AMERICAN UNIVERSITY OF BEIRUT

UNDERGRADUATE CAPSTONE PROJECT
IN
LANDSCAPE ARCHITECTURE

SUBMITTAL FORM

Nahr El Kalb: Reviving the Ecological Corridor

by

Deema Abdul Rahman

LDEM 242- ADVANCED DESIGN
SPRING 2017-2018
CAPSTONE PROJECT COORDINATOR:
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Date of project presentation: **May, 10, 2020**

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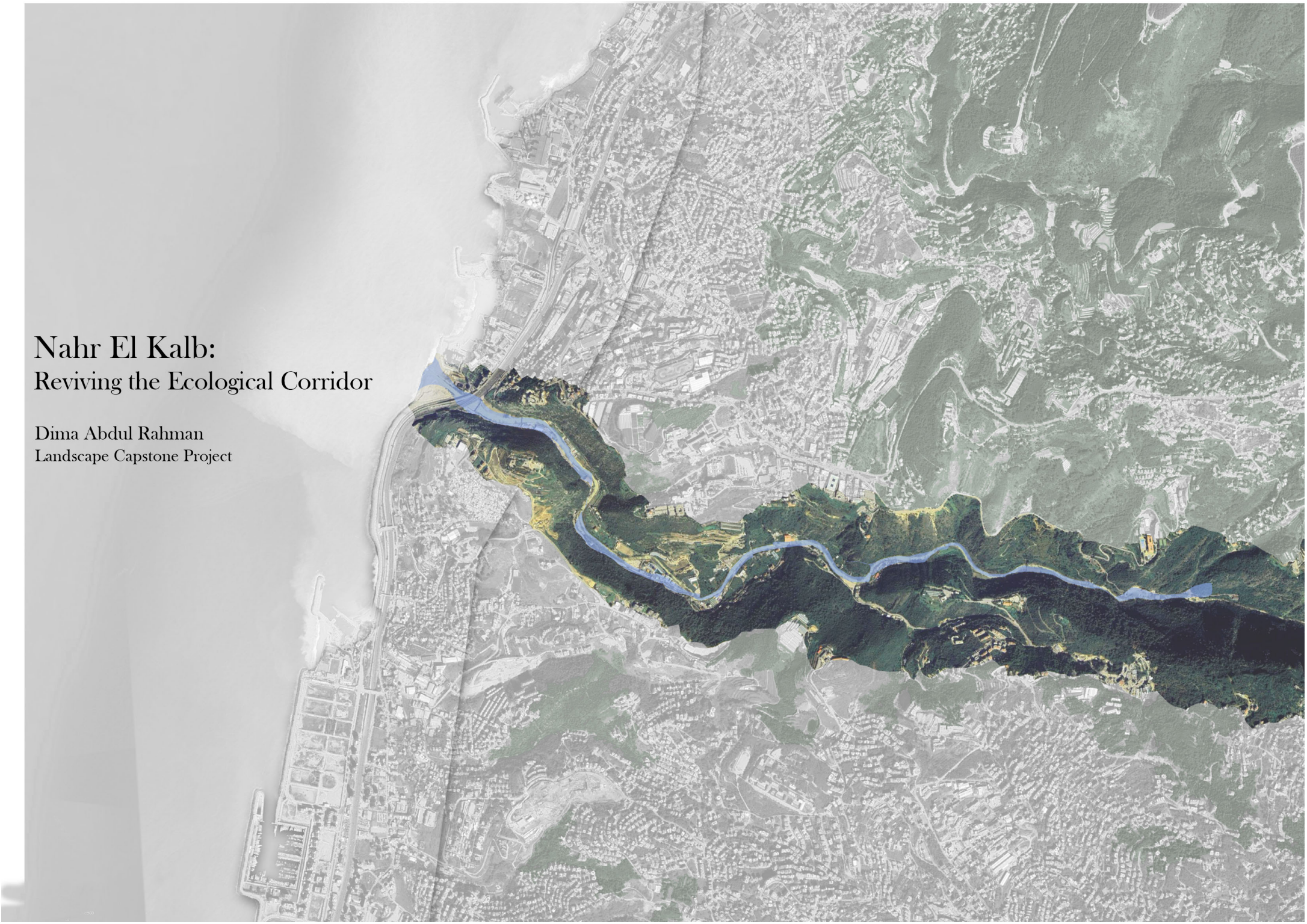
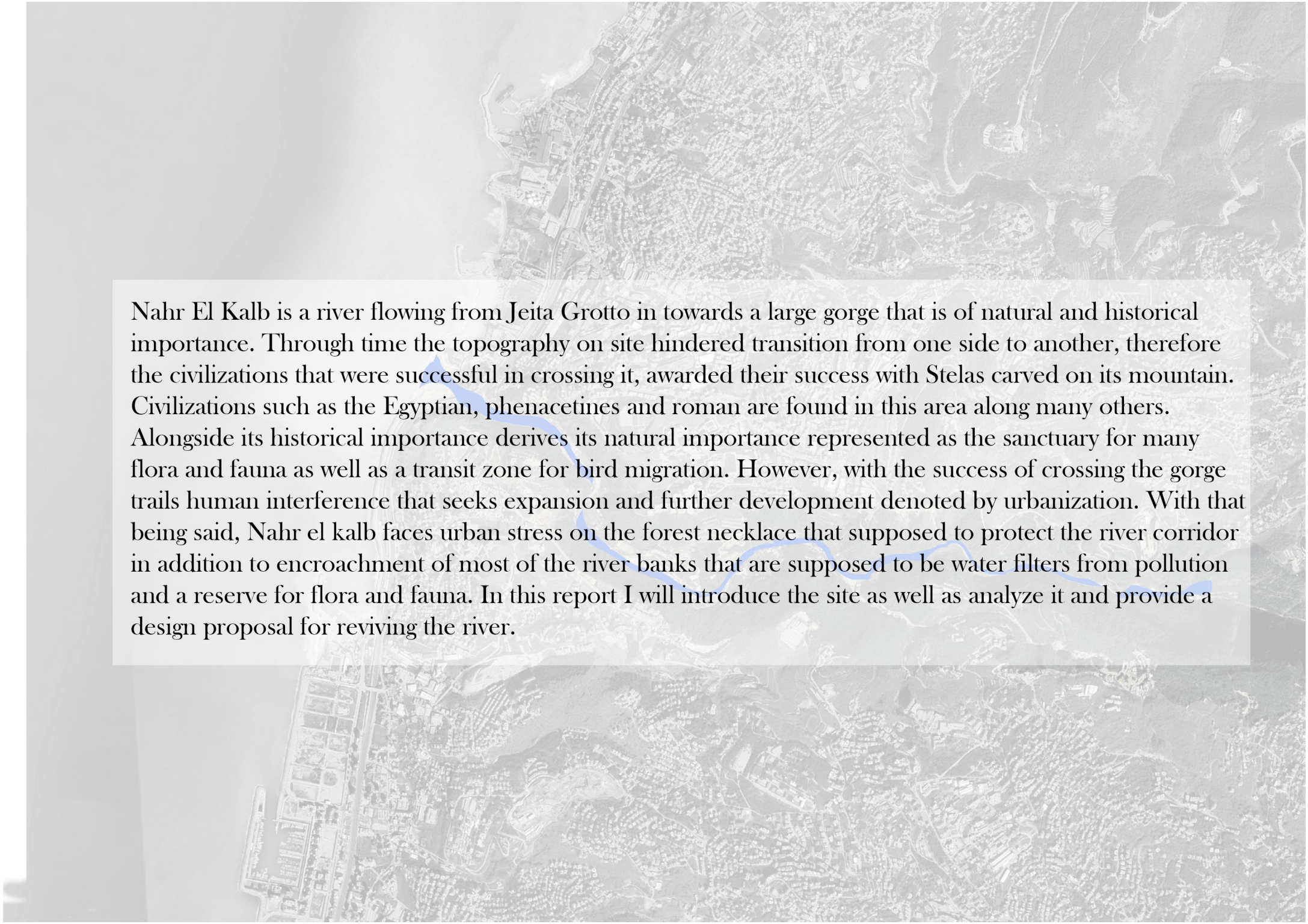
Nahr El Kalb:
Reviving the Ecological Corridor

Dima Abdul Rahman
Landscape Capstone Project





Nahr El Kalb is a river flowing from Jeita Grotto in towards a large gorge that is of natural and historical importance. Through time the topography on site hindered transition from one side to another, therefore the civilizations that were successful in crossing it, awarded their success with Stelas carved on its mountain. Civilizations such as the Egyptian, phenacetines and roman are found in this area along many others. Alongside its historical importance derives its natural importance represented as the sanctuary for many flora and fauna as well as a transit zone for bird migration. However, with the success of crossing the gorge trails human interference that seeks expansion and further development denoted by urbanization. With that being said, Nahr el kalb faces urban stress on the forest necklace that supposed to protect the river corridor in addition to encroachment of most of the river banks that are supposed to be water filters from pollution and a reserve for flora and fauna. In this report I will introduce the site as well as analyze it and provide a design proposal for reviving the river.

Nahr El Kalb:
Reviving the Ecological Corridor

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Reviving the Ecological Corridor

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Phase I Introduction:

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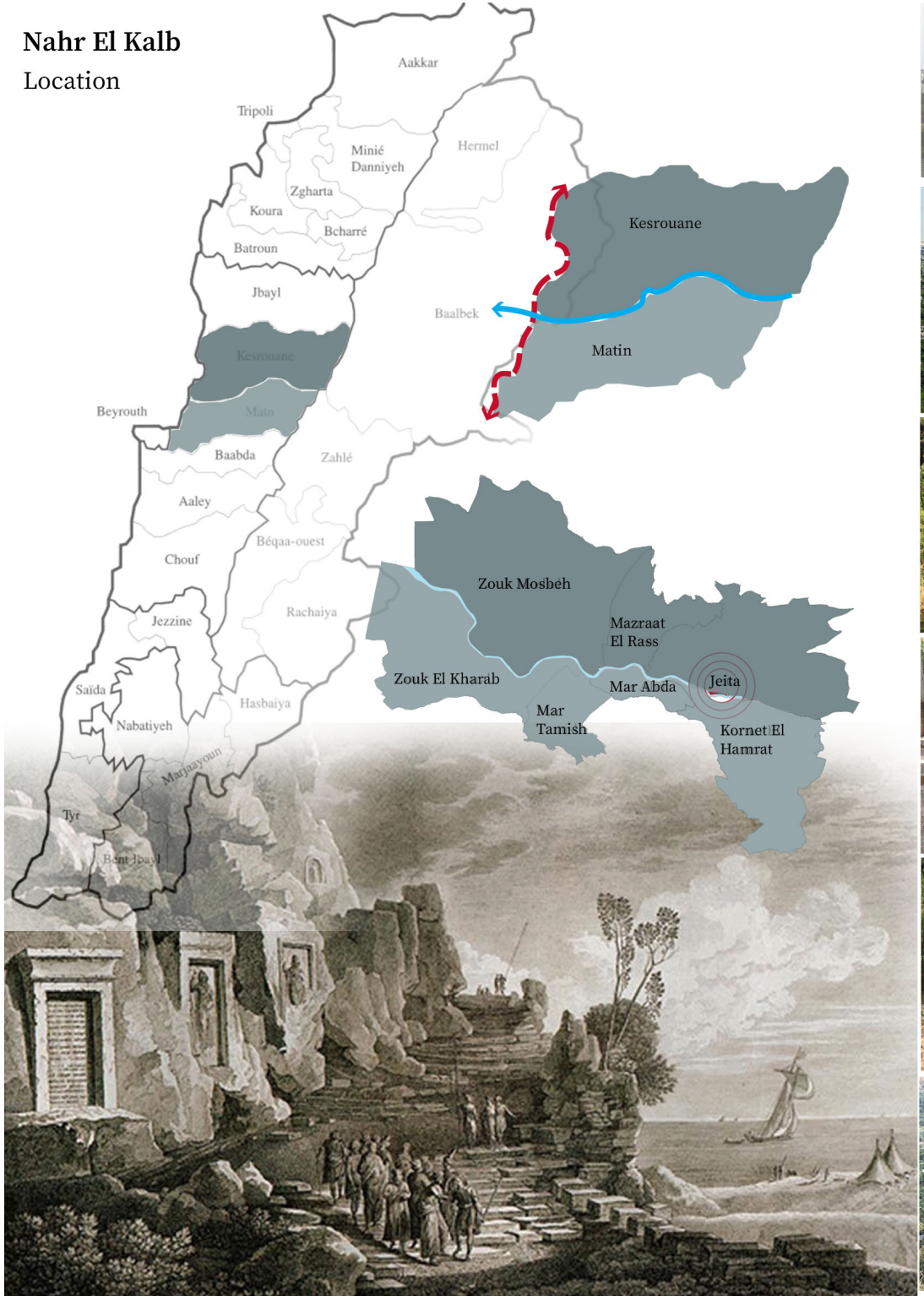
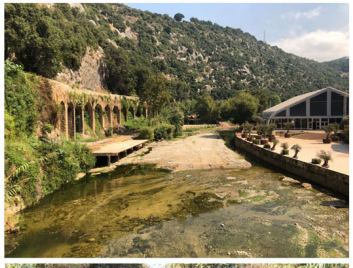
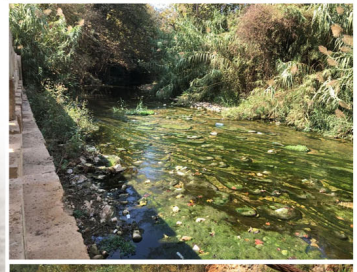
Nahr El Kalb

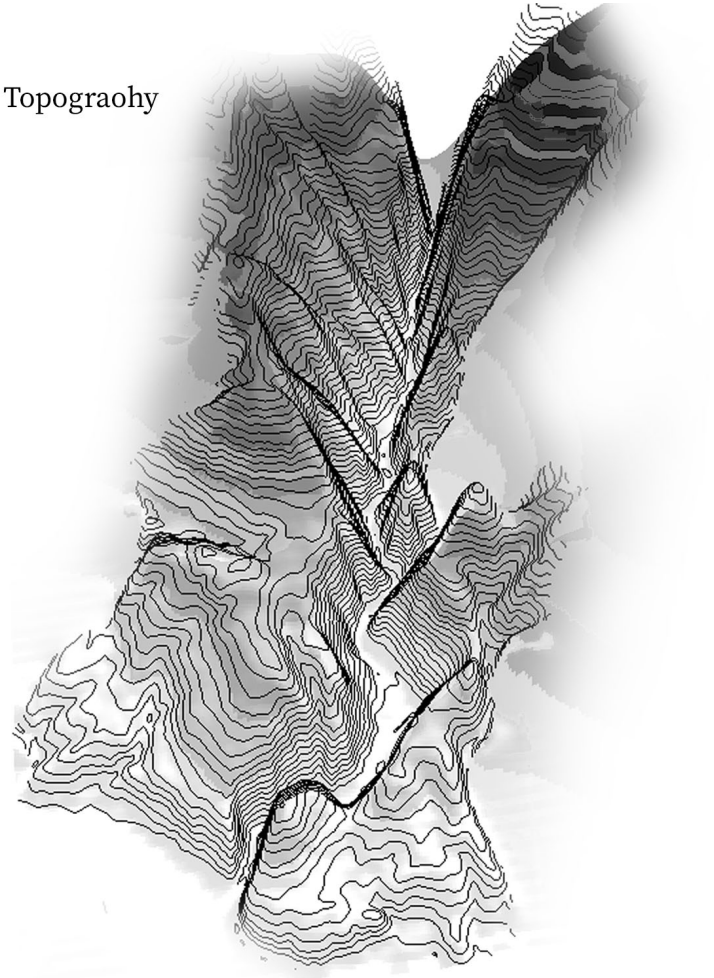
Location



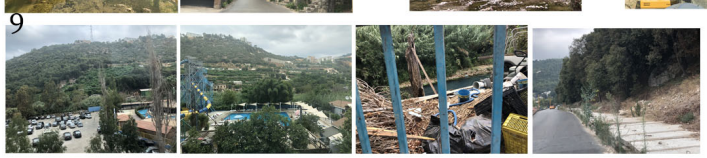


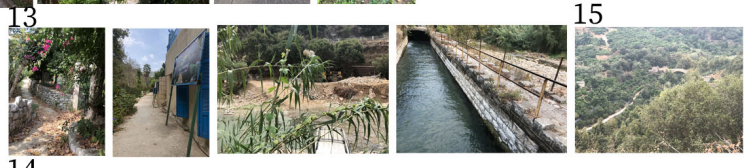


Topograohy



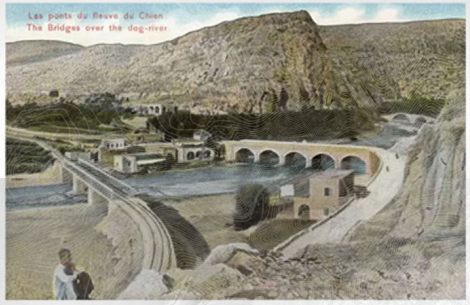
Images of the site





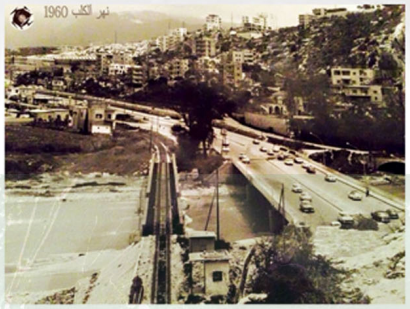
NAHR EL-KALB OVER TIME

1887



1930

1952

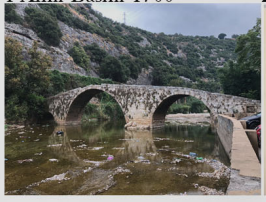


1960

2018

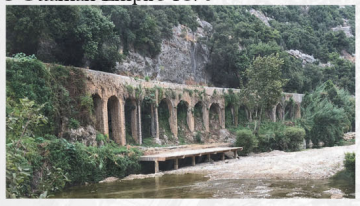
Nahr El Kalb Landmarks

1 Amir Bashir 1700

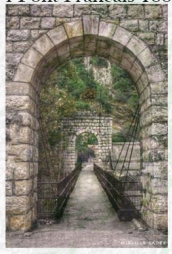


2 Pont Ottaman 1870

3 Ottaman Empire 1870



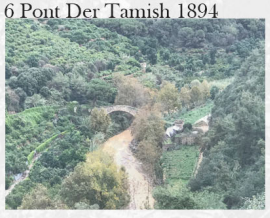
4 Pont Francais 1880

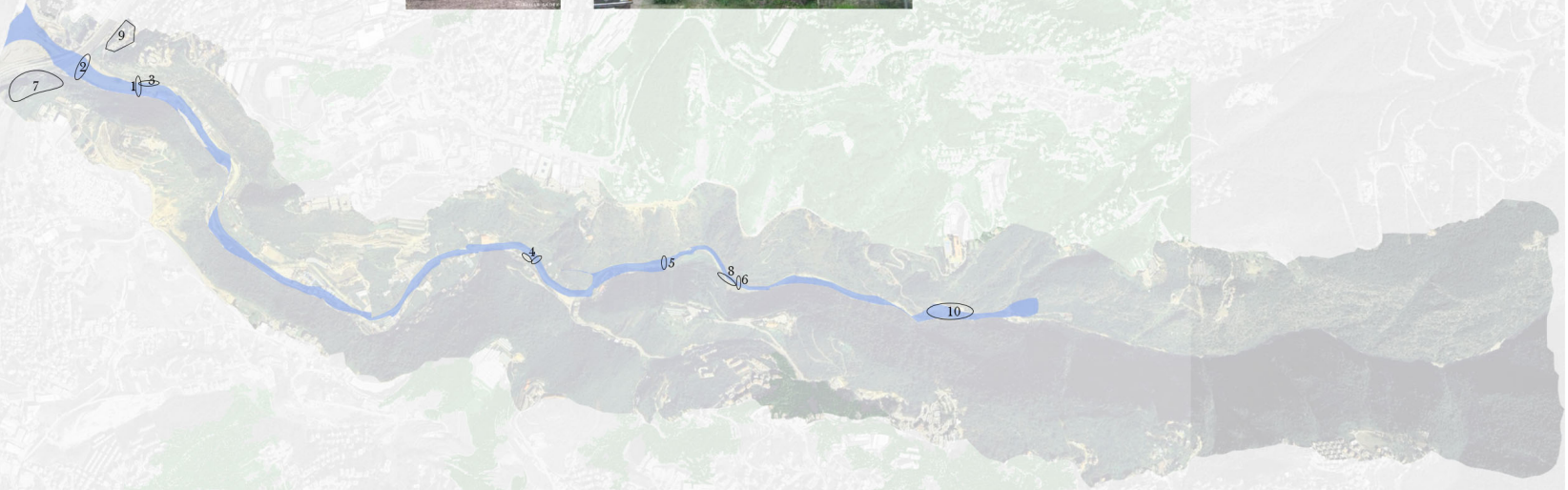


4 Cannal D'eau Francaise 1880

5 Pont Mar Abda 1883

6 Pont Der Tamish 1894





7 Jabal al Asar (Mountain of Monuments)

8 Windmill

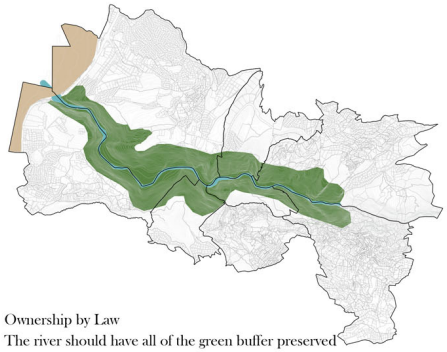
9 Jesus is King

10 Jeita Grotto

Nahr El Kalb

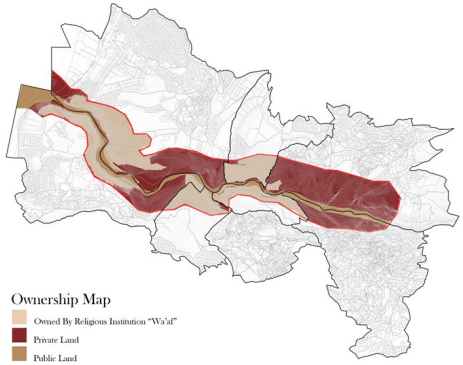
Understanding The Context

Understanding the context begins by labeling the site's main features, how is the site occupied and the different activities happening on it.



Ownership by Law

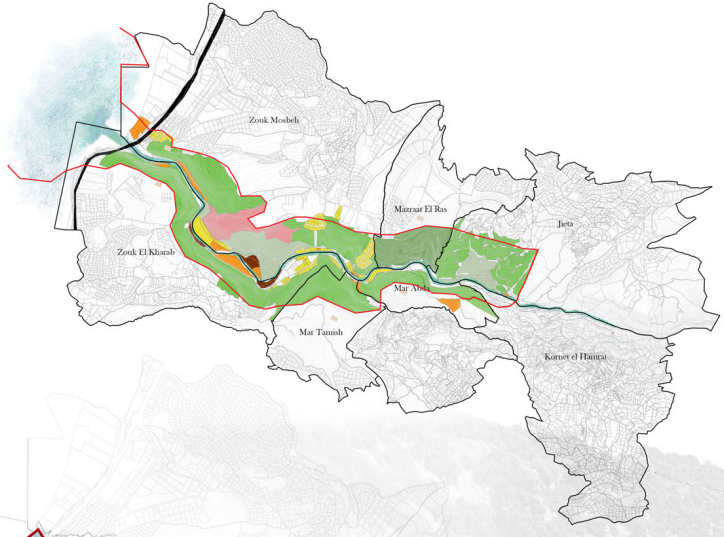
The river should have all of the green buffer preserved as a connecting patch for various species of flora and fauna, prevents erosion and keeps the river clean.
Costal area should be purely sand since it is an important location for fish and marine life



Ownership Map

- Owned By Religious Institution "Wa'af"
- Private Land
- Public Land

Eventhough the site is considered an Important Ecological area it is not treated in the proper way



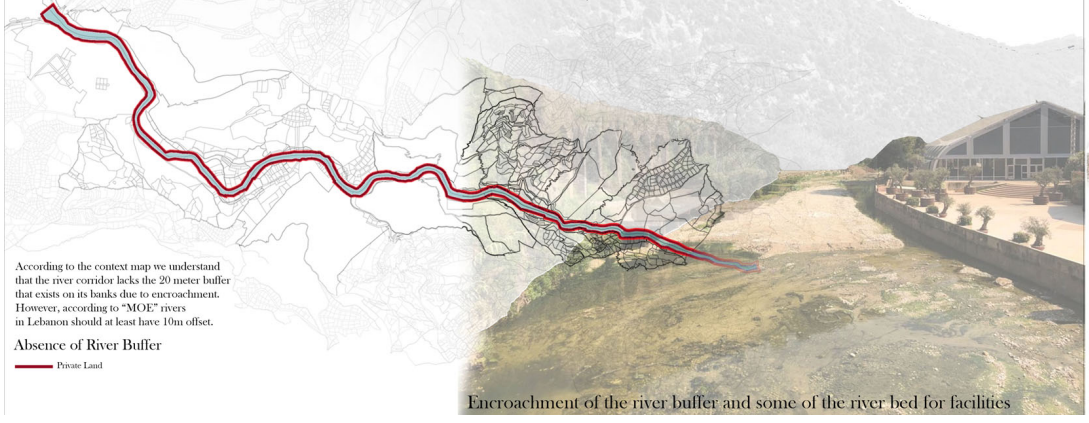
Labeling the landuse on site helps us understand how the site's is occupied and if its is used properly according to its context

The context map shows that most of the activities are found next to the river bed with minimal to no space for buffer.

Investigating the sites social activity is neccessary to comprehand further why most of the site activity is located on the riverbed

LandUse Map
Scale 1:1500

- Residential Communities
- Forest
- Shrubland
- Agriculture
- Religious Institution
- Touristic areas
- Industrial Site
- Educational Institutions



According to the context map we understand that the river corridor lacks the 20 meter buffer that exists on its banks due to encroachment. However, according to "MOE" rivers in Lebanon should at least have 10m offset.

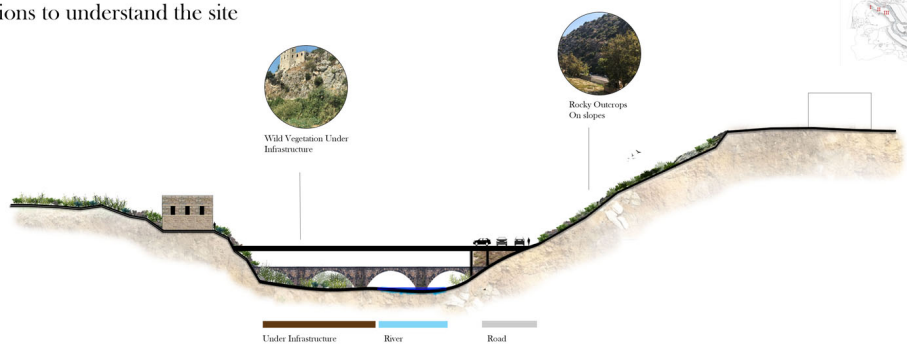
Absence of River Buffer

- Private Land

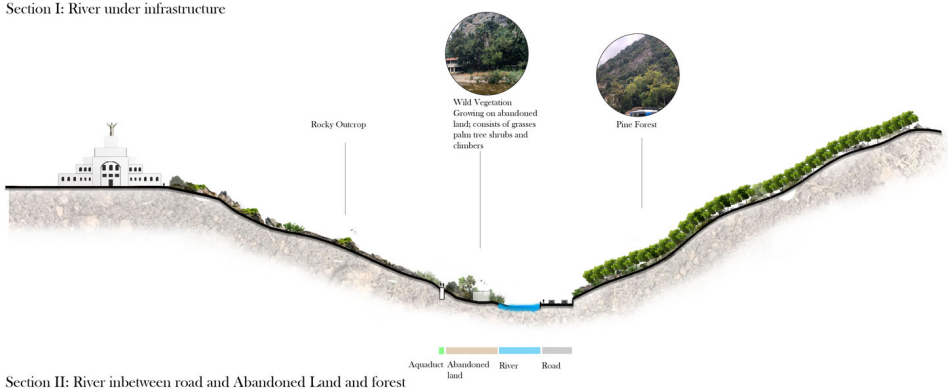
Encroachment of the river buffer and some of the river bed for facilities

Nahr El Kalb

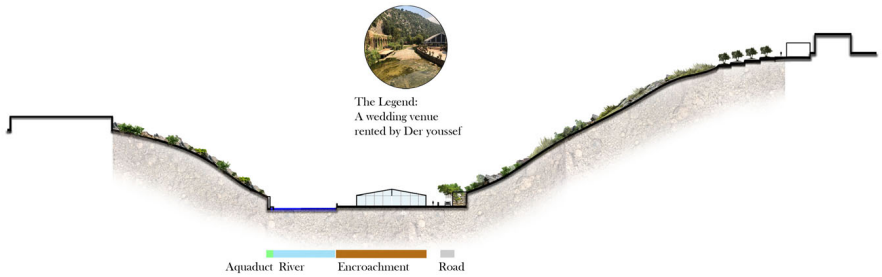
Sections to understand the site



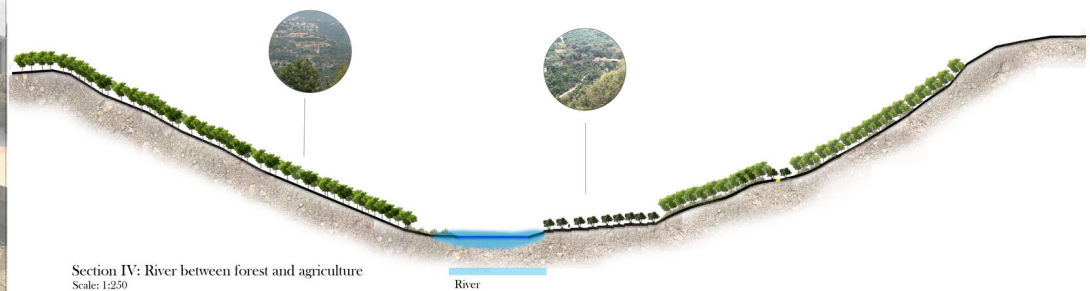
Section I: River under infrastructure



Section II: River inbetween road and Abandoned Land and forest
Scale: 1:250



Section III: River Buffer invaided by structure
Scale: 1:250



Section IV: River between forest and agriculture
Scale: 1:250

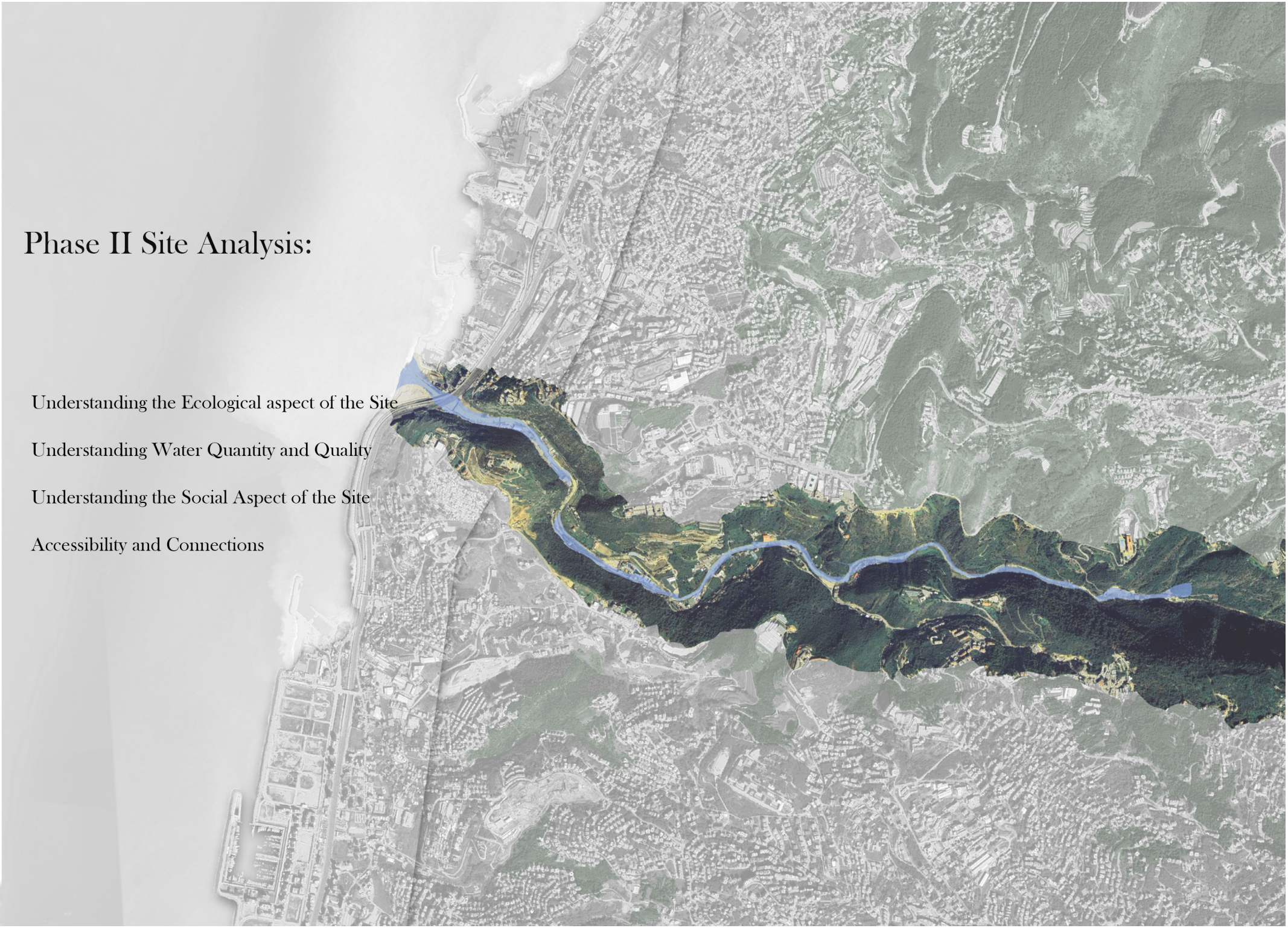
Phase II Site Analysis:

Understanding the Ecological aspect of the Site

Understanding Water Quantity and Quality

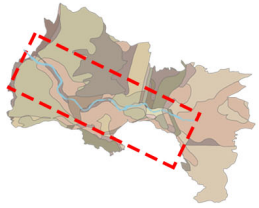
Understanding the Social Aspect of the Site

Accessibility and Connections



Understanding the Ecological Aspect of the site

To understand the ecological formation at Nahr el kalb river certain layers like soil, geology and slope were overlayed to interpret the existing landcover and derive whether the site is used to its full ecological potential

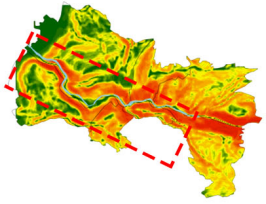


Map of different types of soil

- Areno-Entric Leptosols — Best kept for forest potential for tree crops or extensive grazing.
- Association of Haplic Luvisols and Leptic Luvisols — Good for agriculture
- Entric Arenosols — Eroded soil and deposition site
- Entric Cambisols — Good soil for agriculture, most productive soils on earth
- Entric Leptosols — Best kept for forest potential for tree crops or extensive grazing.
- Rendzic Leptosols — Best kept for forest potential for tree crops or extensive grazing.

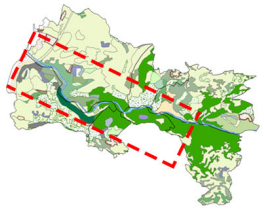
Map of different types of geology

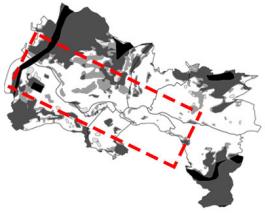
- Calcareous marls
- Limestone with marls and shales.
- Chalky marl, limestone thin to medium bedded, highly jointed
- Limestone with few calareous shale bedded, jointed
- Well bedded limestone
- Stylolitic medium to thick bedded and massive, partly jointed
- oss-bedded or thin to thick bedded and massive sandstone with limestone.



Map showing slope analysis in %

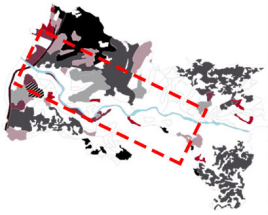
0-4 7 9 10 12 14 15 16 18 20 23 25 30 35 42 47 56 67 85 110





Urban Expansion Over Time

- 1963
- 1994
- 2006
- 2013



Different Urban Fabric

- Dense urban Fabric
- Dense informal urban Fabric
- Medium density urban fabric
- Low density urban fabric
- Urban sprawl on dense woodlands
- Touristic resorts
- Industrial or commercial

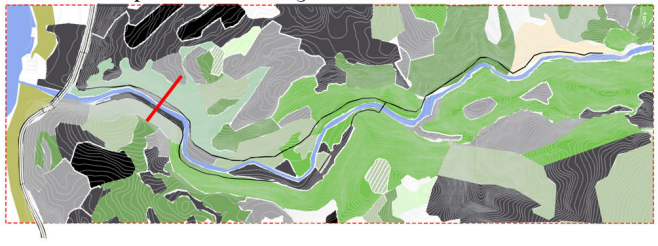
Many of these areas are not effectively protected and are being systematically destroyed by urban expansion, the building of dams and other infrastructure and road development projects. This is the case for riparian areas such as Nahr el-Kalb.

The above maps were retrived from GIS

Landcover map of 1963 according to army map

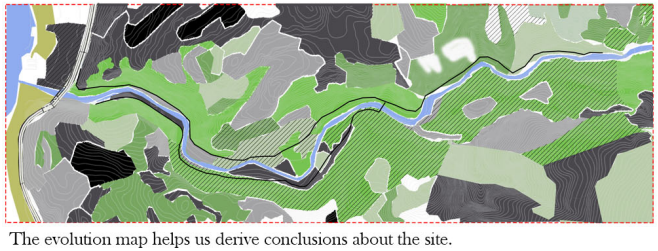
- Rocky outcrop
- Medium dense urban
- Orchrad trees
- Shrubland
- Agriculture
- Forest

Landcover map of 2019 according to GIS data



- Costal area
- Low dense urban
- Medium dense urban
- High dense urban
- Rocky outcrop
- Fruit trees
- Shrubland
- Agriculture
- Forest

Evolution of site: Over lap of 1963 and 2019



- Costal area
- Low dense urban
- Medium dense urban
- High dense urban
- Rocky outcrop
- Shrubland
- Agriculture
- Forest

The evolution map helps us derive conclusions about the site.
Accordingly the hatched zones are the only areas that remained the same through time.
Noticable changes are the expansion of urban areas, decrease in agricultural practices transformation of most of the scrubland to forests and finally the widening of the coastal line.

Section 1.1: 2019 existing site landcover
Scale 1:500

Section 1.2: 1963 landcover
Scale 1:500

In 1963 the slopes of Nahr El Kalb were made of scrubland and rockyoutcrop

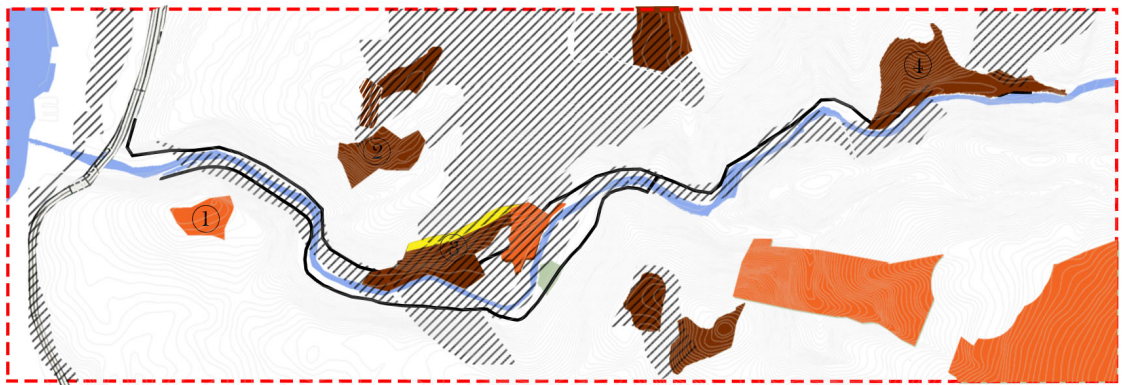
River bed consists of aquatic vegetation; however the road was narrower than before used as the only road into the internal villages

The southern slopes are mostly rocky towards the coast

The Evolution of agriculture through time

Evolution of agriculture helps us understand how the agricultural practices changed interms of location and type.
In this layer we derived that people drifted away from agricultural practices and substituted it with differentt activities as a source of income

1963
2019



Assessment Criteria:
-Good soil
-Well maintained terraces
-Properly arranges agricultural grids

Very Good
Good
Not Good

Location 1 & 2 carry crops on flat land and green houses

Location 3 Mosts of the agriculture is on terraces Location 4

Types of agriculture on site:

Citrus s.

Persea americana
Avocado tree

Arundo donax

Myrtle berries

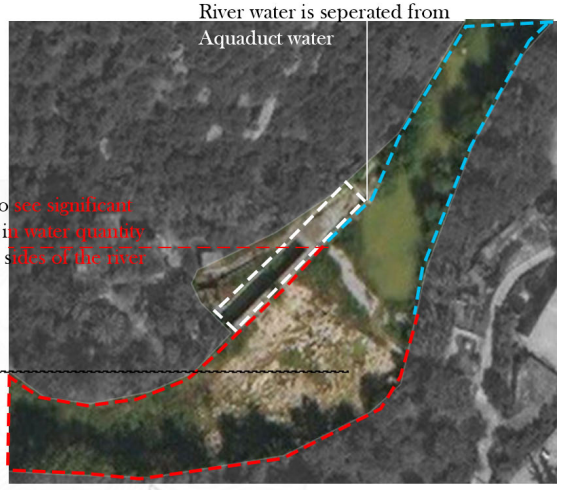
River Bed Typologies:

Understanding Water Quantity and Quality

Understanding the water quantity and quality helps us create a better understanding about Nahr El Kalb's Condition

Aquaduct

Nahr El kalb is know as the main source of water for Beirut and Jounieh and that is due to the fact that the river flows from water of tables Jeita and also is fed from Faraya and Sannien water table
Therefore, the site has two major aquaducts that seperates clean water from the river water.



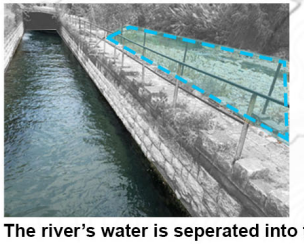
Mediterranean Sea

Towards Jounieh

Towards Beirut

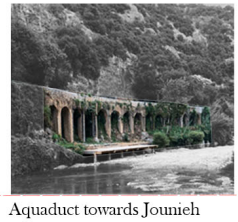
Jeita

Aquaduct towards Beirut



The river's water is seperated into two:
-The actual river bed with minimum water
-The water duct that is straight from the grotto's water table

The bridge was built for the sole purpose of transfering water to the other side which takes to Beirut



Aquaduct towards Jounieh

Nahr El Kalb is the main water resource for Beirut and Jounieh. Accordingly we have two Aquaducts that deliver the water

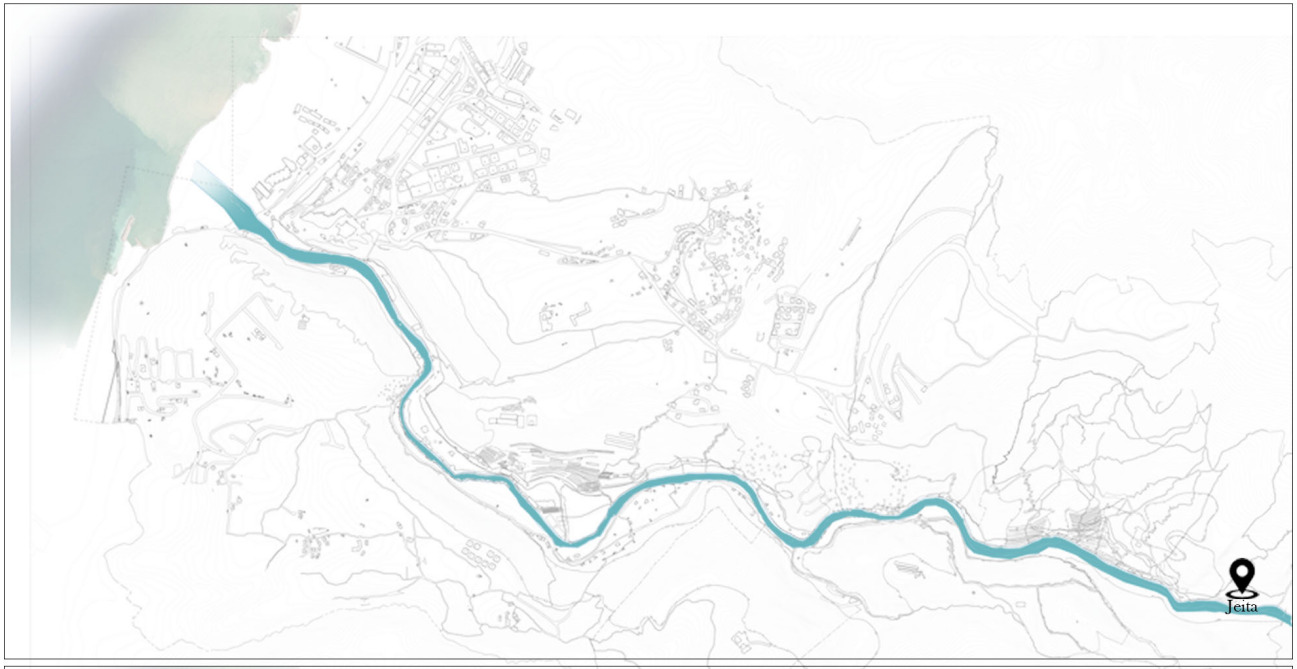
Water Quantity

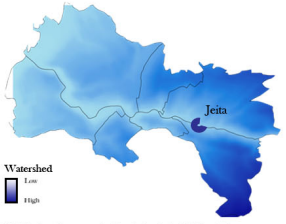
Studying the site in different seasons and knowing that an aquaduct spreads through the site helped us understand better the quantity of water delivered by Nahr El Kalb river and categories the river.
According to research I was able to evaluate the river intensity in differnt seasons.

During winter: Peak January

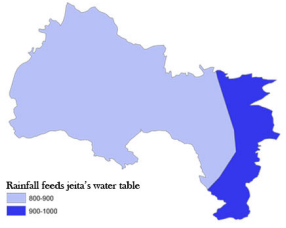
Maximum of 250 000m^3 per day
(Water Supply within Beirut-Mount Lebanon)

Some areas closest to Jeita's water table has water all year long





Heighest water concentration is located at high points and jeita act as a main source for feedind the river.

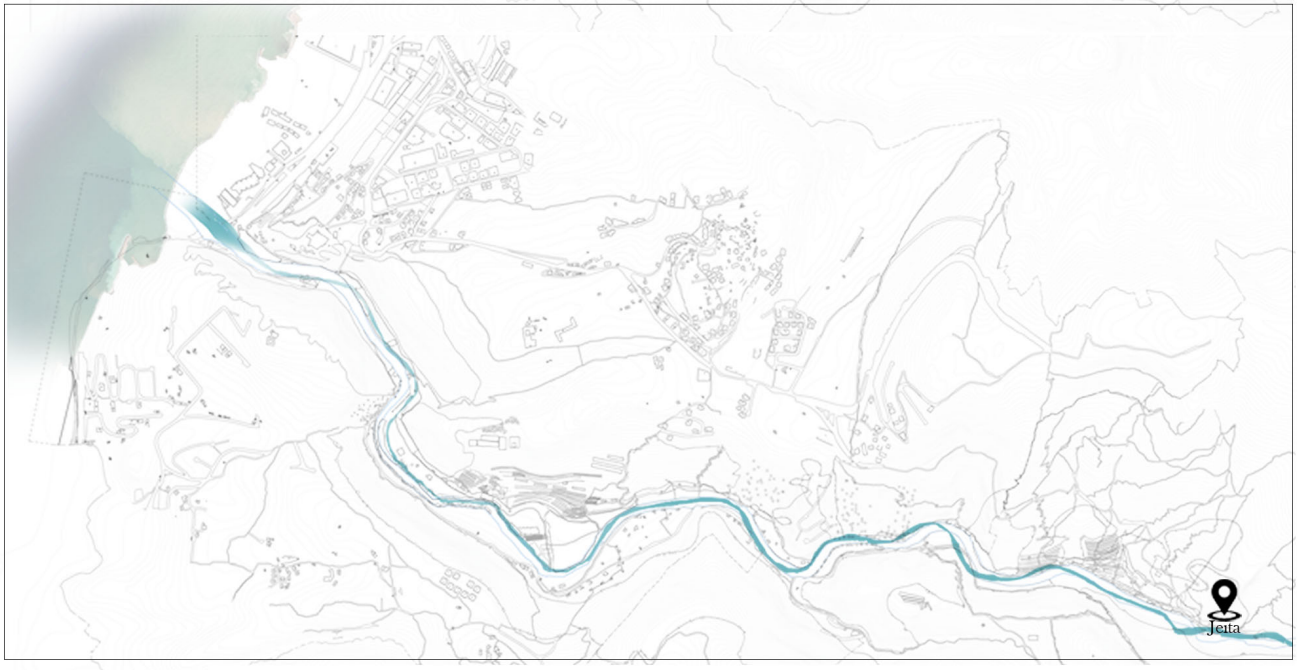


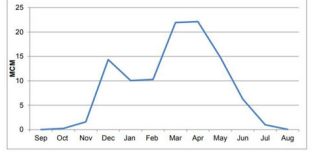
Maps retrieved from GIS

During Summer: Peak August

In some areas can be dry
(Water Supply within Beirut-Mount Lebanon)

Some areas are compeletly dry that some cars park on the river bed





Water Quality

The following diagram investigates the different types of pollution on site.It includes direct and indirect: direct being dumping straight to the river, indirect is through urban areas expanding over the water table

Map of polluting elements on site

Urban areas direct the sewage system into the river or to underground water

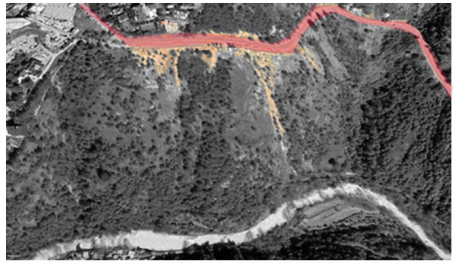
Industrial Site dumping waste into the river

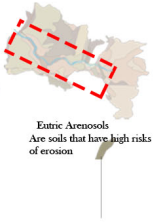
Dumping of solid wastes

Reo Lento waste

Erosion

Other disturbances that are happening on site





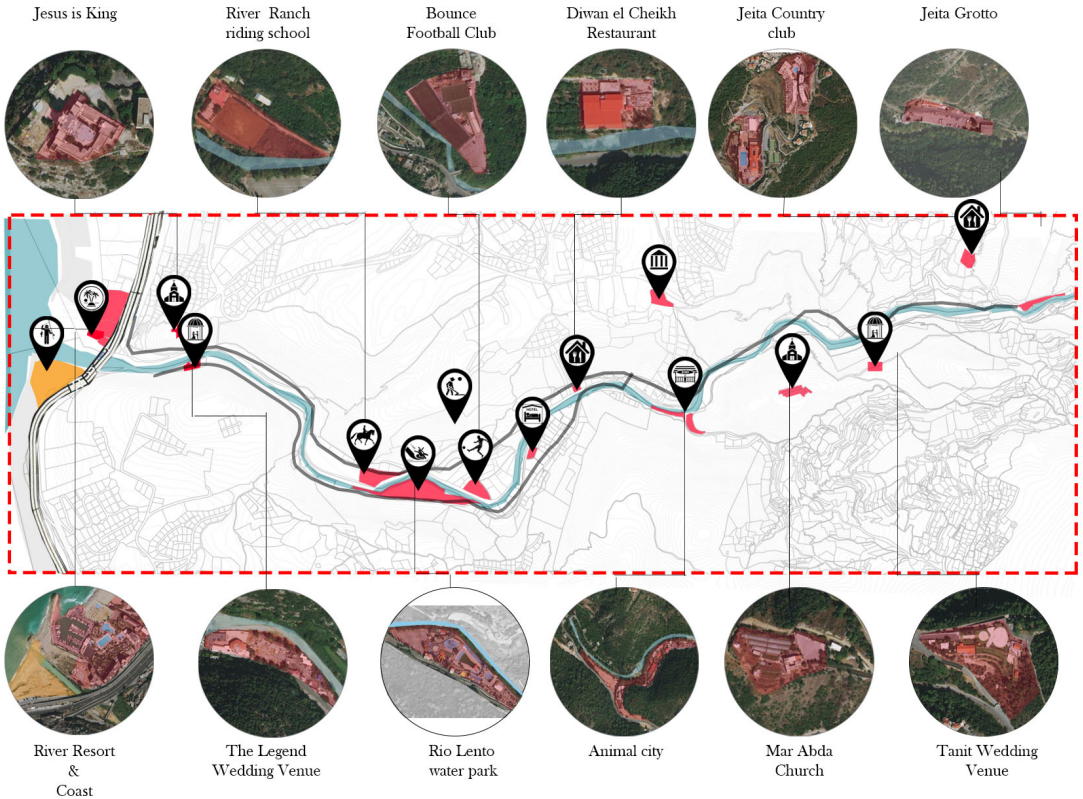
Disturbances such as erosion is due to building of roads and the expansion area without studying the location

Erosion of river bed due to extensive urbanization flow

Disturbances on forests slopes

Understanding the Social Avtivity On Site

To better understand the social activity on site we investigated all the social places found on site. we looked at their location in proximity with the rive, the type of activity if it is indoor or outdoor (formal or in formal) and the intensity in which each place has interms of social concentration

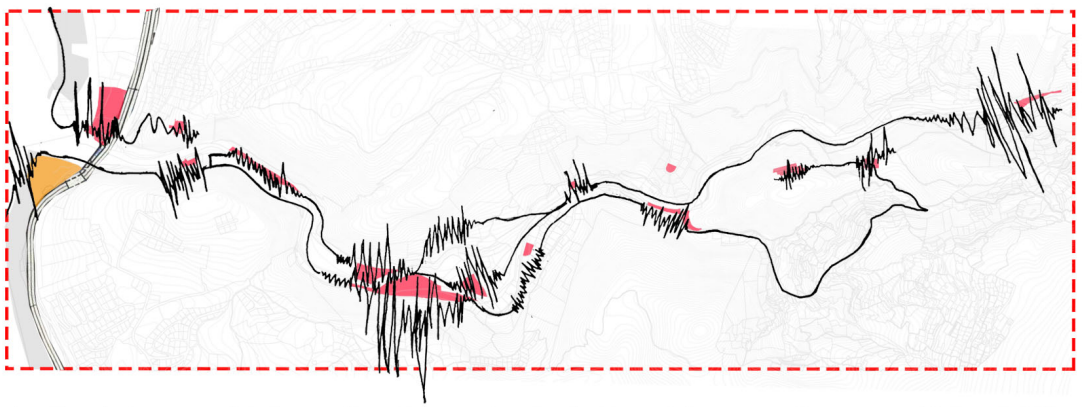


Types and location of social activity

Formal Social spaces

Informal Social spaces

Social activity intensity according to location



According to the above maps we derive that most of the social spaces on site are formal social spaces, indoors, not accessible to everyone and the house the heighest social activity.

The only outdoor space that was occupied was the coast with few 2 fishermen and a family swimming.

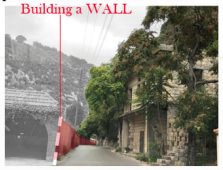
Accessibility and Connections

After understanding the site's social spaces, I looked at the site's accessibility to further understand how people could access the site, not only from Beirut but also from sarrounding villages. Accordingly I categorized the different types of roads that are on site to see if it is human friendly.

Road typologies

Road with no sidewalk
YET stairs for people to access the historical stellas

Narrow roads with no sidewalk priatization of river buffer and Building a WALL

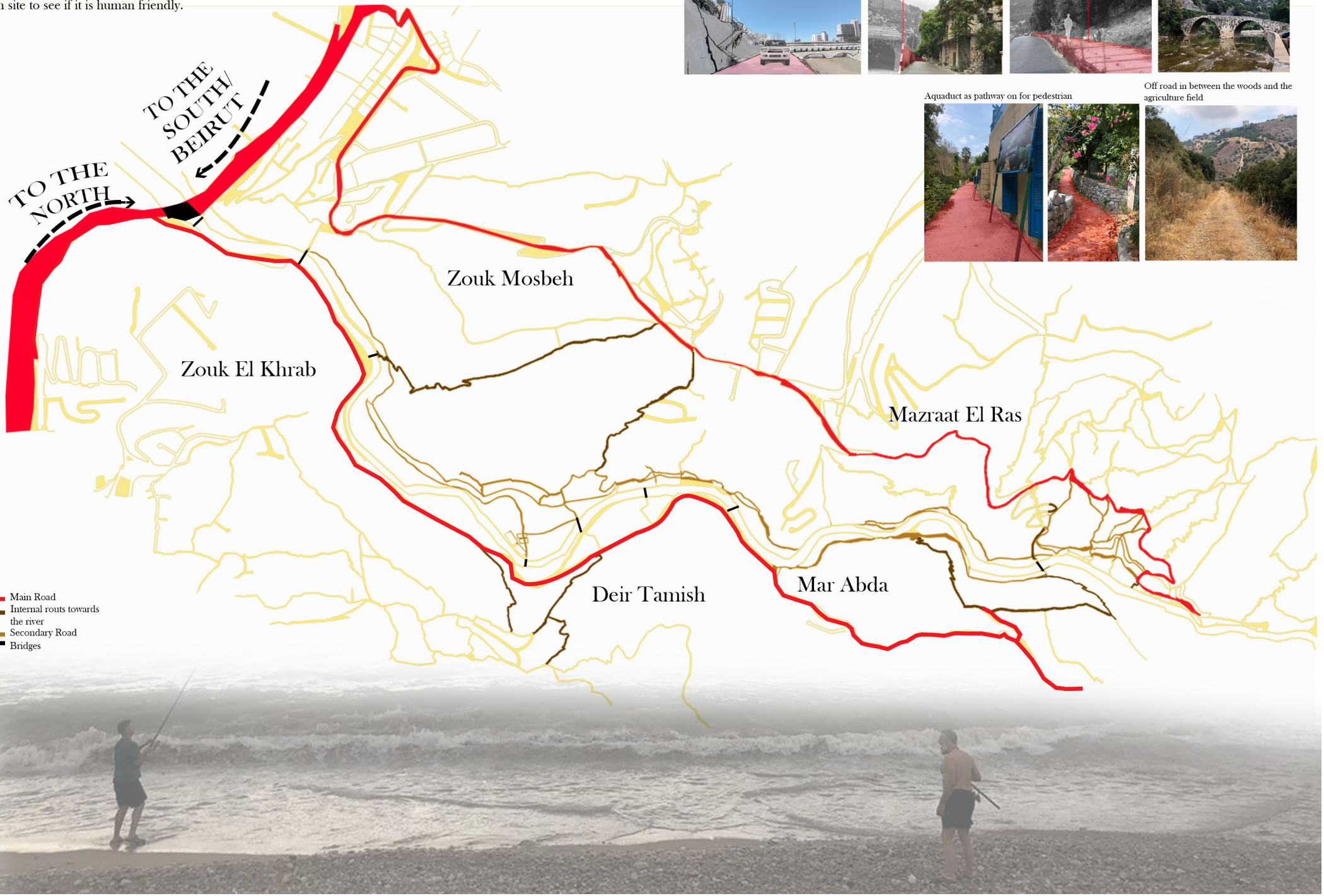


Road with sidewalk
Aquaduct as sidewalk

Bridges as the only crossing to the otherside

Aquaduct as pathway on for pedestrian

Off road in between the woods and the agriculture field



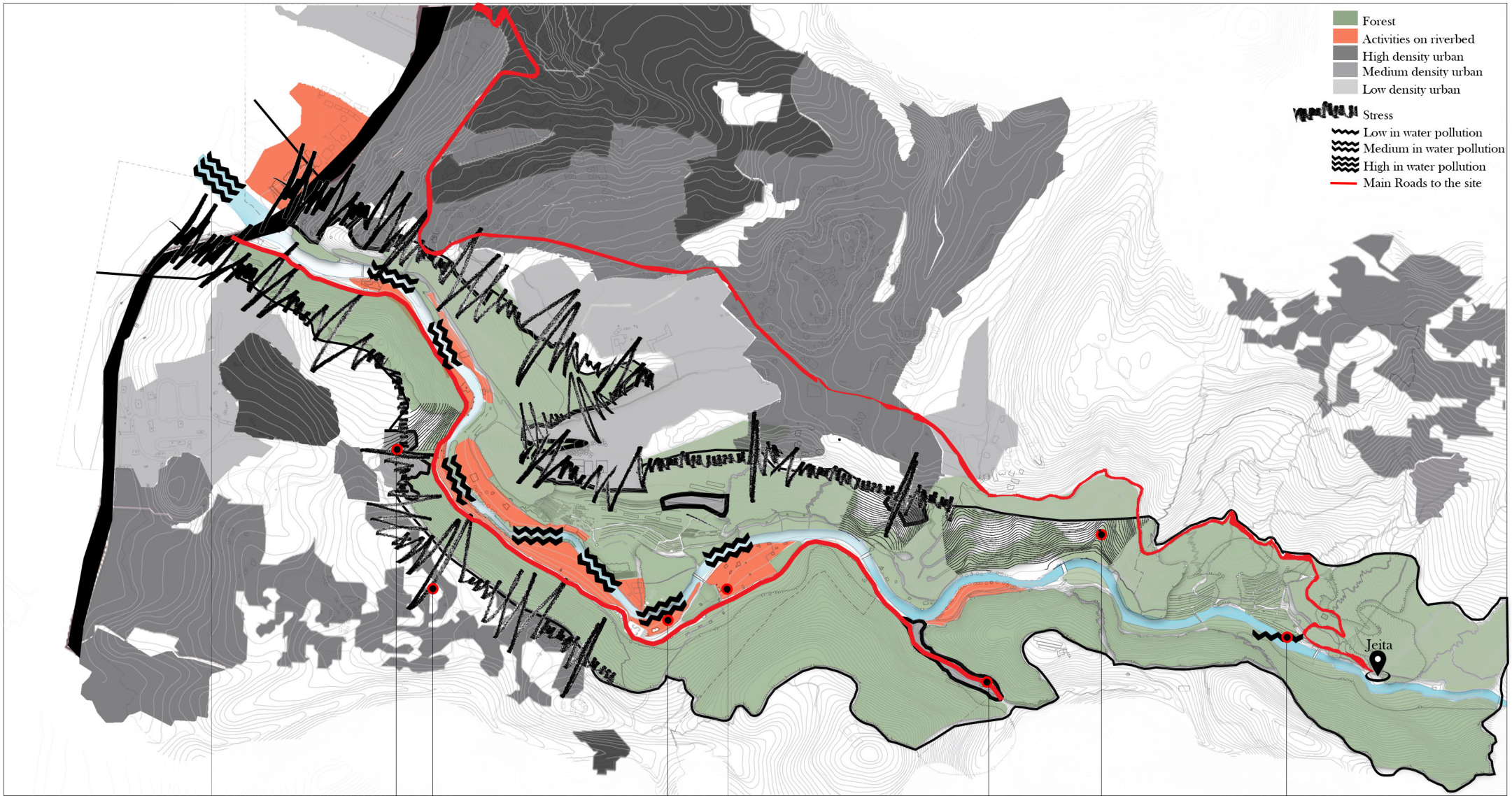
Phase III Conclusion:

Constrains Map

Opportunities Map

Constrains Map:

Scale 1:12000



Marine Life in Danger

Most polluted site due to the accumulation of water pollution built from top of the river.

Urban expansion on coastal lands

Uncontrolled Urban Expansion

Urban Stress on the green corridor defined as eco-habitat home

Urban Expansion infiltrates the green corridor

No Master plan for the site

Uncontrolled Urban Expansion

Resorts and factories built on river bed that causes pollution

Formal Spaces as Social spaces inaccessible for everyone

Difficult accessibility

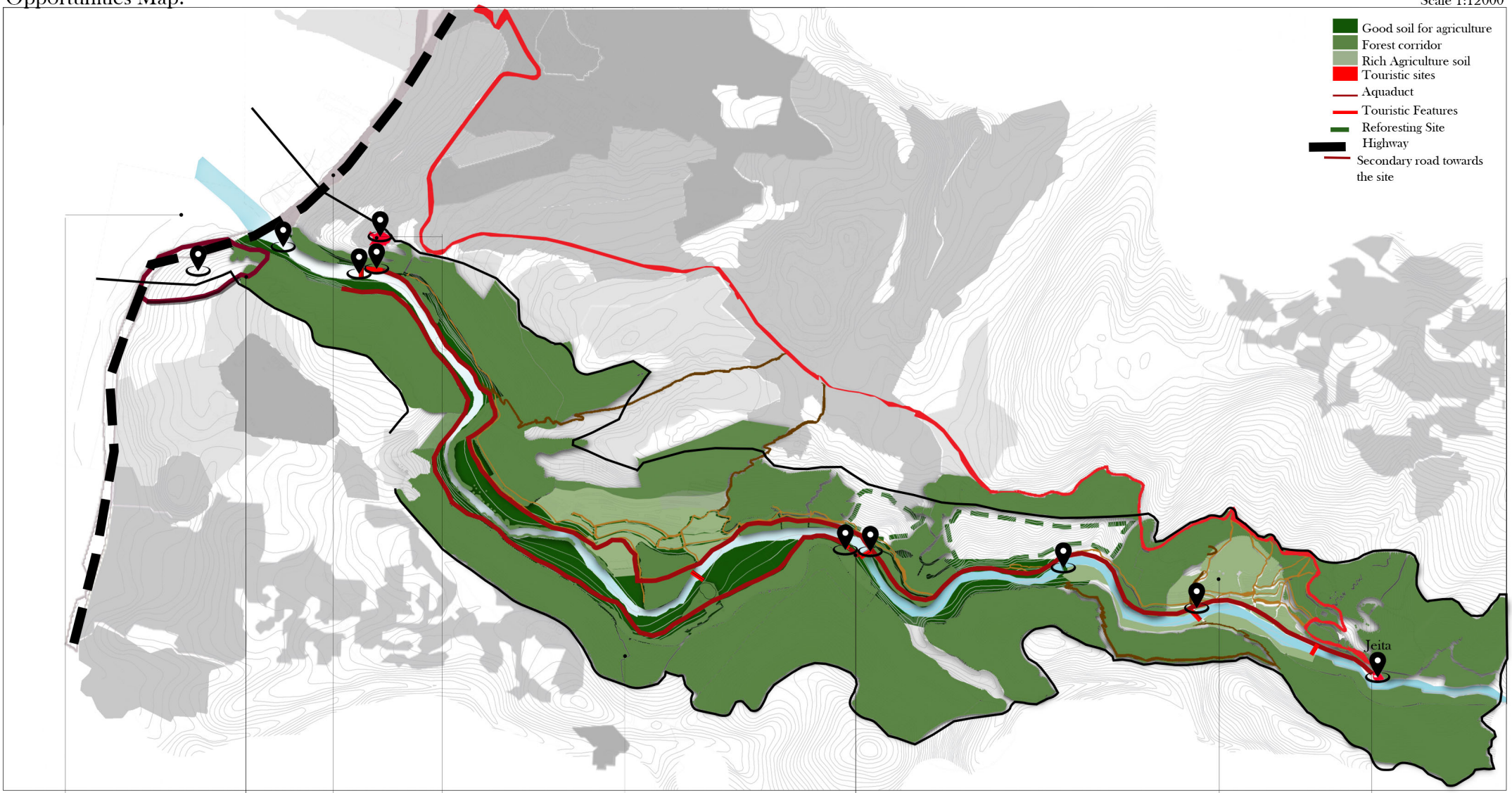
One main road that is unsafe.
Few hidden roads to the other side.

Erosion due to building of roads on steep slopes that have low to no vegetation cover.

Low water pollution

Opportunities Map:

Scale 1:12000



Future social paces
Locations in which future activites that correlates with nature occur.
All in which are supposed to be public lands

Stella Hill
Location of important historical stellas that are carved in the mountain.

Close in proximity to major cities
like Beirut, Jounieh, Tripoli

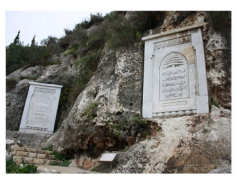
Important Religious site
Jesus is God statue

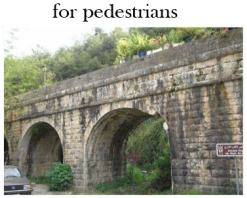
Forest Corridor
Important for preservation since it is a habitat migrating path

Major water source for Beirut and Jounieh which is channeled through aquaducts.
Aquaducts are seen as potential pathways for pedestrians

Active Agriculture

Major touristic attraction: Jeita Grotto


Phase IV Design:

Design Boundary

Concept & Strategy

Master Plan

Zoomin: River Garden

- Concept Map
- Zoomin Map
- Estuary
- RestGard
- AquaGard

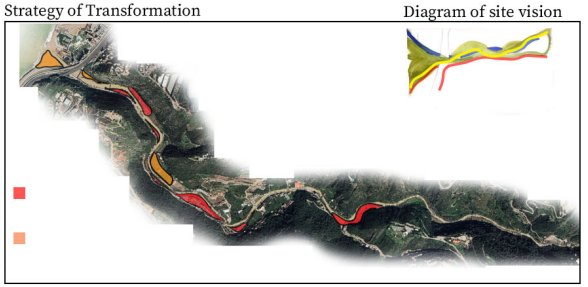
Trail Sections

NAHR EL KALB: Reviving The Riparian Corridor

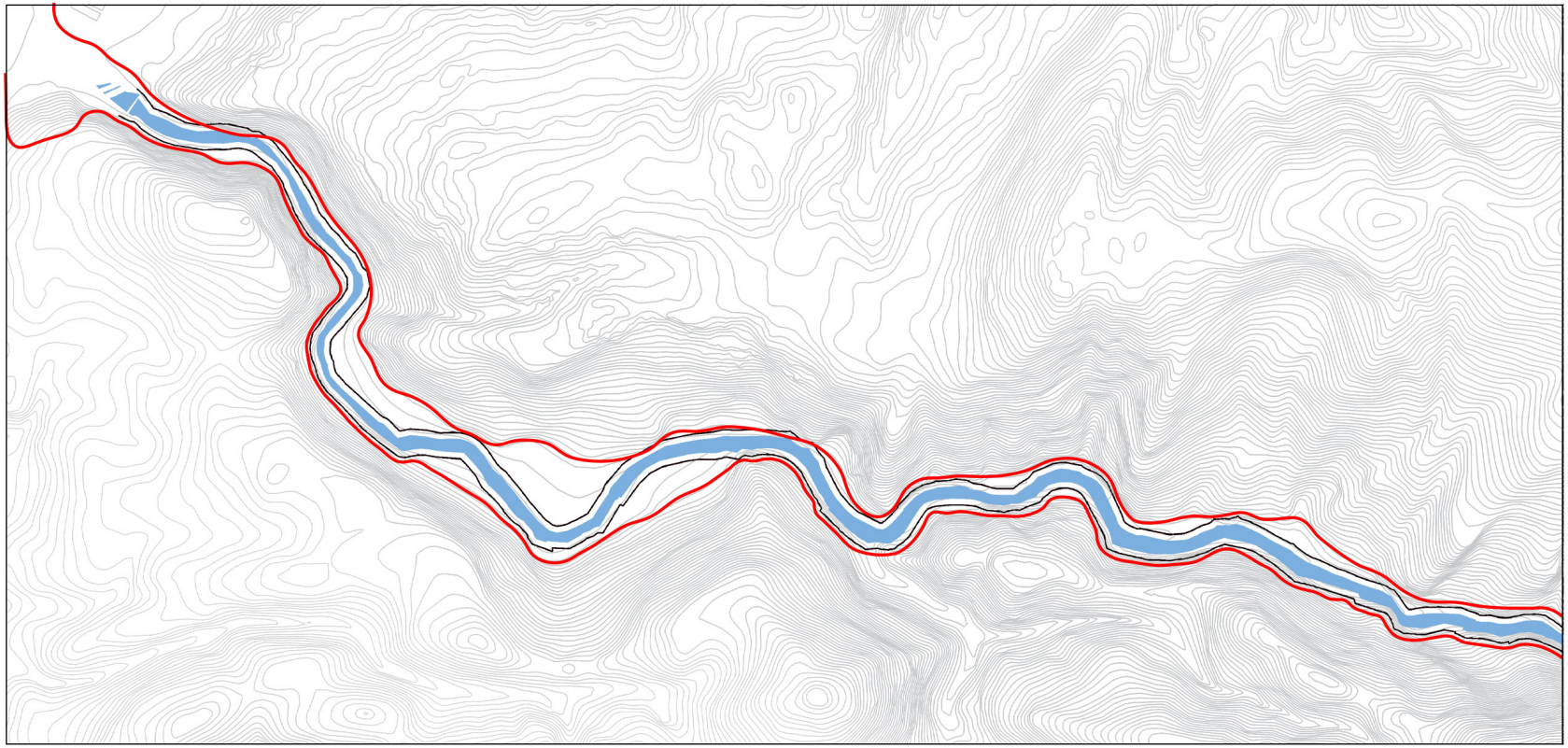
Deriving a Concept and Site Boundary

Strategy of Transformation

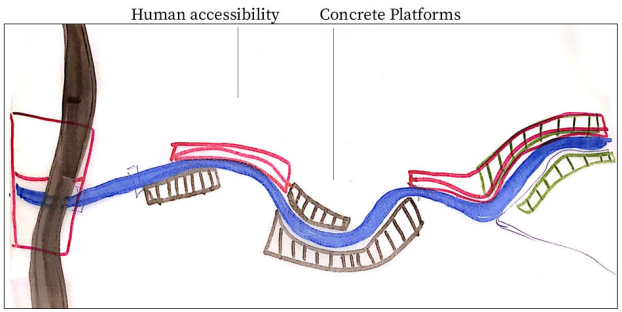
Diagram of site vision



Site Boundary: Represented by flatlands

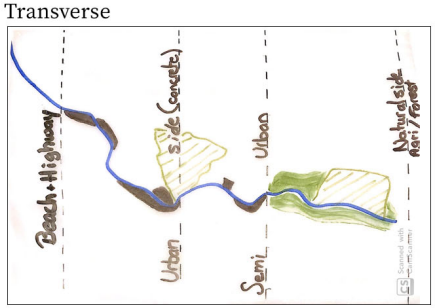


Typologizing the site

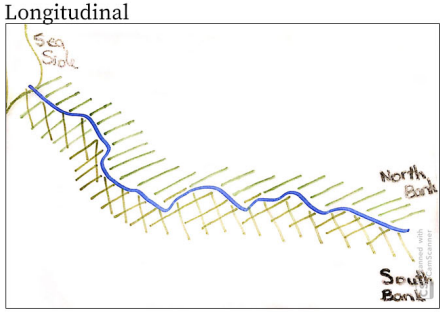


Characterizing the site longitudinal and transverse

Transverse



Longitudinal



Strategy

A plan of reclamation

Strategy 1: Reclaiming the riparian Buffer

Reclaiming the natural buffer allows for a healthy river system and a smooth transition for the fauna from the forest necklace towards the river.

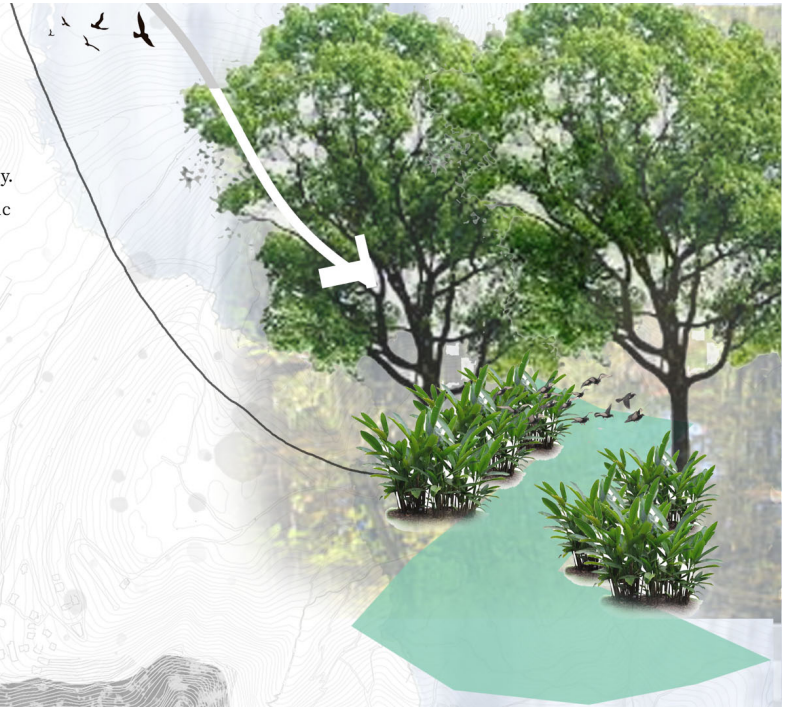
This is accomplished by removing all concrete platform that are on river buffer

Strategy 2: Adopting abandoned spaces

Abandoned Spaces developed unique natural habitat after the time it took to heal.

The natural transforming accompanied by human intervention will allow the formation of recreational hubs for people to occupy & enjoy.

The pocket spaces will hold unique characteristic either natural, cultural or historical that will narrate a story through an experience



Strategy 3&4: A trail system to connect history & Nature

System of trails are designed to allow for a continious experience through natural and historical sites that could be for education, enjoyment or mobility

4 Historic Monuments

3 Trail Path

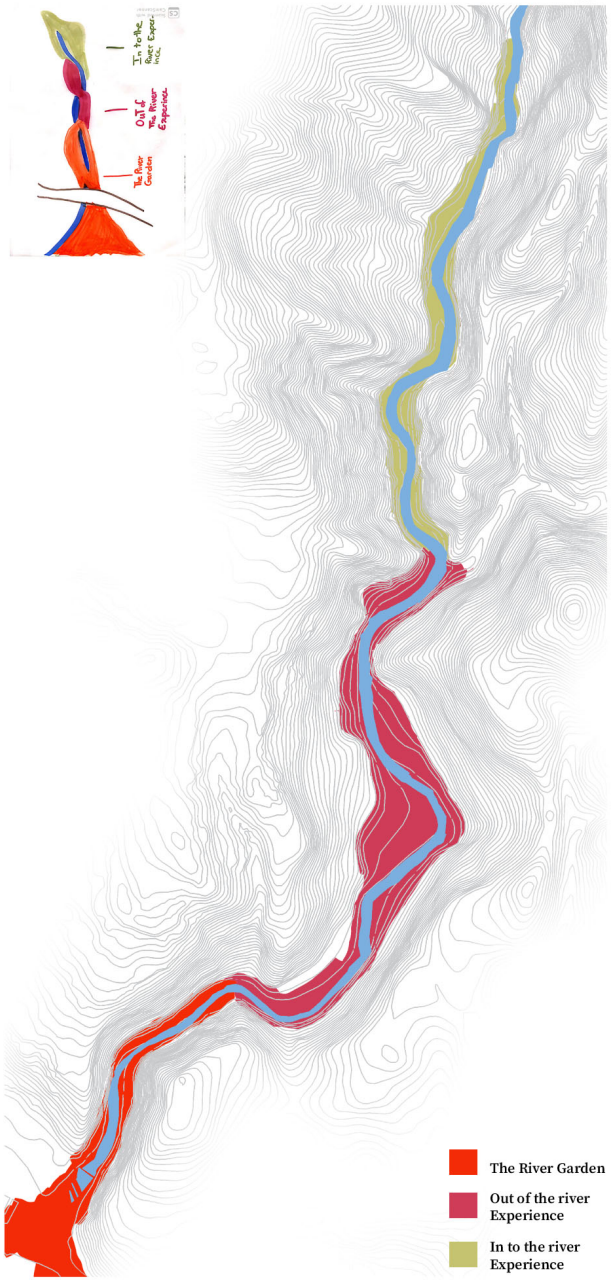
2 Reraitional spots

1 Reclaimed areas

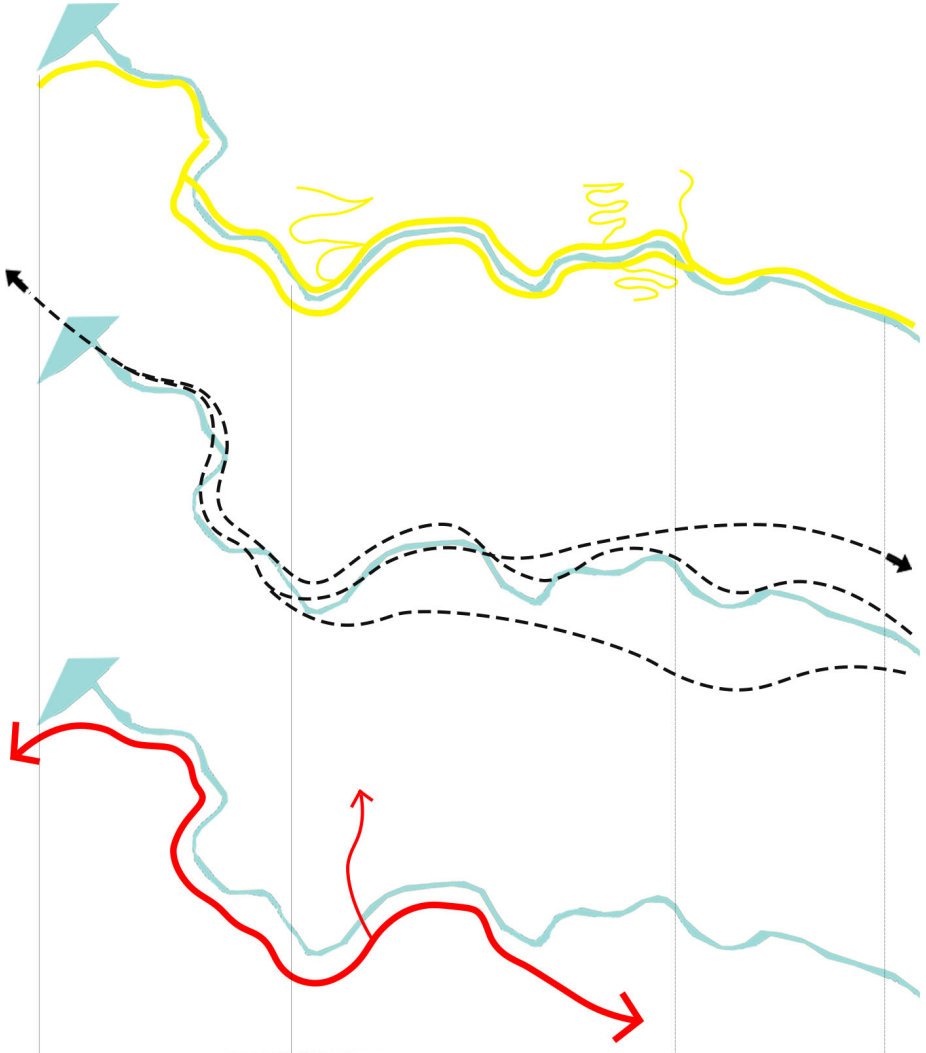
NAHR EL KALB: Reviving The Riparian Corridor

Conceptualizing and Typologizing

The general design Typologies three main areas - Program



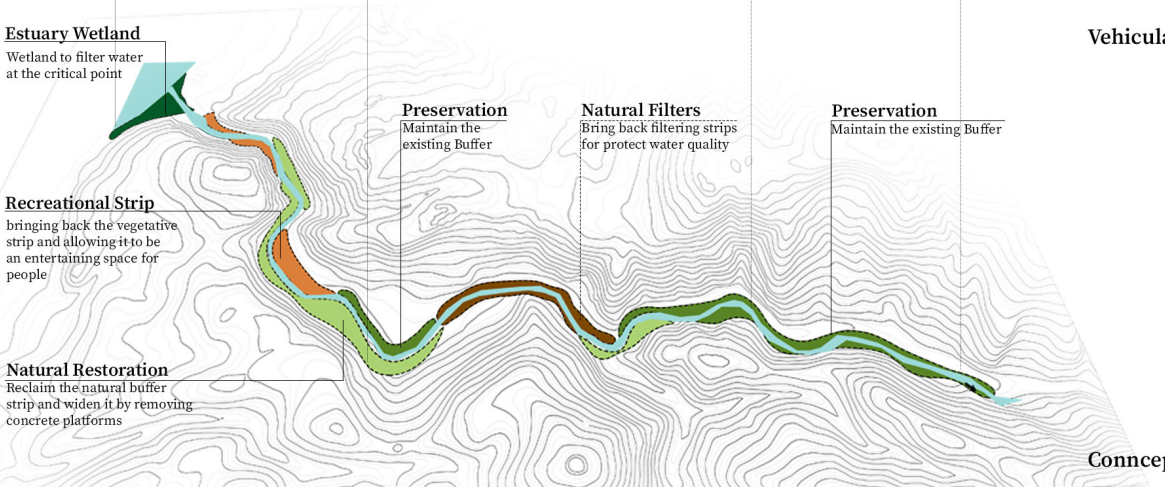
Conceptual diagram of Accessibility & Vegetation Typologies



Pedestrian Connection

Bird Migration

Vehicular Connection



Conncept Map

NAHR EL KALB: Reviving The Riparian Corridor
Master Plan

Nahr el kalb, a majestic gorge with river flow, represents an important location for many historical successes. However, faces many problems that are mostly related to human encroachment and pollution. Thus, the design will aim to improve the ecological system represented by the riparian corridor and the forest necklace to sustain the flora and fauna's flow and wellbeing. This improvement will allow the sustainable integration of human activity which in turn will reinforce the engagement between the people and the history of the site and also provide an outdoor entertainment spaces in a much-needed location.

River Garden

Consists of three main areas
-Aquagarden that contains water activity
- RestGard a unique seating space viewing Nahr el Kalb bridge
- A Wetland

Out of the river experince

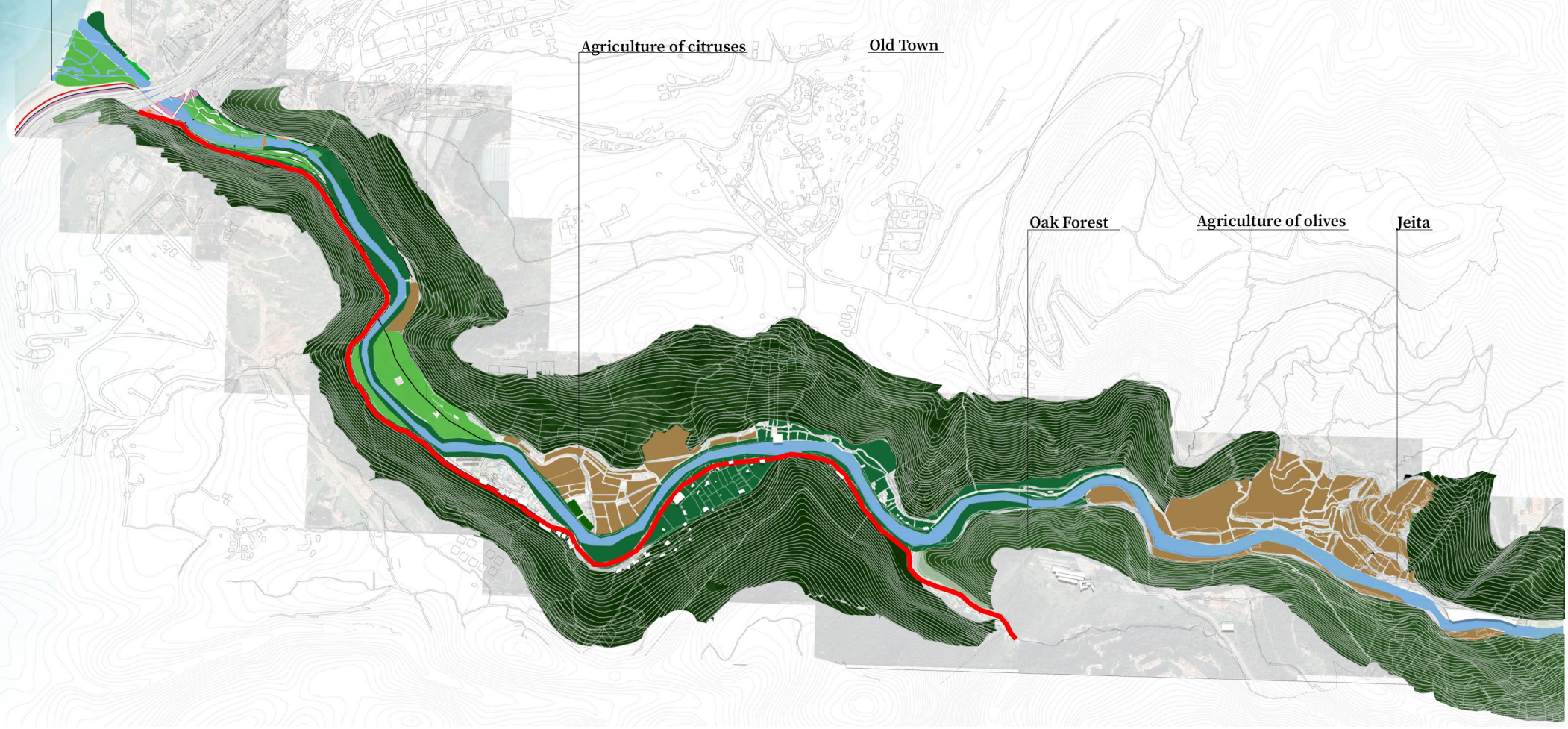
Agriculture of citruses

Old Town

Oak Forest

Agriculture of olives

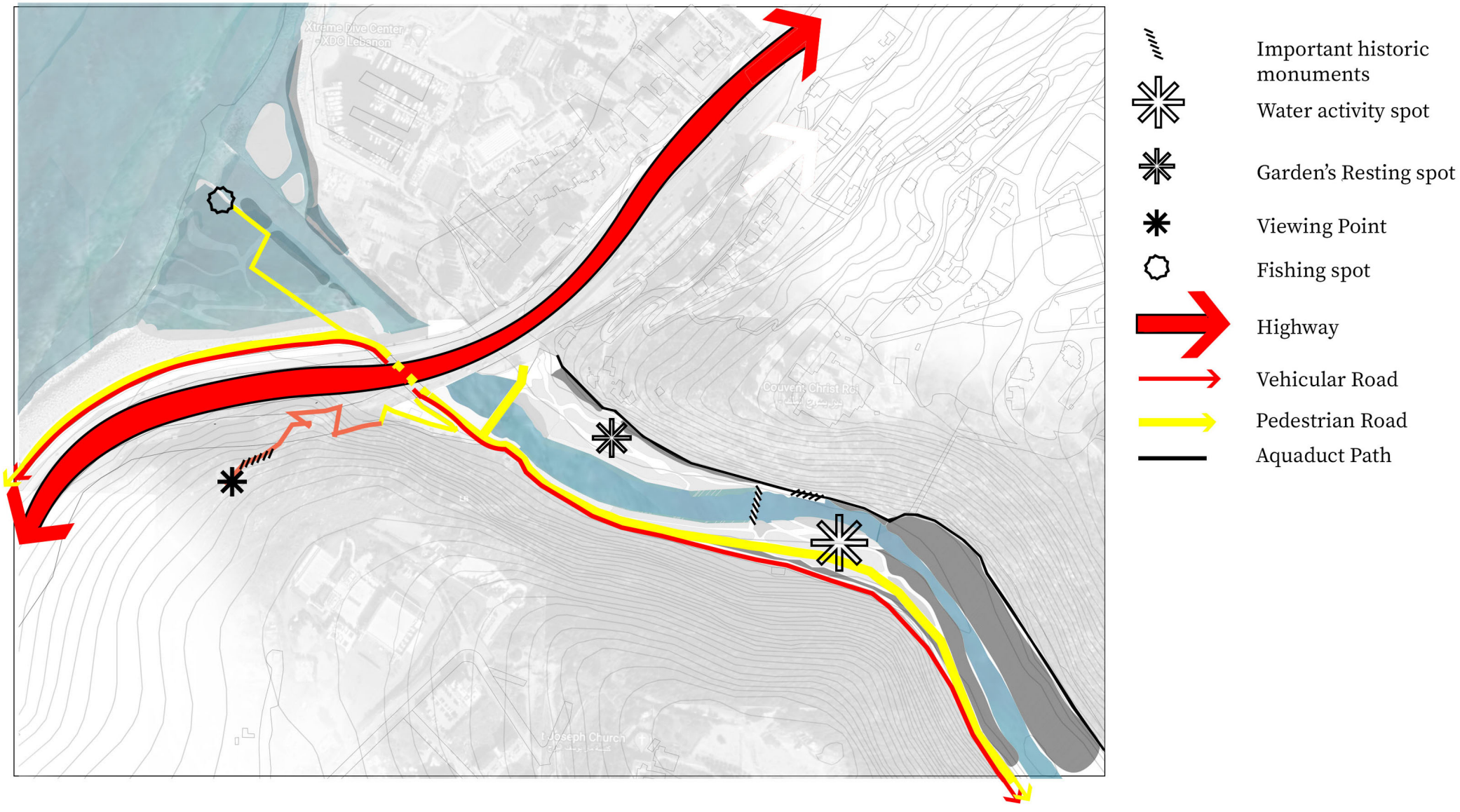
Jeita



NAHR EL KALB: Reviving The Riparian Corridor

River Garden: Concept

Conceptual diagram - Accessibility



River Garden

Nature's Restoration

Transform the existing concrete platform in to a nature's place for flora and fauna, restricting human accessibility

AquaGarden

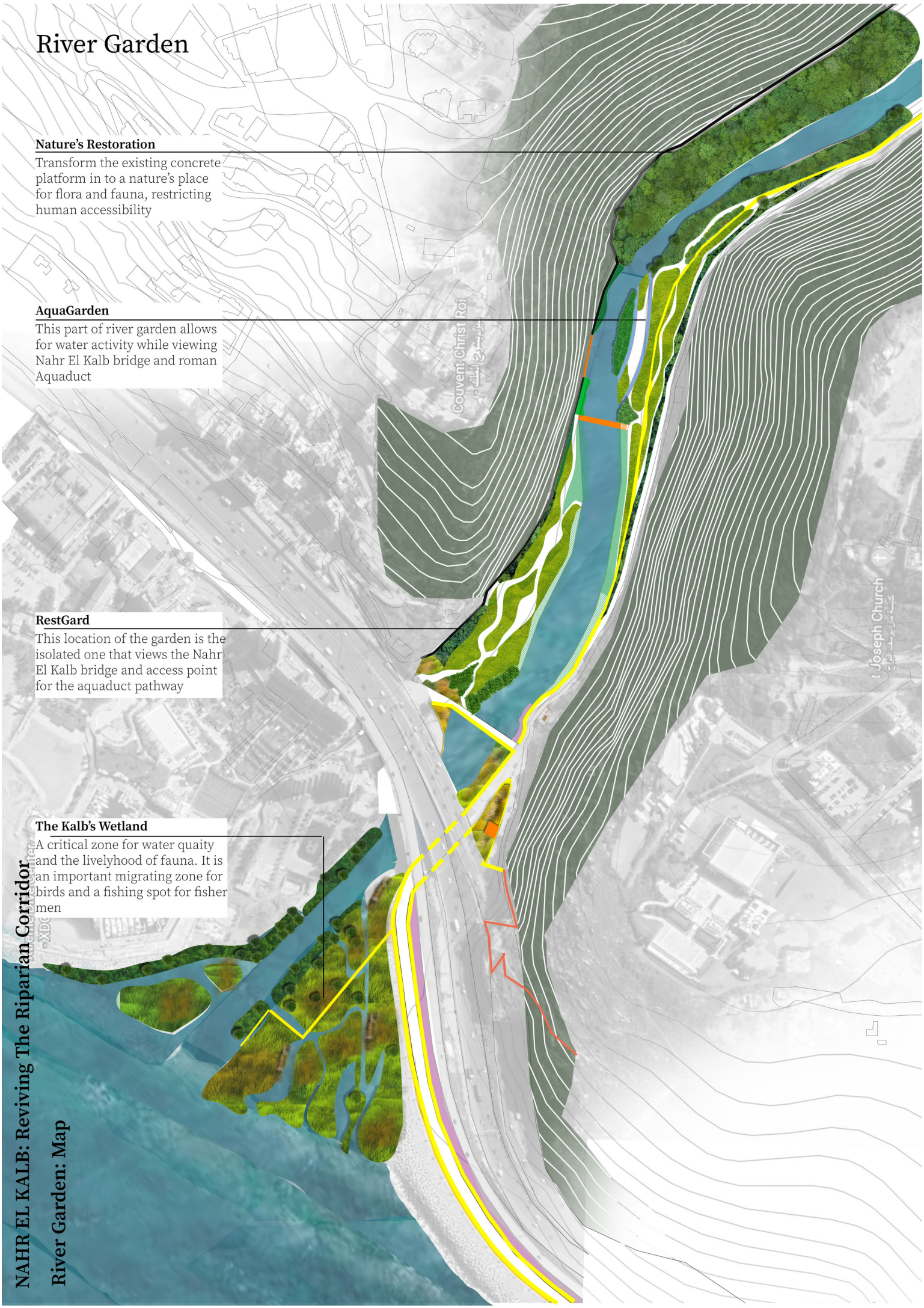
This part of river garden allows for water activity while viewing Nahr El Kalb bridge and roman Aquaduct

RestGard

This location of the garden is the isolated one that views the Nahr El Kalb bridge and access point for the aquaduct pathway

The Kalb's Wetland

A critical zone for water quaity and the livelyhood of fauna. It is an important migrating zone for birds and a fishing spot for fisher men

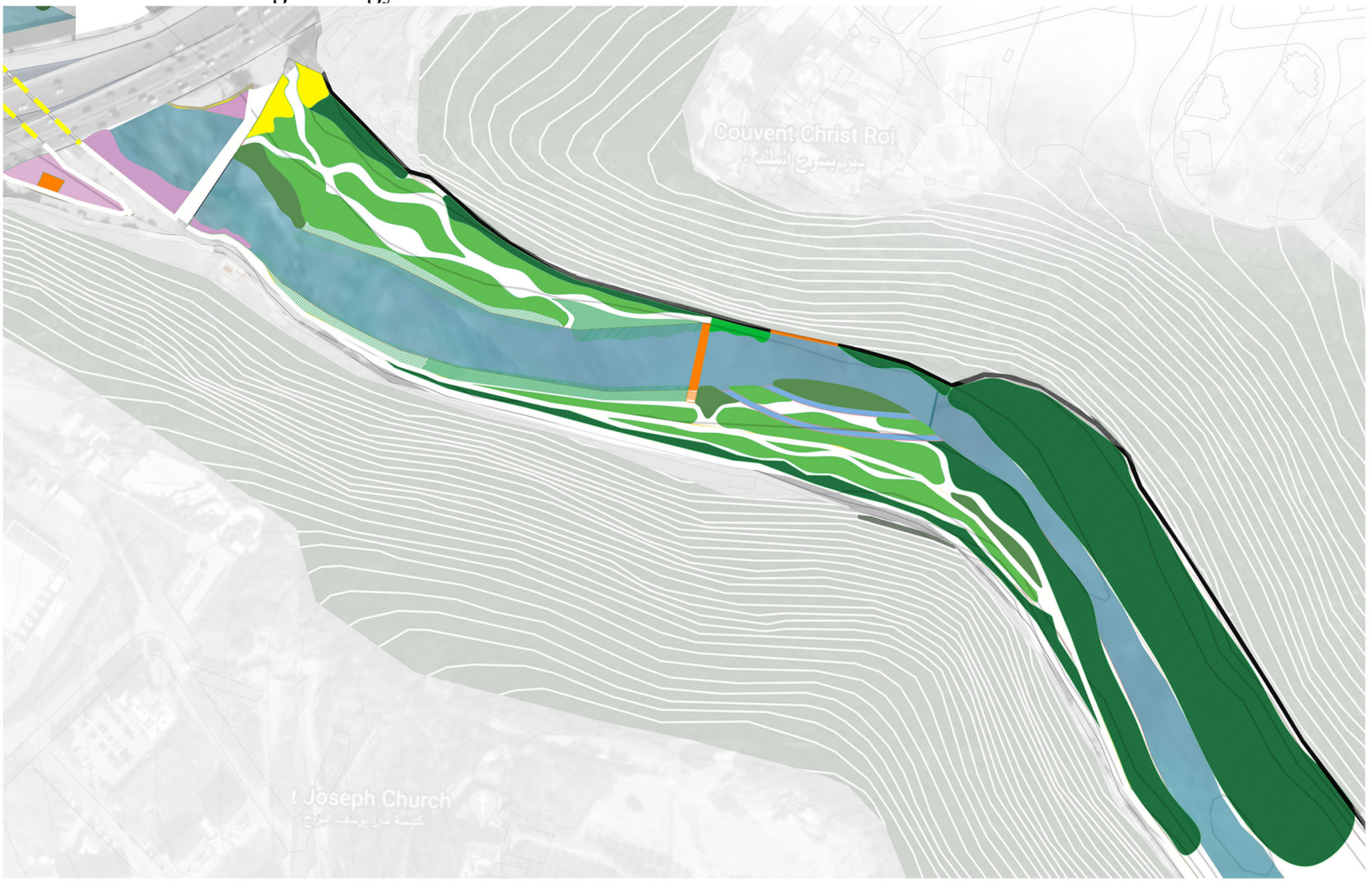


NAHR EL KALB: Reviving The Riparian Corridor

River Garden: Map

NAHR EL KALB: Reviving The Riparian Corridor

River Garden: Planting Strategy



Planting Strategy

- Trees and high shrubs - for protection and visual block
- Grasses and low shrubs
- Low shrubs - allow visual connection and act as protective buffer
- Grasses that allow people to access water
- Colorful plants as Eye catchers for people passing by

Ostrya Carpinifolia

Arundo donax

Asclepias curassavica

Senna alata

Agapanthus africanus

Echium candicans

Cortaderia selloana

Senna corymbosa

Typha angustifolia

Canna indica

Schoenoplectus lacustris

Miscanthus

Imperata cylindrica

Anethum graveolens

Murraya paniculata

Nerium Oleander 'Red'

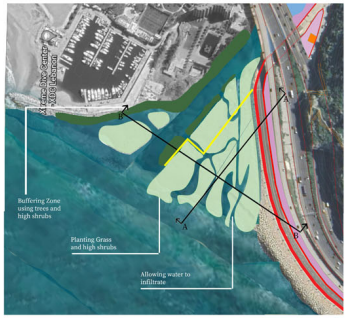
Plants that are used above are not limited to the color category but are also used in different areas

NAHR EL KALB: Reviving The Riparian Corridor

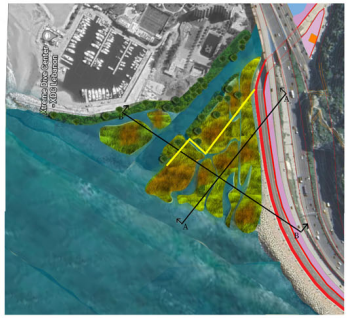
River Garden: The Estuary

Current Condition

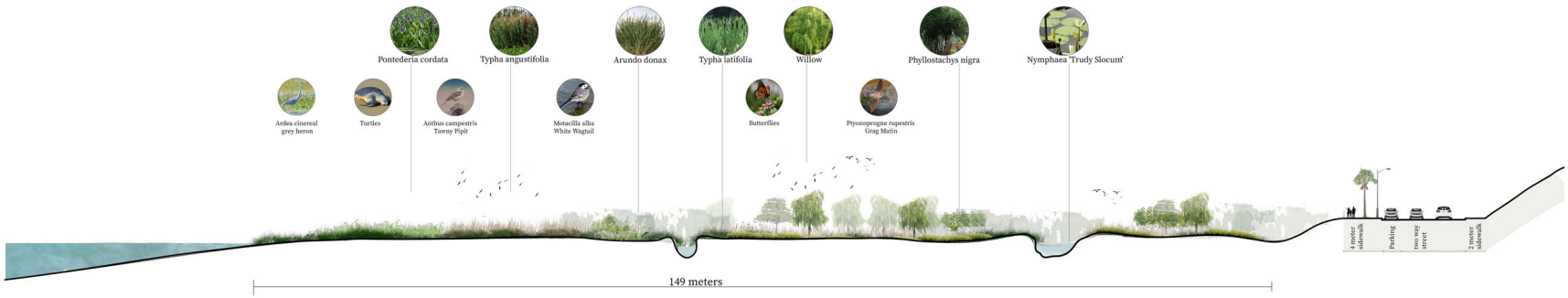
Phase I: 2-5 YEARS: Plantation phase



Phase II: 10 YEARS Maturatiy phase



Estuary: section I-A Phase I (2-5 years)
scale 1:200



Estuary: section II-A Phase II (10 years period)
scale 1:200

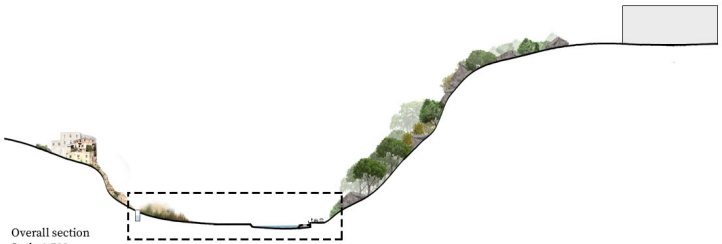
Estuary: section I-B Phase I (2-5 years period)
scale 1:200

Estuary: section II-B Phase II (10 years period)
scale 1:200

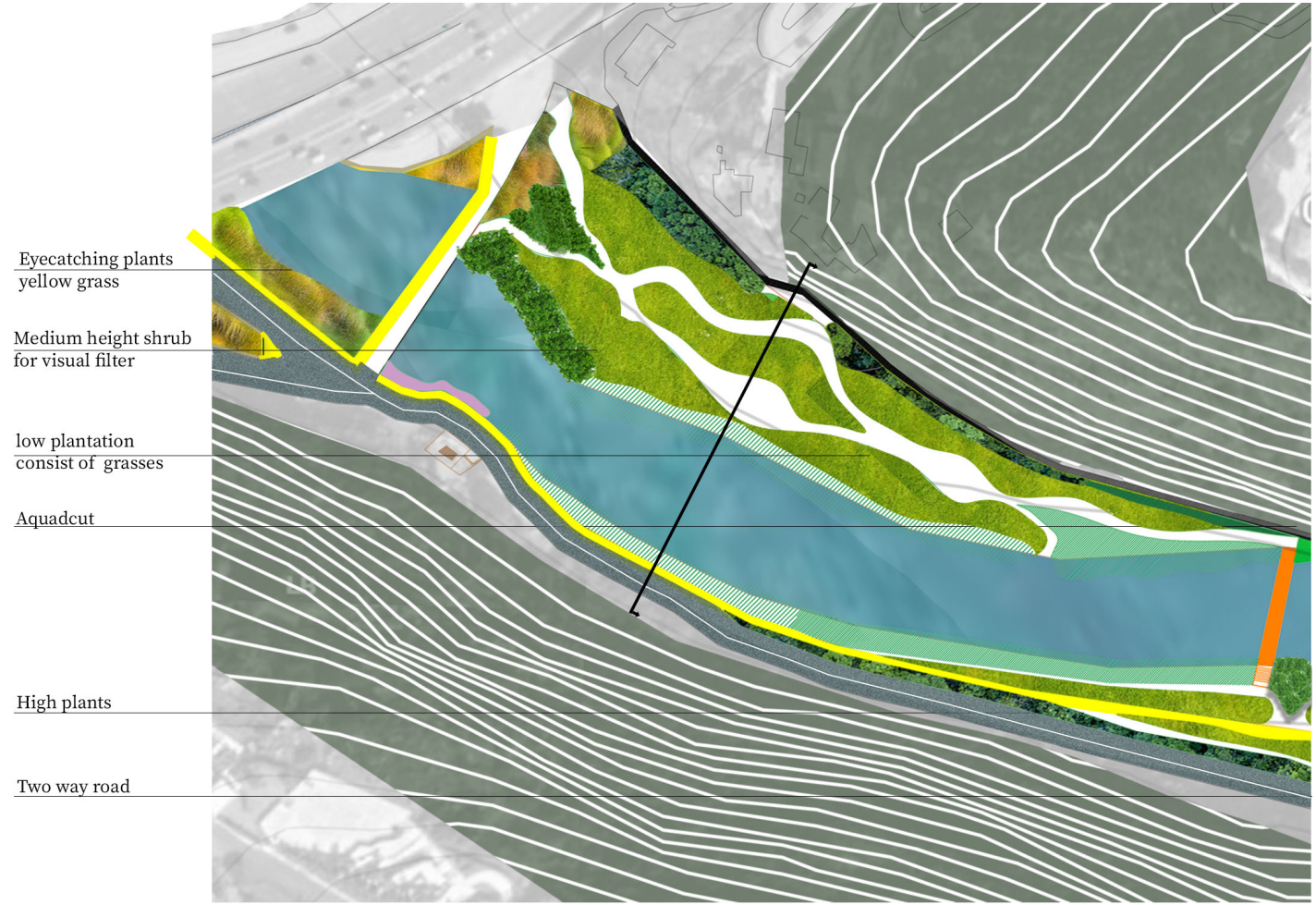
NAHR EL KALB: Reviving The Riparian Corridor

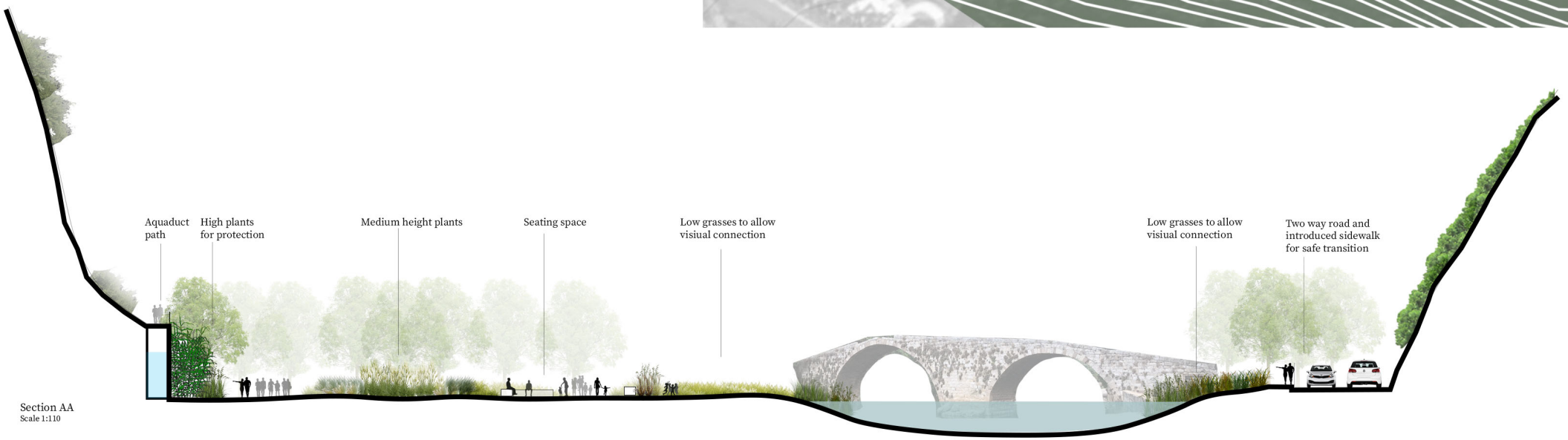
River Garden: The Estuary

NAHR EL KALB: Reviving The Riparian Corridor
River Garden: The RestGarden



Overall section
Scale 1:700





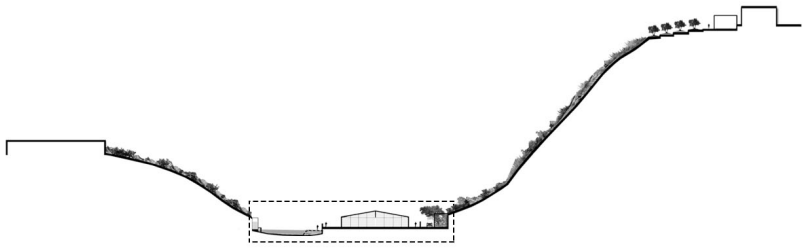
Section AA
Scale 1:110

NAHR EL KALB: Reviving The Riparian Corridor

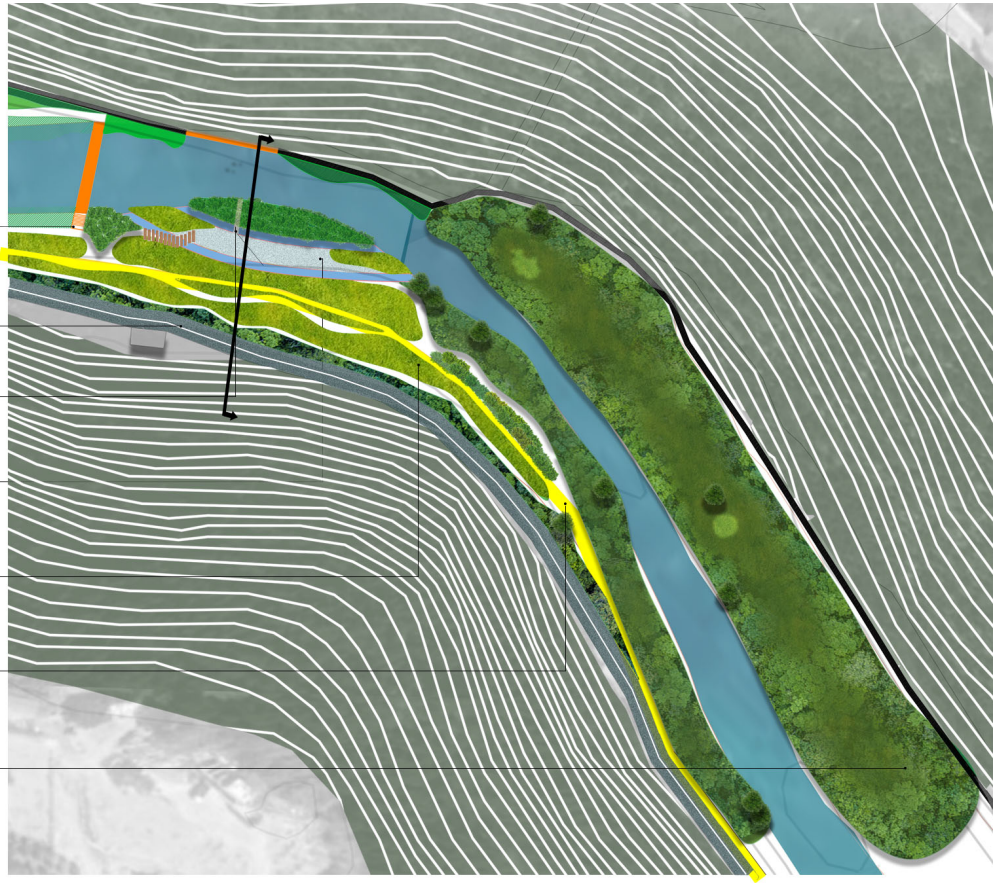
River Garden: The RestGarden

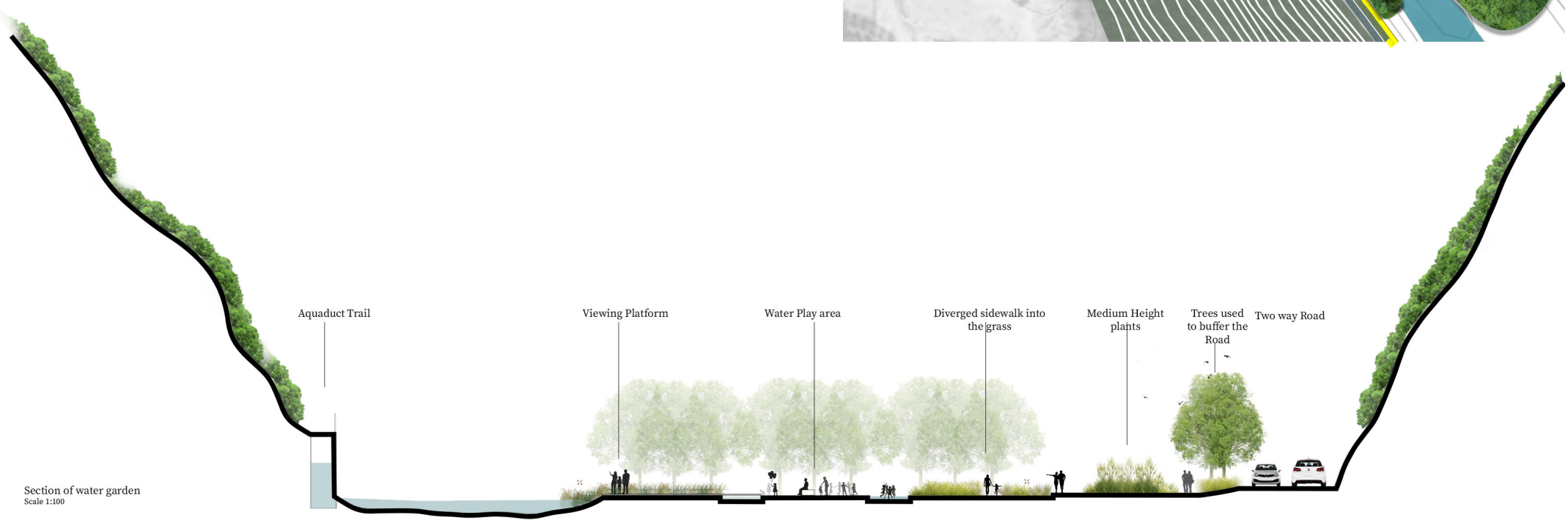
NAHR EL KALB: Reviving The Riparian Corridor

River Garden: The AquaGarden



River Buffer invaided by structure
Scale: 1:600





Section of water garden
Scale 1:100

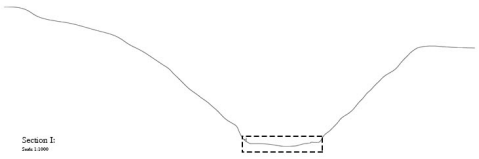
NAHR EL KALB: Reviving The Riparian Corridor

River Garden: The AquaGarden

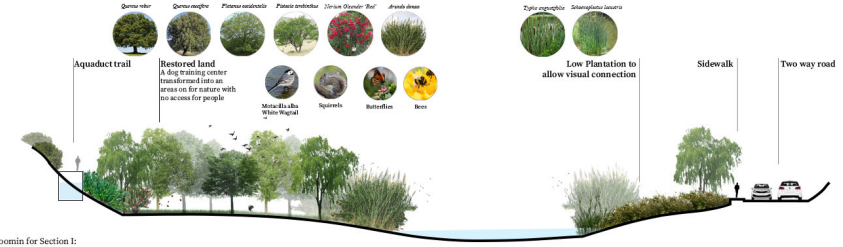
NAHR EL KALB: Reviving The Riparian Corridor

Trail Sections

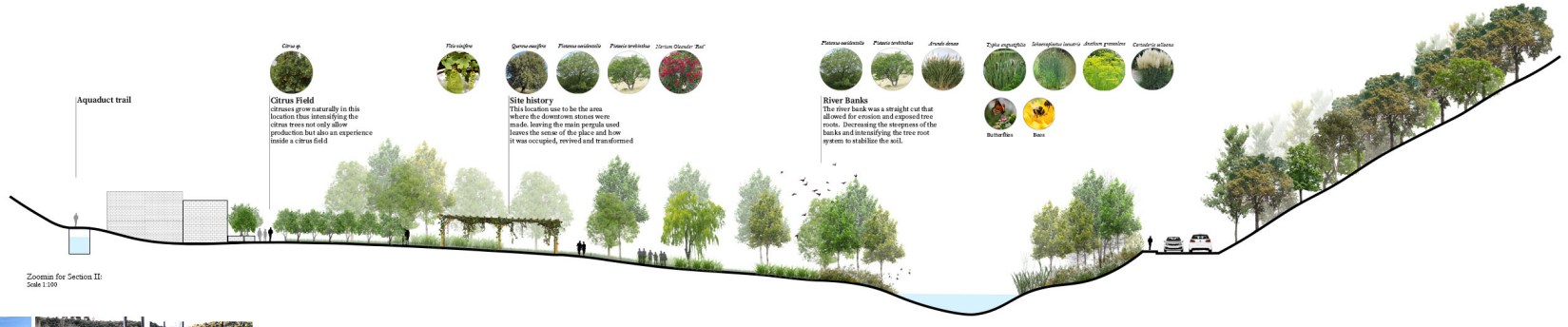
Trail Sections



Existing location Condition: currently used as dog training center

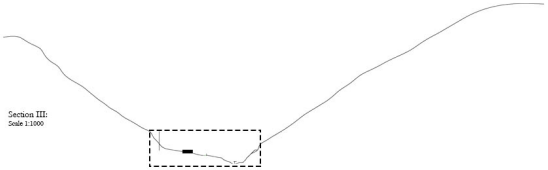


Zoomin for Section I:
Scale 1:100

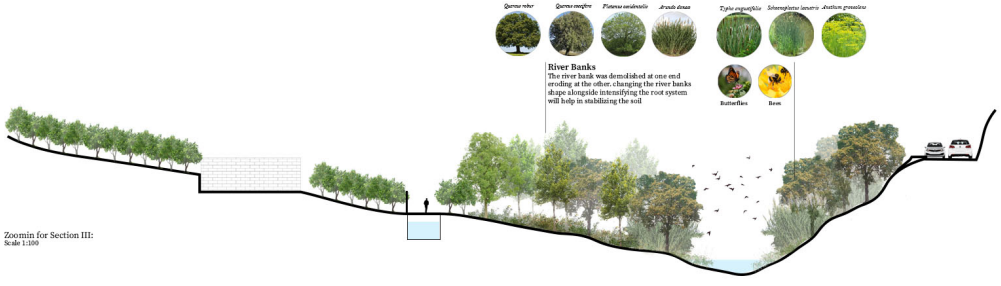


Zoomin for Section II:
Scale 1:100

Existing location Condition: Abandoned land previously used to produce downtown building stone



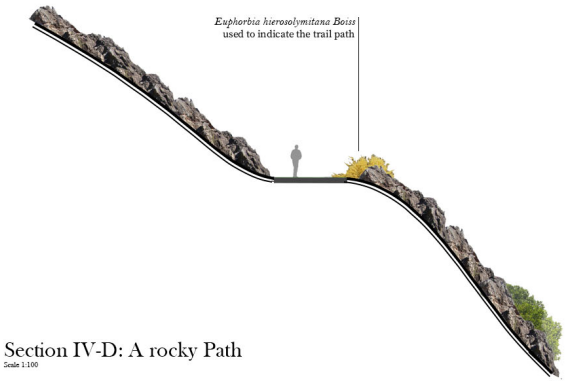
Existing location Condition: Old Town



Zoomin for Section III:
Scale 1:100

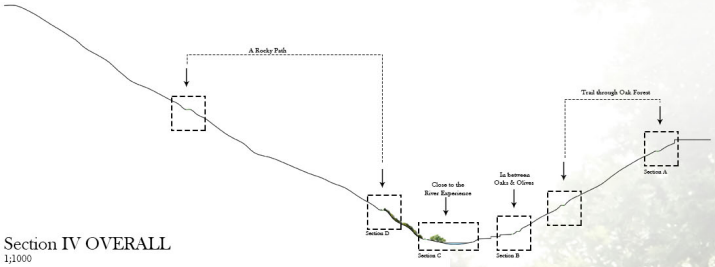
NAHR EL KALB: Reviving The Riparian Corridor

Trail Sections



Section IV-D: A rocky Path

Scale 1:100



Section IV OVERALL

1;1000

Section IV-A: The Oak Forest

Scale 1:100

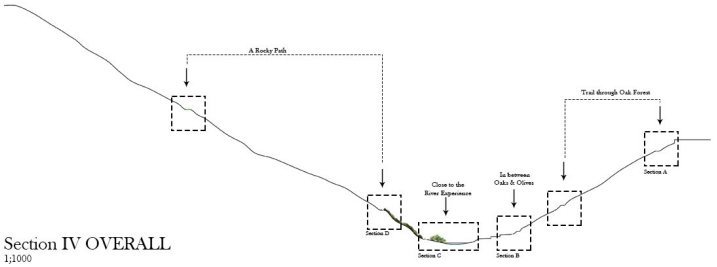
Section IV-B: In between Oaks & Olives

Scale 1:100

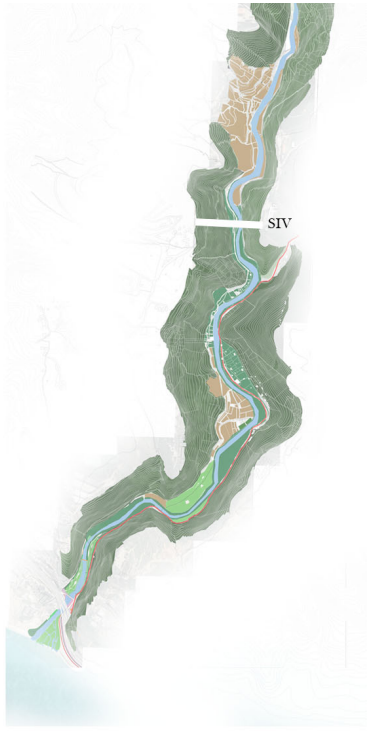
Start

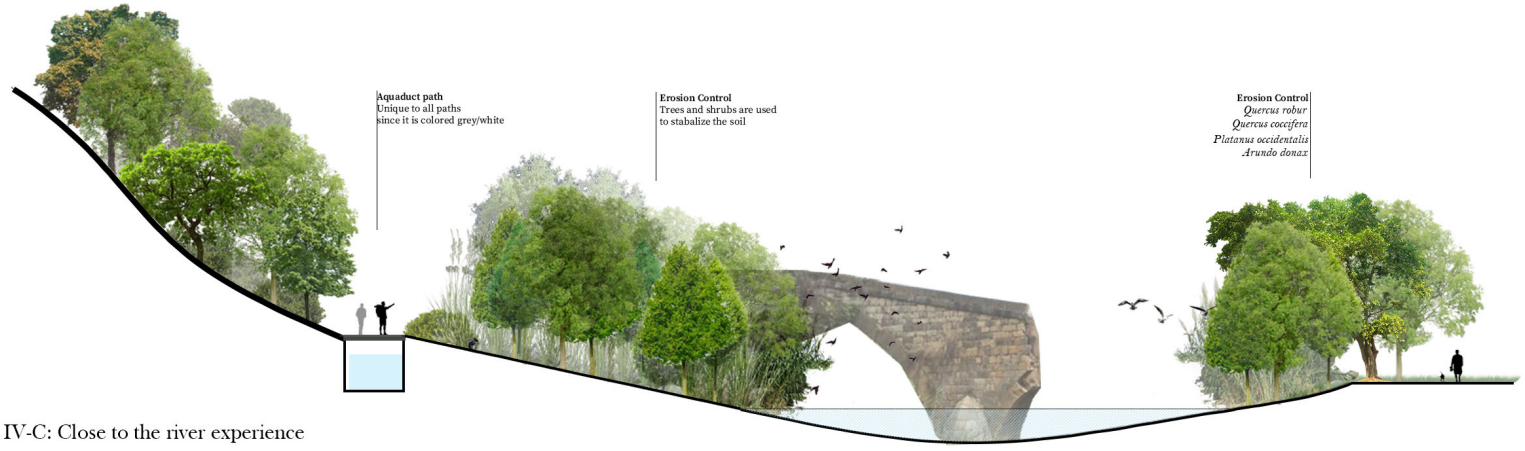
NAHR EL KALB: Reviving The Riparian Corridor

Trail Sections

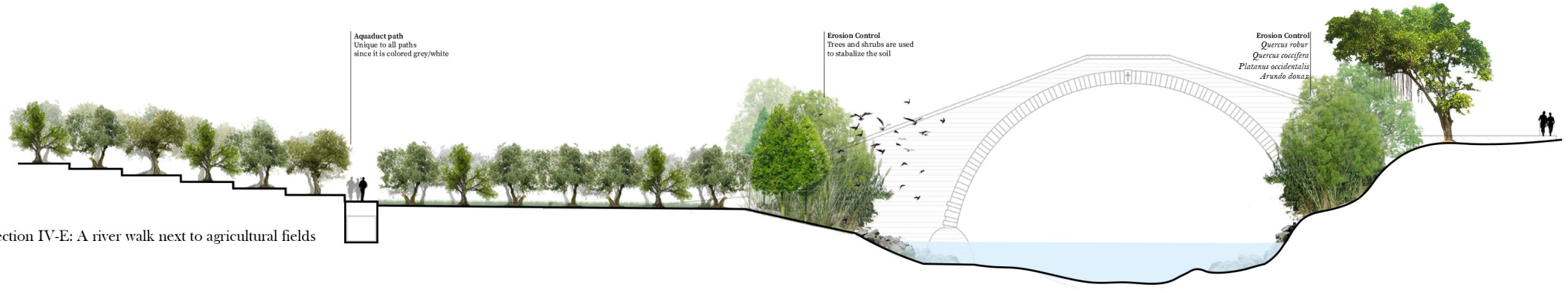


Section IV OVERALL
1;1000





Section IV-C: Close to the river experience



Section IV-E: A river walk next to agricultural fields

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