TECHNISCHE UNIVERSITÄT KAISERSLAUTERN

BUFFER ZONE METHOD, LAND USE PLANNING AND CONSERVATION STRATEGIES ABOUT WETLANDS UNDER URBANIZATION PRESSURE IN TURKEY

von

Barış ERGEN

beim Fachbereich
Architektur/Raum- und Umweltplanung/Bauingenieurwesen der Universität Kaiserslautern eingereichte
DISSERTATION

Fachrichtung: Landschafts- und Freiraumentwicklung
Doktorvater: Prof. Dr. Kai TOBIAS

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ABBREVIATION LIST

CIS: Common Implementation Strategy

DS: (Doğal park) Natural Conservation Area

DSI: (Devlet Su İşleri) State Hydraulic Works

EU: European Union

EIA: Environmental Impact Assessment

EPASA: Environmental Protection Agency for Special Areas

ESDP: European Spatial Development Perspective

EWFD: European Water Framework Directive

GIS: Geographic Information Systems

HKS: (Vahşi Hayatı Koruma Sahası) Conservation of Wild Life Area

İMP: Istanbul Metropolitan Planning and Urban Design Center

İSKİ: Directorate of Istanbul Water supply and Sewerage

MP: (Milli Park) National park

OPTIMA: Optimization for Sustainable Water Resources Management

ÖÇKB: (Özel Çevre Koruma Bölgesi) Special environment protection area

Ra: Ramsar district

SKKY: (Su Kirliliği Kontrol Yönetmeliği) The act of Control of Water Contamination

TEM: Transport European Motorway

TKA: (Tabiat Koruma Alanı) Nature Conservation Area

TP: (Tabiat Parkı) Nature Park

WCA: Wetland Conservation Act

SHAPE AND DIAGRAM LIST

TABLE LIST

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ABSTRACT

Wetlands are special areas that they offer habitat for terrestrial and water life. Wetlands are nest sides also for amphibian, for this reason wetlands offer wide range diversity for species. Wetlands are also reproduction regions for birds. Wetlands have special importance for ecosystem because they obstruct erosion. Wetlands absorb contaminants from water therefore wetlands contribute to clean water and they offer more potable water. Wetlands obstruct waterflood. In that case wetlands must be maintained and conserved. Wetlands must be conserved because wetlands vanish very rapidly because of contamination, excessively agriculture, urban sprawl, dams…etc. this PhD thesis contributes to solve problems of wetlands that they are affected from urbanization especially metropolitan areas. Growth of cities requires more land for settlements; the more settlements bring about the more urban sprawl. The more urban sprawl deteriorates more natural regions. In this cycle wetlands are also affected from urbanization effects. In this sense some precautions should be developed in order to protect wetlands from urbanization effect. These precautions should include anticipation about effects of urbanization. An important tool for conserving wetlands and protecting these regions from cities is land uses and land use planning in city and regional planning. First step of land use planning is determination of settlement appropriateness. Settlement appropriateness contributes to choose correct locations for settlement in this respect wetlands can be affected in minimum level from urban sprawl. This PhD thesis inquires a method about buffer zones around wetlands and Thresholds in basin of wetlands; and this method is examined in two case study areas Mogan and Büyükçekmece Lake. According to results of Mogan and Büyükçekmece Lake the PhD method will be generalized to other quasi wetlands that they exist near cities and are affected from urban sprawl.

Key Words: Wetland Conservation, Land Use Planning, Buffer Zone Method, Settlement Appropriateness and Thresholds, Büyükçekmece and Mogan Lake

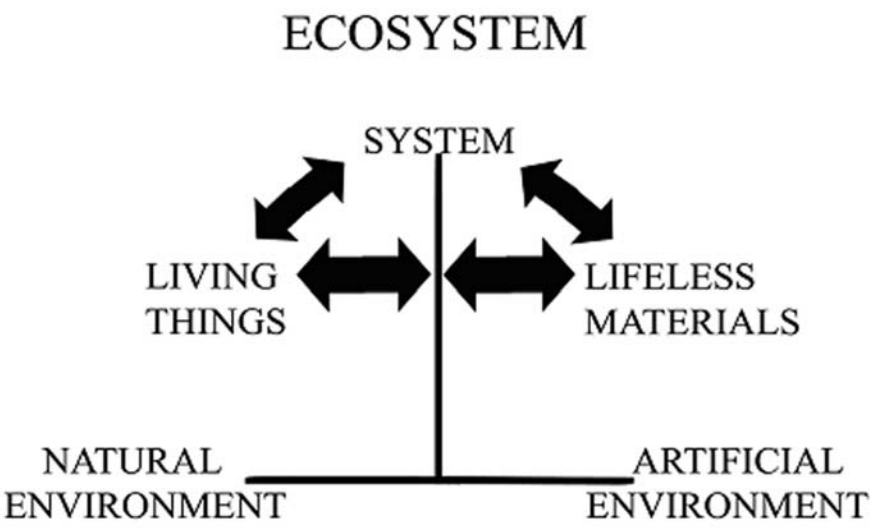
1. INTRODUCTION and PROBLEM STATEMENT

Nowadays cities develop either urban sprawl and population or technologic progress. Both urban agglomeration and industrial improvement and services increment cause to deteriorate natural areas. Urban agglomeration and urban sprawl damage rural and natural areas which are reserve areas for next generations. The more urban population brings about the more settlement areas, dwelling areas, service areas, working areas, recreational areas and urban infrastructure. These interactions cause to unbalance the urban-natural equilibrium, the urbanization side of this equilibrium has a strong influence than natural areas. In particularly after industrial revolution the balance of nature and urban equilibrium became to unbalance to the side of urbanization. Industrial revolution caused to attract more people to the cities from rural. Cities have become to grow more than the other times. At the same time industrial development has increased technological inventions. Together with technological inventions both average life-span and life quality have increased. Population increases as an outcome of increment of life-span and life quality. The more population entails more requirements for human beings. The more requirements necessitate the more industrial and technological development. In that case it can be said the requirements of human beings are infinitive, for this reason the requirements of human beings include "continuity". Development must continue and increase forever. Conversely natural resources are limited; there is an important definition for natural resources, this definition is "scarcity". At the beginning of the 20^{th} century mass production became to be important in economy and industrial production. This type of production can be named Fordizm. Mass production requires more raw materials, more and big industrial places, more products and more market in order to sell these products. Therefore Fordizm requires more population. This population both works for industrial production and constitute market for mass production. However Fordizm include an important deficiency in its production philosophy. Fordizm wants to produce continuously, this means mass production ignore not only market's demand but also natural environment. Gradually supply-demand balance had become to be upset; supply had stared to be more than demand. This inequality caused economic crisis. Petroleum crisis was also economic crisis because of mass production. Supply had not found

adequate market and demand for this reason crisis occurred. This crisis indicated also an important factor for production. This factor is raw materials, energy and natural resources; these natural resources and environment are limited resources. One day will come and these resources will be exhausted by industrial and technological development. In particularly after Second World War technological and industrial development rapidly deteriorated environment. Great industrial and technological development brought about environmental destruction. This environmental destruction causes to make difficult not only to find cheap raw materials and energy for production but also to find livable places for human and the other species. After 1970s right along with economic development environmental aspect has become important. Natural resources were realized that they are limited. Environmental researches indicate that rapidly development causes to exhaust nature concurrently contaminate environment. Species start to become extinct because of this pollution. This extinction spoils the equilibrium of ecosystem. When the equilibrium of ecosystem is deteriorated, some species start to vanish and life-cycle of species is damaged. Nourishment chain will be harmed by contamination and human beings will be affected from this change. Limited natural areas must be maintained for next generations because natural resources are scarcity; this maintenance constitutes definition of "sustainability" "it means simply that in a global context any economic or social development should improve, not harm, the environment" (Newman P., Kenworthy J., 1999). Sustainability can be defined that continue economic development together with maintain natural resources and ecology, and develop social structure; take into consideration next generation's requirements. Sustainability will provide more livable places for human beings in the future. Sustainability has three fundamental topic; they are economic, ecologic and social sustainability. Ecologic sustainability consists of maintenance of "ecosystem". Ecosystem is a system which has a harmony natural environment together with artificial environment and interaction between living things and lifeless materials. Ecosystem comprises both natural environment and artificial environment. Ecosystem can be different kind such as water ecosystem, mountain ecosystem, sea ecosystem as well urban ecosystem… in these ecosystems the basic elements either living things or lifeless elements of ecosystem are different from each other. For example a mountain ecosystem consists of meadows, plants, flowers, insects,

endemic species… etc. and an urban ecosystem composed of human beings, settlements, social structure, buildings, parks… etc. Figure 1.1 shows parts and relations of ecosystem.

Fig. 1.1 Components of ecosystem



As it can be seen in figure 1.1 natural and artificial environment are important parts of ecosystem in that case definition of "environment" should be explained. Environment is a physical structure which includes water, air, soil, land, flora, fauna, and human beings and as well as cities; environment can be considered in five categories. These categories determine conservation strategies as well as carrying capacity of environment. These categories are:

1. Natural systems
2. Modified systems
3. Cultivated systems
4. Build systems
5. Degraded Systems (Kozlowski, J., Hill, G., 1993) (Özer, A., Ö., Arapkirlioğlu, K., Erol, C., 1996)

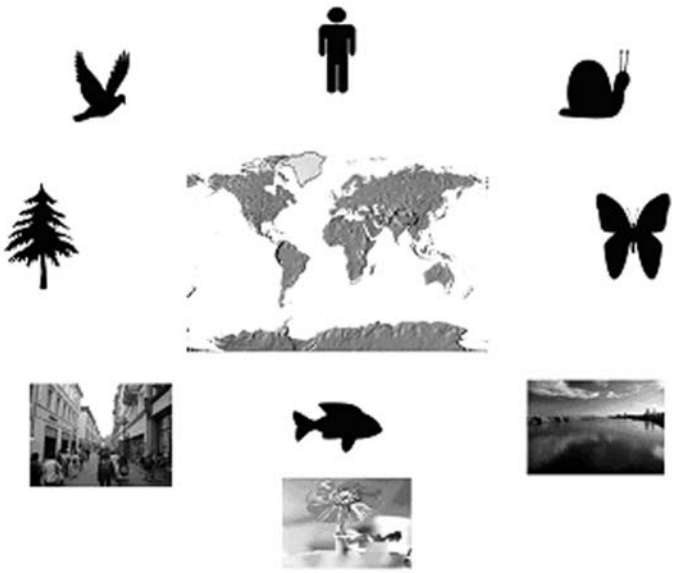
Natural systems are systems that human beings' activities do not exist in these systems. Modified systems are systems that human beings' activities effect environment without deterioration environment. Cultivated systems are systems that human beings use environment in order to produce production; like agriculture or fish farm. Build system are systems that human beings build dwellings, roads, parks, industries… etc. like cities, towns or villages. Degraded systems are systems that living things can not live in these systems for instance eutrophicated lakes, streams that industries give off their wastes. Because of this degradation environmental researches have started since 1960s.

After 1970s ecological researches has become to be important together with sustainability approach. It can be said that after 1970s environmental approaches has changed together with environmental researches. Till 1970s it has been accepted that "environment" is composed of on the centre human being and the "surrounding things". Human being is surrounded by living and lifeless things; at this approach the other things except human are worthless. Figure 1.2 shows surrounding approach for environment.

Fig. 1.2 Human centralist approach

Environment was deteriorated for a long time from industry revolution to petroleum crisis because of this “surrounding” approach. Together with new researches definition of “environment” was explained and started to use in literature. It was understood that environment has limited structure and for this reason it was realized necessary to sustainable development after 1970s. New approach put the world at the centre and human beings and the other living things and lifeless things are piece of ecosystem. This means with this approach natural and artificial environment as well as human beings are pieces of complete system of ecosystem. Figure 1.3 shows “environment centralist” approach.

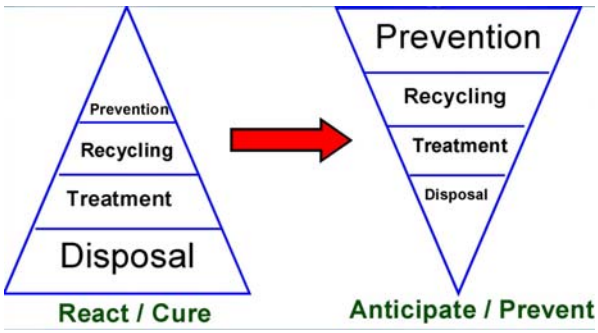
Fig. 1.3 Environment centralist approach



Endeavor of protection of environment has started, firstly “react-cure” (Özer, A., Ö., Arapkirlioğlu, K., Erol, C., 1996) approach was become a current issue. There were a lot of implementations that they ignored environment therefore they had effects to environment before environmental researches. According to this approach first cities grow, industries developed and established, technological inventions deteriorate

environment and then human beings and researchers determine the negative effects of urbanization, industries and technology. Second level of this approach is cure phase, at this cure phase the negative effects of urbanization, industries and technology are tried to solve; in this manner environment will be cured. In that case in the basic of "react-cure" approach comprise to determine effects of negative effects of urbanization, industries and technology; and then cure of these negative effects. Mark COTTER (2009) defines and pictures phases of "react and cure" approach as in sequence "disposal-treatment-recycling-prevention" (Cotter, M., 2009) at Greening Your Business Bottom Line and Pollution Prevention Workshop on 21th of January of 2009. Together with this approach "control of contamination" was improved in environmental planning. As time passes it has been understood that control of contamination and purify and clean environment is expensive process. For this reason these expenses were noticed that they are a burden to both economy and sustainable development. In this respect solutions should be developed before pollutions and environmental destruction are occurred. This approach comprises "anticipate-prevent" (Özer, A., Ö., Arapkirlioğlu, K., Erol, C., 1996) idea in its philosophy. Figure 1.4 indicates philosophy of react/cure and anticipate/prevent approaches in environmental planning.

Fig. 1.4 Approaches react/cure and anticipate/prevent in environmental planning



Source: Cotter, M., (2009)

This "anticipate-prevent" philosophy includes precautionary approach and "in order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage,

lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation"(Douma, W., Th., 1996). In this way both "environmental costs" and "environmental deteriorations" will be decreased. Environmental planning compasses two "anticipate-prevent" approaches that they are "appropriate land use decisions" and "environmental impact assessment".

Urban and regional planning is a system planning which has a lot of pieces and these pieces constitute entirety. Future of cities and rural areas, population, economic development, natural areas and conservation areas, highways and roads… etc. as well as "land uses" are determined in urban and regional planning. The effects of land uses were inquired land use researches from 1970s till today. In that case the effects of land uses to environment can be anticipated. In this respect the negative effects of land uses can be prevented before the environmental pollution and environmental destruction occur. This anticipation of negative effects of development and land uses will be provided to reduce pollution and environmental destruction.

As second approach of anticipate-prevent idea is "environmental impact assessment". Environmental impact assessment provides to minimize negative effects of land use implementations. Environmental impact assessment is a process that minimizes negative effects of a project with anticipation of whole damages to environment not only from beginning construction of project but also effects of project after construction.

Urban and regional planning has anticipation and suggestion for future of cities and rural areas in its philosophy. In this respect land use strategies and environmental impact assessment are two major planning tools in order to minimize pollution and maintain sustainable growth. Sensitive planning approach provides conserving environment. "Carrying capacity" is important subject in environmental planning in order to provide sustainable growth. Carrying capacity can be defined as "capacity of an ecosystem to support healthy organisms while maintaining its productivity, adaptability, and capability of renewal" (IUCN/UNEP/WWF 1991) (Sellis, T., and Georgoulis, D., eds, 1997). Carrying capacity is now broadly applied to describe the limits of environment or

ecosystems to accommodate development and specific activities (Sellis, T., and Georgoulis, D., eds, 1997). Every recipient place and every ecosystem has its own carrying capacity. Carrying capacity is an important definition that maintains whole natural and artificial factors in this environment and ecosystem. Urban planning is planning system that considers all factors in planning region. It should be improved McHarg's ecologic approach. Mcharg (1971) determined climate, geology, geography, vegetation, wild life and land use as ecologic factors. However human beings and artificial components should be added to this approach. In that case the environmental factors should be considered as below:

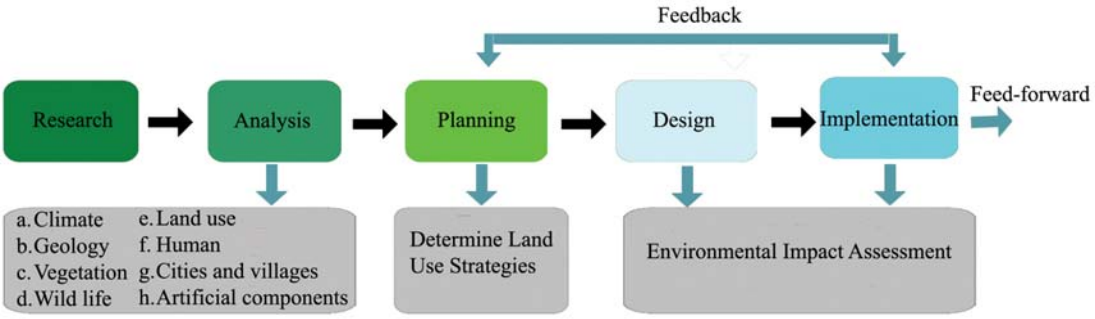
a. Climate
b. Geology
c. Vegetation
d. Wild life
e. Land use
f. Human
g. Cities and villages
h. Artificial components

These factors should be maintained in order to conserve natural life as well as artificial environment. Natural conservation area, nature park, national park, wild life area, forest, wetland area… etc. is determined in order to maintain natural areas in planning process. However just determination of natural areas is not adequate to conserve these areas. This approach is passive conservation idea. Natural areas need more than passive conservation. Appropriate land use decisions, environmental impact assessment, environment management, contamination control are necessitate for active conservation.

"Scale" is an important concept in urban and regional planning. Scale designates boundaries of planning area, parameters and factors, regional and local systems and also details of planning approach. Regional and local systems manifest significance of natural life and sustainability of planning area. Every ecosystem has its own features because of

different component of environmental factors. Urban and regional planning is process that begins from research to implementation. Environmental planning approach comprises quasi-affinities with urban and regional planning. Figure 1.5 show process of environmental planning approach.

Fig. 1.5 Environmental planning approach



Data from researches constitute fundamental for analysis studies in environmental and regional planning. Environmental factors are inquired in analysis studies. These environmental factors are climate, geology, vegetation, wild life, land use, human being, cities and villages and artificial components. Planning decisions are determined according to results of analysis of environmental factors. These planning decisions and land use strategies contain anticipations and foresights about planning area. This anticipations and foresights provide to prevent contamination and environmental deterioration. In this sense the negative effects of rapid urbanization and development can be minimized. Design and implementation stages can be named as project phase of environmental planning. Design and implementation stage of environmental planning process encompass an important anticipation and foresight tool in order to conserve environment as well maintain sustainable growth; this tool is environmental impact assessment. After implementation phase planning decisions will be controlled in order to measure performance of planning. According to success and fault of planning; good planning decisions will be feed-forward to plan and the other quasi-plans. Wrong planning decisions and faults will be corrected and planning decisions will be examined; and some researches of analysis can be redid or inquired again if it is necessary so that feedback to planning phase of environmental

planning process will be begun.

This PhD study comprises and inquires land use strategies and settlement appropriateness as a part of anticipate-prevent approach in order that we protect environment from rapidly urbanization process. Anticipation and foresight exists in nature of urban and regional planning. Therefore anticipate-prevent approach is accepted as PhD thesis' conceptual comprehension. Anticipate-prevent approach and land use strategies provide to prevent wetlands from contamination and negative effects of urbanization, industries and technological developments. In that case environment can be conserved and negative effect can be minimized. This approach provides sustainable growth. Problems are anticipated before they occur therefore minimum burden affects environment. On the other hand costs of curing environment decrease and costs of cleaning pollutions can be reduced.

Environmental planning is wide range and interdisciplinary process; environmental planning contains economy, geography, biology, landscape planning, urban and regional planning, sociology, architecture, geology, hydrology, civil engineering… etc. Basic and fundamental components of planning area designate ecosystem in environmental planning area. When basic element of ecosystem shallow water systems this ecosystem forms wetland ecosystem. At this PhD study wetland ecosystem is researched scope of urban and regional planning in environmental planning. The aim of PhD study researches negative effects of urbanization to wetlands especially metropolitan cities and develop a land use model with buffer zones in respect of maintaining wetland near metropolitan cities. In that case wetland should be defined. A definition from Gosh is "wetlands are parts of earth's surface between true terrestrial and aquatic systems. Thus shallow lakes, marshes, swamps, bogs, dead riverbeds, borrow pits, are all wetlands irrespective of their extent and degree of human interventions. Wetlands are generally shallow and thus differentiated from deep water bodies. Wetlands often include three main components. These are the presence of water, unique soils differing from those of uplands and presence of vegetation adapted to wet conditions" (Gosh, D., 1995) (Malisie, A., F., 2008). An other definition for wetland; wetland is defined RAMSAR Convention (Article

1.1) “areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters and may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six meters at low tide lying within the wetlands” (RAMSAR 2000). As it is seen in definition; definition of wetlands are wide different and comprehensive. In this PhD study concerns lake systems near metropolitan cities. Wetlands had been chosen as case study because they have significance in water ecosystem. Wetlands have special feature on environmental planning.

Wetland areas are important ecosystems on world. This ecosystem balances the water and land, also life areas for birds. These wetland areas not useful for ecological balance but also it has positive microclimatic effects, it balances underground water sources, it filters some poisonous matters and sediment, due to these functions wetlands play important role on sustaining natural life.

- Wetland areas are important ecosystems on world
- This ecosystem balances the water and land, also life areas for birds
- Wetland areas not only useful for ecological balance but also it has positive microclimatic effects
- It balances underground water sources
- It filters some poisonous matter and sediment
- It preserve water flood
- It has an important role prevent from erosion
- It has habitat for a lot of endemic species

Turkey is as a rapid developing country confronted by rapid population growth and urban development. This rapid population growth brings about employment and housing problems and wrong decisions on land use strategies. These land use strategies cause uncontrolled expansion of urban areas. This is one of the reason of deterioration wetlands of Turkey. Another important reason of deterioration of wetlands is the transformation of

wetlands into agricultural lands. But it is observed that transformation of wetlands to agricultural lands is not fertile and transformation of wetlands eventuate erosion. At the same time wetlands lose its role in maintaining living diversity in ecosystem and as evolution of biotope areas because of demolishing wetlands.

An important obstacle for evolution of Turkish wetland is legal aspect; wetlands can be demolished easily except they are officially requested by laws; drying of marsh areas by state hydraulic works struggle with malaria all accepted before 1970's.

Main problem in conserving the wetlands and ecological system is the maintaining the balance between conservation-use balance for urban development. In sustainable development, sustaining natural environment is important as urban development.

In this respect in order to consider problems and potential researches; about these subjects has to be examined:

- Interventions to water regime
- Deterioration of water quality
- Deterioration of habitat
- To drop stranger species into natural wetlands
- Management of wetland areas

As a result, search for solving the problems of urban development and maintain ecological balance with urban development gains importance. In this respect it is important to determine effect of urban development to environment; thus wetlands can be maintained. Land use planning and settlement appropriateness can be helped planners so as to conserve wetlands. Buffer zone method and thresholds will be evaluated in next chapters as a method for maintaining wetlands however Environmental Impact Assessment (EIA) and efficient management of these areas are also important subjects in environmental planning.

1.1 Effects of Urbanization on Wetland Areas

Wetlands have several problems. Urban development is one of them. There are five basic dimensions that metropolitan development is effective on wetland areas.

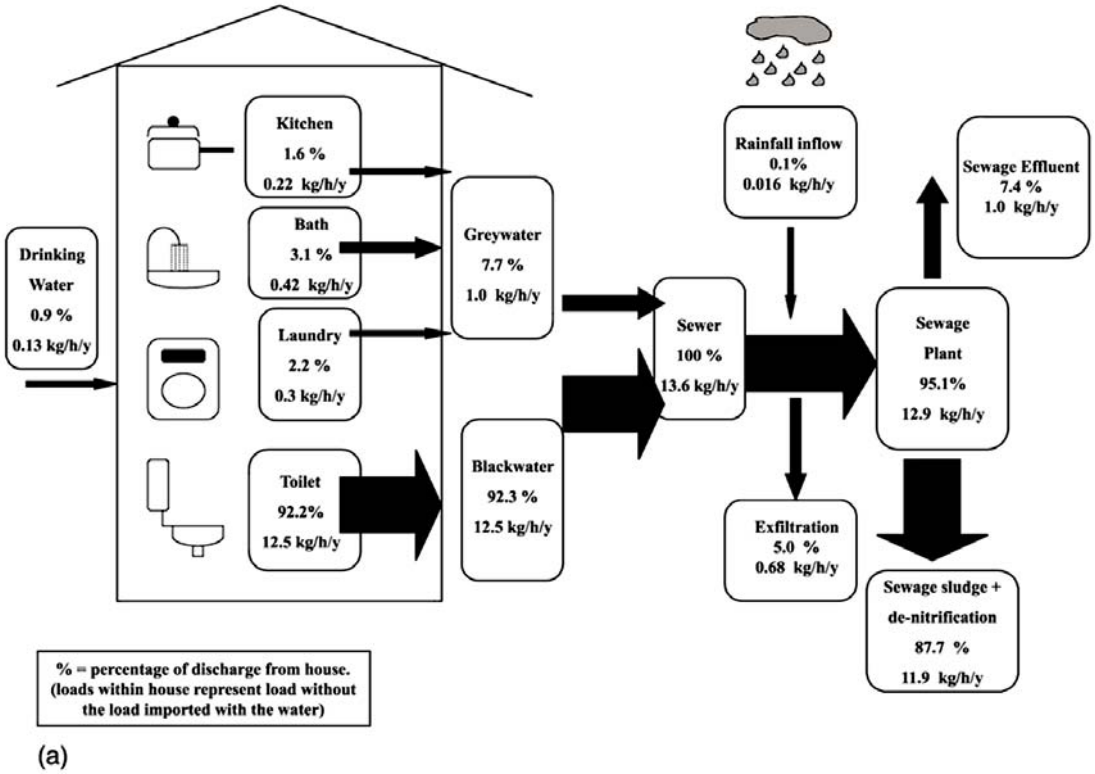
- Natural environment
- Spatial environment
- Transportation environment
- Neighborhood environment
- Micro environment (Perlaff, 1969, p:18-19)

These environments affect habitats in difference ways. Within context of pollution problem of wetland areas are considered under the title of introduction and problem statement. In General deterioration may be composed by two ways on wetlands. One is the deterioration due to water and environmental pollution with urbanization and urban sprawl; and second is about water requirement. Water contamination with urbanization process is considered below. Water requirement will be considered in management of wetlands in second chapter of PhD thesis.

Wetlands are polluted due to effluent from wastewater, industries as well as residential areas. Residential areas cover huge amount of area in a planning region. Residential areas cover more area than commerce area, industry, transportation, services areas and open spaces in a city or city development. For this reason urban residential areas should be researched in order to obtained scientific values. Scientific values facilitate to make decision for conserving wetlands from cities. There are three important contaminant sources to be considered in urban pollution. They are Nitrogen (N), Ammonia (NH_3) and Phosphorus (P). These contaminant sources cause eutrophication. Eutrophication is a process that algae and bacterium use N , P , NH_3 and create PO_4^{-3} , NO_2 , NO_3 , NH_3^- , H_2S . Nutrients are composed of these compositions and outcome of

using N , P , NH_3 appear compositions and salts. These compositions pollute water and species become vanishing. O_2 become exhausted for this reason living things especially algae start to die. Algae cover surface of water and sunshine can not reach deep of lake. Gradually nearly whole living things die because of inadequate O_2. This process is named as “eutrophication” on the other hand “algae are the most important element in order to determine eutrophication process. Algae reproduce excessively and then die process of algae start. Death of algae cause residual and these residue fill up depth of lake and lake becomes to shallow. Erosion causes also shallow process in lakes” (Tıktık, Ö., 1995). Erosion carries sediments and soil to lake; and then lake starts to fill up with soil and sediments. Depth of lake becomes to shallow and sun lights reach directly to base of lake, and vegetation on base of lake start to change. This process deteriorates and damages quality of water. Vegetation starts to increase on base of lake. This process damages of lake’s ecosystem. On the other hand algae bloom on the surface of water can be observed, and surface of lake cover with algae for this reason sunlight can not reach to base of lake and then living things start to die; this process can be explained as eutrophication. Eutrophication is both natural and artificial process that it can be occurred. These compositions and nutrients exist in natural environment however quantity of these compositions are small amount. Urbanization and residential areas increase quantity of these compositions in effluent and wastewater therefore the eutrophication process gains speed. Figure 1.6 shows nitrogen loads in wastewater system.

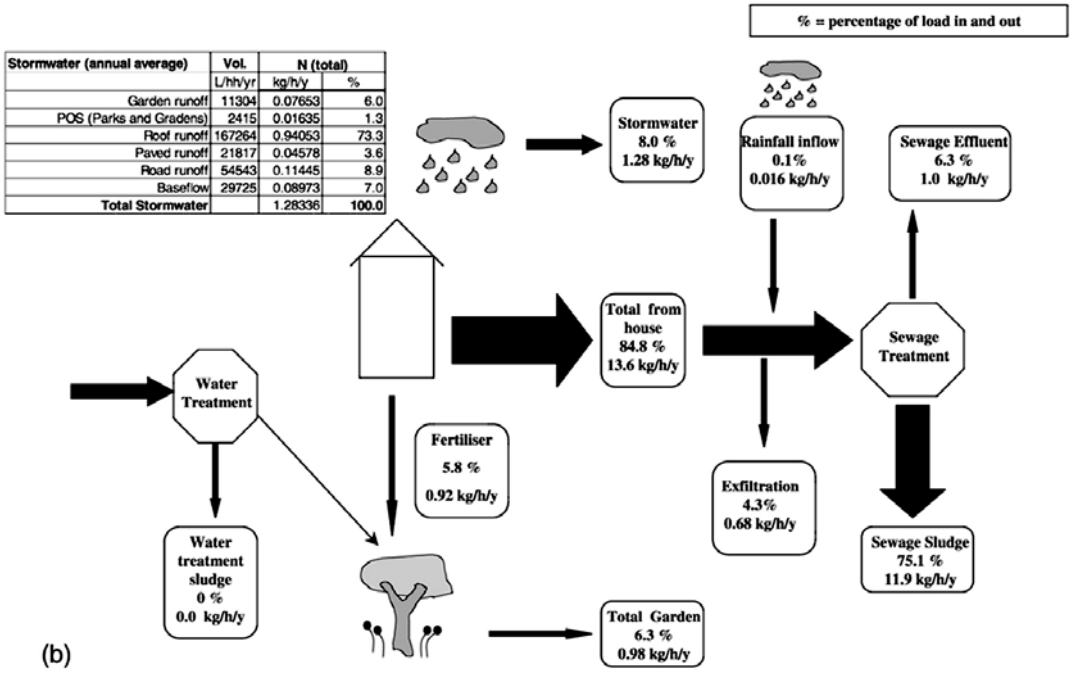
Fig. 1.6 Nitrogen load in wastewater system



Source: Gray, S., R., and Becker, N., S., C., (2002)

"The results are presented in pictorial form and the contaminant loads are given as mass/house/year (kg/h/y). According to figure 1.5 92.2% of nitrogen is sourced from toilet of household" (Gray S. R., Becker N. S., C., 2002). The other nitrogen is sourced from kitchen, bath and laundry and percentage of kitchen, bath and laundry is 7.7%. Figure 1.7 indicates urban residential development. "The main source for nitrogen in domestic wastewater, urine, should not be present in grey wastewater" (Erikson, E., Auffarth, K., Henze, M., Ledin, A., 2002). And Bath contributes the highest level of Nitrogen to grey wastewater. The next figure shows a pictorial about Nitrogen loads in urban residential development.

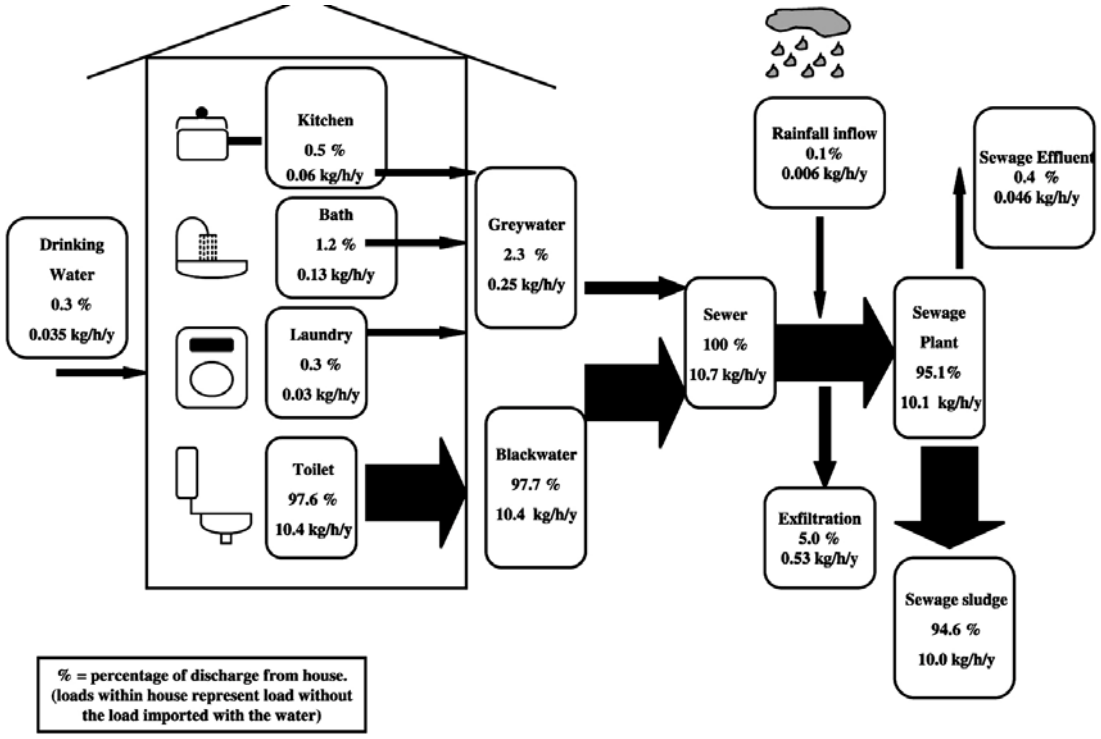
Fig. 1.7 Nitrogen loads in urban residential development



Source: Gray, S., R., and Becker, N., S., C., (2002)

When the figure 1.7 is examined, the great amount of nitrogen is sourced from houses. Percentage of total nitrogen from house is 84.8%. Stormwater is also important according to its nitrogen loads. These totally nitrogen loads are added to 75.1% sewage sludge. Fertilizer gives 5.8% of nitrogen to soil and total garden nitrogen loads are 6.3% in urban residential development. The other important contaminant is ammonia. Figure 1.8 shows ammonia load wastewater system.

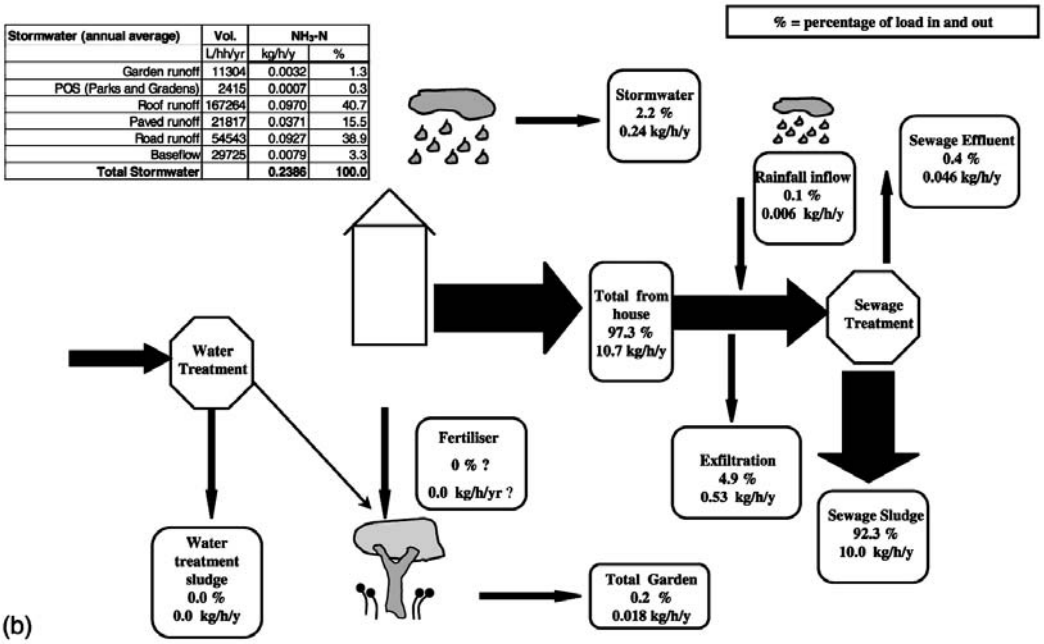
Fig. 1.8 Ammonia load in wastewater system



Source: Gray, S., R., and Becker, N., S., C., (2002)

According to figure 1.8 97.7% of ammonia is sourced from toilet in a settlement. 2.3% of ammonia is sourced from greywater. This ammonia discharges to wastewater system and sewer. Great amount of ammonia mix sewer system as sewage sludge, this is approximately 94.6%. Quantity of ammonia in urban residential development area is given below in figure in order that "considers flows derived from the urban residential development (i.e. stormwater as well as water and wastewater)" (Gray S. R., Becker N. S., C., 2002).

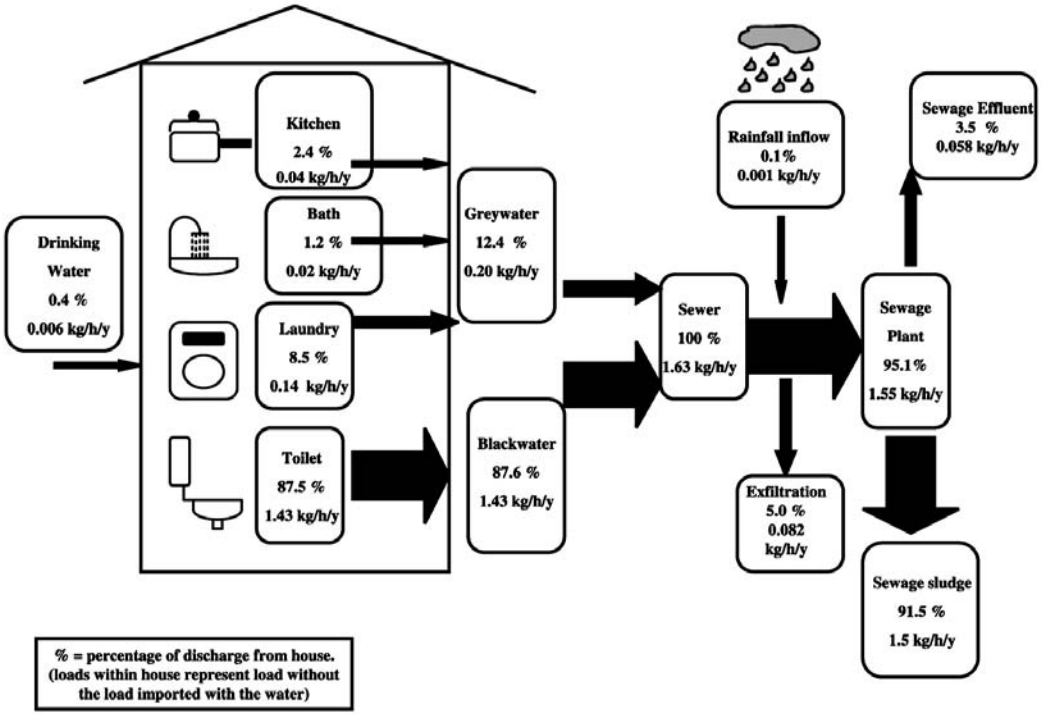
Fig. 1.9 Ammonia load in urban residential development



Source: Gray, S., R., and Becker, N., S., C., (2002)

Highlight is great amount of ammonia 97.3% is sourced from houses in urban residential development at figure 1.9. 92.3% of ammonia adds to sewer system as sewage sludge, this is approximately 10.0 kg/h/y. Third contaminant is phosphorus. The main phosphorus is sourced from also toilet in urban residential settlements. The percentage of phosphorus is 87.6% from house and it mixes sewage system and 91.5% of phosphorus sludge adds system at the end. Figure 1.10 shows phosphorus loads in wastewater system in settle area.

Fig. 1.10 Phosphorus load in wastewater system

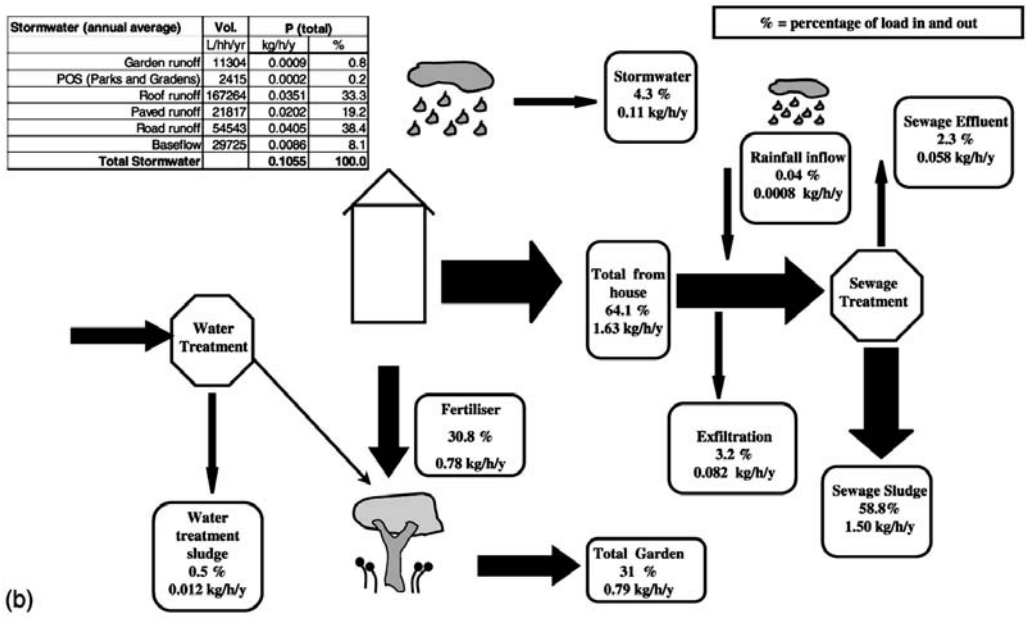


Source: Gray, S., R., and Becker, N., S., C., (2002)

According to figure 1.10 it can be said that we must be taken into consideration to house's blackwater amount. When we decide a new dwelling development area quantity of phosphorus is given the figure below. According to figure 1.11, total phosphorus from house is 64.1% and this percentage is different from the other two contaminants (nitrogen and ammonia). Reason of this difference is using fertilizer in gardens. Approximately 30.8% of phosphorus is added to system from gardens in urban residential development. "Washing detergents are the primary source of phosphates found in grey wastewater in countries that have not yet banned phosphorus-containing detergents (Jeppesen, 1996). Concentrations between 6 and 23 mg Tot-P l_1 can be found in traditional wastewaters in areas where phosphorus detergents are used. However, in regions were non-phosphorus detergents are used the concentrations range between 4 and 14 mg l_1 (Henze et al., 2001). This can explain why the total phosphorus and phosphate concentrations are

generally higher in laundry grey wastewater compared to bathroom grey wastewater" (Erikson, E., Auffarth, K., Henze, M., Ledin, A., 2002)

Fig. 1.11 Phosphorus load in urban residential development



Source: Gray, S., R., and Becker, N., S., C., (2002)

As it is seen urbanization process produces contaminants; and environment is damaged by urbanization. Dwelling area is the biggest part of planning area and as it is described above urban residential area produces phosphorus P, nitrogen N and ammonium NH_3. When average of household increases in a house, quantity of consumption of water, detergents, soap… etc. will be shared so that laundries, dishes… etc. can be washed for more person for this reason production of phosphorus, nitrogen and ammonium decrease per person. In this way deterioration of environment will be lessened. When the density of urban settlement is increased, one person produce small amount of Phosphorus Nitrogen, Lead, Zinc and Sediment. For example with the density of 0.5 unit/ac one person produce 0.8/1.25= 0.64 Phosphorus. With the density 2.0 unit/ac one person produce 0.9/2.0=0.45 Phosphorus. With the density of 10.0 units/ac one person produce 1.5/25=0.06 amount of Phosphorus. The reason of this decrease is less car use, less spoil

the natural environment, more use of public transportation. These values are in the stromwater values.

1.1 Proportion of contaminants in stormwater unit/acre

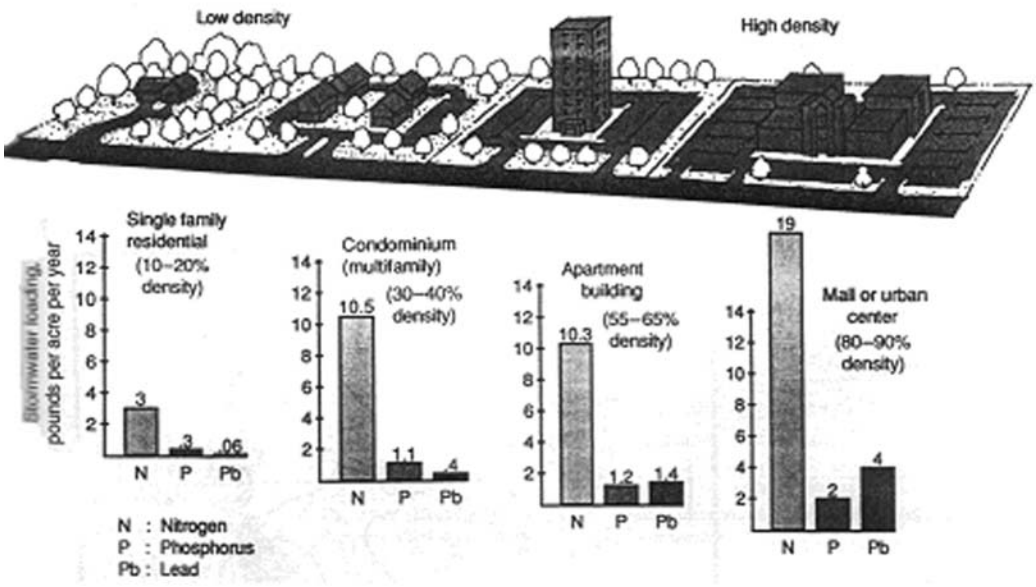
Density	Phosphorus	Nitrogen	Lead	Zinc	Sediment
0.5 unit/ac (1.25 person)	0.8	6.2	0.14	0.17	0.09
1.0 unit/ac (2.5 persons)	0.8	6.7	0.17	0.20	0.11
2.0 units/ac (5 persons)	0.9	7.7	0.25	0.25	0.14
10.0 units/ac (25 persons)	1.5	12.1	0.88	0.50	0.27
Phosphorus, Nitrogen, Lead, Zinc are Pounds per year Sediment is Tons per year					

Source: William, M., M., (1997)

The main problem for metropolitan cities is both third dimension development (development on perpendicular) and urban sprawl and development on horizontal. New settlement requirement causes more environmental deterioration. Especially low density urban residential development requires more land, more roads, more infrastructures, and more cars. Conversely apartment house type of urban residential development shelter more person than low density development in a parcel so that there are less land requirement for apartment house type of urban residential development. Deterioration of environment will be lessened.

Figure 1.12 shows that the settlement types from single family residential to urban centre; and quantity of contaminants (nitrogen, phosphorus, lead) in stormwater in these settlement types.

Fig. 1.12 Water pollution with urban function and its density



Source: William, M., M., (1997)

According to figure 1.12 it is shown that proportion of contaminants is continuously increasing by density in per acre because population increases from single family to urban centre. However quantity of contaminants should be calculated per person in order to understand environmental impacts for every type of settlement. The highest value of density is chosen for calculation per settlement type. 3 units of nitrogen are sourced in stormwater in single family residential and density is accepted 20%, in that case 0.15 units of nitrogen are produced per person. Similarly 10.5 unit of nitrogen with 40% person per acre makes 0.26 units nitrogen per person in multifamily house type. As apartment type house 10.3 units' nitrogen with 65% person per acre makes approximately 0.16 units nitrogen per person. In urban centre 19 units of nitrogen is produced and density of urban centre is 90% per acre in that case 0.21 units of nitrogen is sourced per person. According to these values apartment building (apartment block) type of urban residential development is suitable for urban development.

Wetlands are excessively affected from environmental deterioration because of urbanization process. Wetlands are also an attraction point for luxury houses, wetlands possesses special scene and landscape. Upper income classes prefer to settle near wetlands and lakes for their dwellings.

More urbanization creates more contaminants and environmental deterioration. Contaminants cause to pollute underground water and surface water. When water is polluted, as time passes species become extinct and the balance of wetland ecosystem is damaged. If wetlands systems start to deteriorate species become extinct; water floods occur, erosion increase, quantity of potable water decrease; human can not find enough recreation places and also the positive effects of wetlands' microclimate is bad affected. Wetlands also protect lake, river systems, dams… etc. so that they protect potable water resources. If wetlands dry because of any reason as eutrophication, urban sprawl or erosion etc. potable water resources will lessen.

1.2 The Aim of PhD Study

Wetland is a system so that wetlands must be protected with its whole physical structure as well as its living things. Wetland is composed of living things, lifeless things and also artificial materials. Diversity of endemic species' areas also very important and these areas are sensitive areas that they must be maintained. Besides as a major element of wetlands system "water resources" must also be conserved. A wetland ecosystem encompasses rural and urban effects if there is a settlement in wetland's basin. In order to maintain wetland ecosystem, negative effects of rural and urban land use functions must be obstructed. Conversely positive effects in wetland ecosystem must be maintained. The main problem is maintaining wetland ecosystem, because wetland is rapidly affected from settlements in its basin inside. Deterioration of ecosystem is occurred rapidly when a settlement exists in wetland's basin inside. In that case a quick intervention should be developed in order to conserve wetland. This PhD study inquires a model that includes making decision rapidly. Which physical characteristics should be researched and which effects should be inquired in order to conserve wetlands. Meanwhile this PhD study includes decision process to choose appropriate areas for settlements. In this manner negative effects of urban and rural functions can be obstructed. Buffer zone model will be constituted and researched thus negative effects of rural and urban functions can be hindered or the negative effects of rural and urban effects can be minimized. This PhD study aims to rapidly and successfully make decisions so as to protect wetlands from the effects of urban and rural functions, because wetlands vanish or are damaged rapidly when we make decision or inquire about wetlands. In this way rapidly decision process or model should be developed in order that we can conserve wetlands in particularly exist nearby settlements and metropolitan areas. In this PhD study a conservation of wetland model will be researched and land use strategies will be developed in order to conserve wetlands. Settlement appropriateness will be determined in this PhD method. Determination of buffer zone around wetland method will be researched and these buffer zones are reinforced by some thresholds in wetland's basin. A conservative method will be developed in order to protect wetlands from urbanization.

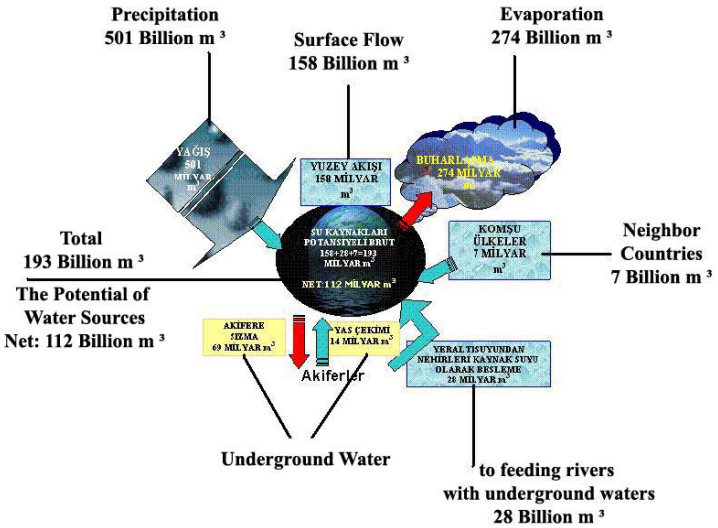
2. MANAGEMENT of WETLAND AREAS

Management of wetlands is difficult process because management includes legislation of land, conservation policies, planning process, collaboration of stakeholders, implementation… etc. topics so that there are a lot of pieces in this equation and process. In this title water usage policy, land use policies and effects of EU in land use policies, managing of stakeholders and planning process will be considered.

2.1 Conservation Policies

Determine good policies are necessity to get the success of management of wetland areas. Consider with this point first we have to give a lot of attention to institutional structure. Institutional coordination and cooperation is the first step to reach water policies. It is better clarify the water potential of Turkey's before research about institutional structure. This diagram is explained that the average of Turkey's water quantity.

Fig. 2.1 Potential of water quantity in Turkey



Source: http://www.dsi.gov.tr/topraksu.htm

When the diagram is examined: there is 95 billion m³ water is obtained from streams, 3 billion m³ water is obtained from neighbor countries, 14 billion m³ water obtained from underground waters. This means that Turkey has total (net one year) 112 billion m³ water. In 2030 population will be 100 million in Turkey. If the problem of Turkey does not solve, Turkey will be a poor water country according to capitation quantity of water.

The main problem of Turkey about water is agricultural irrigation. Turkey uses large part of its water potential to agricultural irrigation. Below this table shows that usage of water with the sectors in Turkey. This is a comparison between year 2003 and 2030.

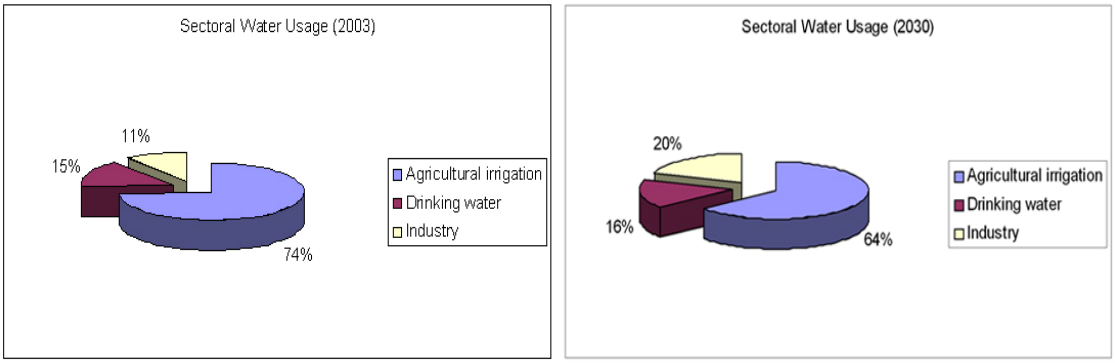
2.1 Sectoral water usage comparison in Turkey (2003-2030)

Sectoral Water Usage (2003)			**Sectoral Water Usage (2030)**		
Agricultural irrigation	29,60	billion m³	Agricultural irrigation	72,00	billion m³
Drinking water	6,2	billion m³	Drinking water	18	billion m³
Industry	4,3	billion m³	Industry	22	billion m³
Total	40,10	billion m³	Total	112,00	billion m³

Source: http://www.dsi.gov.tr/topraksu.htm

These data should be showed as pictorial; in this manner data of water usage of Turkey can be easily understood. Figure 2.2 shows sectoral water usage of Turkey.

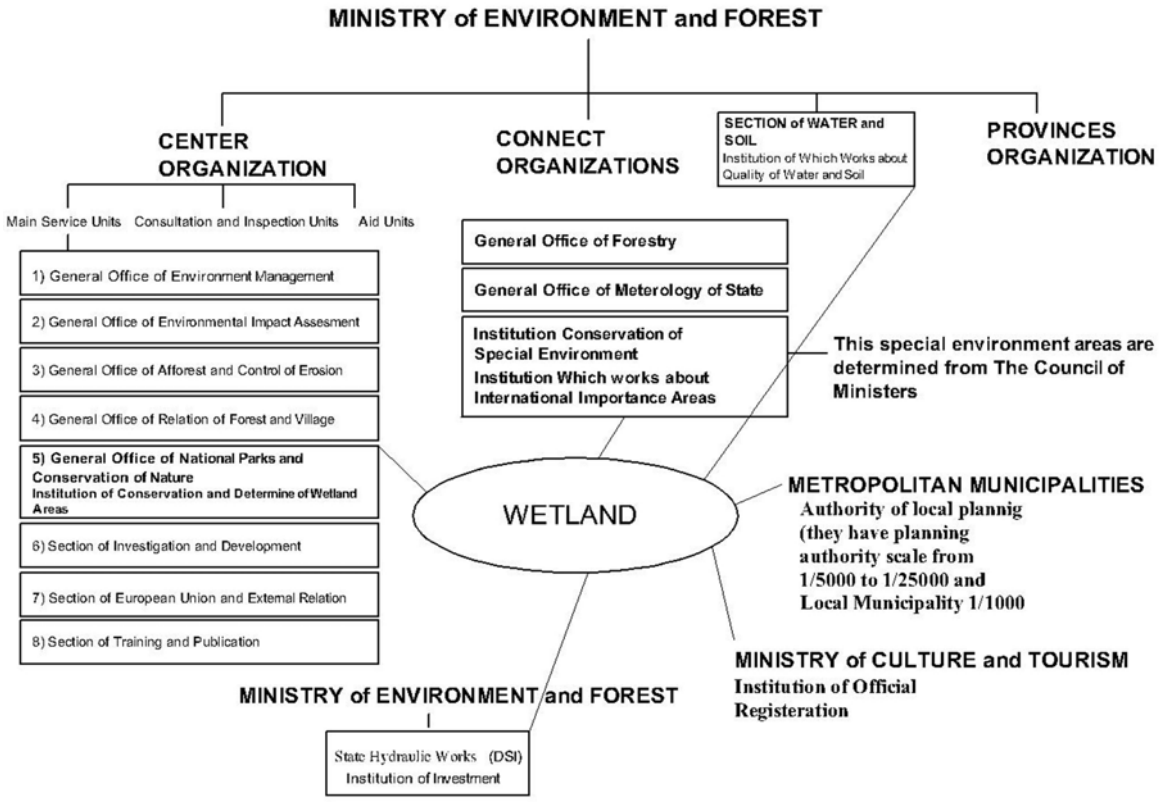
Fig. 2.2 Graphic of sectoral water Usage of Turkey (2003-2030)



Turkey needs the new technology about agricultural irrigation. Turkey uses old technology in the agricultural irrigation.

With this respect research about institutional structure is very important for managing wetlands in Turkey. Below this diagram shows that relation between wetland and institutional structure.

Fig. 2.3 Institutional structure of wetland areas in Turkey



There are important problems of management of wetland in Turkey. In this respect the most problem is the sharing of authority or empowerment of authority and duties defined by laws. For example within them lakes, water channels, improvement of water, valley and river authority is belong to State Hydraulic Works (DSI: Devlet Su İşleri) is the part of Ministry of Forest and Environment. State Hydraulic Works is giving service on engineering basis. However these projects affect ecological balances. On the other hand Ministry of Environment and Forest Wetland Department is studying on conservation and improvement of wetlands. Ministry of Culture and Tourism register officially natural areas as well as wetlands. Municipalities plan in their region. All of these institutions

have their authority; and they decide independent from other institutions. This means there are a lot of institutions and departments that they have an authority about wetlands. There is sometimes authority complication between two state institutions.

Other important problem is the complication between plans. Related to conservation of wetlands Ministry of Environment and Forest has the authority of preparing Environmental Order Plans as well as metropolitan governments at the scale of 1/25000. Most important character for these plans is for urban development rather than conserving ecological structures. As these plans has dominant in planning process in Turkey, all small scale plans (like 1/5000, 1/1000... etc.) have to be coherent with these upper scale plans. For this reason, aim of conservation of ecological sites is not easily maintained due to complication between upper scale and lower scale plans prepared by different authorities. In this respect, there is a requirement regarding ecological based planning approach in Turkey.

The main problem in Turkey is the coordination and cooperation problem between institutions. The institutions behave alone and make plan by their authority. With this respect the plans are not accomplishment. The plans are not applied and implementations are unsuccessful. For this reason the natural environment is not conserved. The investments are not productive at all.

Turkey needs a network power model for the development coordination between institutions. This means Turkey needs a collaborative planning comprehension. In Turkey, nowadays strategic planning is debated between institutions and universities. But strategic planning has a defect which is converging about outcome. It has also stakeholder approach in the planning system but the decision making process is longer than collaborative planning. However the nature environment is vanishing very rapidly. So the time is the most important part of the planning process. Planners have to make decision quickly. They must get information, analysis, innovations, and technical support. So they can make plans about land use. In the collaborative planning process intends

implementation, for this reason the plan making process is required less time the other approaches.

Collaborative planning has three conditions. “When three conditions govern the relationship of agents in a collaborative network: diversity, interdependence, and authentic dialogue (DIAD). When these conditions are met, the participants in the network can develop adaptive innovations that were not apparent or even open to them as individual agents. Like a complex adaptive system, the DIAD network as a whole is more capable of learning and adaptation in the face of fragmentation and rapid change than a set of disconnected agents. Shared meanings emerge from the dialogue and participants can develop identities that link them together. As a result, they are enabled to act both independently and cooperatively for mutual benefit without central direction. This network power model has six topics which are dialogue, collaboration, shared meaning, shared heuristics and norms, cooperative action, diversity and interdependence” (Booher, D., E., Innes, J., E., 2000).

Conservation of wetlands process has seven stakeholders. They are:

- Ministries
- Local government
- Volunteer institutions
- Conservation committee of culture and nature heritage
- Plan making groups
- Universities
- Consumer and investors

This figure below is a model for Turkey’s wetlands conservation network process in collaborative planning. This network power model is developed for Turkey. This is very important for constitute an institutional structure.

Fig. 2.4 Collaborative planning and stakeholder Model for institutional structure

With this model all of the ministries are playing a role as coordinator. They manage the process of conserving wetlands. They get all analysis of wetlands areas, all researches… etc, they constitute instructions for conserving wetlands, and they share all plans and knowledge. They establish dialogue surroundings. Universities support this model as research & development unit. They establish models, new technologies. They use scientific researches about wetlands areas. Consumer and investors are the monetary section of this model. Investors in particularly are multi-national companies and big companies in Turkey. Nowadays "neo-liberal political philosophy … dismiss[es] a concern with place making as largely irrelevant to … economic competitiveness and

environmental sustainability" (Healey P., 1998). This model includes consumers and investors in this manner they are a part of plan making process. So not only economic sustainability but also ecologic and social sustainability proceed in development. The post-fordist (flexible production) production distributes the production process different areas. This means for example when a factory produce a car, but motor produce in one city but vehicle bodies produce another city or sub urban. So the inner part of city, city edges become different. City sprawl develops like fringe or oil stains; the production separated, different production areas constituted their hinterlands and settlement. This development causes the natural destruction. By the way globalization goes on and some multi-national companies bring the production units, which are giving more pollution to the natural environment, to the third world countries. The main problem in Turkey, the regional plans do not have spatial suggestion. In planning area or at plans (1/100.000) the investors choose their investment area with political pressure. Turkey needs upper scale land use plans. The companies choose their investment area but they only care economic income. For this reason the natural environment is damaged. In this model the local government has a role of defend local people's rights and giving more information about planning area. Local people are the most effected from plans or investments. Conservation committee of culture and natural heritage is a committee which committed to The Ministry of Tourism and Culture, however this committee is independent their decisions and they work on official registration. Official registration is important part for conserving the wetlands areas. Plan making groups have such as a role defend community rights with plans. They are bureaus of city planners, architecture, civil engineering…etc. and the chamber of Turkish Engineers and Architects. Volunteer institutions has a role of defend environmental heritage from demolish. These groups want to maintain the environment and they defend ecologic part of the sustainability.

This model contains sustainability when you investigate the model. It has three subjects economic, ecologic, and sociologic.

2.2 Land Use Policies

Land use policies are determined with international acts and agreements. Turkey is as a member of European Union so that the process of being a member of European Union forms the land use policies and socio-economic policies in Turkey.

There are important legislations in European Union in order to protect habitats and diversity of species and conserve water and water regions. “The most wide-ranging legislation are the recent European Union Habitat Directive (92/43/EEC) and Water Framework Directive (WFD; 2000/60/EC) which includes provision for enhancing ecosystem health and preventing further deterioration of aquatic ecosystems, including wetlands” (Large, A., R., G., Mayes W., M., Newson, M., D., Parkin, G., 2007). Rural development, ecological conservation, maintaining and protecting wetlands can not be thought without urban and spatial development. They have an important interaction each other. For this reason European Spatial Development Perspective (ESDP) should be added to this process.

EU, created out the Habitat directions for conservation of flora and fauna on May 21, 1992. Precautions are taken for sustainability, restoration and conservation of natural habitats and species in the important regions for European Union. In this respect, it becomes possible to maintain sustainable development of rural areas, as well as sharing different experiences from these areas. Most important helps in EU are given to rural areas which have cultural, natural and topographic variations. Rural areas mean more than the places of food supply and places of conservation. Rural areas are important areas for development of natural and cultural heritage.

The aim of this directive conserves flora, fauna and natural habitats and helps to bio-diversity in member countries. With this directive, economic, social, cultural necessity and regional, local characteristics are taken into consideration. European Ecological networks with conservation of special areas can be examined under the article of Natura

2000. With this network, natural habitat areas are formed in European rural lands. List of these areas are prepared and suitable conservation status are created.

Within ESDP (1999) that played important role in Europe spatial development perspective, there are three main targets (Ahlke, 2001)

- Balancing the competition power in Europe
- Equity in access to infrastructure and information
- Powerful approach to natural cultural heritage

An important step for conservation of natural and cultural heritage is the creation of European Ecological network named Natura 2000. Especially with Natura 2000, a legal infrastructure due to conservation of natural and cultural habitat was formed and this is an important political step. With this political decision, the direction of Spatial Development Perspective in rural areas is decided.

Spatial development in EU is forming around European Spatial Development Perspective (ESDP). ESDP spatial arrangements are evaluated within regional development models. "Regional plans are planned for determining socio economic development trends, development potentials of settlements, sectoral targets and distribution of activities and infrastructure" within regional development model (Ekşioğlu, 1989). Especially in Regional Planning approaches that contains sectroral preferences, raw material production, achievement of energy; situation of rural areas; in this sense sectoral and infrastructural services play important roles, and they become an important title. ESDP has an approach according to spatial distribution of population as well as economic development. The conservation and development of natural heritage is an important subtitle within ESDP policies aimed the creation multi centered urban system within rural-urban interrelations.

Within ESDP policies, Natura 2000 program is applied among member countries as an interrelation legal aspect to maintain biodiversity and conserve natural heritage.

Strategies and spatial arrangements through conservation of natural heritage and biodiversity areas has to be defined in the process of decision making for sectoral and infrastructural development within regional planning approach. Wetlands are also very important to form in network of natural areas. They offer wide range of species to network of these natural areas.

In forming natural heritage areas, scope is not to define and island of conserved area and left it alone. It is aimed to construct a network of conservation areas resembled to urban network system. In this system main structure is formed by ESDP and Natura 2000, EU Water Framework Directive and Common Implementation Strategy (CIS) are reinforced this network system. In this way wetlands can be successfully conserved. As an important natural area ecologic system wetlands can be taken into place in this network system. In that case EU Water Framework directive should be researched.

There is important conservation directive according to this content in Turkey. Especially E.U Water Directive is binding directive for conservation of water require. "According to EU water framework directive 'Water is not a commercial product like any other but, rather, a heritage which must be protected, defended and treated as such' 'On 29 May 1995 the Commission adopted a communication to the European Parliament and the Council on the wise use and conservation of wetlands, which recognized the important functions they perform for the protection of water resources'" (Directive 2000/60/EC, Official Journal L 327 , 22/12/2000 P. 0001 - 0073). Purposes of directive are listed below:

"The purpose of this Directive is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater which:

(a) Prevents further deterioration and protects and enhances the status of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and *wetlands* directly depending on the aquatic ecosystems;

(b) Promotes sustainable water use based on a long-term protection of available water resources;
(c) aims at enhanced protection and improvement of the aquatic environment, inter alia, through specific measures for the progressive reduction of discharges, emissions and losses of priority substances and the cessation or phasing-out of discharges, emissions and losses of the priority hazardous substances;
(d) Ensures the progressive reduction of pollution of groundwater and prevents its further pollution, and
(e) Contributes to mitigating the effects of floods and droughts" (Directive 2000/60/EC, Official Journal L 327, 22/12/2000 p: 0001 - 0073)

Also Common Implementation Strategy (CIS) is accepted with European Water Directive.

An important instrument that supports European Water Directive is environmental impact assessment (EIA) that plays important role on determination damages of urbanization on ecological balance concerning with water issues. With environmental impact assessment pressures of any urban area on water require can be calculated. Effects of urban areas on water require can be defined by the help of EIA. Especially effects on wetland areas and its process can be defined.

3. IMPLEMENTATION

In this chapter two important processes are considered that they are land use strategies and environmental impact assessment. Land use strategies are determined planning decisions so that this is the beginning part of implementation. According to land use decisions roads, houses, parks as well as industries, dams, power plants, harbors, airports, highways… etc. are built. In this manner EIA will be considered in implementation part. Land use strategies and environmental impact assessment constitute feed back stage in environmental planning process.

3.1 Land Use Strategies

In this section, it is necessary determine land use strategies with the wetland areas context. The first and the most important part and component is water in the wetland areas. With this respect the water sources of the wetland areas which are basin, lake, river … etc must be conserved. There is an important role analyze large scale topography. "Consisted of the large-scale topographic features "macrotopography" that makes for healthy and vibrant wetlands" (Trimbath, K., 2006). If so the first subject is topography. When the buffer zone constitute, the topography must be analyzed. Wetland areas and their water resources must be conserved and the conservation border defines ground and underground water. In topography morphology of land must be analyzed. Morphologic characteristics determine suitable and unsuitable areas for settlements. Morphologic characteristics are also determining reservoir of wetland basin.

Second subject is hydro-geologic characteristics. When hydro-geologic features of wetland basin are well known, non-source of contaminants can be under controlled. Groundwater and as well as underground water characteristics can be determined and according to these values land use strategies can be developed. Contaminants permeate into soil and move trough to lake in permeable and semi-permeable areas. Pollutants move with surface waters and reach directly to lake in non-permeable areas. In that case land use strategies are changed according to permeable soil and non permeable soil. Groundwater flow should be controlled and contaminants must be hindered in non-

permeable areas. Underground water should be clean, and contaminants should be removed from permeable and semi-permeable areas.

The third subject is gentrification and displacement. This is the main subject of urban sprawl. In particular rich citizen of cities demand good comfort, large and luxury house. So they build new houses near cities and suburban. However they also increase the burden on the natural resources or areas. Similarly the middle-class citizen want house owner. They build new settlements around city because the land prices cheaper than the city centre. They build their houses with housing estate and cooperatives. In Turkey poor-class citizen build also their houses near city but their houses is squatter. The planners and the institution of government suggest and present affordable housing with land use plans. Other land use strategy is decentralization of light industry and the heavy industries. If there is heavy industry near conservation zone, it must be decentralized to another area.

Fourth main subject is rural effects; rural effects contribute to facilitate determine land use strategies. Rural land uses can be formed from agricultural areas, forest areas, forbs or meadow areas… etc. rural areas are also nest sites for wild life and endemic species. Wild life areas, endemic species, vegetation must be conserved. However agriculture produces some poisons, and these poisons cause pollution in wetlands and its ecosystem. Fertilizer is used for the purpose of enhancing fertility of yield. Fertilizer increases quantity of phosphorus, nutrients in soil. These contaminants mix underground and groundwater so that eutrophication process happens quickly in wetlands. Pesticides and herbicides are important contaminants that they protect yields from harmful living things and plants diseases. However these pesticides and herbicides pollute soil groundwater as well underground water. Whole living things are affected and become extinct because of these pesticides and herbicides; and lifecycle on wetland basin are spoiled. On the other hand excessive agriculture causes erosion. Sediments move from origin soil to lake by stromwater, river or stream, wind…etc. with erosion. These sediments fill lake and then lake transforms into swamp. In that case it should be taken into consideration when a lake basin is planned, and erosion must be obstructed.

3.2 Environmental Impact Assessment in Planning Process

First environmental act is approved in 1983 with the law number 2872 in Turkey, Environment Law. With this law the first conservation studies and approaches has begun. The environmental impact assessment (EIA) became a current issue when the "National Environmental Policy Act" approved in 1969 in USA. In Turkey the first Environmental Impact Assessment law is approved in 1993. It has changed and improved three times. Last variety is approved in 2003.

"EIA determine affirmative and adverse effects of projects which will be realized. EIA is a process preserving the adverse affects or to mitigate of negative effects as much as minimum. EIA is also a process of determining alternatives of selected areas or technologies, assessment and controlling of all works of project implementation" (the EIA act Turkey). However EIA is a process of determine adverse and negative affects of projects and inform policy makers to prevent these negative affects, but the EIA has a meaning beyond of this situation. Namely, EIA is an instrument of strategic and urgent decision making process, but also it is an essential for utilizing the resources such in balance. Therefore the EIA is a necessity for sustainable growth, for mitigating the adverse effects to the environment, for economic growth with sustainable urban expansion, for achieving the plans. At the same time EIA contribute the process of cooperation between institutions. With this respect EIA is a necessity not only in the projects processes but also in the planning process.

Four main subjects are significant in the environmental impact assessment process. They are:

1- Screening
2- Analysis
3- Informing the decision
4- Evaluation (Bhatia, R., 2007)

Screening stage is the first stage of determination of the existing situation. This stage provides to understand the engagement of problem, threat between potentials, opportunities. Analysis stage is the second stage and it ensures to research empirical researches and environmental conditions and the project relations between project scope and areas. And with this stage it is possible to research the possible effects to environment of the projects. With this stage is constituted *predicting effects*. Then the third part of the EIA's process begins. This stage is informing the decisions. In this stage the data of the project area and the effects of project are appraised. And the alternatives inform to the stakeholders. This stage is important for the participating. In this stage every stakeholder of the project is informed about project. The last stage is evaluation; this stage is the last appraise all stages and outcomes of the project. And then the implication process begins.

In Turkey the EIA process appraise the projects process. There are five types list with the appendix of the environmental impact assessment act. These are Appendix-1 the list the environmental impact assessment is a necessity, Appendix-2 the list select and eliminate criteria carries out (pre-EIA process), Appendix-3 the list the general format project presentation, Appendix-4 the list basis election criteria to prepare project presentation folder, Appendix-5 sensible areas and key biodiversity areas.

With this respect in Turkey EIA is not used for land use plans. When a land use plan is prepared, in this area we designate utilization of planning functions. Nevertheless the urban development is determined. At the same time with land use, development and construction plans determine the construction precedent. When the plan is approved, the investor wants to construct their industry or production units. But at this stage the Ministry Forest and Environment wants report of EIA. By the way the investors buy/bought the land and draw/drew the project. So they invested their money to this area. And then with the EIA project is approved or not approved. Then the implementation stage is beginning. In fact, when the EIA is prepared at the planning process and all suggestion functions is controlled with EIA, we gain more time. And then the EIA report

is prepared for the project. This process provides that fewer projects rejected from the Ministry of Forest and Environment.

There are two main subjects have significance using the EIA in the land use planning process.

a) Enhance the quality of decision-making and achieve the sustainable use of land resources
b) Complement the limitation of project EIA (Tang, T., Zhu, T., Xu, H., Wu, J., 2005)

First subject is related with high level strategic decision making and the utilization limited resources with more scientific in the planning system. Nevertheless the ecologic, economic and social sustainability is appraised in the planning system.

Second subject is related with adopt comprehensive approach, and individual and apart projects are less successful. The comprehensive approach consolidate with land use plans and the perennial practice are together is constituted much stronger effect.

The table below shows the planning system and relationship between EIA. As it shown there is no requirement to the EIA in land-use plans. Every land-use plan has an affirmative and adverse effect on land resources. The land use plans contribute the development of cities and land use plans have an aim of mitigation adverse impact. When EIA is used in the planning system, it helps to mitigate the adverse effects on land resources.

3.1 Hierarchy of planning system and relationship between EIA

Upper scale plans	**Land use plans**	**Specific plans**	**Scale**	**Related institutions**	**Related law (act)**	**EIA**
Socio-economic development plans				Prime ministry state planning organization		Not required
Regional plans				Prime ministry state planning organization	3194 Construction and Development Law	Not required
	Basin and regional plans (environment arrangement plans)		1/100.000 1/50.000 1/25.000	Ministry of forest and environment	5491 Environment Law	Not required
	Environmental arrangement plan		1/25.000	Metropolitan municipality	5216 Metropolitan Municipality Law	Not required
	Environmental arrangement plan		1/25.000	Management of Provincial assembly	5302 Management of Provincial Assembly Law	Not required
	City arrangement development and construction plan		1/5000	If there is metropolitan municipality, metropolitan municipality do, If not local municipality do	3194 Construction and Development Law	Not required
	Development and construction plan		1/1000	Local municipality	3194 Construction and Development Law	Not required
		Conservation aimed plans, tourism plans, transportation plans…etc				Not required

EIA should be incorporated in planning system. More or less every land use functions affect environment, especially industrial regions. In that case some regulation should be enacted in Turkey's planning law system. For instance EIA must be obliged for cover big size land in planning region, in this manner investor know that this area requires EIA. Investor can take into consideration EIA and environmental liability. In particular land use plans environmental arrangement plans (1/25000) City arrangement and development plans (1/5000) and City construction and development plans (1/1000) should include EIA for big size cover land. And then appendix-1 or appendix-2 can be implemented for investment regions.

The main and important point is that "the unplanned areas" in Turkey. In Turkey there are huge amount of "unplanned areas" therefore the solution above can direct the investors to "unplanned areas"; and they can avoid EIA. At this stage EIA and appendix-1 and appendix-2 will be utilized in unplanned areas. Thus EIA can be implemented for whole Turkey and every investment especially industries can be controlled with EIA. This process helps anticipating environmental impacts and effects therefore environmental impacts and negative effects of land uses can be obstructed.

The main problem is the confusion of the institutional land use planning system. There are a lot of institutions which make same plan in particularly environment arrangement plan. In practice the institutions try to solve this confusion. The management of provincial assembly gives its authority to the Ministry of Forest and Environment. If there is metropolitan municipality, the confusion begins. Both metropolitan municipality and the ministry of forest and environment have authority prepare land use plans. Metropolitan municipality prepare 1/25000 and 1/5000 plans and local municipalities prepare 1/1000 in metropolitan areas.

4. CASE STUDIES

In this part the theory of the study's first three topics will be researched. Nevertheless the aims of the study are testing the experience of theory and try to solve the problems of wetlands areas which are affected from metropolitan areas and under urbanization pressure. It should be researched that management and land use plans. In particularly settlement appropriateness should be developed for wetland areas. Management of wetlands and land use plans are the most important instrument of the environmental planning approach. Wetland areas can be conserved and maintained with these instruments, this is also possible that give a direction to sprawl of cities and metropolis. This research has two case study areas. With this research the case study areas compare each other, get expressive results, this results use directed towards to the future. First case study area is Mogan Lake. Mogan Lake is 20 km far away from Ankara. Mogan Lake is affected from Ankara. Mogan has a special conservation status, for this reason it can be possible to constitute a model for these wetland areas. The second case study area is Büyükçekmece Lake. Büyükçekmece Lake is near Istanbul. Büyükçekmece Lake is under affected Istanbul's metropolis. Büyükçekmece Lake is 50 km far away from center of Istanbul; however Istanbul's metropolis settlement starts to choose location from Büyükçekmece Municipality. Büyükçekmece Lake does not have any conservation status yet. Both of these lakes are affected from metropolis, and they have not only international water bird character but also nearly same character when they are evaluated with Ramsar criteria. Büyükçekmece and Mogan Lakes have some problems with urbanization pressure, agriculture, and industry, strong highway connection… these similarities facilitate to compare these areas. It can be possible constitute models and get results for the future of similar wetland areas. The table below shows evaluation of Büyükçekmece and Mogan Lakes with Ramsar criteria.

4.1 Criteria and conservation status of the case study areas

Number of place	NAME OF PLACE	The City	Ra	AREA (ha)	Coordinates									STATUS OF CONSERVATION					
					Latitude (...° ...')	Longitude (...° ...')	1	2	3	4	5	6	7	8	TKA	YHS	DS	MP	TP	ÖÇK
026	Mogan Lake	Ankara		1500	39 42	32 46		+	+	+	+	+								X
067	Büyükçekmece Lake	Istanbul		2850	41 03	28 34		+		+	+	+		+						

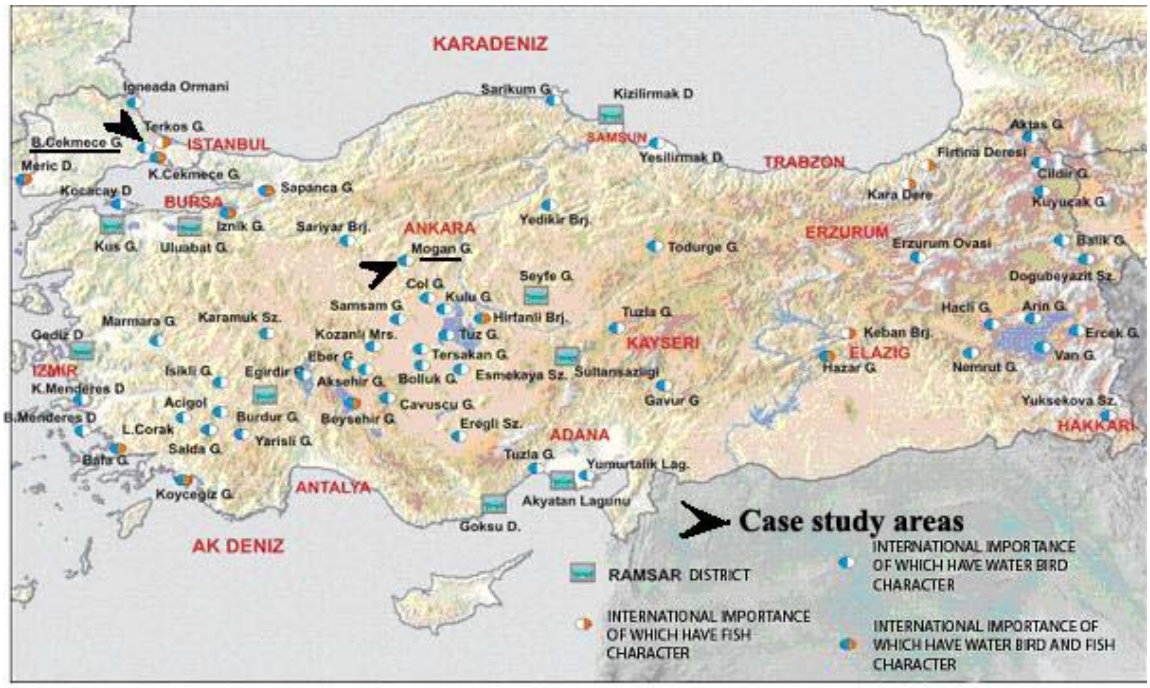
Criteria of Ramsar	
1	Criteria for the representative or uncommon wetlands (typically)
2	if a wetland includes noteworthy quantity uncommon, plant and animal species or sub species which under danger or can be under danger or has these species one or more individual (noteworthy quantity)
3	If the wetland has a special importance because of for maintaining quality of ecology and genetic variety of one region with characteristics of flora and fauna; or
	the wetland area has special importance because of endemic plant and animal species or community, or
	If it has character of wetlands, efficiency (product) or it shows diversity and has noteworthy water birds groups and support them. It can be characterized (described) as has an international importance wetland area
4	If a wetland area has a special importance about the living areas and habitats for the biological circle (cycle) of critical stage (phase) of these plants and animals, It can be characterized (described) as has an international importance wetland area
5	It can be characterized (described) as has an international importance wetland area if the wetland area support continuously 20.000 water birds
6	if a wetland area such a place that it can be possible to get datum and if this wetland area support continuously 1 % of species of water bird or sub species, It can be characterized (described) as has an international importance wetland area
7	if the wetland has huge amounts of natural fish species, or family, the life cycle, the benefit and/or value of wetland, on account of has global variety that indicate the relationship between species or/and populations, It can be characterized (described) as has a international importance wetland area
8	If the wetland inside or the basin of the wetland has important nourishment for the fishes, is a place of lay egg or to be fed and living area or/and is a place of migrating way of fishes, It can be characterized (described) as has an international importance wetland area

TKA: Conservation of Nature Area, **HKS:** Development or Conservation of Wild Life Area, **DS:** Natural Conservation Area (Officially Registered), **MP:** National Park, **TP:** Nature Park, **ÖÇK:** Special Environment Conservation Area, **Ra**: Ramsar Area

Source: Ministry of Environment and Forest, General Directorate of Nature Conservation and National Parks, Department of Nature Conservation-Wetland Division

This table was made by Ministry of Forest and Environment. This table includes all the wetland areas of Turkey which was determined by Ministry of Forest and Environment. There are eight criteria of Ramsar which ministry used to determine wetlands. It can be easily realized that 2. 4. 5. 6. Criteria of Ramsar is same Büyükçekmece and Mogan Lakes. Both Büyükçekmece and Mogan have not Ramsar Area status. Mogan Lake has Special Environment Conservation Area status. Büyükçekmece has not had conservation status yet.

Fig. 4.1 Quality of wetland in Turkey



Source: http://www.cevreorman.gov.tr/sulak/sulakalan/sulaka.htm

Atlas Dergisi (Magazine), (2006) Türkiye Sulak Alanlar Haritası (13.09.2006), http://www.cu.edu.tr/merkezler/tyhm/Sayi38.html

Turkey is a rapid developing country and Turkey has rapid growing urbanization characteristics. This type of urbanization characteristic has to lead unplanned development and deterioration of natural areas nearby metropolitan areas.

Within this approach wetlands are chosen as basic elements of natural conservation, first of all, this thesis will aim to make a threshold analysis on the natural areas. Effects of urbanization on a sample area will be researched with the help of thresholds, and a proposal for an environmental arrangement for the wetland area will be given.

With this study it is aimed to construct a model for conservation of wetland areas. By this way sustainability of natural life and ecosystem can be achieved and a study that contains application dimension of Turkish water policies will be held. And a method will be

developed for not only wetland conservation but also urban land use strategy and land use planning.

4.1 Mogan Lake

Mogan Lake is 20 km far away from Ankara. Mogan Lake is natural lake that it has natural filling lake structure. Approximately 100 years ago a landslide had occurred and lake became blistered in its basin. As time passed Mogan Lake constituted its own special microclimate and habitat. Endemic species and important flora and fauna exist on Mogan Lake and its environment because of its special microclimate.

Strengths and weakness as internal affects of Mogan Lake, and opportunities and threats as external affects of Mogan Lake will be researched in order to comprehend existing situation of Mogan Lake. In this way the existing situation will be easily understood and the conservation method of Mogan Lake will be determined. In this sense the strengths, weakness, treats and opportunities of Mogan Lake will be scrutinized.

4.2 Analysis of Mogan Special Environmental Protection Area

Internal Affects		**External Affects**	
STRENGTHS	WEAKNESS	OPPORTUNITIES	THREATS
a. Important endemic species potential b. Important bird potential c. Diversity of species d. Rushy and reedy places e. Controllable housing and building development	f. Intense erosion g. The eutrophication structure of Lake h. Increasing Macrophytes and rooted water plants i. Wide agricultural places	j. Has a special status of special environmental protection area k. Nearness to Ankara l. The researches in Universities about Mogan	m. Upper income classes dwelling n. Low density housing policy-wide range of land will deteriorate o. Spread out on land because of low density housing require more technical infrastructure p. Recreational interventions

Mogan Lake has important endemic potential and Mogan Lake possesses diversity of species. Flora of Mogan Lake encompasses “476 species, 6 subspecies and 6 varieties and

totally 488 plants exist on Mogan Special Environmental Protection Area. There is 52 endemic species exists in these 488 taxons. Centaurea tchihatcheffii, Erysimum torulosum, Dianthus ancyrensis are under high risk. The characteristic flora of Mogan Lake consist of Crataegus dikmensis, Rannunculus isthmicus, Papaver rhoeas, Amygdalus orientalis, Xeranthemum annuum and Centaurea tchitatcheffi" (Erciyes, Ö. F., Şengünlü, Y., Doğanay, H. İ., and others 2007). They are the important characteristic flora. Mogan has not only flora but also fauna. For example "227 birds present on Mogan; 40 of them reproduce on Mogan, 30 of them live there whole year and the others are observed just their migration period. Mogan has also avian species richness; notable species are Ardeola ralloides, Ixobrychus minutus, Oxyura leucocephala and Falco naumanni are the absolute protection species that these species were listed in Bern Agreement Annex II. Ardeola ralloides, Botaurus stellaris, Ixobrychus minutus, Netta rufina, Aythya ferina, Aythya nyroca and Oxyura leucocephala reproduce on Mogan Wetland Area and which are listed in red list"(http://www.ockkb.gov.tr/EN/Icerik.ASP?ID=132). The other important taxons were given at table below.

4.3 Taxons and characteristics of Taxons in Mogan Special Environ. Protection Area

Name Of Taxon		Endemic	One Point Endemic	Red List		Growth Of Population
				Global	Regional	
	Centaurea tchihatcheffii	1	1	-	CR	existing
	Puccinellia anisoclada ssp. melderisiana	1	0	-	EN	existing
	Acrocephalus melanopogon	0	0	LC	LC	existing (reproduction)
	Ardea purpurea	0	0	LC	LC	3-5 pair (reproduction)
	Ardeola ralloides	0	0	LC	LC	30-40 pair (reproduction)
	Aythya nyroca	0	0	NT	VU	74-200 (migration)
	Aythya nyroca	0	0	NT	VU	10-20 pair (reproduction)
	Botaurus stellaris	0	0	LC	LC	1 pair (reproduction)
	Calandrella rufescens niethammeri	1	0	LC	VU	existing (reproduction)
	Circus aeruginosus	0	0	LC	LC	10 pair (reproduction)
	Falco naumanni	0	0	VU	LC	300 (migration)
	Fulica atra	0	0	LC	LC	25000-70100 (1994 migration)
	Ixobrychus minutus	0	0	LC	LC	10-30 pair (reproduction)

	Netta rufina	0	0	LC	LC	673 (1993 migration)
	Nycticorax nyticorax	0	0	LC	LC	10-20 pair (reproduction)
	Oxyura leucocephala	0	0	EN	VU	3-4 pair (reproduction)
	Testudo graeca	0	0	VU	NT	existing
	Emys orbicularis	0	0	NT	NT	existing
	Rhodeus sericeus amarus	0	0	LC	-	existing
CR: Critically endangered LC: Least concern NT: Near threatened VU: Vulnerable EN: Endangered						

Source: Aydın, A., Mutlu, S., Tuncalı, T., 2006. Mogan Gölü, 58 (volume 2), Turkey'nin Önemli Doğa Alanları. Doğa Derneği, Ankara.

Rushy and reedy places are important; they are not only associated with obstructing sediments, pesticides, and nitrogen and phosphorous but also offer refuge places for birds, nest sites for the other species. Rushy and reedy places serve bedding areas especially birds stop off here and roost when they are in migration. Rushy and reedy places serve benefit and enhance water quality, in this way fishes and the other species find a habitat. The other strength side of Mogan Lake is controllable housing and building development. Because of its conservation status, construction can be easily controlled than the other places.

Besides Mogan Lake has strength sides, it has also some weaknesses. The main problem is erosion; first reason of erosion occurs because of agricultural productions, and second reason of erosion occurs because of vegetation. The vegetation of Mogan Special Environmental Protection Area appropriates for erosion. Intense erosion causes to fill Mogan Lake with sediments and soil. Gradually the depth of Mogan Lake decreases and the lake becomes swamp. Ooze and mire level of Mogan Lake increases day by day. Agricultural production causes also increasing quantity of phosphorus and nutrients in soil at the same time increasing amount of pesticides and herbicides. Pesticides and herbicides poison to water and living things become to die; as time passes the species vanish. Phosphorus and nitrogen prompt increase overflow aquatic vegetations, macrophytes, alga and phytoplankton in water; with this process lake becomes eutrophic. Settlement areas contaminate and cause also eutrophication. Because of Mogan Lake's eutrophic structure aquatic vegetations and macrophytes are in high level.

Although Mogan Lake has some weaknesses and problems there is some opportunities to maintain Mogan Lake and its wetland area. First opportunity is that Mogan Lake has conservation status named by Mogan Special Environmental Protection Area. This means Mogan Lake and its conservation area is managed by own institution. This institution belongs to Ministry of Forest and Environment; therefore Mogan Special Environmental Protection Area is independent from local political pressures. However this institution is entitled to just make plans, planning implementations and technical services are provided from local municipalities. There are two municipalities that they have authority about Mogan Special Environmental Protection Area; they are Ankara Metropolitan Municipality and Gölbaşı Municipality. Mogan Lake has another potential that Mogan Lake closes to Ankara. This nearness facilitates attracting attention to Mogan Special Environmental Protection Area. Every negative intervention easily brings about to generate nongovernmental organization pressure. At this point universities which they present in Ankara can contribute and support nongovernmental organization. On the other hand especially Ankara University, Middle East Technical University, Gazi University and Hacettepe University make/made very different researches about Mogan Lake. These scientific researches are necessity in order to protect/conserve or maintain Mogan Special Environmental Protection Area. In this way we can easily comprehend problems, potentials, threats, opportunities, different point of views; and we can develop solutions to maintain Mogan Special Environmental Protection Area.

During in planning work we have to take into consideration the threats of Mogan Lake. In our planning process we can notice these negativeness and we can lessen the effects of these problems. Mogan Lake is important water region in Ankara; it has a special scene and views with its beautiful environment. It has also a special micro-climate and this micro-climate is better quality than Ankara. This attractiveness brings about that upper income classes choose location Mogan Lake and its environment for their dwellings. These upper classes dwellings have special feature that they are built in low density order and they are less stair (storey) than block apartments. The houses have villa, luxury, duplex characteristic. However in this order of structuring there is more land required and

also this settlement system necessitate more technical infrastructure and roads. For this reason dwellings spread out on Mogan Special Environmental Protection Area and characteristic of Mogan Special Environmental Protection Area gradually deteriorates. In this order of structuring there is more car owner than city centre. This order of structuring and housing does not support mass (public) transport therefore there is more environmental contamination because of exhaust gas. In this order housing get difficult the protection of endemic and the other species. Ecological and environmental deterioration increases in this order of type of settlement. However the master plan of Mogan Environmental Protection Area supports this structure and settlement of order. The other main problem is recreational interventions; Mogan Lake is 20 km far away from Ankara city centre and Ankara has limited water sources. Citizens of Ankara prefer to go Mogan Lake and the other recreational areas for their recreational requirements. However with this recreational interventions damage to reed places near Mogan Lake and these interventions demolish nest sites of birds and refuge places for the other species and wildlife. On the other hand these recreational functions attract people to Mogan Lake and for this reason the pressure on the lake will increase. Conversely the master plan of Mogan Special Environmental Protection Area supports both upper income dwellings and recreational functions and regional urban sport centers. And the other threat of Mogan Lake is waste water discharge. Water discharge and sewerage systems accelerate the process of eutrophication.

In this respect Mogan Lake is very important area, it has important role for birds breeding, roost point for birds and there exist 52 endemic plants. Mogan Lake has also special ecologic environment for species. For this reason Mogan Special Environmental Protection Area must be conserved and maintained. However some difficulties present to conserve Mogan Lake and its conservation area. Taking into account of these weaknesses and threats a new approach should be developed, because problems of Mogan Lake continue until today. In that case we should inquire land use of Mogan Special Environmental Protection Area in order that we can comprehend existing situation of Mogan Special Environmental Protection Area.

4.2 The Reasons of the Mogan Lake as a Case Study Area

The aim of this study (project) consider the problems of wetland areas which are effected from urban development (sprawl and sectoral development), and find the solutions which can be faced in the future in this areas. Mogan Lake contains all basic problems like the other wetlands which are effected urban sprawl and pressure. Mogan Lake had wrong urban planning decisions as the other wetlands near metropolitan areas in Turkey. Mogan Lake has a special conservation status; this status is managed under a special law. Mogan has potential that it can be possible solve all the problems and improve the law system of these conservation status areas. It can be also suggested for the other wetland areas. Mogan should be conserved because "there is not any alternative of Mogan Special Environmental Protection Area and it has special identity" (Çamur, K., C., 1995).

4.3 The Conservation and Management History of Mogan Lake

On 16.02.1976[1] the act of Protecting the Mediterranean Sea was approved in Barcelona. Turkey approved this act 20.07.1986. With this act Turkey guaranteed that determine ecologic, hydrographic and hydrologic areas, and also guaranteed that maintain all these conservation areas. These areas have a special status with the Law of Environment (2872) because of this law's 9. article. This Special Environment Conservation district can be declared by the Council of Ministers. Institution of Conservation Special Environment is the authority that conserves these areas, solve problems of these areas, maintain these areas, make all development and management plans, and determine usage fundamental principles. "This institution was established first belong to prime minister and in 1991 this institution moved without any change of its authority into Ministry of Environment and Forest. Gölbaşı Special Environment Conservation Area is approved in 22.10.1990 by the decision of the Council of Ministers and this decision published in 21.11.1990 the official journal. When the first Gölbaşı Special Conservation Area declared, there was

[1] All the dates and data of this chapter 4.3 are quotation from Environmental Arrangement Plan Report of Gölbaşı Special Conservation Area

Gölbaşı Municipality, villages and development area of Çankaya Municipality in the conservation area. Then on the date 10.07.2004 with law number 5216 Metropolitan Municipality Law the planning and authority area of Ankara determined as radius 50 km. For this reason whole Special Conservation Area joined to Ankara Metropolitan Municipality. This means Ankara Metropolitan Municipality is the authority of investment and infrastructure in Mogan Special Environmental Protection Area. Nevertheless with this law all status of villages was changed to ward (city neighborhood). However the Institution of Environmental Protection Agency for Special Areas (EPASA) is still the only planning authority recently.

4.4 Problems of Mogan Lake

The main problem of this conservation area is strong transportation with Ankara. There are three important motorways in this area. First one is on the east side of the lake Ankara-Konya motorway, second is on the west side of the lake Ankara-Haymana motorway, third one is on the north side of the lake Ankara belt highway. With this respect it can be easily said that the conservation area has strong connection with Ankara. Therefore there is urban pressure on this area.

Second main problem of this area is wrong implementations. “In 1969 there was a big flood in Gölbaşı. After this flood State Hydraulic Works (DSI) built regulator between Mogan and Eymir Lakes” (Gölbaşı Special Environmental arrangement plan report), and also Eymir give excessive water to Ankara Creek (stream). Mogan gives its excessive water to Eymir Lake. Similar Eymir Lake gives its excessive water to Ankara Creek (stream). In this manner Gölbaşı and the other settlements are prevented from waterflood. However lakes need flood area or flood plain, this is necessary against drying. Because of this situation Mogan Lake has problem of its ecological balance. Second wrong implementation was trying to dry swamp which is south part of the Mogan Lake. State Hydraulic Works (DSI) tried to dry Çökek swamp. State Hydraulic Works wanted to gain settlement area. This part of lake is the living area of birds; and this place is full of reedy.

On the other hand this area is not appropriate for building because of the capability of soil. Third wrong was Gölbaşı Municipality used underground water till this municipality joined to metropolitan municipality of Ankara. It caused also water decrease in the lake. At the same time underground water is used for agriculture before this area gained conservation status. Fourth wrong was Gölbaşı Municipality used north region of the lake as a solid waste area.

Third main problem of this area is sedimentation and eutrophication. There is productive soil south and west part of the lake. These areas are using for agriculture, for this reason nutrient and phosphorus mix with water. On the other hand north part of the lake there is Gölbaşı settlement, this settlement produces sewer for this reason residential wastes mix with water. East part of the lake there is motorway (Ankara-Konya) along this road there are industries and industrial stores. Although these industries are light industry, they give burden to conservation area. These reasons cause eutrophication in the lake. One and the more important reason of sedimentation is erosion. North, Northeast and east part of the lake are high erosion regions.

Fourth main problem is planning decisions before the area declared ad special environmental protection area. First plan of this area started in 1970; this plan is a plan that was made whole Ankara. This is Ankara Development Plan and was made by Bureau of Ankara Planning of Development. With this plan it was accepted Gölbaşı was a center for Ankara's recreation area. This plan has projection year for 1990. This plan aimed development of Ankara through Gölbaşı and around the Mogan Lake. On the other hand plan decided that the east and southeast of the lake was as industry and industrial store area. These planning studies started in 1970 and completed in 1977. In 1981 Mogan Lake was declared as a tourism area and this tourism plan completed in 1984. 1985 new planning studies began for whole Ankara Metropolitan Area. This plan had projection year 2015. This plan aimed to become united whole with Ankara. This plan and also the other plans decided about this area as a recreational area of Ankara. This point of view and beautiful landscape and view points caused to choose prestige houses this area. In 1985 Gölbaşı Municipality finished its development plan. In 20.07.1986 Turkey approved

the act of Barcelona. In 1987 Ankara belt highway project was approved. In 19.10.1989 Environmental Protection Agency for Special Areas was established. 22.10.1990 Gölbaşı was declared as a Special Environmental Protection Area. When an area is declared as a Special Environment Conservation Area, all the other plans are cancelled.

4.5 Evaluation of Environment Arrangement Plan of Conservation Area

It has important points of the analysis part. The plan was completed in 1992. The aim of conservation is important in this conservation plan. The plan accepted this area as a recreation area, although Gölbaşı Special Conservation Area has real ecological importance. Plan decided that northwest region of the area as residential development area of Ankara. It is accepted the area of parcel for new settlement is 1500 m² in Gölbaşı Special Environmental Protection Area. The plan accepted from lake to agricultural area 50 meter buffer zone. With Gölbaşı Environmental Arrangement Plan it is decided that all the industries and industrial stores move other places when their economical life finish. Plan has an important wrong that it gives permission for settlement near village or in village, for this reason villages are now growing and developing.

Plan of Gölbaşı Special Environmental Protection Area was revised by Environmental Protection Agency for Special Areas (EPASA) in 2009. According to this revision plan on west side of Mogan Lake had chosen as settlement areas. These settlements have low density and low storey construction characteristic. Typical settlement was envisaged and design as luxury house type like villa, duplex or expensive detached house with a garden. Aquifer areas were determined as conservation zones.

4.6 Büyükçekmece Lake

Büyükçekmece Lake is fifty km faraway from the city center of Istanbul. The Ministry of Forest and Environment researched Büyükçekmece Lake with Ramsar criteria. With this research define that Büyükçekmece Lake is provided Ramsar's 2., 4.,5.,6.,8. Articles (see Table 4.1). Although Büyükçekmece Lake has important ecological potential nowadays Büyükçekmece Lake does not have any ecological conservation status except İSKİ act. Some rules were determined for closing settlements to Büyükçekmece Lake according to İSKİ act because Büyükçekmece Lake provides potable water to Istanbul.

Büyükçekmece exists on the west part of Istanbul. Nowadays there is important urban residential development in Büyükçekmece Basin in order to provide land for growth of Istanbul. Apart from this there are a lot of factories in Büyükçekmece Basin. On the other hand wide range of agricultural areas present on the northwest side of Büyükçekmece Lake. For these reasons Büyükçekmece Lake is polluted and this contamination damages ecological life as well as potable water of Istanbul. As time passes Büyükçekmece Lake will be lost its wetland character because of contamination.

The general qualities and quantities of lake are; the area of the lake approximately 28.6 km², total precipitation of the lake area is 620 km², average depth of the lake is 3.84 m, maximum depth 7.68 m. therefore we can say that Büyükçekmece is a wetland according to Ramsar Criteria (Ramsar Article 1.1) it has shallow structure and the average of depth of Büyükçekmece Lake is less than 6 meters. On the other hand Büyükçekmece Lake is Mesotrophic lake according to phosphorus value in that case eutrophication should be taken into consideration for Büyükçekmece Lake. There are some information quantities and qualities of lake are given at table about Büyükçekmece below.

4.4 Quality and quantity of Büyükçekmece Lake

Lake / Reservoir / Small Dam		Büyükçekmece Lake (Dam)
Basin		Marmara
Sub-Basin		Büyükçekmece
Area (m^2)	Lake surface	28,6 km^2
	Total precipitation	620 km^2
Altitude (m)		- 1,00 m
Conservation Status		Freshwater Lake - Dam (According to SKKY)
Aim of usage		Freshwater
Depth	Maximum depth (m)	7,68 m
	average depth (m)	3,84 m
Average lake temperature (C^0)		14,3 ^{o} C
Volume (m^3)		161 600 000 m^3 /per year
Pollution sources effect lake (settlement (dwelling), industrial, agricultural)		Settlement + Industrial + Agriculture
Lake Flora		There is no special research
Lake Fauna		There is no special research
Type of lake (Oligotrophic, Mesotrophic, Eutrophic)		mesotrophic (according to phosphorus value)
Location	Coordinates	632 ^{150} -4543 ^{050}

Source: Birpınar, M., E., and others 2005 The Report of Istanbul Environment Condition Report

4.7 The Reasons of the Büyükçekmece Lake as a Case Study Area

At this chapter the main reason for choosing Büyükçekmece Lake will be researched; and case study Büyükçekmece compare with Mogan Lake. Büyükçekmece Lake exists near Istanbul on the direction of sprawl, development and growth of Istanbul. Mogan Lake exists 20 km far away from Ankara City center and there is important urban pressure on Mogan Lake. There is important urban pressure on Büyükçekmece Lake because of development of Istanbul. There are important transportation axes in Büyükçekmece Basin; Mogan Lake has also important motorway (Ankara-Konya motorway) in its conservation area. Büyükçekmece Lake has mesotrophic feature so that in the future eutrophication can be observed in Büyükçekmece Lake if the problems of Büyükçekmece Lake will not be solved; Mogan Lake is eutrophic Lake. While Planning decisions are researched it can be seen that Büyükçekmece Basin is chosen as a settlement region of Istanbul. Planning decisions choose west part of Mogan Lake as luxury dwelling area. These similarities with Mogan Lake mentioned above; facilitate comparison of these two lakes. Therefore it can be possible get expressive results. With this respect the model will

be constituted. The big parts of the wetlands of Turkey do not have a conservation status; Büyükçekmece Lake does not have an ecological conservation status also. For this reason it can be possible constitute a model for the other wetlands in Turkey.

4.8 The Conservation and Management History of Büyükçekmece Lake

Büyükçekmece has really ecological importance however there is no conservation status. On the other hand in 1983 State Hydraulic Works (DSI) decided to make a dam for providing freshwater to Istanbul. "The dam was built from 1983 to 1988" (Birpınar, M., E., and others 2005). This dam was built the joining part sea with lake; this area is shore part of lake with sand and soil. This dam started to blister since 1989 for obtaining freshwater to Istanbul. Büyükçekmece Lake provides freshwater to Istanbul, consequently some conservation zones were determined to preserve the basin from urban effects. These conservation zones are in sequence; absolute conservation zone, short distance conservation zone, middle distance conservation zone, and long distance conservation zone. The covered area of these conservation zones is given below at the table.

4.5 Comparison of conservation zones of freshwater resource areas of Istanbul

Resource	**Reservoir surface area km²**	**Total conservation area**	**Absolute conservation area**	**Short distance conservation area**	**Middle distance conservation area**	**Long distance conservation area**
Terkos	32	619	25	51	62	449
Alibeyköy	3	160	12	18	20	107
B.çekmece	**36**	**621**	**19**	**34**	**44**	**488**
Elmalı	4	81	10	12	29	26
Ömerli	23	621	40	55	63	440
Darlık	9	207	16	22	21	140

Source: Birpınar, M., E., and others 2005, The Report of Istanbul Environment Condition Report

As it is seen in the table though the reservoir surface of Büyükçekmece Lake quite bigger than the other lakes, the conservation zones area of Büyükçekmece Lake is smaller than the other lakes. Consequently the lake is affected from urban pressure and sprawl.

4.9 The Problems of Büyükçekmece Lake

The first and the main problem of Büyükçekmece Lake is strong transportation convenience with Istanbul. There are three main roads pass through near Büyükçekmece Lake. Two of them are motorways and one of them is railroad. The first motorway passes through the shore, which is intersecting area with sea, and this motorway goes through Istanbul. This motorway is called E-5 and this way connects to Istanbul Bosporus Bridge. Second motorway passes through north part of the lake, this motorway connects between Europe and Turkey, is named TEM (Transport European Motorway).TEM is connecting to second Bosporus Bridge. Railroad is connecting between Istanbul and Europe, this railroad passes through at north part of Büyükçekmece Lake.

This strong transportation connection creates important attractiveness in particular industrial functions and housing function in Büyükçekmece Basin. Closeness to a "big market" as Istanbul causes that the industries choose place for their factories near Büyükçekmece Lake. When industries build their factories close to lake area, industries attract urban settlement and migration. This population growth and industries' pollution make pressure on lake. As we mentioned before Büyükçekmece has conservation zones because of conserving fresh water of Istanbul. However industries build their factories in conservation zones though Büyükçekmece Lake provides fresh water to Istanbul. There are a lot of factories which exist in absolute conservation, short distance conservation, middle distance conservation and long distance conservation zones.

The second main problem of Büyükçekmece Lake is wrong implementations. The first wrong implementation is determination of Büyükçekmece Lake as providing fresh water area to Istanbul. The first and the main element of wetlands is water and this approach

causes to loose water from Büyükçekmece Lake. Büyükçekmece gives 70 million m^3 potable water per year to Istanbul (Birpınar, M., E., and others 2005) (http://www.dsi.gov.tr/bolge/dsi14/isletme.htm). The second wrong implementation, after having the decision for providing fresh water to Istanbul, there was built a dam between lake and sea. Surface of Büyükçekmece Lake expanded because of blistering water; for this reason species which exist near lake submersed under water. Quality of water changed due to blister water in order to provide potable water to Istanbul.

The third wrong implementation is usage of underground water. Underground water is utilized as fresh water and also for industrial production. However there is really important risk, if the underground water is excessively used, sea will fill these blank space. This causes to loose freshwater. Soil become salty when underground water is utilized excessively for this reason the agricultural lands will be lost around Büyükçekmece Lake. And also lake will be damaged. There are 36 wells in administrative district of Büyükçekmece. These wells provide water 2.02 hm^3/per year (Birpınar, M., E., and others 2005).

4.10 The Values of Pollution in Büyükçekmece Basin

In this section the contaminant and the effects of contaminant to Büyükçekmece Basin will be researched. All wetlands have some problems with pesticides, P, N, chemical wastes… of urban settlements and industries. There is some approach to determine the effects of pollutives. For example "TOC (total organic carbon) measures the amount of organic carbon in a sample by oxidizing it to CO_2 and measuring the amount of CO_2 produced. COD also oxidizes the carbon to CO_2 (chemically) and measures the amount of permanganate reduced" (Gray and Becker, 2002).

"BOD and COD both measure the amount of oxygen required to oxidize carbon to CO_2" (Gray and Becker, 2002). Both BOD (biochemical oxygen demand) and COD (chemical oxygen demand) measure oxidation. With similar approach for chemical process COD

measures parameters. BOD_5 (biochemical oxygen demand), this is a five day duration and the quantity of Oxygen that an organic matter needs to solve in water. According to The act of Control of Water Contamination (SKKY) has a table which is 21.3; the amount of BOD_5 home's water, which the city population is from 100.000 to 1.000.000, is 45 mg/l. At the table in act number 21.5 shows ignorance of the population that BOD_5 value is calculated 50 g/person per day. If total Nitrogen is accepted 8 g/person per day and total Phosphorus 3 g/person per day in this respect the houses' wastewater amounts of Büyükçekmece Basin are at the table below. These values are calculated with population.

4.6 House wastewater quantity according to the population

Year	**1990**	**1995**	**2000**	**2020**
Population	74685	90000	120000	263200
BOD_5	3734	4500	6000	13160
Total N	598	720	960	2106
Total P	224	270	360	790

Source: Istanbul Development Plan Analysis, Büyükçekmece Research Report, İMP, BİMTAŞ (2005)

It is seen that the pollution amounts increase day by day. The population growth increases because of three main reasons. First the population of Istanbul is increasing and Istanbul needs more spaces (urban sprawl of Istanbul). Second are industry regions near the Büyükçekmece Basin. These industries are different types for examples, some of them specialized in textile, some of them in chemical industry, some of them in light industry and some of them in organized industry. The third reason is strong connection between Istanbul (traffic connection). The reason of pollution is not only house wastewater but also industrial. The table below shows distribution amount of pollution according to the industry types.

4.7 Apportion of industrial wastes burdens quantity

Burdens	Quantity	Apportion %
BOD_5	137	
COD	1540.63	51% Stockfarming 32% Fabric Industry 8,43% Milk and Milk Products
TKN	97.29	93% Stockfarming
Total P	63.5	98% Stockfarming
Oil/Gres	225.878	70% Fabric Industry 11% Stockfarming 6,16% Milk and Milk Products 13,1% not classified industries

Source: Istanbul Development Plan Analysis, Büyükçekmece Research Report, İMP, BİMTAŞ (2005)

It is seen that there are a lot of different types of industries. There were built a dam between sea and lake consequently the basin has a special feature of interior basin. Therefore all the organic, inorganic, toxic, pesticides, herbicides…etc. isn't removed from Büyükçekmece Basin and Lake. These substances stay in Basin and mix to lifecycle and gradually the living beings start to disappear.

When the data of inorganic material of Büyükçekmece are evaluated, it is easily noticed that values of the lake are on the limit of clear (spring water) between polluted water. The table below shows the pollution factor and relationship between these contaminants and their degree.

4.8 Classification Büyükçekmece Lake according to P, N, Nh3 (1994-2002)

Pollution Factor	1994	1999	2002
Ammoniac	-*	-	-
Phosphorus	-	3. Degree	-
Nitrite	2. Degree	2-3. Degree	2. Degree

(*) it is not evaluated. [6]

Source: Istanbul Development Plan Analysis, Büyükçekmece Research Report, İMP, BİMTAŞ (2005)

According to the data of Phosphorus the degree of lake is third. The degree of Phosphorus does not change. There is recovery according to the data of Nitrite. The

inorganic level of lake is changing between second and third. In this respect the higher refine is necessity to get drink water from Büyükçekmece Lake. With respect to the control of water pollution act, classify of the water resources of Istanbul is under below.

4.9 Classification of water sources in Istanbul according to the water conservation act

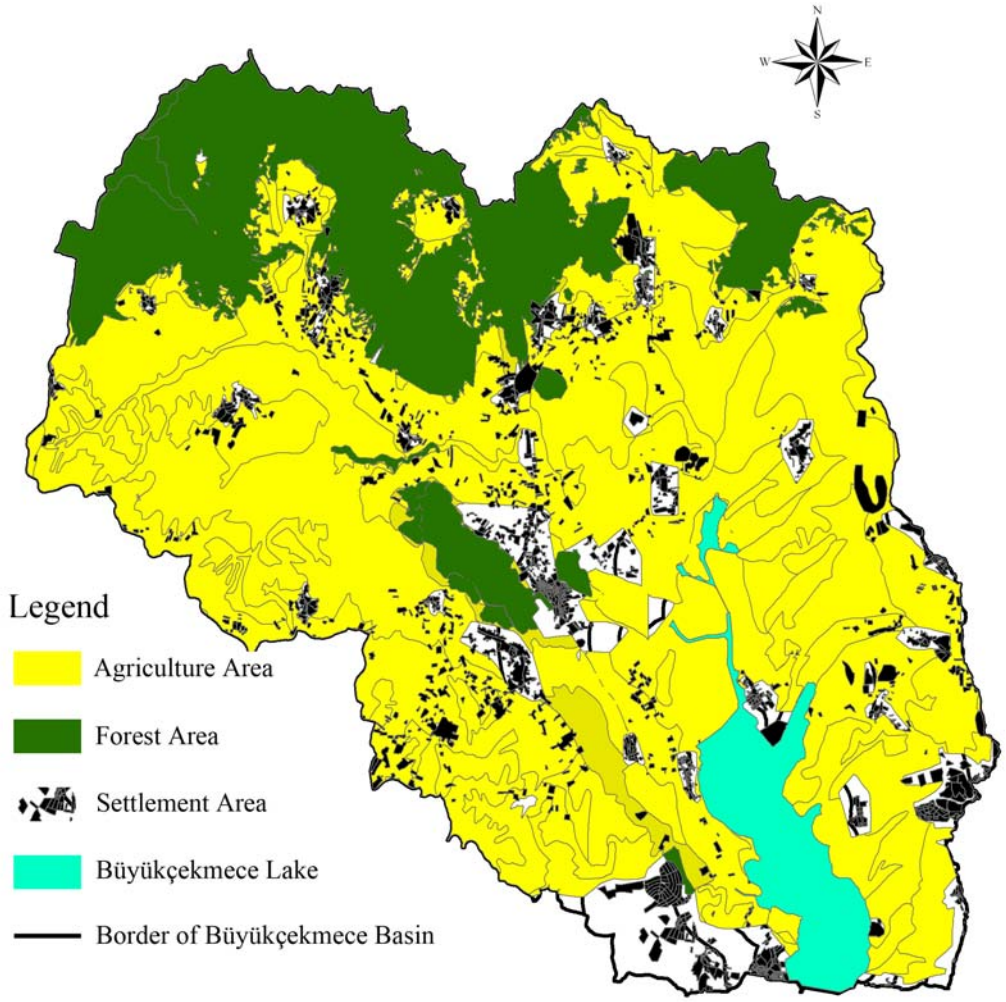
Parameters	Alibey	Elmalı	Terkos	Ömerli	Darlık	B.çekmece
Physically and Inorganic- . Chemical par.	3	4	3	3	2	3
Organic Parameters	2	4	3	1	2	3
Inorganic Pollution Parameters	3	4 .	2	3	2	4
Bacteriologic Parameters	2	2	2	2	1	2

Source: Istanbul Development Plan Analysis, Büyükçekmece Research Report, İMP, BİMTAŞ (2005)

When the table is examined, it can be easily realized that the parameters of inorganic and organic pollution are intense in Büyükçekmece Basin. Industries, agriculture, and settlements cause contamination in Büyükçekmece Lake.

When researcher wants to learn more about wetlands and the pollution reasons, land use of this basin gives a lot of information about pollutives. Consequently conservation method and conservation strategies can be developed in order to conserve wetlands. In this manner sustainable development can be obtained and achieved. Wetlands protect from urbanization for next generations. Figure 4.2 below shows land use of Büyükçekmece Basin. Some land use regions are combined into general subjects. Detailed land uses in Büyükçekmece Basin will be researched according to urban and rural functions.

Fig. 4.2 Land use analysis of basin of Büyükçekmece



The total land use of agricultural aimed area is approximately 54.138 ha in Büyükçekmece Basin (İMP, Department of Soil and Agricultural Areas Synthesis Report, 2005). If it is thought that the total basin area is 63.165 ha, the agricultural area takes huge amount of the basin. Therefore it is easily noticed that the pesticides and other agricultural poisons give burden to the Büyükçekmece Basin because of agriculture. These poisons mix first soil, then mix underground and ground water and streams these process threaten wetlands. These pesticides and poisons are absorbed from living things for example fishes, birds, plants…and then the poisons start to turn and spread out

lifecycle. Consequently the species start to die and disappear because of these poisons. There is some information of usage of pesticides which they are used in 1993.

4.10 Usage quality and quantity of pesticides in basin of Büyükçekmece (1993)

Total Usage kg/day	Class 1 (kg-lt/day)	Class 2 (kg-lt/day)	Class 3 (kg-lt/day)	Class 4 (kg-lt/day)
261.4	–	27.56	98.34	135.5
Apportion %	–	10.55%	37.62%	51.84%
Toxicity	Very toxic	Toxic	Middle level toxic	Little toxic

Istanbul Development Plan Analysis, Büyükçekmece Research Report, İMP, BİMTAŞ (2005)

When the land use values are analyzed, the ranking is in sequence first agricultural areas, second forest and third one settlement. The settlement area is about 7502 ha (İMP, Environment Department, Environment Report, 2005).

4.11 Total N and P loads of built-up area in basin of Büyükçekmece

Unit N load*	unit P load*	total N load*	total P load*
3 kg/ha-year	0.5 kg/ha-year	22506 kg/year 62 kg/day	3751 kg/year 10.3 kg/day

Istanbul Development Plan Analysis, Büyükçekmece Research Report, İMP, BİMTAŞ (2005)

In particular the new settlement areas, that it was planned with Istanbul Environment Arrangement Plan, will increase these covered of settlement values. In Büyükçekmece Basin there are new settlements and urban sprawl. The main motorways also pass through in Büyükçekmece Basin, these reasons cause air pollution. In Istanbul Environment Arrangement Plan there is not solid waste store area, solid waste refinery for this reason dump's water don't mix with underground or ground water.

When the reasons of pollution burden is researched in Büyükçekmece Basin according to the BOI_5, total N, total P it can be easily realized that huge amount of these materials consist of house, industrial and agricultural contaminants. It is given at the table below relationship between pollutives and the sources of pollutives.

4.12 Contaminants and their point of sources in basin of Büyükçekmece

	BOI_5		**Total-N**		**Total -P**		**Toxicity**	
	Kg/day	**%**	**Kg/day**	**%**	**Kg/day**	**%**	**Kg/day**	**%**
House	4500	95	720	40.1	270	71.8		
Industrial	231	5	104	6.0	66	17.6		
Agriculture			783	47.5	22.4	7.1	46	100

Istanbul Development Plan Analysis, Büyükçekmece Research Report, Department of Environment, İMP, BİMTAŞ (2005)

According to table huge amount of BOI_5 and P are sourced from houses. The biggest value of N is sourced from Agricultural areas. Toxicity must be taken into consideration; toxicity is sourced from agricultural areas because of pesticides and herbicides. In particular other industrial wastes burden highly and important level to the basin. It is better not to ignore industrial wastes.

At this point some conservation strategies must be determined to conserve the Büyükçekmece Wetland Area and Basin.

- Agricultural Areas should be used as ecological agricultural area
- All the settlements should be planned away from Büyükçekmece Basin
- All the industries should be decentralized and moved away from Büyükçekmece Basin.
- Wastewater refinery should be built for all city wards
- Erosion regions should be determined and erosion should be obstructed.

These strategies are as a dimension of conservation of Büyükçekmece Lake. When we make city and regional plans we have an important tool for giving direction to city sprawl; this tool is decision for land uses. However wetlands are sensitive areas that they need special approach in order to determine fittest land uses. Next subject researches and refers to make decision for land uses with buffer zone method. Buffer zones reinforce with some thresholds and first step of land use planning settlement appropriateness is determined for two case studies. According to these two case study areas buffer zone

method will be generalized to other quasi wetlands. Chapter 5 explains land use model and settlement appropriateness in case study areas.

5. LAND USE MODEL OF CASE STUDIES

In this chapter we investigate maintaining wetlands context with the preceding chapter research Büyükçekmece and Mogan wetland area. The problems of dry up the wetlands, contamination, and urban pressure, usage of underground water, wrong implementations, and insufficient conservation zones were determined. In particularly insufficient conservation zones are most important part of conserving of wetlands. Conservation zones are buffer zones of settlements; they preserve water and water quality nevertheless they ensure to maintain breeding area for species. In that case with successful buffer zones we can preserve wetlands, protect species, obstruct pollution, and determine land use strategies and urban functions. In Turkey generally we accept the static (constant) conservation zones, it is aimed conserving the source of water namely lake with some buffer zones. Several zones are determined succession from lake to the lake basin. These consecutive buffer zones offer precautionary approach for sediments, erosion, pesticides, agricultural wastes, water flood, pollutives. Nevertheless these buffer zones determine construction density in Turkey. We can control new settlement with buffer zones and also control urban sprawl. Furthermore we can manage urban functions; we can determine which urban function is present in the lake basin. Buffer zones are a specific requirement of protection from non point source pollutants. In that case buffer zones offer three functions:

1) to limit the land uses in basin
2) to manage wetland
3) to abstract the wetland and lake from urban functions

Buffer zones ensure indispensable conservation zones for protecting the wetlands. Buffer zones have role to accumulate and obstruct sediments, pesticides, pollutants in particular surface flow. These buffer zones also provide purifying water before the main water source provide fresh water to city, water is refined then water is given to city. However the special conservation areas need buffer zones also, the conservation approach must be different from fresh water buffer zones. This means static (constant) buffer zones are

inadequate to maintain the eco-hydrological system. This is ecologically appropriate strategies: changeable buffer zone method. This method will be established to conserve the wetlands for this PhD study. This method includes constant buffer zone around lake and some threshold (hydro-geologic, geomorphologic, natural and artificial thresholds) in basin of lake. There is a question why the constant buffer zones are inadequate to maintain the wetlands?

i. Every wetland possesses its special eco-system. There are different species, wetland characteristics for example lake system, a fen system, flood forest… etc.
ii. Every wetland owns its geomorphologic, hydro-geologic, geologic characteristics. These characteristics contribute formation of wetland and continuity. It is difficult to evaluate these characteristics with constant buffer zones. These characteristics can change in constant buffer zone or continue consecutive buffer zones. For this reason we can damage or spoil the wetlands.
iii. Every wetland, which is near metropolitan cities, is affected different land uses or rural functions.

The problematic is generalization of wetland characteristic and evaluates them. In this manner we can constitute a method of all wetlands, and conserve them. This method has these stages:

I. To determine habitats for species
II. To calculate covered areas of geomorphologic, hydro-geologic, geologic characteristics with GIS.
III. To determine urban and rural effects with GIS
IV. To evaluate all these data with statistical method. First normalize all data and then compute distance of similarities all these data, with this method we will calculate affinities of these characteristics. We will determine correlation between buffer zones and characteristics of wetlands. We will determine thresholds according to geomorphologic, hydro-geologic, geologic characteristics in basin of wetland in order to protect wetland.

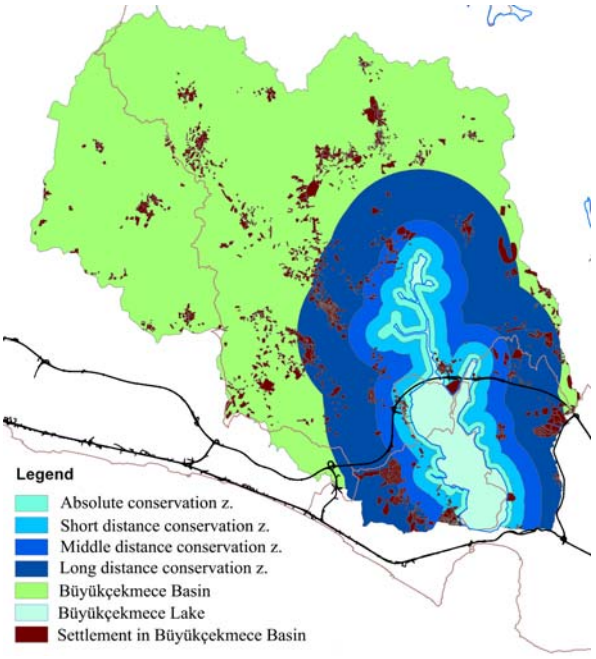
V. To utilize this method with second case study area

VI. To generalize this method for all wetlands.

Wetlands have aquifer areas, permeable, impermeable, semi permeable soils, plain, plateau or mountains… etc. or wetlands have effects of urban or rural land uses. Therefore we can develop and a generalized method for all quasi-wetlands with these data.

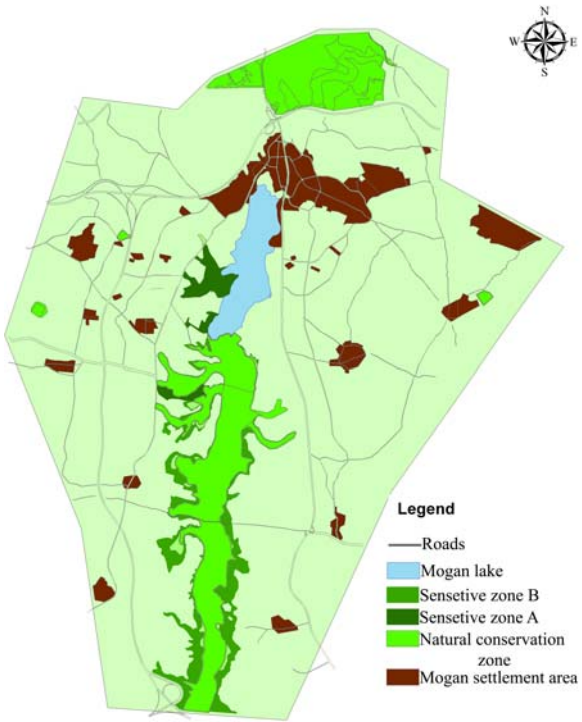
This PhD study has two case study areas; first case study area is Büyükçekmece. Büyükçekmece provides fresh water to Istanbul; therefore Büyükçekmece possesses conservation (buffer) zones. Expanse of absolute conservation zone is from lake to 300 m, short distance conservation zone is 300-1000 m, and middle distance conservation zone is 1000-2000 m, long distance conservation zone is 2000-to Büyükçekmece Basin. According to İSKİ act 2006 long distance buffer zone is accepted from middle distance buffer zone to Büyükçekmece Basin. At the figure 5.1 the buffer zones can be seen in Büyükçekmece Basin:

Fig. 5.1 Correlation between buffer zones and settlements in basin of Büyükçekmece



Second case study area is Mogan Lake; Mogan possesses conservation status. This status is named as special environment protection area; for this reason Mogan Lake has a conservation plan. However Mogan Lake does not have buffer zones around Mogan Lake. Mogan has endemic species and different ecosystem therefore Mogan has conservation status. According to Mogan Special Environment Protection Area Plan Mogan possesses some conservation zones. Fen systems, forests, natural conservation areas, sensitive zones present in Mogan Special Environment Area; and these zones were approved as conservation zones. Unfortunately without buffer zones it is difficult to preserve and maintain Mogan wetland area. Ankara metropolitan area affects Mogan Lake; there is significant urban pressure over Mogan Wetland Area. At the figure 5.2 shows the relationship between conservation zones and settlements in Mogan Special Environment Protection Area.

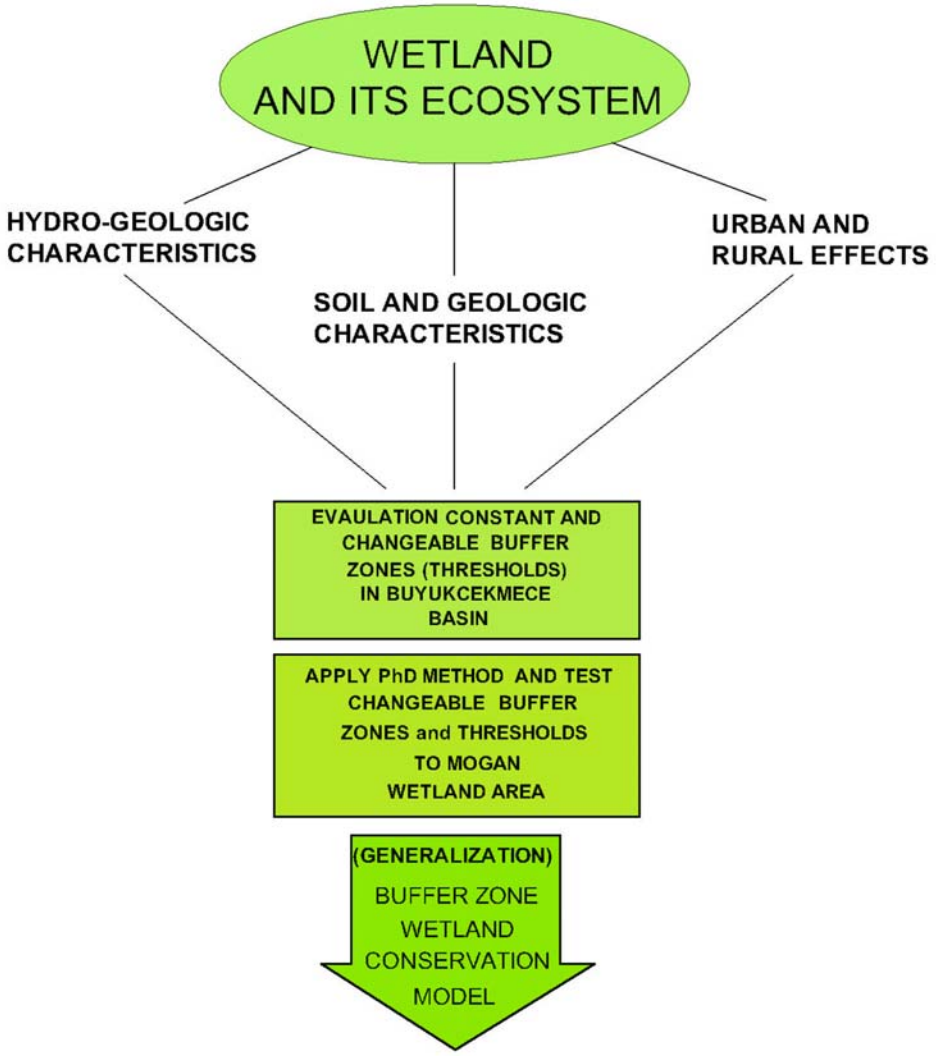
Fig. 5.2 Relationship between conservation zones and settlements in Mogan



According to figure 5.2, south part of natural conservation zone comprises swamp characteristic, swamp area offer nest sites for birds. West and east part of swamp area sensitive B zone presents. West part of Mogan Lake exist rushes, this is refuge and reproduction area for birds; because of this rush area is determined as sensitive B zone. Second natural conservation zone has forest characteristic at north part of lake. As it is shown at the figure 5.2 some conservation zones were determined with Mogan Special Environment Plan. Swamps, breeding areas, nest sites, refuge areas were considered; however specific requirement buffer zones are mandatory to maintain Mogan Wetland Area. In that case some buffer zones should be determined; and sensitive zones at the figure 5.2 should be reinforced with these thresholds and buffer zones around Mogan Lake. These buffer zones consist of buffer zone around Mogan Lake and some thresholds in Mogan Special Environment Protection Area. These thresholds include geomorphologic, hydro-geologic, rural and urban regions in order to protect Mogan Lake from Urbanization. These buffer zones preserve not only the sensitive and natural conservation zones but also Mogan Lake. As it is mentioned at the fourth part of thesis the subject 4.3, Mogan Lake has problems such as sedimentation and eutrophication because of erosion and agricultural reproduction. Buffer zones are necessary in order to accumulate sediments, agricultural pollutants and urban wastes.

In this PhD study Büyükçekmece Basin will be evaluated and changeable conservation zones (hydro-geologic, geomorphologic, urban and rural thresholds) will be created. Then compare with static (constant) buffer zones and changeable buffer zones. This PhD study aims to apply changeable conservation zones to Mogan Wetland Area according to Büyükçekmece's results. These conservation zones will be created for Mogan Wetland Area. Afterwards water dependant conservation method will be developed in order to use this method the other quasi-wetlands and further researches about wetlands. That it is to say this PhD method will be generalized the other wetlands which are affected from urbanization and metropolitan areas. The figure 5.3 reveals stages and progress of PhD study.

Fig. 5.3 Progress scheme of PhD



As a result this wetland conservation method will be developed and generalized for all other wetlands which exist near metropolitan or city. This model is changeable buffer zone method. Expanse of buffer zones around wetland depends on geo-hydrologic, geologic and soil characteristics, urban and rural effects. Besides, these buffer zones around wetland are reinforced by some thresholds in basin of wetland. These thresholds are determined as a result of researches of hydro-geologic, geomorphologic, urban and rural function. In this way wetlands can be protected from urbanization.

5.1 Model Study of Büyükçekmece

This subject aims to evaluate hydro-geologic characteristics, soil and geologic characteristics and urban and rural effects in Büyükçekmece Basin. GIS will be utilized to calculate and evaluate these values. Then statistic and mathematical evaluation part will be applied. In this manner the model will be successfully tested. There are two subjective:

- To evaluate underground and ground characteristics, they constitute structures and main elements of wetland and they are mandatory of wetlands
- To evaluate all effects to wetland, effects of land uses

In this sense buffer zone around wetland can be formed and determined and some thresholds can be allocated in basin of wetland in order to protect structure of wetland. In this manner wetland can be maintained. In this PhD study vector normalize[2] (Normalisierung[3]) and difference of similarity method will be used as a statistical and mathematical evaluation method. In this manner we evaluate the wetlands and we can develop land use strategies in order to protect wetlands. The vector normalize method was chosen because normalize method has some advantages to evaluate values. For example normalization provides simplify the data so that we can evaluate the relationship. We envisage the relations between buffer zones. We prepare our data for similarity analysis. In our study we have the characteristic of buffer zones according to hydro-geologic, morphologic features, urban and rural effects. First these covered area values transform into percentage and tabulate. Then we normalize second table and we

[2]More information about normalization method see
http://en.wikipedia.org/wiki/Multivariate_normal_distribution
http://de.wikipedia.org/wiki/Mehrdimensionale_Normalverteilung

[3] More information about normalization method see
http://de.wikipedia.org/wiki/Normalisierung_%28Mathematik%29
http://people.revoledu.com/kardi/tutorial/Similarity/

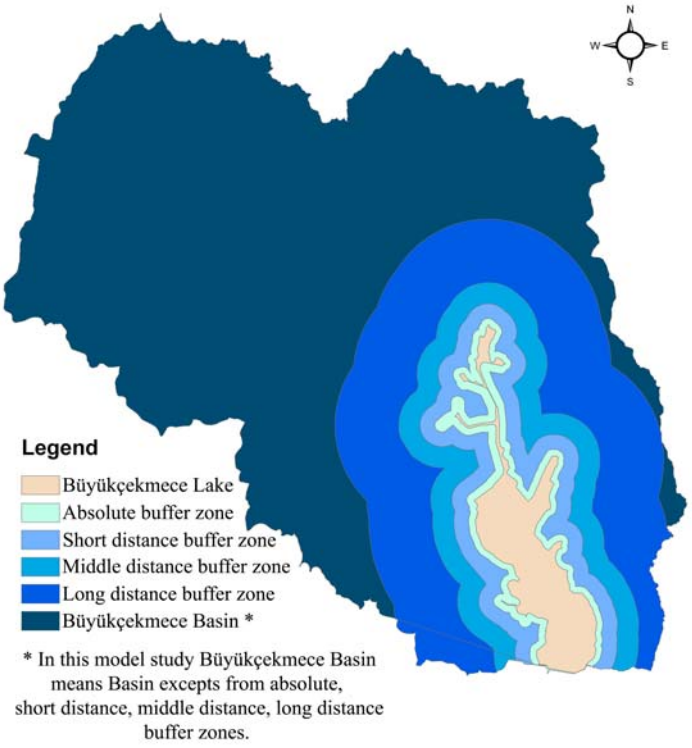
distribute the percentage values into range [1, 0]. At this stage it must not be forgotten that the highest value was accepted the value 1 and the smallest value was closed the value 0. In this PhD study we know the maximum and minimum value of our percentage values for this reason we use $\delta = \frac{d - d^{\min}}{d^{\max} - d^{\min}}$ formula. In our study the minimum data is $d = d^{\min}$ this means the result of this process is $\delta = 0$. The maximum data is $d = d^{\max}$ and the result of this process is $\delta = 1$. All of the values are calculated then these values are tabulated. Then second stage of the process begins; we calculate the similarity of buffer zones to each other. With difference of similarity:

i. We can group and cluster the buffer zones.
ii. We can evaluate similarities and dissimilarities of buffer zones.
iii. We can distinguish one buffer zone to the other buffer zones.
iv. We can suggest land use strategies about buffer zones.
v. We simplify to understand the characteristics of buffer zones.

In this regard the distance of similarity of buffer zones is the framework of the PhD study. With distance of similarity method we can quantify buffer zones in respect of hydro-geologic, morphologic features and urban and rural effects thus we can evaluate the behavior of buffer zones according to these features and effects. When we want to compute distance of similarity of buffer zones any characteristic and/or feature, we have normalized values. For example we have some normalized values like i, j, k, l… these values are into range [1, 0]. We calculate the similarity of buffer zones to each other according to these normalized values. The formula is $s_{ijkl} = 1 - \delta_{ijkl}$. In this calculation 1 is the buffer zone's itself and the other buffer zones are enumerated from similar to less similar. The highest value, which closes to 1, is more similar than the other ones.

In this PhD study five buffer zones were accepted. In sequence they are absolute buffer zone, short distance buffer zone, middle distance buffer zone, long distance buffer zone and Büyükçekmece Basin. Figure 5.4 indicates buffer zones in Büyükçekmece.

Fig. 5.4 Buffer zones in Büyükçekmece

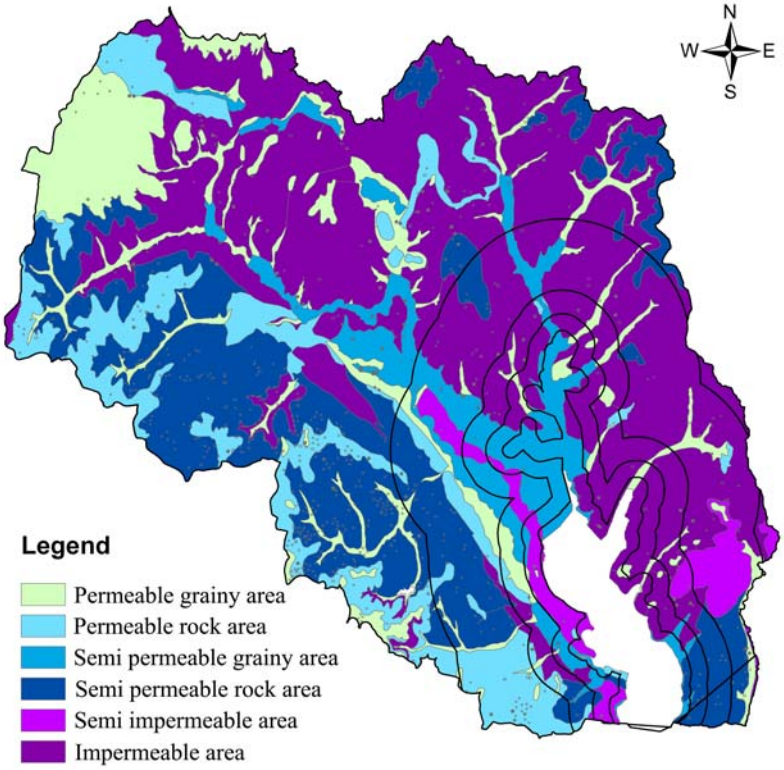


In this PhD method some buffer zones were created. These buffer zones are absolute conservation zone is from lake to 300 m, short distance conservation zone is 300-1000 m, and middle distance conservation zone is 1000-2000 m, long distance conservation zone is 2000-5000 m and Büyükçekmece Basin. In this model study Büyükçekmece Basin means, the basin except from absolute, short distance, middle distance and long distance buffer zones. However it must not be forgotten that Büyükçekmece Basin and long distance buffer zone are evaluated as long distance buffer zone according to İSKİ act 2006. All values of hydro-geologic, morphologic, soil characteristic, rural and urban effects will be evaluated distinctly in each buffer zone. The covered areas of hydro-geologic, geomorphologic characteristic, rural and urban functions will be computed with GIS software; however these covered areas are shown as unit/area; this means there is not a specific unit of measure for covered areas of hydro-geologic, geomorphologic characteristic, rural and urban functions. All of these databases were taken from Istanbul

Metropolitan Municipality İMP department (Istanbul Metropolitan Planning) and İSKİ. These maps and database were created in 2005.

First underground and ground characteristics will be evaluated. Hydro-geologic, geomorphologic relations will be researched. The figure 5.5 shows hydro-geologic characteristics of Büyükçekmece.

Fig. 5.5 Hydro-geologic characteristic of Büyükçekmece



According to figure 5.5 north and northeast area of Büyükçekmece Lake encompasses impermeable characteristic. Precipitation does not permeate underground or permeates very slowly; surface flow occurs on impermeable area during precipitation. In that case pollutants, organic wastes, agricultural wastes and pesticides, sediments and urban wastes reach to Büyükçekmece Lake via surface flow. At these parts of buffer zones expanse of buffer zones and vegetation and planting playing important role, buffer zone accumulate

pollutants, organic wastes, agricultural wastes and pesticides, sediments and urban wastes. Semi permeable grainy soil exists at northwest part of Büyükçekmece Lake. Precipitation flows to underground, and carry all pollutants, organic matters, urban wastes and pesticides to underground water. Semi permeable grainy soil also has surface flow. Land use must be limited in order to conserve Büyükçekmece Lake. Pollutants of agricultural production and urban functions should be removed or obstructed in semi permeable grainy soil area. West part of Büyükçekmece Lake exist in sequence semi impermeable area, semi permeable grainy, semi permeable rock, impermeable, semi impermeable and in long buffer zone semi permeable rock area, semi impermeable and permeable rock area. In absolute and short distance buffer zone, it is necessary to take precautions to surface flow because of semi impermeable area. From short distance buffer zone to long distance buffer zone land use strategies must be developed in order that protect Büyükçekmece Lake from pollutants. Semi permeable rock area presents at the east part of Büyükçekmece Lake. Settlements should be limited and buffer zones should be planted to prevent from surface flow.

As it is seen at figure 5.5 some buffer zones have affinities in that case it should be tabulated all attributes in buffer zones. In this manner similarities of buffer zones can be determined. Land use strategies achieve to preserve water, thus ecosystem can be affected minimum level in wetland. Table 5.1 shows covered area of hydro-geologic characteristic in buffer zones in Büyükçekmece. These values are unit/area; this means there is not a specific unit of measure.

5.1 Hydro-geologic characteristic in Büyükçekmece (covered area)

unit/area	**Permeable Rock Area**	**Semi Permeable Rock Area**	**Permeable Grainy Area**	**Semi Permeable Grainy Area**	**Impermeable Area**	**Semi Impermeable Area**
Absolute B. Z.	258297,38	790086,12	1215517,10	**8949244,68**	8387068,02	1367456,74
Short D. B. Z.	151939,64	2765301,41	1838469,62	8706141,26	**16667778,29**	5348275,26
Middle D. B. Z.	2309482,50	5956033,81	4269503,83	7460236,23	**22304738,86**	2841271,23
Long D. B. Z.	16743748,11	26391915,12	9739330,80	8554201,62	**59864217,37**	9481033,41
Büyükçekmece Basin	51370791,60	91422080,18	57661092,62	15740946,50	**150860866,56**	653340,44

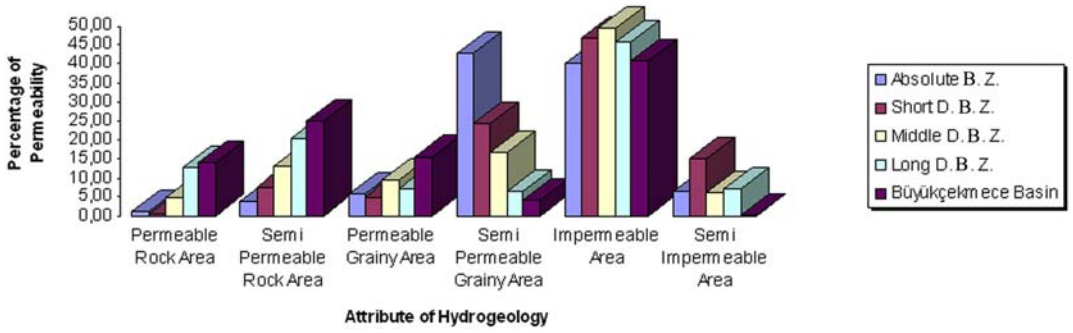
At table 5.1 includes values of hydro-geologic characteristic in buffer zones; from short distance buffer zone to Büyükçekmece Basin impermeable area is the biggest value. Percentage of hydro-geologic characteristics in buffer zones shows comparison between buffer zones. Table 5.2 indicates percentage of covered areas of hydro-geologic characteristic in buffer zones in Büyükçekmece.

5.2 Percentage of hydro-geologic characteristic in each buffer zone (Büyükçekmece)

	Permeable Rock Area	**Semi Permeable Rock Area**	**Permeable Grainy Area**	**Semi Permeable Grainy Area**	**Impermeable Area**	**Semi Impermeable Area**
Absolute B. Z.	1,23	3,77	5,80	42,68	40,00	6,52
Short D. B. Z.	0,43	7,79	5,18	24,54	46,98	15,08
Middle D. B. Z.	5,12	13,19	9,46	16,53	49,41	6,29
Long D. B. Z.	12,80	20,18	7,45	6,54	45,78	7,25
Büyükçekmece Basin	13,97	24,86	15,68	4,28	41,03	0,18

Percentage of semi permeable grainy and impermeable area is the biggest value in absolute buffer zone and total of semi permeable grainy and impermeable area is 82.68%. Percentage of impermeable area is 46.98% in short distance buffer zone, the total of impermeable and semi permeable grainy area is 71.52%. Percentage of impermeable area is the biggest value in middle distance buffer zone and its value is 49.41%. Second biggest value is semi permeable grainy area and its value is 16.53%. Total of semi permeable grainy and impermeable area is 65.91%. Impermeable area is the biggest value in long distance buffer zone and its value is 45.78%. Second biggest value is semi permeable rock area and its value is 20.18%. The biggest value in Büyükçekmece Basin is impermeable area and its value is 41.03%. Second biggest value is semi permeable rock area and its value is 24.86%. Figure 5.6 shows percentage of characteristics of soils in buffer zones.

Fig. 5.6 Percentage of hydro-geologic characteristic in each buffer zone (Büyükçekmece)



At figure 5.6 all percentages of permeability can be evaluated in every buffer zone. However all columns must be compared, in that case the table should be normalized in order to get more accurate results. This table is tabulated from table 5.2 percentage of permeability in buffer zones. All row values normalized to standard from zero (0) to one (1). At table 5.3 below explain normalization to standard [0-1] of evaluation of all permeability values in buffer zones.

5.3 Normalization of hydro-geologic characteristic in buffer zones (Büyükçekmece)

	Permeable Rock Area	**Semi Permeable Rock Area**	**Permeable Grainy Area**	**Semi Permeable Grainy Area**	**Impermeable Area**	**Semi Impermeable Area**
Absolute B. Z.	0,02	0,06	0,10	0,72	0,67	0,11
Short D. B. Z.	0,01	0,14	0,09	0,44	0,84	0,27
Middle D. B. Z.	0,09	0,24	0,17	0,30	0,90	0,11
Long D. B. Z.	0,24	0,38	0,14	0,12	0,86	0,14
Büyükçekmece Basin	0,27	0,47	0,30	0,08	0,78	0,00

According to table 5.3 if the value of 42.68% semi permeable grainy area is accepted 0.72 in absolute conservation zone, the value of 40.00% impermeable area is 0.67. The value of 6.52% semi impermeable area is 0.11. The value of 5.80% permeable grainy area is 0.10. The value of 3.77% semi permeable rock area is 0.06 and the value of 1.23% permeable rock area is so small to evaluate and closes to 0.02. If the value of 46.98%

impermeable area is accepted 0.84 in short distance buffer zone, the value of 24.54% semi permeable grainy area is 0.44. The value of 15.08% semi impermeable area is 0.27. The value of 7.79% semi permeable rock area is 0.14. The value of 5.10% permeable grainy area is 0.09. Value of 0.43% permeable rock area closes to 0.01. If the value of 49.41% impermeable area is accepted 0.90 in middle buffer zone, the value of 16.53% semi permeable grainy area is 0.30. The value of 13.19% semi permeable rock area is 0.24. The value of 9.49% permeable grainy area is 0.17. The value of semi impermeable area is 0.11. The value of permeable rock area has so small value to evaluate therefore the value closes to 0.09. Long distance buffer zone can be evaluated similarly; if the value of 45.78% impermeable area is accepted 0.86, the value of 20.18% semi permeable rock area is 0.38. The value of 12.08% permeable rock area is 0.24. Value of 7.45% permeable grainy area is 0.14. Value of semi impermeable area is 0.14. Value of semi permeable grainy area is so small value to evaluate for this reason value closes 0.12. When the value of 41.03% impermeable area is appraised 0.78, the value of 24.86% semi permeable rock area is 0.47. The value of 15.68% permeable grainy area is equal to 0.30. The value of 13.97% permeable rock area is equal to 0.27. The value of 4.28% semi permeable grainy area is equal to 0.08. Value of semi impermeable area is so small value to evaluate for this reason value closes 0. This table facilitates to evaluate all columns according to rows, so it is easy to evaluate all values in columns according to buffer zones. The other process is, to determine distance of similarity of buffer zones.

If we determine similarity of buffer zones we have to compare all rows according to the other rows. Distance of similarity analysis is analysis that indicates similarity of characteristics in buffer zones according to normalization table above. Table 5.4 shows distance of similarity analysis of hydro-geology in buffer zones. This table determines similarity of buffer zones. This table also associated with normalization table 5.3, all values of rows compared with the other rows therefore distance of similarities was computed between rows (buffer zones).

5.4 Distance of similarity of hydro-geologic characteristic in buffer zones (Büyükçekmece)

	Absolute B. Z.	**Short D. B. Z.**	**Middle D. B. Z.**	**Long D. B. Z.**	**Büyükçekmece Basin**
Absolute B. Z.	1,00	0,87	0,76	0,57	0,48
Short D. B. Z.	0,87	1,00	0,93	0,79	0,65
Middle D. B. Z.	0,76	0,93	1,00	0,93	0,84
Long D. B. Z.	0,57	0,79	0,93	1,00	0,94
Büyükçekmece Basin	0,48	0,65	0,84	0,94	1,00

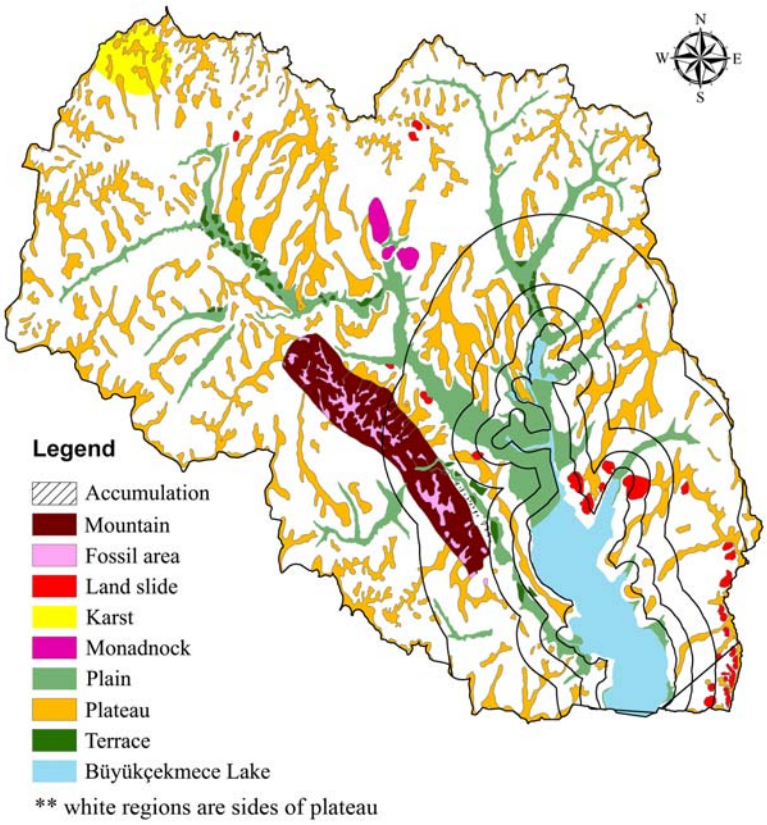
When absolute buffer zone's hydro-geologic characteristic is appraised 1, short distance buffer zone is 0.87 similar to absolute buffer zone; absolute buffer zone is 0.76 similar with middle buffer zone; as well absolute buffer zone is 0.48 similar with long distance buffer zone and Büyükçekmece Basin. In accordance with the table it can be compared characteristic of buffer zones and can be determined affinity of characteristics. If short distance buffer zone's hydro-geologic characteristic is appraised 1, absolute buffer zone is 0.87 similar to short distance buffer zone. Middle distance buffer zone is 0.93 similar to short distance buffer zone. Long distance buffer zone is 0.79 to short distance buffer zone and Büyükçekmece Basin is 0.65 similar to short distance buffer zone. When middle distance buffer zone's hydro-geologic characteristic is appraised 1, absolute buffer zone is 0.76 similar to middle distance buffer zone; short distance buffer zone is 0.93 similar to middle distance buffer zone. Long distance buffer zone is 0.93 similar to middle distance buffer zone; as well Büyükçekmece Basin is 0.84 similar to middle distance buffer zone. If long distance buffer zone's hydro-geologic characteristic is appraised 1, absolute buffer zone 0.57 similar to long distance buffer zone; short distance buffer zone is 0.79 similar to long distance buffer zone. Middle distance buffer zone is 0.93 similar to long distance buffer zone and Büyükçekmece Basin is 0.94 similar to long distance buffer zone. When Büyükçekmece Basin's hydro-geologic characteristic is appraised 1, absolute buffer zone 0.48 similar to Büyükçekmece Basin; short distance buffer zone is 0.65 similar to Büyükçekmece Basin. Middle distance buffer zone is 0.84 similar to Büyükçekmece Basin and long distance buffer zone is 0.94 similar to Büyükçekmece Basin. In that case

it can be computed similarity of characteristic in buffer zones. In this manner land use strategies can be designated for buffer zones or new buffer zone borders can be determined. Some buffer zones can be joined or expanse of buffer zones can be changed in order that conserve wetlands and lakes. However only hydro-geological analysis is not adequate to evaluate wetlands, geomorphology is also mandatory to compare. In this way we can get expressive results.

When Büyükçekmece Basin is researched deeply according to surfaces, some subjects are noticeable; these are accumulation, mountain, fossil area, land slide, karst, monadnock, plain, plateau and terrace. Some land surfaces are known, however some of them are uncommon. Therefore these land surfaces should be explained. Monadnock "is an isolated hill, knob, ridge, outcrop, or small mountain that rises abruptly from a gently sloping or virtually level surrounding plain" (http://en.wikipedia.org/wiki/Monadnock). "Karst is a landscape shaped by the dissolution of a layer or layers of soluble bedrock, usually carbonate rock such as limestone or dolomite. Due to subterranean drainage, there may be very limited surface water, even to the absence of all rivers and lakes. Many karst regions display distinctive surface features, with sinkholes or dolines being the most common" (http://en.wikipedia.org/wiki/Karst). A terrace deposit is geological term for a flat platform of land created alongside of a river or sea, where, at some time in the past, the river has cut itself a deeper channel (http://en.wikipedia.org/wiki/Terrace_deposit).

These surfaces affect settlements; sometimes they hinder settlements because of their special feature. Some surfaces are suitable for settlements and some surfaces are inappropriate areas for settlements. They affect also ground and underground water because of their gradient or surface features. For this reason geomorphologic characteristics are important constituents of wetlands. The figure 5.7 shows the land surfaces and geomorphologic characteristics in Büyükçekmece Basin.

Fig. 5.7 Geomorphologic characteristics of Büyükçekmece



We can evaluate these surfaces and geomorphologic characteristics in different approaches. If we compare plain area with hydro-geology map, it will be seen that plain areas are gathered in two groups; first one is semi permeable grainy and this is huge amount of plain areas. And second one is permeable grainy areas. In that case plain areas are also permeable and semi permeable areas and these areas possess aquifer characteristics. It must be considered when we decide land use strategies in plain areas. Second important point is; when we constitute conservation strategy, it must be considered which urban or rural function should exist here. We should avoid industries, housing and pesticides in plain surfaces; this abets to conserve Büyükçekmece Lake from non-point source pollutants. If we compare land slide with hydro-geology map, land slide areas exist in impermeable, semi impermeable semi permeable rock and permeable grainy areas. Land slide surface is not appropriate surfaces to settle. These areas should be planted in order to protect from land slide. Monadnock is isolated hill or small

mountain that rises abruptly from plain. This surfaces offer different temperature and moisture for living things, therefore these land surfaces are biodiversity areas. These areas are habitat of distinct vegetation. For this reason these areas should be conserved. These areas are not appropriate surfaces to settle. When we compare hydro-geologic characteristic map with morphologic characteristic map; it can be seen the huge percentage of mountain area have semi-permeable rock area feature. This mountain area is not suitable for settling, it is not appropriate to settle because of gradient. This mountain area will be evaluated according to forest characteristic. In this manner some suggestions will be proposed for buffer zones because of semi permeable rock feature of mountain area. Karst possesses soluble rock, carbonate rock like limestone or dolomite; water can be permeated directly to underground in this kind of soil, for this reason it must be taken into consideration non point source pollutants, as well planners should be careful when they suggest settlements on karst soil. It had better not settle on karst soil. Plateau surface is relative high surfaces from plain; therefore these areas should be planted when planners suggest settling on these areas, as well building surfaces should be suggested small according to plot. White regions in Figure 5.7 are sides of plateau. For this reason they are not taking into consideration as separate layer for morphologic characteristics of Büyükçekmece. In respect land surfaces ought to be evaluated with statistical data, in this manner land use strategies can be successfully determined. All morphologic attribute values at the figure 5.7 are tabulated at the table 5.5.

5.5 Geomorphologic characteristics of Büyükçekmece (covered area)

unit/area	**Karst**	**Accumulation**	**Mountain**	**Land Slide**	**Monadnock**
Absolute B. Z.	0	0	0	850861,97	0
Short D. B. Z.	0	0	0	1261099	0
Middle D. B. Z.	0	0	0	379849,09	0
Long D. B. Z.	0	75969,82	10255925,6	1914439,44	0
Büyükçekmece Basin	5424245,1	0	9496227,37	425430,99	2233512,68
	Plain	**Plateau**	**Fossil Area**	**Terrace**	
Absolute B. Z.	**8219934**	1017995,57	0	0	
Short D. B. Z.	**9253124**	4725322,74	0	151939,64	
Middle D. B. Z.	6533404,4	**8447843,87**	0	714116,3	
Long D. B. Z.	9359481,7	**24371117,93**	2020797,19	714116,3	
Büyükçekmece Basin	18886097	**72368849,57**	2172736,82	1732111,87	

When we examine table 5.5, plain and plateau characteristic are dominant; in particular plain characteristic is the highest value in absolute and short distance buffer zone. Plateau characteristic is the second biggest value in absolute and short distance buffer zone. Land slide must be taken into consideration in absolute and short distance buffer zone. Plateau is the biggest value in middle distance buffer zone, plain is the second biggest value. In long distance buffer zone characteristic starts to change and plateau area is the biggest area but mountain is the second biggest value; as well value of plain area is close to mountain area. Plateau is the biggest value and plain is the second biggest value in Büyükçekmece. Monadnock and karst area must be taken into consideration when we plan Büyükçekmece Basin on ecological approach. These values are unit/area for this reason we need to percentage values in order to evaluate this table. Table 5.6 indicates percentage of morphologic characteristics in each buffer zone of Büyükçekmece.

5.6 Percentage of geomorphologic characteristics in buffer zones (Büyükçekmece)

	Karst	**Accumulation**	**Mountain**	**Land Slide**	**Monadnock**	**Plain**	**Plateau**	**Fossil Area**	**Terrace**
Absolute B. Z.	0,00	0,00	0,00	8,43	0,00	81,48	10,09	0,00	0,00
Short D. B. Z.	0,00	0,00	0,00	8,19	0,00	60,12	30,70	0,00	0,99
Middle D. B. Z.	0,00	0,00	0,00	2,36	0,00	40,64	52,55	0,00	4,44
Long D. B. Z.	0,00	0,16	21,05	3,93	0,00	19,21	50,03	4,15	1,47
Büyükçekmece Basin	4,81	0,00	8,42	0,38	1,98	16,75	64,19	1,93	1,54

Plain area is the biggest value in absolute buffer zone, percentage of plain area is 81.48%. Plateau is the second biggest value; it is 10.09% and land slide is third biggest value, and the percentage of land slide is 8.43%. Plain area is the biggest value and it appraises 60.12%. Plateau is the second biggest value and it is appraised 30.70% and land slide is third biggest value and it is 8.19%. Plateau is the biggest value in middle distance buffer zone and it is 52.55%. Plain is the second biggest value and it is 40.64%. Terrace is 4.44% and land slide is 2.36% in middle distance buffer zone. Plateau is 50.03% and it is the biggest value in the long distance buffer zone. Mountain is 21.05% and it is the second biggest value, plain is 19.21% and it is the third biggest value. Fossil area is 4.15%, land slide 3.93%, terrace is 1.47% and accumulation is 0.16% in long distance buffer zone. Plateau is 64.19% and the biggest value in Büyükçekmece Basin. Plain is the

second biggest value and it is 16.75%. Mountain is the third biggest value it is 8.42%. Karst is 4.81%, monadnock is 1.98%, fossil area is 1.93%, and terrace is 1.54% and land slide is 0.38% in Büyükçekmece Basin. The figure at below indicates percentage of morphologic characteristics in Büyükçekmece in order that easily examine all values.

Fig. 5.8 Percentage of geomorphologic characteristics in every buffer zones (Büyükçekmece)

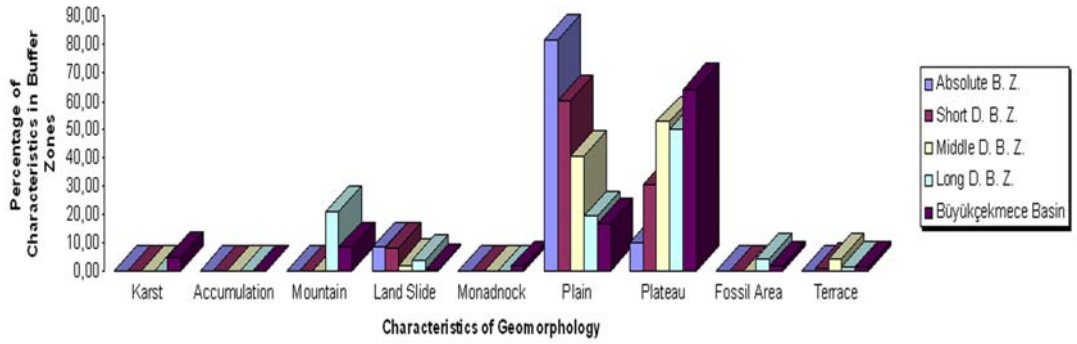


Figure 5.8 facilitates to examine geomorphologic characteristics in Büyükçekmece. Land slide is second highlight point in this figure. However percentage is not the only component in order to get results. In that case the table should be normalized; table 5.7 shows normalization of table 5.6. All row values normalized to standard from zero (0) to one (1). We can compare effects of percentage values in normalization table. The highest value closes to 1.

5.7 Normalization of geomorphologic characteristics in buffer zones (Büyükçekmece)

	Karst	**Accumulation**	**Mountain**	**Land Slide**	**Monadnock**	**Plain**	**Plateau**	**Fossil Area**	**Terrace**
Absolute B. Z.	0,00	0,00	0,00	0,10	0,00	0,99	0,12	0,00	0,00
Short D. B. Z.	0,00	0,00	0,00	0,12	0,00	0,88	0,45	0,00	0,01
Middle D. B. Z.	0,00	0,00	0,00	0,04	0,00	0,61	0,79	0,00	0,07
Long D. B. Z.	0,00	0,00	0,36	0,07	0,00	0,33	0,86	0,07	0,03
Büyükçekmece Basin	0,07	0,00	0,13	0,01	0,03	0,25	0,96	0,03	0,02

Table 5.7 facilitates to examine all the values, when we normalize all the values; we get the results subsequent sentences. If the percentage value of plain area (81.48%) appraises 0.99, with 10.09% value of plateau area takes 0.12; the percentage value of land slide area (8.43%) takes 0.10 in absolute buffer zone. If the percentage of plain area (60.12%) is 0.88; 30.7% of plateau area is 0.45; 8.19% of land slide area is 0.12; and 0.99% of terrace area is 0.01 in short distance buffer zone. If 52.55% of plateau area takes value 0.79 in middle distance buffer zone; 40.64% of plain is 0.61; 4.44% of terrace is 0.07; and 2.36% of land slide is 0.04. If the value of 50.03% plateau area is accepted 0.86, the value of 21.05% mountain area is 0.36; the value of 19.21% plain is 0.33; the value of 4.15% of fossil area is 0.07; the value of 3.93% land slide is 0.07; and 1.47% of terrace area is 0.03 in long distance buffer zone. If the value of 64.19% plateau area is accepted 96; the value of 16.75% plain area appraises 0.25; the value of 8.42% mountain area is 0.13; the value of 4.81% karst area is 0.07; the value of 1.98% monadnock is 0.03; the value of 1.93% fossil area is 0.03; and the value of 1.54% terrace area is 0.02 in Büyükçekmece Basin. In that case it should be estimated the distance of these values in order to determine the similarities of buffer zones. Table 5.8 indicates distance of similarity analysis of morphologic characteristic in Büyükçekmece.

5.8 Distance of similarity of geomorphologic characteristic between buffer zones (Büyükçekmece)

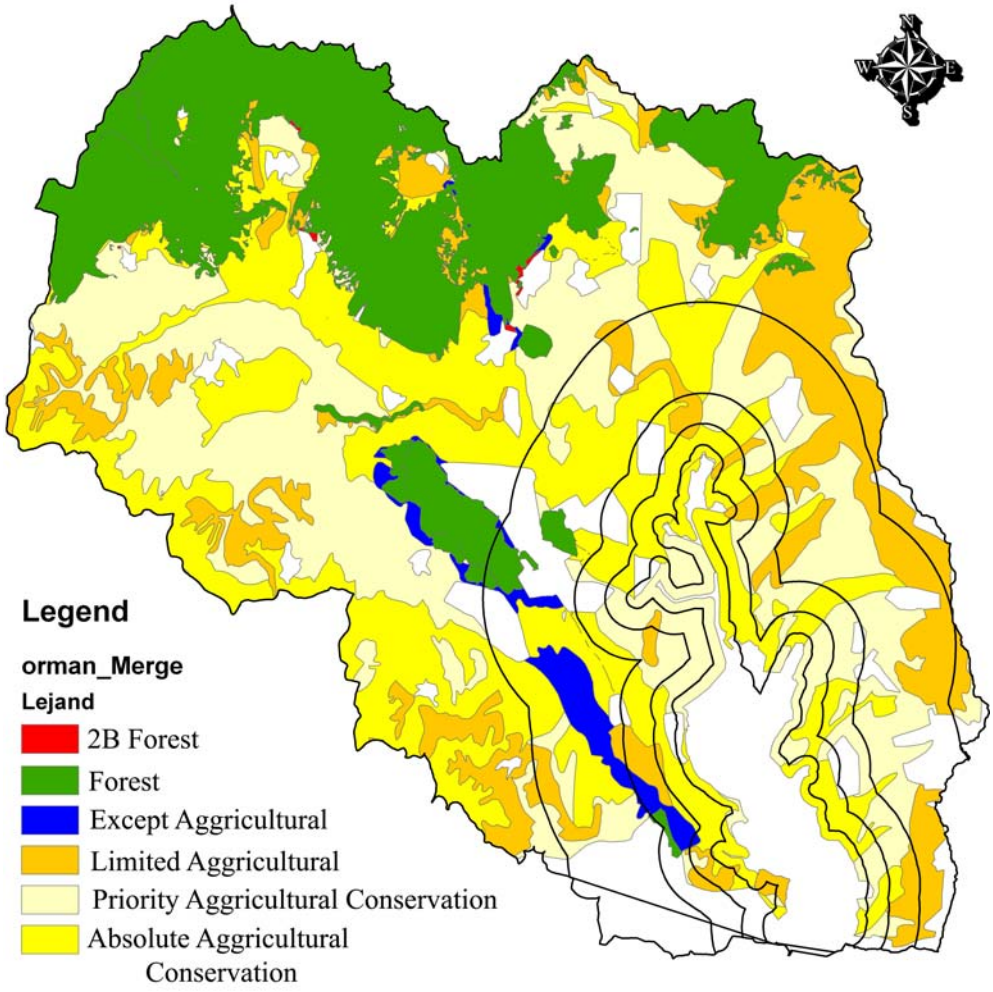
	Absolute B. Z.	**Short D. B. Z.**	**Middle D. B. Z.**	**Long D. B. Z.**	**Büyükçekmece Basin**
Absolute B. Z.	1,00	0,89	0,54	0,28	0,22
Short D. B. Z.	0,89	1,00	0,82	0,53	0,49
Middle D. B. Z.	0,54	0,82	1,00	0,80	0,83
Long D. B. Z.	0,28	0,53	0,80	1,00	0,92
Büyükçekmece Basin	0,22	0,49	0,83	0,92	1,00

When we determine distance of all buffer zones in their own characteristic according to normalization of geomorphology characteristic, we can get similarity of buffer zones in Büyükçekmece. When a value however much closes to 1, it means this is so a nearly value that we calculate. In this respect it can correctly enough to make decision about

buffer zones. In that case at first row absolute and short distance buffer zones are such a nearly values that we compute with normalization of morphology characteristic. At second row short distance buffer zone is approximately the same quality as absolute and middle distance buffer zones. However absolute buffer zone is more similar than middle distance buffer zone, because the value of short distance buffer zone is 0.89 and the value of middle distance buffer zone is 0.82. Middle distance buffer zone is similar to short distance and long distance buffer zones as well as Büyükçekmece Basin. When we evaluate long distance buffer zone, Büyükçekmece Basin is more similar than that of middle distance buffer zone, because the value of Büyükçekmece Basin is 0.92 and middle distance buffer zone is 0.80. Büyükçekmece Basin resembles to long distance buffer zone because of (0.92) value. Büyükçekmece Basin also resembles to middle distance buffer zone according to value of middle distance buffer zone; this value is 0.80. In that case we can say that some buffer zones resemble each other, and some buffer zones become distant from the other ones. Middle distance buffer zone can be divided into two parts; first one is absolute and short distance buffer zones, and second one is long distance buffer zone and Büyükçekmece Basin. Preceding subject we evaluated geo-morphology and permeability of Büyükçekmece, however it is required to examine on ground characteristics therefore we can get non point source pollutants in order to conserve Büyükçekmece Lake. Figure 5.9 indicates forest and agricultural characteristics in Büyükçekmece; in this way we can determine rural and agricultural affects to Büyükçekmece Lake.

When we examine figure 5.9, we can realize that white regions are settlements in Büyükçekmece, settlements will be evaluated adjacent subject. 2B forest means that these areas lost their forest quality because of urban affects, fire, agricultural affects… etc. Excepted agricultural area means that these areas are not suitable because of mountain and high gradient. In particular forest presents north part of Büyükçekmece.

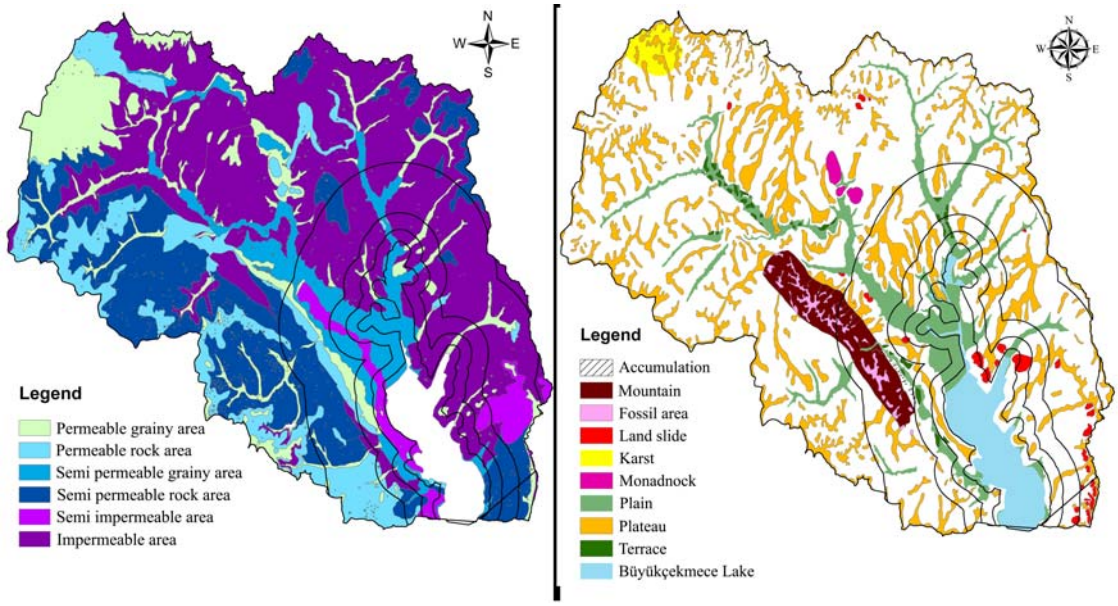
Fig. 5.9 Rural characteristic in Büyükçekmece



If we compare figure 5.9 with figure 5.7 and figure 5.5; see next figure 5.10 (cf. with 5.10), we can realize that on the middle of Büyükçekmece absolute agricultural conservation areas are almost similar with plain areas and permeable rock and semi permeable rock area. This means these areas are aquifer areas and reservoirs; water is accumulated and carried to Büyükçekmece Lake via plain areas on the middle of Büyükçekmece. Soil is alluvium and productive because of its morphologic and permeable characteristic on this part of Büyükçekmece. In that case we have to care pesticides, sediments, fertilizers, proportion of nutrient and phosphorous on this part of Büyükçekmece. The connection point between lake and streams must be planted with

three stages. First stage is wild grass; this stage traps sediments and a part of sediments. Second stage is shrubs, shrubs accumulate sediments and nutrients. Third stage is trees, trees provide soil stability with deep roots, they protect water flood, and trees collect pesticides nutrients and phosphorus, which they presents in deep part of soil, with deep roots. Besides trees generate special habitat and support wildlife for species. Forest areas should be united each other and also exception of agricultural areas. In this way wildlife continuity can be obtained from lake to north part of Büyükçekmece.

Fig. 5.10 Comparison of hydro-geology and geomorphology (Büyükçekmece)



In this respect numeric data will be facilitated to evaluate Büyükçekmece and its buffer zones. Table 5.9 shows forest and agricultural unit/area in each buffer zone. Absolute agricultural conservation area covers highest value in absolute buffer zone and short distance buffer zone; when we examine table 5.5 plain area covers the highest value in absolute and short distance buffer zone. When we compare this result with permeability analysis (table 5.1), semi permeable grainy area is the highest value in absolute buffer zone and impermeable area is the highest but semi permeable grainy area is the second biggest value in short distance buffer zone. In middle distance buffer zone and long

distance buffer zone priority agricultural conservation area is the biggest value. According to table 5.1 impermeable area is the biggest value in middle distance and long distance buffer zone; and according to table 5.5 plateau is the biggest value in middle distance and long distance buffer zone.

5.9 Rural characteristic in Büyükçekmece (covered area)

unit/area	**Forest**	**2B Forest**	**Limited Agricultural**	**Absolute Agricultural Conservation**	**Except Agricultural**	**Priority Agricultural Conservation**
Absolute B. Z.	0,00	0,00	905119,46	**8652328,35**	0,00	7056863,55
Short D. B. Z.	0,00	0,00	2393197,20	**17734204,92**	76705,04	10968820,52
Middle D. B. Z.	383525,19	0,00	7563116,81	12150078,11	1580123,80	**14942141,52**
Long D. B. Z.	3068201,54	0,00	27306993,74	30758720,48	5860264,95	**34517267,37**
Büyükçekmece Basin	**118708717,73**	322161,16	50318505,32	84728385,64	2592630,30	98826771,73

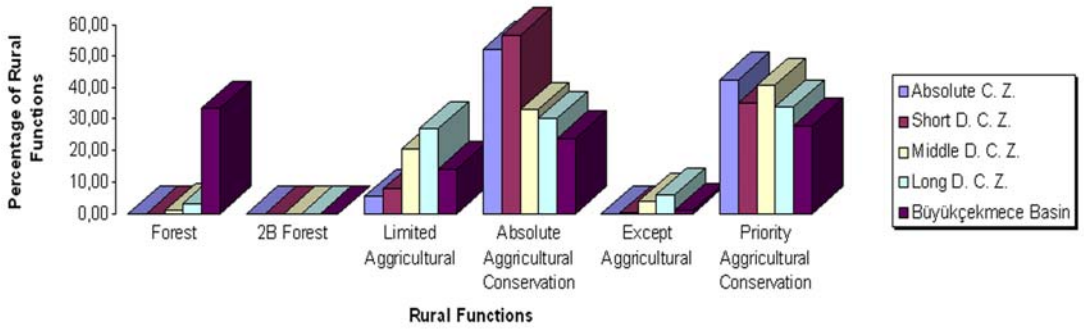
At table 5.9 forest area is the biggest value in Büyüçekmece Basin. Table 5.10 facilitates to understand rural affects in order to preserve from contamination in Büyükçekmece. When we examine table 5.10 the highlight is total agricultural function (limited agricultural, absolute agricultural conservation area and priority agricultural conservation area) covers nearly ninety percent from absolute buffer zone to long distance buffer zone. This means we should consider sediment, pesticides, erosion, nutrient (because of fertilizer) and phosphorus. This feature changes just Büyükçekmece Basin, because of forest characteristic however total agricultural functions are 65.78%.

5.10 Percentage of rural characteristics (Büyükçekmece)

	Forest	**2B Forest**	**Limited Agricultural**	**Absolute Agricultural Conservation**	**Except Agricultural**	**Priority Agricultural Conservation**
Absolute B. Z.	0,00	0,00	5,45	52,08	0,00	42,47
Short D. B. Z.	0,00	0,00	7,68	56,89	0,24	35,19
Middle D. B. Z.	1,05	0,00	20,65	33,18	4,32	40,80
Long D. B. Z.	3,02	0,00	26,90	30,30	5,78	34,00
Büyükçekmece Basin	33,39	0,09	14,15	23,83	0,74	27,80

Figure 5.11 shows relationship between percentage of buffer zones and rural characteristics in Büyükçekmece.

Fig. 5.11 Percentage of rural characteristics of buffer zones (Büyükçekmece)



In this respect all the values must be normalized in order that we can evaluate percentage of rural characteristics in Büyükçekmece, table 5.11 indicates normalization of all rural functions. At this table all buffer zones were normalized according to columns namely the forest and agricultural areas in Büyükçekmece so as to evaluate easily all the values.

5.11 Normalization analysis of rural areas in buffer zones (Büyükçekmece)

	Forest	2B Forest	Limited Agricultural	Absolute Agricultural Conservation	Except Agricultural	Priority Agricultural Conservation
Absolute B. Z.	0,00	0,00	0,08	0,77	0,00	0,63
Short D. B. Z.	0,00	0,00	0,11	0,84	0,00	0,52
Middle D. B. Z.	0,02	0,00	0,36	0,59	0,08	0,72
Long D. B. Z.	0,06	0,00	0,50	0,57	0,11	0,64
Büyükçekmece Basin	0,65	0,00	0,27	0,46	0,01	0,54

At table 5.11 the highest percentage value is (1); from biggest value to smallest one in succession of percentages take value from 1 to 0. We can determine influences of these areas according to their areas; these values determine similarity of buffer zones. In that case similarity of buffer zones should be calculated so as to determine distance of these buffer zones. Table 5.12 shows distance of similarities of buffer zones.

5.12 Distance of similarity of rural characteristic between buffer zones (Büyükçekmece)

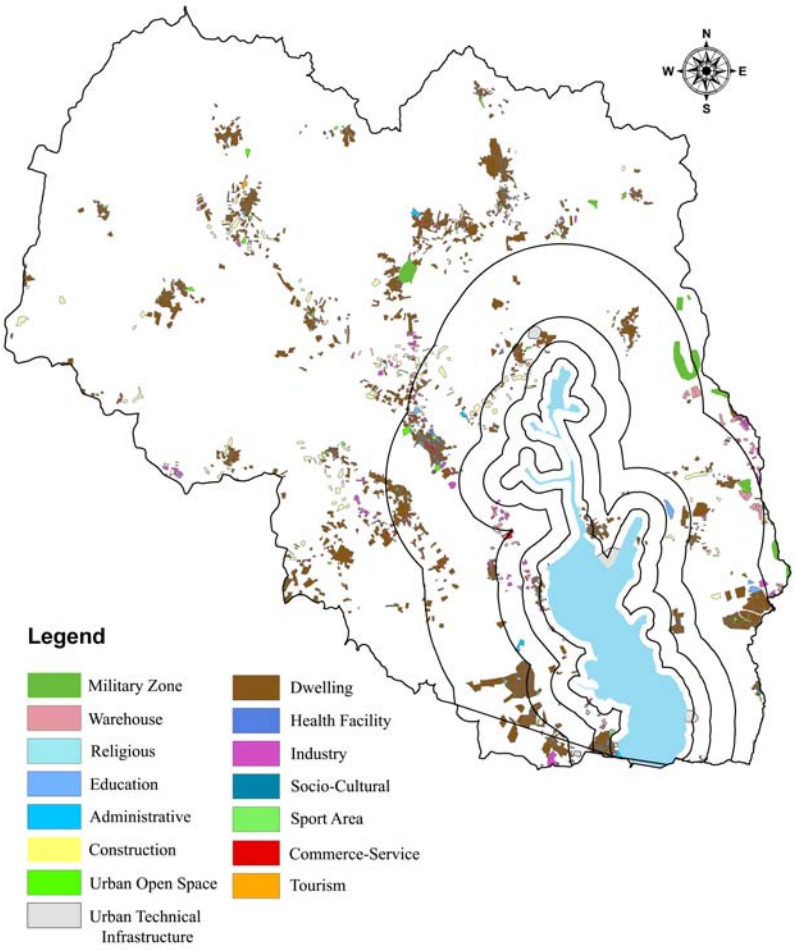
	Absolute B. Z.	Short D. B. Z.	Middle D. B. Z.	Long D. B. Z.	Büyükçekmece Basin
Absolute B. Z.	1,00	0,98	0,88	0,79	0,56
Short D. B. Z.	0,98	1,00	0,84	0,77	0,54
Middle D. B. Z.	0,88	0,84	1,00	0,97	0,63
Long D. B. Z.	0,79	0,77	0,97	1,00	0,64
Büyükçekmece Basin	0,56	0,54	0,63	0,64	1,00

Preceding table we normalize percentage of rural characteristic, maximum value takes 1 and minimum value takes 0. At table 5.12 we calculate difference of similarity; all the values in row are calculated and compared with the other rows so that we determine the similarities of all buffer zones according to each other. When a value however much closes to 1 so it means this is so a nearly value that the other one, the distribution of variations transforms into range 0 (dissimilar) and 1 (exactly similar). In this respect absolute buffer zone, short distance buffer zone, middle distance buffer zone and long distance buffer zone are similar to each other because of agricultural areas. Büyükçekmece Basin is just 0.64 similar with long distance buffer zone however long distance buffer zone is 0.97 similar with middle distance buffer zone, this difference is because of forest area. We have evaluated hydro-geology, geomorphology (soil and surface characteristic) and rural affects (rural pollutant). We have to determine urban effects in order that we would determine non point source pollutants. We can hinder contamination in Büyükçekmece when we want to plan Büyükçekmece. In that case we have to evaluate urban effects in Büyükçekmece.

Figure 5.12 shows urban effects of Büyükçekmece, this map contains urban functions and these functions are based on area. Dwelling, industry and warehouse areas cover large areas when we investigate this map. Urban settlements are located in scattered form in Büyükçekmece, the other important problem is they start to union each other; in other words urban settlements stretch out in Büyükçekmece. This sprawl causes to make difficult to control and obstruct pollution; at the same time it is difficult enough to

determine source of pollutants. However we know there are important problems in Büyükçekmece and urban effect is the one of them, in that case we can develop strategies to conserve Büyükçekmece.

Fig. 5.12 Urban effects in Büyükçekmece



According to İSKİ act absolute and short distance conservation zones are allotted green areas in order to protect water from urban settlements and their affects. Although it is banned to settle and forbidden construct any building in absolute and short distance buffer zones, we can see settlements and besides there are municipalities in absolute buffer zone. The settlements sprawl to basin area, basin area is aquifer areas that these settlements damage water quality in Büyükçekmece; nevertheless the main pollutant is

housing areas. When we determine quantity of urban functions, we can find the amount of burdens and wastes so that we can obstruct pollutants. Table 5.13 shows covered area of urban function areas in Büyükçekmece.

5.13 Urban functions in Büyükçekmece (covered area)

unit/area	Dwelling	Commerce-Service	Urban Open Space	Education	Religious	Administrative	Warehouse	Tourism
Absolute B. Z.	342980,53	63514,91	0,00	12702,98	0,00	63514,91	12702,98	0,00
Short D. B. Z.	**1041644,56**	101623,86	25405,96	12702,98	25405,96	12702,98	50811,93	0,00
Middle D. B. Z.	**1727605,61**	38108,95	38108,95	139732,81	25405,96	76217,89	165138,77	0,00
Long D. B. Z.	**9069929,47**	342980,53	203247,72	241356,67	12702,98	88920,88	571634,21	0,00
Büyükçekmece Basin	**13541379,29**	342980,53	266762,63	88920,88	0,00	76217,89	381089,47	88920,88
	Sport Area	Industry	Health Facility	Urban Technical Infrastructure	Socio-Cultural	Military Zone	Construction	
Absolute B. Z.	0,00	38108,95	0,00	**635149,12**	0,00	0,00	0,00	
Short D. B. Z.	25405,96	165138,77	0,00	177841,75	0,00	0,00	0,00	
Middle D. B. Z.	12702,98	152435,79	0,00	304871,58	0,00	0,00	0,00	
Long D. B. Z.	25405,96	508119,30	50811,93	50811,93	25405,96	863802,81	0,00	
Büyükçekmece Basin	63514,91	965426,67	0,00	25405,96	0,00	1371922,10	12702,98	

Table 5.13 includes urban areas that they cover plot as unit/area. Housing areas cover huge amount of urban functions, just absolute buffer zone is different from the other buffer zones, because urban technical infrastructure presents in absolute buffer zone. These urban technical infrastructure areas provide to Istanbul freshwater; facilities and infrastructure of freshwater exist there. Dwelling is the biggest value in all buffer zones except absolute buffer zone. Industrial areas exist in all buffer zones although it is forbidden to construct any building in absolute and short distance buffer zones according to İSKİ act. Percentage values of covered areas facilitate to present existing situation. Table 5.14 was tabulated in order to evaluate all values easily.

5.14 Percentage of urban functions in Büyükçekmece

	Dwelling	Commerce-Service	Urban Open Space	Education	Religious	Administrative	Warehouse	Tourism
Absolute B. Z.	29,35	5,43	0,00	1,09	0,00	5,43	1,09	0,00
Short D. B. Z.	**63,56**	6,20	1,55	0,78	1,55	0,78	3,10	0,00
Middle D. B. Z.	**64,47**	1,42	1,42	5,21	0,95	2,84	6,16	0,00
Long D. B. Z.	**75,23**	2,85	1,69	2,00	0,11	0,74	4,74	0,00
Büyükçekmece Basin	**78,62**	1,99	1,55	0,52	0,00	0,44	2,21	0,52
	Sport Area	Industry	Health Facility	Urban Technical Infrastructure	Socio-Cultural	Military Zone	Construction	
Absolute B. Z.	0,00	3,26	0,00	**54,35**	0,00	0,00	0,00	
Short D. B. Z.	1,55	10,08	0,00	10,85	0,00	0,00	0,00	
Middle D. B. Z.	0,47	5,69	0,00	11,37	0,00	0,00	0,00	
Long D. B. Z.	0,21	4,21	0,42	0,42	0,21	7,17	0,00	
Büyükçekmece Basin	0,37	5,60	0,00	0,15	0,00	7,96	0,07	

Table 5.14 includes percentage of urban functions which they cover area/plot in each buffer zone. We can realize easily effects of urban functions. Adjacent step is normalizing of all these values, because we want to get expressive results and similarity and dissimilarity of buffer zones. We transformed our percentage values into a range of 0 and 1, we expect to get our index as the range of (d^{max}, d^{min}) in the range of [1, 0]. Table 5.15 shows normalization of percentages of urban functions.

5.15 Normalization percentages of urban functions (Büyükçekmece)

	Dwelling	Commerce-Service	Urban Open Space	Education	Religious	Administrative	Warehouse	Tourism
Absolute B. Z.	0,47	0,09	0,00	0,02	0,00	0,09	0,02	0,00
Short D. B. Z.	0,97	0,09	0,02	0,01	0,02	0,01	0,05	0,00
Middle D. B. Z.	0,97	0,02	0,02	0,08	0,01	0,04	0,09	0,00
Long D. B. Z.	0,99	0,04	0,02	0,03	0,00	0,01	0,06	0,00
Büyükçekmece Basin	0,99	0,03	0,02	0,01	0,00	0,01	0,03	0,01
	Sport Area	Industry	Health Facility	Urban Technical Infrastructure	Socio-Cultural	Military Zone	Construction	
Absolute B. Z.	0,00	0,05	0,00	0,87	0,00	0,00	0,00	
Short D. B. Z.	0,02	0,15	0,00	0,17	0,00	0,00	0,00	
Middle D. B. Z.	0,01	0,09	0,00	0,17	0,00	0,00	0,00	
Long D. B. Z.	0,00	0,06	0,01	0,01	0,00	0,09	0,00	
Büyükçekmece Basin	0,00	0,07	0,00	0,00	0,00	0,10	0,00	

We have to determine similarities of buffer zones according to table 5.15 thus we can evaluate buffer zones and can develop successful land use strategies. Highlight is dwelling function closes to 1 in short distance, middle distance, long distance buffer zones and Büyükçekmece Basin. Table 5.16 indicates distance of similarity and dissimilarity of buffer zones according to normalization of urban functions in Büyükçekmece.

5.16 Distance of similarity of urban effects between buffer zones (Büyükçekmece)

	Absolute B. Z.	Short D. B. Z.	Middle D. B. Z.	Long D. B. Z.	Büyükçekmece Basin
Absolute B. Z.	1,00	0,45	0,45	0,32	0,31
Short D. B. Z.	0,45	1,00	0,98	0,95	0,95
Middle D. B. Z.	0,45	0,98	1,00	0,96	0,95
Long D. B. Z.	0,32	0,95	0,96	1,00	1,00
Büyükçekmece Basin	0,31	0,95	0,95	1,00	1,00

When we examine table 5.16, we realize that absolute buffer zone is dissimilar to the other buffer zones. Short distance, middle distance, long distance buffer zones and Büyükçekmece Basin reflect similar character to each other according to covered areas of urban functions. Long distance buffer zone and Büyükçekmece Basin have same characteristic; short distance buffer zone and middle distance buffer zone are nearly similar to each other. Short distance buffer zone is 0.98 similar to middle distance buffer zone. Short distance buffer zone resembles 0.95 similar to long distance buffer zone and Büyükçekmece Basin. Middle distance buffer zone is 0.98 similar to short distance buffer zone; as well middle distance buffer zone is 0.96 similar to long distance buffer zone long distance buffer zone and it is 0.95 similar to Büyükçekmece Basin. Long distance buffer zone is same to Büyükçekmece Basin and it is 0.96 similar to middle distance buffer zone and 0.95 similar to short distance buffer zone. Büyükçekmece Basin is same to long distance buffer zone and it resembles 0.95 to short distance and middle distance buffer zones.

However normally according to the İSKİ act absolute and short distance buffer zones must have resembled completely each other. It is banned to construct constructions, buildings, service buildings, commerce buildings… etc. These two buffer zones are allotted for green strips to conserve Büyükçekmece Lake.

This PhD study inquires how to maintain wetlands. Difference of similarity model has been used as an easy and quick decision making method for determination constant buffer zone around Büyükçekmece Lake. This method ensures determining correspondence of buffer zones. The buffer zones' characteristics were measured according to values of hydro-geologic, morphologic, rural and urban effects. The constant buffer zones were researched; and their success was examined. With this PhD study some questions were inquired:

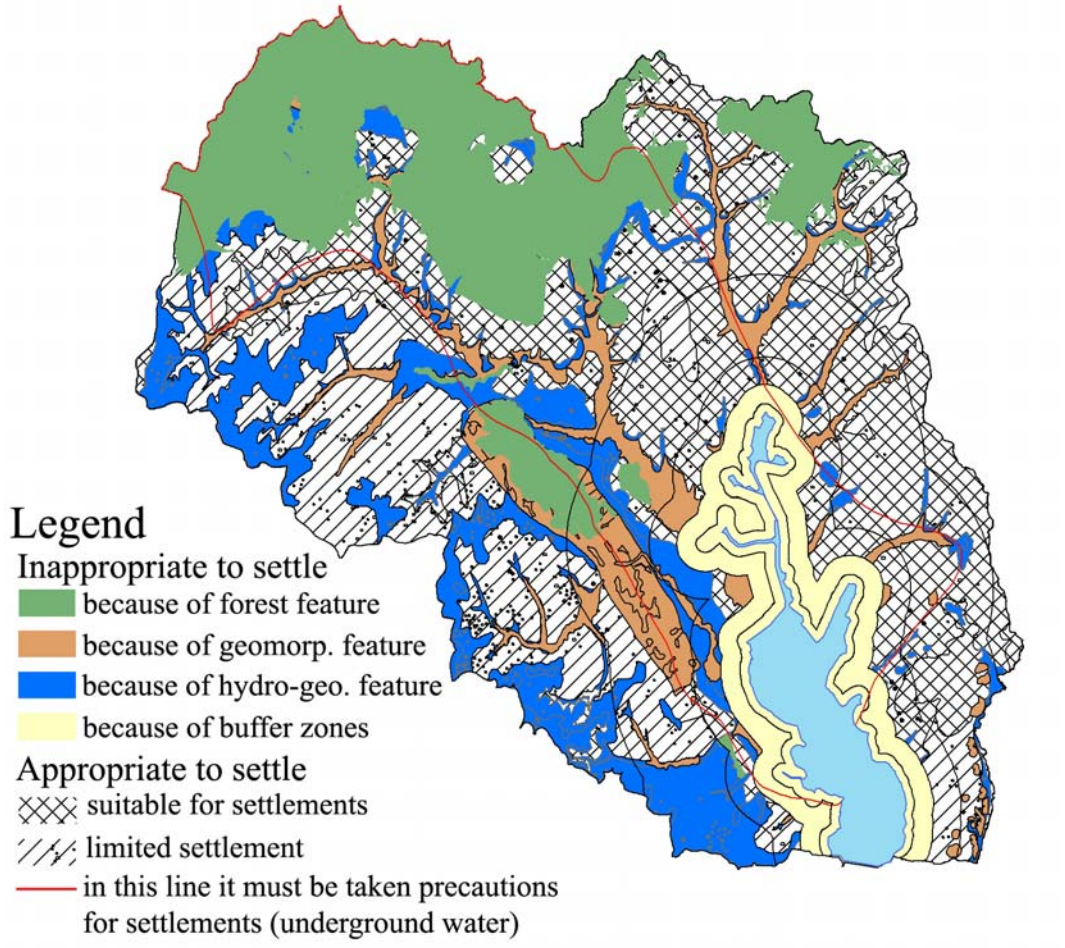
i. Where is suitable for settling?
ii. How we decide settlements?
iii. Are buffer zones successful? And if not how we can improve their effects?
iv. How can we protect wetlands from urban sprawl? And how we decrease the negative effects of urban development?

In this respect, these questions about constant buffer zones of Büyükçekmece were researched and some settlements strategies were prepared in order to protect Büyükçekmece Lake. A map had been prepared; and this map is a synthesis study of difference of similarity of hydro-geology and morphology features, urban and rural effects.

Figure 5.13 is given below is appropriate for settlements analysis of Büyükçekmece. At this map two main headgears were determined; they are inappropriate to settle and appropriate to settle area. Inappropriate to settle area was evaluated in four stages as forest feature, geomorphologic feature and hydro-geologic feature; these are physical attributes that they create thresholds for settlement. The other inappropriate area is in buffer zone around Büyükçekmece Lake (constant buffer zone). Expanse of this buffer zone around Büyükçekmece Lake was determined and created according to distance of similarity method. Absolute and short distance buffer zones are similar to each other according to table 5.4, 5.8, 5.12, 5.16. It is not forgotten that the pressure of urban development is in high level; and its effects direction from south to north (near Marmora Sea), east to west (East Part of Büyükçekmece Lake), and northwest to southeast (at the

plain on the northwest part of Büyükçekmece Lake). And second heading of legend is appropriate to settle area; it has three headgears suitable for settlements, limited settlement and the appropriate areas for settlements in underground water area.

Fig. 5.13 Settlement Appropriateness of Büyükçekmece



In this settlement appropriateness map some restrictive thresholds are accepted. As forest feature all the forest character was accepted, these are forest which is known its proprietorship, forest which is unknown its proprietorship and even 2B forest areas. 2B forest areas mean that they have lost their forest quality. They have lost their forest feature either because of human beings interventions or because of natural reasons. These forest characteristics were chosen as a threshold because forest both maintains ecological

life in Büyükçekmece and absorbs wastes and traps sediments. These forests are natural buffer zones for wetlands. As geomorphologic feature mountain, fossil area, land slide, karst, monadnock and plain areas were chosen. Mountain area is inappropriate to settle because of its high gradient. Fossil area is located in mountain area therefore it is not appropriate to settle. Land slide is also inappropriate to settle. Karst has a special feature because it absorbs water directly to underground and also these areas are high soluble areas. For these reasons it is not suitable for settling. Monadnock (inselberg) is small mountain; these areas has a special characteristic as their moisture, vegetation, ecology and living things. Therefore these inselberg areas must conserve; they are not to suitable for settlements. Plain areas are not appropriate to settle; they are not only aquifer areas but also very important agricultural areas. These areas should be allocated only for bio-agriculture. Otherwise pesticides, sediments, organic wastes, nutrient (with artificial fertilizer) degrade the ecological life of Büyükçekmece Lake. As hydro-geologic characteristic the three main areas were chosen; they are permeable grainy, permeable rock and semi permeable grainy areas. These areas have a special feature of water absorption; and also semi permeable grainy area nearly overlaps with plain areas. As buffer zones absolute buffer zone and short distance buffer zone were accepted. Constructions are forbidden in these two buffer zones. These buffer zones obstruct water flood, sediments, and pesticides, urban and rural wastes. They protect Büyükçekmece Lake. According to our study some part of middle distance buffer zone can be added in these buffer zones because of the similarity between short distance buffer zone and middle distance buffer zone according to table 5.4, 5.8, 5.12, 5.16. This means buffer zone around Büyükçekmece Lake can be enlarged. However absolute buffer zone and short distance buffer zone were selected as constant buffer zone around Büyükçekmece Lake in order to protect Büyükçekmece Lake. Absolute buffer zone expanses 300 meter from Büyükçekmece Lake and short distance Buffer zones covers 700 meter from absolute buffer zone; totally approximately 1000-1200 meter constant buffer zone is suggested around Büyükçekmece Lake.

In this settlement appropriateness map two main suitable for settlement area were defined. These are suitable for settlement and limited settlement areas. In suitable

settlement areas hydro-geologic, forest and agricultural and morphologic values are appropriate to settle; however this area should be afforested with plants in order to obstruct surface flood. In this manner contaminants of settlements can be hindered to reach to Büyükçekmece Lake. However in underground water region settlements should take into consideration underground water. In limited settlement areas there is a little negative effect of hydro-geology; in these areas water can be absorbed in underground more than appropriate to settle areas. In these areas settlements should be limited and vegetation must be increased in order to hinder the negative effects of settlements.

5.2 Model Study of Mogan Lake

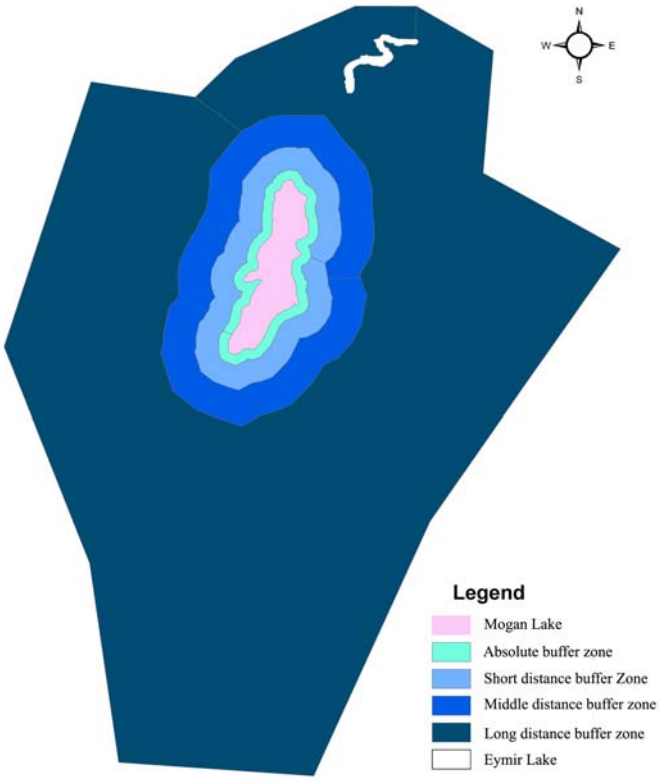
In this part the comparison between Mogan Lake and Büyükçekmece Lake were aimed in order to get expressive results. With these results model study of PhD will generalize to the other wetlands. In a sequence the hydro-geologic, the morphologic, rural characteristics and urban effects will be evaluated so that the ground and underground effects and constituents can be understood. The preceding chapter we determined classification of suitable areas for settlements in order to protect Büyükçekmece Lake; the quasi map will be prepared for Mogan Lake according to physical attributes and thresholds.

Mogan Lake has a special status; it belongs to Environmental Protection Agency for Special Areas. This means Mogan Lake has conservation status however Mogan Lake does not have any buffer around Mogan Lake zone according to its conservation status. Some buffer zones were created in order that we can evaluate the Mogan Special Environmental Protection Area; in that case we can calculate covered areas of hydro-geologic, geomorphologic characteristic and as well as urban and rural functions. In this manner we can easily compare two case study areas. These buffer zones are shown at the figure 5.14 below.

At the figure 5.14 there are four buffer zones, in a sequence these buffer zones are absolute buffer zone, short distance buffer zone, middle distance buffer zone, long

distance buffer zone. Absolute buffer zone encompasses the area from lake to 300 m; short distance buffer zone covers the area from absolute buffer zone's border to 700 m, middle distance buffer zone contains the area from short distance buffer zone's border to 1000 m; and long distance buffer zone comprises the area from middle distance's border to Mogan Special Environmental Protection Area's border. In this part of PhD method, covered areas of geomorphologic, hydro-geologic characteristics and rural and urban functions will be calculated with GIS software in buffer zones. However these values are unit/area; this means there is not a specific unit of measure.

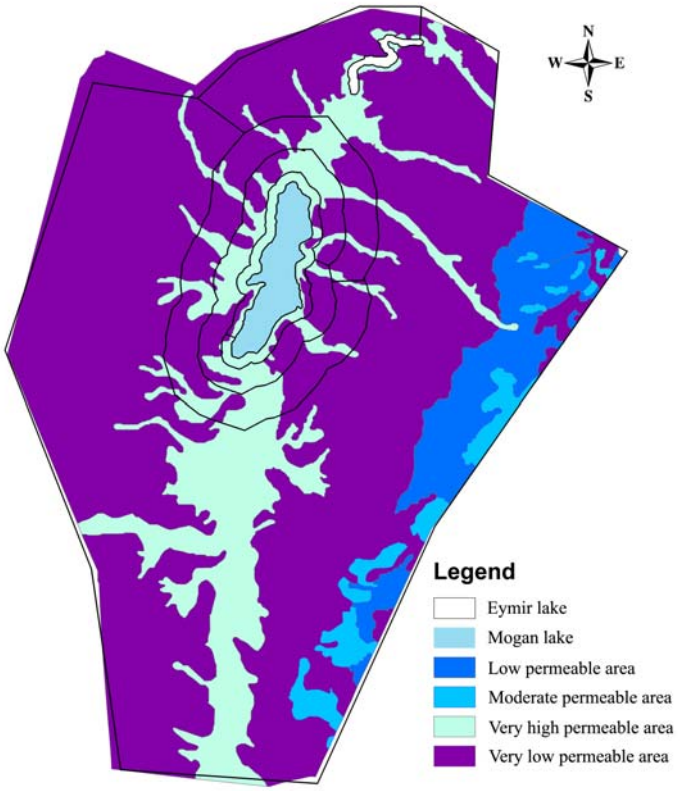
Fig. 5.14 Buffer zones in Mogan



The study aims to research hydro-geologic characteristics, urban and rural affects to Mogan Lake therefore buffer zones can be created successfully for Mogan Lake in order to protect Mogan Lake. Meanwhile suitable settlement areas can be defined.

The underground and ground features will be evaluated. First step of this evaluation is investigation of hydro-geologic characteristic of Mogan Lake. Hydro-geologic characteristic of Mogan Lake will be researched in this manner affects of the ground and underground water will be determined. The article "Afforestation areas defined by GIS in Gölbaşı specially protected area Ankara/Turkey" (Dilek, F., E., Şahin, Ş., Yılmazer, İ., 2007) was utilized in order to create the permeability map of Mogan Lake. The map was digitized from this article for this reason the margin of error has to take into account. The northwest of coordinate system is not one to one congruent however the soil characteristic and permeability feature of soil are same; for this reason these margin of error does not affect negatively the permeability analysis of Mogan Lake. Figure 5.15 shows hydro-geologic characteristic of Mogan Lake, the exterior border of these studies is Mogan Special Environmental Protection Area's border.

Fig. 5.15 Hydro-geologic characteristic of Mogan Special Environmental Protection Area



According to Figure 5.15 there are considerable four different permeability characteristics in Mogan Special Environmental Protection Area. These areas are low permeable area, moderate permeable area, very high permeable area and very low permeable area. Highlight is the great amount of soil characteristics are very low permeable area and very high permeable area. Moderate permeable area and low permeable area are located in east and southeast of Mogan Lake. Very high permeable area contains aquifer areas, these areas are reservoir of Mogan Lake; these aquifer areas carry water directly to Mogan Lake. In this manner these aquifer areas are sensitive areas that they have to protect agricultural wastes, pesticides, urban wastes, settlements. We infer from very high permeable areas that we should plan these areas take into consideration underground water flow. In very low permeable areas we should care surface flow; these areas do not absorb water easily so that surface flow carries pesticides, sediments, agricultural wastes and/or urban wastes. We should plant and these areas with trees, shrubs and herbaceous plants in order to trap sediments and absorb phosphorus and nutrients. Thus we protect the lake from eutrophication and lengthen the lake's environmental life. At the east and southeast of the lake there are low permeable and moderate permeable areas, these areas absorb water and these areas also carry water on surface. We should take into consideration surface flow and underground water. These areas should vegetate because we can hinder pollutants in underground water and surface water flow. These areas are hilly and mountainous places therefore settlements must be controlled and limited.

The buffer zones were created in order that special environment protection can be easily evaluated. These buffer zones reveal affinities and dissimilarities of special features of Mogan Lake. On the other hand we get quantitative data about Mogan Lake so that we can constitute successful land use strategies. In this manner we can control and plan Mogan Special Environmental Protection Area on the objective conserve Mogan Lake. The table below contains quantitative results according to soil permeability of Mogan Lake. These values are permeable type of soil's covered area valued at unit area in Mogan special environmental protection area.

5.17 Hydro-geologic characteristic in Mogan (covered area)

Unit/area	**Very Low Permeable Area**	**Very High Permeable Area**	**Low Permeable Area**	**Moderate Permeable Area**
Absolute B. Z.	15812393,14	6944745,10	0,00	0,00
Short D. B. Z.	6248041,14	5807724,24	0,00	0,00
Middle D. B. Z.	1008827,34	3516961,60	0,00	0,00
Long D. B. Z.	164210337,25	33536541,96	19111983,11	8204385,87

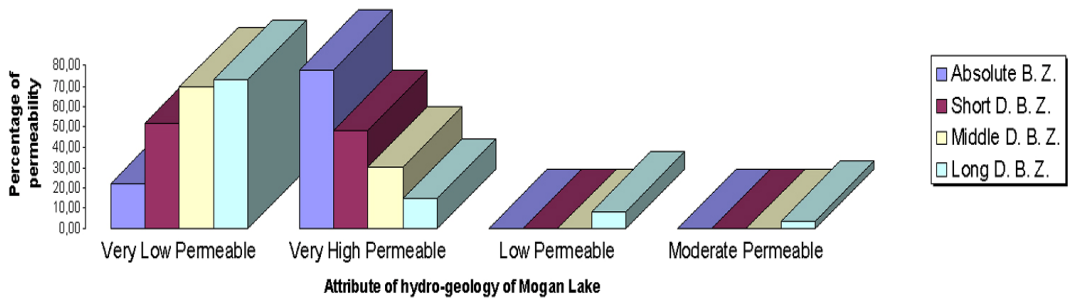
According to table 5.17 the three buffer zones consist of very low permeable and very high permeable area. Only long distance buffer zone includes low permeable and moderate permeable area. A different land use strategy should be developed for Mogan Lake. We should group buffer zones according to their similarities and dissimilarities. These unit/area values should be calculated at percentage in order to evaluate them easily. The table 5.18 shows percentage of hydro-geologic characteristics in Mogan.

5.18 Percentage of hydro-geologic characteristic in each buffer zone (Mogan)

	Very Low Permeable Area	**Very High Permeable Area**	**Low Permeable Area**	**Moderate Permeable Area**
Absolute B. Z.	22,29	77,71	0,00	0,00
Short D. B. Z.	51,83	48,17	0,00	0,00
Middle D. B. Z.	69,48	30,52	0,00	0,00
Long D. B. Z.	72,96	14,90	8,49	3,65

As it is seen at table 5.18 the percentages of the values have differences from each other. It is such a good way that we interpret these values easily. Figure 5.16 displays the percentage of hydro-geologic characteristic in each buffer zone in Mogan.

Fig. 5.16 Percentage of hydro-geologic characteristic in each buffer zone (Mogan)



According to figure 5.16 the percentage of very low permeable area increases from absolute buffer zone to long distance buffer zone. The percentage of very high permeable area lessens from absolute buffer zone to long distance buffer zone. Low permeable area and moderate permeable area are located in long distance buffer zone. However these are only percentage values; we have to normalize these values in order to simplify these percentage values. This simplification contributes to group these buffer zones; we prepare also these normalization values to distance of similarities. The table 5.19 shows normalization of percentage of hydro-geology values according to buffer zones.

5.19 Normalization of hydro-geologic characteristic in buffer zones (Mogan)

	Very low permeable area	**Very high permeable area**	**Low permeable area**	**Moderate permeable area**
Absolute B. Z.	0,28	0,96	0,00	0,00
Short D. B. Z.	0,73	0,68	0,00	0,00
Middle D. B. Z.	0,92	0,40	0,00	0,00
Long D. B. Z.	0,97	0,20	0,11	0,05

At table 5.19 normalization of hydro-geologic characteristic can be seen in buffer zones in Mogan. At this table the percentage of hydro-geologic characteristic values were normalized into range [0, 1]. The maximum normal value equalized 1 and minimum normal value equalized 0; in this way very small values do not evaluate and the biggest value emphasizes and its effect ascends. Table 5.19 facilitates to understand associated with percentage of hydro-geology values. In this respect the similarities of buffer zones should be estimated. Table 5.20 shows similarity of buffer zones according to normalized values above.

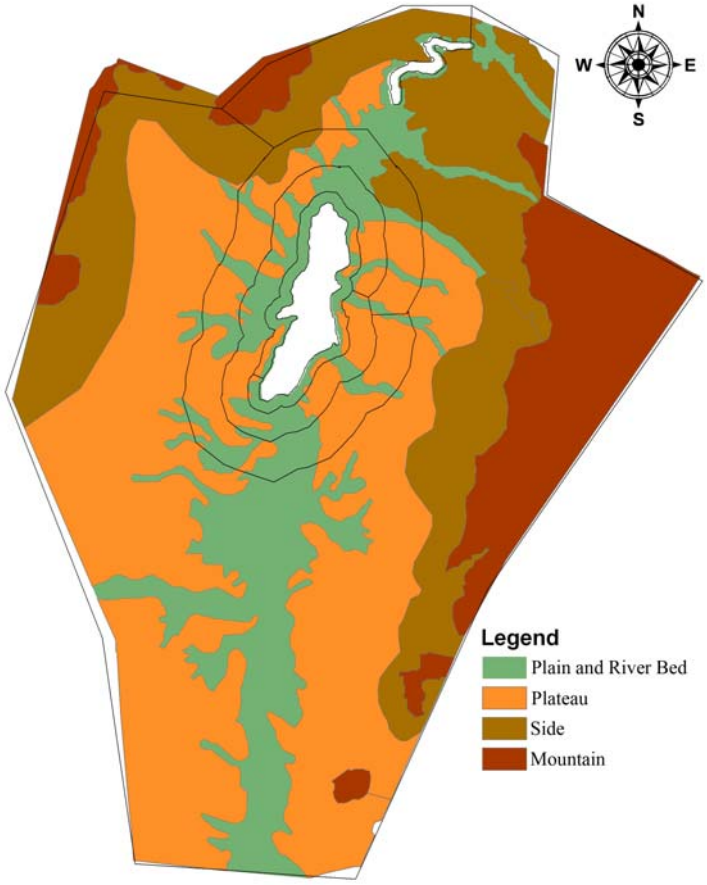
5.20 Distance of similarity of hydro-geologic characteristic between buffer zones (Mogan)

	Absolute B. Z.	**Short D. B. Z.**	**Middle D. B. Z.**	**Long D. B. Z.**
Absolute B. Z.	1,00	0,75	0,47	0,30
Short D. B. Z.	0,75	1,00	0,89	0,74
Middle D. B. Z.	0,47	0,89	1,00	0,94
Long D. B. Z.	0,30	0,74	0,94	1,00

Table 5.20 determines the similarities of buffer zones in Mogan Special Environmental Protection area. In this respect short distance buffer zone and middle distance buffer zone are similar; middle distance buffer zone is 0.89 similar with short distance buffer zone. Long distance buffer zone is similar with middle distance buffer zone. Absolute buffer zone is different from the other buffer zones because of the great value of very high permeable area. Three main strategies can be developed in order to preserve Mogan Lake and its special environmental protection area. First strategy is for very high permeable areas. These areas are aquifer areas; this means these areas are reservoir areas that they are sensitive areas. These areas should maintain and conserve; when we plan these areas we have to protect these areas from settlements, urban wastes and agricultural wastes. Second strategy is for very low permeable areas. These areas possesses feature that they carry sediments, pesticides, urban wastes, nutrients and phosphorus with storm runoff. In that case surface flow is the main element that we should care. In particular vegetation is the main element in buffer zones and close to Mogan Lake. These areas are suitable areas for settlements with control density and construction. Third strategy is for low permeable and moderate permeable areas. These areas have not only surface flow but also underground water flow; in that case two strategies should be thought. First settlements should be limited. Second strategy is vegetation to trap surface flow, and absorb surface water; thus contamination on the ground can be hindered to carry and absorb. However the landforms have different characteristic for this reason hydro-geologic data must be evaluated with geomorphology. Because some forms are valley and they act to move runoff, some forms are hilly or mountain and there are difficulties to absorb water because of gradient. Some landforms are in plain characteristic so that water is gathered in these areas. In that case next step must be morphologic characteristic.

Figure 5.17 shows geomorphologic characteristics of Mogan Special Environmental Protection area. Four main geomorphologic characteristics exist in Mogan Special Environmental Protection Area. They are plain and river bed, plateau, side and mountain. South side of Mogan Special Protection Area is composed of plain and plateau. South side is smooth area; altitude rises from Mogan Lake to North West and east side of Mogan Lake.

Fig. 5.17 Geomorphologic characteristics of Mogan Special Environmental Protection Area



Plain and river bed is aquifer areas that these areas must be protected from urban and rural contaminants. Mountain area is not appropriate for settling because of its high gradient. Side areas are limited appropriate for settlement because gradient gradually rises and some side areas are not suitable for settlement. Plateau areas are suitable because of its small gradient. Surface water flow should be taken into consideration on plateau areas. Mountain areas should be afforested in order to lessen the effects of erosion. Side areas should be limited settled and great amount of side land should be afforested. Covered areas of geomorphologic characteristics should be computed in buffer zones in order to similarities of buffer zones can be evaluated. Thus land use strategies can be determined. Table 5.21 includes covered area of geomorphologic features in buffer zones.

5.21 Geomorphologic characteristics in Mogan (covered area)

Unit/area	**Plateau**	**Plain and River Bed**	**Side**	**Mountain**
Absolute b. z.	995396,70	**3492229,77**	0,00	0,00
Short d. b. z.	**6328276,24**	5738823,45	0,00	0,00
Middle d. b. z.	**13679753,57**	6812072,41	2235471,92	0,00
Long d. b. z.	**95524718,20**	31268802,56	60374424,58	35567359,27

According to table 5.21 plain and river bed covers more land than plateau. In absolute buffer zone there does not exist side and mountain area. As similar there do not exist side and mountain areas in short distance buffer zone. However the biggest value is plateau in short distance buffer zone. Characteristics become distinct in middle distance buffer zone. In long distance buffer zone covered plateau area begins to decrease; value of side increases and mountain area presents in long distance buffer zone. Percentage of covered areas facilitates to evaluate geomorphologic characteristics with buffer zones. Table 5.22 includes values of percentage of morphologic features in buffer zones.

5.22 Percentage of geomorphologic characteristics in Mogan

	Plateau	**Plain and River Bed**	**Side**	**Mountain**
Absolute b. z.	22,18	77,82	0,00	0,00
Short d. b. z.	52,44	47,56	0,00	0,00
Middle d. b. z.	60,19	29,97	9,84	0,00
Long d. b. z.	42,88	14,04	27,11	15,97

Table 5.22 above contains percentages and plain and river bed values gradually decreases from absolute buffer zone to long distance buffer zone. Side exists just in middle and long distance buffer zone. Mountain just presents in long distance buffer zone. Covered area of plateau increases absolute buffer zone to middle distance buffer zone. Percentage of plateau value is 42.88 in long distance buffer zone. Figure 5.18 includes percentage of geomorphologic characteristics.

Fig. 5.18 Percentage of geomorphologic characteristics in each buffer zone (Mogan)

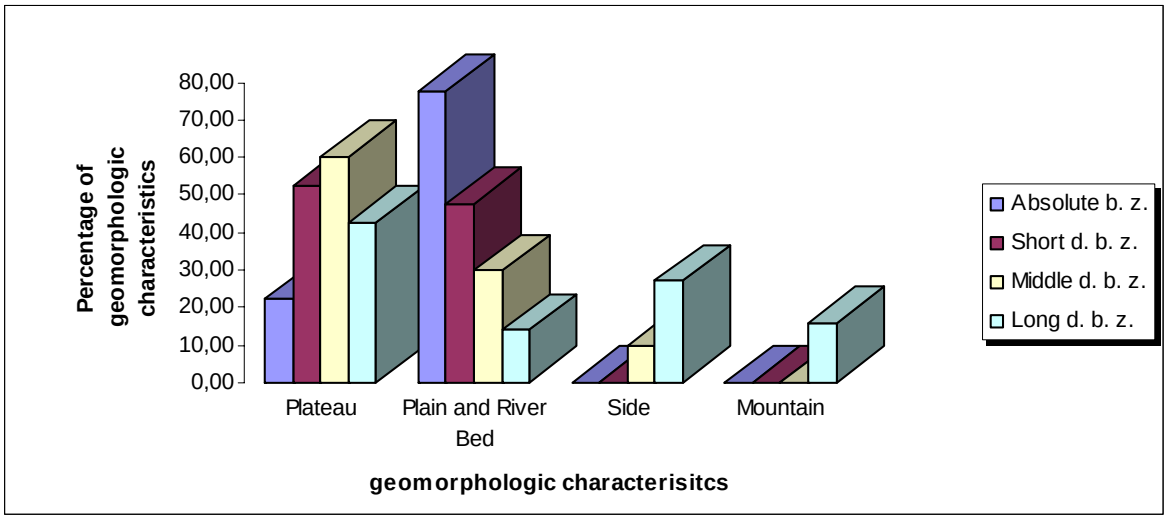


Figure 5.18 indicates percentage of geomorphologic characteristics in each buffer zone of Mogan Special Environmental Protection Area. Percentage values should be normalized into range [1 0] in order to determine effects of these values. Highest value takes 1 and the other values are dispersed from 0.99 to 0. Normalization table of percentage values are given below.

5.23 Normalization of geomorphologic characteristics in buffer zones (Mogan)

	Plateau	**Plain and River Bed**	**Side**	**Mountain**
Absolute b. z.	0,27	0,96	0,00	0,00
Short d. b. z.	0,74	0,67	0,00	0,00
Middle d. b. z.	0,89	0,44	0,14	0,00
Long d. b. z.	0,78	0,26	0,49	0,29

According to table 5.23 plain and river bed areas take 0.96 value in absolute buffer zone. Plateau is 0.74 in short, middle and long distance buffer zones. Plateau takes 0.27 in absolute buffer zone. Plain and river bed takes 0.67 in short distance buffer zone. In middle distance buffer zone plain and river bed takes 0.44. Side is second biggest value in long distance buffer zone. These values are effects of percentage of geomorphologic

characteristics in buffer zones of Mogan Special Environmental Protection Area. According to these values distance of similarities of buffer zones should be computed. Table 5.24 includes values of distance of similarities in buffer zones according to table 5.23.

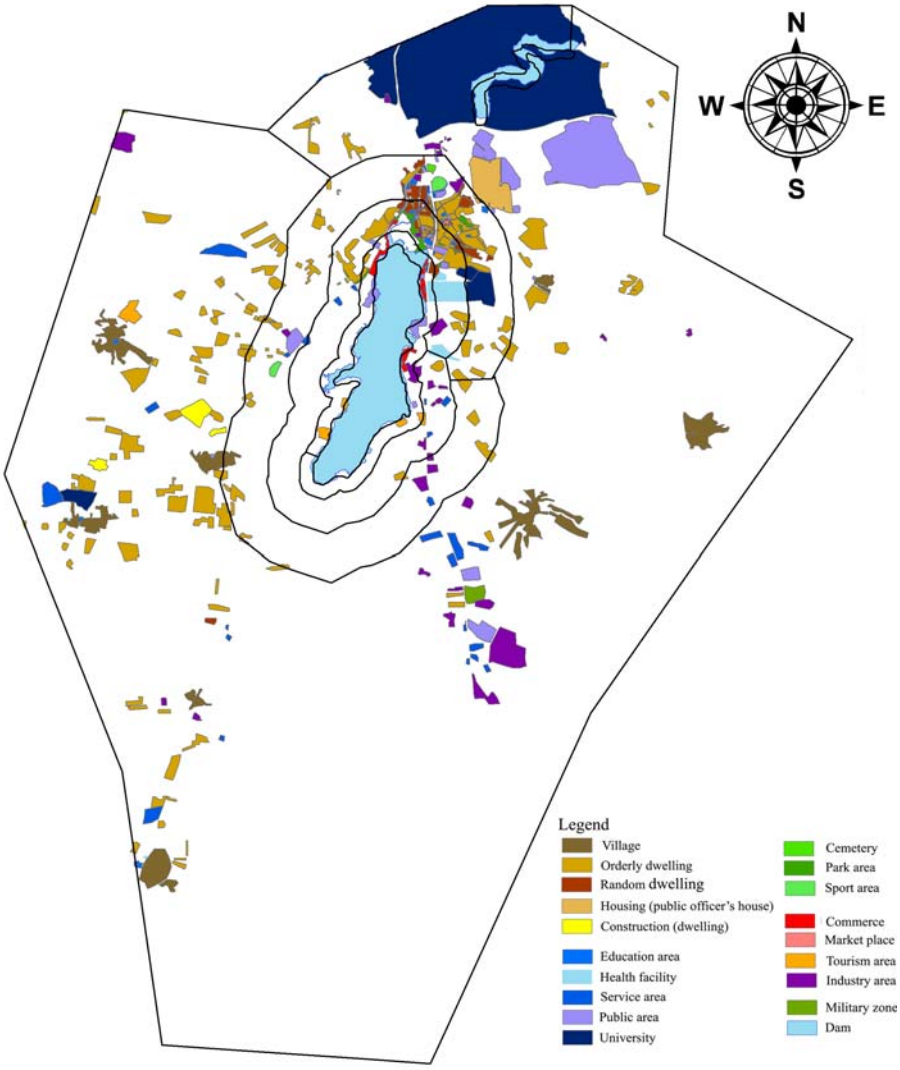
5.24 Distance of similarity of geomorphologic characteristics between buffer zones (Mogan)

	Absolute b. z.	**Short d. b. z.**	**Middle d. b. z.**	**Long d. b. z.**
Absolute b. z.	1,00	0,74	0,50	0,30
Short d. b. z.	0,74	1,00	0,91	0,60
Middle d. b. z.	0,50	0,91	1,00	0,78
Long d. b. z.	0,30	0,60	0,78	1,00

Short distance and middle distance buffer zones are so similar a buffer zone that the values close to each other. At this point of view land use strategies should be determined by these similarities. Absolute buffer zone is also similar with short distance and middle distance buffer zones. However long distance buffer zone is 0.78 similar with middle distance buffer zone but long distance buffer zone is different from absolute and short distance buffer zones.

Hydro-geologic, soil and morphologic characteristics constitute natural structure of land. We can anticipate ground and underground water movements, soil behaviors, gradients of land therefore we can control aquatic systems of wetlands. This control provides to determine water contamination in this manner pollution of water can be obstructed. However characteristics of land are not adequate to obstruct water contamination. There are some urban and rural contaminants near metropolitan cities for wetlands. These contaminants determine according to buffer zones in this way contamination of water and wetlands can be obstructed. Non source contaminants can be obstructed with buffer zones. In this respect rural and urban contaminants must be determined, urban and rural effects must be inquired in these buffer zones. Figure 5.19 shows urban functions on area based in Mogan Special Environmental Protection Area.

Fig. 5.19 Urban effects in Mogan Special Environmental Protection Area



According to figure 5.19 from yellow to brown colors show housing types in Mogan Special Environmental Protection Area. Tones of blue color show service facilities in Mogan Special Environmental Protection Area. From red color to purple color shows urban working areas. Purple color indicates industrial areas in Mogan Special Environmental Protection Area, these areas are important because they produce contaminant. Industries become intense on the east part of Mogan Lake along highway Ankara-Konya. Settlement exists on north side of Mogan Lake, this settlement is Gölbaşı

Municipality. This settlement composes danger for Mogan Lake. Dwelling areas become intense on the west side of Mogan Lake. These values should be evaluated and quantitative values should be gotten according to buffer zones on Mogan Special Environmental Protection Area; thus we will get expressive results. Besides conservation strategies can be developed.

Table 5.25 shows urban functions in Mogan Special Environmental Protection Area. These functions are on covered area and unit/area base. In absolute buffer zone commerce and public spaces are important values. The other important value is dwelling in absolute buffer zone. Dwelling is the highest value and health facility is the second highest value in short distance buffer zone. Dwelling is the highest value and university is the second highest value in middle distance buffer zone. University area is the highest value in long distance buffer zone. Dwelling, public spaces and villages cover great amount in long distance buffer zone. Villages exist in middle distance buffer zone and long distance buffer zone. Industries present every buffer zone in Mogan Special Environmental Protection Area. Commerce area covers gradually less area consecutive from absolute buffer zone to long distance buffer zone. In absolute buffer zone there exists tourism area because of nearness to Mogan Lake.

5.25 Urban functions in Mogan (covered area)

Unit/area	**Military zone**	**Dwelling**	**Construction**	**Education**	**Public spaces**	**Village**	**Service**	**Public dwelling**	**Cemetery**
Absolute b. z.	0,00	74174,41	0,00	0,00	182583,15	0,00	11411,45	0,00	0,00
Short d. b. z.	0,00	1300904,97	0,00	34234,34	96997,30	0,00	74174,41	0,00	0,00
Middle d. b. z.	0,00	2139646,33	0,00	51351,51	188288,88	79880,13	79880,13	28528,62	22822,89
Long d. b. z.	136937,37	4604518,91	359460,58	28528,62	3189499,47	2995504,87	924327,22	770272,68	0,00
	Park	**Market place**	**Health facility**	**Industry**	**Sport area**	**Commerce**	**Tourism**	**University**	
Absolute b. z.	22822,89	0,00	51351,51	79880,13	0,00	205406,05	119820,19	0,00	
Short d. b. z.	154054,54	5705,72	456457,88	171171,71	0,00	45645,79	17117,17	34234,34	
Middle d. b. z.	45645,79	28528,62	22822,89	211111,77	136937,37	34234,34	0,00	439340,71	
Long d. b. z.	0,00	0,00	5705,72	1243847,73	0,00	0,00	159760,26	9836667,41	

However only the cover area values are inadequate to understand existing effects on Mogan Lake, therefore these values should be made simpler. Percentage values of covered area of urban functions facilitate to comprehend existing urban function in every buffer zone. Table 5.26 shows percentage values of urban functions in every buffer zone.

5.26 Percentage of urban functions in Mogan

	Military zone	**Dwelling**	**Construction**	**Education**	**Public spaces**	**Village**	**Service**	**Public dwelling**	**Cemetery**
Absolute b. z.	0,00	9,92	0,00	0,00	24,43	0,00	1,53	0,00	0,00
Short d. b. z.	0,00	54,42	0,00	1,43	4,06	0,00	3,10	0,00	0,00
Middle d. b. z.	0,00	60,98	0,00	1,46	5,37	2,28	2,28	0,81	0,65
Long d. b. z.	0,56	18,98	1,48	0,12	13,15	12,35	3,81	3,18	0,00
	Park	**Market place**	**Health facility**	**Industry**	**Sport area**	**Commerce**	**Tourism**	**University**	
Absolute b. z.	3,05	0,00	6,87	10,69	0,00	27,48	16,03	0,00	
Short d. b. z.	6,44	0,24	19,09	7,16	0,00	1,91	0,72	1,43	
Middle d. b. z.	1,30	0,81	0,65	6,01	3,90	0,98	0,00	12,52	
Long d. b. z.	0,00	0,00	0,02	5,13	0,00	0,00	0,66	40,56	

According to table 5.26 dwelling areas increase in short distance and middle distance buffer zone. University area is the highest value in long distance buffer zone; this area belongs to Middle East Technical University. Commerce is important value in absolute buffer zone. There are two reasons; first reason is settlement of Gölbaşı Municipality exists in absolute buffer zone on the north part of Mogan Lake. Center of Gölbaşı Town has commerce in order to provide service and trade for citizen of Gölbaşı Municipality. Second reason is restaurants exist near Mogan Lake. Public spaces are dense in absolute buffer zone and in long distance buffer zone. Percentage of urban functions should be normalized in order to facilitate to understand existing situation in Mogan Special Environmental Protection Area.

5.27 Normalization of percentage of urban functions (Mogan)

	Military zone	Dwelling	Construction	Education	Public spaces	Village	Service	Public dwelling	Cemetery
Absolute b. z.	0,00	0,23	0,00	0,00	0,56	0,00	0,04	0,00	0,00
Short d. b. z.	0,00	0,93	0,00	0,02	0,07	0,00	0,05	0,00	0,00
Middle d. b. z.	0,00	0,97	0,00	0,02	0,09	0,04	0,04	0,01	0,01
Long d. b. z.	0,01	0,39	0,03	0,00	0,27	0,25	0,08	0,07	0,00
	Park	**Market place**	**Health facility**	**Industry**	**Sport area**	**Commerce**	**Tourism**	**University**	
Absolute b. z.	0,07	0,00	0,16	0,25	0,00	0,63	0,37	0,00	
Short d. b. z.	0,11	0,00	0,32	0,12	0,00	0,03	0,01	0,02	
Middle d. b. z.	0,02	0,01	0,01	0,10	0,06	0,02	0,00	0,20	
Long d. b. z.	0,00	0,00	0,00	0,11	0,00	0,00	0,01	0,83	

At table 5.27 percentage of urban functions' covered area were normalized into range [1 0] and highlight is dwelling value is 0.93 and 0.97 in short distance buffer zone and middle distance buffer zone. This means dwelling is the highest value in short distance buffer zone and middle distance buffer zone. According to normalization of percentage of urban functions short distance and middle distance buffer zone are more similar than the other buffer zones. Distance of similarity measures similarities of each buffer zone. In that case distance of similarity should be tabulated in order to determine similarities of buffer zones. Table 5.28 shows distance of similarities of each buffer zone.

5.28 Distance of similarity of urban effects between buffer zones (Mogan)

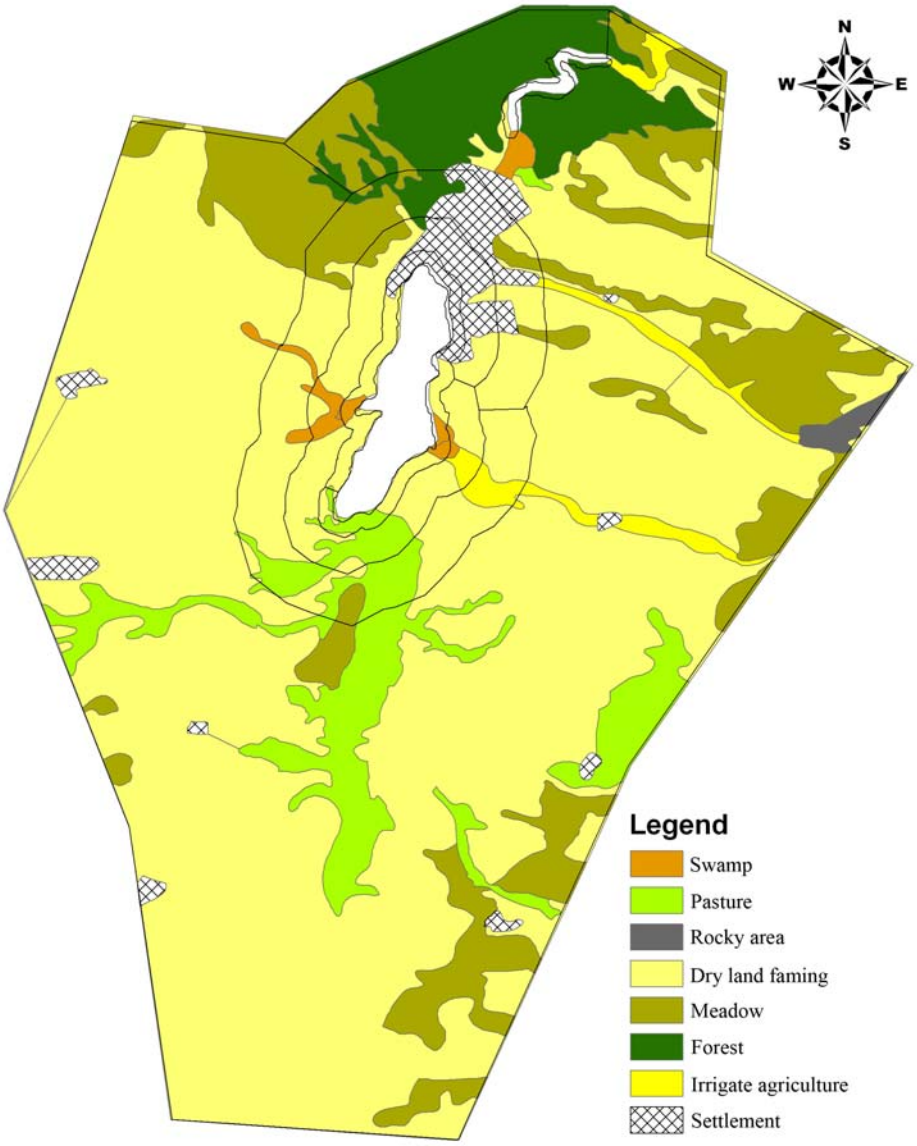
	Absolute b. z.	Short d. b. z.	Middle d. b. z.	Long d. b. z.
Absolute b. z.	1,00	0,22	0,18	0,16
Short d. b. z.	0,22	1,00	0,86	0,26
Middle d. b. z.	0,18	0,86	1,00	0,42
Long d. b. z.	0,16	0,26	0,42	1,00

According to distance of similarity table short distance and middle distance buffer zones are similar to each other. Absolute buffer zone becomes distinct from the other buffer zones because of commerce and public spaces. Long distance buffer zone is different from the other buffer zones because of university however long distance buffer zone is more similar than absolute buffer zone to the other buffer zones because of dwelling. Dwelling is the second highest value in long distance buffer zone therefore long distance buffer zone takes 0,41 similar with middle distance buffer zone in normalization. In this respect same land use strategies should be developed in short and middle distance buffer zones according to distance of similarities. Same effects can be observed to environment in short distance and middle distance buffer zones.

Effects of urban functions were evaluated above in order to constitute land use strategies in Mogan Special Environmental Protection area. Thus successful buffer zones will be created in order to conserve Mogan Lake, however rural effects affect also Mogan Lake. In particularly, wide agricultural areas cause pollution. In agricultural production pesticide and herbicide are used so as to protect farm products from agricultural pests. On the other hand agricultural production causes erosion if there are inadequate precautions. In that case rural effects should be researched in Mogan Special Environmental Protection Area.

Figure 5.20 indicates land use of rural functions in Mogan Special Environmental Protection Area. It should be taken into consideration margin of errors between buffer zones and rural land use characteristics. This margin of error occurred as the land use of rural characteristics map digitized. This value was obtained from Ankara Metropolitan City Municipality (2023 Capital City Ankara Development and Arrangement Plan Explanation Report Etudes Intervention Forms) and then digitized from development plan report.

Fig. 5.20 Rural characteristics in Mogan Special Environmental Protection Area



At figure 5.20 huge amount of rural land use is dry land farming in Mogan Special Environmental Protection Area. Pasture exist at south of Mogan Lake and these pasture areas consist of bulrushes and reeds. These bulrushes and reeds offer nest areas especially for birds and the other living things. Swamp areas are also reproduction areas for birds and the other species, these areas provide diversity for living things.

However land use of rural land use in Mogan Special Environmental Protection Areas is not adequate to evaluate rural effects on Mogan Lake. Quantitative data should be created in order to evaluate existing rural land use effects in Mogan Special Environmental Protection Area; in this manner precautions can be developed in Mogan Special Environmental Protection Area. Thus successful buffer zones can be constituted in order to conserve Mogan Lake. In that case covered area of rural land uses should be calculated in Mogan Special Environmental Protection Area. Table 5.29 below shows covered area per unit/area of rural functions in Mogan Special Environmental Protection Area.

5.29 Rural characteristic in all buffer zones of Mogan (covered area)

Unit/area	**Pasture**	**Settlement**	**Swamp**	**Meadow**	**Irrigate agriculture**	**Rocky area**	**Forest**	**Dry land farming**
Absolute buffer zone	0,00	944233,68	392482,67	460740,53	0,00	0,00	0,00	**2497099,91**
Short distance buffer zone	381106,36	2024983,07	551751,01	1188824,33	341289,28	0,00	62569,70	**7531116,82**
Middle distance buffer zone	2974904,91	2184251,40	307160,35	2588110,39	705331,18	0,00	1080749,39	**12895046,70**
Long distance buffer zone	31432742,87	2525540,69	648449,64	15306824,30	3151237,70	915792,91	14413784,01	**159200073,72**

Highlight is dry land farming is the highest covered area in all buffer zones in Mogan Special Environmental Protection Area. Settlement is the second covered area in Absolute buffer zone. As similar with absolute buffer zone settlement is the second highest value in short distance buffer zone. In middle distance buffer zone and long distance buffer zone pasture is the second highest covered area. According to these values primarily dry land faming should be taken into consideration when buffer zones are created; besides negative agricultural effects as pesticide, sediment, herbicides... etc. must be obstructed while buffer zones are created, as well land use strategies should be constituted with consideration dry land farming is the highest value in all buffer zones in Mogan Special Environmental Protection Area. In particularly it is worthy of notice

settlements in absolute and in short distance buffer zones. Housing discharges and wastes as well as commerce and industrial contaminants should be considered when land use strategies are constituted.

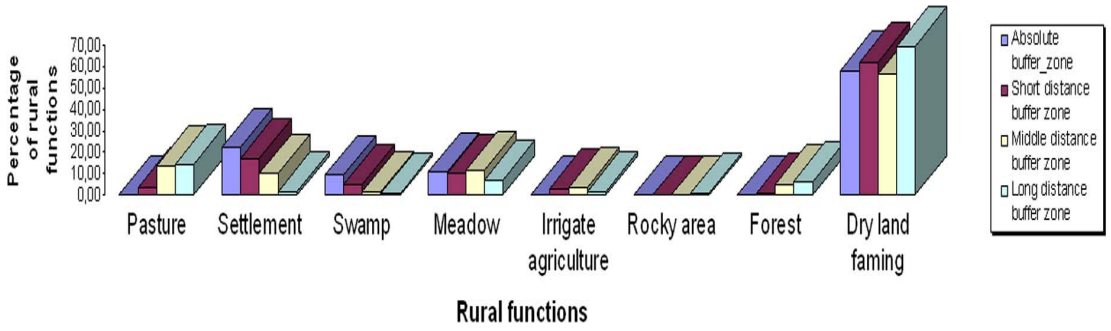
5.30 Percentage of rural characteristics in buffer zones (Mogan)

	Pasture	**Settlement**	**Swamp**	**Meadow**	**Irrigate agriculture**	**Rocky area**	**Forest**	**Dry land farming**
Absolute buffer zone	0,00	**21,99**	9,14	10,73	0,00	0,00	0,00	**58,15**
Short distance buffer zone	3,15	**16,76**	4,57	9,84	2,82	0,00	0,52	**62,34**
Middle distance buffer zone	**13,08**	9,61	1,35	11,38	3,10	0,00	4,75	**56,72**
Long distance buffer zone	**13,81**	1,11	0,28	6,73	1,38	0,40	6,33	**69,95**

Percentage of rural characteristics facilitates to evaluate covered area of rural function in buffer zones of Mogan Special Environmental Protection Area. When percentage values are calculated, covered area of rural functions divide total buffer zone area. According to table 5.29 pasture areas cover more area from absolute buffer zone to long distance buffer zone. Percentage of settlement value decreases consecutively from absolute buffer zone to long distance buffer zone. Swamp area covers less area in sequence form absolute buffer zone to long distance buffer zone. These swamp areas have special significance for their rich diverse species therefore these areas are sensitive areas because of their variety of fauna and flora. In this respect it should be considered their sensitivity while land use strategies are determined. Forest area exists in middle distance buffer zone and long distance buffer zone. Because of wide range dry land farming pasture and meadow characteristic it should be taken into consideration erosion effect in whole Mogan Special Environmental Protection Area.

Figure 5.20 simplifies to comprehend the relationship between buffer zones and rural characteristics on percentage base. Table 5.30 and Figure 5.20 should be together thought in order to conceive relations between rural characteristics and buffer zones.

Fig. 5.21 Percentage of rural functions in buffer zones (Mogan)



Percentage values can be understood with figure 5.21. According to ratio dry land farming is highest value. The other percentage values can also be read from figure 5.21. Percentage values emphasize ratios of rural function in buffer zone however similarities of buffer zones should be researched according to percentage values. In this manner successful buffer zones can be created and accomplished land use strategies can be developed. The first step of determination of similarities of buffer zones is normalization of table 5.30 into range [1 0]. Highest value of percentage of rural characteristic is appraised 1 and the smallest value at table 5.30 is estimated 0 in normalization table. This normalization table facilitates to evaluate the percentage values.

5.31 Normalization analysis of rural characteristics in buffer zones (Mogan)

	Pasture	**Settlement**	**Swamp**	**Meadow**	**Irrigate agriculture**	**Rocky area**	**Forest**	**Dry land farming**
Absolute buffer zone	0,00	0,34	0,14	0,17	0,00	0,00	0,00	0,91
Short distance buffer zone	0,05	0,26	0,07	0,15	0,04	0,00	0,01	0,95
Middle distance buffer zone	0,22	0,16	0,02	0,19	0,05	0,00	0,08	0,94
Long distance buffer zone	0,19	0,02	0,00	0,09	0,02	0,01	0,09	0,97

Normalization of percentage values of rural land uses facilitates to affect of rural functions in buffer zones. According to table 5.31 the highest value is dry land farming in

all buffer zones. The other rural land use functions are listed in order [1 0] according to their percentage values at table 5.30. The highest value is closesd 1 and the other values are estimated from 1 to 0. This normalization table demonstrates the effects of rural land use functions in Mogan Special Environmental Protection Area. With respect to table 5.31 the effects of rural functions affect similar in buffer zones. However the distance of similarities should be computed between buffer zones according to percentage of rural functions. Table of 5.32 indicates distance of similarity of buffer zones according to rural characteristics.

5.32 Distance of similarity of rural characteristics between buffer zones (Mogan)

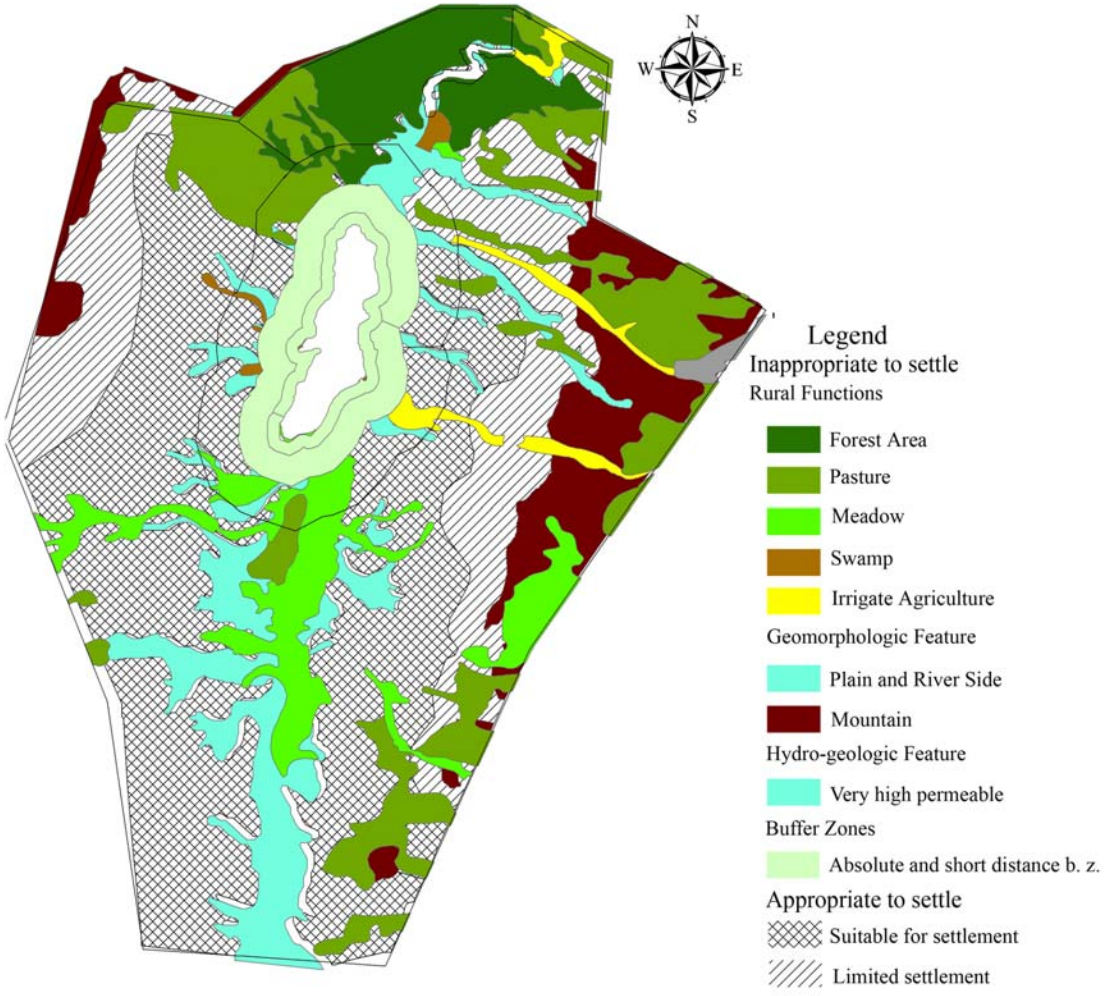
	Absolute buffer zone	**Short distance buffer zone**	**Middle distance buffer zone**	**Long distance buffer zone**
Absolute buffer zone	1,00	0,98	0,90	0,83
Short distance buffer zone	0,98	1,00	0,95	0,91
Middle distance buffer zone	0,90	0,95	1,00	0,97
Long distance buffer zone	0,83	0,91	0,97	1,00

At table 5.32 highlight is all of buffer zones similar to each other however absolute and short distance buffer zones are more similar than the other buffer zones. Correlatively middle distance and long distance buffer zones are more similar than the other two buffer zones. In this manner same land use strategies can be developed for absolute and short distance buffer zones. Meanwhile similar precautions can be evolved for absolute and short distance buffer zones so as to protect Mogan Lake from negative effects of rural functions. Similarly same land use strategies can be developed for middle distance and long distance buffer zones so that Mogan Lake is conserved and protected from negative effects of rural functions.

In this context settlement appropriateness should be created and mapped with data of hydro-geologic, morphologic characteristic of Mogan Special Environmental Protection Area. Precautions and buffer zone features should be determined with effects of rural and urban land uses. Figure 5.22 includes settlement appropriateness in Mogan Special

Environmental Protection Area. This map is a synthesis of hydro-geologic and geomorphologic characteristics and rural and urban functions. Settlement appropriateness is determined in three titles that they are inappropriate to settle, appropriate to settle and limited settlement.

Fig. 5.22 Settlement Appropriateness of Mogan Special Environmental Protection Area



As settlement appropriateness is composed, some characteristics of hydro-geologic, geomorphologic features and rural, urban functions are playing important role and decisive in order to conserve Mogan Special Environmental Protection Area. For instance some rural functions are not suitable for settlement. These rural functions are forest,

pasture, meadow, swamp, irrigate agricultural areas. These areas have special feature that they must be maintained. For this reason these areas are not suitable for settlements. These areas are not only necessary for continuity and maintenance of Mogan Lake but also these areas includes diversity of flora and fauna and offer habitat for living things. Additionally these areas facilitate to decrease effects of erosion, in this way Mogan Lake can be protected from filling up. Soil, mud, sediment, small gravels in course of time fills up the lake in that case some buffer zones or protection areas should be suggested. In addition to this some geomorphologic characteristics misbecome for settlements. These surfaces are plain and river side and mountain regions. Plain and river beds are overlapping with very high permeable areas; this means these areas are also aquifer areas that they carry ground and underground water to Mogan Lake. Hence these areas must be conserved so as to maintain Mogan Lake. Furthermore these areas are water flood areas for lake and rivers for this reason these areas misbecome for settlements. There are two main reasons that mountain regions are not suitable for settlements. First reason is high gradient and inappropriate surface formation. Latter during precipitation water mixes to soil and meanwhile surface flow continue in mountain regions because of its low permeable and moderate permeable characteristic. Therefore these areas should be conserved from settlements. Buffer zones around Mogan Lake hinder sediment, gravel, mud as well as contaminants, pesticides and herbicides. Buffer zones should absolutely be afforested in order to protect Mogan Lake from all contaminants. Distance of similarity method is used in order to determine these buffer zones. According to our study similarity of absolute buffer zone between short distance buffer zone is less that the similarity of short distance buffer zone between middle distance buffer zone; this means expanse of buffer zone around Mogan Lake can be slightly narrowed. This constant buffer zone around Mogan Lake encompasses absolute buffer zone and some part of short distance buffer zone. Expanse of absolute buffer zone is 300 meter from Mogan Lake and expanse of short distance buffer zone is 700 meter from absolute buffer zone in this manner the constant buffer zone around Mogan Lake can be covered land approximately 800 meter from Mogan Lake. This means approximately 800 meter constant buffer zone is suggested around Mogan Lake.

Three main characteristics are decisive in determination of appropriate areas for settlement in Mogan Special Environmental Protection Area. These are very low permeable areas in hydro-geologic characteristic, plateau in geomorphologic characteristic and dry land farming in rural characteristic. Surface flow should be taken into consideration in appropriate for settlement areas. Slope of land befit for settlement in Mogan Special Environmental Protection Area. Limited settlements have quasi qualification with appropriate settlement areas however slope of these limited settlement lands is higher than appropriate settlement areas.

6. CONCLUSION

Wetlands are very sensitive areas that they are composed of water ecosystem, endemic species, nest sides for living things, reproduction areas for living things; and as well wetlands offer wide range of diversity of species because they constitute crossing region between water and terrestrial zone. Before evaluation of model of PhD thesis, the relations of components of natural heritage of conservation planning should be referred. Figure 6.1 shows relationship between conservation planning and its components.

Fig. 6.1 Components of conservation planning

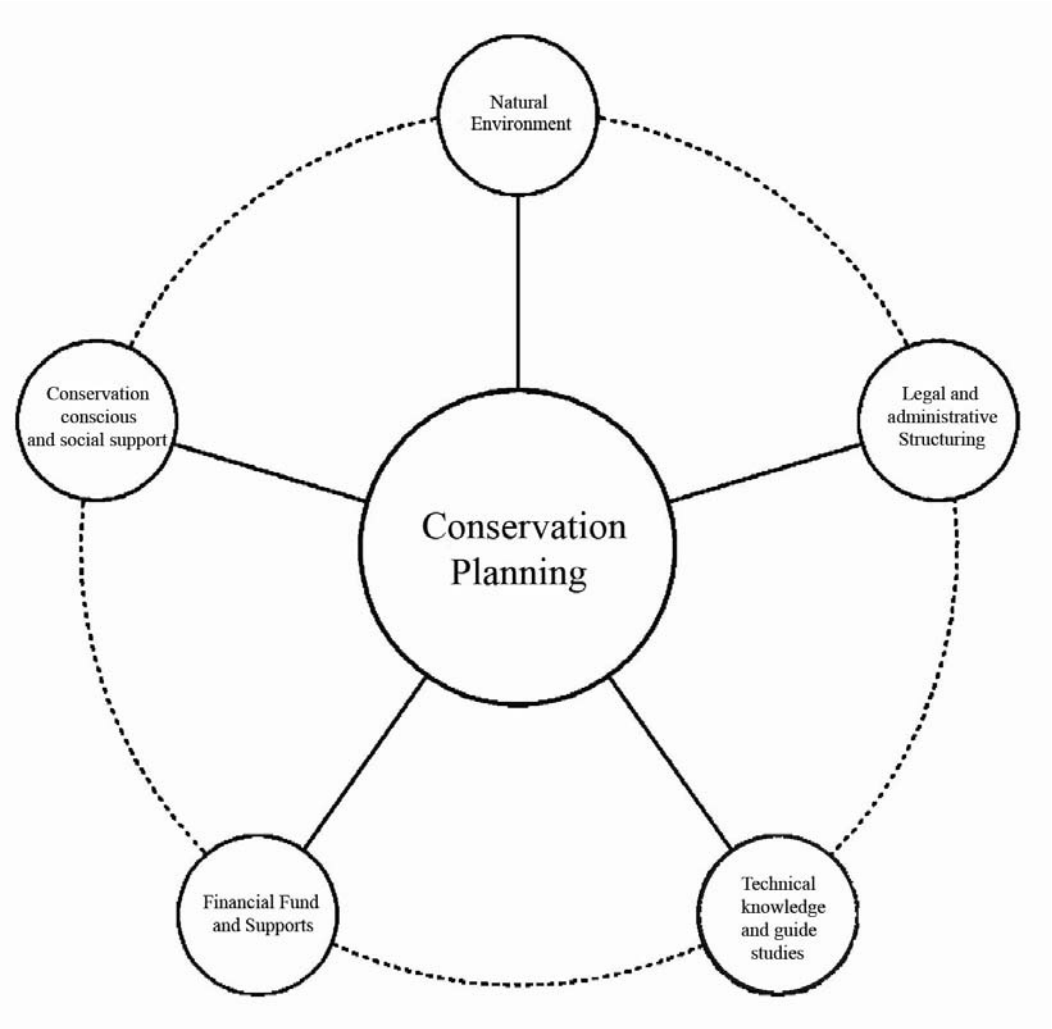


Figure 6.1 indicates components of conservation planning. These components are necessities of conservation planning. These five components constitute basic idea and include basic approach. These five components are:

a) Natural environment
b) Legal and administrative structuring
c) Conservation conscious and social support
d) Financial fund and supports
e) Technical knowledge and guide studies

These five components are entirety and conservation planning can not be occurred if any lack happens in their relation with conservation planning. For this reason these components were drawn straight and continuously. This continuous line means and shows strength of relationship between components and conservation planning. Intermittent line indicates sensitivity of relations. If this chain breaks natural environment can not be conserved.

If natural environment does not exist, conservation planning can not be mentioned. However just natural environment is not adequate to conserve them. Conservation conscious and social support is a necessary component for conservation planning. This support comprises from upper level for example ministries, government to local level like municipalities, non government organizations, owner of lands. Legal and administrative structuring supports conscious and social support and this component contains sanctions and mandatory. Conservation planning needs financial funds and supports. Financial funds contribute to purify pollutions, to make plans, to enhance local, non governmental organizations and central government and ministries. Technical knowledge and guide studies inquire to enhance strategies, intervention methods, and conservation studies. In this way successful land use strategies and plans can be developed. This PhD thesis is a guide study to develop land use strategies and conservation plans for wetlands. These components are basic requirements in order to make successful conservation plans.

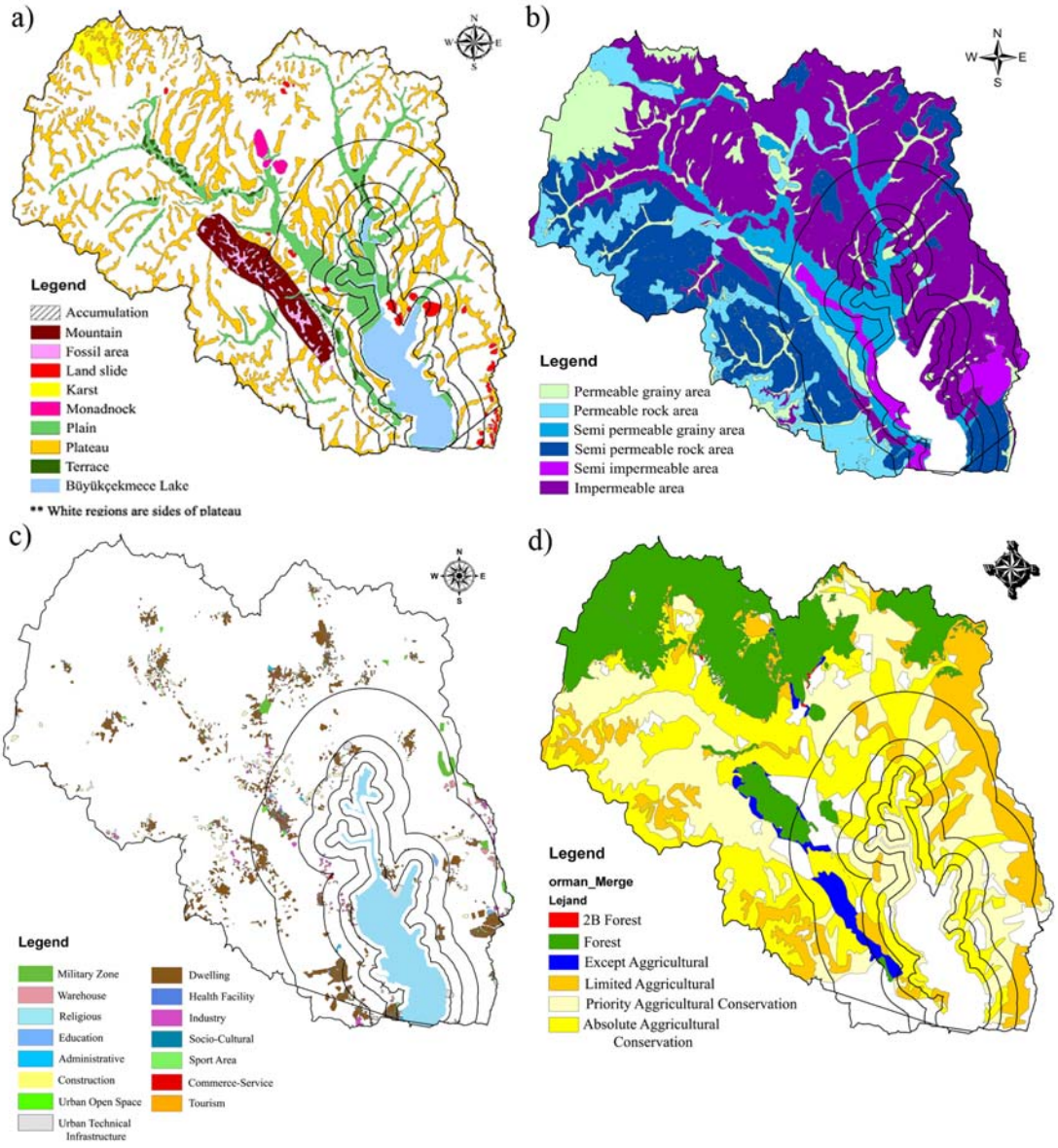
In this respect the results of case studies Mogan and Büyükçekmece must be evaluated. These data abet to compare two case studies each other; as well these data facilitate to evaluate buffer zone method. This comparison reveals expressive results for subsequent quasi wetlands. This PhD thesis inquires rapid making decision for nearby metropolitan areas because wetlands are affected from settlement very quickly. Rapid and successful planning decisions and interventions aid to maintain wetland ecosystem. Settlements deteriorate and spoil wetland ecosystem. In generally constant buffer zones are determined in order to conserve wetlands and their ecosystem. Constant buffer zones mean that buffer zones are determined definite meters from wetlands. This PhD thesis researches similarities of features in buffer zones. In this manner land use strategies can be successfully determined; appropriateness of settlements can be constituted. In this respect, outcomes of case studies Büyükçekmece and Mogan are evaluated below.

In this PhD model some subjects are determined in order to make decisions for wetlands. These subjects are geomorphologic characteristics, hydro-geologic features, rural effects and urban effects. Geomorphologic characteristics and hydro-geologic characteristics constitute movements of water and water regimes. Urban and rural effects constitute negative effects on wetlands. When negative effects can obstruct with buffer zones then water system can be protected. When water and water regimes can prevent from settlement and appropriate land use strategies can be developed then water and water systems can be protected.

In that case results of case studies of Büyükçekmece and Mogan should be presented according to the results of hydro-geologic and geomorphologic characteristics and the results of urban and rural features. Figure 6.2 shows hydro-geologic, geomorphologic characteristics, urban and rural features. At the figure some letters were given these are:

a) Geomorphologic characteristics
b) Hydro-geologic characteristics
c) Effects of urban effects
d) Effects of rural effects

Fig. 6.2 Geomorphologic hydro-geologic rural and urban characteristics of Büyükçekmece



Settlements have scattered pattern feature in Büyükçekmece Basin. Therefore it is difficult to control non-source of contaminants. Plain areas in geomorphologic map and semi permeable grainy areas in hydro-geologic map cover similar areas. These areas are important water regions and aquifer areas. Because of its productive and aquifer characteristics, plain areas possess absolute agricultural conservation area feature. In that

case these maps and research facilitate to comprehend existing situations and similarities. These plain areas are aquifer areas that they encompass water movement and regime. These similarities prove that PhD model is successful in making decisions rapidly. Meanwhile land use strategies can be developed rapidly and constant buffer zones can be compared. It can be seen that features have differences in buffer zones namely some areas have different qualities inside. Every constant buffer zone is composed of a lot of feature. In that case it is difficult to determine same land use strategies in constant buffer zone. Distance of similarities can show similarities of buffer zones; in this way similarities of buffer zones can be calculated (see and cf. Table 5.4, 5.8, 5.12 and 5.16).

Distance of similarities measures similarities of characteristics between buffer zones according to covered areas of functions in buffer zones. This method facilitates to comprehend existing situation and to compare buffer zones when land use strategies are determined. Every wetland has its own ecosystem and characteristics in that case similarities must be determined between buffer zones in order to determine appropriate and successful land use strategies. Constant buffer zones are determined, definite distance gives different results however sometimes buffer zones can be similar. After evaluation with distance of similarity method; settlement appropriateness map was created (see and cf. Fig. 5.13).

Same study had been researched in Mogan Special Environmental Protection Area; physical attributes, thresholds and constant buffer zone around Mogan Lake had been inquired in order to determine settlement appropriateness in Mogan Special Environmental Protection Area. This is a parallel study that constant buffer zones around Mogan Lake have been computed with distance of similarity method; at the same time thresholds of Mogan Special Environmental Protection Area has been determined. Thresholds had been determined as a result of four characteristics; these physical attributes are geomorphologic, hydro-geologic features and urban and rural functions (land use effects) in Mogan Special Protection Area. Figure 6.3 shows analysis of physical attributes and thresholds which had been done in Mogan Special Environmental Protection Area.

Fig. 6.3 Geomorphologic hydro-geologic rural and urban characteristics of Mogan

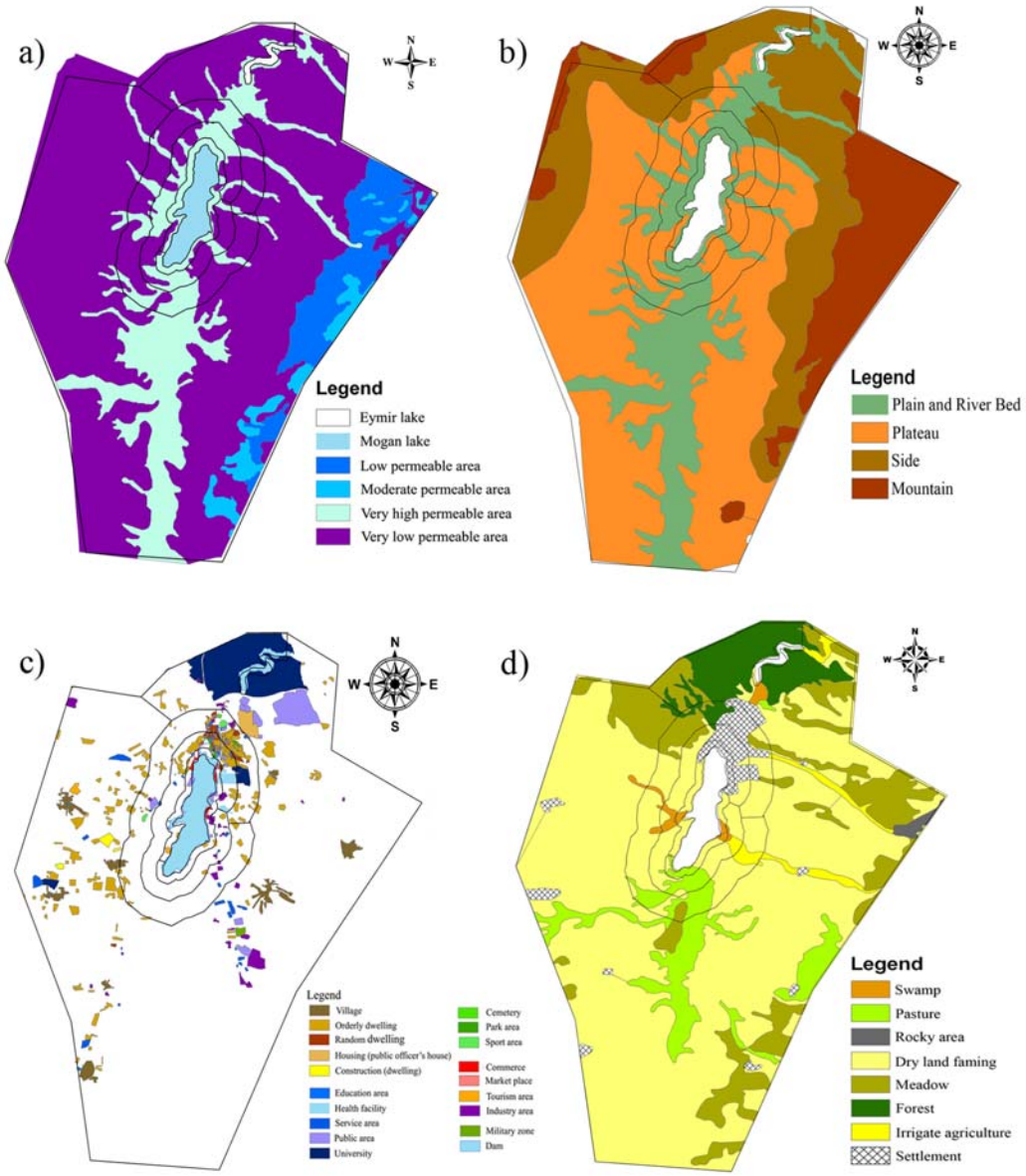


Figure 6.3 includes geomorphologic, hydro-geologic, rural and urban characteristics in Mogan Special Environmental Protection Area. These maps facilitate to determine thresholds and inappropriate settlement areas; and these thresholds had been reinforced with constant buffer zone around Mogan Lake. This constant buffer zone was computed

with distance of similarity method. Distance of similarity method facilitates to make understandable existing situation in buffer zones (see and cf. table 5.20, 5.24, 5.28 and 5.32). After determining thresholds and constant buffer zone around Mogan Lake settlement appropriateness map were prepared (see figure 5.22)

The basic element is water in a wetland ecosystem. Water provides nest side for birds as well as the other living things. Water ensures breeding areas for species. A special microclimate exist water sides therefore attractiveness presents for human beings. Wetlands and water sides have important landscape and scene for this reason wetlands present priority preferences for settlement. Streams, creeks, rivers… etc. bring alluvium soil. Water sides are productive areas because of alluvium for this reason agricultural production is preferred near wetlands. Agricultural production is priority reason for settlements villages or towns when we choose settlement location. Water life provides rich diversity of species; therefore wetlands have opportunity of fishery. This is also an important reason for settlements. Agricultural production, raw materials, water are important sources for industries and industrial production. These productions cause contamination in water systems. In respect to the reasons above wetlands, water and watersides are attractive areas for settlements.

Constant buffer zones are necessity conserving wetlands however only constant buffer zones are inadequate to conserve wetlands, so that land surface characteristics, hydro-geologic structure, rural characteristic and urban characteristics must be evaluated and certain areas should be allocated in order to conserve wetlands. These areas (constant buffer zone and variable buffer zones) hold off from settlements in this manner buffer zones can be shored up. These areas are also reserved areas and habitat for birds and other animals as well plants. In this manner more efficient buffer zones can be developed. No settlements are proposed in these buffer zones and the other areas can be classified in appropriateness for settlements according to their characteristics. In this PhD thesis two case study areas were researched according to their geomorphologic, hydro-geologic characteristics, urban and rural land uses. Buffer zones were evaluated with normalization

and distance of similarity method to each other. This model facilitates to get rapid results meanwhile this PhD model aid to determine settlement areas in lake basins.

Constant buffer zones around lakes possess preventive property from contaminants beside this these buffer zones prevent lake from convergence with settlement or obstruct to get close settlement to lake. On the other hand constant buffer zones around lake protect settlement from water flood on during maximum precipitation; they offer flood plain for lake during precipitation; besides constant buffer zones around lake provide important recreational places, green areas, and healthy places for humans. These recreation areas contribute to spend leisure time for humans and offer alternative to sedentary life. This PhD model consolidates constant buffer zones with variable buffer zones in basin of lake. Namely constant buffer zones consolidate with buffer zones in basin of lake so as to conserve wetlands and lakes. This strategy was reinforced with successful site selection; when site location can be successfully developed then land uses can also be determined. Settlement appropriateness is also presented with this PhD model.

Population of Turkey increases and rapid population growth brings about more land demand for settlements. The more land demand causes the more urban sprawl and this cycle deteriorates more wetlands and their ecosystem. Turkey and the other countries like Turkey need solutions to respond population growth. This PhD model offer rapid making decision about settlement appropriateness and successful buffer zones for wetlands. This thesis considers conservation-utilization balance for wetland basins. It must not be forgotten that soil and land are very precious. In this respect this PhD model should be generalized other quasi-wetlands. Generalization of PhD model facilitates to implement this model to other wetlands thus wetlands that they exist in rapidly developing countries and near metropolitan areas can be conserved with same approach. The important part of PhD thesis is generalization of PhD model.

6.1 Generalization of PhD Model

This PhD thesis focuses on wetlands and wetland conservation with buffer zone model. Fundamental point of view of PhD thesis assembles two main approaches. First approach is thresholds of wetland basin; thresholds can be natural and/or artificial. As thresholds are determined four main characteristics are researched in basin of wetland according to PhD model. These characteristics are geomorphologic, hydro-geologic, urban function, rural function characteristics. Latter approach is maximum and minimum values of geomorphologic, hydro-geologic, urban and rural function in buffer zones. These values normalize so that the effects of covered areas can be computed in buffer zones. Then the similarities of buffer zones are determined thus successful buffer zones can be created. This dual evaluation based on physical attribute and according to these physical values settlement appropriateness can be determined. In other words constraints of physical attributes are determined and then the other lands can be determined as appropriate settlement areas and can be classified suitable for settlement or limited settlement; and the other step is determining land uses. Fittest choosing settlement locations can minimum affect wetlands and environment in this way fittest land uses can be decided. This method facilitates to determine constant buffer zone around wetlands.

In this respect model of PhD thesis is composed of six phases. These are:

a. Create buffer zones with certain distances around lake
b. Compute covered areas according to geomorphologic, hydro-geologic, urban and rural function values
c. Calculate percentage of covered areas in buffer zones
d. Calculate normalization values of percentage of covered areas in buffer zones and tabulate normalization values
e. Calculate similarities of buffer zones
f. According to these values above create settlement appropriateness map.

When settlement appropriateness map is created, some areas are determined that these areas must be conserved and these areas are not suitable for settlements. These areas are:

1) Hydro-geologic characteristic

Permeable, permeable grainy, permeable rocky, very permeable and/or semi permeable grainy areas, aquifer areas

2) Geomorphologic characteristic

Mountain, high gradient areas, plain, river beds, land slide, karst, monadnock (inselberg) areas

3) Rural functions

Forest, first degree agricultural areas, absolute agricultural conservation area, priority agricultural conservation area, endemic species regions, swamps, reedy places and bulrush areas, meadows, pastures

4) Urban functions

Urban functions do not close determinated constant buffer zone around wetland

In this sense buffer zones around the wetlands supported with regions and/or buffer zones above, this approach reinforces constant buffer zones around wetland. Limits of city growth can be decided with this method therefore minimum negative effects occur in wetland basin and wetlands can be protected from city sprawl. Aim of this PhD method is maximum utilization of land and minimum negative effects.

Thresholds are determined results of evaluation above. Constant buffer zone around wetland is determined according to distance of similarity method. Except from these areas are appropriate areas; appropriate areas consist of two category. First category is appropriate areas and second category is limited settlement areas. Criteria of limited settlement areas is that one of the physical attributes is negative than suitable areas so that these settlement areas are determined as limited settlement areas.

If we reinforce buffer zone around wetland with thresholds in basin of wetland, we can protect wetland from effects of urbanization. And then we can create successful settlement appropriateness map, and we can choose fittest location for settlements.

We can examine this PhD method in these processes below in generalization part of PhD method.

a. Determination of constant buffer zone around wetland
b. Evaluate physical attributes in basin of wetland, and then constitute and determine thresholds in basin of wetland (determination sensitive areas)
c. Integrate thresholds and constant buffer zone around wetland

This PhD method is demonstrated with a virtual wetland below. This virtual implementation proved generalization of PhD method. Figure 6.4 is virtual wetland below.

Fig. 6.4 Virtual wetland and physical attributes (generalization PhD method)

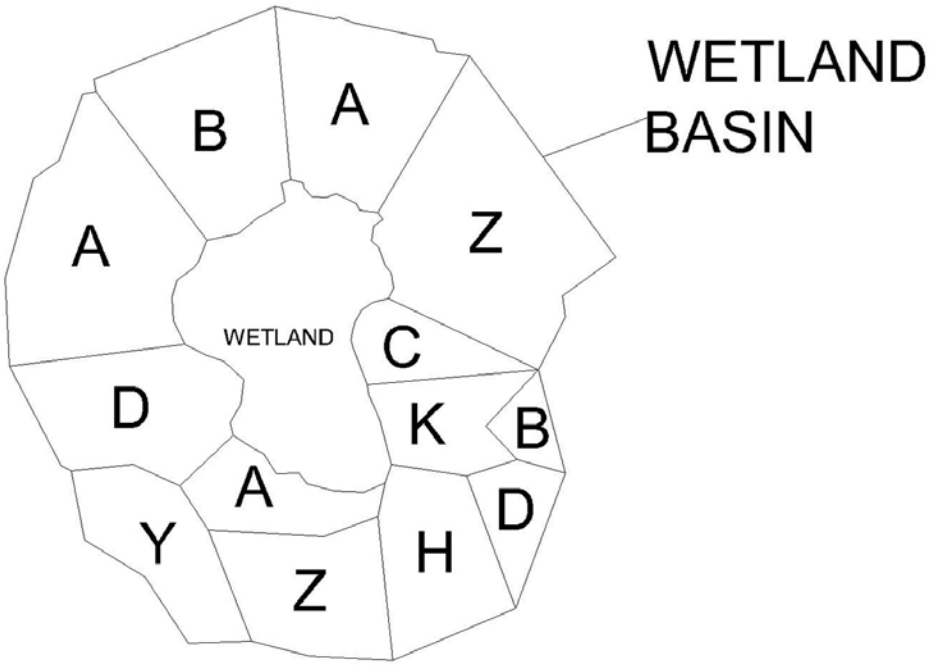
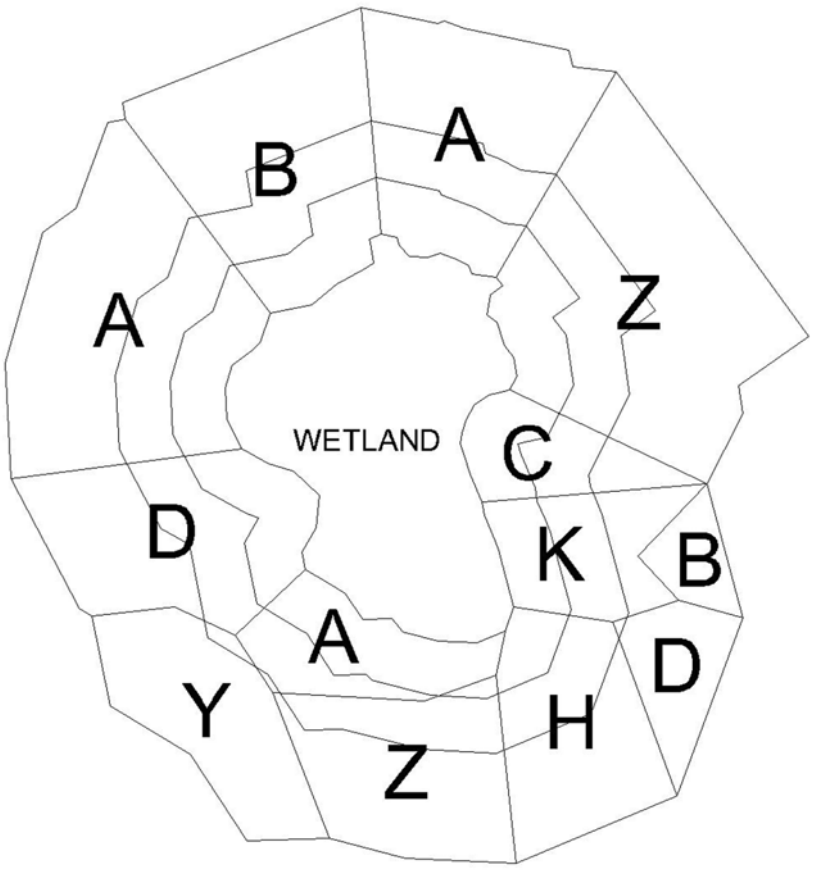


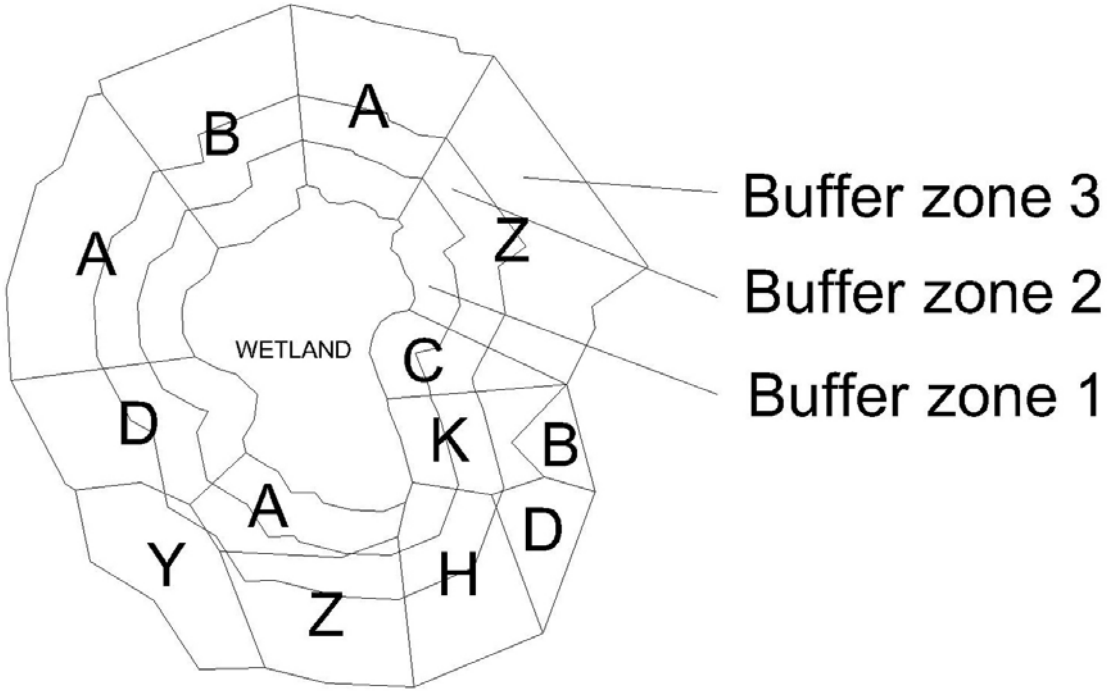
Figure 6.4 includes wetland, wetland basin and qualification of wetland. A, B, C, D, H, K, Y, Z are attributes of any hydro-geologic, geomorphologic, rural and urban characteristic. All of these attributes are projected with their covered area in wetland basin. Next phase is drawing buffer zones around lake; figure 6.5 shows buffer zones in wetland basin.

Fig. 6.5 Create buffer zones around virtual wetland (generalization PhD method)



Three buffer zones were created in wetland basin at figure 6.5. These are buffer zone 1, buffer zone 2 and buffer zone 3. Physical attributes cover areas in every buffer zone. The next phase is calculation of covered areas of physical attributes in every buffer zone.

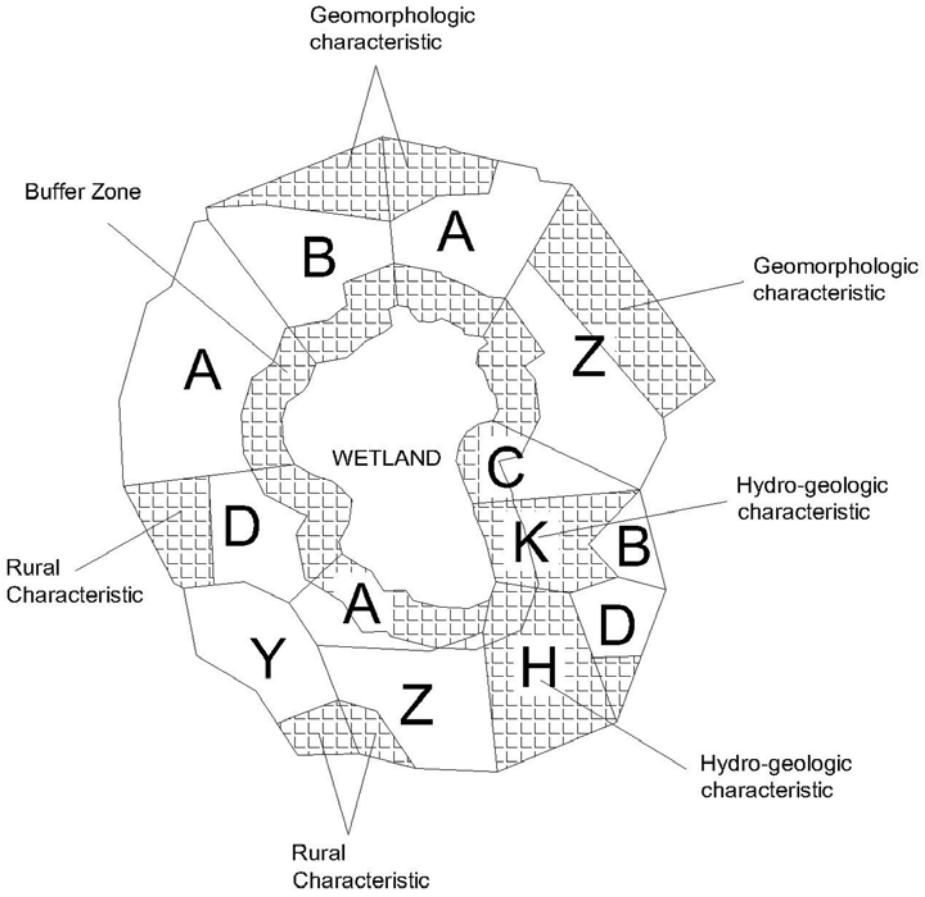
Fig. 6.6 Calculate covered physical attributes in buffer zones (generalization PhD method)



Calculation of covered physical attributes includes four steps. First covered area of physical attributes calculated in buffer zone 1, buffer zone 2 and buffer zone 3. For instance attribute A cover how much land in buffer zone 1, buffer zone 2 and buffer zone 3. Similar approach is valid for all physical attributes. Percentages of covered areas are computed at second step. For example covered area of attribute A divides total covered area of buffer zone and multiply this result with 100. This operation is made and repeated every attribute and every buffer zone. Then these results are tabulated. The next step is normalization of percentage values. Normalization shows the effects of percentage values to buffer zone; these results are calculated into range [1 0]. The maximum value closes to 1 and the minimum value closes 0. The next step is distance of similarity; at this step similarities of buffer zones are calculated according to normalization values. This similarities are also evaluated into range [1 0]. This means every buffer zone takes value from 0 to 1 and the closer values are similar and so buffer zones are. In this sense constant buffer zone can be determined. In our virtual wetland buffer zones are not

similar to each other so that buffer zone 1 is selected as constant buffer zone. This buffer zone is absolute buffer zone that settlements are not proposed in this area. Next phase is determination of inappropriate areas for settlement in wetland basin. Figure 6.7 shows inappropriate areas for settlement in virtual wetland basin.

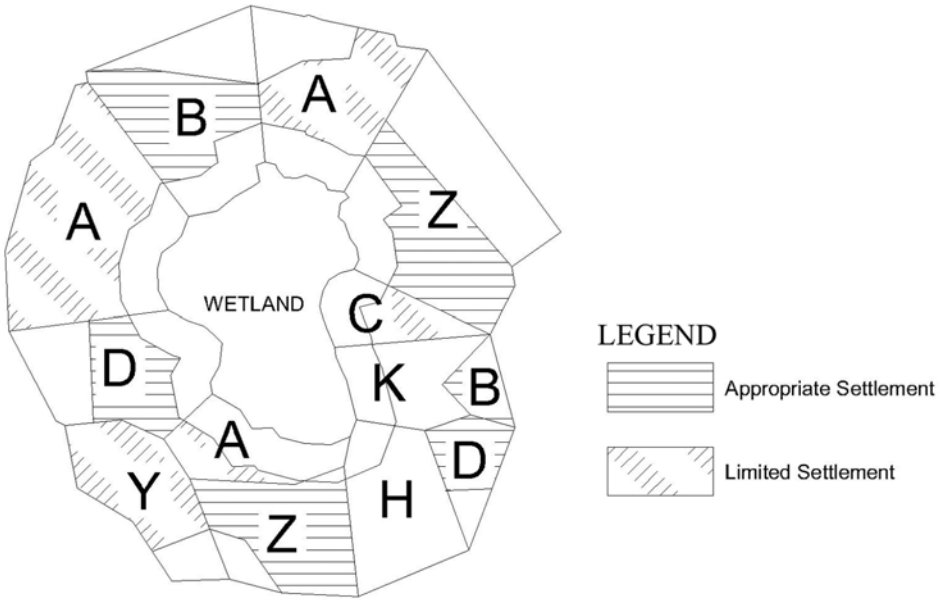
Fig. 6.7 Inappropriate areas in virtual wetland's basin (generalization PhD method)



Constant buffer zone is supported with some areas in wetland's basin. These regions are thresholds of wetland's basin. These thresholds were determined according to attributes of hydro-geologic, geomorphologic, urban functions, rural functions. Settlements must be circumscribed and restricted with these regions in order to conserve wetland ecosystem. As this settlement appropriateness is determining, the criteria of inappropriate areas (see page 132) were taken into consideration. According to physical attributes of wetland basin H and K are permeable areas (very permeable, permeable grainy, aquifer… etc.)

that they misbecome for settlements. On west side of wetland D and on the south side of wetland Y and Z have special rural characteristics (for instance priority agricultural conservation area, endemic species regions, swamps and forest… etc.) therefore these areas are not suitable for settlement. On the north and northeast side of wetland exists geomorphologic thresholds such as high gradient areas, plain, river beds, land slide, karst and monadnock… etc. in region A, B and Z. These inappropriate settlement areas reinforce buffer zone that exists around wetland. Next step is determining suitable settlement areas. Appropriate settlement areas can be examined into two categories; first category is suitable for settlement areas and latter is limited settlement areas. In limited settlement areas one of the physical attributes is negative than suitable areas so that these settlement areas are determined as limited settlement areas. These negative effects can be higher slope than suitable settlement areas, underground water, semi permeable rocky areas… etc. figure 6.8 includes suitable settlement areas in virtual wetland's basin.

Fig. 6.8 Appropriate for settlement areas in virtual wetland's basin (generalization PhD method)

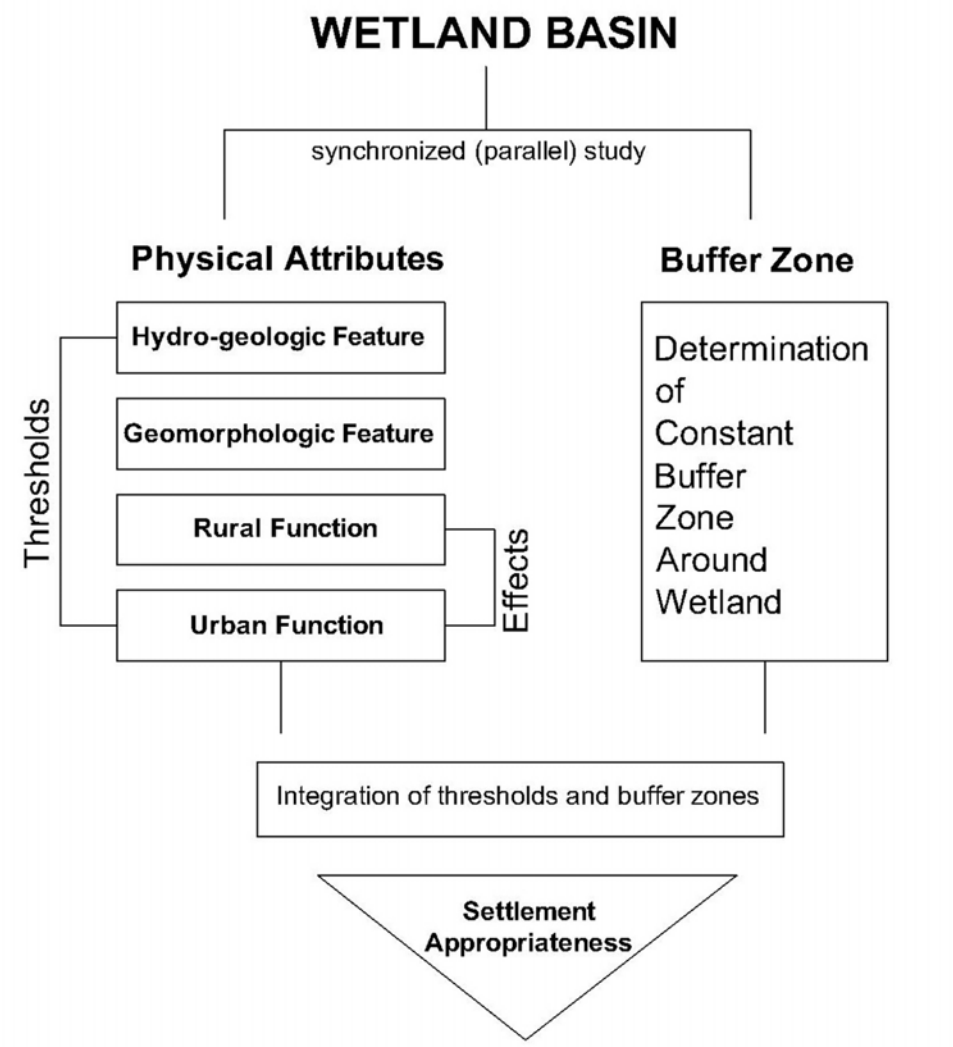


As it can be seen at the figure some areas are suitable for settlement and some of them are limited settlement areas. On the north side of wetland attribute B, on the northeast side of wetland attribute Z, on the west side of wetland attribute D, on the south side of wetland

attribute Z and on the southeast side of wetland attribute B and D are appropriate for settlement areas. On the north side, northwest side and south side exists attribute A, east side of wetland exists attribute C and southwest side of wetland exists attribute Y; and these regions have a negative future of higher slope, underground water, semi permeable rocky… etc. therefore these areas were determined as limited settlement regions.

Generalization of PhD method and process of this method is showed below as a chart. This chart will be facilitated understanding of virtual wetland study. These parallel studies were done in our virtual wetland study.

Fig. 6.9 Generalization of PhD method



Wetlands are highly sensitive areas that they must be conserved and their ecosystem must be maintained. This is a necessity not only for ecological balance but also endangered species, flora, fauna and as well as human beings. In this PhD thesis a conservation method for wetlands is researched. Wetlands can be varied types according to their locations, physical attributes, quality of water… etc. this thesis deals with wetlands that they exist near metropolitan areas and/or under urban pressure. These wetlands vanish very rapidly so that a conservation method must be developed in order to protect these wetlands. Cities threaten wetlands with its sprawl and effects. Essentially wetland must be maintained and conserved with their whole basin and environment. However this is not possible many a time because of economic development and pressures, social demands and pressures, political pressures, wrong implementations, incompetence law system, inadequate economic funds… etc. In that case as an important tool city and regional planning can be given a direction to this urban development. In Turkey and rapidly economic and population growth countries as Turkey can not conserve environment and/or ecology because of economic development and land demands… etc. However we can give a direction to urban sprawl with urban and regional planning at the same time we can allocate sufficient land for settlements meanwhile minimum deterioration can be occurred in wetland's ecosystem. This PhD thesis will be a conservation guide study so as to maintain wetlands that they exist near metropolitan areas and under urban pressure.

As a result wetlands must be conserved and maintained with their whole ecosystem. When metropolitan cities close to wetland basin, and city can not be given direction to anywhere and/or new settlements can not be allocated somewhere in the direction of city development then wetland's basin can be suggested for settlement but locally and limited with conservation method. This PhD method can help city planners when they plan wetland basin near metropolitan cities. This PhD method facilitates to develop settlement appropriateness and land use planning. Physical attributes and living species can be maintained with this PhD method. This PhD method inquires to give minimum negative effect to wetlands. However collaboration between institutions should be established in that case wetlands management plan should be prepared in order to pan out or achieve

maintenance of wetlands. This method will determine limits of urban sprawl in wetland's basin near metropolitan areas. Sustainable city growth can be obtained not only for cities but also for wetlands. Endangered species, endemic species, flora and fauna can be bequeathed for next generations with sustainable wetlands; wetlands achieve their ecosystem function and obstruct erosion and waterflood, provide more potable water, and absorb nutrients, pesticides and herbicides. Sustainable city growth provides more recreational places around wetlands. Agricultural Areas in wetland's basin should be organic cultivated land in order that agricultural wastes, herbicides and pesticides can be hold off from wetlands. Buffer zones should be vegetated and afforested with grass, shrubs and trees in order to obstruct sediments, agricultural and city wastes. Forest, meadow and swamps should be conserved because these areas are nest sides for living things.

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