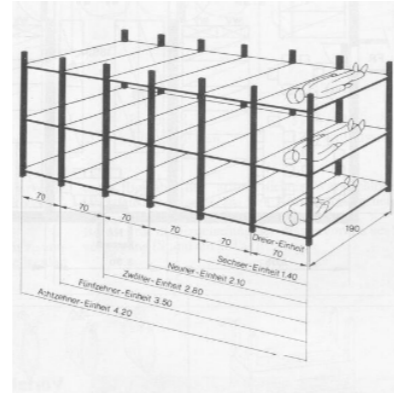


Sanitary area with showers

Architectural guidelines

Modular furniture

a. Furniture pieces designed to serve multiple purposes, providing versatility and adaptability in various settings and efficient space utilization.



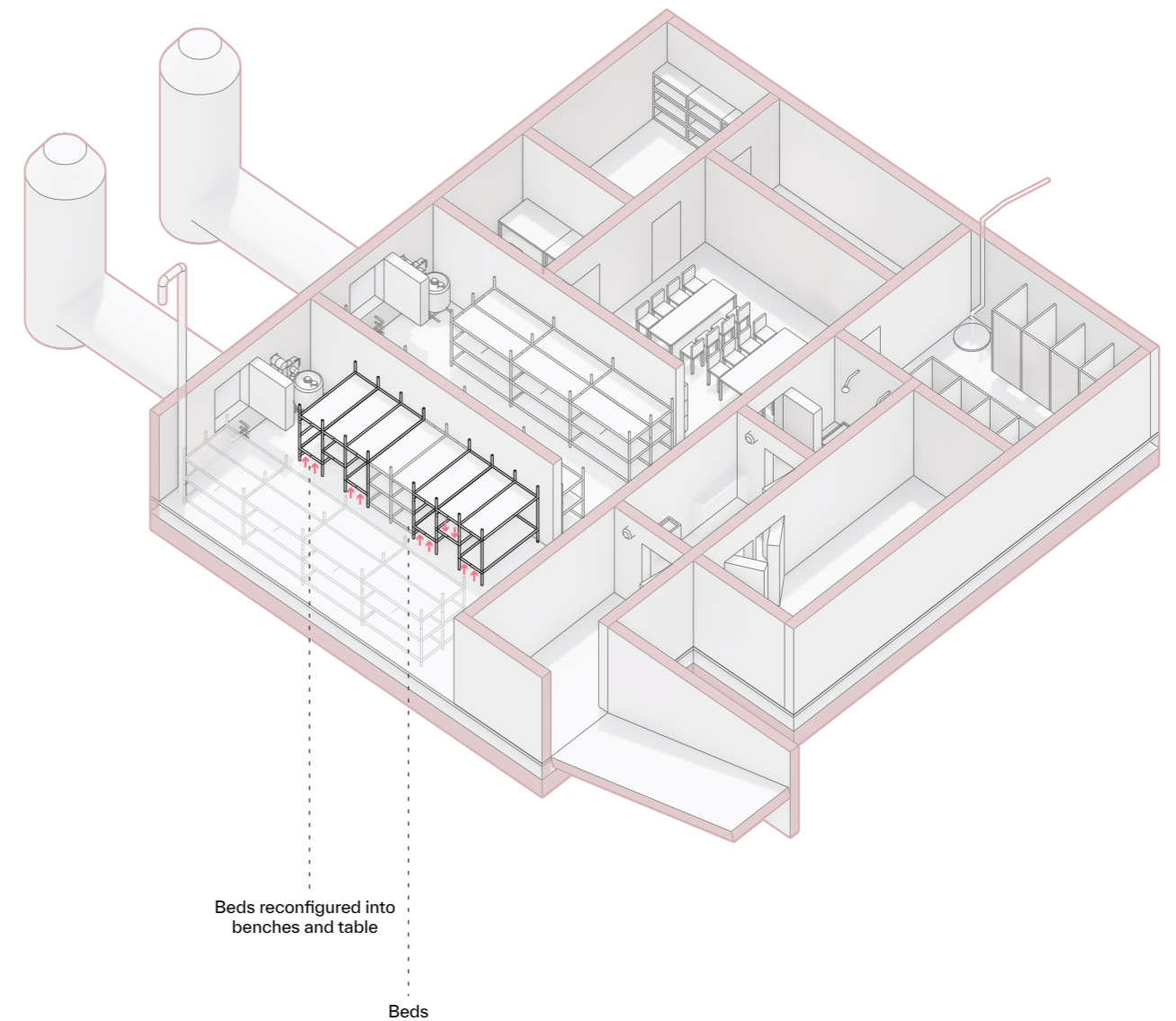
Versatility

The furniture units are designed to serve multiple functions and purposes. For example, a single unit may function as a seating area, storage compartment, and sleeping space, maximizing utility within the limited space available in shelters.



Foldable furniture

By utilizing foldable furniture system, shelter designers can maximize space optimization without sacrificing functionality or comfort. The ability to adjust and customize furniture layouts ensures that every inch of space is utilized efficiently.

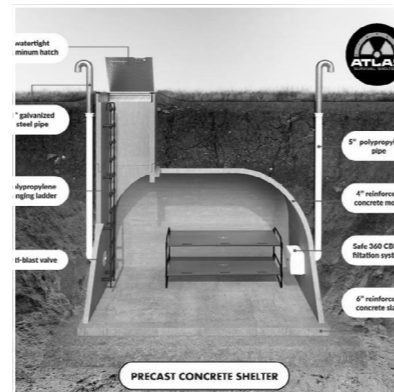


Modular furniture

Architectural guidelines

Water and gas removal systems

- a. Gas removal system - Install sub-slab de-pressurization systems to vent gas out of the shelter.
- b. Water removal system - Install sump pumps at the lowest points to actively remove water.



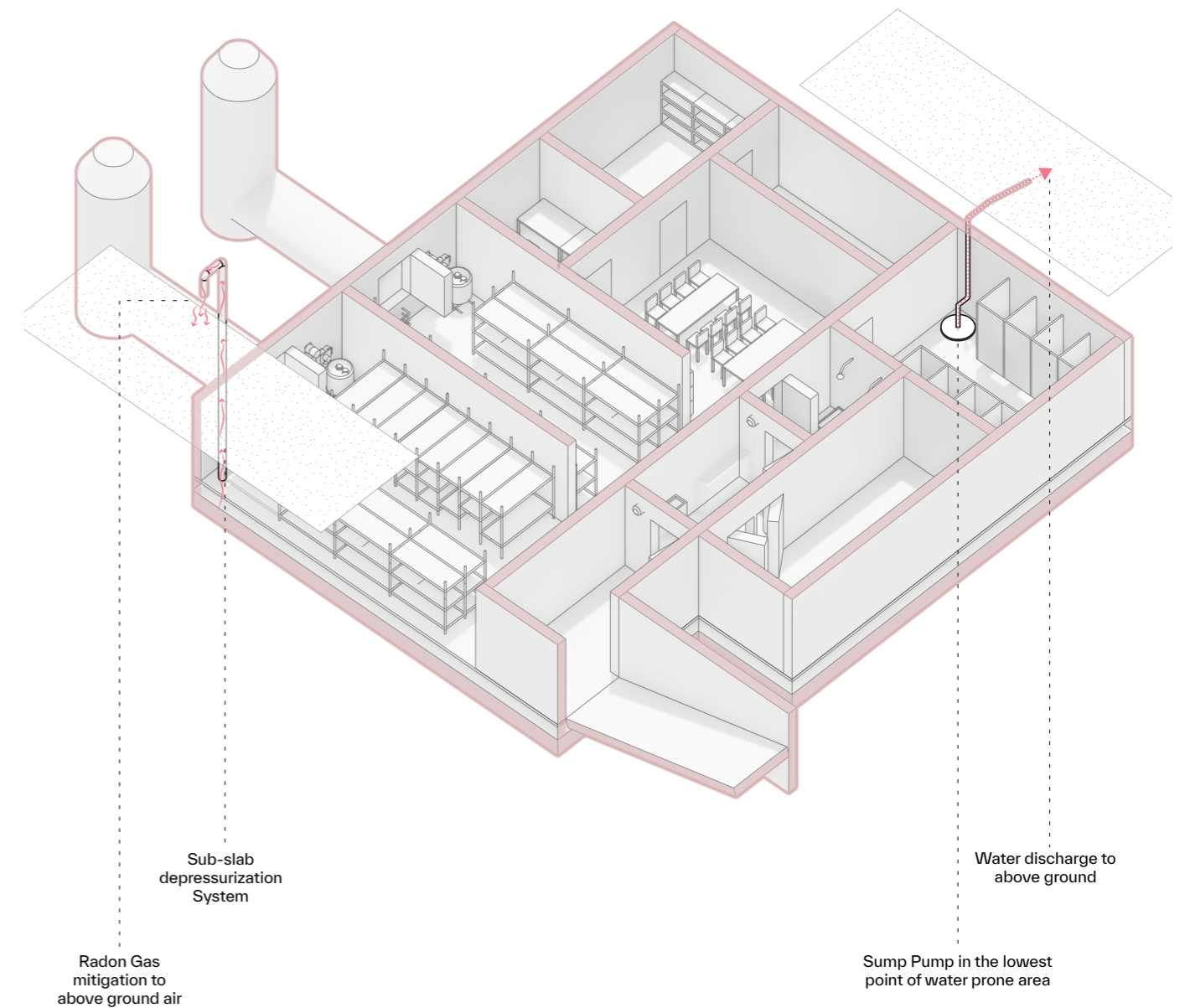
Gas removal

Gas removal system plays a critical role in maintaining a safe and healthy environment within the shelter by detecting and removing harmful gases in a timely manner.



Sump water pump

A sump pump is a specialized device designed to remove water that has accumulated in a sump pit, typically located in the lowest part of a building's basement or crawl space.



Water and gas removal systems

Architectural guidelines

Power supply, storage and technical areas

a. Power supply - Centrally located within the shelter to ensure it is easily accessible from all parts of the shelter and, Placed in a well-protected core area of the shelter, away from potential impact zones.

b. Storage room - Located near the Living Quarters and Kitchen Area: This location ensures easy and quick access to water for drinking, cooking, and hygiene purposes

c. Communication room - Centrally located within the shelter to ensure it is easily accessible from all parts of the shelter and, Placed in a well-protected core area of the shelter, away from potential impact zones.



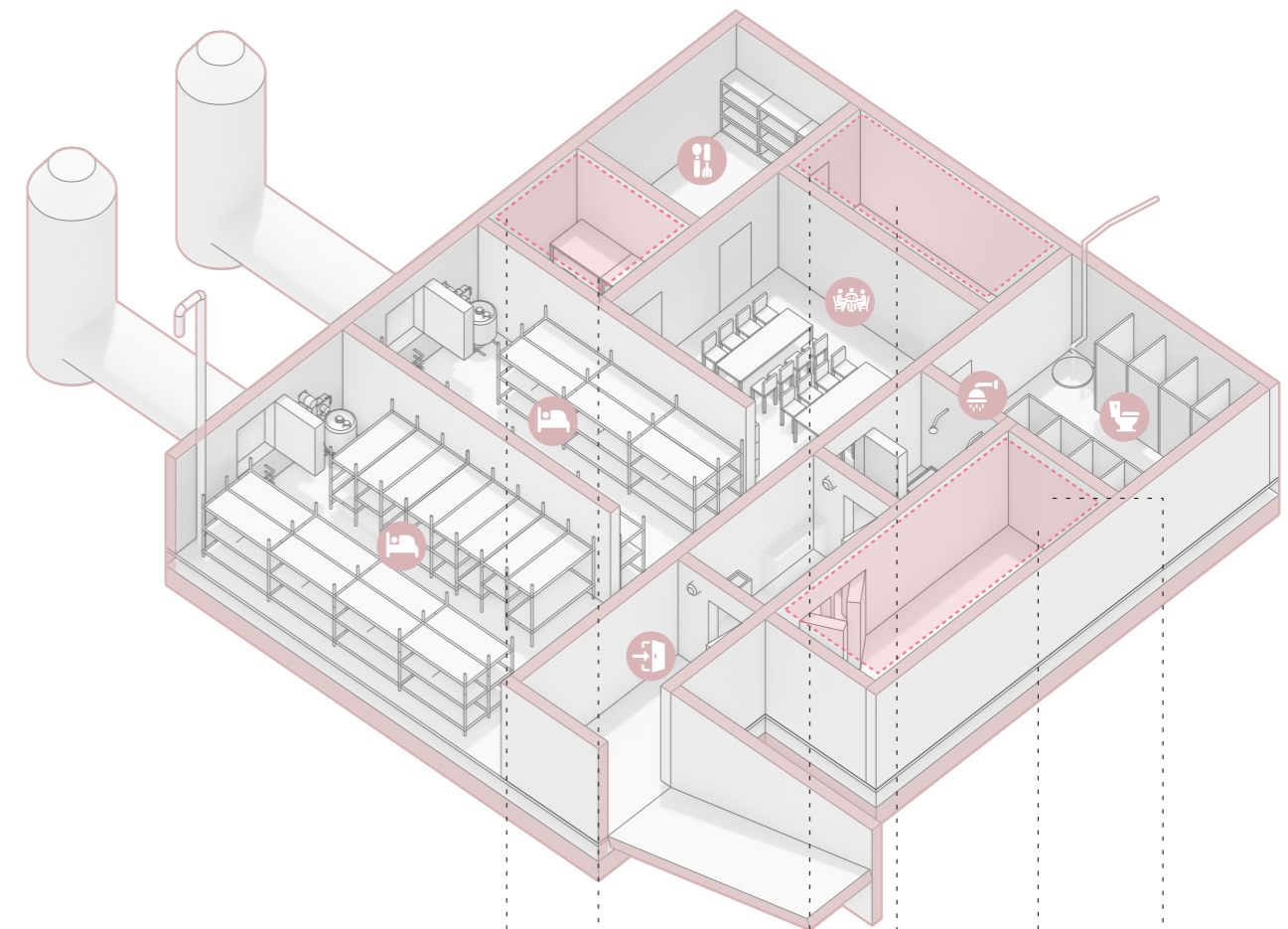
Communication room

The communication room is usually situated in a central area of the shelter to ensure optimal coverage and accessibility to all areas.



Power supply room

The power supply room is often situated near the entrance or in a central area of the shelter to ensure easy access for maintenance personnel and emergency responders. Placing it near the entrance allows quick access in case of power-related emergencies or maintenance needs.



Communication Area: Located in a well-protected central core

Water storage area: Located near living areas, the restrooms and kitchen area

Power storage: Away from sleeping and living area to reduce risks and discomforts

Technical areas in a shelter layout

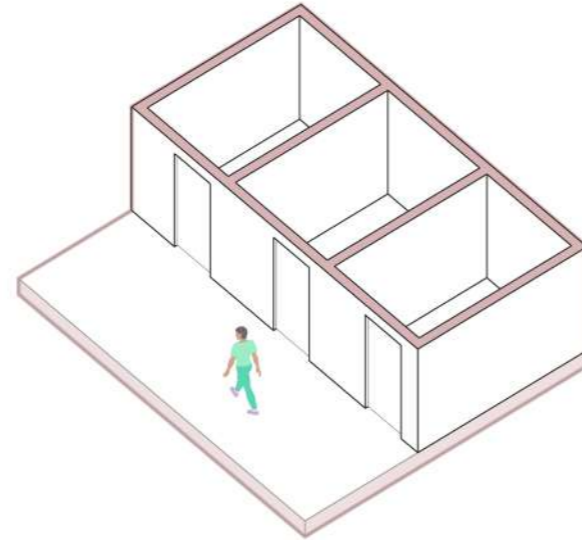
Architectural guidelines

Spatial reconfiguration Storage transformation

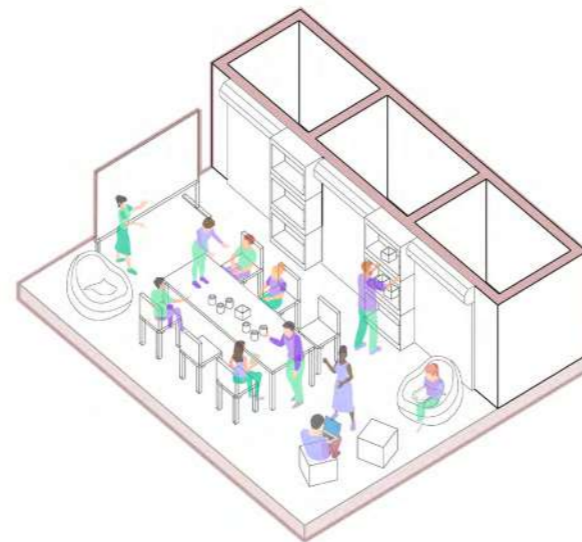
By repurposing or reducing basement storage areas, shelter administrators can create larger communal areas within the shelter.

The shared use of basement areas can accommodate a wide range of functions and activities, serving as multipurpose zones that cater to diverse community interests and preferences. For example, a portion of the space can be designated for recreational activities, while another section may be used for educational programs or emergency supplies distribution.

Regular basement storage

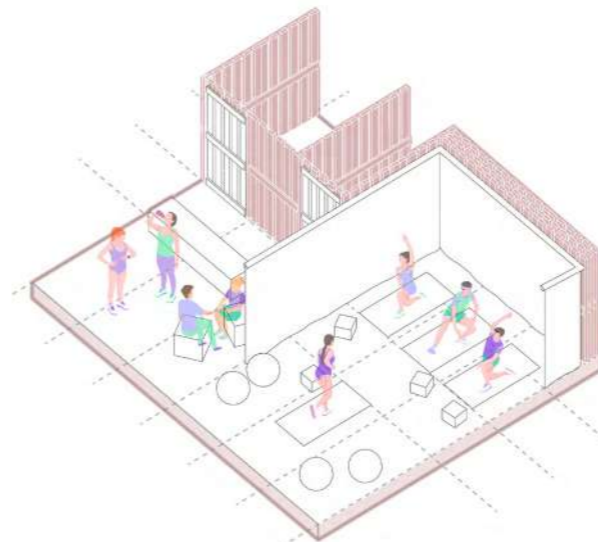


Transformations



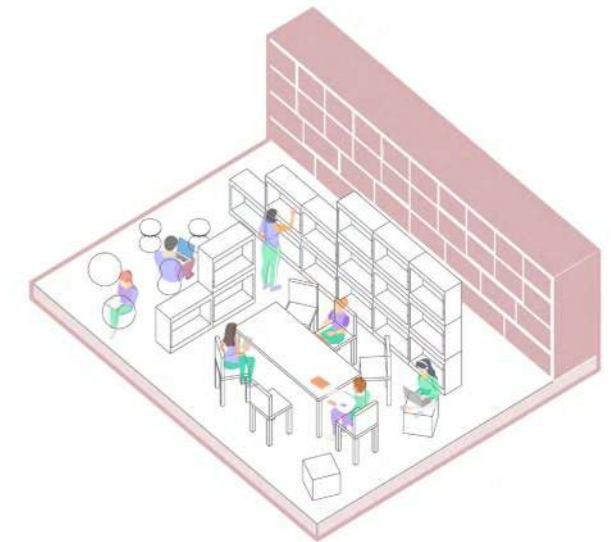
1. Half-Size Storage Units

Reduce the size of existing storage units to half their original length, install rolling-up doors to save space, and ensure security and use these units to store larger items.



2. Modular Storage Units

These partitions can be rearranged or expanded based on the needs of the space, making them highly versatile for various configurations. They are typically easy to set up and take down, making them ideal for spaces that require frequent reconfiguration.



3. Storage Cubbies

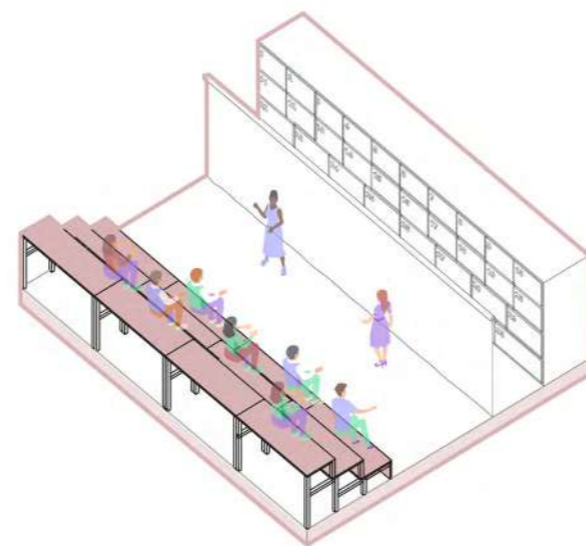
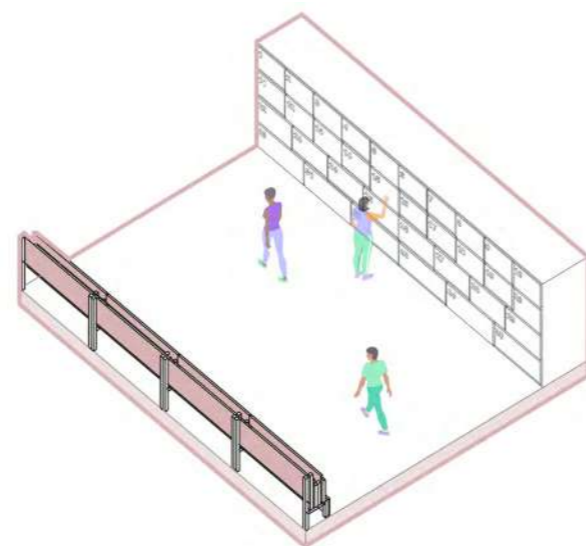
Replace storage units with smaller, secure cubbies for each apartment to store smaller items. Use a portion of the walls for these cubbies.

Architectural guidelines

Spatial reconfiguration. Interior elements

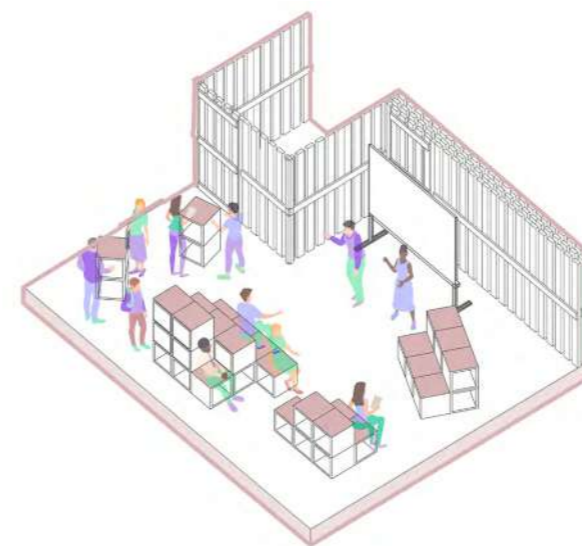
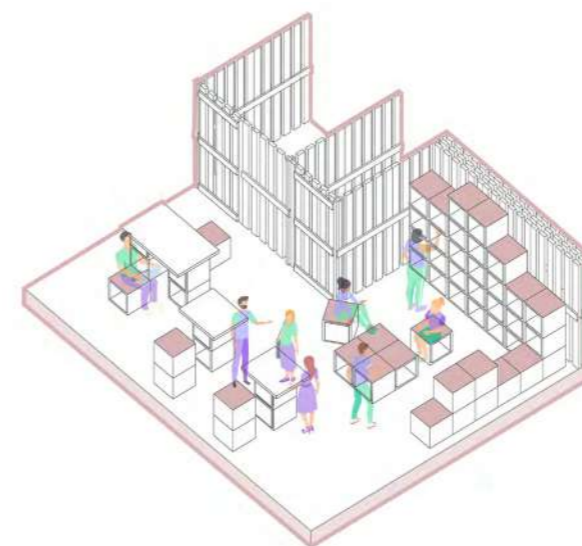
Flexible layouts optimize the use of available space within the shelter. Mobile furniture, such as folding tables and collapsible chairs, can be easily stored when not in use, freeing up valuable floor space for other purposes. Modular furniture systems enable shelters to create customized configurations that maximize spatial efficiency and accommodate diverse activities, from sleeping and dining to recreation and storage.

By offering versatile spaces that can be customized to individual preferences, shelters can enhance the quality of life for their occupants and promote a sense of autonomy, security, and dignity.



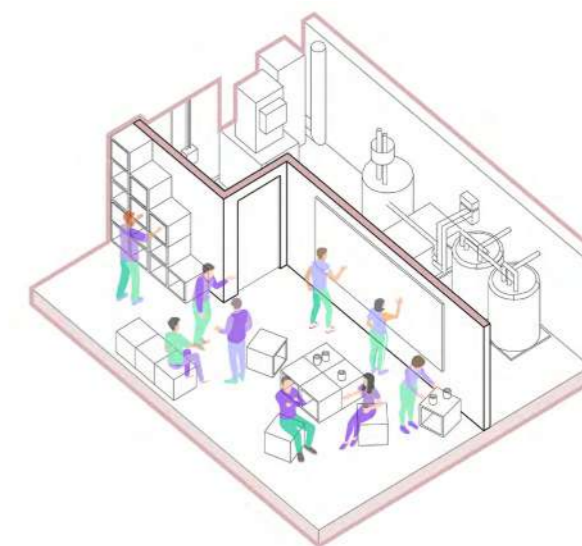
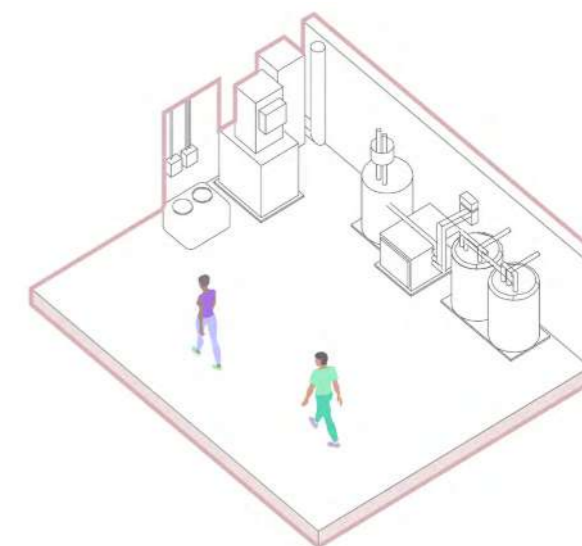
1. Foldable furniture

Equip the space with foldable tables and chairs that can be stored away when not in use.



2. Modular and mobile furniture

Use modular furniture that can be rearranged for different activities, such as book clubs or study groups.



3. Dual-purpose Wall

Partition off areas housing critical utility devices with secure, lockable rooms. Use these walls as dual-purpose elements by adding built-in shelving or display areas for community use and informational boards.

PROGRAMMING GUIDELINES

Underground shelters transcend their role as mere refuges during emergencies, showcasing remarkable adaptability to fulfill various peacetime functions.

This chapter explores the creative possibilities of these shelters, emphasizing their dual and alternative uses. We present a versatile toolbox designed to accommodate the needs of diverse community scales ranging from neighborhoods to entire cities.

This toolbox addresses a wide array of requirements, including cultural activities, community engagement, education, skill sharing, leisure, and sports. Utilizing these spaces during peacetime is a strategic move to economize the often-unused areas of shelters. By re purposing these spaces, we ensure they remain vibrant and functional, providing significant benefits to the community. This approach not only maximizes the value of the infrastructure but also fosters a sense of communal resourcefulness and sustainability.

The following chapter vividly demonstrates how shelter spaces can be creatively repurposed, enriching community life and functionality even in times of peace.

Toolbox of programing solutions

Culture & Engagement

Community kitchen

Event space

Gallery

Education & Skill sharing

Library

Workshop space

Youth club

Leisure & Sport area

Meditation and exercise

Playroom

Gym & Fitness

Programming guidelines

Toolbox of programming solutions

The toolbox we present is a versatile collection of strategies designed to maximize the utility of underground shelters. It caters to various community scales, from neighbourhoods to cities, addressing cultural, educational, recreational, and community engagement needs.

By integrating these multifunctional elements, the toolbox transforms unused shelter spaces into vibrant, productive environments. This innovative approach not only enhances daily life but also promotes sustainability and efficient resource management, turning shelters into dynamic hubs that support the community in both peace and crisis

Neighbourhood scale

Program fostering sense of community among residents of one neighbourhood.

District scale

Program fostering community on a district level, fostering sense of belonging.

City scale

Program serving community on a wider scale promoting grass roots initiatives.

Culture & Engagement



Community kitchen

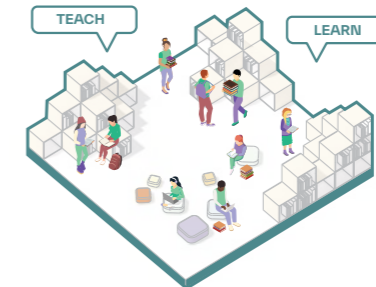


Event space

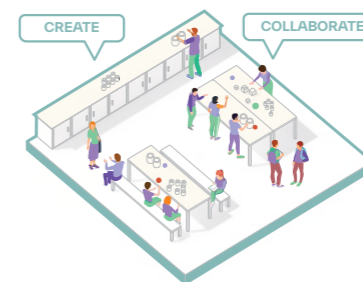


Gallery

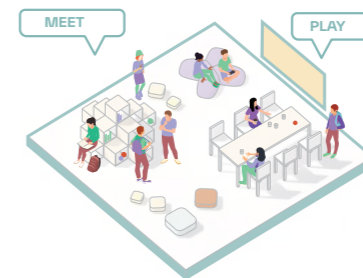
Education & Skill sharing



Library



Workshop area



Youth club

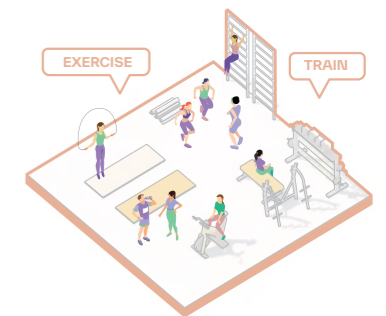
Leisure & Sport



Meditation
Exercising space



Playroom
Board games



Gym
Fitness space

Programming guidelines

Culture & Engagement. Community kitchen

A community kitchen and dining space in an underground shelter can greatly benefit a neighbourhood by providing a hub for social interaction and communal meals, fostering stronger community bonds. This space can also host cooking classes, potluck dinners, and food-related events, making it a versatile asset that enhances neighborhood cohesion and resource sharing during peacetime, while also serving critical functions during emergencies



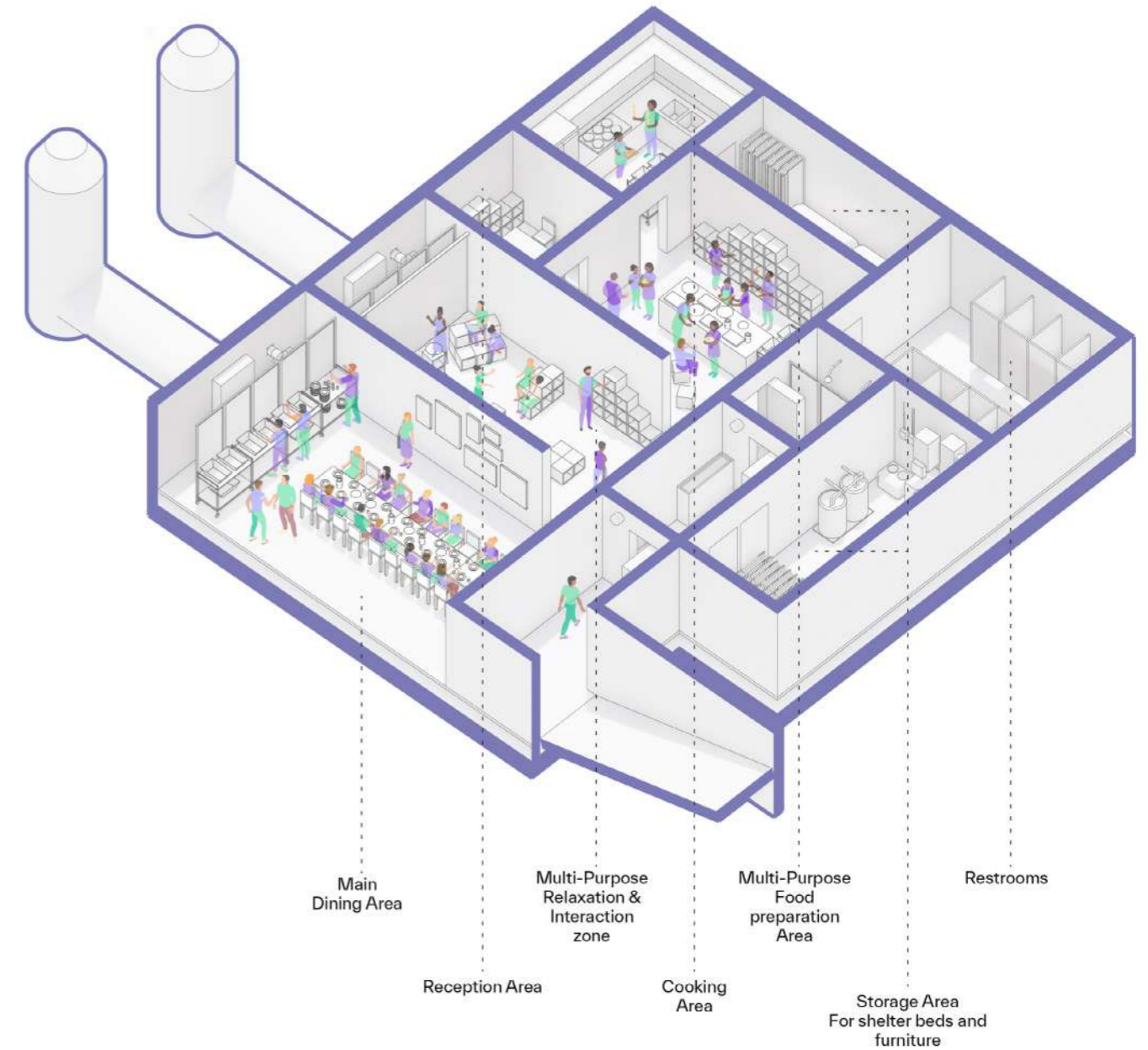
Community kitchen - Coop Spreefeld in Berlin



Community space - multi use



Communal dining space, England



Main Dining Area

Multi-Purpose Relaxation & Interaction zone

Multi-Purpose Food preparation Area

Restrooms

Reception Area

Cooking Area

Storage Area For shelter beds and furniture

Programming guidelines

Culture & Engagement. Event space

An event space and small cinema in an underground shelter can benefit a district by providing a central venue for social and cultural activities, even within a compact area. These spaces can host intimate film screenings, community meetings, and small performances, promoting cultural enrichment and engagement. This dual-use approach maximizes the shelter's value, ensuring it serves as a vibrant community hub during peacetime and a crucial resource in emergencies



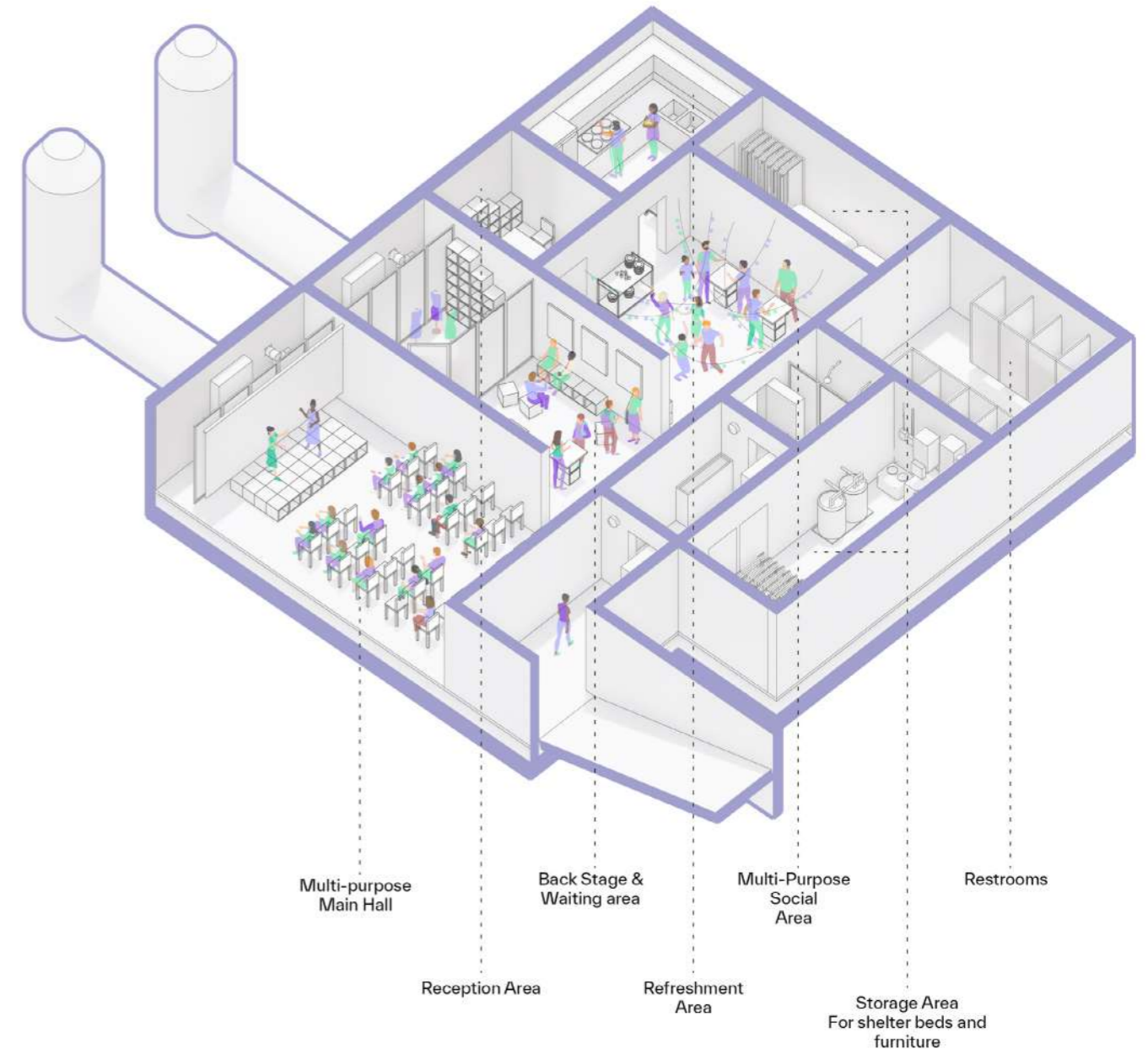
Community cinema



Community event in former shelter, Beijing



Community movie watching, London



Programming guidelines

Culture & Engagement. Gallery

A gallery and exhibition space in an underground shelter can benefit an entire city by offering a unique venue for showcasing art and cultural exhibits, attracting visitors and fostering city-wide cultural appreciation. These spaces can host rotating art exhibitions, local artist showcases, and community art projects, providing a dynamic cultural hub. This dual-use approach maximizes the shelter's potential, ensuring it remains an active and valuable resource for cultural enrichment during peacetime and a vital refuge during emergencies



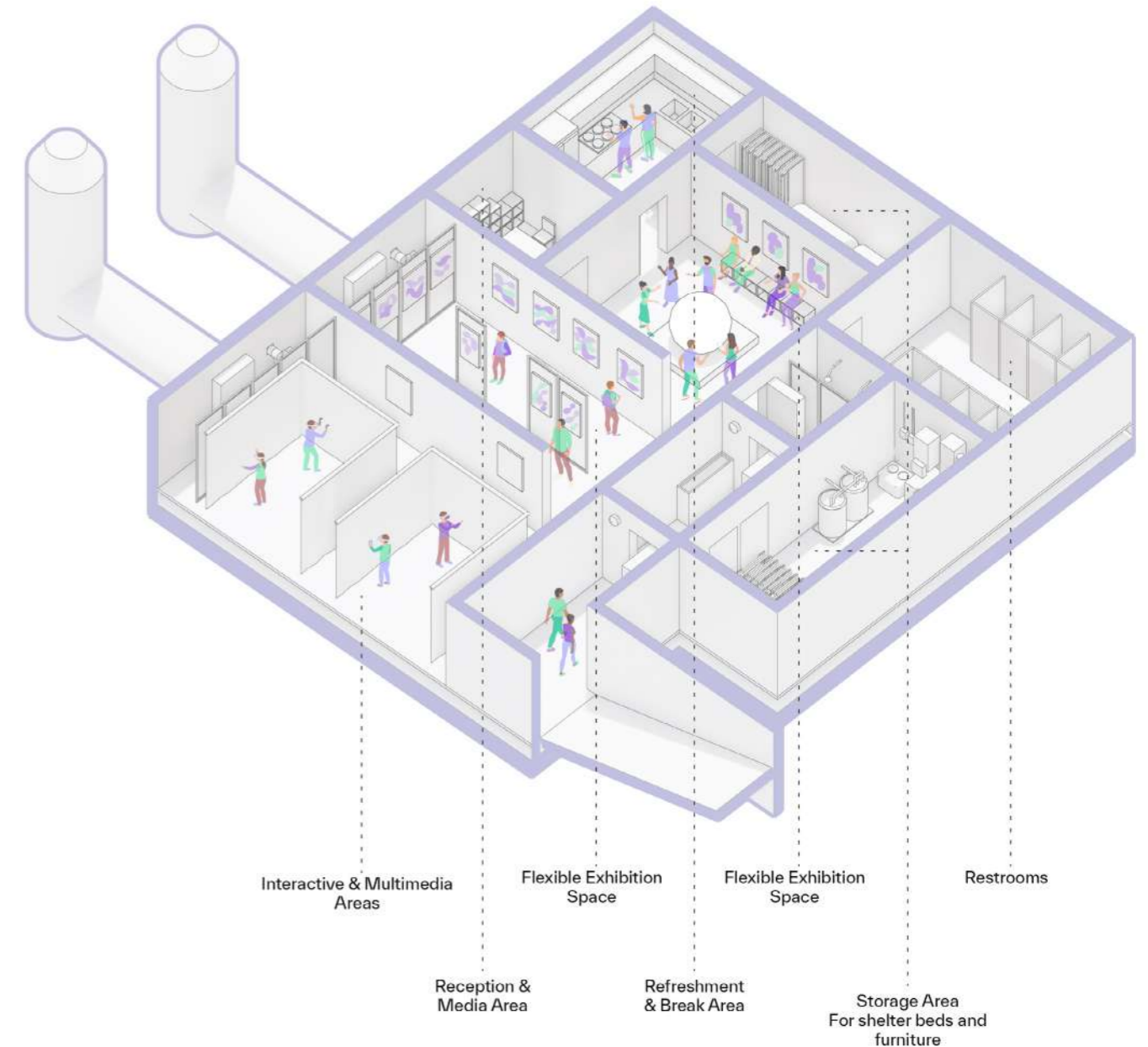
Digua Shequ community center, Beijing



Miró Foundation Underground, Spain



Underground Gallery, New York



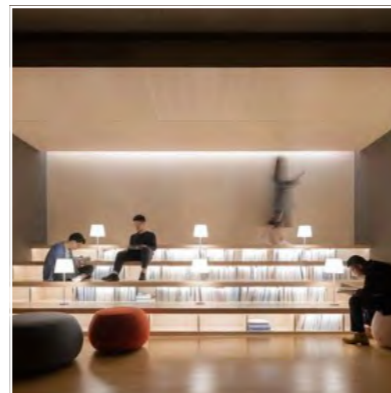
Programming guidelines

Education & Skill sharing. Library

A library in an underground shelter can benefit a neighborhood by providing a quiet, accessible space for reading, learning, and community programs. It can host book clubs, educational workshops, and literacy programs, fostering a love of reading and continuous learning. This dual-use approach ensures the shelter serves as a vital educational and cultural resource during peacetime, while also providing a safe and functional refuge during emergencies



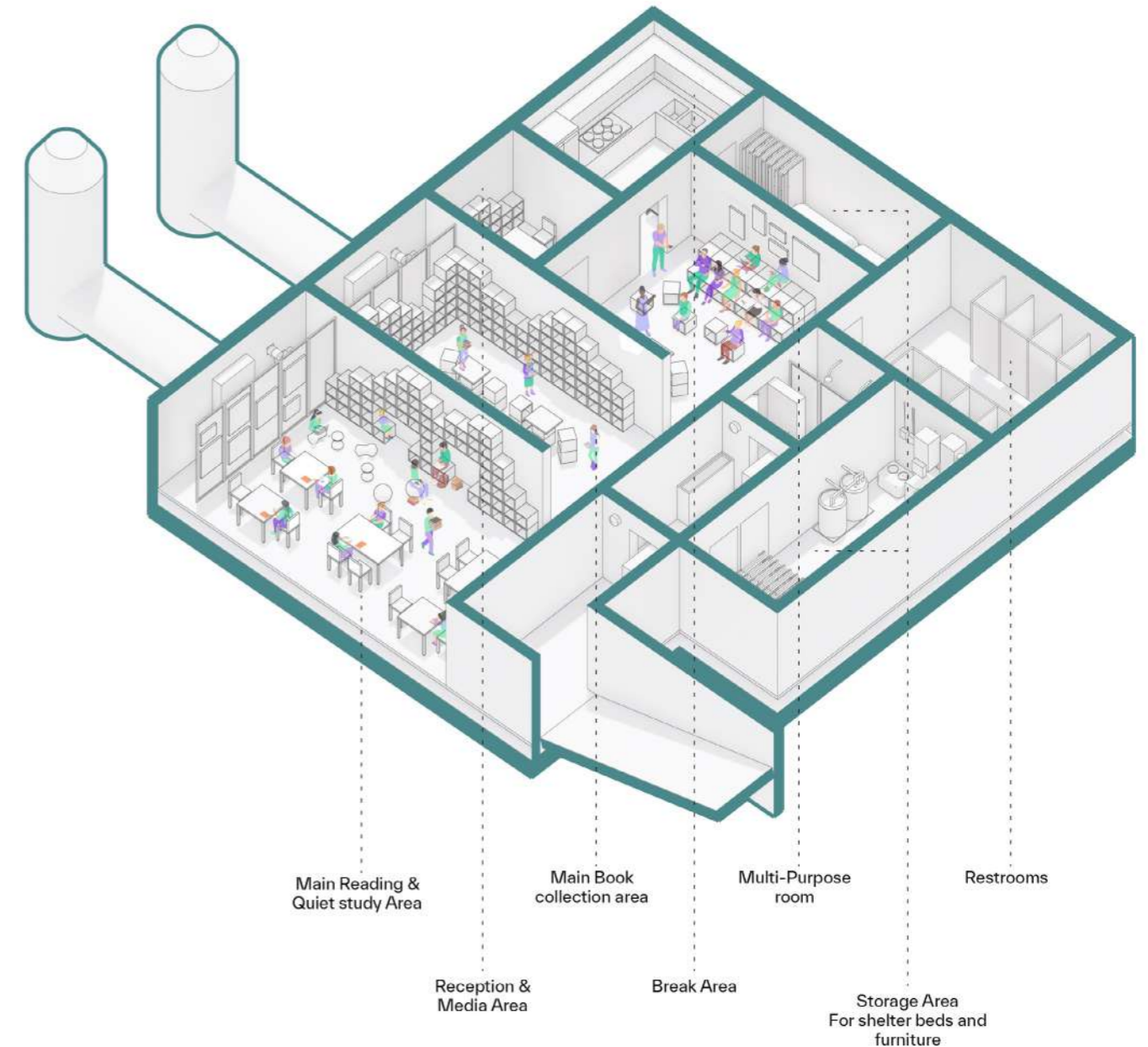
Underground Gallery, New York



Quiet reading room



Group study in former shelter , Beijing



Programming guidelines

Education & Skill sharing. Workshop space

A workshop space in an underground shelter can benefit a district by providing a centralized location for hands-on learning, skill development, and collaborative projects. It can host craft classes, DIY workshops, and community-building activities, fostering creativity and skill-sharing among residents. This dual-use approach maximizes the shelter's functionality, ensuring it serves as a vibrant educational and social hub during peacetime and a valuable resource during emergencies



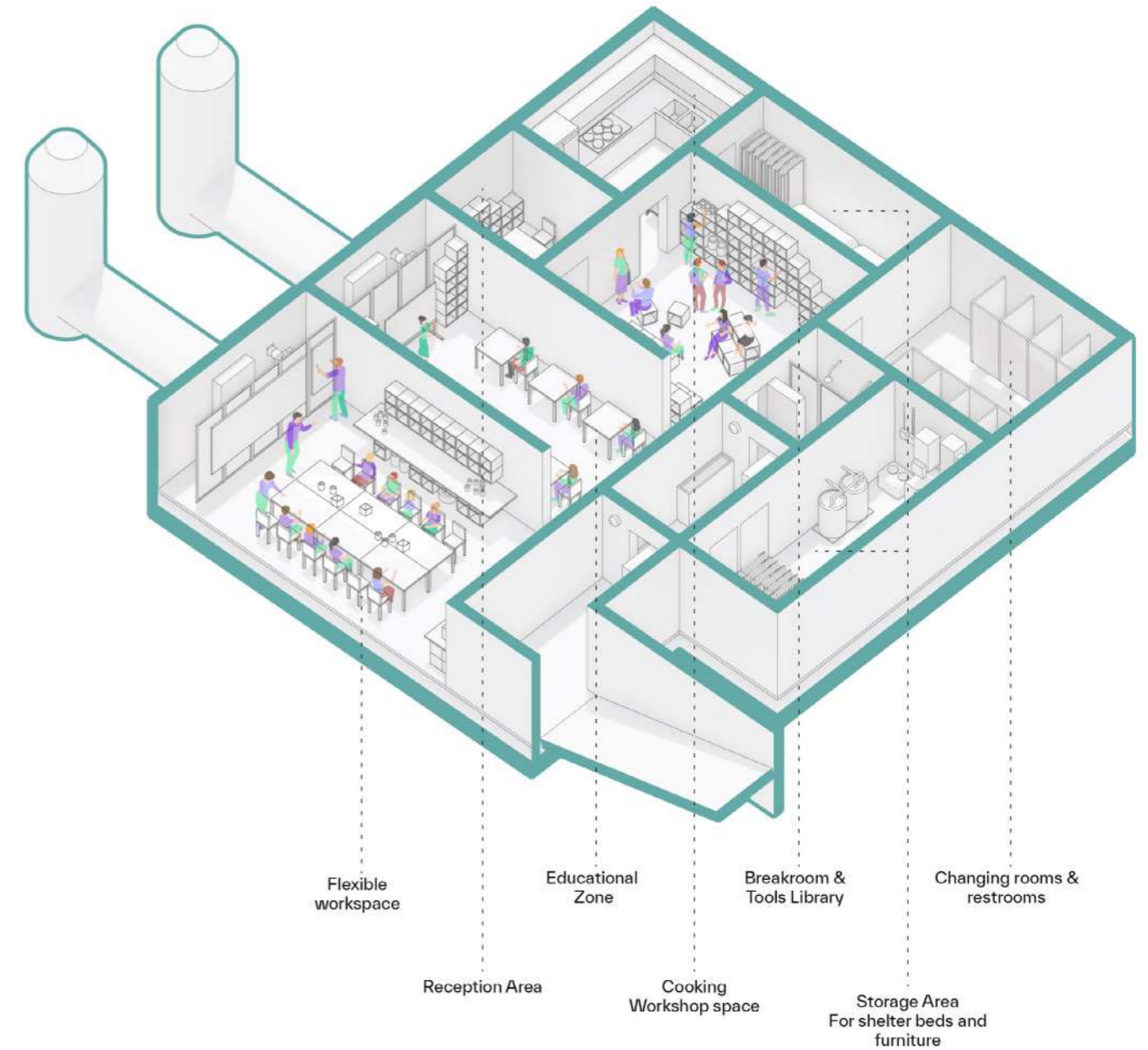
SPACE 10 - Community run vertical farm



Community workshop area



Workshop area



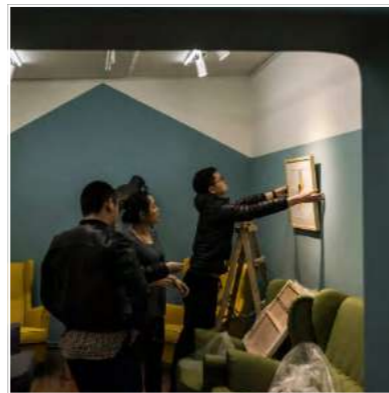
Programming guidelines

Education & Skill sharing. Youth club

A youth club in an underground shelter can benefit an entire city by providing a dedicated space for social, educational, and creative activities. It can host workshops, mentorship programs, and art projects, fostering personal growth and community engagement among the city's youth. This dual-use approach ensures the shelter remains a vibrant and supportive environment during peacetime while serving as a vital refuge and resource during emergencies.



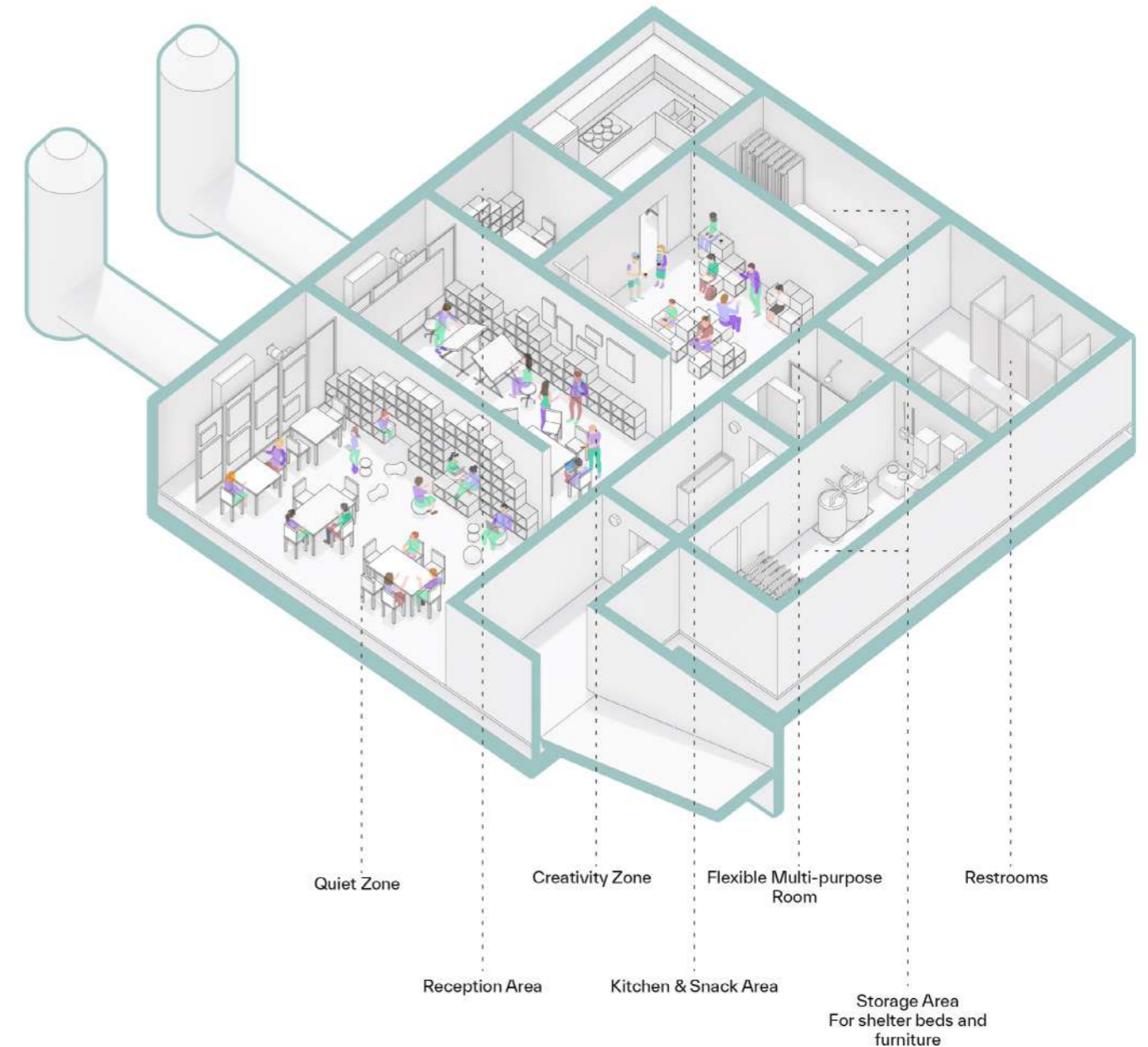
Digua Shequ community center, Beijing



Community center youth gallery, Beijing



CosmoCaixa Non-profit Organization, Spain



Programming guidelines

Leisure & Sport area. Meditation and exercise

A meditation and exercise space in an underground shelter can benefit a neighbourhood by providing a tranquil environment for physical wellness and mental relaxation. It can host yoga classes, mindfulness sessions, and fitness activities, promoting overall health and well-being among residents. This dual-use approach ensures the shelter remains a serene and functional space during peacetime while serving as a vital refuge and resource during emergencies.



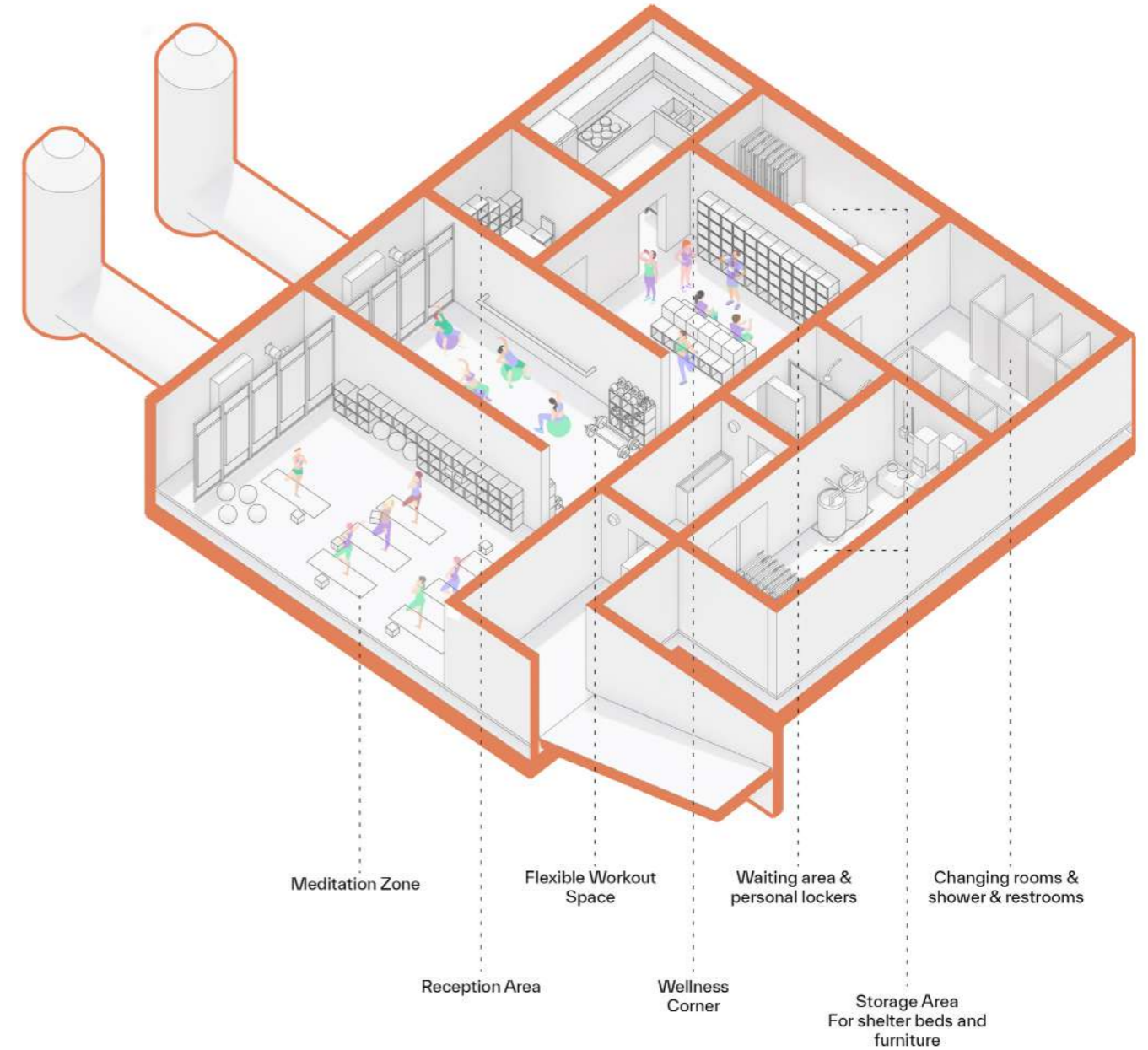
The Cave - Meditation space in Highschool



Exercise area for kids



Immersive Yoga class



Programming guidelines

Leisure & Sport area. Playroom

A playroom space in an underground shelter can benefit a district by providing a safe and engaging environment for children and adults of different age groups to play and learn. It can host age-appropriate activities, educational games, and creative workshops, fostering development and social interaction among young residents. Additionally, a multimedia area within the playroom can be used for video games, VR experiences, and other interactive technologies, offering diverse entertainment options. This dual-use approach ensures the shelter serves as a vibrant and supportive space for children during peacetime while also offering a crucial refuge and resource during emergencies.



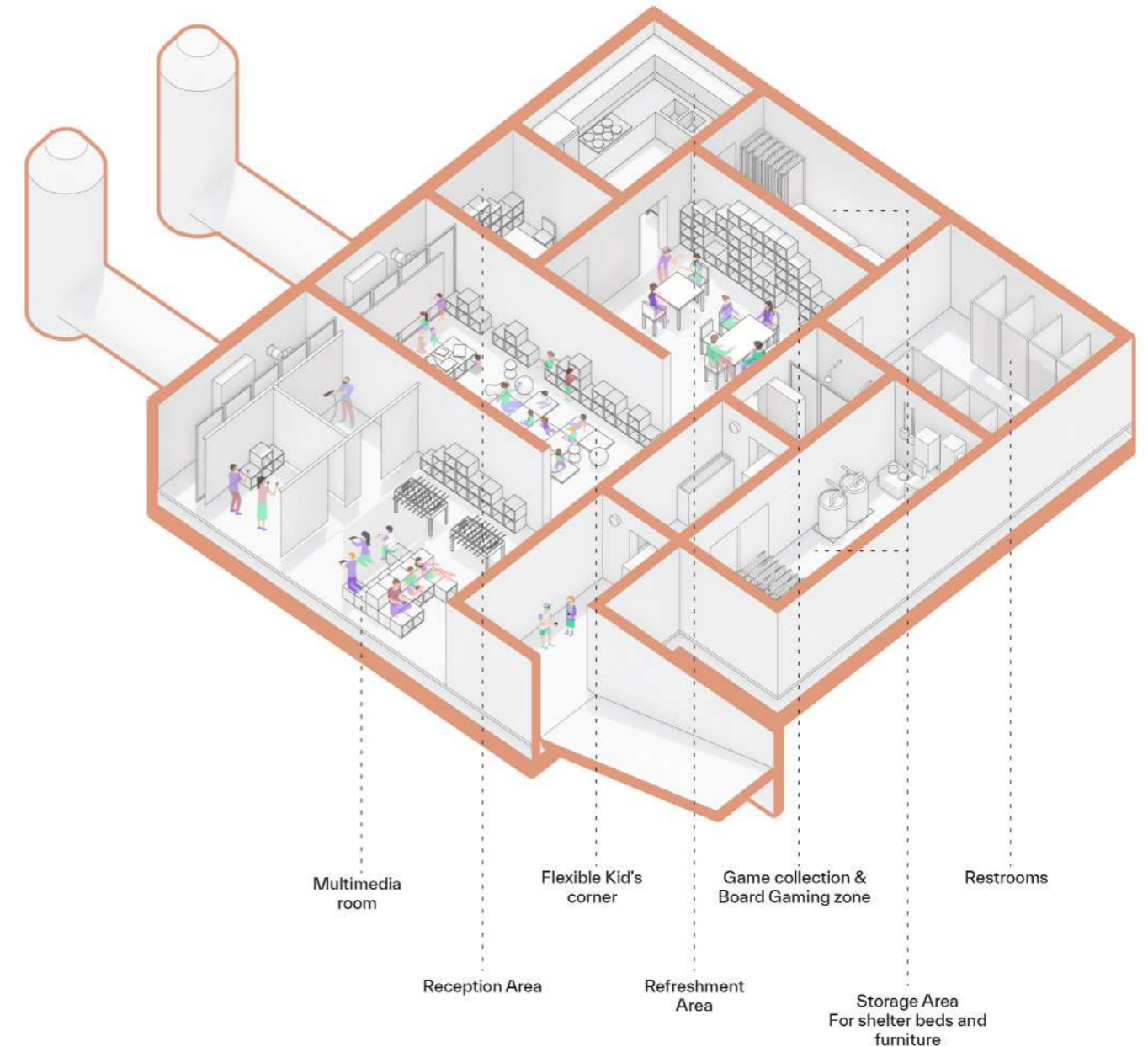
Chambers of Wonder, The Netherlands



Game corner, England



Pockets of Play, Romania



Programming guidelines

Leisure & Sport area. Gym & Fitness

A gym and fitness space in an underground shelter can benefit an entire city by providing a comprehensive facility for physical health and wellness. It can host exercise classes, strength training, and cardio workouts, catering to a wide range of fitness levels and interests. The amenities and devices used in this space can be easy to assemble and disassemble, affordable, and versatile enough to support a variety of sports and fitness needs. This dual-use approach ensures the shelter remains a vibrant and active hub for physical well-being during peacetime while serving as a vital refuge and resource during emergencies.



Digua Shequ community center, Beijing



Underground Gym



Kid's Fitness space

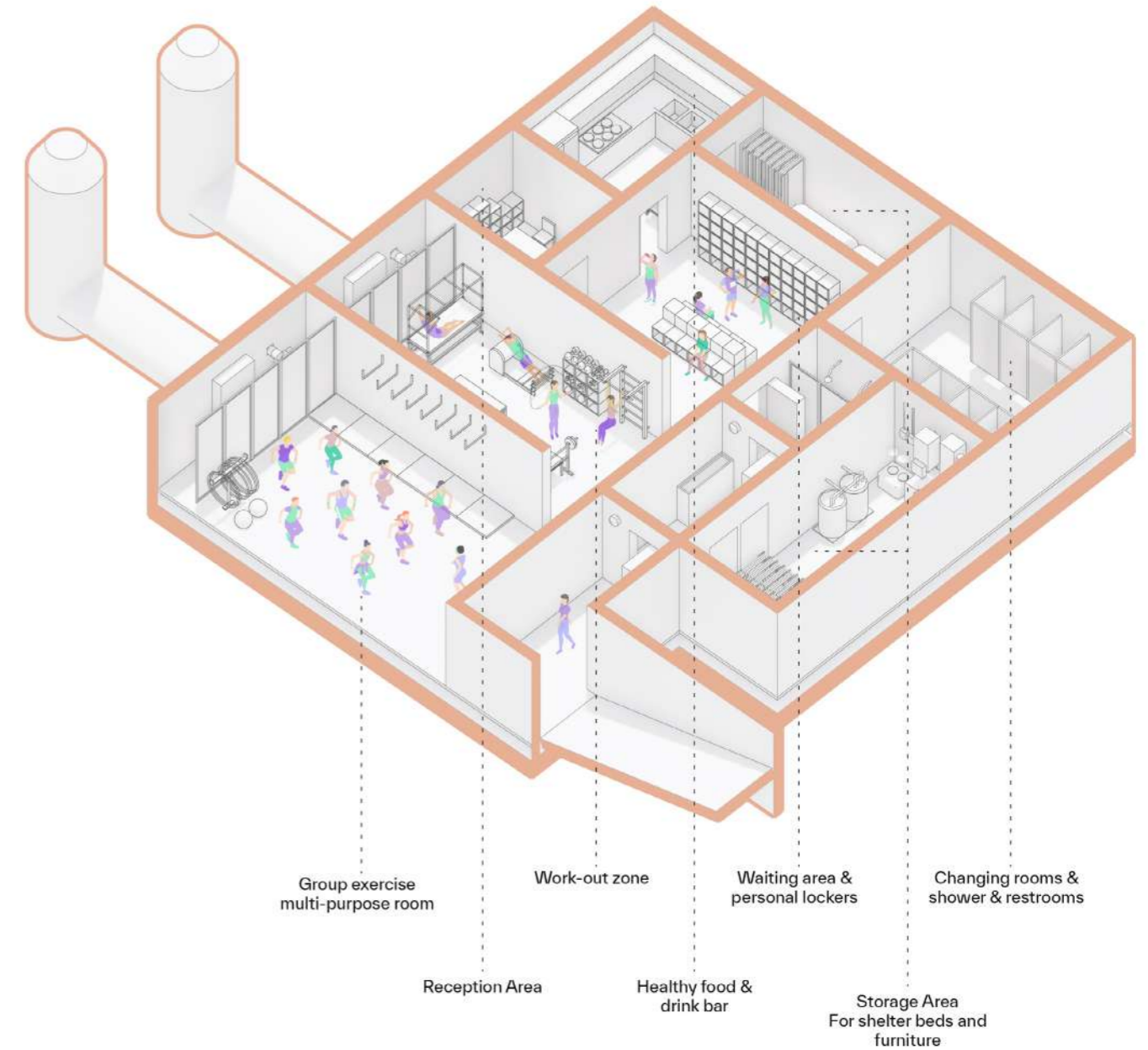


IMAGE SOURCES

Page 13

Photos: Restart

Page 14

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Page 17

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Page 22

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Page 31

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Page 32

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Page 34

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Page 37

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Page 38

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Page 39

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Page 82

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Page 83

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Page 112

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Page 113

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Page 116

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Page 172

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