REJUVENATION OF STATIC WATER BODY

Thesis Submitted in Partial Fulfilment of the requirements
for the award of the degree of

MASTERS OF PLANNING
(URBAN PLANNING)

By
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1220152005

Under The Guidance of
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SCHOOL OF ARCHITECTURE & PLANNING,
BABU BANARASI DAS UNIVERSITY
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2023-2024

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UNDERTAKING

I, Ms. Reshma Khan, the author of the thesis titled "**REJUVENATION OF STATIC WATER BODY**", hereby declare that this is an independent work of mine, carried out towards fulfilment of the requirements for the award of the Masters in Urban Planning at the Department of Architecture and Planning, BBDU, Lucknow. The work has not been submitted to any other organization / institution for the award of any Degree/Diploma.

…….

Reshma Khan
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Department of Architecture and Planning
Date: June,2024

EXECUTIVE SUMMARY

Rapid urbanisation coupled with industrial growth has made its adverse impacts on the physical quality of life in the city and on the natural environment. Natural patterns are distorted by human intervention to the extent that their inter-relationships are destroyed. The balance between resource consumption and generation is skewed. This has resulted in depletion and pollution of natural recourses. In terms of effect to the water system, the result is drying up of natural water bodies at alarming rates; flooding during the monsoon and rapidly declining water table. The study proposes a hypothesis, that by conserving local water body all of these three urban problems could be addressed simultaneously and effectively.

The motive of this thesis is to Lessening pollution, improving the lake's water quality, and creating habitat that supports the largest number of aquatic species should all be goals of restoration efforts. In any case, they are now just useful as a sink for solid waste and wastewater. Systemic violations and malfunctions continue to undermine waterbodies' health. More and more, it is becoming clear that failing to fix the water bodies in the medium to long term will have significant implications on urban improvement. City planners purposely ignored these water bodies and allowed them to deteriorate while being aware of their significance for the environment, society, and the economy. These bodies of water are now overgrown and polluted with trash and sewage. Unplanned urbanization has left a significant section of the region surrounding the lakes covered in impervious surfaces. To clean up the city's central environment. to start balancing the development of the old and modern city parts. to give many people real-world environmental experience.

In conclusion, Restoration activities ought to lessen pollution, enhance the quality of the lake's water, and provide habitat that supports the greatest amount of aquatic life. Gaps in the current rejuvenation path are I lack of understanding of functional aspects of a lake – ecological, hydrological and remediation aspects in addition to recreation services; (ii) the focus of lake rejuvenation is only to utilize the allocated funds (activities matching the allocated funds have been proposed and implemented) without any scientific evaluation of the lake and the need assessment; (iii) not decontaminating the lake – partial removal of contaminated silt (accumulated over a period); (iv) reuse of contaminated silt – shoreline stabilization, creation of ‘islands’.

ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to the individuals who have contributed to the completion of my Master's thesis in Urban Planning. Their unwavering support and encouragement have played a crucial role in my academic journey. First and foremost, I am immensely grateful to my thesis guide, Ar. Kunwar Ghanshyam Yadav Sir. His invaluable guidance, expertise, and unwavering support throughout this research endeavor have been instrumental in shaping the direction and quality of my work. His continuous encouragement, insightful feedback, and patience have truly been a source of inspiration for me.

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I would also like to express my gratitude to my family who have been there for me throughout this journey. Their unwavering support, understanding, and encouragement have provided me with the strength and motivation to overcome challenges and persevere. Their presence has brought joy, laughter, and solace during the demanding times of thesis work.

Lastly, I would like to extend my appreciation to all the individuals who have directly or indirectly contributed to my growth as a researcher and planner. Your collective efforts have played an integral role in shaping my academic and personal development.

To everyone mentioned above and to those not mentioned individually but who have been a part of my journey, please accept my heartfelt gratitude for your unwavering support, guidance, and encouragement. This thesis would not have been possible without each and every one of you. Thank you for being a part of this significant milestone in my academic life.

(Reshma Khan)

CONTANT TABLE

List of Figures

INTRODUCTION

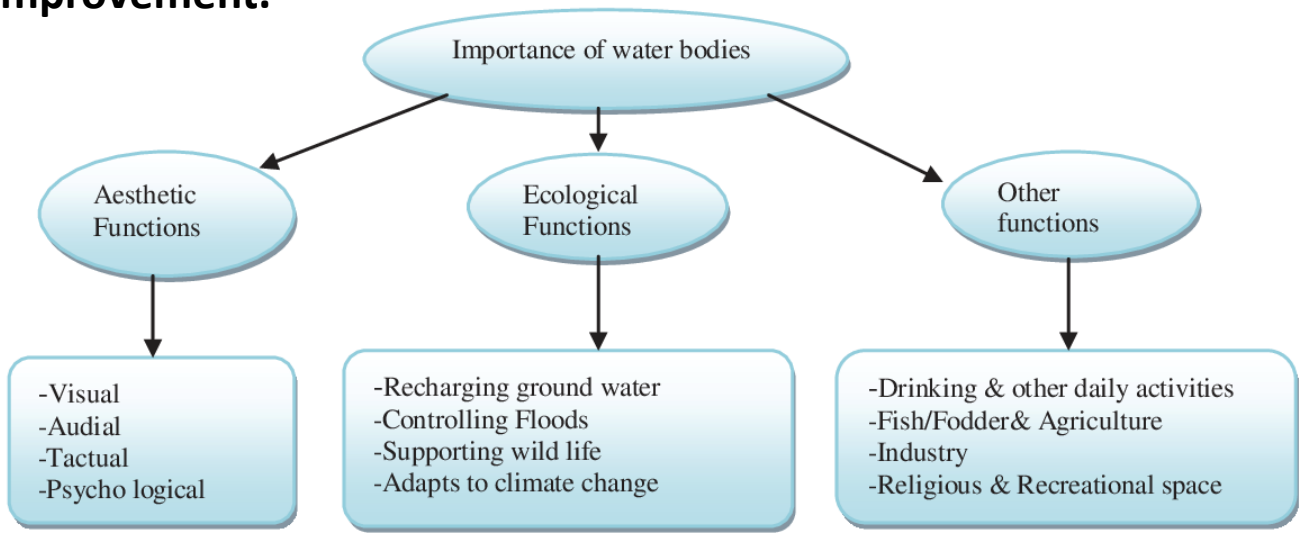
1.1 Water Body

➢**Water features, both static (stationary) and dynamic (energetic or forceful), have been important throughout human history and have contributed to the rise of civilizations.**

➢**Aside from being crucial sources of water, water bodies like lakes, rivers, ponds, and wetlands contribute to people's livelihoods and offer essential ecosystem services. They are also important components of our natural environment.**

➢**Static water features regulate microclimate, provide homes for plants and wildlife, and improve the beauty of the environment in addition to providing us with room for pleasure.**

➢**Waterbodies are essential to the development of metropolitan areas. They can be used for a variety of things, including domestic purposes, wastewater weakening, environmental administrations, managing green spaces, biodiversity, and controlling temperature. In any event, they have already reduced to serving as a sink for wastewater and solid garbage. The health of waterbodies continues to be harmed by systemic violations and breakdowns. It is becoming more and more obvious that failure to repair the water bodies in the medium to long run will have important recommendations on urban improvement.**



Rejuvenation of a static water body

Source: google

1.1.1 STATIC WATER BODIES

➢In addition to enhancing the aesthetics of the environment, hydrostatic spaces also offer space for recreational activities, serve as habitats for plants and fauna, and influence the microclimate. In addition to improving the physical and socioeconomic environment, they are crucial for maintaining urban ecosystems. Development initiatives near still waters frequently disregard water protection and continue with other projects. Therefore, maintaining, preserving, and rejuvenating such static waterbodies in metropolitan environments is crucial. Pooled water, or lentic water, typically originates from lakes and ponds.

a. Lake

➢A lake is a water body, either natural or artificial.

➢The lake serves as a reservoir. It has the capacity to store water (for flood control) and supply it for a variety of uses, such as waders, irrigation, water supply, fishing, and tourism.

➢A lake is a body of water that is contained inside a basin, encircled by land, and separate from any rivers or other outlets that are used to fill or empty the lake. Although lakes are located on land and are not oceans, they do contribute to the Earth's water cycle much like the much bigger oceans do.

b. Ponds

➢They can be thought of as little blobs of static water that are shallow enough to allow the plant to grow on them. Ponds are frequently created by human activity and are typically hydrated by rainwater, groundwater, or sporadic streams.

➢A pond is a standing mass of water, either natural or artificial, usually smaller than a lake. They can occur naturally in floodplains as part of the river system.

➢People also make ponds. Various artificial bodies of water are classified as ponds.

Rejuvenation of a static water body

Source: google

1.1.2 NON-STATIC WATER BODIES

The still water area not only enhances the aesthetics of the landscape, but also provides space for leisure activities, is a habitat for flora and fauna, and affects microclimate. They are important for maintaining urban ecosystems, and the presence of all forms of water improves the physical and socio-economic environment.

a. Ocean

- Everyone is aware that seawater is salty. Because most of the water that emerges from the seas is clean water that evaporates from the surface, river water that flows into the oceans has only trace levels of dissolved ions.
- The sea constitutes the largest type of body of water.

b. Rivers & Streams

- The water that flows on the surface of the earth forms a river, Or a small version called stream.
- In most cases, freshwater from these channels will eventually flow into the sea, but rivers may or may not flow all year round, but may also flow into closed pools with no exits.

1.2 AIM OF THE STUDY

- To provide and implement the planning strategies to rejuvenate Static water body.

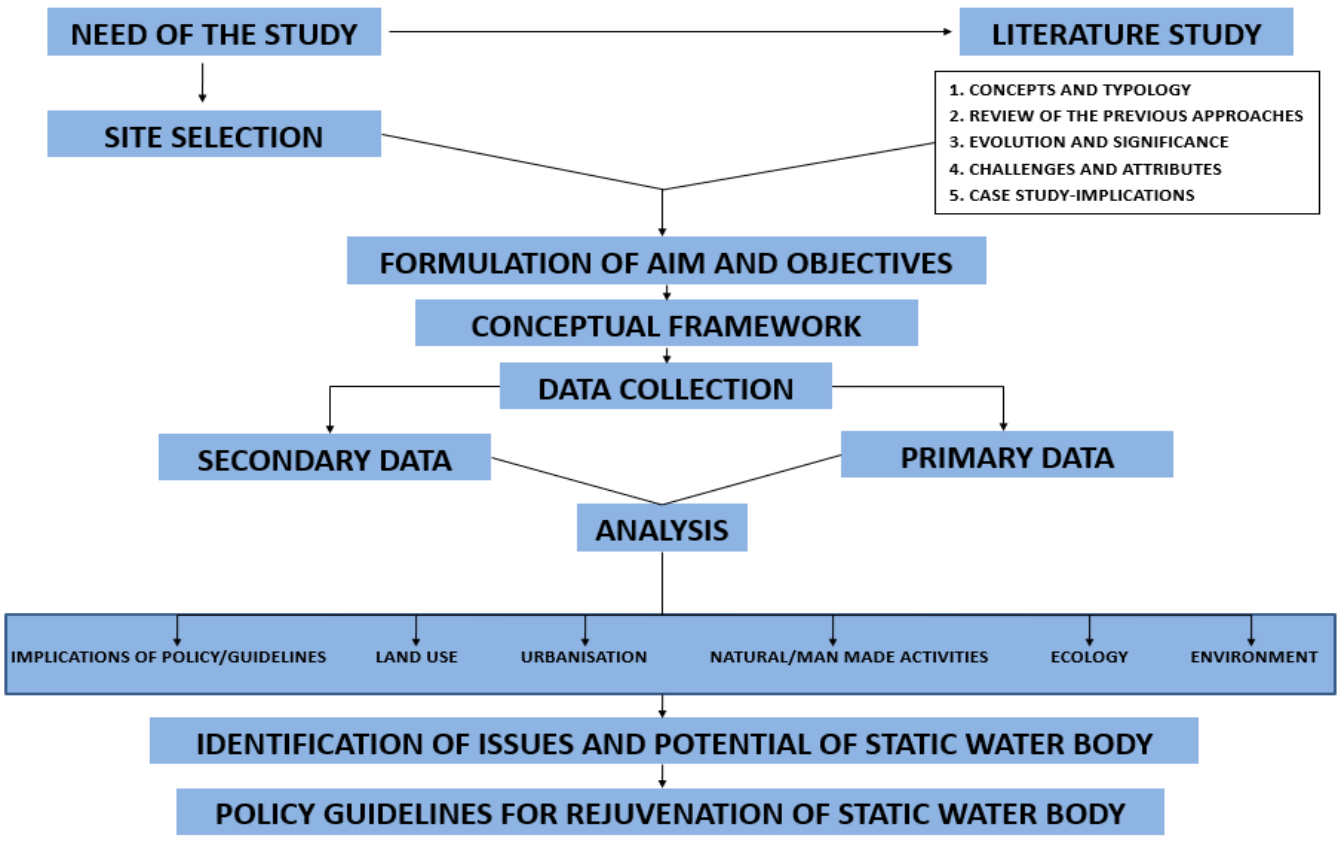
1.3 OBJECTIVES OF THE STUDY

- To examine Static water body.
- To study different process of rejuvenation Static water body.
- To study and understand problems faced by local peoples and visitors.
- To study the scope for further development in the surrounding after rejuvenation.
- To recommend planning strategies for rejuvenation.

1.4 SCOPE & LIMITATIONS

- Rejuvenating the whole shoreline.
- Finding the possible ways of protecting natural basin of Static water body .
- Studying the scope of urban development along the Static water body.
- Study focused on built up structures and habitants around the Static water body.
- Studying the scope of improvement of water quality.

1.5 METHODOLOGY:



LITERATURE STUDY: 1

ANASAGAR LAKE AJMER RAJASTHAN

LITERATURE STUDY – ANASAGAR LAKE AJMER RAJASTHAN

2.1 INTRODUCTION

- An manmade lake called anasagar lake is located in the ajmer city of rajasthan.
- Ajmer has a semi-arid climate with a dry, scorching summer and a chilly winter. Ajmer's average temperature varies from 3°C (minimum) to 22°C (maximum) in the winter and from 25°C (minimum) to 47°C (maximum) in the summer.
- About 500 mm of rain falls on average in the city.
- The lake was created by king anaji chauhan between the years of 1135 and 1150 ad by building a dam across the luni river, and it was first used to furnish drinking water.
- Currently, boating, fishing, and pleasure are all done on the lake.
- A significant volume of untreated waste water from the neighbourhood is dumped into the lake.
- When the water recedes, agriculture is practised in lake areas often.
- The overflow from lake reaches khanpura pond where it is used for irrigation.

2.2 LOCATION OF ANASAGAR LAKE

Source: Rajasthan tourism

2.3 SALIENT FEATURES OF ANASAGAR LAKE

CHARACTERISTICS	DESCRIPTION
Geographic location	26°25'N-26°29'N(Latitude) 74°38'E-74°42'E (Longitude)
Location in Ajmer	North-West of Ajmer, Rajasthan
Lake type	Artificial lake, constructed by damming over Luni River
Lake water spread area	0.97 sq km to 1.87 sq km
Highest flood level	485.305 m above MSL (as revised in 2013)
Catchment area	53 sq km (gross), 20 sq km (intercepted by Lake Foysagar), 5 sq km (built up area)
Topography of lake catchment area	Steep to gentle slope with low vegetal cover
Storage capacity of lake	5.68 Million Cum (at HFL)
Lake circumference	7.3 km (at HFL)
Source of water in lake	Rainfall runoff and overflow from Lake Foysagar through Bandi River
Depth	4.4 m
Overflow arrangements	Four overflow gates (size 1.2m X 1.8m)

(Source: Detailed Project Report, 2007: Lake rejuvenation project, Anasagar Lake, Ajmer and Nagar Nigam: 2013, Land use details in Anasagar Lake catchment)

2.4 CURRENT STATE AND ANALYSIS

- Fish frequently die both in the summer and the winter. Summer time sees a regular evolution of bad gases in the lake region, which has made living miserable in the neighbouring residential neighbourhoods.
- Large amounts of solid waste and silt have clogged the storm water drains, and frequent flooding as a result of this is typical throughout the rainy season.
- The lake coastline is not protected, and human meddling and encroachment are evident throughout the lake region.
- Storm water drains allow untreated waste water to enter the lake, and this amount has grown as the population has grown. The lake's water transparency has diminished over time, and lakeside vegetation has grown.
- In the lake watershed, the area of bare ground has steadily increased while the area of forest has steadily decreased. Lake catchment activities that are caused by people have grown over time.
- The activities of bathing and washing in the lake have grown over time and are especially noticeable during the Pushkar fair. With time, the variety and quantity of migrating birds at Anasagar Lake have declined.
- In case of heavy rainfall, the overflow from Anasagar is conveyed by Anasagar Escape channel to Khanpura Talab.
- Due to the absence of proper sewerage system the drains carry the municipal wastewater and finally discharging into Anasagar Lake.
- Presently the lake is used for recreational purpose.

Rejuvenation of a static water body

Source: Rajasthan tourism

2.5 SURFACE WATER QUALITY PARAMETERS OF ANA SAGAR LAKE (AJMER)

List of surface water sampling sites in Ana Sagar Lake.

Sampling Points	Location
01	Behind NCC (Cloth washing)
02	Mid of Lake
03	Baradari
04	Ghat
05	Near Nallah Vaishali Nagar

Location of Sampling Sites.

Source- https://www.semanticscholar.org/paper/Potential-of-floating-photovoltaic-system-for-and-Mittal-Saxena/376808a66884478ccaa210f140c9fb423316ffc8

SURFACE WATER QUALITY PARAMETERS OF ANA SAGAR LAKE (AJMER)

➢ pH

The pH of water samples of Ana Sagar Lake was found in the range of pH 9 to 9.44 during water sampling in March 2021. pH value of all the sites is alkaline due to carbonate and bicarbonate. The maximum pH was recorded from source 05 (Near nallah Vaishali Nagar) whereas minimum was recorded from source 04 (Ghat).

➢ DISSOLVED OXYGEN

Dissolved Oxygen is a basic requirement for a healthy aquatic

ecosystem. Most fish and aquatic insect need dissolved oxygen to survive. In present study value of dissolved oxygen is 0.10 to 4.60 mg/l. This is probably due to high rate of decomposition of autochthonous and allochthonous organic matter in water which consumed oxygen in the process. Secondly at higher temperature the solubility of oxygen in water reduces and surplus oxygen is lost to atmosphere.

➢ BOD (BIOLOGICAL OXYGEN DEMAND)

BOD is an indicator of the potential for a water body to become depleted in oxygen and possibly become anaerobic due to biodegradation. During present study BOD range from 5.9 to 48.3 mg/l. The highest BOD value was at station 02 (mid of lake) and the lowest was at station 03 (Baradari). The high BOD in the lake due to high decomposition activity of microorganism acted on dead aquatic plants, sewage and organic fertilizer.

➢ TOTAL HARDNESS

The hardness of water depends on the presence of dissolved calcium and magnesium salts. The total hardness of the study area was observed in the range of 222 to 375 mg/l in source 01 (washing cloth) and 04 (ghat) respectively. Hard water is not fit for its domestic use. It may scale in the pipes and obstruct lather with soap during washing.

➢ TOTAL DISSOLVED SOLIDS

The Total Dissolved Solids of water are the amounts of Dissolved inorganic constituents of water. The permissible limit of Total Dissolved Solids in drinking water is 500 mg/l and 600 mg/l as prescribed by WHO and BIS respectively. The Total Dissolved Solids of surface water of Ana Sagar Lake was found in the range of 1061 to 1110 mg/l during water samples exceeds the permissible limit of Total Dissolved Solids.

2.5.1 CONCLUSION OF SURFACE WATER QUALITY

Following conclusions can be drawn from the study:

1. All the results we concluded are that the Ana Sagar Lake water is not safe for domestic purpose. The unnatural color and unpleasant odor of surface water suggest that the surface water of Ana Sagar Lake is highly polluted due to municipal sewage of Ajmer city.
2. The pH value of lake water is crossing the maximum desirables limit. In few areas like Behind NCC, Baradari and Near Nallah Vaishali Nagar total hardness found within maximum desirable limit (300 mg/l). Total hardness is high in water due to addition of calcium and magnesium salts from detergents, which were used for bathing and washing by the local people. Hard water is not fit for its domestic use. It may scale in the pipes and obstruct lather with soap during washing.
3. Dissolved Oxygen level is low because of high rate of decomposition organic matter in water which consumed oxygen in the process. Due to high temperature Dissolved Oxygen level is also decreased.
4. The high value of BOD in the lake due to high decomposition activity of microorganisms acted on dead aquatic plants, sewage and organic fertilizer.
5. Total Dissolved Solids is received in the lake water by the agricultural runoff and residential runoff and by the discharge from industrial and sewage treatment plants.

2.5.2 REMEDIAL MEASURES FOR SURFACE WATER QUALITY

In the light of conclusions drawn from this study, following suggestions are made for future research work in this area:

1. The study shows that Ana Sagar Lake is severely eutrophied. Hence a continuous monitoring and analysis of lake eutrophication can be carried out using Remote Sensing and Geographical Information Systems as eutrophication and

increase in productivity are associated with change in optical properties of the water mass. It would enable to capture and update all water quality parameters and plan, compare, visualize and evaluate the outcome resulting from simulating various management scenarios.

2. Sewage treatment plant (STP) to treat waste water may start functioning in near future, allowing the treated effluent to enter the Ana Sagar Lake. Hence, analysis of lake pollution can be revised later on and identification of lake use can be ascertained on the basis of treatment cost/ benefit ratio and other aspects considering various lake uses.

2.6 GOVERNMENT

- Rajasthan State Pollution Control Board
- Ajmer Development Authority
- Water Resources Department, Government of Rajasthan State of India
- Ajmer Municipal Corporation and Pushkar Municipal Board

2.6.1 POLICIES/PROGRAMS/ PROJECTS:

- As a strategy, the lake restoration programme must involve activities to protect, restore, manipulate & provide for the functions & values emphasizing quality & sustainable usage of water resource.
- Catchment development plan and lake area development. Establishment of sewage treatment plant(stp) to treat waste water.
- Strict enforcement of rules and regulations and environmental laws to control human induced activities.

Source: Rajasthan tourism

2.7 ALL OVER OBSERVATIONS:

- A layout plan for lake Anasagar was designed in view of both recreational activities and maintaining ecological integrity for long term restoration and sustainability.
- The peripheral area is restored through proposed Eco architectural plan. This includes periodic removal of sediments and organic debris from littoral zone.

2.8 KEY INTERVENTIONS TO SUSTAIN ANASAGAR LAKE

- To reduce pollution, sewage treatment plants (STPs) must be established to handle sewage and waste water from lake catchment areas.
- Activities such as bathing, washing, idol immersion, and feeding fish in lakes should all be severely forbidden.
- It should be encouraged to use idols manufactured of organically biodegradable materials rather than natural ones.
- Private landowners continue to exploit the region beneath the lake for unsustainable farming operations, small-scale manufacturing, and laundry services.
- The municipal government should act quickly to purchase this privately held land To stop human-induced activities like illegal building, encroachments, the use of organ chlorine pesticides in agricultural practises, and illegal fishing that are to blame for the degradation of lake environments, strict enforcement of rules and regulations as well as environmental laws is required.
- The use of organic insecticides, fertilisers, and agricultural techniques should be encouraged among the farmers.
- It would lessen the amount of dangerous and harmful compounds and nutrient load entering the lake.

LITERATURE STUDY: 2

SAROORNAGAR LAKE, HYDERABAD

LITERATURE STUDY – SAROORNAGAR LAKE, HYDERABAD

3.1 INTRODUCTION

- Saroornagar lake is an artificial lake, spreads over an area of 99 acres (40ha) with a Depth of 6.1 meters (20 ft).
- It lies in the coordinates of 17.3561°n,78.5333°E located at Hyderabad india, and is at a distance of 18km from secunderabad railway station.
- It is one of The five major water bodies in the hyderabad. From the year 1626 to 1956 it was a clean lake.
- Inevitably, untreated domestic sewage, solid waste and industrial effluents entered into the Catchment area of this lake in later stage that resulted in greaterdegree of pollution.
- Subsequently, the influent water was treated and restored the lake in good condition by the Hyderabad urban development authority (huda) in 2003-04.
- After restoration of the lake, Migratory birds returned to the lake in big numbers a few years later. However by 2009, the Filtration unit of the sewage treatment plant was not properly functioning and again the lake Was getting polluted with domestic waste.

LITERATURE STUDY – SAROORNAGAR LAKE, HYDERABAD

3.2 LOCATION

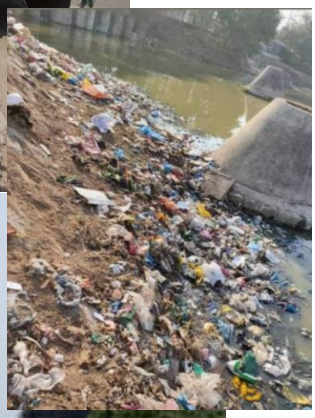
3.3 SALIENT FEATURES

1. This is manmade lake , The lake was established in 1626 for drinking and agricultural reasons.
2. The lake is **99 acres (40 hectares)** in size and reaches a maximum depth of **6.1 metres (20 ft.)**.
3. It is one of Hyderabad's five main water bodies.

Location	Hyderabad, Telangana
Coordinates	17.35584°N 78.52714°E
Type	artificial lake
Basin countries	India
Surface area	99 acres (40 ha)[1]
Max. depth	6.1 metres (20 ft)
Settlements	Hyderabad

3.4 ISSUES

- Hyderabad saw extraordinary population expansion, industrialization, and agricultural use of synthetic fertilisers and pesticides after 1956, when the city was named the state capital of Andhra Pradesh.
- ***Untreated home sewage, solid waste, and industrial effluents inexorably found their way into the lake's catchment region.***



3.5 GOVERNMENT ACTION

- **The lake and its environs would be constructed at a cost of 200 million (US$2.6 million), according to an announcement made by the Andhra Pradesh Minister of Tourism in 2003. Two sewage treatment facilities with a daily capacity to handle 250 million litres of sewage were to be erected as part of this programme.**

Rejuvenation of a static water body

GOVERNMENT ACTION

- The officials said that 95% of the sewage was treated four years after the sewage treatment facility was installed. The lake had a large influx of migrating birds as the groundwater conditions improved. A park measuring 5 acres (2.0 hectares) was built next to the lake in 2007 for a total of 15 million ($200,000). The park had sculptures, decorative landscaping, a boating area, and a centre for environmental education.
- Additionally, tourist-oriented facilities including a lakeside boating facility, a kids' park, and a café were to be built. Additionally, the minister declared that all work on the lakebed was to come to an end. The lake was soon cleaned up by the *city's municipal organisation, Hyderabad Urban Development Authority.*

LAKESIDE BOATING FACILITY

KIDS' PARK

DECORATIVE LANDSCAPING

SCULPTURES

FOOD FACILITY

Rejuvenation of a static water body

3.6 ANALYSIS

- The biodiversity is greatly enhanced by the lake and the extensive wooded regions that are there.
- The lake's water is serene, motionless, and almost devoid of biological trash.
- The lake has boating amenities accessible.
- Due to a lack of care, the edge condition is poor in several locations.
- It was first nourished by collecting storm water. Its original size was four times larger than it is now.

3.7 POLICIES:

To restore the lake, the government launched a number of restoration initiatives and spent millions. Following measures:

1. water body sealing
2. automated harvesting
3. ecological recovery
4. Redirecting sewage
5. Drainage

3.8 OBSERVATION

- By offering recreational opportunities next to the lake, the government has made an investment in promoting the lake as a tourist destination.
- With the lake's health improving, migrating birds can occasionally be seen, making it a popular location for birding.
- The government implemented a number of restoration plans and spent millions to repair the lake. Over the past five years, the lake has begun to exhibit encouraging indications of restoration

3.9 CONCLUSIONS

- The water quality analysis gives the detailed pollutional status of saroornagar lake and
- confirmed the higher degree of pollution. This was due to discharge of untreated domestic
- sewage and industrial effluents, washing of clothes and cleaning of vehicles.

3.10 SURFACE WATER QUALITY PARAMETERS

It is very essential and important to test the water before it is used for drinking, domestic, Agricultural or industrial purpose, because water does contain different types of floating, Dissolved, suspended and microbiological as well as bacteriological impurities. Standard lake Water quality analysis are performed with various physico-chemical parameters, *such a temperature, ph, total solids, total dissolved solids, alkalinity,total hardness, calcium Hardness, magnesium, chlorides, carbonates, bicarbonates, dissolved oxygen (DO), Biological oxygen demand (bod) and chemical oxygen demand(cod) .*

LOCATION OF SAMPLING STATIONS

Four Sampling stations were chosen around the lake : they are

1.PRIYADARSHINI PARK,

2. POCHAMMA TEMPLE,

3.SINGARENI COLONY AND

4.GREEN PARK COLONY.

The surface water samples were collected for the period of three months from Jan to Mar 2018.

Saroornagar Lake Water Quality

S.no.	Para meters	Units	Stations				Permissible limits
			S1	S2	S3	S4	
1.	Temperatu re	°C	26.5	26.5	247.6	26.8	25
2.	pH	mg/l	9.27	9.31	9.35	9.38	6.5-8.5
3.	Total solids	mg/l	2845.0	2845.0	2785	2835	500
4.	Total dissolved solids	mg/l	2648.0	2648.0	2584	2638	500
5.	Alkalinity	mg/l	158	158	159	159	200
6.	Total hardness	mg/l	832.0	832.0	830	810.0	200
7.	Calcium hardness	mg/l	192.0	288	192.0	192.0	75
8.	Magnesium	mg/l	94.8	102.1	99.8	126	30
9.	Chl orides	mg/l	574.5	597.0	550.9	587.0	250
10	Carbo nates	mg/l	38	38	38.0	36.0	500
11.	Bicarbonates	mg/l	584.7	584.7	597.8	547.8	500
12	Dissolved oxygen	mg/l	2.4	2.4	2.6	2.4	18
13	BOD	mg/l	216	216	300	300	5
14.	COD	mg/l	300	320	328	384	500

pH:

From the study, it reveals that pH values are higher than the permissible limit as given in Table

Total solids:

Total solids values are in the ranges between 2584 to 2845 mg/l, which were higher than the permissible limits as given in Table

Total dissolved solids

- **During the study TDS values were found in the ranges of 2638 mg/l to 2785 mg/l, which were higher than the permissible limit as given in Table.**
- **This is mainly be due to leaching of various pollutants into the surface water.**
- **Higher TDS can decrease the potability and causes gastro intestinal irritation and laxative effect in human.**

Total hardness

- **Hardness is an important parameter of water for its use in domestic purpose. Calcium and magnesium are important parameter for total hardness in groundwater.**
- **Total hardness values were ranged from 810 mg/l to 832 mg/l, which were much higher than permissible value of 75 mg/las given in Table.**

Rejuvenation of a static water body

- Excess hardness is undesirable mostly for economic reasons.

Calcium and Magnesium

- Calcium content is very common in groundwater, because they are abundantly available in most of the rocks and directly related to hardness. Calcium concentration varies between 192 mg/l to 288 mg/l in all the tested samples and exceeded the permissible limit of 75mg/l, as given in Table.
- Magnesium concentration were varied between 94.8 mg/l to 126 mg/l in all the tested samples and exceeded the prescribed limit (<30 mg/l) as per BIS.

Bicarbonate and Carbonate

- The primary source of Bicarbonate and Carbonate in groundwater is the dissolvedCO_2 in rainwater that entering in the soil and dissolves more CO_2. Carbonates values were in the ranges between 36 to 38mg/l in all the tested samples and much less than the desirable limit of500mg/l as given in Table.
- However bicarbonates values were above the desirable limit of 500mg/l that were in the ranges between547 to 598mg/l of all the tested samples.

Dissolved oxygen (DO) and BOD

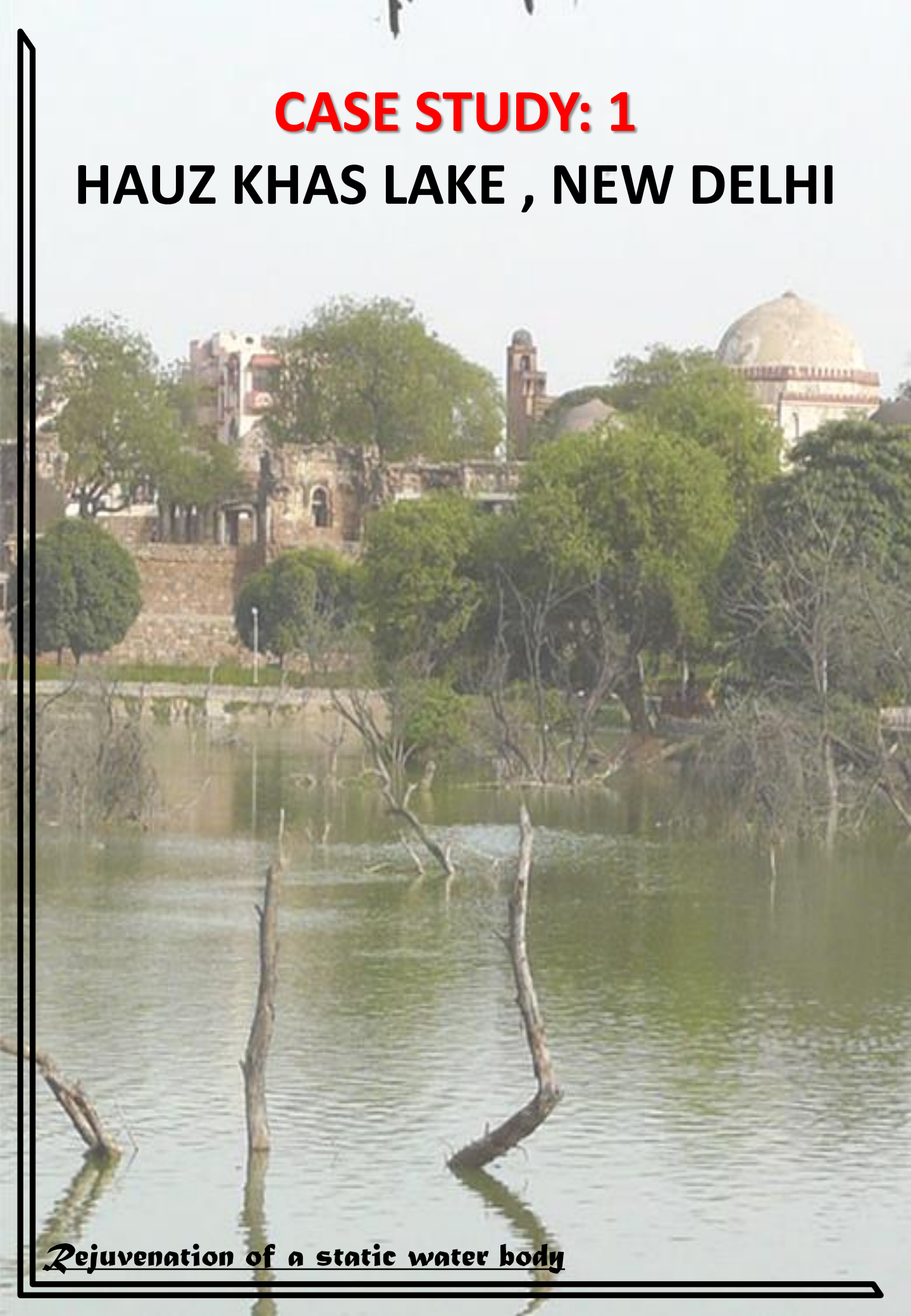
- Dissolved oxygen values were in the ranges between 2.4 mg/l to 2.6 mg/l , and less than the desirable limit of 18mg/l.
- It reveals that saroornagar lake water was facing lack of oxygen supply to support the microbial activity and to maintain the aerobic condition, which will lead the eutrophic condition of water.
- BOD values were in the ranges of 216 mg/l and higher than the desirable limit of 5mg/las given in Table .

3.11 CONCLUSIONS

- The water quality analysis gives the detailed pollutional status of saroornagar lake and confirmed the higher degree of pollution.
- This was due to discharge of untreated domestic sewage and industrial effluents, washing of clothes and cleaning of vehicles.
- Important parameters such as Temperature, pH, Total solids, Total dissolved solids, Total hardness, Calcium hardness, Magnesium, Bicarbonates and Biological oxygen demand were higher than the permissible limit.
- Whereas alkalinity, Carbonates and COD values are well below the permissible limit. Both BOD and COD values reveals that lake water had been much polluted with biodegradable organic matter.
- Above results show that saroornagar lake water were facing lack of oxygen supply to maintain aerobic condition, which clearly indicates the eutrophic condition of lake water.
- Further, it has been confirmed that saroornagar lake water could not be used for domestic, agriculture, industrial and other activities without appropriate treatment.
- Mechanical surface aerators or diffused aerators may be installed at suitable points for initiating aerobic biological treatment.
- Greater Hyderabad Municipal Corporation (GHMC) may take appropriate measure for treating the saroornagar lake water.

CASE STUDY: 1

HAUZ KHAS LAKE , NEW DELHI



Rejuvenation of a static water body

CASE STUDY – HAUZ KHAS LAKE , NEW DELHI

4.1 INTRODUCTION

HISTORICAL PERSPECTIVE: Purpose of Construction

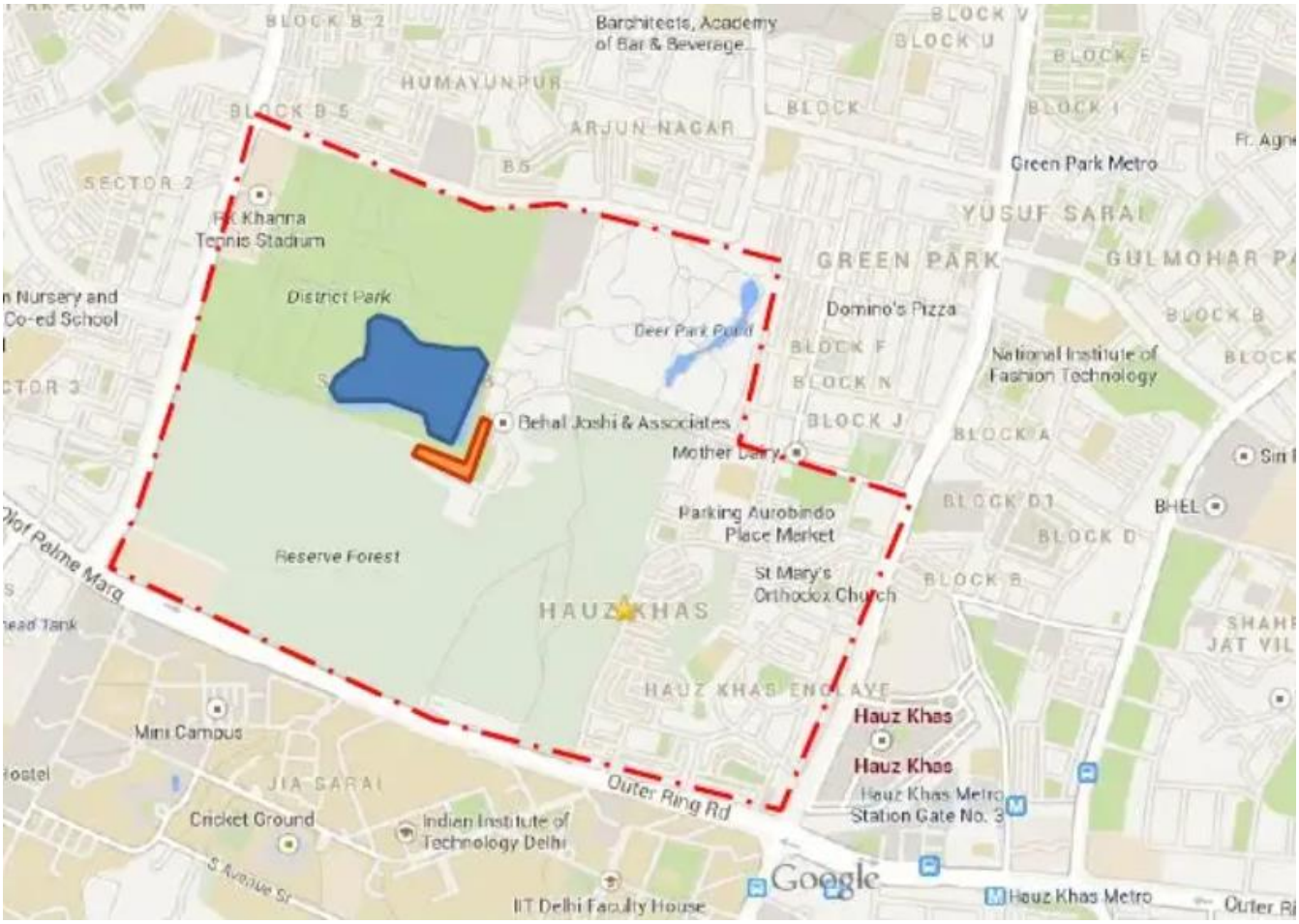
- In 13th century (700-year-old artificial lake), there was a large plain called SIRI where important battles were fought by Alauddin Khilji against Mongols. At the end of the 13th century, Alauddin khilji decided to built reservoir to serve Basic needs of growing population.
- The tank called Hauz e- Alai (tank of Alauddin) was spread over huge area of 6 hectares With capacity of 800 million lts. of water which remained filled of monsoon water naturally.
- After death of Alauddin, focus shifted away from Siri to Jahanpanah as new capital. The water channels get silted up and dry bed began to cultivated. In the middle of 14th century, Firoz Shah Tughlaq ascended the throne and he shown great interest in educational buildings and laying out gardens etc. so the tank was delisted again and along eastern and southern edge, Madarsa was built set Amidst beautiful gardens and named HAUZ KHAS.
- After the death of Firoz Shah, the tank again silted up and area came to be inhabited by rural population Which grows to Hauz Khas village.
- During the re-establishment of the Hauz Khas Village in the 1980s it was ensured that the monuments and the water tank remain protected (INTACH) Indian National Trust for Art and Cultural Heritage .

- 13th CENTURY, HAUZ KHAS LAKE- ALLAUDIN KHILJI
- 14th CENTURY, L-SHAPED MADARSA- FIROZ SHAH
- 20th CENTURY VILLAGE FORMATION+ MIXED LANDUSE

4.2 OWNERSHIP

➢In 1931, ASI (Archaeological Survey of India) declared HAUZ KHAS
COMPLEX, the monument of national importance. The village on
The other side had developed as an agrarian settlement constituting 100 Jatt and Muslim families inform of compact low
rise plotted development.

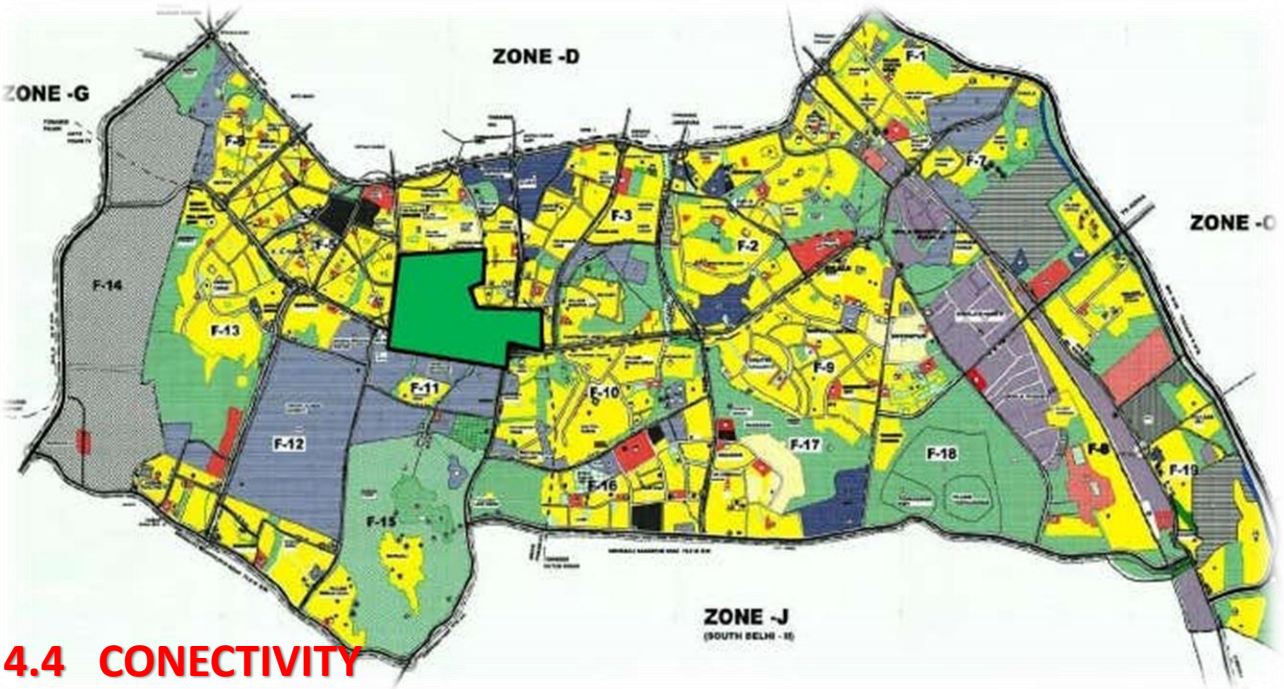
➢During 1960s, city development authority i.e. DDA started consolidating land and village areas. The forested area i.e. Deer park, rose garden, district park and village area surrounding the complex and R.K. KHANNA STADIUM is under DDA(Delhi Development Authority)



4.3 LOCATION

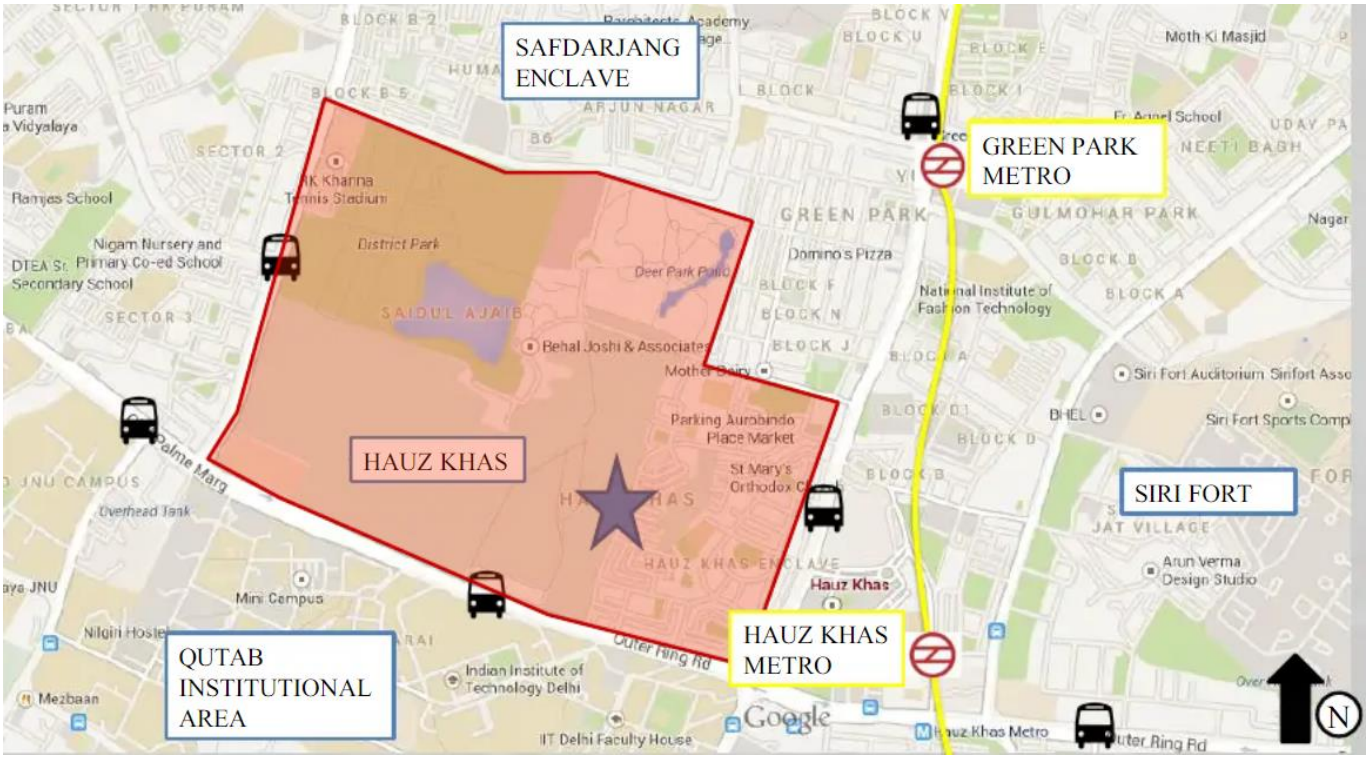
It is located in South Delhi in Zone F which is full of protected monuments, forested areas and heritage sites so, it is called "GREEN LUNG" of the Delhi city.

- **The lake is spread over an area of 15 acres, surrounded by historical structures, a district park, a deer park, a rose garden, a wooded area and a commercialized village.**
- **Originally, the lake was fed by three main storm drains. Currently the lake is fed by treated effluent from a sewage treatment plant in Vasant Kunj and rainfall from the catchment area.**



4.4 CONECTIVITY

- **The area is easily connected through METRO and DTC Buses (Delhi Transport Corporation).**
- **METRO STATION-2.2 KMS (EXPECTED TIME-10 MIN)**
- **BUS STOPS- 1.5 KMS (EXPECTED TIME-6 MIN.)**
- **Nearest Railway Stations to Hauz Khas ,New Delhi ,India ; (SWNR) Sewa Nagar, 5, 4.43 Kms ; (LPNR)Lajpat Nagar, 5, 5.07 Kms**
- **The distance between Hauz Khas and Delhi Airport Station is 10 km.**



4.5 SURROUNDINGS

➢In surroundings, there are several prestigious institutes like JNU, IIT, NIFT and has good Hospitals like AIIMS, SAFDARJANG etc.

➢ This is also surrounded by several monuments like-

1. Barakhamba Tomb,
2. Dadi Poti Gumbad,
3. Biran ka Gumbad,
4. Kali Gumti,
5. Tohfewala Gumbad and many more.

<u>Rejuvenation of a static water body</u>

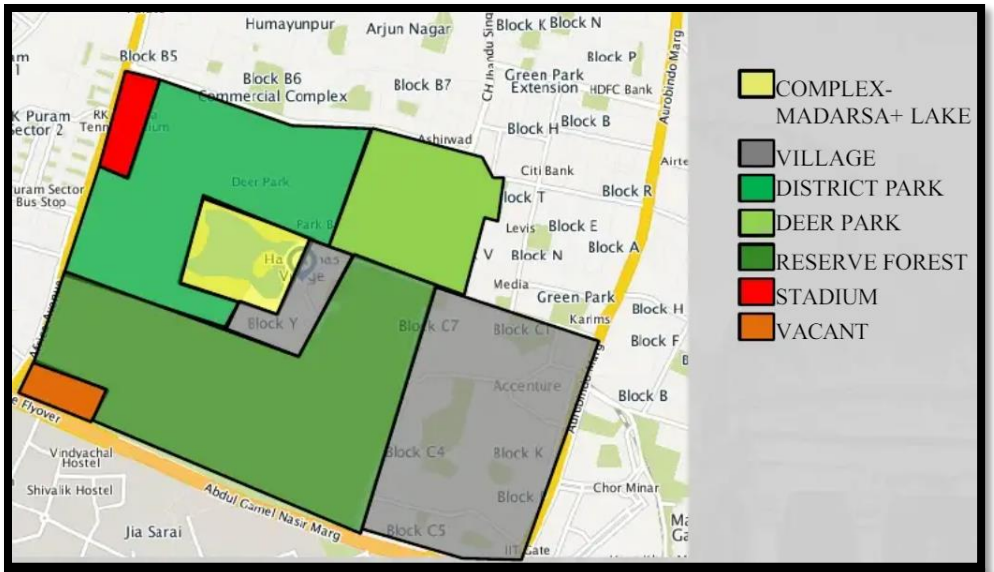
4.6 PRESENT STATUS

➢Complete with a forest groove, wild animals, historic water reservoir, ruins of an academy HAUZ KHAS is distinctly picturesque.

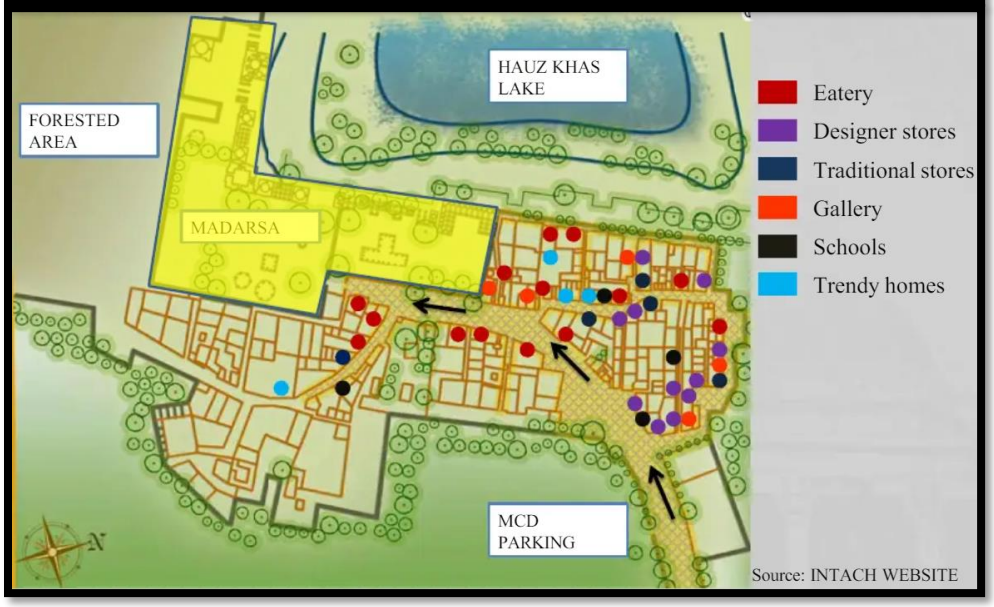
➢Located between two primary arteries of the city (inner & outer ring road), HAUZ KHAS village is hidden Behind forested area.

➢Several boutiques were launched by fashion designer which was beginning of a trend that convert this forgotten village into smartest retail destination in the city.

➢Since then, the village has been continuously evolving. It has emerged at staging space for new sub-cultures allowing innovative ideas to grow. Its coffee shops, experimental artwork, exhibits, etc find room in evolving urban loads.



ACTIVITIES AT MACRO SCALE



ACTIVITIES AT MICRO SCALE

Rejuvenation of a static water body

- The biodiversity is greatly enhanced by the lake and the extensive wooded regions that are there.
- The lake's water is serene, motionless, and almost devoid of biological trash.
- The lake has boating amenities accessible.
- Due to a lack of care, the edge condition is poor in several locations.
- It was first nourished by collecting storm water.
- Its original size was four times larger than it is now.
- The 700-year-old HAUZ KHAS Lake, which had been completely empty for 40 years, is now filled with recycled water from the nearby sewage treatment facility.

4.7 OBJECTIVE

- The research makes an effort to assess the initiative's short-term effects, long-term viability, and potential applicability to other historic water bodies and water storage buildings in the city.
- The restoration of the lake's surrounding natural ecosystem, including the return of water birds as a result of its filling up, is examined while assessing the project's effects on the groundwater table.
- The report also captures the opinions of various government representatives and NGOs evaluating the contribution of other comparable initiatives to addressing Delhi's water problem.

4.8 ISSUES

ENVIRONMENTAL ISSUES

- Restaurants in HAUZ KHAS Village in south Delhi running without environmental clearance.
- The present activities in the village are without treatment plants for waste water, and sewage system.
- Height of building surrounding to the complex are restricting the sun.

➢Most restaurants are less than 100 meters from the monuments and so are under archaeological laws and the area has no municipal water supply, the restaurants, bars and pubs are using ground water, thereby depleting the resources.

➢According to the fire department officials, only two or three buildings in the area have got fire safety certificates . The rest are operating without the necessary no-objection certificate (NOC) from the department.

MAINTAINENCE ISSUES

The Madarsa and HAUZ KHAS complex is not well maintained as the condition is very bad, about to deteriorate. Conservation is needed at early pace.

1. Building is in bad condition
2. Steps to lake are unsafe as Unmaintained
3. Safety is concern issue, some places are Dangerous to stay

FACILITIES ISSUES

PARKING ISSUE: Parking facility is a problem as availability is poor.

BASIC FACILITIES ISSUE: There is no facility of Drinking water and public toilets within the HAUZ KHAS complex which creates problem among visitors. No public amenities like benches, dustbins, shades etc are given.

SIGNAGES: Proper way finding signages are not provided in the complex, people do not easily find the way to village.

4.9 SAMPLING POINTS

In hauz khas lake samples collected from the 4 sampling points. Lake is approximately 1.5km long so, we divided the lake into four zones are as follows:

Chemical and Biological analysis result of Hauz Khas Lake

S. No.	Parameters	Unit	Zone1	Zone 2	Zone 3	Zone 4
1	pH		7.98	9.6	9.7	8.1
2	Electrical Conductivity	µmhos/cm	758	745	797	760
3	Total Dissolved Solids	mg/L	440	420	460	500
4	Total Hardness(as $CaCO_3$)		110.26	106.19	211.64	129.13
5	Calcium Hardness		107.3	85.1	105.8	75.1
6	Magnesium Hardness		2.96	21	105.8	54
7	Chloride		145.9	164.87	139.09	160.98
8	Sulphate		146.2	154.5	132.9	163.6
9	Nitrate		14.6	12.7	11.6	9.71
10	Fluoride		0.46	0.45	0.45	0.38
11	Boron		0	1.22	0.25	1.42
12	Ammonia		0.14	0.21	0.11	0.07
13	Dissolved Oxygen		5.9	6.0	9.4	7.9
14	Biochemical Oxygen Demand		10	24	64.9	54

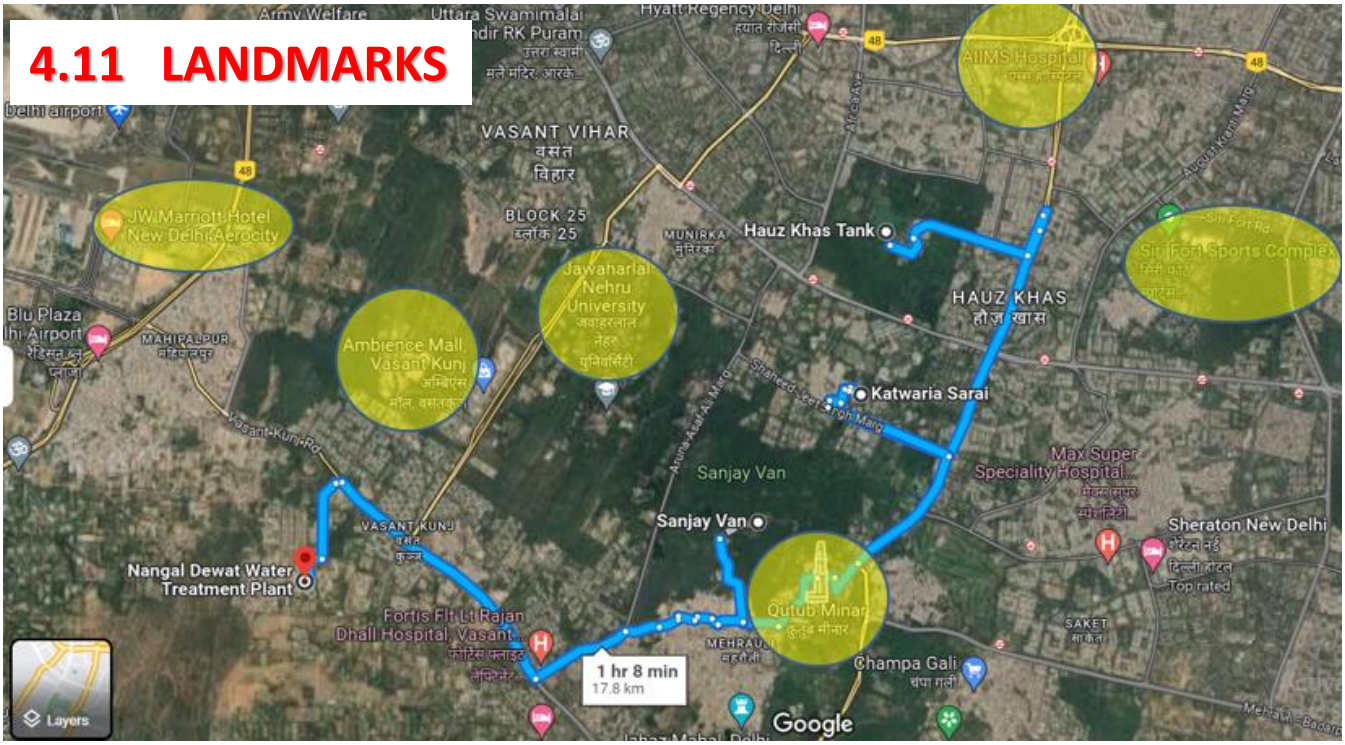
4.10 CONCLUSION

- **It is concluded from the present study the concentration of Ph in zone 2 was 9.6 and in zone 3 was 9.7 which showed the lake water in zone 2 and 3 is not suitable for irrigation, fish culture , outdoor bathing.**
- **But the pH in zone 1 and 4 was 7.9 and 8.1that area may be suitable for outdoor bathing, fish culture and may source for drinking water with conventional treatment but after disinfection.**
- **But the pH in zone 4 was 8.1 which showed that the area is only suitable for irrigation purposes.**
- **Electrical conductivity in all zones were higher than the prescribed limit it ranged from 745 to 797 µS/cm it showed that the lake water is not suitable for certain species of fish.**
- **Turbidity also found maximum in all zone it may affect the ability of fish gills to absorb dissolved oxygen.**
- **High turbidity levels can reduce the amount of light reaching lower depths, which can inhibit growth of submerged aquatic plants and consequently affect species which are dependent on them, such as fish and shellfish.**

- **Whereas, remaining parameters like ammonia, fluoride, chloride, total hardness, nitrate and boron all these parameters found within the limit as per IS:2296: 1992 except DO and BOD.**
- **DO recorded in zone 1 was 5.9 mg/L which may be suitable for outdoor bathing and DO in zone 2was 6mg/L that area of lake may be suitable for drinking purpose but with conventional treatment but after d isinfection and DO found in zone 3 and 4 was 9.45 mg/L and 7.93mg/L it showed the presence of high algal growth and BOD in all is not suitable for bathing, irrigation and very dangerous for aquatic life.**
- **It is also clear that the reason of eutrophication in lake that an untreated sewage is released into the lake. By this way, it harms the aquatic life.**

Multiple attempts were made to rejuvenate this lake, and rejuvenation elements are successful to varying degrees. Despite the problems, HAUZ KHAS lake still remains a haven for those who seek a moments peace in the fast-paced life of the capital city.

4.11 LANDMARKS



Rejuvenation of a static water body

1. ENTRY POINT OF THE TREATED WASTEWATER INTO THE SANJAY VAN

2. PASSAGE FOR THE FLOW OF TREATED WASTEWATE R WITHIN SANJAY VAN

3. WATER RETAINED IN THE CHECK DAM BEFORE MOVING TO THE LAKE

4. GREEN COLOUR WATER OF THE HAUZ KHAS LAKE ALONG WITH TREES THAT HAVE TAKEN ROOT ALONG THE SIDES OF THE LAKE. THIS VEGETATION MULTIPLIES THE IN- SITU ORGANIC LOAD THROUGH DECAY AND LEAF FALL

Rejuvenation of a static water body

5. HERITAGE BUILDINGS SURROUNDING THE HAUZ KHAS LAKE

6. FLOATING WETLAND ALMOST ON THE VERGE OF DROWNING (INSIDE HAUZ KHAS LAKE)

7. CONSTRUCTED WETLAND ARRANGEMENT AT THE ENTRY POINT OF WATER INTO THE LAKE

8. BIO ENZYME BEING DOSED ALONG THE BOUNDARY OF THE LAKE

Rejuvenation of a static water body

4.12 KEY INTERVENTIONS AT HAUZ KHAS LAKE

The following interventions were part of the Hauz Khas Lake Rejuvenation

➢LAKE RECHARGE & WASTEWATER TREATMENT INTERVENTIONS

1. **Diversion of storm water and treated wastewater through Sanjay Van (2002)**
2. **Bio engineering of check dams in Sanjay Van by introduction of**

aquatic plants (2002)

1. **Installation of Floating aerators in HAUZ KHAS Lake (2002)**
2. **Bacterial Bioremediation in HAUZ KHAS Lake (2002 until now)**
3. **Installation of Floating wetlands in the HAUZ KHAS Lake (2017)**
4. **Creation of planted gravel filter/constructed wetland arrangement at the primary inlets to the lake (2017)**

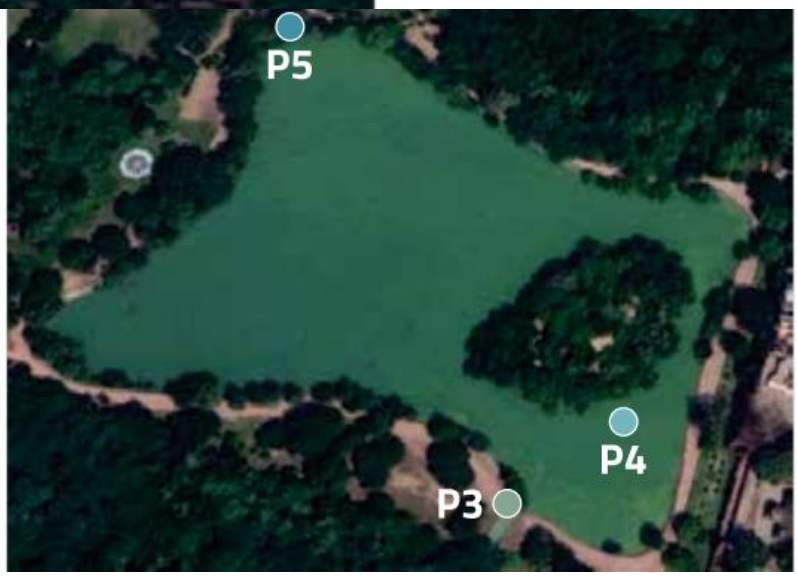
➢ BIODIVERSITY ENHANCEMENT INTERVENTIONS

Introduction of fish species in the lake and the reservoirs inside Sanjay Van (2002).

➢ BIO ENGINEERING OF CHECK DAMS

1. **There are five check dams inside Sanjay Van.**
2. **The water stored behind the dams were populated with duckweeds (spirodella, lemna, wolffia and water hyacinth) which uptake the various organic pollutants through their root system and transfer oxygen to the waters, thereby reducing the organic load.**

1. **The water is then conveyed through a system of pipes.**
2. **The entire flow of water from the outlet of the STP to the Hauz Khas lake is via gravity.**



. Hauz Khas Lake Project: Sustainability Matrix

	Objectives	Measures	Initiatives	Performance Indicators
Economic	- Long term financial sustainability - Bringing down cost of water supply including tankers and borewells	- Recovery of capital cost - Cost of water supply - Life cycle cost	- Using existing STP as water source - Using natural gradient of land to reduce pumping costs - Using cascade aerators to reduce electricity costs	- Capital cost recovery within short period due to reduced cost of water supply - Annual maintenance cost recovery in terms of health and recreation
Environmental	- Restoration of lake and surrounding environment - Recycling of water - Raising of Groundwater Table	- Water Quality (CPCB norms) and Quantity - Ground Water Level - Per Capita Water availability - Revival of lake ecosystem	- Using treated water from STP as a continuous water source - Frequent water testing by CPCB - Additional bioremediation of water - Composting of collected waste - Introduction of fish to tackle algae/ weeds - Using aerators	- Permanent presence of water in the lake - Water Quality in accordance with CPCB norms for lakes - Rise in groundwater table - Ease of watering in adjacent parkland - Reuse of waste as compost - Presence of variety of water birds
Social	- Increasing water availability - Enhancing aesthetic value - Creating recreational space - Improving public health	- Better household water supply - Aesthetically pleasing surroundings - Number of visitors - Air and water quality	- Development of adjacent parkland - Provision of boating - Creation of walkways and shelters - Introducing moving fountains in the lake - Spraying insecticides for mosquito removal - Public discussions to explain benefits	- Increased satisfaction with domestic water supply - Increase in visitors in the surrounding areas - Increase in morning walkers - Increase in photographers and birdwatchers - Visitor satisfaction

Rejuvenation of a static water body

4.13 POLICIES/ PROGRAM/PROJECTS:

- The inlets to the reservoir were closed during previous attempts by the Delhi Development Authority to build Hauz Khas village, which caused the lake to dry up for a while.
- In order to correct the problem, a plan was put into action in 2004 to redirect storm water produced at Delhi's southern ridge into the lake after being stored behind an embankment.
- Water birds such spot bill ducks, pochards , mallards, shovellers , grebes, gadwall geese, black- winged stilts, and pintail ducks have been drawn to the lake due to its availability of water. The Delhi Bird Group now reports many more winged visits, including pintail ducks that fly across from Siberia, as opposed to the prior discovery of just warblers and birds of prey in the area.
- The surrounds are now more lush and beautiful because of the birds' presence. There are now more people visiting the lake and park, including morning walkers and birdwatchers. Since the air quality improved, yoga practitioners have also begun to frequent the area. Council sessions are held at a cottage next to the lake in the Hauz Khas settlement.

4.14 INFERENCE

1. There is a visible green algae layer in the entire lake that indicates eutrophication and unhealthy conditions. Relatively better organic concentration is observed near the inlet of the lake. This could be because of regular dosing of bio enzymes and flow of water through the constructed wetlands. However, at other locations, due to stagnancy and accumulation of organic content, high organic load is visible.
2. During the sample collection, the water was stagnant inside the lake as well as the inlets. Bio enzyme dosing can become ineffective in the absence of proper mixing and microbial colony formation can be hindered.
3. All parameters have not been analyzed hence a conclusive remark on the water quality cannot be made.

CASE STUDY: 2

YASHWANT LAKE, MAHARASHTRA

Rejuvenation of a static water body

LITERATURE STUDY – YASHWANT LAKE, MAHARSHTRA

5.1 INTRODUCTION / LOCATION

- A tranquil lake completely surrounded by dense vegetation on its sides is Yashwant Lake, located in the southern portion of the Toranmal plateau. It currently resembles a topographical depression filled with trash and overgrown vegetation. The local populace is now concerned about their health because of the lake's use as a landfill.
- Toranmal is 1,150 metres (3,770 feet) above mean sea level and is situated between the latitudes of 21° 52' 48" N and 74° 27’ 36" E. With an about 41.43 square kilometre size, Toranmal is a hill station in the Nandurbar district in the Indian state of Maharashtra.
- The plateau is shaped like a soccer ball, and a creek runs across it from south to north.
- The Yashwant Lake, which has a surface area of 1.59 km2 and a maximum depth of 27 metres, is created when a stream is constrained in the southern portion of the plateau.
- Further towards the north on the same stream is the Lotus lake which derives its name from the fact that it is always covered with lotus flowers. Same stream jumps down the cliff in Sita Khai, into the gorge forming an enthralling waterfall in rainy season.

Rejuvenation of a static water body

Source: maharasthra tourism

5.2 LOCATION OF YASHWANT LAKE, MAHARASHTRA

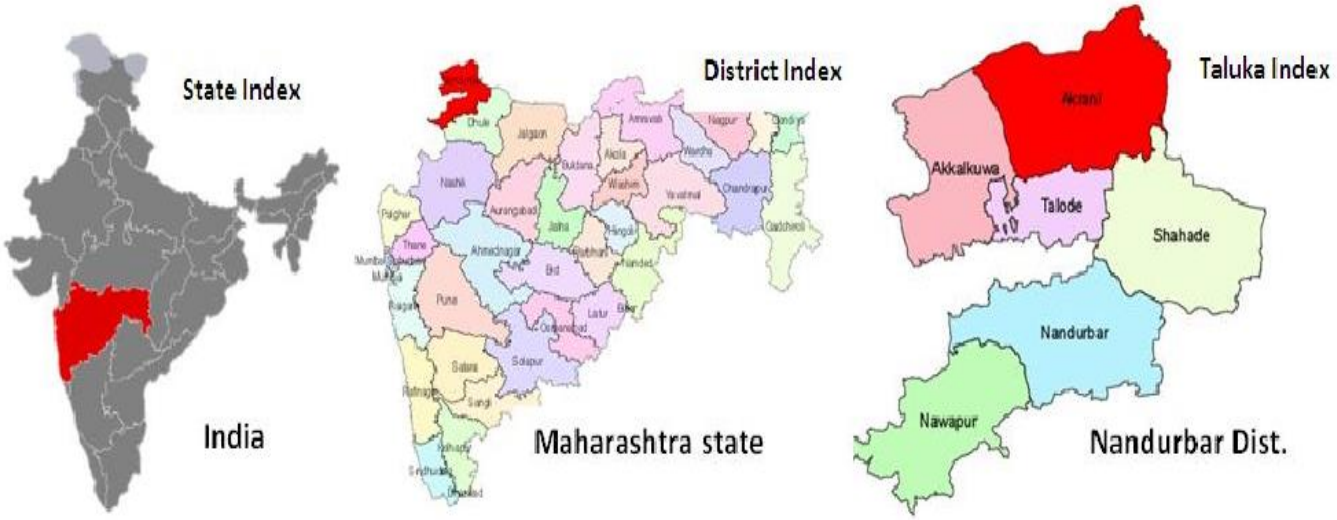


Fig1: Akrani (Dhadgaon) taluka (source: MRSAC)

Fig2: Toranmal hill station (source: Google maps)

NEED OF RESEARCH:

Rejuvenation truly relates to the social cohesion. As Rejuvenation of lake provides alternate opportunities of water management. This place has a religious, tourist and geographical researching background so there is a need of development. The lake's use as a dumping ground has raised health concerns for the local population. This can be countered by rejuvenating the Yashwant Lake.

5.3 AIM:

To study and analyze the impact of rejuvenation of Yashwant lake on its surrounding settlement.

5.4 OBJECTIVES:

- To examine the lake.
- To study different process of rejuvenation.
- To study and understand problems faced by local peoples and visitors.
- To study the scope for further development in the surrounding after rejuvenation of the lake.

5.5 SCOPE:

- Rejuvenating the whole shoreline of the lake.
- Rejuvenating the shoreline near settlement only.
- As a tourist destination there will be scope for developing lakefront at Yashwant lake.
- Strawberry is main byproduct so there will be scope for developing strawberry processing

plant near Yashwant lake.

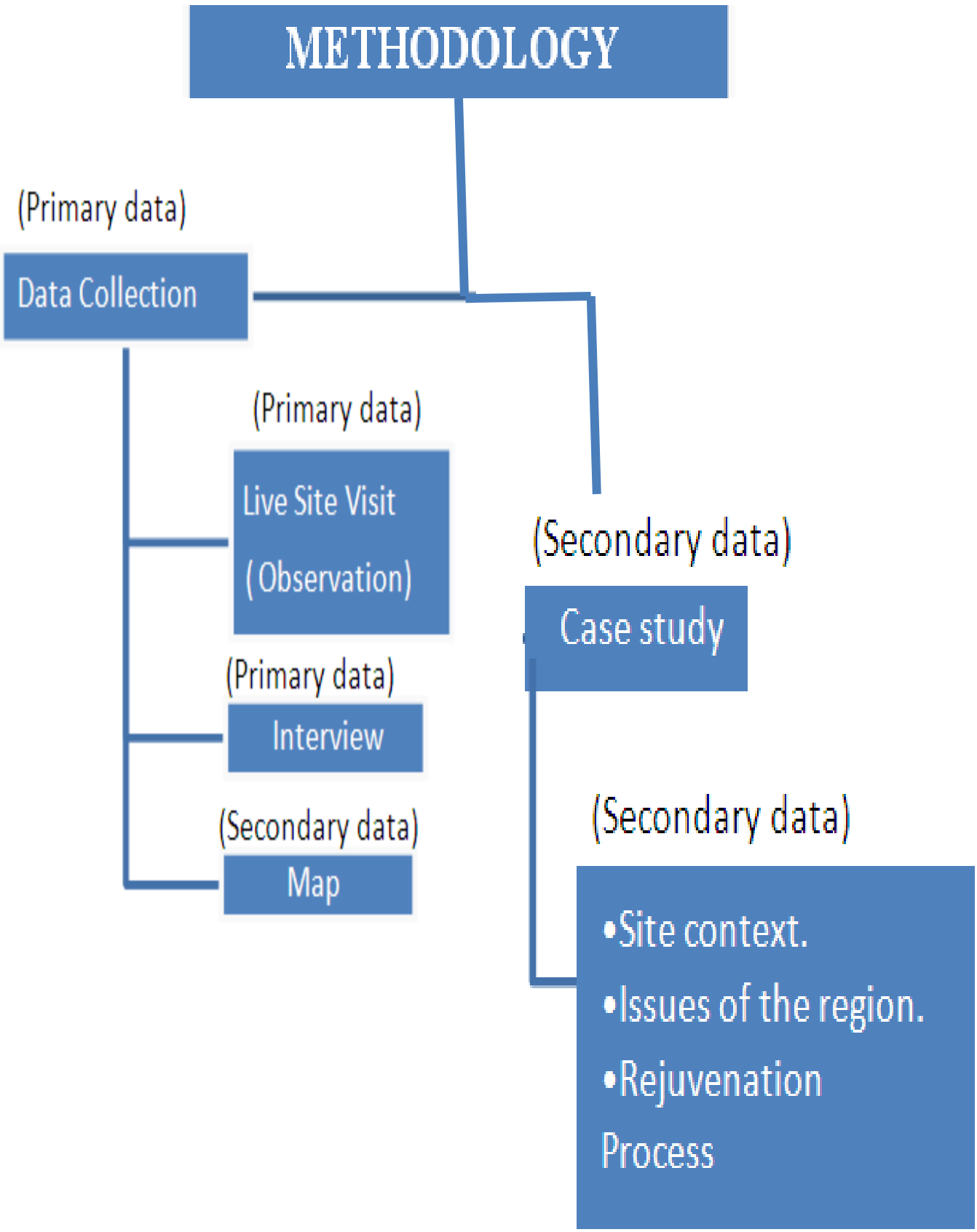
- As a tourist destination there will be scope for developing hospitality infrastructure.

5.6 LIMITATION:

- The research is limited only to the Rejuvenation of the shoreline near settlement.

5.7 METHODOLOGY :

- Detailed field study was carried out to assess the present status of Yashwant Lake.
- Different available literature regarding rejuvenation were studied for clear understanding of the topic.
- During field study village people around the Yashwant lake were consulted to know their problems.


METHODOLOGY
(Primary data)
Data Collection
(Primary data)
Live Site Visit
(Observation)
(Primary data)
Interview
(Secondary data)
Map
(Secondary data)
Case study
(Secondary data)
•Site context.
•Issues of the region.
•Rejuvenation Process

5.8 ISSUES

1. There is raise in the health issues due to contamination of Yashwant lake.

2. The surrounding environment and the ecology of the lake are also affected due to the contamination of lake

3. There is indirect effect on agriculture i.e. effect on economy

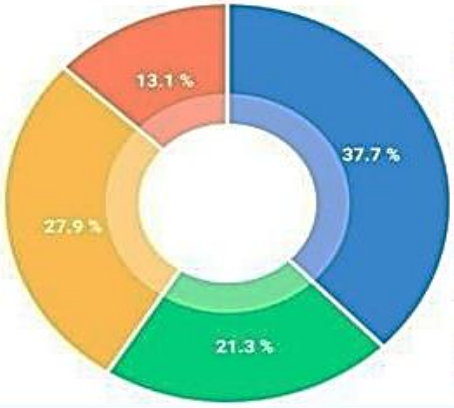
4. The major issue for the contamination of the Yashwant Lake is it's use as dumping ground

.

Sewage and wastewater also seem to be contributing for the contamination of Yashwant lake.

5. Overgrown grass and use of chemical fertilizer / pesticides not majorly but yes contribute to the

contamination of lake.



Choices	%
Use as Dumping Ground	37.70
Overgrown grass	21.31
Sewage and wastewater	27.87
Chemical fertilizers and pesticides	13.11

Fig5: statistics showing issue at Yashwant Lake

5.9 DERIVING POLICY FOR REJUVENATION OF YASHWANT LAKE:

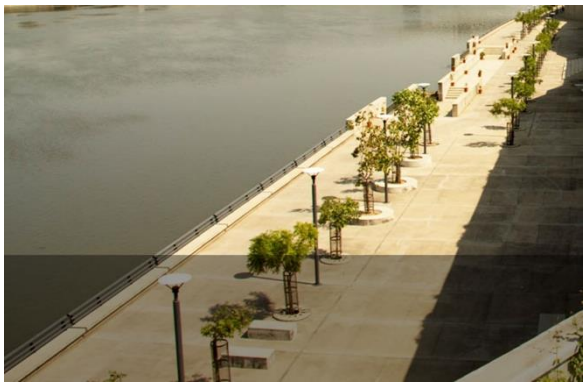
1. NMC (Nandurbar Municipal Corporation)will take up the work of removing overgrown grass and garbage and cleaning of lake.
2. The solid waste management and sewage water treatment can be done without violation of rule and regulations.
3. There will be accessibility to different income people.
4. They will develop Lake front providing facilities like Toy Train, Indoor sports Stadium, Laser show, Jogging Track, Aquarium, Zoo, Park, Amusement Park, Butterfly Park, Food Court, Lighting. The lake and garden will attract local people and visitors.
5. NMC can charge Rs 10 for entry ticket so as to recover the expenditure.

Policy for rejuvenation of Yashwant lake:

	Yashwant Lake
Hydrological and ecological issues	1.Major issues for contamination of Yashwant lake is waste dumping and sewage and wastewater 2. The overgrown grass is also issue for contamination of shoreline
Economic issues	1.Use of chemical fertilizer and pesticides in farm area near wetlands results in poor agricultural activities which leads to economy of people. 2.Also the contaminated lake reduces the tourist potential in that area.
Ecological improvement	Cleaning of lake will improve the quality of water and will invite various bird species.
Recreational use	Developing Lake front and providing facilities like Toy Train, Indoor sports Stadium, Laser show, Jogging Track, Aquarium, Zoo, Park, Amusement Park, Butterfly Park, Food Court, Lighting. The lake and garden will attract local people and visitors.
Accessibility to different income people	There will be accessibility to different income people.
Violations of rules and regulations	NMC (Nandurbar Municipal Corporation) will take up the work of removing overgrown grass and garbage and cleaning of lake. The solid waste management and sewage water treatment can be done without violation of rule and regulations.
Major End beneficiaries	Government and Public

5.10 Proposal:

They will develop Lake front providing facilities like Toy Train, Indoor sports Stadium, Laser show, Jogging Track, Aquarium, Zoo, Park, Amusement Park, Butterfly Park, Food Court, Lighting. The lake and garden will attract local people and visitors.



LAKE FRONT

AMUSEMENT PARK

INDOOR SPORTS

TOY TRAIN

FOOD COURT

JOGGING TRACK

Rejuvenation of a static water body

COPARATIVE TABLE FOR ADAPTIVE MEASURES OF LAKE

ANASAGAR LAKE, AJMER RAJASTHAN	SAROORNAGAR LAKE, HYDERABAD
Strict enforcement of rules and regulations.	Hypolimnetic drainage- By the withdrawal of water from the bottom layers instead of from the top, the nutrients in the lake are reduced and the dissolved oxygen condition is improved.
Establishment of sewage treatment plants (stp) to treat waste water.	Aeration (artificial circulation)- it provides increased oxygen to the lake by circulating the water and exposing it to the atmosphere.
	Lake bottom sealing.

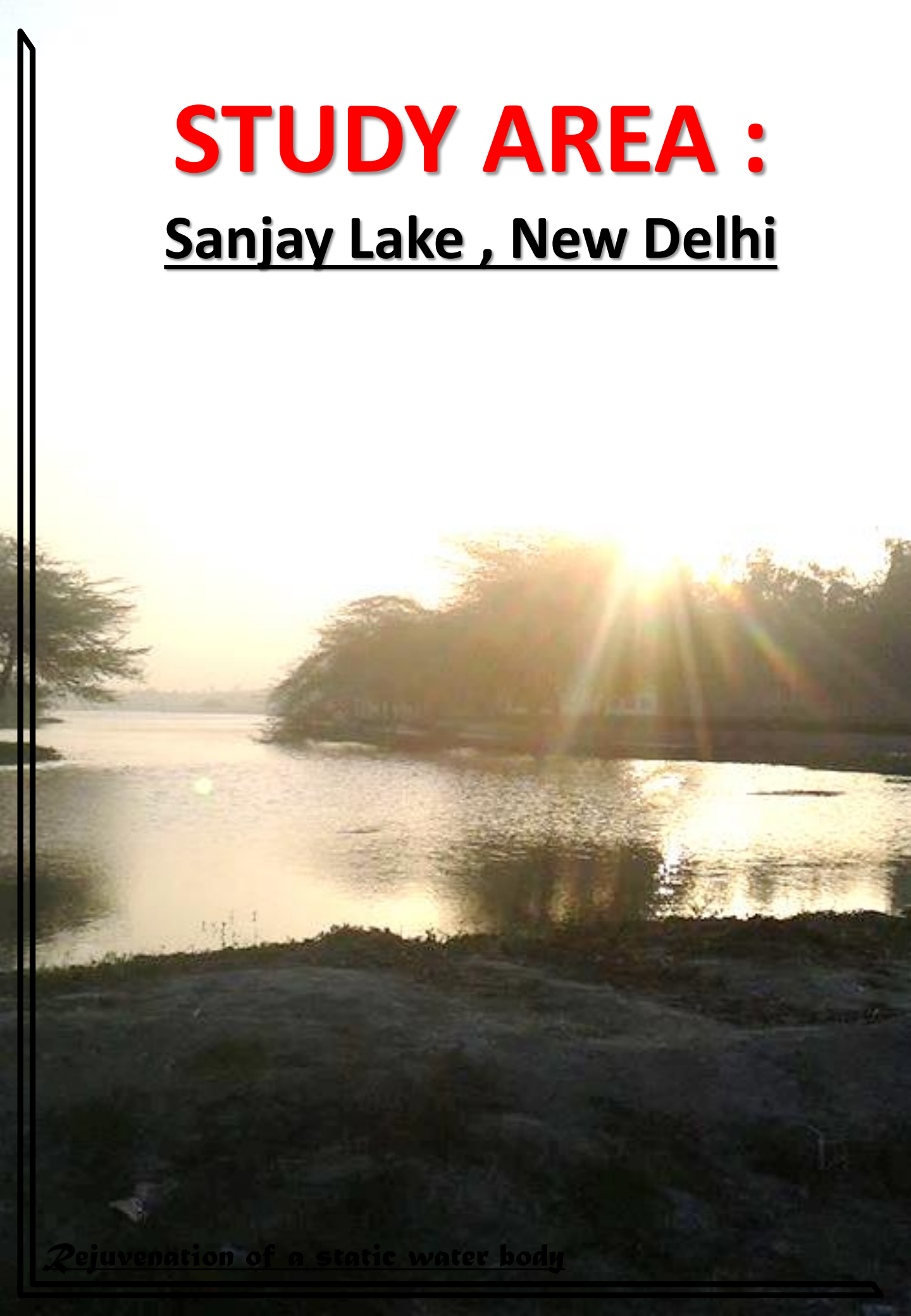
HAUZ KHAS LAKE, NEW DELHI	YASHWANT LAKE, MAHARASHTRA
Manual removal of leaf litter from the lake.	Establishment of sewage treatment plant.
Operation of vertical aerator fountains.	Lakefront development.
Maintenance of the inflow route to keep it clear of any unauthorized tapping and blockages.	

5.11 CONCLUSION:

1. **Water bodies sustain all kinds of life forms and a project like this can be a medium through which the people can be educated about the need to revive water bodies.**
2. **Such initiatives are easy to plan and implement and can spark an environmental revolution which is the need of the hour. Proper implementation and achievement of Rejuvenation activities should be with community involvement.**
3. **They should be made aware about the ecological, hydrological, environmental and socio-cultural importance of the lake.**
4. **This can be done through various outreach programs and publications.**
5. **The active participation of the students and community in planning, design, execution, cleaning, measuring water quality, planting trees, bird watching, drawing competition and self-help program for lake rejuvenation give the opportunity for practical environmental education. Community Awareness and involvement about conservation activities will also reduce the burden on governing body.**
6. **Formation of lake development trust or residents trust, involving community and NGO will help in raising funds, maintenance of lake and spreading awareness of about lake conservation activities.**
7. **This will also make lake a platform for social gathering place.**

STUDY AREA :

Sanjay Lake , New Delhi



6.1 INTRODUCTION

- East Delhi, India, is home to the sizable artificial lake known as Sanjay Lake.
- The Delhi Development Authority built this lake in the 1970s.
- In 1982, Sanjay Lake became available to the public.
- A manmade lake called Sanjay Jheel was cared for by DDA from 1982 until 2009.
- It has been looked after by the Delhi Tourism Department since 2009.
- The lake grows amid a vast, 170-acre woodland tract that is also known as Sanjay Lake Park.
- On 42 acres of land, the lake is located in the center of Sanjay Jheel Park.
- It is one of the largest lakes in Delhi because of its vast area.
- One of this lake's most well-known activities is boating.

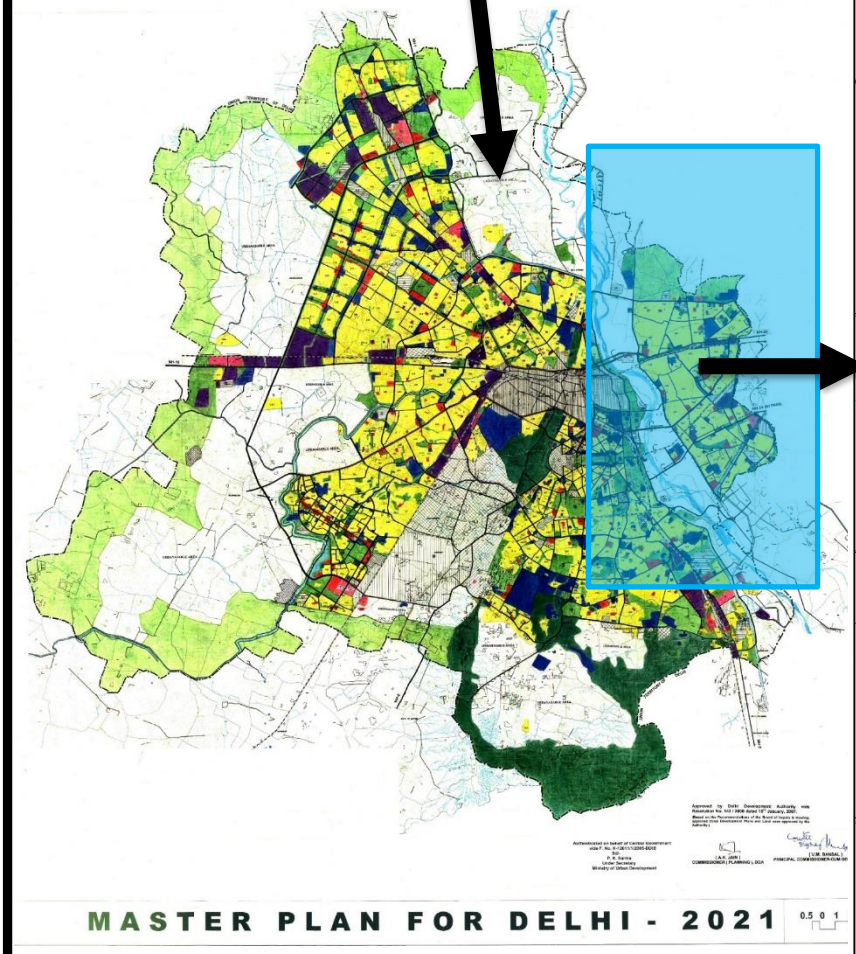
- **TOTAL AREA OF SITE : 170.6 ACRES**
- **LAKE AREA : 52.3 ACRES**
- **WATER DEPTH : VARIES FROM 0.7 TO 1.8 M**
- **WATER TABLE : VARIES FROM 1.4 TO 2.5 M BELOW GROUND**
- **RAIN FALL : 617 MM ANNUAL**
- **INFLOW : RAIN WATER AND UNDER GROUND WATER THROUGH BOREWELLS**
- **WELLS : 3 BOREWELLS AT THE RATE OF 150 CUM/HR**
- **DISCHARGE TIME : 4-6 HOURS PER DAY FOR EACH BOREWELL**
- **DISCHARGE QUANTITY : 2700 CUM PER DAY**
- **CATCHMENT AREA : 128 ACRES**
- **PAVED AREAS : 2.6 ACRES**
- **OUT FLOW EVAPORATION : 10-12 MM PER DAY (DEPENDING ON THE WEATHER CONDITIONS)**
- **THE LAKE IS 0.30 M WIDE AT ITS NARROWEST POINT AND 270 M WIDE AT ITS WIDEST POINT**

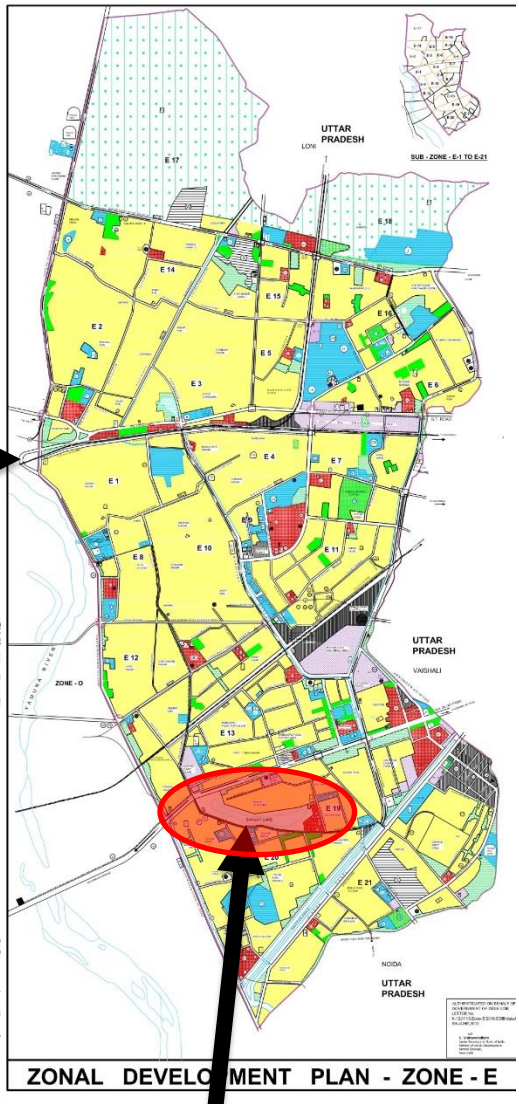
- The residential communities of Mayur Vihar, Kalyanpuri, and Trilok Puri are all located around The Jheel.
- Rain and floodwaters supplied it with water.
- The hidden beauty of Delhi and the main tourist destination in East Delhi is Sanjay Lake.
- It is very calm and peaceful place far from the hustle bustle and chaos of the city.
- Around 90 different kinds of migrating birds, according to the locals, may be seen here. Along with many kinds of flowers and flora, the park also contains many native trees.

- On December 16, 2015, an adventure park is also established here. As part of a public-private partnership (PPP) arrangement, this park is governed by the Delhi Tourism and Transportation Development Corporation (DTTDC) and the Delhi Development Authority (DDA).
- Boating, beach volley ball, archery, jungle, home, tree top course, and other activities are available here.
- Boating on Sanjay Lake is another well-known and sought-after Sanjay Park sport.
- One of the few lakes in Delhi where people may go boating is this one. Boating is available for visitors to enjoy on East Delhi's big lake. The Delhi Sanjay Lake Park offers raft and paddle boat rentals. The quiet surroundings provide for an excellent boating experience.

Rejuvenation of a static water body

6.2 Location



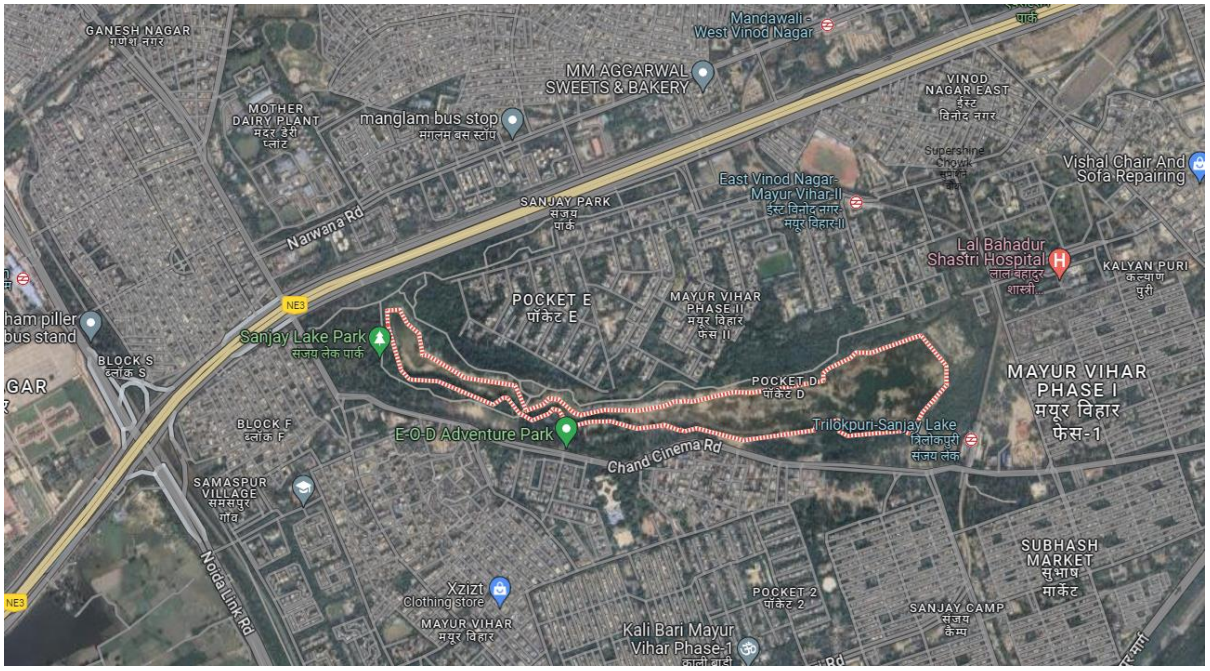


Sanjay Lake ,
New Delhi

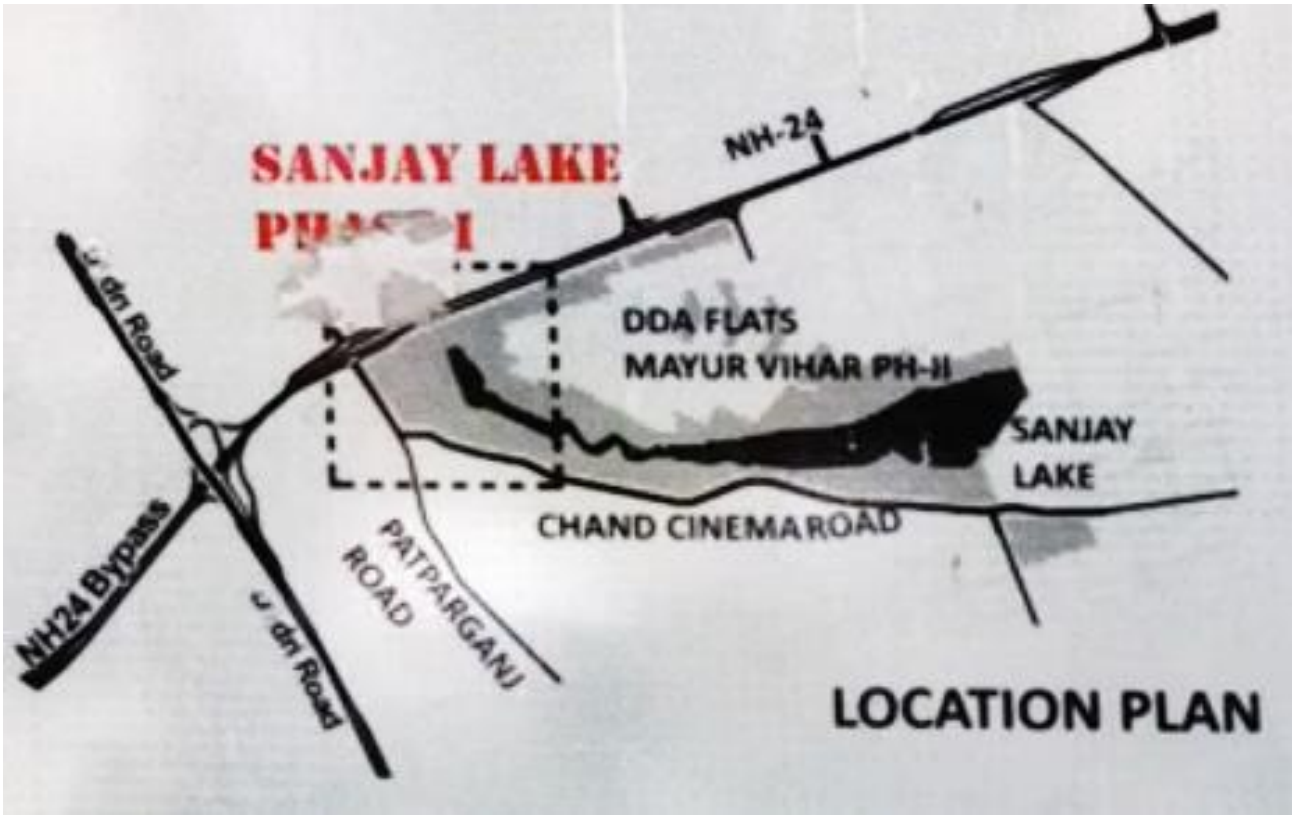
Rejuvenation of a static water body

Rejuvenation of a static water body

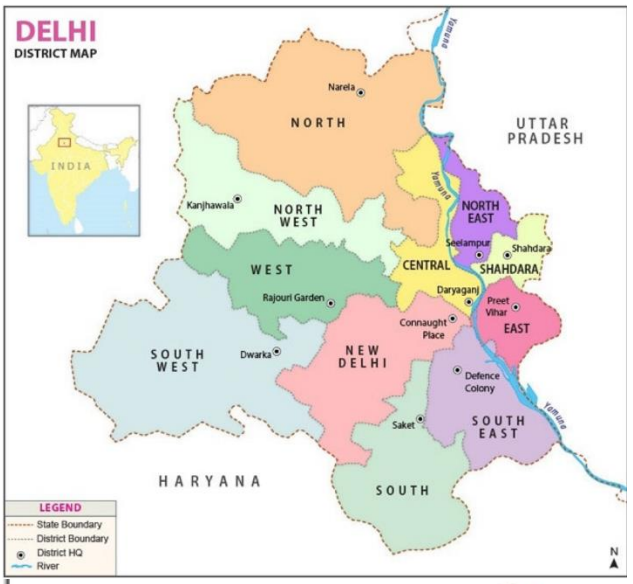
1. Kids play area/ jungle play
2. Stepped seating
3. Play fields
4. Eatery joints
5. Butterfly garden
6. Over looking deck
7. Stepped seating with fountains
8. Seating court with pergola
9. Nature trail
10. Ecological park
11. River walk
12. Retrofitting of library block
13. Open gym
14. Parking
15. Jogging trails
16. Sensory garden
17. Tactile garden
18. Bamboo grove
19. Boating decks
20. Camping
21. Formal court
22. Community park with sensory garden ,Jogging trails , Kids play areas

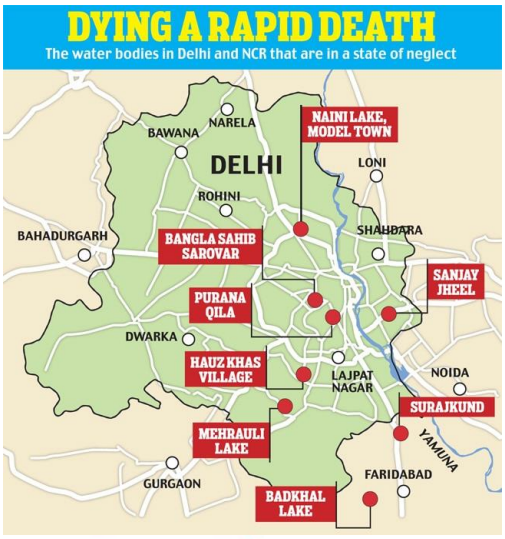


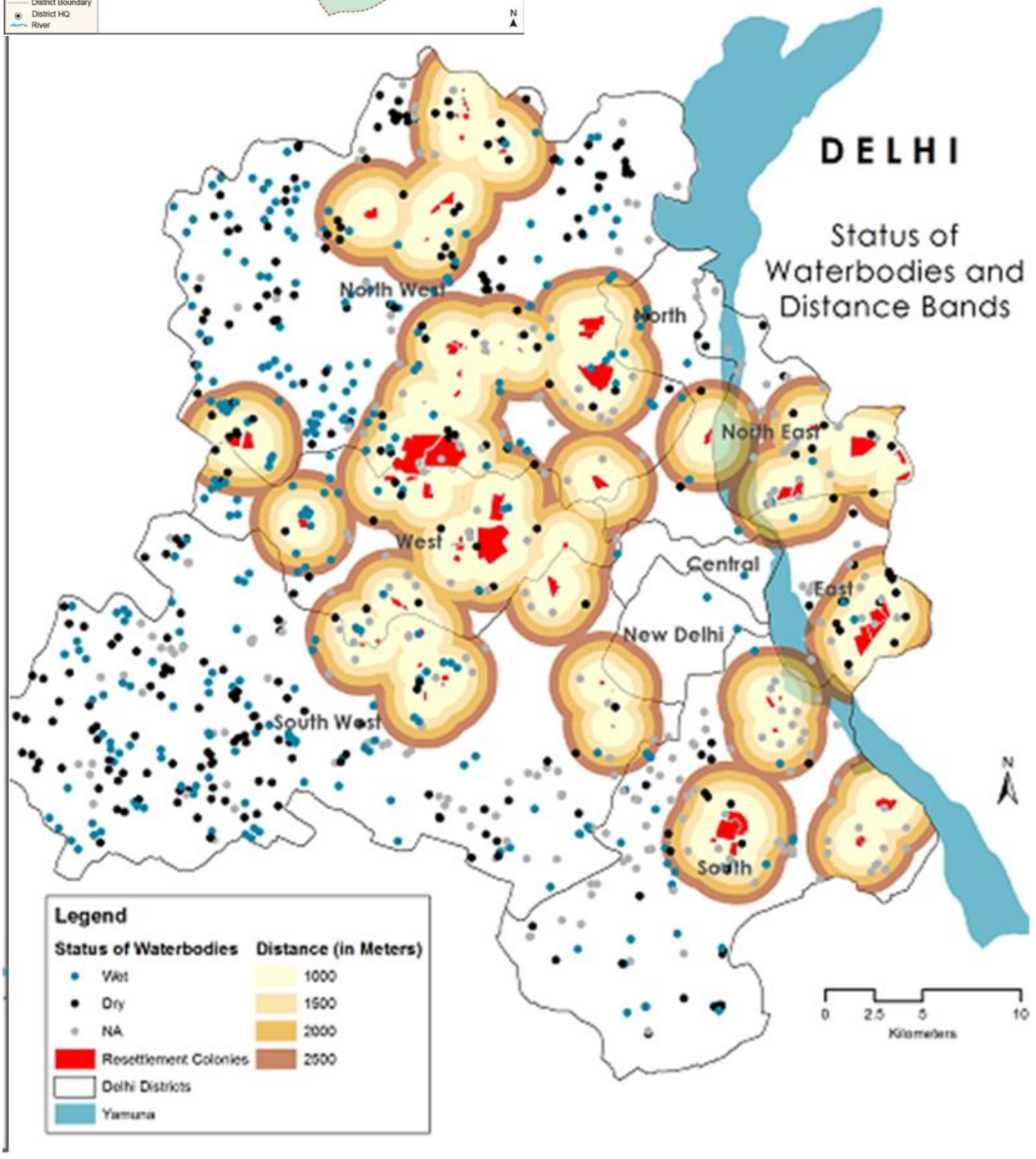
- **Nearest national highway (NH24).**
- **The nearest metro station to Sanjay Lake is Trilokpuri – Sanjay lake metro station 450M away.**
- **The nearest RAILWAY station to Sanjay Lake is MWC/Mandawali Chandra Vihar 2 km away.**
- **Indira Gandhi International Airport is 22.3km away**



Rejuvenation of a static water body







Rejuvenation of a static water body

6.3 HISTORICAL BACKGROUND SETTING OF ZONE E: TRANS YAMUNA

- In the Master Plan for Delhi 2021, the NCT of Delhi has been split into 15 planning zones (divisions) marked from "A" to "P" (apart from Zone-I). The Planning Zone-E covers 8797 Ha in total (approx) The State of Uttar Pradesh borders it on three sides, while the Yamuna River borders it on the fourth.
- Since before India gained its independence, this zone has evolved through MPDs in 1962, 2001, and the present MPD 2021. As a result, the region is diverse, with both planned and unplanned sectors coexisting according to different plans' standards.

SETTING OF TRANS-YAMUNA AREA

- Planning Zone (Division) 'E', known as Trans-Yamuna Area (TYA) is located in the Eastern portion for the National Capital Territory of Delhi across river Yamuna abutting Loni, Sahibabad and Noida, areas of Uttar Pradesh. Total area of Zone 'E' is 8797 Ha. (approx).

POSITION UP TO 1962 UP TO 1960

- it had very small area like Shahdara, which was inhabited. It was connected with other parts of the National Capital Territory by only one road cum-railway bridge near Red Fort.
- In addition, one Pantoon bridge used to supplement as additional access except during monsoon season, when it was dismantled, leaving only one link with Trans-Yamuna Area.

POSITION BETWEEN 1962-1981

At the beginning of the implementation of the Master Plan in 1962, Trans Yamuna Area remained vacant except for some old developments like Shahdara, Geeta Colony etc.

POSITION BETWEEN 1981-1992

In the course of urban development and expansion during the last decade, the population has reached more than 20 lacs as per 1991 Census and even the existing bridges became insufficient and two more road bridges were added near ISBT Kashmere Gate and Madanpur Khadar

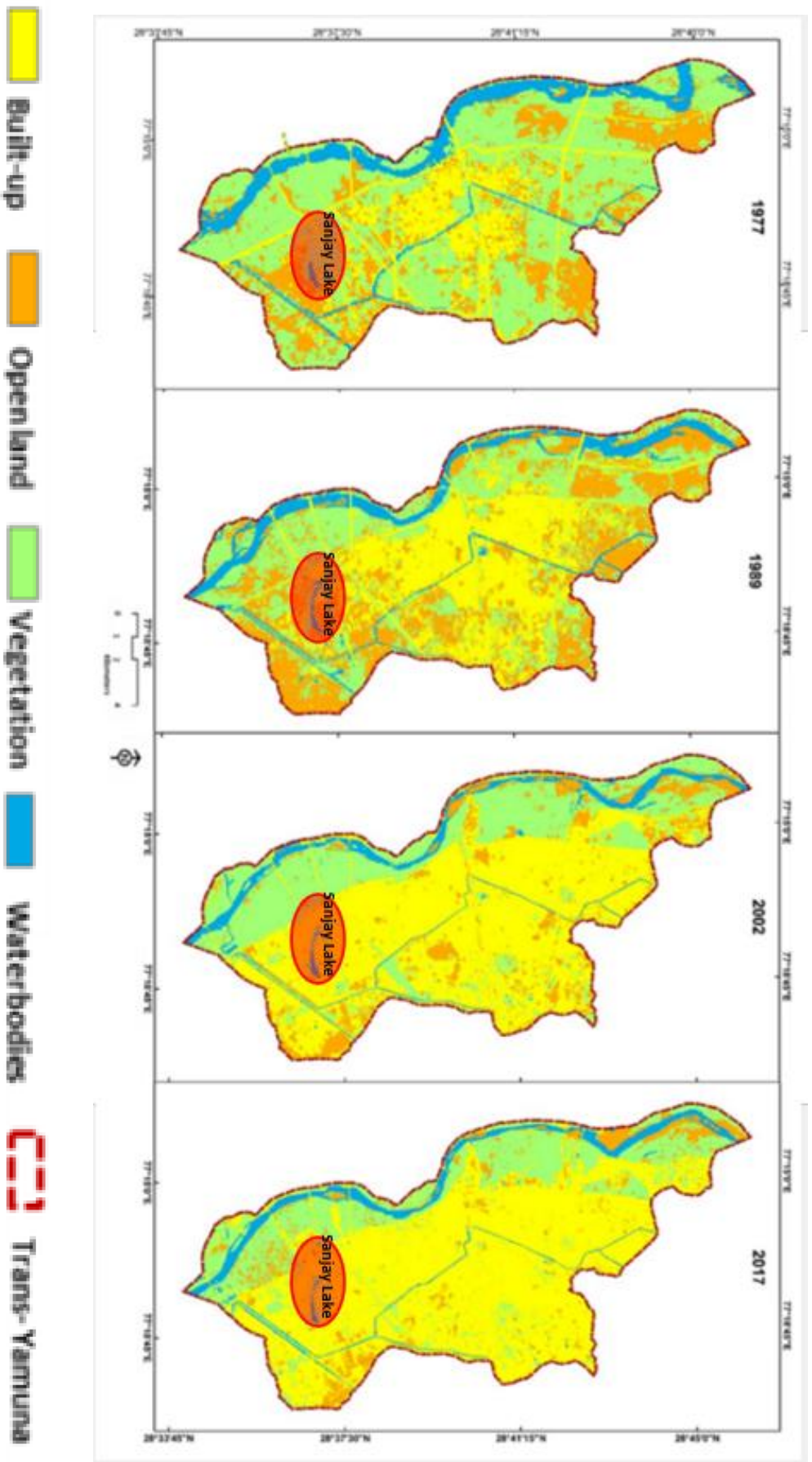
POSITION BETWEEN 1993-2007

During this period, following major infrastructure initiatives were taken for this area –

i) Parallel bridges on River Yamuna at I.T.O. and Nizamuddin.

ii) DND Flyover under Public-Private Partnership

Trans- Yamuna Region, ZONE E of Delhi, (1977, 1989, 2002, and 2017)



Rejuvenation of a static water body

6.4 URBAN SETTING TIMELINE

- **1970 :** Initially the lake spread over 89 acres and together with the surrounding park it covered an area of 178 acres.
- **1980** : It was greatly shrunk after DDA started developing the area for its housing colonies.
- **1998 :** National Highway 24 (NH 24) was built to connect the national capital to Lucknow. which cut through the lake. Lake was reduced to the present 170 acres.
- **2005 :** Efforts were made by Delhi Development Authority to conserve and restore the lake.
- **2015 :** A 5.2 acre Amusement Park was introduced in the park to promote and increase the inflow of people.

6.5 ECOLOGICAL CONTEXT

- East Delhi is the least ecologically diverse part of the city, and Sanjay Lake is the only significant green space there. Several migrating birds frequent Sanjay Lake. Few green, open places provide breathing room between densely populated communities. Multiple industries present close have a negative impact on the ecosystem.

6.5.1 ECOLOGICAL BENEFITS OF SANJAY LAKE

- Regulating ambient temperatures
- Filtering air
- Carbon sequestration
- Preserve biodiversity
- Protect habitats
- Maintaining water table

6.6 HYDROLOGY

- Sanjay Lake is a scour depression in East Delhi's low-lying regions that was once washed by the Yamuna River. **TOPOGRAPHY**
- Sanjay East Lake Delhi is an artificial lake that was built next to Mayur Vihar and other residential areas in the 1970s. Development Spread it across the Authority's 170 acres of native trees and migrating birds. A well-designed workout track is highly well-liked by devotees.

Rejuvenation of a static water body

6.7 FLORA AND FAUNA OF SANJAY VAN LAKE

The forest hosts a large number of fauna and flora.

- Its habitats are ***Peacock, Kingfishers, Tawny Eagles, Cotton Pygmy Geese, Doves, Little Egrets, White Ducks.***

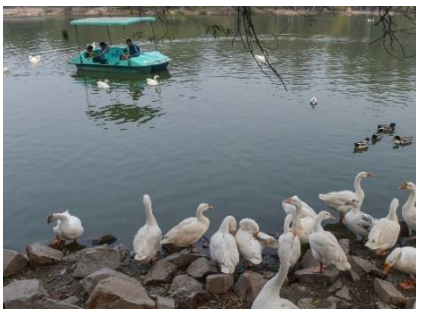
Tawny Eagles

Doves

Cotton Pygmy Geese

Peacock

Little Egrets



White Ducks

- The common native trees are ***Ronjh (Acacia Leucorrhoea), desi Keekar (Acacia Nilotica), Ber (Ziziphus mauritiana),*** etc.

Ronjh (Acacia Leucorrhoea)

Ber (Ziziphus mauritiana)

desi Keekar (Acacia Nilotica)

- The It also contains a medicinal plant garden. The medicinal plantation consists of ***Neem (Azadirachta indica), Giloe (Tinospora cordifolia), Ashoka (Sarca asoca), Guggal (Commiphora wightii), Bael (Moringa oleifera), Amla (Phyllanthus emblica), etc.***

Neem (Azadirachta indica)

Giloe (Tinospora cordifolia)

Ashoka (Sarca asoca)

Guggal (Commiphora wightii)

Bael (Moringa oleifera)

Amla (Phyllanthus emblica)

Rejuvenation of a static water body

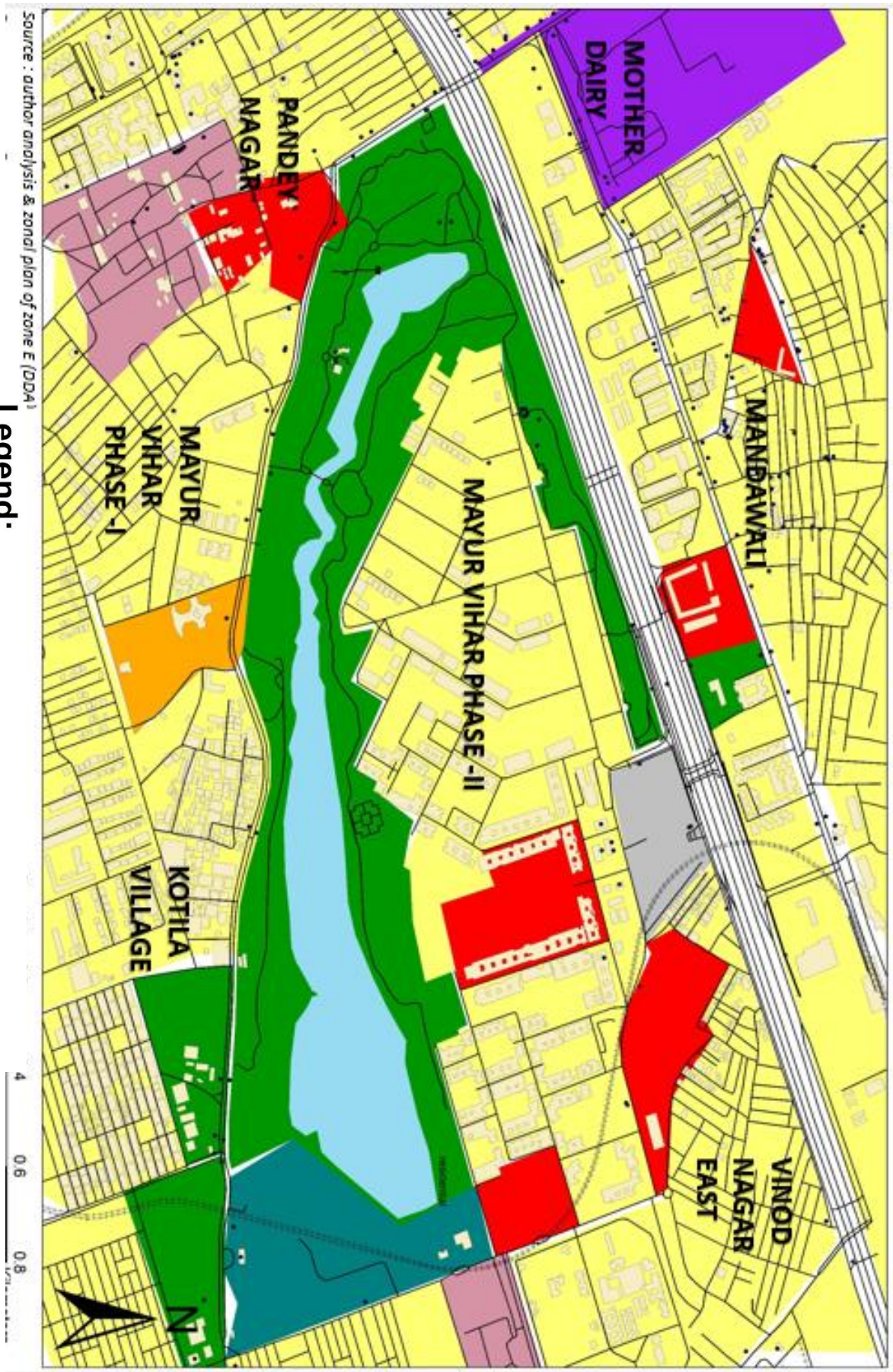
6.8 LAND USE PATTERN

- Yamuna Sports Complex and Sanjay Lake are designated as recreational zones in Zone "E" of the Zonal Development Plan. 2021 DDA MASTER PLAN.
- They serve the full population of this Sub- Region of the NCR in addition to the trans Yamuna area's residents.
- The Master Plan also recommends that a significant boating/recreational/multicultural complex might be built around Sanjay Lake.
- The Zonal Development Plan expressly shows these two areas as different in order to reflect this.

LAND USE TABLE

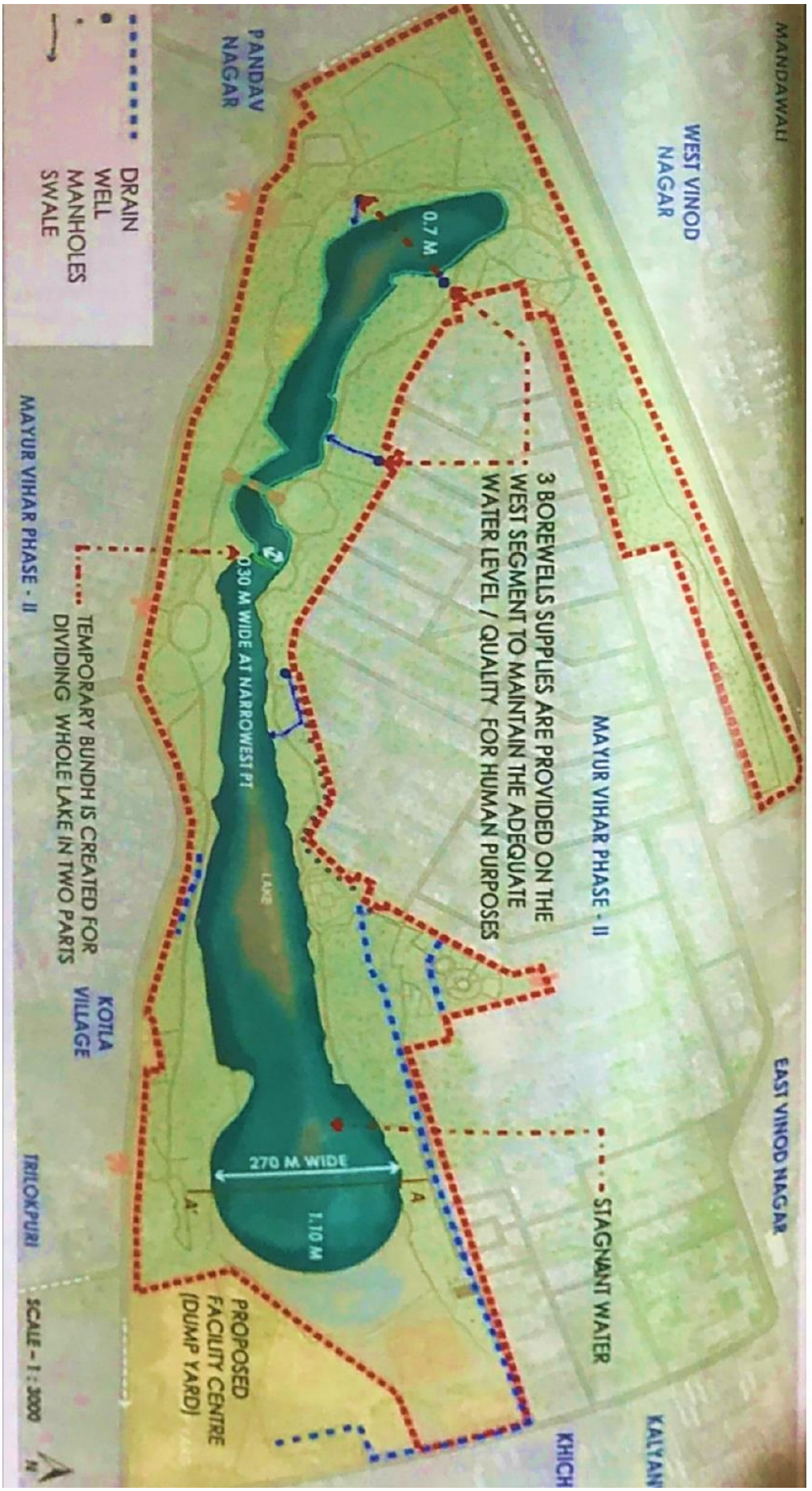
Land use	Area (Ha)	%age
Residential	5652.55	64.26
Commercial	311.26	3.54
Industrial	190.54	2.16
Recreational	935.33	10.63
Transportation/circulation	1060.81	12.06
Public & Semi-public facilities	426.45	4.85
Utilities	220.00	2.50
TOTAL	**8797.00**	**100.00**

LAND USE PATTERN



Rejuvenation of a static water body

6.9 SANJAY LAKE DEMARCATION PLAN



6.10 SANJAY LAKE LOOP PLAN

This 4.2-km loop around sanjay lake , new delhi. Generally considered an easy route, it takes an average of 56 min to complete.

This is a popular trail for birding, hiking, and running, but you can still enjoy some solitude during quieter times of day. The trail is open year-round and is beautiful to visit anytime.

Rejuvenation of a static water body

6.11 VISUAL ISSUES

1. Residents now utilize the location of the proposed twin tower and business complex as a waste yard. This lowers the park's and lake's environmental quality.
2. The park has water logging in several areas because of an insufficient drainage.
3. Several locations in the lake frequently experience algae development. This shows that the park need more cleaning operations.
4. In certain locations, the edge is not maintained, and trash is put there.
5. The lake's water quality is impacted by garbage dumped somewhere in the lake complex.





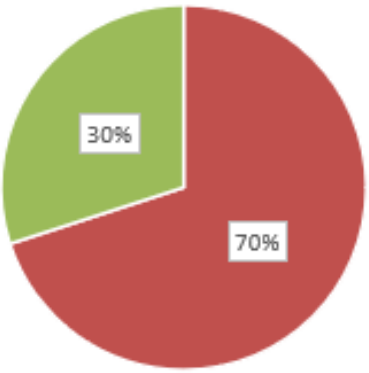


6.12 STAKEHOLDERS

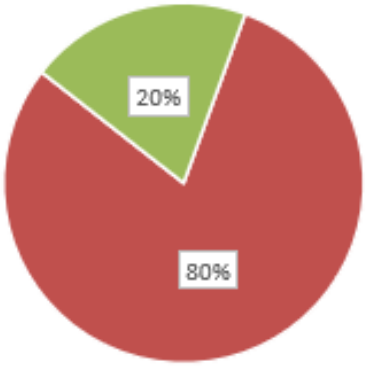
yes no sometimes

❑ SURVEY ANALYSIS

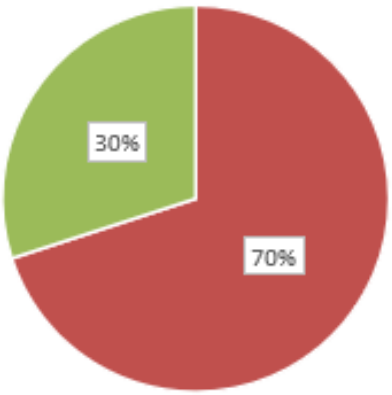
Did you observed any illegal activities?



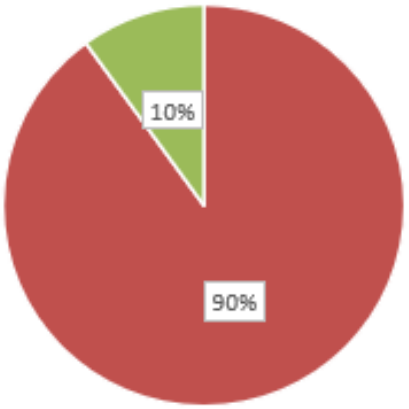
Have you ever noticed garbage dumping around the lake?



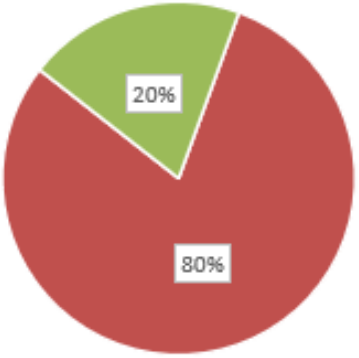
Did you observed any dead fishes/aquatic species in lake?



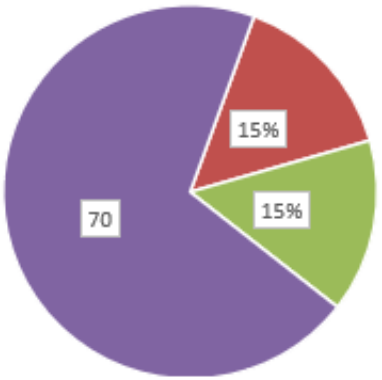
Did you observed any decrease in migratory birds?



Have you suffered from malaria and dengue in last 2 years?



According to you does lake is managed or maintained by Govt. body?



6.12.1 Inference:

- Illegal Activities are practiced around sanjay lake, as it does not have enough tourist footfall. Lake area appears to very quiet. In some areas it is also unsafe.
- Lots of mosquitoes, due to garbage dumped and water logging across the lake, causes malaria and dengue to nearby residents.
- Due to the lake's water quality declining, a high number of dead fish and aquatic creatures have been found there.
- Only 13 species were documented in the survey that the 2022 census performed on January 7th, down from 17 species between 2019 and 2021.
- When Sanjay Lake's oxygen supply is low, bacteria break down the waste at the lake's bottom, causing water to develop carbon dioxide and hydrogen sulphide , As a result, people in nearby areas report smelling foul, which indicates that the lake's oxygen apply is very low.
- As the weather warms, warm air rises and contributes to the foul smell.

6.12.2 INTERVIEW WITH STAKEHOLDERS

Visitor 1

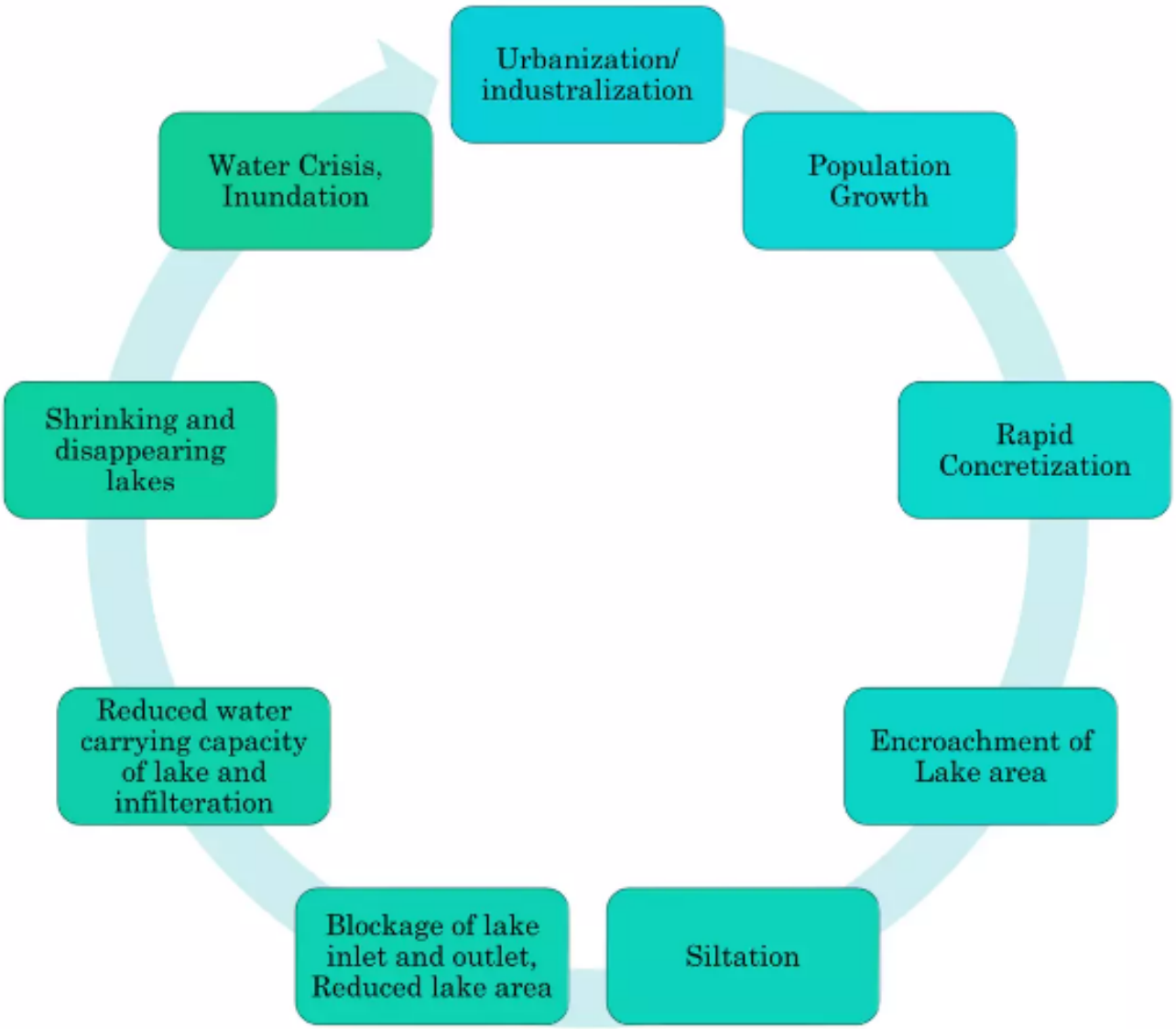
Was SWCURITY GUARD living with his family there. Need a clean space to live around lake. As he spends hours daily. Garbage around the lake should be treated as it creates foul smell and mosquitos around the area.

Visitor 2

Mostly Domestic Visitor. Visit 1 day per month. Would like to visit the boating area and other activities around the lake and would like to spend 2-3 hours there. A Visitor information centre should be developed so as to orient the visitors and brief them about the things. Garbage around the lake should be treated as it creates foul smell around the area. Lake water is not clean enough, as it results in death of aquatic animal.

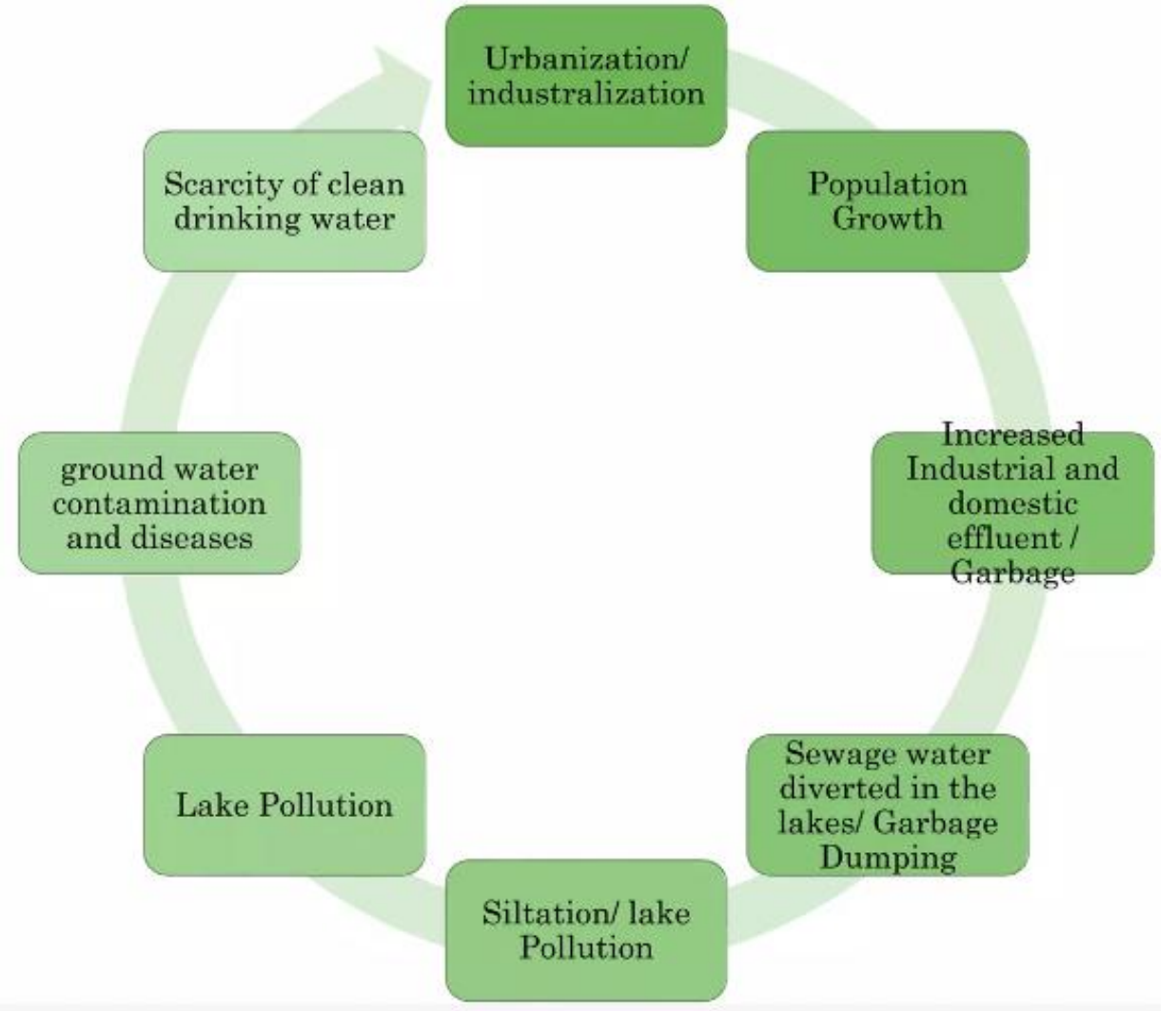
6.13 APPROACH TO REVIVE A LAKE

Major factors subsequently causing shrinking of lakes at various stages



APPROACH TO REVIVE A LAKE

Factors causing pollution of lakes at various stage



FOLLOWING ARE THE APPROACHES TO REVIVE THE LAKE:

1. Environmental And Economic Development
2. Enhancing Aesthetic Quality
3. Stakeholders Involvement
4. Preserving Biodiversity
5. Lake Water Recharge
6. Waste Water Treatment
7. Maximizing The Benefits Of Lake
8. Minimizing The Impact Of Human Activities
9. Lake Management
10. Managing Ecosystem

Rejuvenation of a static water body

6.14 SWOT ANALYSIS

STRENGTH

- Density of surrounding areas is high & this could be a strong determinant.
- Provision of adequate social infrastructure inside the site premises strengthens the development.

WEAKNESS

- At some places the edges is not maintained & garbage is dumped at such places.
- The jogging track is often intruded by two wheelers who use the track as a shortcut to cross the park.

OPPORTUNITIES

- Sanjay lake to get facelift, which will turn into recreational hub.

THREATS

- The lake has no water catchment areas it is man-made and depends upon rainwater for recharge.
- years of negligence had led the rainwater lake to become a cesspool of toxic waste.

6.15 EXISTING MEASURES FOR RESTORATION

Delhi development authorities

- The Sanjay Lake area in Mayur Vihar is being worked on by the Delhi Development Authority (DDA) to become one of east Delhi's major recreation centres.
- More than two years ago, DDA began the ecological rehabilitation of the land.
- As contaminated water is incorporated into the lake, the water becomes foul.
- There are proposals to build a STP for sewage treatment.
- The official said that the lake depends on rains and other sources for its hydration because it is artificial and lacks catchment lands.
- Plans exist to utilise water from a neighbouring storm water drain, which would make use of the STP.
- The Delhi Development Authority (DDA) has pledged that all building activity would be carried out with the goal of raising the water level and addressing other environmental problems.
- Sanjay Lake's surrounding landscape enhancement project, estimated to cost Rs. 1.66 crore, is scheduled to begin in July 2021 and be finished by March 2022.

- **FACILITIES THAT WERE SAID TO BE COMPLETED BY MARCH 2022**

- BIOSWALE: A Trench with Thick Vegetation for Bio-Filtration of Storm Water.
- Pergolas of Brick Jalisa to Be Used for Sitting.
- Toddlers Play Area
- Mounds
- Natural Trails- Signage

REVAMP MODE

170.6 acres | Area of Sanjay Lake and surrounding green area

52.3 acres | Area of the waterbody

10.3 hectares | Area on which the Sanjay Lake View Complex TOD project is planned

₹ 1.66 crore | Project cost of landscape development around Sanjay Lake, slated to start this month

8 months | Project completion period; expected to be completed by March, 2022

File photo

FACILITIES THAT HAVE COME UP NEAR SANJAY LAKE

Amphitheatre | Green zone | Cycling track | Walking trail

FACILITIES COMING UP BY MARCH 2022

- Bioswale: A trench with thick vegetation for bio-filteration of storm water
- Pergolas of brick *jaalis* to be used for sitting
- Toddlers' play area
- Mounds
- Nature trails
- Pathways
- More cycle tracks
- Benches and sitting platforms

OTHER FACILITIES PLANNED AROUND SANJAY LAKE

Duck house | Sculpture court | Artist court | Palm avenue | Craft hut | Lake view court | Fountains | Food court | Observation deck | Meditation garden | Jungle play aera | Open gym | Cactus garden

DJB cleans Sanjay Van Lake under rejuvenation plan

SOMRITA GHOSH @ New Delhi

CONTINUING the project of rejuvenation of water bodies in the national capital, the Delhi Jal Board has successfully cleaned the Sanjay Van Lake.

"We have successfully cleaned Sanjay Van Lake (holding capacity 129 MGD) and deployed floating rafters to enhance water quality. This will not only beautify but also improve groundwater table," tweeted Delhi Jal Board Vice-Chairperson Raghav Chadha.

The Sanjay Van Lake, which is also under the 'city of lakes project', is one of the five lakes where this concept of floating wetland islands is being implemented, the others being at Rani Khera, Jaffarpur Kalan, Nangloi and Sonia Vihar.

"The DJB is working on its rejuvenation with a combination of wetland and aeration. Though it is under the jurisdiction of the DDA, CM Arvind Kejriwal approved funding from Delhi government budget for its rejuvenation in 2018. Fifty such water bodies will be ready by December 2021," said a senior DJB official.

The rejuvenation is done through a combination of wetland and aeration | EXPRESS

> **We have successfully cleaned Sanjay Van Lake and deployed floating rafters to enhance water quality. This will not only beautify but also improve groundwater table** —Raghav Chadha, DJV Vice-chairperson

"There are three things required wherever the water is polluted --- air, bacteria and surface where bacteria can grow. So, when we are putting floating plants and floating wetlands in the lake, or any flowing water or stream, then three things are happening. One, plants are actually absorbing nutrients from the waste water and those nutrients are pollutants, basically nitrogen and phosphorus. The surface of the roots act as a hosting place for bacteria to grow. The bacteria need a place to get attached. We are also adding aeration equipment in the lake so that we can maintain high dissolved oxygen levels. So, bacteria will take oxygen and remove ammonia from the water," explained Ankit Srivastava, Advisor, DJB.

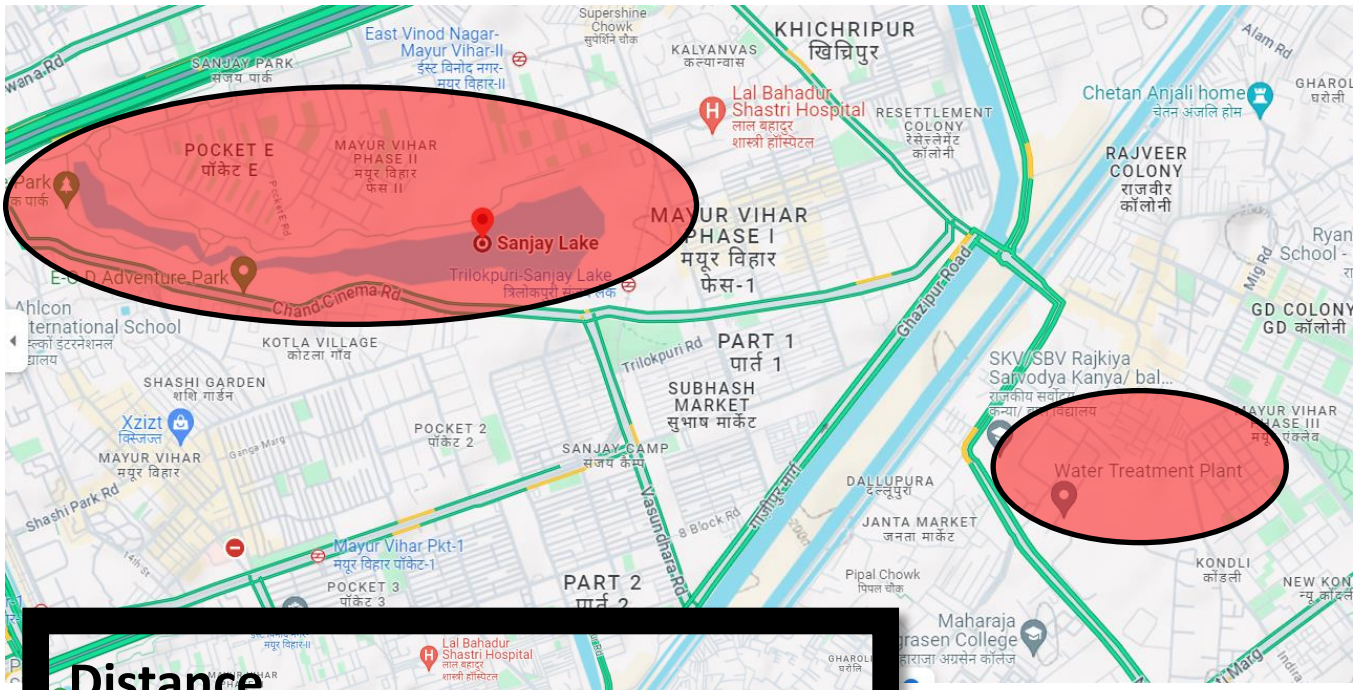
"We had already done it in Rajokri lake and it is also proposed for Bawana lake. Currently, we have already put that in around six lakes. We are waiting for certain permissions to install the aeration system as well," he noted.

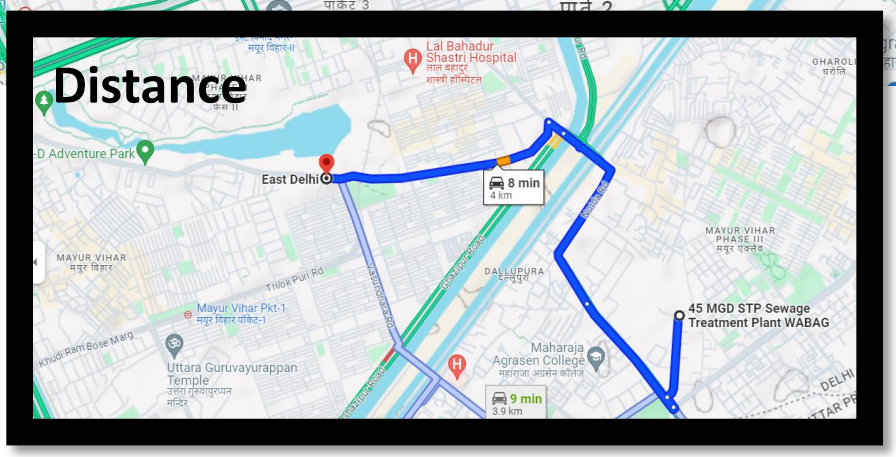
Rejuvenation of a static water body

दिल्ली सरकार ने किया
संजय वन लेक का कायापलट

Rejuvenation of a static water body

- The lake will be filled with treated water from nearby Kondli sewage treatment plant.
- The lake's rejuvenation is crucial to the 24x7 water supply project in East Delhi. While DDA manages the lake, DJB has taken over the project to rejuvenate it. The project is likely to increase the groundwater, which will help in providing water to residents of unauthorized colonies in the area.
- "As per the plan, the lake will be filled with treated water to increase the area's groundwater. Then, with the help of tubewells, the water will be extracted from ground and supplied to homes with the help of reverse osmosis plants. The body has the capacity of generating at least 15 million gallons has the capacity of generating at least 15 million gallons per day of water.





Rejuvenation of a static water body

6.16 PROPOSALS

1. POLICY PROPOSAL

Policies To Rejuvenate Sanjay Lake	
Hydrological and ecological issues	dumping and sewage and wastewater. The overgrown grass is also issue for contamination of shoreline.
Economic issues	Use of chemical fertilizer and pesticides in farm area near wetlands results in poor agricultural activities which leads to economy of people. Also the contaminated lake reduces the tourist potential in that area.
Ecological improvement	Cleaning of lake will improve the quality of water and will invite various bird species.
Recreational use	Developing Lake front and providing facilities like Toy Train, Indoor sports Stadium, Laser show, Jogging Track, Aquarium, Zoo, Park, Amusement Park, Butterfly Park, Food Court, Lighting. The lake and garden will attract local people and visitors.
Accessibility to different income people	There will be accessibility to different income people.
Violations of rules and regulations	DDA will take up the work of removing overgrown grass and garbage and cleaning of lake. The solid waste management and sewage water treatment can be done without violation of rule and regulations.
Major End beneficiaries	Government and Public

2. DIVERTING THE SEWAGE CHANNELS

- Desilting the lakes for which water needed to be drained out was the initial phase in the restoration effort.
- Water level might be efficiently decreased via diversion canals.
- This will be inconvenient since it will smell bad and could attract insects downstream.
- However, this is a step that must be made to address the lakes.
- civic organizations bieng told that go-ahead to meet with residents downstream and gain their trust.
- Additionally, the civic organizations have been told to take action to stop the mosquito problem and other health problems.

3. LEGAL CONTROL MEASURES

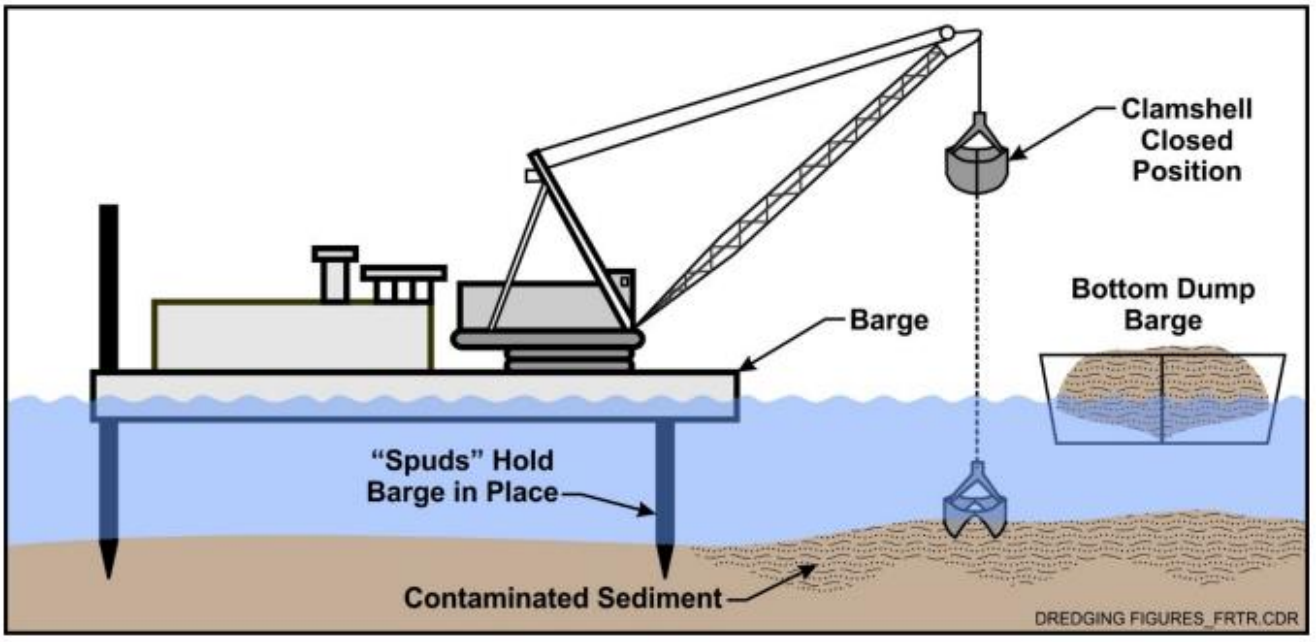
- Landuse control refers to the definition of land use principles for flood-prone areas and integration of flood features into spatial planning. These ideas ought to cover flood risk-adapted land use and construction standards.
- By taking legal actions such as restricting industrial land use etc.

4. LAKE DREDGING

- The removal of silt and debris from the bottom of lakes and other bodies of water is known as dredging.
- Although it might not be cost-effective, the revitalization process would go quickly.
- The process of dredging involves clearing silt and other detritus from the bottom of lakes.
- Sedimentation, the natural process of sand and silt moving downstream, progressively fills channels and ports, making it a common requirement in waterways across the world.
- Dredging is also done to stop the spread of toxins to other parts of the water body and to lessen the coposure of fish, animals, and people to contaminants.

- The majority of pond and lake restoration and dredging initiatives aim to return the waterbody to its former state. For these kinds of initiatives, the majority of project goals result in a combination of some of the following intended outcomes:

1. Improved Water Quality
2. Improved Water Circulation
3. Increased Water Depths
4. Better control of Aquatic Invasive Species
5. Diminish/reduce erosion in the watershed
6. Improved fish habitat
7. Bank Stabilization
8. Better access for recreational activities



Rejuvenation of a static water body

5. STORM WATER CHANNELIZATION FROM THE CATCHMENT AREA TO NATURALLY MAINTAIN THE WATER LEVEL

- Installing a septic drain line will transport roof runoff from homes and other locations in the catchment region that supplied Sanjay Lake.

- Storm water management is crucial.
- maintain the hydrologic cycle naturally.
- Reduce the likelihood of floods.
- Protect water quality,
- avoid unwelcome stream erosion,
- and Keep the soil from eroding

Green roofs Cisterns and rain barrels.

- Using or putting up permeable pavements.

❑ Advantages

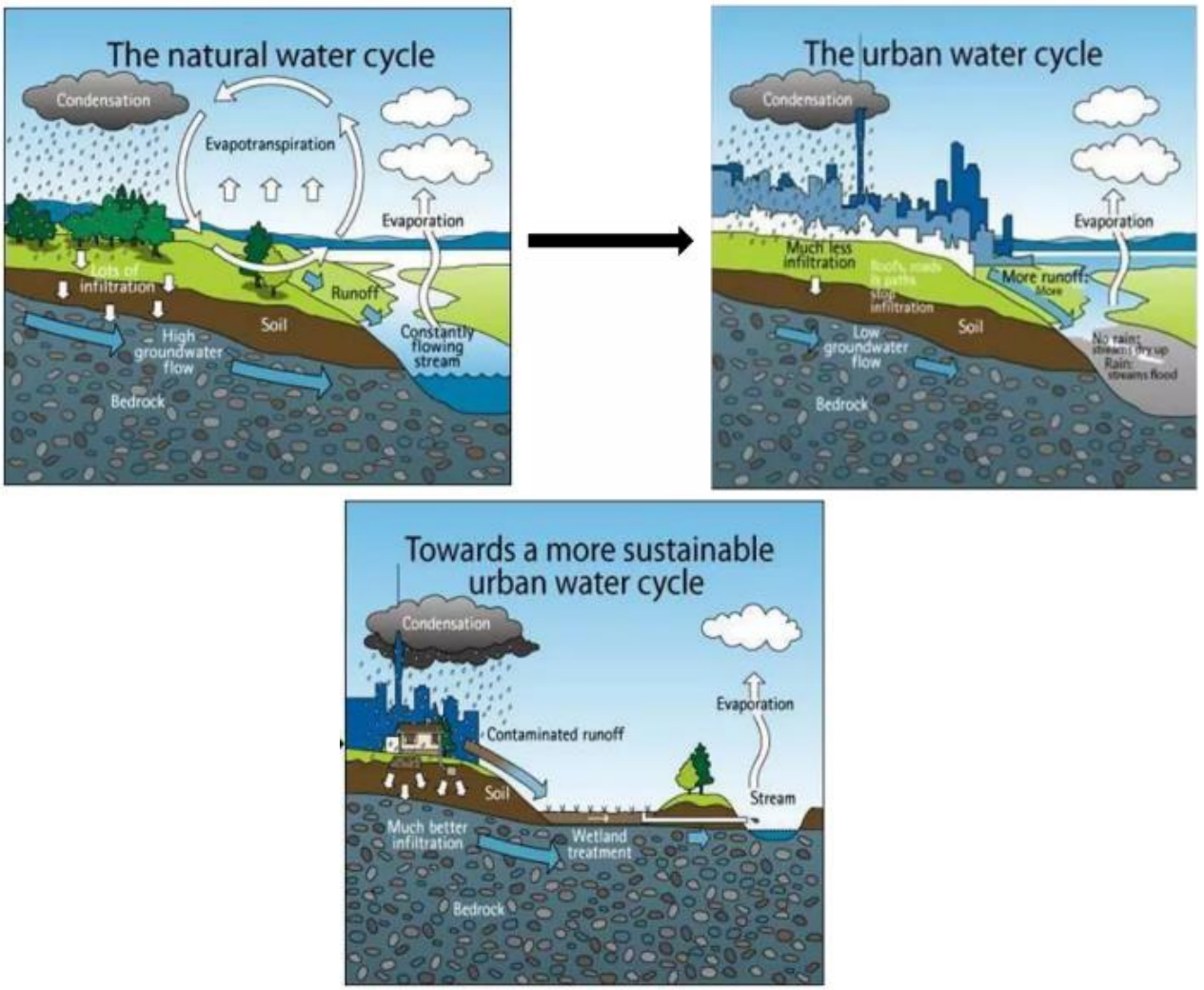
- Proper surface run-off drainage.
- Possibility of recharging groundwater and (re-)using surface runoff for irrigation or domestic usage.
- Earliest possible storm water treatment.
- Prevents damage to infrastructure (such as public roadways and private properties) and prevents flooding.
- Can provide green spaces and leisure places that may be incorporated into the urban landscape.

❑ Disadvantages

- Expert organisation, execution, management, and upkeep.
- Depending on the method, a lot of work and operation are needed.
- High sedimentation rates put infiltration systems at risk of clogging.

Rejuvenation of a static water body

6. STORM WATER MANAGEMENT IN URBAN AREAS



- Pipelines have been laid to channelize the rain water flowing from NH-24, which runs parallel to the Sanjay lake, and several other adjoining residential areas into the lake.
- This will particularly prevent waterlogging in these colonies during the upcoming monsoon months.
- to ensure that the residential colonies do not get flooded/waterlogged during the monsoon months, being issued specific instructions to divert the rainwater from these areas to the lake.
- At the same time, the sewage discharge from certain residential pockets has been completely checked so as to maintain the quality of water to support aquatic flora and fauna.

Rejuvenation of a static water body

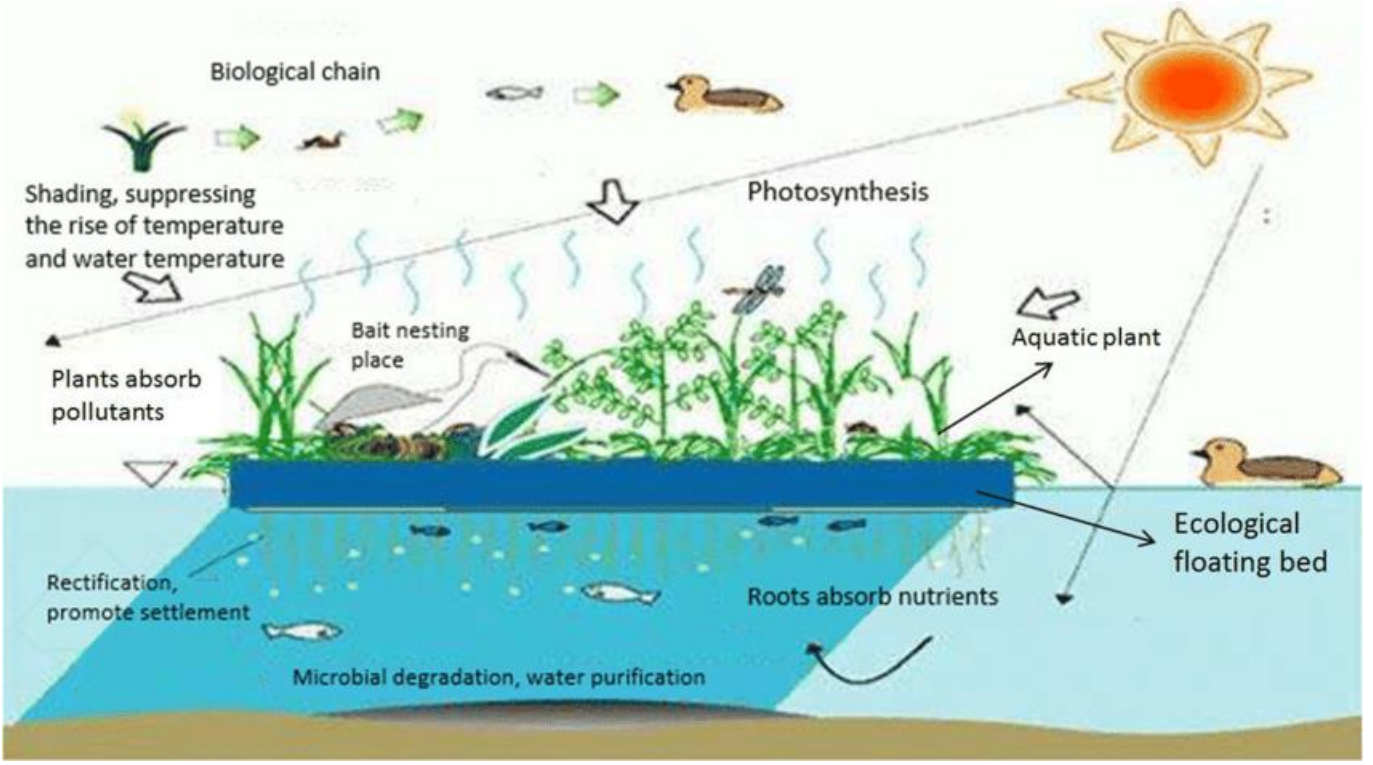
7. PLANNING PROPOSALS

Artificial Floating Island

- In order to enhance water quality, artificial floating islands (AFIs) are a type of wetland treatment technology.
- PVC pipes, plastic bottles, and a nylon mesh may all be used to create the lightweight framework.
- constructing artificial ecosystems to restore habitat.
- Artificial Floating Islands (AFIs) are floating constructions that were created by humans and are able to support aquatic flora. The concept was developed in Canada and has subsequently been used commercially in several water bodies all across Japan.
- AFIs have gained widespread acceptance as an effective technique for habitat restoration in the last ten years throughout various European and American nations (Winston, Hunt, and Kennedy 2012).

Rejuvenation of a static water body

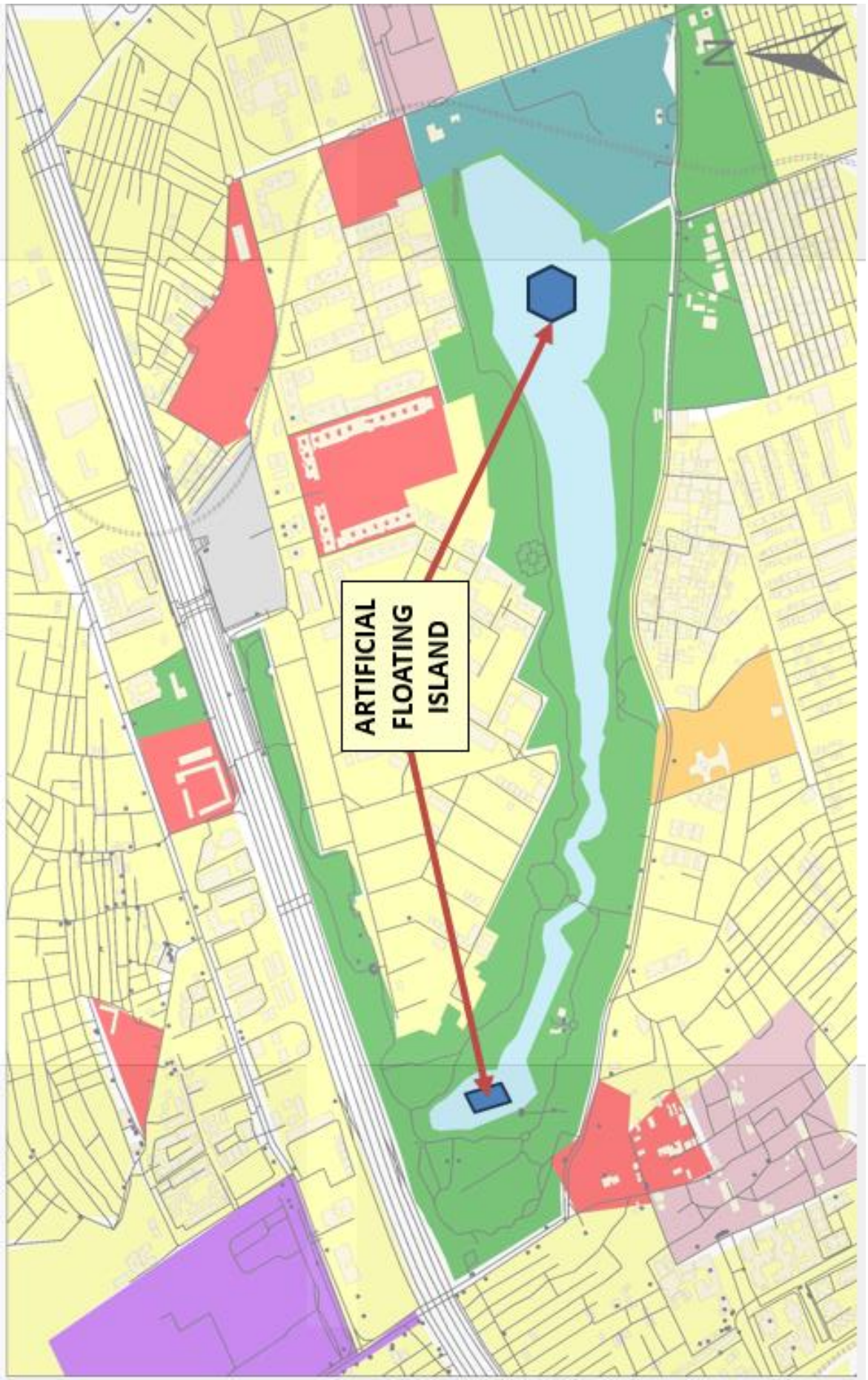
- These AFIs develop miniature near-shore aquatic habitats without taking up any coastal area.
- AFIs are able to rise and fall with changing water levels because they support their plants on floating platforms. Depending on the numerous kinds of water bodies (rivers, streams, ponds, and lakes) they serve, they might be movable.
- AFIs have shown to be excellent storm water management techniques because their macrophytes offer a root-zone habitat for microorganisms that aid in nutrient uptake by plant tissue.



Benefits:

- Improves Water Quality & Diverse Habitat
- These floating wetlands can help reduce algae by cycling phosphorus and nitrogen.
- They can reduce total suspended solids which cause cloudy water.

Rejuvenation of a static water body



Rejuvenation of a static water body

WATER AERATION

- The process of raising or keeping water's oxygen saturation level at a desired level in both natural and man-made situations, commonly used to solve low oxygen levels or algae blooms in lakes and reservoir management.

Aeration as a Management Tool

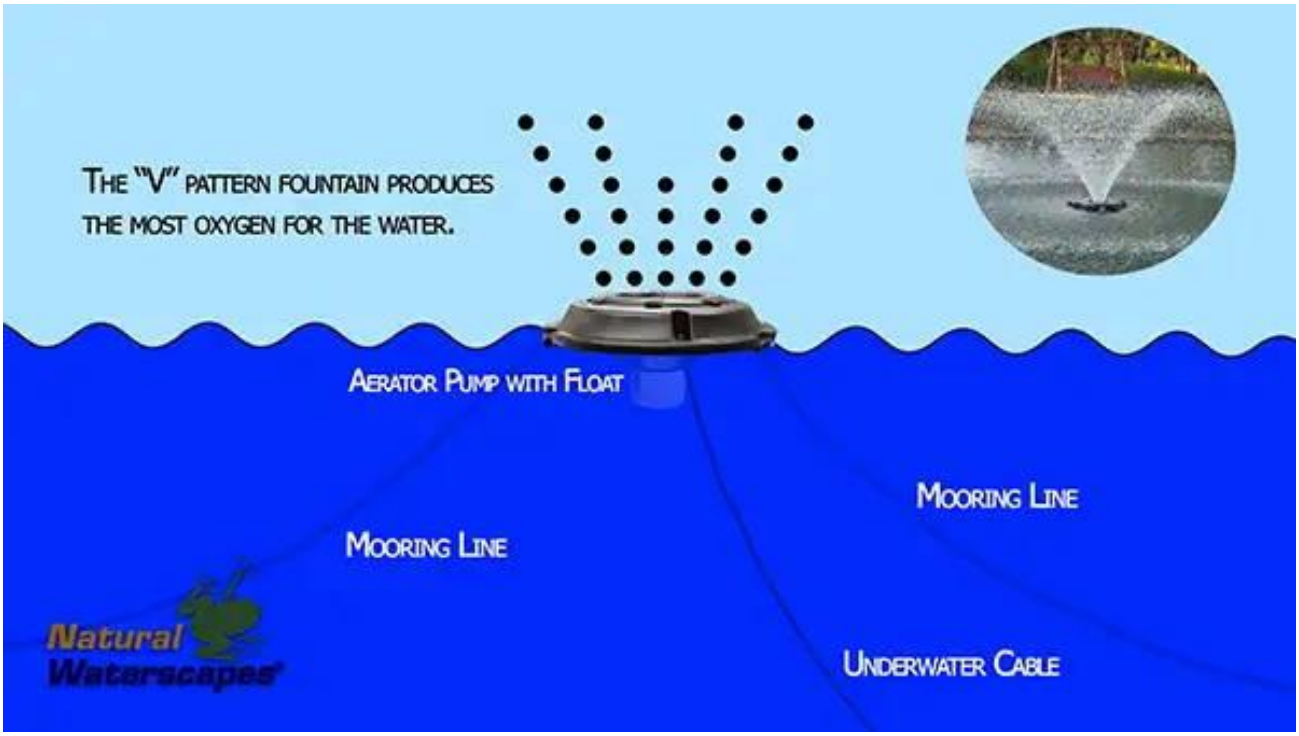
Aeration is an in-lake management tool used to increase the concentration of dissolved oxygen to address symptoms of eutrophication.

Increasing the concentration of dissolved oxygen can:

Improve fish habitat in waterbodies suffering from low dissolved oxygen;

Homogenize water quality and pH levels to help reduce treatment costs in drinking water reservoirs; and

Manage algae blooms through a variety of mechanisms, depending on the characteristics of the waterbody.



Rejuvenation of a static water body

Goals of the whole -lake aeration system would be to:

- prevent oxygen depletion near the lakebed sediments during summer stratification, thereby decreasing release of legacy phosphorus from the sediments, and
- create physical conditions that hinder cyanobacteria blooms.

The Pros of Whole Lake Aeration Reduce the frequency and intensity of cyanobacteria blooms by:

- reducing anoxic conditions
- creating a physical environment better suited for other diatoms and algae species.

The Potential Cons* of Whole-Lake Aeration:

- Changing the communities of phytoplankton, zooplankton and other primary food sources that larval and juvenile fish species rely on

- Making nutrients more available to phytoplankton and aquatic plants, increasing their rate of growth

- Decreasing the availability of still water to those species that need it

- Increasing temperature throughout the water column due to the mixing of warm surface water downward

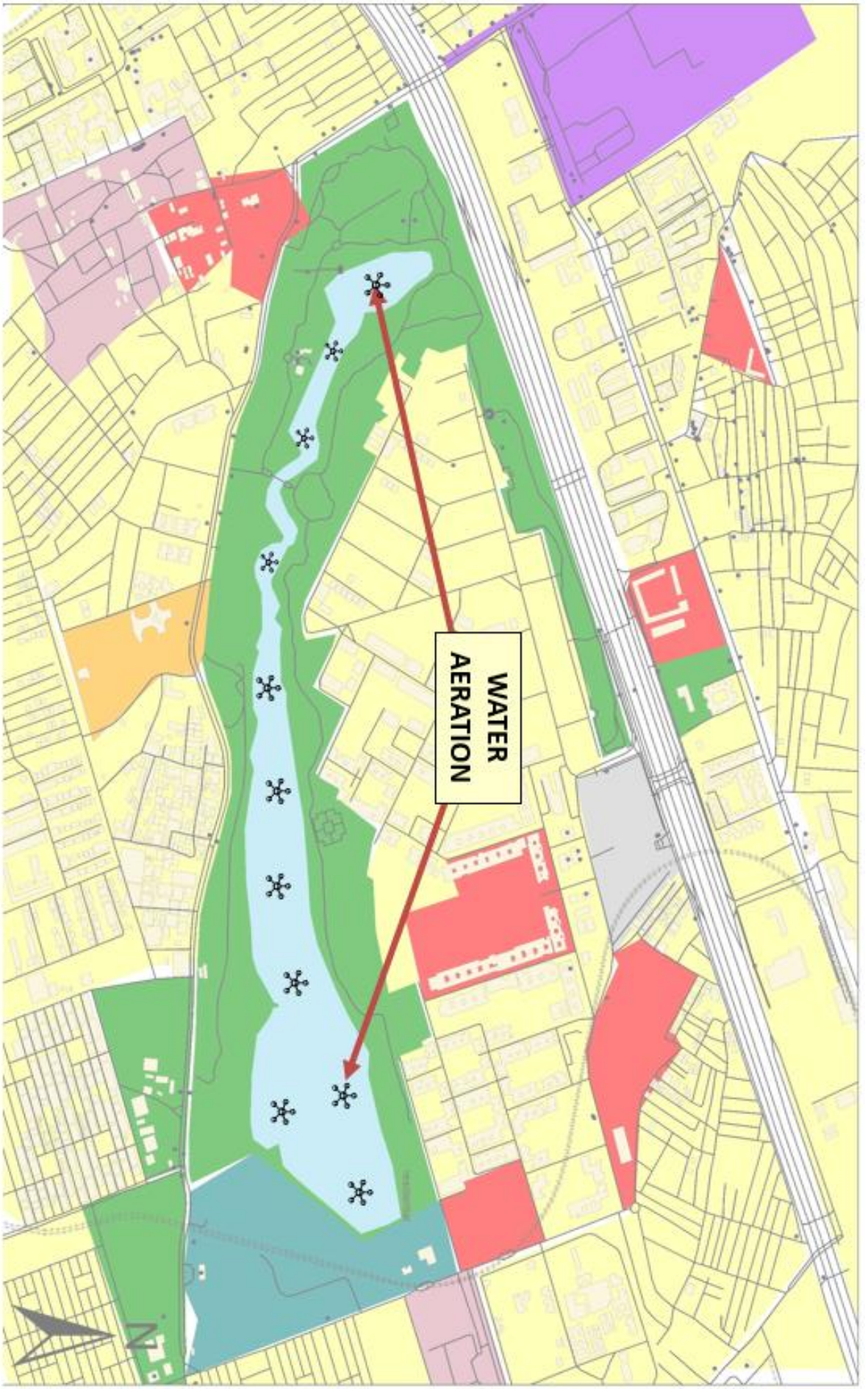
CLEAR IDENTIFICATION OF THE PROBLEM

CLEAR, CONCISE SHORT AND LONG-TERM GOALS, WATER QUALITY TARGETS, AND EXPECTATIONS ACHIEVED BY AN IN-LAKE TREATMENT

THE CHOSEN AERATION SYSTEM WILL ADDRESS THE IDENTIFIED PROBLEM

THE CHOSEN AERATION SYSTEM WILL NOT ADVERSELY AFFECT THE PUBLIC GOOD

Rejuvenation of a static water body

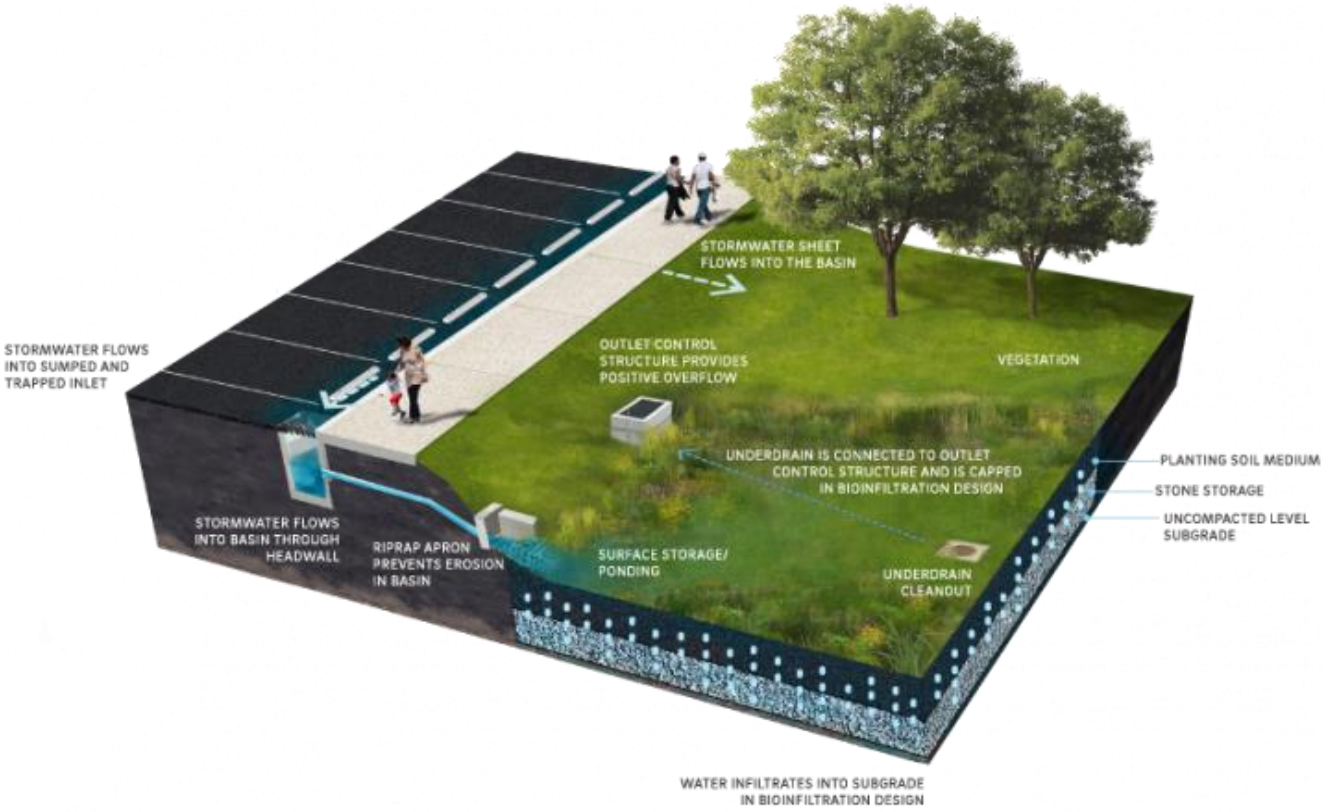


Rejuvenation of a static water body

- While the frequency and intensity of cyanobacteria blooms will decrease, blooms are rarely eliminated. Cyanobacteria are native and blooms naturally occur under certain conditions.
- Whole-lake aeration is a short-term inlake management tool used to alleviate immediate water quality issues. It does not address the underlying causes of eutrophication. Work in the watershed needs to continue.

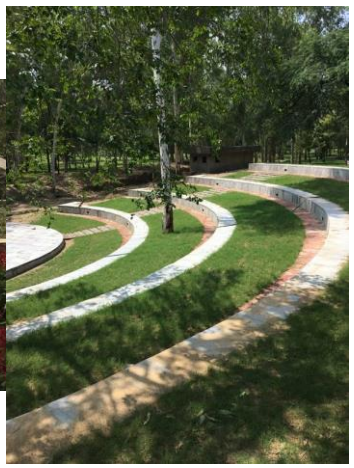
8. BIOSWALES

- Bioswales are landscape features that collect polluted stormwater runoff, soak it into the ground, and filter out pollution.
- Bioswales are like rain gardens but capture more water coming from larger areas like parking lots.
- Like rain gardens, bioswales use native plants to help absorb more water and prevent erosion.



- A philosophy of creating memorable destinations, building on the role of Sanjay Lake as a PLACE dedicated to engaging the public in the development of a new cultural identity on the waterfront through artistic expression, in the process the aim is also to reconnect the city with its waterfronts.
- A site of great economic, ecological, and cultural complexity, the waterfronts in our city can serve as a rich resource and can become potential site for art and cultural expression along with ecological areas reinstating the faith that we can still live in our cities in a healthy manner.
- Sanjay Lake has the potential to become one of the finest and most lively contemporary green area in east Delhi. It will be designed as an interactive experience, one where you can touch, feel, and experience things personally. The park will have the elegance and expansiveness, generous spaces will draw people not only from surrounding neighborhoods, but also from the entire city.
- After detailed site studies, The Concept proposes a design and a program of a continuous line/ribbon signifying 'movement', punctuated with nodes or special program areas signifying 'moments'. The nodes will be designed to become destinations for gatherings, play areas, environmental education hub, areas for art making, water activities like boating, fishing, water scooters etc.
- The nodes can be designed as stepped seating's, canopies, seat walls, game tables, play fields, artist huts/ platforms, viewing decks, fishing zones.





Rejuvenation of a static water body

6.17 RESULTS

species. Development along the lake will be planned as a special place for relaxation and will be enriching. It will flourish. Both local and tourist tourists will flock to this tourism destination. The habits of dumping waste, encroaching, constructing, and The culture of walkability (public friendliness), public art, festivals, sports, and other activities will take the place of heritage abuse. Recreation.

6.18 ANALYSIS:

Rejuvenation depends on three factors: the economy, the environment, and society. The social aspect, which includes promoting the project's environmental advantages and raising environmental consciousness, particularly in the local community, is the most difficult of the three. The trash must be removed from the area. Furthermore, the growing grass needs to be eliminated.

6.19 CONCLUSION:

Water bodies support a variety of living forms, and a project like this may serve as a platform for educating the public about the need of reviving water sources. Such efforts can launch an environmental revolution, which is urgently needed, and are simple to organize and carry out. Community participation is necessary for the effective implementation and completion of revitalization efforts. They need to be informed about the lake's biological, hydrological, environmental, and sociocultural significance. This may be accomplished through a range of outreach initiatives and media. Practical environmental education is made possible by the active involvement of the students and community in the planning, designing, carrying out, cleaning, monitoring water quality, planting trees, bird watching, drawing competition, and self-help programe for lake rejuvenation.

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