CLEAN FUTURE OF CHIATURA CITY

POLITECNICO
MILANO 1863

SCHOOL OF ARCHITECTURE URBAN PLANNING CONSTRUCTION ENGINEERING
Master of Science

CLEAN FUTURE OF CHIATURA CITY

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ABSTRACT

The main idea of the thesis is to create a clean and healthy environment in industrial town Chiatura which holds an outstanding place among the cities of Georgia with its importance, which, above all is determined by the Manganese industry. However, the town has other resources which today are very important in the course of searching the ways for its sustainable development. Chiatura is rightly considered to be one of the first industrial cities in Georgia. The rapid development of exploration, extraction and processing of the Manganese resulted in the formation of Chiatura as a town. The major quality of the town is the industrial infrastructure related to manganese industry giving a distinctive and unique character in terms of cultural heritage. In the town and its surroundings, there are a lot of unused, as well as operating historical mines, shafts, cargocableways, ore enrichment plants, narrow gauge railway and their engineering infrastructure. The main problem for Chiatura, as well as for the other industrial cities of Georgia, is the extremely polluted environment as a result of the failure to comply with standards of ore extraction and processing. Limited financial and human resources of self-government and state institutions are still the main challenge for Chiatura. Lack of professional resources is mainly associated with high levels of emigration and unemployment. A number of cultural heritage sites of Chiatura, unfortunately, is vacant, abandoned or is physically in a bad condition. This tendency is mostly caused by the massive emigration of a population from the town, degradation of urban functions and by economic hardships. Resolving the issue related to the provision of pure drinking water, purification of rivers, prevention of air and soil pollution, rehabilitation of recreational infrastructure, etc., is one of the preconditions for sustainable development and creating healthy living conditions.

GEORGIA

CHARACTERISTICS

Georgia, country of Transcaucasia located at the eastern end of the Black Sea, on the southern flanks of the main crest of the Greater Caucasus Mountains. On the north and northeast the country is bounded by Russia, by Azerbaijan on the east and southeast, by Armenia and Turkey on the south, and by the Black Sea on the west. Georgia includes three ethnic enclaves:
Abkhazia, in the northwest (principal city Sokhumi); Ajaria, in the southwest (principal city Batumi); and South Ossetia, in the north (principal city Tskhinvali). The capital of Georgia is Tbilisi. The roots of the Georgian people extend deep in history; During the medieval period, a powerful Georgian kingdom existed, reaching its height between the 10th and 13th centuries. After a long period of Turkish and Persian domination, Georgia was annexed by the Russian Empire in the 19th century.

LAND

With the notable exception of the fertile plain of the Kolkhida Lowland—ancient Colchis, where the legendary Argonauts sought the Golden Fleece—the Georgian terrain is largely mountainous, and more than a third is covered by forest or brushwood. There is a remarkable variety of landscape, ranging from the subtropical Black Sea shores to the ice and snow of the crest line of the Caucasus. Such contrasts are made more noteworthy by the country's relatively small area. A variety of soils are found in Georgia, ranging from grey-brown and saline semidesert types to richer red earth and podzols. Artificial improvements add to the diversity.

RESOURCES

The interior of Georgia has coal deposits (notably at Tkvarcheli and Tkibuli), petroleum (at Kazeti), and a variety of other resources ranging from peat to marble. The manganese deposits of Chiatura rival those of India, Brazil, and Ghana in quantity and quality. Its waterpower resources are also considerable. The deepest and most powerful rivers for hydroelectric purposes are the Rioni and its tributaries, the Enguri, Kodori, and Bzyph. Such western rivers account for three-fourths of the total capacity, with the eastern Kura, Aragvi, Alazani, and Khrami accounting for the rest. Oil deposits have been located near Batumi and Poti under the Black Sea.

CLIMATE

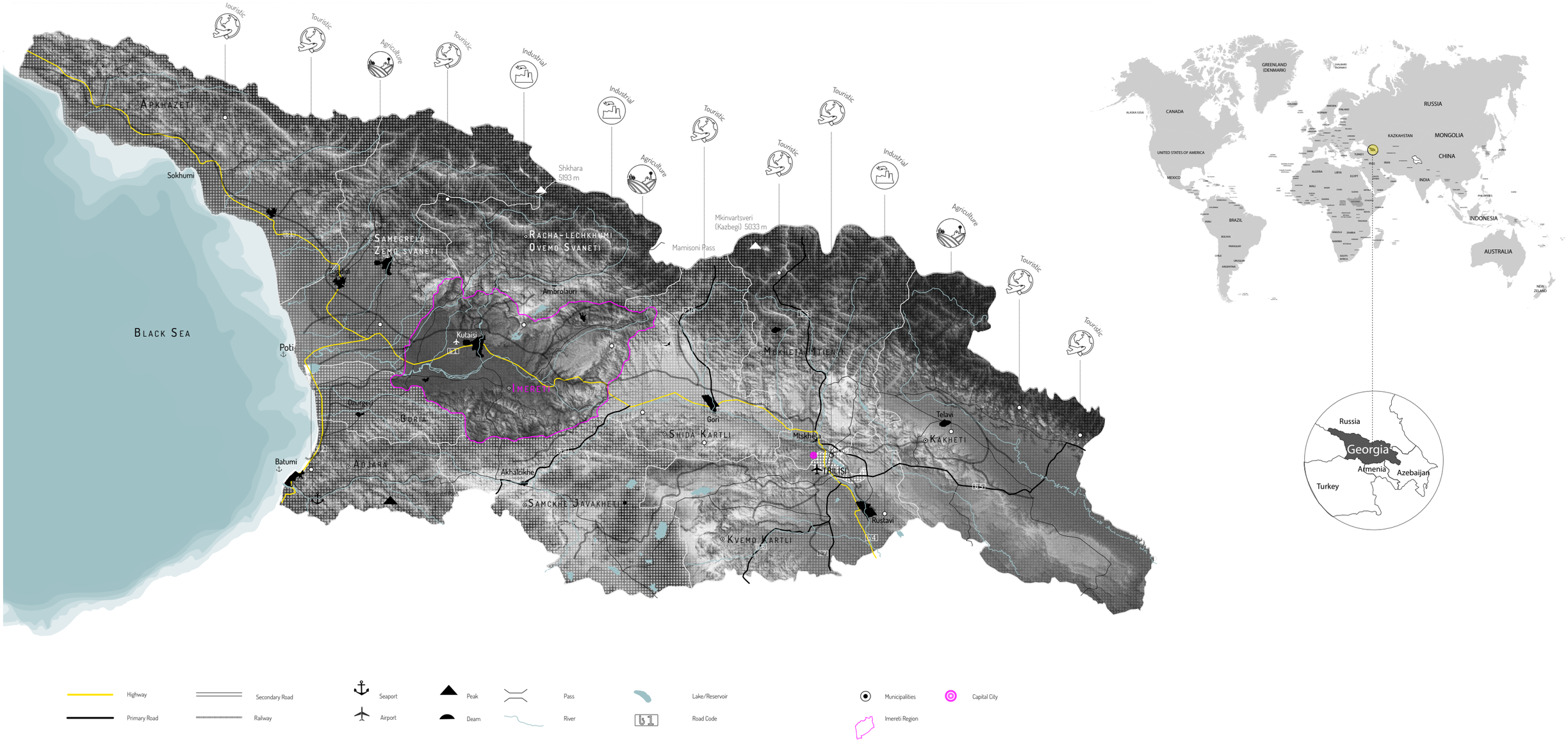
The Caucasian barrier protects Georgia from cold air intrusions from the north, while the country is open to the constant influence of warm, moist air from the Black Sea. Western Georgia has a humid subtropical, maritime climate, while eastern Georgia has a range of climate varying from moderately humid to a dry subtropical type. Western Georgia has heavy rainfall throughout the year, totalling 40 to 100 inches (1,000 to 2,500 mm) and reaching a maximum in autumn and winter. Southern Kolkhida receives the most rain, and humidity decreases to the north and east. Winter in this region is mild and warm; the mean January temperature never falls below (0°C), and relatively warm, sunny winter weather persists in the coastal regions, where temperatures average about (5°C). Summer temperatures average about (22°C). In Eastern Georgia, precipitation decreases with distance from the sea, reaching 16 to 28 inches in the plains and foothills but increasing to double this amount in the mountains. The southeastern regions are the driest areas, and winter is the driest season; the rainfall maximum occurs at the end of spring. The highest lowland temperatures occur in July (25°C), while average January temperatures over most of the region ranges from (0 to 3°C).

SETTLEMENT PATTERN

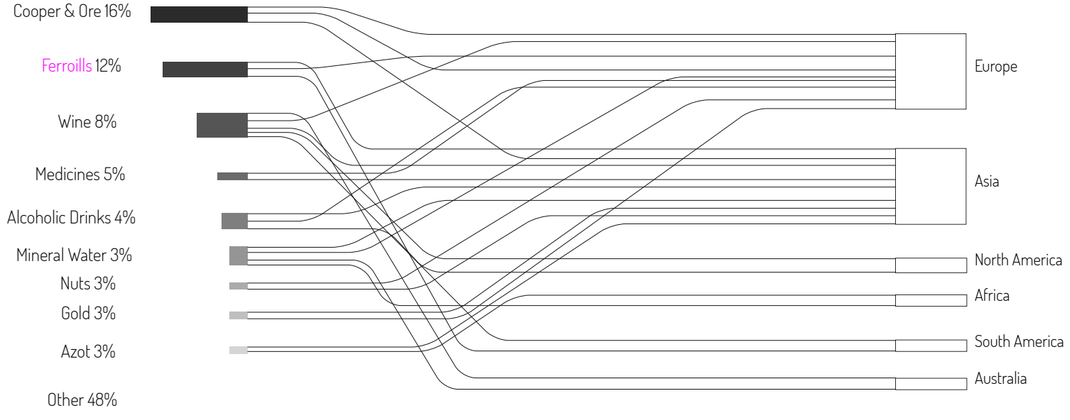
More than half the population now lives in cities. Further, a considerable portion of the population that is defined as rural is in fact engaged in the urban economy of nearby cities. There also was a significant shift in the distribution of the population to urban centres in recent years, as the rural population has decreased by about one-fourth since the beginning of the 21st century. Enterprises for primary processing of agricultural products have been constructed in the villages, while ore-processing plants and light industry also are increasing in number. As a result, many of the slow-paced traditional villages have developed into distinctly modern communities. The number of rural inhabitants remains as high as it is because of the wide distribution of labour-intensive branches of the economy such as the tea and subtropical crop plantations.

Economy

The Georgian economy includes diversified and mechanized agriculture alongside a well-developed industrial base. In recent years tourism has been developed. Georgia is the importer of foodstuffs, energy carriers, cars, machinery and transportation equipment. Georgia exports mineral waters, wines, tea, citrus fruits, pipes, alloys of ferrous and nonferrous metals, and textile products. Besides, it is engaged in re-export of crude oil. The volume of import in 2000y. totalled 898 million dollars, export – 372 mln. dollars. The largest import partners are the EU countries, Russia, Turkey, and the USA; export – Russia, Turkey, Azerbaijan and Armenia. Major industries are food (including tea, tinned goods, wines; tung oil, fragrant essences, mineral waters etc.), light industry, mechanical engineering, chemical and petrochemical industry, oil refining, extraction of manganese ores, coal, ores of non-ferrous metals, barite, etc.


Touristic
Touristic
Agriculture
Touristic
Industrial
Industrial
Touristic
Touristic
Industrial
Agriculture
Touristic
Touristic
Apkhazeti
Sokhumi
Shkhara
5193 m
Samegrelo
Zemo Svaneti
Racha-Lechkhumi
Ovemo Svaneti
Mamisoni Pass
Mkinvartsveri
(Kazbegi) 5033 m
Ambrolauri
Black Sea
Poti
Kutaisi
Imereti
Mekheta-Mtiena
Ozurgeti
Gori
Telavi
Batumi
Adjara
Akhalcikhe
Shida Kartli
Mtskheta
Kakheti
Tbilisi
Samckhe-Javakheti
Rustavi
Kvemo Kartli
Highway
Primary Road
Secondary Road
Railway
Seaport
Airport
Peak
Deam
Pass
River
Lake/Reservoir
Road Code
Municipalities
Imereti Region
Capital City
GREENLAND (DENMARK)
CANADA
UNITED STATES OF AMERICA
MEXICO
BRAZIL
RUSSIA
KAZKHSTAN
MONGOLIA
CHINA
INDIA
INDONESIA
AUSTRALIA
Russia
Georgia
Armenia
Azebaijan
Turkey

Export Rate (2017)



IMERETI REGION

[source] Agora News

REGION CHARACTERISTICS

Imereti region is located in the west side of Georgia. From a historical perspective, Imereti is one of the important regions of Georgia. The main city of Imereti - Kutaisi, who is the second largest in the country of Georgia, also played an important role in the country since ancient times. Information about the old West Georgia or Colchis and Kutaisi be found in many (Greek, Arabic, Armenian) historical sources and chronicles. The region of Imereti is situated along the middle and upper end of the Rioni river the second river in Georgia, along its length (327 km). The main city of the region is Kutaisi. Where is located the second important Airport after Tbilisi and Georgian Parliament. Imereti is divided into two parts: Upper and Lower Imereti. The districts of the Upper Imereti are Kharagauli, Terjola, Tkibuli, Sachkhere Chiatura, Zestaphoni. The Lower include Kutaisi, Tskhaltubo, Khoni, Samtredia, Vani, Baghdadi.

MINERAL RESOURCES AND INDUSTRY

This region is distinguished by its natural resources. There are located two cities with mines Chiatura - where are Manganese ores and Tkibuli where is the extraction of the coal. Zestafoni and the smaller neighbouring town of Shorapani are industrial centres of the country. The Zestafoni ferro-alloy plant processes raw manganese ore shipped by rail down the Kvirila valley from Chiatura, supplying 6% of world demand. The largest ferroalloy plant in the country, in 1998 it produced 35,000 tonnes of silicomanganese and 11,000 tonnes of medium-carbon manganese alloy. This was well below its previous peak production of 110,000 tonnes of manganese-based alloys. Main industrial sectors: metallurgy; food industry; electric power production; mining industry; machine-building; and light industry. The region is distinguished with its variety of mineral deposits. Currently, there are more than 100 deposits of minerals and raw resources that are known of in the region. Half of the extracted minerals are exported to foreign markets.

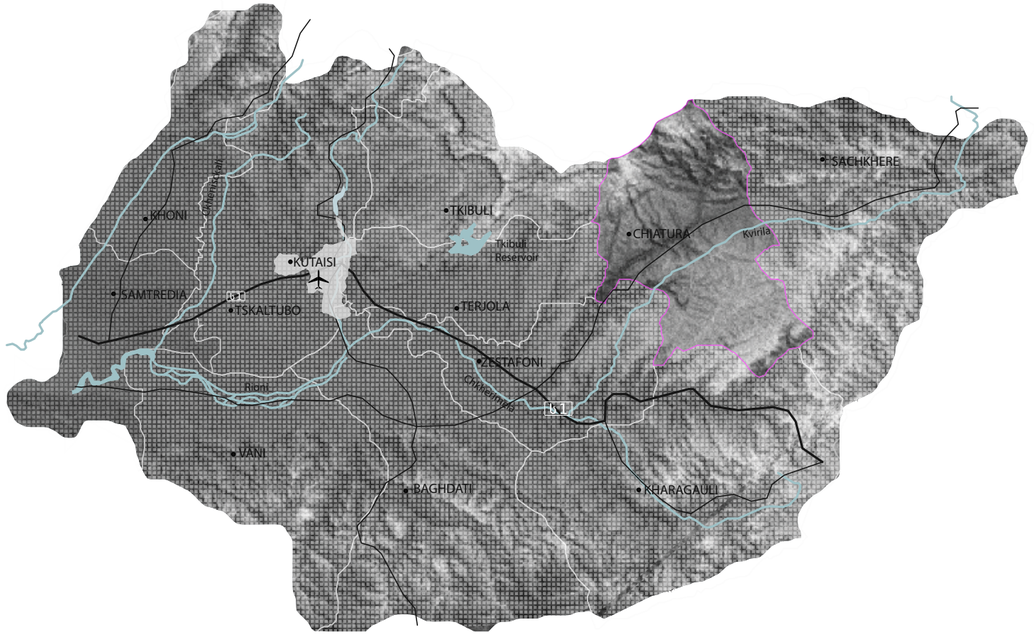
RESORT FACILITIES AND TOURISM RESOURCES

The geographical location of Imereti, its landscape, historical-cultural and natural monuments, agriculture, rich national traditions, especially Imeretian hospitality, represent good preconditions for the development of tourism in the region. The region is home to more than 250 historical monuments, which may create a clear imagination for the guests about the rich and unique Georgian culture and history. There are a lot of sights In Imereti, cultural - architectural monuments; many of them are included in the list of World Heritage - UNESCO. From the Antique Epoch until the beginning of the XX century their location in wonderful landscapes greatly impressed visitors from all over the world. 1.360.000 tourists visited Imereti in 2016, 41% foreign tourists among them.

MIGRATION

Many large and small-sized cities lost almost a third of their population. Imereti, after Racha - Lechkhumi, Kvemo Svaneti is the second region in the migration process, flows increased by 19%. There are various complex factors ranging from economic and societal to political and personal. This tendency has only partially changed since 2005 when industrial activities started reviving. Economic reforms implemented in the country during the past decades, along with increased political stability and security, But the migration process continues and it is difficult to single out the sole factor contributing to emigration and/or immigration from/to Georgia. Rather, have fostered an increase in immigration flows. However, this has not reduced emigration levels. The 2014 census shows that 75% of emigrants are in the 20-54 age category. The outflow of working and reproductive age population adversely affects the economic and demographic situation in the country.

Imereti Map

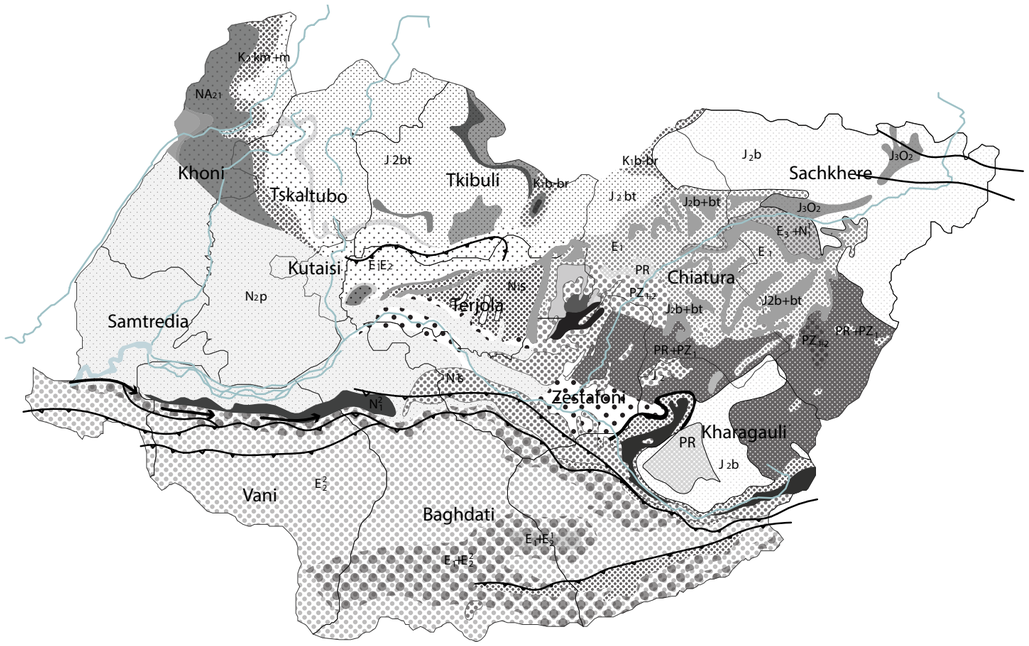


Highway — Primary Road — Secondary Road — Railway — Airport

River — Lake/Reservoir — 61 Road Code

[source] Institute of Earth Sciences and National Seismic Monitoring Centre

Geological Map



E_2^2 Clay - clast Conglomerate, Marbles, Basalt, Sandstone

$E_1+E_2^2$ Pelagic argeles, Marbles, Basalt-clast Conglomerate, Sandstone

J_2b+bt Gravely Sandylimestone

$E_1+E_2^1$ Allevrolite, Sandstone, Vulcanic ash

N_2p Sand, Clay, Sandstone

K_1b-br Ammonite limestone

E_1 Coloredmarble, Sand, Clay

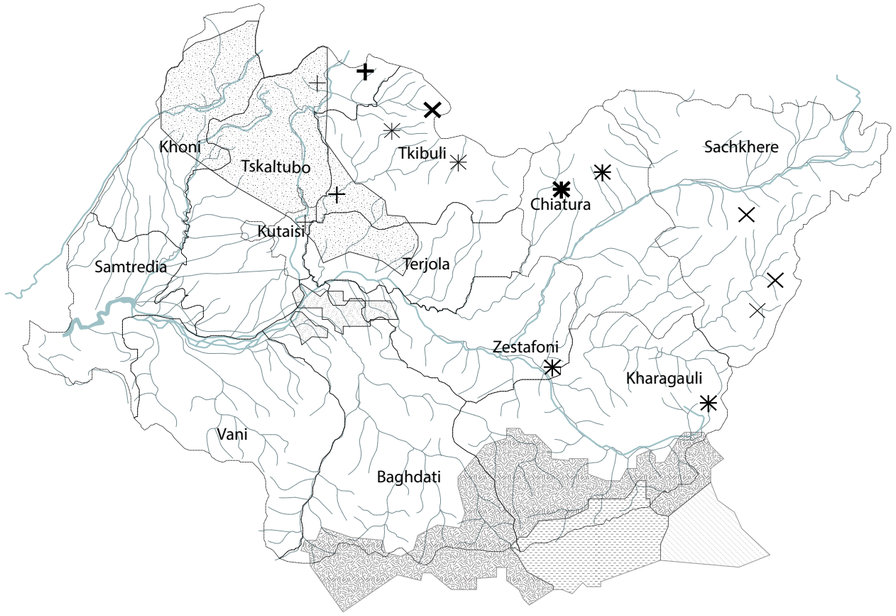
N_2^1 Oolithiclimestone, Clay, sandstone

$E_3+N_1^1$ Sandstone, Carbonateclay, Gypsum

Nappe — Thrust sheet

[source] Institute of Earth Sciences and National Seismic Monitoring Centre

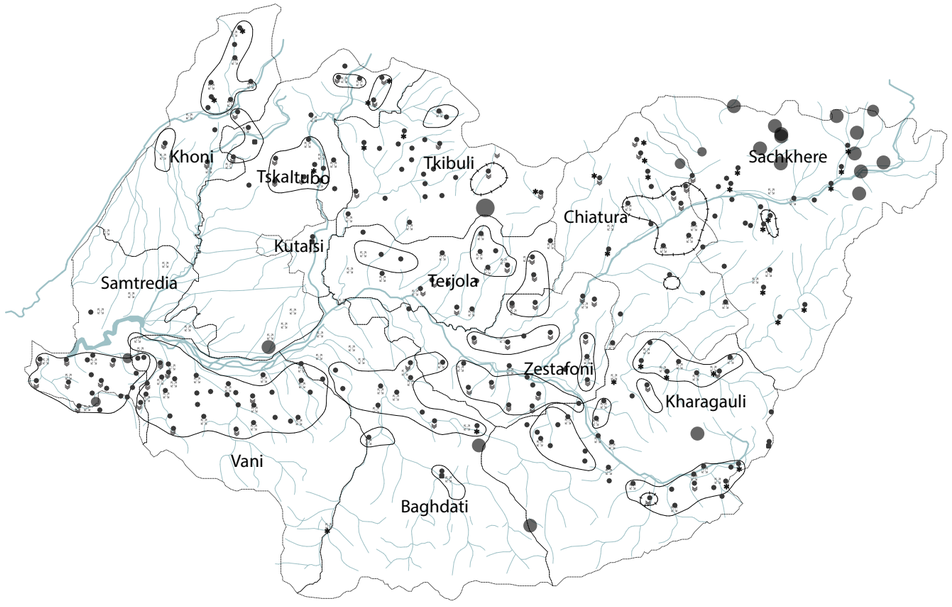
Mineral Resources Map



- Manganese
- Marble
- Loose Clay
- Jet
- Kaolinite
- Limestone
- Baryte
- Gypsum
- Coal
- Sand
- Diabase
- Nature Monument
- Wildlife Refuge
- State Reserve
- National Park

[source] Institute of Earth Sciences and National Seismic Monitoring Centre

Natural Hazards Map



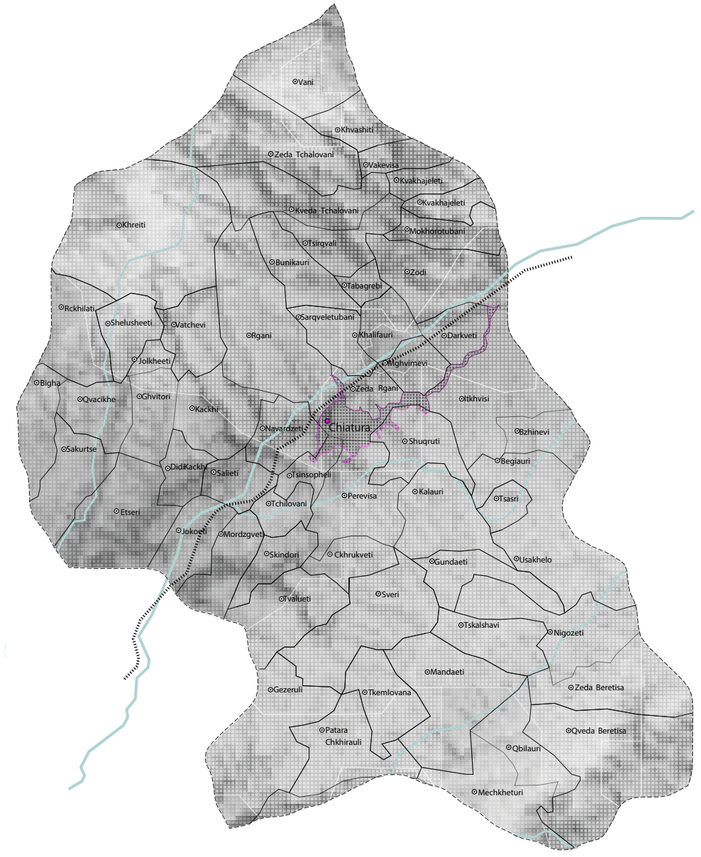
- Earthquake
- Downpour
- Landslide
- Landfill
- Flooded River Banks
- Dangerous Zones of Natural Disasters
- Technogenic areas
- Waterstreams

[source] Institute of Earth Sciences and National Seismic Monitoring Centre

Water Map

[source] Institute of Earth Sciences and National Seismic Monitoring Centre

Natural Hazards Map



[source] Institute of Earth Sciences and National Seismic Monitoring Centre

627 400 PEOPLE

510 700 PEOPLE

The number of population decreased by 19 % in 15 years

KUTAISI
• Area 70 km²
• Population
2002 y 180 900
2007 y 166 500
2012 y 152 400
2017 y 141 900

TSQALTUBO
• Area 632.3 km²
• Population
2002 y 63 700
2007 y 60 800
2012 y 57 800
2017 y 52 100

ZESTAFONI
• Area 423 km²
• Population
2002 y 67 000
2007 y 63 000
2012 y 58 900
2017 y 56 700

CHIATURA
• Area 545 km²
• Population
2002 y 48 600
2007 y 44 400
2012 y 41 000
2017 y 39 400

TKIBULI
• AREA 478 KM2
• Population
2002 y 27 900
2007 y 24 700
2012 y 21 800
2017 y 19 600

SAMTREDIA
• Area 364.1 km²
• Population
2002 y 54 900
2007 y 52 300
2012 y 49 500
2017 y 46 300

KHONI
• Area 428.5 km²
• Population
2002 y 29 300
2007 y 27 100
2012 y 25 200
2017 y 22 400

VANI
• Area 557 km²
• Population
2002 y 29 300
2007 y 27 100
2012 y 25 200
2017 y 23 000

TERJOLA
• Area 357 km²
• Population
2002 y 38 700
2007 y 37 400
2012 y 35 900
2017 y 33 600

BAGHDATI
• Area 815 km²
• Population
2002 y 25 000
2007 y 23 500
2012 y 22 100
2017 y 20 100

KHARAGAULI
• Area 913.9 km²
• Population
2002 y 23 500
2007 y 21 700
2012 y 20 100
2017 y 19 200

SACHKHERE
• Area 973 km²
• Population
2002 y 40 000
2007 y 38 900
2012 y 37 800
2017 y 36 500

TOTAL AREA TOTAL POPULATION

[source] National Statistics Office of Georgia - GEOSTAT

CHIATURA MASTERPLAN

Legend

- Primary Road (SH13)
- Secondary Road
- Railway
- River
- Roapway
- Parks
- Enrichment Industry
- Old City Area

CHIATURA STORY LINE

VILLAGE CHIATURA

1846

WHILHEM HERMANN VON ABICH founded and studied the manganese ore in the vicinities of Chiatura and Sachkhere

1870

Geological study the ores for its further processing later. It was continued by the direct initiative of the famous Georgian writer AKAKI TSERETELI and geologist SPIRIDON SIMONOVICH.

1876

AKAKI TSERETELI STARTED ORE MINING between villages of Upper Rgani and Mgvimevi.

1890

Georgian Manganese was mainly intended for EXPORT. Georgian ore deposits were utilized by England, Germany, Frence, Belgium, Austria-Hungary, USA etc. The Georgian Manganese were utilized by large metalurgical factories like AMERICAN COMPANY BETHLEHEM STEEL CORPORATION, GERMAN KRUPP, ITALIAN ILVA.

1895

ON 4 FABRUARY, NARROW RAILED RAILROAD LINE OF CHIATURA - SHORAPANI, was officially inagurated - one more branch of the trans-Caucasus central main line.

1913

Extraction of deposits and its export were stabily increasing and REACHED ITS PEAK. 966 000 TONS OF MANGANESE WERE EXTRECTED FROM CHIATURA MINE. Georgia was the main exporter of manganese ore - Georgia supplied 50% of the world's ore.

1914

FIRST WORLD WAR I and closing of the Dardanelles strait abruptly stopped the peak of industry.

1917

The more Chiatura was acquiring the image of the city, the more discussion regarding the city governance system introduction was taking the place.
FINALLY, IN THE YEAR OF THE 1917 CHIATURA WAS DECLARED AS A CITY.

1921

THE PRODUCTION OF THE MANGANESE COMPLETLY STOPPED.

1925

Chiatura production by concession agreement was transferred to the AMERICAN POLITICIAN AN ENTREPRENEUR W. AVERELL HARIMAN FOR 20 YEARS. With the contract, Harriman monopolized the entire industry from extraction to export. Harriman was supposed to restore the fallen production, though his work in Chiatura was unsuccessful. THE CONTRACT TERMINATED IN 1928 AND ENTIRE PRODUCTION WAS ASSUMED BY THE GOVERMENT.

1930

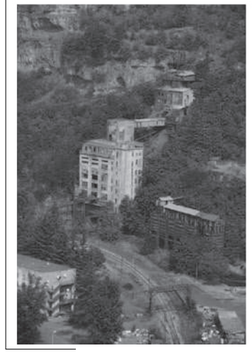
ZESTAFONI FERROALLOY FACTORY was built. which up-to-date continues to be Chiatura's Manganese ore's main user. At the same time of the Zestafoni plant construction, another ferromarganese pilot plant was built in Tbilisi.

1935

THE FIRST LARGE ORE PROCESSING PLANT of the soviet period was built under the design of the German firm "KRUPP" and still know under the name "N25-bis. It is subordinated to perevisa mine.

1939

PEROXIDE ENRICHMENT ORE PROCESSING PLANT"PEROFI", the annual capacity of which amounted to 100 000 tones per annum, was build. It is subordinated to Rgani mine, being distingushed for clear, interesting layout of the rectangle, vertical openings.



1953
1957

PROCESSING PLANTS CMP 1 AND CMP 2 ARE THE LARGEST ENTERPRISES with respect to the annual capacity, which is reflected on their sizes and multitude of mutually related premises. Both of the plants are allocated on the overall industrial site.

1953

It is beleived that the FIRST ROPEWAY THROUGHOUT THE SOVIET UNION WAS BUILT IN CHIATURA. Such one is named to be public ropeway "Chiatura - perevisa", to which another line - "Sashevardno" was added.

1990

The political and economical turmoil of the early 1990s forced the production to face difficult challanges again. THE PRODUCTION INFRASTRUCTURE WAS DETERIORATED: Undergraound tunnels, factories with utility buildings, freight pathways.

2006

THE MANAGEMENT OF THE MINES IS EXECUTED BY GEORGIAN MANGANESE HOLDING LIMITED. Which is the owner of "Chiatura Manganese," Zestafoni ferroalloy factory and Vartsikhe hydroelectric station.

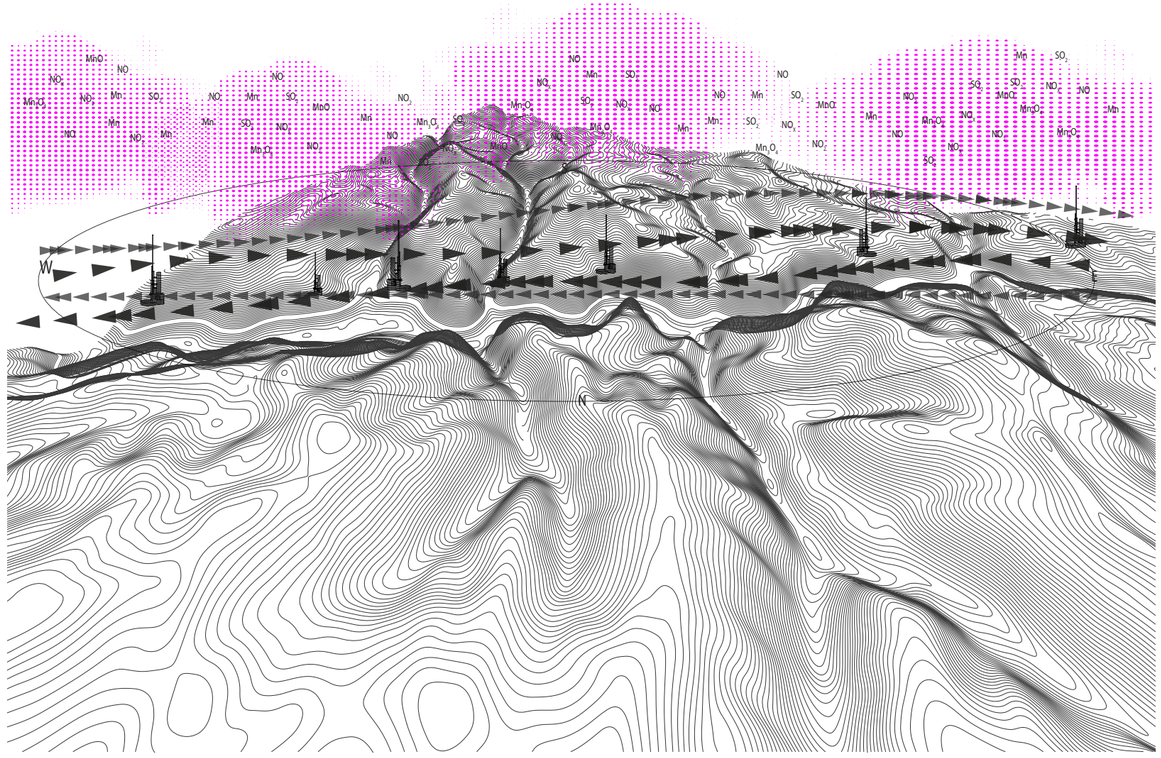
2018

GEORGIAN MANGANESE HAS BUILT A NEW ENRICHMENT FACTORY. ALMINERAL is a joint project of Germany and Poland.

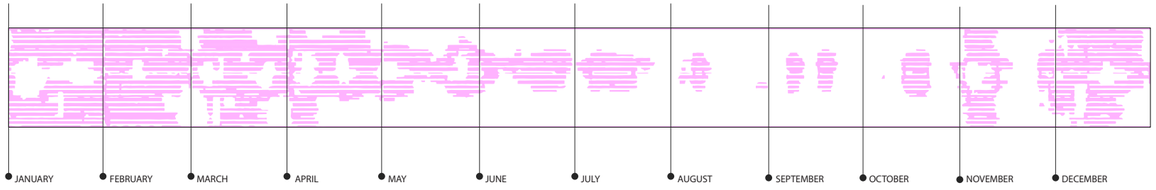
[source] The National Parliamentary Library

ENVIRONMENTAL ANALYSIS

AIR STUDY

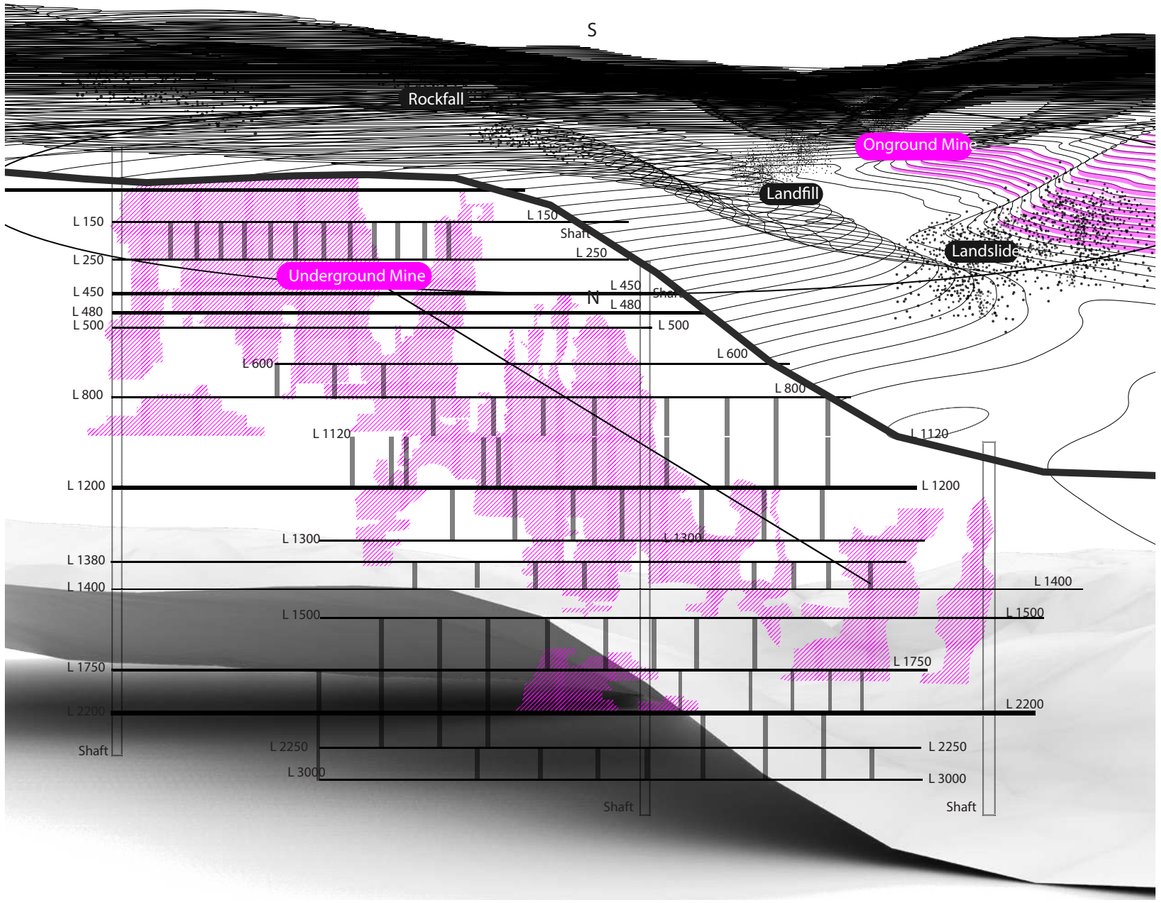


Annual Wind Intensity Distribution



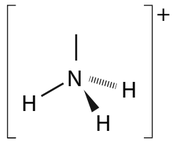
[source] www.windy.com

Soil Study

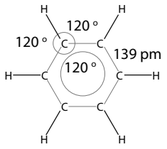


Chemical Elements In The Soil

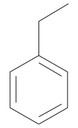
Ammonium



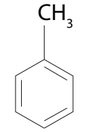
Benzene



Ethyl-benzene

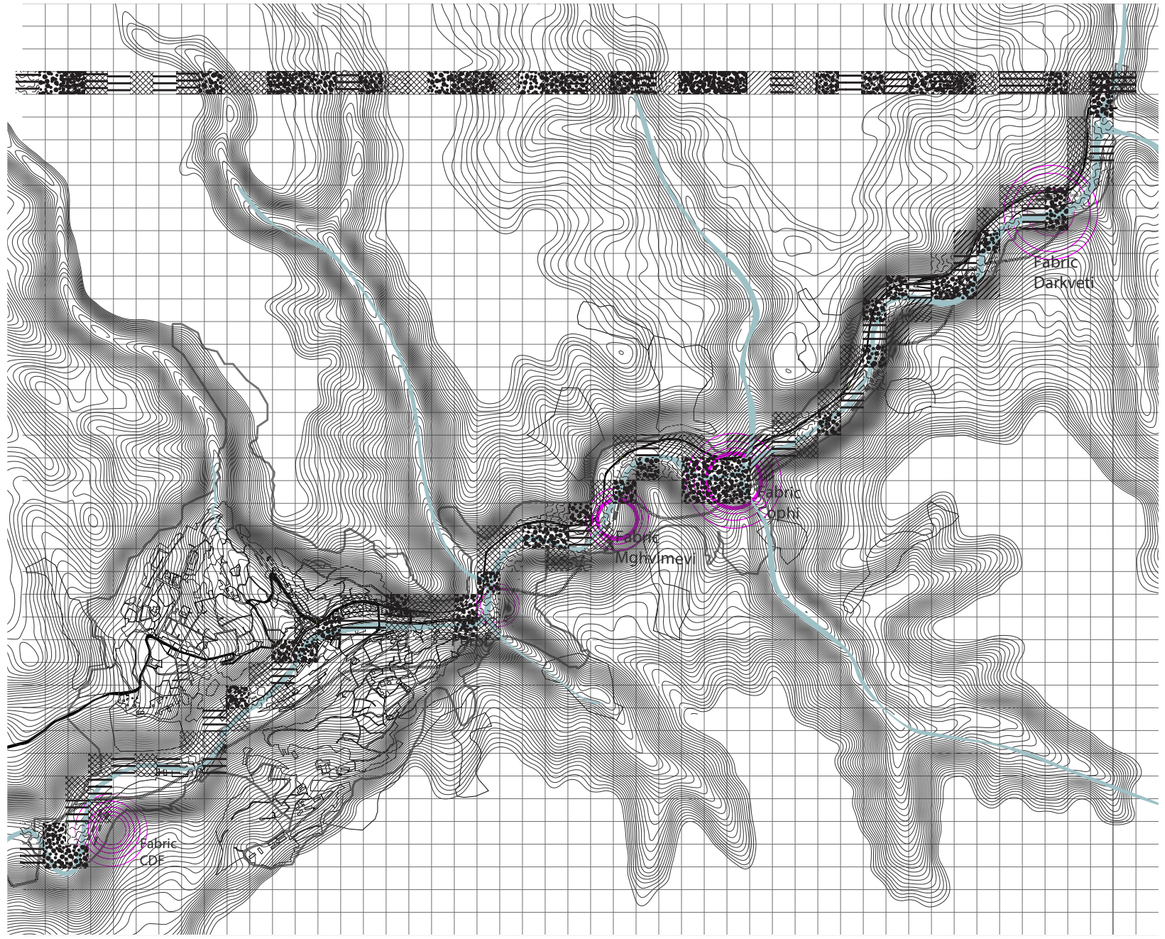


Toluene



[source] Caucasus Environmental NGO Network

Soil Study

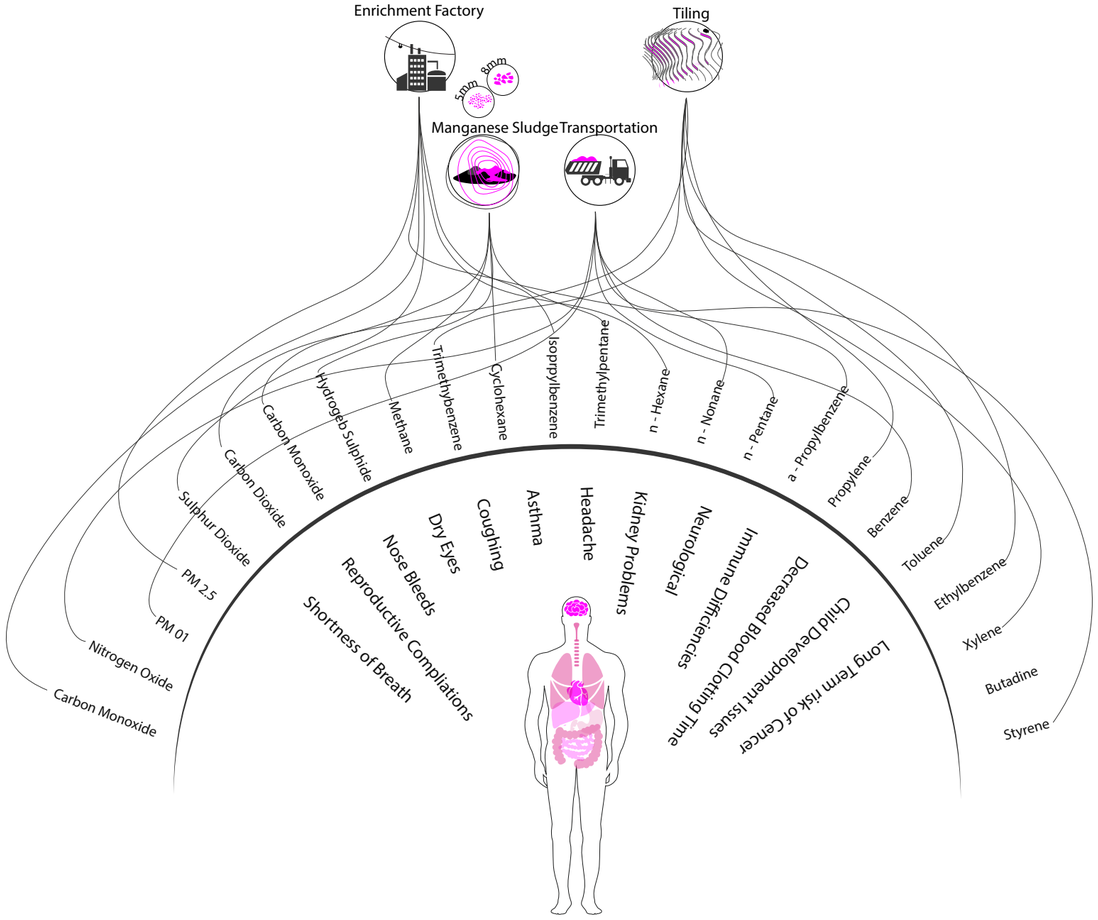


Chemical Elements In The Water

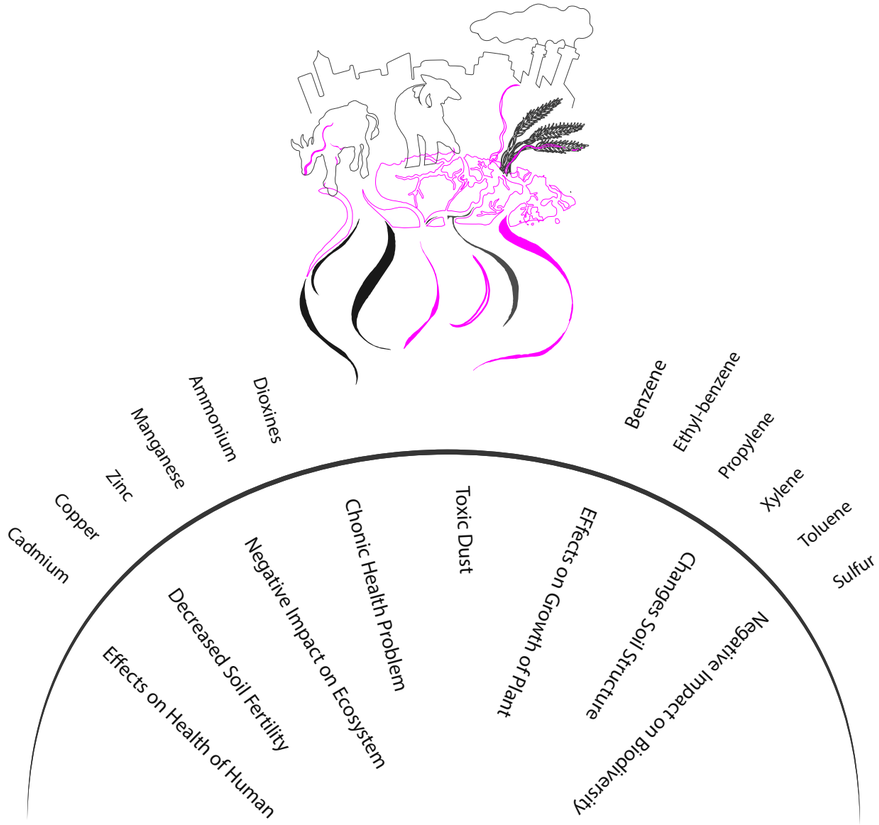
25	13	29	27	48	26	28
Mn	Al	Cu	Co	Cd	Fe	Ni
MANGANESE	ALUMINIUM	COOPER	COBALT	CADIUM	IRON	Nickel

[source] Caucasus Environmental NGO Network

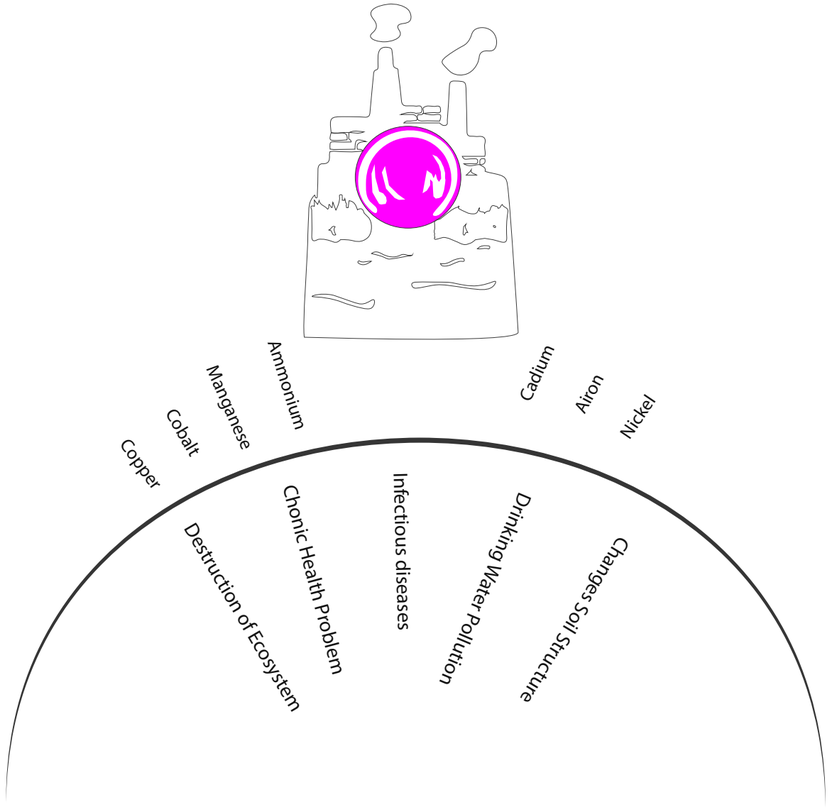
Air Pollution And Effects



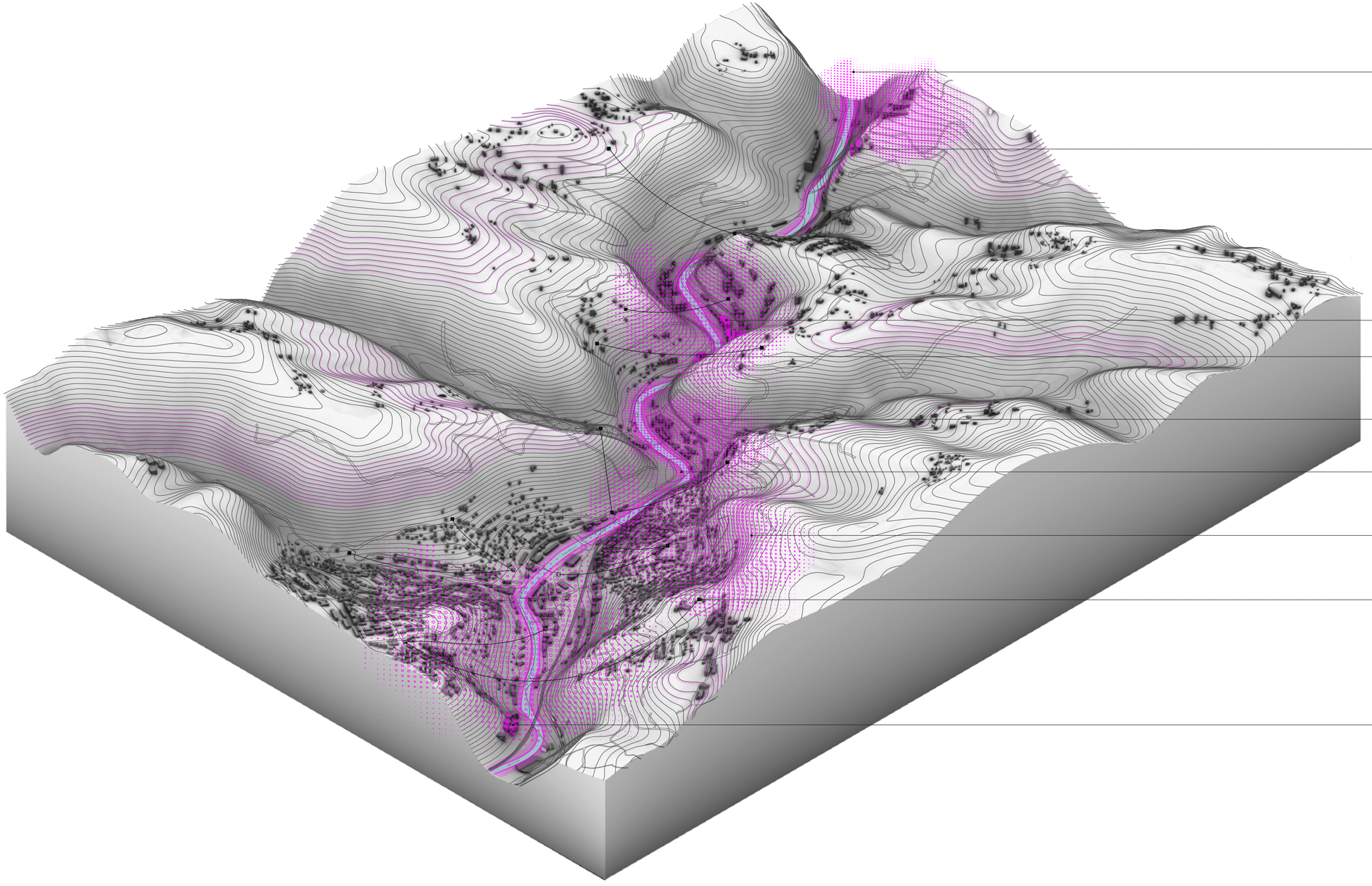
Soil Pollution And Effects



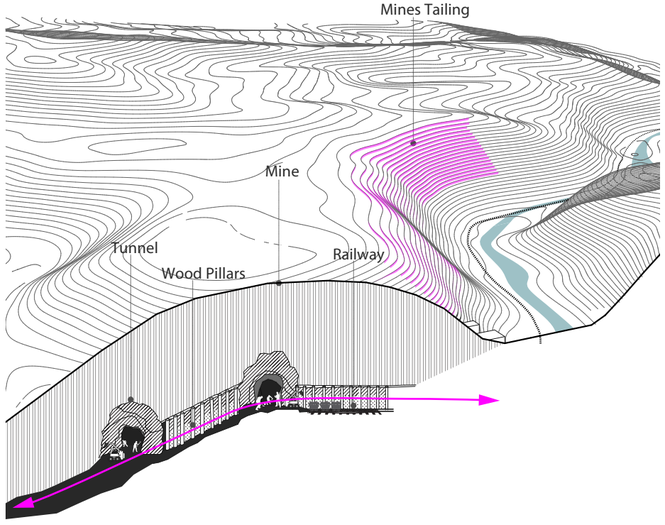
Water Pollution And Effects



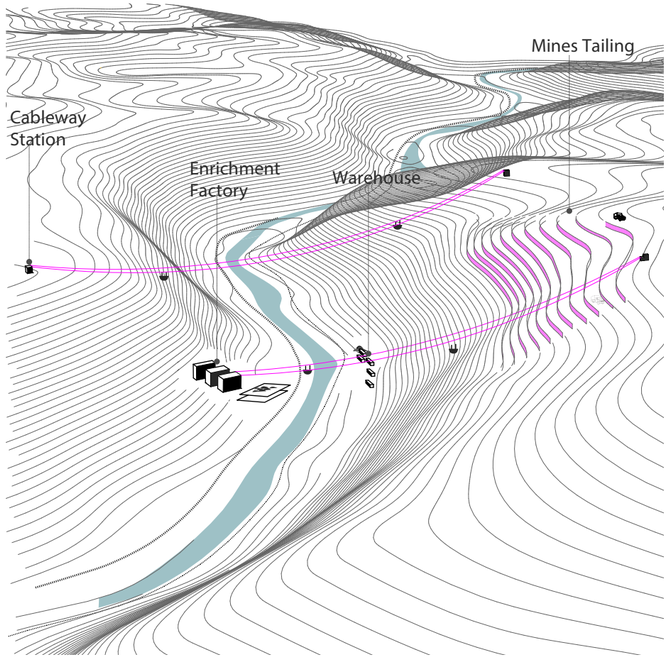
INDUSTRIAL CITY CHIATURA TODAY


Polluted Air
Enrichment Industry MGHVIMEVI
Enrichment Industry DARKVETI
Enrichment Industry COPHI
Former Enrichment Industry PEROF
Polluted River KVIRILA
Mine Tailings
Cable Car Station
Enrichment Industry CDF

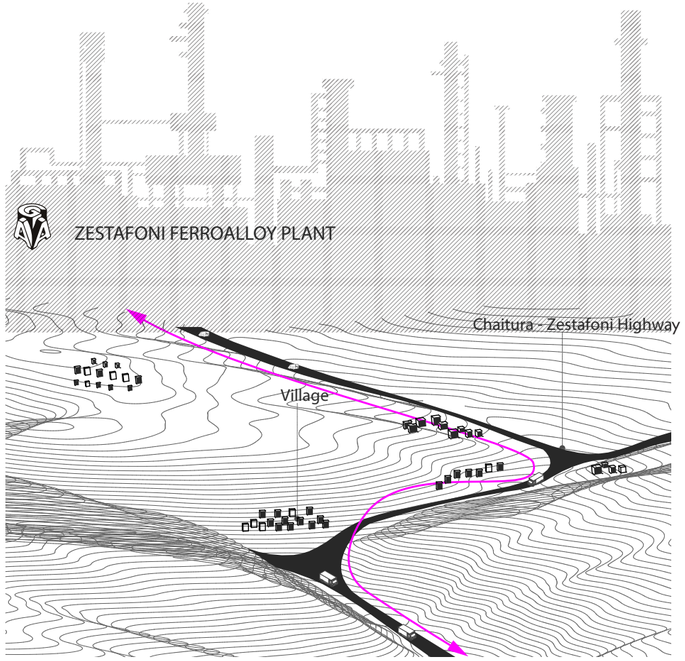
Mining



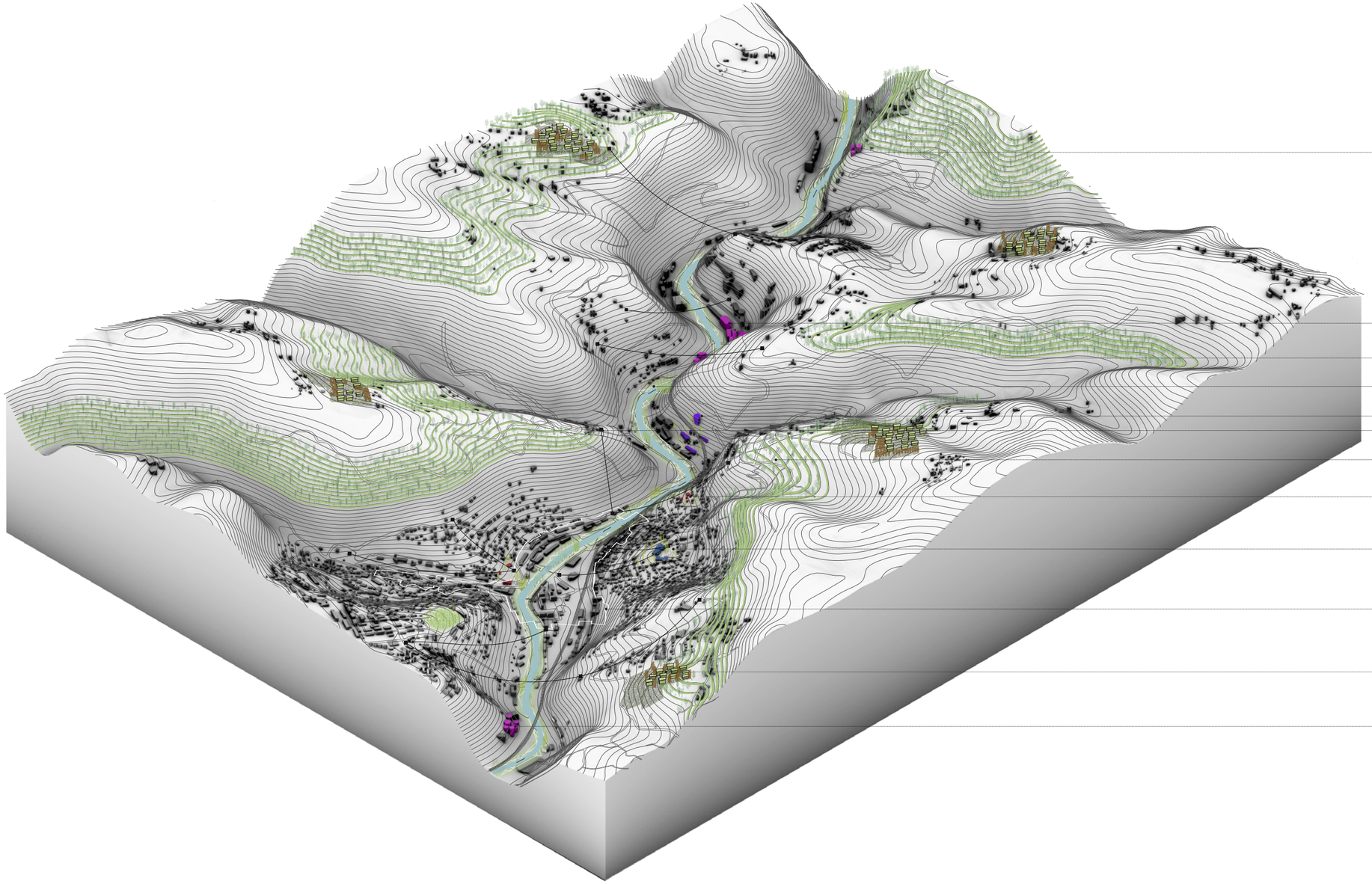
Enrichment



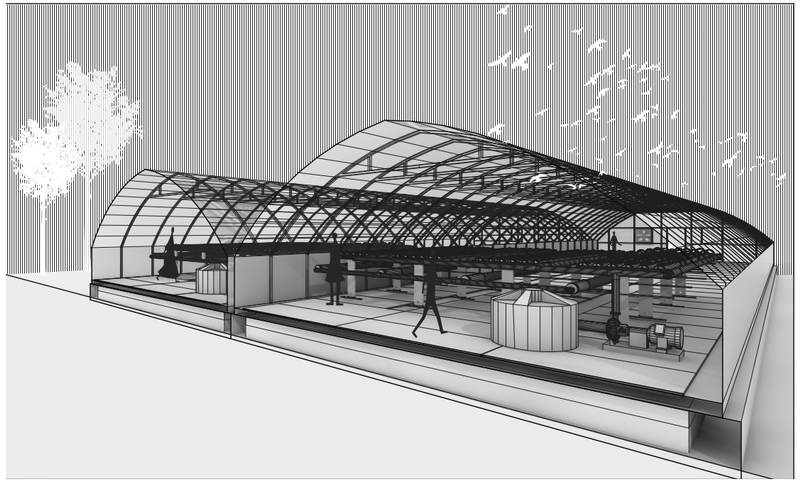
Transportation



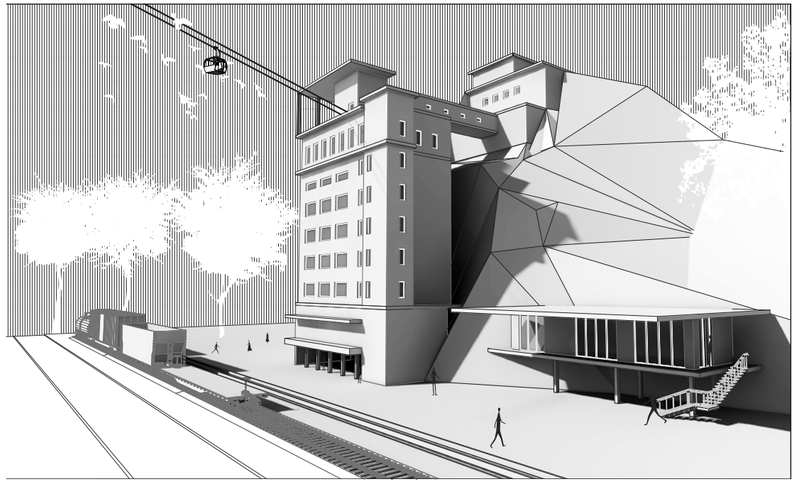
INDUSTRIAL
CITY CHIATURA AFTER 50 YEARS


Enrichment Industry MGHVIMEVI
Enrichment Industry COPHI
Enrichment Industry DARKVETI
Park along the River Kvirila
Research laboratory
Cable Car Station
Land reclamation
Agro market
Hospital
Old city
Hydroponics
Enrichment Industry CDF

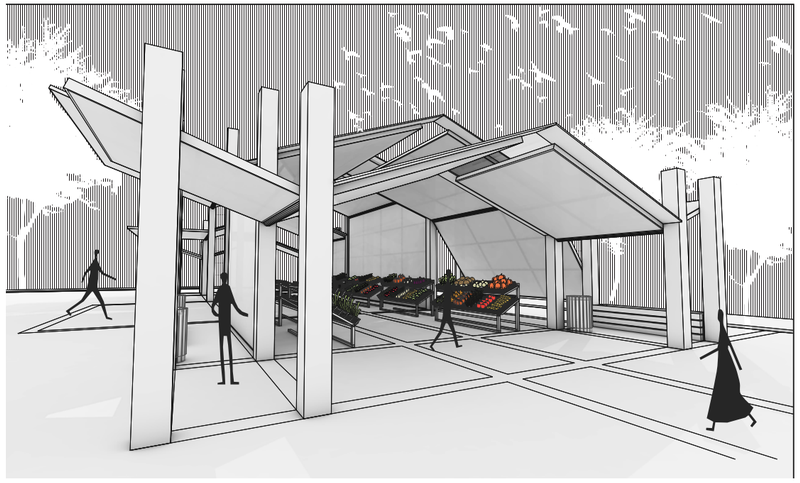
HYDROPONICS



RESEARCH LABORATORY

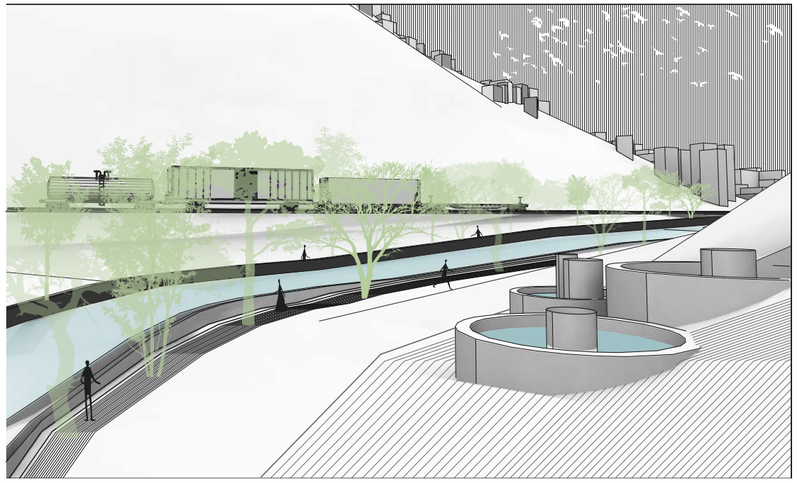


AGRO MARKET



ROPEWAY TRANSPORTATION

PARK ALONG THE RIVER WITH WATER FILTRATION



HYDROPONICS

PROBLEM

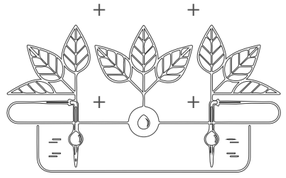
SOIL POLLUTION

- DECREASED SOIL FERTILITY
- CHANGES SOIL STRUCTURE
- EFFECTS ON GROWTH OF PLANT
- TOXIC DUST

→ NO HEALTHY FOOD

SOLUTION

HYDROPONICS



- ZERO SOIL
- 2X GROWTH RATE
- NO WEEDS
- NUTRIENT EFFICIENCY

→ HEALTHY FOOD

SELECTING A PROPER SITE FOR A HYDROPONIC

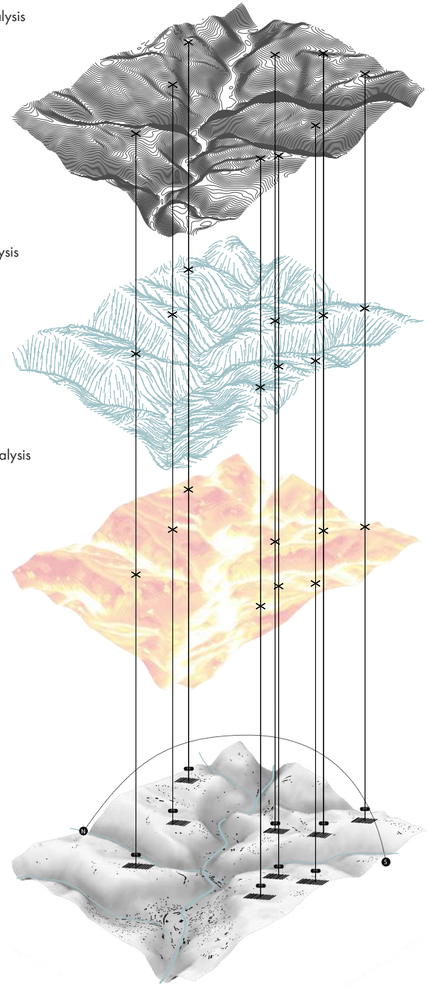
FLAT TOPOGRAPHY — WATER — SOLAR RADIATION — AVAILABILITY OF LABOR

Topography Analysis

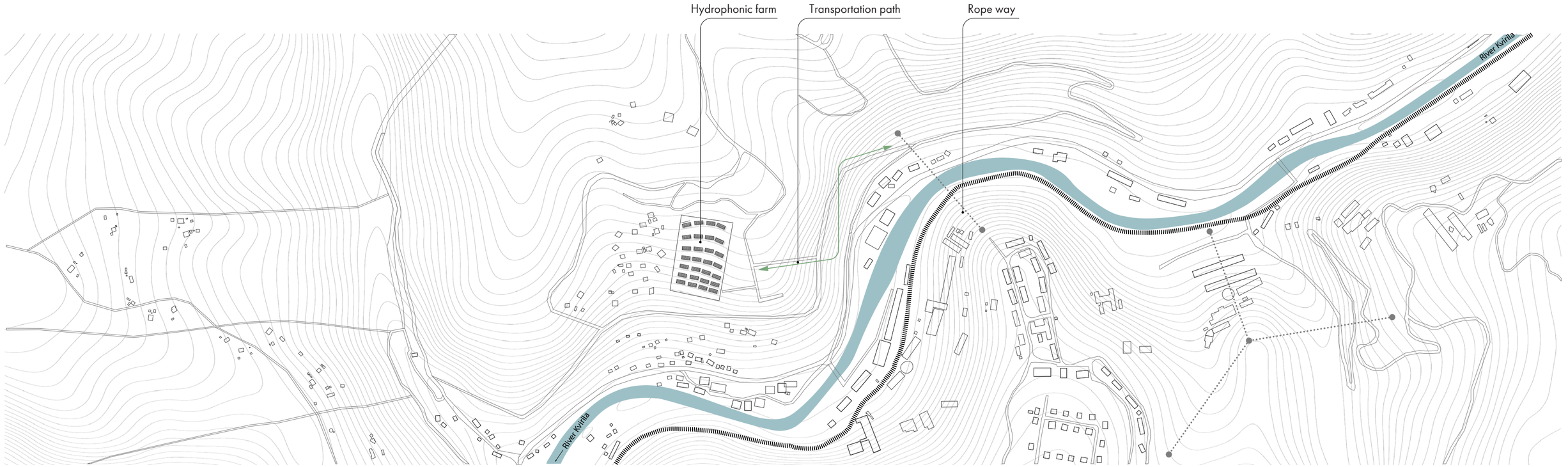
Water flow Analysis

Sun radiation Analysis

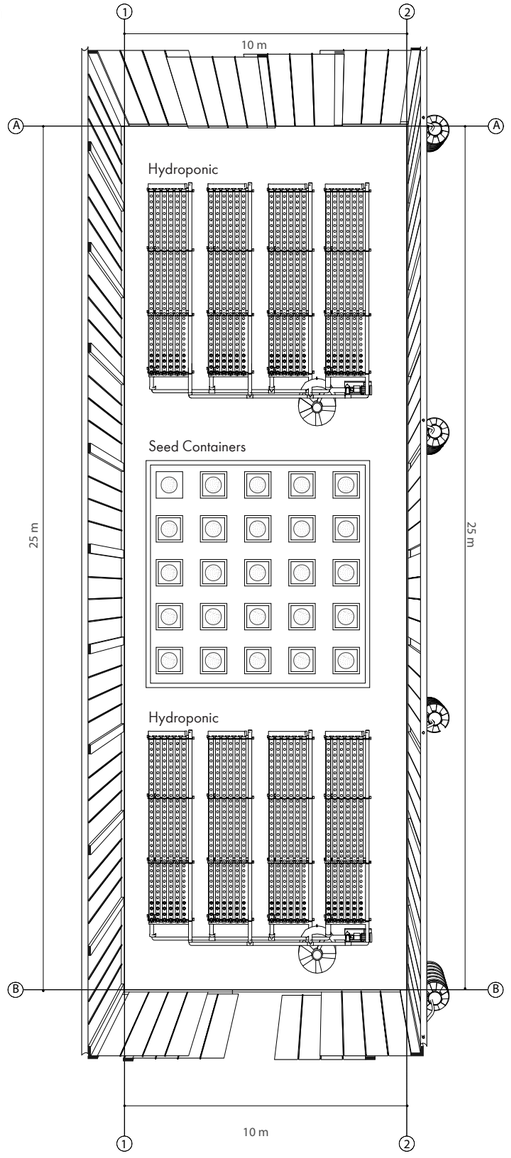
Green Houses



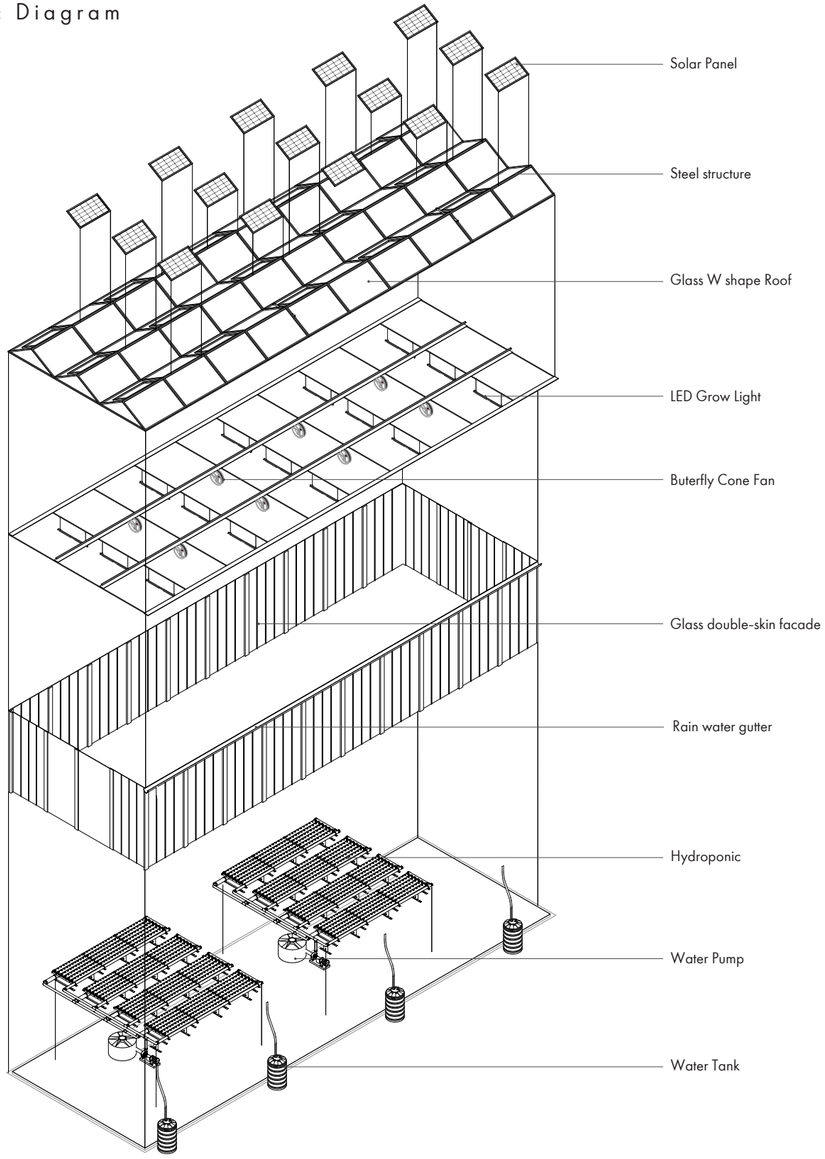
Context Masterplan



Plan



Exploded Axonometric Diagram

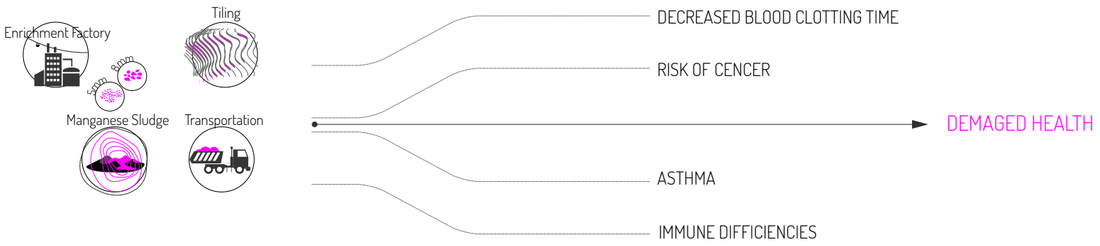


Masterplan

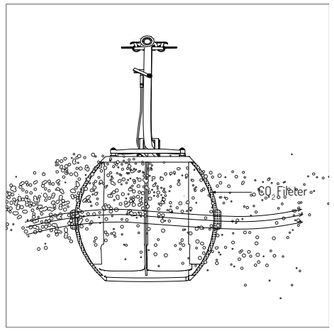
RESEARCH LABORATORY

PROBLEM

AIR POLLUTION AND EFFECTS



SOLUTION

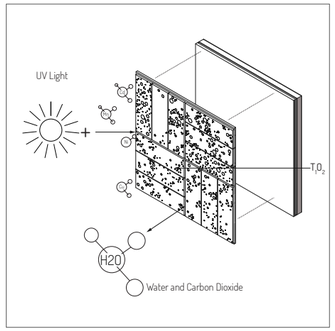


SMOG FREE CABLE CAR

The innovative cable car inhales polluted air, cleans it by carbon dioxide fiilters, and spread clean air to the environment.

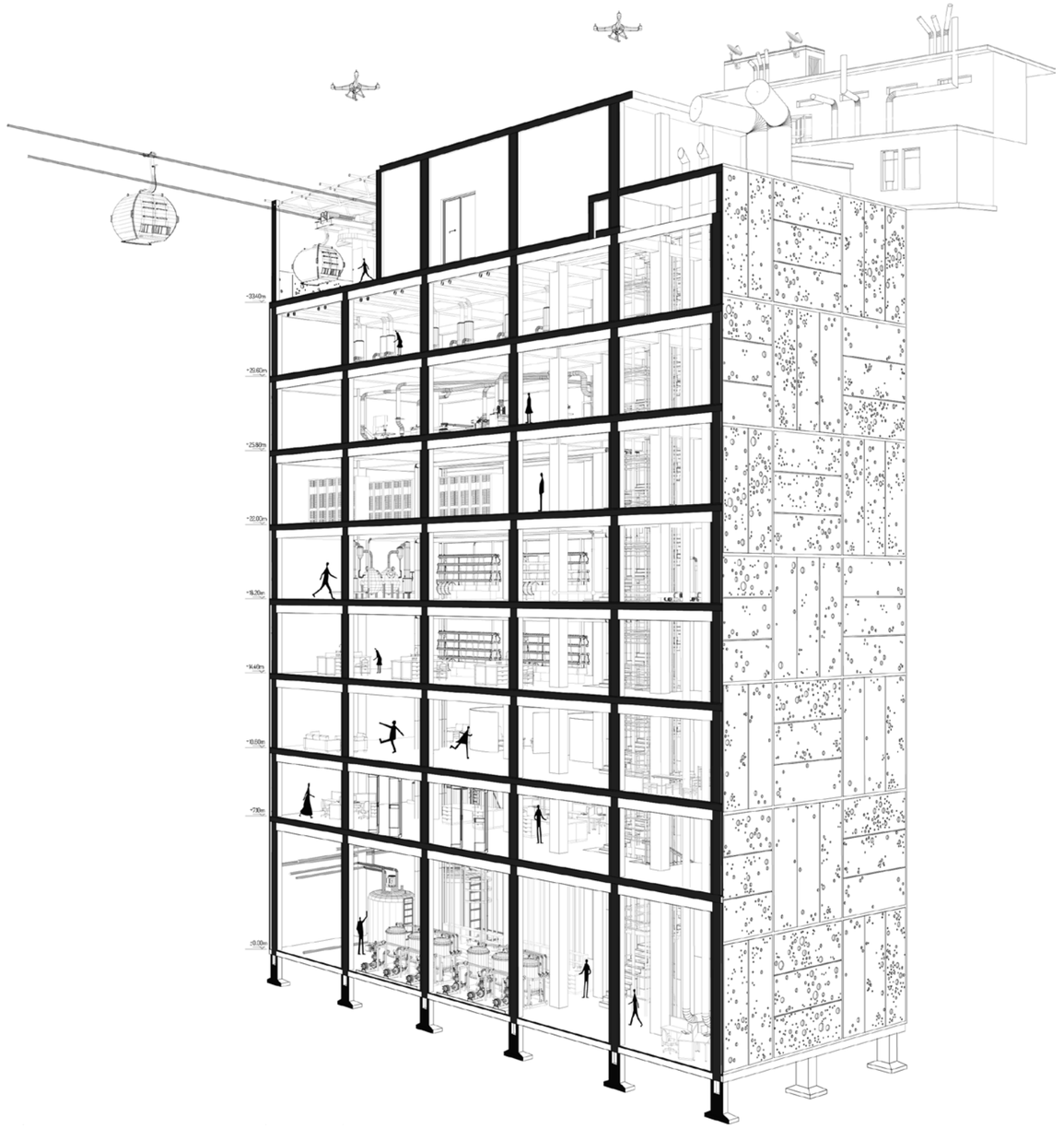
MONITORING AIR POLLUTION DRONES

The drones, used in a study at the Industrial, Energy and Environmental Systems Laboratory of the Technical University of Crete, were able to capture air pollutant emissions and to create a 3D visualization tool of a determined area.

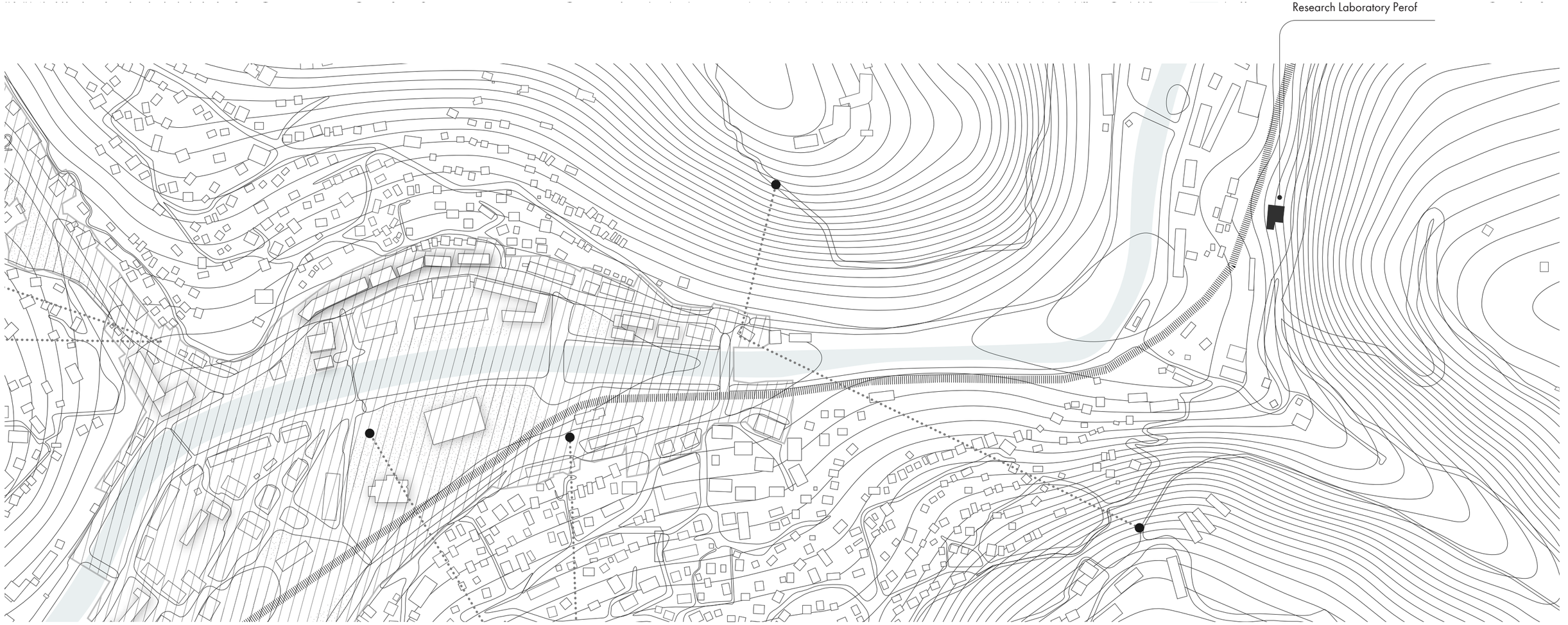


TITANIUM DIOXIDE COATING T1O2

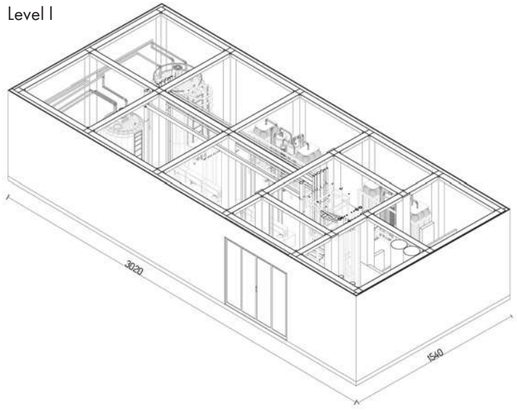
T1O2, is that titanium dioxide is a heterogeneous photocatalyst that uses sunlight to absorb and render oxides of nitrogen (NO and NO2) harmless by converting them to nitrate ions (NO3), which then can be washed away by rain or soaked into the concrete to form stable compounds.



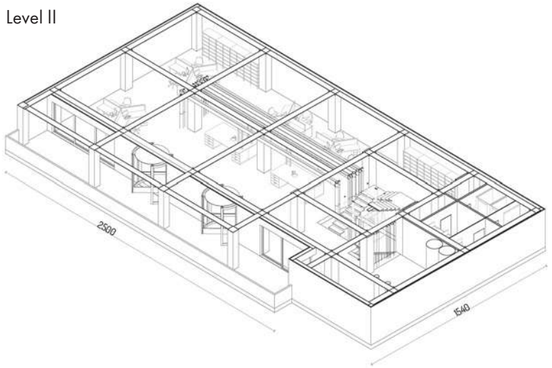
Context Masterplan



Level I



Level II



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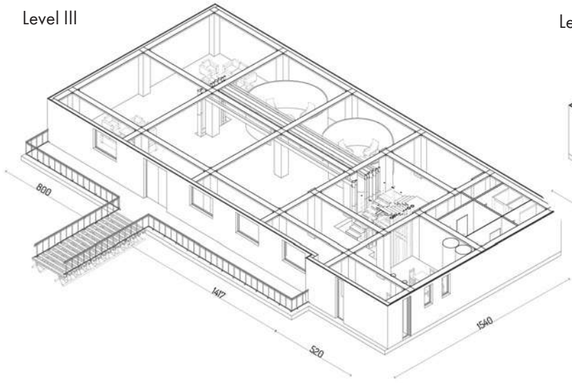

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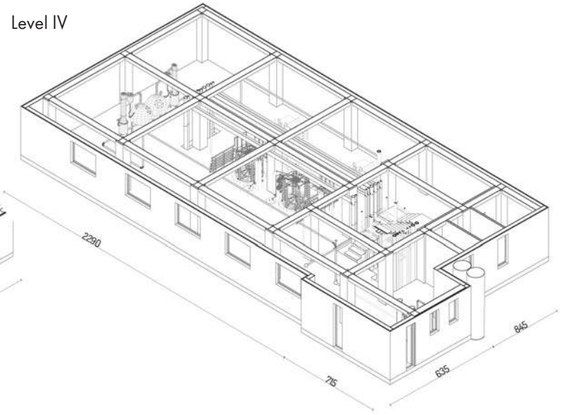

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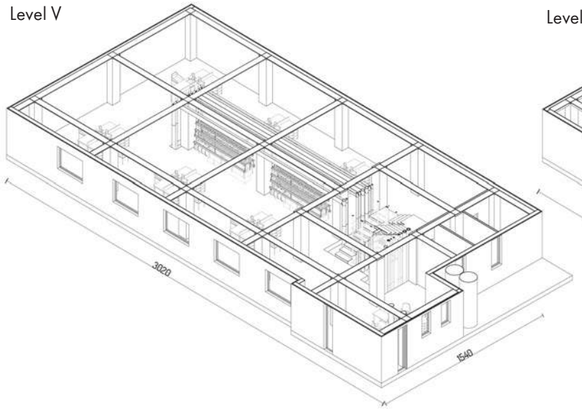

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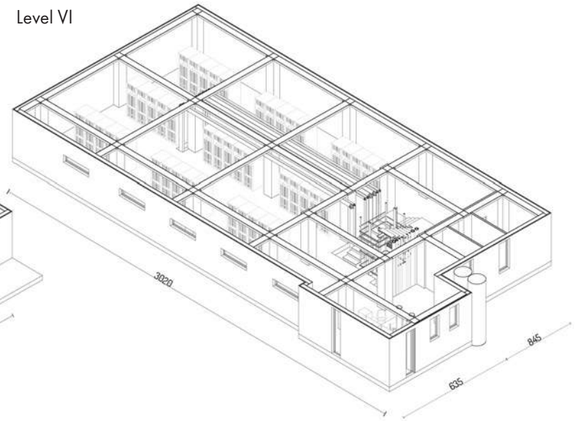

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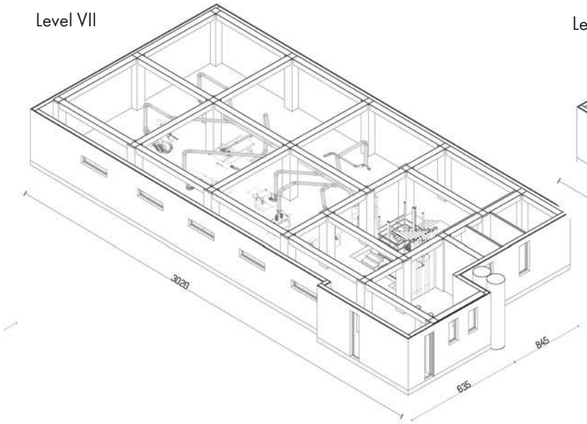
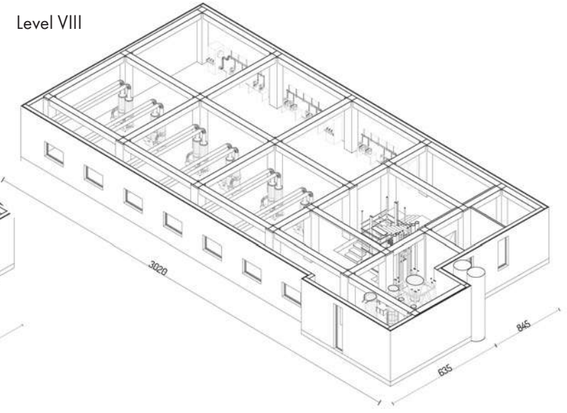


Level VIII



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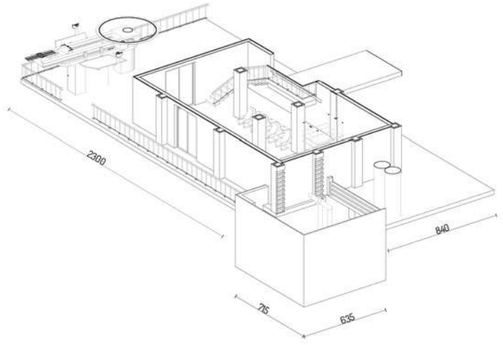
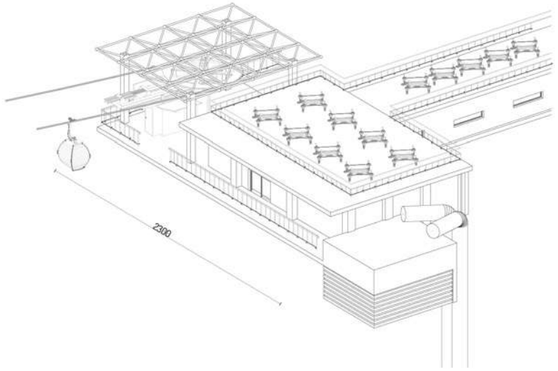


Level X



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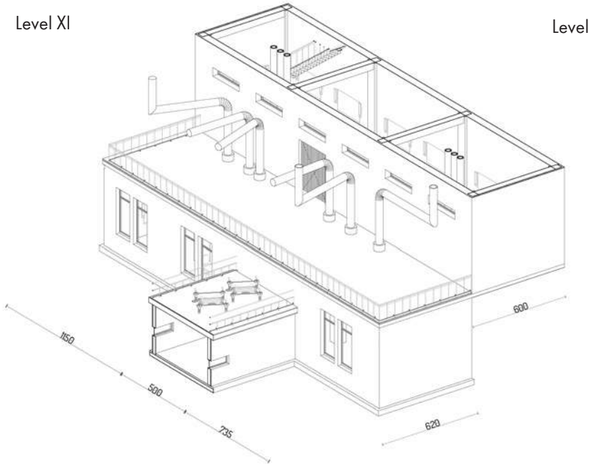

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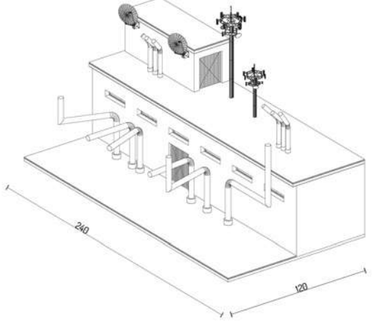
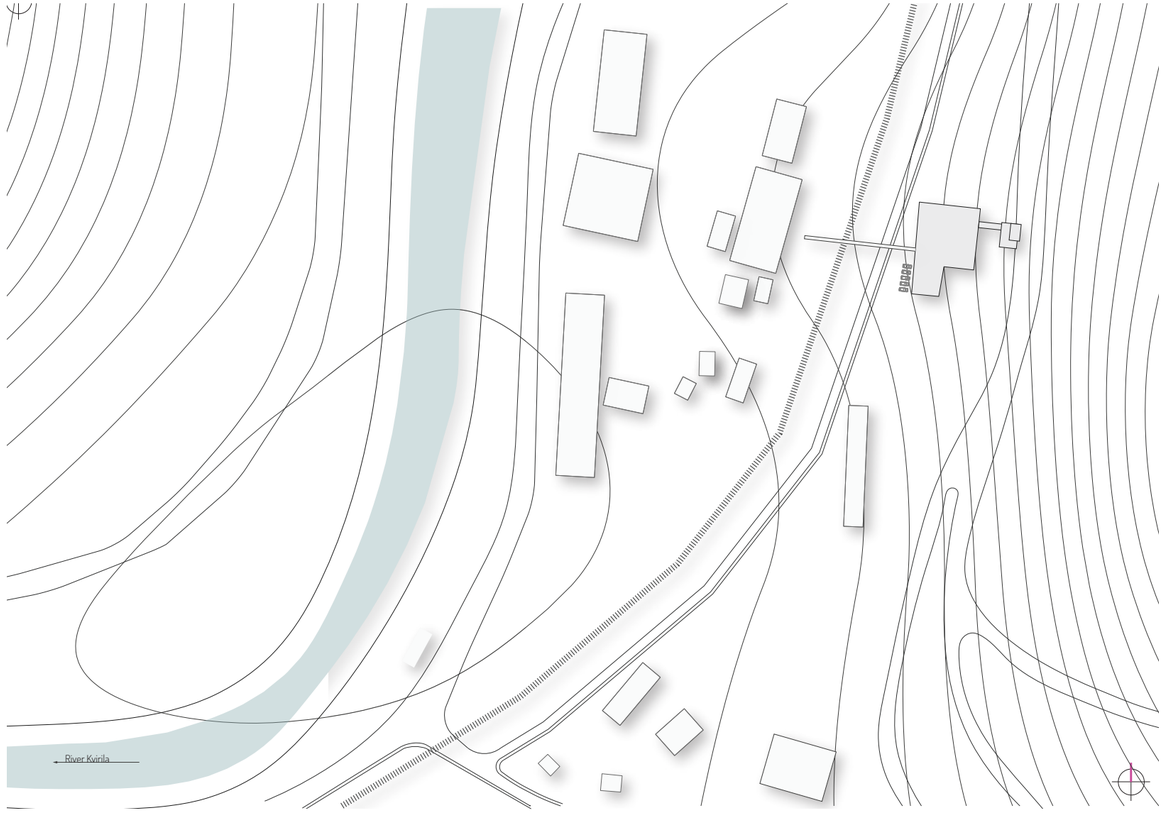
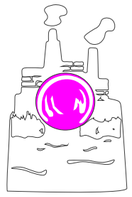




PARK ALONG THE RIVER

RIVER WATER
POLLUTION AND EFFECTS



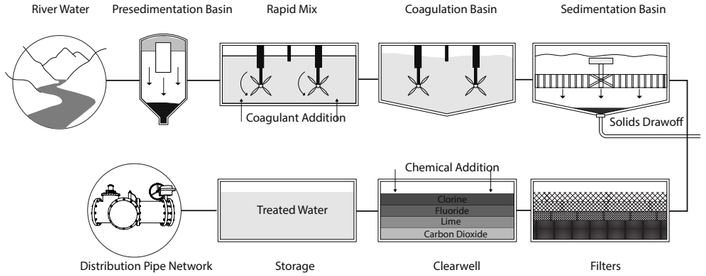
DRINKING WATER POLLUTION

INFECTIOUS DISEASES

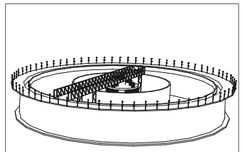
DEMAGED HEALTH

CHONIC HEALTH PROBLEM

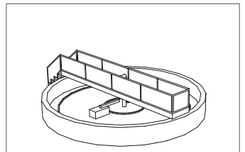
DESTRUCTION OF ECOSYSTEM



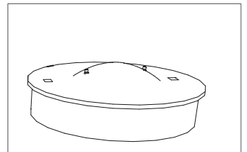
Rapid Mix



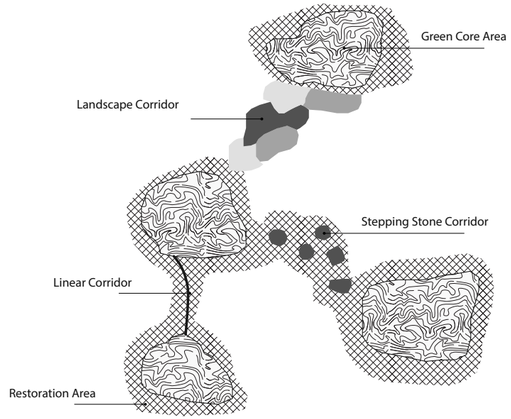
Coagulation Basin



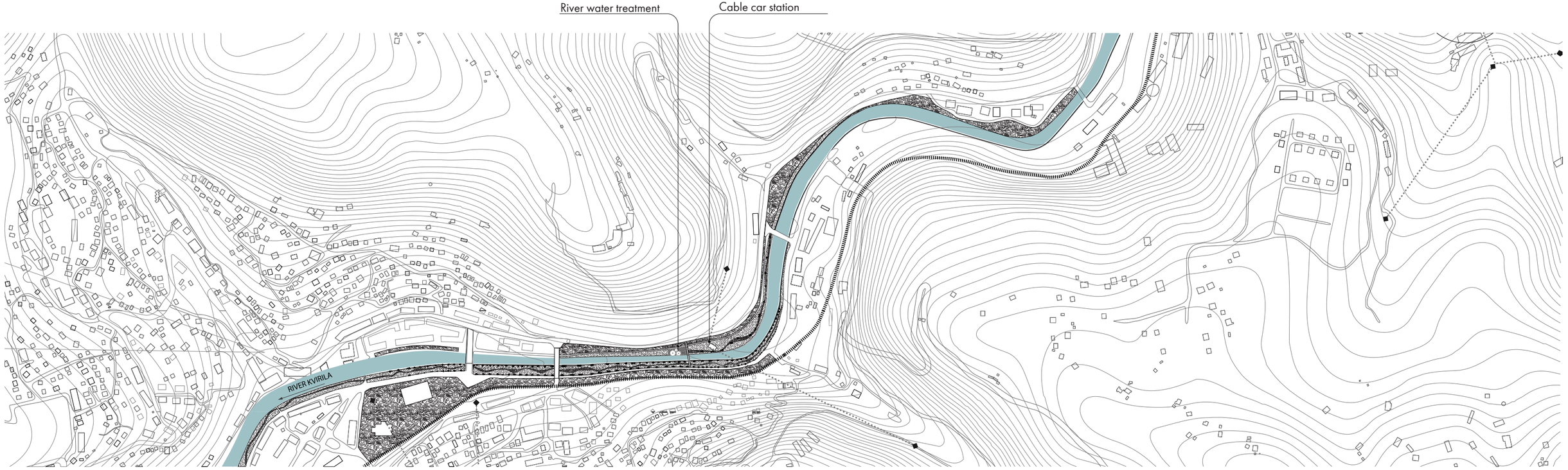
Storage

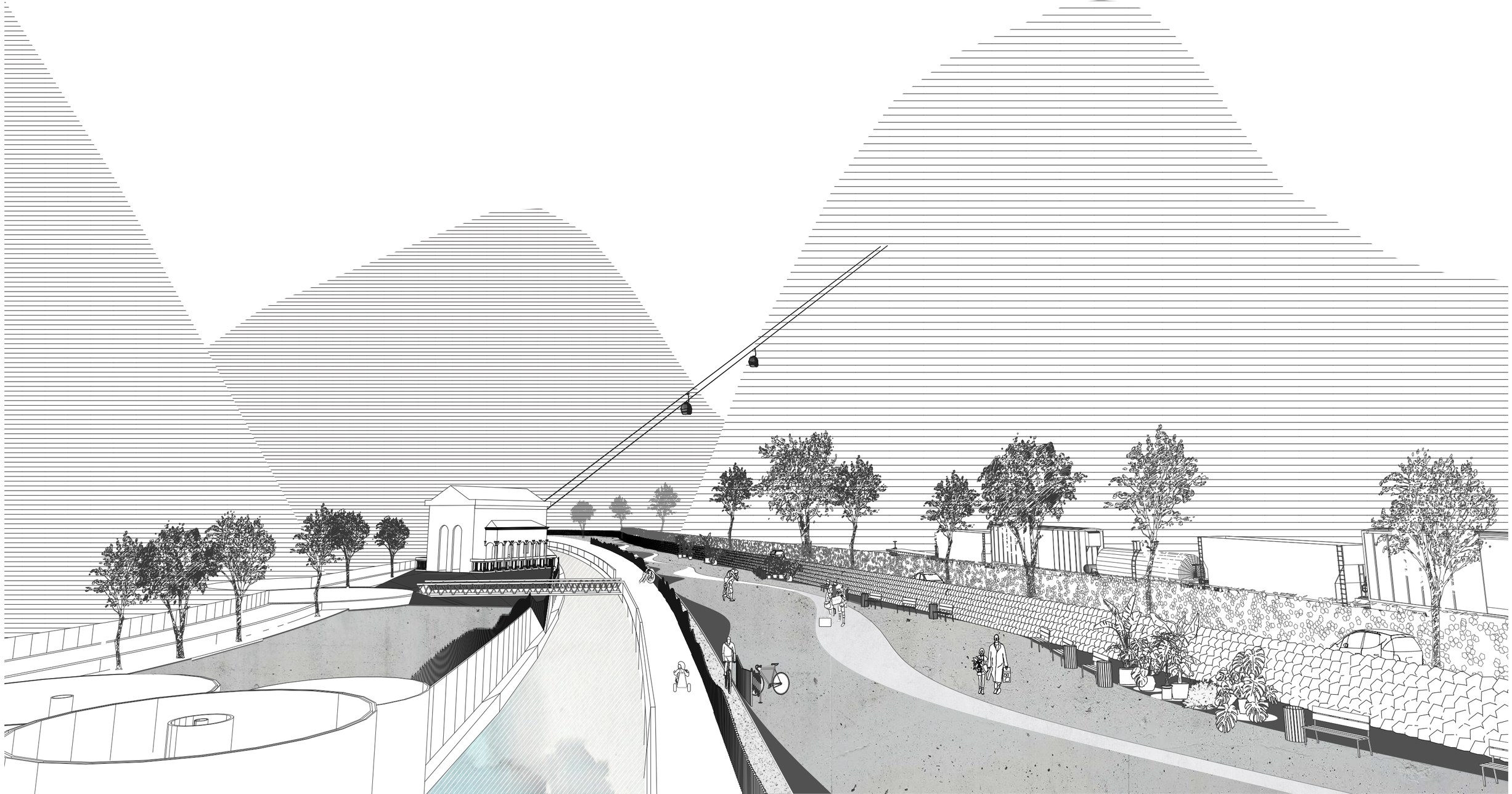


ECOLOGICAL NETWORK

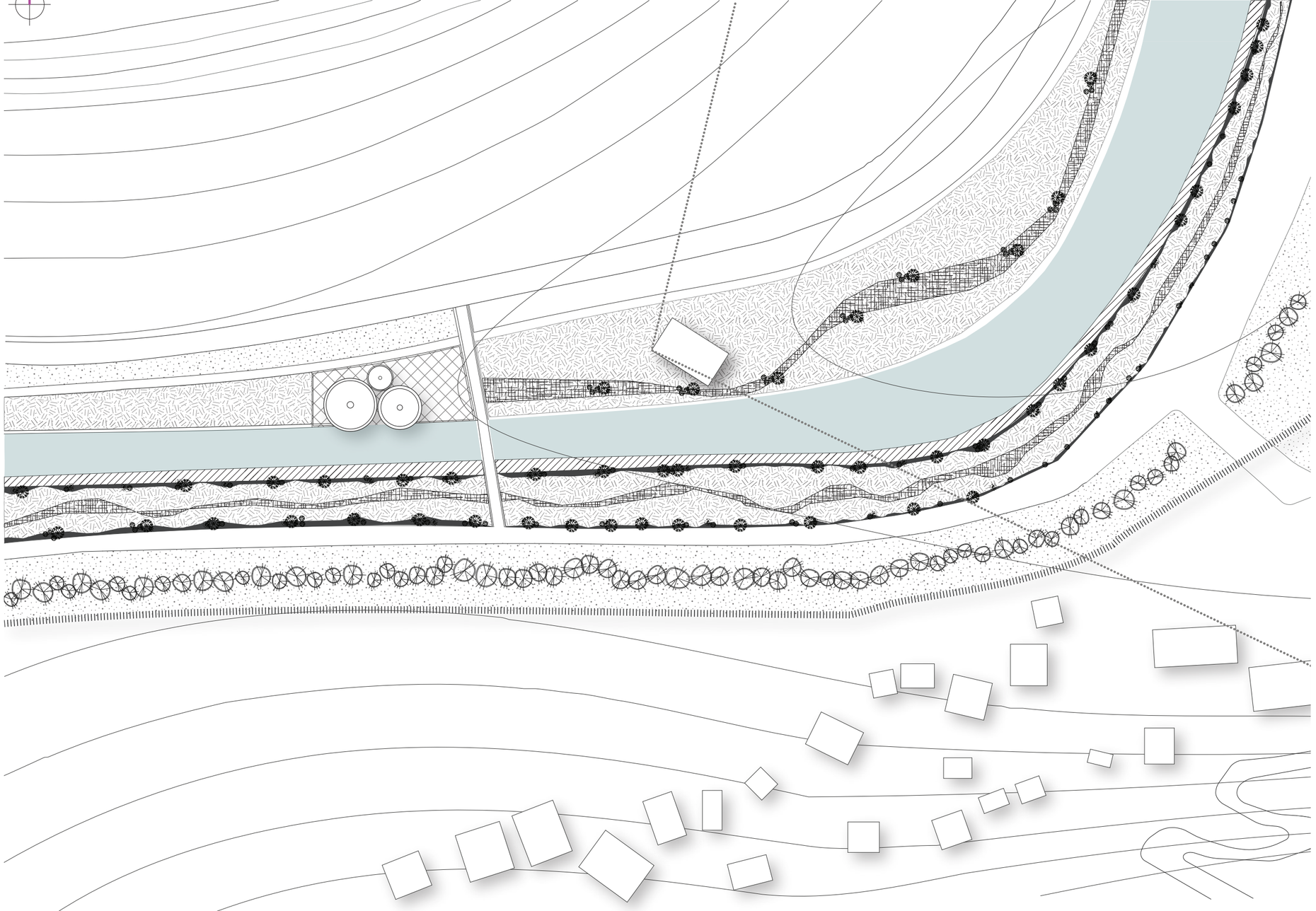


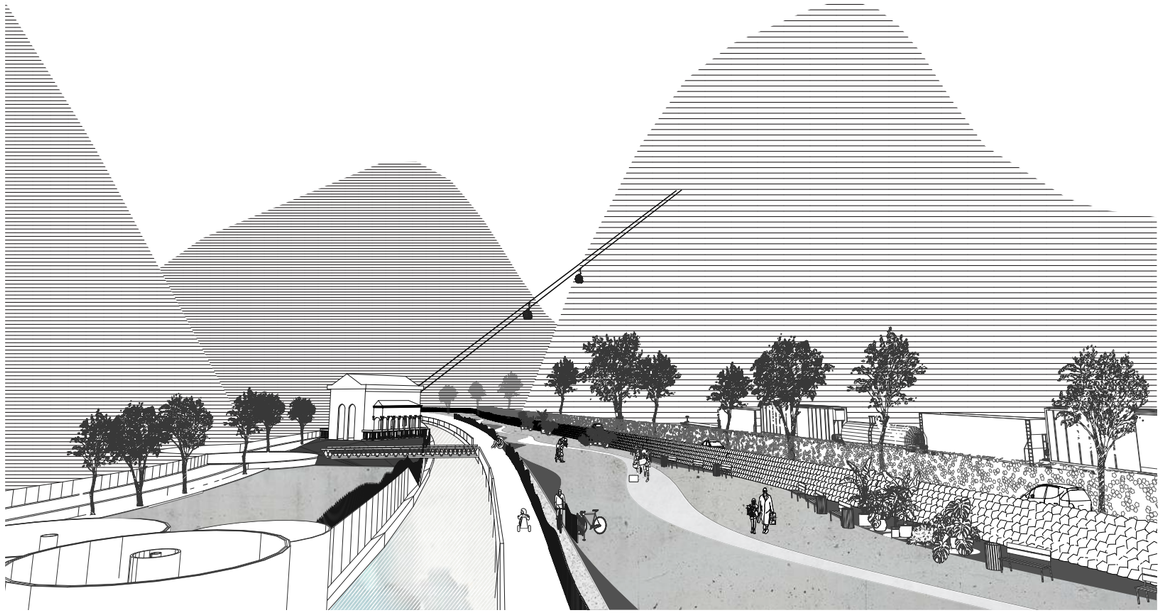
Context Masterplan

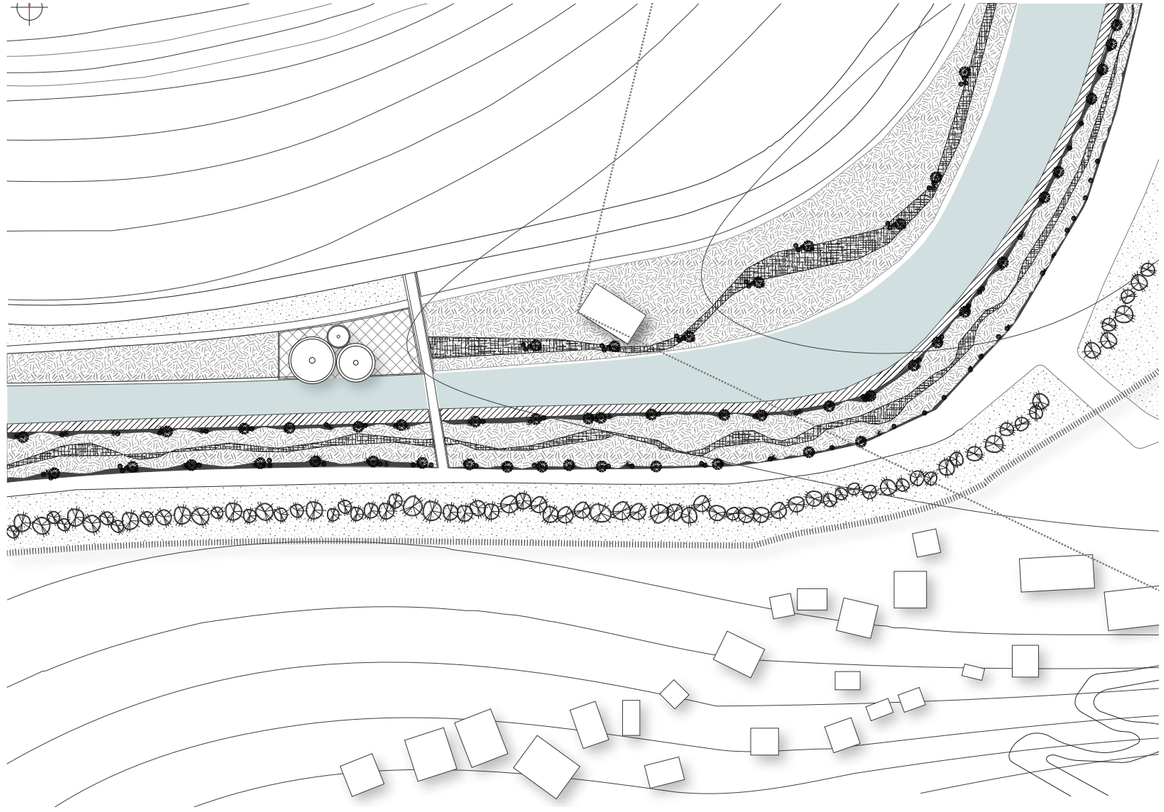


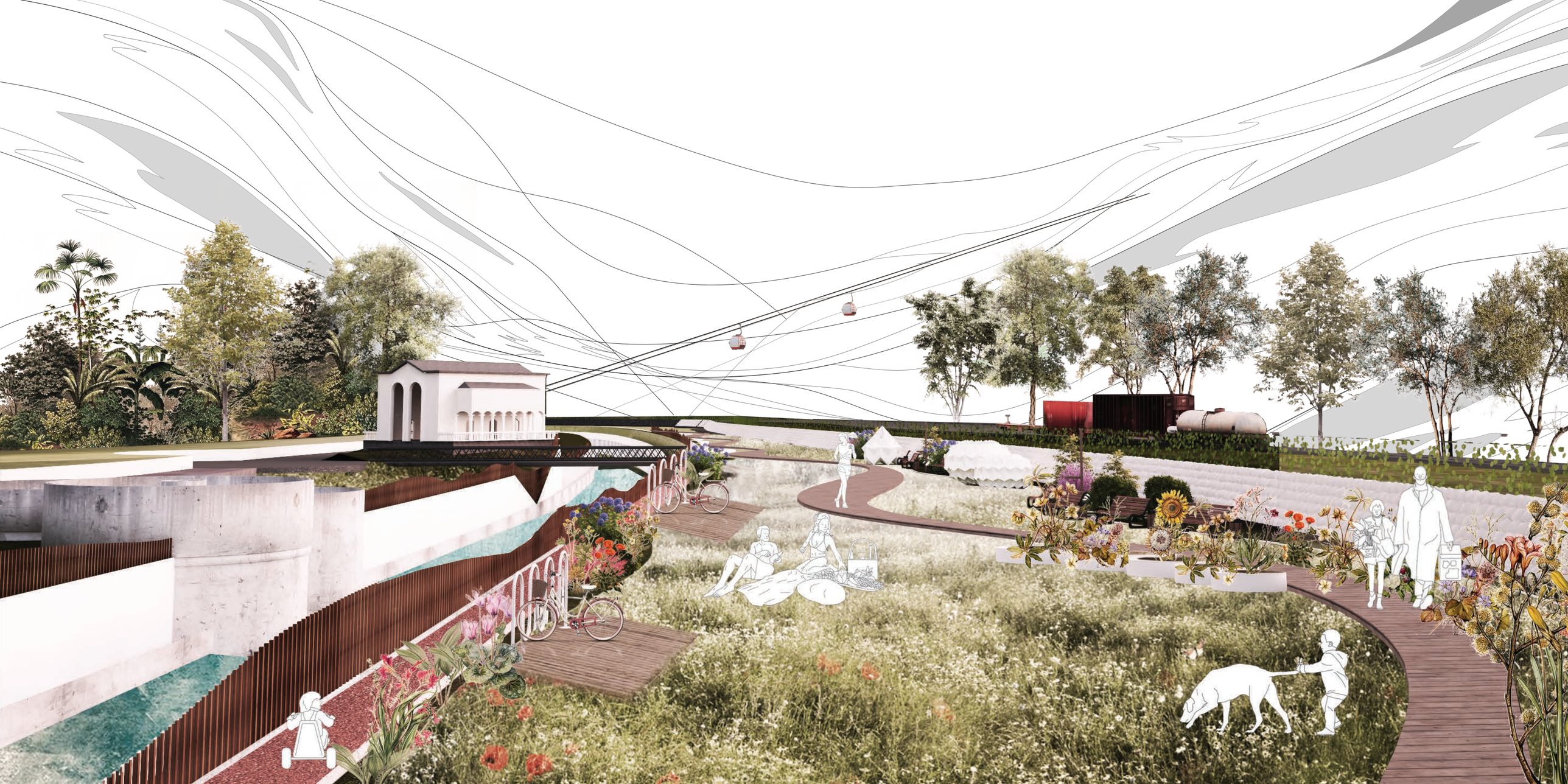


Masterplan

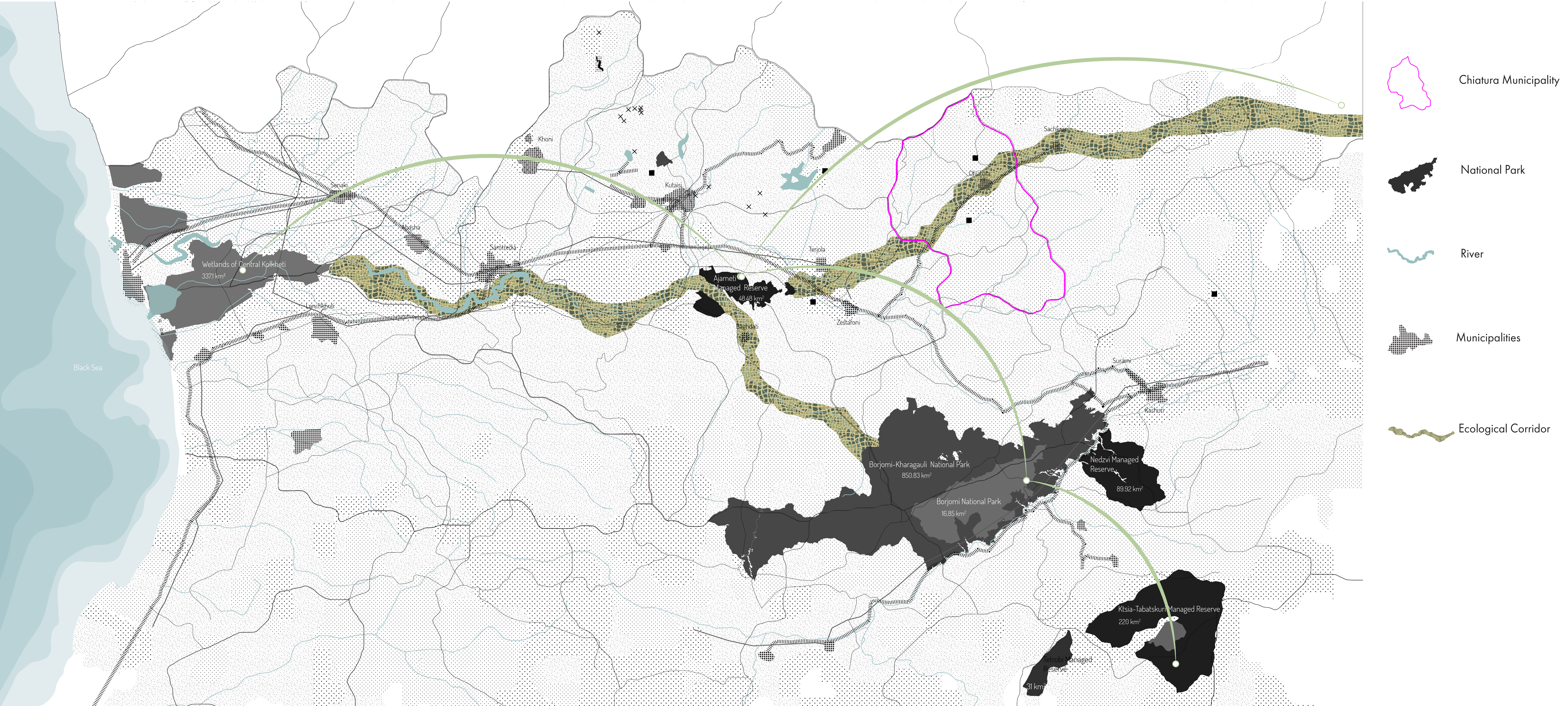








ECOLOGICAL CORRIDOR



Chiatura Municipality
National Park
River
Municipalities
Ecological Corridor
Black Sea
Wetlands of Central Kolkheti
337.1 km²
Senaki
Abasha
Samtredia
Lanchkhuti
Khoni
Kutaisi
Terjola
Ajameti Managed Reserve
48.48 km²
Baghdati
Zestafoni
Chiatura
Sachkere
Surami
Kashuri
Borjomi-Kharagauli National Park
850.83 km²
Borjomi National Park
16,85 km²
Nedzvi Managed Reserve
89.92 km²
Ktsia-Tabatskuri Managed Reserve
220 km²
Tetrobi Managed Reserve
31 km²

BIBLIOGRAPHY