



Workpackage 4

Title : “Hadrian's Aqueduct as Heritage Commons:
Defining tangible and intangible aspects”

Deliverable 4.1.7

Mapping the link between
the natural and the cultural



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Executive Summary

WP4 is structured on three sets of interrelated activities that focus inter alia on the creation of a Local Archive on Hadrian's Aqueduct as a common source of heritage values in the human-geographic unit of CHalandri, to be hosted in the digital H.ID.RAN.T platform. Deliverable 4.1.7 "Mapping the link between the natural and the cultural" aims to highlight the relationship between the natural element of water and people in the area of Chalandri, as it has been expressed through its cultural manifestations, and how this relationship has changed over time. A landscape approach was used to assess and map the interaction of people and the environment, and the ecosystem services framework to analyze this relationship systematically. Results demonstrate the transition from a rural to an urban character of the landscape. Also, elements of the rural character of the area are gradually lost showing a shift from provisioning to cultural ecosystem services.



1. Introduction

1.1 Synopsis of Work Package 4

The project 'Hidden cultural identities that reappear through water networks' (CULTURAL H.ID.RA.N.T) aims to re-introduce Hadrian's Aqueduct from the Roman period to the contemporary urban life of Halandri in Athens in order to raise awareness of local cultural and natural heritage and contribute to citizens' wellbeing.

WP4 focuses on the creation of a Local Archive that will shed light on the tangible and intangible aspects of Hadrian's Aqueduct as a common source of heritage values in the area, together with an online platform that will host the archive and tell its story in a simple and meaningful way in an attempt to engage residents and other users alike. As a final step, the archive will pass into the hands of the local community through a series of events that will facilitate its management, promotion, and expansion. In addition, a local HIDRANT Festival will be collectively organised to promote and celebrate Hadrian's Aqueduct and its heritage value as an integral part of the municipality's history. MedINA is the leader of WP4 with the support of all project partners, some of which lead on specific deliverables, analysed in more detail in Section 2.2. of the present report.

1.2 Purpose of D4.1.7. "Integrating natural and cultural heritage assessment"

The present report which constitutes Deliverable D 4.1.7 aims to highlight the relationship between nature and culture through time in the area of Chalandri, focusing on the natural element of water. People, since time immemorial, have used natural resources and altered the natural environment to support their needs in ways that can reveal a given society's values and social beliefs. In this context, Hadrian's Aqueduct along with its supporting branches *is* such a manifestation, revealing information not only on the socio-cultural context in which it was built but also on the way it was used or disused over the centuries. In our search to reveal the cultural heritage of this Roman monument, we need to understand the relationship between the community of Chalandri and the element of water, the cultural environment and the natural ecosystem. Looking into changes in this relationship we can develop an understanding of how the socio-cultural context, people's values and social structures have been transformed over time.

In this context the present study introduces these research questions:

- How has the management of water changed over time in the area of Chalandri?
- Which are the cultural manifestations of this relationship?

A considerable amount of data accessible through open web resources provides valuable information to this set of research questions. Besides disclosing and organizing the available data, the report also demonstrates an innovative methodological approach to cultural-natural heritage issues, providing an initial background, themes, and tools for further investigation.



2. Methods

2.1 Theoretical Tools

A landscape approach has been used to assess and map the interaction of people and their natural environment and an Ecosystem Services framework (MEA 2005) to explore this relationship in a systematic manner.

The landscape approach framework was selected as such approaches are used widely to understand the complexity of human and natural system's interrelation. Landscapes are the interface of nature and society and express a tight interplay of physical features of the human environment with social structures and human ideas (Selman 2012), and therefore their study has become essential not just for natural but also social sciences. For the present study, the definition used in the European Landscape Convention as “an area, as perceived by people, whose character is the result of action and interaction of natural and/or human factors” (EC 2000:3) has been adopted which merits an interdisciplinary research approach.

Landscapes represent through their composition, configuration and elements, the actions and decisions made by people in a specific cultural context for the management of their environment and its natural resources. These landscape aspects are usually assessed and map through land cover, land use and landscape elements. Land use represents the most recognizable cultural indicator of human-nature interaction. By mapping the land uses in an urbanizing landscape the aim is to assess how people organize the use of land and the impacts on water resources in the area of Chalandri. Landscape elements - natural or manmade - such as terraces, hedgerows, stonewalls etc, are features of the landscape's character that can be seen as artifacts of human-nature interaction and are widely used to describe traditional landscapes and/or as historical landmarks (Bastian O., & Walz U., 2013). In this study following Keele, V. et al 2019, they have been used to identify water uses in relation to the services that the river ecosystem provides. Some elements refer to direct use for consumption either for domestic use or for agricultural and industrial use, while others are connected indirectly with the presence of water such as those for recreational uses or spiritual purposes. For the latter ones, an assessment is made on the extent to which they are linked to the presence of water.

To understand what these manifestations in the landscape signify, the framework of ecosystem services (ES) approach has been used. Ecosystem services refer to the interface between ecosystems and human well-being and are described as the many different benefits ecosystems provide to people (Böck K., et al 2018). The ecosystem services approach has been developed in order to understand relationships in complex socio-ecological systems (SeS). Many different methodological frameworks and tools have been developed for the assessment of ES such as the Millennium Ecosystem Assessment, The Economics of Ecosystems and Biodiversity (TEEB) and the Common International Classification of Ecosystem Services (CICES). River ecosystems specifically have been the centre of many studies (Keele, V. et al 2019, Thiele, J. et al 2020, Hornung, L. et al 2019). Mapping



ecosystem services is essential to understand how ecosystems contribute to human wellbeing and where this interaction takes place.

Considering the available data, a choice was made to focus on provisioning and cultural services using the classification provided in Yeakley A. et al (2016). It should be noted that river ecosystems also provide a wide variety of regulating and supporting services, however, mapping these services requires a more complex procedure, using biophysical models, that require information on hydrological regimes and data on biodiversity and climate conditions (Burkhard B, Maes J (Eds.) 2017).

2.2. Definition of area and time periods

Water has always been a constitutional element of the character of the Chalandri area. The present study focuses on the area of Chalandri and especially on the stream of Chalandri, which is known as Kalamas river, part of the stream of Polydrosos, and connected with the Hadrian's Aqueduct.

The interaction of people with the river ecosystem of the Kalamas stream is examined through the landscape characteristics, components and elements, in three different time periods; the end of the 19th century, the mid-20th century, and the end of the 20th century.

The first time period of interest is the end of 19th century when Athens is the newly founded capital of the Modern Greek state. It is a city of approximately 600 people¹ and Hadrian's aqueduct is rediscovered and used for the water supply of the new capital. The area of Chalandri was a settlement with rural character which administratively a part of Athens². The second time period of interest is mid-20th century when Chalandri was still a discrete settlement and from 1945 onwards became a separate municipality. The population had risen to approximately 15000 people incorporating refugees from Asia Minor as most of the areas around Athens, with its character was a mix of rural and industrial activities. In the following decades Chalandri will follow the general urban population growth trend of the expansion of Athens and the integration in the wider Athens metropolitan area. The area was especially affected by the suburbanization trends of the '80s and '90s, as middle-class mostly people were leaving the congested and overpopulated areas of the center of Athens, moving to the more favorable suburbs like Chalandri. The beginning of the 21st century, which is the third period of interest, finds Chalandri with a population of approximately 74000 inhabitants (2011 census).

¹ Ministry of Interior – census of 1879

² In 1909 the first urban plan is implemented



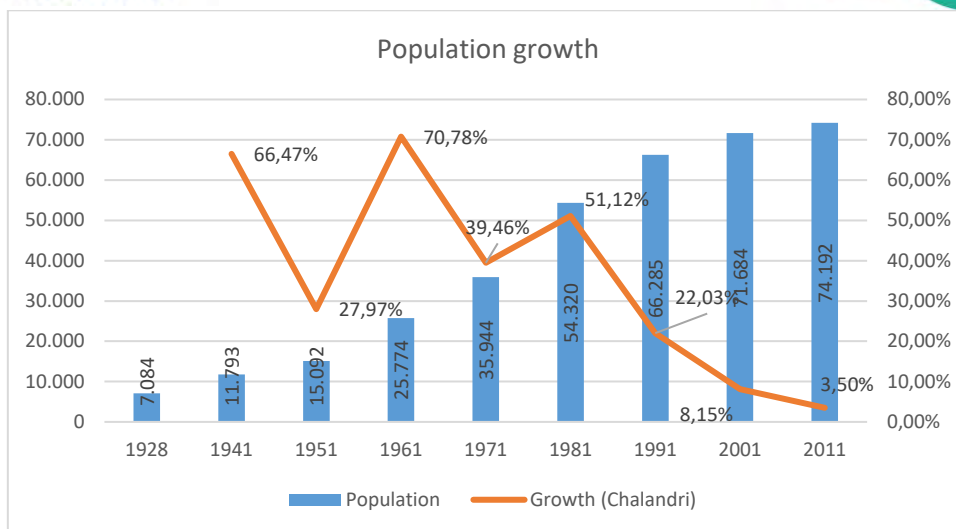


Diagram 1: Evolution of population of Chalandri from 1951 to 2011 (source Hellenic Statistical Authority)

2.3 Sources and data

The examination of how the socio-economic changes mentioned in 2.2. have influenced the relationship of people with the environment is assessed through information derived from different historical maps. For the first time period of interest, the Curtius – Kaupert map of Attica which was published through the years of 1878 to 1904 (Korres 2008; Livieratos 2009) provides information about land uses and landscape elements - focusing mainly on archeological elements. The part of this collection which includes Chalandri is under the label V.Kephisia and it was published in 1883. To assess land uses we used the legend provided for the catalogues. Although some categories were not clear we cross-checked with the work by Livieratos (Liveriatos et al, 2009) to associate the land use classification.

The charts produced for the urban plans from 1929 to 1959, available from the municipality GIS archive³, provide useful information for the 2nd period (mid-20th century), along with a “semi-cadastral” map of Athens in 1955, available from the Municipality of Athens archive⁴. For this period information was extracted by the subsequent urban plans that were produced for the planning of the new area under urbanization. In this series of urban plans, the most prominent dates were 1931 and 1958 when large areas were included in the plan. In these plans the stream of Kalamas is incorporated in the urban area, redefining its borders. It is also in these plans that the urban regime of “Open space” is attributed to the area around the stream that is left outside the building area. Information for the area outside the city was obtained from the semi-cadastral map of 1955 which

³ <http://gis.chalandri.gr/>

⁴ <https://www.cityofathens.gr/istorikoarxeio/content-28>



provides information for agricultural areas and other uses outside the building areas. In 1950 also a large part of the area of Patima was redistributed for agricultural land.

For the third period of interest, the beginning of the 21st century, several sources were used: a map produced by the “Association for the protection of the environment of Penteli-Chalandri stream”, data from the Urban Atlas provided by Copernicus Services⁵ and a topographical map of Chalandri stream provided by the municipality of Chalandri.

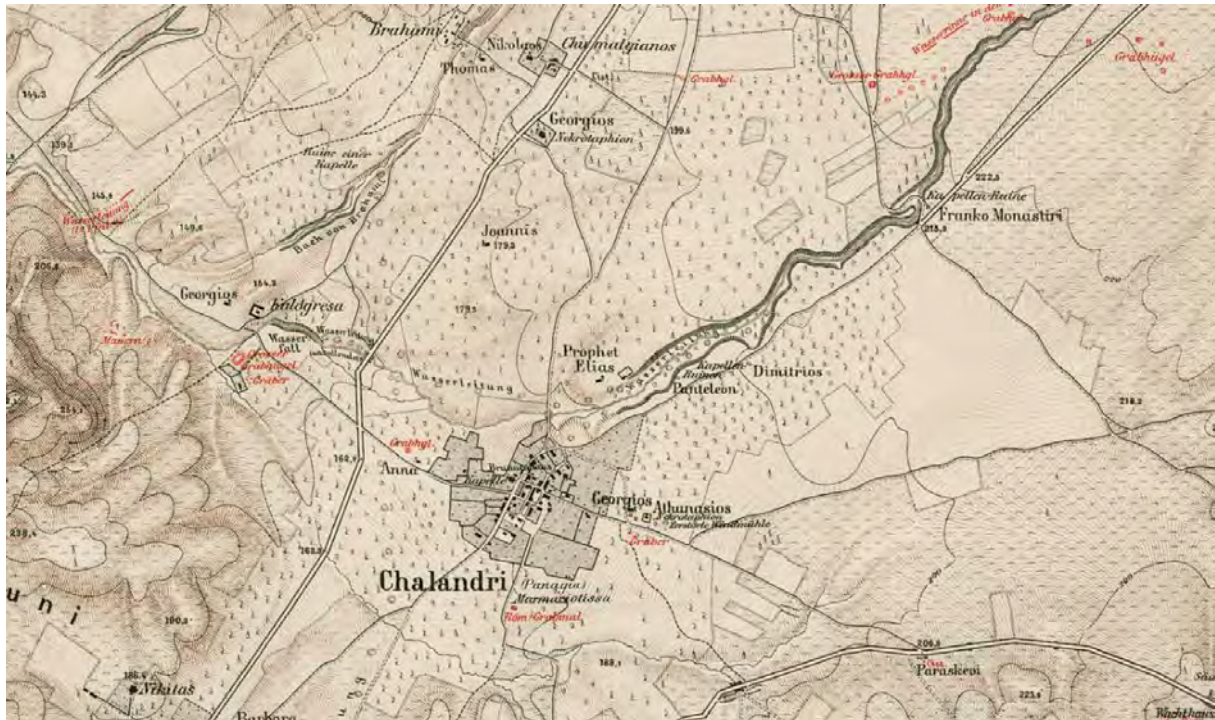


Image 1: A sample of Johann A. Kaupert and Ernst Curtius’ “Karten von Attika” map collection published in Berlin 1903, showing Chalandri, Chalandri stream and Hadrian’s Aqueduct.

Source: Heidelberg University Library

2.4 Data processing

To acquire information from the maps mentioned in unit 2.3, some data processing was necessary in order to work in a Geographical Information System. Data homogenisation is crucial to ensure compatibility among users and to this end, all data are converted into the same format and coordinate system. Regarding data format, shapefile is selected since it is the most commonly-used format among the project team, while Greek Grid (EPSG: 2100) has been selected as the shared coordinate system of the project, as the most suitable EPSG for Greek data. For all elements and

⁵ Urban Atlas is a joint initiative of the Commission Directorate-General for Regional and Urban Policy and the Directorate-General for Defence Industry and Space (DEFIS) in the frame of the EU Copernicus programme, with the support of the European Space Agency and the European Environment Agency

components, manual interpretation and digitisation were performed after all images had been georeferenced.

Land uses:

From Kaupert and Curtius map, information on urban areas, categories of cultivated land (vineyards, olive groves and grain crop fields), streams, forest and sparse vegetation were extracted. From the mid-20th century urban plans, information for the urban areas and streams were retrieved; information on agricultural land was combined from the semi-cadastral map of 1950 and the agricultural redistribution plan of 1950. From the Urban Atlas of 2018 for Athens, information on urban area, cultivated land, sparse vegetation (Herbaceous vegetation associations), land without use and urban open space (green areas and sport facilities) were extracted. For the area covered by the stream, a topographical map from 2019 and the riverbed was digitized (table 1).

| | Source | Land uses | | | | | | | |
|-----------|---------------------------------------|-----------|-------------|-----------------|-----------------------|--------|---------|--------|-------------------|
| | | Urban | | Permanent crops | | Fields | Streams | Forest | Sparse vegetation |
| | | Urban | Open spaces | Vineyards | Orchards olive groves | | | | |
| 1883 | Kaupert and Curtius | x | | x | x | x | x | x | x |
| 1929-1959 | Urban plans | x | x | | | x | x | | |
| 1950 | Agricultural land redistribution plan | | | | | | | | |
| 1955 | Semi-cadastral map | | | | x | x | | | |
| 2018 | Urban Atlas | x | x | | | x | | - | x |
| 2019 | Topographical map of Chalandri stream | | | | | | x | | |

Table 1. Sources used for land uses and their categorization.

Landscape elements:

Based on the same datasets and on the information provided by the maps, the following landscape elements were recorded. The map of 1883 marks several elements focusing on ancient artifacts such as aqueducts, tombs and ruins, as well as more elements of the era such as mills, churches etc. Apart from the street plan and building blocks, the urban plans from 1929 to 1959 contain topographical



data on specific buildings and other elements at that time. For contemporary information, we used data on recreational uses from the municipality’s digital archive that contains information from various modifications of the urban plan, as well as from the hiking map that has been produced by the Environmental Association for the protection of Chalandri stream. Moreover, the work undertaken in WP5 of the Cultural HIDRANT project, provided information on existing wells today (table 2).

| | Source | Landscape elements | | | | | | | | | Playgrounds | Sports |
|-----------|--|--------------------|------------|-----------------------|-----------|-----------|-------------|--------|----------|----------|-------------|--------|
| | | Wells | Watertanks | Springs/ fountains | Aqueducts | Factories | Restaurants | Kiosks | Churches | Theatres | | |
| 1883 | Kaupert and Curtius | | | | x | | | | x | | | |
| 1929-1959 | Urban plans | x | x | x | | x | x | x | x | | | |
| 1955 | Semi-cadastral map | | | | | x | | | | | | |
| Today | Hiking map by the Environmental Association of Chalandri | | | x | | | | x | | x | x | |
| Today | EYDAP | x | | | | | | | | | | |
| Today | Municipal GIS archive | | | | | | | x | x | x | x | x |

Table 2. Sources used for landscape elements and their categorization.

Ecosystem services:

Table 3 offers an integrated and correlated view into selected ecosystem services (ES), consumption use, landscape components or elements associated, and management level. The landscape elements and components are used here as a proxy to map the potential demand for an ES by an ecosystem. For example, wells and water tanks are used as proxies for the demand for water consumption, whereas potteries for the demand for abiotic material – clay.

| | Specific Services | Uses | Management Level/scale | Landscape Components/ Elements |
|------------------------------|---------------------------|------------------------|------------------------|--------------------------------|
| <i>Provisioning services</i> | Water for consumptive use | Drinking, domestic use | Local | wells |
| | | | Local | water tanks |
| | | | Local | Springs |
| | | | Supra-local | aqueducts |

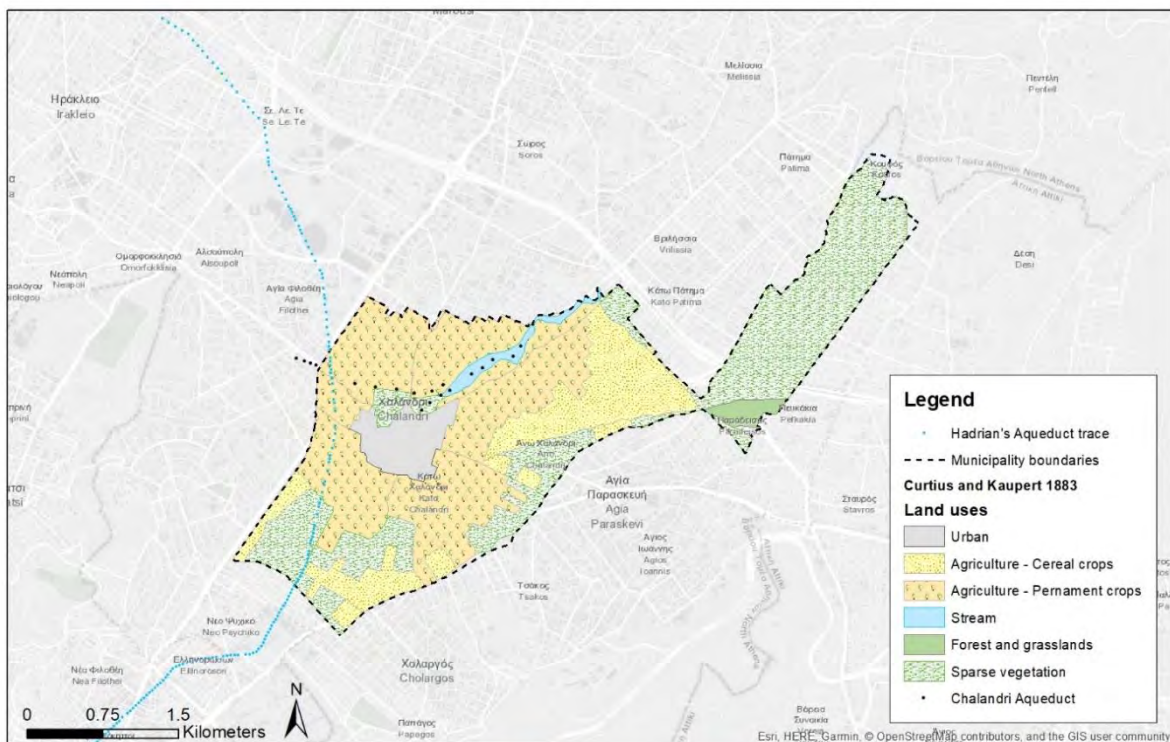
| | | | |
|-------------------|--------------------------------|----------------|-------------------|
| | Agriculture | Local | wells |
| | | Local | water tanks |
| | | Local | Agricultural land |
| | Industrial use | Local | factories |
| | Abiotic materials | industrial use | Local |
| Cultural services | Recreation | Local | Open areas |
| | | Local | Kiosks |
| | | Local | Restaurants |
| | | Local | Paths |
| | Spiritual and religious values | Tangible | Local |

Table 3. Ecosystem services that were approached in the study and the proxy indicators that were used for their mapping

3. Results

3.1 Land uses

3.1.1. End of the 19th century



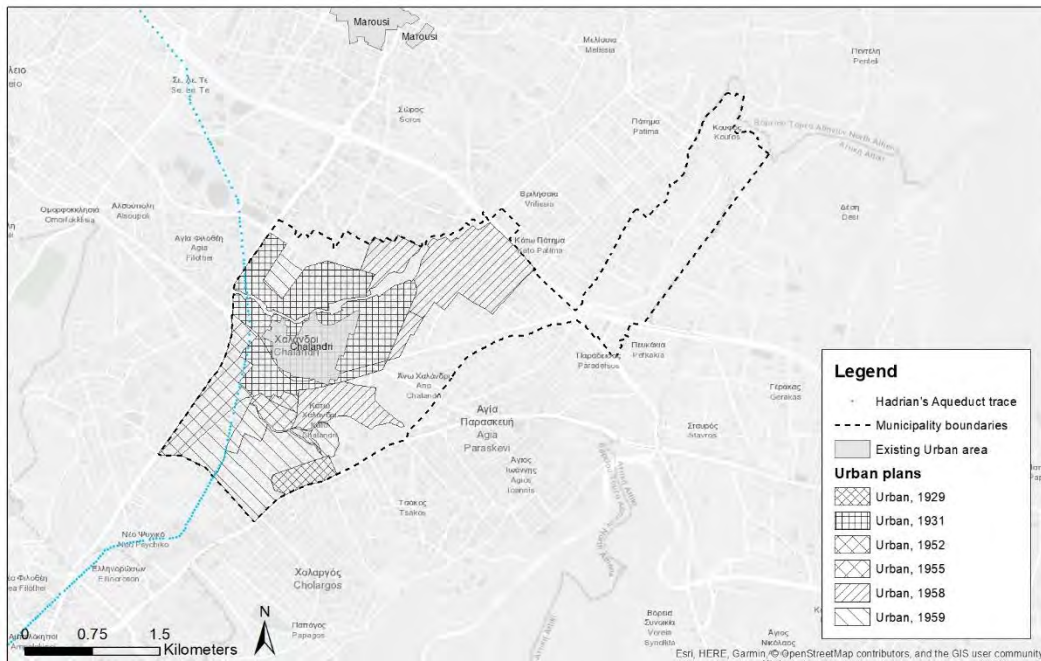
Map 1: Land uses and landscape elements based on Kaupert and Curtius map

At the end of the 19th century, Chalandri was part of the Athens municipality and its residents were 558 people according to a census in 1879. Results from the digitization of the Kaupert and Curtius map are shown in Map 1. The map shows an urban area of 0.50 km² and an agricultural area that covers 5.8 km², which is more than half of today's municipality area; the rest of the area appears as sparse vegetation, except for a small woody feature in the outskirts at Pefkakia. The Kalamas riverbed covers an area of 0.16 km² inside the boundaries of Chalandri municipality. When the river reaches Prophetes Ilias, the riverbanks disappear and only a small trace of the stream is visible, only to reappear in Kalogreza. This might be an indication that the lower area of the stream in Chalandri was flooding. In addition, another small stream appears in the southern part without any riverbed. Most of the area near the river is covered by permanent crops; cereal crops cover the area further away; and sparse vegetation, which could have served as grazing land, covers the outskirts. This land-use zoning appears to be consistent with the general layout that has been typical of Roman cultural landscapes (Antrop M. 2017).

3.1.2. Middle 20th century

Three important events mark the mid-century demographic history for Greece, the influx of refugees from Asia Minor during the decade of 1920 and the end of the WWII and subsequently the civil war in 1949.





Land uses

Urban expansion during the mid-20th century



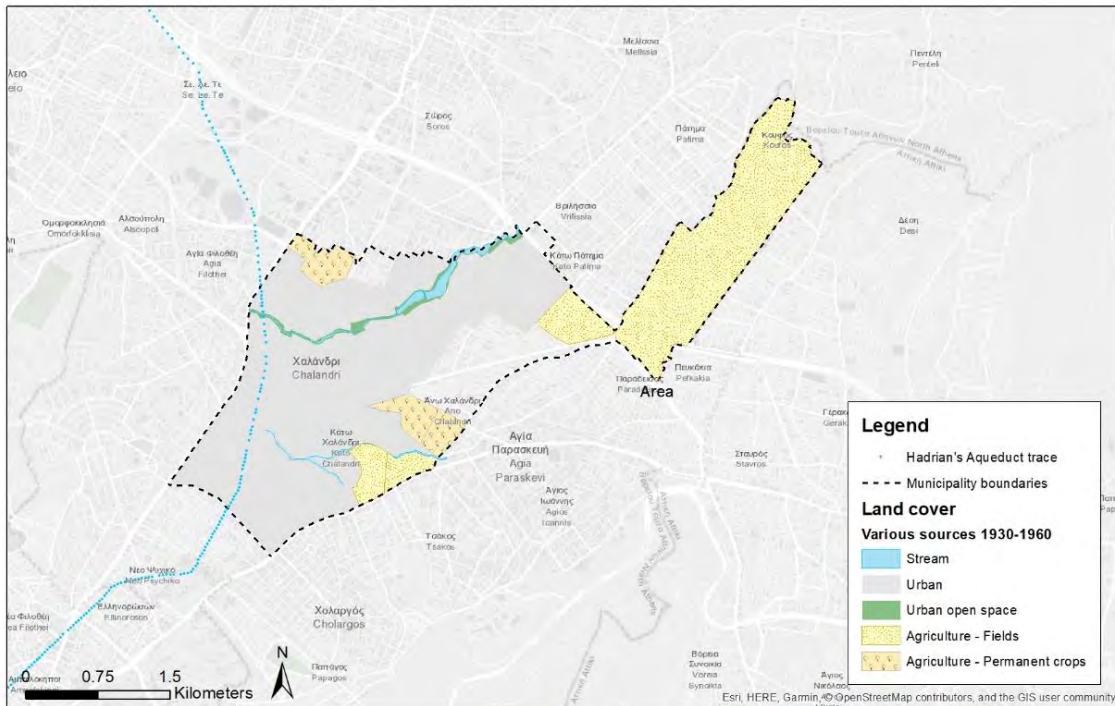
Map 2: Urban expansion based on urban plans from 1929 to 1959

Both have left their imprint in the urbanization of Chalandri, as they marked expansions of the urban area. In the urban plans of 1931, the urban area covers 2.32 km² and in the urban plans that cover the 1950's decade, it grows at 5.73 km² (map 2).

The agricultural area is decreasing at 3.12 km² while a plan of distribution of agricultural fields in 1950 illustrates the expansion of agriculture in the area of Patima. The few olive groves that appear in the semi-cadastral map of 1955 are in the outskirts of the urban area. Kalamas river along with the stream in the south cover about 0.15 km² while both are surrounded by urban areas. A new element that appears with the urban plans is the designation of “Open Space” areas as part of the city’s public infrastructure. Several parts of the area of the riverbed of Kalamas are designated as “Open Space”. This area was measured at 0.11 km².

For the rest 10,7% of the area, enough information on land cover/land use was not available from any source (map 3).





Land uses
Mid-20th century



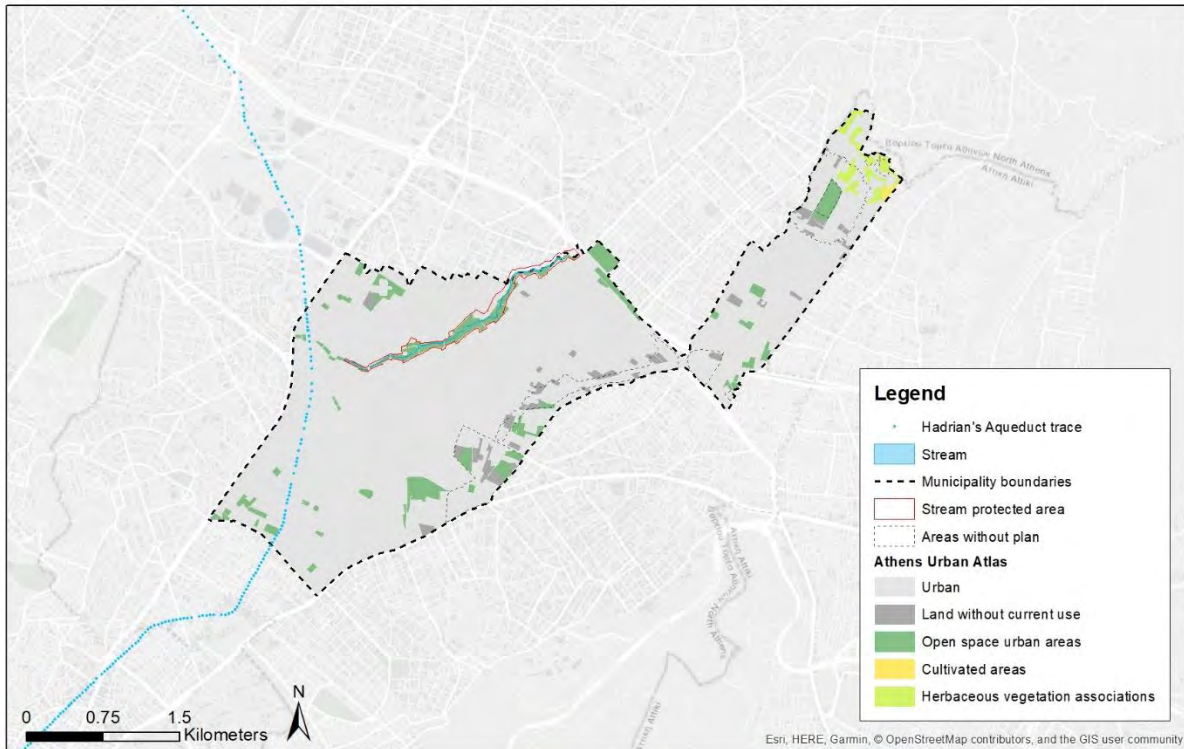
Map 3: Land uses based on multiple sources

3.1.3. 21st century - present

Chalandri continued to grow during the next decades; at the end of the century, it received many new residents due to an outflux from the inner city of Athens to the suburbs. As a result, about 90% of the municipality area appears to be urban according to the Urban Atlas of 2018. Interestingly, applying a layer that demonstrates which areas are covered by an official urban plan reveals that a great part of the area without a plan is already urbanized.

The agricultural area has been diminished to small bits in the northern outskirts accounting for only 0.12% of the area or 0.012 km². Areas with sparse vegetation (probably abandoned fields) are situated next to these agricultural areas accounting for 0.12 km². Another 2.55% of the area is characterized as “Land without current use” which is scattered mostly in the areas without an urban plan.





Land uses
Contemporary



Map 4: Land uses today based on Urban Atlas by Copernicus

Open Space areas have been growing accounting for 6.47% or 0.66 km². This includes sport facilities and green spaces. About 25% of these areas are near the Chalandri stream and inside the Chalandri Stream Protected Area as it was designated in FEK 659/D/1995. Other large areas are found in the outskirts of the municipality.

3.1.4. Evolution of land uses

From the comparison of the land uses in these different time frames, the end of the 19th century around 1883, the mid-20th century around 1960 and the beginning of the new century, we witness the historical timeline of the urbanization of the rural area of Chalandri. Primarily a settlement of few hundred residents that cultivated olives, grapes and cereals using probably water from Kalamas river and taking advantage of occasional floods, Chalandri developed into a countryside for Athenians during the mid-century and was populated as a suburb during the end of the 20th century.

Urban area grew from 5% in Kaupert maps, to 56% in the urban plans of the 1950s decade and currently occupies 90% of all land in Chalandri. Agricultural land has shrunk from 56%, to 30% and has been diminished to less than 1% today. Demand for open spaces, green areas and sport facilities



seems to have grown from the 1950's when it constituted 1% to today where it has increased to 6.5% in 2018.

The streams seem to have decreased in size, partly due to different ways of representation (riverbed versus riverbanks) but mostly due to significant covering by roads or green urban areas (Diagram 1).

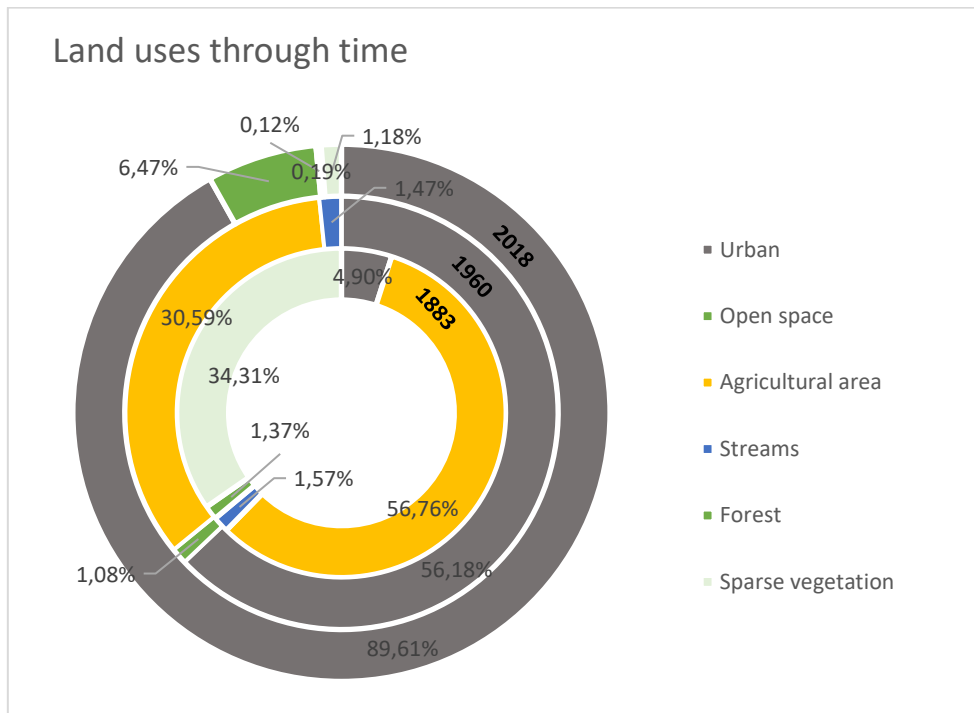


Diagram 2: Evolution of land uses through the use of maps

3.2 Landscape elements

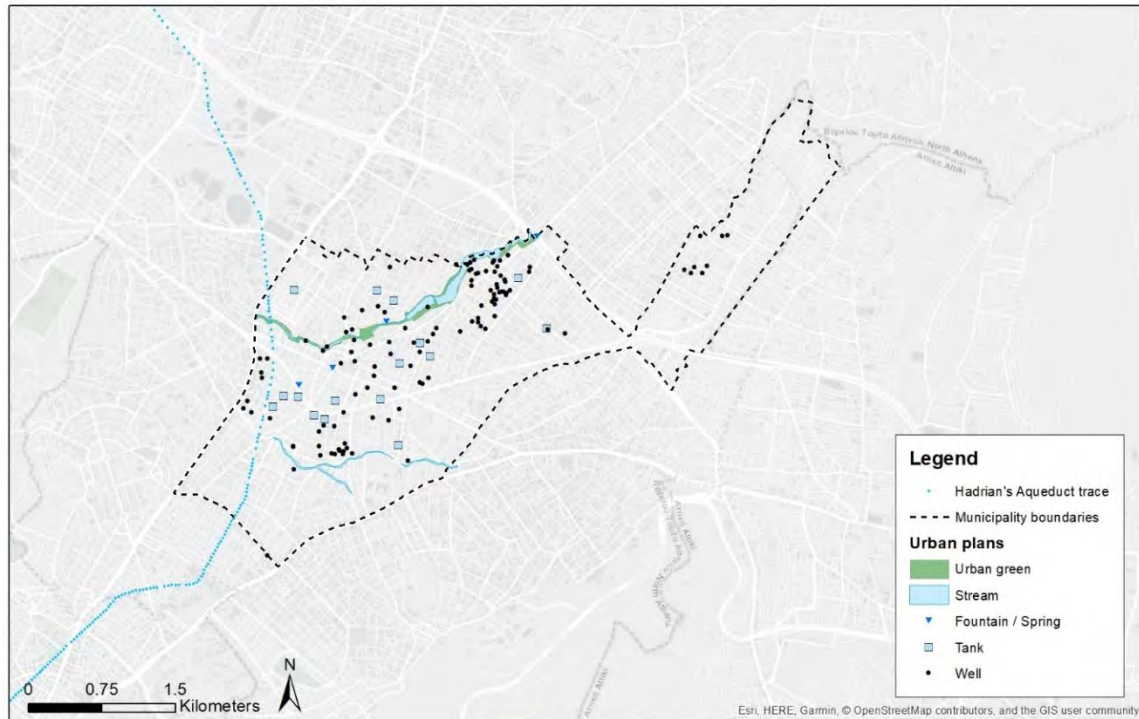
3.2.1 Aqueducts

Apart from the Hadrian's aqueduct which is clearly depicted, another aqueduct (Wasserleitung) appears in the Kaupert and Curtius map, following the path of Chalandri's stream from today's bridge on Polidrosou street until Hadrian's aqueduct (map 1). This information is in accordance with other sources (Pappas 1999, P. Defteraios, and N. Mamassis 2019). It indicates that water from the river ecosystem of Kalamas was streamed through the Chalandri aqueduct to Hadrian's aqueduct. Survey visits from Defteraios (P. Defteraios, and N. Mamassis 2019) and Perleros⁶ have provided evidence of this infrastructure alongside Chalandri's stream. In future maps such as the urban plans, only Hadrian's aqueduct is marked.

⁶ <https://www.slideshare.net/jk2013/perleros-rematia-221020>

3.2.2 Wells / Tanks / Fountains and springs

The urban plans from 1929 to 1959 provide the locations of wells (“Φρέαρ») throughout the plan expansion areas. 123 wells were recorded and are shown in Map 5.



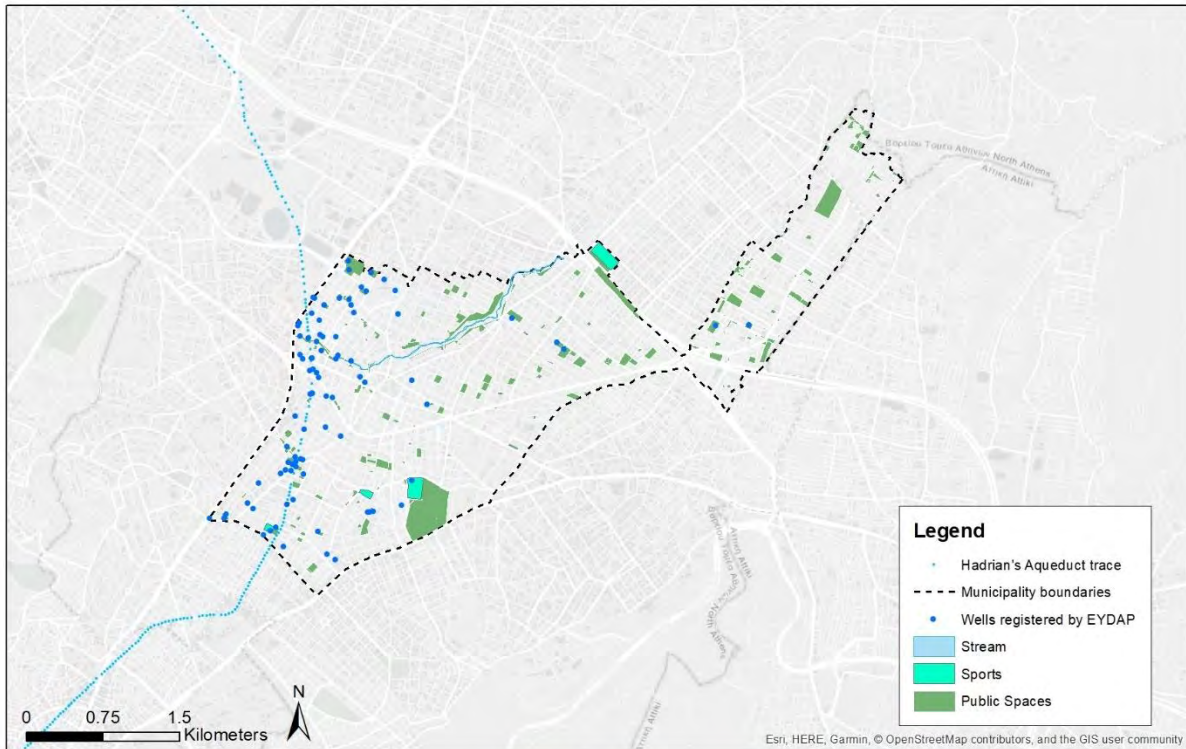
Elements of water use
 Mid-century 1929-1959



Map 5: Wells, fountains and water tanks from the urban plans of 1929-1959

The distribution of these wells appears to be clustered, but this fact could be due to a lack of data for all areas, as not all plans provided this kind of information. The average nearest neighbor distance is around 95 meters indicating a high density which is more evident in the northern part of the study area. Alongside many of the wells, water tanks can be found – 16 were recorded - that are used to store water possibly for irrigation. Also, 4 springs and fountains were recorded, two of them in public squares and another two on the riverside. From the data produced for WP5 by EYDAP and CommonSpace, wells and drillings were recorded although the survey was spatially focused in specific areas. Through this procedure, about 90 were mapped and are shown in map 6.





Elements of water use

Contemporary



Map 6: Wells registered by EYDAP for the purposes of WP5

3.2.3 Industrial elements - Factories

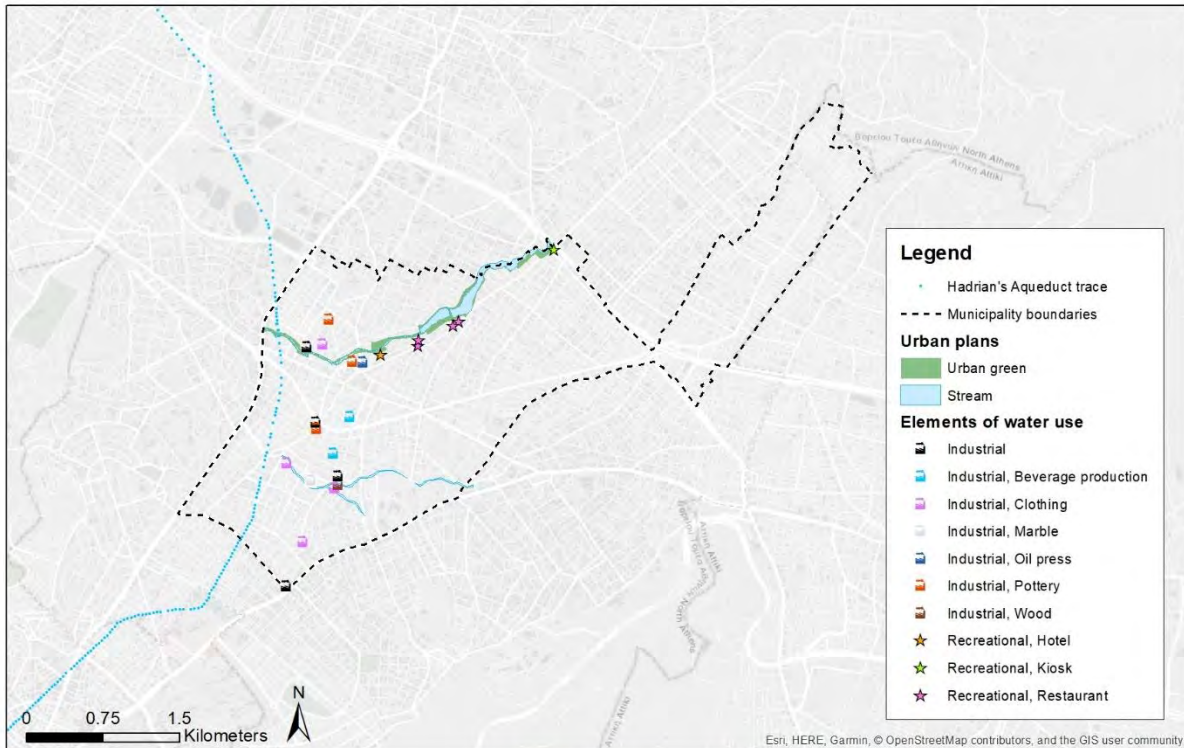
The industrial sector consumes a big amount of water for its purposes. In 1934 in Athens, 11,6% of water consumption was attributed to the industrial sector⁷. Moreover, streams have always been used for industrial waste discharges, providing a cheap and easy way to dispose of industrial wastes, leading to pollution and soil contamination. The urbanization of Chalandri was accompanied by the creation of a number of factories and workshops from the beginning of the century, when the pottery of Pagkakis was created, until the closure of all factories in the early eighties.

Although there is a lack of any evidence on the use of water by those factories, their location illustrates that half (8 out of 16) were interacting with the river ecosystem in some way (map 7). Most potteries must have been using clay from alluvial deposits of the streams and there is at least

⁷ Χεκίμογλου Ε. (2014). ΥΔΑΤΙΝΗ ΙΣΤΟΡΙΟΓΡΑΦΙΑ, Χρονικό της διαχείρισης του νερού στην Αττική. ΕΥΔΑΠ



one testimony that records that these potteries were using a distinctive sign to indicate the origin of the clay which was in the nearby area of Kalogreza⁸.



Elements of water use

Mid-century 1929-1959



Map 7: Industrial and recreational uses from various sources in mid-20th century

3.2.4 Recreation

The area of Chalandri has been a place that residents from Athens have been visiting for recreational uses since the beginning of the century. The presence of water and riparian vegetation has provided a pleasant gateway for Athenians and the creation of many restaurants by the river are witness of this fact. The picture below illustrates the river terraces of Chalandri stream as a quaint spot of the Athenian countryside.

⁸ <https://en-gb.facebook.com/groups/875245355878171/permalink/1924861864249843/>



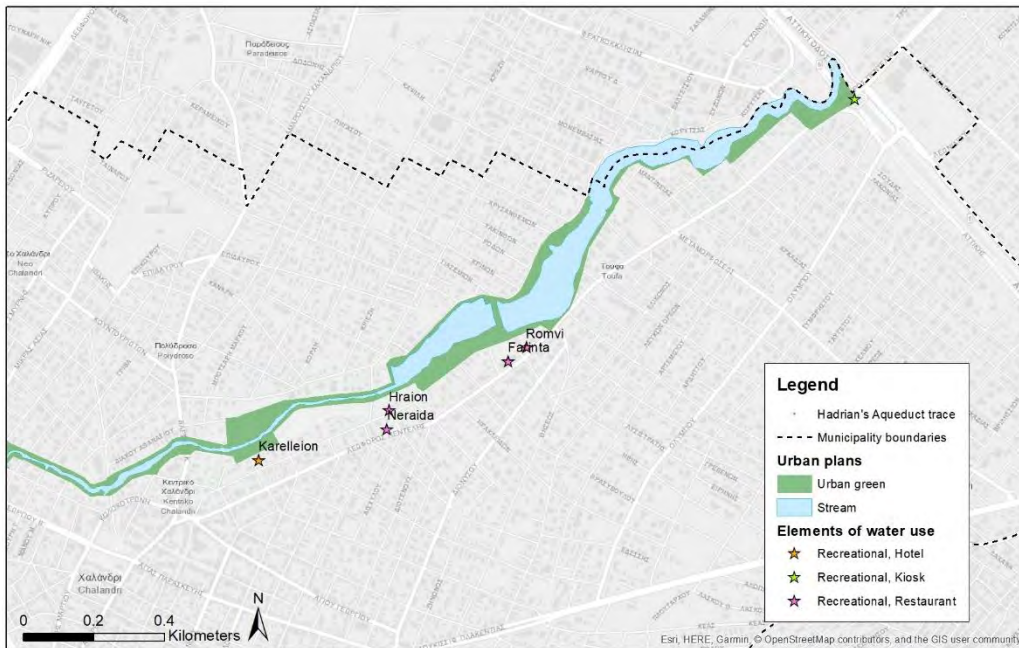


Fig.1 A photo of Chalandri's stream terraces in 1920, collection of Charalampos Gkouvas

From the urban plans of 1930, 4 restaurants and a hotel, “Karelleion Palace” were recorded, as well as a kiosk in the area of Fragkoklissia. These recreational “centers” were well known to all Athenians and their names have not been forgotten by the locals. Hotel “Karelleion Palace” was represented by a different name in the plans (“Afroditi”) but after cross-checking with other sources, the original was kept (map 8). Unfortunately, urban plans of other periods do not depict such information. Nowadays, we witness that these uses have developed mostly along and around the market of Chalandri. A survey of the existing recreational facilities could cover this gap of information.

Information on playgrounds, sports and kiosks was gathered to depict the current situation of recreational uses (map 9). Although the distribution of public spaces, sports and playgrounds is dispersed, the Chalandri stream is still a significant pole for such uses. The theatre of Rematia is a prominent feature of the recreational uses of today, hosting a summer cultural festival every year.

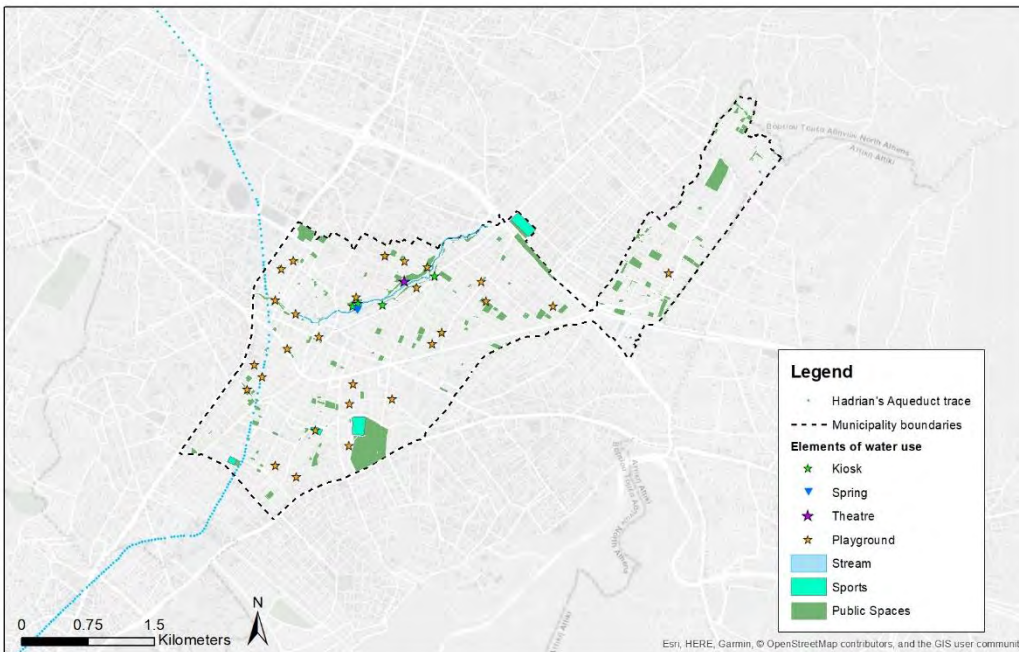
The part of the stream that was covered up has been designated as a public space. Two playgrounds are located in this section whereas three more playgrounds are built around the Chalandri stream. Kiosks and paths complement the design of the area around the stream but the whole area is fragmented in smaller parts as the Hiking map of the stream indicates. Nonetheless, it remains a prominent recreational area for the entire municipality.



Elements of water use
Mid-century 1929-1959



Map 8: Recreational uses along the stream in the mid-20th century



Elements of water use
Contemporary



Map 9: Recreational uses in Chalandri today

Δήμος Χαλανδρίου



3.3 Ecosystem services

The mapping of the landscape elements and land use was used as a proxy (based on Table 3) for assessing the demand for ecosystem services. To assess their evolution we provide a matrix which shows i) if an element or a component (land use) was present (Yes or No), ii) if its presence has increased or decreased (green or red color shades) and iii) the intensity of change (dark or light shades). Grey represents a lack of quantity data; where there was no info at all, the box is left blank.

Lack of consistency in data acquisition restrains us from quantifying change in ecosystem services demand. Nonetheless there is evidence the provision services have been declining. People depend less on local water resources for domestic uses and the shifting of the economy plus the rapid urbanization of the second half of the century have diminished water demand for irrigation. The industrial sector has declined and vanished as well, along with the demand for any such uses.

| | Services | Uses | | Landscape Components/ Elements | Beginning of the century (1890-1900) | Post war (Decade 1950-1960) | Recent years (2018) |
|-----------------------|--------------------------------|------------------------|------------|--------------------------------|--------------------------------------|-----------------------------|---------------------|
| Provisioning services | Water for consumptive use | drinking, domestic use | Local | Wells | - | Yes | Yes |
| | | | Local | Watertanks | - | Yes | - |
| | | | Local | Springs | - | Yes | Yes |
| | | | Supralocal | aqueducts | Yes | No | No |
| | | agriculture | Local | Wells | - | Yes | Yes |
| | | | Local | Watertanks | - | Yes | - |
| | | | Local | Agricultural land | Yes | Yes | Yes |
| | industrial use | Local | factories | Yes | Yes | No | |
| Abiotic materials | industrial use | Local | Pottery | Yes | Yes | No | |
| Cultural services | Recreation | | Local | Open areas | - | Yes | Yes |
| | | | Local | Kiosks | Yes | - | Yes |
| | | | Local | Restaurants | - | Yes | - |
| | | | Local | Paths | - | Yes | Yes |
| | | | Local | Cultural facilities | - | - | Yes |
| | Spiritual and religious values | | Local | Churches | Yes | Yes | Yes |

Table 4: Evolution of demand of selected ecosystem services for the river ecosystems of Chalandri

Cultural services on the other hand continue to play a strong role in the urbanized environment and demand for some has increased. Although Chalandri cannot be considered countryside nowadays, the lack of green and open spaces in the city today has increased the demand for recreational

services. The sense of a wild environment of Chalandri’s stream that offers moments of relaxation has contributed to the demand for more open-air recreational and cultural services.

4. Discussion/Conclusions

Ecosystems provide specific services that people can benefit, but at the same time socio-ecological system are not static and change through time, as do human needs. The demand for ecosystem services represents in each time the socio-economic context in which the human-nature relationship takes place. Results from the study demonstrate the transition from a rural to an urban character of the landscape. Also, elements of the rural character of the area are gradually lost showing a shift in demand from provisioning to cultural ecosystem services.

This shift in character and in demand of ES, shapes also how this river ecosystem of the Chalandri stream is valued. As people depend less on the river for provisioning services, their values shift to other aspects of the ecosystem such as leisure, recreation, culture, ecological education etc. Decline in provisioning services and their evaluation has been well documented in other cases (Martin-Lopez B. et al 2012, Lapoint M. et al 2021) as well as the surge in cultural ecosystem services demand and appreciation in urban environments. Weber and Anderson (2010) assessed the perceived benefits that park users obtained from regional and urban parks, to find that common preferences included enjoying nature, escaping personal/social pressures, escaping physical pressures and enjoying the outdoor climate.

It is in this context that organizations such as the “Association for the protection of the environment of Penteli-Chalandri stream” have emerged representing ecological values. Or that the municipality’s major cultural event takes place and is named after the Chalandri stream. Both seem to contribute in a revaluation of the river ecosystem of Chalandri stream.

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