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Greenway Planning Based on River for Sustainable Cities: An Example of Ankara City

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Abstract

Greenway as a linear open space established along either a natural corridor, such as riverfront, stream valley, or ridgeline, or overland along a railroad right-of-way converted to recreational use, a canal, a scenic road, or other route. This linear open space is a connector linking parks, nature reserves, cultural heritage, including classified urban settlements, with each other and with populated areas.

Today, urban areas have come face to face many problems like air, water and noise pollution and lack of open-green areas along with the increasing urbanization. Greenways have become an important for urban landscape planning because of protecting numerous sources with at least area. It is possible to see the benefits of greenways at most on river corridor.

Although, the population of Ankara, which is capital city of Turkey, has increased ten times in the last 70 years, per capita active green areas have decreased. The city has a lot of streams. But they have been neglected for years. In this study, some streams and streamsides in Ankara were evaluated in terms of greenway scope. A conceptual greenway plan was prepared. Suggestions were offered in this context.

Keywords: Greenway, river greenway, stream, CBS, Hatip stream, Ankara

INTRODUCTION

The urban areas inhabited by the majority of the world population provide urban people with various opportunities, however they are also faced with many environmental problems like air and water pollution, floods, decrease of open and green areas and biodiversity. Along with these problems, various problems on economical and social level are also experienced in the cities [1].

The greenways, which are planned, designed and managed as linear space networks, provide contributions for solving the problems in the cities with their environmental, economical and social benefits [2]. These contributions can be summarized like protection and improvement of water resources like rivers, forming life space for plants and animals, providing the urban people with alternative transportation and recreation opportunities with the uses they accommodate within them (bicycle use, walking) and connection between open-green areas of the cities, decreasing some of the public costs. Greenways are also important means for developing environmental consciousness.

A greenway is a linear open space established along either a natural corridor, such as a riverfront, stream valley, or ridgeline, or overland along a railroad right-of-way converted to serve recreational uses; a canal, scenic rood, or other route. This linear open space is a connector linking parks, nature reserves, cultural heritage, including classified urban settlements, with each other and with populated areas [3]. According to [4], although most parts of the greenways are for recreation or nature protection, some parts of them are planned to include both of them.

When the decrease of open spaces in the urban areas became clear on the state scale during the 1970s in the USA, the greenway concept, whose first applications and planning works for protection date back to 1865, gained importance. Those corridors proposing less need for areas compared to the traditional parks, providing opportunities for various recreational activities and forming a system by easily associating the open and green spaces of different qualities, were supported by the authorities and the foundations concerned with protection of environment [5, 3]. According to Yunghuo and Guangming (2005), greenway planning has become a worldwide movement today [6]. According to [7], it is possible to see greenway examples more than 600 on the state scale.

The basic qualities of greenways are listed below, according to [2]:

- Their spatial forms are linear,
- They make connection between life spaces by forming association with landscape forms of all scales with their binding qualities,
- They can be multifunctional like ecological, recreational and cultural,
- They are consistent with the sustainable development,
- They have a form that completes landscape planning.

The river corridors are one of the unique greenway resources with the linearity presented by their natural states and the water resource they contain. Arendt (1994) said that when placed along streams and rivers, greenways function as effective water quality buffers, trapping sediment and pollutants from urban and agricultural stormwater runoff [8].

The greenways, whose origins date back to parkway and green belt concepts, are classified under five groups as urban riverside greenways, recreational greenways, ecologically significant natural corridors, scenic and historic routes, comprehensive greenway systems or networks [3].

Urban riverside greenways, usually created as parts of a redevelopment program along neglected, often run-down city waterfronts [3].

The capital city Ankara is an example city where problems arise out of unplanned and fragmentation approach tendencies, as the first and probably the most planned city of the Republic of Turkey [5].

Although its population has increased by 10 times in the past 70 years, the active green space per person in the city has decreased [9].

There are many streams and side rivers with unstable regimes in Ankara. Flood facilities were started to be built in 1957 to protect the city from floods. 185 people died between 1946 and 1992 because of the floods that took place in the city [10].

Some of the streams were covered to prevent floods and for other reasons, and they became almost invisible on the maps. These streams are also being polluted with various wastes.

In this study, the streams running through Ankara urban area were evaluated in the scope of urban river side greenway and a conceptual greenway plan was prepared. Suggestions were made in this way.

MATERIALS AND METHODS

The main material of the study is composed of the streams running through Ankara urban area. The streams are Çubuk Stream, Ankara Stream and Hatip Stream. Çubuk and Hatip streams flow into Ankara Stream. Two main rivers run through Ankara provincial borders. There are Sakarya and Kızılırmak. Ankara Stream, flows into Sakarya River by takin these streams and many other watercourses. The capital city Ankara is located in the northwest of the Central Anatolia Region 39˚ and 57' north latitudes and 32˚ and 53' east longitudes (Figure 1).

The adjuvant materials of the study are maps with various scales (contour lines, geology, geomorphology, flood project, land use, etc.), reports and Geographical Information Systems software (GIS). Observations on site and photos were also used.

According to [11], the method of the study is composed of 5 stages related to each other.

In the **1st stage,** literature review was made to define the qualities of the method and the area in accordance with the goal of the study. A database was made by transferring the maps provided from related foundations into computer environment with the help of GIS. New data (slope, general property, floodplain) were produced out of the gained data. According to İzbırak (1978), streams and watercourses of Ankara, are classified as ''flood type rivers'' according to river typing carried out in accordance with climactic factors [12]. As the corridor to be the resource for the greenway; Ankara Stream, Çubuk Stream and Hatip Stream courses were taken into evaluation. However, a conceptual greenway plan was suggested by [11] for Ankara Stream and Çubuk Stream course (between Çubuk I Dam-Ankara S.). Therefore, Hatip Stream course was taken into account in the study. According to Flink and Searns (1993), in the planning of a stream-focused greenway, floodplains as areas are very suitable because of those facts that they aren't fit for settlement, they have a perfect linear qualities and an important role in the protection of rivers [8]. The floodplain borders of Hatip Stream was defined by overlaying the geomorphologic, geological structure and digital elevation maps in the GIS environment.

In the **2nd stage**, the features of Hatip Stream (water quality, flood project, pollution resources) and the floodplain of the stream were analyzed in terms of topography, geology, slope, vegetation, animals, land use, property, population and transportation.

In the studies of greenway, slope is evaluated as a quite important measure in the planning of the activities. In the slope map formed with the help of GIS, the values of the slope groups were given according to the qualities of the greenway trails [13]. In the map, the slope groups were taken into account under 7 categories with percentage (%) slope type. There are between %0-3, %3-5, %5-8, %8-10, %10-15, %15-20 and % 20-74.

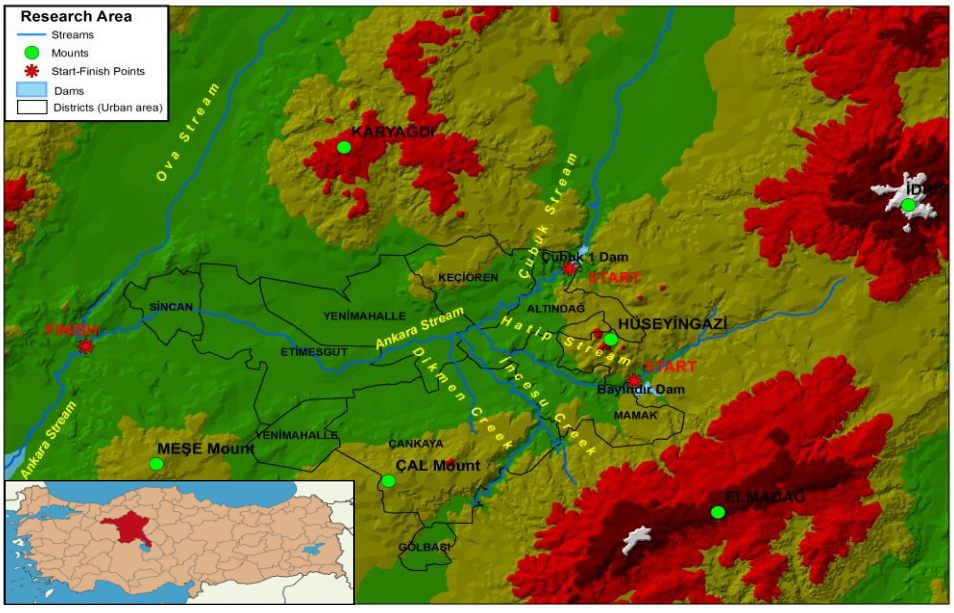

Figure 1. Location of Research Area (Original, 2014)

In the **3rd stage**, according to Conine et al (2004), Flink (2006), Anonymous (2005c), Hatip stream floodplain and the hubs around it were defined in accordance with the approach of forming a greenway based on hubs and links [11].

In the **4th stage**, Hatip Stream floodplain, defined in the 1st stage, is the potential link corridor. To decide whether this corridor was suitable for greenway or not, according to [11], McHarg's (1969) suitability analysis was carried out in accordance with the measures defined in the approaches of Conine et al. (2004). In this context, the Floodplain and the Area Property were overlayed. The possibility of linking the hubs of the suitable areas, defined by this analysis, were evaluated in the GIS environment. If those suitable areas cannot link the defined hubs, the hubs will be linked with the trails that will harbour various uses (bicycle, walking ways) inside them. Therefore, current ways were also evaluated according to Flink et al.'s (1993) slope measures. For this purpose, the transportation map, the slope map, the map of suitable areas for hubs and greenway were overlayed on the air photograph. Thus, the greenway course was defined [11].

In the **5th stage**, relevant suggestions were made by evaluating all of the stages to enable applicability of the conceptual greenway plan.

RESULTS AND DISCUSSIONS

Ankara city, has a rich geomorphologic diversity formed by Ankara stream and its branches [14]. According to [15], Ankara city geomorphologic units are Lowland and Plains[1], Low Plateaus (1000-1100 m.), Middle and High Plateaus (1100-1500m.).

Hatip Stream, flowing into Ankara Stream, comes out as Hasanoğlan watercourse on the northwest slopes of Elmadağ and combines with Çubuk Stream in front of DSİ Etlik Facilities by taking various side-watercourses. They form Ankara Stream by taking İncesu Watercourse coming from the south in Akköprü.

Hatip Stream flows at 960m. height at the start point (Mavi Göl) that was defined for the greenway and flows into Ankara Stream at 840m. level.

The streams and the watercourses running through the city were reformed partly closed and partly open for protecting flood [9]. In the scope of the flood project, embankment 8532m. of Hatip Stream was reformed as hypaethral concrete channel and its 6875m. was reformed as closed concrete channel (Figure 2) [10]. The hypaethral part of the stream is called Bentderesi because of the embankment made in the Roman Period [bent in Turkish] (not present today). Arif Yıldız, Bentderesi and Etlik streets pass from the top of the closed part.

According to the Water Contamination Control Regulations in our country, the quality of water is evaluated under four classes [16]:

- **Class I:** High quality water,
- **Class II:** Water with low contamination,
- **Class III:** Contaminated water,
- **Class IV:** Highly contaminated water.

According to [17], some values of Hatip Stream comply with IV. class, and sometimes they comply with III.class - contaminated water. The resources of contamination are

Figure 2. Entrance of hypaetral part Hatip Stream's (Original, 2014)

agricultural and home wastes, dairy farms, slaughterhouses, meat combined facilities, marble factories, faecal wastes [17, 18]. According to Anonim (2006a), Ankara Stream, which the stream flows into, is in the IV. class-highly contaminated water [11]. Many unlicensed sewer systems were connected to the parts of the watercourse beds that were taken into concrete boxes and to the rain water lines [9]. Anonim (2006), no fish species is present in Hatip Stream because of the contamination [11].

The geological form of both sides of the stream is made up of alluvium. The alluvium consists of clay, pebbles, etc. that are carried and precipitated by the stream. Etimesgut, Aglomera, Tüf, Karyağdı formations are gathered around this formation [19].

According to the slope analysis carried out on the flood plain of the stream; the slope changes between %0-3 and %3-5.

According to Doğanay (1993), there is a close relationship between rivers and lakes and the climactic qualities of the region [20]. The fact that semi-arid climate is dominant in the city caused the streams to have unstable regimes [9]. The annual average precipitation in Ankara city centre is 376.6mm [21]. There is more precipitation in the valleys than city centre [11].

The natural vegetation of Ankara is classified under two groups according to the climatic features and topographical structure like steppe zone and natural forest zone. Some groups of the steppe zone are stream beds and the plains around them. The most characteristic plant of the stream beds is *Tamarix pallasii*. Additionally, the trees and shrubs that took place within the valley later like *Populus pyramidalis, Salix alba, Salix purpurea, Eleagnus hortensis* are the characteristic plants of the running water beds [22].

The floodplain of the stream covers a territory of 709ha. Land uses were determined according to Ankara 2005 Land Use Map [23]. There are mixed urban uses (trade, industry, urban service, urban sit., etc.) towards the west of the land and there are urban service areas, education areas, residential areas being dense in the east and south east of the land. There are two types of residential areas which are regular and irregular (Figure 3).

[1] Lowlands and Plains were evaluated as; Valley bottom plains, Lowland plains, Alluvial cones, Low terraces, High terraces

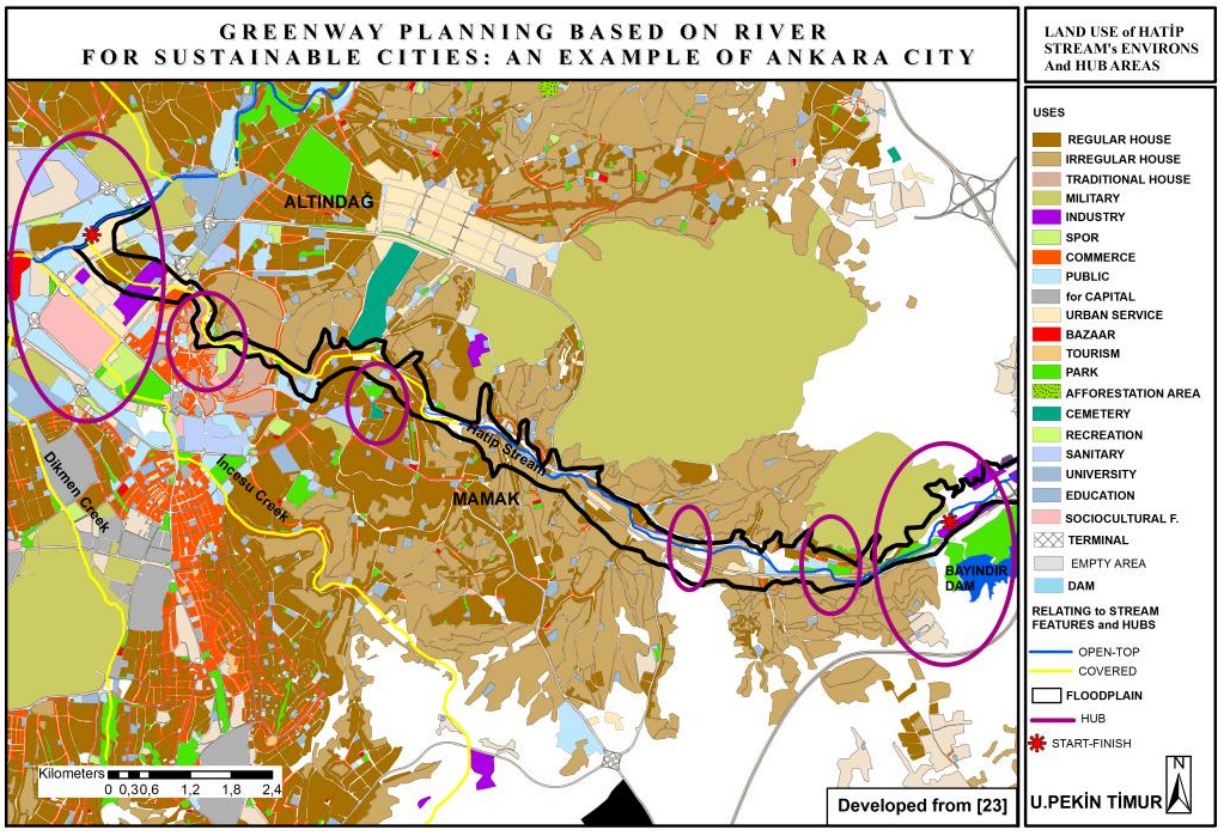

Figure 3. Developed from [23], land use of Hatip Stream's Environs and Hub Areas (Original, 2014)

There are industrial areas close to the stream around the Mavi Göl. The park areas on the floodplain is nearly 25ha. in total. The park areas consists of just %4 of the flood plain when they are approximated as %.

The floodplain and the hubs around it was defined to form a greenway system based on hubs and links. Parks, recreational areas and historically and culturally important areas were chosen as the hub areas (Figure 3).

These are the Gençlik Park, which is of 25ha and one of the symbols of the Republic period, 19 May Stadium, Atatürk Culture Centre area, Ankamall, the Rome Bathhouse in Ulus, Traditional Usage Area (Hacı Bayram Mosque, Ulus Historical City Centre, The Ankara Castle at the height of 110 m from Hatip Stream), Şafaktepe Park (5ha.), Kartaltepe Urban Park (under construction) and Mavi Göl (Mavi Lake) Recreational Area (212ha.). This recreayional area has a green areas (8,5ha), picnic areas (125ha), water area (60ha), sport and playgrounds [24].

Making the property on parcel basis is ideal during the greenway works. However, the data of the research area wasn't obtained from the related associations. When the floodplain was analysed in terms of spatial property, it was found that public areas were very few. There are much more private property areas on the site. Although especially the irregular residents are generally unlicensed residential areas, new development rights are obtained by carrying out urban transformation projects with the repentance laws.

According to Anonim (2000), in 1927, the population of Ankara was counted as 404581 and it rose to 4007860 in 2000. Mamak and Altındağ counties are within the floodplain area. The populations of these counties are respectively 412771 and 200023 [11].

By Anonim (2005p), Ankara province is located on the point where state highways, which connect Europe to the Middle East and Caucasia, and TEM (Trans-European Motorway) intersect. The railway line, which traverses the city from east to west, passes from the south of the Ankara Stream [11]. The commuter train travels on the route of Sincan-Center Station-Kayaş and it passes close to the Hatip Stream.

The Hatip Stream is under the control of the laws and regulations concerning the water resources in our country, because of the water resource it has. However, it
is not subject to the Coastal Law. 16 running waters are subject to the regulations about the implementation of Coastal Law in our country, but the Hatip Stream is not one of them [25]. At the end of the suitability analysis, it was seen that the chosen hubs of the areas which were considered to be suitable couldn't link many places. Therefore, a trail was tried to be formed to link the starting and finishing points and other hubs to each other.

It was seen that, in many examples, Flink (2006) the roads that had views or were used by making their landscapes on the highways (street, avenues) were used by being turned into trails, or greenways were formed by separating an area on the road with a line for trail use [11].

The trails on the research area were formed by carrying out examinations on the territory and overlaying air photograph, transportation, slope analysis, property status, suitable areas and hubs maps.

This condition and the slope scales that were needed by usages were taken into account while forming trails on the research area (Table 1).

Table 1. The slope measures based on users [13, 26]

User	Slope (%)
Pedestrian	No limitation
Bicycle	Preferably %3, max. %8
Riding a horse	Max. % 10
Roller skate	Preferably % 3, max. % 5
Multipurpose	% 5

According to this; some land must be obtained by making expropriation on the hypaethral parts of the Stream on the both sides of the stream to the extent permitted by the territory starting from Mavi Göl (Figure 4). Multipurpose trails were formed by taking this situation into account. Activities like sunbathing and beach volleyball must be put into use for the public by forming artificial beaches on the coast of the stream and on the Mavi Göl Recreational Area.

It is ideal to open the top of the streets from the point where the top of the stream is closed to the point where some parts of Arif Yıldız Street, Bentderesi Street and Etlik Street mixes into the Ankara Stream. If it is impossible to open it, it is important to make connections by means of multipurpose trails on the top of the road by making landscape arrangements of the streets.

Also, according to Anonymous (2004c) enabling the safe intersection of the links with the roads is one of the critical components of trail design. Some signals must be put on the road to warn the vehicles about the trail intersection along the road [11].

CONCLUSIONS

Fast urbanization, population increase and developments in industrialization have caused many environmental problems today. According to Spirn (1994), althougt the problems arising from urbanization may vary from city to city and from country to country, they are many common features, and for this reason, solving them is similar, too [5]. Greenways, which enable many resources to be saved with least area [5], are quite effective in the solution of these problems. Greenways aren't formed only to protect the environment and the nature, but they are also formed for people's use. This feature of greenways complies with the principle of sustainable development which of building a balance between resource use and protection [2].

Greenway practices, the origin of which is based on Olmsted's concept of parkway and which are used for solving the environmental problems increasing in the cities, decreasing the open areas and meeting the increasing need of people for recreation, have never been so important in any period as they are today [27]. It is possible to see many successful examples of greenway plans and practices in the world, especially in the USA.

Greenways can be built for various purposes based on natural corridors or human made corridors. The purpose of building a greenway is the most important factor that directs the course of planning.

In this study, a conceptual greenway plan based rivers was tried to be formed for Ankara city by taking the advantage of the principles of greenway planning. In this scope, a greenway was suggested for the Hatip Stream course, which is 16 km and starts around the Bayındır Dam (Mavi Göl) to the point where it flows into the Ankara Stream, to the greenway which was suggested by [11] for the Çubuk and Ankara Stream course, which is 48 km in total and between Çubuk I Dam and the Ova (Zir) Stream. This conceptual plan was formed with an integrated approach that took the advantage of the opportunities and evaluated the present unities. The goals of the plan is listed below:

- Connections between the hubs that are present or will be suggested,
- Resource protection,
- Alternative transportation,
- Spaces for people,
- Recreational opportunities for the public.

The suggestions that were put forward to carry out this plan, being suggested for the Hatip stream, with success were presented under four topics. The are:

The suggestions for land use that restricts the greenway construction on the floodplain

There are various land uses in the Hatip Stream flood plain that forms the potential greenway corridor. It is requited that enabling the industrial areas to be transferred to other areas, and if it is impossible to do that, treatment facilities must be built for their wastes and they must be under control. Industrial areas must be also permitted to be built. In the space use, the empty spaces, the purpose of which is not clear, must be enabled to be publicised. The irregular residential areas must be removed completely and construction of regular residential areas must be stopped and they must be restricted. Additionally, the stream bed

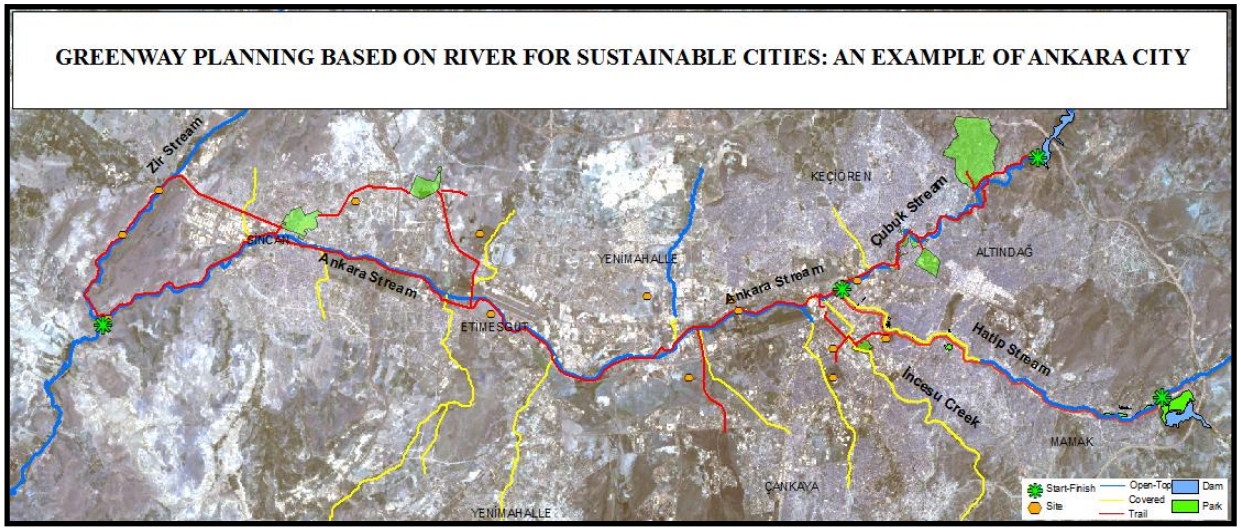

Figure 4. Developed from [11], conceptual greenway plan based on rivers for Ankara City (Original, 2014)

must be publicised to the extent permitted by the territory and parks or multipurpose recreational trails must be built on it. Realizing these suggestions will increase the water quality and will decrease possible flood harms.

Suggestions concerning the stream

The suggestions concerning the stream are gathered under three topics. These are:

Suggestions concerning improvement

The Hatip stream was improved as partly hypaethral and partly closed concrete channel. Therefore, the stream has lost its natural quality and got contaminated with various wastes. To recover that; it is suggested that the closed parts of the stream must be opened and a coastal improvement that is compatible with the nature must be carried out in other parts. Enabling both visual and physical access will more or less diminish the longing for water in the city. According to [28], Cheonggyecheon Canal, which was turned into a road by closing its top in Seoul, was restored by reopening its top within the scope of urban renewal and an environmentally friendly atmosphere was formed. It is possible to see other suggestions in this sense.

Suggestions to make the flow of the stream regular

The flows of the Hatip Stream and other streams in the urban area is quite low, because they are flood type rivers. This situation affects the appearance of the city negatively. According to Büyükerşen ve Efelerli (2005), solve this problem, control structures on the level of water should be built to make the stream flow regular and keep the water in the same level in the improved parts and enable the full flow [11].

Suggestions to improve the water quality of the stream

The water quality of the stream is in the contaminated water group according to our country's water regulation. Therefore, wastes must be prevented from mixing into the stream. Some facilities dispose their wastes into the stream during the night, so authorities must carry out controls during the night as much as they do during the day. With respect to [18], although some facilities have treatment systems, they don't use them. Measurements must be carried out on the stream by taking samples from certain parts of the stream regularly.

Improvement ways like biological, chemical, precipitation, carbon filtration, etc. should be researched by making evaluations based on the measures of the resources of contamination [29].

Planting the trails

Trails can show an extraordinary landscape and rich experiences. Different kinds of trees and bushes create shadow effects and define the area visually. Use of big plants can direct the trail traffic. Trees and bushes greatly contribute to curtaining the adjacent properties, protecting from winds and emphasising the beautiful view [13].

In the choose of plants, the plants of Ankara's present vegetation and the plants that are suitable for the climactic features should be used.

According to Thompson and Sorvig (2000), one should be careful about not affecting the water level and using hydrophytes during making vegetation on the coasts of running waters. Those hydrophytes are *Eichornia crassipes, Lysimachia sp., Melaleuca quinquenervia, Phalaris arundinacea, Pragmites australis, Salix sp., Tamarix sp., Typha latifolia ve T. Angustifolia* [11].

The tree kinds should be positioned properly on the trails for them to take advantages of positive effects. If the evergreens are positioned on the south of the trail, they increase frosting; and if they are positioned on the north of the trail, they protect the trail from cold winter winds. If the evergreen trees are positioned correctly on the trail, they function as snow fences. The deciduous trees should be positioned on the south of the trail. These trees provide shadow during summer and they make the trail benefit from sun rays by defoliating during winter [13].

Suggestions on organisation

According to Anonymous (2000c) greenway projects are composed of very complex and comprehensive processes. To overcome difficulties, an organisation should be formed in which who will manage the greenway or trail project and who will take parts in the project groups should be determined. Different occupational disciplines like biologists, landscape architects, urban planners, geotechnics engineers, etc. should be involved in the project group [11]. Providing public participation in the organisations is extremely important.

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