

**URBAN RIVERFRONT DESIGN: A STUDY OF  
PEDIEOS RIVER**

**A THESIS SUBMITTED TO THE INSTITUTE OF  
GRADUATE STUDIES  
OF  
NEAR EAST UNIVERSITY**

**BY  
ALAA ALNASSAR**

**In Partial Fulfilment of Requirements for  
the Degree of Master of Science  
in  
Architecture**

**NICOSIA, 2021**

**ALAA  
ALNASSAR**

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**Prof. Dr. K. Hüsnü Can Başer**

**We certify this thesis is satisfactory for the award of the degree of Masters of Science  
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I hereby declare that all the information in this document has been obtained and presented in accordance with the academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all materials and results that are not original to this work.

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A rectangular box containing a handwritten signature in blue ink, which appears to read 'Alaa Alnassar'.

Date: 15 June 2021

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**To my parents...**

## ABSTRACT

Rivers are an invaluable element of any city and it is of the utmost importance in urban planning and design. In urban planning, it is important to integrate the riverfront into the architectural identity of the city. Pedieos River also need urgent focus in that sense. The existing problem is very critical due to the obvious ignorance of the tributaries in the city landscape design. Thus the Pedieos River, which is considered to be one of the most important river within Northern Nicosia, is the subject of this study. Within this framework after the introduction, in second chapter the topic of urban rivers' natural elements and restoration is discussed and evaluated. In third chapter, the evaluation of urban rivers within urban landscape planning and design is made. Later in fourth chapter international cases and Pedieos River in particular are handled to investigate with the help of several determined criteria. It can be concluded that there is an urgent need of focusing on the planning and design of the Pedieos River with the help of a comprehensive multi-disciplinary project and implementation including restoration, urban design, landscape design and ecological management. Such a project has the opportunity to restore the biodiversity of the river and boost the urban landscape potential for the city.

**Keywords:** Urban rivers; river restoration; riverfront landscape design; Pedieos River, Nicosia

## ÖZET

Nehirler, kentlerin paha biçilmez bir unsurudur ve şehir planlaması ve tasarımında son derece önemlidir. Kent planlamada, nehir kıyısını kentin mimari kimliğine entegre etmek önemlidir. Kanlıdere'nin de bu anlamda acil bir odaklanmaya ihtiyacı var. Mevcut sorun, kentin peyzaj tasarımında derenin varlığının açık bir şekilde göz ardı edilmesinden dolayı çok kritiktir. Dolayısıyla, Kuzey Lefkoşa'nın en önemli derelerinden biri olarak kabul edilen Kanlıdere (Pedieos River) bu çalışmanın konusunu oluşturmaktadır. Bu çerçevede girişten sonra ikinci bölümde kent akarsularının doğal unsurları ve restorasyonu konusu ele alınmış ve değerlendirilmiştir. Üçüncü bölümde, kentsel akarsuların kentsel peyzaj planlama ve tasarımı kapsamında değerlendirilmesi yapılmıştır. Daha sonra dördüncü bölümde, uluslararası vakalar ve özellikle Pedieos Nehri, belirlenen çeşitli kriterler yardımıyla araştırmak üzere ele alınmıştır. Restorasyon, kentsel tasarım, peyzaj tasarımı ve ekolojik yönetimi içeren kapsamlı bir çok disiplinli proje ve uygulama yardımıyla Pedieos Nehri'nin planlanması ve tasarımına acilen odaklanılması gerektiği sonucuna varılabilir. Böyle bir proje, nehrin biyolojik çeşitliliğini geri kazanma ve şehrin kentsel peyzaj potansiyelini artırma fırsatına sahiptir.

**Anahtar Kelimeler:** Kent içi dereler; dere restorasyonu; nehir kıyısı peyzaj tasarımı; Kanlıdere, Lefkoşa



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## LIST OF ABBRIVIATIONS

<b>AD:</b>	Anno Domini
<b>BC:</b>	Before Christ
<b>CES:</b>	Cultural Ecosystem Services
<b>ES:</b>	Ecosystems
<b>EU-WFD:</b>	European Water Framework Directive
<b>IPBES:</b>	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
<b>MT:</b>	Main Tributary
<b>NCP:</b>	Nature Contribution to People
<b>REC:</b>	River Environment Classification
<b>T:</b>	Tributary
<b>TRNC:</b>	Turkish Republic Of Northern Cyprus
<b>UN:</b>	United Nations
<b>URS:</b>	Urban River Survey

# CHAPTER 1

## INTRODUCTION

### 1.1 Background

During the 21st century, the interest within the subject of sustainability has become more important, within the aim of resilience cities. Ecologists within the landscape majors are interested in this subject, as they have enough knowledge within the place formation, dynamics, and nature. They always trying to connect these measurements within the available policies regarded the topic. The United Nations (UN), is directing those policies, as more than 50% of the world's population living in the cities, and by 2050 the number is expected to be 70% (UN Habitat 2006) cited in (Ahern, 2013).

This knowledge of the landscape ecologists will help the challenges that have faced the planning and the management for the new urban world, as it will have a good come from its point of view, (Beatley 2000), cited in (Ahern, 2013). The synthesizing of urban sustainability is the clue key for the urban planning, and it leads to develops the city within a smart mold, as this urban process within the technological processes has been attached to the policies of urban development, as there's no such a concept for the modern developed city- smart city, as the human, social, and information, communicational technological, aspects (Garau & Pavan, 2018).

Table 1. 1 that has been done by Garau & Pavan, (2018) shows the indicators of sustainability for smart cities' resilient. This group of indicators is provided for such a study to indicate the ratio of the urban quality of life, to provide a theoretical methodology to assess the smart presents of the city and they are originated from categories of, use and frustration, health and wellbeing, appearance, management, environment, and safety and security, as these categories, divided into categories, and subcategories (Table 1. 1).





**Figure 1. 1:** Minnesota, USA, Riverfront of the city, (original, 2006), cited in (Cengiz, 2013b)

**Table 1. 1:** The categories of the indicators and sub indicators of the Urbanization. Source: (Garau & Pavan, 2018)

<b>Categories</b>	<b>Indicators</b>	<b>Sub-Indicators</b>
Use and fruition	Accessibility Flexibility	Traffic accessibility Pedestrian accessibility Accessibility for people with disabilities Sustainable walkability Ciclability
	Flexibility and functionality	Services for people with disabilities Multifunctional and sustainable urban equipment
	Minimum service provided	Availability of services and equipment Availability of waste container
Health and wellbeing	Emotional wellbeing	Presence of green areas Attractiveness of living place Quality of Street lighting Easy mobility services

<b>Categories</b>	<b>Indicators</b>	<b>Sub-Indicators</b>
	Quality of life	Environmental maintenance Urban traffic noise pollution Air pollution Housing Livability and sustainability of public spaces Presence of spaces, services and activities Sustainable daycare and healthcare services
	Social wellbeing Environment	Spaces, services and activities suitable for children Provision of services or activities for particular group Economic opportunity and social inclusion Perception
Appearance	Environment characteristics Built Built environment characteristics	Quality of urban landscape Green maintenance Urban design maintenance Quality of housing and urban-esthetic characteristics

Due to the increase in population and the expansion of cities, urban planning issues are becoming more and more important around the world. It was recognized that biological methodologies must be coordinated in urban interrelated activities. In European cities especially, the creation of green corridors and green paths is a very recent phenomenon. The advancement of green space along urban waterways can mitigate the effects of urban warmth on islands, improve the physical and mental prosperity of city occupants, improve flood resistance, and can also preserve biodiversity (İnançoğlu, Özden, & Kara, 2020).

Urban areas consist of diverse semi-natural habitats such as wastelands, parks, flowing streams, and other vital organisms that are highly susceptible to humans. Supporting the urban

biodiversity of the population and its fundamental value that is being researched with population expansion and as the expansion of urban areas requires high natural information to be incorporated into the urban arrangement (İnançoğlu et al., 2020).

Urbanization and the resulting of it is mainly actions has an intensive leading to change the landscape, as it was performed by the human behavior and the changes that the human leads to change in nature (Dallimer et al., 2012).

The activities of humans have a tendency to cause changes in land use and occupation patterns which can leads to certain operations with the potential to change the quality of both the natural and build environment. Historically, such changes have led to the development of a degradation vector. (Wheater & Evans, 2009; Zope, Eldho, & Jothiprakash, 2016) cited in (Veról et al., 2020).

With the development of urbanization, urban rivers have witnessed major changes in form and stability in the past 60 years, and the problem of environmental security of urban waters has been highlighted. Using a combination of research findings from more than 100 studies conducted globally (Yin et al., 2018).



**Figure 1. 2:** Mississippi River in New Orleans, Louisiana-USA, cited in Cengiz, 2013b)

The Landscape Architecture is a science towards the organization, which integrates the urbanization. The main purpose is to achieve the maximum amount of sustainability, as the landscape is an important process forward toward a resilient city. Rivers, considered a water corridor within the city landscape element, when nature was existing before the existence of the manmade habitation, in the presence of the new urbanization. The city is the place for human activities with a maximum amount of educational, and services must be provided, as well as the urban expansion is in an increasing order over nature, and the topographic surfaces of the earth.

## **1.2 Research Problem**

According to the historical reviews of the city's river, Pedieos River is considered as a natural element of the city, within this issue of flooding events, it's very important to look back at the history of the river during the ancient time until nowadays river landscape, as to understand how does the human settlements has been dealt with the river, and what was the biggest challenge for them, as the river is passing through the city, from south part to the northern one as the study area is located in TRNC.

Rivers is very important within the city landscape, that it can play a good role in enhancing the green open spaces within the city patch, even the designing of riverfront areas can have a good opportunities within rising the place sensitivity and the esthetics views within the city, as this procedures needs a landscape, urban planners, architects, and hydrologist engineering too.

Pedieos river suffers from a real pollution issue, and degradation at the level of the natural state, such as the river banks corrosion, and the water quality, has been extremely exposed to the hardscape water runoff, and there's no places has been designed all over the city, within the river banks which makes the population isolated from an important natural element.



**Figure 1. 3:** Pedios River in Kucukaymakli region over the bridge in Şehit Mustafa Ahmet Ruso Caddesi -20/11/2020

Nicosia city started to grow more as after 1974, after the war, which means left the river divide into two parts, north and south, this river is the longest and the most important river within the whole country. Pedieos River is a dendritic pattern as if starts from a point, and it ends up with various tributes, as the river draws a way of tree branches, which is drawing the drainage flow all over the North Nicosia city.

The problem of the Pedieos River in Northern Nicosia city is very critical due to the obvious ignorance of the river tributaries, in the city landscape design, which the river is exposed directly to a hardscape urbanization process, as the water is obviously polluted.

The importance of this study content, as the problem is considered as ignorance to the city drainage natural system, which also affects the city sustainability ranking, and the socioeconomic aspects, as well as the biodiversity of the natural element in the city.

### **1.3 Research Aim and Questions**

The problem is commonly conducted with the ignorance of rivers within the city landscapes, which is affected the biodiversity of the river corridors within the city, even the climatic comfort that is conducted with the river elements, as the main critical problem of having rivers within the city is flooding phenomena when the first statement of the problem is contacted with the second reason that might happen in the city.

The knowledge gap, is as the restoration of the rivers within the city, to improve the life quality at the whole sectors of the economy, and the social life, and to avoid the flood plain with the future events, the gap is with those correlated issues which when the restoration didn't occur the floods will occur and destroy the human's construction. The importance of the rivers within the city landscape, it's to enhance the life quality, the personal health, at the level of the population of Nicosia as it suffers from the hardscape, structures with limited parks within the city, as the rivers landscapes is well ignored.

The purpose of this research is to extract the helpful knowledge into engaging the actions within the city river, to issue the problematic condition in Nicosia city, forwarding the best actions to renovate the river tributaries, to avoid the natural floods. Therefore research questions are below.

1. What is the restoration process, and the river natural elements?
2. How can we design an efficient urban riverfront to enhance the rivers role within the city landscape?
3. What are the related international cases that are implemented for the riverfront design?
4. What is the condition of the Pedieos River? And does it meet the riverfront landscape design criteria?

### **1.4 Methodology**

This research involves a theoretical part and fieldwork as a case study. The theoretical part involves several topics that contain topics related to the nature of the river, within the urban areas, and how can we understand the natural elements of the urban rivers and their importance

within the urban context. Restoration is very important to manage the rivers within the urban areas. Understanding the restoration process will help this research to continue towards the next related chapters. Within the qualitative part of the study, there is a chapter focusing on international cases. Understanding some examples related to the riverfront design within the urban context will upgrade the knowledge towards the last trends in the river design and how to integrate the rivers within the urban spaces.

In the fieldwork part of the study, Pedieos River is evaluated as the case study. The selected locations of the Pedieos River within the Northern Nicosia, which are eleven in total, have been visited to be observed for the evaluation. An evaluation criteria have been set in order to evaluate the international cases and Pedieos River within Nicosia city as the case study. This criteria have several items: 'surround buildings and the neighborhood', 'water', 'open green spaces', 'riverfront design' and 'urban furniture such as benches, lightings etc.'

## **CHAPTER 2**

### **URBAN RIVERS NATURAL ELEMENTS AND RESTORATION**

#### **2.1 Introduction**

We can highly consider that river is the source of life, as well as the water, and used by humans in means of transport, agricultural activities, shops (Qi, Shuang, 2004) all cited (Liu, 2020). As the created environments were created by the rivers, noticed an important historical picture of developments in human existence, as the ancient ancestors settled alongside the rivers and lakes for water resources, also for the cultivation of crops, as agricultural activities, as the source of life was obligatory for human existence in life (Liu, 2020).

Like all the known cities and the famous ones, they were settled next to the river corridors and the rivers themselves, since it was involved within the history of the culture within the particular civilization as the birthplace on it, since it played an important role in the development of the cultures within the existing of rivers, as the relationship between rivers and populated cities has become stronger and more welded, as we can rely on rivers not only for cultural and economic improvements and developments, as the rivers themselves can also strengthen the image of urbanization and its visible identity (Xue-dong, 2007) cited in (Liu, 2020).

The ecology of the landscape is one aspect of developing the realistic perspective of the water element as corridors that integrate the whole structure of the site, since (Forman and Gordon 1981) have defined the water corridors (rivers) within the city as an important element in the landscape (Ward, Malard, & Tockner, 2002).

The value of rivers has always been taken into account and appreciated (Bashak LA., Brown RD, 1995) and (Francis RA, 2012) as it is in the aspect of water sources, including for the conservation context, and the activities of fishing, and consideration at the level of landscape appreciation, as a valuable source, (Gardiner JL, 1997, and Grimm NB et al, 2008). Also, rivers



have a value at the level of the economy, environment, and cultural aspects, as a value on which the existing rivers are based, since the rivers have been used by man for certain purposes, such as tap water for drinking, for agriculture as irrigation, including in the industrial sectors, and electricity production, such as electric power, and a means of transport that catches floods, fishing activities, boating, swimming also, and many aspects of activities to enjoy the human being, since the river landscape has played a role of communication between the people who inhabit the rivers, since they are considered as different communities, as a purpose to preserve the ideas of creativity for the use of the rivers and sustainable actions, also as recommended for the public, and private sectors to work together to obtain the best solutions for the use of the river as a sustainable water resource, and human activities (Anonymous, 2006) all cited in (Cengiz, 2013)

There has been an obvious observation of water consumption and the cultural diversity that has settled on these water resources, at the level of the culture of the society, (Cengiz B. A, 2007), as many cities have been built along the river, (Francis RA, 2012, Cengiz B. A, 2007, and Sardon RC et al, 1995), as many civilizations have signed treaties with the Euphrates side - Tigris Rivers in Mesopotamia, in Egypt (Nile River), in India (The Ganges River), in Pakistan (Indus River), China (Huang-Ho River), throughout history, (Novaresio P, 2006), London (Thames River), Paris (Seine River), Rome (Tiber River), Prague (Vltava River), and Budapest (Danube River), (Mann R, 2006, and Torre LA, 1989), New York City (Hudson River), Melbourne (Yarra River), (Francis RA, 2012), as in Turkey we can mention the following rivers: Adana (Seyhan River), Amasya (Yeşilirmak river), Antakya (Asi River), Diyarbakır (Tigris River, Edirne (Meriç river), Eskişehir (Porsuk River), and in Bartın (Bartın river), (Cengiz B. , 2007) all cited in (Cengiz, 2013).

Urban areas may include some of the streams that are passing through, the cities, and can be classified into stream types according to Juracek & Fitzpatrick (2003), and in Table 2.1, the types are illustrated.

**Table 2. 1:** Description of Level I Stream Types in the Rosgen Stream Classification. Source: (Juracek & Fitzpatrick, 2003), Originated from (Rosgen, 1996)

<b>River Type</b>	<b>Infringement</b>	<b>Shape Of The Channel</b>	<b>Span-Bottom-Proportion</b>	<b>Flexure</b>	<b>Slope</b>
Type A1	Deep-Seated	Pond Or Rake	Stubby	Stubby	Extreme
Type B1	Moderate	Sway	Moderate	Average	Average
Type C1	Small	Pond Or Rake	Average To Extreme	Average To Elevated	Stubby
Type D1	A Slightly If There Is	Twist	Very Extreme	Extreme Elevated	Stubby
Type Da1	Small	Conjunction	Extreme Variable	Extreme Changeable	Stubby
Type E1	Slight	Pond Or Rake	Stubby	Extreme	Stubby
Type F1	Deep-Seated	Pond Or Rake	Moderate To Extreme	Average	Stubby
Type G1	Deep-Seated	Pond Or Rake	Stubby	Average	Average

The demanding of Urban Development process is a must, as the classification of the urban rivers is related with it, as it becomes slowly under the classification sector, as river's channels could be classified into two consecutive types, such as the natural one, and the artificial at the second hand, as the artificial one is mainly done by a human, within a manual work, as in those days we can say that the most urban river's channels are made by a human, as we can consider it artificial, as in Table 2. 2, the classification is mentioned (Liu, 2020).

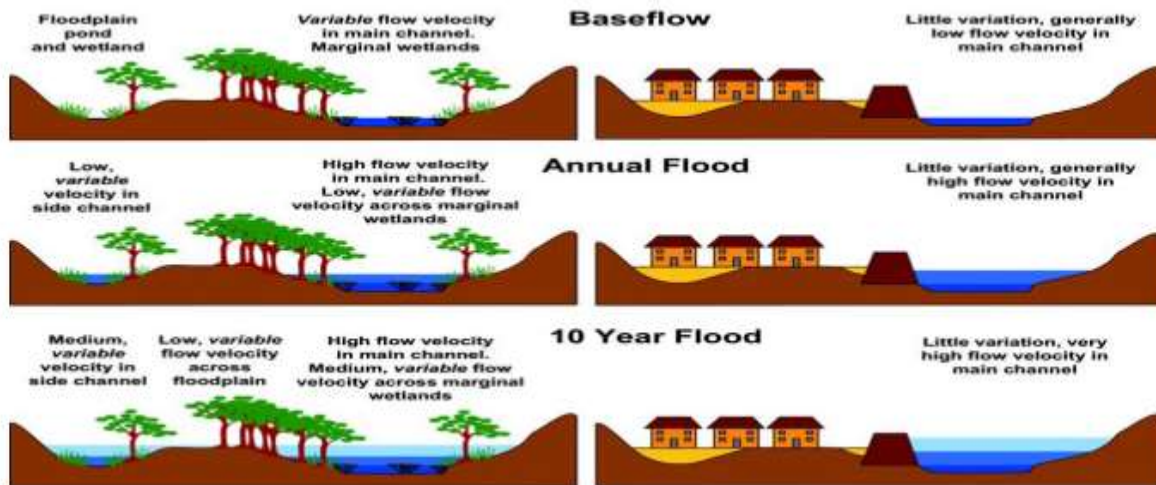
**Table 2. 2:** The classification of urban rivers, according to the flow, and the structure. Source: (Liu, 2020), \*Originated from (Liu, 2020)

<b>Classification</b>	<b>Flow</b>	<b>Function</b>
Transit river	Large medium	Its main function is related to connecting a number of rivers within one watershed at the end and can help the transportation and exportation of the other

Classification	Flow	Function
Navigation river	Large medium	tributaries which can form waterfront areas Can connect the urban economy within the locals and the nears to enhance the economic functions of the urban areas
Moat channel	Small medium	Enhancing the drainage of the urban profile within the means of culture and the history of the urban area
Diversion channel	Small medium	Can improve the urban areas within providing the waterfronts for activities and more

## 2.2 Urban Rivers Natural Elements

In natural statues of the river's, as they are conducted within their own floodplains, they are formed of complex, as they can be different within the hydrology, geomorphology, and the ecology, all those features can type one patch of mosaic in different ways on its own of formations (Frissell et al. 1986) cited in (Gurnell, Lee, & Souch, 2007).



**Figure 2. 1:** Urban development, and the changing of the urban floodplains, at the three flow stages, within the urban development, and the natural untouched one. Source: (Gurnell et al., 2007)

The changing can be occurred within this mosaic, by time, and space, within the river flow, disrupting, and the movements of the sediments in a long way, within the down and the upper parts both of the stream's flow, or even lateral by channel as a floodplain, and vertically, within the level of the surface, and the subsurface, due to the climate, even the hydrological, and biochemical patterns (Ward 1998; Ward et al. 2002) all cited in (Gurnell et al., 2007).

### ***River Flow***

According to Bunn and Arthington, (2002) the river flow can be considered as a key factor of river ecosystem, as they suggested four mechanism's that tend to conjunct river hydrology and aquatic ecology.

River Flow mechanisms can determine:

1. Physical habitats.
2. Longitudinal, and lateral connections between the rivers corridors.
3. Aquatic species
4. Altered flow regimes

Vegetation can be considered as the further key, which can accelerate the sedimentations, and can be led to a major changes within the river texture, and riverine habitation, (Bennett and Simon 2004; Gurnell 2007; Gurnell and Petts 2002; Hupp and Osterkamp 1996) all cited in (Gurnell et al., 2007).

### ***River Flood Plains***

Since cities and most urban developments are integrated into the river drainage system, we must take into account the natural phenomena of river systems, which are beneficial for urban developments.

Apart from the advantages of the rivers and water elements within the urban context, the other side is expressed in the disadvantages, such as the flood plains, as they will be integrated into human activities, and the human losses, at the level of housing floods, since urban activity damages wildlife and the surrounding, here nature receives the disadvantages as a benefit,

(Smardon RC, 1995). Since the activities that have occurred through the past, a serious circumstance for the river conditions, besides the uncertain conditions, the impact on water sources within the urban context, there is an increase in the obtaining of water treatment systems such as the sewerage drainage system, since there is a hope to fix the river conditions in all aspects of the morphology of the river, and the economic scenes, all cited in (Cengiz, 2013).

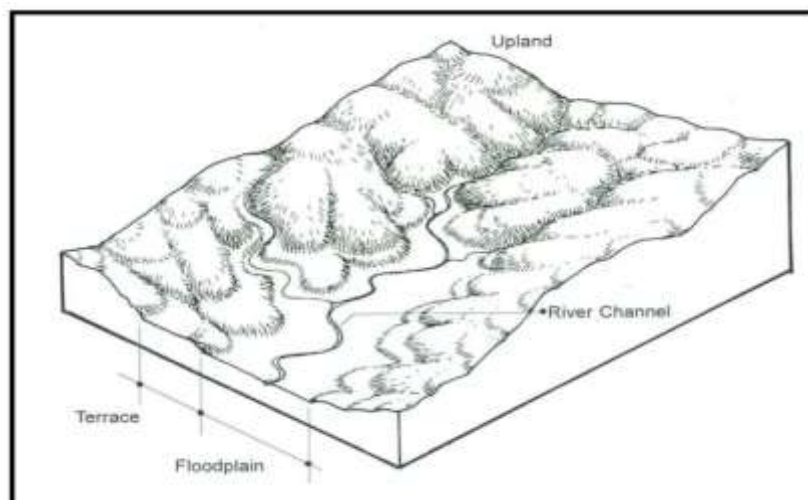
In order to improve life at the level of quality within the urban context, which includes water, since cities are located on the banks of rivers, attention must be paid to flood plains, as we call them Flood Control System, and water quality must also be considered in the urban context since this consideration has been taken into account, great attention is paid to rivers throughout the world (Cengiz, 2013).

The main consideration of the urban river, attention has been drawn in Northern America, as in the United States, and in the Asian part (China), and Western Europe, (Francis, 2012) cited in (Cengiz, 2013). In the typical state of the river path, several conditions define this path, such as the geology and hydrology of the river. The river path represents itself by maintaining the landscape, by going through the caving process to form the landscape, by going through a natural sculptural process by the land topography (terrain), creating a sedimentary deposit through this process, by the delay in this sedimentation forming a wetland, being filled up by a flood or at certain times of a flood fall (Smardon, 1995) cited in (Cengiz, 2013).

The edges of rivers, as well as the riverbeds, of rivers and also of streams, since rivers can form terraces when they flow down from the upper streams, then towards a higher elevation, (Smardon, 1995), and they are a natural phenomenon of river ecology, as the welling warnings due to flood events are to be condemned, as flood experts statistically measure the flood events ranging from 1 to 10, as a frequency value per time, as  $kt$  calculated between flood events and the larger flood events such as the 10-year floods can be represented by the events that have occurred each year through these 10-year flood records, since, on the basis of historical data, the calculation of flood events has been staggered to represent 10-year or 25-year and 100-year

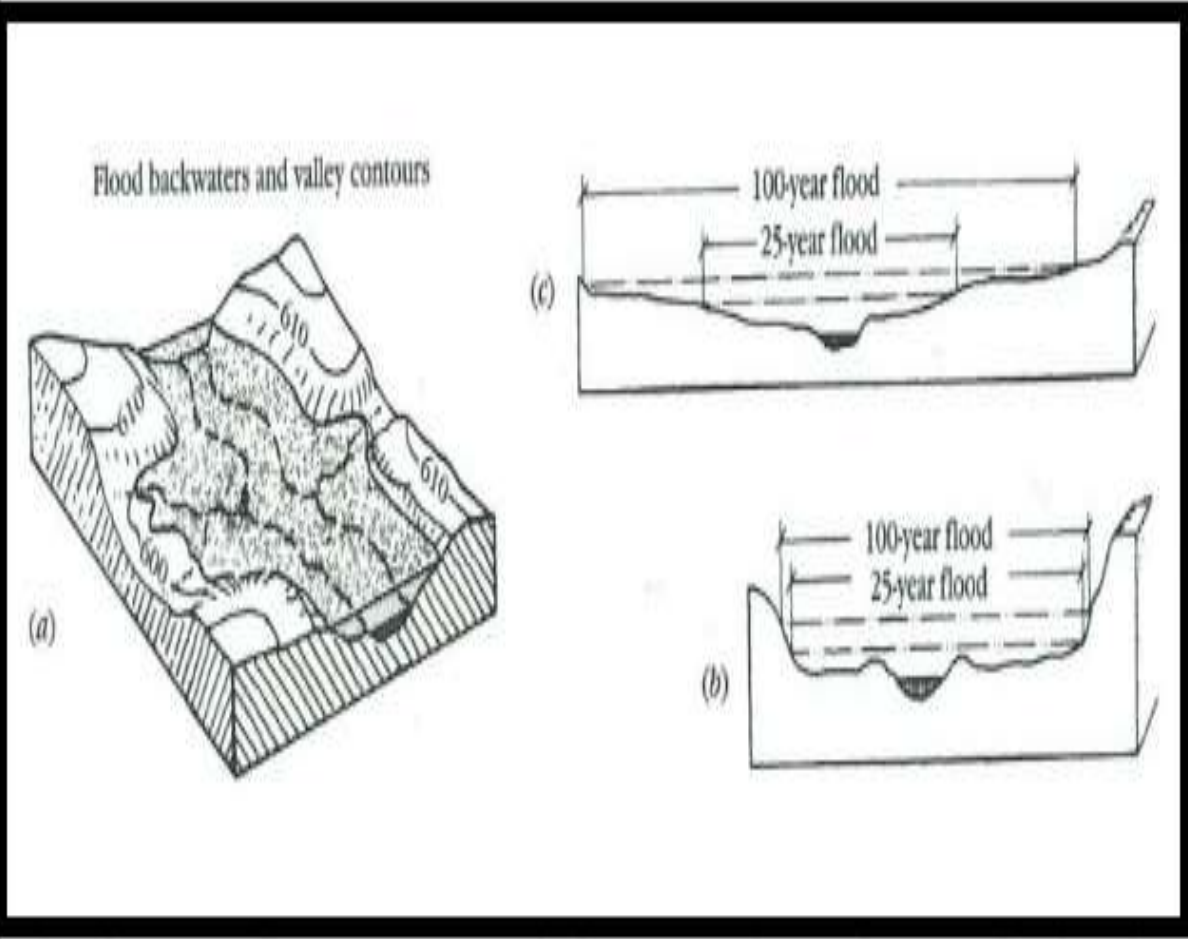
floods, that the probability of a flood event occurring in each year of the entire 100-year period is 1 per cent, since 5 per cent can represent a 20-year flood event, and that a number of factors should be taken into account according to the frequency of measurements, such as high precipitation, changes in human land use, as these factors influence the frequency to be observed (Anonymous, 2006) cited in (Cengiz, 2013).

The representation of the 100 years flooded area is condemned by the USA National Insurance Program, the zone of the flooded area is shown in Figure 2.2, since it can be between the association of the data and the height to which the water flows, this program was considered at two points, the flood path and the edge of the flood path, since the flood path is the lower part of the occurrence of the flood plains, where the water flows more efficiently, deeper and more often, since the edge of the flood plains in the area, which receives fewer flood events from the river, and we can fake the events on it by the 100-year flood events, because in the case of settlements next to the river in the two zones, the first is very dangerous and more likely to flood, even if there is flood insurance, and the second is available for settlements if the risk of flooding must be taken, (Marsh, 2010) all cited in (Cengiz, 2013).

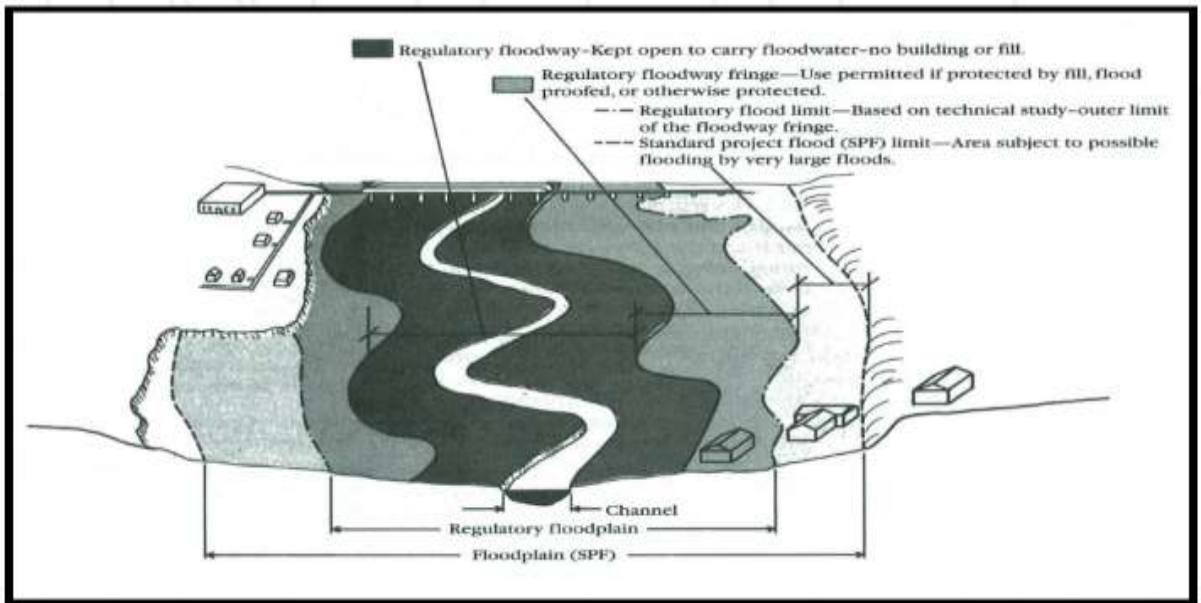


**Figure 2. 2:** The elements of the typical floodplain, as a physiographic representation (Smardon, 1995), cited in (Cengiz, 2013a).

An improvement and upgrading of manual developments at the level of the channel, and the wider flood channel is a must, such as the erected buildings, and the developed paths, such as the roads can be flooded in the period of 10 years, and the 100 years of flooding, such as In this situation, income is allegedly bad and catastrophic, for the people, as they represent the resident population in developed urban areas, as this situation must be considered in the context of the consequences and the work to prevent flooding is expensive and can cause a distraction for the naturally existing river landscape (Turner, 1998) cited in (Cengiz, 2013).



**Figure 2. 3:** The relation of the backwater with the valley land layers, the counter lines, (Marsh, 2010, cited in (Cengiz, 2013b))



**Figure 2. 4:** A diagram by the US National Flood Insurance that presents both the flood path, and the fringe, cited in (Cengiz, 2013b)

On the side of implementing the solution to cope with the flood phenomena, it must be understood by the landscape of the country to have a solution as presented and proposals can be applied to the cities:

1. In half a year, we will be able to see the playgrounds, gardens, and preserved natural landscapes.
2. In half a year we can look at the unnecessary parking spaces, the traffic lights for street lighting, the buildings tolerated for the floods.
3. For the 25 years we can consider many roads, including the parking lots, the ground floor levels and the unnecessary buildings.
4. For the 100 years, we can consider the large urban development areas and the areas that have been designated for landscape planning, taking into account the study areas.

(Cook, 1991), (Cengiz et al., 2001), (Anonymous, 2006), (Smardon, 1995), (Marsh, 2010), (Otto et al., 2004) all cited in (Cengiz, 2013).



The various urban development's adjacent to riverbeds have had an impact on the ecology of nature at the river level, and there is also a difference between the two groups of developed urban spaces, with food levels as areas of large overcrowded development in the management of these areas will be different from those built up within an open space, including the design of these areas (Smardon, 1995).

The four main uses according to the consideration of the flood plains:

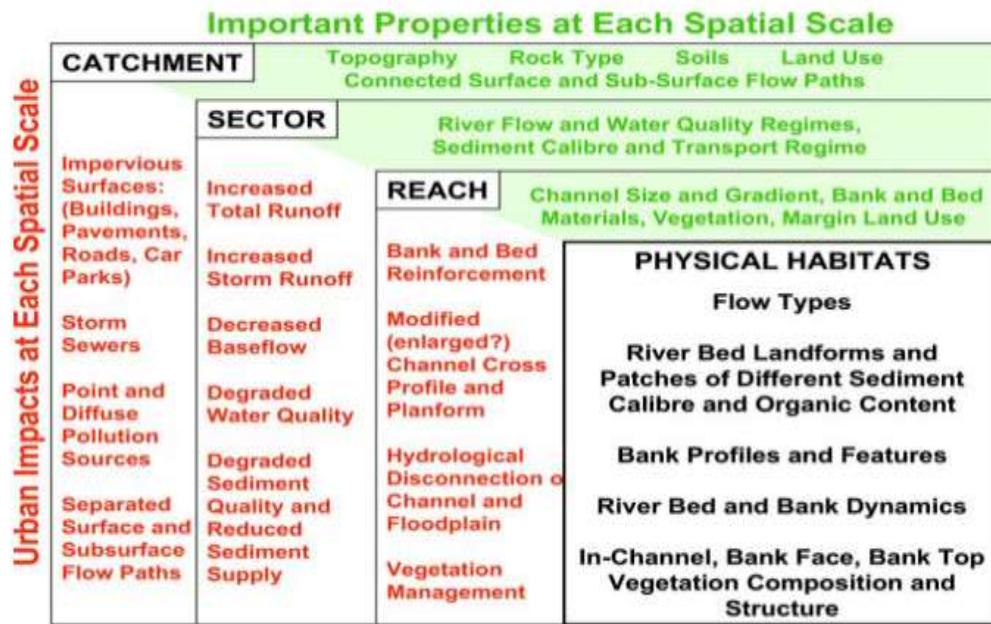
1. Urban areas: As in these areas, flood plains must be upgraded and well designed, as the restoration aspects of natural areas must be taken into account and well managed.
2. Suburban and pre-urban areas: These areas are already at risk from flooding, but there are still open spaces that can be used for these measures. It is recommended that walls be built, which, in addition to providing water sources and restoring existing vegetation, also provides for the use of good plans that can protect communities from these hazards.
3. Rural areas: In these communities where agricultural work is the main aspect of life activities, we can consider these places as open spaces that can contain the risks of flood plains, since it is necessary to control soil erosion, with the excessive use of nutrients, such as the maintenance of natural vegetation species on the riverbanks.
4. Wild Lands: as these areas are considered as a natural well preserved by itself, and the floodplains do not affect the soil, as the presence of the natural ecosystem will prove it by itself as a natural restoration, and should also have a good water quality.

(Smardon, 1995), cited in (Cengiz, 2013).

### ***Water and Sediment Quality***

According to the US Environmental Protection Agency (2000), water quality can be effected within a certain number of reasons that led to this degradation within the water quality such as it came from the urban areas, and the areas around the urban texture of the city such as the suburban areas too, as these places produces runoffs from the hardscape urban surfaces, even the industrial ones, and the municipal ones, aimed to increase the nutrients concentrations, even

the alloy materials, the insecticide, also the organic toxins, such as the oil industry, and the generated harsh chemical that this producer can reflect nature. There is also another toxin that has been recorded that can affect the thermal system of the rivers that are located in urban areas or even pass from there naturally (Gurnell et al., 2007).



**Figure 2. 5:** Urban impacts with respect to spatial scale. Source: (Gurnell et al., 2007)

For a while, urban developments, affecting the river flow have been detected. River flow, is exposed to have more water runoff, and discharges within the catchment areas, as affected the rate of flooding events, even these effects showed by analysis recently:

1. Some showed that there was a peak in river discharge quantity.
2. Decreasing in the time for the river peak discharge, and increasing in the peak discharge.
3. Low the response of the river flow in the seasonal times.
4. General decreasing in the river flow discharges.

The changes can be linked to:

1. The excessive construction, and the rapid ones, can lead to discharge the water directly to the river channel, especially within the rainfall events.
2. The storm water drainage system, which works efficiently, discharges the rainwater directly to the rivers.

Sediments transportation, is directly affected by the flow regime, as the last one is transformed in the first place, as the sediments can be formed by the river flow naturally, but due to the urban runoff, which contains heavy materials, can prevent the natural formation of sediments, as they can be anti-resistance to the river flow, even linked to the reinforcing of the river channels within this material, and the more urban spreading, all cited in (Gurnell et al., 2007).

### ***River Geomorphology***

Based on Gregory (2002), and Chin and Gregory (2005) evolve a categorizing of geomorphology for urban rivers channels, which conduct the human activities, as a management for the channels, towards the geomorphological shapes, the adjusting and the risks, to direct it as a management operator tool, they are six in total:

1. Besides the natural channels.
2. Recoverable channels by adjusting them.
3. Unrecoverable without interfering can't be done, such as the huge incision that occurred.
4. Partly channelized, with the ability to recover.
5. Heavily engineered channels.
6. Culverted channels.

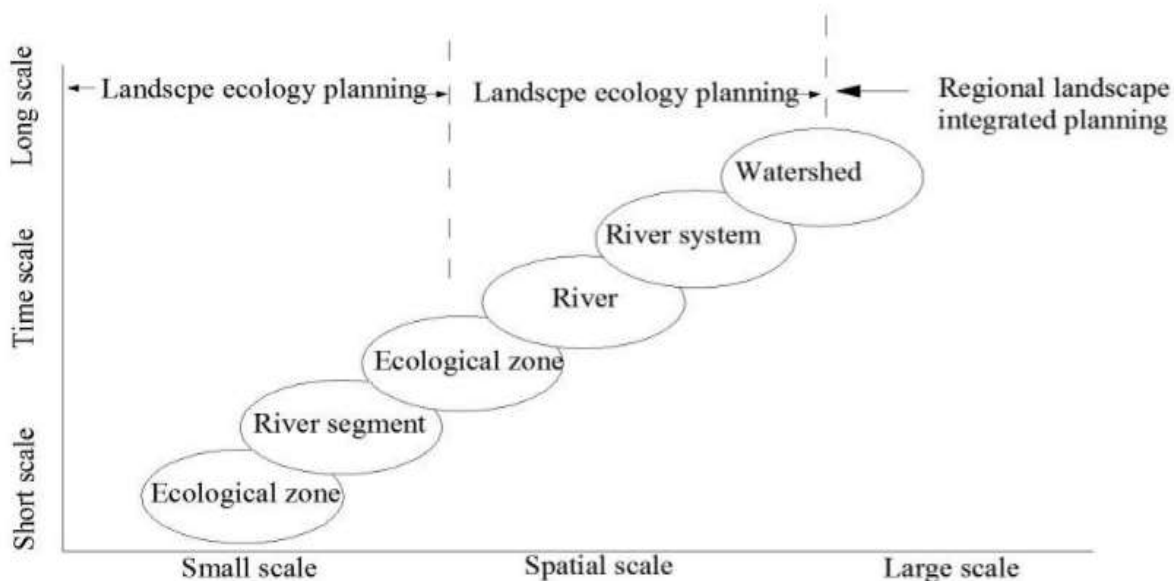
Channel hazards are conducted within the types number 2, 3, 4, (degradation, flood frequency, flood drainage, all conducted with human activities such as: increasing in trash rates, and changes in river aquatic life, even the vegetation's), all cited in (Gurnell et al., 2007).

### 2.3 Urban River Landscape Ecology

Researchers found evidence for river ecology degradation, (Gurnell et al., 2007). Rivers deals with four aspects of the dimensional space, such as patterns, process, gradients, proportion of the direction, connection, and the sway (the dynamic) of the river landscape, (Xu, 2021). The fundamental contents of urban river aimed the landscape ecology:

#### *Scale*

Urban rivers show different, attitude and features, as it reflects the river scale, (Xu, 2021).



**Figure 2. 6:** The planning aimed the scale degree of the ecological planning. Source: (Xu, 2021)

#### *The Ecological Effects and the Heterogeneity of River Landscape*

Xu, 2021, the heterogeneity of river landscapes includes the non-continuous issuing of abiotic factors - a non-living factor or inanimate nature factor, even the areas aimed the biological spreading's from their groups, even the bunch of uncoherent spreading's of a certain biological groups. The four factors are:

1. Transforming geological, topographic and geomorphological genes.

2. The areas within the place characteristics (earth, humidity, temperature, etc).
3. The usual classification for the morphologies aimed the nature, such as the geography.
4. The structure of the river landscape patch is hierarchical and 3D environmental landscape characteristics of the river.

***Characteristics of the Physical Habitat of Urban River Channels***

Concrete is well used in urban rivers, for reinforcement purposes, which it affects the habitats, as the urban enlargement affect the size if the river, also the channel’s dynamics. The purpose of engineering the river channels within the urban context is to provide a good a flow, as a part in controlling the river flood events, as the urban rivers affected by the sediment quality, and quantity, even the riparian zones too (Gurnell et al., 2007).

Urban river surveys, help to characterize rivers, and identifying the corridors. Using Urban River Survey, an analysis for information has been done, conducted several 143 pieces of research for three catchments areas in the European region, (URS; Boitsidis and Gurnell 2004), the rivers area, shows, and explain the physical habitats to understand the variety, of it, all cited in (Gurnell et al., 2007). For example: United Kingdom: The Tame River, Germany: Emscher River, Czech Republic: The Botic River.

**Table 2. 3:** Layout, profile and interference types are used to define riverbeds of a single geometrical trait. Source: (Gurnell et al., 2007).

<b>Shape of the Plan</b>	<b>The Section</b>	<b>The Boosting of the River</b>
Straight (modified within a design)	Extended river bed, and shaped to have a wider river shape even it can be combined within he natural shape at the same location	At the whole areas of the bank , and the river flow too
Meandering (engineered sinuous)	Amputated, also designed to have more efficiency at the level of dynamics	At the level of the river be, and the river bank

<b>Shape of the Plan</b>	<b>The Section</b>	<b>The Boosting of the River</b>
Recovering (engineered straight or sinuous but showing significant planform readjustment as it's detected within the river flow regime)	There's at least one area to contain the flood of the river, and the another one is to contain the river flow after the first step has been taken in place	At the level of the river be, but at one side of the river bank
Partially natural (not touched or designed, even there must be no evidence for a such editing)	The editing at the level of the biological barriers as unusual positions such as trees	One side of the river
	Restoration, and rewilding the river	The bottom of the river
	Human activities within the river, and some editing's	Boosting is not enough

#### **2.4 Urban River Restoration**

According to Binder, Göttle, & Shuhuai, 2015, there's two definition for river ecology improvements:

1. Rehabilitation: Can improve some ecological aspects, but limited dynamic processes.
2. Restoration: suitable for the rivers, that can closely meets the natural related elements.

#### ***River Restoration Principles***

Rivers is the dynamics of life's system, the untouched ones can be found in the upper mountains in Europe, and Beijing, starting from nature; rivers, we can observe a good wealth statues of hydro-morphological levels within the river context, such as the natural flood plains and the riparian areas, those without any human interference, like hydro-engineering activities can still be found (Binder et al., 2015).



**Figure 2. 7:** Several rivers channelled into Central Europe. Lost habitats of plants and animals, Source: (Binder et al., 2015)

90% of rivers within the European region have been modified over 150 years, from activities like hydropower and irrigation, even the constructed wires in the sectional level of the river led to limit the fish habitat and destroying the aquatic life. Urban expansion has led to the shrinking of the fauna, flora of the river's hydro-morphological mechanism. Within the last century European countries directed to construct the water treatment power plant, and nowadays, the condition of river's water is better than before, as the river was exposed to industrial and agricultural water runoff (Binder et al., 2015).

Due to the extensive river channel's engineering (hydraulic engineering), led to disturbing the hydro-morphology of the river's, and nowadays the main purpose is directed to restore the hydro-morphology processes (Binder et al., 2015).

### ***The EU-WFD, European Water Framework Directive***

Several laws in Europe asking for river restoration, the most on is European Water Framework Directive, (Directive 2000/60/EC). Ranging from 1 over 5, a chemical, and ecological evaluation, asked to be done for ranking. The ecological improvements must be achieved after the improvements at the level of hydro-morphological parts and the biological traits. In case of the level of ranging declined below class 1, 2, 3, acts must be taken, to boost the natural state of the rivers as most of the rivers show decline within the hydro-morphological levels (Binder et al., 2015).

Restoration means, the improving within the river at the ecological level, such as the restoring of the original habitat, from animals, to plants, as they all complete each other within a one ecosystem (Water is for Life 2010) cited in (Binder et al., 2015).

Many, and possibly most restoration measures depend on perceptions of "good" or "desirable" habitat types, or on a narrow set of methods that have been developed to manage river canals over the past several decades, (Beechie et al., 2010). Beechie et al., 2010, mentioned Four basic process-based principles, to avoid mistakes in river restoration, (Table 2.4).

**Table 2. 4:** Summary of the four principles based on restoration operations. Source: (Beechie et al., 2010)

<b>Principle</b>	<b>Restoration Description</b>
1. Aiming the reason of the changes occurred within the ecosystem	A good target within this process is target the main issues that is related to the degradations of the habitat within the river, and the causes from the main reason, also within taken the human activities into consideration.
2. Privatization to the local aspects of the restoration at the targeted place	Ever each point of the river must be detected in order to look at the relations between the point to complete the process of regenerating as all of them take a unity process
3. Meeting the scaling issue together	We need here to detect the right scale for each activity, as we need to meet the needs of the



<b>Principle</b>	<b>Restoration Description</b>
4. Let the results be true	restoration within the location that we detected. We need to wait until the recovery process reach the results as there will be a duration of time between the required action and the natural statues of the river to be fully recovered

River restoration is a tool that we can use to mold our changes within the river levels, such as the convicted channels, riparian zones, also the flood plains, as well as the water quality, even the sediment conditions, (Bennett et al., 2011). The used tools that refer to the river will help us to achieve the purpose of improvement at the level of hydrology, as the geography too, as we can replace the damage within the water quality, and convert it to better conditions (Wohl et al., 2005) all cited in (Robinson, 2008). In Table 2.5 we can see some goals that aimed at the restoration of the retorted rivers.

**Table 2. 5:** The goals towards the river restoration. Source: (Robinson, 2008).

<b>Goal</b>	<b>Description</b>
Educational goals	<ul style="list-style-type: none"> <li>• The community awareness and interaction within the outcomes of the restoration actions</li> </ul>
The stability of the river edges	<ul style="list-style-type: none"> <li>• Within this we can protect the river banks from erosion, and corrosion of the soil, and prevent more unexpected damages</li> </ul>
Editing of the channel	<ul style="list-style-type: none"> <li>• Playing and directing the river channel may affect the bad outcomes that can help the river morphology.</li> </ul>
Extraction of the constructed Dams	<ul style="list-style-type: none"> <li>• Eliminating the dams can improve the river aquatic habitat to roam and move in a good way that they can practice the natural life ( natural ways without barriers that can affect the count and the exporting)</li> </ul>
Habitat ways and movements	<ul style="list-style-type: none"> <li>• We need to make sure that there will be no barriers at the upper streams, and the down ones, in order to let the fish migration process go well</li> </ul>
The reengaging of the floodplains areas	<ul style="list-style-type: none"> <li>• The connection of the river’s within the flood plains can enhance the biodiversity, and the whole ecosystem at the location</li> </ul>

<b>Goal</b>	<b>Description</b>
The editing at the level of river flow	<ul style="list-style-type: none"> <li>• Some procedures can be helpful; for the river in order to control the flow and minimize the risks that can be occurred</li> </ul>
Nourishing the local habitat	<ul style="list-style-type: none"> <li>• This will allow the diversity of the habitat to widen their scales, and having a good breeding at the level of the local ecosystem</li> </ul>
The managing of the spices	<ul style="list-style-type: none"> <li>• The reposition of the original habitat, within the river and excluding the harm ones that can alter the another species can improve the aquatic life within the river</li> </ul>
Purchasing the land	<ul style="list-style-type: none"> <li>• The land preservation projects can be effective at the level of the securing the natural habitat and the ecosystem within the certain points</li> </ul>

Note: Definitions from National River Restoration Science Synthesis Project.

As we can consider restoration is extracted from the rehabilitation, to collect the engineering works, to meet it up within the biota of the biodiversity, as we fix the riparian zones, also the river's banks, and these took decades to achieve (Robinson, 2008).

The wells rivers conditions when they appear that means that the maintenance of healthy social income for the habitats adjacent to the rivers, also with the consideration of river ecology, (Postel and Richter, 2003), as the restoration act for the streams and rivers is a trend now and an important measure towards the water corridors, (NRC 1996; Holmes 1998; Henry, Amoros and Roset 2002; Ormerod 2003), since a billion-dollar investment in river restoration is being specialized in the USA itself, (Plamer et al., 2003; Malakoff 2004). Since there is guidance for these actions of the restorations, the regulations for this law are not stable, and somehow it was missed to meet to reach an agreement, (Gleick, 2003), since these regulations must now be fulfilled and it is time to reach an agreement for this law, all cited in (Palmer et al., 2005).

Several five criteria have been obtained, to add successful measurements for the river restorations, to achieve the ecological values by (Palmer et al., 2005).

1. A clear guide to draw the right picture for the restoration because the dynamic points must be recognized to have the right guides.

2. The improvement at the ecosystem level must be achieved to measure the ecological status.
3. The improvement of restoration is reviled because the condition of the river must be improved compared to the previous condition.
4. The damage caused during the process must be temporary and then disappear.
5. The achievement of the ecological objectives must be achieved during the period before and after the restoration process because we get clear information about the restoration work.

The aesthetic concerns of the landscape must be appreciated in the context of urban design, and it carries weight in the field of research studies, since it goes beyond other studies on geography, landscape architecture, architectural design, and psychology, as does philosophy, since it stimulates sustainable design and planning and management roles, (Berleant, 1997) cited in (Batista e Silva, Saraiva, Ramos, & Bernardo, 2005)

A methodological aspect has been granted by Belton (2002), to support the aesthetic evaluation, for the rivers within the context of the urban, for the meaning of understanding the approaches, and the features that can be able to enhance and suggest a dealing to improve the meaning of the river rehabilitation aspects, as also can contradict the performance of the working that can be done for the river rehabilitation, as the implications of the resources to value the statues can be established, cited in (Batista e Silva et al., 2005).

The methodology follows up three actions to value the landscape of the rivers within the urban context. First is Exploring, second is Structuring, and third the Modeling:

1. The Exploring Step: This step can help us in forming a general image about the ideas that will generate later by evaluating the status of the aesthetic values, as well as the quality with the urban context, as we can as what of these aspects can enhance the quality of the water elements within the city, as an urban value in this place.

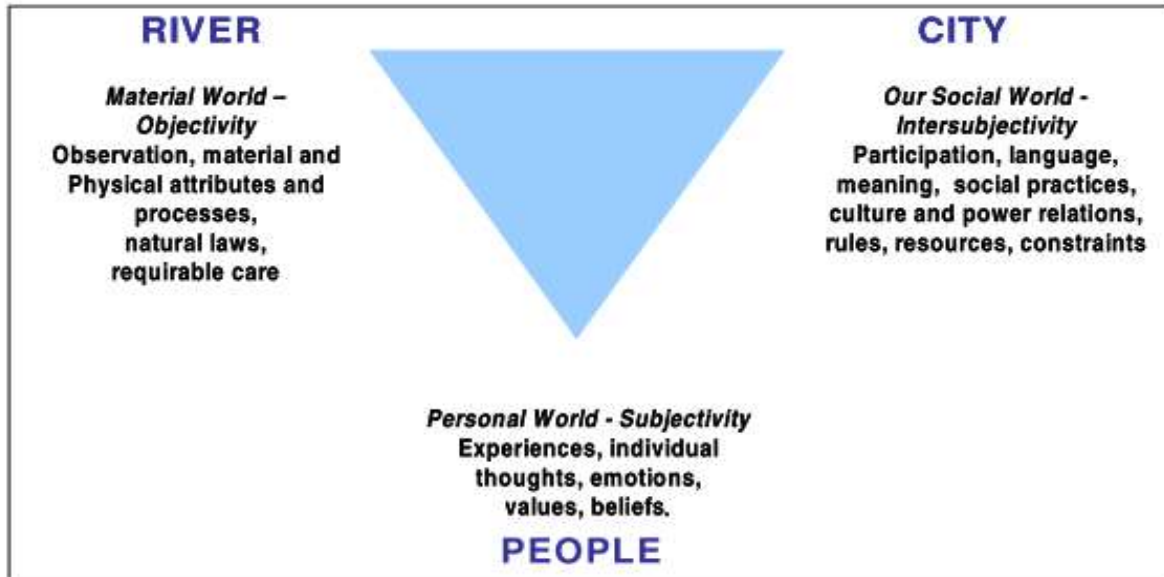
2. The Structuring Step: This step, can be obtained by the working of the experts in their domains, as a modeling for a master plan can be taken out within a certain software.
3. The Modelling Step: This step must handle the applying of the recommended work to know the aspects of the comparing, and the performance of the same aspects. Aspects of these evaluating must be taken into consideration for the suitable selection of the aesthetic statues, as a general profile (Batista e Silva et al., 2005).

The research has been held as mentioned by Batista e Silva et al., 2005, as three stages considered for this purpose as it represents that three main dimension to evaluate the aesthetic river, as it consists of the River, People, and the City itself, as they relate to the World of Habermas, mentioned in (Mingers, 2001: 290) all cited in (Batista e Silva et al., 2005).

The (ES), Ecosystems is considered such as a service that has been provided by the rivers, as it became an important scale for the biodiversity and the managing of the wildlife ecosystems too, (Díaz Set al. 2015), as the history of the ecosystems evaluating,(MEA. 2005)has been conducting lots of researches, as it related the relation between the Ecosystems, and the biodiversity of the natural existent's of the water corridors, as it focused on the regulating this process between them, (Cardinale BJ et al. 2012), although as we consider the economic issues is worthy and relevant to the value of appreciation, this kind of looking up at the biodiversity is important, and has its boundaries (Bekessy S, Runge M, Kusmanoff A, Keith D, Wintle B. 2018).

Even at the level of the social needs for the community will be upsetting, and ignored to upgrade, as these cultural social acts is an important aspect for the humans, (Daniel TC et al. 2012; Cooper N, Brady E, Steen H, Bryce R. 2016), even though to break down these borders of the biodiversity, as for purpose to make it more elastic the IPBES, worked on putting a definition for the social, and cultural values (Sociocultural), to be a concept named nature's contribution to people(NCP), (Diaz S et al. 2018), as this definition has been covered the material, and the non-material bonds between humans and the existed nature, as it comes to be (CESSs), which it tends to Cultural Ecosystem Services. As the landscape of the CESSs, is related to the aesthetic

values of the rivers, as it includes the healthy, the life quality, as it must be obtained the soul of life in the space as the harmony must exist, (MEA. 2005) all cited in (Tribot, Deter, & Mouquet, 2018).



**Figure 2. 8:** The River Ecosystems, and the Relation between the Aesthetic Experience and Biodiversity, (Batista e Silva et al., 2005)

## CHAPTER 3

### EVALUATION OF URBAN RIVERS WITHIN URBAN LANDSCAPE

#### 3.1 Introduction

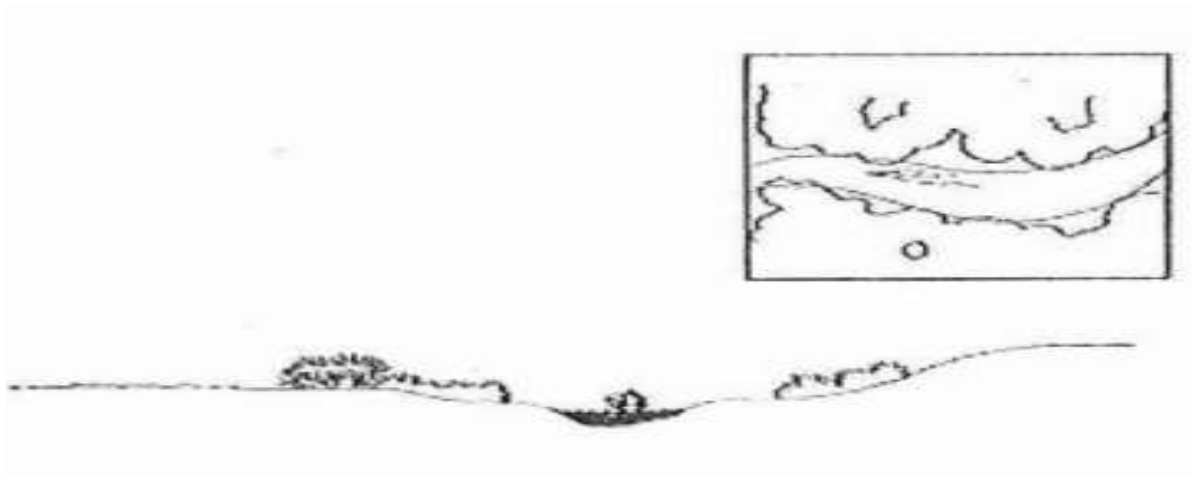
The idea of landscape architecture, as a profession, has been not a trend until the seventies, as this profession had a fast reply to the urbanization peaks, and the industrialization era, to call itself landscape architecture, for an environmental contains (Hussein, 2006). Urban waterfront means: “the urban space which has a direct relation with water”, as it’s described within the English Dictionary of Oxford (Canyon Hydro et al., 2013).

#### *Urban River Front Development through History*

Six eras have been defined the development of riverfront in an urban context (Hussein, 2006):

1. First riverfront settlement (2000BC- 100 AD)

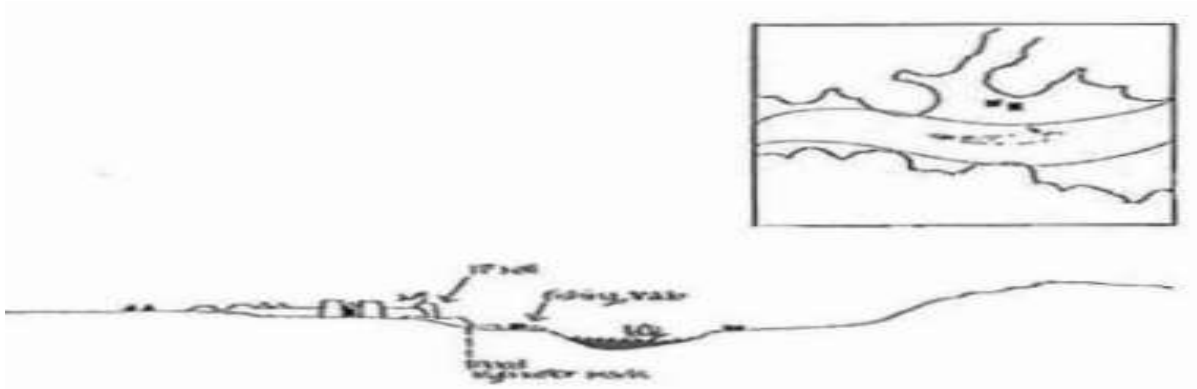
Transportation was the main process in this period, in the purpose of traveling and products, as the developing took place at the river edge, but riverfront was not the main demand for the cities, as this period was representing an initial conducting with the rivers (Hussein, 2006).



**Figure 3. 1:** River as a mean of transportation, domestic, and trading goods. Source: (Hussein, 2006)

## 2. Middle ages (1000AD-1600AD)

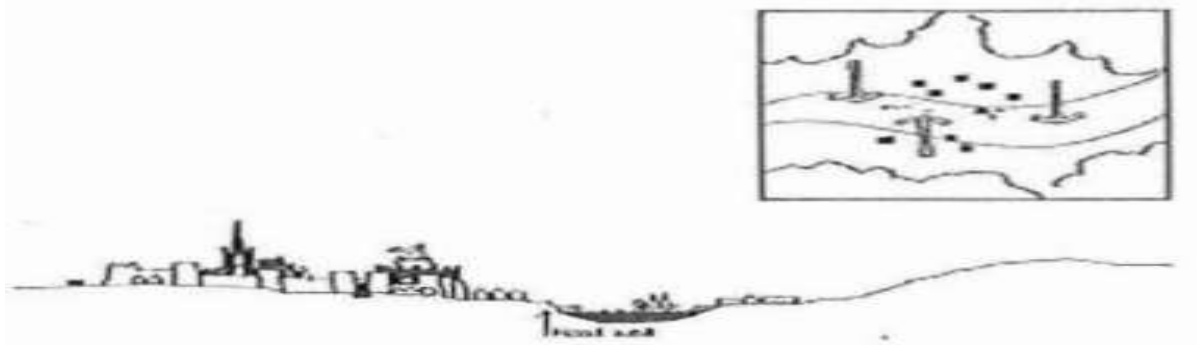
The colonization of the river beds, attached within the trading process, as they started to settle on, in the mean of safety, as the far places were demonstrated by the existence of forests, and the danger can exist, as the river was considered to be the source of water, for home uses, and trading means, (Hussein, 2006).



**Figure 3. 2:** River started to be the main element for the cities flourishing, Source: (Hussein, 2006)

## 3. Renaissance era (1600AD -1800AD)

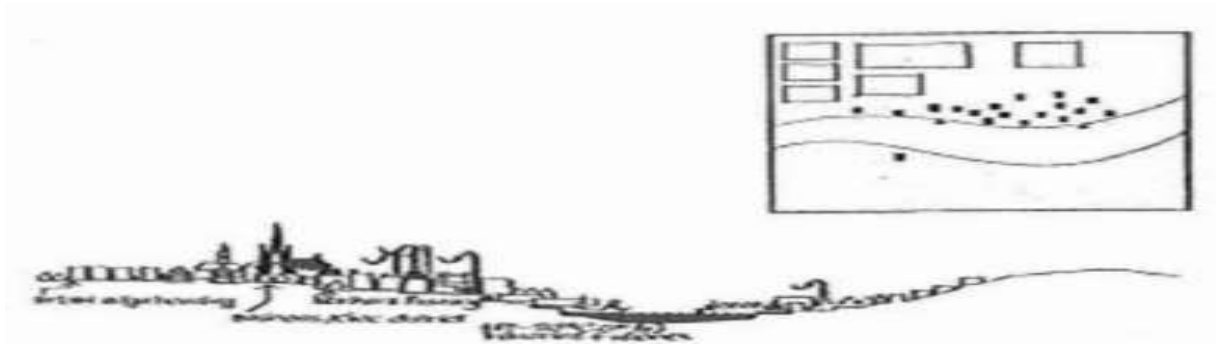
Colonization appeared more, as more land needed to use, the elimination of trees occurred, as the business activities within the river's expanded, and rivers became the point of attention, (Hussein, 2006).



**Figure 3. 3:** Developing of the city, and the river necessity, Source: (Hussein, 2006)

#### 4. Industrialization era

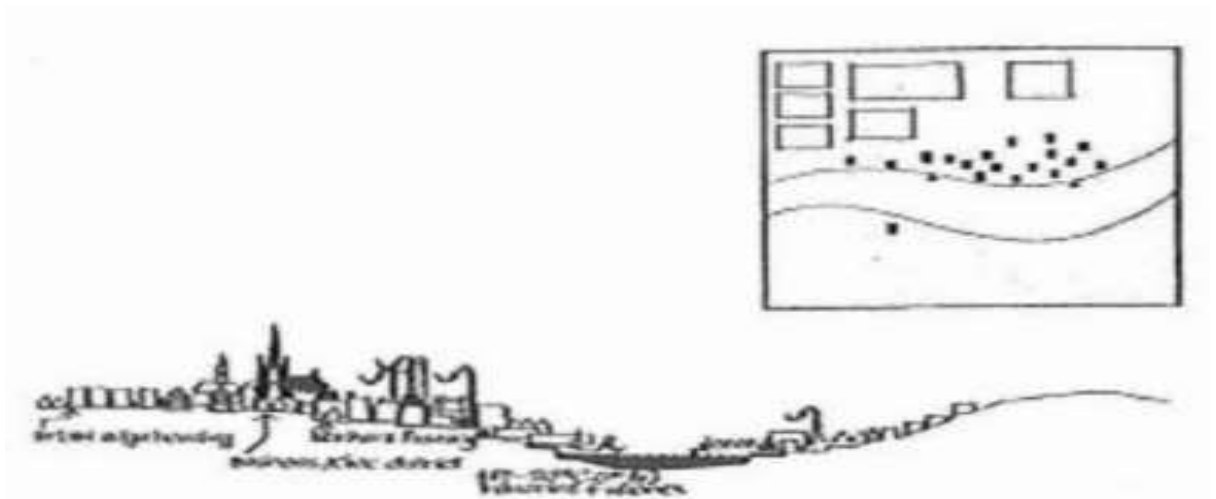
Small settlements, enlarged and settled as a town, as the buildings settled up, even structures, as warehouses faced the river, and the area was busy (Hussein, 2006).



**Figure 3. 4:** Open spaces, and corridors were obtained within the busy area, and the continuity of developing, Source: (Hussein, 2006)

#### 5. Riverfront shrinking (1975 -1990)

Roads, railways, and more means of transportation emerged in the purpose of a new model of transportation (Hussein, 2006).

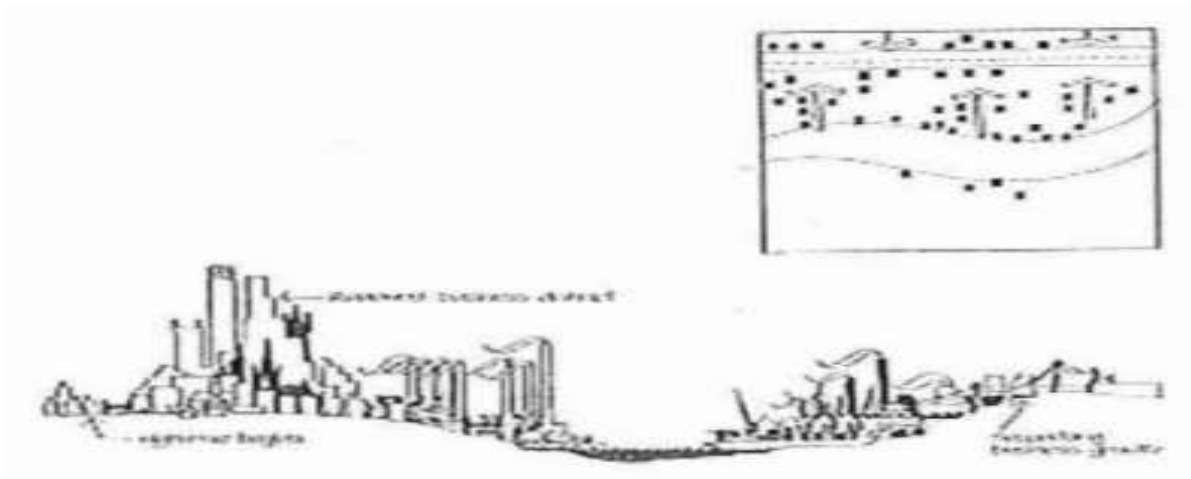


**Figure 3. 5:** The new trend of transportation emerged and the river's declination as a mean of transportation, (Hussein, 2006)



## 6. Reconsideration of riverfront (1990- present day)

The settlements stepped back from the river edges, within the reaming of the old existences, as the river was polluted (Hussein, 2006).



**Figure 3. 6:** Rivers considered as the back place of the developed cities, as it was a turning on point to let it go from the river, Source: (Hussein, 2006)

### 3.2 Components of Urban Rivers within Urban Landscape

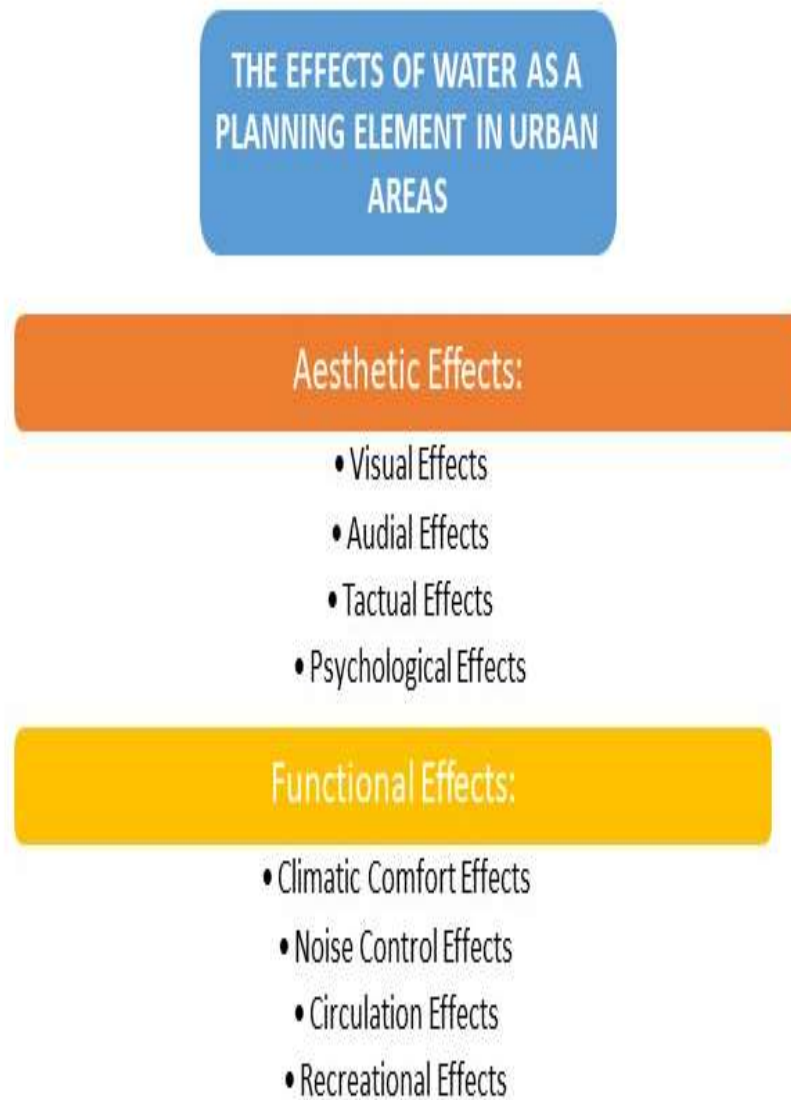
Urban rivers have an identity elements that is reprints the sense of the place, such the theme, the image, authenticity, and the functions, all play a one role in order to contain the whole urban river landscape planning schemes.

1. Theme: Including the People places such as public spaces.
2. Image: that refers to the art within the design of the place, and the urban furniture's.
3. Authenticity: such as the nature of the surrounded buildings.
4. Functions: such as the open spaces and the design of the river front (Hussein, 2006).

From here we can generate the components of the urban riverfront:

1. Surround buildings and the neighborhood
2. Water
3. Open green spaces with hardscape and soft cape material

4. Riverfront Design
5. Urban furniture's such as benches, lightings, etc.



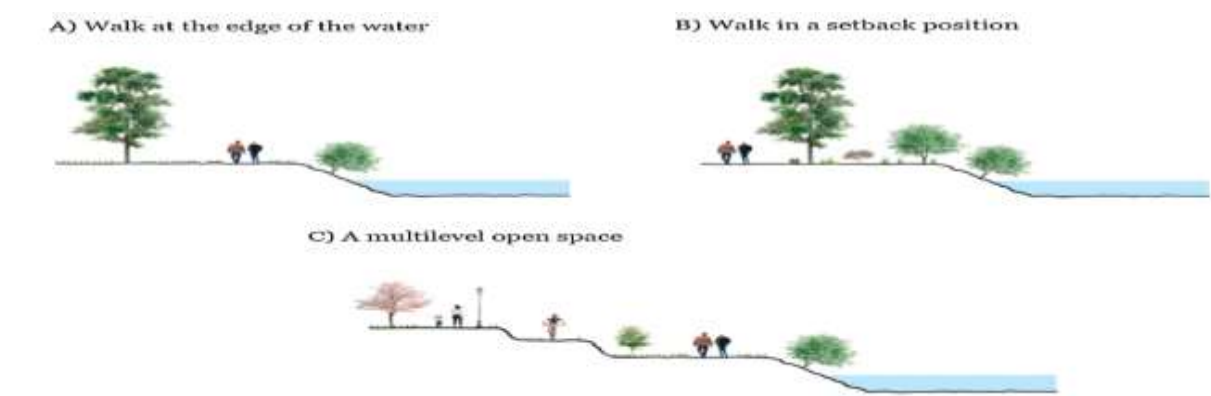
**Figure 3. 7:** Effects of water within the urban context, aesthetic and functional effects. Source: (Canyon Hydro et al., 2013)

**Table 3. 1:** The characteristics of waterfront area. Source: (Costanza, 1999), cited in (Yassin, 2011).

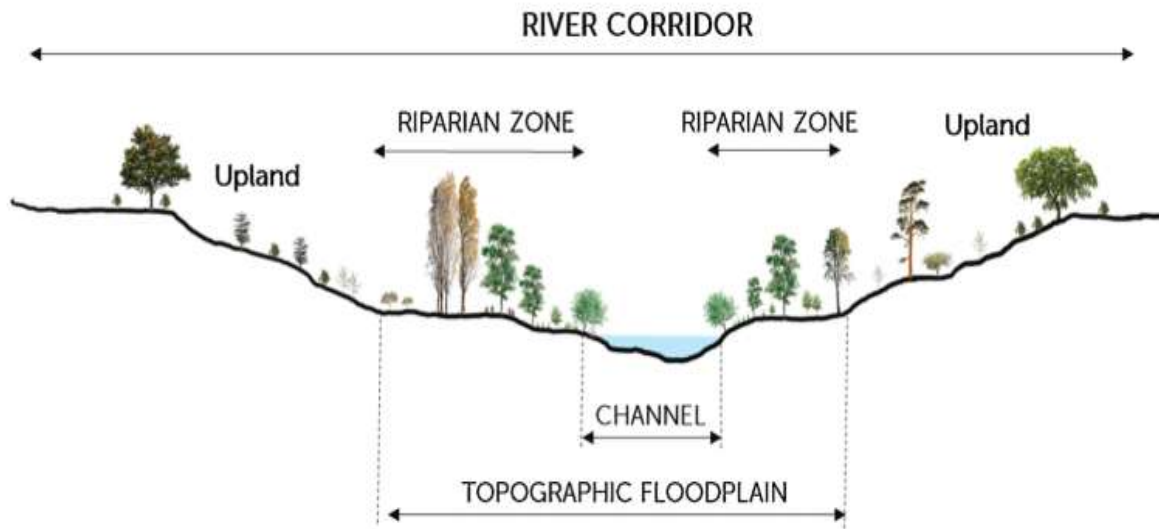
Characteristic	Description
The ecological traits	The river channel is mainly consisting of a whole ecosystem that all is connected within each other, even that the chemical and the substances of the river components is in an continuous changing process that can be adapted within each other or even have a bad results for the waterfront
The economic traits	Waterfront can be the refresh areas to the population that they live within the places that existed as they can improve the economic traits within the usage of the places
The social traits	Waterfront areas can be the meeting areas, and the exportation, and importation activities occurs within the location using the water element

### *Riverfront Open Spaces Classifications*

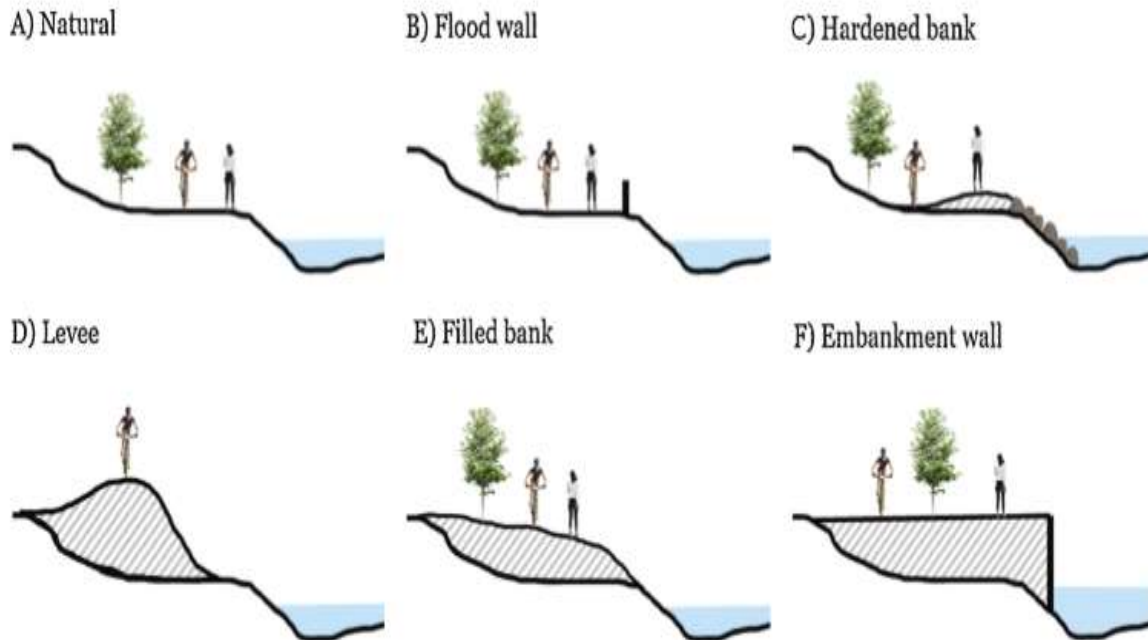
River open spaces can be deigned within a different shapes for a different purposes, and this also can affect the nature, and the use of the land.



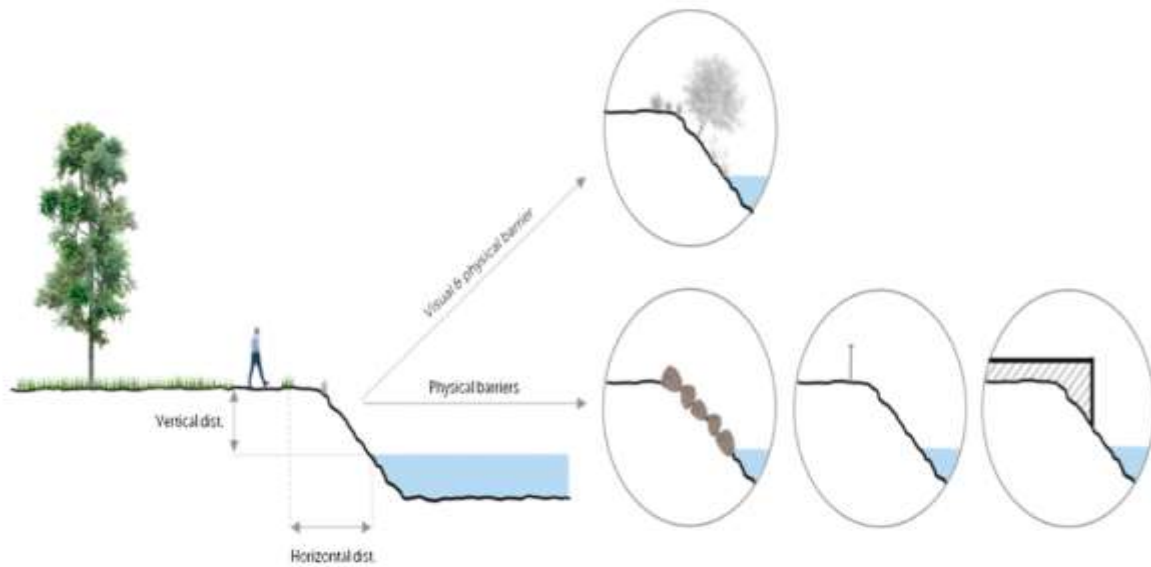
**Figure 3. 8:** Differences in the location of open spaces overlooking the river in relation to the distance to the water. Source: (Durán Vian et al., 2021)



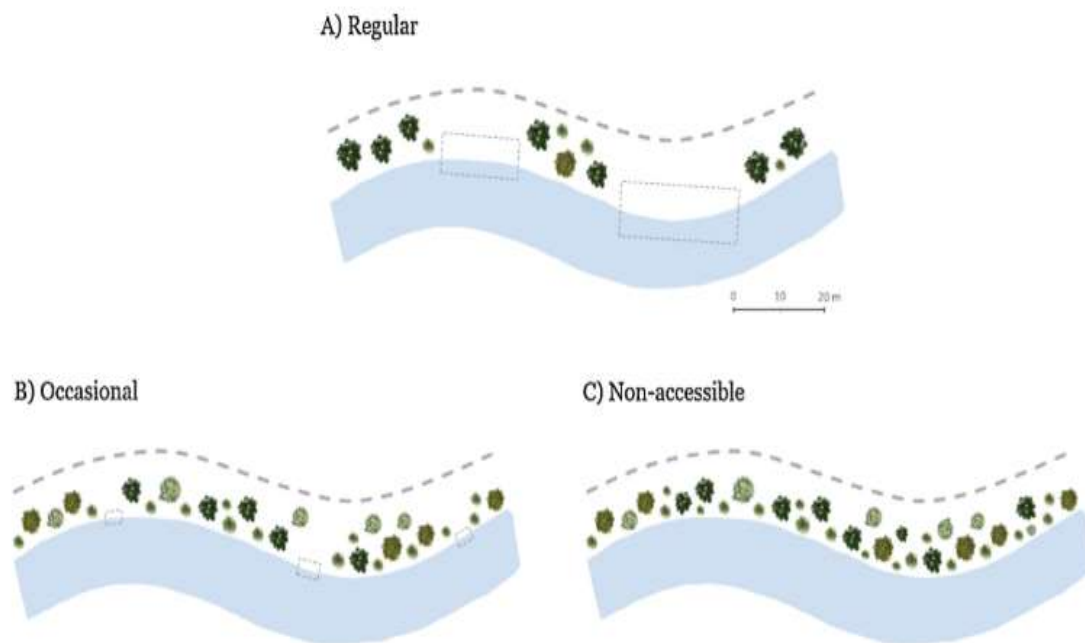
**Figure 3. 9:** The cross section of a natural corridor is symmetric, Source: (Durán Vian et al., 2021)



**Figure 3. 10:** Natural river rim (A) and common water barriers, Source: (Durán Vian et al., 2021)



**Figure 3. 11:** An illustration of some visual and physical water barriers. Source: (Durán Vian et al., 2021)

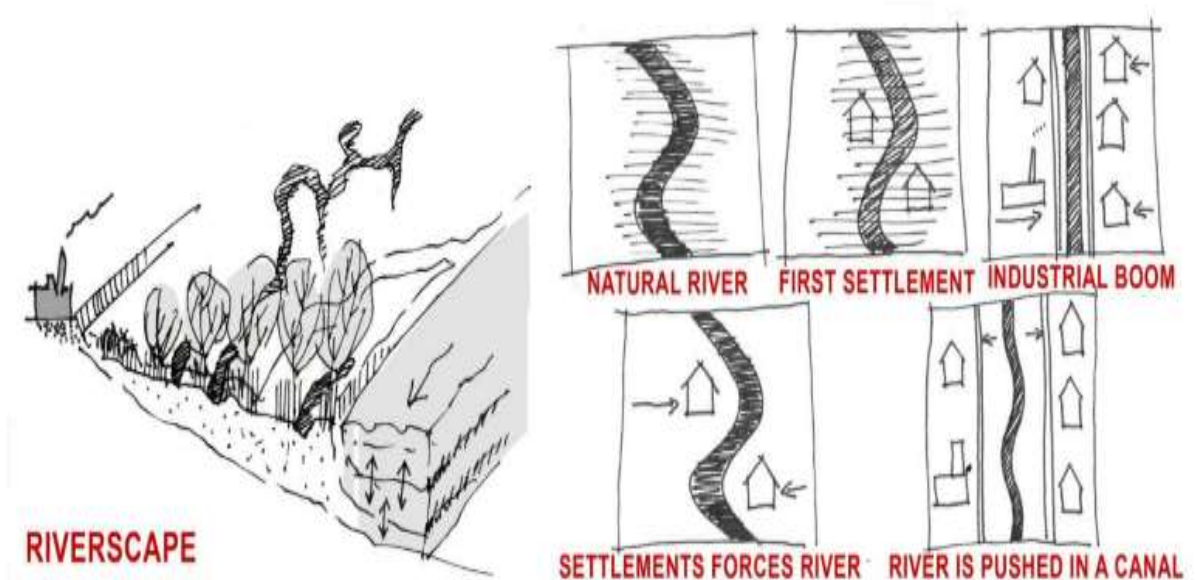


**Figure 3. 12:** Types of water accessibility along the green river road, Source: (Durán Vian et al., 2021)

### ***Riverfront as a Public Space Potential***

Wittmann, M., (2008) defined the functions of riverfront as a public space, within a typology into the following categories: All cited in (Hradilová, 2012).

1. Transportation such as: roads, networks, cycling routs, pavements, connections up, and down.
2. The social interaction such as: meeting, public services, gathering.
3. The function of the place, such as the existing of the buildings within a different functions.
4. Enjoyment facilities, like regenerating the live to the space.
5. Artificial activities, and the usage aimed the manmade.



**Figure 3. 13:** The potential of settlements at the river banks, Source: (Havránková, 2014)

Obviously, it is useful, if the river creates instability. The ideal use of such landscapes is let's say a garden, an urban garden in the condition of a city. Obviously, these precarious places are very valuable in the city and should be used as public spaces (Havránková, 2014).

According to Havránková, 2014, the basic potential urban spaces within the riverbed can be:

1. To provide a meeting point in a close natural environment
2. A place to observe natural processes
3. A passive barrier in permeability in the city
4. Veins for transportation
5. Creation of the microclimate in the city
6. A substance that brings smell and sound to the environment

Riverlife Pittsburgh, 2014, mentioned that planning a river front, prerequisite a certain number of principles must me on the track:

1. Make the riverfront the front door.
2. View the history of the river.
3. Activation of the river.
4. Reducing obstacles and connecting to the river.
5. Get involved in water.
6. Smoothly communicate along the river and into the neighborhoods.
7. Environmental reform and improvement.
8. Employing high quality and sustainable architectural materials engineering practices.

### ***The Nature of River Edge***

Riverbanks, beaches, river stores, and river habitats are of the utmost importance when planning any riverfront project. It also examines the research, as well as their considerations, environmental plans, and environmental plans. In opportunities for design, escalation, re-precipitation, habitat restoration, arrangement, rehabilitation, development (Riverlife Pittsburgh, 2014). The river connections toward the urban space can be summarized below.

1. Vertical connections

Aiming the vertical connections can be related to the function of connecting people to the place within the roads, pavements, ways, and much more. (Riverlife Pittsburgh, 2014).



**Figure 3. 14:** Vertical connections towards the urban river, Sidewalks, public boulevards, driveways, and parks, Source: (Riverlife Pittsburgh, 2014)

## 2. Parallel connection

This connection is relatively conducted within the bringing the public space to be aligned within the river corridor in a coherent way, that can reflect the beauty of the nature and the use of the place within a safe access (Riverlife Pittsburgh, 2014).

### **3.3 Urban Riverfront Elements**

River connections elements is so important within the designing of the riverfront in the urban context, and this section will handle these elements.

#### ***Landing Elements***

This elements is mostly used within the purpose of connecting two public points together within a two different sides, in this case like river banks, as these elements can bring the life to the place within connecting the activities all over the space, even landing can provide a good connection within the existing averment and place, from the nature to the human and more, even can widen the human perspective to the nature and the sense of the place (Riverlife Pittsburgh, 2014).





Figure 3. 15: Landings within the urban river design, Source: (Riverlife Pittsburgh, 2014)

### *Neighborhood Surroundings*

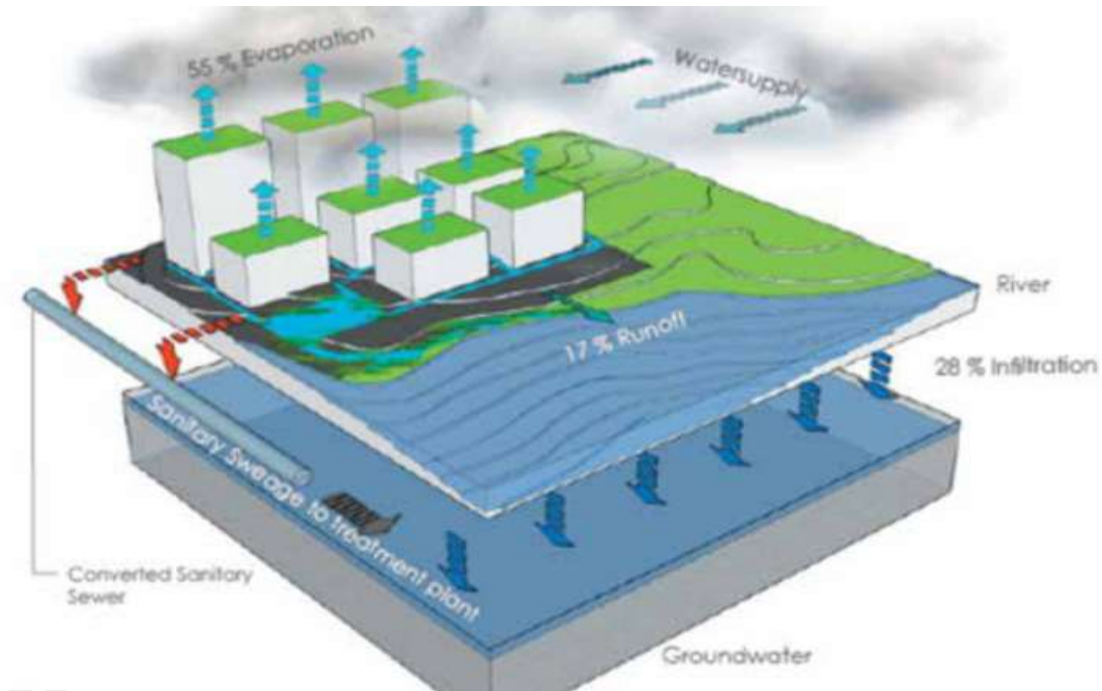
Planning is an important point, in order to have the sense of the surrounding such as the riverfront buildings must have the sense of nature, and the design aimed the surroundings can speak the good language in order to have the harmony within the place, so we need to adapt the place within what we have (Riverlife Pittsburgh, 2014).



**Figure 3. 16:** Riverfront design, transportation, site, public spaces, and the river, Source: (Riverlife Pittsburgh, 2014)

### ***Buildings and Connections to River***

Buildings that rely on the river edges have a good amount of connection to the water landscape elements, as they can be remarked and be important within the site as they have direct connection within the important natural element, as we can say they can have a landmark within the location (Riverlife Pittsburgh, 2014).



**Figure 3. 17:** Storm water management within the buildings, to reduce the runoff towards the river, Source: (Riverlife Pittsburgh, 2014)

### ***Urban Furniture within the Riverfront Landscape***

Artificial and natural elements within the riverfront, and the riverbanks can improve the image related to the place identity. As we can have open public spaces within the river edges like gardens, parks, as a good landscape designing can provide a good connection within the river banks and the surrounded areas all over the space. Even within the human perception these designed place can have a memorial footprint to the rudiments and the users (Riverlife Pittsburgh, 2014).

One of the urban future unit can be the public arts, such as this works can reflect the identity and the culture of the population, as they can improve the sense of the place, and the perspective of creativity will be enhanced, even those works can be a landmark within the space that can attract people to have a quality time together (Riverlife Pittsburgh, 2014).



**Figure 3. 18:** Public art within the river front, to enhance the public attraction, and the place identity, Source: (Riverlife Pittsburgh, 2014).

Illumination items, and light within the riverfront place deign, can bring the comfortability, and even the a good sense of place, since the presence of light elements can provide a safe place during the dark times of the day, and can reflect the buildings around the riverfront by night, as they are a useful elements within the design process (Riverlife Pittsburgh, 2014).



**Figure 3. 19:** Lighting for the river front, without bridge, and the bridge case, also the floating landing case, (Riverlife Pittsburgh, 2014).

## **CHAPTER 4**

### **INTERNATIONAL CASES**

#### **4.1 Evaluation Criteria**

Waterfront locations have traditionally been perceived as having special qualities from a real estate, urban, and tourist point of view. Many cities have developed along the waterfront and some of their most important urban fabrics face waterways: rivers, canals, streams, lakes, or seas. Some small and medium-sized riverside towns have been able to preserve or adapt their industrial-era cultural heritage to new uses. In many cases, tourism has taken advantage of these places for community-oriented recreation, sports, and outdoor events on the land-water interface (Bray, 1993; Kostopoulou, 2013) all cited in (Balsas, 2016).

A criterion has been developed to evaluate the international cases that have a riverfront design in different countries through a certain number of literature reviews. The evaluation criteria are as below.

1. Surround buildings and the neighborhood
2. Water
3. Open green spaces
4. Riverfront design
5. Urban furniture such as benches, lightings, etc.

#### **4.2 International Cases**

A number of case studies will be taken in consideration from the worldwide, especially from the US, and Europe, also one case study from Turkey, as Pedieos river case will be the last one, following the international cases in order to know more about the international design statuses of the riverfront.

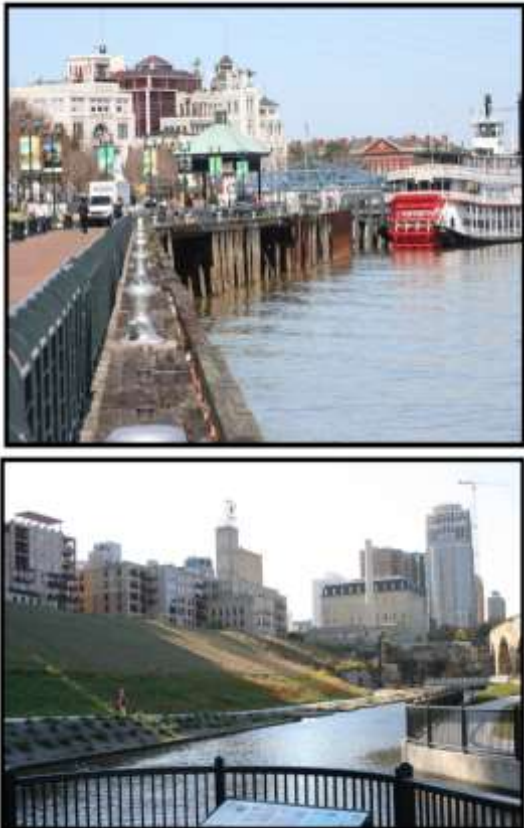


#### 4.2.1 The Mississippi River – USA



Mississippi river is considered as the second largest drainage system in the region of northern America, as this river passes through couples of states, and cities, such as, Minneapolis – Minnesota, Baton Rouge-Louisiana, and New Orleans-Louisiana, as The river investigation case, is passes through these three different cities.

The river length is 3,730 km, within the USA, and this river has been used in order to develop such a places including the riverfront design, and the integration within the urban planning as we can see in the table below, Table 4.2.

**Table 4. 1:** Evaluation of the riverfront, Mississippi river, USA

Criteria	Description	Evaluation
Surrounding Buildings And Neighborhood		The presence of the old buildings, and the modern style one, is obvious within a two different location. The building types is mainly residential and commercial



Criteria	Description	Evaluation
Green Space		<p>Green spaces were replaced within along of the river design, and included grass and trees.</p>
Urban Furniture		<p>Traffic lights, kids play ground, Walking bridges, seating elements, walking pedestrians, stairs, all presented within the site.</p>

Criteria	Description	Evaluation
River Front		<p>The river front designed within an inclination within the edges in order to prevent water from reaching the top level, and designed within grass and walking routes, also extruded landings.</p>
Water		<p>The length of the river is about 3.730 km, and the river discharge an amount of 16.790m<sup>3</sup>/s, as the depth can range from 2.7m to 18m</p>




#### 4.2.2 The San Antonio River - USA

The San Antonio River is restored aimed at the tourism attraction, in Texas, as this restoration process has been integrated within the places for tourism purposes. A report showed that 96.6% of the population that the restoration enhanced the place and attracted people for tourism, and 80% of the population aimed that this action created an economic benefit, (Riley AL, 1998), cited in (Canyon Hydro et al., 2013).

**Table 4. 2:** Evaluation of San Antonio River Walk in San Antonio, Texas-USA

Criteria	Description	Evaluation
Surrounding Buildings And Neighborhood		The building within this point of the city, in Texas, I shaving a commercial and residential units
Green Space		The green spaces within the city is limited at the edges of the river and having some trees and grass





Criteria	Description	Evaluation
Urban Furniture		Includes, lights, signs, walking bridges, urban stairs, mobile shading elements, paved edges and semipublic spaces run within a private shops aimed the services such as restaurants.
River Front		The riverfront of San Antonio river, is condensed within the buildings and the constructed artificial edges using the concrete in order to create a spaces for people gathering and tourism
Water		The river is starting from the mid of Texas city, formed from the meltdown springs, and ends at the Gulf of Mexico, as it's named by San Antonio Bay, the river is 386 km within the length along the state of Texas

#### 4.2.3 The Nine Mile Creek – USA


This basin is 300km<sup>2</sup> in area, and 28.98 km length, as the wetlands and the original forests is considering to be important for the creek, as it has a good habitat also within a good water quality (Smardon RC, 2006) cited in (Canyon Hydro et al., 2013).

The creek of the nine mile, has been restored aimed the restoring of the natural habitat, and the original state of the river, which it helped the fish habitat to return, and the wildlife’s species too, as the lands beside the creek is considered to be a wetlands, within trees and original plant habitats, and here we can conclude this type of river is natural, and crossing throw a rural areas.

**Table 4. 3:** Evaluation of the Nine Mile Creek, New York, USA

Criteria	Description	Evaluation
Surrounding Buildings And Neighborhood		Buildings there were consisted of a small tiny houses made of wood represents a rural pattern
Green Space		Long large green spaces, from trees and grass, and the meadows


Criteria	Description	Evaluation
Urban Furniture	 	Signs for directions, and wooden walking pride with bicycle routes
River Front		Designed within a natural state, and sloped edges within a rock line for water control and protecting against the river bed corrosion

Criteria	Description	Evaluation
Water		It's mainly a tributary which is generated from Minnesota river, and the length of the creek is about 24.62 km





#### 4.2.4 The Onondaga Creek - USA

The creek has been going through a revitalization project plan, within 14.49km, along the city of Syracuse, in New York City, as it aimed the population at the level of society, and the economy for more extended purposes, also restoring the habitat, and the improving the water quality, alongside the creek, (Canyon Hydro et al., 2013).

**Table 4. 4:** Evaluation of the Onondaga Creek – USA

Criteria	Description	Evaluation
Surrounding Buildings And Neighborhood		Modern and old buildings along within the river with a small urban dense, and the buildings is residential and commercial like offices








Criteria	Description	
Green Space		<p>Botanical Gardens, and parks and some green spaces alongside the river edges</p>
Urban Furniture		<p>Wooden landings, and shade elements (temporary ones).</p>
River Front		<p>Supported within a concrete walls (lateral supporting ones)</p>
Water		<p>The river is considered to be a tributary that is generated from the Onondaga Lake, within a length of 44 km</p>

#### 4.2.5 The Trinity River Corridor - USA

This river is prepared for the flood events, and the transportation purposes, also the integration within the social and economic means, as it provides the environmental process (Canyon Hydro et al., 2013).

**Table 4. 5:** Evaluation of the Trinity River Corrido, USA

Criteria	Description	
Surrounding Buildings And Neighborhood		Urban buildings within a whole types, residential, commercial, and industrial
Green Space		Available within a grass, and planted trees, and used as a flood areas (wetlands)
Urban Furniture		Walking over constructed canals, and hand railings, lights, street signs, trash cans, benches




Criteria	Description	
River Front		Designed within a modern bridges, and the city have a view on it, but there's no connection within the city directly
Water		The length of the river is 1,143km, as it's considered as the longest river in Texas city, and within a discharge of 180.3m <sup>3</sup> /s

#### 4.2.6 The Isar River – Germany

The river Isar is considering to be the green element of the Munich city, as they used the concert canals aimed the protection against the flood events, and to generate energy (Canyon Hydro et al., 2013).

**Table 4. 6:** Evaluation of the River Isar, Germany

Criteria	Description	
Surrounding Buildings And Neighborhood		Monumental buildings, and old style, basically commercial and residential

Criteria	Description	
Green Space		<p>Green spaces is considered of planted trees and grass, alongside the river</p>
Urban Furniture		<p>Walking bridges, car bridges, pedestrian lights</p>
River Front		<p>The area next to the river is designed within a natural rocks in order to decrease the river corrosion and the unusual flow, also used as a play and gathering space</p>

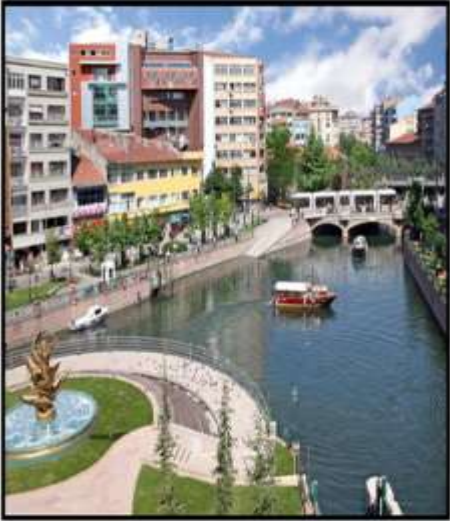


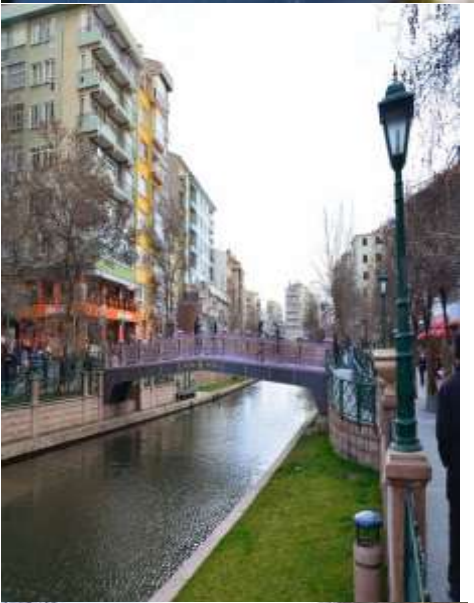
Criteria	Description
Water	 <p>The source of the water came from the Alp mountains and enter Germany then ending at the Danube River. The river length is 295km long, and the power of discharge is 175m<sup>3</sup>/s</p>


#### 4.2.7 The Porsuk Creek – Turkey

The restoration of this river aimed the 10km along the canals used for the irrigation purposes, as the main purpose of the restoration was to prevent the flooding events, expect foe the 1.5km of the river is passed through the city center, and exposed to a good amount of pollutants (Canyon Hydro et al., 2013).

**Table 4. 7:** Evaluation of the Porsuk Creek, Turkey

Criteria	Description	Evaluation
Surrounding Buildings And Neighborhood		Commercial and residential buildings alongside the river

Criteria	Description	Evaluation
Green Space		<p>Constructed alongside the river edges with grass and different types of trees, and limited spaces of the green areas</p>
Urban Furniture		<p>Walking bridges, street lights, trash cans, seating benches, railings, fences</p>
River Front		<p>Protected within a wall constructed above the river level in case of contain the flood events</p>

<b>Criteria</b>	<b>Description</b>	<b>Evaluation</b>
Water	 A photograph showing a green arch bridge spanning a canal. The bridge has a prominent arch structure and is surrounded by lush green trees and foliage. In the background, some buildings are visible through the trees. The water in the canal is calm and reflects the surrounding greenery.	Flow over a distance of 448 km, and having two dams constructed and used as a water reservoirs

## **CHAPTER 5**

### **PEDIEOS RIVER AS A CASE STUDY**

#### **5.1 Pedieos River as Research Context**

Nicosia, is the capital of Cyprus, and due to the political conflicts that have been occurred for more than 45 years, it leads to dividing the city landscape, and the urbanization of the city itself is in a critical condition which we can observe the modern urbanization, integrated with good planning at least in the southern part, vice versa in the northern part, which it has week urbanization development and a smaller city scale at the level of urbanization rising.

Cyprus has a total number of 26 rivers, which the largest one is Pedieos river, as it started from Troodos Mountains, and ends up at Salamina Town (ancient) – Machairas Monastery, and passes through Nicosia city, with a total length of 98 km, and a maximum depth of 10 in certain points, as it covers up an 18 km long through Nicosia city, as two dams are constructed at the river, as the largest one is called Tamassos, which is constructed in 2002.

The northern part of the divided city, has the main important river Pedieos, which is considered as the water nerve of the city landscape, integrated by the urbanization rising in the city of Lefkosa (the northern part in TRNC, of Nicosia in Turkish Language), this river is considered as a hydrological feature of the city.

Pedieos River is considered the longest river in Cyprus, as it is similar to most streams located on the island, it is an impermanent, transient waterway that flows mostly during the heavy rainy winter months or even after extremely heavy rainfall percentages. The Pedieos River was linked to the history of Nicosia as it is one of the reasons for the city's presence on the site. The increase in unimplemented areas as a result of urbanization is considered as the main reason for floods events within the city (İnançoğlu et al., 2020).



**Figure 5. 1:** North Nicosia city located at TRNC

## **5.2 Pedieos River within Nicosia City – A Historical Review**

Rivers known as the main stem of the city growing, and forwarding toward the developments, as at the same time they also have been titled as they have a bad impact over the city, and threats the humans, which it can reach the threat of losing human's life, as a result of flooding in the urban areas, which has been developed for the city existing, as the river passes through there within the city, as Pedieos river is considered a temporary water current, it was the main element of the city which is helped in developing Nicosia city over the ancient time, since the presence of the archaic period in the history as it was between (750 – 485 BC), as the river was recorded plenty of flooding's, as the schedules since the 14th-century records are showing those events (Charalambous, Bruggeman, Bakirtzis, & Lange, 2016).

The river is consist of 100 km long, as it considers the longest river in Cyprus, as it represents to be an intermittent flowing river, as its only flow during the winter season when the rainfall is considered to be heavy, it flows from Troodos Mountain's In the south part of Cyprus, at the height of 1400m above the sea level, and flows towards the northern part of Cyprus until the



Famagusta city bay, which is passing through the capital Nicosia, also it crosses the buffer zone which is considered to be the UN area, as the country divided in 1974, then it turns toward the eastern part of the TRNC, republic, as the river basin is receiving total average precipitation, measured between 350mm, to 670mm from the upstream side – as it was recorded in between (1980-2010) (Charalambous et al., 2016).

According to the south side of Nicosia city, the river basin is flowing south with a depth of 20km, as there's a dam has been constructed, also the river is consisting of a total of 124km of the river basin, in the southern part, with the total of the main flow and the tributaries of it (Charalambous et al., 2016).

The river has been considered as the main element in developing of Nicosia city, as it was the source of water, to supply the city, as its main one was the groundwater reserves, (Grivaud 2012a), cited in (Charalambous et al., 2016).

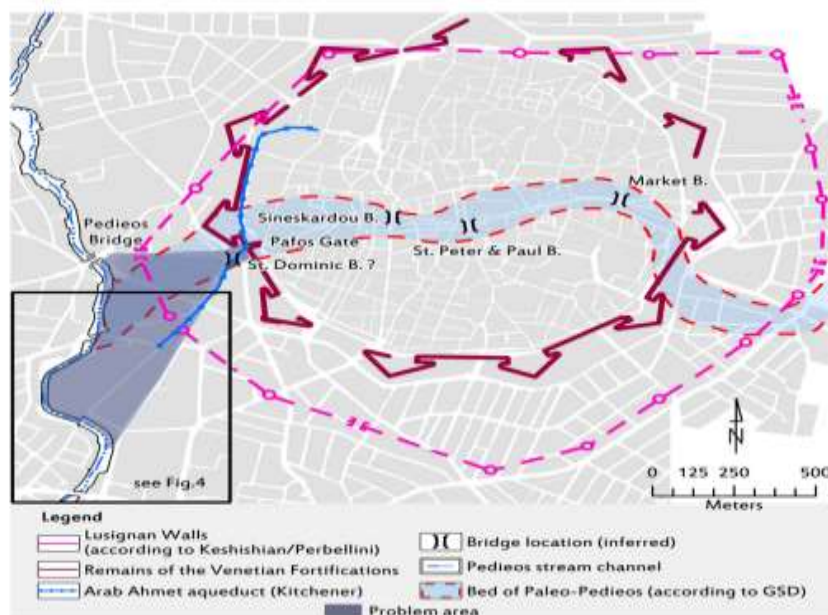


**Figure 5. 2:** The location of Pedieos River, within the south urban side of Nicosia, Source: (Charalambous et al., 2016)

The existing of the river has been played a good role, and applied to admit a reason of the human settlements in the city, as the soil has a good fertility range, as the good weather, also the mountains from the north and western parts, have been considered as protection elements for the settlements (Maratheftis 1977; Michaelides 2012) cited in (Charalambous et al., 2016).

The river also considered as a power of supplying the agricultural works, as of the settlements had been existing in Strovolos, and Lakatamia, which it presents in (Figure 1. 5), as in the winter the river is recharging the water in it, to provide the agricultural areas (Pavlidis 2005; Perikleous 2011) cited in (Charalambous et al., 2016).

During the ancient time, as the Archaic period between (750-475 BC), the earliest period of this time, the settlements appeared, as the first one was held in the northern part of the river, at the city side, which later on it swiped toward the Sothern parts of the riverbank (Maratheftis 1977), cited in (Charalambous et al., 2016).



**Figure 5. 3:** Pedieos river crossing Nicosia city in a horizontal axis during the Lusignan period, between (12th – 15th century), and the Venetian period taken from Kesishian 1989, cited in (Charalambous et al., 2016)

As the city started to develop, and expand during the Byzantine period (650-1191), as it started to be the administrative theme of Cyprus, (Charalambous et al., 2016). At this time of the settlements, and the developments that have been started over, the rural areas started to appear in the area along with the river flow direction in Nicosia, (Papacostas 2012), cited in (Charalambous et al., 2016). The river was entering the walled city, from the western part of the city, along with to the eastern part, and exited along from three points in the east, as it crosses the city in a horizontal axis during the Lusignan rule (12th – 15th century) see (Figure 1. 6) (Charalambous et al., 2016).

In the year 1330, the river has been recorded a severe flood, in November of this year, as has been cited, and mentioned by many, the nearest date as the flood has occurred during the events occurred by chronicle leontios Machairas, who lived between the date of 1360, and 1450. As Machairas, mentioned that the heavy rains have been held on the night of 10th November in this year, ended up flooding the river, and taking off the trees, as it was settled at the river banks, the water carried out the tress directly towards the city (Pavlidis 1982) cited in (Charalambous et al., 2016).

A huge changing has been occurred in the river direction during the Venice administrative era, in between (1567-1570), as an action has been taken to defend the city from the ottoman attacks they took this action rapidly, as these changes affected the city's landscape entirely, until today (Charalambous et al., 2016).

Architect, and engineer Giuliano Savorgano, designed a new wall, with the function of supporting the city, to prepare as a response for any attack by using the siege, (Grivaud 2012b). The architect plan was to destroy the old medieval wall, with a 9km wide diameter, to a 3km diameter to contain the attack, and the defense process in the city, which this wall is very thick, as it's shown in (Figure 1. 6), (Maratheftis 1977). The new secure walls system, has three gates in it, as the names were chosen according to the three main cities in Cyprus, the Famagusta gate in eat, Kyrenia gate in north, and Paphos Gate on the western side, as the main challenge is to



direct the river drainage basin outside the city, towards the western side, out of the walls, as the river is entering the city by Paphos Gate, as the conversation in the river direction is considered a major transformation in the city urban landscape infrastructure, all cited in (Charalambous et al., 2016).

As of the November of 1809, the river basin water has been exceeded, and flood occurred in the Paphos gate, as it spreads out toward Famagusta gate, which led killing of 16 people, (Hill 1972). Also in 1840, the water overflowed towards the river banks near to Strovolos, and by the narrow one arched bridge of Pedeios river, also the water flowed to the city (Charalambous et al., 2016).

The British took over the city in 1878, as the whole country becomes a British colony by 1925, as some rumors were taken over, the Royal engineering took a step forward to meditate the river flooding by taking the measurements, serially, as the public work department by that time has been ordered to construct another second arch in the Pedeios river bridge (Charalambous et al., 2016).

Another flood has been recorded during the British colony time, in 1918, as a heavy rainfall occurred in 15th of December by that year, and it was disastrous, which it lasted for 2 hours, caused damage within the city, and loss of some people time. The final decision was to construct a third arch for the bridge, suggested by Mr. K.A. Twitchell, and the engineer that time (Charalambous et al., 2016).

Since the year 1918, there were no flooding cases has been recorded in comparison to the previous ones that recorded, But after the rapid urbanization in the city, and due to the year 1960, the flooding issues have been recorded, and started to be more complex (Charalambous et al., 2016).

A total number of 38 floods has been recorded between 1960, and 2012 years, recorded by I.A.CO Ltd (2011a, b), as in 2002 a dam has been constructed called Tamassos near Pera

community. In the year 2003 the police issued some warning for the residents in Strovolos, to stay tuned during the night in case of flooding, which was predicted, to occur by the river, (Anonymous 2003), also in 2005 June's a traffic motion has been stopped, and paralyzed, due to the heavy rain occurred in the riparian areas of the river (Anonymous 2005) all cited in (Charalambous et al., 2016).

Since 2005 the Sewerage Board of Nicosia, prepared an illustrated study for storm water management, as a plan for Nicosia city, but these activities have been never showing up (Louis Berger Group 2007a, b) cited in (Charalambous et al., 2016).

As according to (Charalambous et al., 2016) the flooding issues within the city of Nicosia has occurred in three different ways: from the river drainage basin, the fragmented drainage system as the rainfall peaks at the highest ranges when it recharges the water flow of the river, and the rainfall that cannot be directed to the water drainage directly, as he mentioning that the lacking of suitable planning for the city, which is became urbanized, and continue to, the flooding is still a major problem within the city, as the authors also mentioned the irritations of the river beds is leading to a continuous river flooding events, conducted with this river corrosions.

Pedieos River consists 100 km long, considered to be the longest river within the Turkish Republic of Northern Cyprus, and it's considered as a non-enduring waterway, consisting of streams during the peak precipitations within the winter months, it's flowing from the Troodos top, at the height of 1400 m above the sea level, and flows all along towards the capital Nicosia, starting from south to northern part of the island, as the width of the river ranges from 5 meters to 20 meters in different points, according to the geomorphological traits (İnançoğlu et al., 2020).

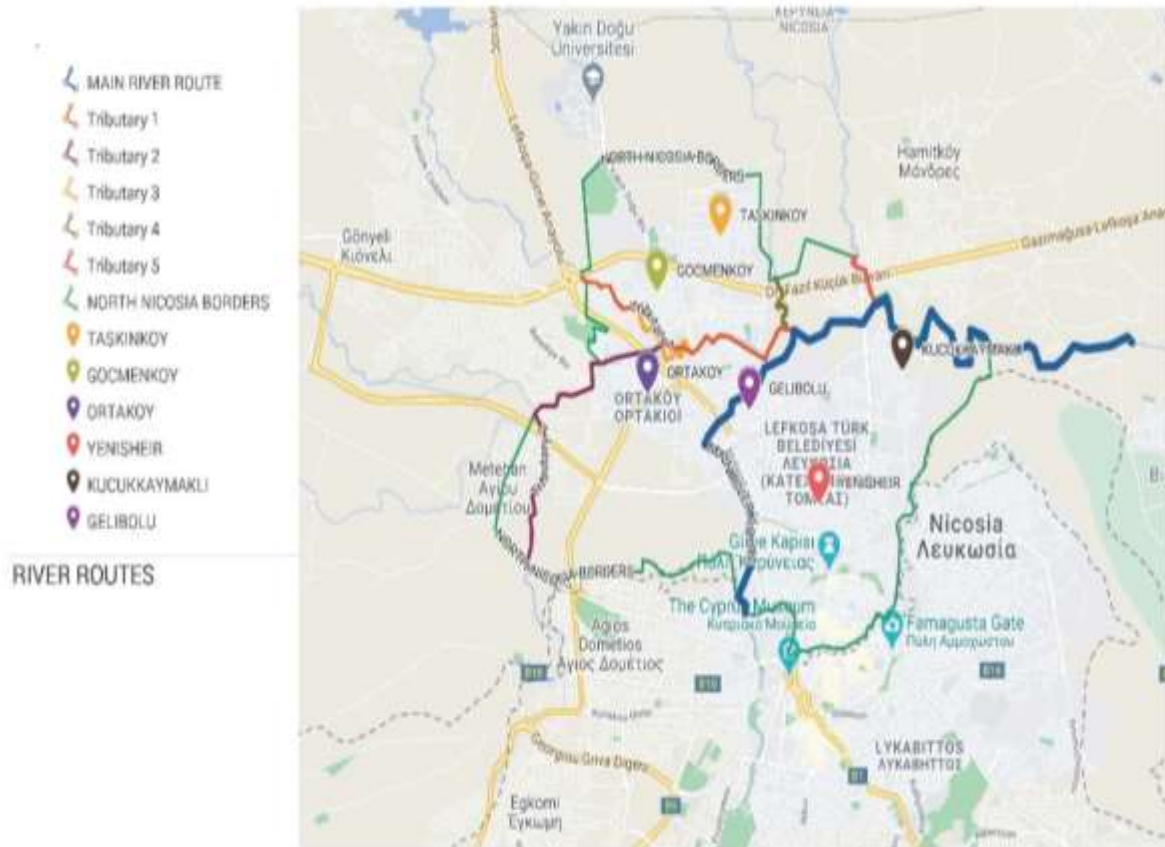


**Figure 5. 4:** Northern Nicosia region, Pedieos River in the red line Source: Google Maps

Using google map, to track the river that is passing through Northern Nicosia, as the river flows there with a total length of 20.918 km, as the river basin in North Nicosia is consisting of five tributaries, branches from the main river stream, before directing to the eastern side of the country reaching the watershed of the river discharge in Famagusta city.

In Figure 4. 2, the google map of North Nicosia, showing the river basin all over the city, as the length of each tributary is as respectively, which T means tributary, and each one has its color, and number, T1 = 3.68 km, T2 = 4.05 km, T3 = 1.37 km, T4 = 776 m, T5 = 642 m, and the main tributary of the river is mentioned by MT, as the main tributary, which MT = 10.40 km.

## PEDIEOS RIVE MAP



**Figure 5. 5:** The river basin within the North metropolitan Nicosia city in TRNC

A number of photos have been taken from different points in Nicosia city, where the river is flowing there, in order to investigate the condition of the river and the integration of the criteria that have been cited within this study.

We can observe the ignorant and the absence of the riverfront design within the city, and the presence of the railing to protect from falling, even the railing seems in a bad condition, and the river is exposed directly to the hardscape elements such as pavements, roads, and the sewage discharging, also the constructed bridges designed totally for the cars to pass by over the river without paying attention to the river itself, as the pavements seem risky to walk by due to the railing defenses design.

The degradation at the level of the riverbeds is an obvious sense at some points there are no natural elements that can prevent or mitigate the soil corrosions, as some of the residential building is directly exposed to the river which can be risky in the possibility of the flood events, as there are no flood areas designed to contain the level of water within the rainy weather.

### **5.3 Evaluation of Pedieos River**

Existing determined criteria have been used in order to evaluate the current condition of the Pedieos River within Nicosia city, at the northern part of the city (TRNC), and the related explanation is below within each unit.

Within Figure 5.6, a map has been set in order to determine the set of locations within the selected areas that have been choosing, these areas are mainly selected within an intersection of the place near roads and the existing buildings, and surroundings, since the access to river bed is not provided, and the snaps have been taken within the driveway, and walking within the available pedestrian.

The intersections are mainly a constructed bridges within a constructed roads and pavement over the river path within the city, as the river has a set of six tributaries, (see figure 5.5), and each tributary is located within a definite area of the city.

The selected sites have been covered a total of 11 locations within the provided snaps later and the descriptions of the criteria, had an opportunity to cover the whole existing condition of the urban riverfront design within the path through the city, as the snap included the street furniture, sidewalks – pavements, lightening elements, street signs, roads, the existed buildings, the river canal, the river banks, the water condition, the existing green spaces, and the plants within the river banks, the hardscape elements, and each spot has owned its own characteristics within the place, and the related area.

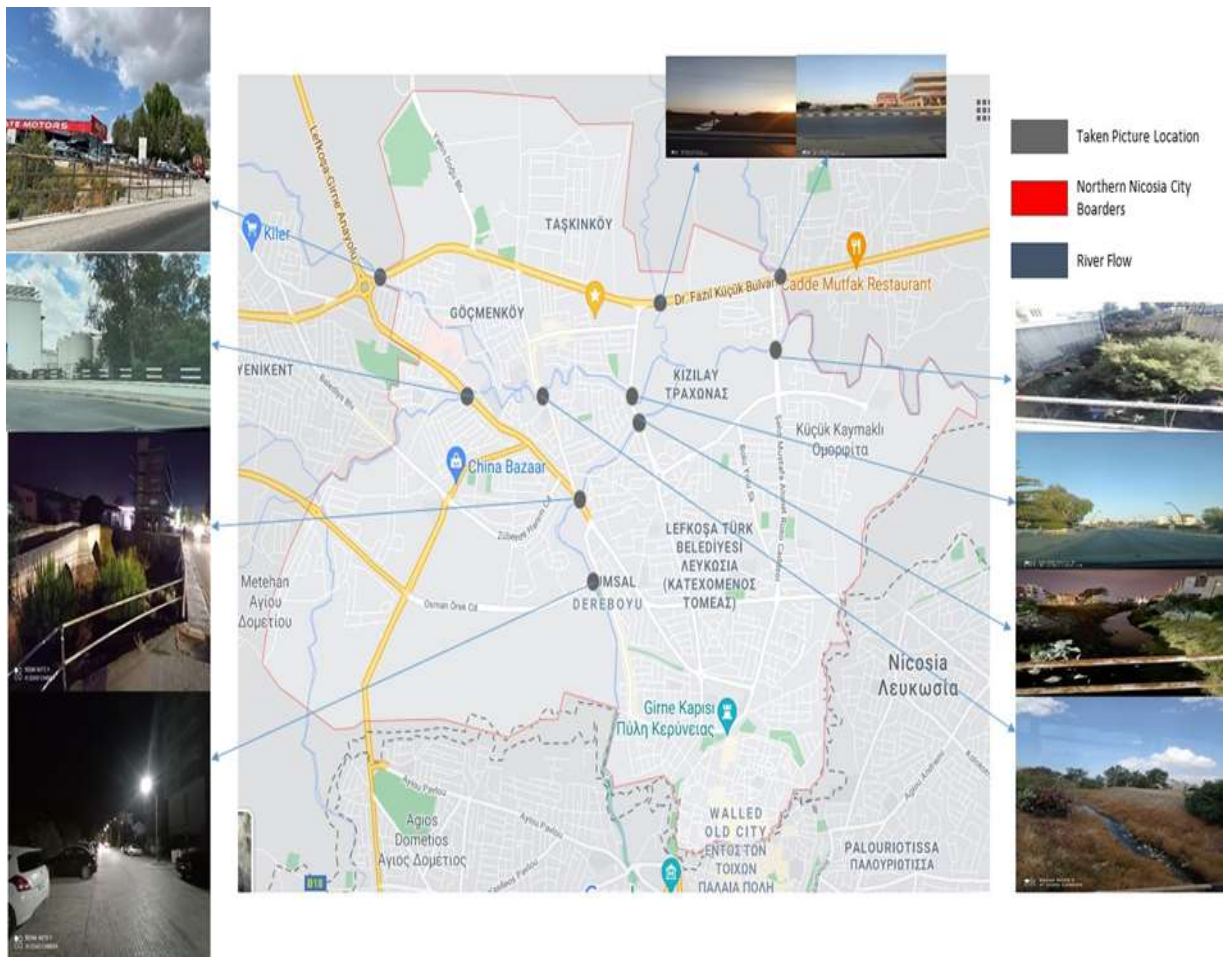


Figure 5. 6.The selected locations for Pedieos river evaluation

### 5.3.1 Surrounding Buildings and Neighborhood

The riverfront within the urban patch is ways surrounded within a building texture's as the existing of the commercial, and economic activities is almost representing the area and the way of living, in order to meet the human's needs. Within the case of Pedieos River, the observed buildings within the taken snap are mainly residential buildings and in some points, there are industrial and services shops are existing.





**Figure 5. 7 :** A residential building near the riverfront of the river, Main Tributary, Galibolu area –Lefkosa –Nicosia



**Figure 5. 8:** Industrial tanks near the river band, Main Tributary, Galibolu area –Lefkosa – Nicosia



**Figure 5. 9:** Residential buildings constructed at the river edge, Tributary one, Marmara area, –Lefkosa –Nicosia

### **5.3.2 Green Spaces**

Green space is an inclusive component within designing the riverfront, as it can enhance the original habitat and have aesthetic impacts on the urban patch of the city, even they can be used within the flood events of the river to save the surrounding and the city from the flooding and prevent damaging as they can work as open space for gathering and having a quality time within nature, and the river.

Within the case of Pedieos River, there was no green space designed or planned in order to contain any flood events, or to reach from the river banks, as we can observe the existence of the raw soil beside the river banks.





**Figure 5. 10:** River flow without any design for the green spaces, Tributary one, Ortakoy, area

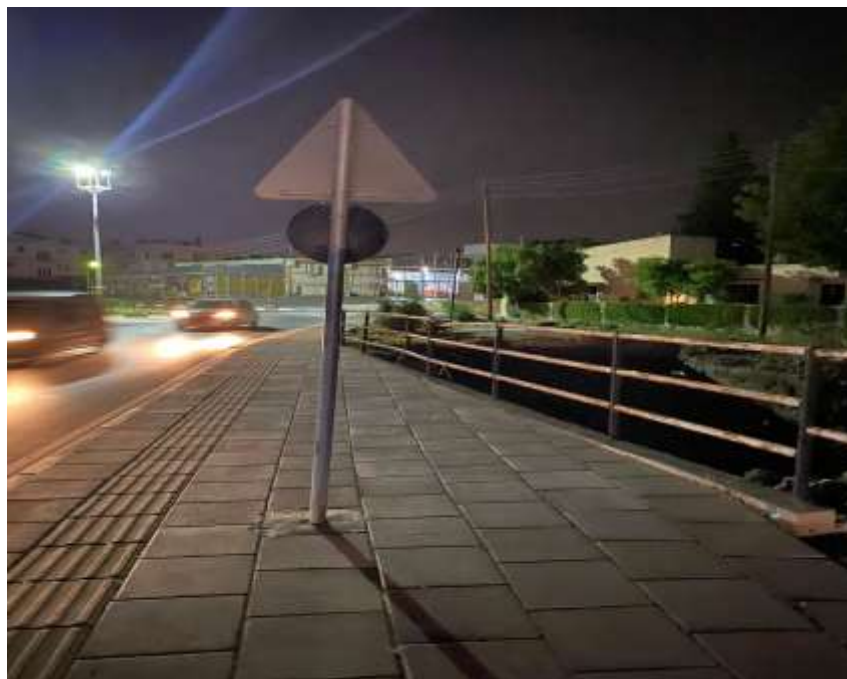
### **5.3.3 Urban Furniture**

Urban furniture is important to guide the user and to provide a good amount of comfortability, within their riverfront design, from benches, trash cans, lights, signs, and more, all of those can serve the region of the designed riverfront area, as we need to meet the environment in order to have the effective design of the urban furniture within the designed place.

Within the case of Pedieos River, a few urban furniture has been detected and most of them don't really serve the river, but the hardscape areas like the streets mainly.



**Figure 5. 11:** A huge ads block the view of the river, Main Tributary, Gelibolu district



**Figure 5. 12:** Street sign, and a non-safe railing beside the river edges, Tributary one, Marmara area, –Lefkosa –Nicosia



**Figure 5. 13:** A broken structure, and isolation of the river with a cracked dangerous pavement, Tributary one, Marmara area, –Lefkosa –Nicosia

#### **5.3.4 River Front**

Urban riverfront is the main component within the city landscape, and urban design, in the case of the presence of a river flow within the city, can be the important element for the city health and design of the open spaces, and the integration within nature, and have lots of activities within the river edges.

River front design have a number pf step in order to achieve the design, first, we need to restore the river to the initial natural state, within a possible work, also then we can have the design within the urban planners, and the landscape planners too, also the architects to design parks, and the flood areas too as we can use this flooded area as a temporary designed place for entertaining.

Within the case of Pedieos River there was no river front design has been observed, and the river is just tautly ignored within the city landscape, and planning, which makes the river exploded

directly to the hardscape elements, and the corrosion of the river banks is observed within spots around the city. This could harm the existing habitat and makes the river more polluted and hard to regenerate again.



**Figure 5. 14:** An extraction work for a the soil is ongoing within the river edges, Tributary two Ortakoy area –Lefkosa –Nicosia



**Figure 5. 15:** Old Bridge for crossing the river and the new urban one which looks risk to the residents, Main Tributary, Galibolu area –Lefkosa –Nicosia



Figure 5. 16: Cross road area within the commercial livable road of the city (Deraboyu), Main Tributary, Galibolu area –Lefkosa –Nicosia

### 5.3.5 Water

Water the source of life within the river corridor, which can nourish and makes life possible within the drainage system of the river, and is the reason of existing for the aquatic life, as this water must be of good quality, and any damage to the water can lead to severe changes within the ecosystem of the river and destroy the aquatic life.

Within the case, observation of green water, and polluted water has been snapped within the picture, and the green layer of algae due to a high level of toxins within the water, and thus prevent the sun to penetrate the water in order to have a good income for the existed habitat, such as birds, fish, and insects.

Water is important to preserve that can provide a good income to supply homes, and the agricultural activities and even to generate power, and more.





**Figure 5. 17:** Concert wall, and a runoff discharge is exposed to the river directly, Main Tributary, Kucukkaymakli area –Lefkosa –Nicosia



**Figure 5. 18:** Waste, and trash within the river edges, Main Tributary, Kucukkaymakli area – Lefkosa –Nicosia




**Figure 5. 19:** Concrete and industrial tubes exposed to the water surface of the river, Kucukkaymakli district-Nicosia

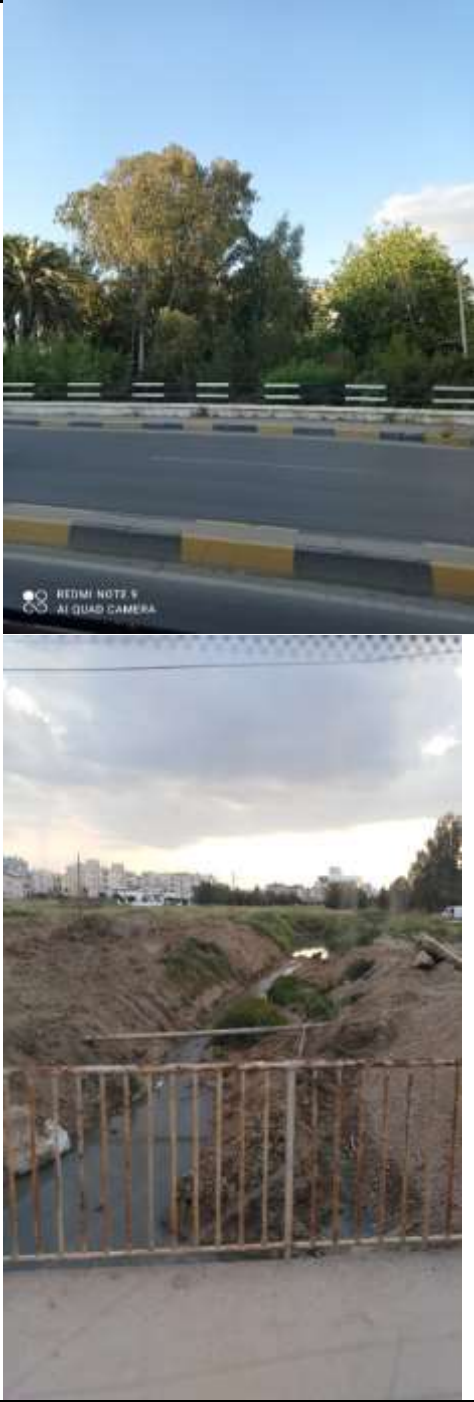



**Figure 5. 20:** Old arched bridge over the river, and the formation of plant sediments, Gocmenkoy district, Nicosia

**Table 5. 1:** Evaluation of Pedieos River

Criteria	Description	Evaluation
Surrounding Buildings And Neighborhood		<p>The buildings surrounding the river is mainly residential buildings, and there's some educational building such as institutes, and some commercial ones, and industrial also</p>



Criteria	Description	Evaluation
Green Space		<p>The river has green spaces, but it's not designed and lifted as an empty lot of soils, and some wild plants, and the access to the green spaces is dangerous and not possible, since there's no ways designed to reach the river edges</p>

Criteria	Description	Evaluation
Urban Furniture		<p>Urban furniture surrounded the river is mainly consisted of old railing for protecting the residents when the walk alongside the paved, ways, but at some points the design of the railing is not safe, also its old and having a destroyed parts within a certain locations. Traffic lights, paved ways, street signs, walking bridges, and cars ways (bridges types).</p>

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River Front



There's no riverfront design, as the river front seems risky in some location, and just have a wild plants, and soils on the edges, even an extensive exposing of the hardscape elements (whole of the city), such as the streets, and the paved ways, also the wastewater drainage system is connected to the river in some points (KucukKaynakli Area), as the river edges is supported within a concrete beds in some points (Main street of the city), and within a natural stones in one point(KucukKaynakli Area), and the rest is just lifted, and we can observe the corrosion of the soil at some locations (Yenikent Area), as the residential buildings is exposed to the riverfront directly in (Maramara Area), and there's no such a wetland in order to contain any flood events within the future

Criteria	Description	Evaluation
Water		<p>The water quality seemed poor, due to the changing of the colors from winter to summer, as the river discharge is week during the summer time, and average during the winter (rainfall season), as the peak of the flood events has been observed on Novembers, as the water is exposed directly to the hardscape that can be observed within the photos, and the water is clearly polluted.</p>

## **CHAPTER 6**

### **CONCLUSION AND RECOMMENDATIONS**

#### **6.1 Conclusion**

River is so important within the cities when they exist, as they can play a really important role within the ecosystem of the city, as cities suffering from the noisy attitude and atmosphere. Landscape architecture is founded to handle the issues of the natural elements within the designing of the city in order to integrate the natural elements in a good way, as the architectural planning of the city must to have a better quality within the life cycle at the social, cultural and the economical levels. Rivers can provide sustainable solutions to the city's planning and can provide freshwater, more efficient urban design, livability to the place, and more.

Valuing rivers and preserving them to the original statues can provide a way to better planning and good managing to the city planning and designing, as the rivers can represent the good example for ecosystem element within the urban and landscape design, integrating and creating more live able spaces, for the social interaction purposes, such as designing the riverfront can provide green spaces, water accessibility, protection for the agricultural activities, as riverfront can be the place to walk, interact, have some activity, and provides lots of human needs at the level of sociocultural, and economical aspects too. Designing a waterfront within the river corridor can protect and mitigate human activities against nature, as it will add a beautiful green corridor to the existing urban patch.

This research aimed at the evaluation of the condition of the Pedieos River, the introduction included general information about the urban river within the urban context, including the research aim, and methodology. Then a brief explanation about the urban river natural elements and restoration process has been explained and continuing toward the evaluation of the urban river aimed at the riverfront design and the main components within the landscape architecture. The international cases have been explained within a picture, in order to estimate the status of

some cases, then brief documentation about the Pedieos river history and snaps has been taken in order to evaluate the river case, and the statues of the riverfront within the city of northern Nicosia.

The results aimed the evaluation criteria for Pedieos river, showed that the river is polluted, and not designed to be integrated within the surroundings, since the riverfront is ignored and there was non-convenient urban furniture has been sited within the river, as the extreme exposure to the hardscape and urbanization process make the river suffers more.

Riverfront within the case study has been shown an ignorance, within the design as the observations from the site visit and the taken snaps gave us a result of retarded condition in comparison within the international cases, thus the condition of Pedieos river is very critical and far enough from meeting the international examples which let the city isolated from the existing of the river, and no design integration within the whole observed areas.

## **6.2 Recommendations**

From the environmental, and the implementation of green edges of the city within Pedieos River in Nicosia, we can create a green open space to enhance the level of green spaces, but this needs a master plan, and good restoration work in order to restore the river to the original natural state. The solution for a well-done master plan is a must, as we need to restore the river to its natural status before we design the riverfront, and by that, we can start to create green space, to let the city population enjoy the riverfront design, and the sense of the place.

A set of applications is a must:

- Ecological evaluation for the river within the city.
- Working within the restoration at the definite scale and the possible conditions that the river has.
- Ecologists, Hydro engineering, Architects, Landscape, and urban designers is a must in order to have a good scale covering to the riverfront design.

- Master plan aiming the design of the riverfront.
- The implantation of the floodplains within the design.
- Water collection system within the rooftop of the building to prevent the excessive water discharge within the river channel, to mitigate the flood risk (creating green roofs).
- Having legislations against the building construction restriction within the river bed.
- Suitable urban furniture that reflects the space theme.
- Supporting the river edges within a suitable natural, or artificial supports within the required conditions.
- Educational lessons within the young generations, and to local people about the existing river and the importance of the outcomes of the place design, and preservation.

## REFERENCES

- Ahern, J. (2013). Urban landscape sustainability and resilience: The promise and challenges of integrating ecology with urban planning and design. *Landscape Ecology*, 28(6), 1203–1212. <https://doi.org/10.1007/s10980-012-9799-z>
- Anonymous (2003) “Houses were evacuated and roads were close”. *Fileleftheros newspaper*, 13 February 2003, p 1 (Greek)
- Anonymous (2005) “Pedieos River Bed becomes impassable for hours”. *Fileleftheros newspaper*, 1 June 2005, p 12 (Greek)
- Anonymous. A handbook for Stream Enhancement & Stewardship / The Izaak Walton League of America. Blacksburg, Va. : McDonald & Woodward Pub. Co. ; Gaithersburg, Md.: *Izaak Walton League of America*; 2006.
- Balsas, C. (2016). Riverfront Planning Initiatives in Upstate New York: The Cases of Kingston, Albany and Schenectady. *Proceedings of the Fábos Conference on Landscape and Greenway Planning*, 5(2, Article 56), 175–182. Retrieved from <https://scholarworks.umass.edu/fabos/vol5/iss2/56>
- Baschak LA., Brown RD. An Ecological Framework for the Planning, Design and Management of Urban River Greenways. *Landscape and Urban Planning* 1995;33 211- 225.
- Batista e Silva, J., Saraiva, M. G., Ramos, I. L., & Bernardo, F. (2005). Methodology of aesthetic evaluation of rivers in urban context. *Urban River Rehabilitation Conference*, (September), 113–121.
- Beatley T (2000) Green urbanism learning from European cities. Island Press, Washington



- Beechie, T. J., Sear, D. A., Olden, J. D., Pess, G. R., Buffington, J. M., Moir, H., ... Pollock, M. M. (2010). Process-based principles for restoring river ecosystems. *BioScience*, 60(3), 209–222. <https://doi.org/10.1525/bio.2010.60.3.7>
- Bekessy S, Runge M, Kusmanoff A, Keith D, Wintle B. 2018 Ask not what nature can do for you: a critique of ecosystem services as a communication strategy. *Biol. Conserv.* 224, 71–74. (doi:10.1016/j.biocon.2018.05.017)
- BELTON, V. ; Stewart, T. J. (2002) Multiple Criteria Decision Analysis. *Kluwer Academic Publishers, Dordrecht.*
- Bennett, S. J., A. Simon, J. M. Castro, J. F. Atkinson, C. E. Bronner, S. S. Blersch, and A. J. Rabideau (2011), The evolving science of stream restoration, in Stream Restoration in Dynamic *Fluvial Systems: Scientific Approaches, Analyses, and Tools*, *Geophys. Monogr. Ser.*, vol. 194, edited by A. Simon et al., pp. 1–8, AGU, Washington, D. C.
- Bennett, S. J., and Simon, A. (eds) (2004). Riparian Vegetation and Fluvial Geomorphology. Water Science and Application 8. *Washington, DC: American Geophysical Union.*
- BERLEANT, A. (1997) Living in the Landscape. *Towards an Aesthetic of the Environment.* *University Press of Kansas.*
- Binder, W., Göttle, A., & Shuhuai, D. (2015). Ecological restoration of small water courses, experiences from Germany and from projects in Beijing. *International Soil and Water Conservation Research*, 3(2), 141–153. <https://doi.org/10.1016/j.iswcr.2015.04.004>
- Boitsidis, A. J., and Gurnell, A. M. (2004). Environmental Sustainability Indicators for Urban River Management. *Report Produced as Part of the Sustainable Management of Urban*

*Rivers and Floodplains Project (SMURF)*. [online]. Retrieved on 8 March 2007 from [http:// www.smurf-project.info/reports.html](http://www.smurf-project.info/reports.html)

Bray, R. (1993). The New Urbanism: Celebrating the city. *Places*, 8(4), 56-65.

Bunn, S. E., and Arthington, A. H. (2002). Basic principles and ecological consequences of altered flow regimes for aquatic biodiversity. *Environmental Management* 30, pp. 492–507.

Canyon Hydro, Summary, E., Of, F., Potential, T. H. E., Ferreres, X. R., Font, A. R., ... Masuelli, M. (2013). We are IntechOpen , the world ' s leading publisher of Open Access books Built by scientists , for scientists TOP 1 %. *Intech*, 32(July), 137–144. Retrieved from <http://www.intechopen.com/books/trends-in-telecommunications-technologies/gps-total-electron-content-tec-prediction-at-ionosphere-layer-over-the-equatorial-region%0AInTec%0Ahttp://www.asociatiamhc.ro/wp-content/uploads/2013/11/Guide-to-Hydropower.pdf>

Cardinale BJ et al. 2012 Biodiversity loss and its impact on humanity. *Nature* 486, 59–67. (doi:10. 1038/nature11148)

Cengiz B. A research on the determination and assessment of landscape characteristics of the Bartın River. PhD thesis. Ankara University, Graduate School of Natural and Applied Sciences, Department of Landscape Architecture. *Ankara*; 2007. (original text in Turkish)

Cengiz B., Smardon RC., Memlük Y. Assessment of River Landscapes in terms of Preservation and Usage Balance: A Case Study of The Bartın River Floodplain Corridor (Western Black Sea Region, Turkey). *Fresenius Environmental Bulletin* 2011;20(7) 1673- 1684.

- Cengiz, A. (2013). Urban River Landscapes. *Advances in Landscape Architecture*, (July 2013).  
<https://doi.org/10.5772/56156>
- Cengiz, B. (2013a). Urban River Landscapes. *Advances in Landscape Architecture*, (March).  
<https://doi.org/10.5772/56156>
- Cengiz, B. (2013b). Urban River Landscapes. *Advances in Landscape Architecture*, (July 2013).  
<https://doi.org/10.5772/56156>
- Charalambous, K., Bruggeman, A., Bakirtzis, N., & Lange, M. A. (2016). *Historical flooding of the Pedieos River in Nicosia, Cyprus. Water History*, 8(2), 191–207.  
<https://doi.org/10.1007/s12685-016-0162-1>
- Chin, A., and Gregory, K. J. (2005). *Managing urban river channel adjustments. Geomorphology* 69, pp. 28–45.
- Cook EA. Ecosystem Modeling as A Method for Designing Synthetic Fluvial Landscapes: A Case Study of the Salt River in Arizona. *Landscape and Urban Planning* 1991;20 291-308.
- Cooper N, Brady E, Steen H, Bryce R. 2016 Aesthetic and spiritual values of ecosystems: recognising the ontological and axiological plurality of cultural ecosystem ‘services’. *Ecosyst. Serv.* 21, 218–229. (doi:10.1016/j.ecoser.2016. 07.014)
- Costanza, R. (1999). The ecological, economic, and social importance of the oceans. *Ecological Economics* 31, 199-213. Durán Vian, F., Pons Izquierdo, J. J., & Serrano Martínez, M. (2021). *River-City Recreational Interaction: a Classification of Urban Riverfront Parks and Walks. Urban Forestry & Urban Greening*, 59(January), 127042.  
<https://doi.org/10.1016/j.ufug.2021.127042>

Cyprus State Archives SA1: 858/1928—Complaint by Najem Houry of damage done to his property by the digging of gravel and sand from the bed of the river Pedias at Nicosia/Dumping of rubbish in the Pedias river bed

Cyprus State Archives SA1:1258/1918—Flood in Nicosia on the 15th December 1918 Cyprus

Dallimer, M., Rouquette, J. R., Skinner, A. M. J., Armsworth, P. R., Maltby, L. M., Warren, P. H., & Gaston, K. J. (2012). Contrasting patterns in species richness of birds, butterflies and plants along riparian corridors in an urban landscape. *Diversity and Distributions*, 18(8), 742–753. <https://doi.org/10.1111/j.1472-4642.2012.00891.x>

Daniel TC et al. 2012 Contributions of cultural services to the ecosystem services agenda. *Proc. Natl Acad. Sci. USA* 109, 8812–8819. (doi:10.1073/pnas.1114773109)

Di'az S et al. 2015 The IPBES conceptual framework — connecting nature and people. *Curr. Opin. Environ. Sustainability* 14, 1–16. (doi:10.1016/j.cosust.2014.11.002)

Diaz S et al. 2018 Assessing nature's contributions to people. *Science* 359, 270–272. (doi:10.1126/science.aap8826)

Forman R.T.T. and Godron M. 1981. Patches and structural components for a landscape ecology. *BioSci.* 31: 733–740.

Francis RA. Positioning Urban Rivers within Urban Ecology. *Urban Ecosystem* 2012;15 285-291.

Frissell, C. A., et al. (1986). A hierarchical framework for stream habitat classification: viewing streams in a watershed context. *Environmental Management* 10, pp. 199–214.

- Garau, C., & Pavan, V. M. (2018). Evaluating urban quality: Indicators and assessment tools for smart sustainable cities. *Sustainability (Switzerland)*, 10(3).  
<https://doi.org/10.3390/su10030575>
- Gardiner JL. River Landscapes and Sustainable Development: A Framework for Project Appraisal and Catchment Management. *Landscape Research* 1997;22(1) 85-114.
- Gleick, P.H. (2003) Global freshwater resources: soft-path solutions for the 21st century. *Science*, 302, 1524–1527.
- Gregory, K. J. (2002). Urban channel adjustments in a management context: an Australian example. *Environmental Management* 29, pp. 620–633.
- Grimm NB., Faeth SH., Golubiewski NE., Redman CL., Wu JG., Bai XM., Briggs JM. Global Change and the Ecology of Cities. *Science* 2008;319 756-760.
- Grivaud G (2012a) The capital of the sweet land of Cyprus, Frankish and Venetian Nicosia (1191-1570). In: *Michaelides D (ed) Historic Nicosia. Rimal Publications, Nicosia*, pp 115–120.
- Gurnell, A. M. (2007). Analogies between the dynamics of mineral sediments and vegetative particles in fluvial systems. *Geomorphology* 89, pp. 9–22.
- Gurnell, A., Lee, M., & Souch, C. (2007). Urban Rivers: Hydrology, Geomorphology, Ecology and Opportunities for Change. *Geography Compass*, 1(5), 1118–1137.  
<https://doi.org/10.1111/j.1749-8198.2007.00058.x>

- Havránková, T. (2014). the Potential of River in Urban Spaces. *European Scientific Journal*, 2(September), 414–422.
- Henry, C.P., Amoros, C. & Roset, N. (2002) Restoration ecology of riverine wetlands: a 5 year post-operation survey on the Rhône River, France. *Ecological Engineering*, 18, 543–554.
- Hill G (1972) A history of Cyprus, the Frankish period, 1192-1432, vol II. *Cambridge University Press*, Cambridge
- Hradilová, I. (2012). Influence of urban waterfront appearance on public space functions. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 60(8), 261–268. <https://doi.org/10.11118/actaun201260080261>
- Hupp, C. R., and Osterkamp, W. R. (1996). Riparian vegetation and fluvial geomorphic processes. *Geomorphology* 14, pp. 277–295.
- Hussein, H. (2006). Urban recreational riverfronts : Successful revitalisation elements. *Journal of Design and the Built Environment*, 2(1), 1–14.
- I.A.CO Ltd (2011b) Preliminary evaluation of floods. *Final Report for the Water Development Department* (Greek)
- İnançoğlu, S., Özden, Ö., & Kara, C. (2020). Green corridors in urban landscapes, case study nicosia pedieos river. *European Journal of Sustainable Development*, 9(1), 1–8. <https://doi.org/10.14207/ejsd.2020.v9n1p1>
- Jormala J. Urban Rivers. In: Gumiero B, Rinaldi M, Fokkens B (eds.) *proceedings of the 4th ECRR International Conference on River Restoration*, 16-19 June 2008, Venice, Italy; 2008. p889-890.

- Juracek, K. E., & Fitzpatrick, F. A. (2003). Limitations and implications of stream classification. *Journal of the American Water Resources Association*, 39(3), 659–670. <https://doi.org/10.1111/j.1752-1688.2003.tb03683.x>
- Kesishian K (1989) Lefkosia—the capital of Cyprus, then and now. *Mouflon, Nicosia* (Greek)
- Kostopoulou, S. (2013). On the Revitalized Waterfront: *Creative milieu for creative tourism. Sustainability*, 5, 4578-4593.
- Liu, Y. (2020). Study on Urban River Ecological Landscape Design. *Journal of Physics: Conference Series*, 1549(2). <https://doi.org/10.1088/1742-6596/1549/2/022090>
- Louis Berger Group (2007a) Feasibility study for the upgrade of the storm water drainage system, preparation of a river basin management plan and an environmental impact assessment study for the greater Nicosia area. *Environmental Impact Assessment Report*
- Louis Berger Group (2007b) Feasibility study for the upgrade of the storm water drainage system, preparation of a river basin management plan and an environmental impact assessment study for the greater Nicosia area. *Pedhieos River Basin Management Plan*
- Malakoff, D. (2004) The river doctor. *Science*, 305, 937–939.
- Maratheftis FS (1977) Location and development of the town of Leucosia (Nicosia) Cyprus. Thesis submitted in 1958 to the University of Bristol, *Nicosia Municipality*, Nicosia
- Marsh WM. Landscape Planning: Environmental Applications, Fifth Edition. John Wiley & Sons, Inc; 2010.

MEA. (2005) Ecosystems and human well-being: synthesis. Washington, DC: Island Press.

Michaelides D (ed) (2012) Historic Nicosia. Rimal Publications, Nicosia.

MINGERS, J. (2001), “Multimethodology – mixing and matching methods” in Rosenhead, J. et al, „Rational Analysis for a Problematic World Revisited”, 2001, Jonh Wiley & Sons, Ltd.

Novaresio P. Great Rivers of the World. Barnes&Noble. New York; 2006. [12] Mann R. Rivers in the City. Newton Abbot, David and Charles; 1973. [13] Torre LA. *Waterfront Development*. Van Nostrand Reinhold. New York; 1989.

NRC (1996) Upstream: Salmon and Society in the Pacific Northwest, National Academy Press, Washington, DC.

Ormerod, S.J. (2003) Restoration in applied ecology: editor’s introduction. *Journal of Applied Ecology*, 40, 44–50.

Otto B., McCormick K., Leccese M. Ecological Riverfront Design: Restoring Rivers, Connecting Communities. *American Planning Association, Planning Advisory Service Report Number: 518-519*, Chicago, IL; 2004.

Palmer, M. A., Bernhardt, E. S., Allan, J. D., Lake, P. S., Alexander, G., Brooks, S., ... Sudduth, E. (2005). Standards for ecologically successful river restoration. *Journal of Applied Ecology*, 42(2), 208–217. <https://doi.org/10.1111/j.1365-2664.2005.01004.x>

Palmer, M.A., Hart, D.D., Allan, J.D. & the National River Restoration Science Synthesis Working Group (2003) Bridging engineering, ecological, and geomorphic science to enhance riverine restoration: local and national efforts. Proceedings of a National



Symposium on Urban and Rural Stream Protection and Restoration (eds P. Bizier & P. DeBarry) (cd-rom). *EWRI World Water and Environmental Congress, Philadelphia, PA* (June 2003). American Society of Civil Engineers, Reston, VA

Papacostas T (2012) Byzantine Nicosia (650-1191). In: Michaelides D (ed) *Historic Nicosia*. Rimal Publications, Nicosia, pp 77–109

Pavrides A (1982) Recital concerning the sweet land of Cyprus entitled ‘Chronicle’ by Leontios Machairas. *Translation by Andros Pavrides; Illustrated by Giorgos Mavrogenis. Philokypros*, Nicosia (Greek)

Pavrides A (2005) Strovolos—history, geography and modern life. Strovolos Municipality, Nicosia (Greek)

Perikleous C (2011) *Lakatamia a town in green*, 2nd edn. Municipality of Lakatamia, Nicosia

Petts, G. E., Heathcote, J., and Martin, D. (eds) (2002). *Urban Rivers: Our Inheritance and Future*. London: *IWA Publishing*.

Postel, S. & Richter, B. (2003) *Rivers for Life: Managing Water for People and Nature*, *Island Press, Washington, DC*.

Riley AL. *Restoring Streams in Cities: A Guide for Planners, Policymakers and Citizens*. *Island Press, Washington, D.C.*; 1998.

Riverlife Pittsburgh. (2014). *A Guide to Riverfront Development*. 48. Retrieved from <http://riverlifepgh.org/wp-content/uploads/2016/10/A-Guide-to-Riverfront-Development.pdf>

- Robinson, L. N. (2008). Water resources research progress. *Water Resources Research Progress*, 1–433. <https://doi.org/10.1002/2014WR016874>.Received
- Rosgen, D. L., 1996. Applied River Morphology. *Wildland Hydrology*, Pagosa Springs, Colorado.
- Smardon RC. Nine Mile Creek Watershed an Eco-tourism Guide. Prepared by: Cornell Cooperative Extension of Onondaga County, Nine Mile Creek Conservation Council, Save The County Land Trust, Syracuse, New York; 2006.
- Smardon RC., Felleman JP., Senecah S. Protecting Floodplain Resources: A Guidebook for Communities. *Federal Interagency Floodplain Management Task Force, FEMA publication number 268*, Wash., DC; 1995.
- TAI Xue-dong. Experience and Enlightenment of Waterfront Development in UK - A Case Study of Cardiff Bay and Docks Development in London[J]. *JIANGSU URBAN PLANNING*. 2007 (12):29-33.
- Tribot, A. S., Deter, J., & Mouquet, N. (2018). Integrating the aesthetic value of landscapes and biological diversity. *Proceedings of the Royal Society B: Biological Sciences*, 285(1886). <https://doi.org/10.1098/rspb.2018.0971>
- Turner T. Landscape Planning and Environmental Impact Design. 2nd edition. *The Natural and Built Environment Series*; 1998.
- Turoglu H., Özdemir H. Floods and Flash Floods in Bartın Causes, Effects, Prevention-Mitigation. Cantay Publisher, İstanbul; 2005. (original text in Turkish)
- UN Habitat (2006) State of the world's cities 2006/07. Earth- scan, London

- US Environmental Protection Agency. (2000). National Water Quality Inventory, 1998 Report to Congress. [online]. Retrieved on 23 March 2007 from <http://www.epa.gov/305b/98report>
- Veról, A. P., Lourenço, I. B., Fraga, J. P. R., Battemarco, B. P., Merlo, M. L., de Magalhães, P. C., & Miguez, M. G. (2020). River restoration integrated with sustainable urban water management for resilient cities. *Sustainability (Switzerland)*, 12(11). <https://doi.org/10.3390/su12114677>
- Ward, J. V. (1998). Riverine landscapes: biodiversity patterns, disturbance regimes, and aquatic conservation. *Biological Conservation* 83, pp. 269–278.
- Ward, J. V., et al. (2002). Riverine landscape diversity. *Freshwater Biology* 47, pp. 517–539.
- Ward, J. V., Malard, F., & Tockner, K. (2002). Landscape ecology: A framework for integrating pattern and process in river corridors. *Landscape Ecology*, 17(SUPPL.), 35–45. <https://doi.org/10.1023/A:1015277626224>
- Wheater, H., & Evans, E. (2009). Land use, water management and future flood risk. *Land Use Policy*, 26(SUPPL. 1), 251–264. <https://doi.org/10.1016/j.landusepol.2009.08.019>
- Wheater, H.; Evans, E. Land use, water management and future flood risk. *Land Use Policy* 2009, 26, 251–264. [CrossRef].
- Wohl, E., P. L. Angermeier, B. Bledsoe, G. M. Kondolf, L. MacDonnell, D. M. Merritt, M. A. Palmer, N. L. Poff, and D. Tarboton (2005), *River restoration*, *Water Resour. Res.*, 41, W10301, doi:10.1029/2005WR003985

- Xu, S. (2021). Advances in Urban River Landscape Ecology Research. *IOP Conference Series: Earth and Environmental Science*, 657(1). <https://doi.org/10.1088/1755-1315/657/1/012020>
- Yassin, A. B. (2011). Lincoln University Digital Thesis *Developing New Guidelines for Riverfront Development in Malaysia*. *Pacific Rim Property Research Journal*, 4, 511–530.
- Yin, X. L., Yuan, S. X., Liu, Y. C., Huang, C. P., Liu, X. C., Wang, J., & Huang, G. Q. (2018). Research progress on urban river landscapes and equilibrium profile. *IOP Conference Series: Earth and Environmental Science*, 191(1). <https://doi.org/10.1088/1755-1315/191/1/012099>
- Zhang Qi, YU Shuang, Research on Renovation and Reutilization of Existing Buildings and Environment in Low-lying Water Area[J]. *BULDING SCIENCE*. 2004, 20 (2):60-66.
- Zope, P. E., Eldho, T. I., & Jothiprakash, V. (2016). Impacts of land use-land cover change and urbanization on flooding: *A case study of Oshiwara River Basin in Mumbai, India*. *Catena*, 145, 142–154. <https://doi.org/10.1016/j.catena.2016.06.009>
- Zope, P.E.; Eldho, T.I.; Jothiprakash, V. Impacts of land use-land cover change and urbanization on flooding: A case study of Oshiwara River Basin in Mumbai, India. Ahern, J. (2013). Urban landscape sustainability and resilience: *The promise and challenges of integrating ecology with urban planning and design*. *Landscape Ecology*, 28(6), 1203–1212. <https://doi.org/10.1007/s10980-012-9799-z>

## **APPENDICES**

## Appendix 1

### Similarity Report

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**Appendix 2**  
**Ethical Approval Document**

Date: 15/02/2021

To the **Institute of Graduate Studies of Near East University**

The thesis titled “*Urban Riverfront Design: A Study of Pedieos River*” has been evaluated. Since the researcher will not collect primary data from humans, animals, plants or earth, this project does not need to go through the ethics committee.

**Title:** Assoc. Prof. Dr.

**Name Surname:** Buket Asilsoy

**Signature:**

**Role in the**  **Thesis:** Supervisor